Technical Support Document for the Proposed Locomotive/Marine Rule: Ozone Modeling

EPA 454/R-07-004
March 2007

Technical Support Document for the Proposed Locomotive/Marine Rule: Air Quality Modeling:

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Assessment Division
Research Triangle Park, NC 27711
March 2007

I. Introduction

This document describes the air quality modeling performed by EPA in support of the proposed Locomotive/Marine rule. A national scale air quality modeling analysis was performed to estimate the effect of the proposed rule on future year: annual $PM_{2.5}$ concentrations, daily maximum 8-hour ozone concentrations, and visibility. To model the air quality benefits of this rule we used the Community Multiscale Air Quality (CMAQ)[1] model. CMAQ simulates the numerous physical and chemical processes involved in the formation, transport, and destruction of ozone and particulate matter. In addition to the CMAQ model, the modeling platform includes the emissions, meteorology, and initial and boundary condition data which are inputs to this model.

It should be noted that the emission control scenarios used in the air quality and benefits modeling are slightly different than the emission control program being proposed. The differences reflect further refinements of the regulatory program since the air quality modeling for this rule was performed. Emissions and air quality modeling decisions are made early in the analytical process. Chapter 3 of the draft regulatory impact analysis[2] (RIA) describes the changes in the inputs and resulting emission inventories between the preliminary assumptions used for the air quality modeling and the final proposed regulatory scenario. These refinements to the proposed program are not expected to significantly change the results summarized here.

II. CMAQ Model Inputs and Configuration

The air quality modeling that estimated the impacts from locomotive and marine engines was based generally on CMAQ modeling that was done in support of the final $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) regulatory impact analysis. That modeling analysis is fully described in the PM NAAQS RIA[3], but a condensed description is provided below. The two primary differences from the PM NAAQS modeling were:

1) the incorporation of a finer grid over the eastern U.S. for specific episode days to enable a higher-resolution estimate of ozone impacts, and

2) the use of updated base and future year emissions estimates for the nine source categories in Table II-1.

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[1] Byun, D.W., and K. L. Schere, 2006: Review of the Governing Equations, Computational Algorithms, and Other Components of the Models-3 Community Multiscale Air Quality (CMAQ) Modeling System. Applied Mechanics Reviews, Volume 59, Number 2 (March 2006), pp. 51-77.

[2] U.S. Environmental Protection Agency, Regulatory Impact Analysis: Control of Emissions of Air Pollution from New Locomotives and New Marine Compression-Ignition Engines Less Than 30 liters per cylinder, Office of Transportation and Air Quality, February 2006.

[3] U.S. Environmental Protection Agency; Technical Support Document for the Final Clean Air Interstate Rule: Air Quality Modeling; Office of Air Quality Planning and Standards; RTP, NC; March 2005.

Table II-1. Locomotive and Commercial Marine Source Categories

SCC	Description
2280002100	Mobile Sources: Marine Vessels, Commercial: Diesel: Port emissions
2280002200	Mobile Sources: Marine Vessels, Commercial: Diesel: Underway emissions
2282020005	Mobile Sources: Pleasure Craft, Diesel: Inboard/Sterndrive
2282020010	Mobile Sources: Pleasure Craft, Diesel: Outboard
2285002006	Mobile Sources: Railroad Equipment: Diesel: Line Haul Locomotives: Class I Operations
2285002006	Mobile Sources: Railroad Equipment: Diesel: Line Haul Locomotives: Class II/III Operations
2285002006	Mobile Sources: Railroad Equipment: Diesel: Line Haul Locomotives: Passenger Trains
2285002006	Mobile Sources: Railroad Equipment: Diesel: Line Haul Locomotives: Commuter Lines
2285002006	Mobile Sources: Railroad Equipment: Diesel: Yard Locomotives

A. Model version

CMAQ is a non-proprietary computer model that simulates the formation and fate of photochemical oxidants, including $PM_{2.5}$ and ozone, for given input sets of meteorological conditions and emissions. The latest version of CMAQ available at the time of the Locomotive-Marine modeling, version 4.5, was employed for this analysis. This version reflects recent updates in a number of areas to improve the underlying science, including:

1) a state-of-the-science inorganic nitrate partitioning module (ISORROPIA) and updated gaseous, heterogeneous chemistry in the calculation of nitrate formation,

2) a secondary organic aerosol (SOA) module that includes a more comprehensive gas-particle partitioning algorithm from both anthropogenic and biogenic SOA,

3) an in-cloud sulfate chemistry module that accounts for the nonlinear sensitivity of sulfate formation to varying pH, and

4) an updated CB-IV gas-phase chemistry mechanism and aqueous chemistry mechanism that provide a comprehensive simulation of aerosol precursor oxidants.

B. Model domain and grid resolution

The CMAQ modeling analyses were performed for a domain covering the majority of the United States, as shown in Figure II-1. This domain has a parent horizontal grid of 36 km with a finer-scale 12 km grid over the eastern U.S. The model extends vertically from the surface to 100 millibars using a sigma-pressure coordinate system. The 36 km grid was used in the determination of annual average $PM_{2.5}$ impacts, while the 36 and 12 km grids[4] were used in the 8-hour ozone determinations. Table II-2 provides the remainder of the basic geographic information regarding the simulations.

[4] The use of the coarser 36 km grid resolution over the western U.S. requires that these results be used with caution. In the final rule analyses, it is anticipated that finer grid modeling will be used for the entire U.S.

Figure II-1. Map of the CMAQ modeling domain. The gray outer box denotes the entire modeling domain (36 km) and the green inner box is the fine grid (12 km).

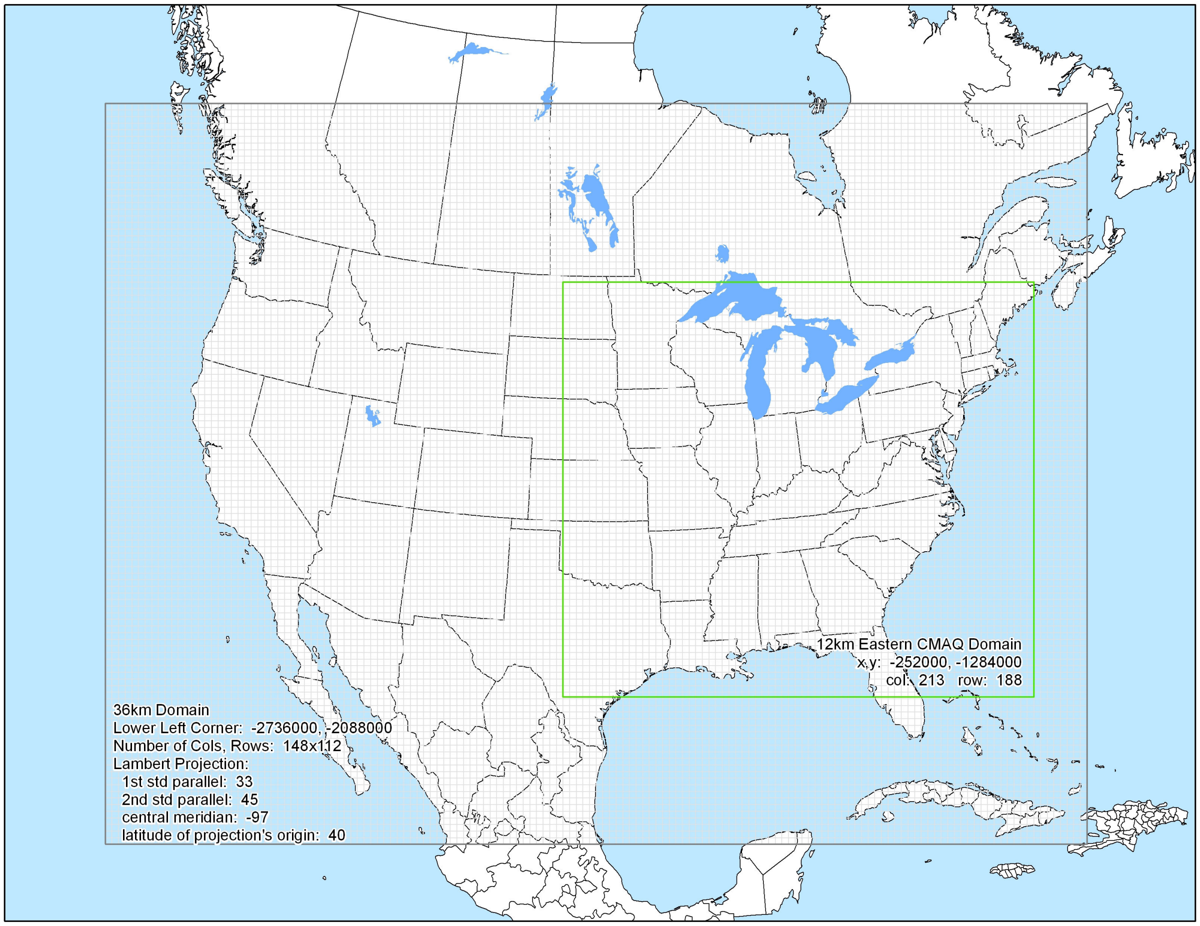


Table II-2. Configuration of air quality modeling domain.

	CMAQ Modeling Configuration	
	National Grid	**Eastern U.S. Fine Grid**
Map Projection	Lambert Conformal Projection	
Grid Resolution	36 km	12 km
Coordinate Center	97 W, 40 N	
True Latitudes	33 and 45 N	
Dimensions	148 x 112 x 14	213 x 188 x 14
Vertical extent	14 Layers: Surface to 100 mb level (see Table II-4)	

C. Modeling Period / Ozone Episodes

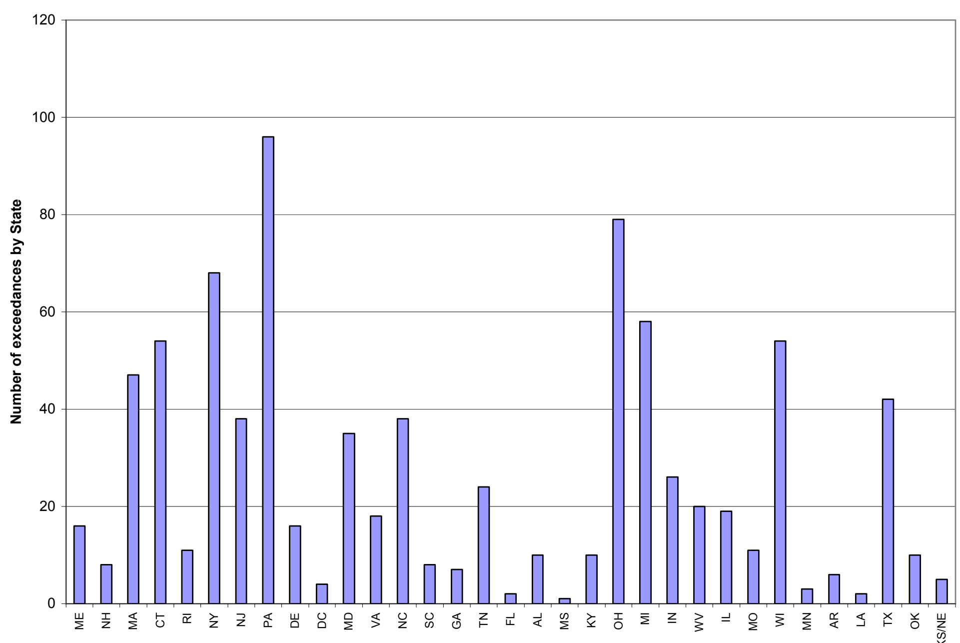
There are several considerations involved in selecting the appropriate duration of an air quality modeling analysis[5]. In general, the goal is to model several types of meteorological conditions that lead to ambient $PM_{2.5}$ and ozone levels similar to an area's design value[6]. For the annual $PM_{2.5}$ standard, it was determined that modeling an entire year of meteorology (2001) was needed to estimate the impacts of the proposed controls on annual average levels of $PM_{2.5}$. For the 8-hour ozone standard, 40 episode days from the summer of 2001 were modeled. These ozone episodes are listed in Table II-3 and correspond to periods of relatively high ambient ozone during that summer, especially in the northeastern U.S., as is shown in Figure II-2.

Table II-3. Dates of CMAQ 12 km ozone modeling episodes.

Episode 1	June 13 - 30, 2001
Episode 2	July 12 - August 10, 2001

The first three days of each period are called the "ramp-up" days. These days are used to minimize the effects of initial conditions and are not considered as part of the output analyses.

Figure II-2. Number of 8-Hour Ozone Exceedances by State in 2001 during the 12 km CMAQ Ozone Episodes



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[5] U.S. EPA, Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS; EPA-454/R-05-002; Research Triangle Park, NC; October 2005.

[6] A design value is a statistic that describes the air quality status of a given area relative to the level of the National Ambient Air Quality Standards (NAAQS). For 8-hour ozone, the 3-year average annual fourth-highest daily maximum 8-hour average ozone concentration is the air quality design value for a site.

D. Model Inputs: Emissions, Meteorology and Boundary Conditions

A CMAQ modeling platform was used for the air quality modeling of future baseline emissions and control scenarios. As noted in the introduction, in addition to the CMAQ model, the modeling platform also consists of the base- and future-year emissions estimates (both anthropogenic and biogenic), meteorological fields, as well as initial and boundary condition data which are all inputs to the air quality model.

1. Base and Future Base Year Emissions: The 2001 base and 2020 base year emissions were identical to the PM NAAQS emissions estimates for 2001 and 2020, except for the nine source classification categories (SCCs) listed in Table II-1 which used updated emissions estimates. For the 2030 base year emissions inventory we used 2030 estimates of onroad and nonroad emissions from the National Mobile Inventory Model (NMIM) model and 2020 emissions estimates for area and point sources. The final PM NAAQS RIA[7] contains more detail on the preparation of the emissions estimates. For the nine updated SCCs, a top-down national inventory was developed[8] for 2001/2002, 2020, and 2030. The emissions were then assigned to States based on National-to-State ratios from the 2002 National Emissions Inventory (NEI).

2. Meteorological Input Data: The gridded meteorological data for the entire year of 2001 at 36 km and for the two 12 km episodes during the summer of 2001 were derived from simulations of the Pennsylvania State University / National Center for Atmospheric Research Mesoscale Model. This model, commonly referred to as MM5[9], is a limited-area, nonhydrostatic, terrain-following system that solves for the full set of physical and thermodynamic equations which govern atmospheric motions. For this analysis, version 3.6.1 (36 km) and version 3.6.3 (12 km) of MM5 were used. The 36 km horizontal domain consisted of a single 165 by 129 cell grid. The 12 km MM5 domain consisted of a 290 x 251 grid that extends well beyond the 12 km CMAQ grid.

The meteorological outputs from both MM5 sets were processed to create model-ready inputs for CMAQ using the Meteorology-Chemistry Interface Processor (MCIP)[10], version 3.1, to derive the specific inputs to CMAQ: horizontal wind components (i.e., speed and direction), temperature, moisture, vertical diffusion rates, and rainfall rates for

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[7] U.S. Environmental Protection Agency, Final RIA PM NAAQS, Chapter 2: Defining the PM2.5 Air Quality Problem. October 17, 2006.

[8] U.S. Environmental Protection Agency, Draft Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression-Ignition Engines Less than 30 Liters per Cylinder, EPA420-D-07-001, January 2007.

[9] Grell, G., J. Dudhia, and D. Stauffer, 1994: A Description of the Fifth-Generation Penn State/NCAR Mesoscale Model (MM5), NCAR/TN-398+STR., 138 pp, National Center for Atmospheric Research, Boulder CO.

[10] Byun, D.W., and Ching, J.K.S., Eds, 1999. Science algorithms of EPA Models-3 Community Multiscale Air Quality (CMAQ modeling system, EPA/600/R-99/030, Office of Research and Development). Please also see: http://www.cmascenter.org.

each grid cell in each vertical layer. The MM5 was run on the same map projection as CMAQ. Both sets of 2001 MM5 runs utilized 34 vertical layers with a surface layer of approximately 38 meters. The MM5 and CMAQ vertical structures are shown in Table II-4 and do not vary by horizontal grid resolution.

Table II-4. Vertical layer structure for MM5 and CMAQ (heights are layer top).

CMAQ Layers	MM5 Layers	Sigma P	Approximate Height (m)	Approximate Pressure (mb)
0	0	1.000	0	1000
1	1	0.995	38	995
2	2	0.990	77	991
3	3	0.985	115	987
	4	0.980	154	982
4	5	0.970	232	973
	6	0.960	310	964
5	7	0.950	389	955
	8	0.940	469	946
6	9	0.930	550	937
	10	0.920	631	928
	11	0.910	712	919
7	12	0.900	794	910
	13	0.880	961	892
	14	0.860	1,130	874
8	15	0.840	1,303	856
	16	0.820	1,478	838
	17	0.800	1,657	820
9	18	0.770	1,930	793
	19	0.740	2,212	766
10	20	0.700	2,600	730
	21	0.650	3,108	685
11	22	0.600	3,644	640
	23	0.550	4,212	595
12	24	0.500	4,816	550
	25	0.450	5,461	505
	26	0.400	6,153	460
13	27	0.350	6,903	415
	28	0.300	7,720	370
	29	0.250	8,621	325
	30	0.200	9,625	280
14	31	0.150	10,764	235
	32	0.100	12,085	190
	33	0.050	13,670	145
	34	0.000	15,674	100

Complete descriptions of the configurations of the 2001 meteorological modeling are contained in McNally (2003, 2004)[11,12], however some of the key MM5 model physics options that were utilized are as follows:

- Cumulus Parameterization: Kain-Fritsch
- Planetary Boundary Layer Scheme: Pleim-Chang
- Explicit Moisture Scheme: Reisner 2
- Radiation Scheme: RRTM
- Land Surface Model: Pleim-Xiu

In terms of the 2001 MM5 model performance evaluations, we used an approach which included a combination of qualitative and quantitative analyses to assess the adequacy of the MM5 simulated fields. The qualitative aspects involved comparisons of the model estimated synoptic patterns against observed patterns from historical weather chart archives. Qualitatively, the model fields closely matched the observed synoptic patterns, which is expected given the use of nudging. The statistical portion of the evaluation examined the model bias and error for temperature, water vapor mixing ratio, and the index of agreement for the wind fields. These statistical values were calculated on a regional basis. Tables II-5 and II-6 show the results of the statistical evaluation of the 2001 model data by season for four major meteorological parameters[13]. In general, the bias and error values associated with the 2001 data are in the range of model performance found from other non-EPA regional meteorological model applications[14].

Table II-5. Mean Absolute Error by Season within 36/12 km 2001 MM5 Simulations

	2001 36 km MM5				**2001 12 km MM5**			
	T	**Q**	**WS**	**WD**	**T**	**Q**	**WS**	**WD**
Winter	2.58	0.72	1.44	31.93	2.49	0.65	1.32	24.88
Spring	1.91	1.31	1.36	36.33	2.10	1.34	1.34	28.03
Summer	1.69	1.65	1.20	42.23	2.05	1.91	1.19	32.00
Fall	1.75	0.90	1.29	35.79	2.37	1.56	1.42	25.88

Table II-6. Mean Bias by Season within 36/12km 2001 MM5 Simulations

	2001 36 km MM5				**2001 12 km MM5**			
	T	**Q**	**WS**	**WD**	**T**	**Q**	**WS**	**WD**
Winter	-1.58	0.19	-0.13	4.67	-0.92	-0.09	-0.15	3.43
Spring	-0.62	0.39	-0.14	1.86	0.36	0.09	-0.05	3.15
Summer	-0.31	-0.05	-0.21	1.45	0.35	1.01	-0.15	3.32
Fall	-0.31	0.07	-0.22	2.44	-0.02	0.88	0.17	2.49

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[11] McNally, D, Annual Application of MM5 for Calendar Year 2001, Topical report to EPA, March 2003.

[12] McNally, D, Annual Application of MM5 for Calendar Year 2001 at 12 km Resolution, Topical report submitted to EPA, December 2004.

[13] T = Temperature (C), Q = Mixing Ratio (g/kg), WS = Wind Speed (m/s), WD = Wind Direction (deg).

[14] Environ, Enhanced Meteorological Modeling and Performance Evaluation for Two Texas Episodes, August 2001.

3. Initial and Boundary Conditions: The lateral boundary and initial species concentrations are provided by a three-dimensional global atmospheric chemistry model, the GEOS-CHEM[15] model. The global GEOS-CHEM model simulates atmospheric chemical and physical processes driven by assimilated meteorological observations from the NASA's Goddard Earth Observing System (GEOS). This model was run for 2001 with a grid resolution of 2.0 degree x 2.5 degree (latitude-longitude) and 20 vertical layers. The predictions were used to provide one-way dynamic boundary conditions at three-hour intervals and an initial concentration field for the CMAQ simulations.

E. CMAQ Base Case Model Performance Evaluation

1. $PM_{2.5}$: An operational model performance evaluation for $PM_{2.5}$ and its related speciated components (e.g., sulfate, nitrate, elemental carbon, organic carbon, etc.) was conducted using the 2001 PM NAAQS[16] simulation data in order to estimate the ability of the CMAQ modeling system to replicate base year $PM_{2.5}$ and $PM_{2.5}$ species concentrations. In summary, model performance statistics were calculated for observed/predicted pairs of daily/monthly/seasonal/annual concentrations. Statistics were generated for the following geographic groupings: domain wide, Eastern U.S, and Western U.S. (as divided based on the 100th meridian). The "acceptability" of model performance was judged by comparing our CMAQ 2001 performance results to the range of performance found in recent regional $PM_{2.5}$ model applications for other, non-EPA studies[17]. Overall, the fractional bias, fractional error, normalized mean bias, and normalized mean error statistics shown in Table II-7 are within the range or close to that found by other groups in recent applications. The model performance results give us confidence that our application of CMAQ using this modeling platform, as was done in the Final PM NAAQS RIA analyses, provide a scientifically credible approach for assessing $PM_{2.5}$ concentrations for the purposes of the Locomotive/Marine assessment. A detailed summary of the CMAQ model performance evaluation is available within the PM NAAQS RIA, Appendix O[18].

[15] Yantosca, B., 2004. GEOS-CHEMv7-01-02 User's Guide, Atmospheric Chemistry Modeling Group, Harvard University, Cambridge, MA, October 15, 2004.

[16] The changes to the 2001 base year locomotive and marine emissions used for this study are not expected to affect model performance on a regional basis compared to the evaluation performed for the PM NAAQS.

[17] See Appendix C of the CMAQ Model Performance Evaluation Report for 2001 updated March 2005 (CAIR Docket OAR-2005-0053-2149). These other modeling studies represent a wide range of modeling analyses which cover various models, model configurations, domains, years and/or episodes, chemical mechanisms, and aerosol modules.

[18] U.S. Environmental Protection Agency, Final RIA PM NAAQS, Appendix O: CMAQ Model Performance Evaluation for 2001. October 17, 2006.

Table II-7. Annual CMAQ 2001 model performance statistics for PM NAAQS

PM NAAQS CMAQ 2001 Annual			# of Obs	FB (%)	FE (%)	NMB(%)	NME(%)
$PM_{2.5}$ Total Mass	STN	National	6356	-10	42	-8	39
		East	5124	-5	39	-2	35
		West	1232	-29	53	-36	54
	IMPROVE	National	13218	-11	51	-11	47
		East	5606	-11	47	-11	41
		West	7612	-10	54	-12	55
Sulfate	STN	National	6723	-16	45	-13	36
		East	5478	-8	41	-9	34
		West	1245	-52	64	-51	58
	IMPROVE	National	13477	-21	50	-20	39
		East	5657	-15	41	-16	34
		West	7790	-26	57	-33	52
	CASTNet	National	3791	-29	37	-21	27
		East	2784	-22	29	-19	25
		West	1007	-47	59	-45	51
Nitrate	STN	National	5883	-39	89	-15	74
		East	4673	-23	81	14	70
		West	1210	-103	116	-76	82
	IMPROVE	National	13398	-72	116	-10	86
		East	5636	-53	109	16	90
		West	7762	-85	121	-42	82
Total Nitrate (NO3 + HNO3)	CASTNet	National	3788	4	38	9	35
		East	2781	13	34	14	33
		West	1007	-21	51	-27	47
Ammonium	STN	National	6723	20	63	6	54
		East	5478	27	59	16	51
		West	1245	13	78	-53	75
	CASTNet	National	3791	-17	38	-11	31
		East	2784	-8	32	-10	29
		West	1007	-39	57	-37	51
Elemental Carbon	STN	National	6842	19	60	22	69
		East	5551	26	59	34	71
		West	1291	-8	65	-13	63
	IMPROVE	National	13441	-15	60	-2	63
		East	5646	-26	53	-18	46
		West	7795	-7	66	19	85
Organic Carbon	STN	National	6685	-46	65	-43	54
		East	5401	-45	65	-41	51
		West	1284	-46	68	-47	61
	IMPROVE	National	13428	6	63	4	68
		East	5658	-28	60	-24	51
		West	7770	31	64	38	88

2a. Ozone (12 km Eastern U.S.): An operational model performance evaluation for hourly and eight-hour daily maximum ozone was conducted in order to estimate the ability of the CMAQ modeling system to replicate the base year ozone concentrations for the 12-km Eastern United States domain[19] shown in Figure II-1. Ozone measurements from 822 sites in the eastern U.S. were included in the evaluation and were taken from the 2001 State/local monitoring site data in the Air Quality System (AQS) Aerometric Information Retrieval System (AIRS). The ozone metrics covered in this evaluation include hourly ozone concentrations and eight-hour daily maximum ozone concentrations. The evaluation principally consists of statistical assessments of model versus observed pairs that were paired in time and space on an hourly and/or daily basis, depending on the sampling frequency of each measurement site (measured data). This ozone model performance evaluation was limited to the two episodes that were modeled for the Locomotive/Marine proposed rule: June 16, 2001 thru June 30, 2001 and July 15, 2001 thru August 10, 2001. Statistics were generated for the following geographic groupings: domain wide and four large subregions[20]: Midwest, Northeast, Southeast, and Central U.S. Appendix A contains a more detailed summary of ozone model performance over the 12km Eastern U.S. grid. A summary of the evaluation is presented here.

As with the national, annual $PM_{2.5}$ CMAQ modeling, the "acceptability" of model performance was judged by comparing our CMAQ 2001 performance results to the range of performance found in recent regional ozone model applications (e.g., EPA's Clean Air Interstate Rule[21]). Overall, the normalized mean bias and error (NMB and NME), as well as the fractional bias and error (FB and FE) statistics shown in Table II-8 indicate that CMAQ-predicted 2001 hourly and eight-hour daily maximum ozone residuals (i.e., observation vs. model predictions) are within the range of other recent regional modeling applications. The CMAQ model performance results give us confidence that our applications of CMAQ using this modeling platform provide a scientifically credible approach for assessing ozone concentration changes resulting from the proposed Locomotive/Marine emissions reductions.

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[19] This evaluation includes updates to the CMAQ Model Performance Evaluation Report for 2001 updated March 2005 (CAIR Docket OAR-2005-0053-2149).

[20] The subregions are defined by States where: Midwest is IL, IN, MI, OH, and WI; Northeast is CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT; Southeast is AL, FL, GA, KY, MS, NC, SC, TN, VA, and WV; Central is AR, IA, KS, LA, MN, MO, NE, OK, and TX.

[21] U.S. Environmental Protection Agency; Technical Support Document for the Final Clean Air Interstate Rule: Air Quality Modeling; Office of Air Quality Planning and Standards; Research Triangle Park, NC; March 2005.

Table II-8. CMAQ 2001 hourly ozone model performance statistics calculated for a threshold of 40 ppb.

CMAQ 2001 Hourly Ozone: Threshold of 40ppbV		No. of Obs.	NMB (%)	NME (%)	FB (%)	FE (%)
Aggregate of Two Episodes	12-km Eastern domain	322,705	-8.9	18.9	-10.9	21.3
	Midwest	94,848	-8.6	19.0	-10.9	21.7
	Northeast	77,100	-11.6	21.2	-14.1	24.2
	Southeast	89,921	-4.1	16.1	-4.6	16.9
	Central U.S.	59,978	-12.9	20.0	-16.2	23.5
Episode 1	12-km Eastern domain	127,125	-6.8	17.6	-8.2	19.7
	Midwest	37,362	-8.2	17.6	-10.0	20.1
	Northeast	27,315	-8.3	19.5	-9.8	21.9
	Southeast	37,897	-2.1	15.8	-2.3	16.6
	Central U.S.	24,255	-10.3	18.4	-13.0	21.6
Episode 2	12-km Eastern domain	195,580	-10.3	19.8	-12.6	22.3
	Midwest	57,486	-8.9	20.0	-11.5	22.7
	Northeast	49,785	-13.5	22.1	-16.5	25.5
	Southeast	52024	-5.7	16.2	-6.3	17.1
	Central U.S.	35,723	-14.8	21.2	-18.3	24.8

2b. Ozone (36 km Western U.S.): As shown in Figure II-1, there are areas of the U.S. that were not covered by the finer scale 12 km domain. For areas outside the 12 km domain we relied on modeling for our 36 km nationwide domain.

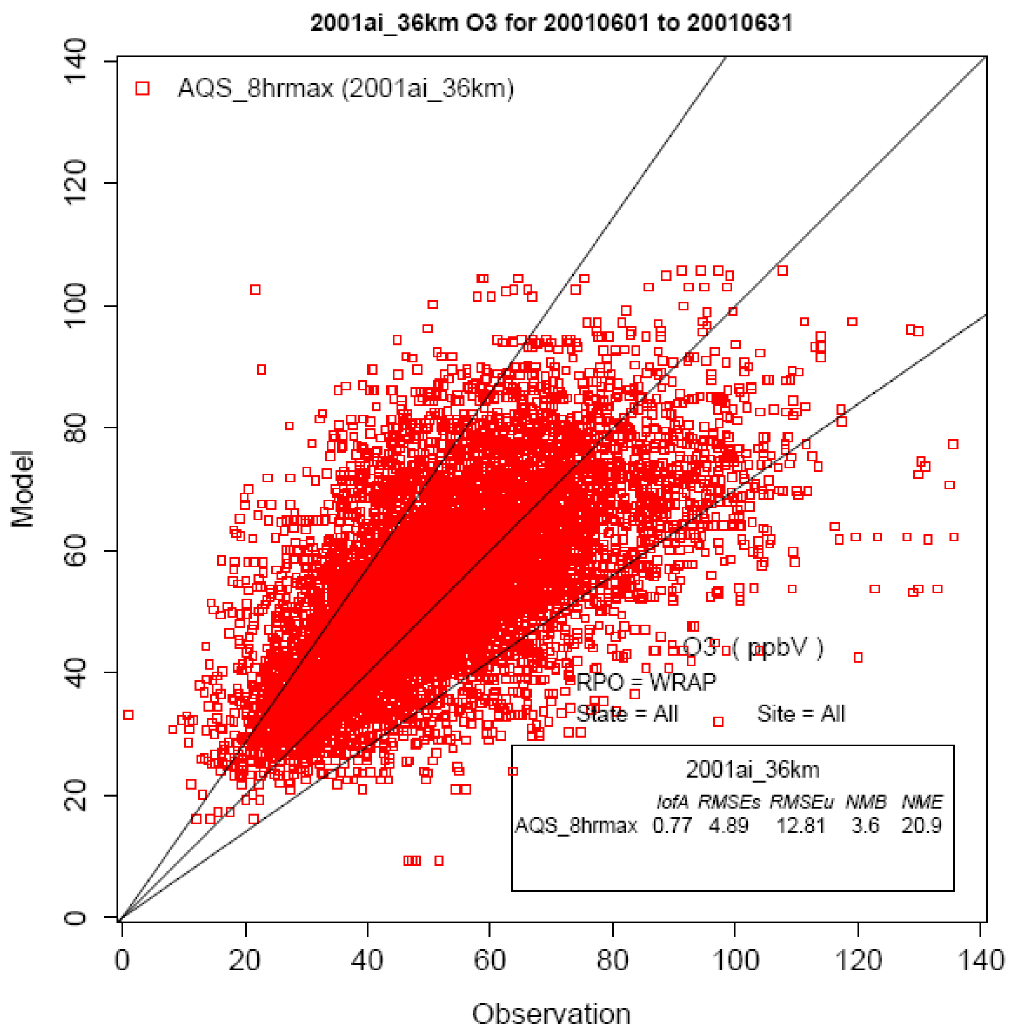
The 36 km ozone modeling was performed for the period from May 1 to September 30, 2001. Table II-9 lists the average monthly NMB and NME values for daily maximum 8-hourly ozone over the western portion[22] of the 36 km domain. 334 AIRS sites were used in these model-to-monitor comparisons. Figure II-3 shows a sample scatter plot of observed versus model pairs for June 2001 over the same region. While the resolution is less than ideal for an ozone impact analysis it is encouraging that the operational performance statistics are within the range of other recent regional modeling applications and in the range of the 12 km eastern U.S. results.

[22] Includes the following States: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, and WY.

Table II-9. 36 km CMAQ 8-hourly daily maximum ozone model performance statistics calculated for a threshold of 40 ppb over the western U.S. for 2001.

	NMB (%)	NME (%)
May	10.2	21.4
June	3.6	20.9
July	-7.0	21.5
August	-5.4	21.5
September	1.6	21.2

Figure II-3. CMAQ 8-hourly daily maximum ozone model performance scatter plot for June 2001.



F. CMAQ Locomotive/Marine Modeling Scenarios

The CMAQ modeling system was used to calculate annual $PM_{2.5}$ concentrations, daily 8-hour ozone concentrations, and visibility estimates for each of the following seven emissions scenarios:

1) 2001 base year
2) 2020 future base year
3) 2020 future control year – primary strategy
4) 2020 future control year – primary strategy, locomotive controls only
5) 2030 future base year
6) 2030 future control year – primary strategy
7) 2030 future control year – primary strategy, locomotive controls only

Model predictions are used in a relative sense to estimate scenario-specific, future-year design values of $PM_{2.5}$ and ozone. This is done by calculating the simulated air quality ratios between any particular future year simulation and the 2001 base. These predicted change ratios are then applied to ambient base year design values. The design value projection methodology used in this analysis followed EPA guidance[23] for such analyses. Additionally, the raw model output are also used in a relative sense as inputs to the health and welfare impact functions of the benefits analysis.

III. CMAQ Model Results

A. Impacts of Proposed Rule on Future $PM_{2.5}$ Annual Averages

The modeling results indicate that the emissions reductions from this proposed rule will contribute to lower ambient $PM_{2.5}$ levels in future years. Tables III-1 and III-2 show the projected average annual $PM_{2.5}$ design values, in various years as a result of the Locomotive/Marine control scenarios discussed in Section II.F. Average design values are shown for the 39 existing nonattainment (NA) $PM_{2.5}$ areas, all 557 counties with base year $PM_{2.5}$ monitoring data, and all 826 $PM_{2.5}$ base year monitors within the U.S. In general, the $PM_{2.5}$ improvement from the locomotive controls is roughly equivalent to that of the commercial marine controls. Appendix B contains a table of design values by county for each modeling scenario.

[23] U.S. EPA, Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS; EPA-454/R-05-002; Research Triangle Park, NC; October 2005.

Table III-1. Average projected $PM_{2.5}$ design values for Primary strategy modeling scenario. Units are $\mu g/m^3$.

	Average Baseline Design Value[24]	2020		2030	
	Base	Future Base	Primary Strategy	Future Base	Primary Strategy
NA areas	17.73	13.94	13.88	14.04	13.90
All Counties	12.60	10.34	10.30	10.39	10.31
All Monitors	12.82	10.56	10.52	10.64	10.55

Table III-2. Average projected $PM_{2.5}$ design values for Locomotive-Only strategy modeling scenario. Units are $\mu g/m^3$.

	Average Baseline Design Value	2020		2030	
	Base	Future Base	Locomotive Strategy	Future Base	Locomotive Strategy
NA areas	17.73	13.94	13.90	14.04	13.97
All Counties	12.60	10.34	10.31	10.39	10.35
All Monitors	12.82	10.56	10.54	10.64	10.59

On a population-weighted basis, the average modeled future-year annual $PM_{2.5}$ design value for all counties is expected to decrease by 0.06 $\mu g/m^3$ in 2020 and 0.13 $\mu g/m^3$ in 2030. The greatest impacts from the proposed Locomotive/Marine emissions reductions tend to occur in areas with high populations. Figures III-1 through III-4 display the projected county-level, annual $PM_{2.5}$ design value changes expected from various proposed control scenarios and years associated with this rule. The largest impacts tend to be in areas near water, where commercial marine source contributions can be large.

[24] For the modeled attainment tests EPA guidance recommends using the average of the three design value periods which include the baseline inventory year (2001). Therefore, the baseline design values here are a weighted average for the five years between 1999 and 2003.

Figure III-1. Model-projected change in annual $PM_{2.5}$ design values from the Primary Locomotive/Marine control scenario in 2020. Units are $\mu g/m^3$.

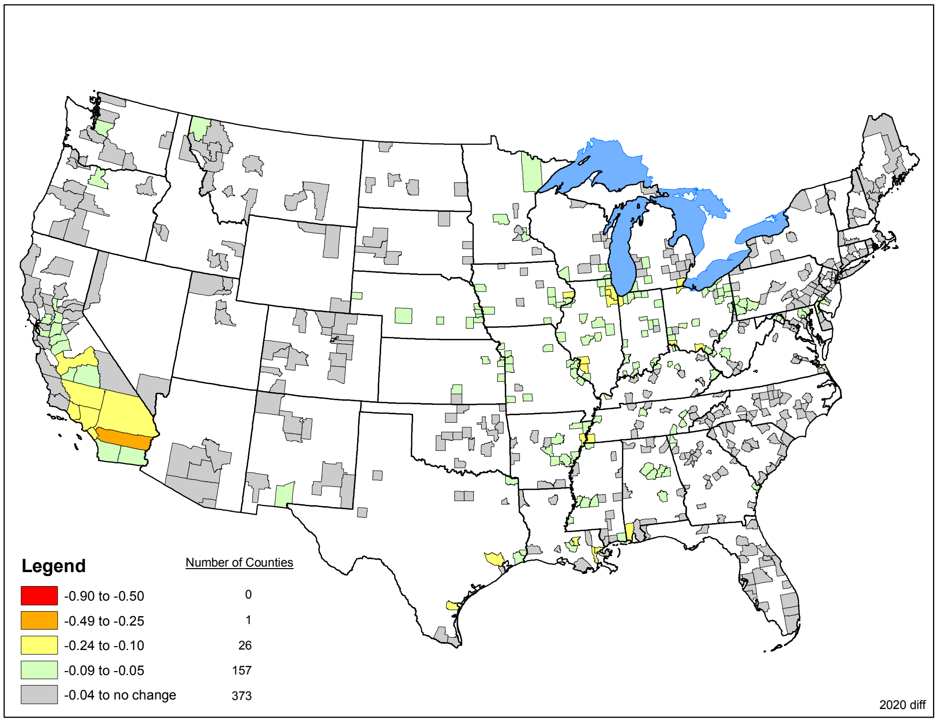


Figure III-2. Model-projected change in annual $PM_{2.5}$ design values from the Locomotive-only control scenario in 2020. Units are $\mu g/m^3$.

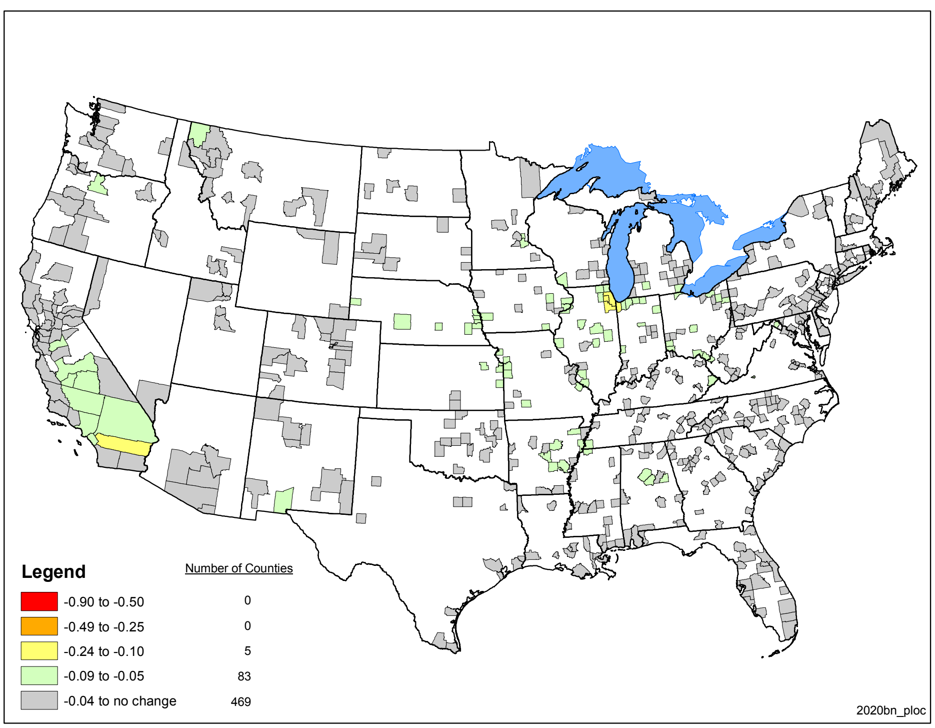


Figure III-3. Model-projected change in annual $PM_{2.5}$ design values from the Primary Locomotive/Marine control scenario in 2030. Units are µg/m^3.

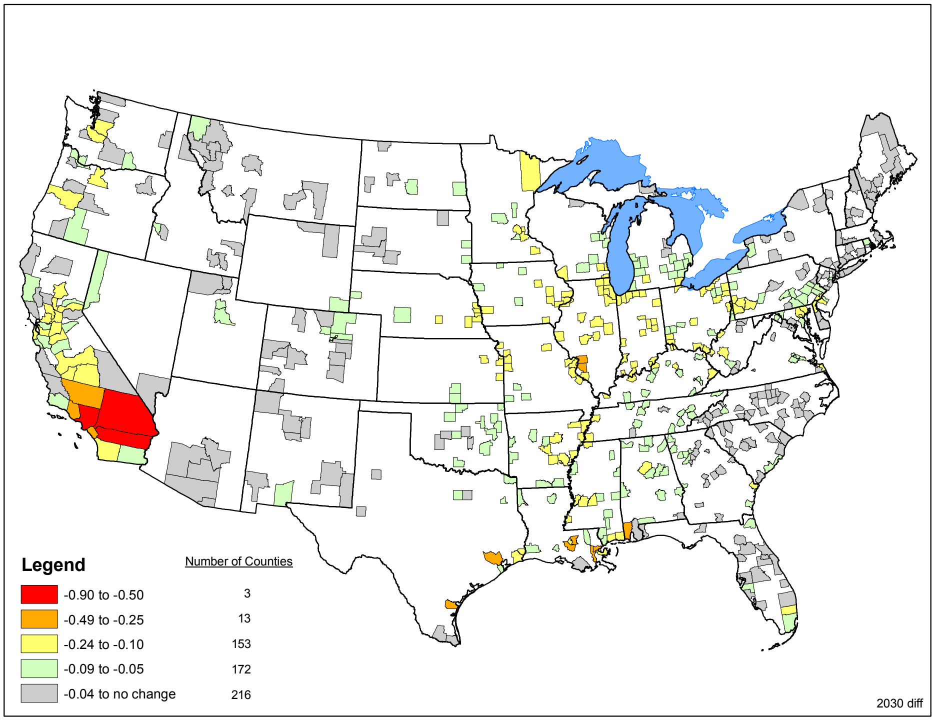
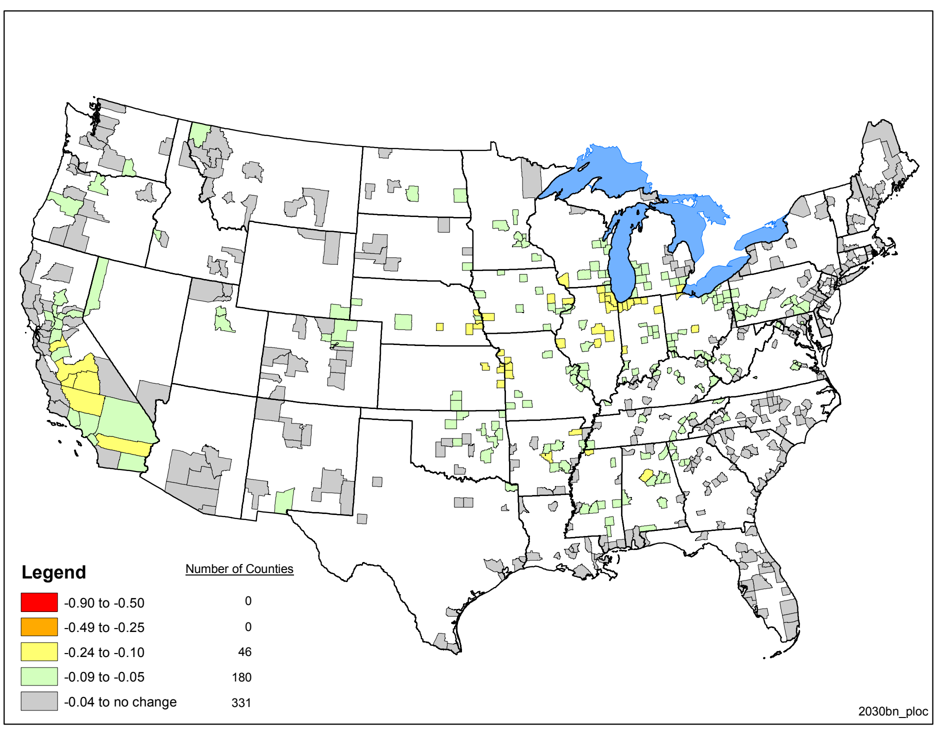


Figure III-4. Model-projected change in annual $PM_{2.5}$ design values from the Locomotive-only control scenario in 2030. Units are µg/m^3.



B. Impacts of Proposed Rule on Daily Maximum 8-Hour Ozone Concentrations

This section summarizes the results of our modeling of ozone air quality impacts in the future due to the proposed reductions in locomotive and commercial marine diesel emissions. Tables III-3 and III-4 show the average, model-projected, future-year, 8-hour ozone concentrations, in various years as a result of the Locomotive/Marine control scenarios discussed in Section II.F. Average design values are shown for the 126 existing ozone nonattainment areas, all 645 counties with base year ozone monitoring data, and all 1,105 eligible ozone monitors within the U.S. As in the earlier $PM_{2.5}$ analyses, the ozone improvements from the locomotive controls is roughly equivalent to that of the commercial marine controls. Appendix C contains design values by county for each modeling scenario.

Table III-3. Average projected 8-hour Ozone design values for Primary strategy modeling scenario. Units are ppb.

	Average Baseline Design Value	2020		2030	
	Base	Future Base	Primary Strategy	Future Base	Primary Strategy
NA areas	91.54	77.51	77.16	76.69	75.75
All Counties	86.21	73.34	73.02	72.58	71.72
All Monitors	84.22	73.14	72.82	72.28	71.42

Table III-4. Average projected 8-hour Ozone design values for Locomotive-Only strategy modeling scenario. Units are ppb.

	Average Baseline Design Value	2020		2030	
	Base	Future Base	Locomotive Strategy	Future Base	Locomotive Strategy
NA areas	91.54	77.51	77.31	76.69	76.14
All Counties	86.21	73.34	73.16	72.58	72.10
All Monitors	84.22	73.14	72.97	72.28	71.84

On a population-weighted basis, the average, all-counties, model-predicted, future-year 8-hour ozone design value would decrease by 0.29 ppb in 2020 and 0.80 ppb in 2030, as a result of the primary control strategy. This is similar, but slightly less than the overall change in design values. Figures III-5 through III-8 display the projected county-level, 8-hour ozone design value changes expected from various proposed control scenarios and years associated with this rule. As with $PM_{2.5}$, the largest impacts tend to be in areas near water, where commercial marine source contributions can be large, as well as over the Midwestern U.S. While the modeling indicates that the reductions from this proposed rule will contribute to reducing ambient ozone concentrations and potential exposures in future years for the vast majority of areas, there are a few counties where small (i.e., less than 1 ppb) increases in 8- hour ozone design values are projected.

Figure III-5. Model-projected change in annual 8-hour Ozone design values from the Primary Locomotive/Marine control scenario in 2020. Units are ppb.

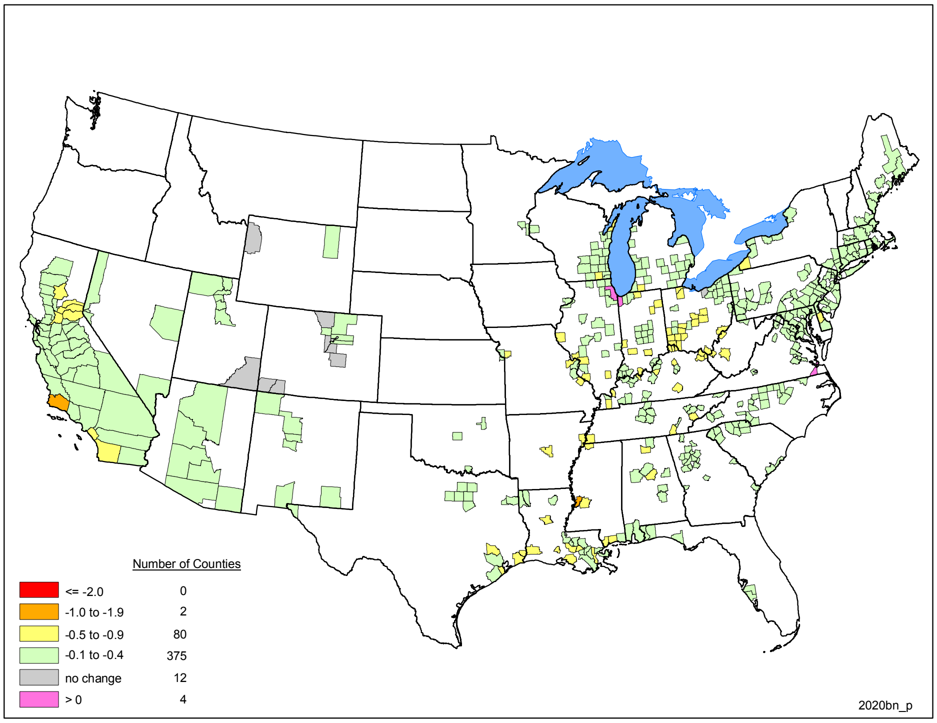


Figure III-6. Model-projected change in annual 8-hour Ozone design values from the Locomotive-only control scenario in 2020. Units are ppb.

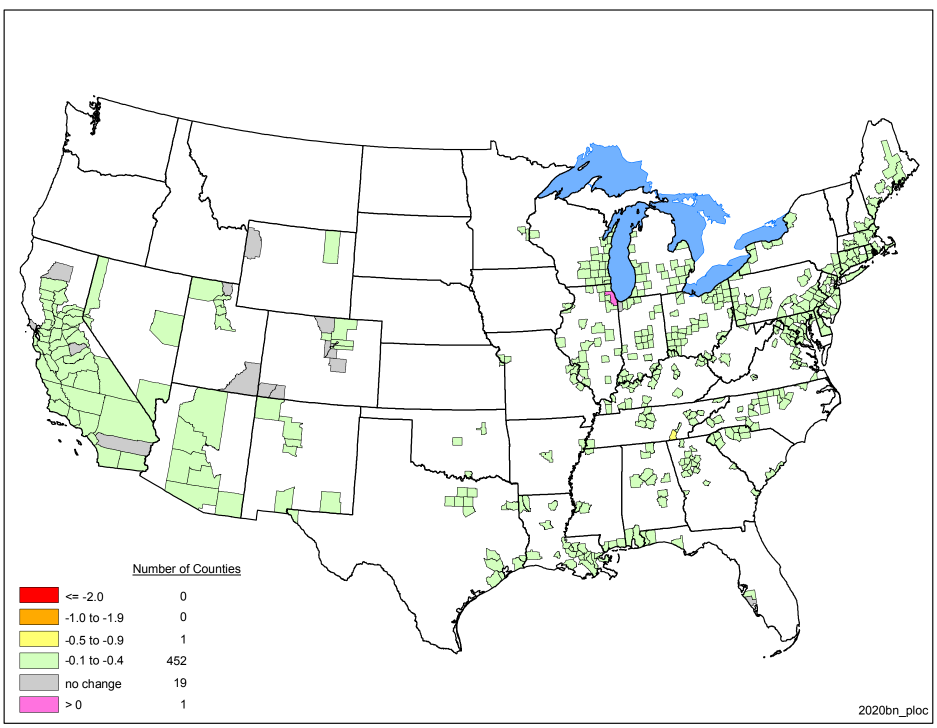


Figure III-7. Model-projected change in annual 8-hour Ozone design values from the Primary Locomotive/Marine control scenario in 2030. Units are ppb.

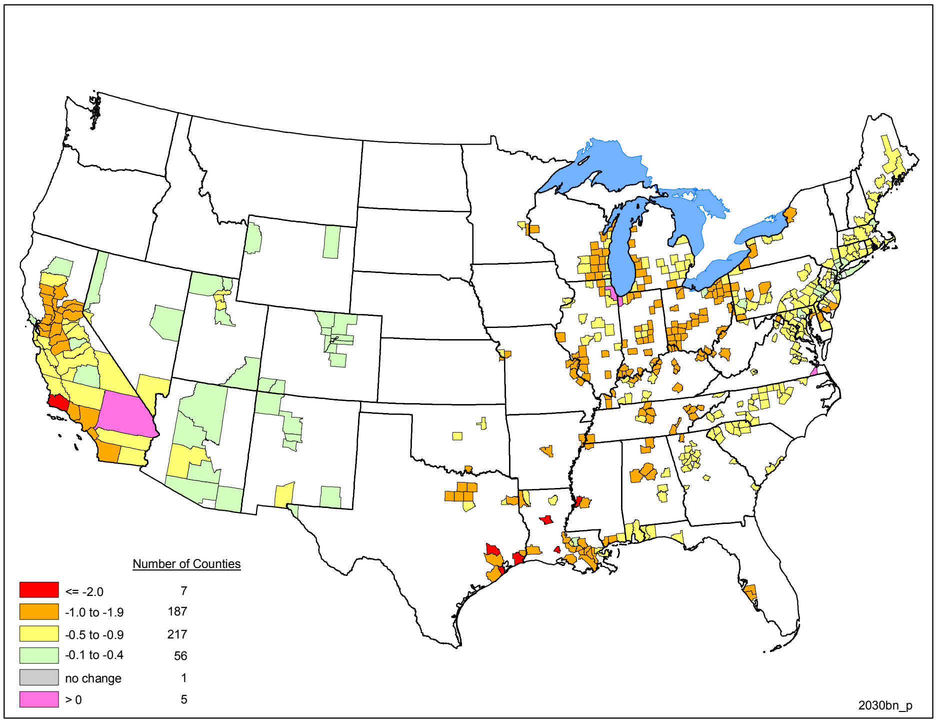
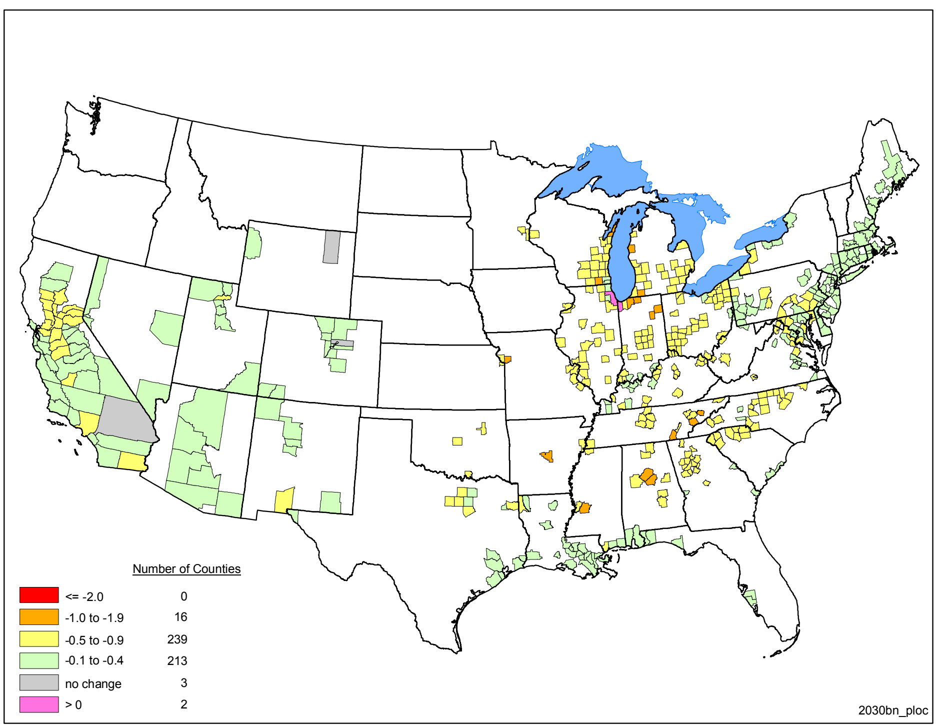


Figure III-8. Model-projected change in annual 8-hour Ozone design values from the Locomotive-only control scenario in 2030. Units are ppb.



C. Impacts of Proposed Rule on Visibility

The modeling conducted for the proposed Locomotive/Marine rule was also used to project the impacts of the reductions on visibility conditions over the 116 mandatory class I federal areas across the US in 2020 and 2030. The results indicate that improvements in visibility would occur in all 116 mandatory class I federal areas, although all these areas would continue to have annual average deciview[25] levels above background in both 2020 and 2030. The average deciview improvement is 0.02 in 2020 and 0.05 in 2030. The greatest visibility improvement due to this proposed rule would occur at Agua Tibia Wilderness where a 0.24 deciview improvement is projected by 2030 beyond the non-control scenario.

[25] The level of visibility impairment in an area is based on the light-extinction coefficient and a unit less visibility index, called a "deciview", which is used in the valuation of visibility. The deciview metric provides a scale for perceived visual changes over the entire range of conditions, from clear to hazy. Under many scenic conditions, the average person can generally perceive a change of one deciview. The higher the deciview value, the worse the visibility. Thus, an improvement in visibility is a decrease in deciview value.

Appendix A: 2001 Episodic CMAQ Model Performance Evaluation for Ozone

An operational model performance evaluation for hourly and eight hour daily maximum ozone was conducted using the 2001 State/local monitoring sites data in the Air Quality System (AQS) Aerometric Information Retrieval System (AIRS) in order to estimate the ability of the CMAQ modeling system to replicate the base year concentrations for the 12-km Eastern United States domain[26].[27] We included ozone measurements from 822 sites in the Eastern U.S. The ozone data were measured and reported on an hourly basis. The ozone metrics covered in this evaluation include hourly ozone concentrations and eight-hour daily maximum ozone concentrations. This evaluation principally comprises statistical assessments of model versus observed pairs that were paired in time and space on an hourly and/or daily basis. This evaluation primarily focuses on observed and predicted hourly ozone concentrations and eight-hour daily maximum ozone concentrations at a threshold of 40ppb. For certain time periods with missing ozone observations we excluded the CMAQ predictions from those time periods in our calculations. It should be noted when pairing model and observed data that each CMAQ concentration represents a grid-cell volume-averaged value, while the ambient network measurements are made at specific locations. In conjunction with the model performance statistics, we also provide spatial plots for individual monitors of the calculated bias and error statistics (defined below). This ozone model performance was limited to the two episodes that were modeled for the Locomotive-Marine Proposed Rule: Episode 1: June 16, 2001 thru June 30, 2001 and Episode 2: July 15, 2001 thru August 10, 2001. Performance statistics were calculated for the aggregate of the two episodes and for the two episodes separately for the following geographic groupings: the entire Eastern 12-km domain and four large subregions[28]: Midwest, Northeast, Southeast, and Central U.S.

There are various statistical metrics available and used by the science community for model performance evaluation. For a robust evaluation, the principal evaluation statistics used to evaluate CMAQ performance were two bias metrics, normalized mean bias and fractional bias; and two error metrics, normalized mean error and fractional error.

Normalized mean bias (NMB) is used as a normalization to facilitate a range of concentration magnitudes. This statistic averages the difference (model - observed) over the sum of observed values. NMB is a useful model performance indicator because it avoids over inflating the observed range of values, especially at low concentrations.

[26] See OTAQ Locomotive-Marine Proposed Rule AQTSD (Figure II-1) for the map of the CMAQ modeling domain.
[27] This evaluation includes updates to the CMAQ Model Performance Evaluation Report for 2001 updated March 2005 (CAIR Docket OAR-2005-0053-2149).
[28] The subregions are defined by States where: Midwest is IL, IN, MI, OH, and WI; Northeast is CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT; Southeast is AL, FL, GA, KY, MS, NC, SC, TN, VA, and WV; Central is AR, IA, KS, LA, MN, MO, NE, OK, and TX.

Normalized mean bias is defined as:

$$\text{NMB} = \frac{\sum_{1}^{n}(P-O)}{\sum_{1}^{n}(O)}*100$$

Normalized mean error (NME) is also similar to NMB, where the performance statistic is used as a normalization of the mean error. NME calculates the absolute value of the difference (model - observed) over the sum of observed values. Normalized mean error is defined as:

$$\text{NME} = \frac{\sum_{1}^{n}|P-O|}{\sum_{1}^{n}(O)}*100$$

Fractional bias is defined as:

$$\text{FB} = \frac{1}{n}\left(\frac{\sum_{1}^{n}(P-O)}{\sum_{1}^{n}\left(\frac{(P+O)}{2}\right)}\right)*100$$, where P = predicted concentrations and O = observed concentrations. FB is a useful model performance indicator because it has the advantage of equally weighting positive and negative bias estimates. The single largest disadvantage in this estimate of model performance is that the estimated concentration (i.e., prediction, P) is found in both the numerator and denominator. Fractional error (FE) is similar to fractional bias except the absolute value of the difference is used so that the error is always positive. Fractional error is defined as:

$$\text{FE} = \frac{1}{n}\left(\frac{\sum_{1}^{n}|P-O|}{\sum_{1}^{n}\left(\frac{(P+O)}{2}\right)}\right)*100$$

The "acceptability" of model performance was judged by comparing our CMAQ 2001 performance results to the range of performance found in recent regional ozone model applications (e.g., Clean Air Interstate Rule)[29]. Overall, the NMB, NME, FB, and FE statistics shown in Tables A-1, A-2, and A-3 below for CMAQ predicted 2001 hourly and eight-hour daily maximum ozone concentrations are within the range or close to that found in recent OAQPS applications. The CMAQ model performance results give us confidence that our applications of CMAQ using this modeling platform provide a scientifically credible approach for assessing ozone concentrations for the purposes of the Locomotive-Marine Proposed Rule. We discuss in the following sections the bias and error results for the hourly ozone concentrations and eight-hour daily maximum ozone concentrations evaluated at a threshold of 40 ppb.

Hourly Ozone Performance

Ozone Performance: Threshold of 40 ppb

Table A-2 provides hourly ozone model performance statistics calculated for a threshold of 40 ppb of observed and modeled concentrations, restricted to the two episodes modeled for the 12-km Eastern U.S. domain and the four subregions (Midwest, Northeast, Southeast, and Central U.S.). Spatial plots of the NMB and NME statistics (units of percent) for individual monitors are also provided as a complement to the tabular statistical data (Figures A-1 – A-6). Hourly ozone model performance is under predicted domainwide when applying a threshold of 40 ppb for these modeled time periods. For the 12-km Eastern domain, the bias and error statistics are comparable for the aggregate of the two episodes and for each individual episode, with a NMB range of 7-15% and a FB range of 8-12%, and a NME range of 18-20% and a FE range of 20-22%. Hourly ozone model performance when compared across the four subregions shows better performance in the Southeast, with NMB and FB values ranging from 2% to 6% and NME and FE values of approximately 16% to 17%. In general, the Northeast, Midwest, and Central U.S. exhibit similar bias and error statistics for the episodes modeled, NMB=8-15%; FB=10-18%; NME=18-22%; and FE=20-25%. Episode 1 shows slightly better bias and error model performance results, although the results are spatially and temporally comparable across the two modeled episodes.

[29] See U.S. Environmental Protection Agency; Technical Support Document for the Final Clean Air Interstate Rule: Air Quality Modeling; Office of Air Quality Planning and Standards; RTP, NC; March 2005.

Table A-2. CMAQ 2001 hourly ozone model performance statistics calculated for a threshold of 40 ppb.

CMAQ 2001 Hourly Ozone: Threshold of 40 ppb		No. of Obs.	NMB (%)	NME (%)	FB (%)	FE (%)
Aggregate of Two Episodes	12-km Eastern domain	322,705	-8.9	18.9	-10.9	21.3
	Northeast	94,848	-8.6	19.0	-10.9	21.7
	Midwest	77,100	-11.6	21.2	-14.1	24.2
	Southeast	89,921	-4.1	16.1	-4.6	16.9
	Central U.S.	59,978	-12.9	20.0	-16.2	23.5
Episode 1	12-km Eastern domain	127,125	-6.8	17.6	-8.2	19.7
	Northeast	37,362	-8.2	17.6	-10.0	20.1
	Midwest	27,315	-8.3	19.5	-9.8	21.9
	Southeast	37,897	-2.1	15.8	-2.3	16.6
	Central U.S.	24,255	-10.3	18.4	-13.0	21.6
Episode 2	12-km Eastern domain	195,580	-10.3	19.8	-12.6	22.3
	Northeast	57,486	-8.9	20.0	-11.5	22.7
	Midwest	49,785	-13.5	22.1	-16.5	25.5
	Southeast	52024	-5.7	16.2	-6.3	17.1
	Central U.S.	35,723	-14.8	21.2	-18.3	24.8

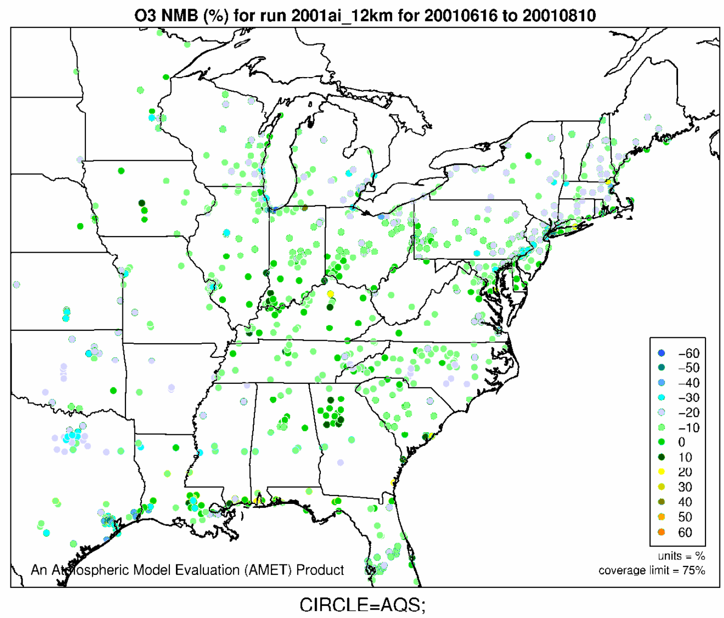


Figure A-1. Normalized Mean Bias (%) of hourly ozone (40 ppb threshold) by monitor for the aggregate of the two episodes.

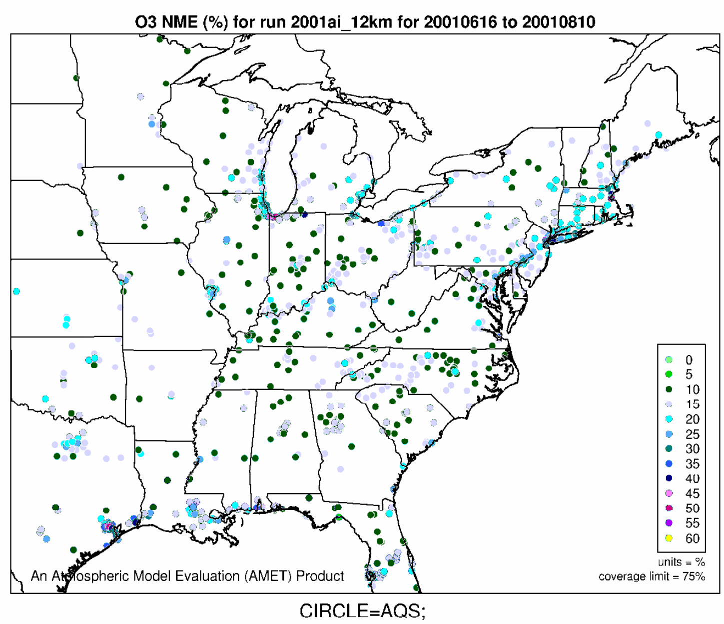


Figure A-2. Normalized Mean Error (%) of hourly ozone (40 ppb threshold) by monitor for the aggregate of the two episodes.

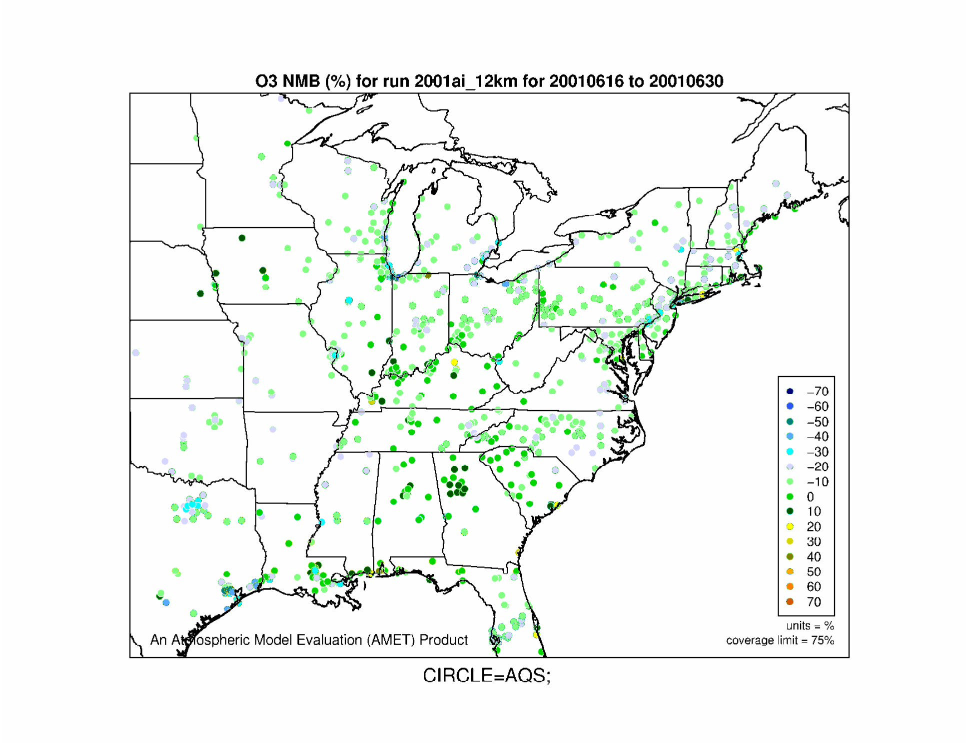


Figure A-3. Normalized Mean Bias (%) of hourly ozone (40 ppb threshold) by monitor for Episode 1.

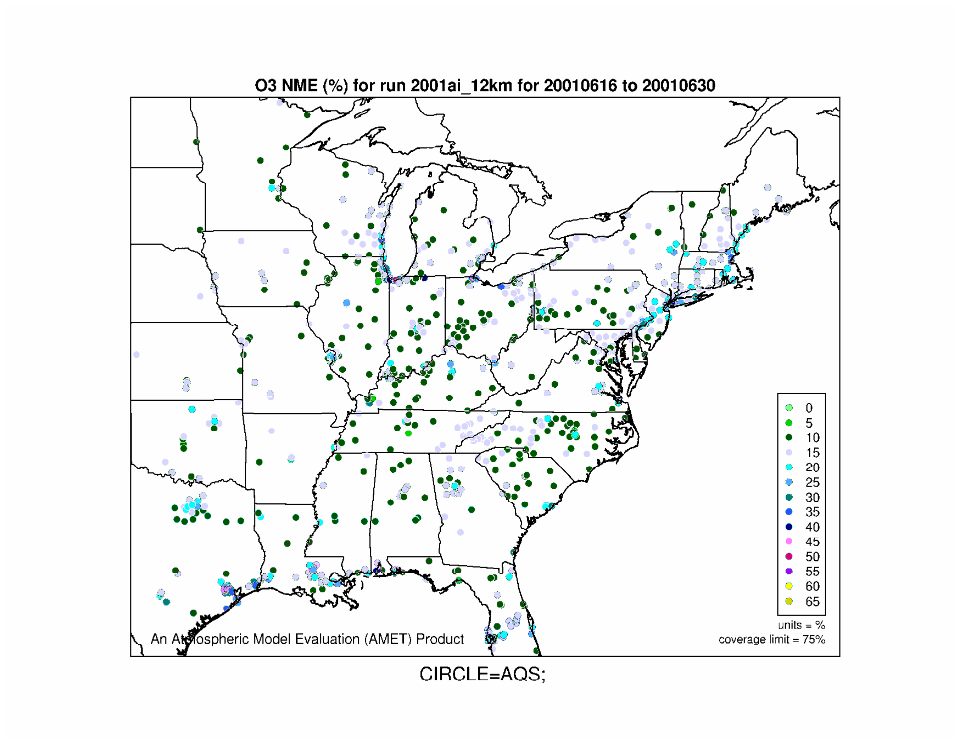


Figure A-4. Normalized Mean Error (%) of hourly ozone (40 ppb threshold) by monitor for Episode 1.

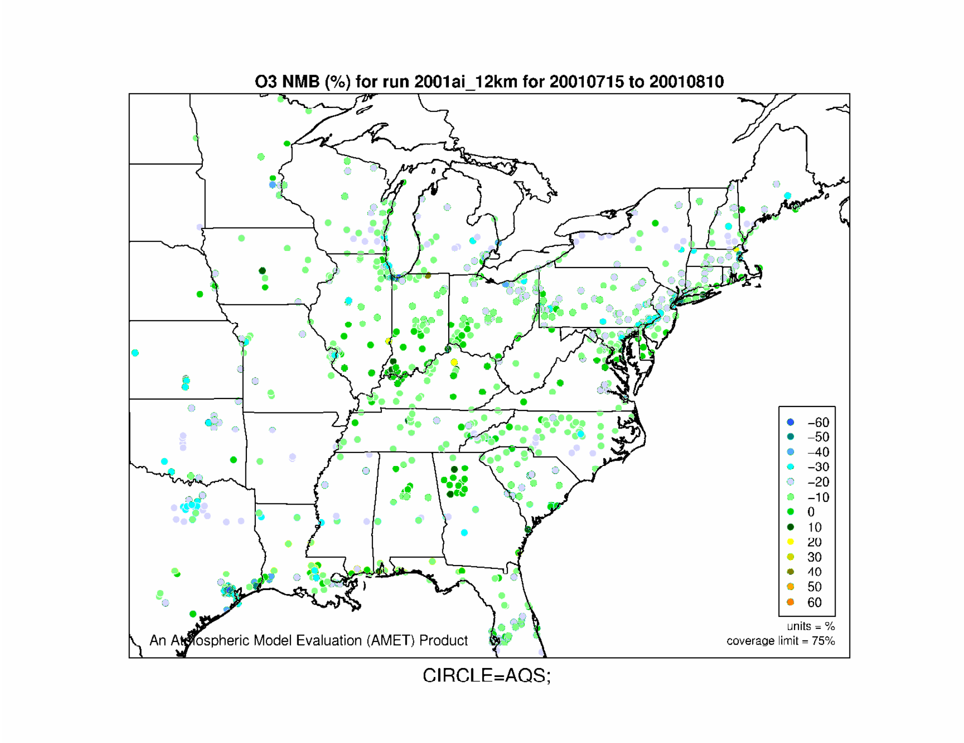


Figure A-5. Normalized Mean Bias (%) of hourly ozone (40 ppb threshold) by monitor for Episode 2.

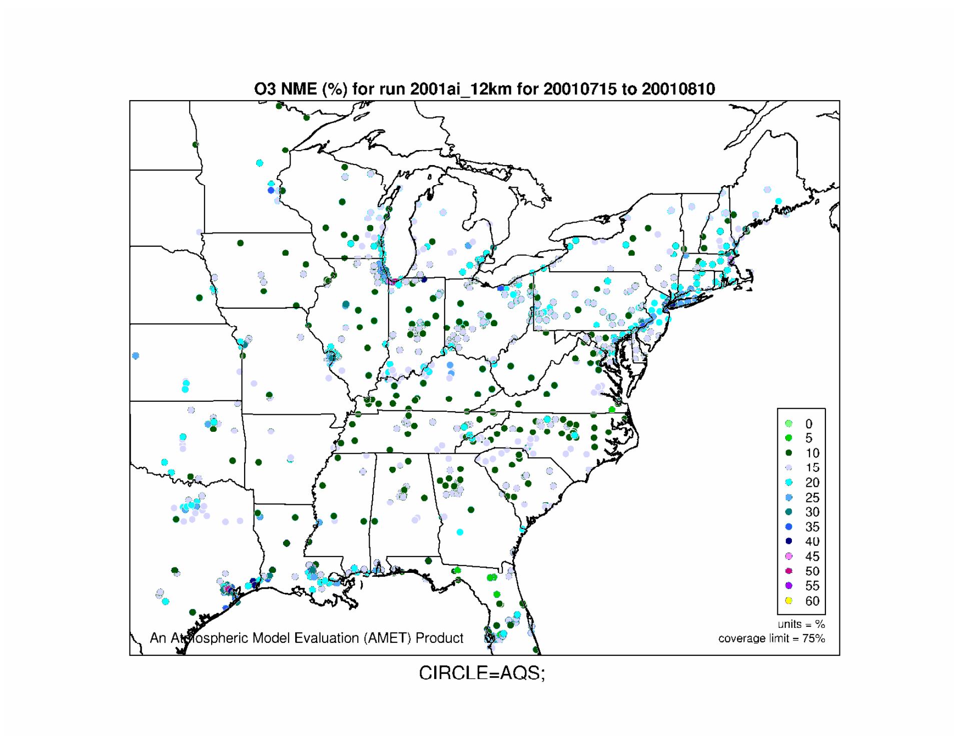


Figure A-6. Normalized Mean Error (%) of hourly ozone (40 ppb threshold) by monitor for Episode 2.

Eight-hour Daily Maximum Ozone Performance

Ozone Performance: Threshold of 40 ppb

Table A-4 presents eight-hour daily maximum ozone model performance bias and error statistics for the entire range of observed and modeled concentrations at a threshold of 40 ppb for the two episodes modeled for the 12-km Eastern U.S. domain and the corresponding subregions defined above. Spatial plots of the NMB and NME statistics (units of percent) for individual monitors based on the aggregate and the two episodes modeled respectively are shown in Figures A-7 through A-12. In general, CMAQ slightly under predicts eight-hourly daily maximum ozone with a threshold of 40 ppb, which also exhibits better model performance than the ozone hourly analysis for these two modeled time periods. For the 12-km Eastern domain, the bias statistics are within the range of approximately -2% to -6%, while the error statistics range from 14% to 15% for the aggregate of the two episodes and for each individual episode. The Southeast region shows good model performance with bias and error statistics approximately -1% and 13%, respectively. The Northeast, Midwest, and Central U.S. show relatively similar eight-hour daily maximum ozone performance, with bias values ranging from -3% to -10% and error values ranging from 13% to 17%. Analogous to the hourly ozone model performance, episode 1 shows slightly better overall bias and error results. The bias and error spatial plots (Figures A-9 – A-12) are similar across the two modeled episodes.

Table A-4. CMAQ 2001 eight-hour daily maximum ozone model performance statistics calculated for a threshold of 40 ppb.

CMAQ 2001 Eight-Hour Maximum Ozone: Threshold of 40 ppb		No. of Obs.	NMB (%)	NME (%)	FB (%)	FE (%)
Aggregate of Two Episodes	12-km Eastern domain	25,972	-4.7	14.6	-4.2	15.0
	Northeast	7,468	-4.0	14.5	-3.6	14.9
	Midwest	5,927	-7.1	16.1	-6.6	16.7
	Southeast	7,821	-1.3	13.1	-0.8	13.2
	Central U.S.	4,690	-7.7	15.1	-7.7	15.8
Episode 1	12-km Eastern domain	9,773	-2.8	13.7	-1.9	14.0
	Northeast	2,744	-4.0	13.2	-3.2	13.6
	Midwest	2,050	-4.6	15.0	-3.2	15.5
	Southeast	3,151	0.5	13.3	1.3	13.5
	Central U.S.	1,805	-4.7	13.5	-3.9	13.8
Episode 2	12-km Eastern domain	16,199	-5.8	15.2	-5.6	15.6
	Northeast	4,724	-4.1	15.3	-3.8	15.7
	Midwest	3,877	-8.6	16.8	-8.4	17.4
	Southeast	4,670	-2.6	13.0	-2.2	13.1
	Central U.S.	2,885	-9.8	16.1	-10.0	17.0

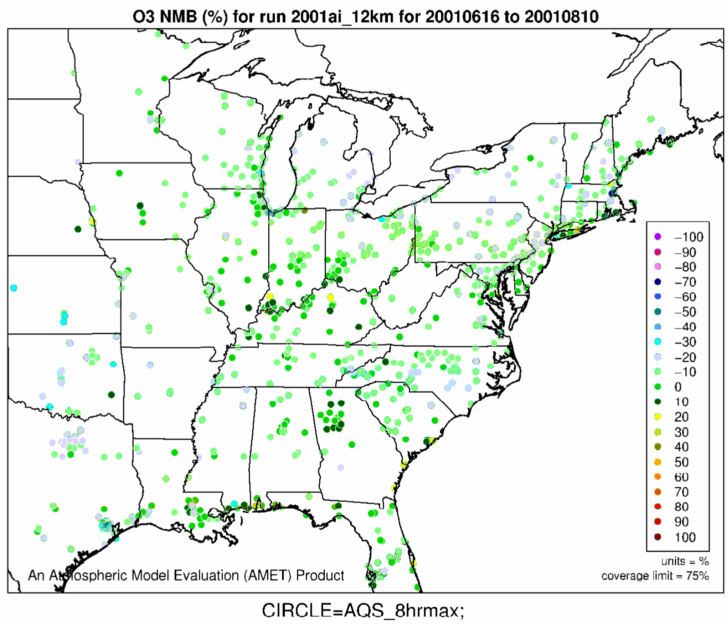


Figure A-7. Normalized Mean Bias (%) of eight-hour daily maximum ozone (40 ppb threshold) by monitor for the aggregate of the two episodes.

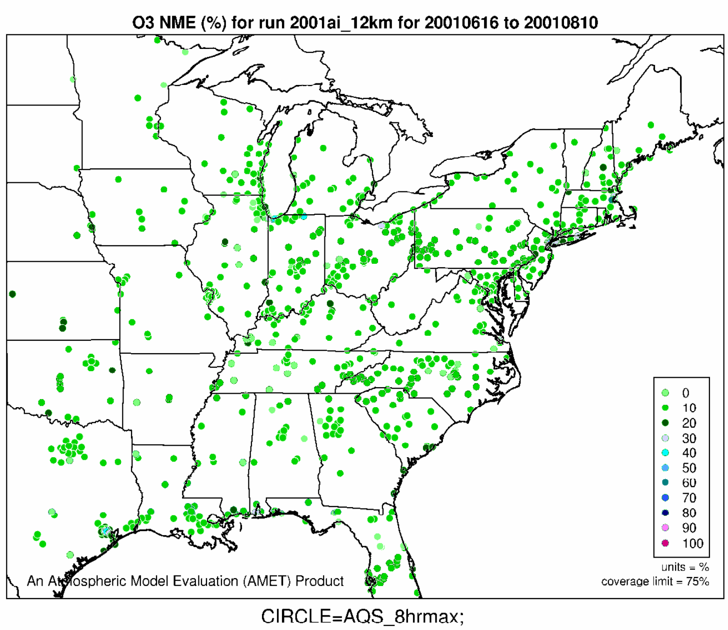


Figure A-8. Normalized Mean Error (%) of eight-hour daily maximum ozone (40 ppb threshold) by monitor for the aggregate of the two episodes.

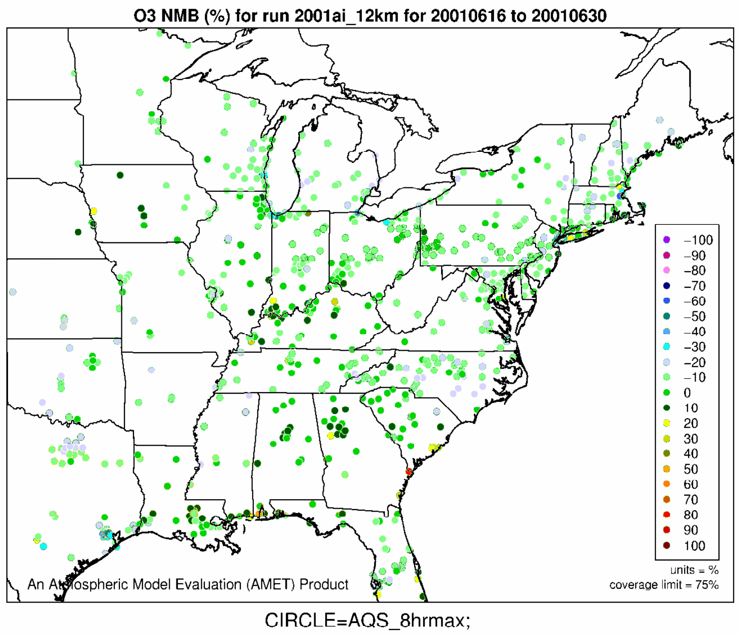


Figure A-9. Normalized Mean Bias (%) of eight-hour daily maximum ozone (40 ppb threshold) by monitor for Episode 1.

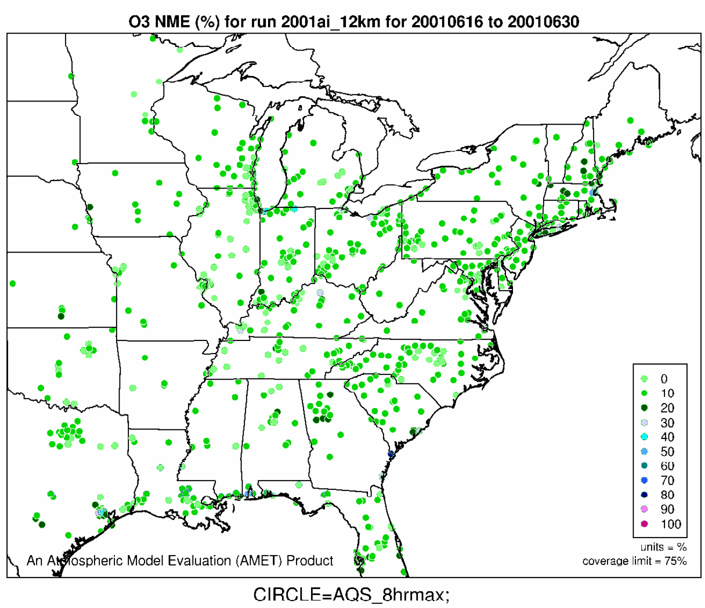


Figure A-10. Normalized Mean Error (%) of eight-hour daily maximum ozone (40 ppb threshold) by monitor for Episode 1.

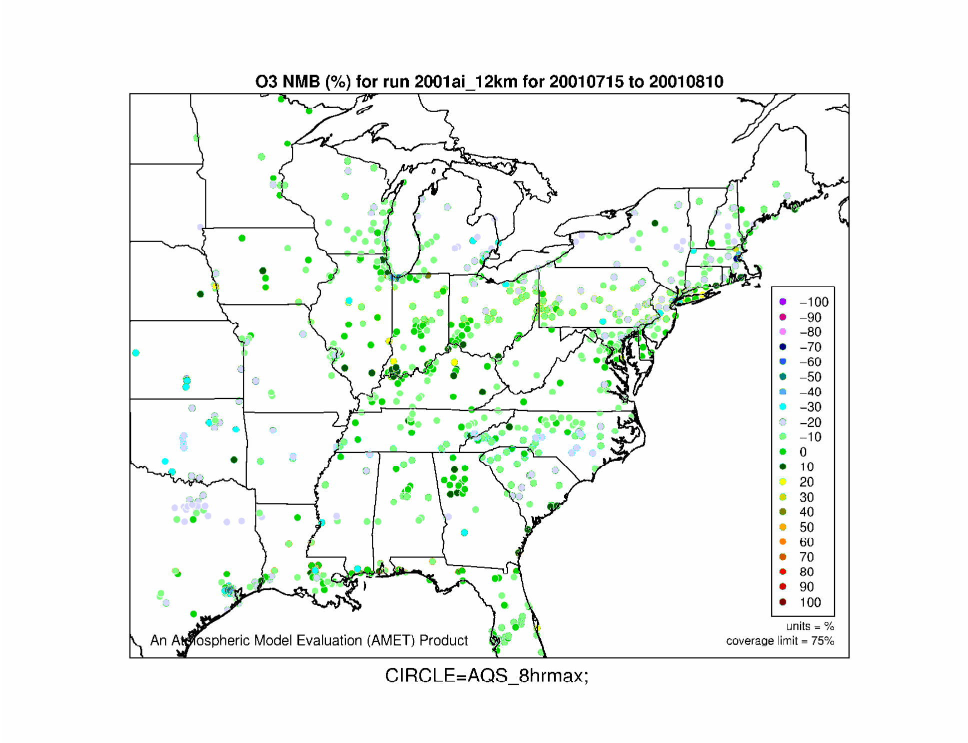


Figure A-11. Normalized Mean Bias (%) of eight-hour daily maximum ozone (40 ppb threshold) by monitor for Episode 2.

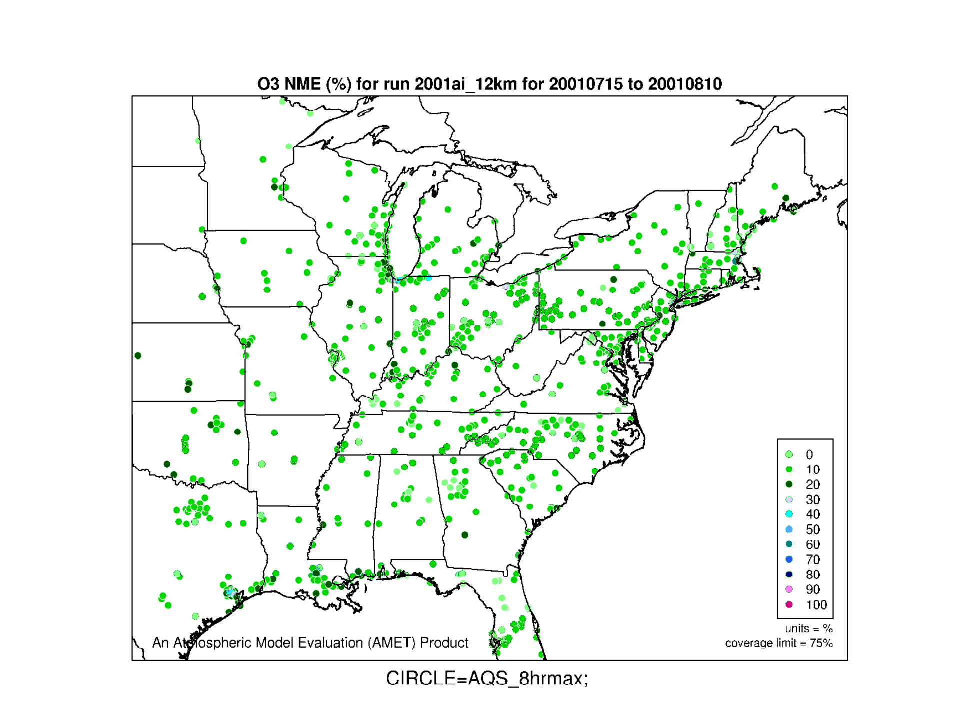


Figure A-12. Normalized Mean Error (%) of eight-hour daily maximum ozone (40 ppb threshold) by monitor for Episode 2.

Appendix B: Annual Average $PM_{2.5}$ Design Values for Locomotive/Marine Scenarios (units are $\mu g/m^3$)

State Name	County Name	Baseline DV	2020 Base	2020 Locomotive only	2020 Primary	2030 Base	2030 Locomotive only	2030 Primary
Alabama	Baldwin Co	11.43	9.08	9.07	9.06	9.16	9.14	9.12
Alabama	Clay Co	14.27	10.89	10.84	10.84	10.87	10.80	10.79
Alabama	Colbert Co	13.94	10.96	10.94	10.93	10.99	10.96	10.94
Alabama	DeKalb Co	15.62	12.06	12.03	12.03	12.06	12.00	11.99
Alabama	Escambia Co	13.03	10.59	10.57	10.57	10.61	10.56	10.55
Alabama	Houston Co	14.69	12.27	12.26	12.26	12.28	12.27	12.26
Alabama	Jefferson Co	19.05	15.74	15.68	15.68	15.74	15.64	15.62
Alabama	Madison Co	14.81	11.19	11.17	11.17	11.22	11.18	11.17
Alabama	Mobile Co	13.69	12.07	12.06	11.96	12.54	12.52	12.26
Alabama	Montgomery Co	15.41	12.81	12.77	12.76	12.82	12.75	12.75
Alabama	Morgan Co	15.81	12.83	12.81	12.80	12.87	12.82	12.80
Alabama	Russell Co	16.29	13.17	13.15	13.15	13.17	13.13	13.12
Alabama	Shelby Co	15.33	12.23	12.18	12.17	12.23	12.15	12.14
Alabama	Sumter Co	13.28	10.47	10.45	10.44	10.51	10.46	10.45
Alabama	Talladega Co	16.05	12.35	12.31	12.30	12.34	12.26	12.25
Arizona	Gila Co	9.53	9.12	9.11	9.11	9.12	9.11	9.11
Arizona	Maricopa Co	11.36	10.15	10.14	10.14	10.18	10.17	10.16
Arizona	Pima Co	7.46	7.13	7.12	7.12	7.14	7.12	7.12
Arizona	Pinal Co	8.33	8.02	8.00	8.00	8.03	7.99	7.99
Arizona	Santa Cruz Co	11.89	11.95	11.94	11.94	11.96	11.96	11.96
Arkansas	Arkansas Co	12.38	10.01	9.96	9.95	10.02	9.94	9.91
Arkansas	Ashley Co	12.72	10.56	10.54	10.52	10.64	10.60	10.56
Arkansas	Craighead Co	12.39	9.94	9.87	9.85	9.95	9.85	9.81
Arkansas	Crittenden Co	13.35	11.17	11.12	11.07	11.45	11.37	11.24
Arkansas	Faulkner Co	12.57	10.46	10.43	10.42	10.48	10.42	10.40
Arkansas	Jefferson Co	13.28	11.35	11.30	11.29	11.36	11.28	11.25
Arkansas	Mississippi Co	12.05	9.74	9.71	9.68	9.83	9.79	9.72
Arkansas	Phillips Co	12.49	10.09	10.07	10.04	10.26	10.22	10.12
Arkansas	Polk Co	11.35	9.16	9.15	9.14	9.19	9.16	9.14
Arkansas	Pope Co	12.48	10.64	10.62	10.61	10.66	10.62	10.61
Arkansas	Pulaski Co	14.54	12.01	11.94	11.93	12.02	11.92	11.89
Arkansas	Sebastian Co	12.66	10.49	10.47	10.46	10.51	10.47	10.46
Arkansas	Union Co	13.03	11.78	11.77	11.76	11.83	11.80	11.77
Arkansas	White Co	11.92	9.69	9.63	9.62	9.70	9.61	9.59

California	Alameda Co	11.96	13.06	13.04	13.01	12.90	12.86	12.77
California	Butte Co	14.31	13.02	12.99	12.98	12.83	12.74	12.71
California	Calaveras Co	9.06	8.11	8.10	8.09	7.96	7.92	7.89
California	Colusa Co	9.88	9.31	9.29	9.29	9.23	9.20	9.19
California	Contra Costa Co	11.07	12.44	12.43	12.41	12.40	12.37	12.31
California	El Dorado Co	7.84	7.34	7.34	7.33	7.30	7.29	7.28
California	Fresno Co	21.85	19.59	19.52	19.49	19.09	18.94	18.87
California	Humboldt Co	8.85	8.08	8.07	8.07	8.10	8.09	8.07
California	Imperial Co	15.22	14.66	14.63	14.61	14.66	14.61	14.58
California	Inyo Co	6.22	6.01	6.01	6.00	5.99	5.98	5.97
California	Kern Co	22.74	20.76	20.67	20.63	20.25	20.08	19.96
California	Kings Co	18.52	16.77	16.72	16.70	16.43	16.33	16.28
California	Lake Co	5.00	4.72	4.72	4.71	4.68	4.67	4.66
California	Los Angeles Co	24.21	23.43	23.37	23.22	24.72	24.63	24.22
California	Mendocino Co	8.08	7.66	7.65	7.64	7.60	7.57	7.55
California	Merced Co	16.73	15.54	15.51	15.49	15.41	15.35	15.32
California	Monterey Co	8.45	8.47	8.46	8.45	8.42	8.40	8.39
California	Nevada Co	8.31	7.67	7.65	7.65	7.63	7.59	7.58
California	Orange Co	20.39	19.71	19.66	19.52	20.84	20.77	20.37
California	Placer Co	12.20	11.13	11.10	11.09	11.01	10.94	10.90
California	Riverside Co	28.82	27.06	26.95	26.71	27.48	27.30	26.58
California	Sacramento Co	12.96	12.04	12.01	11.99	11.97	11.91	11.87
California	San Bernardino Co	25.27	24.14	24.08	23.93	25.04	24.95	24.50
California	San Diego Co	16.44	14.98	14.97	14.90	15.17	15.15	14.95
California	San Francisco Co	11.80	11.34	11.33	11.29	11.46	11.44	11.35
California	San Joaquin Co	15.46	15.92	15.89	15.85	15.80	15.73	15.61
California	San Luis Obispo Co	9.68	9.27	9.26	9.25	9.32	9.30	9.28
California	San Mateo Co	11.09	10.50	10.48	10.46	10.26	10.22	10.16
California	Santa Barbara Co	9.69	9.37	9.36	9.35	9.42	9.40	9.37
California	Santa Clara Co	11.45	11.98	11.96	11.94	11.66	11.62	11.58
California	Santa Cruz Co	8.57	7.94	7.93	7.92	7.78	7.76	7.73
California	Shasta Co	9.66	8.72	8.71	8.71	8.72	8.70	8.69
California	Solano Co	12.18	11.69	11.67	11.64	11.86	11.84	11.75
California	Sonoma Co	10.55	9.82	9.81	9.81	9.82	9.81	9.79
California	Stanislaus Co	17.87	16.19	16.14	16.11	15.77	15.66	15.56
California	Sutter Co	12.08	10.93	10.89	10.88	10.78	10.70	10.67
California	Tulare Co	23.06	20.59	20.53	20.50	20.01	19.87	19.78
California	Ventura Co	14.59	13.34	13.32	13.18	13.87	13.82	13.43

California	Yolo Co	10.86	10.00	9.97	9.96	9.90	9.84	9.80
Colorado	Adams Co	10.38	9.06	9.02	9.02	9.02	8.96	8.96
Colorado	Arapahoe Co	8.89	7.97	7.95	7.95	7.94	7.91	7.91
Colorado	Boulder Co	9.36	8.37	8.34	8.34	8.34	8.29	8.29
Colorado	Delta Co	8.34	7.82	7.81	7.81	7.81	7.79	7.79
Colorado	Denver Co	10.87	9.56	9.52	9.52	9.53	9.46	9.46
Colorado	Elbert Co	4.34	3.98	3.97	3.97	3.98	3.96	3.96
Colorado	El Paso Co	7.74	6.97	6.95	6.95	6.97	6.94	6.93
Colorado	Gunnison Co	6.71	6.41	6.41	6.41	6.41	6.41	6.41
Colorado	La Plata Co	5.48	5.14	5.13	5.13	5.13	5.12	5.12
Colorado	Larimer Co	8.04	7.42	7.40	7.40	7.40	7.37	7.37
Colorado	Mesa Co	7.61	7.11	7.09	7.09	7.11	7.07	7.07
Colorado	Pueblo Co	7.99	7.47	7.45	7.45	7.46	7.43	7.43
Colorado	Routt Co	7.46	7.20	7.19	7.19	7.19	7.18	7.18
Colorado	San Miguel Co	5.61	5.34	5.34	5.34	5.34	5.34	5.34
Colorado	Weld Co	9.59	8.35	8.31	8.31	8.29	8.22	8.22
Connecticut	Fairfield Co	13.40	10.85	10.85	10.83	10.97	10.97	10.93
Connecticut	Hartford Co	12.72	10.38	10.38	10.38	10.45	10.45	10.44
Connecticut	New Haven Co	13.95	11.06	11.06	11.04	11.16	11.16	11.12
Connecticut	New London Co	11.74	9.29	9.29	9.28	9.33	9.33	9.33
Delaware	Kent Co	13.13	9.38	9.37	9.36	9.48	9.46	9.44
Delaware	New Castle Co	16.41	13.04	13.02	12.98	13.52	13.49	13.36
Delaware	Sussex Co	14.08	10.34	10.33	10.32	10.39	10.38	10.36
District of Columbia	District of Columbia	16.25	11.47	11.44	11.44	11.51	11.47	11.47
Florida	Alachua Co	10.35	8.19	8.18	8.18	8.20	8.20	8.19
Florida	Brevard Co	7.88	5.68	5.68	5.68	5.71	5.70	5.70
Florida	Broward Co	8.52	6.68	6.67	6.64	6.91	6.91	6.80
Florida	Citrus Co	9.69	6.89	6.89	6.89	6.91	6.91	6.90
Florida	Duval Co	10.82	8.77	8.76	8.74	8.90	8.89	8.84
Florida	Escambia Co	12.21	9.92	9.92	9.91	9.98	9.96	9.96
Florida	Hillsborough Co	11.86	8.64	8.63	8.63	8.70	8.70	8.67
Florida	Lee Co	8.94	6.32	6.32	6.32	6.35	6.35	6.35
Florida	Leon Co	12.93	10.82	10.80	10.80	10.82	10.80	10.80
Florida	Manatee Co	9.96	7.00	7.00	6.98	7.11	7.10	7.06
Florida	Marion Co	10.37	7.91	7.91	7.91	7.93	7.92	7.92
Florida	Miami-Dade Co	9.82	7.63	7.63	7.61	7.70	7.69	7.65
Florida	Orange Co	10.73	8.14	8.14	8.13	8.19	8.19	8.19
Florida	Palm Beach Co	7.69	5.60	5.59	5.59	5.63	5.63	5.63

Florida	Pinellas Co	11.14	7.90	7.90	7.89	8.06	8.06	8.02
Florida	Polk Co	10.91	8.70	8.69	8.69	8.72	8.71	8.70
Florida	St. Lucie Co	9.00	6.60	6.60	6.60	6.62	6.62	6.62
Florida	Sarasota Co	9.86	7.06	7.05	7.05	7.13	7.13	7.10
Florida	Seminole Co	9.78	7.26	7.26	7.26	7.30	7.30	7.30
Florida	Volusia Co	9.81	7.18	7.18	7.18	7.22	7.21	7.21
Georgia	Bibb Co	16.42	13.61	13.58	13.58	13.61	13.57	13.57
Georgia	Chatham Co	14.99	12.32	12.30	12.26	12.54	12.52	12.40
Georgia	Clarke Co	17.07	12.58	12.57	12.56	12.58	12.54	12.54
Georgia	Clayton Co	17.51	13.69	13.66	13.66	13.74	13.70	13.70
Georgia	Cobb Co	17.12	13.37	13.34	13.34	13.40	13.35	13.35
Georgia	DeKalb Co	17.65	13.34	13.32	13.32	13.38	13.35	13.34
Georgia	Dougherty Co	15.10	12.59	12.57	12.57	12.58	12.56	12.56
Georgia	Floyd Co	16.67	13.96	13.94	13.93	13.96	13.91	13.90
Georgia	Fulton Co	19.51	15.30	15.28	15.28	15.37	15.33	15.32
Georgia	Glynn Co	12.01	9.98	9.96	9.95	10.00	9.98	9.95
Georgia	Gwinnett Co	16.34	12.50	12.48	12.48	12.55	12.52	12.51
Georgia	Hall Co	16.08	11.97	11.96	11.96	11.98	11.95	11.95
Georgia	Houston Co	12.85	10.55	10.53	10.53	10.55	10.51	10.51
Georgia	Lowndes Co	12.04	10.02	10.01	10.01	10.02	9.99	9.99
Georgia	Muscogee Co	16.33	13.21	13.19	13.19	13.21	13.17	13.16
Georgia	Paulding Co	15.34	11.67	11.64	11.64	11.68	11.62	11.61
Georgia	Richmond Co	15.86	12.75	12.73	12.73	12.75	12.72	12.72
Georgia	Walker Co	15.57	12.07	12.03	12.02	12.11	12.05	12.02
Georgia	Washington Co	15.44	12.57	12.55	12.55	12.57	12.54	12.53
Georgia	Wilkinson Co	16.26	13.45	13.43	13.43	13.45	13.42	13.41
Idaho	Ada Co	9.42	8.83	8.81	8.81	8.80	8.76	8.76
Idaho	Bannock Co	9.30	9.08	9.07	9.07	9.07	9.06	9.06
Idaho	Bonneville Co	6.71	6.55	6.54	6.54	6.54	6.53	6.53
Idaho	Canyon Co	9.97	9.12	9.09	9.09	9.05	8.99	8.98
Idaho	Power Co	10.68	10.44	10.42	10.42	10.43	10.41	10.41
Idaho	Shoshone Co	12.76	12.36	12.34	12.34	12.34	12.31	12.30
Illinois	Adams Co	13.04	11.11	11.05	11.03	11.07	10.97	10.92
Illinois	Champaign Co	12.93	10.49	10.43	10.43	10.46	10.36	10.33
Illinois	Cook Co	18.00	15.30	15.20	15.18	15.34	15.18	15.14
Illinois	DuPage Co	15.01	12.47	12.36	12.34	12.49	12.31	12.28
Illinois	Kane Co	14.40	12.12	12.04	12.03	12.07	11.94	11.92
Illinois	Lake Co	12.98	11.16	11.10	11.10	11.19	11.10	11.08

Illinois	McHenry Co	13.14	10.99	10.92	10.91	10.94	10.83	10.80
Illinois	McLean Co	13.87	11.54	11.48	11.47	11.50	11.40	11.37
Illinois	Macon Co	14.22	11.90	11.83	11.82	11.86	11.75	11.72
Illinois	Madison Co	17.40	15.12	15.08	15.01	15.42	15.33	15.14
Illinois	Peoria Co	14.33	12.11	12.06	12.05	12.11	12.02	11.97
Illinois	Randolph Co	13.06	10.56	10.51	10.48	10.63	10.55	10.47
Illinois	Rock Island Co	12.44	10.36	10.31	10.30	10.29	10.21	10.17
Illinois	St. Clair Co	16.87	14.57	14.52	14.46	14.86	14.77	14.59
Illinois	Sangamon Co	13.60	11.22	11.18	11.16	11.19	11.10	11.06
Illinois	Will Co	15.35	13.11	12.98	12.97	13.08	12.89	12.86
Indiana	Allen Co	14.52	11.78	11.72	11.71	11.76	11.65	11.63
Indiana	Clark Co	16.90	13.39	13.37	13.34	13.57	13.52	13.44
Indiana	Delaware Co	14.71	11.56	11.52	11.51	11.56	11.48	11.45
Indiana	Dubois Co	16.02	12.68	12.65	12.63	12.76	12.71	12.65
Indiana	Elkhart Co	15.31	12.48	12.42	12.41	12.45	12.35	12.33
Indiana	Floyd Co	15.35	11.87	11.85	11.82	12.00	11.96	11.88
Indiana	Henry Co	13.55	10.50	10.47	10.46	10.50	10.43	10.40
Indiana	Howard Co	14.88	11.95	11.90	11.89	11.91	11.82	11.80
Indiana	Knox Co	13.83	10.61	10.57	10.55	10.60	10.52	10.49
Indiana	Lake Co	15.47	13.34	13.21	13.19	13.43	13.24	13.19
Indiana	La Porte Co	13.52	11.44	11.37	11.36	11.42	11.30	11.27
Indiana	Madison Co	14.82	11.58	11.54	11.53	11.57	11.50	11.47
Indiana	Marion Co	16.88	13.26	13.22	13.21	13.28	13.20	13.16
Indiana	Porter Co	14.01	12.36	12.28	12.27	12.39	12.26	12.24
Indiana	St. Joseph Co	14.35	11.97	11.91	11.90	11.95	11.84	11.82
Indiana	Spencer Co	14.43	11.07	11.05	11.01	11.21	11.18	11.09
Indiana	Vanderburgh Co	15.60	12.54	12.51	12.47	12.70	12.64	12.53
Indiana	Vigo Co	14.88	11.85	11.79	11.77	11.83	11.72	11.69
Iowa	Black Hawk Co	11.48	9.74	9.70	9.70	9.64	9.56	9.54
Iowa	Cerro Gordo Co	10.55	8.98	8.95	8.94	8.87	8.80	8.79
Iowa	Clinton Co	12.26	10.36	10.27	10.26	10.31	10.16	10.12
Iowa	Emmet Co	8.82	7.45	7.43	7.42	7.34	7.29	7.28
Iowa	Johnson Co	11.52	9.81	9.77	9.76	9.74	9.65	9.63
Iowa	Linn Co	11.23	9.78	9.73	9.72	9.72	9.61	9.59
Iowa	Muscatine Co	13.03	11.15	11.11	11.09	11.11	11.02	10.98
Iowa	Polk Co	10.68	8.94	8.90	8.90	8.87	8.79	8.78
Iowa	Pottawattamie Co	10.48	8.95	8.90	8.90	8.89	8.79	8.79
Iowa	Scott Co	12.76	10.58	10.53	10.52	10.51	10.42	10.39

Iowa	Van Buren Co	10.45	8.76	8.71	8.70	8.69	8.60	8.58
Iowa	Woodbury Co	10.08	8.68	8.64	8.63	8.59	8.51	8.50
Kansas	Johnson Co	11.95	9.95	9.87	9.87	9.89	9.76	9.75
Kansas	Linn Co	10.92	8.90	8.82	8.82	8.85	8.72	8.71
Kansas	Sedgwick Co	11.39	9.60	9.56	9.55	9.56	9.49	9.48
Kansas	Shawnee Co	11.03	9.46	9.40	9.39	9.41	9.30	9.29
Kansas	Sumner Co	10.31	8.63	8.59	8.59	8.60	8.53	8.52
Kansas	Wyandotte Co	13.69	11.73	11.65	11.64	11.74	11.59	11.56
Kentucky	Bell Co	14.98	10.95	10.93	10.92	10.96	10.92	10.91
Kentucky	Boyd Co	15.16	11.37	11.33	11.30	11.67	11.61	11.53
Kentucky	Bullitt Co	15.41	11.69	11.67	11.65	11.76	11.73	11.68
Kentucky	Campbell Co	14.31	10.57	10.53	10.50	10.75	10.69	10.61
Kentucky	Carter Co	12.48	9.00	8.98	8.96	9.10	9.07	9.03
Kentucky	Christian Co	14.06	10.95	10.93	10.92	10.98	10.94	10.91
Kentucky	Daviess Co	14.81	11.27	11.25	11.23	11.37	11.34	11.27
Kentucky	Fayette Co	16.06	11.88	11.84	11.83	11.93	11.86	11.83
Kentucky	Franklin Co	14.07	10.21	10.17	10.16	10.25	10.19	10.17
Kentucky	Hardin Co	14.36	10.82	10.80	10.79	10.87	10.84	10.81
Kentucky	Jefferson Co	17.07	13.57	13.54	13.51	13.75	13.70	13.61
Kentucky	Kenton Co	15.36	11.36	11.32	11.29	11.57	11.50	11.42
Kentucky	McCracken Co	14.16	11.31	11.29	11.26	11.43	11.38	11.32
Kentucky	Madison Co	13.99	10.10	10.07	10.06	10.13	10.07	10.05
Kentucky	Perry Co	13.54	9.79	9.75	9.75	9.81	9.76	9.75
Kentucky	Pike Co	14.33	10.39	10.34	10.33	10.47	10.39	10.37
Kentucky	Warren Co	14.52	11.08	11.06	11.05	11.12	11.09	11.06
Louisiana	Caddo Parish	13.13	11.27	11.24	11.24	11.34	11.30	11.28
Louisiana	Calcasieu Parish	12.02	10.16	10.15	10.13	10.36	10.35	10.28
Louisiana	East Baton Rouge Parish	13.71	12.91	12.90	12.81	13.65	13.63	13.40
Louisiana	Iberville Parish	13.08	12.17	12.16	12.08	12.93	12.91	12.68
Louisiana	Jefferson Parish	12.82	11.51	11.50	11.39	12.23	12.22	11.93
Louisiana	Lafayette Parish	11.60	9.82	9.82	9.79	10.01	10.00	9.92
Louisiana	Orleans Parish	13.05	11.72	11.71	11.60	12.47	12.45	12.16
Louisiana	Ouachita Parish	12.15	10.84	10.82	10.81	10.91	10.88	10.85
Louisiana	St. Bernard Parish	10.88	8.84	8.84	8.81	9.09	9.08	8.99
Louisiana	Tangipahoa Parish	12.15	10.23	10.22	10.21	10.50	10.49	10.45
Louisiana	Terrebonne Parish	10.61	9.05	9.04	9.04	9.30	9.29	9.27
Louisiana	West Baton Rouge Parish	13.29	12.51	12.50	12.42	13.23	13.22	13.00
Maine	Androscoggin Co	10.60	9.22	9.21	9.21	9.22	9.22	9.22

Maine	Aroostook Co	11.16	10.32	10.32	10.32	10.32	10.32	10.32
Maine	Cumberland Co	11.44	9.80	9.80	9.79	9.81	9.81	9.80
Maine	Hancock Co	6.20	5.27	5.27	5.27	5.29	5.29	5.28
Maine	Kennebec Co	10.55	9.22	9.22	9.22	9.23	9.23	9.23
Maine	Oxford Co	10.29	9.11	9.11	9.11	9.11	9.11	9.11
Maine	Penobscot Co	9.87	8.87	8.87	8.87	8.88	8.88	8.88
Maine	York Co	9.63	8.23	8.23	8.22	8.25	8.25	8.23
Maryland	Anne Arundel Co	15.47	10.98	10.96	10.95	11.09	11.06	11.04
Maryland	Baltimore Co	15.09	11.21	11.18	11.14	11.46	11.42	11.30
Maryland	Harford Co	13.26	9.80	9.77	9.74	10.01	9.98	9.88
Maryland	Montgomery Co	12.97	9.06	9.04	9.04	9.11	9.08	9.08
Maryland	Washington Co	14.35	9.86	9.83	9.83	9.90	9.86	9.85
Maryland	Baltimore city	17.12	12.86	12.83	12.78	13.14	13.09	12.93
Massachusetts	Berkshire Co	12.26	10.34	10.33	10.32	10.37	10.36	10.35
Massachusetts	Hampden Co	13.74	11.41	11.41	11.41	11.48	11.47	11.47
Massachusetts	Plymouth Co	11.19	9.01	9.00	8.99	9.04	9.03	9.02
Massachusetts	Suffolk Co	12.76	10.08	10.08	10.07	10.06	10.05	10.03
Michigan	Allegan Co	12.36	10.63	10.60	10.60	10.63	10.57	10.55
Michigan	Bay Co	11.22	10.22	10.21	10.20	10.23	10.22	10.20
Michigan	Berrien Co	12.60	10.70	10.66	10.65	10.69	10.62	10.60
Michigan	Chippewa Co	8.28	7.88	7.87	7.87	7.90	7.89	7.88
Michigan	Genesee Co	12.70	10.98	10.96	10.95	11.00	10.96	10.95
Michigan	Ingham Co	13.35	11.28	11.25	11.24	11.28	11.22	11.21
Michigan	Kalamazoo Co	14.92	12.60	12.55	12.55	12.58	12.49	12.47
Michigan	Kent Co	13.91	11.81	11.77	11.76	11.78	11.71	11.69
Michigan	Macomb Co	13.31	11.20	11.18	11.18	11.24	11.20	11.19
Michigan	Monroe Co	15.33	12.58	12.50	12.48	12.67	12.54	12.47
Michigan	Muskegon Co	12.23	10.66	10.64	10.63	10.67	10.61	10.59
Michigan	Oakland Co	14.85	12.88	12.86	12.85	12.97	12.93	12.91
Michigan	Ottawa Co	13.41	11.41	11.38	11.37	11.39	11.33	11.30
Michigan	Saginaw Co	10.80	9.54	9.53	9.53	9.56	9.53	9.52
Michigan	St. Clair Co	13.92	12.57	12.55	12.54	12.64	12.60	12.58
Michigan	Washtenaw Co	14.57	12.07	12.04	12.03	12.13	12.08	12.05
Michigan	Wayne Co	19.62	17.29	17.26	17.25	17.41	17.35	17.32
Minnesota	Dakota Co	10.32	8.74	8.69	8.68	8.70	8.61	8.58
Minnesota	Hennepin Co	10.81	9.32	9.29	9.28	9.35	9.28	9.25
Minnesota	Mille Lacs Co	7.40	6.44	6.42	6.42	6.41	6.36	6.35
Minnesota	Olmsted Co	11.17	9.39	9.36	9.35	9.31	9.23	9.21

Minnesota	Ramsey Co	12.24	10.53	10.48	10.47	10.56	10.47	10.43
Minnesota	St. Louis Co	8.41	7.98	7.97	7.92	8.25	8.22	8.10
Minnesota	Scott Co	10.42	8.84	8.81	8.81	8.77	8.70	8.69
Minnesota	Stearns Co	9.65	8.36	8.32	8.31	8.30	8.23	8.21
Mississippi	Adams Co	11.35	9.48	9.47	9.42	9.74	9.73	9.61
Mississippi	Bolivar Co	12.81	10.40	10.38	10.37	10.47	10.44	10.40
Mississippi	DeSoto Co	13.18	10.66	10.59	10.57	10.78	10.68	10.61
Mississippi	Forrest Co	13.54	11.13	11.10	11.10	11.20	11.15	11.13
Mississippi	Hancock Co	10.97	8.89	8.87	8.86	9.08	9.06	9.01
Mississippi	Harrison Co	11.56	9.35	9.34	9.31	9.52	9.50	9.42
Mississippi	Hinds Co	13.85	11.36	11.32	11.31	11.43	11.35	11.33
Mississippi	Jackson Co	12.56	10.42	10.41	10.34	10.77	10.75	10.55
Mississippi	Jones Co	15.29	12.49	12.46	12.46	12.57	12.52	12.50
Mississippi	Lauderdale Co	13.34	10.58	10.55	10.54	10.62	10.56	10.54
Mississippi	Lee Co	13.20	10.43	10.40	10.40	10.47	10.41	10.40
Mississippi	Lowndes Co	13.68	11.25	11.23	11.22	11.27	11.23	11.22
Mississippi	Pearl River Co	11.68	9.72	9.70	9.69	9.85	9.82	9.79
Mississippi	Rankin Co	13.35	10.77	10.73	10.72	10.84	10.77	10.73
Mississippi	Scott Co	11.88	9.37	9.34	9.33	9.41	9.35	9.33
Mississippi	Warren Co	12.50	10.28	10.27	10.19	10.69	10.67	10.45
Missouri	Buchanan Co	12.54	10.59	10.53	10.52	10.53	10.41	10.39
Missouri	Cass Co	11.39	9.49	9.42	9.42	9.45	9.32	9.31
Missouri	Cedar Co	11.61	9.49	9.46	9.45	9.46	9.38	9.37
Missouri	Clay Co	12.88	11.01	10.93	10.92	11.02	10.88	10.85
Missouri	Greene Co	12.27	10.22	10.17	10.17	10.22	10.15	10.14
Missouri	Jackson Co	12.27	10.49	10.41	10.40	10.45	10.31	10.28
Missouri	Jasper Co	13.85	11.61	11.57	11.56	11.59	11.51	11.50
Missouri	Jefferson Co	14.80	12.41	12.37	12.35	12.46	12.38	12.33
Missouri	Monroe Co	11.16	9.33	9.29	9.28	9.29	9.21	9.18
Missouri	St. Charles Co	14.52	12.13	12.09	12.06	12.20	12.12	12.03
Missouri	Ste. Genevieve Co	13.98	11.68	11.63	11.60	11.76	11.69	11.61
Missouri	St. Louis Co	14.46	12.14	12.10	12.08	12.23	12.15	12.10
Missouri	St. Louis city	15.62	13.43	13.38	13.32	13.69	13.61	13.44
Montana	Cascade Co	6.04	5.80	5.80	5.80	5.79	5.79	5.79
Montana	Flathead Co	8.54	8.03	8.02	8.02	8.02	8.00	7.99
Montana	Gallatin Co	8.72	8.39	8.38	8.38	8.37	8.36	8.36
Montana	Lake Co	9.69	9.23	9.23	9.22	9.21	9.20	9.19
Montana	Lincoln Co	16.24	14.89	14.84	14.84	14.85	14.78	14.77

Montana	Missoula Co	11.03	10.51	10.50	10.49	10.51	10.48	10.47
Montana	Ravalli Co	9.32	8.89	8.88	8.88	8.86	8.85	8.84
Montana	Rosebud Co	6.97	6.80	6.79	6.79	6.80	6.79	6.79
Montana	Sanders Co	6.51	6.24	6.23	6.23	6.22	6.21	6.20
Montana	Silver Bow Co	8.74	8.37	8.37	8.37	8.36	8.35	8.35
Montana	Yellowstone Co	7.62	7.24	7.23	7.23	7.24	7.23	7.23
Nebraska	Cass Co	10.38	8.82	8.76	8.76	8.74	8.64	8.63
Nebraska	Douglas Co	10.83	9.27	9.22	9.22	9.19	9.10	9.09
Nebraska	Hall Co	8.55	7.50	7.42	7.42	7.42	7.31	7.30
Nebraska	Lancaster Co	10.01	8.61	8.55	8.54	8.54	8.44	8.43
Nebraska	Lincoln Co	7.10	6.34	6.28	6.27	6.30	6.21	6.21
Nebraska	Sarpy Co	10.32	8.80	8.75	8.75	8.74	8.64	8.64
Nebraska	Scotts Bluff Co	6.03	5.49	5.43	5.43	5.46	5.37	5.37
Nebraska	Washington Co	9.90	8.50	8.44	8.43	8.41	8.31	8.30
Nevada	Clark Co	10.96	9.81	9.79	9.79	9.76	9.73	9.73
Nevada	Washoe Co	9.38	8.70	8.67	8.67	8.64	8.58	8.57
New Hampshire	Cheshire Co	11.81	9.90	9.90	9.90	9.93	9.93	9.93
New Hampshire	Coos Co	10.11	8.93	8.93	8.93	8.94	8.94	8.93
New Hampshire	Merrimack Co	9.96	7.95	7.94	7.94	7.98	7.97	7.97
New Hampshire	Sullivan Co	9.95	8.32	8.32	8.31	8.33	8.33	8.33
New Jersey	Bergen Co	14.09	10.88	10.87	10.86	10.86	10.83	10.82
New Jersey	Camden Co	14.54	10.99	10.98	10.96	11.17	11.15	11.10
New Jersey	Gloucester Co	13.99	11.15	11.14	11.10	11.57	11.55	11.45
New Jersey	Hudson Co	15.39	11.76	11.75	11.74	12.81	12.78	12.76
New Jersey	Mercer Co	14.27	10.74	10.73	10.72	10.85	10.84	10.82
New Jersey	Middlesex Co	12.67	9.53	9.52	9.52	9.75	9.74	9.73
New Jersey	Morris Co	12.68	9.46	9.45	9.45	9.59	9.58	9.57
New Jersey	Union Co	15.94	11.99	11.97	11.96	13.08	13.05	13.02
New Jersey	Warren Co	13.55	10.16	10.15	10.14	10.26	10.24	10.23
New Mexico	Bernalillo Co	6.50	6.37	6.36	6.36	6.40	6.39	6.39
New Mexico	Chaves Co	6.78	6.36	6.35	6.35	6.36	6.35	6.35
New Mexico	Dona Ana Co	11.18	10.36	10.30	10.30	10.32	10.24	10.24
New Mexico	Grant Co	5.97	5.74	5.74	5.74	5.74	5.73	5.73
New Mexico	Lea Co	6.77	6.35	6.35	6.35	6.35	6.35	6.35
New Mexico	Sandoval Co	10.17	9.85	9.85	9.85	9.87	9.85	9.85
New Mexico	San Juan Co	6.30	6.03	6.03	6.03	6.03	6.02	6.02
New Mexico	Santa Fe Co	4.88	4.61	4.61	4.61	4.61	4.61	4.61
New York	Bronx Co	15.99	12.66	12.65	12.65	12.67	12.66	12.65

New York	Chautauqua Co	10.97	8.18	8.16	8.16	8.21	8.19	8.18
New York	Erie Co	14.35	11.07	11.05	11.04	11.12	11.09	11.07
New York	Essex Co	6.49	5.33	5.32	5.32	5.35	5.35	5.34
New York	Kings Co	14.90	11.71	11.70	11.69	11.64	11.62	11.60
New York	Monroe Co	11.52	9.06	9.05	9.05	9.10	9.07	9.06
New York	Nassau Co	12.36	9.64	9.63	9.63	9.58	9.57	9.56
New York	New York Co	16.67	13.82	13.81	13.81	13.95	13.92	13.90
New York	Niagara Co	12.25	9.74	9.73	9.73	9.77	9.74	9.73
New York	Onondaga Co	10.68	8.62	8.60	8.60	8.64	8.63	8.62
New York	Orange Co	11.64	9.43	9.42	9.42	9.46	9.46	9.45
New York	Queens Co	13.56	10.62	10.62	10.61	10.66	10.65	10.64
New York	Richmond Co	12.35	9.29	9.28	9.27	10.14	10.12	10.10
New York	St. Lawrence Co	8.62	7.44	7.44	7.44	7.46	7.46	7.44
New York	Steuben Co	9.95	7.30	7.30	7.30	7.33	7.33	7.32
New York	Suffolk Co	12.41	9.60	9.60	9.59	9.64	9.63	9.62
New York	Westchester Co	12.55	9.77	9.77	9.76	9.77	9.76	9.75
North Carolina	Alamance Co	14.47	10.23	10.21	10.21	10.24	10.21	10.21
North Carolina	Buncombe Co	13.67	10.18	10.16	10.16	10.19	10.15	10.15
North Carolina	Cabarrus Co	15.03	10.86	10.84	10.84	10.87	10.84	10.84
North Carolina	Caswell Co	13.90	9.66	9.64	9.64	9.66	9.64	9.64
North Carolina	Catawba Co	16.19	11.82	11.80	11.80	11.82	11.79	11.78
North Carolina	Chatham Co	12.81	8.99	8.98	8.98	8.98	8.97	8.97
North Carolina	Cumberland Co	14.69	11.15	11.13	11.13	11.16	11.13	11.13
North Carolina	Davidson Co	16.56	11.93	11.91	11.91	11.94	11.91	11.90
North Carolina	Duplin Co	12.37	9.53	9.52	9.52	9.54	9.53	9.53
North Carolina	Durham Co	14.65	10.48	10.47	10.47	10.49	10.47	10.47
North Carolina	Forsyth Co	15.40	10.73	10.72	10.72	10.75	10.74	10.74
North Carolina	Gaston Co	14.62	10.63	10.61	10.61	10.63	10.60	10.60
North Carolina	Guilford Co	15.11	10.45	10.44	10.44	10.47	10.44	10.44
North Carolina	Haywood Co	14.17	10.99	10.99	10.98	11.00	10.99	10.98
North Carolina	Jackson Co	12.59	9.51	9.51	9.50	9.53	9.51	9.51
North Carolina	Lenoir Co	11.94	8.90	8.89	8.89	8.92	8.91	8.91
North Carolina	McDowell Co	15.06	11.25	11.22	11.22	11.25	11.20	11.20
North Carolina	Mecklenburg Co	15.77	11.49	11.48	11.48	11.52	11.50	11.50
North Carolina	Mitchell Co	14.39	10.63	10.61	10.61	10.64	10.60	10.60
North Carolina	Montgomery Co	12.57	8.96	8.95	8.95	8.96	8.94	8.94
North Carolina	Onslow Co	11.60	8.82	8.81	8.81	8.84	8.83	8.82
North Carolina	Orange Co	13.67	9.69	9.68	9.68	9.68	9.67	9.67

North Carolina	Pitt Co	12.56	9.62	9.61	9.61	9.63	9.62	9.61
North Carolina	Robeson Co	12.75	9.68	9.67	9.67	9.68	9.66	9.66
North Carolina	Swain Co	13.15	9.82	9.81	9.81	9.83	9.81	9.80
North Carolina	Wake Co	14.54	10.68	10.66	10.66	10.71	10.69	10.69
North Carolina	Wayne Co	14.50	11.05	11.04	11.04	11.06	11.05	11.05
North Dakota	Billings Co	4.52	4.27	4.24	4.24	4.25	4.21	4.21
North Dakota	Burke Co	5.75	5.28	5.28	5.28	5.26	5.25	5.25
North Dakota	Burleigh Co	6.76	6.06	6.02	6.02	6.01	5.95	5.95
North Dakota	Cass Co	8.11	7.16	7.12	7.12	7.07	7.01	7.01
North Dakota	Mercer Co	6.22	5.70	5.68	5.68	5.66	5.63	5.63
Ohio	Athens Co	12.47	8.62	8.60	8.59	8.70	8.67	8.64
Ohio	Butler Co	16.78	12.37	12.31	12.30	12.43	12.35	12.30
Ohio	Clark Co	14.67	11.43	11.39	11.38	11.43	11.36	11.34
Ohio	Cuyahoga Co	19.25	15.20	15.14	15.11	15.34	15.26	15.17
Ohio	Franklin Co	17.28	13.46	13.39	13.38	13.49	13.38	13.34
Ohio	Hamilton Co	18.55	14.09	14.04	13.99	14.33	14.24	14.13
Ohio	Jefferson Co	18.36	13.99	13.97	13.94	14.12	14.09	14.02
Ohio	Lake Co	13.75	10.77	10.73	10.71	10.86	10.81	10.76
Ohio	Lawrence Co	16.31	12.81	12.75	12.72	13.03	12.95	12.85
Ohio	Lorain Co	13.88	11.05	11.01	11.00	11.19	11.14	11.09
Ohio	Lucas Co	15.07	12.33	12.24	12.22	12.40	12.26	12.18
Ohio	Mahoning Co	15.77	11.63	11.58	11.57	11.67	11.60	11.56
Ohio	Montgomery Co	15.75	12.12	12.09	12.08	12.16	12.10	12.07
Ohio	Portage Co	14.88	11.02	10.97	10.97	11.06	10.99	10.97
Ohio	Preble Co	13.51	10.27	10.23	10.22	10.27	10.21	10.18
Ohio	Scioto Co	19.53	15.41	15.34	15.29	15.68	15.59	15.45
Ohio	Stark Co	17.85	12.97	12.93	12.91	13.01	12.94	12.90
Ohio	Summit Co	16.98	12.96	12.93	12.92	13.01	12.96	12.93
Ohio	Trumbull Co	15.60	11.84	11.80	11.79	11.89	11.83	11.79
Oklahoma	Caddo Co	8.66	7.57	7.56	7.56	7.57	7.54	7.54
Oklahoma	Canadian Co	8.99	7.29	7.27	7.27	7.27	7.23	7.23
Oklahoma	Carter Co	10.21	8.29	8.26	8.26	8.31	8.27	8.26
Oklahoma	Cherokee Co	11.72	9.67	9.64	9.64	9.68	9.63	9.62
Oklahoma	Garfield Co	10.03	8.47	8.43	8.43	8.41	8.35	8.35
Oklahoma	Kay Co	10.71	9.11	9.07	9.07	9.08	9.01	9.00
Oklahoma	Lincoln Co	10.08	8.28	8.26	8.25	8.28	8.24	8.24
Oklahoma	Mayes Co	12.01	10.70	10.66	10.66	10.69	10.63	10.62
Oklahoma	Muskogee Co	12.17	10.22	10.18	10.18	10.23	10.17	10.16

Oklahoma	Oklahoma Co	10.61	8.68	8.65	8.65	8.69	8.64	8.63
Oklahoma	Ottawa Co	11.78	9.72	9.68	9.68	9.70	9.64	9.62
Oklahoma	Pittsburg Co	11.52	9.57	9.54	9.54	9.59	9.54	9.53
Oklahoma	Seminole Co	9.47	7.72	7.70	7.70	7.73	7.70	7.69
Oklahoma	Tulsa Co	12.03	10.06	10.03	10.03	10.09	10.04	10.02
Oregon	Columbia Co	6.38	5.89	5.88	5.86	6.02	6.01	5.95
Oregon	Deschutes Co	7.34	7.05	7.04	7.03	7.03	7.02	7.01
Oregon	Jackson Co	11.34	10.84	10.83	10.83	10.82	10.80	10.80
Oregon	Klamath Co	10.16	9.99	9.96	9.96	9.97	9.93	9.92
Oregon	Lane Co	13.43	12.84	12.80	12.80	12.82	12.73	12.71
Oregon	Linn Co	8.32	7.99	7.99	7.99	8.00	7.99	7.98
Oregon	Multnomah Co	8.82	8.31	8.30	8.28	8.51	8.49	8.44
Oregon	Union Co	6.78	6.45	6.42	6.42	6.44	6.40	6.40
Oregon	Wasco Co	7.70	7.07	7.02	7.01	7.08	7.00	6.97
Oregon	Washington Co	9.54	8.94	8.94	8.93	9.00	8.99	8.97
Pennsylvania	Adams Co	13.35	9.19	9.17	9.17	9.22	9.19	9.19
Pennsylvania	Allegheny Co	21.17	16.25	16.22	16.17	16.48	16.43	16.29
Pennsylvania	Beaver Co	15.97	11.85	11.82	11.79	12.00	11.95	11.88
Pennsylvania	Berks Co	16.24	11.99	11.97	11.96	12.03	11.99	11.97
Pennsylvania	Bucks Co	13.93	10.54	10.53	10.51	10.72	10.70	10.65
Pennsylvania	Cambria Co	15.62	10.95	10.92	10.91	11.01	10.96	10.94
Pennsylvania	Centre Co	13.01	9.17	9.16	9.16	9.23	9.20	9.19
Pennsylvania	Dauphin Co	15.60	10.86	10.83	10.83	10.90	10.85	10.83
Pennsylvania	Delaware Co	15.27	12.31	12.30	12.25	12.76	12.74	12.62
Pennsylvania	Erie Co	13.43	10.41	10.39	10.38	10.50	10.46	10.44
Pennsylvania	Lackawanna Co	12.20	8.96	8.95	8.95	9.01	8.99	8.98
Pennsylvania	Lancaster Co	16.99	12.00	11.97	11.96	12.05	12.00	11.97
Pennsylvania	Lehigh Co	14.11	10.38	10.37	10.36	10.44	10.41	10.39
Pennsylvania	Luzerne Co	12.89	9.54	9.54	9.53	9.62	9.60	9.59
Pennsylvania	Mercer Co	14.28	10.81	10.78	10.77	10.85	10.80	10.77
Pennsylvania	Montgomery Co	13.96	10.43	10.42	10.41	10.57	10.55	10.51
Pennsylvania	Northampton Co	14.30	10.75	10.74	10.73	10.84	10.82	10.81
Pennsylvania	Perry Co	12.83	9.27	9.24	9.24	9.31	9.26	9.25
Pennsylvania	Philadelphia Co	16.39	13.25	13.23	13.18	13.72	13.69	13.55
Pennsylvania	Washington Co	15.58	11.29	11.27	11.23	11.48	11.43	11.34
Pennsylvania	Westmoreland Co	15.56	10.72	10.68	10.67	10.81	10.76	10.71
Pennsylvania	York Co	16.69	12.09	12.06	12.05	12.12	12.07	12.05
Rhode Island	Kent Co	8.79	6.83	6.82	6.82	6.87	6.87	6.86

Rhode Island	Providence Co	11.35	9.25	9.24	9.23	9.37	9.37	9.32
South Carolina	Beaufort Co	11.02	8.78	8.77	8.76	8.83	8.81	8.79
South Carolina	Charleston Co	11.91	9.62	9.61	9.59	9.76	9.74	9.69
South Carolina	Chesterfield Co	12.40	9.23	9.22	9.22	9.23	9.21	9.21
South Carolina	Edgefield Co	12.80	9.70	9.69	9.69	9.71	9.69	9.69
South Carolina	Florence Co	13.22	10.30	10.29	10.29	10.31	10.29	10.29
South Carolina	Georgetown Co	13.25	10.59	10.59	10.58	10.64	10.63	10.61
South Carolina	Greenville Co	15.33	11.15	11.14	11.14	11.17	11.15	11.15
South Carolina	Greenwood Co	13.96	10.26	10.24	10.24	10.26	10.22	10.22
South Carolina	Horry Co	11.12	8.71	8.71	8.70	8.74	8.73	8.72
South Carolina	Lexington Co	14.52	10.96	10.95	10.95	10.97	10.95	10.95
South Carolina	Oconee Co	11.41	8.21	8.20	8.20	8.21	8.19	8.19
South Carolina	Richland Co	14.43	10.90	10.89	10.89	10.91	10.89	10.88
South Carolina	Spartanburg Co	14.35	10.48	10.47	10.47	10.50	10.47	10.47
South Dakota	Brookings Co	9.37	8.08	8.05	8.05	7.97	7.93	7.92
South Dakota	Brown Co	8.31	7.39	7.37	7.37	7.30	7.27	7.27
South Dakota	Jackson Co	5.50	5.14	5.13	5.13	5.13	5.12	5.12
South Dakota	Meade Co	6.25	5.94	5.94	5.94	5.94	5.93	5.93
South Dakota	Minnehaha Co	9.82	8.32	8.29	8.29	8.21	8.15	8.14
South Dakota	Pennington Co	7.74	7.39	7.38	7.38	7.38	7.36	7.36
Tennessee	Blount Co	14.12	10.17	10.15	10.14	10.20	10.16	10.15
Tennessee	Davidson Co	15.55	12.33	12.30	12.28	12.41	12.36	12.32
Tennessee	Dyer Co	12.35	10.01	9.98	9.95	10.19	10.15	10.05
Tennessee	Hamilton Co	17.23	13.43	13.39	13.38	13.48	13.41	13.39
Tennessee	Knox Co	18.11	13.08	13.05	13.04	13.12	13.06	13.04
Tennessee	Lawrence Co	12.65	9.71	9.70	9.70	9.75	9.74	9.72
Tennessee	McMinn Co	15.34	11.79	11.75	11.74	11.83	11.78	11.75
Tennessee	Maury Co	13.65	10.82	10.81	10.80	10.85	10.82	10.80
Tennessee	Montgomery Co	13.75	10.90	10.89	10.87	10.95	10.92	10.88
Tennessee	Putnam Co	13.70	10.31	10.30	10.29	10.33	10.30	10.29
Tennessee	Roane Co	15.38	11.51	11.47	11.46	11.55	11.48	11.46
Tennessee	Shelby Co	14.81	12.44	12.38	12.32	12.74	12.65	12.50
Tennessee	Sullivan Co	15.56	12.22	12.18	12.18	12.25	12.19	12.19
Tennessee	Sumner Co	14.47	11.23	11.21	11.20	11.28	11.24	11.21
Texas	Bowie Co	14.10	11.99	11.95	11.94	12.03	11.96	11.94
Texas	Cameron Co	9.90	9.21	9.20	9.19	9.26	9.26	9.24
Texas	Dallas Co	13.76	11.19	11.18	11.18	11.28	11.26	11.25
Texas	Ector Co	7.57	7.32	7.31	7.31	7.33	7.32	7.32

Texas	Galveston Co	9.64	7.77	7.77	7.74	8.00	8.00	7.92
Texas	Gregg Co	12.49	10.41	10.39	10.38	10.48	10.45	10.43
Texas	Harris Co	14.13	13.28	13.27	13.15	14.40	14.38	14.08
Texas	Hidalgo Co	10.84	10.55	10.55	10.55	10.58	10.57	10.57
Texas	Jefferson Co	11.25	10.11	10.10	10.04	10.64	10.63	10.47
Texas	Lubbock Co	7.65	7.08	7.08	7.08	7.08	7.07	7.07
Texas	Nueces Co	10.30	9.92	9.91	9.79	10.67	10.67	10.35
Texas	Orange Co	11.41	10.29	10.28	10.22	10.82	10.81	10.64
Texas	Tarrant Co	12.36	9.89	9.86	9.86	9.95	9.91	9.90
Utah	Box Elder Co	9.01	8.50	8.49	8.49	8.48	8.47	8.47
Utah	Cache Co	12.90	12.34	12.33	12.33	12.32	12.30	12.29
Utah	Salt Lake Co	14.05	12.22	12.18	12.18	12.09	12.02	12.01
Utah	Utah Co	10.81	9.08	9.05	9.05	9.00	8.94	8.94
Utah	Weber Co	9.77	8.87	8.85	8.85	8.84	8.81	8.81
Vermont	Chittenden Co	9.36	7.66	7.66	7.66	7.70	7.69	7.68
Virginia	Arlington Co	14.61	10.30	10.28	10.28	10.33	10.30	10.30
Virginia	Charles City Co	13.30	9.20	9.17	9.17	9.24	9.20	9.19
Virginia	Chesterfield Co	13.89	9.76	9.73	9.73	9.81	9.76	9.76
Virginia	Fairfax Co	14.28	9.71	9.69	9.69	9.77	9.74	9.73
Virginia	Henrico Co	13.91	9.74	9.71	9.70	9.79	9.74	9.74
Virginia	Loudoun Co	13.64	9.23	9.21	9.21	9.29	9.26	9.26
Virginia	Page Co	13.16	8.94	8.93	8.93	8.97	8.96	8.95
Virginia	Bristol city	15.21	11.12	11.08	11.08	11.14	11.09	11.08
Virginia	Chesapeake city	12.97	9.83	9.82	9.81	9.91	9.90	9.87
Virginia	Hampton city	12.95	10.00	10.00	9.93	10.35	10.35	10.18
Virginia	Newport News city	12.30	9.09	9.08	9.07	9.15	9.13	9.11
Virginia	Norfolk city	13.29	10.44	10.43	10.37	10.79	10.79	10.60
Virginia	Richmond city	14.47	10.17	10.14	10.14	10.23	10.18	10.17
Virginia	Roanoke city	14.84	10.42	10.36	10.36	10.45	10.37	10.37
Virginia	Salem city	14.95	10.62	10.56	10.56	10.65	10.57	10.57
Virginia	Virginia Beach city	12.83	10.07	10.07	10.00	10.42	10.41	10.24
Washington	Benton Co	6.84	6.42	6.39	6.38	6.41	6.36	6.35
Washington	Clark Co	9.82	9.10	9.08	9.06	9.25	9.23	9.16
Washington	King Co	11.59	10.91	10.90	10.85	11.21	11.19	11.04
Washington	Pierce Co	11.14	11.62	11.61	11.58	11.79	11.77	11.69
Washington	Snohomish Co	11.45	11.45	11.44	11.43	11.51	11.49	11.47
Washington	Spokane Co	10.34	9.60	9.58	9.57	9.60	9.57	9.57
Washington	Thurston Co	9.49	8.84	8.83	8.82	8.91	8.90	8.87

Washington	Whatcom Co	7.67	7.65	7.65	7.65	7.67	7.66	7.66
Washington	Yakima Co	10.31	9.37	9.37	9.36	9.37	9.36	9.34
West Virginia	Berkeley Co	16.18	11.83	11.78	11.78	11.87	11.81	11.80
West Virginia	Brooke Co	16.96	12.72	12.70	12.68	12.85	12.81	12.75
West Virginia	Cabell Co	17.22	13.35	13.29	13.26	13.67	13.60	13.51
West Virginia	Hancock Co	17.40	13.26	13.24	13.21	13.38	13.35	13.28
West Virginia	Harrison Co	14.40	10.29	10.27	10.27	10.34	10.32	10.31
West Virginia	Kanawha Co	17.75	13.60	13.56	13.54	13.70	13.65	13.60
West Virginia	Marion Co	15.58	11.24	11.23	11.22	11.31	11.29	11.27
West Virginia	Marshall Co	16.07	11.63	11.61	11.59	11.77	11.75	11.68
West Virginia	Mercer Co	12.97	8.98	8.96	8.96	9.01	8.98	8.97
West Virginia	Monongalia Co	14.96	10.52	10.50	10.50	10.57	10.55	10.53
West Virginia	Ohio Co	15.37	10.96	10.95	10.92	11.10	11.07	11.01
West Virginia	Raleigh Co	13.54	9.51	9.48	9.48	9.55	9.50	9.50
West Virginia	Summers Co	10.46	7.18	7.15	7.15	7.20	7.16	7.16
West Virginia	Wood Co	16.88	12.60	12.57	12.55	12.75	12.71	12.64
Wisconsin	Brown Co	11.52	10.14	10.12	10.11	10.13	10.08	10.07
Wisconsin	Dane Co	12.81	10.87	10.83	10.83	10.81	10.74	10.72
Wisconsin	Dodge Co	11.39	9.55	9.52	9.51	9.51	9.44	9.42
Wisconsin	Grant Co	11.78	9.98	9.92	9.91	9.92	9.81	9.78
Wisconsin	Kenosha Co	11.90	10.13	10.09	10.08	10.16	10.07	10.05
Wisconsin	Manitowoc Co	10.09	8.54	8.52	8.51	8.54	8.48	8.47
Wisconsin	Milwaukee Co	13.74	11.98	11.94	11.93	12.02	11.95	11.92
Wisconsin	Outagamie Co	11.04	9.48	9.46	9.45	9.46	9.41	9.39
Wisconsin	Vilas Co	6.26	5.57	5.56	5.55	5.57	5.54	5.53
Wisconsin	Waukesha Co	13.55	11.64	11.60	11.59	11.62	11.54	11.51
Wyoming	Campbell Co	6.35	6.13	6.11	6.11	6.13	6.10	6.10
Wyoming	Laramie Co	5.12	4.82	4.79	4.79	4.81	4.76	4.76
Wyoming	Sheridan Co	10.77	10.45	10.43	10.43	10.44	10.42	10.42

Appendix C: 8-Hour Ozone Design Values for Locomotive/Marine Scenarios (units are ppb)

State Name	County Name	Baseline DV	2020 Base	2020 Locomotive only	2020 Primary	2030 Base	2030 Locomotive only	2030 Primary
Alabama	Baldwin	79.0	68.6	68.4	68.3	68.2	67.9	67.5
Alabama	Clay	82.0	63.6	63.4	63.4	62.6	62.1	62.0
Alabama	Elmore	78.3	64.1	63.9	63.8	63.2	62.6	62.4
Alabama	Jefferson	87.3	67.8	67.4	67.4	66.3	65.2	65.0
Alabama	Madison	82.7	64.2	64.0	63.9	63.0	62.3	61.9
Alabama	Mobile	79.0	69.4	69.3	69.2	69.0	68.7	68.4
Alabama	Montgomery	80.0	65.1	64.9	64.8	64.0	63.3	63.1
Alabama	Morgan	83.0	66.8	66.5	66.3	65.8	65.0	64.6
Alabama	Shelby	91.7	70.3	69.9	69.8	68.9	67.9	67.7
Alabama	Tuscaloosa	78.0	58.7	58.4	58.3	57.3	56.4	56.2
Arizona	Cochise	70.3	67.6	67.5	67.5	67.3	67.2	67.1
Arizona	Coconino	73.0	70.3	70.2	70.1	69.8	69.6	69.5
Arizona	Maricopa	85.0	79.5	79.4	79.4	78.6	78.2	78.1
Arizona	Pima	72.3	68.3	68.2	68.2	67.8	67.6	67.5
Arizona	Pinal	83.0	76.8	76.7	76.7	75.9	75.6	75.6
Arizona	Yavapai	79.5	76.0	75.9	75.9	75.5	75.2	75.1
Arkansas	Crittenden	92.7	77.0	76.7	76.4	76.1	75.3	74.5
Arkansas	Pulaski	84.7	70.4	70.0	69.8	69.3	68.3	67.9
California	Alameda	82.3	75.0	74.9	74.7	72.5	72.1	71.5
California	Amador	88.0	79.9	79.7	79.6	77.7	77.3	76.9
California	Butte	89.0	77.1	76.8	76.6	73.7	72.9	72.3
California	Calaveras	92.3	83.1	82.9	82.8	80.5	80.1	79.6
California	Colusa	76.0	66.2	66.0	65.8	63.4	62.9	62.3
California	Contra Costa	80.0	72.9	72.8	72.6	70.5	70.0	69.5
California	El Dorado	105.7	90.7	90.4	90.2	86.5	85.7	84.9
California	Fresno	111.3	102.8	102.6	102.5	100.3	99.9	99.6
California	Glenn	74.7	65.4	65.2	65.0	62.6	62.1	61.6
California	Imperial	87.0	80.8	80.6	80.5	79.5	79.0	78.6
California	Inyo	80.3	75.6	75.5	75.3	74.5	74.3	73.9
California	Kern	112.0	104.5	104.4	104.2	102.5	102.1	101.8
California	Kings	97.3	86.8	86.6	86.6	83.6	83.1	82.8
California	Los Angeles	110.0	106.7	106.5	106.3	105.6	105.1	104.2
California	Madera	90.7	83.7	83.6	83.6	81.7	81.4	81.2
California	Marin	48.7	46.3	46.3	46.2	45.6	45.5	45.3

California	Mariposa	88.3	85.3	85.3	85.2	84.7	84.6	84.4
California	Merced	101.3	91.4	91.2	91.0	88.5	87.9	87.5
California	Monterey	64.3	58.6	58.5	58.4	56.5	56.2	55.9
California	Nevada	97.7	83.4	83.1	82.9	79.5	78.7	77.9
California	Orange	82.7	79.7	79.6	79.2	78.7	78.4	76.8
California	Placer	100.3	86.1	85.8	85.6	82.1	81.3	80.6
California	Riverside	108.7	105.1	105.1	105.0	105.0	104.6	104.2
California	Sacramento	99.7	84.8	84.5	84.2	80.4	79.6	78.8
California	San Benito	81.0	71.8	71.7	71.6	68.9	68.5	68.2
California	San Bernardino	129.3	120.3	120.1	119.9	121.7	121.7	121.8
California	San Diego	94.0	83.2	83.1	82.6	80.6	80.3	78.9
California	San Joaquin	83.0	72.2	72.0	71.8	68.7	68.2	67.5
California	San Luis Obispo	73.0	67.7	67.6	67.5	66.3	66.0	65.6
California	San Mateo	53.0	52.3	52.2	52.2	50.9	50.6	50.4
California	Santa Barbara	82.0	73.5	73.3	72.5	71.5	71.2	68.8
California	Santa Clara	79.0	69.1	68.9	68.8	65.7	65.3	64.9
California	Santa Cruz	57.3	57.4	57.3	57.3	56.7	56.5	56.2
California	Shasta	74.3	70.8	70.8	70.7	69.9	69.8	69.6
California	Solano	71.7	65.2	65.0	64.9	63.6	63.1	62.6
California	Stanislaus	94.0	79.8	79.6	79.4	75.6	75.0	74.3
California	Sutter	84.3	73.4	73.2	73.0	70.3	69.8	69.1
California	Tehama	84.3	77.9	77.7	77.6	76.1	75.7	75.4
California	Tulare	105.3	99.7	99.6	99.5	98.3	98.1	97.9
California	Tuolumne	91.5	85.1	85.0	84.9	83.6	83.3	83.0
California	Ventura	97.7	98.2	98.1	97.8	97.0	96.7	95.3
California	Yolo	82.7	73.5	73.4	73.2	70.7	70.2	69.7
Colorado	Adams	65.0	64.9	64.8	64.8	64.8	64.8	64.7
Colorado	Arapahoe	77.7	76.7	76.6	76.6	76.4	76.3	76.3
Colorado	Boulder	74.0	72.9	72.8	72.8	72.8	72.7	72.7
Colorado	Denver	72.7	72.5	72.5	72.5	72.5	72.4	72.4
Colorado	Douglas	82.5	80.4	80.4	80.4	80.2	80.1	80.1
Colorado	El Paso	71.0	68.9	68.9	68.9	68.7	68.6	68.6
Colorado	Jefferson	83.7	82.4	82.4	82.4	82.3	82.2	82.2
Colorado	La Plata	59.3	58.1	58.1	58.1	58.0	57.9	57.9
Colorado	Larimer	77.7	76.7	76.7	76.7	76.6	76.5	76.5
Colorado	Montezuma	68.3	67.2	67.2	67.2	67.1	67.0	67.0
Colorado	Weld	74.3	71.7	71.6	71.6	71.4	71.3	71.2
Connecticut	Fairfield	98.7	92.2	92.1	92.1	92.9	92.7	92.6

Connecticut	Hartford	89.3	78.4	78.3	78.2	78.7	78.4	78.1
Connecticut	Litchfield	83.0	69.6	69.5	69.4	69.6	69.3	69.1
Connecticut	Middlesex	98.0	87.0	86.9	86.9	87.5	87.2	87.0
Connecticut	New Haven	99.0	89.8	89.7	89.6	90.5	90.3	90.0
Connecticut	New London	90.7	79.9	79.8	79.6	80.3	80.1	79.7
Connecticut	Tolland	93.0	80.2	80.1	80.0	80.4	80.1	79.7
Delaware	Kent	91.3	77.9	77.8	77.4	78.1	77.9	76.9
Delaware	New Castle	95.3	81.2	81.0	81.0	81.1	80.7	80.6
Delaware	Sussex	93.3	78.2	78.1	77.9	78.3	78.0	77.4
D.C.	Washington	94.3	82.5	82.3	82.3	82.6	82.3	82.1
Florida	Bay	80.0	69.4	69.3	69.1	68.8	68.4	68.1
Florida	Escambia	83.7	72.5	72.3	72.2	71.7	71.3	70.9
Florida	Manatee	83.0	69.3	69.2	68.9	69.1	68.9	67.9
Florida	Santa Rosa	82.0	70.1	69.9	69.7	69.4	69.0	68.6
Florida	Sarasota	82.3	65.3	65.3	64.9	64.9	64.6	63.7
Georgia	Bibb	92.0	75.7	75.4	75.4	74.6	73.9	73.8
Georgia	Chatham	71.0	60.5	60.3	60.1	60.0	59.7	59.1
Georgia	Cherokee	77.0	57.4	57.1	57.1	55.6	55.0	54.9
Georgia	Cobb	94.7	74.6	74.4	74.3	72.4	71.6	71.5
Georgia	Coweta	92.0	74.4	74.2	74.1	73.2	72.6	72.5
Georgia	Dawson	82.0	62.1	61.9	61.8	60.4	59.9	59.7
Georgia	De Kalb	95.3	79.7	79.5	79.4	78.0	77.4	77.3
Georgia	Douglas	94.7	73.5	73.3	73.2	71.5	70.8	70.7
Georgia	Fayette	90.7	72.3	72.1	72.0	70.6	70.0	69.9
Georgia	Fulton	99.0	83.7	83.4	83.4	81.9	81.3	81.1
Georgia	Gwinnett	89.3	68.8	68.6	68.5	66.8	66.2	66.0
Georgia	Henry	98.0	75.8	75.5	75.5	73.9	73.2	73.1
Georgia	Murray	86.0	65.1	64.8	64.7	63.6	62.7	62.5
Georgia	Muscogee	82.0	68.0	67.8	67.8	67.0	66.6	66.5
Georgia	Paulding	90.3	71.0	70.8	70.7	69.3	68.6	68.4
Georgia	Richmond	85.7	70.3	70.1	70.0	69.3	68.9	68.7
Georgia	Rockdale	96.3	74.4	74.2	74.2	72.3	71.6	71.5
Illinois	Adams	76.0	63.7	63.5	63.2	63.1	62.4	61.7
Illinois	Champaign	77.3	67.1	66.8	66.8	66.2	65.6	65.4
Illinois	Clark	75.0	57.6	57.5	57.3	56.9	56.4	56.0
Illinois	Cook	87.7	80.8	80.9	81.0	80.3	80.7	81.0
Illinois	Du Page	70.7	68.0	67.9	67.9	67.7	67.3	67.2
Illinois	Effingham	77.7	63.6	63.3	63.2	62.6	62.0	61.6

Illinois	Hamilton	78.7	67.4	67.2	66.9	67.0	66.4	65.7
Illinois	Jersey	89.0	75.0	74.8	74.4	74.3	73.8	72.7
Illinois	Kane	77.7	72.0	71.8	71.7	71.2	70.3	70.1
Illinois	Lake	83.3	76.7	76.5	76.4	76.2	75.9	75.8
Illinois	McHenry	83.3	74.9	74.6	74.6	74.1	73.3	73.0
Illinois	McLean	77.0	65.0	64.8	64.7	64.0	63.3	63.1
Illinois	Macon	76.7	64.8	64.5	64.5	63.9	63.2	63.0
Illinois	Macoupin	79.3	65.8	65.6	65.4	65.0	64.3	63.9
Illinois	Madison	85.0	72.6	72.4	72.1	71.7	71.2	70.5
Illinois	Peoria	79.0	68.5	68.3	68.2	67.6	67.0	66.7
Illinois	Randolph	78.7	67.2	66.9	66.7	66.5	65.9	65.3
Illinois	Rock Island	70.0	59.1	58.9	58.8	58.1	57.5	57.2
Illinois	St Clair	83.3	72.5	72.3	72.2	71.7	71.2	70.7
Illinois	Sangamon	76.0	61.3	61.1	61.0	60.3	59.7	59.4
Illinois	Will	79.3	69.6	69.4	69.3	68.9	68.3	68.2
Illinois	Winnebago	76.0	64.2	63.9	63.8	63.0	62.3	62.1
Indiana	Allen	87.7	67.8	67.4	67.3	66.5	65.4	65.2
Indiana	Boone	89.0	74.3	74.1	74.0	73.3	72.7	72.3
Indiana	Clark	89.3	77.1	76.9	76.7	76.7	76.3	75.7
Indiana	Floyd	83.7	73.1	73.0	72.8	72.8	72.4	71.9
Indiana	Gibson	71.7	56.2	56.0	55.8	55.5	55.0	54.5
Indiana	Greene	88.5	70.9	70.6	70.4	70.0	69.4	68.7
Indiana	Hamilton	93.3	78.8	78.6	78.4	77.6	77.1	76.7
Indiana	Hancock	91.7	76.4	76.1	76.0	75.0	74.4	74.0
Indiana	Hendricks	86.5	73.5	73.3	73.1	72.4	71.8	71.5
Indiana	Huntington	85.0	69.2	68.8	68.7	67.8	66.7	66.4
Indiana	Jackson	85.0	68.9	68.7	68.4	68.1	67.6	67.0
Indiana	Johnson	86.7	71.3	71.0	70.9	70.1	69.5	69.0
Indiana	Lake	90.7	84.9	84.9	85.0	84.4	84.5	84.6
Indiana	La Porte	90.0	76.7	76.4	76.3	75.7	74.7	74.4
Indiana	Madison	91.0	73.9	73.6	73.5	72.4	71.8	71.4
Indiana	Marion	90.0	77.8	77.5	77.4	76.8	76.2	75.9
Indiana	Morgan	86.7	71.8	71.6	71.4	70.8	70.2	69.8
Indiana	Perry	90.0	72.4	72.2	71.8	72.1	71.7	70.5
Indiana	Porter	89.0	77.6	77.4	77.3	76.4	75.9	75.7
Indiana	Posey	85.7	72.9	72.7	72.5	72.4	71.9	71.2
Indiana	St Joseph	89.0	73.1	72.7	72.6	71.7	70.6	70.3
Indiana	Shelby	93.5	78.7	78.4	78.3	77.4	76.6	76.3

Indiana	Vanderburgh	83.3	70.8	70.7	70.4	70.3	69.8	69.2
Indiana	Vigo	87.0	71.6	71.3	71.1	70.7	69.9	69.5
Indiana	Warrick	84.5	71.0	70.8	70.6	70.5	70.1	69.5
Iowa	Scott	79.0	66.7	66.5	66.4	65.6	65.0	64.7
Kansas	Wyandotte	80.3	70.8	70.6	70.5	70.0	69.2	69.0
Kentucky	Boone	85.3	67.8	67.6	67.2	67.6	67.1	66.0
Kentucky	Boyd	88.3	73.0	72.8	72.5	73.0	72.2	71.4
Kentucky	Bullitt	83.7	68.1	67.9	67.6	67.5	67.0	66.2
Kentucky	Campbell	91.7	78.5	78.3	77.9	77.9	77.3	76.4
Kentucky	Carter	80.3	64.9	64.6	64.4	64.8	64.2	63.6
Kentucky	Christian	85.0	66.4	66.3	66.1	65.7	65.3	64.9
Kentucky	Daviess	77.3	64.3	64.2	63.9	63.9	63.5	62.9
Kentucky	Fayette	78.3	63.1	62.8	62.8	62.2	61.4	61.2
Kentucky	Graves	81.0	68.9	68.7	68.4	68.5	68.1	67.4
Kentucky	Greenup	84.0	68.3	68.0	67.7	68.0	67.3	66.5
Kentucky	Hancock	82.7	67.9	67.7	67.4	67.5	67.1	66.2
Kentucky	Hardin	80.7	69.4	69.2	69.0	68.7	68.3	67.9
Kentucky	Henderson	80.0	68.8	68.7	68.5	68.4	68.0	67.5
Kentucky	Jefferson	84.3	72.3	72.1	71.9	71.7	71.2	70.7
Kentucky	Jessamine	78.0	62.1	61.8	61.7	61.3	60.5	60.3
Kentucky	Kenton	86.3	74.7	74.5	74.2	74.1	73.6	72.7
Kentucky	Livingston	85.0	71.0	70.7	70.4	70.5	70.0	69.1
Kentucky	McCracken	81.7	69.6	69.5	69.2	69.2	68.8	68.1
Kentucky	McLean	84.0	67.4	67.3	67.1	66.8	66.4	65.9
Kentucky	Oldham	88.0	73.7	73.6	73.3	73.2	72.7	71.9
Kentucky	Pulaski	81.3	64.9	64.6	64.4	64.1	63.2	62.9
Kentucky	Scott	70.7	56.6	56.3	56.1	55.8	55.1	54.7
Kentucky	Simpson	84.0	68.1	67.9	67.7	67.1	66.6	66.2
Kentucky	Trigg	76.7	61.3	61.1	61.0	60.7	60.2	59.8
Kentucky	Warren	84.0	65.3	65.1	65.0	64.4	63.9	63.5
Louisiana	Ascension	81.7	72.2	72.0	71.6	72.3	71.9	70.9
Louisiana	Bossier	84.7	74.7	74.5	74.3	74.1	73.7	73.2
Louisiana	Caddo	79.7	69.2	69.0	68.8	68.7	68.2	67.5
Louisiana	Calcasieu	81.7	73.2	73.1	72.6	73.5	73.2	71.9
Louisiana	East Baton Rouge	87.3	77.8	77.7	77.7	77.5	77.2	77.1
Louisiana	Grant	77.7	65.8	65.7	65.1	65.6	65.3	63.5
Louisiana	Iberville	86.7	77.6	77.5	76.9	77.9	77.6	76.3
Louisiana	Jefferson	85.3	73.5	73.3	73.0	73.2	72.8	72.0

Louisiana	Lafayette	80.7	71.2	71.1	70.4	71.6	71.3	69.6
Louisiana	Lafourche	81.0	72.0	71.9	71.6	72.6	72.3	71.5
Louisiana	Livingston	83.3	72.8	72.7	72.4	73.2	72.8	72.0
Louisiana	Orleans	72.0	62.0	61.8	61.7	61.7	61.4	61.0
Louisiana	Ouachita	78.7	68.9	68.7	68.5	68.4	68.0	67.5
Louisiana	Pointe Coupee	73.0	65.0	64.9	64.6	64.9	64.7	63.9
Louisiana	St Bernard	79.3	69.9	69.7	69.6	69.7	69.3	69.0
Louisiana	St Charles	81.7	70.8	70.7	70.4	70.6	70.3	69.5
Louisiana	St James	77.3	69.2	69.1	68.8	69.3	69.0	68.3
Louisiana	St John The Baptist	81.7	72.5	72.4	72.1	72.3	72.0	71.2
Louisiana	St Mary	78.0	68.8	68.7	68.2	69.6	69.2	68.1
Louisiana	West Baton Rouge	85.7	75.6	75.5	75.3	75.4	75.0	74.7
Maine	Cumberland	84.7	71.7	71.6	71.6	71.7	71.4	71.2
Maine	Hancock	92.0	77.4	77.3	77.2	77.5	77.2	76.8
Maine	Kennebec	77.7	64.4	64.3	64.2	64.3	64.0	63.7
Maine	Knox	83.3	68.8	68.7	68.6	68.7	68.4	68.1
Maine	Penobscot	83.0	68.3	68.1	68.0	68.2	67.9	67.5
Maine	York	89.0	75.4	75.3	75.2	75.4	75.1	74.8
Maryland	Anne Arundel	101.0	84.9	84.7	84.6	85.0	84.5	84.4
Maryland	Baltimore	93.0	82.3	82.2	82.1	82.4	82.2	82.0
Maryland	Calvert	89.0	72.1	72.0	71.9	72.0	71.6	71.4
Maryland	Carroll	91.3	77.1	76.9	76.9	77.1	76.7	76.5
Maryland	Cecil	102.7	86.4	86.2	86.0	86.5	86.0	85.6
Maryland	Charles	94.7	76.8	76.7	76.6	76.7	76.2	76.0
Maryland	Frederick	90.0	74.8	74.6	74.5	74.7	74.1	73.9
Maryland	Harford	103.7	89.7	89.6	89.4	89.8	89.4	89.1
Maryland	Kent	99.0	81.4	81.2	81.0	81.3	80.7	80.2
Maryland	Montgomery	88.7	78.9	78.8	78.7	79.2	78.9	78.7
Maryland	Prince Georges	95.0	81.6	81.4	81.4	81.8	81.4	81.2
Maryland	Washington	86.0	70.6	70.4	70.3	70.2	69.6	69.3
Massachusetts	Barnstable	94.7	80.2	80.1	79.9	80.4	80.1	79.6
Massachusetts	Bristol	92.7	79.0	78.9	78.7	79.4	79.1	78.6
Massachusetts	Essex	89.7	77.0	76.9	76.8	77.4	77.2	77.1
Massachusetts	Hampden	90.3	76.9	76.7	76.6	76.9	76.5	76.2
Massachusetts	Hampshire	88.3	75.0	74.9	74.7	75.0	74.6	74.3
Massachusetts	Middlesex	88.7	74.6	74.4	74.3	74.5	74.3	74.0
Massachusetts	Suffolk	88.0	75.9	75.8	75.7	76.5	76.3	76.1
Massachusetts	Worcester	85.3	71.7	71.6	71.5	71.7	71.4	71.1

Michigan	Allegan	92.0	78.2	78.0	77.9	77.2	76.5	76.2
Michigan	Benzie	87.7	73.3	73.0	72.9	72.4	71.5	71.2
Michigan	Berrien	88.3	75.0	74.8	74.7	74.0	73.3	73.1
Michigan	Cass	90.0	72.9	72.5	72.3	71.4	70.3	70.0
Michigan	Clinton	83.3	67.5	67.3	67.2	66.5	66.0	65.7
Michigan	Genesee	86.7	69.6	69.4	69.3	68.2	67.6	67.4
Michigan	Huron	84.0	70.5	70.3	70.2	69.5	69.0	68.7
Michigan	Ingham	83.3	68.0	67.8	67.7	67.0	66.5	66.2
Michigan	Kalamazoo	83.0	67.2	66.9	66.8	66.0	65.1	64.8
Michigan	Kent	84.7	69.8	69.6	69.5	68.7	68.0	67.8
Michigan	Lenawee	85.0	71.0	70.8	70.6	70.5	69.8	69.2
Michigan	Macomb	91.0	81.5	81.3	81.2	81.2	80.7	80.4
Michigan	Mason	89.0	75.2	74.9	74.8	74.2	73.2	72.9
Michigan	Muskegon	92.0	80.3	80.1	80.0	79.6	78.8	78.6
Michigan	Oakland	87.0	78.9	78.7	78.6	78.4	77.9	77.7
Michigan	Ottawa	86.0	72.5	72.3	72.2	71.5	70.7	70.5
Michigan	St Clair	87.7	75.0	74.8	74.7	74.2	73.7	73.4
Michigan	Washtenaw	88.3	77.4	77.2	77.0	76.8	76.3	75.9
Michigan	Wayne	88.0	78.2	78.0	77.9	78.3	77.8	77.5
Minnesota	Anoka	71.0	58.7	58.5	58.4	57.3	56.7	56.5
Minnesota	Washington	75.0	61.6	61.3	61.2	60.1	59.4	59.0
Mississippi	De Soto	84.3	70.5	70.1	69.8	69.7	68.9	67.9
Mississippi	Hancock	83.7	71.7	71.5	71.1	71.7	71.2	70.0
Mississippi	Harrison	83.3	67.6	67.4	66.8	67.6	67.2	65.7
Mississippi	Hinds	76.3	58.9	58.5	58.4	57.5	56.5	56.1
Mississippi	Jackson	83.0	71.7	71.5	71.3	71.3	71.0	70.5
Mississippi	Warren	76.7	57.3	57.0	56.2	57.3	56.7	54.4
Missouri	Clay	84.3	71.4	71.0	70.9	70.2	69.2	68.9
Missouri	Jefferson	87.3	77.3	77.1	77.0	76.6	76.1	75.5
Missouri	Platte	81.7	71.2	70.9	70.8	70.3	69.6	69.4
Missouri	St Charles	90.7	77.4	77.2	76.9	76.7	76.1	75.3
Missouri	Ste Genevieve	84.0	68.6	68.4	68.1	68.0	67.4	66.6
Missouri	St Louis	89.3	80.5	80.3	80.1	79.9	79.3	78.8
Missouri	St Louis City	87.0	78.9	78.7	78.5	78.2	77.7	77.2
Nevada	Clark	81.7	75.6	75.4	75.3	74.3	73.9	73.6
Nevada	Douglas	71.7	66.2	66.1	66.0	64.8	64.5	64.3
Nevada	Washoe	73.3	69.0	68.9	68.8	67.8	67.6	67.4
Nevada	White Pine	72.0	70.5	70.4	70.4	70.2	70.1	70.0

Nevada	Carson City	68.7	64.8	64.7	64.7	63.8	63.6	63.4
New Hampshire	Hillsborough	85.0	71.5	71.3	71.3	71.4	71.0	70.8
New Hampshire	Rockingham	82.7	70.0	69.8	69.8	69.8	69.5	69.3
New Jersey	Atlantic	90.3	77.3	77.2	76.9	77.5	77.2	76.5
New Jersey	Bergen	92.5	81.4	81.3	81.3	81.4	81.1	81.1
New Jersey	Camden	102.3	87.0	86.9	86.8	87.0	86.6	86.5
New Jersey	Cumberland	96.7	80.9	80.8	80.5	81.1	80.8	80.1
New Jersey	Essex	67.0	60.3	60.3	60.2	60.1	60.0	59.9
New Jersey	Gloucester	100.3	85.9	85.8	85.7	85.9	85.5	85.2
New Jersey	Hudson	88.0	81.9	81.8	81.9	81.3	81.2	81.3
New Jersey	Hunterdon	97.3	82.4	82.2	82.2	82.2	81.9	81.7
New Jersey	Mercer	102.3	89.4	89.3	89.2	89.3	89.0	88.7
New Jersey	Middlesex	100.7	87.2	87.1	87.0	87.3	87.0	86.6
New Jersey	Monmouth	95.7	85.1	85.0	84.9	85.2	85.0	84.8
New Jersey	Morris	97.7	80.8	80.7	80.5	80.6	80.2	79.9
New Jersey	Ocean	109.0	90.9	90.8	90.6	90.8	90.5	90.1
New Jersey	Passaic	88.3	75.8	75.7	75.6	75.8	75.5	75.3
New Mexico	Bernalillo	75.7	73.2	73.1	73.1	72.9	72.7	72.7
New Mexico	Dona Ana	79.7	75.4	75.2	75.2	75.0	74.5	74.5
New Mexico	Eddy	69.0	66.8	66.7	66.7	66.6	66.4	66.3
New Mexico	Sandoval	72.0	70.1	70.0	70.0	69.8	69.6	69.6
New Mexico	San Juan	75.0	73.3	73.2	73.2	73.0	72.9	72.8
New Mexico	Valencia	68.0	65.6	65.5	65.5	65.3	65.1	65.1
New York	Bronx	82.7	73.5	73.4	73.4	73.9	73.7	73.6
New York	Chautauqua	91.7	77.2	76.9	76.5	77.0	76.3	75.4
New York	Dutchess	91.3	74.0	73.8	73.7	73.8	73.5	73.3
New York	Erie	96.0	82.3	82.1	81.9	82.0	81.3	80.8
New York	Jefferson	91.7	78.3	78.1	77.9	78.0	77.6	77.0
New York	Monroe	86.5	76.4	76.3	76.2	76.2	75.8	75.7
New York	Niagara	91.0	79.4	79.2	79.1	79.0	78.6	78.3
New York	Orange	86.0	69.3	69.1	69.0	69.1	68.8	68.5
New York	Putnam	91.3	77.9	77.8	77.7	77.9	77.7	77.6
New York	Queens	85.0	76.3	76.3	76.2	76.7	76.5	76.4
New York	Richmond	96.0	83.4	83.3	83.2	83.2	82.9	82.8
New York	Suffolk	98.5	89.8	89.7	89.7	90.3	90.1	90.0
New York	Wayne	84.0	73.0	72.9	72.8	72.8	72.5	72.3
New York	Westchester	92.0	81.0	80.9	80.9	81.2	81.0	80.9
North Carolina	Alexander	88.7	68.9	68.8	68.7	67.9	67.5	67.3

North Carolina	Buncombe	82.0	65.7	65.5	65.5	64.6	64.1	64.1
North Carolina	Caswell	89.7	67.1	66.9	66.9	65.8	65.3	65.1
North Carolina	Davie	94.7	71.9	71.6	71.6	70.3	69.7	69.5
North Carolina	Durham	89.0	66.9	66.7	66.6	65.2	64.7	64.5
North Carolina	Forsyth	93.7	70.9	70.7	70.7	69.2	68.7	68.5
North Carolina	Franklin	89.0	62.8	62.6	62.6	60.7	60.2	60.0
North Carolina	Granville	92.0	68.4	68.2	68.2	66.9	66.4	66.2
North Carolina	Guilford	90.7	67.5	67.3	67.2	65.8	65.2	65.0
North Carolina	Haywood	86.3	68.2	68.0	67.9	67.2	66.7	66.6
North Carolina	Lincoln	92.3	72.2	72.0	72.0	70.9	70.5	70.3
North Carolina	Mecklenburg	100.3	76.0	75.8	75.8	74.3	73.7	73.6
North Carolina	Northampton	83.3	67.9	67.7	67.6	67.2	66.6	66.3
North Carolina	Person	90.0	71.1	70.9	70.9	70.3	69.8	69.7
North Carolina	Randolph	85.0	63.6	63.4	63.3	61.9	61.3	61.2
North Carolina	Rockingham	88.7	67.1	66.9	66.8	66.0	65.4	65.2
North Carolina	Rowan	99.7	75.4	75.1	75.1	73.6	72.8	72.7
North Carolina	Union	87.7	66.8	66.5	66.5	64.9	64.2	64.1
North Carolina	Wake	92.7	69.6	69.5	69.4	67.6	67.1	66.9
Ohio	Allen	87.7	72.2	72.0	71.8	70.9	70.2	69.9
Ohio	Ashtabula	94.0	79.9	79.6	79.5	79.4	78.9	78.5
Ohio	Butler	89.0	73.4	73.2	72.8	72.4	71.8	70.9
Ohio	Clark	88.3	68.5	68.2	68.0	66.9	66.2	65.7
Ohio	Clermont	89.7	72.8	72.6	72.3	72.1	71.5	70.6
Ohio	Clinton	95.7	73.5	73.2	72.9	72.3	71.5	70.6
Ohio	Cuyahoga	86.3	73.3	73.1	72.9	73.0	72.4	71.8
Ohio	Delaware	90.3	71.9	71.6	71.4	70.5	69.6	69.2
Ohio	Franklin	95.0	77.2	76.9	76.7	75.9	75.0	74.6
Ohio	Geauga	98.3	82.2	82.0	81.8	81.5	80.8	80.2
Ohio	Greene	87.0	68.2	67.9	67.7	66.9	66.2	65.6
Ohio	Hamilton	89.3	75.2	75.0	74.7	74.5	73.9	73.0
Ohio	Jefferson	85.3	69.4	69.3	69.0	69.2	68.8	68.1
Ohio	Knox	89.3	70.0	69.7	69.5	68.6	67.7	67.3
Ohio	Lake	92.7	79.1	78.9	78.7	78.8	78.2	77.7
Ohio	Lawrence	85.0	69.1	68.8	68.5	68.8	68.1	67.3
Ohio	Licking	89.0	69.9	69.6	69.4	68.6	67.8	67.4
Ohio	Lorain	85.3	72.7	72.6	72.7	72.1	71.7	72.0
Ohio	Lucas	88.7	75.2	74.9	74.7	74.7	73.9	73.3
Ohio	Madison	89.0	68.8	68.6	68.4	67.4	66.7	66.2

Ohio	Mahoning	87.3	73.3	73.2	73.0	72.8	72.2	71.8
Ohio	Medina	87.7	72.1	71.9	71.7	71.2	70.5	70.1
Ohio	Miami	86.3	66.1	65.8	65.7	64.3	63.6	63.2
Ohio	Montgomery	86.7	68.9	68.6	68.5	67.4	66.7	66.3
Ohio	Portage	92.0	76.4	76.2	76.0	75.5	74.9	74.5
Ohio	Preble	80.3	62.2	61.9	61.7	61.0	60.2	59.6
Ohio	Stark	89.0	73.2	73.0	72.8	72.5	71.9	71.4
Ohio	Summit	94.3	77.0	76.8	76.6	75.9	75.3	74.9
Ohio	Trumbull	91.0	76.0	75.8	75.6	75.3	74.7	74.3
Ohio	Warren	89.7	71.6	71.3	71.0	70.4	69.7	68.9
Ohio	Washington	87.0	65.2	65.0	64.7	65.1	64.5	63.7
Ohio	Wood	87.0	72.4	72.1	71.9	71.5	70.7	70.2
Oklahoma	Marshall	85.0	72.0	71.8	71.6	71.1	70.5	70.0
Oklahoma	Oklahoma	80.7	67.7	67.5	67.4	66.8	66.3	66.0
Oklahoma	Tulsa	86.7	73.5	73.3	73.2	72.6	72.1	71.7
Pennsylvania	Allegheny	93.0	81.0	80.9	80.9	80.8	80.5	80.5
Pennsylvania	Armstrong	92.0	76.0	75.8	75.6	75.9	75.5	74.9
Pennsylvania	Beaver	90.7	78.4	78.3	78.2	78.3	78.0	77.7
Pennsylvania	Berks	92.7	77.4	77.2	77.2	77.2	76.7	76.5
Pennsylvania	Blair	84.3	66.7	66.5	66.3	66.4	65.9	65.5
Pennsylvania	Bucks	103.0	90.7	90.6	90.6	90.7	90.4	90.3
Pennsylvania	Cambria	87.7	74.0	73.8	73.7	73.7	73.3	73.0
Pennsylvania	Chester	96.5	81.0	80.9	80.8	81.1	80.6	80.3
Pennsylvania	Clearfield	86.7	69.4	69.2	69.0	69.1	68.6	68.1
Pennsylvania	Dauphin	91.0	77.4	77.2	77.2	77.3	76.8	76.6
Pennsylvania	Delaware	93.7	80.2	80.0	80.0	79.9	79.6	79.5
Pennsylvania	Erie	89.0	73.8	73.6	73.5	73.0	72.6	72.4
Pennsylvania	Franklin	93.0	76.2	76.0	75.9	75.7	75.1	74.8
Pennsylvania	Greene	90.3	70.5	70.3	70.1	70.1	69.7	69.1
Pennsylvania	Lackawanna	85.3	70.2	70.0	70.0	70.0	69.7	69.5
Pennsylvania	Lancaster	94.0	78.2	78.0	77.9	78.1	77.6	77.4
Pennsylvania	Lawrence	78.7	65.6	65.4	65.3	65.2	64.8	64.4
Pennsylvania	Lehigh	93.3	78.2	78.1	78.0	78.0	77.7	77.4
Pennsylvania	Luzerne	84.7	69.4	69.3	69.2	69.2	68.9	68.7
Pennsylvania	Mercer	91.3	75.4	75.2	75.0	74.8	74.3	73.8
Pennsylvania	Montgomery	96.3	83.2	83.1	83.1	82.9	82.6	82.6
Pennsylvania	Northampton	93.0	78.1	77.9	77.8	77.8	77.5	77.3
Pennsylvania	Perry	84.7	70.4	70.2	70.1	70.2	69.5	69.3

Pennsylvania	Philadelphia	97.5	86.0	85.9	86.0	85.8	85.5	85.7
Pennsylvania	Washington	87.7	72.9	72.8	72.5	72.7	72.3	71.8
Pennsylvania	Westmoreland	87.7	73.3	73.2	73.0	73.1	72.7	72.2
Pennsylvania	York	90.3	76.6	76.4	76.3	76.4	76.0	75.8
Rhode Island	Kent	95.3	81.2	81.1	80.9	81.5	81.3	80.8
Rhode Island	Providence	90.3	78.0	77.9	77.7	78.2	78.0	77.6
Rhode Island	Washington	93.3	81.7	81.6	81.4	82.1	81.9	81.5
South Carolina	Anderson	88.0	66.9	66.7	66.6	65.3	64.8	64.6
South Carolina	Charleston	72.0	62.1	62.0	61.9	61.7	61.5	61.2
South Carolina	Cherokee	86.0	63.2	62.9	62.9	61.7	61.1	61.0
South Carolina	Chester	84.3	66.3	66.1	66.1	65.1	64.6	64.4
South Carolina	Oconee	84.5	68.8	68.6	68.5	67.7	67.2	67.0
South Carolina	Pickens	85.3	66.1	65.9	65.8	64.8	64.2	64.1
South Carolina	Spartanburg	90.0	68.1	67.9	67.8	66.6	65.9	65.8
South Carolina	Union	80.7	63.7	63.5	63.4	62.4	61.9	61.7
South Carolina	York	83.3	64.2	64.0	63.9	63.0	62.5	62.4
Tennessee	Anderson	89.7	64.7	64.4	64.4	63.2	62.4	62.2
Tennessee	Blount	94.0	72.4	72.0	71.9	71.0	70.0	69.7
Tennessee	Davidson	81.3	64.6	64.3	64.2	63.2	62.5	62.2
Tennessee	Hamilton	90.7	69.2	68.7	68.6	67.7	66.6	66.2
Tennessee	Jefferson	94.0	69.4	69.1	69.0	67.8	66.8	66.5
Tennessee	Knox	94.7	70.8	70.4	70.4	69.3	68.4	68.2
Tennessee	Meigs	90.5	69.8	69.5	69.4	68.5	67.6	67.4
Tennessee	Rutherford	83.3	66.4	66.2	66.1	65.0	64.3	64.0
Tennessee	Shelby	90.7	73.6	73.3	73.0	72.8	72.1	71.2
Tennessee	Sullivan	89.3	73.3	73.1	73.0	72.4	71.8	71.7
Tennessee	Sumner	89.0	69.8	69.6	69.4	68.3	67.7	67.3
Tennessee	Williamson	86.3	68.5	68.3	68.1	67.2	66.6	66.3
Tennessee	Wilson	84.7	65.7	65.4	65.3	64.1	63.4	63.1
Texas	Brazoria	91.0	83.3	83.2	82.9	83.3	83.0	82.1
Texas	Collin	93.3	76.6	76.4	76.2	74.7	74.3	73.7
Texas	Dallas	91.0	81.0	80.9	80.7	79.7	79.3	78.7
Texas	Denton	99.0	80.0	79.8	79.6	78.4	77.9	77.3
Texas	Ellis	85.3	73.8	73.6	73.6	72.6	72.1	72.0
Texas	El Paso	78.7	75.3	75.2	75.2	75.0	74.7	74.7
Texas	Galveston	92.0	83.5	83.4	82.7	83.6	83.2	81.6
Texas	Gregg	88.3	80.4	80.3	80.1	80.0	79.7	79.3
Texas	Harris	105.0	96.3	96.2	95.9	96.3	95.9	95.1

Texas	Harrison	76.0	66.1	65.9	65.7	65.5	65.0	64.5
Texas	Jefferson	90.5	82.3	82.2	81.5	82.5	82.2	80.5
Texas	Montgomery	90.7	77.3	77.2	76.6	77.3	76.9	75.3
Texas	Orange	78.3	70.4	70.2	69.7	70.4	70.0	68.8
Texas	Parker	87.5	69.0	68.8	68.6	67.3	66.6	66.3
Texas	Tarrant	98.3	81.3	81.1	80.9	79.7	79.2	78.7
Utah	Box Elder	79.0	74.4	74.3	74.2	73.8	73.5	73.4
Utah	Cache	69.3	67.3	67.3	67.2	67.1	67.0	66.9
Utah	Davis	81.3	76.5	76.4	76.4	75.8	75.4	75.3
Utah	Salt Lake	80.0	75.9	75.8	75.8	75.4	75.0	74.9
Utah	San Juan	71.0	69.6	69.6	69.6	69.5	69.4	69.4
Utah	Utah	78.3	76.4	76.3	76.3	75.8	75.5	75.4
Utah	Weber	77.7	71.9	71.8	71.7	71.1	70.6	70.5
Virginia	Arlington	95.7	85.2	85.1	85.0	85.5	85.2	85.0
Virginia	Caroline	84.0	68.9	68.6	68.6	68.6	68.1	67.9
Virginia	Charles City	89.3	78.0	77.8	77.7	77.8	77.5	77.2
Virginia	Chesterfield	86.0	75.5	75.4	75.3	75.4	75.0	74.8
Virginia	Fairfax	96.3	83.9	83.8	83.7	84.0	83.7	83.5
Virginia	Fauquier	81.0	68.2	68.1	68.0	68.2	67.8	67.6
Virginia	Frederick	84.3	69.8	69.6	69.4	69.3	68.7	68.4
Virginia	Hanover	94.0	79.3	79.2	79.1	79.1	78.7	78.5
Virginia	Henrico	90.0	77.4	77.3	77.2	77.2	76.9	76.7
Virginia	Loudoun	89.3	75.5	75.3	75.2	75.6	75.1	74.9
Virginia	Page	81.3	65.0	64.8	64.7	64.7	64.3	64.0
Virginia	Prince William	85.7	71.4	71.2	71.1	71.2	70.7	70.5
Virginia	Roanoke	86.0	71.0	70.7	70.6	70.4	69.7	69.5
Virginia	Stafford	86.3	71.8	71.6	71.5	71.8	71.3	71.1
Virginia	Alexandria City	90.0	78.4	78.3	78.2	78.5	78.2	78.0
Virginia	Hampton City	88.7	79.5	79.5	79.9	78.9	78.7	79.7
Virginia	Suffolk City	87.3	78.3	78.2	78.9	77.2	76.9	78.7
West Virginia	Berkeley	86.0	71.2	71.0	70.9	70.8	70.1	69.8
West Virginia	Cabell	88.0	72.4	72.1	71.8	72.6	71.9	71.3
West Virginia	Hancock	84.3	70.6	70.5	70.3	70.4	70.1	69.6
West Virginia	Kanawha	87.0	68.4	68.1	67.8	67.9	67.1	66.5
West Virginia	Monongalia	80.0	66.3	66.2	66.1	65.9	65.6	65.3
West Virginia	Ohio	84.7	69.1	69.0	68.7	69.0	68.6	67.9
West Virginia	Wood	87.7	66.6	66.4	66.0	66.4	65.8	65.0
Wisconsin	Brown	81.7	69.4	69.1	69.0	68.4	67.7	67.4

Wisconsin	Columbia	77.7	64.6	64.4	64.3	63.4	62.8	62.6
Wisconsin	Dane	77.3	65.0	64.8	64.8	63.8	63.3	63.1
Wisconsin	Dodge	81.0	66.2	65.9	65.8	64.9	64.1	63.8
Wisconsin	Door	92.7	78.8	78.4	78.3	77.9	76.9	76.6
Wisconsin	Fond Du Lac	79.0	64.1	63.8	63.7	62.7	61.9	61.7
Wisconsin	Jefferson	84.5	69.8	69.5	69.4	68.5	67.7	67.5
Wisconsin	Kenosha	98.7	89.0	88.9	88.8	88.5	88.2	88.0
Wisconsin	Kewaunee	90.0	78.6	78.4	78.3	77.9	77.2	77.0
Wisconsin	Manitowoc	90.0	79.8	79.5	79.5	79.1	78.4	78.2
Wisconsin	Milwaukee	91.3	80.3	80.0	80.0	79.5	78.9	78.7
Wisconsin	Ozaukee	95.3	84.3	84.1	84.1	83.9	83.3	83.1
Wisconsin	Racine	91.7	82.4	82.3	82.2	81.9	81.5	81.3
Wisconsin	Rock	84.3	72.0	71.7	71.6	70.9	70.0	69.9
Wisconsin	St Croix	72.7	58.6	58.4	58.2	57.3	56.6	56.2
Wisconsin	Sheboygan	98.0	85.6	85.3	85.2	84.8	84.0	83.7
Wisconsin	Walworth	83.3	70.6	70.2	70.1	69.5	68.4	68.2
Wisconsin	Washington	82.7	69.5	69.2	69.2	68.3	67.5	67.3
Wisconsin	Waukesha	82.7	70.9	70.6	70.5	70.1	69.2	69.0
Wisconsin	Winnebago	80.0	66.5	66.2	66.1	65.3	64.6	64.2
Wyoming	Campbell	71.0	70.0	69.9	69.9	69.8	69.8	69.7
Wyoming	Teton	65.7	64.9	64.9	64.9	64.9	64.8	64.8

United States Environmental Protection Agency	Office of Air Quality Planning and Standards Air Quality Assessment Division Research Triangle Park, NC	Publication No. EPA 454/R-07-004 March 2007