

## MEMORANDUM

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Date: May 14, 2020

Project #:  
197520

To: Ms. Saravana Suthanthira  
Ms. Aleida Andrino-Chavez  
Alameda County Transportation Commission  
1111 Broadway, Suite 800  
Oakland, CA 94612

From: Mike Aronson

Project: Alameda Countywide Travel Model

Subject: Vehicle-Miles of Travel Methodology

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Calculations of vehicle-miles of travel (VMT) by transportation analysis zone have been prepared using the Alameda Countywide Travel Model. The calculations are provided for VMT per capita and VMT per employee. This memorandum describes the methodologies for the calculations.

### SUMMARY

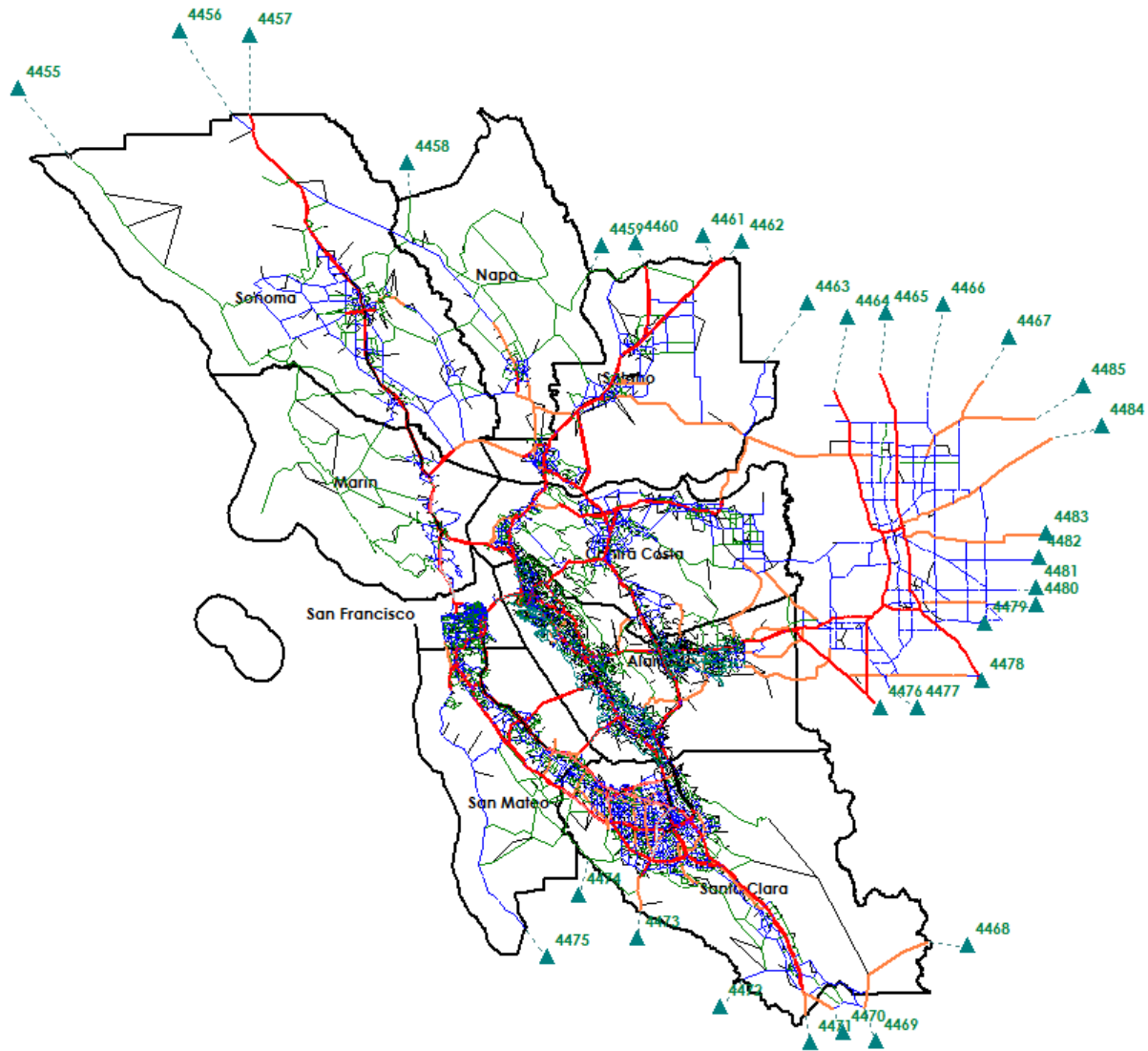
VMT per capita is calculated as the sum of VMT for home-based vehicle trips plus a prorated share of non-home trip VMT generated at the destinations of the home-based trips.

VMT per employee is calculated as the sum of home-based work VMT at the employment site.

### TRIP LENGTHS

Trip lengths are calculated between each transportation analysis zone (TAZ) and each other TAZ in the Alameda Countywide model (Figure 1). There are 1,580 TAZs within Alameda County, 1,230 in the other eight Bay Area counties, 26 in San Joaquin County and 31 external gateways. The distances are calculated along the shortest time path between each pair of TAZs under congested (AM peak period) conditions.

Figure 1: Alameda Countywide Model Study Area and Gateways



## External Trip Distance

The trip lengths used for VMT calculations include an estimated distance beyond each of the gateways external to the ten-county model area (**Error! Not a valid bookmark self-reference.**).

**Table 1: Alameda Countywide Model Gateway Distances**

Gateway TAZ	Road	County Line	Estimated Average Distance (miles)
4455	SR 1 N	Mendocino	50
4456	SR 128	Mendocino	67
4457	US 101 N	Mendocino	35
4458	SR 29	Lake	43
4459	SR 128	Yolo	25
4460	I-505	Yolo	75
4461	SR 113	Yolo	12
4462	I-80	Yolo	16
4463	SR 160	Sacramento	23
4464	I-5 N	Sacramento	27
4465	SR 99 N	Sacramento	27
4466	Dustin Rd	Sacramento	27
4467	SR 88	Amador	22
4468	SR 152 E	Merced	90
4469	SR 156	Santa Clara	7
4470	SR 25	San Benito	13
4471	US 101 S	San Benito	21
4472	SR 152 W	Santa Cruz	7
4473	SR 17	Santa Cruz	15
4474	SR 9	Santa Cruz	30
4475	SR 1 S	Santa Cruz	18
4476	I-5 S	Merced	150
4477	SR 33	Stanislaus	20
4478	SR 99 S	Stanislaus	103
4479	Escalon Rd	Stanislaus	8
4480	SR 120	Stanislaus	5
4481	Lone Tree Rd	Stanislaus	7
4482	Dodds Rd	Stanislaus	10
4483	SR 4	Calaveras	28
4484	SR 26	Calaveras	25
4485	SR 12	Calaveras	22

Most travel models used in the Bay Area do not include this external distance in their trip length and VMT calculations. The Santa Clara Valley Transportation Authority (VTA) model used for Santa Clara and San Mateo counties includes additional counties to the south (Monterey, San Benito, Santa Cruz) within its model area as well as the ten counties included in the Alameda Countywide model.

## VMT PER CAPITA

The VMT per capita calculations are intended to account for all VMT made by residents of a particular TAZ, divided by the population of that TAZ.

Total VMT by residents is calculated by multiplying vehicle trips between each pair of TAZs by the trip length between the pair of TAZs. This is done for the following trip purposes:

- Home-Work (4 income categories)
- Home-Shop/Other
- Home-Social/Recreational
- Home-Grade School
- Home-High School
- Home-College

The home-based VMT for residents is calculated by summing the VMT for the home end of each of these trip purposes to all of the possible destinations<sup>1</sup>. The VMT includes both trips from home and to home.

### Estimate of Resident VMT Away from Home

The Alameda Countywide model is a “trip-based” model, where trips between TAZs are estimated individually without tracking how some sequences of trips are made by the same person (or persons). An “activity-based” model such as the MTC regional model (Model One or Model Two) estimates sequences of trips (“tours”) made by individuals. Therefore, an activity-based model can identify trips made by residents of a TAZ even if the trips occur away from that TAZ, for example, a worker who goes out from their workplace to run an errand and stop for lunch. These trips away from home can be considered part of the VMT per capita generated at the home TAZ.

In order to estimate this VMT by residents away from their homes, the Alameda Countywide model includes an additional calculation. At each TAZ, the non-home-based trip VMT generated from that TAZ is allocated to home TAZs based on the proportions of home-based trips that have their destination (non-home end) at that TAZ. For example, if TAZ 1280 has an office building that generates 2,000 VMT in non-home-based trips for lunches and errands, and TAZ 462 generates 2 percent of the trips that travel from home to TAZ 1280, then 40 non-home VMT ( $2000 * 2\%$ ) will be allocated to the residents of TAZ 462.

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<sup>1</sup> The vehicle trip matrices are in Production-Attraction format, so the home-based VMT can be calculated by summing the rows which correspond to the Production TAZ.

## Total VMT per Capita

The total VMT per capita for each TAZ is calculated as:

$$(\text{Home-Based VMT at TAZ} + \text{Share of Non-Home VMT Allocated to TAZ}) / \text{Population in TAZ}$$

## VMT PER EMPLOYEE

The VMT per employee calculations are intended to account for VMT generated by employees at their workplace.

An activity-based model can track all of the trips made by an employee, including their commute trips to and from home as well as other trips made from the workplace. The trip-based model does not provide a way to allocate trips made by employees from the workplace, as it is not known if non-home-based trips are made by employees or by visitors. Therefore, only the commute trips between home and workplaces are included.

VMT by employees is calculated by multiplying vehicle trips between each pair of TAZs by the trip length between the pair of TAZs. This is done for the following trip purposes:

- Home-Work (4 income categories)

The home-based VMT for residents is calculated by summing the VMT for the workplace end of each of these home-work trip purposes from all of the possible home origins<sup>2</sup>. The VMT includes both trips from home to work and from work to home.

## Total VMT per Employee

The total VMT per employee for each TAZ is calculated as:

$$(\text{Home-Based VMT at Workplace TAZ}) / \text{Total Employment in TAZ}$$

## VMT RESULTS

The average VMT per capita and per employee for cities, planning areas and counties are summarized for 2020 (Table 2) and 2040 (Table 3). The results are also available by individual TAZ in spreadsheet and GIS formats.

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<sup>2</sup> The vehicle trip matrices are in Production-Attraction format, so the workplace-based VMT can be calculated by summing the columns which correspond to the Attraction TAZ.

**Table 2: Alameda Countywide Model 2020 VMT by Subarea**

**2020 VMT by City**

City	Population	Household VMT	VMT/Capita	Employment	Employee VMT	VMT/Employee
Alameda	86,244	1,362,245	15.8	36,305	673,324	18.5
Alameda County	13,472	602,318	44.7	3,661	111,504	30.5
Albany	19,456	270,493	13.9	5,110	120,066	23.5
Ashland	28,430	454,897	16.0	3,208	67,641	21.1
Berkeley	127,833	1,459,680	11.4	115,388	1,453,955	12.6
Castro Valley	58,630	1,575,810	26.9	13,288	314,321	23.7
Cherryland	11,913	194,921	16.4	1,752	38,575	22.0
Dublin	58,427	1,526,862	26.1	20,454	265,593	13.0
Emeryville	12,594	129,726	10.3	19,091	274,685	14.4
Fremont	230,820	5,474,670	23.7	101,664	1,793,599	17.6
Hayward	167,507	3,446,296	20.6	68,866	1,246,586	18.1
Livermore	85,233	2,876,580	33.7	55,843	908,346	16.3
Newark	48,985	1,107,558	22.6	19,887	337,636	17.0
Oakland	478,718	6,336,819	13.2	236,135	3,414,749	14.5
Piedmont	10,648	200,082	18.8	2,034	48,235	23.7
Pleasanton	81,011	2,297,799	28.4	67,765	990,527	14.6
San Leandro	96,880	1,692,026	17.5	54,274	998,309	18.4
San Lorenzo	29,187	569,151	19.5	4,781	108,877	22.8
Union City	73,980	1,754,198	23.7	24,352	374,641	15.4
<b>Total</b>	<b>1,719,968</b>	<b>33,332,131</b>	<b>19.4</b>	<b>853,858</b>	<b>13,541,168</b>	<b>15.9</b>

**2020 VMT by County Planning Area**

Planning Area	Population	VMT_HH	VMT/Capita	Employment	VMT_EMP	VMT/Employee
Central	404,322	8,330,014	20.6	148,335	2,842,557	19.2
East	227,582	6,939,927	30.5	145,829	2,214,883	15.2
North	735,493	9,759,046	13.3	414,063	5,985,014	14.5
South	352,571	8,303,145	23.6	145,631	2,498,715	17.2
<b>Total</b>	<b>1,719,968</b>	<b>33,332,131</b>	<b>19.4</b>	<b>853,858</b>	<b>13,541,168</b>	<b>15.9</b>

**2020 VMT by County**

County	Population	Household VMT	VMT/Capita	Employment	Employee VMT	VMT/Employee
San Francisco	958,402	9,720,053	10.1	774,257	9,403,259	12.1
San Mateo	795,882	11,817,493	14.8	406,819	8,977,086	22.1
Santa Clara	1,981,950	31,076,451	15.7	1,103,369	23,112,962	20.9
Alameda	1,719,968	33,332,131	19.4	853,858	13,541,168	15.9
Contra Costa	1,128,020	28,279,110	25.1	428,097	7,751,791	18.1
Solano	427,561	12,741,875	29.8	140,104	2,755,024	19.7
Napa	141,239	4,202,415	29.8	71,607	1,596,652	22.3
Sonoma	501,300	18,702,401	37.3	227,575	4,489,186	19.7
Marin	260,774	7,073,451	27.1	133,725	3,182,795	23.8
<b>Total</b>	<b>7,915,096</b>	<b>156,945,380</b>	<b>19.8</b>	<b>4,139,411</b>	<b>74,809,923</b>	<b>18.1</b>

**Table 3: Alameda Countywide Model 2040 VMT by Subarea**

**2040 VMT by City**

City	Population	Household VMT	VMT/Capita	Employment	Employee VMT	VMT/Employee
Alameda	95,451	1,481,856	15.5	42,793	784,739	18.3
Alameda County	14,951	607,768	40.7	3,356	106,172	31.6
Albany	20,684	296,838	14.4	5,313	128,467	24.2
Ashland	31,245	495,916	15.9	3,381	76,696	22.7
Berkeley	141,229	1,617,236	11.5	121,710	1,566,754	12.9
Castro Valley	63,012	1,594,380	25.3	13,641	309,278	22.7
Cherryland	13,530	214,462	15.9	1,702	39,848	23.4
Dublin	80,567	1,928,070	23.9	28,752	390,985	13.6
Emeryville	34,640	279,816	8.1	19,818	297,394	15.0
Fremont	279,534	5,696,285	20.4	118,617	2,093,184	17.6
Hayward	188,515	3,556,157	18.9	75,880	1,423,579	18.8
Livermore	111,523	3,606,029	32.3	53,083	861,662	16.2
Newark	51,768	1,055,939	20.4	22,871	412,749	18.0
Oakland	632,032	7,608,601	12.0	273,838	4,113,381	15.0
Piedmont	11,222	201,917	18.0	1,905	50,586	26.6
Pleasanton	91,844	2,424,144	26.4	74,589	1,209,697	16.2
San Leandro	108,465	1,822,008	16.8	53,925	938,059	17.4
San Lorenzo	31,412	582,257	18.5	5,038	119,863	23.8
Union City	81,258	1,682,360	20.7	28,575	419,408	14.7
<b>Total</b>	<b>2,082,882</b>	<b>36,752,038</b>	<b>17.6</b>	<b>948,787</b>	<b>15,342,500</b>	<b>16.2</b>

**2040 VMT by County Planning Area**

Planning Area	Population	VMT_HH	VMT/Capita	Employment	VMT_EMP	VMT/Employee
Central	449,474	8,688,886	19.3	155,296	2,965,019	19.1
East	286,842	8,172,267	28.5	158,268	2,516,869	15.9
North	935,258	11,486,264	12.3	465,377	6,941,322	14.9
South	411,308	8,404,621	20.4	169,846	2,919,290	17.2
<b>Total</b>	<b>2,082,882</b>	<b>36,752,038</b>	<b>17.6</b>	<b>948,787</b>	<b>15,342,500</b>	<b>16.2</b>

**2040 VMT by County**

County	Population	Household VMT	VMT/Capita	Employment	Employee VMT	VMT/Employee
San Francisco	1,167,689	11,650,405	10.0	872,499	10,136,949	11.6
San Mateo	915,365	12,471,097	13.6	472,056	10,593,123	22.4
Santa Clara	2,532,772	36,180,473	14.3	1,289,874	26,377,230	20.4
Alameda	2,082,882	36,752,038	17.6	948,787	15,342,500	16.2
Contra Costa	1,385,902	33,135,623	23.9	497,765	9,229,910	18.5
Solano	509,796	15,238,660	29.9	150,981	3,150,727	20.9
Napa	158,040	4,787,877	30.3	83,364	2,121,900	25.5
Sonoma	596,627	25,597,907	42.9	243,588	5,252,439	21.6
Marin	277,254	7,730,790	27.9	134,960	3,326,875	24.7
<b>Total</b>	<b>9,626,327</b>	<b>183,544,870</b>	<b>19.1</b>	<b>4,693,874</b>	<b>85,531,653</b>	<b>18.2</b>