SECTION 7.13

WINDBLOWN DUST - UNPAVED ROADS

(Updated August 1997)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Fugitive Windblown Dust

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
650-652-5400-0000 (83352) Windblown Dust - Unpaved Roads

METHODS AND SOURCES

This source category provides estimates of the fugitive dust emissions resulting from wind erosion of soil from unpaved roads. The emissions are estimated for each county based on the unpaved road mileage and local parameters that affect wind erosion. Table 1 summarizes TSP and PM_{10} emissions for windblown dust from unpaved roads.

OVERVIEW OF ESTIMATION METHODOLOGY

Windblown dust emissions from unpaved roads are computed by using an equation which estimates the overall wind related soil erosion from the road. The results from this equation are then scaled to estimate the portion of the eroded soil that is entrained to the air. The soil erosion and emissions calculations are based on the estimated number of unpaved road miles in each county. The mileage data are based on reports compiled by Caltrans.

EMISSIONS ESTIMATION METHODOLOGY

Emission Factor. The emission factor used for our estimates of geologic dust emissions from wind erosion of unpaved road material is based on an equation developed by the U.S. Department of Agriculture.[1] The equation was originally derived in the 1960's to predict topsoil losses from agricultural fields. In 1974, the equation was modified by Midwest Research Institute (MRI)[2] to estimate the quantity of the eroded soil that is entrained to the air. This was done by simplifying the original equation somewhat, and scaling the results it provides to estimate the total particulate emissions suspended to the air. The total suspended particulate (TSP) emission factor equation is as follows:

$$E_s = a\ I\ C\ K\ L'\ V'$$

where: Es = the quantity of unpaved road dust entrained to the air by wind erosion, tons TSP/acre/year
a = portion of the total roadway wind erosion losses that are assumed to be suspended into the air; estimated to be 0.038 for TSP[3] which is PM_{30}
I = soil erodibility, tons/acre/year
C = climatic factor, dimensionless
K = surface roughness factor, dimensionless
L' = unsheltered field width factor, dimensionless
V' = vegetative cover factor, dimensionless

In summary, the 'I' term in the windblown dust equation provides an estimate of the soil erosion from an area that is large, flat, bare, and highly erodible. The additional terms in the equation reduce emissions from this worst-case scenario. The climatic, C, factor helps to account for regional differences in wind and rainfall. If a surface is rough, as represented by K, soil erosion is decreased. If the length of the erodible area parallel to the wind is short, then the erosion is decreased, as represented by the L' factor. If there is crop residue on the erodible area, then erosion is further decreased by the V' factor. The following paragraphs describe each parameter in further detail.

Entrained Soil Factor - a. This factor was derived by Midwest Research Institute, and it is the estimated quantity of the total eroded material that actually gets suspended to the air. Roughly, this corresponds to the 30 micron size and smaller particles, which are know as TSP. The default 'a' value is 0.038 for unpaved roads.[3]

Soil Erodibility - I. The soil erodibility, I, of an unpaved road is related to the soil type of the road surface. Because roadway soil types are not readily available, the county specific, average soil types are used to estimate the erodibility. The county soil types are computed using a geographic information system (GIS) to average detailed county soil profile maps provided by the Natural Resources Conservation Service.[4] This approach assumes that unpaved road surfaces have the same soil characteristics as the base soils in the vicinity of the roadway. The 'I' factors used for each county are listed in Table 2.

Climatic Factor - C. The rate of soil erosion varies directly with the wind velocity and inversely with the soil surface moisture. The climatic factor is used to adjust for these parameters. ARB staff computed the county 'C' factors based on regional rainfall and windspeed data measured in California.[5] The 'C' factors used for each county are provided in Table 2.

Surface Roughness - K. Surface roughness can help to reduce soil erosion. The 'K' factor is used to account for ridges or furrows that help to minimize wind related erosion. Because most unpaved roads are flat, the surface roughness factor is assumed to be 1.0,

indicating no reduction in emissions due to surface texture.

Unsheltered Field Width Factor - L'. Soil erosion is directly related to the unprotected width of the area in the prevailing wind direction. For unpaved roads, depending on the wind direction, the width of the erosive area parallel to the wind direction could be very narrow, very long, or somewhere in between. For an effective L' factor, it may be assumed that wind direction is equally distributed for all roads. Based on an EPA report[3], the average value of L' for a specified erodibility ranges from 0.29 to 0.34. For this category, the approximate midpoint of 0.32 is used for the L' factor.

Vegetative Cover Factor - V'. Vegetative cover reduces soil erosion. For unpaved roads, it is assumed that there is no vegetative cover, therefore a value of 1.0 is used.

By applying the listed parameters to the windblown dust emission factor equation, emission factors for each California county are computed. The county input parameters and the resulting emission factors are listed in Table 2. Table 2 also includes TSP and PM_{10} emission factors. Based on analysis of resuspended California soil samples[6], it was estimated that 50% of the total suspended particulates (TSP) from unpaved road windblown dust is PM_{10} or less.

Activity Data. Activity data for the windblown dust emission factor equation is based on the acreage of erodible land. Using estimates of unpaved road mileage in each county and an average unpaved road width of 20 feet, the acres of unpaved roads in each county are computed. The unpaved road mileage was developed from the Caltrans, "Assembly of Statistical Reports" documents.[7] The ARB's unpaved road dust background document[8] describes how the road mileages were derived from the Caltrans data. Table 2 summarizes the road mileage and the resulting acreage for each county. This methodology does not include windblown dust from agricultural unpaved roads. It is assumed that windblown emissions from agricultural unpaved roads are included in the source category for windblown dust from agricultural lands.

TEMPORAL ACTIVITY AND GROWTH

Windblown dust emissions may occur 24 hours per day, 7 days per week. Monthly activity varies by county and is based on the climatic factors for each county. The fraction of estimated monthly windblown dust for each county is provided in Table 3. In general, emissions are smaller when there is less wind and when there is more rain. Future projections of unpaved road windblown dust emissions are related to the miles of unpaved road. Because this information is not readily available, forecasts are based on population increases or other factors.

ASSUMPTIONS AND LIMITATIONS

1. It is assumed that the unpaved road soil characteristics are approximately the same as the soils in the vicinity of the unpaved road that are not used for vehicular travel. This implies that no additional gravel or other treatments have been applied to the unpaved roads.

2. This methodology assumes that the soil wind erosion equation may be reasonably applied to estimate windblown dust from unpaved roads. Because of the large differences between unpaved road surfaces and agricultural lands, the validity of this assumption is questionable.

3. Using the soil erosion equation, it is assumed that 3.8% of the total eroded material is entrained to the air. ('a' factor = 0.038)

4. It is assumed that the county average soil erodibility, 'I', and climatic, 'C', factors are representative (on average) of the overall county conditions.

5. It is assumed that a value of 0.32 for the unsheltered width factor, L', is valid.

6. It is assumed that unpaved roads have no vegetative cover and are essentially flat.

7. The typical unpaved road width is 20 feet.

8. This methodology assumes no extraordinary windstorm activity; only average annual conditions are estimated.

CHANGES IN THE METHODOLOGY

There were several changes made to the unpaved road windblown dust methodology for this update. They are:

- Update of the unpaved road mileage to reflect 1993 conditions.
- Incorporation of new county climatic, 'C', factors based on improved region specific data.
- Use of updated, region specific, erodibility factors, 'I', based on analysis of digitized soil characteristic data.
- The average unpaved road width was changed from 25 to 20 feet based on review of Caltrans data.
- The seasonal profile was updated to reflect the expected changes in windblown dust emissions based on average winds and precipitation.

COMMENTS AND RECOMMENDATIONS

The methodology for estimating windblown dust is built on a foundation of dubious

assumptions. Because of the differences between unpaved roads and agricultural lands, it is unlikely that the agricultural soil erosion equation provides very accurate estimates of windblown road dust. The emissions estimates could be improved by performing limited wind tunnel tests on unpaved roads, and then extrapolating the resulting emission factors to the remainder of the State. With the use of geographic information systems, it is also possible to incorporate localized climatological and soil texture properties into the emission estimates. In addition, the mileage of unpaved roads could be improved using available digital maps which include public, as well as private unpaved roads.

SAMPLE CALCULATIONS

The instructions and associated table below provide an example of estimating the windblown dust from unpaved roads in Inyo county.

Step 1: Emission Factor. Using the wind erosion equation, compute the emission factor. Table 2 summarizes the input parameters and the TSP and PM_{10} emission factors for each county in California.

Step 2: Miles of Road. From Table 1 or Table 2, find the county road mileage.

Step 3: Acres of Road. Convert the miles of road to acres of erodible road surface by multiplying the miles of road by 2.42. The conversion factor is computed by first converting the road mileage to square feet per mile. In this case, each mile of road is 105,600 ft^2/mile *(i.e., 20 feet x 5280 feet/mile = 105,600 ft^2/mile)*. Next, converting to acres *(i.e., 105,600 ft^2/mile x 1 acre/43,560 ft^2 = 2.42 acres/mile)*, produces the conversion factor of 2.42 acres/mile of road.

Step 4: Compute Emissions. Multiply the county emission factor by miles of road to compute the emissions, then divide by 2000 lbs/ton to compute the annual tons. *Emissions = (Emission Factor x Acres of Road)/2000*. Convert to PM_{10} by multiplying the TSP emissions by 0.5.

Estimating Windblown Unpaved Road Dust Emissions in Inyo County

Step 1	Emission Factor	1778
Step 2	Miles of Road	1600
Step 3	Acres of Road	3879
Step 4	TSP Emissions *(tons TSP/year)*	3448
	PM_{10} Emissions *(tons PM_{10}/year)*	1724

REFERENCES

1. Woodruff, N.P., Siddoway, F.H. A Wind Erosion Equation. Soil Science Society of America Proceedings, Vol. 29, No. 5, September-October 1965, pages 602-608, Madison, Wisconsin. (Report provided in: Investigation of Fugitive Dust - Sources, Emissions, and Control. PEDCo- Environmental Specialists. Prepared for EPA. Contract No. 68-02-0044, OAQPS. May 1993.)

2. Cowherd, Chatten, et al. Development of Emission Factors for Fugitive Dust Sources. Midwest Research Institute for U.S. EPA, OAQPS, Contract No. 68-02-0619. EPA-450/3-74-037. June 1974.

3. EPA. Guideline for Development of Control Strategies in Areas With Fugitive Dust Problems. EPA 450/2-77-029. U.S. Environmental Protection Agency, Research Triangle Park. October 1977. L' factor from Table 3-7 (L' value from previous 1989 methodology, not verified.)

4. Soil Analysis performed by Skip Campbell, California Air Resources Board, using STATSGO data layers from the NRCS. 1997.

5. Climatic Factor derivation by Steve Francis, California Air Resources Board, using California regional meteorological data. 1997. See also Section 7.12 of this document, Windblown Dust from Agricultural Lands, for further information.

6. Houck, J.E., Chow, J.C., Watson, J.G., et al. Determination of Particle Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California, Final Report. Desert Research Institute & OMNI Environmental. Prepared for California Air Resources Board. Agreement No. A6-175-32. June 30, 1989.

7. California Department of Transportation. Assembly of Statistical Reports, 1992, and Assembly of Statistical Reports, 1993. California Public Road Data Including Highway Performance Monitoring System (HPMS) Data. February 1994 and January 1995.

8. Gaffney, Patrick. Entrained Dust from Unpaved Road Travel, Emission Estimation Methodology, Background Document. California Air Resources Board. September 1997.

UPDATED BY

Patrick Gaffney
August 1997

Table 1
1993 Windblown Dust from Unpaved Roads

AB	CO	County	Unpaved Road Mileage	Unpaved Road Acreage	TSP Emissions (tons/year)	PM_{10} Emissions (tons/year)
GBV	2	ALPINE	115.4	279.8	14.6	7.3
	14	INYO	1600.0	3878.8	3447.8	1723.9
	26	MONO	1696.6	4113.0	560.2	280.1
LC	17	LAKE	468.3	1135.3	59.4	29.7
LT	9	EL DORADO	71.2	172.7	9.0	4.5
	31	PLACER	40.1	97.2	5.1	2.5
MC	3	AMADOR	258.9	627.6	32.8	16.4
	5	CALAVERAS	442.7	1073.2	56.1	28.1
	9	EL DORADO	522.4	1266.4	66.2	33.1
	22	MARIPOSA	480.5	1164.9	60.9	30.5
	29	NEVADA	587.7	1424.7	74.5	37.3
	31	PLACER	244.7	593.1	31.0	15.5
	32	PLUMAS	965.1	2339.6	122.3	61.2
	46	SIERRA	768.9	1864.0	97.5	48.7
	55	TUOLUMNE	336.8	816.5	42.7	21.4
NC	8	DEL NORTE	301.9	731.9	38.3	19.1
	12	HUMBOLDT	897.3	2175.3	113.7	56.9
	23	MENDOCINO	974.9	2363.4	123.6	61.8
	49	SONOMA	44.0	106.6	3.6	1.8
	53	TRINITY	1180.7	2862.3	149.7	74.8
NCC	27	MONTEREY	309.0	749.1	104.2	52.1
	35	SAN BENITO	413.7	1002.9	137.4	68.7
	44	SANTA CRUZ	362.3	878.3	17.5	8.7
NEP	18	LASSEN	1368.8	3318.3	173.5	86.8
	25	MODOC	1107.7	2685.3	421.2	210.6
	47	SISKIYOU	953.8	2312.2	120.9	60.5
SC	19	LOS ANGELES	716.5	1736.8	110.8	55.4
	30	ORANGE	24.3	58.9	2.5	1.2
	33	RIVERSIDE	231.3	560.7	486.5	243.2
	36	SAN BERNARDINO	157.4	381.6	508.4	254.2
SCC	40	SAN LUIS OBISPO	647.0	1568.5	93.5	46.8
	42	SANTA BARBARA	154.2	373.8	10.2	5.1
	56	VENTURA	120.0	290.9	18.6	9.3
SD	37	SAN DIEGO	1329.0	3221.8	133.8	66.9
SED	13	IMPERIAL	1333.7	3233.2	4307.6	2153.8
	15	KERN	453.8	1100.1	189.8	94.9
	19	LOS ANGELES	337.2	817.3	52.1	26.1
	33	RIVERSIDE	658.3	1595.9	1384.5	692.3
	36	SAN BERNARDINO	2466.1	5978.4	7965.0	3982.5
SF	1	ALAMEDA	43.3	105.0	2.1	1.0
	7	CONTRA COSTA	65.9	159.8	3.2	1.6
	21	MARIN	88.6	214.8	4.3	2.1
	28	NAPA	24.9	60.4	5.4	2.7
	38	SAN FRANCISCO	0.2	0.5	0.0	0.0
	39	SAN MATEO	122.7	297.5	5.9	3.0
	43	SANTA CLARA	482.1	1168.7	160.1	80.1
	48	SOLANO	28.8	69.8	3.2	1.6
	49	SONOMA	28.1	68.2	2.3	1.2
SJV	10	FRESNO	1742.2	4223.5	851.3	425.6
	15	KERN	964.3	2337.7	342.4	171.2
	16	KINGS	76.6	185.7	40.0	20.0
	20	MADERA	291.3	706.2	126.8	63.4
	24	MERCED	608.6	1475.4	336.8	168.4
	39	SAN JOAQUIN	398.3	965.6	75.6	37.8
	50	STANISLAUS	60.1	145.7	21.5	10.7
	54	TULARE	391.5	949.1	79.5	39.8
SV	4	BUTTE	568.8	1378.9	29.1	14.6
	6	COLUSA	319.6	774.8	50.2	25.1
	11	GLENN	215.2	521.7	31.6	15.8
	31	PLACER	116.3	282.0	14.7	7.4
	34	SACRAMENTO	556.7	1349.6	36.3	18.1
	45	SHASTA	1140.0	2763.6	150.3	75.1
	48	SOLANO	115.1	279.1	12.6	6.3
	51	SUTTER	144.8	351.0	18.0	9.0
	52	TEHAMA	600.1	1454.8	80.6	40.3
	57	YOLO	137.1	332.4	25.7	12.9
	58	YUBA	213.0	516.4	15.7	7.8
		Totals	34686	84088	23872	11936

PM Fraction: PM_{10} = TSP x 0.5 (TSP Emissions = PM_{10}/0.5)

Table 2
Emission Factors for Windblown Dust from Unpaved Roads*

Air Basin	CO #	County	Unpaved Road Miles	Unpaved Road Acres	Emission Factor Terms**						TSP		PM_{10}	
					(a)	(I)	©	(K)	('L)	(V)	Ems Fctr (lbs/acre/yr)	Emissions (tons/year)	Ems Fctr (lbs/mile)	Emissions (tons/year)
GBV	2	ALPINE	115	280	0.038	86	0.050	1.00	0.32	1.00	105	14.6	127	7.3
	14	INYO	1600	3879	0.038	86	0.850	1.00	0.32	1.00	1778	3447.8	2155	1723.9
	26	MONO	1697	4113	0.038	56	0.200	1.00	0.32	1.00	272	560.2	330	280.1
LC	17	LAKE	468	1135	0.038	86	0.050	1.00	0.32	1.00	105	59.4	127	29.7
LT	9	EL DORADO	71	173	0.038	86	0.050	1.00	0.32	1.00	105	9.0	127	4.5
	31	PLACER	40	97	0.038	86	0.050	1.00	0.32	1.00	105	5.1	127	2.5
MC	3	AMADOR	259	628	0.038	86	0.050	1.00	0.32	1.00	105	32.8	127	16.4
	5	CALAVERAS	443	1073	0.038	86	0.050	1.00	0.32	1.00	105	56.1	127	28.1
	9	EL DORADO	522	1266	0.038	86	0.050	1.00	0.32	1.00	105	66.2	127	33.1
	22	MARIPOSA	481	1165	0.038	86	0.050	1.00	0.32	1.00	105	60.9	127	30.5
	29	NEVADA	588	1425	0.038	86	0.050	1.00	0.32	1.00	105	74.5	127	37.3
	31	PLACER	245	593	0.038	86	0.050	1.00	0.32	1.00	105	31.0	127	15.5
	32	PLUMAS	965	2340	0.038	86	0.050	1.00	0.32	1.00	105	122.3	127	61.2
	46	SIERRA	769	1864	0.038	86	0.050	1.00	0.32	1.00	105	97.5	127	48.7
	55	TUOLUMNE	337	816	0.038	86	0.050	1.00	0.32	1.00	105	42.7	127	21.4
NC	8	DEL NORTE	302	732	0.038	86	0.050	1.00	0.32	1.00	105	38.3	127	19.1
	12	HUMBOLDT	897	2175	0.038	86	0.050	1.00	0.32	1.00	105	113.7	127	56.9
	23	MENDOCINO	975	2363	0.038	86	0.050	1.00	0.32	1.00	105	123.6	127	61.8
	49	SONOMA	44	107	0.038	56	0.050	1.00	0.32	1.00	68	3.6	83	1.8
	53	TRINITY	1181	2862	0.038	86	0.050	1.00	0.32	1.00	105	149.7	127	74.8
NCC	27	MONTEREY	309	749	0.038	86	0.133	1.00	0.32	1.00	278	104.2	337	52.1
	35	SAN BENITO	414	1003	0.038	86	0.131	1.00	0.32	1.00	274	137.4	332	68.7
	44	SANTA CRUZ	362	878	0.038	86	0.019	1.00	0.32	1.00	40	17.5	48	8.7
NEP	18	LASSEN	1369	3318	0.038	86	0.050	1.00	0.32	1.00	105	173.5	127	86.8
	25	MODOC	1108	2685	0.038	86	0.150	1.00	0.32	1.00	314	421.2	380	210.6
	47	SISKIYOU	954	2312	0.038	86	0.050	1.00	0.32	1.00	105	120.9	127	60.5
SC	19	LOS ANGELES	716	1737	0.038	86	0.061	1.00	0.32	1.00	128	110.8	155	55.4
	30	ORANGE	24	59	0.038	56	0.061	1.00	0.32	1.00	83	2.5	101	1.2
	33	RIVERSIDE	231	561	0.038	56	1.274	1.00	0.32	1.00	1735	486.5	2103	243.2
	36	SAN BERNARDINO	157	382	0.038	86	1.274	1.00	0.32	1.00	2665	508.4	3230	254.2
SCC	40	SAN LUIS OBISPO	647	1568	0.038	86	0.057	1.00	0.32	1.00	119	93.5	145	46.8
	42	SANTA BARBARA	154	374	0.038	56	0.040	1.00	0.32	1.00	54	10.2	66	5.1
	56	VENTURA	120	291	0.038	86	0.061	1.00	0.32	1.00	128	18.6	155	9.3
SD	37	SAN DIEGO	1329	3222	0.038	56	0.061	1.00	0.32	1.00	83	133.8	101	66.9
SED	13	IMPERIAL	1334	3233	0.038	86	1.274	1.00	0.32	1.00	2665	4307.6	3230	2153.8
	15	KERN	454	1100	0.038	86	0.165	1.00	0.32	1.00	345	189.8	418	94.9
	19	LOS ANGELES	337	817	0.038	86	0.061	1.00	0.32	1.00	128	52.1	155	26.1
	33	RIVERSIDE	658	1596	0.038	56	1.274	1.00	0.32	1.00	1735	1384.5	2103	692.3
	36	SAN BERNARDINO	2466	5978	0.038	86	1.274	1.00	0.32	1.00	2665	7965.0	3230	3982.5
SF	1	ALAMEDA	43	105	0.038	86	0.019	1.00	0.32	1.00	40	2.1	48	1.0
	7	CONTRA COSTA	66	160	0.038	86	0.019	1.00	0.32	1.00	40	3.2	48	1.6
	21	MARIN	89	215	0.038	86	0.019	1.00	0.32	1.00	40	4.3	48	2.1
	28	NAPA	25	60	0.038	56	0.131	1.00	0.32	1.00	178	5.4	216	2.7
	38	SAN FRANCISCO	0	0	0.038	86	0.019	1.00	0.32	1.00	40	0.0	48	0.0
	39	SAN MATEO	123	297	0.038	86	0.019	1.00	0.32	1.00	40	5.9	48	3.0
	43	SANTA CLARA	482	1169	0.038	86	0.131	1.00	0.32	1.00	274	160.1	332	80.1
	48	SOLANO	29	70	0.038	47	0.079	1.00	0.32	1.00	90	3.2	109	1.6
	49	SONOMA	28	68	0.038	56	0.050	1.00	0.32	1.00	68	2.3	83	1.2
SJV	10	FRESNO	1742	4224	0.038	65	0.255	1.00	0.32	1.00	403	851.3	489	425.6
	15	KERN	964	2338	0.038	73	0.165	1.00	0.32	1.00	293	342.4	355	171.2
	16	KINGS	77	186	0.038	75	0.236	1.00	0.32	1.00	430	40.0	522	20.0
	20	MADERA	291	706	0.038	69	0.214	1.00	0.32	1.00	359	126.8	435	63.4
	24	MERCED	609	1475	0.038	76	0.247	1.00	0.32	1.00	457	336.8	553	168.4
	39	SAN JOAQUIN	398	966	0.038	74	0.087	1.00	0.32	1.00	157	75.6	190	37.8
	50	STANISLAUS	60	146	0.038	70	0.173	1.00	0.32	1.00	295	21.5	357	10.7
	54	TULARE	392	949	0.038	65	0.106	1.00	0.32	1.00	168	79.5	203	39.8
SV	4	BUTTE	569	1379	0.038	56	0.031	1.00	0.32	1.00	42	29.1	51	14.6
	6	COLUSA	320	775	0.038	86	0.062	1.00	0.32	1.00	130	50.2	157	25.1
	11	GLENN	215	522	0.038	86	0.058	1.00	0.32	1.00	121	31.6	147	15.8
	31	PLACER	116	282	0.038	86	0.050	1.00	0.32	1.00	105	14.7	127	7.4
	34	SACRAMENTO	557	1350	0.038	47	0.047	1.00	0.32	1.00	54	36.3	65	18.1
	45	SHASTA	1140	2764	0.038	86	0.052	1.00	0.32	1.00	109	150.3	132	75.1
	48	SOLANO	115	279	0.038	47	0.079	1.00	0.32	1.00	90	12.6	109	6.3
	51	SUTTER	145	351	0.038	86	0.049	1.00	0.32	1.00	102	18.0	124	9.0
	52	TEHAMA	600	1455	0.038	86	0.053	1.00	0.32	1.00	111	80.6	134	40.3
	57	YOLO	137	332	0.038	86	0.074	1.00	0.32	1.00	155	25.7	188	12.9
	58	YUBA	213	516	0.038	86	0.029	1.00	0.32	1.00	61	15.7	74	7.8
		TOTALS	34686	84088								23872		11936

*Emission factors are provided both in units of pounds per acre for TSP and pounds per mile for PM_{10}. This was done just to provide flexibility in estimating emissions. The TSP emission factor can be converted to a PM_{10} emission factor by multiplying it by 0.5.

**For further information about these parameters, refer to the section of this methodology about the emission factor.

Table 3
Seasonal Profile for Unpaved Road Windblown Dust Emissions

Basin	Co #	County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GBV	2	ALPINE	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	14	INYO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	26	MONO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
LC	17	LAKE	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
LT	9	EL DORADO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	31	PLACER	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
MC	3	AMADOR	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	5	CALAVERAS	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	9	EL DORADO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	22	MARIPOSA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	29	NEVADA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	31	PLACER	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	32	PLUMAS	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	46	SIERRA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	55	TUOLUMNE	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
NC	8	DEL NORTE	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	12	HUMBOLDT	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	23	MENDOCINO	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	49	SONOMA	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	53	TRINITY	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
NCC	27	MONTEREY	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	35	SAN BENITO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	44	SANTA CRUZ	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
NEP	18	LASSEN	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	25	MODOC	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	47	SISKIYOU	0.024	0.022	0.023	0.084	0.093	0.151	0.151	0.151	0.151	0.082	0.040	0.031
SC	19	LOS ANGELES	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
	30	ORANGE	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
	33	RIVERSIDE	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
	36	SAN BERNARDINO	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
SCC	40	SAN LUIS OBISPO	0.020	0.023	0.022	0.071	0.069	0.126	0.159	0.159	0.132	0.104	0.078	0.036
	42	SANTA BARBARA	0.015	0.020	0.020	0.087	0.066	0.127	0.137	0.128	0.145	0.130	0.087	0.037
	56	VENTURA	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
SD	37	SAN DIEGO	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
SED	13	IMPERIAL	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
	15	KERN	0.042	0.044	0.029	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.087	0.057
	19	LOS ANGELES	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
	33	RIVERSIDE	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
	36	SAN BERNARDINO	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
SF	1	ALAMEDA	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	7	CONTRA COSTA	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	21	MARIN	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	28	NAPA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	38	SAN FRANCISCO	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	41	SAN MATEO	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	43	SANTA CLARA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	48	SOLANO	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	49	SONOMA	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
SJV	10	FRESNO	0.030	0.033	0.026	0.099	0.121	0.121	0.121	0.121	0.121	0.104	0.058	0.046
	15	KERN	0.042	0.044	0.029	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.087	0.057
	16	KINGS	0.039	0.035	0.028	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.093	0.060
	20	MADERA	0.030	0.033	0.026	0.099	0.121	0.121	0.121	0.121	0.121	0.104	0.058	0.046
	24	MERCED	0.029	0.023	0.026	0.110	0.094	0.110	0.110	0.110	0.110	0.110	0.110	0.055
	39	SAN JOAQUIN	0.024	0.026	0.025	0.080	0.096	0.138	0.138	0.138	0.138	0.103	0.051	0.043
	50	STANISLAUS	0.028	0.028	0.029	0.092	0.080	0.121	0.121	0.121	0.121	0.115	0.098	0.047
	54	TULARE	0.028	0.032	0.021	0.104	0.115	0.121	0.121	0.121	0.121	0.121	0.058	0.039
SV	4	BUTTE	0.024	0.029	0.026	0.069	0.078	0.099	0.209	0.209	0.115	0.075	0.037	0.030
	6	COLUSA	0.020	0.022	0.025	0.077	0.099	0.153	0.153	0.153	0.133	0.105	0.034	0.027
	11	GLENN	0.017	0.025	0.023	0.074	0.060	0.147	0.147	0.147	0.133	0.123	0.075	0.029
	31	PLACER	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	34	SACRAMENTO	0.023	0.021	0.022	0.086	0.105	0.153	0.153	0.153	0.153	0.074	0.035	0.024
	45	SHASTA	0.024	0.022	0.023	0.084	0.093	0.151	0.151	0.151	0.151	0.082	0.040	0.031
	48	SOLANO	0.023	0.026	0.023	0.068	0.076	0.185	0.185	0.185	0.096	0.079	0.030	0.024
	51	SUTTER	0.023	0.021	0.022	0.086	0.105	0.153	0.153	0.153	0.153	0.074	0.035	0.024
	52	TEHAMA	0.023	0.026	0.023	0.068	0.076	0.185	0.185	0.185	0.096	0.079	0.030	0.024
	57	YOLO	0.016	0.020	0.021	0.076	0.086	0.155	0.155	0.155	0.149	0.108	0.039	0.021
	58	YUBA	0.021	0.020	0.021	0.055	0.067	0.144	0.178	0.178	0.178	0.069	0.045	0.023