Technical Support Document for the Final Mobile Source Air Toxics Rule: Ozone Modeling

EPA 454/R-07-003
February 2007

Technical Support Document for the Final Mobile Source Air Toxics Rule: Ozone Modeling

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

Table of Contents

I. Introduction

This document was prepared to describe the ozone air quality modeling performed by EPA in support of the Mobile Source Air Toxics (MSAT) rule. Included is information on (1) the air quality modeling and the development of model inputs, (2) the performance of the models as compared to measured data, and (3) an assessment of the expected air quality improvements from the VOC emissions reductions that are part of this proposal.

Because of the availability of reductions from different precursor pollutants and types of sources, applying the model for individual chosen control scenarios may miss alternative strategies that achieve greater air quality benefits at a lower cost. As a result, a new approach known as air quality *metamodeling* has been developed to aggregate numerous individual air quality modeling simulations into a multi-dimensional air quality "response surface". Simply, this metamodeling technique is a "model of the model" and can be shown to reproduce the results from an individual modeling simulation with little bias or error. This approach allows for the rapid assessment of air quality impacts of different combinations of emissions reductions and was used here to project the effects of the portable fuel container controls within the MSAT rule.

II. Methodology

A. CAMx Base Case Modeling Simulations

The foundation for the ozone modeling analyses considering impacts from portable fuel containers was the CAMx modeling that was done in support of the final Clean Air Interstate Rule (CAIR). The CAIR modeling is fully described in the CAIR air quality modeling technical support document (TSD)[1], but a brief description is provided below. The modeling procedures used in this analysis (e.g., domain, episodes, meteorology) have been used for several EPA rulemaking analyses over the past 5 years and are well-established at this point.

The modeling simulations that comprised the MSAT metamodeling were conducted using CAMx version 3.10. CAMx is a non-proprietary computer model that simulates the formation and fate of photochemical oxidants, including ozone, for given input sets of meteorological conditions and emissions. The gridded meteorological data for three historical episodes were developed using the Regional Atmospheric Modeling System (RAMS), version 3b.[2] In all, the 30 episode days in 1995 modeled for this

[1] 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.

[2] Pielke, R.A., W.R. Cotton, R.L. Walko, C.J. Tremback, W.A. Lyons, L.D. Grasso, M.E. Nicholls, M.D. Moran, D.A. Wesley, T.J. Lee, and J.H. Copeland, 1992: A Comprehensive Meteorological Modeling System - RAMS, Meteor. Atmos. Phys., Vol. 49, pp. 69-91.

analysis were associated with frequently-occurring, ozone-conducive, meteorological conditions in portions of the Eastern U.S.. Emissions estimates were developed for the evaluation year (1995) as well as a future base year (2015).

The CAMx model applications were performed for a domain covering all, or portions of, 37 States (and the District of Columbia) in the Eastern U.S., as shown in Figure II-1. The domain has nested horizontal grids of 36 km and 12 km, however the output data from the metamodeling is provided at a 12 km resolution (i.e., cells from the outer 36 km cells populate the nine finer scale cells, as appropriate). Table II-1 provides the basic information regarding the simulations.

Table II-1. Configuration of ozone modeling domain.

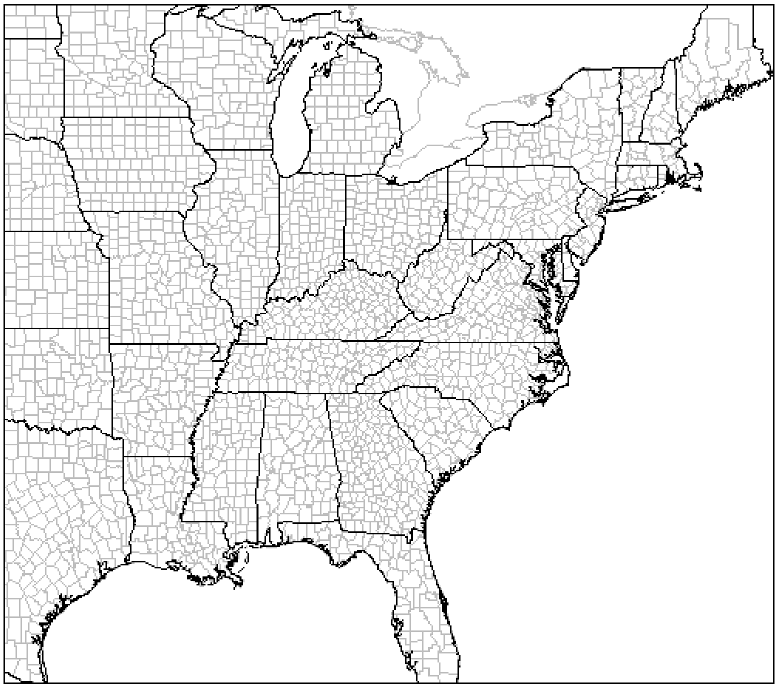
	CAMx MSAT Eastern U.S. Modeling	
	Coarse Grid	**Fine Grid**
Map Projection	latitude/longitude	latitude/longitude
Grid Resolution	1/2˚longitude, 1/3˚latitude (~ 36 km)	1/6˚longitude, 1/9˚latitude (~ 12 km)
East/West extent	-99 W to -67 W	-92 W to -69.5 W
North/South extent	26 N to 47 N	32 N to 44 N
Dimensions	64 x 63 x 9	137 x 110 x 9
Vertical extent	9 Layers: surface to 4 km	
Layer structure (m)	0-50, 50-100, 100-300, 300-600, 600-1000, 1000-1500, 1500-2000, 2000-2500, 2500-4000	

Before one can combine multiple CAMx simulations into a metamodel, one must ensure that the base simulations show adequate model performance. EPA guidance on ozone modeling for attainment demonstrations[3] notes that the performance of an air quality model can be evaluated in two ways: (1) how well is the model able to replicate observed concentrations of ozone and/or precursors, and (2) how accurate is the model in characterizing sensitivity of ozone to changes in emissions? For the first evaluation approach, EPA conducted an operational performance evaluation of CAMx for the 1995 episodes as part of the CAIR modeling analysis. The details of that ozone performance evaluation are provided in the CAIR TSD. In general, the model was determined to be performing acceptably, with relatively-low levels of bias and error at most space/time scales. As for the second evaluation approach, there is some initial evidence that past

[3] U.S. Environmental Protection Agency, 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, 27711, 128pp, October 2005.

modeling applications with similar configurations have successfully reproduced observed changes in air quality.[4]

Figure II-1. Map of the CAMx domain used for MSAT ozone metamodeling.



B. CAMx Future Case Modeling Simulations

As noted above, emissions estimates were developed for a future year (2015). The 2015 emissions estimates account for the net effects of economic growth and emissions reductions expected to result from existing and recently promulgated control programs, including the reductions resulting from CAIR, the Clean Air NonRoad Diesel Rule (CAND), the NOx SIP Call, and other rules. For more information on the development of the 2015 emissions, please see the CAIR Emissions Inventory TSD.[5] This 2015 CAIR future-year emissions inventory was the starting point for the ozone metamodeling done for the MSAT rule.

The CAIR 2015 modeling indicates that substantial improvement is expected in ambient levels of 8-hour ozone between the present and 2015. Only six Eastern U.S. ozone nonattainment areas are projected to remain nonattainment of the 8-hour ozone

[4] U.S. Environmental Protection Agency, Evaluating Ozone Control Programs in the Eastern United States: Focus on the NOx Budget Trading Program, 2004, Office of Air and Radiation, Washington DC, August 2005.

[5] U.S. Environmental Protection Agency, CAIR Emissions Inventory Technical Support Document, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2005.

NAAQS in 2015: Baltimore, Chicago, Houston, Milwaukee, New York City, and Philadelphia.

C. Development of the Metamodeling Experimental Design

The ozone metamodeling used for assessing the effects of reducing evaporative VOC emissions was part of a broader effort to determine what additional emissions controls may be needed to attain the 8-hour ozone NAAQS by 2015. In order to maximize the information we could obtain for use in comparing relative efficacy of different emissions control strategies, we established an experimental design consisting of a carefully selected set of air quality modeling runs. For this analysis, we selected an experimental design that covered three key areas: type of precursor emission (NOx or VOC), emission source type (i.e., onroad vehicles, nonroad vehicles, area sources, electrical generating utility (EGU) sources, and non-utility point sources), and location within or without a 2015 model-projected residual ozone nonattainment area. This resulted in a set of 14 emissions factors:

1) Nonroad mobile source VOC emissions in residual O3 nonattainment areas
2) Nonroad mobile source VOC emissions in O3 attainment areas
3) Area source VOC emissions in residual O3 nonattainment areas
4) Area source VOC emissions in O3 attainment areas
5) Nonroad mobile source NOx emissions in residual O3 nonattainment areas
6) Nonroad mobile source NOx emissions in O3 attainment areas
7) EGU NOx emissions in residual O3 nonattainment areas
8) EGU NOx emissions in O3 attainment areas
9) Non-EGU point source NOx emissions in residual O3 nonattainment areas
10) Non-EGU point source NOx emissions in O3 attainment areas
11) Onroad mobile source VOC emissions in residual O3 nonattainment areas
12) Onroad mobile source VOC emissions in O3 attainment areas
13) Onroad mobile source NOx emissions in residual O3 nonattainment areas
14) Onroad mobile source NOx emissions in O3 attainment areas

The experimental design for these 14 factors is described in Battelle(2004)[6]. That report lists three potential designs; this analysis used design #1. The particular type of Latin Hypercube design used is called a Maximin Latin Hypercube design. Based on a rule of thumb of ten runs per factor, we developed an overall design with 140 runs (a base case plus 139 control runs). The range of emissions reductions considered within the metamodel ranged from 0 to 100 percent of the 2015 CAIR emissions. Additionally, there were runs with emissions increases in these factors by up to 20 percent. This experimental design resulted in a set of CAMx simulations which serve as the inputs to the statistical metamodeling.

Because the metamodeling was going to be used to assess the impacts of the MSAT standards, the experimental design also included “oversampling” (i.e., additional

[6] Battelle, Final Experimental Designs for Ozone Modeling, WA2-05 Final Technical Report: Task 7, Columbus OH, September 2004.

runs) in the range of 0 to 10 percent control for the nonroad VOC sector. Additional CAMx runs were completed that only included VOC controls, or were heavily weighted toward nonroad VOC controls. The modeling was done in a four-step process.

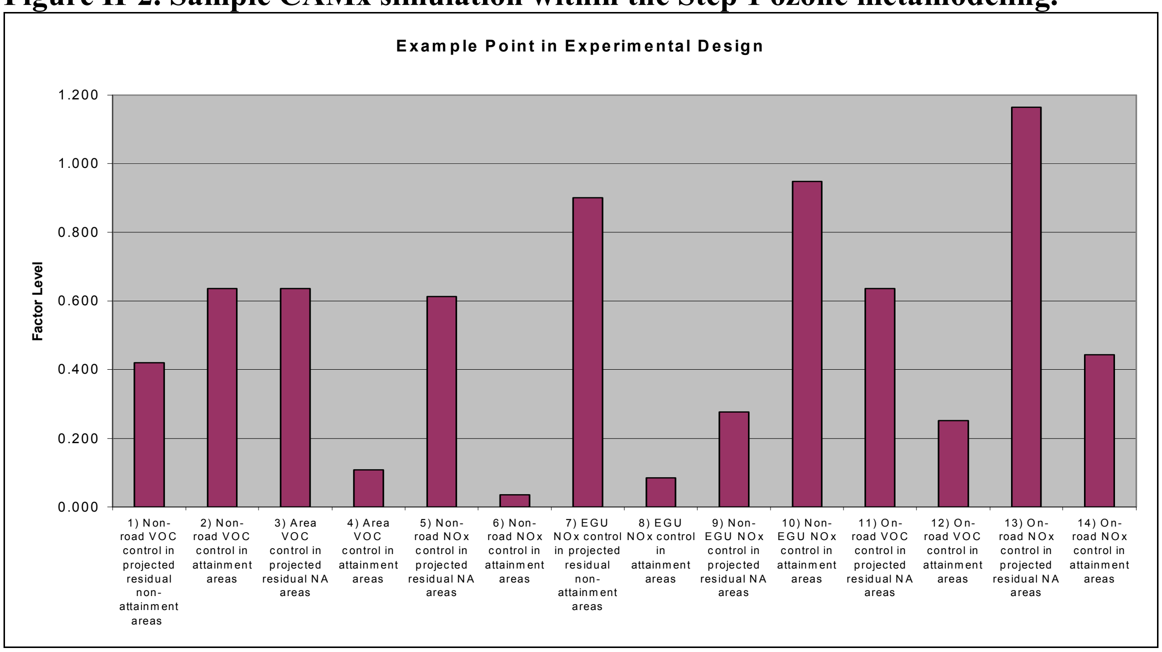
Step 1: Construct a 129 run, Maximin Latin Hypercube design modeling the 14 sectors and consider emissions factors ranging from 0 to 1.2. Figure II-2 shows a sample run within the Step 1 metamodeling.

Step 2: Augment the 129 run design obtained in Step 1 by adding ten more points in an optimal fashion using the Maximin design criterion while remaining within the class of Latin Hypercube design. These runs focused on the 0.9 to 1.0 range of VOC emissions from the area and nonroad categories. Figure II-3 shows the emissions changes associated with a sample run.

Step 3: A series of 10 "out-of-sample" evaluation runs were also modeled. These runs are part of the same overall experimental design as the first 139 simulations and are intended to provide a representative set of points from the policy space that have yet to be modeled in Steps 1 and 2. The results of these comparisons are discussed in Section III.

Step 4: Because some of our initial testing indicated small differences between VOC-only standalone[7] CAMx modeling runs and the metamodeling predictions, an additional five runs were modeled that looked at primarily VOC controls. In the end, all 154 runs were combined to build the CAMx metamodel.

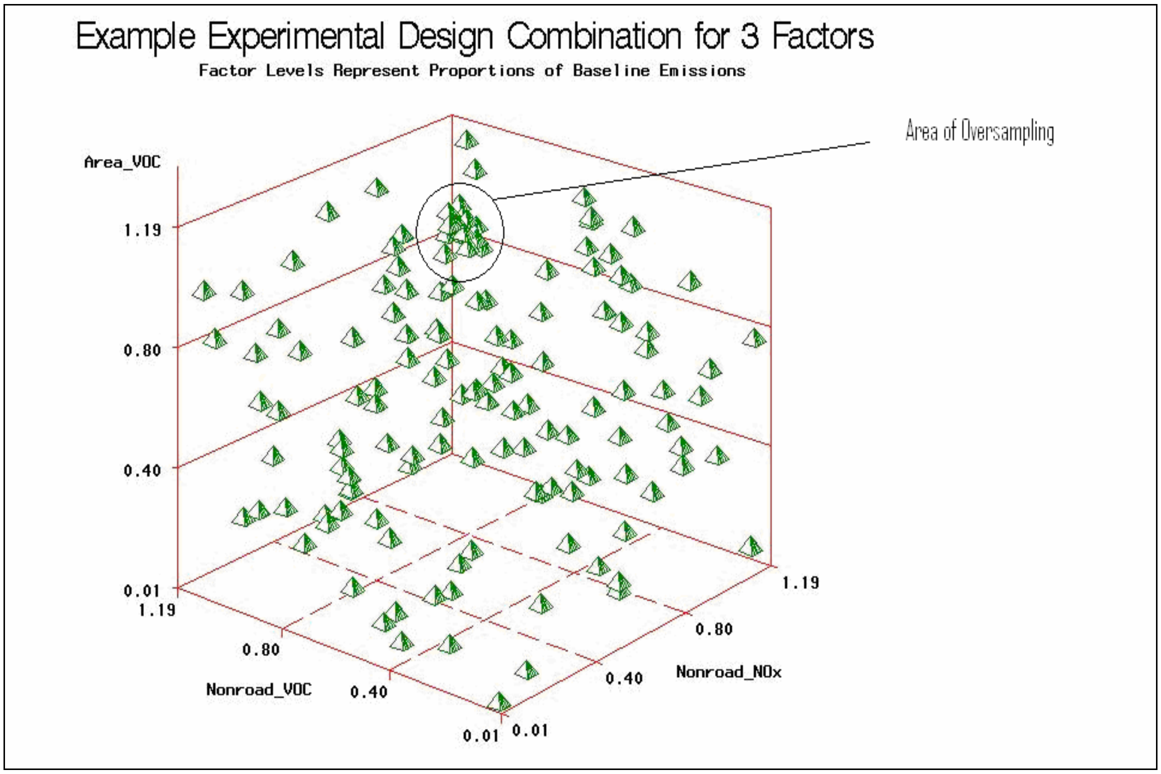
Figure II-2. Sample CAMx simulation within the Step 1 ozone metamodeling.



---

[7] Standalone modeling refers to an individual CAMx simulation of a particular set of emission reductions, as opposed to the metamodeling technique.

Figure II-3. Display of three (of the 14) metamodeling dimensions (area VOC, nonroad VOC, and nonroad NOx) showing the oversampling between 0.9 and 1.0.



D. Building the Response Surfaces within the Metamodeling

To develop a metamodeling approximation to standalone CAMx modeling, we used a multidimensional kriging approach, as described in Battelle (2004). This modeling approach is well suited to data generated using a non-stochastic computer model, and can approximate highly nonlinear surfaces as long as they are locally continuous. We modeled the predicted changes in ozone in each CAMx grid cell as a function of the weighted average of the modeled responses in the experimental design. The weight assigned to a particular modeled output depends on the Euclidean distance between the factor levels defining the policy to be predicted and the factor levels defining the CAMx experimental run.

A separate response-surface was fit for each ozone metric. Seven metrics were identified for the MSAT metamodeling.

1) the mean of all 1-hour daily ozone maxima over the 30 modeling days,
2) the mean of all 8-hour daily average ozone maxima over the 30 modeling days,
3) the mean of all 8-hour daily averages (9am to 5pm) over the 30 modeling days,
4) the mean of all 5-hour daily averages (10am to 3pm) over the 30 modeling days,

5) the mean of all 24-hour daily averages over the 30 modeling days,
6) the sum of all hourly O3 concentrations >= to 0.06 ppm occurring between 8am and 8pm over the 30 modeling days, and
7) the projected 2015 8-hour ozone design values for the 525 counties with recent ozone monitoring data.

III. Evaluation of Ozone Metamodeling

The metamodeling was validated using three separate techniques. The simplest approach involved visual inspection of prediction maps and other model output to confirm overall spatial comparability in the metamodeling predictions versus standalone CAMx modeled outputs for selected runs within and outside of the metamodeling experimental design. As a second approach, cross-validation was used to evaluate overall response-surface performance. In this method, one of the experimental model runs is left out of the model estimation, and the response-surface model is computed with the validation run left out. The metamodel is then used to predict the ozone changes for the factor levels corresponding to the "left out" model run and compared with the actual CAMx model outputs for that run. A set of standard model performance evaluation metrics are then computed for that run, including bias, error, normalized bias and error, and fractional bias and error. This process is then repeated for each experimental design model run, and the distributions of the performance metrics are then examined over all 155 model runs to gauge the overall performance of the metamodeling across the experimental design. Finally, out-of-sample validation was also completed, by comparing predicted values from the metamodeling through steps 1 and 2 with actual CAMx outputs for a set of 10 model runs that were not part of the initial 139 simulations.

Various visual comparisons were completed to compare the standalone CAMx modeling to the CAMx metamodel. All generally showed good agreement between the two techniques. Figure III-1 shows sample differences between the design values at two high-ozone sites for a particular simulation.

Cross-validation and out-of-sample performance metrics for the projected 2015 ozone design value metric are presented in Table III-1. For the cross-validation method, the mean, minimum, and maximum values of the performance metrics across all 140 Step 1 and 2 model runs are presented. For example, for the mean bias performance metric, the bias is calculated for each of the 525 counties and then the mean of the bias across counties is calculated for each of the 140 model runs. The mean of the 140 mean bias estimates is then calculated and reported in the "Mean" column of Table III-1. The minimum of the 140 mean bias estimates is reported in the "Minimum" column, and the maximum of the 140 mean bias estimates is reported in the "Maximum" column. All performance measures indicate that the metamodel produces very accurate and generally non-biased predictions of the CAMx model response for the design value metric. The mean of the spatially averaged error across all 140 runs is only 0.28 ppb, or less than half a percent in relative terms. This indicates that the metamodel replicates the CAMx response to emissions changes very well for most emissions combinations and in most locations.

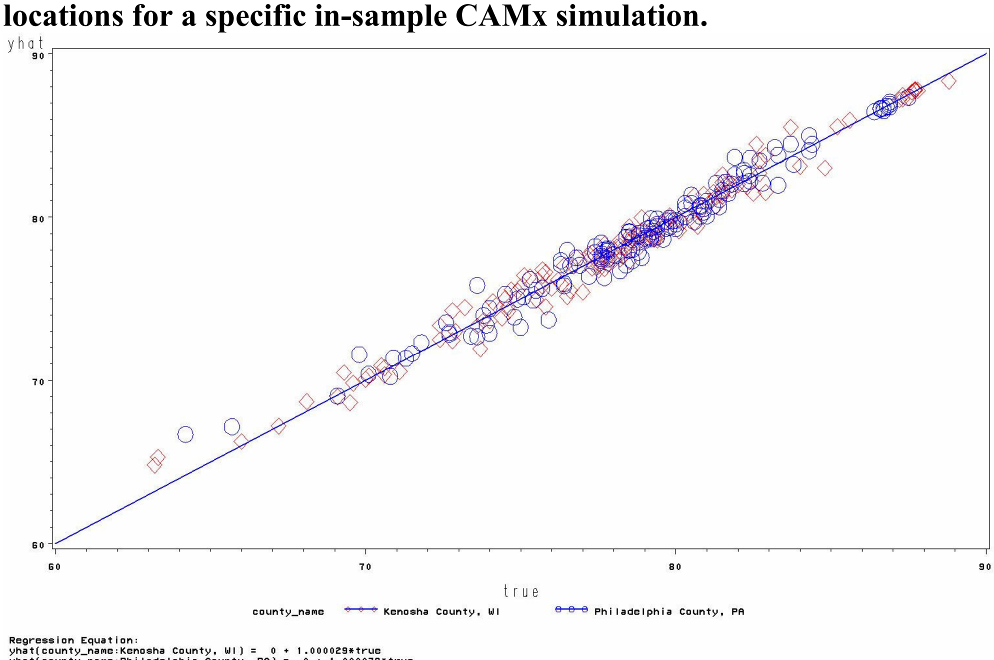
For the out-of-sample method, the mean, minimum, and maximum values of the performance metrics across 10 CAMx validation runs are presented. These results are very similar to the cross validation results, and as shown in Table III-1 also indicate very good performance of the metamodel (e.g., based on this approach the mean error was 0.26 ppb).

The metrics with the largest errors and biases were the design value and "sum06" metrics. Performance statistics were also generated for the other five metrics and were shown to be near zero bias/error.

Table III-1. Validation Performance Metrics for the Predicted Ozone Design Value

Performance Metric	**Cross Validation (n=139)**			**Out of Sample (n=10)**		
	Mean	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**
Mean Bias (ppb)	0.01	-0.52	0.79	-0.01	-0.35	0.30
Mean Error (ppb)	0.28	0.04	0.83	0.26	0.18	0.39
Mean Normalized Bias (%)	0.02%	-0.91%	1.81%	-0.02%	-0.61%	0.44%
Mean Normalized Error (%)	0.47%	0.05%	1.87%	0.44%	0.29%	0.66%
Normalized Mean Bias (%)	0.01%	-1.10%	1.13%	-0.02%	-0.71%	0.44%
Normalized Mean Error (%)	0.46%	0.08%	1.19%	0.44%	0.36%	0.58%
Mean Fractional Bias (%)	0.02%	-0.92%	1.79%	-0.02%	-0.61%	0.44%
Mean Fractional Error (%)	0.47%	0.05%	1.85%	0.44%	0.29%	0.66%

Figure III-1. Comparison of Standalone vs. Metamodeling Design Values for two locations for a specific in-sample CAMx simulation.



IV. Summary of Ozone Metamodeling Results

A. Adjusting the MSAT Metamodeling Emissions

The inputs for the response surface metamodel (RSM) are percent adjustments in emissions from the 2015 RSM base case. These adjustments were calculated by taking the ratio of a future year inventory projection for each factor compared with CAIR 2015 inventories for each factor for a base case and a control case. As described below, because the CAIR modeling did not include all of the portable fuel container emissions, the adjustments also had to account for the missing emissions in the 2015 RSM case.

For the MSAT analysis, the years of interest were 2020 and 2030 which allows sufficient time for use of the new portable fuel containers to become widespread. Inventory projections for 2020 were taken from modeling work done for the CAIR. Inventories for 2030 were based on mobile source inventory model projections and stationary sources were held constant from 2020 to 2030. As noted above, some of the spillage emissions associated with portable fuel containers are currently included in the NONROAD 2004 emissions model, however the remaining emissions were not included in the CAIR inventories. For the purposes of the MSAT analysis, the remaining portable fuel container emissions were included as part of the nonroad factor. For additional detail on the portable fuel container emission projections, see the portable fuel container inventory TSD.[8]

As discussed in Section II.A, the modeling domain covers 37 States in the Eastern U.S. In using the metamodel to calculate the change in air quality associated with a certain change in emissions, the emissions reductions are applied equally, on a percentage basis across the domain (i.e., in both projected attainment and projected nonattainment areas). Since some states have already implemented, or are in the process of implementing, their own portable fuel container emission control programs, the emissions reductions from the MSAT controls do not affect each state in the same way. For the MSAT analysis the metamodel was run twice for the base and control scenario for each year. The emissions inputs for the two runs reflect the varying level of control projected for: a) those states with their own portable fuel container control programs and b) those without a local program. Those states without an independent portable fuel container control program will experience a larger degree of emissions reductions from the MSAT controls. There are 25 states in the 37 state RSM domain that do not have their own portable fuel container control programs. There are 12 states plus the District of Columbia which do or will have their own portable fuel container control program by 2010. A list of the states with and without their own control program is presented in Table IV-1.

[8] US EPA (2007) Estimating Emissions Associated with Portable Fuel Containers. EPA Document # EPA420-R-07-001.

Table IV-1. Status of Portable fuel container Control Programs over the 37 States in the Eastern U.S. Modeling Domain

State	State Portable fuel container Control Program?	State	State Portable fuel container Control Program?
AL	No	MO	No
AR	No	NE	No
CT	Planning	NH	No
DE	Yes	NJ	Planning
DC	Planning	NY	Yes
FL	No	NC	No
GA	No	ND	No
IL	No	OH	No
IN	No	OK	No
IA	No	PA	Yes
KS	No	RI	Planning
KY	No	SC	No
LA	No	SD	No
ME	Yes	TN	No
MD	Yes	TX	Planning
MA	Planning	VT	Planning
MI	No	VA	Planning
MN	No	WV	No
MS	No	WI	No

The impact of the MSAT controls was then assessed by coupling the results from two metamodeling runs: 1) states with their own controls and 2) states without existing or planned State programs. In all, eight RSM simulations were completed:

1) 2020 base / no existing portable fuel container controls,
2) 2020 base / planned or existing portable fuel container control program,
3) 2020 control / no existing portable fuel container controls,
4) 2020 control / planned or existing portable fuel container control program,
5) 2030 base / no existing portable fuel container controls,
6) 2030 base / planned or existing portable fuel container control program,
7) 2030 control / no existing portable fuel container controls,
8) 2030 control / planned or existing portable fuel container control program,

The results from runs 1, 3, 5, and 7 were used for locations within the 25 States without the MSAT portable fuel container program. The results from runs 2, 4, 6, and 8 were used in the other areas. The coupling approach does not allow for a consideration of ozone changes resulting from transport. As a result, this modeling is a slightly conservative estimate of the actual air quality change which will result from the MSAT controls.

An example of calculating the NonRoad VOC input adjustment factor for run 1 is provided below. In that case the RSM input adjustment factor was calculated as follows:

$$\frac{(CCNRALM2020*2020\_25ratio)+2020\_GCB\_25}{(CCNRALM2015*2015\_25ratio)}$$

where:

CCNRALM 2020 = CAIR control NonRoad VOC inventory for 2020,
CCNRALM 2015 = CAIR control NonRoad VOC inventory for 2015,

2020_25ratio = ratio of 2020 NonRoad VOCs for 25/37 states,
2015_25ratio = ratio of 2015 NonRoad VOCs for 25/37 states, and

2020 GCB_25 = portable fuel container emissions inventory for a base case for 2020 for the 25 states without their own portable fuel container control programs

The final input adjustments for each of the factors used in the MSAT analysis are shown in Table IV-2 below.

Table IV-2. Input Adjustment Factors used in the MSAT metamodeling

Adjustment Factor Table	NRoad VOC	NRoad NOx	OnRd VOC	OnRd NOx	Area VOC	EGU NOx	NEGU NOx
2020 base – 25 state	1.12	0.92	0.87	0.79	1.02	1.00	1.08
2020 base –12 state	1.07	0.92	0.87	0.79	1.02	1.00	1.08
2020 control – 25 state	0.94	0.92	0.87	0.79	1.02	1.00	1.08
2020 control – 12 state	0.98	0.92	0.87	0.79	1.02	1.00	1.08
2030 base – 25 state	1.16	0.83	0.81	0.64	1.02	1.00	1.08
2030 base –12 state	1.11	0.83	0.81	0.64	1.02	1.00	1.08
2030 control – 25 state	0.96	0.83	0.81	0.64	1.02	1.00	1.08
2030 control – 12 state	1.01	0.83	0.81	0.64	1.02	1.00	1.08

B. Modeling Results from the MSAT Strategy

Since the net improvement, when population weighted, in the design value metric was so small, the remaining ozone metrics were not utilized for the MSAT rule, as they would likely lead to negligible monetized benefits. As discussed in more detail in EPA guidance on 8-hour ozone model attainment demonstrations, model predictions are used in a relative rather than absolute sense to project what levels of ozone will exist in the future in both base and control cases. These projections are anchored to present-day ambient concentrations. This is done by calculating a relative reduction factor (RRF) between any future CAMx simulation and the baseline CAMx simulation (i.e., control / base). The RRF is then multiplied by the representative baseline observed ozone to yield the projected future value. In the case of the MSAT modeling, the CAMx baseline was a 2001 simulation, and the representative base ambient period was a three-year average of 8-hour ozone design values from 2001[9] to 2003. Starting with an observed concentration as the base value reduces problems in interpreting model results.

The projected 8-hour ozone design value results from the metamodeling for 2020 are shown in Appendix A for the 525 counties within the eastern U.S. modeling domain that had valid ozone monitoring data for the period between 1999 and 2003. Similar results for 2030 are shown in Appendix B. Both of these tables contain the model projected design value to one decimal place (ppb), and the design value change from the MSAT controls to two decimal places (ppb).

The results indicate that the net effect of the portable fuel container controls is a very small, net improvement in future ozone, after weighting for population. Table IV.3 shows the population-weighted design value projections in 2020 and 2030, for the base and MSAT control scenarios. As can be seen, the population-weighted design value over the eastern U.S. is projected to decrease from 72.20 ppb to 72.15 ppb in 2020 as a result of this rule. It can be noted from this table that the positive impacts from the rule are less in 2030 than in 2020. This occurs because NOx emissions are projected to be reduced at a faster pace than VOC emissions between 2020 and 2030 (see Table IV.2). As a result, the eastern U.S. airshed is projected to become increasingly NOx-limited and less responsive to VOC controls.

Table IV-3. 2020 and 2030 Average Eastern U.S. 8-Hour Ozone Design Values in the MSAT Base / Control Cases, and the Expected Effect of the MSAT Controls

	Base	Control	Change
2020 Pop Weighted	72.20	72.15	-0.051
2030 Pop Weighted	70.67	70.64	-0.027

In certain urban areas the effects of the rule are even larger. In particular, for those areas that are strongly VOC limited the reductions can be larger. For example, in Kenosha Co., WI, which is the controlling county for both the populous Chicago and Milwaukee nonattainment areas, the 2020 design value is projected to drop from 87.95 to 87.67 ppb. It is also important to note that the RSM results in Appendix A and B indicate that the counties which are projected to experience the greatest improvement in ozone design values are generally also those that are projected to have the highest ozone design values (see Table IV-4). Those counties that are projected to experience an extremely

[9] Because 8-hour ozone design values are themselves, three-year averages of fourth-highest ozone concentrations over an ozone season, the net effect here is to average ozone over a five-year period (1999-2003) with the greatest weighting being applied to the base year (i.e., 2001).

small increase in ozone design values generally have design values that are lower, below 70 ppb.

Table IV-4. 2020 and 2030 Population-Weighted Average Change in 8-Hour Ozone Design Values for counties in which future design value is projected to be equal to or above 80 ppb

	Projected Change due to MSAT Controls (ppb)
2020	-0.145
2030	-0.153

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-07-003 February 2007

Appendix A: 2020 MSAT Metamodeling Results

State Name	County Name	2001-2003 Baseline	2015 CAIR	2020 Base	2020 Control	2020 Population	Effect of MSAT controls (ppb)
Alabama	Baldwin Co	79.0	67.4	66.7	66.7	220,357	0.04
Alabama	Clay Co	82.0	59.2	58.3	58.3	15,770	0.03
Alabama	Elmore Co	78.3	59.4	58.2	58.2	88,681	0.04
Alabama	Jefferson Co	86.7	65.5	63.9	64.0	673,910	0.06
Alabama	Lawrence Co	78.7	62.3	61.4	61.4	39,006	0.05
Alabama	Madison Co	82.7	62.7	61.1	61.2	343,602	0.04
Alabama	Mobile Co	79.0	68.0	67.4	67.5	441,060	0.04
Alabama	Montgomery Co	80.0	60.8	59.8	59.8	257,062	0.02
Alabama	Morgan Co	83.0	66.7	65.8	65.9	133,114	0.07
Alabama	Shelby Co	91.7	68.2	66.5	66.6	262,960	0.04
Alabama	Sumter Co	74.0	58.2	58.0	58.0	14,352	0.03
Alabama	Tuscaloosa Co	78.0	58.3	57.3	57.3	192,889	0.03
Arkansas	Crittenden Co	92.7	78.0	76.7	76.8	54,856	0.06
Arkansas	Montgomery Co	68.0	55.9	54.9	55.0	10,484	0.04
Arkansas	Pulaski Co	84.7	68.4	67.2	67.2	382,597	0.02
Connecticut	Fairfield Co	98.7	90.6	89.9	89.9	900,915	-0.03
Connecticut	Hartford Co	89.3	76.8	74.6	74.6	862,512	-0.03
Connecticut	Litchfield Co	83.0	70.8	68.9	68.9	199,790	-0.03
Connecticut	Middlesex Co	98.0	88.4	86.8	86.7	175,771	-0.03
Connecticut	New Haven Co	99.0	89.1	87.6	87.5	837,362	-0.03
Connecticut	New London Co	90.7	81.1	79.4	79.4	274,769	0.00
Connecticut	Tolland Co	93.0	79.1	76.9	76.9	151,381	0.00
Delaware	Kent Co	91.3	75.5	73.4	73.4	153,886	0.00
Delaware	New Castle Co	95.3	81.5	79.9	79.8	569,214	-0.03
Delaware	Sussex Co	93.3	77.3	75.3	75.3	210,515	0.00
D.C.	Washington Co	94.3	82.7	74.2	74.2	535,936	-0.03
Florida	Alachua Co	75.3	55.1	53.4	53.4	266,004	0.06
Florida	Baker Co	72.7	53.8	52.3	52.3	29,729	0.02
Florida	Bay Co	80.0	68.7	67.9	67.9	199,951	0.07

Florida	Brevard Co	75.0	53.9	52.2	52.2	586,754	0.01
Florida	Columbia Co	71.0	52.8	51.4	51.4	75,039	0.04
Florida	Duval Co	70.3	50.6	48.9	49.0	935,231	0.04
Florida	Escambia Co	83.7	70.2	69.4	69.4	342,038	0.04
Florida	Highlands Co	64.0	46.3	44.7	44.8	109,389	0.04
Florida	Hillsborough Co	80.3	63.4	61.9	61.7	1,263,025	-0.24
Florida	Holmes Co	72.3	58.3	57.2	57.2	22,785	0.04
Florida	Lake Co	76.0	54.8	53.0	53.0	283,796	0.02
Florida	Lee Co	70.7	51.8	49.9	50.0	630,873	0.01
Florida	Leon Co	73.3	57.5	56.2	56.3	317,982	0.05
Florida	Manatee Co	79.0	60.9	59.2	59.2	384,419	0.03
Florida	Marion Co	75.7	55.1	53.7	53.7	342,271	0.01
Florida	Orange Co	78.3	56.8	54.9	54.9	1,221,146	0.01
Florida	Osceola Co	73.7	53.2	51.3	51.4	302,483	0.04
Florida	Palm Beach Co	69.7	51.3	49.4	49.5	1,740,927	0.04
Florida	Pasco Co	77.7	59.9	58.1	58.2	447,595	0.03
Florida	Pinellas Co	77.3	62.3	60.6	60.6	1,027,120	0.05
Florida	Polk Co	78.0	55.7	53.7	53.7	596,212	0.04
Florida	St Lucie Co	69.3	51.2	70.6	70.3	257,007	-0.25
Florida	Santa Rosa Co	82.0	69.0	68.2	68.2	204,793	0.04
Florida	Sarasota Co	81.7	61.1	58.8	58.7	400,885	-0.17
Florida	Seminole Co	77.7	56.0	54.1	54.1	572,859	0.03
Florida	Volusia Co	72.0	51.4	49.8	49.8	561,973	0.03
Florida	Wakulla Co	76.0	62.3	61.4	61.4	34,713	0.02
Georgia	Bibb Co	92.0	77.6	76.8	76.9	162,877	0.10
Georgia	Chatham Co	71.0	56.6	55.3	55.3	251,911	0.02
Georgia	Cherokee Co	77.0	56.0	53.7	53.7	232,098	0.05
Georgia	Cobb Co	94.7	71.2	68.1	68.1	881,392	0.00
Georgia	Coweta Co	92.0	69.7	67.7	67.7	133,947	0.02
Georgia	Dawson Co	82.0	59.2	56.7	56.7	30,379	0.02
Georgia	De Kalb Co	95.3	74.5	71.7	71.7	734,094	0.01
Georgia	Douglas Co	94.7	71.2	68.3	68.3	137,597	0.02

Georgia	Fayette Co	90.7	70.1	67.4	67.4	148,297	0.02
Georgia	Fulton Co	99.0	77.6	74.7	74.7	898,343	0.01
Georgia	Glynn Co	72.7	56.6	55.3	55.3	81,832	0.02
Georgia	Gwinnett Co	89.3	66.6	63.5	63.5	896,126	0.02
Georgia	Henry Co	98.0	74.3	72.3	72.3	187,382	0.08
Georgia	Murray Co	86.0	63.1	60.9	61.2	48,494	0.31
Georgia	Muscogee Co	82.0	62.2	60.5	60.6	201,874	0.04
Georgia	Paulding Co	90.3	64.3	62.3	62.3	128,213	0.02
Georgia	Richmond Co	85.7	68.4	67.2	67.3	216,360	0.10
Georgia	Rockdale Co	96.3	72.8	70.1	69.9	106,283	-0.24
Georgia	Sumter Co	80.3	61.8	60.5	60.5	36,461	0.02
Illinois	Adams Co	76.0	63.4	62.4	62.4	71,525	0.07
Illinois	Champaign Co	77.3	62.7	61.8	61.9	190,915	0.06
Illinois	Clark Co	75.0	60.0	59.1	59.2	17,745	0.09
Illinois	Cook Co	87.7	81.1	81.3	81.0	5,369,914	-0.31
Illinois	Du Page Co	70.7	66.1	66.3	66.1	1,134,209	-0.28
Illinois	Effingham Co	77.7	63.1	62.1	62.1	39,079	0.04
Illinois	Hamilton Co	78.7	62.3	61.3	61.3	9,014	0.01
Illinois	Jersey Co	89.0	72.8	71.7	71.5	24,278	-0.23
Illinois	Kane Co	77.7	70.2	69.6	69.3	525,845	-0.27
Illinois	Lake Co	83.3	75.0	74.2	74.0	819,659	-0.22
Illinois	McHenry Co	83.3	74.6	73.8	73.5	355,735	-0.25
Illinois	McLean Co	77.0	61.3	60.1	60.1	181,440	0.04
Illinois	Macon Co	76.7	60.6	59.8	59.8	112,812	0.02
Illinois	Macoupin Co	79.3	62.6	61.4	61.4	52,570	0.05
Illinois	Madison Co	84.7	70.7	69.4	69.4	276,839	0.02
Illinois	Peoria Co	79.0	62.2	61.4	61.4	193,897	0.02
Illinois	Randolph Co	78.7	63.3	62.4	62.5	36,381	0.03
Illinois	Rock Island Co	71.0	60.6	59.7	59.7	147,587	0.01
Illinois	St Clair Co	83.3	71.1	70.0	70.0	250,436	0.05
Illinois	Sangamon Co	76.0	59.4	58.5	58.5	204,341	0.03
Illinois	Will Co	79.3	68.9	68.7	68.4	679,025	-0.30

Illinois	Winnebago Co	76.0	63.0	61.5	61.3	316,890	-0.23
Indiana	Allen Co	87.7	72.0	70.4	70.4	372,693	0.04
Indiana	Boone Co	89.0	73.0	71.8	71.7	62,319	-0.01
Indiana	Carroll Co	84.0	68.4	67.4	67.4	23,020	0.00
Indiana	Clark Co	89.3	73.5	72.3	72.3	117,910	0.03
Indiana	Delaware Co	88.0	70.4	69.0	69.0	119,281	-0.02
Indiana	Elkhart Co	80.0	65.8	64.5	64.5	209,907	0.02
Indiana	Floyd Co	83.7	70.3	69.3	69.4	85,064	0.05
Indiana	Gibson Co	71.7	57.9	57.4	57.4	33,695	0.01
Indiana	Greene Co	88.5	70.1	69.1	69.2	38,005	0.04
Indiana	Hamilton Co	93.3	76.2	74.5	74.5	278,447	0.02
Indiana	Hancock Co	91.7	75.0	73.6	73.6	76,531	0.00
Indiana	Hendricks Co	86.5	70.9	69.4	69.5	160,948	0.05
Indiana	Huntington Co	85.0	69.3	67.9	67.9	40,823	0.03
Indiana	Jackson Co	85.0	66.6	65.5	65.5	49,252	0.01
Indiana	Johnson Co	86.7	68.8	67.5	67.5	161,471	0.02
Indiana	Lake Co	90.7	80.7	80.6	80.2	492,577	-0.36
Indiana	La Porte Co	90.0	79.4	78.9	78.6	113,133	-0.32
Indiana	Madison Co	91.0	72.9	71.2	71.2	143,024	0.06
Indiana	Marion Co	90.0	74.6	73.0	73.1	901,295	0.03
Indiana	Morgan Co	86.7	70.6	69.6	69.6	87,704	-0.02
Indiana	Perry Co	90.0	70.5	69.7	69.7	19,079	0.01
Indiana	Porter Co	89.0	78.6	78.3	78.0	186,219	-0.31
Indiana	Posey Co	85.7	70.5	69.6	69.7	29,059	0.04
Indiana	St Joseph Co	89.0	74.0	72.8	72.8	283,158	0.02
Indiana	Shelby Co	93.5	76.2	74.6	74.6	49,521	0.02
Indiana	Vanderburgh Co	83.3	68.3	67.4	67.4	179,061	0.04
Indiana	Vigo Co	87.0	70.2	69.3	69.3	105,439	0.05
Indiana	Warrick Co	84.5	69.5	69.0	69.0	66,271	0.04
Iowa	Bremer Co	70.5	58.8	57.7	57.7	24,995	0.01
Iowa	Clinton Co	78.3	67.5	66.3	66.4	49,101	0.05
Iowa	Harrison Co	75.7	64.8	63.7	63.7	16,876	0.03

Iowa	Linn Co	71.0	60.8	60.0	60.0	224,554	0.00
Iowa	Palo Alto Co	66.0	55.1	54.2	54.1	9,154	0.00
Iowa	Polk Co	58.7	47.4	46.3	46.3	457,301	0.03
Iowa	Scott Co	79.0	67.8	66.7	66.7	176,720	0.03
Iowa	Story Co	63.3	51.5	50.3	50.3	84,771	0.02
Iowa	Van Buren Co	74.0	61.6	60.5	60.5	8,052	0.02
Iowa	Warren Co	63.3	51.4	50.5	50.5	53,002	-0.02
Kansas	Linn Co	76.7	68.5	67.7	67.7	10,077	0.02
Kansas	Sedgwick Co	81.0	70.5	69.5	69.9	526,038	0.32
Kansas	Sumner Co	79.0	69.4	68.7	68.7	27,230	0.03
Kansas	Wyandotte Co	80.3	70.7	69.6	69.6	144,221	0.04
Kentucky	Bell Co	83.3	60.1	58.8	58.8	33,324	0.03
Kentucky	Boone Co	85.3	68.0	66.7	66.7	124,843	0.02
Kentucky	Boyd Co	89.5	74.0	72.9	73.0	47,850	0.09
Kentucky	Bullitt Co	83.7	69.3	68.3	68.3	83,269	0.05
Kentucky	Campbell Co	92.5	76.8	75.5	75.5	94,543	0.02
Kentucky	Carter Co	80.3	63.2	62.3	62.3	32,249	0.03
Kentucky	Christian Co	85.0	60.3	59.5	59.5	76,235	0.03
Kentucky	Daviess Co	77.3	62.4	61.6	61.6	101,799	0.05
Kentucky	Edmonson Co	84.0	64.0	62.7	62.8	12,923	0.03
Kentucky	Fayette Co	78.3	62.8	61.5	61.6	325,177	0.03
Kentucky	Graves Co	81.0	65.5	64.5	64.5	39,648	0.02
Kentucky	Greenup Co	84.0	68.5	68.7	68.7	36,856	0.02
Kentucky	Hancock Co	82.7	66.9	66.5	66.5	8,845	0.00
Kentucky	Hardin Co	80.0	63.8	62.7	62.7	107,611	0.02
Kentucky	Henderson Co	79.5	65.7	64.9	64.9	48,211	0.05
Kentucky	Jefferson Co	84.3	71.1	70.2	70.2	717,730	0.03
Kentucky	Jessamine Co	78.0	62.3	61.1	61.1	55,681	0.04
Kentucky	Kenton Co	86.3	71.3	70.1	70.1	170,113	0.01
Kentucky	Livingston Co	85.0	68.2	67.2	67.3	10,632	0.03
Kentucky	McCracken Co	81.7	65.9	65.0	65.0	73,919	0.02
Kentucky	McLean Co	84.0	66.4	65.7	65.8	10,377	0.01

Kentucky	Oldham Co	88.0	71.0	70.0	70.0	68,732	0.01
Kentucky	Perry Co	75.5	56.7	55.7	55.7	32,982	0.02
Kentucky	Pike Co	76.3	56.8	55.8	55.6	77,738	-0.24
Kentucky	Pulaski Co	81.3	62.4	61.1	61.2	69,071	0.04
Kentucky	Scott Co	70.3	54.3	53.4	53.4	47,764	0.00
Kentucky	Simpson Co	84.0	63.0	61.7	61.8	17,843	0.03
Kentucky	Trigg Co	76.7	60.4	59.8	59.8	14,302	0.01
Kentucky	Warren Co	84.0	63.9	62.9	62.9	112,955	0.00
Louisiana	Ascension Parish	81.7	75.2	74.6	74.7	116,308	0.08
Louisiana	Beauregard Parish	75.0	67.5	67.1	67.2	37,481	0.03
Louisiana	Bossier Parish	84.7	74.1	73.3	73.3	123,042	0.03
Louisiana	Caddo Parish	79.7	69.7	69.1	69.1	265,973	0.01
Louisiana	Calcasieu Parish	81.7	73.8	73.5	73.6	214,593	0.05
Louisiana	East Baton Rouge Parish	87.3	79.3	78.7	78.8	516,961	0.08
Louisiana	Grant Parish	77.7	67.3	66.7	66.8	21,626	0.03
Louisiana	Iberville Parish	85.0	78.2	77.6	77.6	33,064	0.05
Louisiana	Jefferson Parish	85.3	77.1	76.4	76.5	531,771	0.04
Louisiana	Lafayette Parish	80.7	71.6	70.9	70.9	231,597	0.05
Louisiana	Lafourche Parish	79.0	72.7	72.1	72.1	98,181	0.05
Louisiana	Livingston Parish	83.3	76.6	76.0	76.1	158,340	0.05
Louisiana	Orleans Parish	72.0	65.4	65.3	65.3	426,316	0.02
Louisiana	Ouachita Parish	78.7	70.2	70.0	70.0	163,669	0.02
Louisiana	Pointe Coupee Parish	73.0	65.4	64.7	64.8	23,240	0.08
Louisiana	St Bernard Parish	79.3	71.3	70.9	70.9	69,530	0.04
Louisiana	St Charles Parish	81.7	75.0	74.7	74.8	56,316	0.01
Louisiana	St James Parish	77.3	71.2	71.0	71.0	22,447	0.02
Louisiana	St John The Baptist Parish	81.7	75.3	75.1	75.1	48,025	0.03
Louisiana	St Mary Parish	78.0	71.8	71.4	71.5	53,994	0.06
Louisiana	West Baton Rouge Parish	85.7	77.4	76.5	76.6	23,836	0.06
Maine	Cumberland Co	84.7	73.0	71.0	71.0	309,052	-0.03
Maine	Hancock Co	92.0	76.8	74.4	74.4	56,913	0.00
Maine	Kennebec Co	77.7	64.9	62.7	62.7	124,170	0.00

Maine	Knox Co	83.3	70.4	68.2	68.2	46,017	0.00
Maine	Oxford Co	61.0	52.7	51.6	51.6	60,323	0.00
Maine	Penobscot Co	83.0	69.5	67.6	67.6	155,834	0.00
Maine	York Co	89.0	77.6	75.7	75.7	217,887	0.00
Maryland	Anne Arundel Co	101.0	84.9	82.3	82.3	603,613	0.00
Maryland	Baltimore Co	93.0	81.0	79.6	79.6	826,595	0.00
Maryland	Calvert Co	89.0	71.2	69.3	69.3	121,391	0.00
Maryland	Carroll Co	91.3	76.3	68.1	68.1	211,357	0.00
Maryland	Cecil Co	102.7	85.4	83.0	83.0	108,489	0.00
Maryland	Charles Co	94.7	75.6	73.4	73.4	174,404	0.01
Maryland	Frederick Co	90.0	74.2	72.2	72.2	275,299	0.00
Maryland	Harford Co	103.7	89.6	87.3	87.3	320,395	-0.03
Maryland	Kent Co	99.0	82.3	79.9	79.9	21,370	0.01
Maryland	Montgomery Co	88.7	76.4	74.1	74.1	1,014,224	-0.03
Maryland	Prince Georges Co	95.0	80.9	78.4	78.4	895,723	-0.02
Maryland	Washington Co	86.0	69.3	67.9	67.9	149,671	0.00
Maryland	Baltimore City	82.0	71.4	70.2	70.2	575,702	0.00
Massachusetts	Barnstable Co	94.7	80.2	77.7	77.6	281,619	-0.03
Massachusetts	Berkshire Co	87.0	73.2	71.1	71.0	130,821	-0.03
Massachusetts	Bristol Co	92.7	80.0	77.6	77.5	583,227	-0.03
Massachusetts	Essex Co	89.7	80.2	78.9	78.9	774,701	-0.03
Massachusetts	Hampden Co	90.3	76.7	74.3	74.3	449,454	0.00
Massachusetts	Hampshire Co	87.3	74.9	72.6	72.6	166,475	-0.03
Massachusetts	Middlesex Co	88.7	75.8	73.7	73.7	1,512,313	0.00
Massachusetts	Suffolk Co	88.0	74.9	72.8	72.8	660,289	0.00
Massachusetts	Worcester Co	85.3	72.9	71.0	71.0	811,989	0.00
Michigan	Allegan Co	92.0	79.5	78.2	78.0	138,052	-0.16
Michigan	Benzie Co	87.7	74.0	72.6	72.6	19,860	0.03
Michigan	Berrien Co	88.3	74.8	73.9	73.9	167,713	0.01
Michigan	Cass Co	90.0	74.4	73.2	73.2	56,429	0.02
Michigan	Clinton Co	83.3	69.0	67.7	67.7	80,032	-0.01
Michigan	Genesee Co	86.7	72.5	71.1	70.9	448,450	-0.26

Michigan	Huron Co	84.0	71.9	70.6	70.6	37,998	0.03
Michigan	Ingham Co	83.3	69.0	67.6	67.5	292,434	-0.03
Michigan	Kalamazoo Co	83.0	67.9	66.9	66.6	263,783	-0.26
Michigan	Kent Co	84.7	70.7	69.3	69.3	681,627	0.02
Michigan	Lenawee Co	85.0	71.2	69.9	70.0	109,629	0.04
Michigan	Macomb Co	91.0	84.2	84.5	84.2	884,628	-0.25
Michigan	Mason Co	89.0	74.7	73.4	73.4	33,441	-0.01
Michigan	Missaukee Co	80.3	67.4	66.3	66.3	17,744	0.03
Michigan	Muskegon Co	92.0	79.2	78.1	77.9	181,441	-0.21
Michigan	Oakland Co	87.0	79.2	78.3	78.1	1,411,792	-0.23
Michigan	Ottawa Co	86.0	74.0	72.6	72.7	317,800	0.09
Michigan	St Clair Co	87.7	78.0	76.9	76.6	193,628	-0.24
Michigan	Washtenaw Co	89.0	78.0	76.8	76.9	369,791	0.03
Michigan	Wayne Co	88.0	84.1	84.3	84.1	1,879,877	-0.23
Minnesota	Anoka Co	72.5	60.8	59.5	59.5	416,960	-0.02
Minnesota	Dakota Co	68.0	59.0	57.7	57.7	567,662	0.04
Minnesota	Mille Lacs Co	72.0	59.9	58.7	58.7	28,691	0.01
Minnesota	Washington Co	74.5	61.8	59.9	60.0	334,587	0.05
Mississippi	Adams Co	79.7	67.2	66.0	66.1	33,275	0.08
Mississippi	Bolivar Co	78.0	63.4	62.7	62.8	37,676	0.05
Mississippi	De Soto Co	84.3	69.7	68.6	68.7	174,319	0.07
Mississippi	Hancock Co	83.7	70.9	70.1	70.1	61,194	0.08
Mississippi	Harrison Co	83.3	69.3	68.3	68.4	226,217	0.06
Mississippi	Hinds Co	76.3	59.1	58.0	58.0	267,168	0.03
Mississippi	Jackson Co	83.0	70.4	69.8	69.9	154,372	0.07
Mississippi	Lauderdale Co	76.0	58.3	57.8	57.8	84,442	0.01
Mississippi	Lee Co	82.0	62.1	60.7	60.8	95,711	0.06
Mississippi	Madison Co	76.3	61.2	60.7	60.7	103,396	0.02
Mississippi	Warren Co	76.7	56.2	55.4	55.4	52,910	0.00
Missouri	Cass Co	79.0	70.5	69.5	69.5	116,011	0.06
Missouri	Cedar Co	82.0	68.6	67.4	67.4	14,974	-0.03
Missouri	Clay Co	84.3	73.1	71.8	71.8	243,794	0.03

Missouri	Greene Co	74.7	59.0	57.6	57.6	288,638	0.01
Missouri	Jefferson Co	87.3	72.1	70.5	70.6	266,558	0.01
Missouri	Monroe Co	79.3	65.2	64.5	64.5	9,331	0.00
Missouri	Platte Co	81.7	72.0	70.9	70.9	104,962	0.05
Missouri	St Charles Co	90.7	76.5	75.3	75.3	405,732	0.03
Missouri	Ste Genevieve Co	84.0	69.8	68.5	68.5	20,954	0.04
Missouri	St Louis Co	89.3	76.7	75.6	75.4	1,031,773	-0.22
Missouri	St Louis City	88.5	75.6	74.3	74.0	298,671	-0.21
Nebraska	Douglas Co	67.5	58.0	57.3	57.1	545,559	-0.23
Nebraska	Lancaster Co	54.0	47.0	46.1	46.2	318,957	0.02
New Hampshire	Belknap Co	78.0	65.0	62.9	62.9	65,252	0.02
New Hampshire	Carroll Co	66.5	58.0	56.6	56.6	56,418	0.01
New Hampshire	Cheshire Co	73.7	62.0	60.4	60.4	81,662	-0.02
New Hampshire	Hillsborough Co	85.0	73.9	72.1	71.9	447,344	-0.25
New Hampshire	Merrimack Co	73.0	61.8	59.7	59.7	159,225	0.01
New Hampshire	Rockingham Co	82.7	72.9	71.4	71.1	353,429	-0.27
New Hampshire	Strafford Co	77.3	66.5	64.7	64.4	128,542	-0.27
New Jersey	Atlantic Co	91.0	77.7	75.7	75.7	286,405	0.00
New Jersey	Bergen Co	92.5	84.5	80.8	80.8	911,737	-0.03
New Jersey	Camden Co	102.3	88.3	87.4	87.3	512,662	-0.04
New Jersey	Cumberland Co	96.7	80.9	78.9	78.9	153,502	0.00
New Jersey	Essex Co	68.0	63.0	61.9	61.9	740,227	-0.03
New Jersey	Gloucester Co	101.3	88.2	83.7	83.7	304,923	-0.03
New Jersey	Hudson Co	89.0	82.4	83.6	83.6	603,949	-0.03
New Jersey	Hunterdon Co	97.7	85.4	83.5	83.5	160,454	0.00
New Jersey	Mercer Co	103.0	92.4	91.1	91.1	369,956	-0.04
New Jersey	Middlesex Co	100.7	88.8	86.8	86.8	858,721	0.00
New Jersey	Monmouth Co	96.0	83.2	80.7	80.7	731,191	-0.03
New Jersey	Morris Co	97.7	81.8	79.8	79.8	535,685	0.00
New Jersey	Ocean Co	111.0	96.9	94.7	94.7	642,051	0.00
New Jersey	Passaic Co	88.3	77.4	76.2	76.2	504,685	0.00
New York	Albany Co	83.0	70.7	68.8	68.8	307,198	0.01

New York	Bronx Co	82.7	79.5	79.8	79.8	1,269,835	0.01
New York	Chautauqua Co	91.7	78.6	77.5	77.4	140,795	-0.03
New York	Chemung Co	81.0	66.9	64.8	64.8	89,286	0.00
New York	Dutchess Co	91.3	78.1	76.3	76.3	304,668	-0.03
New York	Erie Co	96.0	84.2	82.9	82.8	951,156	-0.03
New York	Essex Co	88.5	75.6	73.9	73.9	40,688	0.00
New York	Hamilton Co	79.0	68.2	66.5	66.6	5,749	0.01
New York	Herkimer Co	74.0	63.5	61.9	61.9	64,887	0.01
New York	Jefferson Co	91.7	78.0	76.5	76.5	115,332	0.00
New York	Madison Co	80.0	69.4	67.6	67.6	76,137	0.00
New York	Monroe Co	86.5	74.3	72.5	72.5	759,752	0.00
New York	Niagara Co	91.0	80.3	79.1	79.1	219,840	0.00
New York	Oneida Co	79.0	66.3	64.7	64.7	227,339	0.00
New York	Onondaga Co	83.0	69.0	66.9	66.9	461,939	-0.03
New York	Orange Co	86.0	74.6	72.8	72.8	405,639	-0.03
New York	Putnam Co	91.3	79.3	77.7	77.7	122,586	-0.03
New York	Queens Co	86.0	76.0	74.5	74.4	2,237,890	-0.04
New York	Richmond Co	96.0	83.9	81.5	81.5	538,856	-0.03
New York	Saratoga Co	85.5	71.8	70.0	70.0	250,621	0.00
New York	Schenectady Co	77.3	66.4	64.7	64.7	144,830	-0.03
New York	Suffolk Co	98.5	89.0	88.2	88.1	1,531,991	-0.04
New York	Ulster Co	81.7	70.0	68.5	68.5	191,921	0.00
New York	Wayne Co	84.0	71.6	69.8	69.8	107,277	0.00
New York	Westchester Co	92.0	83.1	82.8	82.8	963,790	-0.03
North Carolina	Alexander Co	88.7	66.8	64.8	65.1	39,141	0.28
North Carolina	Avery Co	77.3	57.4	55.6	55.7	19,660	0.05
North Carolina	Buncombe Co	82.0	61.1	59.2	59.2	254,104	0.05
North Carolina	Caldwell Co	85.7	64.4	62.5	62.5	91,336	0.02
North Carolina	Camden Co	80.0	70.5	69.2	69.0	7,947	-0.25
North Carolina	Caswell Co	89.7	67.4	65.8	65.9	25,684	0.05
North Carolina	Chatham Co	82.0	62.2	60.3	60.3	61,507	0.05
North Carolina	Cumberland Co	87.0	66.3	64.2	64.3	339,753	0.03

North Carolina	Davie Co	94.7	69.9	68.2	68.2	40,507	0.02
North Carolina	Duplin Co	80.7	62.2	60.7	60.7	53,258	0.00
North Carolina	Durham Co	89.0	67.2	65.2	65.2	281,001	0.06
North Carolina	Edgecombe Co	88.0	70.1	68.6	68.6	57,310	0.03
North Carolina	Forsyth Co	93.7	69.5	67.7	67.7	365,216	0.04
North Carolina	Franklin Co	89.0	68.1	66.1	66.1	59,412	0.02
North Carolina	Granville Co	92.0	69.6	67.7	67.7	56,117	0.03
North Carolina	Guilford Co	90.7	67.9	77.9	77.7	496,393	-0.21
North Carolina	Haywood Co	86.3	63.9	62.3	62.4	63,637	0.05
North Carolina	Jackson Co	85.0	62.6	61.2	61.2	44,534	0.05
North Carolina	Johnston Co	85.7	65.4	63.4	63.4	161,038	0.01
North Carolina	Lenoir Co	81.3	62.6	61.2	61.3	63,751	0.01
North Carolina	Lincoln Co	92.3	68.5	66.3	66.4	80,757	0.02
North Carolina	Martin Co	80.3	65.6	77.3	77.1	26,134	-0.24
North Carolina	Mecklenburg Co	100.3	75.0	72.7	72.8	937,478	0.07
North Carolina	New Hanover Co	77.3	63.2	62.1	62.1	234,495	0.02
North Carolina	Northampton Co	83.3	66.9	65.3	65.3	24,837	0.05
North Carolina	Person Co	90.0	67.2	65.7	65.7	42,067	0.02
North Carolina	Pitt Co	83.0	65.1	63.3	63.4	185,086	0.05
North Carolina	Randolph Co	85.0	63.1	64.2	64.3	162,119	0.08
North Carolina	Rockingham Co	88.7	66.0	67.1	67.1	99,055	0.00
North Carolina	Rowan Co	99.7	74.1	72.1	72.1	156,561	0.04
North Carolina	Swain Co	73.7	53.3	52.3	52.3	15,966	0.00
North Carolina	Union Co	87.7	65.2	63.1	63.1	163,040	0.03
North Carolina	Wake Co	92.7	70.8	68.6	68.6	947,706	0.02
North Carolina	Yancey Co	86.3	64.6	62.7	62.8	21,660	0.03
Ohio	Allen Co	87.7	72.6	71.5	71.6	105,640	0.02
Ohio	Ashtabula Co	94.0	80.0	49.9	49.9	107,401	0.02
Ohio	Butler Co	89.0	73.6	72.1	72.2	438,844	0.02
Ohio	Clark Co	88.3	69.9	68.1	68.2	143,288	0.03
Ohio	Clermont Co	90.0	72.5	71.0	71.0	236,350	0.02
Ohio	Clinton Co	95.7	75.7	74.1	74.2	54,121	0.04

Ohio	Cuyahoga Co	86.3	74.0	73.0	72.8	1,305,880	-0.24
Ohio	Delaware Co	90.3	72.1	70.5	70.5	162,991	0.00
Ohio	Franklin Co	95.0	77.0	75.1	75.2	1,220,750	0.03
Ohio	Geauga Co	98.3	82.5	80.7	80.8	113,978	0.05
Ohio	Greene Co	87.0	69.3	68.1	68.1	162,603	0.02
Ohio	Hamilton Co	89.3	74.3	72.8	72.9	841,466	0.04
Ohio	Jefferson Co	85.3	71.2	69.1	69.1	67,142	0.08
Ohio	Knox Co	89.3	71.4	69.8	69.6	64,724	-0.23
Ohio	Lake Co	92.7	78.9	77.5	77.6	248,161	0.03
Ohio	Lawrence Co	85.0	69.3	67.9	67.9	64,104	0.02
Ohio	Licking Co	89.0	70.2	68.7	68.7	177,293	0.04
Ohio	Lorain Co	87.5	75.5	74.3	74.4	301,429	0.04
Ohio	Lucas Co	88.7	76.8	75.5	75.6	439,311	0.06
Ohio	Madison Co	89.0	71.2	69.7	69.8	48,938	0.04
Ohio	Mahoning Co	88.0	70.5	72.8	72.8	245,464	0.05
Ohio	Medina Co	87.7	72.0	70.3	70.4	200,152	0.03
Ohio	Miami Co	86.3	68.3	66.6	66.7	105,363	0.07
Ohio	Montgomery Co	86.7	69.6	68.2	68.2	547,314	0.01
Ohio	Portage Co	92.0	74.9	73.4	73.3	174,572	-0.02
Ohio	Preble Co	80.3	63.3	62.0	62.1	46,037	0.05
Ohio	Stark Co	89.0	71.7	70.1	70.1	386,952	0.03
Ohio	Summit Co	94.3	77.4	75.5	75.5	564,374	0.04
Ohio	Trumbull Co	92.5	74.7	78.5	78.3	228,159	-0.21
Ohio	Warren Co	92.0	75.1	73.7	73.7	214,368	0.03
Ohio	Washington Co	87.0	65.1	64.3	64.3	63,799	0.02
Ohio	Wood Co	87.0	73.8	72.7	72.5	138,096	-0.21
Oklahoma	Cherokee Co	76.0	68.4	67.7	67.7	54,792	0.02
Oklahoma	Cleveland Co	77.3	65.2	64.1	64.1	260,375	-0.01
Oklahoma	Kay Co	75.0	66.3	65.5	65.5	49,620	0.05
Oklahoma	Mc Clain Co	78.5	66.6	65.2	65.3	34,761	0.03
Oklahoma	Oklahoma Co	80.7	68.1	66.7	66.8	721,520	0.02
Oklahoma	Ottawa Co	79.0	71.7	71.2	71.2	33,536	0.03

Oklahoma	Tulsa Co	85.0	76.4	75.6	75.6	654,835	0.01
Pennsylvania	Allegheny Co	93.0	78.9	56.3	56.3	1,234,866	0.00
Pennsylvania	Armstrong Co	92.0	76.1	74.8	74.8	73,516	0.01
Pennsylvania	Beaver Co	91.0	76.8	69.0	69.0	186,166	0.00
Pennsylvania	Berks Co	92.7	76.9	74.7	74.8	405,118	0.00
Pennsylvania	Blair Co	84.3	67.7	66.5	66.5	129,726	0.00
Pennsylvania	Bucks Co	103.0	91.8	90.7	90.7	704,253	-0.03
Pennsylvania	Cambria Co	87.7	72.9	71.6	71.6	141,248	0.01
Pennsylvania	Centre Co	85.5	70.7	69.2	69.2	161,236	0.01
Pennsylvania	Chester Co	96.5	82.2	80.6	80.6	528,280	-0.03
Pennsylvania	Clearfield Co	86.7	70.5	69.0	69.0	87,215	-0.03
Pennsylvania	Dauphin Co	91.0	76.0	74.0	74.0	279,565	0.01
Pennsylvania	Delaware Co	93.7	81.0	79.4	79.3	537,547	-0.03
Pennsylvania	Erie Co	89.0	76.0	74.5	74.6	289,834	0.00
Pennsylvania	Franklin Co	93.0	75.5	73.5	73.5	142,965	0.00
Pennsylvania	Greene Co	90.3	68.9	68.1	68.1	44,723	-0.03
Pennsylvania	Lackawanna Co	85.3	70.0	67.9	67.9	204,667	0.00
Pennsylvania	Lancaster Co	94.0	78.4	76.2	76.2	557,896	0.00
Pennsylvania	Lawrence Co	78.7	63.9	62.6	62.6	96,156	0.00
Pennsylvania	Lehigh Co	93.3	78.3	76.3	76.3	334,116	0.00
Pennsylvania	Luzerne Co	84.7	67.9	65.7	65.7	305,105	-0.03
Pennsylvania	Lycoming Co	83.0	67.4	65.6	65.6	123,856	0.00
Pennsylvania	Mercer Co	91.3	73.2	71.4	71.4	124,877	0.01
Pennsylvania	Montgomery Co	96.3	84.9	75.9	75.8	791,523	-0.03
Pennsylvania	Northampton Co	93.0	78.1	86.9	86.9	293,668	0.00
Pennsylvania	Perry Co	84.7	69.8	64.4	64.4	57,009	0.00
Pennsylvania	Philadelphia Co	97.5	87.5	86.8	86.8	1,322,901	0.00
Pennsylvania	Tioga Co	83.7	68.5	66.0	66.0	45,790	0.01
Pennsylvania	Washington Co	87.7	74.8	73.9	73.8	208,159	-0.03
Pennsylvania	Westmoreland Co	87.7	73.9	72.9	72.9	377,031	0.00
Pennsylvania	York Co	90.3	74.8	73.0	73.0	430,126	0.00
Rhode Island	Kent Co	95.3	83.2	81.2	81.2	182,031	0.00

Rhode Island	Providence Co	90.3	78.1	76.0	76.0	622,459	0.00
Rhode Island	Washington Co	93.3	81.3	78.9	78.8	155,633	-0.03
South Carolina	Abbeville Co	84.0	63.6	61.7	61.8	28,719	0.05
South Carolina	Aiken Co	84.7	67.7	67.1	67.1	169,960	0.02
South Carolina	Anderson Co	88.0	65.8	63.6	63.7	198,579	0.03
South Carolina	Barnwell Co	81.3	63.2	61.8	61.8	24,890	0.06
South Carolina	Berkeley Co	71.0	55.1	53.9	53.9	181,075	0.05
South Carolina	Charleston Co	74.0	57.4	61.1	61.2	412,802	0.06
South Carolina	Cherokee Co	86.0	62.8	61.2	61.2	59,474	0.01
South Carolina	Chester Co	84.3	64.3	62.7	62.7	39,387	0.02
South Carolina	Colleton Co	78.7	61.8	60.5	60.6	46,823	0.05
South Carolina	Darlington Co	84.7	65.8	66.0	66.0	75,093	0.04
South Carolina	Edgefield Co	80.7	61.9	60.5	60.6	26,439	0.02
South Carolina	Oconee Co	84.0	61.1	59.2	59.2	76,009	0.00
South Carolina	Pickens Co	85.3	63.7	61.7	61.8	154,902	0.05
South Carolina	Richland Co	93.0	70.7	68.5	68.5	378,345	0.02
South Carolina	Spartanburg Co	90.0	66.3	63.9	64.0	296,741	0.07
South Carolina	Union Co	80.7	60.1	58.2	58.3	31,211	0.04
South Carolina	Williamsburg Co	72.3	55.5	54.3	54.3	38,187	0.04
South Carolina	York Co	83.3	63.2	61.4	61.5	214,589	0.04
Tennessee	Anderson Co	89.7	62.8	61.0	61.0	80,828	0.04
Tennessee	Blount Co	94.0	68.5	66.6	66.7	137,355	0.06
Tennessee	Davidson Co	81.3	64.9	63.6	63.6	610,103	0.04
Tennessee	Hamilton Co	90.7	67.6	66.2	66.2	346,604	0.01
Tennessee	Haywood Co	89.0	71.4	70.1	70.1	20,677	0.01
Tennessee	Jefferson Co	94.0	69.6	67.9	68.0	58,984	0.05
Tennessee	Knox Co	94.7	68.1	66.7	66.7	471,905	0.04
Tennessee	Lawrence Co	79.3	59.6	58.1	58.2	48,297	0.07
Tennessee	Meigs Co	90.5	66.2	65.2	65.3	16,125	0.01
Tennessee	Putnam Co	85.0	64.4	63.0	63.0	76,951	0.02
Tennessee	Rutherford Co	83.3	63.7	61.8	61.9	276,027	0.05
Tennessee	Sevier Co	96.0	70.2	68.7	68.7	121,221	0.02

Tennessee	Shelby Co	90.7	73.6	72.2	72.2	1,019,066	0.06
Tennessee	Sullivan Co	89.3	69.9	68.9	69.0	167,368	0.05
Tennessee	Sumner Co	89.0	71.3	69.9	69.9	180,862	0.08
Tennessee	Williamson Co	86.3	65.4	63.9	63.9	206,016	0.07
Tennessee	Wilson Co	84.7	67.6	66.2	66.3	128,651	0.05
Texas	Bexar Co	85.7	66.7	65.8	65.8	1,811,674	0.00
Texas	Brazoria Co	91.0	82.7	82.6	82.6	321,123	0.00
Texas	Collin Co	93.3	77.6	75.8	75.8	876,851	0.01
Texas	Dallas Co	91.0	77.9	76.4	76.4	2,541,480	0.00
Texas	Denton Co	99.0	81.3	79.2	79.2	678,368	0.01
Texas	Ellis Co	85.3	70.4	69.3	69.3	149,313	0.00
Texas	Galveston Co	92.0	83.2	82.7	82.7	315,425	0.00
Texas	Gregg Co	88.3	76.3	75.6	75.6	130,936	0.00
Texas	Harris Co	105.0	96.4	96.6	96.6	4,142,898	-0.01
Texas	Harrison Co	76.0	65.2	64.6	64.6	68,328	0.00
Texas	Hood Co	84.0	68.7	67.5	67.5	64,889	0.00
Texas	Jefferson Co	91.0	84.1	83.9	83.9	265,060	0.00
Texas	Johnson Co	89.5	73.9	72.9	72.9	189,419	0.00
Texas	Kaufman Co	71.5	60.2	59.1	59.1	97,962	0.00
Texas	Montgomery Co	91.0	77.9	76.7	76.7	533,560	0.00
Texas	Orange Co	78.3	70.8	70.5	70.5	92,568	0.00
Texas	Parker Co	87.5	71.6	70.2	70.2	134,537	0.01
Texas	Rockwall Co	82.0	69.7	68.3	68.3	80,884	-0.03
Texas	Smith Co	82.5	70.0	69.3	69.3	210,351	0.00
Texas	Tarrant Co	98.3	82.2	80.5	80.5	1,968,880	0.00
Texas	Travis Co	84.3	69.4	68.5	68.5	1,095,409	0.00
Vermont	Bennington Co	79.7	67.2	65.6	65.6	40,259	0.01
Virginia	Arlington Co	95.7	83.8	82.3	82.3	198,100	-0.03
Virginia	Caroline Co	84.0	68.8	66.9	66.9	27,308	0.00
Virginia	Charles City Co	89.3	74.9	73.8	73.8	7,998	0.00
Virginia	Chesterfield Co	86.0	71.8	70.3	70.3	376,855	0.00
Virginia	Fairfax Co	96.3	83.0	81.3	81.3	1,210,471	-0.03

Virginia	Fauquier Co	81.0	66.8	65.1	65.1	77,054	0.01
Virginia	Frederick Co	84.3	67.1	65.4	65.4	72,596	0.01
Virginia	Hanover Co	94.0	77.9	76.2	76.2	108,636	0.00
Virginia	Henrico Co	90.0	75.5	73.6	73.6	324,561	0.00
Virginia	Loudoun Co	89.3	75.4	73.5	73.5	258,230	0.00
Virginia	Madison Co	86.3	65.0	63.3	63.3	14,975	0.00
Virginia	Page Co	81.3	60.5	58.9	58.9	25,922	0.00
Virginia	Prince William Co	85.7	72.0	70.3	70.2	408,665	-0.03
Virginia	Roanoke Co	86.0	68.8	62.9	62.9	102,632	0.01
Virginia	Rockbridge Co	79.0	63.2	61.7	61.7	22,630	0.00
Virginia	Stafford Co	86.3	70.5	68.6	68.6	137,858	0.00
Virginia	Wythe Co	80.7	60.6	59.2	59.2	30,342	0.00
Virginia	Alexandria City	90.0	78.8	81.0	80.9	131,423	-0.03
Virginia	Hampton City	88.7	76.6	75.3	75.3	158,675	0.00
Virginia	Suffolk City	87.3	75.4	74.1	74.1	73,780	0.00
West Virginia	Berkeley Co	86.0	69.6	67.8	67.9	107,293	0.09
West Virginia	Cabell Co	88.0	73.2	72.1	72.1	91,004	0.06
West Virginia	Greenbrier Co	81.7	60.8	60.0	60.0	37,267	0.02
West Virginia	Hancock Co	84.3	70.3	75.8	75.9	30,462	0.09
West Virginia	Kanawha Co	87.0	68.0	67.2	67.3	196,337	0.06
West Virginia	Monongalia Co	80.0	63.6	64.4	64.5	88,267	0.05
West Virginia	Ohio Co	84.7	66.5	65.6	65.6	45,941	0.03
West Virginia	Wood Co	87.7	65.0	64.0	63.8	87,965	-0.25
Wisconsin	Brown Co	81.7	69.0	67.7	67.8	270,395	0.05
Wisconsin	Columbia Co	77.7	63.7	62.3	62.3	63,885	0.04
Wisconsin	Dane Co	77.3	63.6	62.0	61.8	541,398	-0.24
Wisconsin	Dodge Co	81.0	67.7	66.4	66.4	101,632	0.02
Wisconsin	Door Co	92.7	77.9	76.9	76.9	33,971	0.00
Wisconsin	Fond Du Lac Co	79.0	65.9	64.9	64.9	106,620	0.02
Wisconsin	Green Co	74.5	61.6	60.2	60.3	39,374	0.04
Wisconsin	Jefferson Co	84.5	69.5	68.1	68.2	80,430	0.03
Wisconsin	Kenosha Co	98.7	88.8	87.9	87.7	182,420	-0.25

Wisconsin	Kewaunee Co	90.0	75.7	74.6	74.6	20,886	0.00
Wisconsin	Manitowoc Co	90.0	75.9	74.6	74.7	83,779	0.03
Wisconsin	Marathon Co	73.7	60.8	59.8	59.9	148,715	0.04
Wisconsin	Milwaukee Co	90.7	79.0	77.9	77.7	899,138	-0.25
Wisconsin	Outagamie Co	77.3	64.9	64.1	64.1	201,422	-0.01
Wisconsin	Ozaukee Co	95.3	82.0	80.5	80.6	109,255	0.02
Wisconsin	Racine Co	91.7	81.6	80.7	80.4	209,777	-0.24
Wisconsin	Rock Co	84.3	69.1	67.4	67.5	177,297	0.01
Wisconsin	St Croix Co	72.7	58.9	57.5	57.6	79,183	0.01
Wisconsin	Sauk Co	74.3	59.9	58.6	58.7	74,181	0.07
Wisconsin	Sheboygan Co	98.0	83.6	82.1	82.2	125,032	0.03
Wisconsin	Vernon Co	71.7	59.6	58.5	58.2	29,911	-0.26
Wisconsin	Walworth Co	83.3	70.1	68.7	68.7	115,672	0.00
Wisconsin	Washington Co	82.7	71.8	70.6	70.7	148,756	0.01
Wisconsin	Waukesha Co	82.7	71.3	70.4	70.1	469,302	-0.28
Wisconsin	Winnebago Co	80.0	66.3	65.0	65.0	182,969	0.02
Average over 525 counties		**84.8**	**69.8**	**68.4**	**68.4**	**154,603,475**	**-0.0017**

Appendix B: 2030 MSAT Metamodeling Results

State Name	County Name	2001-2003 Baseline	2015 CAIR	2030 Base	2030 Control	2030 Population	Effect of MSAT controls (ppb)
Alabama	Baldwin Co	79.0	67.4	65.2	65.3	257,851	0.08
Alabama	Clay Co	82.0	59.2	56.9	57.0	16,137	0.06
Alabama	Elmore Co	78.3	59.4	56.5	56.6	98,992	0.08
Alabama	Jefferson Co	86.7	65.5	62.1	62.3	700,808	0.11
Alabama	Lawrence Co	78.7	62.3	60.0	60.1	40,643	0.08
Alabama	Madison Co	82.7	62.7	59.3	59.4	377,947	0.09
Alabama	Mobile Co	79.0	68.0	66.0	66.1	463,170	0.08
Alabama	Montgomery Co	80.0	60.8	58.3	58.3	280,833	0.04
Alabama	Morgan Co	83.0	66.7	64.3	64.5	144,575	0.13
Alabama	Shelby Co	91.7	68.2	64.6	64.6	316,490	0.09
Alabama	Sumter Co	74.0	58.2	56.9	56.9	13,959	0.05
Alabama	Tuscaloosa Co	78.0	58.3	56.0	56.1	211,108	0.06
Arkansas	Crittenden Co	92.7	78.0	74.8	75.0	57,412	0.13
Arkansas	Montgomery Co	68.0	55.9	53.6	53.7	11,331	0.08
Arkansas	Pulaski Co	84.7	68.4	65.7	65.8	402,406	0.03
Connecticut	Fairfield Co	98.7	90.6	88.8	88.7	1,014,302	-0.02
Connecticut	Hartford Co	89.3	76.8	72.3	72.3	997,230	-0.02
Connecticut	Litchfield Co	83.0	70.8	66.9	66.9	207,802	-0.03
Connecticut	Middlesex Co	98.0	88.4	84.8	84.7	185,717	-0.02
Connecticut	New Haven Co	99.0	89.1	85.7	85.7	949,856	-0.02
Connecticut	New London Co	90.7	81.1	77.3	77.3	294,226	0.00
Connecticut	Tolland Co	93.0	79.1	74.4	74.4	159,148	0.00
D.C.	Washington Co	94.3	82.7	71.9	71.9	561,812	-0.02
Delaware	Kent Co	91.3	75.5	71.2	71.2	165,331	0.00
Delaware	New Castle Co	95.3	81.5	78.1	78.0	626,208	-0.02
Delaware	Sussex Co	93.3	77.3	73.1	73.1	221,682	0.00
Florida	Alachua Co	75.3	55.1	51.6	51.7	283,541	0.12
Florida	Baker Co	72.7	53.8	50.6	50.6	31,771	0.03
Florida	Bay Co	80.0	68.7	66.3	66.4	223,423	0.14

Florida	Brevard Co	75.0	53.9	50.3	50.4	647,282	0.04
Florida	Columbia Co	71.0	52.8	49.6	49.7	80,706	0.08
Florida	Duval Co	70.3	50.6	47.3	47.4	1,050,884	0.07
Florida	Escambia Co	83.7	70.2	68.0	68.1	363,972	0.06
Florida	Highlands Co	64.0	46.3	43.2	43.3	129,444	0.08
Florida	Hillsborough Co	80.3	63.4	60.1	59.9	1,527,540	-0.20
Florida	Holmes Co	72.3	58.3	55.7	55.8	24,117	0.07
Florida	Lake Co	76.0	54.8	51.1	51.2	317,754	0.04
Florida	Lee Co	70.7	51.8	48.1	48.1	716,789	0.03
Florida	Leon Co	73.3	57.5	54.7	54.7	359,757	0.09
Florida	Manatee Co	79.0	60.9	57.2	57.3	440,199	0.07
Florida	Marion Co	75.7	55.1	52.0	52.0	379,637	0.02
Florida	Orange Co	78.3	56.8	52.9	52.9	1,664,879	0.03
Florida	Osceola Co	73.7	53.2	49.4	49.5	369,515	0.08
Florida	Palm Beach Co	69.7	51.3	47.6	47.7	2,144,969	0.07
Florida	Pasco Co	77.7	59.9	56.2	56.3	504,121	0.06
Florida	Pinellas Co	77.3	62.3	58.7	58.8	1,120,046	0.09
Florida	Polk Co	78.0	55.7	51.7	51.8	668,686	0.08
Florida	Santa Rosa Co	82.0	69.0	66.8	66.9	247,180	0.08
Florida	Sarasota Co	81.7	61.1	56.5	56.4	434,701	-0.08
Florida	Seminole Co	77.7	56.0	52.1	52.2	687,272	0.05
Florida	St Lucie Co	69.3	51.2	69.4	69.1	287,570	-0.21
Florida	Volusia Co	72.0	51.4	48.0	48.1	627,171	0.05
Florida	Wakulla Co	76.0	62.3	59.9	59.9	40,100	0.03
Georgia	Bibb Co	92.0	77.6	75.0	75.3	170,309	0.22
Georgia	Chatham Co	71.0	56.6	53.6	53.6	260,803	0.04
Georgia	Cherokee Co	77.0	56.0	51.4	51.5	275,334	0.11
Georgia	Cobb Co	94.7	71.2	65.1	65.1	1,212,431	0.00
Georgia	Coweta Co	92.0	69.7	65.8	65.8	145,411	0.02
Georgia	Dawson Co	82.0	59.2	54.4	54.5	37,590	0.03
Georgia	De Kalb Co	95.3	74.5	68.8	68.8	861,751	0.02
Georgia	Douglas Co	94.7	71.2	65.6	65.6	167,327	0.02

Georgia	Fayette Co	90.7	70.1	64.6	64.6	168,741	0.04
Georgia	Fulton Co	99.0	77.6	71.7	71.8	1,006,105	0.02
Georgia	Glynn Co	72.7	56.6	53.7	53.8	86,555	0.04
Georgia	Gwinnett Co	89.3	66.6	60.6	60.6	1,318,759	0.03
Georgia	Henry Co	98.0	74.3	69.9	70.1	218,805	0.16
Georgia	Murray Co	86.0	63.1	58.7	59.1	55,678	0.33
Georgia	Muscogee Co	82.0	62.2	58.8	58.9	216,384	0.08
Georgia	Paulding Co	90.3	64.3	60.2	60.3	149,870	0.05
Georgia	Richmond Co	85.7	68.4	65.4	65.6	229,855	0.19
Georgia	Rockdale Co	96.3	72.8	67.3	67.1	127,341	-0.21
Georgia	Sumter Co	80.3	61.8	59.0	59.0	37,151	0.04
Illinois	Adams Co	76.0	63.4	61.1	61.2	73,663	0.13
Illinois	Champaign Co	77.3	62.7	60.5	60.6	200,561	0.11
Illinois	Clark Co	75.0	60.0	57.8	58.0	18,079	0.17
Illinois	Cook Co	87.7	81.1	81.8	81.4	5,935,525	-0.35
Illinois	Du Page Co	70.7	66.1	66.2	66.0	1,308,511	-0.30
Illinois	Effingham Co	77.7	63.1	60.8	60.8	41,841	0.07
Illinois	Hamilton Co	78.7	62.3	60.0	60.1	9,066	0.02
Illinois	Jersey Co	89.0	72.8	70.1	69.9	25,594	-0.19
Illinois	Kane Co	77.7	70.2	68.7	68.4	575,717	-0.27
Illinois	Lake Co	83.3	75.0	73.0	72.8	980,211	-0.16
Illinois	Macon Co	76.7	60.6	58.6	58.6	114,302	0.03
Illinois	Macoupin Co	79.3	62.6	59.8	59.9	54,572	0.09
Illinois	Madison Co	84.7	70.7	67.9	67.9	289,084	0.04
Illinois	McHenry Co	83.3	74.6	72.6	72.3	398,774	-0.23
Illinois	McLean Co	77.0	61.3	58.7	58.7	198,311	0.09
Illinois	Peoria Co	79.0	62.2	60.1	60.2	201,305	0.03
Illinois	Randolph Co	78.7	63.3	61.1	61.2	37,773	0.06
Illinois	Rock Island Co	71.0	60.6	58.4	58.4	149,831	0.02
Illinois	Sangamon Co	76.0	59.4	57.2	57.3	212,810	0.06
Illinois	St Clair Co	83.3	71.1	68.5	68.6	251,393	0.09
Illinois	Will Co	79.3	68.9	68.1	67.8	764,812	-0.31

Illinois	Winnebago Co	76.0	63.0	59.9	59.7	348,659	-0.20
Indiana	Allen Co	87.7	72.0	68.6	68.7	401,733	0.08
Indiana	Boone Co	89.0	73.0	70.3	70.3	70,813	-0.01
Indiana	Carroll Co	84.0	68.4	66.0	66.0	25,001	0.01
Indiana	Clark Co	89.3	73.5	71.0	71.1	130,432	0.05
Indiana	Delaware Co	88.0	70.4	67.5	67.4	120,023	-0.05
Indiana	Elkhart Co	80.0	65.8	63.0	63.0	232,741	0.03
Indiana	Floyd Co	83.7	70.3	68.2	68.3	93,369	0.09
Indiana	Gibson Co	71.7	57.9	56.5	56.5	34,549	0.04
Indiana	Greene Co	88.5	70.1	67.9	67.9	40,553	0.07
Indiana	Hamilton Co	93.3	76.2	72.8	72.8	329,451	0.03
Indiana	Hancock Co	91.7	75.0	72.0	72.0	86,077	0.00
Indiana	Hendricks Co	86.5	70.9	68.0	68.1	191,532	0.09
Indiana	Huntington Co	85.0	69.3	66.2	66.3	42,370	0.06
Indiana	Jackson Co	85.0	66.6	64.1	64.2	54,295	0.02
Indiana	Johnson Co	86.7	68.8	66.1	66.1	184,261	0.05
Indiana	La Porte Co	90.0	79.4	78.3	77.9	116,540	-0.36
Indiana	Lake Co	90.7	80.7	80.8	80.4	519,423	-0.45
Indiana	Madison Co	91.0	72.9	69.3	69.4	148,117	0.13
Indiana	Marion Co	90.0	74.6	71.5	71.6	983,012	0.05
Indiana	Morgan Co	86.7	70.6	68.4	68.4	98,104	-0.04
Indiana	Perry Co	90.0	70.5	68.5	68.5	19,203	0.02
Indiana	Porter Co	89.0	78.6	78.0	77.6	205,015	-0.34
Indiana	Posey Co	85.7	70.5	68.5	68.6	29,922	0.07
Indiana	Shelby Co	93.5	76.2	73.1	73.1	53,433	0.03
Indiana	St Joseph Co	89.0	74.0	71.2	71.3	303,062	0.04
Indiana	Vanderburgh Co	83.3	68.3	66.2	66.2	185,524	0.07
Indiana	Vigo Co	87.0	70.2	67.8	67.9	106,896	0.11
Indiana	Warrick Co	84.5	69.5	67.9	68.0	71,745	0.08
Iowa	Bremer Co	70.5	58.8	56.5	56.5	25,436	0.02
Iowa	Clinton Co	78.3	67.5	65.0	65.1	48,998	0.09
Iowa	Harrison Co	75.7	64.8	62.6	62.6	17,580	0.05

Iowa	Linn Co	71.0	60.8	59.1	59.1	244,431	0.01
Iowa	Palo Alto Co	66.0	55.1	53.1	53.0	8,704	-0.01
Iowa	Polk Co	58.7	47.4	45.1	45.1	511,985	0.06
Iowa	Scott Co	79.0	67.8	65.3	65.4	187,601	0.05
Iowa	Story Co	63.3	51.5	49.1	49.1	87,916	0.03
Iowa	Van Buren Co	74.0	61.6	59.2	59.2	8,214	0.04
Iowa	Warren Co	63.3	51.4	49.4	49.4	58,398	-0.04
Kansas	Linn Co	76.7	68.5	66.6	66.6	10,386	0.05
Kansas	Sedgwick Co	81.0	70.5	68.2	68.6	576,530	0.36
Kansas	Sumner Co	79.0	69.4	67.4	67.5	28,389	0.06
Kansas	Wyandotte Co	80.3	70.7	68.1	68.2	164,435	0.09
Kentucky	Bell Co	83.3	60.1	57.2	57.3	34,873	0.07
Kentucky	Boone Co	85.3	68.0	65.4	65.4	145,804	0.03
Kentucky	Boyd Co	89.5	74.0	71.5	71.6	47,545	0.17
Kentucky	Bullitt Co	83.7	69.3	67.1	67.2	92,764	0.09
Kentucky	Campbell Co	92.5	76.8	73.9	74.0	100,544	0.03
Kentucky	Carter Co	80.3	63.2	61.0	61.0	34,486	0.06
Kentucky	Christian Co	85.0	60.3	58.4	58.4	83,066	0.05
Kentucky	Daviess Co	77.3	62.4	60.5	60.6	108,874	0.11
Kentucky	Edmonson Co	84.0	64.0	61.4	61.5	13,367	0.06
Kentucky	Fayette Co	78.3	62.8	60.2	60.2	364,548	0.06
Kentucky	Graves Co	81.0	65.5	63.2	63.3	40,827	0.03
Kentucky	Greenup Co	84.0	68.5	67.6	67.6	36,804	0.04
Kentucky	Hancock Co	82.7	66.9	65.6	65.6	8,768	0.00
Kentucky	Hardin Co	80.0	63.8	61.4	61.5	115,787	0.04
Kentucky	Henderson Co	79.5	65.7	63.8	63.9	50,196	0.10
Kentucky	Jefferson Co	84.3	71.1	69.1	69.1	754,333	0.05
Kentucky	Jessamine Co	78.0	62.3	59.8	59.9	64,205	0.09
Kentucky	Kenton Co	86.3	71.3	68.6	68.6	184,172	0.01
Kentucky	Livingston Co	85.0	68.2	66.0	66.1	11,009	0.07
Kentucky	McCracken Co	81.7	65.9	63.8	63.8	79,299	0.04
Kentucky	McLean Co	84.0	66.4	64.8	64.8	10,460	0.02

Kentucky	Oldham Co	88.0	71.0	68.8	68.8	78,214	0.01
Kentucky	Perry Co	75.5	56.7	54.5	54.5	34,370	0.03
Kentucky	Pike Co	76.3	56.8	54.4	54.2	82,013	-0.20
Kentucky	Pulaski Co	81.3	62.4	59.7	59.8	75,744	0.08
Kentucky	Scott Co	70.3	54.3	52.3	52.3	56,301	0.00
Kentucky	Simpson Co	84.0	63.0	60.3	60.4	18,467	0.06
Kentucky	Trigg Co	76.7	60.4	58.7	58.7	14,841	0.02
Kentucky	Warren Co	84.0	63.9	61.7	61.7	127,507	-0.01
Louisiana	Ascension Parish	81.7	75.2	73.4	73.5	133,078	0.18
Louisiana	Beauregard Parish	75.0	67.5	66.1	66.2	39,141	0.06
Louisiana	Bossier Parish	84.7	74.1	72.2	72.2	136,707	0.05
Louisiana	Caddo Parish	79.7	69.7	68.1	68.1	279,974	0.01
Louisiana	Calcasieu Parish	81.7	73.8	72.4	72.5	231,195	0.09
Louisiana	East Baton Rouge Parish	87.3	79.3	77.2	77.4	581,616	0.16
Louisiana	Grant Parish	77.7	67.3	65.4	65.5	22,438	0.07
Louisiana	Iberville Parish	85.0	78.2	76.3	76.4	33,041	0.10
Louisiana	Jefferson Parish	85.3	77.1	75.3	75.4	587,866	0.06
Louisiana	Lafayette Parish	80.7	71.6	69.4	69.5	254,421	0.10
Louisiana	Lafourche Parish	79.0	72.7	70.8	70.9	102,050	0.10
Louisiana	Livingston Parish	83.3	76.6	75.0	75.1	191,024	0.10
Louisiana	Orleans Parish	72.0	65.4	64.7	64.8	410,680	0.04
Louisiana	Ouachita Parish	78.7	70.2	69.0	69.1	173,151	0.05
Louisiana	Pointe Coupee Parish	73.0	65.4	63.2	63.4	22,960	0.15
Louisiana	St Bernard Parish	79.3	71.3	70.0	70.1	74,525	0.09
Louisiana	St Charles Parish	81.7	75.0	73.9	73.9	60,938	0.01
Louisiana	St James Parish	77.3	71.2	70.0	70.0	22,557	0.05
Louisiana	St John The Baptist Parish	81.7	75.3	74.1	74.2	51,893	0.06
Louisiana	St Mary Parish	78.0	71.8	70.1	70.3	53,642	0.11
Louisiana	West Baton Rouge Parish	85.7	77.4	74.8	75.0	24,811	0.12
Maine	Cumberland Co	84.7	73.0	69.0	68.9	332,397	-0.02
Maine	Hancock Co	92.0	76.8	71.8	71.8	58,549	0.00
Maine	Kennebec Co	77.7	64.9	60.5	60.5	127,089	0.00

Maine	Knox Co	83.3	70.4	65.8	65.9	48,542	0.00
Maine	Oxford Co	61.0	52.7	50.3	50.3	63,013	0.00
Maine	Penobscot Co	83.0	69.5	65.4	65.4	161,015	0.00
Maine	York Co	89.0	77.6	73.6	73.6	231,469	0.00
Maryland	Anne Arundel Co	101.0	84.9	79.7	79.7	648,839	0.00
Maryland	Baltimore City	82.0	71.4	68.6	68.6	536,970	0.00
Maryland	Baltimore Co	93.0	81.0	77.9	77.9	912,664	0.00
Maryland	Calvert Co	89.0	71.2	67.3	67.3	139,212	0.00
Maryland	Carroll Co	91.3	76.3	66.2	66.2	239,968	0.01
Maryland	Cecil Co	102.7	85.4	80.4	80.4	119,377	0.01
Maryland	Charles Co	94.7	75.6	71.2	71.2	201,208	0.01
Maryland	Frederick Co	90.0	74.2	69.9	69.9	311,347	0.00
Maryland	Harford Co	103.7	89.6	84.9	84.9	362,783	-0.03
Maryland	Kent Co	99.0	82.3	77.4	77.4	22,334	0.01
Maryland	Montgomery Co	88.7	76.4	71.8	71.8	1,155,446	-0.03
Maryland	Prince Georges Co	95.0	80.9	76.0	76.0	981,451	-0.01
Maryland	Washington Co	86.0	69.3	66.2	66.2	160,363	0.00
Massachusetts	Barnstable Co	94.7	80.2	75.1	75.1	307,672	-0.02
Massachusetts	Berkshire Co	87.0	73.2	68.8	68.8	128,741	-0.02
Massachusetts	Bristol Co	92.7	80.0	75.0	74.9	634,579	-0.02
Massachusetts	Essex Co	89.7	80.2	77.6	77.5	874,741	-0.02
Massachusetts	Hampden Co	90.3	76.7	72.0	72.0	490,399	0.00
Massachusetts	Hampshire Co	87.3	74.9	70.4	70.4	171,774	-0.02
Massachusetts	Middlesex Co	88.7	75.8	71.6	71.6	1,635,409	0.00
Massachusetts	Suffolk Co	88.0	74.9	70.7	70.7	712,565	0.00
Massachusetts	Worcester Co	85.3	72.9	68.8	68.8	905,029	0.00
Michigan	Allegan Co	92.0	79.5	76.1	76.1	158,549	-0.04
Michigan	Benzie Co	87.7	74.0	71.0	71.0	21,732	0.05
Michigan	Berrien Co	88.3	74.8	72.4	72.5	172,162	0.04
Michigan	Cass Co	90.0	74.4	71.6	71.6	59,270	0.04
Michigan	Clinton Co	83.3	69.0	66.2	66.2	86,214	-0.02
Michigan	Genesee Co	86.7	72.5	69.6	69.3	455,261	-0.24

Michigan	Huron Co	84.0	71.9	69.0	69.1	38,789	0.07
Michigan	Ingham Co	83.3	69.0	66.0	65.9	307,380	-0.06
Michigan	Kalamazoo Co	83.0	67.9	65.3	65.0	277,882	-0.25
Michigan	Kent Co	84.7	70.7	67.6	67.6	770,873	0.04
Michigan	Lenawee Co	85.0	71.2	68.3	68.4	115,975	0.09
Michigan	Macomb Co	91.0	84.2	84.4	84.1	959,860	-0.26
Michigan	Mason Co	89.0	74.7	71.9	71.8	35,801	-0.02
Michigan	Missaukee Co	80.3	67.4	64.8	64.9	19,433	0.06
Michigan	Muskegon Co	92.0	79.2	76.3	76.1	190,798	-0.14
Michigan	Oakland Co	87.0	79.2	77.4	77.2	1,572,260	-0.21
Michigan	Ottawa Co	86.0	74.0	70.5	70.7	366,864	0.20
Michigan	St Clair Co	87.7	78.0	75.4	75.2	209,229	-0.20
Michigan	Washtenaw Co	89.0	78.0	75.3	75.4	401,718	0.07
Michigan	Wayne Co	88.0	84.1	84.2	84.0	1,862,888	-0.21
Minnesota	Anoka Co	72.5	60.8	57.9	57.9	485,744	-0.03
Minnesota	Dakota Co	68.0	59.0	56.2	56.3	679,024	0.09
Minnesota	Mille Lacs Co	72.0	59.9	57.3	57.4	32,139	0.03
Minnesota	Washington Co	74.5	61.8	58.1	58.2	388,944	0.09
Mississippi	Adams Co	79.7	67.2	64.2	64.4	33,130	0.16
Mississippi	Bolivar Co	78.0	63.4	61.4	61.5	35,914	0.10
Mississippi	De Soto Co	84.3	69.7	67.0	67.1	207,134	0.14
Mississippi	Hancock Co	83.7	70.9	68.6	68.7	71,294	0.15
Mississippi	Harrison Co	83.3	69.3	66.7	66.8	248,708	0.11
Mississippi	Hinds Co	76.3	59.1	56.4	56.5	286,101	0.06
Mississippi	Jackson Co	83.0	70.4	68.2	68.4	166,408	0.14
Mississippi	Lauderdale Co	76.0	58.3	56.6	56.6	88,344	0.01
Mississippi	Lee Co	82.0	62.1	59.2	59.3	106,167	0.10
Mississippi	Madison Co	76.3	61.2	59.3	59.4	115,744	0.04
Mississippi	Warren Co	76.7	56.2	54.0	54.0	54,998	-0.01
Missouri	Cass Co	79.0	70.5	67.8	68.0	131,423	0.14
Missouri	Cedar Co	82.0	68.6	66.7	66.7	15,588	-0.08
Missouri	Clay Co	84.3	73.1	70.2	70.2	277,813	0.07

Missouri	Greene Co	74.7	59.0	56.3	56.3	316,059	0.00
Missouri	Jefferson Co	87.3	72.1	68.9	69.0	300,515	0.02
Missouri	Monroe Co	79.3	65.2	63.4	63.4	9,045	0.00
Missouri	Platte Co	81.7	72.0	69.3	69.4	120,065	0.10
Missouri	St Charles Co	90.7	76.5	73.7	73.8	465,491	0.07
Missouri	St Louis City	88.5	75.6	72.6	72.5	283,982	-0.16
Missouri	St Louis Co	89.3	76.7	74.1	73.9	1,074,467	-0.17
Missouri	Ste Genevieve Co	84.0	69.8	66.9	67.0	22,680	0.08
Nebraska	Douglas Co	67.5	58.0	56.2	56.0	631,889	-0.18
Nebraska	Lancaster Co	54.0	47.0	45.3	45.3	363,829	0.03
New Hampshire	Belknap Co	78.0	65.0	60.8	60.8	69,093	0.04
New Hampshire	Carroll Co	66.5	58.0	55.0	55.0	61,554	0.02
New Hampshire	Cheshire Co	73.7	62.0	58.7	58.7	84,859	-0.05
New Hampshire	Hillsborough Co	85.0	73.9	70.1	69.9	481,661	-0.22
New Hampshire	Merrimack Co	73.0	61.8	57.6	57.6	168,998	0.02
New Hampshire	Rockingham Co	82.7	72.9	69.5	69.2	385,193	-0.27
New Hampshire	Strafford Co	77.3	66.5	62.8	62.5	137,864	-0.29
New Jersey	Atlantic Co	91.0	77.7	73.5	73.5	325,200	0.00
New Jersey	Bergen Co	92.5	84.5	79.1	79.1	992,732	-0.02
New Jersey	Camden Co	102.3	88.3	86.2	86.1	573,079	-0.04
New Jersey	Cumberland Co	96.7	80.9	76.7	76.7	168,624	0.00
New Jersey	Essex Co	68.0	63.0	60.6	60.6	812,130	-0.02
New Jersey	Gloucester Co	101.3	88.2	82.3	82.3	327,831	-0.02
New Jersey	Hudson Co	89.0	82.4	82.4	82.4	752,226	-0.03
New Jersey	Hunterdon Co	97.7	85.4	81.3	81.3	176,974	0.00
New Jersey	Mercer Co	103.0	92.4	89.3	89.2	418,099	-0.03
New Jersey	Middlesex Co	100.7	88.8	84.7	84.7	1,060,757	0.00
New Jersey	Monmouth Co	96.0	83.2	78.1	78.0	805,031	-0.02
New Jersey	Morris Co	97.7	81.8	77.6	77.6	585,046	0.00
New Jersey	Ocean Co	111.0	96.9	92.3	92.3	701,827	0.00
New Jersey	Passaic Co	88.3	77.4	74.7	74.7	642,081	0.00
New York	Albany Co	83.0	70.7	66.7	66.7	323,337	0.01

New York	Bronx Co	82.7	79.5	79.5	79.5	1,496,920	0.01
New York	Chautauqua Co	91.7	78.6	76.1	76.1	143,972	-0.03
New York	Chemung Co	81.0	66.9	62.6	62.6	88,945	0.01
New York	Dutchess Co	91.3	78.1	74.3	74.3	321,300	-0.03
New York	Erie Co	96.0	84.2	81.3	81.3	980,986	-0.02
New York	Essex Co	88.5	75.6	71.8	71.8	41,348	0.00
New York	Hamilton Co	79.0	68.2	64.7	64.7	5,874	0.01
New York	Herkimer Co	74.0	63.5	60.1	60.1	65,247	0.01
New York	Jefferson Co	91.7	78.0	74.6	74.6	119,438	0.01
New York	Madison Co	80.0	69.4	65.6	65.6	78,603	0.00
New York	Monroe Co	86.5	74.3	70.6	70.7	802,384	0.01
New York	Niagara Co	91.0	80.3	77.3	77.3	224,386	0.01
New York	Oneida Co	79.0	66.3	62.9	62.9	227,123	0.01
New York	Onondaga Co	83.0	69.0	65.0	64.9	482,949	-0.02
New York	Orange Co	86.0	74.6	70.9	70.9	445,910	-0.02
New York	Putnam Co	91.3	79.3	76.0	75.9	135,035	-0.03
New York	Queens Co	86.0	76.0	73.0	73.0	2,667,144	-0.03
New York	Richmond Co	96.0	83.9	79.2	79.1	617,359	-0.02
New York	Saratoga Co	85.5	71.8	67.8	67.8	274,428	0.01
New York	Schenectady Co	77.3	66.4	62.8	62.8	152,224	-0.02
New York	Suffolk Co	98.5	89.0	86.9	86.8	1,698,384	-0.03
New York	Ulster Co	81.7	70.0	66.6	66.6	202,989	0.00
New York	Wayne Co	84.0	71.6	67.9	67.9	113,578	0.00
New York	Westchester Co	92.0	83.1	82.1	82.0	1,087,152	-0.03
North Carolina	Alexander Co	88.7	66.8	62.9	63.2	41,672	0.27
North Carolina	Avery Co	77.3	57.4	53.8	53.9	21,330	0.09
North Carolina	Buncombe Co	82.0	61.1	57.2	57.3	280,754	0.10
North Carolina	Caldwell Co	85.7	64.4	60.4	60.5	98,493	0.05
North Carolina	Camden Co	80.0	70.5	67.6	67.4	8,665	-0.24
North Carolina	Caswell Co	89.7	67.4	64.0	64.1	27,057	0.10
North Carolina	Chatham Co	82.0	62.2	58.4	58.5	69,459	0.09
North Carolina	Cumberland Co	87.0	66.3	62.0	62.1	365,353	0.07

North Carolina	Davie Co	94.7	69.9	66.1	66.2	44,473	0.05
North Carolina	Duplin Co	80.7	62.2	59.0	59.0	58,997	-0.01
North Carolina	Durham Co	89.0	67.2	63.0	63.1	317,922	0.13
North Carolina	Edgecombe Co	88.0	70.1	66.8	66.9	58,512	0.06
North Carolina	Forsyth Co	93.7	69.5	65.7	65.7	423,099	0.07
North Carolina	Franklin Co	89.0	68.1	63.9	64.0	65,985	0.03
North Carolina	Granville Co	92.0	69.6	65.6	65.6	60,620	0.07
North Carolina	Guilford Co	90.7	67.9	76.3	76.2	558,009	-0.13
North Carolina	Haywood Co	86.3	63.9	60.5	60.6	69,061	0.09
North Carolina	Jackson Co	85.0	62.6	59.4	59.5	49,578	0.09
North Carolina	Johnston Co	85.7	65.4	61.4	61.4	181,623	0.02
North Carolina	Lenoir Co	81.3	62.6	59.6	59.6	65,753	0.01
North Carolina	Lincoln Co	92.3	68.5	64.2	64.2	90,859	0.03
North Carolina	Martin Co	80.3	65.6	75.5	75.3	26,343	-0.23
North Carolina	Mecklenburg Co	100.3	75.0	70.3	70.5	1,147,728	0.14
North Carolina	New Hanover Co	77.3	63.2	60.4	60.5	268,891	0.06
North Carolina	Northampton Co	83.3	66.9	63.5	63.6	26,505	0.09
North Carolina	Person Co	90.0	67.2	64.0	64.0	45,544	0.04
North Carolina	Pitt Co	83.0	65.1	61.4	61.5	210,904	0.11
North Carolina	Randolph Co	85.0	63.1	62.2	62.3	186,417	0.17
North Carolina	Rockingham Co	88.7	66.0	65.1	65.1	105,514	0.00
North Carolina	Rowan Co	99.7	74.1	69.9	70.0	172,463	0.08
North Carolina	Swain Co	73.7	53.3	51.0	51.1	17,544	0.01
North Carolina	Union Co	87.7	65.2	61.0	61.0	183,569	0.05
North Carolina	Wake Co	92.7	70.8	66.2	66.3	1,190,984	0.04
North Carolina	Yancey Co	86.3	64.6	60.8	60.9	23,562	0.05
Ohio	Allen Co	87.7	72.6	70.1	70.1	105,256	0.04
Ohio	Ashtabula Co	94.0	80.0	48.4	48.4	110,570	0.05
Ohio	Butler Co	89.0	73.6	70.5	70.5	498,980	0.04
Ohio	Clark Co	88.3	69.9	66.3	66.4	142,177	0.06
Ohio	Clermont Co	90.0	72.5	69.3	69.4	263,985	0.04
Ohio	Clinton Co	95.7	75.7	72.3	72.4	61,121	0.07

Ohio	Cuyahoga Co	86.3	74.0	71.4	71.2	1,309,531	-0.20
Ohio	Delaware Co	90.3	72.1	68.7	68.7	188,485	0.00
Ohio	Franklin Co	95.0	77.0	73.1	73.2	1,337,599	0.06
Ohio	Geauga Co	98.3	82.5	78.6	78.7	125,839	0.09
Ohio	Greene Co	87.0	69.3	66.4	66.5	168,701	0.05
Ohio	Hamilton Co	89.3	74.3	71.2	71.3	860,775	0.08
Ohio	Jefferson Co	85.3	71.2	67.6	67.8	63,718	0.16
Ohio	Knox Co	89.3	71.4	67.9	67.7	69,681	-0.19
Ohio	Lake Co	92.7	78.9	75.8	75.9	259,949	0.06
Ohio	Lawrence Co	85.0	69.3	66.8	66.8	63,818	0.04
Ohio	Licking Co	89.0	70.2	66.8	66.9	192,644	0.09
Ohio	Lorain Co	87.5	75.5	72.7	72.8	318,383	0.09
Ohio	Lucas Co	88.7	76.8	74.1	74.2	440,472	0.12
Ohio	Madison Co	89.0	71.2	67.9	68.0	52,685	0.08
Ohio	Mahoning Co	88.0	70.5	70.8	70.9	246,628	0.09
Ohio	Medina Co	87.7	72.0	68.4	68.5	222,625	0.05
Ohio	Miami Co	86.3	68.3	64.7	64.9	107,641	0.13
Ohio	Montgomery Co	86.7	69.6	66.5	66.5	546,327	0.03
Ohio	Portage Co	92.0	74.9	71.5	71.5	185,929	-0.03
Ohio	Preble Co	80.3	63.3	60.5	60.6	47,696	0.09
Ohio	Stark Co	89.0	71.7	68.3	68.4	394,073	0.05
Ohio	Summit Co	94.3	77.4	73.4	73.5	583,129	0.07
Ohio	Trumbull Co	92.5	74.7	76.6	76.5	230,527	-0.14
Ohio	Warren Co	92.0	75.1	72.0	72.0	243,963	0.07
Ohio	Washington Co	87.0	65.1	63.1	63.1	63,121	0.05
Ohio	Wood Co	87.0	73.8	71.1	71.0	149,194	-0.16
Oklahoma	Cherokee Co	76.0	68.4	66.8	66.8	60,179	0.03
Oklahoma	Cleveland Co	77.3	65.2	62.8	62.8	281,929	-0.02
Oklahoma	Kay Co	75.0	66.3	64.2	64.3	52,556	0.10
Oklahoma	Mc Clain Co	78.5	66.6	63.8	63.9	37,958	0.05
Oklahoma	Oklahoma Co	80.7	68.1	65.3	65.4	748,499	0.03
Oklahoma	Ottawa Co	79.0	71.7	70.2	70.3	34,500	0.06

Oklahoma	Tulsa Co	85.0	76.4	74.5	74.5	700,141	0.01
Pennsylvania	Allegheny Co	93.0	78.9	54.8	54.8	1,239,357	0.00
Pennsylvania	Armstrong Co	92.0	76.1	73.0	73.1	74,217	0.01
Pennsylvania	Beaver Co	91.0	76.8	67.3	67.3	191,163	0.00
Pennsylvania	Berks Co	92.7	76.9	72.4	72.4	446,661	0.00
Pennsylvania	Blair Co	84.3	67.7	65.1	65.2	130,126	0.01
Pennsylvania	Bucks Co	103.0	91.8	89.3	89.2	768,582	-0.03
Pennsylvania	Cambria Co	87.7	72.9	70.1	70.1	136,712	0.01
Pennsylvania	Centre Co	85.5	70.7	67.5	67.5	173,071	0.01
Pennsylvania	Chester Co	96.5	82.2	78.8	78.8	574,228	-0.02
Pennsylvania	Clearfield Co	86.7	70.5	67.4	67.4	88,529	-0.02
Pennsylvania	Dauphin Co	91.0	76.0	71.7	71.7	304,223	0.01
Pennsylvania	Delaware Co	93.7	81.0	77.7	77.6	556,598	-0.02
Pennsylvania	Erie Co	89.0	76.0	72.8	72.8	297,196	0.00
Pennsylvania	Franklin Co	93.0	75.5	71.4	71.4	148,292	0.01
Pennsylvania	Greene Co	90.3	68.9	66.9	66.9	46,056	-0.02
Pennsylvania	Lackawanna Co	85.3	70.0	65.6	65.6	203,918	0.01
Pennsylvania	Lancaster Co	94.0	78.4	73.8	73.8	614,393	0.01
Pennsylvania	Lawrence Co	78.7	63.9	61.2	61.2	98,469	0.00
Pennsylvania	Lehigh Co	93.3	78.3	74.1	74.1	370,859	0.00
Pennsylvania	Luzerne Co	84.7	67.9	63.6	63.5	301,059	-0.02
Pennsylvania	Lycoming Co	83.0	67.4	63.6	63.6	127,692	0.00
Pennsylvania	Mercer Co	91.3	73.2	69.5	69.5	128,130	0.01
Pennsylvania	Montgomery Co	96.3	84.9	73.5	73.5	845,717	-0.02
Pennsylvania	Northampton Co	93.0	78.1	85.4	85.4	315,778	0.00
Pennsylvania	Perry Co	84.7	69.8	62.8	62.8	62,617	0.01
Pennsylvania	Philadelphia Co	97.5	87.5	85.6	85.6	1,355,981	0.00
Pennsylvania	Tioga Co	83.7	68.5	63.2	63.2	47,031	0.01
Pennsylvania	Washington Co	87.7	74.8	72.5	72.5	211,283	-0.02
Pennsylvania	Westmoreland Co	87.7	73.9	71.5	71.5	381,899	0.01
Pennsylvania	York Co	90.3	74.8	70.9	70.9	459,110	0.00
Rhode Island	Kent Co	95.3	83.2	78.9	78.9	191,187	0.00

Rhode Island	Providence Co	90.3	78.1	73.6	73.6	659,404	0.00
Rhode Island	Washington Co	93.3	81.3	76.4	76.4	167,525	-0.02
South Carolina	Abbeville Co	84.0	63.6	59.8	59.9	30,215	0.09
South Carolina	Aiken Co	84.7	67.7	65.6	65.7	186,971	0.03
South Carolina	Anderson Co	88.0	65.8	61.6	61.7	216,608	0.06
South Carolina	Barnwell Co	81.3	63.2	60.1	60.2	25,990	0.12
South Carolina	Berkeley Co	71.0	55.1	52.3	52.4	198,130	0.10
South Carolina	Charleston Co	74.0	57.4	59.0	59.1	469,273	0.11
South Carolina	Cherokee Co	86.0	62.8	59.4	59.4	64,292	0.02
South Carolina	Chester Co	84.3	64.3	60.8	60.9	42,191	0.05
South Carolina	Colleton Co	78.7	61.8	58.9	59.0	50,721	0.09
South Carolina	Darlington Co	84.7	65.8	63.8	63.9	79,076	0.08
South Carolina	Edgefield Co	80.7	61.9	58.8	58.9	26,999	0.05
South Carolina	Oconee Co	84.0	61.1	57.1	57.1	81,707	0.00
South Carolina	Pickens Co	85.3	63.7	59.7	59.8	179,823	0.10
South Carolina	Richland Co	93.0	70.7	66.3	66.3	413,975	0.03
South Carolina	Spartanburg Co	90.0	66.3	61.7	61.8	326,621	0.13
South Carolina	Union Co	80.7	60.1	56.3	56.4	32,024	0.08
South Carolina	Williamsburg Co	72.3	55.5	52.7	52.8	38,588	0.07
South Carolina	York Co	83.3	63.2	59.5	59.5	242,392	0.08
Tennessee	Anderson Co	89.7	62.8	59.1	59.2	85,642	0.08
Tennessee	Blount Co	94.0	68.5	64.5	64.6	152,892	0.11
Tennessee	Davidson Co	81.3	64.9	62.0	62.1	697,634	0.09
Tennessee	Hamilton Co	90.7	67.6	64.3	64.3	370,667	0.03
Tennessee	Haywood Co	89.0	71.4	68.5	68.5	21,407	0.02
Tennessee	Jefferson Co	94.0	69.6	66.0	66.1	66,217	0.10
Tennessee	Knox Co	94.7	68.1	64.9	65.0	518,950	0.08
Tennessee	Lawrence Co	79.3	59.6	56.6	56.7	53,015	0.14
Tennessee	Meigs Co	90.5	66.2	63.8	63.8	18,479	0.01
Tennessee	Putnam Co	85.0	64.4	61.5	61.5	86,013	0.04
Tennessee	Rutherford Co	83.3	63.7	60.0	60.1	325,034	0.10
Tennessee	Sevier Co	96.0	70.2	66.8	66.8	147,424	0.05

Tennessee	Shelby Co	90.7	73.6	70.3	70.4	1,122,842	0.13
Tennessee	Sullivan Co	89.3	69.9	67.5	67.6	174,529	0.09
Tennessee	Sumner Co	89.0	71.3	68.1	68.3	207,450	0.17
Tennessee	Williamson Co	86.3	65.4	62.1	62.2	249,923	0.14
Tennessee	Wilson Co	84.7	67.6	64.6	64.7	147,559	0.11
Texas	Bexar Co	85.7	66.7	64.5	64.5	2,366,164	0.00
Texas	Brazoria Co	91.0	82.7	81.9	81.9	364,164	-0.01
Texas	Collin Co	93.3	77.6	73.8	73.8	1,088,455	0.01
Texas	Dallas Co	91.0	77.9	74.4	74.4	3,268,299	0.01
Texas	Denton Co	99.0	81.3	76.9	77.0	861,191	0.01
Texas	Ellis Co	85.3	70.4	67.6	67.7	166,851	0.01
Texas	Galveston Co	92.0	83.2	81.5	81.5	357,291	0.00
Texas	Gregg Co	88.3	76.3	74.5	74.5	144,748	0.01
Texas	Harris Co	105.0	96.4	96.4	96.4	5,479,162	-0.01
Texas	Harrison Co	76.0	65.2	63.8	63.8	71,029	0.00
Texas	Hood Co	84.0	68.7	66.0	66.0	77,394	0.00
Texas	Jefferson Co	91.0	84.1	82.7	82.7	289,299	0.00
Texas	Johnson Co	89.5	73.9	71.3	71.4	220,182	0.00
Texas	Kaufman Co	71.5	60.2	57.8	57.8	112,925	0.00
Texas	Montgomery Co	91.0	77.9	75.0	75.0	635,003	0.00
Texas	Orange Co	78.3	70.8	69.4	69.4	97,706	0.00
Texas	Parker Co	87.5	71.6	68.4	68.4	158,229	0.01
Texas	Rockwall Co	82.0	69.7	66.7	66.6	98,097	-0.02
Texas	Smith Co	82.5	70.0	68.1	68.1	231,599	0.00
Texas	Tarrant Co	98.3	82.2	78.3	78.3	2,558,997	0.01
Texas	Travis Co	84.3	69.4	67.2	67.2	1,560,488	0.00
Vermont	Bennington Co	79.7	67.2	63.8	63.8	41,545	0.01
Virginia	Alexandria City	90.0	78.8	78.9	78.9	138,102	-0.02
Virginia	Arlington Co	95.7	83.8	80.3	80.3	218,813	-0.02
Virginia	Caroline Co	84.0	68.8	64.8	64.8	29,903	0.01
Virginia	Charles City Co	89.3	74.9	72.3	72.3	8,369	0.00
Virginia	Chesterfield Co	86.0	71.8	68.5	68.5	435,805	0.00

Virginia	Fairfax Co	96.3	83.0	79.4	79.3	1,448,590	-0.03
Virginia	Fauquier Co	81.0	66.8	63.1	63.2	88,338	0.01
Virginia	Frederick Co	84.3	67.1	63.5	63.5	81,277	0.01
Virginia	Hampton City	88.7	76.6	73.7	73.7	170,707	0.00
Virginia	Hanover Co	94.0	77.9	74.2	74.2	125,364	0.00
Virginia	Henrico Co	90.0	75.5	71.7	71.7	370,542	0.01
Virginia	Loudoun Co	89.3	75.4	71.4	71.4	299,598	0.00
Virginia	Madison Co	86.3	65.0	61.5	61.5	16,107	0.00
Virginia	Page Co	81.3	60.5	57.4	57.4	27,476	0.01
Virginia	Prince William Co	85.7	72.0	68.2	68.2	503,471	-0.02
Virginia	Roanoke Co	86.0	68.8	61.6	61.6	111,107	0.01
Virginia	Rockbridge Co	79.0	63.2	59.9	59.9	22,981	0.01
Virginia	Stafford Co	86.3	70.5	66.4	66.4	156,381	0.00
Virginia	Suffolk City	87.3	75.4	72.4	72.4	78,014	0.01
Virginia	Wythe Co	80.7	60.6	57.6	57.6	31,538	0.00
West Virginia	Berkeley Co	86.0	69.6	66.0	66.1	123,305	0.16
West Virginia	Cabell Co	88.0	73.2	70.5	70.6	89,632	0.12
West Virginia	Greenbrier Co	81.7	60.8	58.9	58.9	38,379	0.03
West Virginia	Hancock Co	84.3	70.3	74.2	74.4	29,794	0.19
West Virginia	Kanawha Co	87.0	68.0	65.7	65.8	198,080	0.13
West Virginia	Monongalia Co	80.0	63.6	62.6	62.7	93,661	0.09
West Virginia	Ohio Co	84.7	66.5	64.3	64.3	46,358	0.06
West Virginia	Wood Co	87.7	65.0	62.9	62.6	87,708	-0.24
Wisconsin	Brown Co	81.7	69.0	66.3	66.4	296,461	0.10
Wisconsin	Columbia Co	77.7	63.7	60.7	60.7	70,203	0.07
Wisconsin	Dane Co	77.3	63.6	60.3	60.1	618,749	-0.21
Wisconsin	Dodge Co	81.0	67.7	64.8	64.8	110,358	0.04
Wisconsin	Door Co	92.7	77.9	75.4	75.4	35,946	0.01
Wisconsin	Fond Du Lac Co	79.0	65.9	63.4	63.5	113,999	0.03
Wisconsin	Green Co	74.5	61.6	58.7	58.8	42,534	0.07
Wisconsin	Jefferson Co	84.5	69.5	66.5	66.5	84,126	0.05
Wisconsin	Kenosha Co	98.7	88.8	86.5	86.3	203,415	-0.22

Wisconsin	Kewaunee Co	90.0	75.7	73.1	73.1	21,377	0.00
Wisconsin	Manitowoc Co	90.0	75.9	73.0	73.1	86,748	0.06
Wisconsin	Marathon Co	73.7	60.8	58.5	58.5	163,544	0.08
Wisconsin	Milwaukee Co	90.7	79.0	76.4	76.2	931,405	-0.22
Wisconsin	Outagamie Co	77.3	64.9	62.8	62.8	225,018	0.00
Wisconsin	Ozaukee Co	95.3	82.0	78.8	78.8	123,762	0.03
Wisconsin	Racine Co	91.7	81.6	79.3	79.1	224,077	-0.22
Wisconsin	Rock Co	84.3	69.1	65.7	65.7	190,636	0.02
Wisconsin	Sauk Co	74.3	59.9	57.0	57.2	84,530	0.13
Wisconsin	Sheboygan Co	98.0	83.6	80.4	80.4	135,511	0.05
Wisconsin	St Croix Co	72.7	58.9	56.0	56.0	86,885	0.03
Wisconsin	Vernon Co	71.7	59.6	57.1	56.9	30,988	-0.25
Wisconsin	Walworth Co	83.3	70.1	67.1	67.1	128,080	0.00
Wisconsin	Washington Co	82.7	71.8	69.1	69.2	162,760	0.02
Wisconsin	Waukesha Co	82.7	71.3	68.9	68.6	524,598	-0.28
Wisconsin	Winnebago Co	80.0	66.3	63.6	63.7	199,474	0.04
Average over 525 counties		**84.8**	**69.8**	**66.8**	**66.8**	**173,814,051**	**0.0204**