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**MEMORANDUM**

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**Date:** June 2, 2010

**To:** For 2010 Metropolitan Transportation Plan (MTP) /Supplemental Environmental Impact Report (SEIR) file

**From:** Bhupendra Patel, Senior Transportation Modeler

**Subject:** Technical Memorandum for AMBAG Regional Travel Demand Model (RTDM) Forecasting Methodology

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This memorandum is prepared in response to the comments on the 2010 Metropolitan Transportation (MTP) / Draft Supplemental Environmental Impact Report (DSEIR). The purpose of this memorandum is to summarize the differences in the traffic modeling assumptions and methodology used for the development of the AMBAG 2005 Metropolitan Transportation Plan (MTP) and those used for the Draft 2010 MTP. There is interest in understanding the differences between the modeling assumptions because reviewers have noted that there is a difference in the estimated *base year* Vehicle Miles Travel (VMT) between the two MTP's.

Due to substantial changes in the RTDM methodology and assumptions, there is a significant difference in the model's estimated Vehicle Miles Travel (VMT) for the AMBAG region for the year 2000 and 2005, base years for the 2005 MTP and 2010 MTP respectively (for VMT statistics please see Attachment A).

The following describes the chain of events and methodology/assumptions used for the AMBAG RTDM:

- During the time of 2005 MTP development (fall 2004) AMBAG used a hybrid approach to carryout the conformity /EIR analysis since the new TransCAD model was under development and not ready to use for such analysis. The current AMBAG RTDM is developed in the TransCAD software to represent and manage a very detailed transportation network and analyze more complex travel demand forecast modeling process.
- The MINUTP and FORTRAN files for the 2000 and 2025 analysis years of the 1990 Calibrated AMBAG Model was used and Vehicle Miles Travel (VMT) estimation for the base year 2000 was post processed to include the share of total VMT on lower volume links that was not assigned by the model. These links VMT were estimated separately, as they were not included in the MINUTP model network. The extrapolation and post processing of the VMT for the base year 2000 was reported of 18,205,127 VMT which is 8.36% higher than that of the Federal Highway

Administration's certified Highway Performance Monitoring System (HPMS) reported VMT of 16, 801, 000 (Attachment A & C).

- Each year, the Federal Highway Administration (FHWA) certifies Highway Performance Monitoring System (HPMS) report's VMT statistics that are often used to compare with modeled VMT estimates. According to the HPMS data both the 2005 and 2010 MTP VMT estimates are well within the accepted 10% range of the HPMS values for the AMBAG region for the model base years 2000 and 2005.
- AMBAG staff and consultant worked on additional model refinements between 2004 and 2007, including development of an improved user interface, adding interim years of analysis, incorporating more time period assignments capabilities and carried out the validation of the entire new model. AMBAG did not finalize the model revisions until early 2007.

### **2010 Metropolitan Transportation Plan (MTP)**

In conjunction with the 2010 MTP, the AMBAG model was updated to a 2005 base year. The recent model update, built upon the enhancements, added in the full base year 2000 TransCAD model. This is the first AMBAG MTP to use the TransCAD-based model. The 2005 base year AMBAG models have a number of advantages:

- Does not require off-model VMT adjustments because of added network and zonal details
- Calibrated to the 2001-02 household survey
- Uses 2000 Census demographic data
- Added trip generation details to be sensitive to income, age, auto ownership and household size
- Adds trucks as a separate vehicle class
- Adds Santa Clara County to the model

The 2005 base year model is performing well when compared to 527 count locations around the region. The model validation against counts shows 29.1% Root Mean Square Error (RMSE) and -1.9% count VMT error. Typically, complex large scale regional models (like the one for the AMBAG region) perform in the range from 35-40% RMSE. The system-wide modeled 2005 base year VMT estimate is consistent with the 2005 HPMS estimates (within -5%). The 2005 base year model also uses the latest AMBAG population and employment forecast, which is significantly different than that of previous model.

### **Conclusions**

AMBAG has more confidence in the current version of the AMBG Regional Travel Demand Model and its results. It is more robust and has been superseded with more up to date assumptions and methods as demonstrated above and in the attached model validation summary report (Attachment B). The current overall model validation when compared to local count data and HPMS statistics is exceptionally good.

AMBAG is continuing working on the transit model enhancements and several other components of the current RTDM and expected to be completed by September 30, 2010. This effort will be peer reviewed and a final model validation and associated technical report will be released for model user as well as general public.

Attachments:

- Attachment 1 – AMBAG Region: VMT trends 1999 to 2008 and 2035
- Attachment 2 – Summary of AMBAG 2005 Base Year Model Update
- Attachment 3 – VMT forecasts trend line chart

## Daily Vehicle Miles Traveled (DVMT)

## Highway Performance Monitoring System (HPMS)

Jurisdiction	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
MONTEREY	8,694,900	9,217,300	9,331,900	9,336,174	9,930,000	9,550,738	10,083,737	10,024,028	9,842,988	9,858,882	9,896,342	9,991,845	9,778,089	
SAN BENITO	1,139,600	1,164,600	1,244,100	1,236,084	1,462,000	1,450,965	1,440,795	1,499,057	1,448,116	1,445,072	1,483,230	1,394,031	1,387,044	
SANTA CRUZ	4,896,900	5,116,400	5,192,500	5,197,757	5,409,000	5,356,219	5,509,049	5,608,052	5,626,761	5,647,513	5,543,305	5,428,626	5,354,077	
AMBAG Region	14,731,400	15,498,300	15,768,500	15,770,014	16,801,000	16,357,923	17,033,581	17,131,137	16,917,864	16,951,467	16,922,877	16,814,502	16,519,209	
<b>AMBAG Model Results</b>					<b>2000#</b>					<b>2005*</b>				<b>2035*</b>
MONTEREY					10,474,977					9,228,000				14,998,565
SAN BENITO					1,670,631					1,555,000				3,229,073
SANTA CRUZ					6,059,519					5,292,000				7,451,192
AMBAG Region					18,205,127					16,075,000				25,678,830
% Difference					8.357					-5.170				

**HPMS Data Source:** California Department of Transportation, Transportation System Information Program, Office of Travel Forecasting & Analysis, Highway Inventory & Performance Branch

# DVMT- estimated using AMBAG RTDM and reported in the 2005 Metropolitan Transportation Plan (MTP).

\* DVMT- estimated using AMBAG RTDM and reported in the 2010 Metropolitan Transportation Plan (MTP)

## **Summary of AMBAG 2005 Base Year Model Update**

During late 2009, the AMBAG model was updated, bringing the base year from 2000 to 2005. The primary motivation behind the update project was to incorporate AMBAG's latest land use forecast into the model assumptions, and to use the updated model to analyze capacity projects for the 2010 MTP. The new forecast employment methodology represented a change from the previous model, and a large amount of the work involved in the update was related to this change. The model's network, trip generation, trip distribution, external trips, and truck trips were updated to reflect the new base and horizon year of the model. Overall model validation against count data improved from previous versions. Also, the model validates well against other sources such as HPMS. The following discussion summarizes the update process.

### **Validation to Traffic Counts**

After updating and calibrating each component of the model to match 2005 conditions, the model was validated against 2005 daily count data. The overall model validation achieved 29.03% Root Mean Square Error (RMSE), which is considered excellent, and represents an improved validation than in previous versions of the model. Results for both Monterey and Santa Cruz counties was better than the overall regional validation performance. Model validation was also checked by functional classification, by link type, by volume group, and by aggregate VMT and the model was found to be performing well. Those results are listed below.

**VALIDATION BY FUNCTIONAL CLASS BY COUNTY, BASE YEAR 2005 - AMBAG REGION**

**SANTA CRUZ**

	Functional Class						
Data	2	6	7	12	14	16	All
Number of Links	4	4	4	42	34	52	140
Avg. Pct. Loading Error	-6.3%	-18.7%	-29.9%	1.3%	-19.8%	-26.3%	-10.0%
Avg. Pct. VMT Error	-5.9%	-3.8%	-29.7%	0.3%	-18.4%	-16.9%	-3.4%
RMSE Error	6.7%	38.4%	45.1%	16.2%	30.7%	51.7%	27.8%

**SAN BENITO**

	Functional Class						
Data	2	6	7	12	14	16	All
Number of Links	7	11	3		2	7	30
Avg. Pct. Loading Error	1.0%	-30.5%	-19.8%		47.1%	-55.4%	-13.6%
Avg. Pct. VMT Error	-2.7%	-7.0%	-17.7%		145.5%	-70.4%	-5.8%
RMSE Error	34.7%	56.1%	23.4%		147.1%	86.5%	68.7%

**MONTEREY**

	Functional Class						
Data	2	6	7	12	14	16	All
Number of Links	92	58	29	45	66	46	336
Avg. Pct. Loading Error	-1.2%	3.9%	-49.3%	3.5%	-19.6%	-18.5%	-7.8%
Avg. Pct. VMT Error	-2.7%	2.0%	-50.7%	4.4%	-21.1%	-25.7%	-3.9%
RMSE Error	22.5%	40.5%	63.0%	14.2%	28.6%	33.3%	26.7%

**AMBAG REGION**

	Functional Class						
Data	2	6	7	12	14	16	All
Number of Links	111	74	36	89	105	112	527
Avg. Pct. Loading Error	1.4%	-3.5%	-45.0%	2.6%	-18.6%	-22.5%	-7.5%
Avg. Pct. VMT Error	0.4%	1.9%	-46.4%	2.5%	-19.0%	-22.1%	-1.9%
RMSE Error	26.0%	47.0%	60.7%	15.5%	31.1%	45.2%	29.1%

Table 3 – Validation by Functional Class by County

**Functional Classification System:**

- 2 Rural Other Principal Arterial
- 6 Rural Minor Arterial
- 7 Major Collector
- 12 Freeways & Expressways
- 14 Urban Other Principal Arterial
- 16 Urban Minor Arterial

**VALIDATION BY LINK TYPE, BASE YEAR 2005 - AMBAG REGION**

Data	LINK TYPE			
	FREEWAY	MULTILANE	TWO LANE	ALL
Number of Links	140	131	256	527
Avg. Pct. Loading Error	2.5%	-7.9%	-21.9%	-7.5%
Avg. Pct. VMT Error	1.7%	2.3%	-15.1%	-1.9%
RMSE Error	14.9%	29.5%	48.2%	29.1%

Table 4- Validation Results by Link Type

**VALIDATION BY VOLUME GROUP, BASE YEAR 2005 - AMBAG REGION**

Data	Volume Group							
	250	750	3000	7500	15000	35000	75000	ALL
Number of Links	4	15	82	91	141	184	10	527
Avg. Pct. Loading Error	130.7%	22.0%	-10.9%	-9.7%	-16.8%	-4.7%	2.6%	-7.5%
Avg. Pct. VMT Error	172.5%	14.2%	-13.5%	-2.6%	-10.8%	1.1%	3.7%	-1.9%
RMSE Error	146.7%	79.5%	77.6%	51.1%	30.7%	22.6%	5.8%	29.1%

Table 5 – Validation Results by Volume Group

**SUMMARY VMT VALIDATION STATISTICS - ONLY FOR LINKS WITH COUNTS  
YEAR 2005**

Data	COUNTY			
	MONTEREY	SAN BENITO	SANTA CRUZ	MODEL TOTAL
Sum of vmt model	3,446,396	164,900	1,300,103	4,911,398
Sum of vmt count	3,587,000	175,093	1,345,992	5,108,085
Error	(140,605)	(10,194)	(45,889)	(196,688)
Pct Error	-3.92%	-5.82%	-3.41%	-3.85%
Model/Count Ratio	96.1%	94.2%	96.6%	96.1%

Table 6 – Validation Results for VMT Error

**Comparing VMT with HPMS**

The AMBAG model is being used to estimate the impacts of various project scenarios in the development of the MTP. One of the major outputs from this process is an estimation of total VMT by county and for the region. Because these outputs are critical, the model was also subjected to a validation test against HPMS data. This VMT comparison is different that the one reported in Table 6 above. In Table 6, only links with traffic counts are used. In Table 7, the model was used to estimate all VMT in each of the three AMBAG counties. Table 7 shows that the updated AMBAG model is slightly underestimating VMT when compared to 2005 HPMS estimates, but results are within an acceptable level of error.

### AMBAG Vehicle Miles Travel (VMT) Forecasts

