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## **Adjustments to Vehicle Activity for the Sacramento Ozone Nonattainment Area Rate of Progress Plan**

The Air Resources Board (ARB), the Sacramento Area Association of Governments (SACOG), the Sacramento Metropolitan Air Quality Management District (SMAQMD), and other affected air districts have agreed that SACOG's most recent estimates of vehicle miles traveled (VMT) should be adjusted prior to use in air quality inventories and plans. The agencies propose to use this adjusted VMT in both the upcoming revision to the EMFAC model and in the Sacramento Ozone Nonattainment Area Rate of Progress (ROP) Plan. The agencies also propose to use re-estimated speed distributions, consistent with the VMT adjustment, to calculate the ROP motor vehicle emissions budget for calendar year 2008, in accordance with federal conformity rules.

### **Background**

Estimates of VMT are used in ARB's EMFAC motor vehicle emissions model, which provides emissions inventories for air quality planning. The VMT are provided to ARB by regional transportation planning agencies, including SACOG. As part of ARB's regular quality assurance review, staff compares new submittals of VMT estimates to prior submittals and also to estimates from the Caltrans report, *Motor Vehicle Stock, Travel and Fuel Forecast* (MVSTAFF).

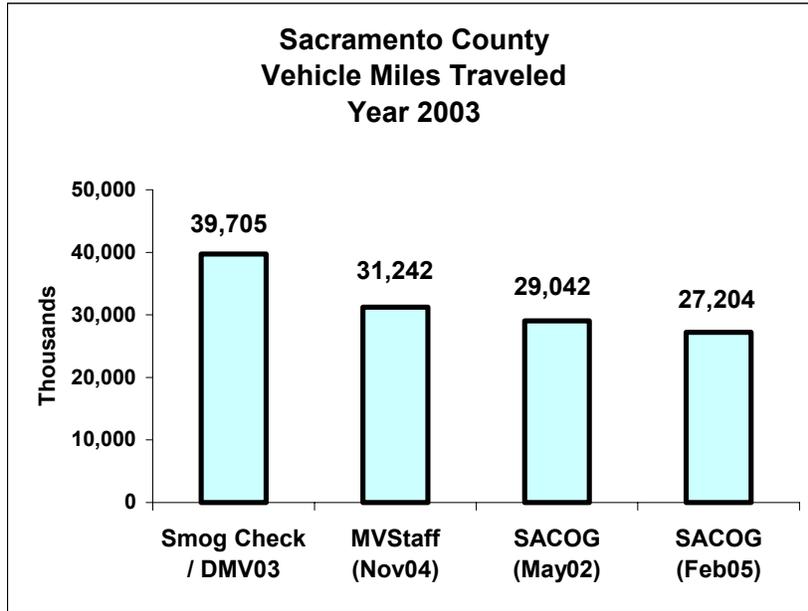
SACOG provided estimates to ARB during the period from December 2004 to March 2005 for calendar years 2000, 2005, 2008, 2013, 2020, and 2027. The estimates were based on SACMET model runs for each county in the Sacramento federal ozone nonattainment area. Calendar year 2000 estimates were about 4 percent below those provided by SACOG in May 2002 and about 12 percent below MVSTAFF estimates (MVSTAFF, November 2003).

These differences for a recent past year led ARB staff to add another point of reference, VMT based on more than 400,000 Smog Check odometer readings and Department of Motor Vehicle (DMV) registration data. Looking at Sacramento County in year 2003, this estimate was substantially higher than the other sources (see Chart 1).<sup>1</sup> Because the differences among the various estimates were substantial and SACOG's new estimates fell below the others, ARB requested a meeting with SACOG and the air districts in the area, which was held April 28, 2005.

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<sup>1</sup> In a subsequent analysis staff compared VMT calculated from Smog Check/DMV data for the four county area of Sacramento, Placer, El Dorado and Yolo counties to the other sources. The difference for this larger area was found to be somewhat greater than that shown for Sacramento alone.

**Chart 1**



Staff from these agencies discussed the strengths and weaknesses of all three estimates, and concluded that there should be an adjustment to VMT before using it in the Rate of Progress (ROP) Plan and the upcoming revision to ARB’s emissions model (EMFAC). The group’s decision was influenced by several facts. First, while additional analysis to explain the differences in the VMT estimates would be helpful, there was no assurance it would result in a more definitive and accurate estimate of VMT in a reasonable period of time. Second, SACOG expects its new activity-based model, to be completed by fall 2005, to project higher VMT than the recent SACMET model estimates. The upcoming estimates would be used in the 8-hour ozone attainment plan and the next regional transportation plan, while the estimates chosen for the ROP will also be used to begin air quality modeling for the attainment plan. Desiring to preserve as much consistency as possible between the ROP plan and the attainment plan, the group concluded that an adjustment to VMT now might help avoid larger discrepancies later in the planning process.

**Adjustments to VMT**

MVSTAFF VMT estimates are the closest to the midpoint among the various estimates. The proposed adjustment uses the year 2003 VMT estimates from the MVSTAFF report in combination with Feb/March 2005 VMT growth rates from the SACMET model.

The MVSTAFF report estimates statewide base year VMT using fuel consumption data provided by the California Board of Equalization and vehicle fuel economy. On the local level, base year

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highway VMT comes directly from the Traffic Operations Program's annual Traffic Accident Surveillance and Analysis System (TASAS) file. Count VMT on all other public roads except local streets are estimated from the annual Highway Performance Monitoring System (HPMS) file. Since local road VMT cannot be obtained from either TASAS or HPMS, statewide local road VMT is calculated as the difference of statewide total VMT minus state highway VMT (TASAS) and other road VMT (HPMS). Statewide local road VMT is then allocated to each county on the basis of the relative distribution of automobile registrations multiplied by the proportion of local road mileage to the total system mileage. The MVSTAFF report may be found at <http://ruralits.org/hq/tsip/docs.htm>.

In May 2005, the Metropolitan Transportation Commission (MTC) provided VMT forecasts for the Sacramento Valley portion of Solano County for calendar years 2000, 2007, 2015, 2025, and 2030. Solano County (SVAB) VMT was adjusted in the same manner as the other counties in the Sacramento Area. The growth rates from MTC data were used to grow the MVSTAFF base year VMT.

There is precedent for using an alternate base year along with locally developed growth rates to offset potential VMT underestimation. For the past several years in the Bay Area, Smog Check/DMV-based VMT estimates have been used for base year VMT. Forecasted VMT has been calculated from these base year estimates using growth rates developed by MTC. Air quality agencies have expressed the view that in an effort to be fully protective of air quality, it is better to have VMT forecasts that err on the side of being too high rather than too low. At the same time, all agencies have agreed to work together to develop the best projections possible. For this reason the new activity-based forecasts under development at SACOG hold promise.

Tables 1 and 2 show the growth rates calculated from the SACOG data submittal and their application by subarea to calendar year 2003 Caltrans MVSTAFF (November 2004) estimates, resulting in adjusted VMT for calendar years 2000, 2002, 2003, 2005, 2008, 2010, 2013, 2015, and 2020.

**Table 1**

**Sacramento Area Growth Rates for Vehicle Miles Traveled**

SACOG Daily VMT

*SACOG Submittal December 2004 to March 2005  
and MTC Submittal May 2005 for Solano County*

<b>County</b>	<b>2000</b>	<b>2002</b>	<b>2003</b>	<b>2005</b>	<b>2008</b>	<b>2010</b>	<b>2013</b>	<b>2015</b>	<b>2020</b>
EIDorado (MC)	2,782,526	2,874,706	2,921,935	3,018,734	3,322,685	3,418,123	3,566,445	3,659,619	3,903,343
Placer (SV)	5,592,741	5,966,378	6,162,456	6,574,154	7,226,256	7,483,355	7,886,255	8,194,990	9,020,747
Placer (MC)	762,647	813,597	840,335	896,475	985,399	1,020,457	1,075,398	1,117,499	1,230,102
Placer (SV+MC)	6,355,388	6,779,975	7,002,790	7,470,629	8,211,655	8,503,812	8,961,653	9,312,489	10,250,849
Sacramento	26,051,522	26,950,434	27,411,455	28,357,291	30,581,321	31,577,905	33,134,003	34,095,597	36,623,452
Sutter	1,689,193	1,701,245	1,707,303	1,719,484	1,936,192	2,015,041	2,139,376	2,228,998	2,469,825
South Sutter	345,317	345,664	345,838	346,185	405,372	415,151	430,264	450,868	506,800
Yolo	4,378,586	4,524,872	4,599,838	4,753,516	5,437,440	5,630,110	5,931,990	6,118,231	6,609,820
Yuba	1,275,755	1,291,085	1,298,819	1,314,426	1,486,583	1,574,723	1,716,827	1,796,508	2,012,269
Solano (SV)	4,170,731	4,284,950	4,343,226	4,462,169	4,793,432	5,240,596	5,990,760	6,549,619	7,110,542
Sac Nonattn Area	44,084,070	45,760,601	46,625,082	48,408,524	52,751,905	54,785,697	58,015,115	60,186,423	65,004,806
<b>Growth Rates</b>									
EIDorado (MC)	0.9523	0.9838	1.0000	1.0331	1.1372	1.1698	1.2206	1.2525	1.3359
Placer (SV)	0.9076	0.9682	1.0000	1.0668	1.1726	1.2143	1.2797	1.3298	1.4638
Placer (MC)	0.9076	0.9682	1.0000	1.0668	1.1726	1.2143	1.2797	1.3298	1.4638
Placer (SV+MC)	0.9076	0.9682	1.0000	1.0668	1.1726	1.2143	1.2797	1.3298	1.4638
Sacramento	0.9504	0.9832	1.0000	1.0345	1.1156	1.1520	1.2088	1.2438	1.3361
Sutter	0.9894	0.9965	1.0000	1.0071	1.1341	1.1802	1.2531	1.3056	1.4466
South Sutter	0.9985	0.9995	1.0000	1.0010	1.1721	1.2004	1.2441	1.3037	1.4654
Yolo	0.9519	0.9837	1.0000	1.0334	1.1821	1.2240	1.2896	1.3301	1.4370
Yuba	0.9822	0.9940	1.0000	1.0120	1.1446	1.2124	1.3218	1.3832	1.5493
Solano (SV)	0.9603	0.9866	1.0000	1.0274	1.1037	1.2066	1.3793	1.5080	1.6372

SACOG provided Placer County VMT for the SV+MC portions combined, along with percentage splits 12% for MC and 88% for SV.

**Table 2**

**Sacramento Area  
Adjusted Daily VMT in thousands  
April 2005 Agreement**

County	Base Year for VMT Adjustment								
	2000	2002	2003	2005	2008	2010	2013	2015	2020
EIDorado (MC)	3,482	3,598	<b>3,657</b>	3,778	4,158	4,278	4,463	4,580	4,885
Placer (SV)	6,834	7,290	<b>7,530</b>	8,033	8,829	9,144	9,636	10,013	11,022
Placer (MC)	932	994	<b>1,027</b>	1,095	1,204	1,247	1,314	1,365	1,503
Placer (SV+MC)	7,765	8,284	<b>8,556</b>	9,128	10,033	10,390	10,950	11,379	12,525
Sacramento	29,692	30,716	<b>31,242</b>	32,319	34,854	35,990	37,764	38,860	41,741
Sutter	2,171	2,187	<b>2,195</b>	2,210	2,489	2,590	2,750	2,865	3,175
South Sutter	444	444	<b>445</b>	445	521	534	553	580	651
Yolo	5,205	5,378	<b>5,468</b>	5,650	6,463	6,692	7,051	7,272	7,857
Yuba	1,723	1,744	<b>1,754</b>	1,775	2,008	2,127	2,318	2,426	2,717
Solano (SV)	4,171	4,286	<b>4,344</b>	4,463	4,794	5,241	5,992	6,551	7,112
Sac Nonattn Area	50,759	52,706	<b>53,711</b>	55,784	60,824	63,126	66,773	69,221	74,771
<b>Growth Rates</b>									
EIDorado (MC)	0.9523	0.9838	1.0000	1.0331	1.1372	1.1698	1.2206	1.2525	1.3359
Placer (SV)	0.9076	0.9682	1.0000	1.0668	1.1726	1.2143	1.2797	1.3298	1.4638
Placer (MC)	0.9076	0.9682	1.0000	1.0668	1.1726	1.2143	1.2797	1.3298	1.4638
Placer (SV+MC)	0.9076	0.9682	1.0000	1.0668	1.1726	1.2143	1.2797	1.3298	1.4638
Sacramento	0.9504	0.9832	1.0000	1.0345	1.1156	1.1520	1.2088	1.2438	1.3361
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Yolo	0.9519	0.9837	1.0000	1.0334	1.1821	1.2240	1.2896	1.3301	1.4370
Yuba	0.9822	0.9940	1.0000	1.0120	1.1446	1.2124	1.3218	1.3832	1.5493
Solano (SV)	0.9603	0.9866	1.0000	1.0274	1.1037	1.2066	1.3793	1.5080	1.6372
Sac Nonattn Area	0.9450	0.9813	1.0000	1.0386	1.1324	1.1753	1.2432	1.2888	1.3921

The Sac NonAttn Area includes El Dorado (MC), Placer (SV+MC), Sacramento, South Sutter, Yolo, and Solano (SV)

Split Counties

SACOG provided Placer County VMT for the SV+MC portions combined, along with percentage splits 12% for MC and 88% for SV. These percents were applied to the 2003 base year to determine the sub-county VMT estimates. Similarly, the percentage split between South Sutter and Sutter County total for year 2003 determined MVSTAFF VMT for South Sutter. MTC provided Solano County VMT for both the SV and SF air basin portions. MTC's percentage split for year 2003 was applied to MVSTAFF VMT to determine the Northern Solano (SV) sub-county VMT estimate.

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## **Adjustments to Speed Distribution**

Because the ROP plan will create a motor vehicle emissions budget for 2008, consideration must be given to federal conformity rules in developing the budget. 40 CFR 93.122(b)(1)(iv) requires the use of speeds based on final assigned traffic volumes. To maintain the linkage between travel speeds and the higher volumes resulting from the VMT estimate, SACOG was able to adjust speeds as described below.

The SACOG regional travel demand model is a multi-county model covering the Sacramento ozone non-attainment area (minus north Solano Co.) plus north Sutter Co. and Yuba Co. Each link in the road network has two fields useful in the vehicle miles traveled (VMT) adjustment process, a district ID field that can be aggregated to counties and a speed-congestion type field used in the trip assignment process. Three types of roads (freeway, urban arterial, and transitional rural roads) have different "speed-congestion curves" that reduce speed as traffic volume increases. When vehicle trips are assigned during each of four time periods (AM period, midday, PM period, and late evening/early morning) additional fields are created for volume (number of trips), the volume to capacity (V/C) ratio, and the congested speed.

A county-specific adjustment process was used to adjust the model's VMT to the county-level estimates from MVSTAFF. In a multi-county model with different adjustments for each county, simply increasing the vehicle trip table and reassigning the trips is not an option. There is no fixed relationship between trips and VMT, as many trips are inter-county trips using links in two or more counties.

For all links in a county, volume was increased by the ratio of MVSTAFF VMT to SACOG model VMT ( $VMT = Volume * Distance$ ). For each link the adjusted volume was used to calculate an adjusted V/C ratio. In the trip assignment the V/C ratio is applied to a speed-congestion curve to calculate the congested speed.

To estimate the adjusted speed resulting from the adjusted volume the speed-congestion relationships were replicated in a link data management program. This calculation assumes that rerouting of vehicle trips does not occur, a compromise necessary because a full re-assignment is not possible. The adjusted VMT and speeds were then summarized to county totals and applied in the EMFAC2002 model to produce emissions.

## **Emissions Comparison**

In order to determine the emissions impacts of the proposed VMT and speeds adjustments, ARB used the scenario generator in EMFAC 2002, Version 2.2 (Apr03). Vehicle population was adjusted proportional to the estimated VMT change. This is the recommended procedure so that start and evaporative emissions, which are tied to the size of the vehicle fleet, are properly estimated.

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The revised SACOG speed distributions were applied to all light-duty cars and trucks, medium-duty vehicles, and motorcycles. Speeds were distributed across thirteen different speed "bins" (5 mph through 65 mph) for the AM peak period (hours 6-8), the mid-day period (hours 9-14), the PM peak period (hours 15-17), and the off-peak period (hours 0-5 and 18-23.)

Calendar year 2008 emissions model runs were conducted in three different ways for each county in the Sacramento nonattainment area. The first set of runs accounted for the VMT and speeds provided by the SACMET model in March 2005. The second reflected an adjustment to VMT with no adjustments to SACMET speeds. The third set of model runs reflected adjustments to both VMT and speeds. Staff was then able to determine the effects of increasing VMT while adjusting speeds to account for more congestion, and also to isolate emissions impacts of the changes in speed distributions.

Table 3 summarizes the results of both VMT and speed adjustments. For the nonattainment area, the VMT and speeds adjustments increased VMT by 9,653,000 miles per day, ROG by 6.71 tons per day, and NOx by 12.11 tons per day. The comparison of speed distributions showed that the more congested speeds increased ROG by 0.26 tons per day and NOx by 0.03 tons per day. Because the effect of speed is slight (less than ¼ percent), and conformity for years other than 2008 could not be affected by speed refinements of this magnitude, adjustments to the speeds provided by SACOG in March 2005 were limited to year 2008 of the ROP plan.

Emissions results from the "Adjusted VMT and Adjusted Speeds" portion of Table 3 are being incorporated into the ROP emissions inventory, and will be used in the final calculation of motor vehicle emissions budgets in the ROP plan.

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**Table 3**  
**Sacramento Nonattainment Area**  
**CY 2008 Comparison of Daily Emissions and VMT**

County	SACMET VMT and Speeds March 2005			Adjusted VMT with SACMET (March 2005) Speeds			Adjusted VMT and Adjusted Speeds		
	VMT (1,000's)	ROG tons/day	NOx tons/day	VMT (1,000's)	ROG tons/day	NOx tons/day	VMT (1,000's)	ROG tons/day	NOx tons/day
EIDorado (MC)	3,322	2.71	3.52	4,158	3.40	4.41	4,158	3.39	4.40
Placer (SV+MC)	8,212	5.47	7.76	10,033	6.68	9.48	10,033	6.76	9.50
Sacramento	30,581	20.85	38.86	34,854	23.77	44.29	34,854	23.96	44.33
South Sutter	405	0.32	0.55	521	0.41	0.70	521	0.41	0.70
Yolo	5,437	3.08	9.92	6,463	3.64	11.79	6,463	3.64	11.77
Solano (SV)	3,213	2.01	4.05	4,794	2.99	6.07	4,794	2.99	6.07
<b>Sac Nonattn Area</b>	<b>51,170</b>	<b>34.44</b>	<b>64.66</b>	<b>60,823</b>	<b>40.89</b>	<b>76.74</b>	<b>60,823</b>	<b>41.15</b>	<b>76.77</b>

Effects of Adjustments for Sac Nonattn Area	VMT (1,000's)	ROG tons/day	NOx tons/day
VMT Adjustment	9,653	6.45	12.08
Speeds Adjustment		0.26	0.03
Total	9,653	6.71	12.11