ENVIRON

MEMORANDUM

To: Lee Alter, Western Governors' Association

From: Gerard Mansell

Date: Revised 22 September 2006

Subject: Summary of the WRAP Fugitive Dust Emissions Inventories.

Introduction

The current WRAP PM dust emission inventory is derived from a variety of sources and estimation methodologies. These sources include regional emission models (e.g., Windblown Dust model), region-wide assessments (e.g., paved and unpaved road dust), and state/local data submissions. ENVIRON has summarized the entire WRAP PM2.5 and PM10 fugitive dust emissions inventories for 2002 and 2018. Summaries were developed by state/county and major source category. Analyses of the model-ready gridded inventories by major source category were also considered. The primary purpose of the work documented herein is to enable the Dust Emissions Joint Forum (DEJF) to evaluate the dust inventory for reasonableness and consistency and to develop the best presentation format for this significant source of regional haze pollution.

The DEJF recently completed a project to evaluate the fine fraction of particulate matter in fugitive dust (MRI, 2005). The result of this study indicates that the analysis procedures and findings on which the EPA's AP-42 Guidance is based may be biased by as much as a factor of 2. This has implications for revising how fugitive dust estimates for many source categories should be partitioned between PM2.5 and PMcoarse. Thus, a second objective of this task was to assess the ratios of PM2.5 to PM10 across jurisdictions and source categories to identify where it may be appropriate, after consultation with the Emissions Forum and others as necessary, to revise the fraction of fugitive dust that should be allocated to PM2.5.

This Technical Memorandum documents the work performed as part of this task. A general description of fugitive dust emission source categories, the estimation methodologies used for each and the source of data for these emission categories as incorporated into the WRAP air quality modeling inventories is presented. Although the fugitive dust emission inventories for all Regional Planning Organizations (RPOs) are considered, the primary focus of this work was on the dust emissions within the WRAP states. Summaries of all fugitive dust emissions are provided at various levels of detail for the base year 2002, planning inventory for 2002 and the base year 2018 inventory, as available at the time the data was obtained from the WRAP Regional Modeling Center (RMC). The ratio of fine to coarse particulate dust by source category is reviewed and summarized. Recommendations are provided with respect to addressing any errors, omissions and/or reporting procedures for these data. Note that since the initial inventory data was obtained for this work, numerous revisions and corrections to the data have been made, which may have already addressed many of the recommendations provided herein.

Fugitive Dust Emission Source Categories

Fugitive dust emissions, as represented in the WRAP modeling inventories, include the following general source categories:

- Agricultural Operations
- Construction and Mining Operations
- Road Dust
- Windblown Dust from Vacant lands

In general, each of these emissions source categories includes more specific sub-categories, as described below. For each, a brief description characterizing the source and the general methodology used to estimate emission rates are provided. For the most part, the estimation methodologies are based on AP-42 guidance. In the case of the WRAP inventory development, specific modifications and/or deviations from these general methodologies are noted.

Agricultural Operations

Dust emissions from agricultural operations result from the disturbance of soil inherent in the preparation of agricultural lands for planting and after harvest activities. These include discing, leveling, and other mechanical operations. Dust emissions from this category exhibit a seasonal pattern as planting and harvesting generally occur in the spring and fall, respectively. In addition, agricultural practices and planting and harvesting calendars are crop-specific in many cases. In addition to operations associated with agricultural land preparation and harvesting, this emission source category includes dust emissions arising from the transport of agricultural crops as well as dust from agricultural feedlots or confined animal feeding operations (CAFOs).

While the current version of AP-42 guidance (5th Edition) does not include estimation methodologies for this dust emission category, guidance was provided in previous versions. However, the California Air Resource Board has developed procedures for estimating PM10 dust emissions from agricultural activities, and these procedures were adopted for development of the WRAP modeling inventories, as describe below.

Particulate dust emissions from agricultural operations are estimated as the product of crop-specific emission factors and appropriate activity data. Emission factors vary as a function of the specific soil preparation operation used for a particular crop, while the activity data is based on harvested acreage, modified by factors to account for the typical number of passes per acre required to prepare a field for planting. The activity data used for estimating land preparation emissions are based on state summaries of crop acreage harvested, further spatially allocated by county and crop type for the each state.

Acre-passes (the total number of passes typically performed to prepare land for planting during a year) are used to compute crop specific emission factors for land preparation. These land preparation operations may occur following harvest or closer to planting, and can include discing, tilling, land leveling, and other operations. Each crop is different in the type of soil operations performed and when they occur; crop profiles from similar crops are used for cases where specific crop data has not been updated. For updating acre-pass data, specific information on when agricultural operations occur is used to create detailed temporal profiles for PM emissions from agricultural land preparations.

Operation specific PM10 emission factors used to estimate the crop specific emissions for agricultural land preparations are based on data developed by the University of California Davis. Five emission factors were developed using 1995 to 1998 test data measured in cotton and wheat fields in California. Operations tested included root cutting, discing, ripping and subsoiling, land planing and floating, and weeding. The PM2.5/PM10 ratio for agricultural tilling dust used by CARB is 0.222.

PM dust emissions from agricultural activities were developed for the WRAP by Eastern Research Group (ERG). A detailed discussion of the development and data sources used by ERG can be found in ERG, 2006.

Construction Operations

Construction operations are significant source of dust emissions that may have a substantial temporary impact on local air quality. This emission source category includes both residential and non-residential construction as well as road construction. Dust emissions during the construction of buildings or roads are associated with land clearing, drilling and blasting, ground excavation, and cut and fill operations (i.e., earth moving). Dust emissions can vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A significant amount of the dust emissions result from construction vehicle traffic over temporary roads at construction sites.

Residential Construction

PM dust emissions from residential construction are a function of the total acres of land disturbed and the volume of soil excavated. The volume of soil excavated also varies by type of structure under construction. County-level housing starts by structure type are used to estimate the disturbed acreage for construction. These data can be obtained from the US Census Bureau and the Department of Commerce. Volume of soil excavated is estimated based on assumed characteristics of single-family homes and whether the structures include basements.

Emission factors are estimated based on structure type and duration of construction. For single family houses, construction duration is assumed to be 6 months; for apartment buildings, 12-month construction duration is assumed. The emissions factors vary from approximately 0.011 tons PM10/acre-month to 0.11 tons PM10/acre-month. Additional adjustments are applied based on soil moisture, silt content and control efficiency. The ratio of PM2.5 to PM10, as documented in AP-42, is assumed to be 0.20.

Non-residential/Commercial Construction

Dust emissions from non-residential and commercial construction are a function of the total acres of land disturbed. Activity data is based on the total value of the construction in $MM. Data for construction values are typically obtained on a national basis from the Department of Commerce. County-level data is allocated from national estimates using employment statistics. County-level valuation data is then used to estimate total acreages disturbed during construction. An assumed value of 1.55 acres/$MM is applied to the county-level valuation data, as specified in AP-42.

An emission factor of 0.19 tons PM10/acre-month is used for the initial emissions estimate. The assumed construction duration is typically 11 months. As with residential construction, emission factors are adjusted to reflect variations in silt content, soil moisture and control efficiency. The ratio of PM2.5 to PM10, as documented in AP-42, is assumed to be 0.20.

Road Construction

PM dust emissions from road construction activities are a function of acres disturbed during construction. Activity data is based on data obtained from the4 Federal Highway Administration (FHWA) as a function of road type. State-level new miles of road constructed are estimated from 2002 FHWA state expenditures for capital outlay data, in thousands of dollars. These data are then converted to new miles of road constructed using 4/mile conversions from the North Carolina Department of Transportation (NCDOT) data. These data also vary by type of road. The new miles of road constructed is then used to estimate total acres disturbed using conversion factors for acres disturbed/mile of road constructed, as a function of road type. State-level acre disturbed are allocated top the county-level based on residential housing starts data.

An emission factor of 0.42 tons PM10/acre-month is used to estimate PM10 dust emission from road construction activities. A construction duration of 12 months is typically assumed. Adjustments are applied for variations in silt content, soil moisture and control efficiency

PM dust emissions from construction activities were developed for the WRAP by Eastern Research Group (ERG). A detailed discussion of the development and data sources used by ERG can be found in ERG, 2006.

<u>Paved Road Dust</u>

Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear and tire wear emissions, and resuspension of loose material on the road surface. In general terms, resuspended particulate emissions from paved roads originate from, and result in the depletion of the loose material present on the surface (i.e., the surface loading). In turn, that surface loading is continuously replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and trackout from unpaved roads and staging areas.

Dust emissions from paved roads have been found to vary with the "silt loading" present on the road surface as well as the average weight of vehicles traveling the road. The term silt loading (sL) refers to the mass of silt-size material (equal to or less than 75 micrometers [µm] in physical diameter) per unit area of the travel surface. The total road surface dust loading consists of loose material that can be collected by broom sweeping and vacuuming of the traveled portion of the paved road. The silt fraction is determined by measuring the proportion of the loose dry surface dust that passes through a 200-mesh screen using the ASTM-C-136 method. Silt loading is the product of the silt fraction and the total loading, and is abbreviated "sL."

The surface silt loading (sL) provides a means of characterizing seasonal variability in a paved road emission inventory. In many areas of the country, road surface silt loadings are heaviest during the late winter and early spring months when the residual loading from snow/ice controls is greatest. Once replenishment of fresh material is eliminated, the road surface silt loading can be expected to reach an equilibrium value, which is substantially lower than the late winter/early spring values.

Particulate emissions from road surfaces due to vehicle travel on a dry paved road may be estimated using the following empirical expression:

$$E = k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C$$

where,

E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range,
sL = road surface silt loading (grams per square meter, g/m^2),
W = average weight (tons) of the vehicles traveling the road, and
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

Unpaved Road Dust

When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Dust emissions also depend on source parameters that characterize the condition of a particular road and the associated vehicle traffic. Characterization of these source parameters allow for "correction" of emission estimates to specific road and traffic conditions present on public and industrial roadways.

Dust emissions from unpaved roads have been found to vary directly with the fraction of silt (particles smaller than 75 micrometers [µm] in physical diameter) in the road surface materials. As the silt content of a rural dirt road will vary with geographic location, it should be measured for use in projecting emissions. For a conservative approximation, the silt content of the parent soil is often used. Tests, however, show that road silt content is normally lower than in the surrounding parent soil, because the fines are continually removed by the vehicle traffic, leaving a higher percentage of coarse particles.

Other variables are important in addition to the silt content of the road surface material. For example, at industrial sites, where haul trucks and other heavy equipment are common, emissions are highly correlated with vehicle weight. On the other hand, there is far less variability in the weights of cars and pickup trucks that commonly travel publicly accessible unpaved roads throughout the United States. For those roads, the moisture content of the road surface material may be more important in determining differences in emission levels between a hot desert environment and a cool moist location.

The PM10 emission factors presented below are based on stepwise linear regressions of field emission test results of vehicles traveling over unpaved surfaces. Due to a limited amount of information available for PM2.5, the expression for that particle size range has been scaled against the PM10 results. The following empirical expressions may be used to estimate the quantity of size-specific particulate emissions from an unpaved road in pounds (lb) per vehicle mile traveled (VMT). For vehicles traveling on unpaved surfaces at industrial sites, emissions are estimated from the following equation:

$$E = k\,(s/12)^{a}(W/3)^{b}$$

and, for vehicles traveling on publicly accessible roads, dominated by light duty vehicles, emissions may be estimated from the following equation:

$$E = \frac{k\,(s/12)^{a}\,(S/30)^{d}}{(M/0.5)^{c}} - C$$

where k, a, b, c and d are empirical constants, and

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
M = surface material moisture content (%)
S = mean vehicle speed (mph)

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C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

The source characteristics s, W and M are referred to as correction parameters for adjusting the emission estimates to local conditions.

For the WRAP, paved and unpaved road dust emissions were estimated using updated VMT for the base and future years provided by state and local contacts as part of the base and future year survey work. Any updated road dust controls provided were also incorporated into the estimates. It is important to note that since the previous WRAP road dust emissions estimates were prepared, EPA's guidance on estimating paved and unpaved road dust emissions was updated; see http://www.epa.gov/ttn/chief/ap42/ch13/index.html. The WRAP Emissions Forum opted to update the road dust emissions only to reflect updated VMT and controls, and not to reflect the updated EPA guidance methodology.

A more detailed discussion of the development of paved and unpaved road dust emissions can be found in Pollack, et al., 2006

Windblown Dust from Vacant lands

Fugitive dust from wind erosion of agricultural and vacant lands represents a significant source of particulate matter emissions, particularly throughout the Western US. For agricultural windblown dust, emission factors may be estimated using the USDA wind erosion equation (WEQ) (ARB, 1997) which relates the PM10 emission factors to various parameters characterizing the specific crops, soil erodibility, surface roughness, vegetative cover and climatic factors. PM10 emissions are obtained by multiplying the resulting emission factor by the total crop acreage in units of tons/acre/yr. For non-agricultural vacant lands, numerous wind tunnel studies have been conducted to estimate appropriate emission factors based on soil types, surface conditions and threshold friction velocities.

Windblown fugitive dust emissions have not been estimated by EPA in previous national emission inventories. ENVIRON has recently completed the development of a windblown dust model for use in WRAP regional haze modeling efforts (Mansell, et. al, 2006). A description of the model development and the most recent results for the WRAP states can be found at http://www.wrapair.org/forums/dejf/fderosion.html. The model estimates fugitive PM dust emissions from vacant lands given wind speed data. All vacant land types are considered; mechanically disturbed lands, e.g., agricultural tilling, are not included. The current version of the model is set up to use the regional-scale land use databases for characterizing vacant lands, and also requires specification of soil characteristics, specifically soil texture. The model provides hourly gridded emission estimates that can be easily summarized on a county level. A complete detailed description of the model development and requisite input databases is included in the project Final Report and related documentation (Mansell, et al., 2006)

Emissions Modeling for Fugitive Dust Sources

For regional air quality modeling, the county-level, annual (or seasonal/monthly) PM dust emissions must be spatially allocated to the modeling grid and temporally allocated hourly. In addition, fugitive dust transport fractions are applied to the PM dust emissions estimates prior to their use in the air quality model. The WRAP RMC utilized the SMOKE emissions processing system to develop the necessary air quality model-ready dust emissions data.

Similar to emissions modeling for other source sectors, the fugitive dust emissions were extracted from the point, area and mobile source inventory data files and processed separately through SMOKE. Dust emissions were extracted from the inventory files based on SCCs. Processing the dust emissions separately allows for more efficient quality assurance of the data and the direct application of the fugitive dust transport fractions. The application of transport fractions is discussed in more detail below. With the exception of the windblown dust emissions, transport fractions are applied using the growth and control modules of SMOKE. The windblown dust emission models incorporate the transport fractions directly in the estimation methodologies used. Note that, except for the gridded emissions summaries, the data presented in the summaries below do not reflect the application of transport fractions.

The final step in preparation of PM dust emissions for air quality modeling involves the spatial and temporal allocation of annual, county-level emissions estimates. The PM10 emissions estimates are also speciated as PMC (=PM10–PM2.5) and PMFINE (=PM2.5). Speciation and spatial and temporal allocation is performed based on detailed SCCs. The revised PM2.5/PM10 ratios, developed by MRI (MRI, 2005), were applied the final versions of the gridded dust emission inventories presented below.

Dust Emission Inventory Summaries

Summaries of the WRAP fugitive dust emission inventories are presented below. These summaries are based on the annual county-level emissions data as input to the SMOKE emissions processing system. Except for the windblown dust emissions, all data are summarized prior to the application of fugitive dust transport fractions. Transport fractions are applied to the windblown dust emissions on a gridded basis, while all other categories are applied at the county level during SMOKE processing. Summaries are provided by state, for each RPO, and by major source category (agricultural, construction, road dust) and by detailed SCC. Note that based on the preliminary summaries of the Base02b inventory, several SCCs which were not included in this inventory were subsequently added to the list of sources extracted from area and point source emissions data files for inclusion in the fugitive dust emissions inventory. These additional source categories are included in the Plan02b and Base18a inventories presented below.

In addition to the county-level dust emission summaries, the gridded, spatially allocated PMC (=PM10–PM2.5) dust emissions are also summarized and presented below. These data include the application of the fugitive dust transport fractions as well as revisions to the PM10/PM2.5 ratios, as noted above and discussed below. The gridded emission inventories summarized herein represent the modeling inventories used in the regional haze air quality modeling at the time of this writing.

2002 Emission Inventories

For 2002, both the Base02b and Plan02b emission inventories are summarized. Table 1 presents the annual Base02b PM10 dust emissions by major source category for all states in the WRAP modeling domain. Table 2 presents the corresponding Base02b annual PM2.5 dust emissions. As noted above, the windblown dust emissions presented included in these tables reflect the application of fugitive dust transport fractions. In addition, since the dust emissions from this category are held constant for all base year and future year modeling inventories, summaries of these data are included only with the Base02b emission inventories. Figures 1 and 2 present the Base02b annual dust emissions by major source category and state for PM10 and PM2.5, respectively. These data are displayed for WRAP states only in Figure 3 (PM10) and Figure 4 (PM2.5), for clarity.

Base02b Fugitive Dust Emissions

In Figures 1 and 2 it should be noted that the Midwest RPO did not report, nor include, in their fugitive dust inventory any dust emissions from several source categories for Michigan, Ohio and Wisconsin. Only Illinois and Indiana report agricultural dust emissions while Illinois alone reported construction dust emissions. The windblown dust emissions are estimated on regional-wide basis using the WRAP Windblown Dust Model (Mansell, et al., 2006), and therefore are included in all WRAP dust inventories.

For the VISTAS RPO states, only paved and unpaved road dust emissions estimates are summarized in Tables 1 and 2. Since all other source categories were not available without the application of the fugitive dust transport fractions they are not included here in order to maintain consistency among the emissions data presented in these tables and charts. Dust emissions from all source categories are summarized for the VISTAS states in the Plan02b and Base18a inventories presented below.

Table 1. Annual 2002 PM10 dust emissions by state and major source category in tons/year (Base02b).

		2002 PM10 Dust Em issions (tpy)					
RPO	**State**	**Agricultural**	**Construction**	**Paved Roads -**	**Unpaved Roads**	**Windblown Dust**	**Total**
WRAP	AK	0	8,969	0	0	0	8,969
	AZ	16,874	44,540	9,557	33,824	62,705	167,500
	CA	1	124,468	147,985	224,724	81,482	578,660
	CO	90,207	52,168	9,858	13,541	150,564	316,339
	ID	15,280	0	5,511	45,922	50,893	117,606
	MT	89,485	46,562	3,860	604,746	366,180	1,110,833
	ND	235,684	39,391	2,875	40,447	175,994	494,391
	NM	17,127	52,724	6,232	14,823	165,333	256,239
	NV	559	50,587	3,459	10,476	102,720	167,801
	OR	32,243	22,668	10,343	95,013	116,926	277,193
	SD	156,837	45,457	2,624	57,021	505,317	767,255
	UT	14,628	6,478	5,109	2,162	76,232	104,608
	WA	95,762	34,230	14,026	57,718	53,803	255,539
	WY	3,034	15,562	1,692	400	57,281	77,969
CENRAP	AR	31,686	20,495	30,305	135,653	39,334	257,473
	IA	236,522	40,243	33,712	151,021	465,745	927,242
	KS	253,845	55,590	32,892	275,026	422,430	1,039,784
	LA	42,443	36,429	36,096	69,014	30,538	214,519
	MN	215,067	47,995	42,462	415,517	139,922	860,963
	MO	104,525	66,003	57,435	693,730	140,223	1,061,916
	NE	138,852	24,974	21,236	251,193	355,126	791,382
	OK	100,164	58,675	38,086	453,978	151,995	802,899
	TX	433,592	359,514	182,502	1,425,070	626,802	3,027,481
MANE-VU	CT	841	10,759	18,251	7,625	23	37,499
	DC	0	3,808	1,895	0	0	5,704
	DE	0	2,712	5,931	0	40	8,683
	MA	1,341	25,508	38,234	99,848	90	165,021
	MD	17,390	28,351	29,042	633	1,329	76,745
	ME	3,297	6,597	28,131	114,097	1,073	153,195
	NH	359	5,319	14,377	8,080	126	28,261
	NJ	256	883	36,918	4,260	532	42,849
	NY	0	84,996	89,199	112,847	16,671	303,712
	PA	50,372	92,951	121,794	83,077	3,575	351,769
	RI	94	3,913	3,144	546	33	7,729
	VT	2,313	5,150	8,266	34,208	180	50,118
MW	IL	382,703	47,176	0	0	49,627	479,506
	IN	213,889	0	0	0	22,631	236,520
	MI	0	0	0	0	22,644	22,644
	OH	0	0	0	0	26,482	26,482
	WI	0	0	0	0	31,854	31,854
VISTAS	AL	0	0	55,344	233,990	7,636	296,970
	FL	0	0	82,423	255,097	8,386	345,907
	GA	0	0	97,104	393,633	2,500	493,238
	KY	0	0	43,278	52,803	26,573	122,654
	MS	0	0	41,331	161,372	16,409	219,112
	NC	0	0	86,194	28,964	2,566	117,724
	SC	0	0	39,379	156,627	1,345	197,351
	TN	0	0	57,594	23,742	15,705	97,042
	VA	0	0	51,006	69,059	4,361	124,426
	WV	0	0	17,267	50,768	494	68,529
	Canada	179,422	829,000	609,561	2,466,434	0	4,084,417
	MEXICO	57,192	0	62,150	538,240	0	657,582
Total		**3,233,884**	**2,400,847**	**2,335,669**	**9,966,971**	**4,600,431**	**22,537,802**

Table 2. Annual 2002 PM2.5 dust emissions by state and major source category in tons/year (Base02b).

		2002 PM2.5 Dust Emissions (tpy)					
RPO	State	Agricultural	Construction	Paved Roads	Unpaved Roads	Windblown Dust	**Total**
WRAP	AK	0	1,794	0	0	0	**1,794**
	AZ	3,375	8,914	2,389	5,079	6,271	**26,027**
	CA	0	24,893	36,996	35,489	8,148	**105,527**
	CO	18,041	10,434	2,465	2,031	15,056	**48,027**
	ID	0	0	1,378	6,888	5,089	**13,355**
	MT	17,897	9,312	965	90,712	36,618	**155,504**
	ND	47,137	7,878	719	6,067	17,599	**79,400**
	NM	3,425	10,545	1,558	2,223	16,533	**34,285**
	NV	112	10,113	865	1,695	10,272	**23,057**
	OR	6,449	4,534	2,586	14,252	11,693	**39,513**
	SD	31,367	9,091	656	8,553	50,532	**100,199**
	UT	2,395	1,168	1,277	324	7,623	**12,788**
	WA	19,169	6,846	3,507	8,658	5,380	**43,560**
	WY	673	3,120	423	60	5,728	**10,004**
CENRAP	AR	7,023	4,099	7,576	20,348	3,933	**42,979**
	IA	47,304	8,049	5,657	22,535	46,574	**130,119**
	KS	50,769	11,118	5,750	41,116	42,243	**150,997**
	LA	8,489	7,286	5,426	10,318	3,054	**34,572**
	MN	43,013	9,599	6,327	62,014	13,992	**134,946**
	MO	20,905	13,201	8,614	103,855	14,022	**160,597**
	NE	27,770	4,995	3,687	37,564	35,513	**109,528**
	OK	20,033	11,735	5,680	67,898	15,200	**120,545**
	TX	81,874	71,902	27,662	213,211	62,680	**457,329**
MANE-VU	CT	168	2,152	2,495	1,140	2	**5,957**
	DC	0	762	132	0	0	**894**
	DE	0	537	737	0	4	**1,279**
	MA	268	5,102	5,260	14,921	9	**25,560**
	MD	3,014	5,670	3,670	95	133	**12,582**
	ME	659	1,319	5,549	17,058	107	**24,693**
	NH	72	1,064	2,512	1,208	13	**4,868**
	NJ	51	177	4,283	639	53	**5,203**
	NY	0	16,999	13,335	16,881	1,667	**48,882**
	PA	10,074	18,590	20,797	12,413	358	**62,232**
	RI	19	783	453	82	3	**1,339**
	VT	463	1,030	1,204	5,114	18	**7,829**
MW	IL	76,540	9,435	0	0	4,963	**90,938**
	IN	42,778	0	0	0	2,263	**45,041**
	MI	0	0	0	0	2,264	**2,264**
	OH	0	0	0	0	2,648	**2,648**
	WI	0	0	0	0	3,185	**3,185**
VISTAS	AL	0	0	9,013	35,098	764	**44,875**
	FL	0	0	8,749	38,265	839	**47,852**
	GA	0	0	15,303	59,045	250	**74,598**
	KY	0	0	6,878	7,920	2,657	**17,455**
	MS	0	0	6,960	24,206	1,641	**32,807**
	NC	0	0	13,363	4,345	257	**17,964**
	SC	0	0	5,857	23,494	135	**29,485**
	TN	0	0	8,677	3,539	1,571	**13,786**
	VA	0	0	7,091	10,359	436	**17,886**
	WV	0	0	2,701	7,615	49	**10,365**
	Canada	33,144	19,264	145,836	367,509	0	**565,753**
	MEXICO	12,471		10,494	114,115	0	**137,079**
Total		**636,942**	**333,506**	**433,512**	**1,525,948**	**460,043**	**3,389,952**

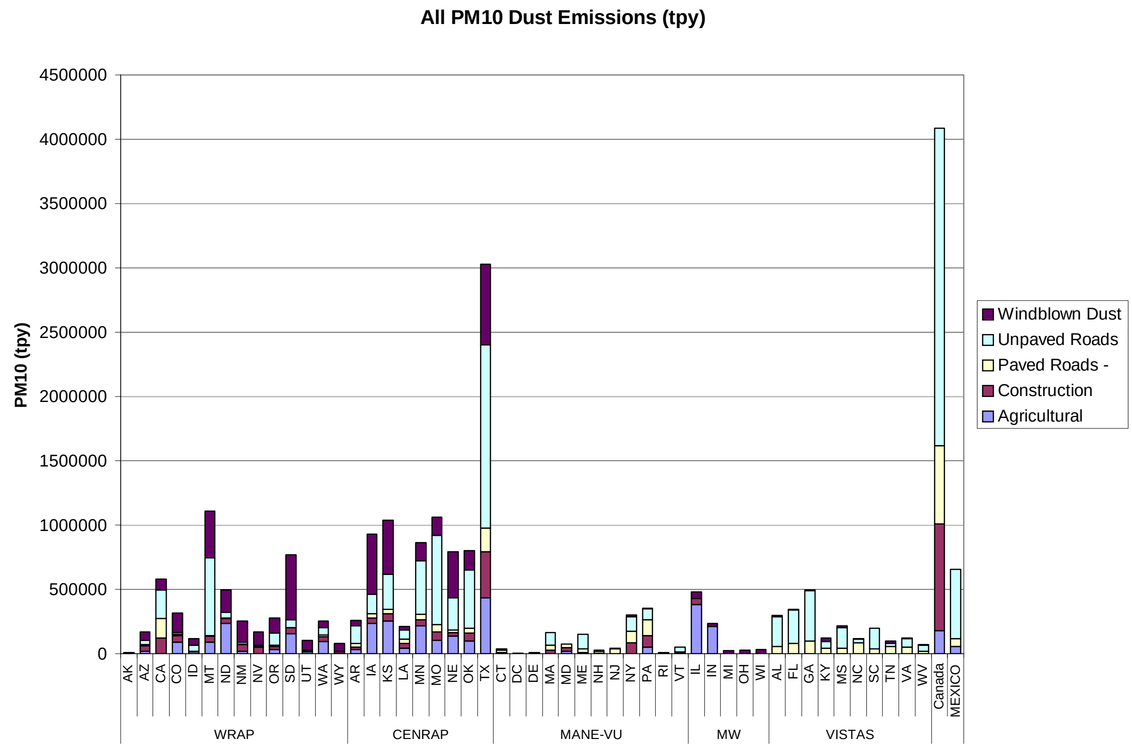

Figure 1. Annual 2002 PM10 dust emissions by major source category (Base02b; tpy)

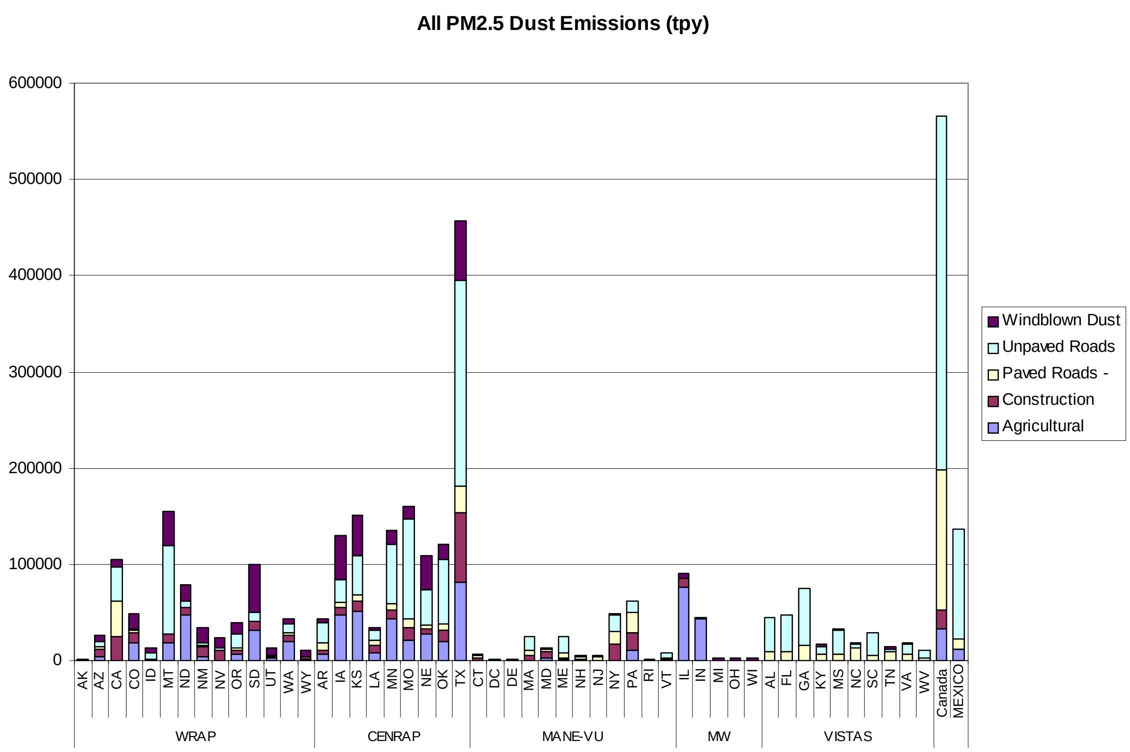

Figure 2. Annual 2002 PM2.5 dust emissions by major source category (Base02b; tpy)

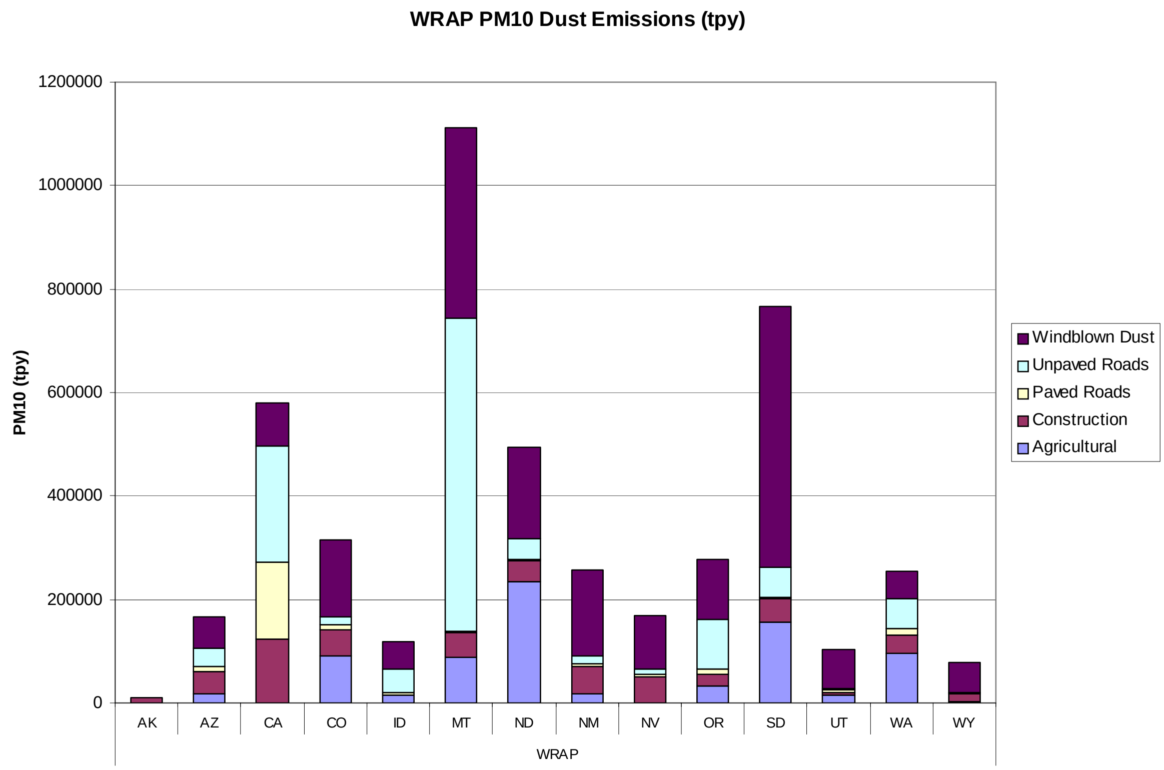

Figure 3. Annual 2002 PM10 dust emissions by major source category for WRAP states (Base02b; tpy)

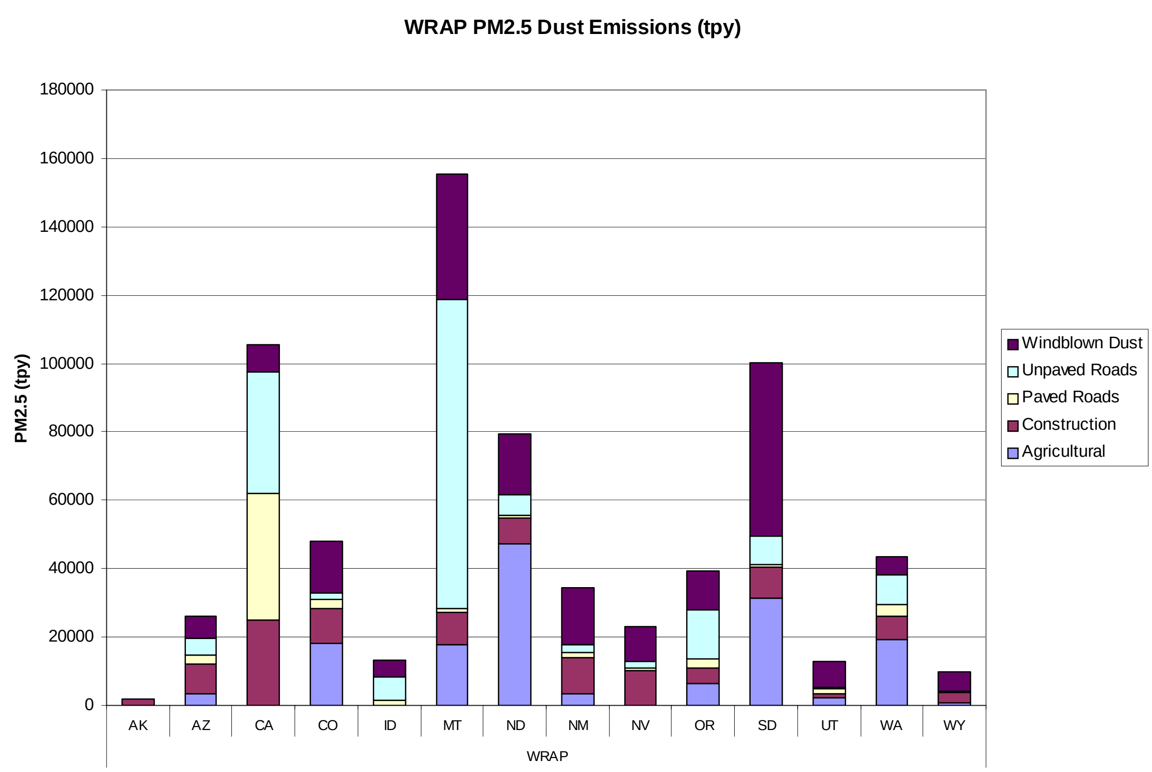

Figure 4. Annual 2002 PM2.5 dust emissions by major source category for WRAP states (Base02b; tpy)

Figure 5 through Figure 7 present the Base02b PM10 dust emissions inventory by the detailed source categories (SCCs) extracted from the area source county-level inventory data files for each WRAP state. The corresponding displays for annual PM2.5 emissions are presented in Figures 8 through 10. The data presented in Figures 5 through 10 represent the status of the WRAP Base02b emissions inventory based on the specific SCCs extracted from the area and point source inventory data used in the SMOKE emissions processing. Based on an evaluation of these data, it was recognized that there were several detailed source category codes that were either not included in the initial list of SCCs for fugitive dust processing, or were found to be reported using the most general SCC descriptions. For example, in some counties in Arizona, construction dust emissions were reported in terms of the general "all processes" SCC and were not included extracted from the area source inventory files. Likewise, agricultural dust emissions in California were provided separately from other fugitive dust source categories and were therefore initially not processed as fugitive dust within the SMOKE emissions modeling.

The ratio of PM2.5 to PM10, as reported in the inventory data were also evaluated for the Base02b fugitive dust emission inventory. Figures 11 and 12 present the results of this evaluation for all WRAP states by major source category and by detailed SCC, respectively. Note that the ratios presented in these figures are based on averages across all counties in the WRAP region. For the most part, these ratios are consistent with AP-42 guidance documents, although some exceptions to this can be seen. Table 3 summarizes these ratios based on AP-42 and also presents the revised factors as recommended by MRI. In 2005, the DEJF initiated a project to evaluate the fine fraction of particulate matter in fugitive dust. The result of this study indicated that the analysis procedures and findings on which the EPA's AP-42 Guidance is based may be biased by as much as a factor of 2. The DEJF study was recently completed (MRI, 2005) and the recommended revisions, by dust emission source category, are included in Table 3.

Table 4 presents the complete listing of fugitive dust emission source category codes currently being used by the RMC for extracting data from area and point source inventory data files. Also included in Table 4 are the original and revised PM2.5/PM10 ratios used in the SMOKE processing. Note that several SCCs listed were not included in the development of the Base02b modeling inventories. Based on the initial review of emissions data for the Base02b inventory, as described above, these SCCs have subsequently been included in the current SMOKE processing procedures and are reflected in the Plan02b and Base18a fugitive dust emissions inventory summaries described below.

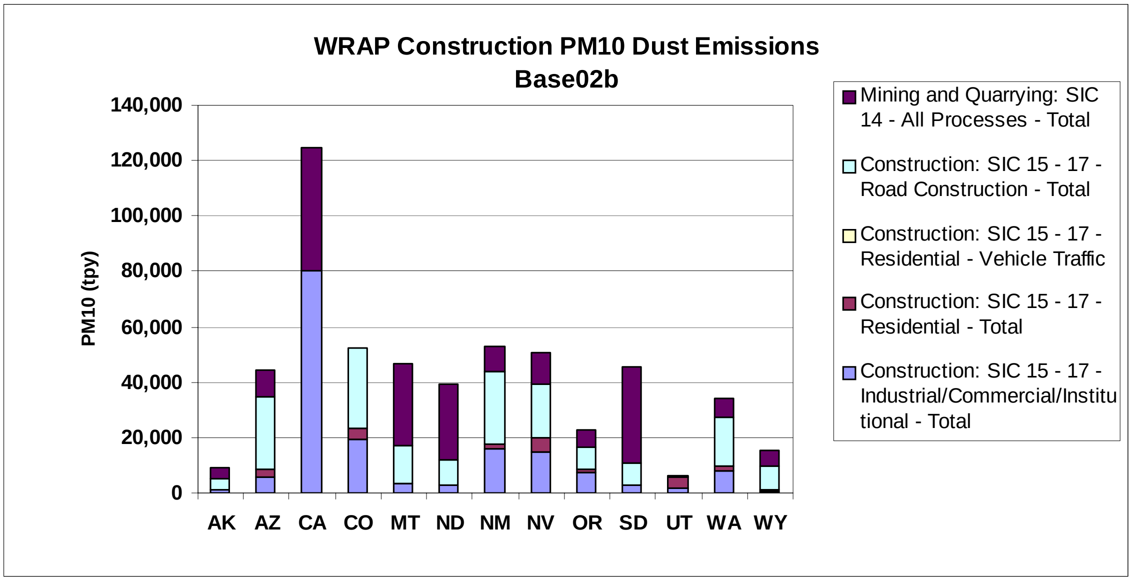

Figure 5. Annual 2002 PM10 construction dust emissions by source category for WRAP states (Base02b; tpy)

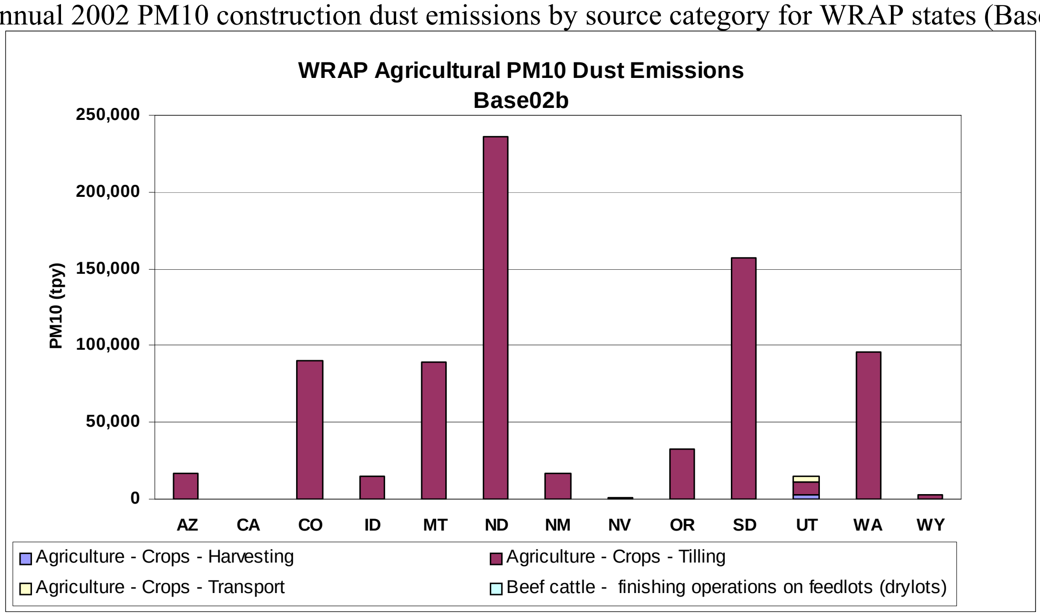

Figure 6. Annual 2002 PM10 agricultural dust emissions by source category for WRAP states (Base02b; tpy)

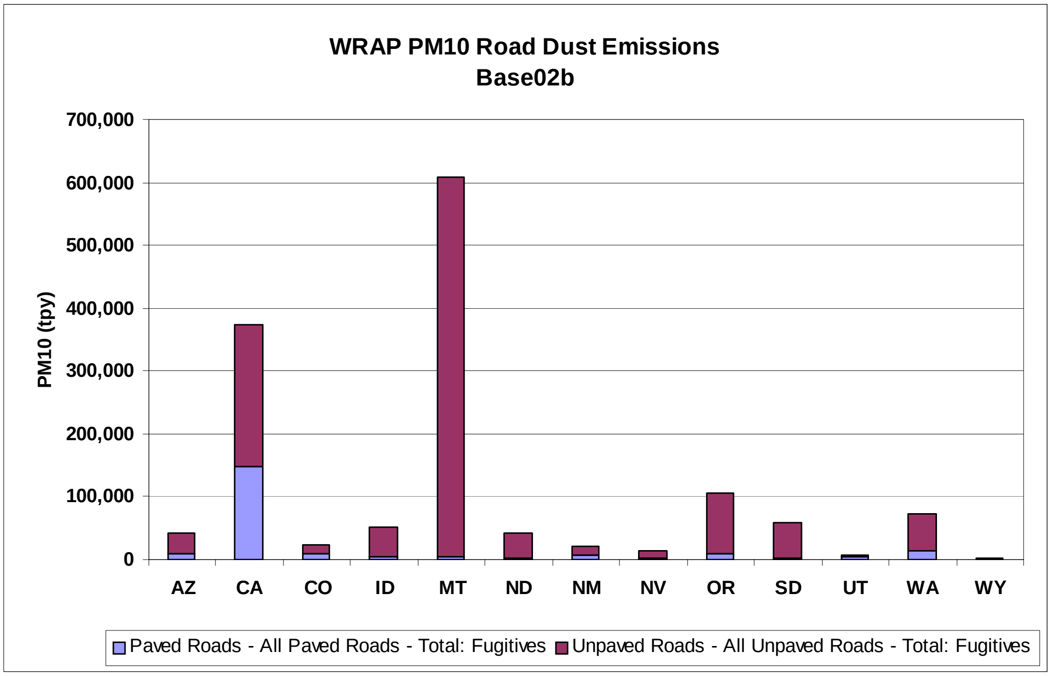

Figure 7. Annual 2002 PM10 road dust emissions by source category for WRAP states (Base02b; tpy)

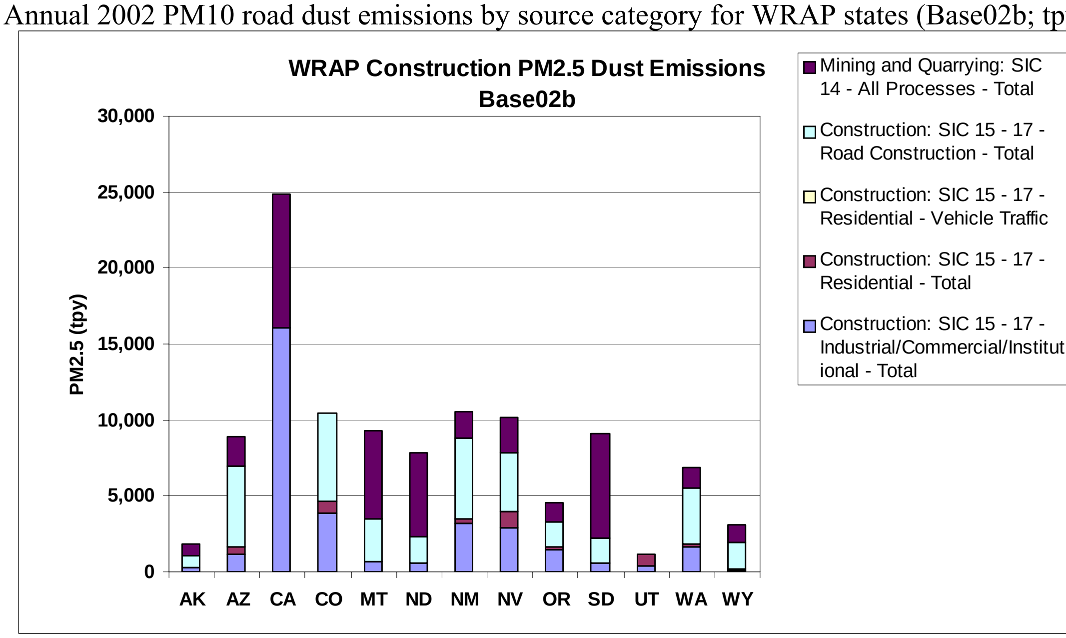

Figure 8. Annual 2002 PM2.5 construction dust emissions by source category for WRAP states (Base02b; tpy)

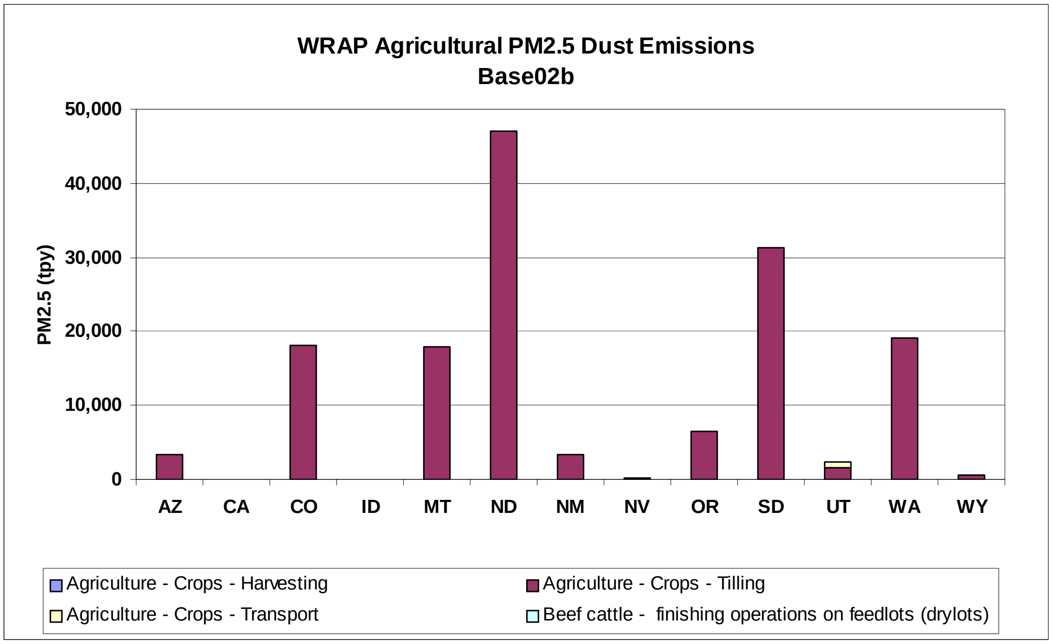

Figure 9. Annual 2002 PM2.5 agricultural dust emissions by source category for WRAP states (Base02b; tpy)

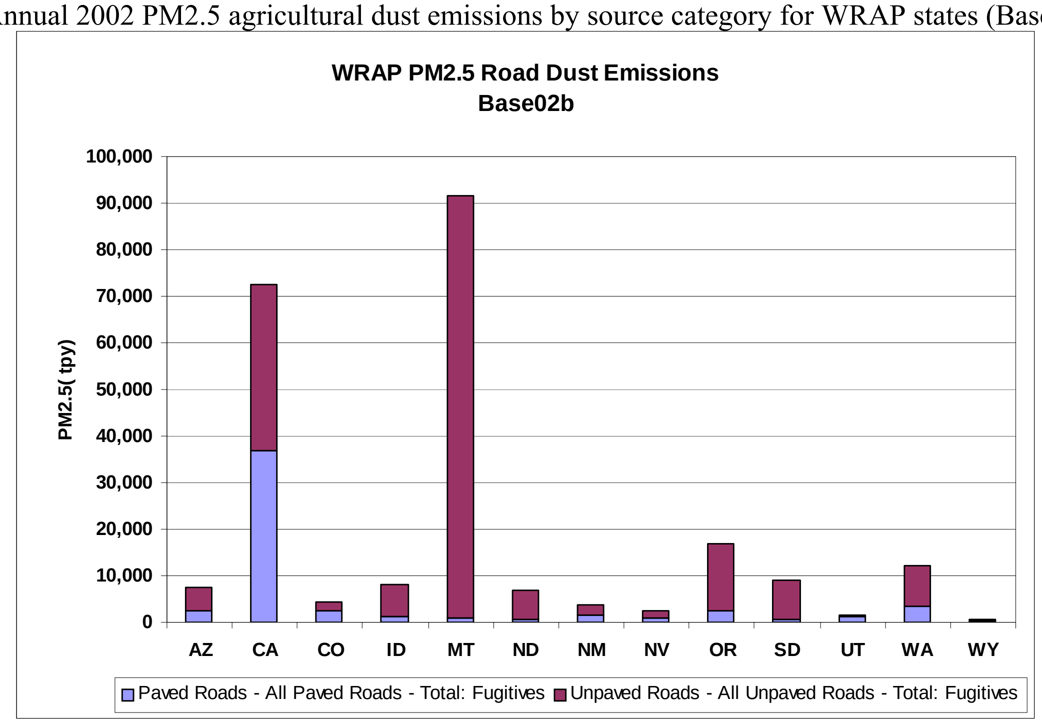

Figure 10. Annual 2002 PM2.5 road dust emissions by source category for WRAP states (Base02b; tpy)

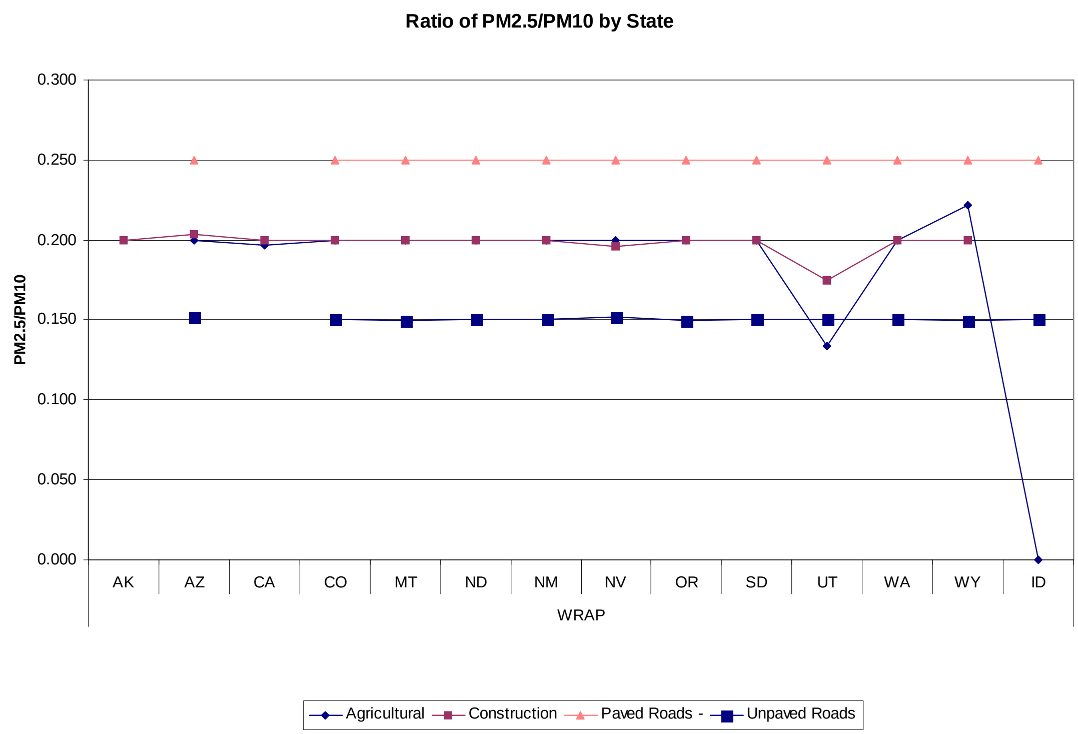

Figure 11. Ratio of PM2.5 to PM10 by major dust emissions source category for WRAP states.

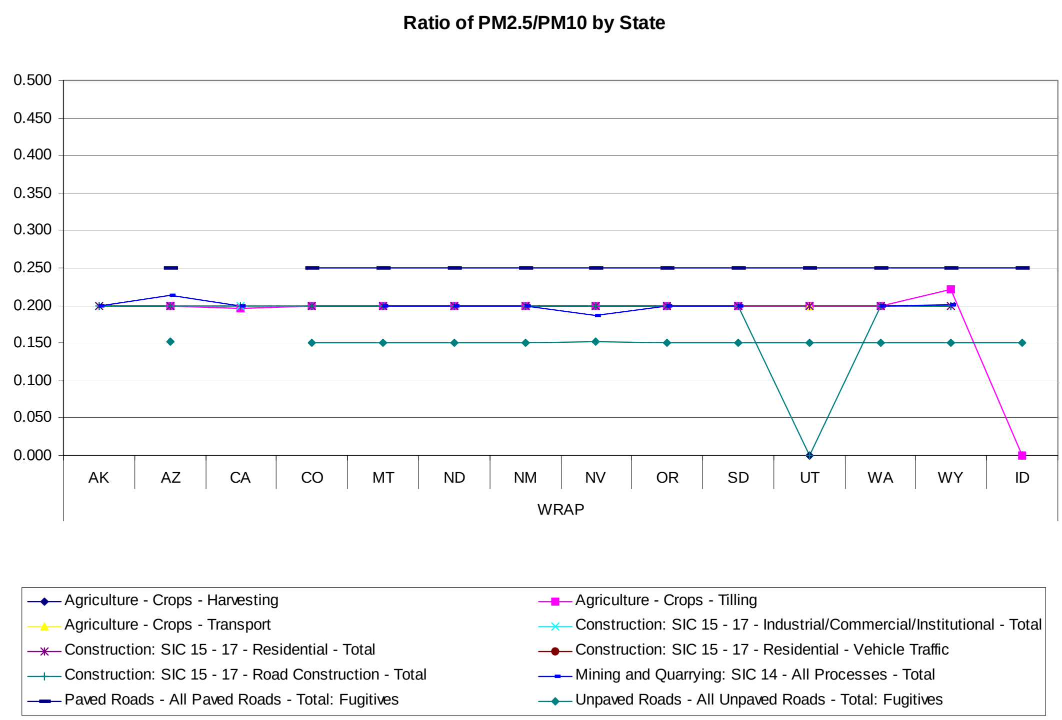

Figure 12. Ratio of PM2.5 to PM10 by detailed dust emissions source category for WRAP states.

Table 3. AP-42 PM2.5/PM10 ratios and recommended ratios from MRI, 2005.

Source Category	AP-42 Section	PM2.5/PM10 Ratio	
		Current	Proposed
Paved Roads	13.2.1	0.25	0.15
Unpaved Roads	13.2.2	0.15	0.10
Construction & Demolition	--	0.208	0.10
Aggregate Handling/Storage Piles	13.2.4	0.314	0.10 (traffic) 0.15 (transfer)
Industrial Wind Erosion	13.2.5	0.40	0.15
Agricultural Tilling	--	0.222	0.20

Table 4. Fugitive dust emission SCCs extracted from area and point source emissions inventory data files.

SCC	Description	PM2.5/PM10 Original	PM2.5/PM10 Revised
2801000001	Agriculture Production - Crops;Agriculture - Crops;Land Breaking	0.222	0.2
2801000002	Agriculture Production - Crops;Agriculture - Crops;Planting	0.222	0.2
2801000003	Agriculture Production - Crops;Agriculture - Crops;Tilling	0.222	0.2
2801000004	Agriculture Production - Crops;Agriculture - Crops;Defoliation	0.222	0.2
2801000005	Agriculture Production - Crops;Agriculture - Crops;Harvesting	0.222	0.2
2801000006	Agriculture Production - Crops;Agriculture - Crops;Drying	0.222	0.2
2801000007	Agriculture Production - Crops;Agriculture - Crops;Loading	0.222	0.2
2801000008	Agriculture Production - Crops;Agriculture - Crops;Transport	0.222	0.2
2805000000	Agriculture Production - Livestock;Agriculture - Livestock;Total	0.222	0.2
2805001000	Agriculture Production - Livestock;Beef Cattle Feedlots;Dust Kicked-up by Hooves	0.222	0.2
2805001001	Agriculture Production - Livestock;Beef Cattle Feedlots;Feed Preparation	0.222	0.2
2805005000	Agriculture Production - Livestock;Poultry Operations;Total (use 2805030000)	0.222	0.2
2805005001	Agriculture Production - Livestock;Poultry Operations;Feed Preparation	0.222	0.2
2805010000	Agriculture Production - Livestock;Dairy Operations;Total (use 2805020000 and subsets)	0.222	0.2
2805010001	Agriculture Production - Livestock;Dairy Operations;Feed Preparation	0.222	0.2
2805015000	Agriculture Production - Livestock;Hog Operations;Total (use 2805025000)	0.222	0.2
2805015001	Agriculture Production - Livestock;Hog Operations;Feed Preparation	0.222	0.2
2805020000	Agriculture Production - Livestock;Cattle and Calves Waste Emissions;Total	0.222	0.2
2805025000	Agriculture Production - Livestock;Hogs and Pigs Waste Emissions;Total	0.222	0.2

SCC	Description	PM2.5/PM10 Original	PM2.5/PM10 Revised
2805030000	Agriculture Production - Livestock;Poultry Waste Emissions;Total	0.222	0.2
2805035000	Agriculture Production - Livestock;Horses and Ponies Waste Emissions;Total	0.222	0.2
2805040000	Agriculture Production - Livestock;Sheep and Lambs Waste Emissions;Total	0.222	0.2
2805045001	Agriculture Production - Livestock;Goats Waste Emissions;Total	0.222	0.2
2275085000	Aircraft;Unpaved Airstrips;Unpaved Airstrips	n/a	0.1
2311000000	Construction: SIC 15 - 17;All Processes;Total	0.208	0.1
2311000010	Construction: SIC 15 - 17;All Processes;Land Clearing	0.208	0.1
2311000040	Construction: SIC 15 - 17;All Processes;Ground Excavations	0.208	0.1
2311000050	Construction: SIC 15 - 17;All Processes;Cut and Fill Operations	0.208	0.1
2311000060	Construction: SIC 15 - 17;All Processes;Construction	0.208	0.1
2311000070	Construction: SIC 15 - 17;All Processes;Vehicle Traffic	0.208	0.1
2311010000	Construction: SIC 15 - 17;General Building Construction;Total	0.208	0.1
2311010010	Construction: SIC 15 - 17;General Building Construction;Land Clearing	0.208	0.1
2311010040	Construction: SIC 15 - 17;General Building Construction;Ground Excavations	0.208	0.1
2311010050	Construction: SIC 15 - 17;General Building Construction;Cut and Fill Operations	0.208	0.1
2311010060	Construction: SIC 15 - 17;General Building Construction;Construction	0.208	0.1
2311010070	Construction: SIC 15 - 17;General Building Construction;Vehicle Traffic	0.208	0.1
2311020000	Construction: SIC 15 - 17;Heavy Construction;Total	0.208	0.1
2311020010	Construction: SIC 15 - 17;Heavy Construction;Land Clearing	0.208	0.1
2311020040	Construction: SIC 15 - 17;Heavy Construction;Ground Excavations	0.208	0.1
2311020050	Construction: SIC 15 - 17;Heavy Construction;Cut and Fill Operations	0.208	0.1
2311020060	Construction: SIC 15 - 17;Heavy Construction;Construction	0.208	0.1
2311020070	Construction: SIC 15 - 17;Heavy Construction;Vehicle Traffic	0.208	0.1
2311030000	Construction: SIC 15 - 17;Road Construction;Total	0.208	0.1
2311030010	Construction: SIC 15 - 17;Road Construction;Land Clearing	0.208	0.1
2311030040	Construction: SIC 15 - 17;Road Construction;Ground Excavations	0.208	0.1
2311030050	Construction: SIC 15 - 17;Road Construction;Cut and Fill Operations	0.208	0.1
2311030060	Construction: SIC 15 - 17;Road Construction;Construction	0.208	0.1
2311030070	Construction: SIC 15 - 17;Road Construction;Vehicle Traffic	0.208	0.1
2311040000	Construction: SIC 15 - 17;Special Trade Construction;Total	0.208	0.1
2305000000	Industrial Processes;Mineral Processes: SIC 32;All Processes;Total	n/a	0.1
2305070000	Industrial Processes;Mineral Processes: SIC 32;Concrete, Gypsum, Plaster Products;Total	n/a	0.1
2305080000	Industrial Processes;Mineral Processes: SIC 32;Cut Stone and Stone Products;Total	n/a	0.1
2325020000	Industrial Processes;Mining and Quarrying: SIC 14;Crushed and Broken Stone;Total	n/a	0.1
2325030000	Industrial Processes;Mining and Quarrying: SIC 14;Sand and Gravel;Total	n/a	0.1
2325040000	Industrial Processes;Mining and Quarrying: SIC 14;Clay, Ceramic, and Refractory;Total	n/a	0.1
2530000020	Storage and Transport;Bulk Materials Storage;All Storage Types;Cement	n/a	0.1
2530000100	Storage and Transport;Bulk Materials Storage;All Storage Types;Limestone	n/a	0.1
2530000120	Storage and Transport;Bulk Materials Storage;All Storage Types;Sand	n/a	0.1
2325000000	Mining and Quarrying: SIC 14;All Processes;Total	n/a	0.1
2294000000	Paved Roads;All Paved Roads;Total: Fugitives	0.25	0.12
2294000001	Paved Roads;All Paved Roads;Total: Average Conditions - Fugitives	0.25	0.12

SCC	Description	PM2.5/PM10 Original	PM2.5/PM10 Revised
2294000002	Paved Roads;All Paved Roads;Total: Sanding/Salting - Fugitives	0.25	0.12
2294005000	Paved Roads;Interstate/Arterial;Total: Fugitives	0.25	0.12
2294005001	Paved Roads;Interstate/Arterial;Total: Average Conditions - Fugitives	0.25	0.12
2294005002	Paved Roads;Interstate/Arterial;Total: Sanding/Salting - Fugitives	0.25	0.12
2294010000	Paved Roads;All Other Public Paved Roads;Total: Fugitives	0.25	0.12
2294010001	Paved Roads;All Other Public Paved Roads;Total: Average Conditions - Fugitives	0.25	0.12
2294010002	Paved Roads;All Other Public Paved Roads;Total: Sanding/Salting - Fugitives	0.25	0.12
2294015000	Paved Roads;Industrial Roads;Total: Fugitives	0.25	0.12
2294015001	Paved Roads;Industrial Roads;Total: Average Conditions - Fugitives	0.25	0.12
2294015002	Paved Roads;Industrial Roads;Total: Sanding/Salting - Fugitives	0.25	0.12
2296000000	Unpaved Roads;All Unpaved Roads;Total: Fugitives	0.15	0.1
2296005000	Unpaved Roads;Public Unpaved Roads;Total: Fugitives	0.15	0.1
2296010000	Unpaved Roads;Industrial Unpaved Roads;Total: Fugitives	0.15	0.1

Plan02b Fugitive Dust Emissions

Table 5 presents the annual Plan02b PM10 dust emissions by major source category for all states in the WRAP modeling domain. Table 6 presents the corresponding Plan02b annual PM2.5 dust emissions. The windblown dust emissions are unchanged from the Base02b inventory and are therefore not repeated in these tables. These data, as well as the Base18a data summarized below, include the revisions to the list of SCCs extracted for fugitive dust emissions processing in addition to the revised PM2.5/PM10 ratios presented in Table 4 above. The PM2.5/PM10 ratios were incorporated into the modeling inventories by retaining the reported PM10 emission estimates and re-scaling the PM2.5 estimates using the data presented in Table 4. Figures 13 and 14 present the Plan02b annual dust emissions by major source category and state for PM10 and PM2.5, respectively. These data are displayed for WRAP states only in Figure 15 (PM10) and Figure 16 (PM2.5), for clarity.

Figure 17 through Figure 19 present the Plan02b PM10 dust emissions inventory by the detailed source categories (SCCs) extracted from the area source county-level inventory data files for each WRAP state. The corresponding displays for annual PM2.5 emissions are presented in Figures 20 through 22.
Summaries of all fugitive dust emissions for non-WRAP states are provided in Figures 23 through 28. Both PM10 and PM2.5 for the Plan02b emission inventory are presented by detailed emissions source category. Emission estimates are included in these summaries for all VISTAS states (unlike for the Base02b summaries), however the Midwest RPO still does not include dust emission estimates for many source categories for Ohio, Michigan and Wisconsin because these emission source categories either were not estimated, were not reported to the EPA, or were not provided to the WRAP RMC.

Table 5. Annual 2002 PM10 dust emissions by state and major source category in tons/year (Plan02b).

		2002 Plan02b PM10 Dust Emissions (tpy)				
RPO	**State**	**Agriculture**	**Construction**	**Paved Roads**	**Unpaved Roads**	**Total**
WRAP	AK	0	0	0	0	**0**
	AZ	16,874	13,107	9,512	33,822	**73,315**
	CA	36,008	70,655	144,002	172,391	**423,055**
	CO	90,170	10,374	9,797	13,520	**123,862**
	ID	15,280	0	5,528	45,922	**66,730**
	MT	89,485	10,056	3,868	604,547	**707,955**
	ND	235,683	39,391	2,875	40,468	**318,417**
	NM	17,127	11,039	6,213	14,823	**49,202**
	NV	559	15,830	3,456	10,476	**30,321**
	OR	32,243	24,008	10,421	94,981	**161,654**
	SD	156,837	9,091	2,614	57,048	**225,590**
	UT	14,628	6,478	5,099	2,162	**28,366**
	WA	95,762	43,754	14,029	57,954	**211,499**
	WY	3,034	3,120	1,699	399	**8,251**
VISTAS	AL	54,687	42,790	62,011	266,428	**425,916**
	FL	35,168	45,042	75,807	261,217	**417,235**
	GA	94,154	96,612	102,940	444,365	**738,071**
	KY	78,231	58,803	49,527	63,172	**249,733**
	MS	99,147	48,141	46,079	180,747	**374,114**
	NC	84,347	57,915	92,685	32,321	**267,268**
	SC	31,732	25,595	42,777	172,331	**272,435**
	TN	64,924	57,802	60,704	26,380	**209,810**
	VA	40,667	74,651	66,865	108,990	**291,173**
	WV	10,811	73,736	51,917	158,267	**294,731**
MRPO	IL	382,703	47,178	0	0	**429,881**
	IN	213,889	0	0	0	**213,889**
MANEVU	DC	0	3,808	1,895	0	**5,704**
	DE	0	2,712	5,931	0	**8,643**
	MA	1,341	25,508	38,234	99,848	**164,932**
	MD	17,390	28,351	29,042	633	**75,415**
	ME	3,297	6,597	28,131	114,097	**152,121**
	NH	359	5,319	14,377	8,080	**28,135**
	NJ	256	883	36,918	4,260	**42,317**
	NY	0	84,996	89,199	112,847	**287,041**
	PA	50,372	92,951	121,794	83,077	**348,193**
	RI	94	3,913	3,144	546	**7,696**
	VT	2,313	5,150	8,266	34,208	**49,937**
CENRAP	AR	31,685	20,495	30,305	135,653	**218,139**
	IA	236,522	40,243	33,712	151,021	**461,497**
	KS	253,845	55,590	32,892	275,026	**617,354**
	LA	42,443	36,429	36,096	69,014	**183,981**
	MN	215,067	48,616	42,462	415,518	**721,663**
	MO	104,525	66,003	57,435	693,731	**921,694**
	NE	138,852	24,974	21,236	251,193	**436,256**
	OK	100,164	58,675	38,086	453,978	**650,904**
	TX	433,592	359,514	184,901	1,426,658	**2,404,665**
Total		**3,626,268**	**1,855,896**	**1,724,479**	**7,192,119**	**14,398,761**

Table 6. Annual 2002 PM2.5 dust emissions by state and major source category in tons/year (Plan02b)

		2002 Plan02b PM2.5 Dust Emissions (tpy)				
RPO	**State**	**Agriculture**	**Construction**	**Paved Roads**	**Unpaved Roads**	**Total**
WRAP	AK	0	0	0	0	**0**
	AZ	3,375	52,400	2,380	5,079	**63,233**
	CA	7,982	14,685	28,173	36,353	**87,193**
	CO	18,034	41,495	2,453	2,028	**64,010**
	ID	0	0	1,387	6,887	**8,274**
	MT	17,897	40,226	969	90,682	**149,774**
	ND	47,137	7,878	722	6,070	**61,807**
	NM	3,425	44,155	1,556	2,223	**51,360**
	NV	112	63,340	865	1,695	**66,012**
	OR	6,449	4,802	2,608	14,247	**28,105**
	SD	31,367	36,366	658	8,557	**76,948**
	UT	2,395	1,168	1,276	324	**5,164**
	WA	19,169	8,751	3,518	8,693	**40,132**
	WY	673	12,442	426	60	**13,601**
VISTAS	AL	10,059	8,558	10,165	39,964	**68,747**
	FL	6,089	9,008	8,097	39,183	**62,376**
	GA	18,189	19,323	16,562	66,655	**120,729**
	KY	14,476	11,721	7,960	9,476	**43,633**
	MS	19,230	9,629	7,788	27,112	**63,758**
	NC	16,411	11,583	14,424	4,848	**47,266**
	SC	6,115	5,119	6,365	25,850	**43,449**
	TN	12,969	11,268	9,262	3,932	**37,431**
	VA	7,247	14,929	9,965	16,349	**48,490**
	WV	1,816	14,746	8,343	23,740	**48,645**
MRPO	IL	76,540	9,436	0	0	**85,976**
	IN	42,778	0	0	0	**42,778**
MANEVU	DC	0	762	132	0	**894**
	DE	0	537	737	0	**1,275**
	MA	268	5,102	5,260	14,921	**25,551**
	MD	3,014	5,670	3,670	95	**12,449**
	ME	659	1,319	5,549	17,058	**24,585**
	NH	72	1,064	2,512	1,208	**4,856**
	NJ	51	177	4,283	639	**5,149**
	NY	0	16,999	13,335	16,881	**47,215**
	PA	10,074	18,590	20,797	12,413	**61,874**
	RI	19	783	453	82	**1,336**
	VT	463	1,030	1,204	5,114	**7,811**
CENRAP	AR	7,023	4,099	7,576	20,348	**39,046**
	IA	47,304	8,049	5,657	22,535	**83,545**
	KS	50,769	11,118	5,750	41,116	**108,754**
	LA	8,489	7,286	5,426	10,318	**31,518**
	MN	43,013	9,723	6,327	62,014	**121,078**
	MO	20,905	13,201	8,614	103,855	**146,575**
	NE	27,770	4,995	3,687	37,564	**74,016**
	OK	20,033	11,735	5,680	67,898	**105,345**
	TX	81,874	71,902	28,050	213,448	**395,274**
Total		**711,734**	**647,167**	**280,623**	**1,087,511**	**2,727,035**

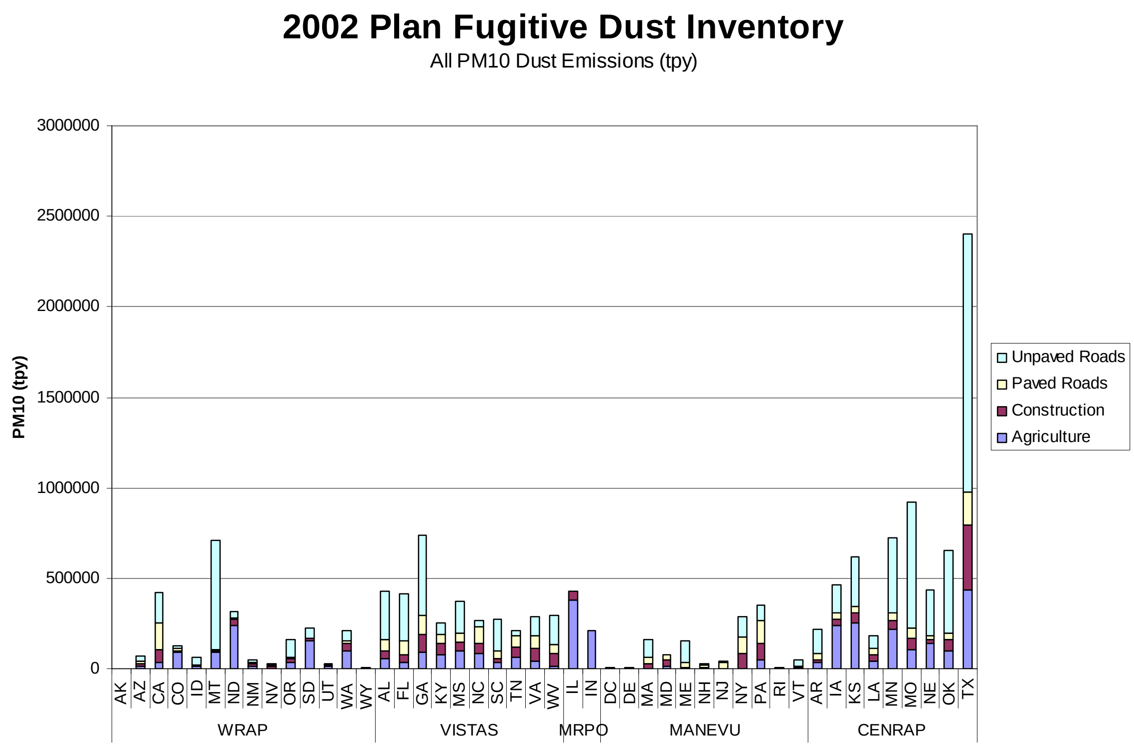

Figure 13. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

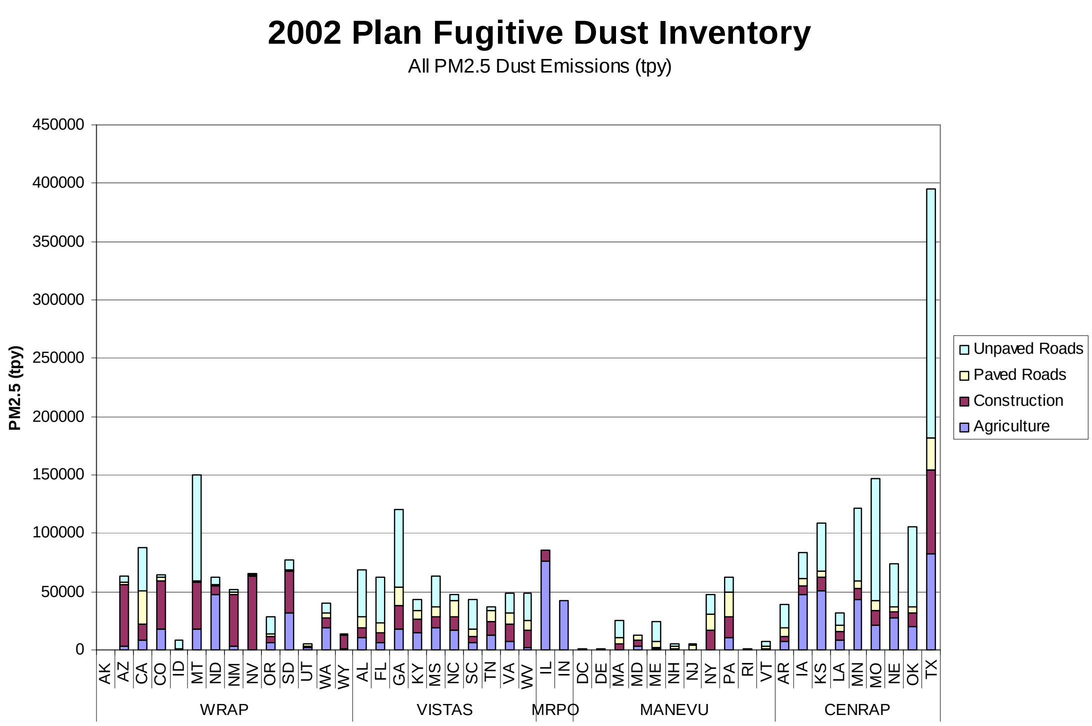

Figure 14. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

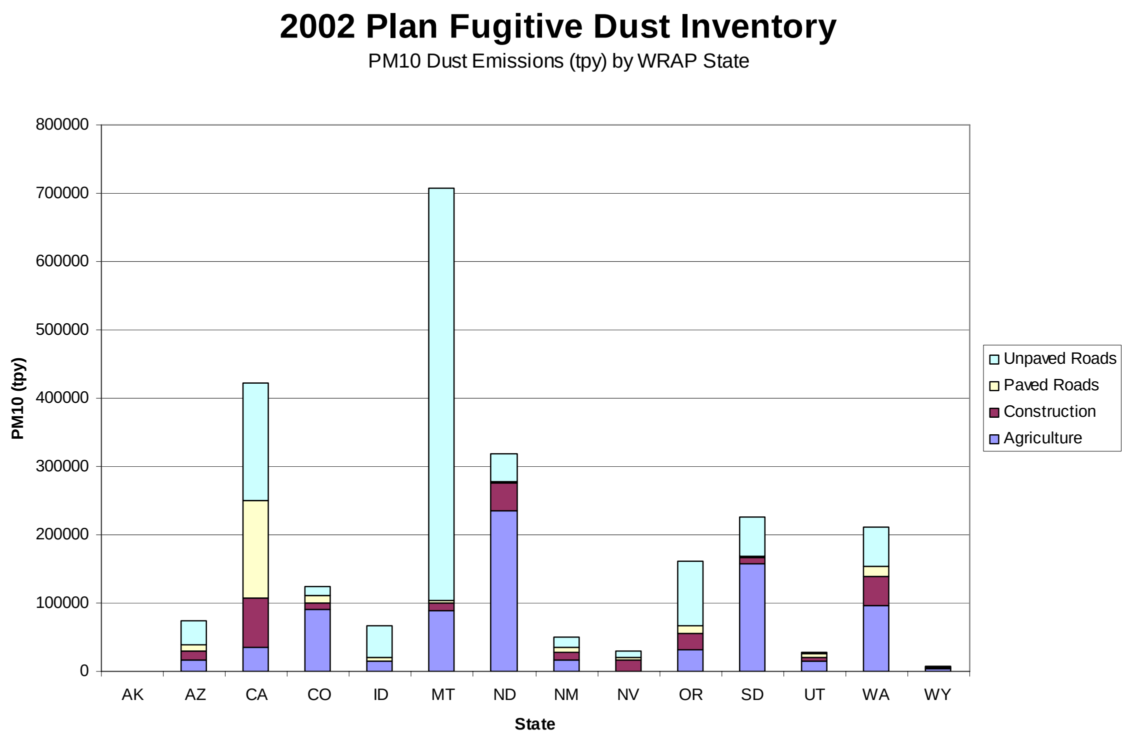

Figure 15. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

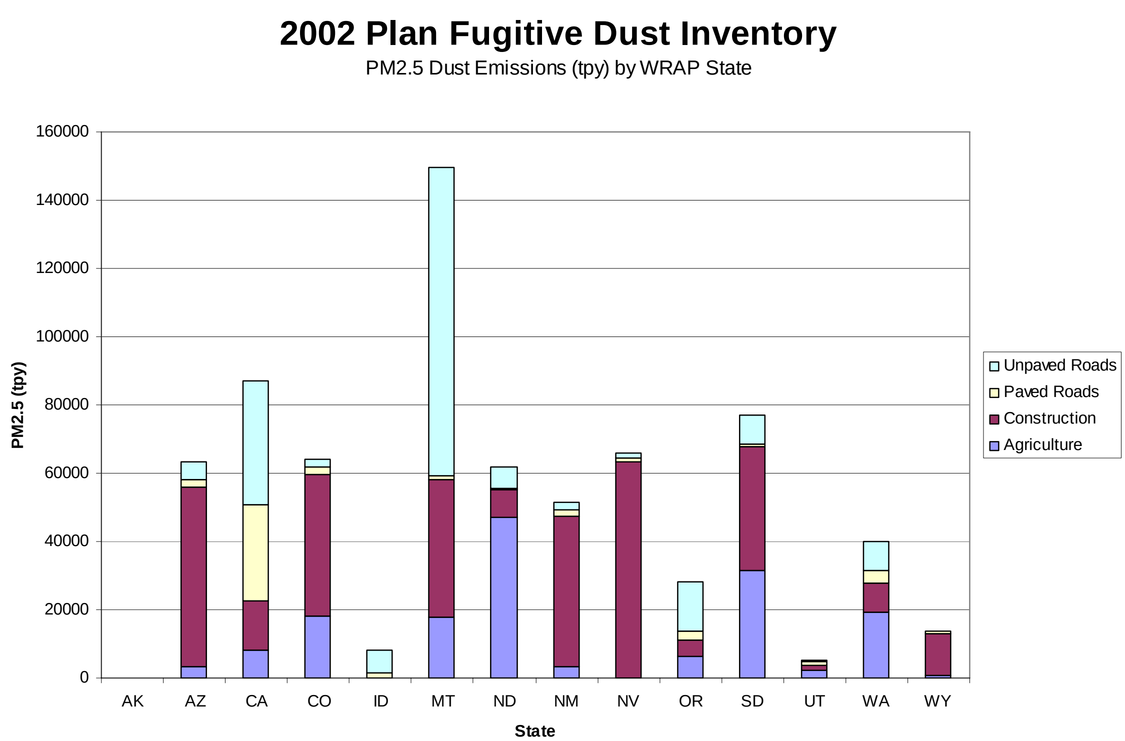

Figure 16. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

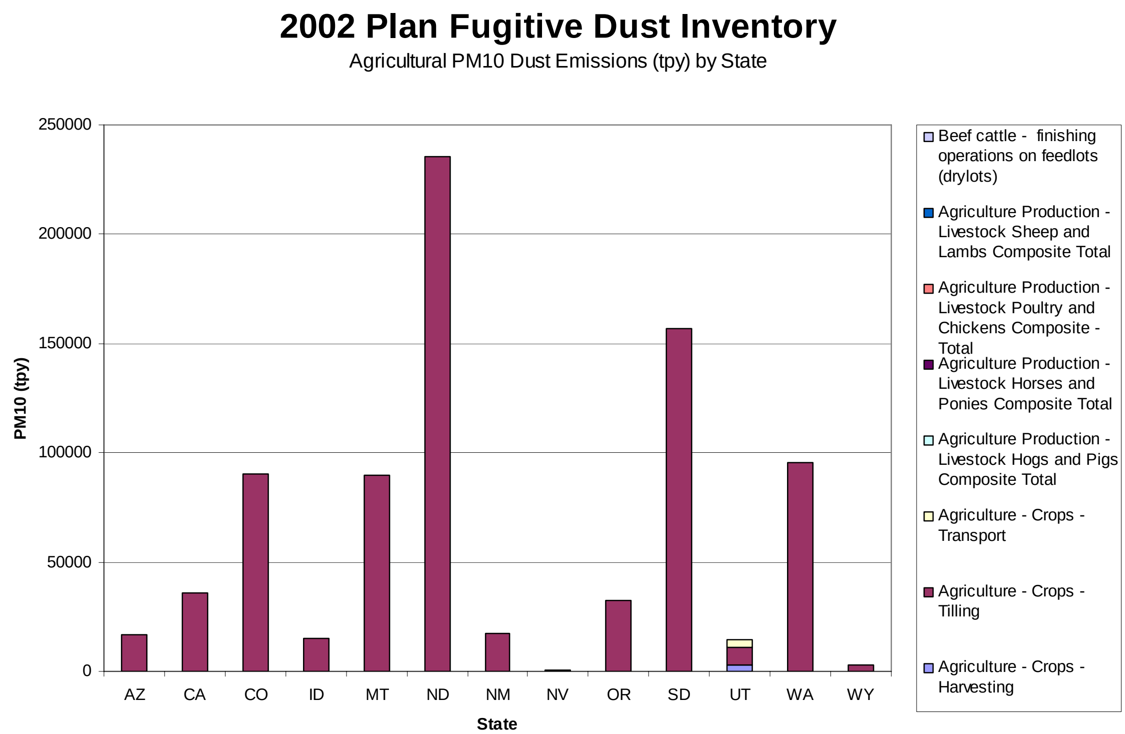

Figure 17. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

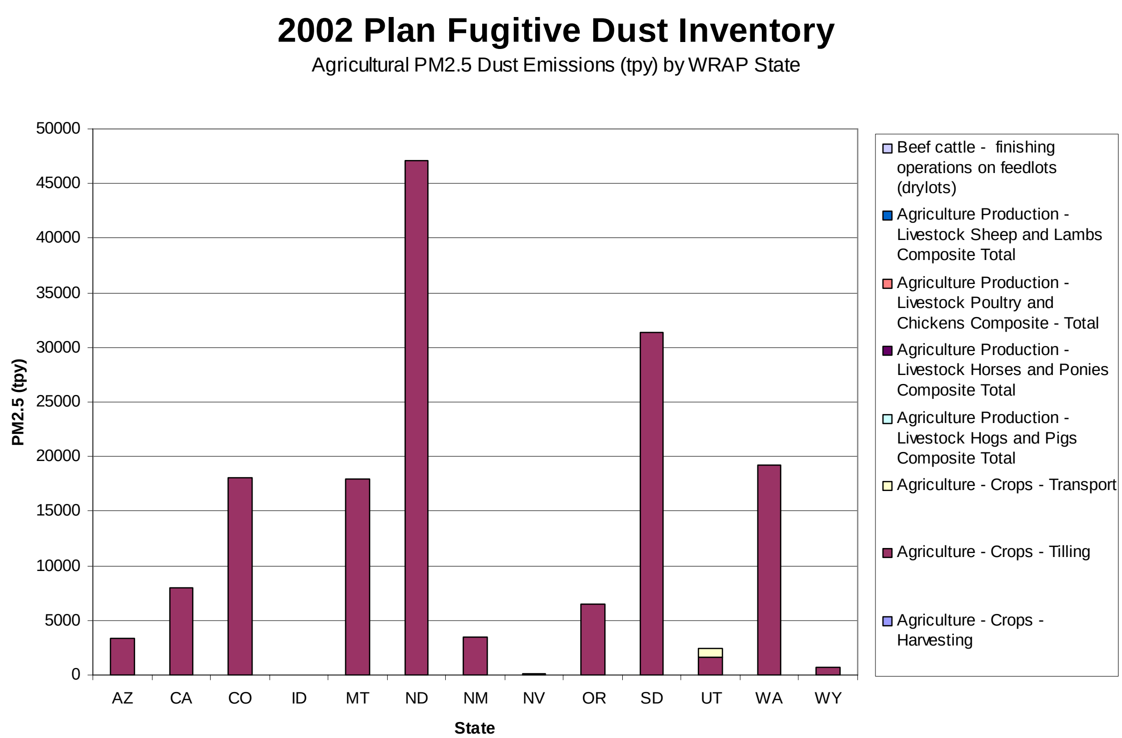

Figure 18. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

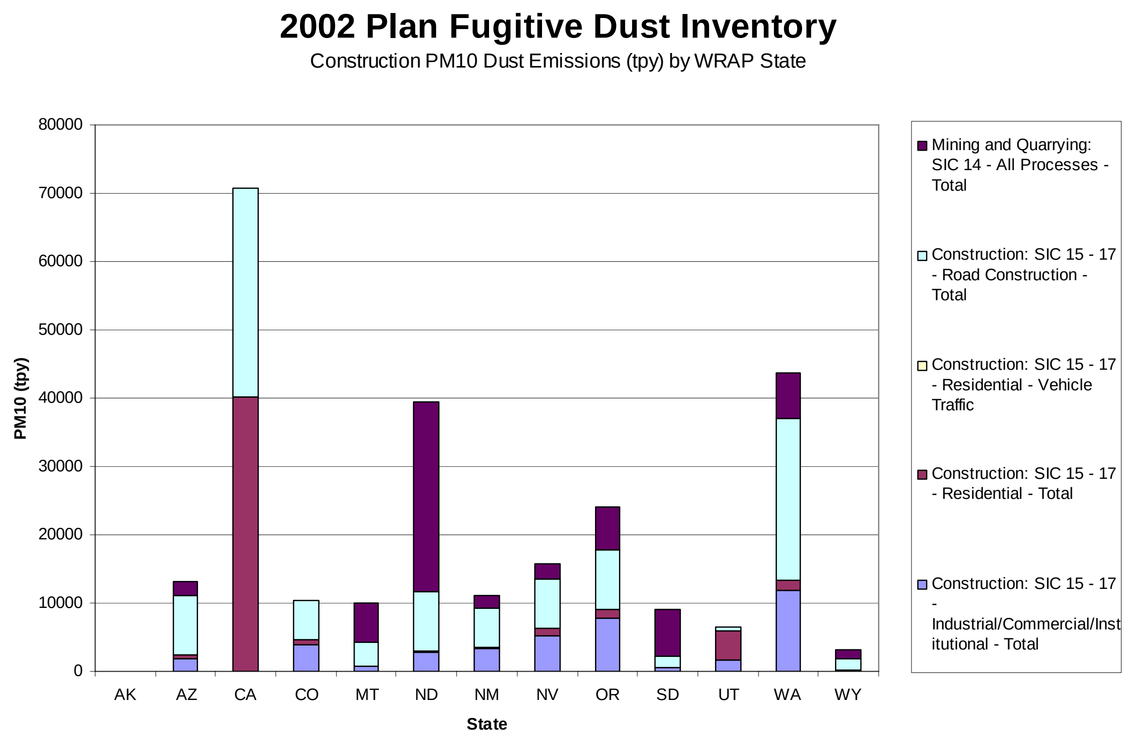

Figure 19. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

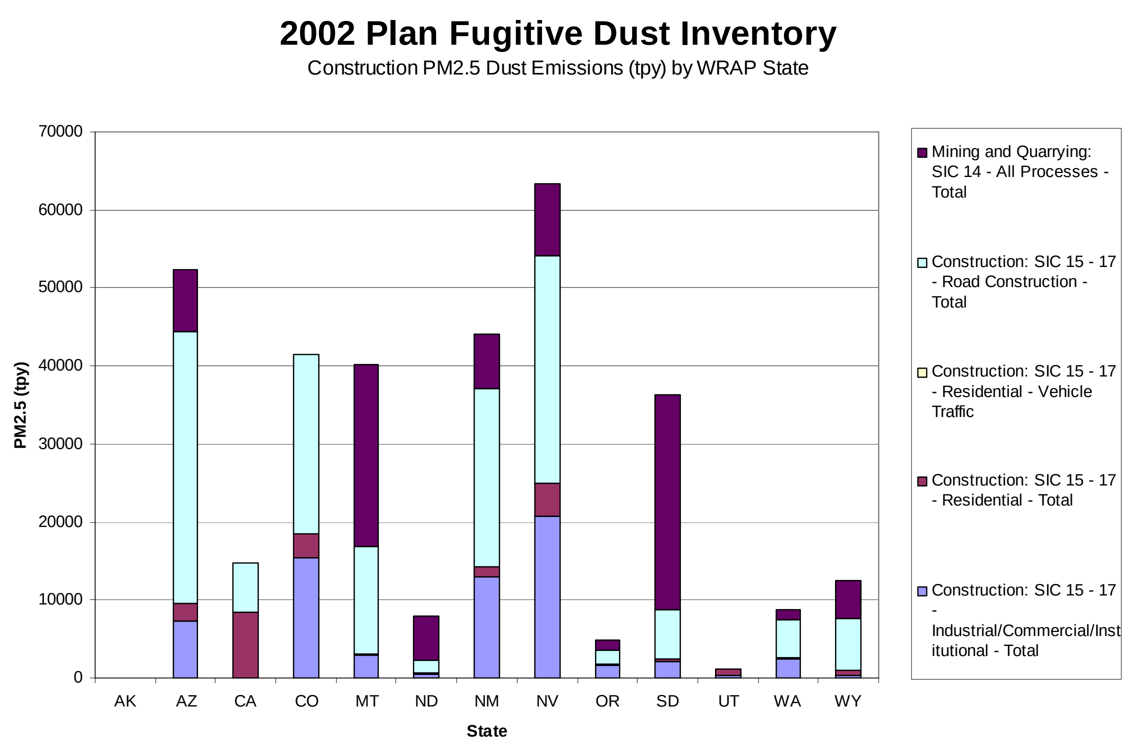

Figure 20. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

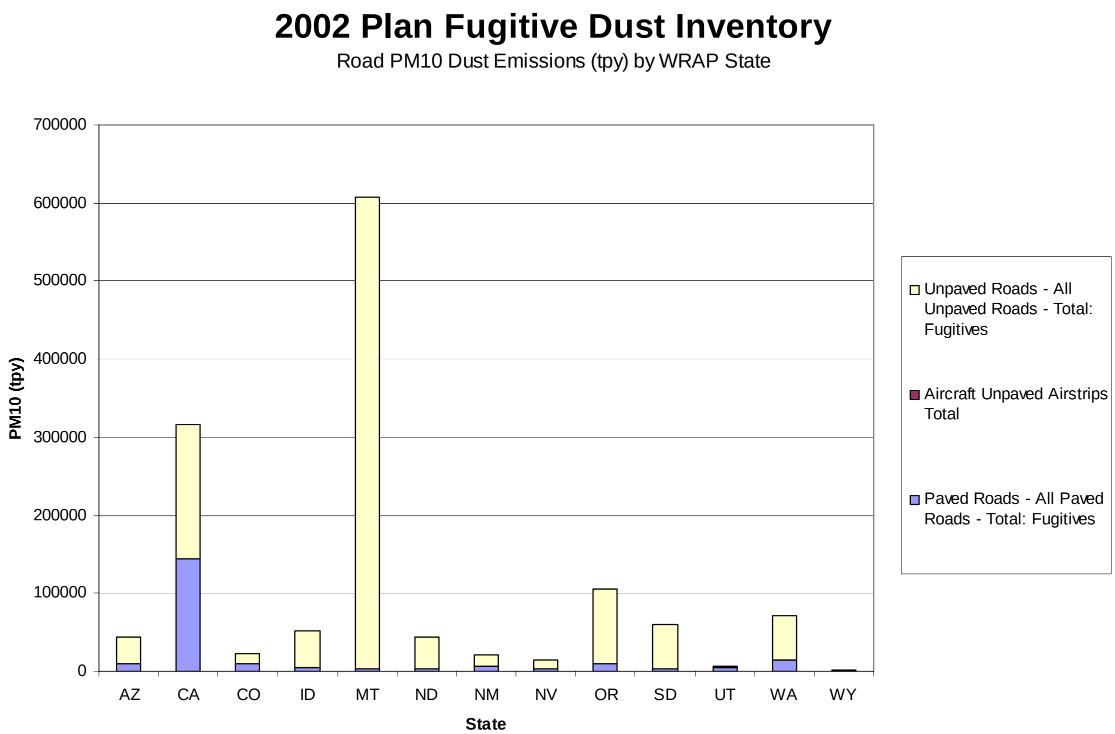

Figure 21. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

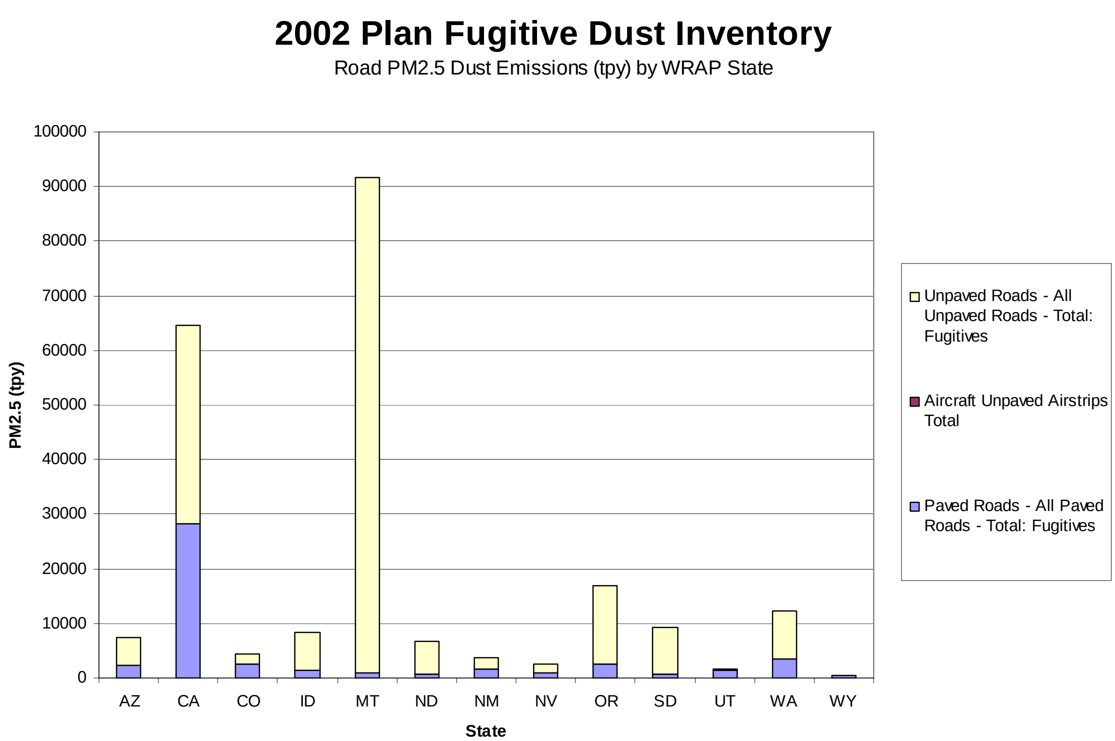

Figure 22. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

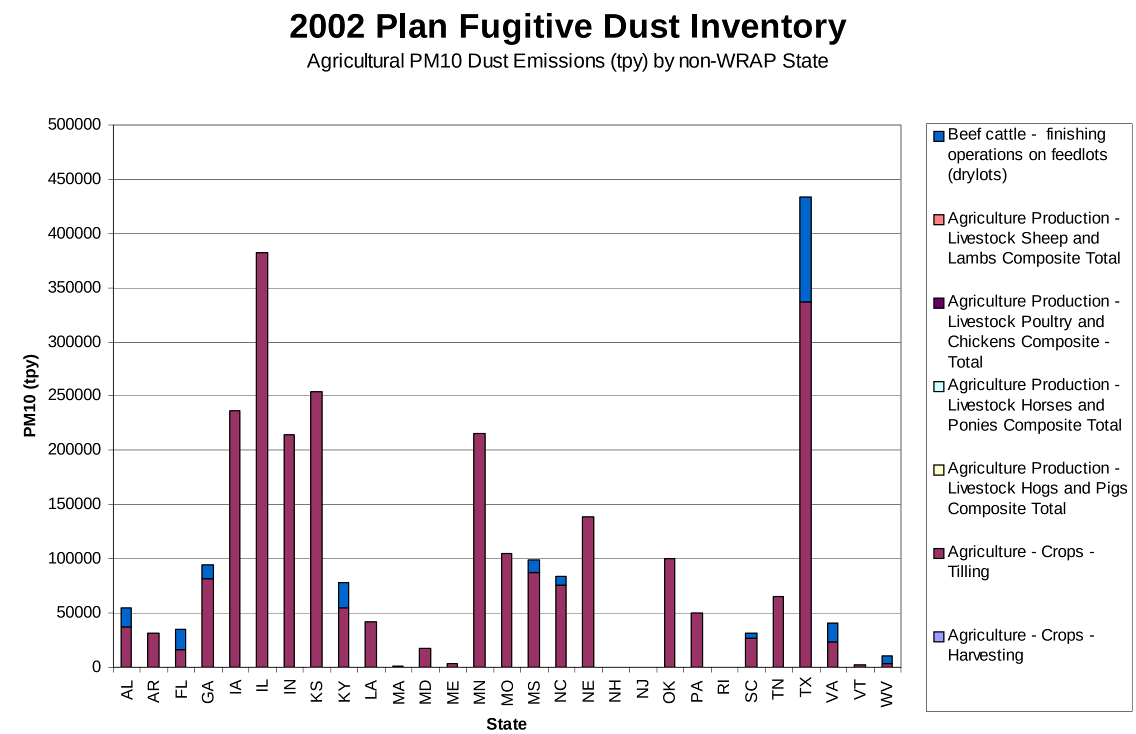

Figure 23. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

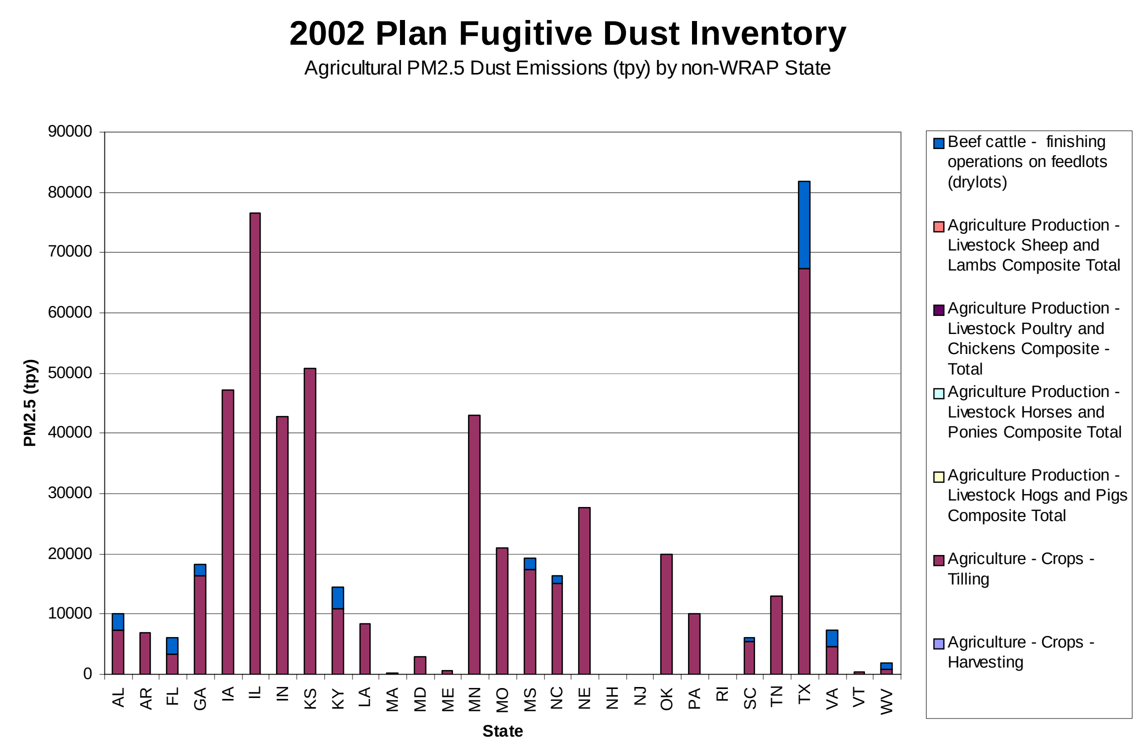

Figure 24. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

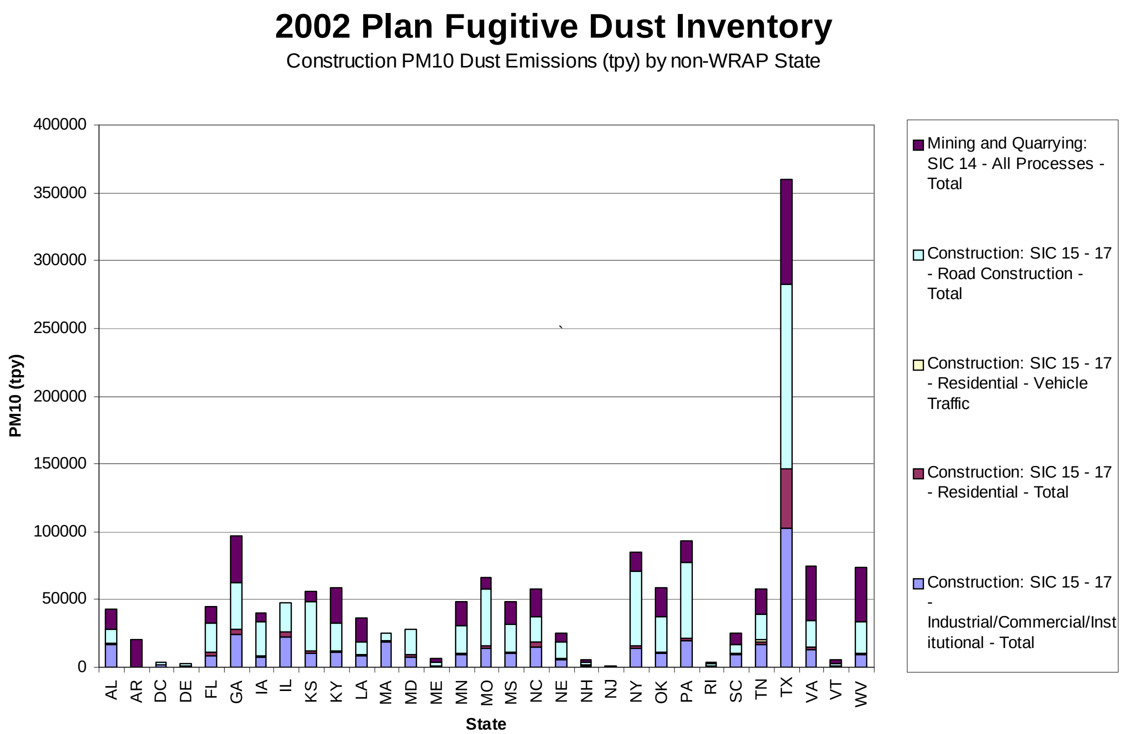

Figure 25. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

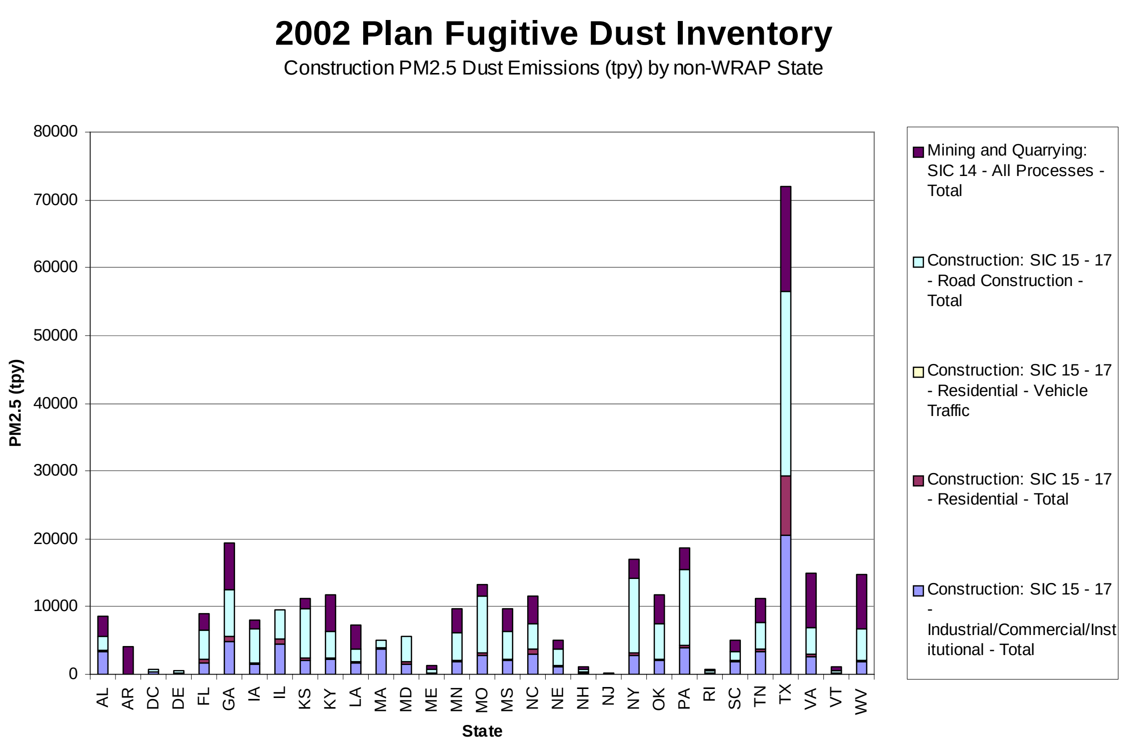

Figure 26. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

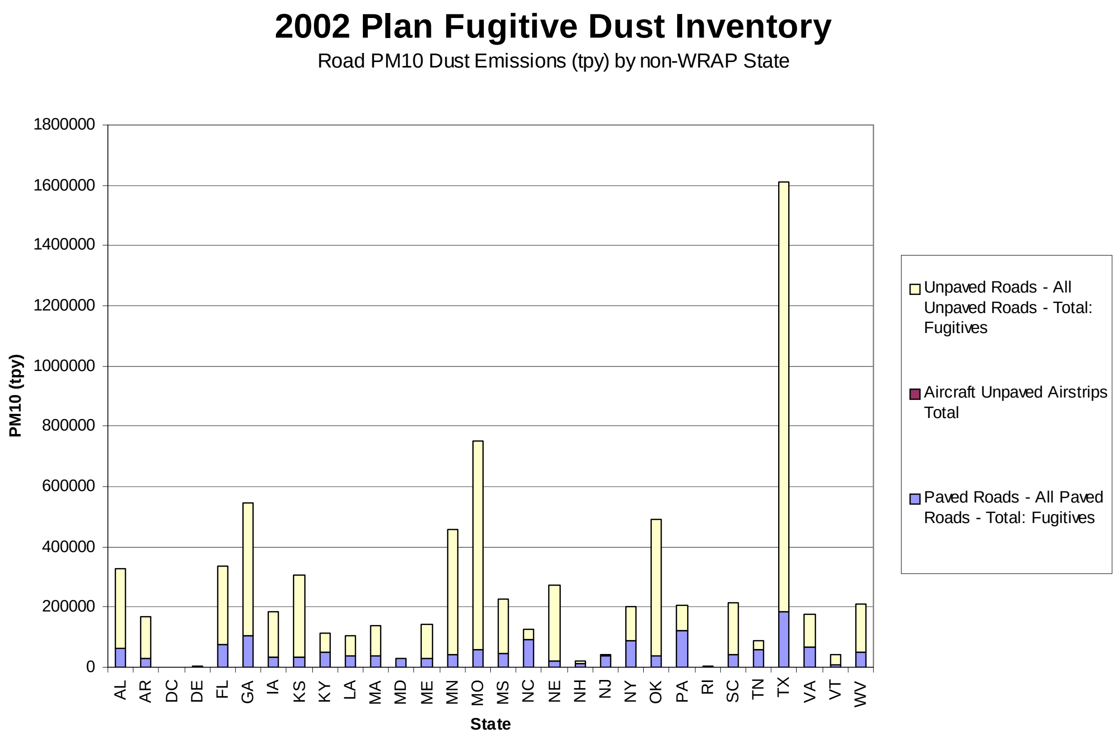

Figure 27. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

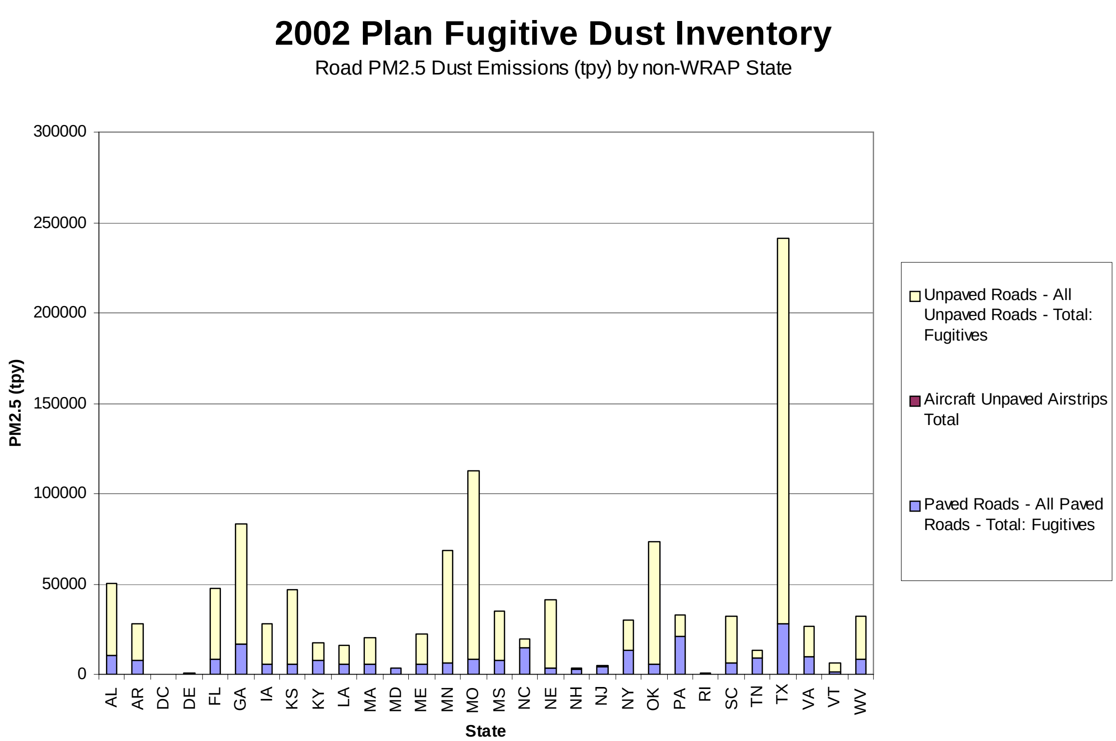

Figure 28. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

2018 Emission Inventories

Table 7 presents the annual Base18a PM10 dust emissions by major source category for all states in the WRAP modeling domain. Table 8 presents the corresponding Base18a annual PM2.5 dust emissions. The windblown dust emissions are unchanged from the Base02b inventory and are therefore not repeated in these tables. As noted previously, these data include the revisions to the list of SCCs extracted for fugitive dust emissions processing in addition to the revised PM2.5/PM10 ratios presented in Table 4 above. Figures 29 and 30 present the Base18a annual dust emissions by major source category and state for PM10 and PM2.5, respectively. These data are displayed for WRAP states only in Figure 31 (PM10) and Figure 32 (PM2.5), for clarity.

Figure 33 through Figure 35 present the Base18a PM10 dust emissions inventory by the detailed source categories (SCCs) extracted from the area source county-level inventory data files for each WRAP state. The corresponding displays for annual PM2.5 emissions are presented in Figures 36 through 38.

Summaries of all fugitive dust emissions for non-WRAP states are provided in Figures 39 through 44. Both PM10 and PM2.5 for the Base18a emission inventory are presented by detailed emissions source category. As with the Plan02b inventory, the Base18a dust emission inventory still reflects a number of omissions for various source categories. Specifically, the Midwest RPO still does not include dust emission estimates for many source categories for Ohio, Michigan and Wisconsin because these emission source categories either were not estimated, were not reported to the EPA, or were not provided to the WRAP RMC.

Table7. Annual 2018 PM10 dust emissions by state and major source category in tons/year (Base18a).

		2018 PM10 Dust Emissions (tpy)				
RPO	**State**	**Agriculture**	**Construction**	**Paved Roads**	**Unpaved Roads**	**Total**
WRAP	AK	0	14,890	0	0	14,890
	AZ	16,169	102,993	13,779	47,891	180,832
	CA	35,324	83,839	174,395	181,728	475,286
	CO	93,467	75,817	13,225	17,865	200,375
	ID	15,832	0	7,274	60,617	83,724
	MT	92,718	61,732	5,788	740,137	900,375
	ND	244,200	53,939	2,842	38,643	339,625
	NM	17,746	75,538	8,367	19,911	121,561
	NV	579	70,281	5,200	15,795	91,855
	OR	33,409	38,432	14,325	131,662	217,827
	SD	162,505	57,111	3,362	72,851	295,829
	UT	39,217	9,130	7,788	2,089	58,224
	WA	99,223	47,847	18,059	57,718	222,847
	WY	3,144	21,182	2,180	513	27,019
VISTAS	AL	49,720	51,686	76,963	304,318	482,688
	FL	32,614	62,267	106,089	359,356	560,326
	GA	84,229	124,515	141,433	589,640	939,817
	KY	70,991	68,621	62,893	72,353	274,858
	MS	88,576	64,483	51,672	205,180	409,910
	NC	75,272	75,219	121,860	41,093	313,444
	SC	28,822	32,396	55,282	203,515	320,014
	TN	57,390	74,259	79,714	32,380	243,743
	VA	37,343	86,811	85,516	134,100	343,770
	WV	10,160	85,017	56,388	157,963	309,530
MRPO	IL	569,462	67,842	0	0	637,304
	IN	318,053	0	0	0	318,053
MANEVU	CT	845	11,871	19,324	8,074	40,113
	DC	0	5,289	2,286	0	7,574
	DE	0	3,332	7,013	0	10,345
	MA	1,394	27,811	40,688	106,497	176,390
	MD	25,877	35,580	34,998	762	97,218
	ME	4,911	9,732	31,583	128,101	174,327
	NH	535	7,005	17,179	9,654	34,374
	NJ	286	930	38,004	4,260	43,480
	NY	0	107,886	90,257	114,577	312,721
	PA	74,923	119,304	128,734	87,951	410,913
	RI	101	5,465	3,305	584	9,455
	VT	3,435	7,382	9,781	40,476	61,073
CENRAP	AR	31,441	30,845	41,670	110,286	214,241
	IA	234,629	56,812	43,320	122,780	457,541
	KS	251,815	76,132	43,944	223,596	595,487
	LA	42,103	55,214	48,310	56,108	201,736
	MN	213,347	62,671	58,172	337,816	672,006
	MO	103,689	89,831	78,442	564,003	835,964
	NE	137,742	34,731	28,037	204,220	404,730
	OK	99,363	84,794	48,560	369,084	601,801
	TX	478,175	487,608	270,802	1,159,873	2,396,458
Total		**3,980,776**	**2,826,072**	**2,198,805**	**7,136,020**	**16,141,674**

Table 8. Annual 2018 PM2.5 dust emissions by state and major source category in tons/year Base18a).

		2018 PM2.5 Dust Emissions (tpy)				
RPO	**State**	**Agriculture**	**Construction**	**Paved Roads**	**Unpaved Roads**	**Total**
WRAP	AK	0.000	2977.984	0.000	0.000	2977.984
	AZ	3,375	20,605	3,445	7,189	34,614
	CA	7,830	17,426	29,447	38,529	93,232
	CO	18,694	15,163	3,306	2,680	39,843
	ID	0	0	1,819	9,093	10,911
	MT	18,544	12,346	1,447	111,020	143,357
	ND	48,840	10,788	711	5,796	66,135
	NM	3,549	15,107	2,092	2,987	23,735
	NV	116	14,051	1,300	2,593	18,060
	OR	6,682	7,686	3,581	19,749	37,699
	SD	32,501	11,422	841	10,928	55,691
	UT	5,090	1,646	1,947	313	8,997
	WA	19,862	9,569	4,515	8,658	42,604
	WY	697	4,247	545	77	5,566
VISTAS	AL	9,099	10,338	12,616	45,648	77,700
	FL	5,612	12,453	11,300	53,903	83,268
	GA	16,228	24,903	22,716	88,446	152,293
	KY	13,071	13,674	10,108	10,853	47,707
	MS	17,138	12,897	8,736	30,777	69,548
	NC	14,614	15,044	18,958	6,164	54,780
	SC	5,542	6,479	8,226	30,527	50,774
	TN	11,464	14,469	12,179	4,826	42,938
	VA	6,615	17,362	12,737	20,115	56,828
	WV	1,699	17,001	9,067	23,694	51,461
MRPO	IL	113,892	13,568	0	0	127,460
	IN	63,610	0	0	0	63,610
MANEVU	CT	169	2,374	2,642	1,207	6,392
	DC	0	1,058	159	0	1,217
	DE	0	660	885	0	1,545
	MA	279	5,563	5,612	15,915	27,368
	MD	4,486	7,116	4,423	114	16,139
	ME	982	1,946	6,230	19,152	28,310
	NH	107	1,401	3,001	1,443	5,953
	NJ	57	186	4,409	639	5,291
	NY	0	21,577	13,474	17,139	52,191
	PA	14,985	23,861	21,968	13,141	73,954
	RI	20	1,093	476	87	1,676
	VT	687	1,476	1,425	6,051	9,639
CENRAP	AR	6,968	6,169	10,417	16,543	40,096
	IA	46,926	11,362	7,270	18,321	83,879
	KS	50,363	15,226	7,683	33,427	106,699
	LA	8,421	11,042	7,262	8,388	35,114
	MN	42,669	12,534	8,669	50,417	114,289
	MO	20,738	17,966	11,761	84,434	134,899
	NE	27,548	6,946	4,866	30,539	69,900
	OK	19,873	16,958	7,242	55,201	99,274
	TX	88,427	97,521	41,146	173,533	400,626
Total		**778,066**	**565,261**	**352,657**	**1,080,258**	**2,776,241**

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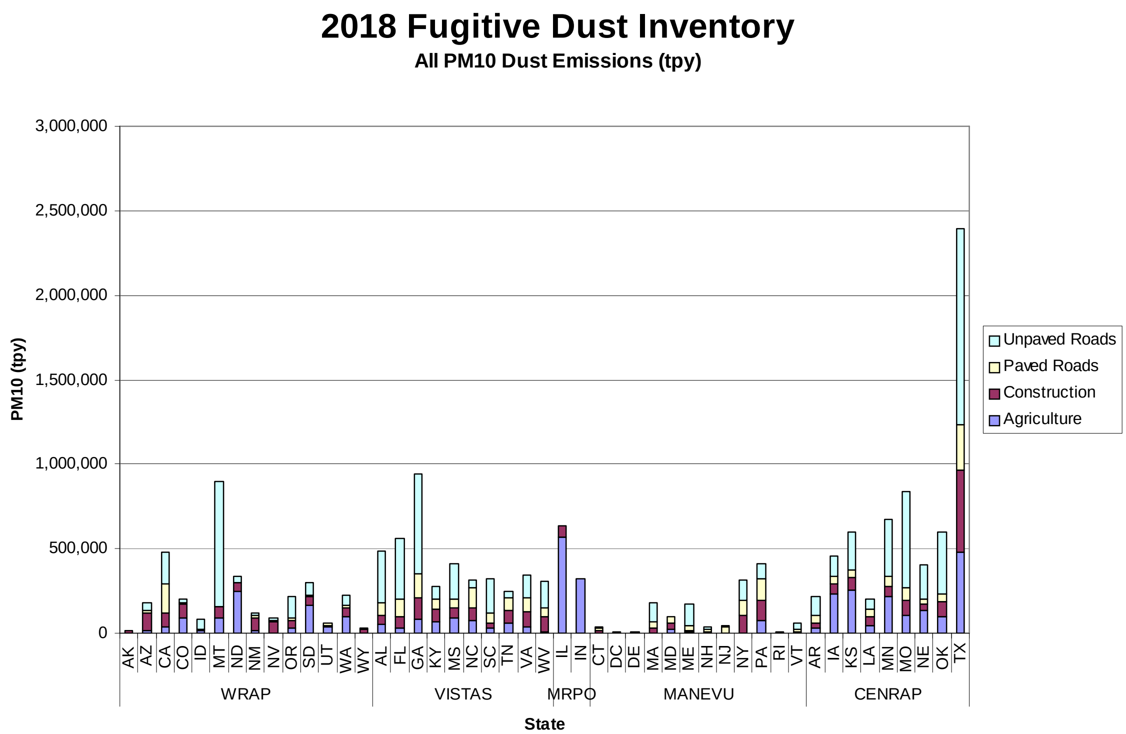

Figure 29. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

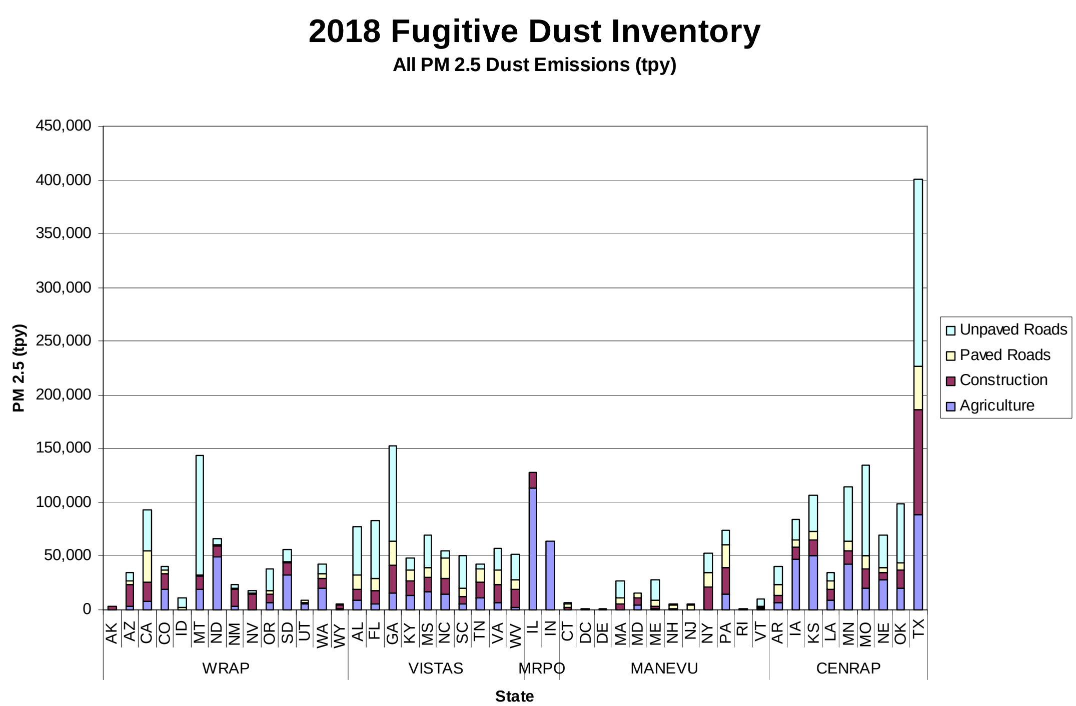

Figure 30. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

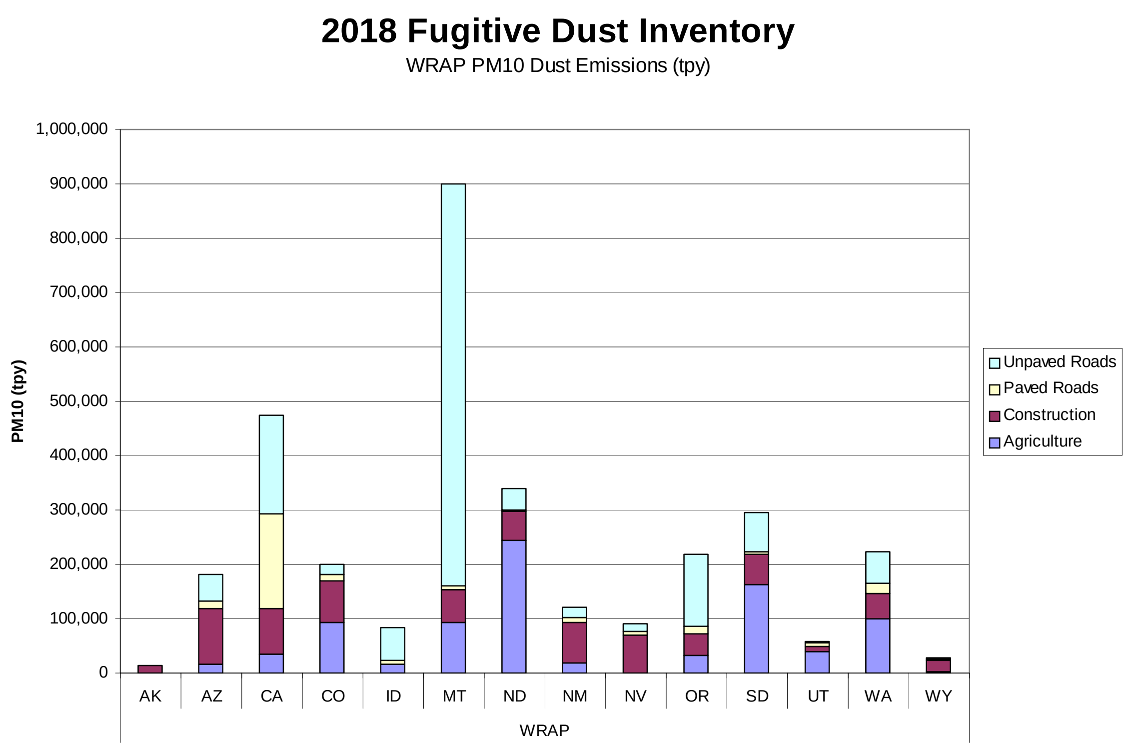

Figure 31. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

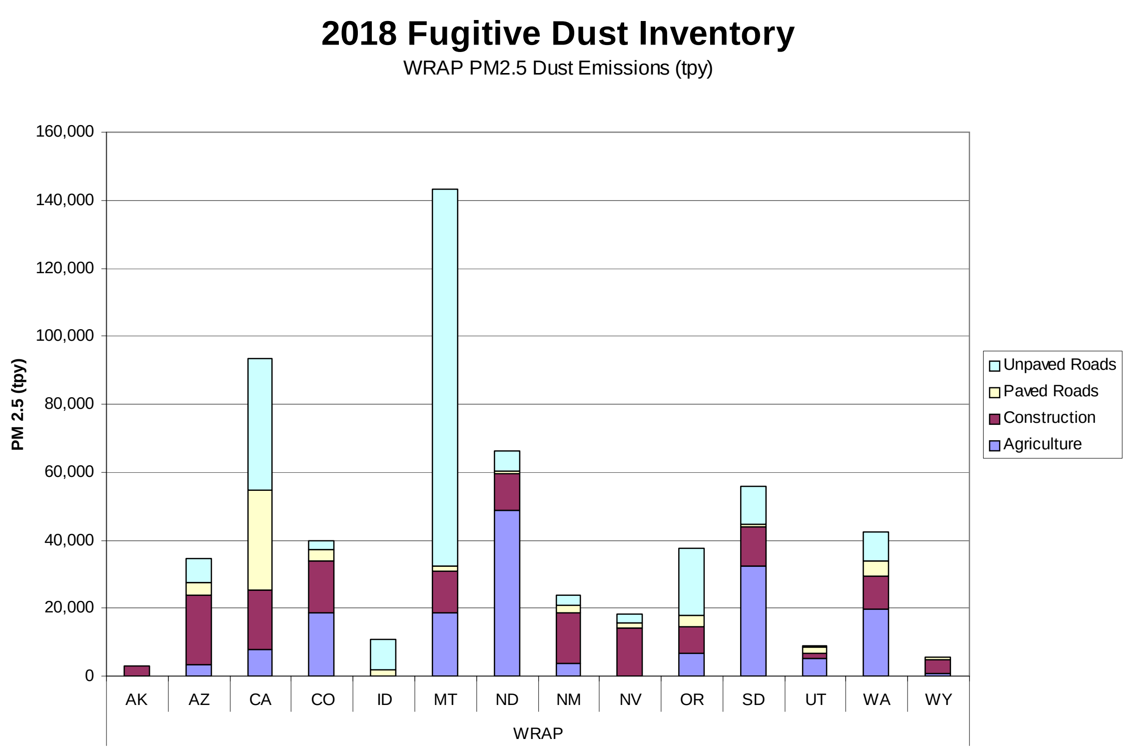

Figure 32. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

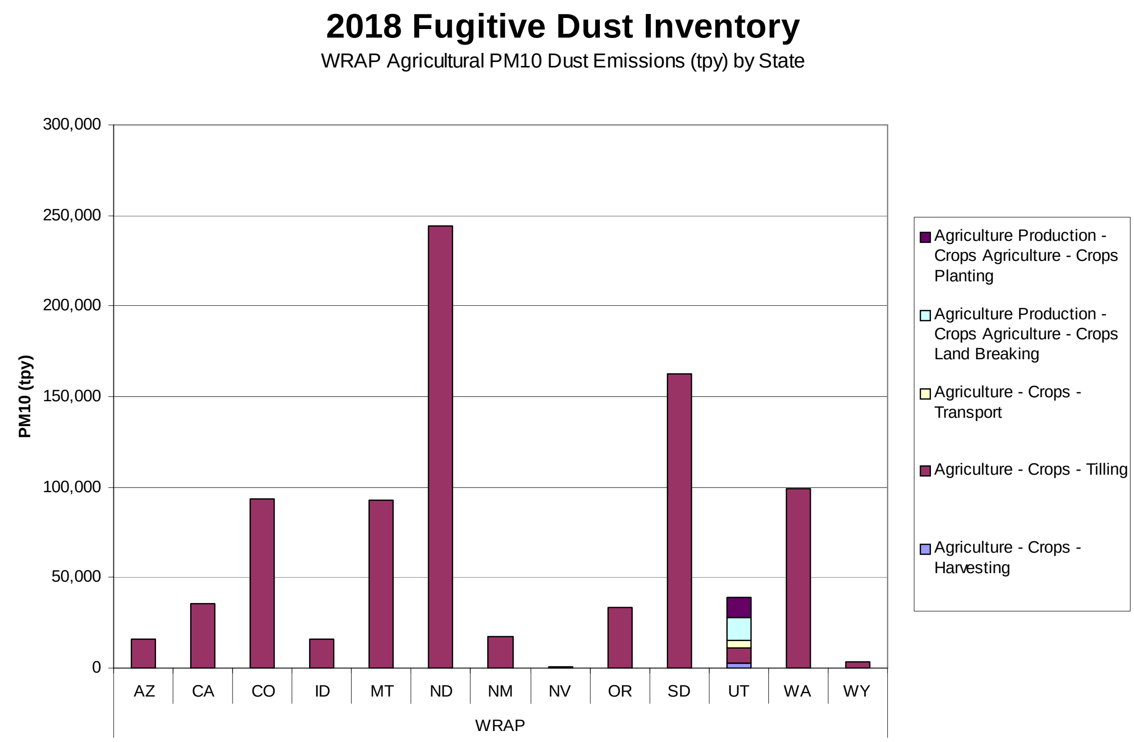

Figure 33. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

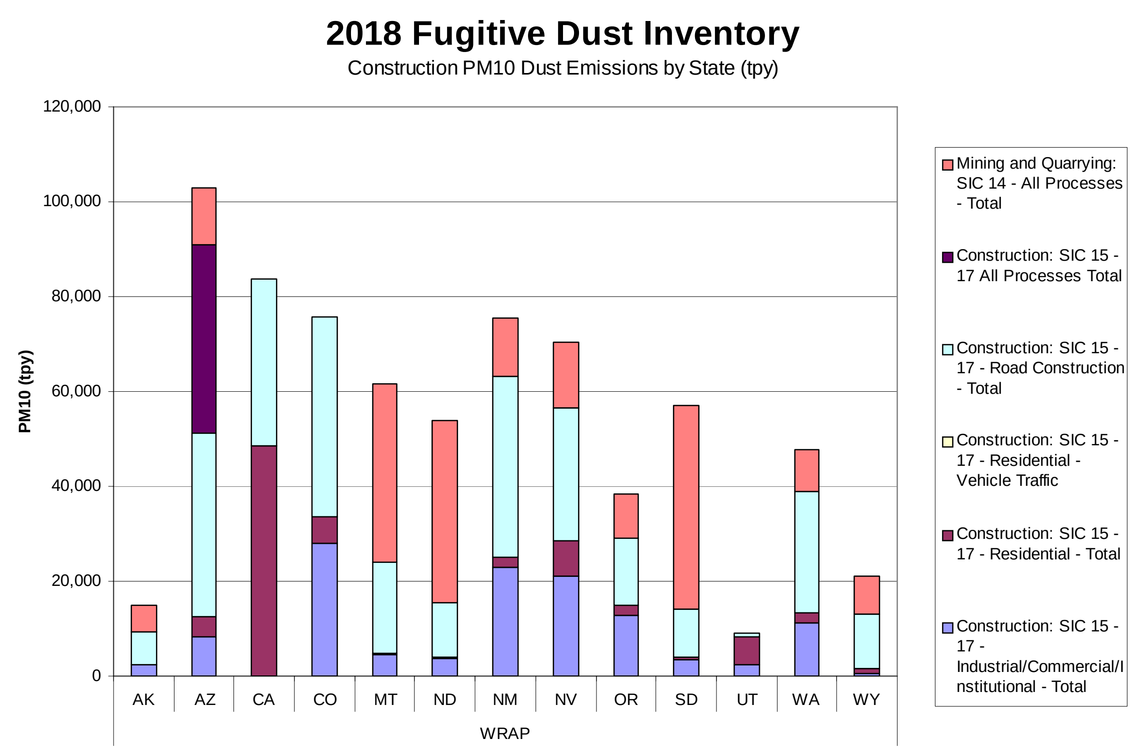

Figure 34. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

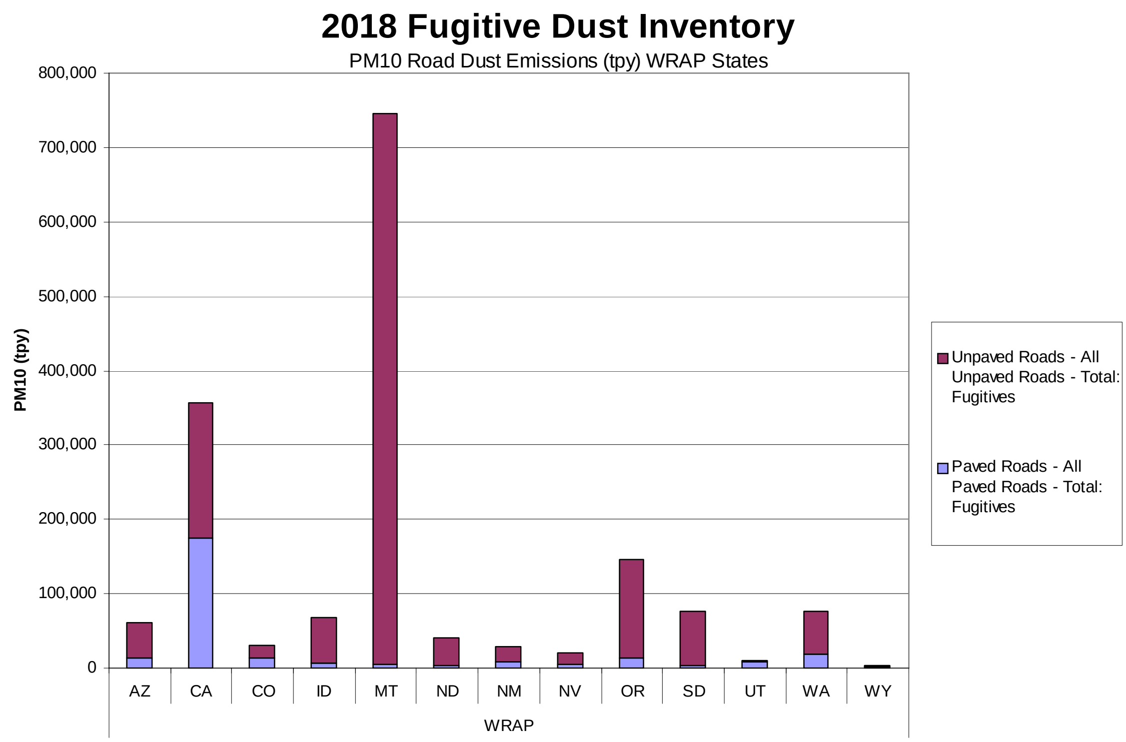

Figure 35. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

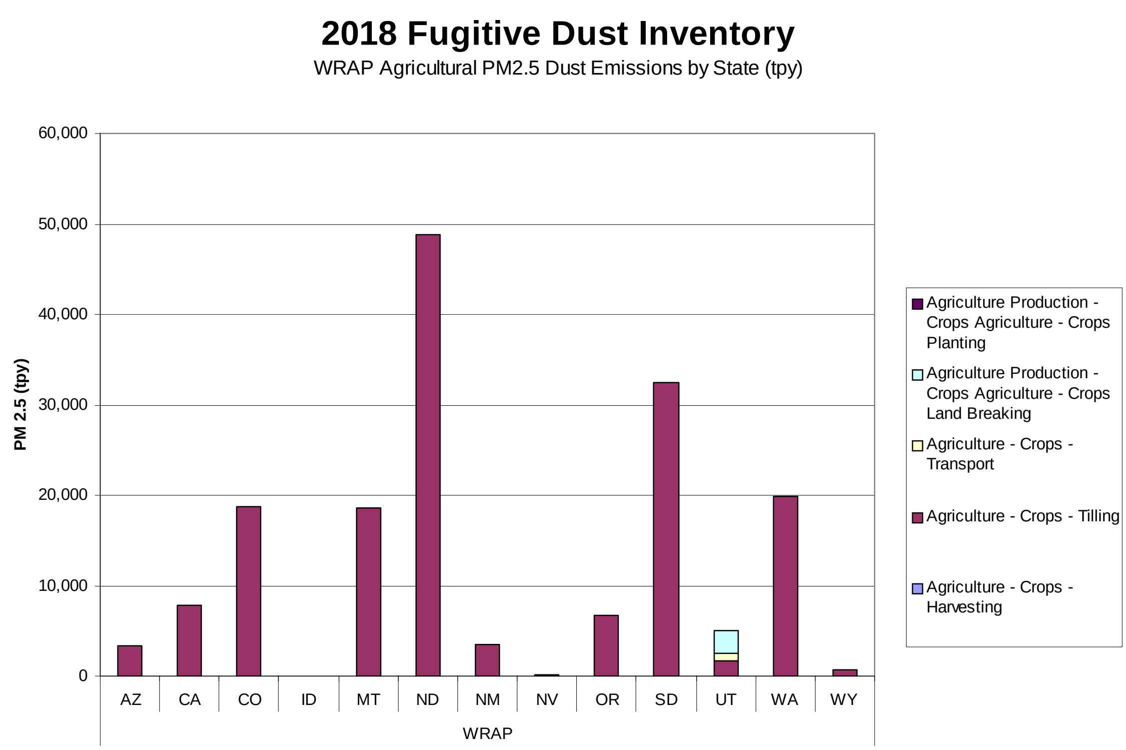

Figure 36. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

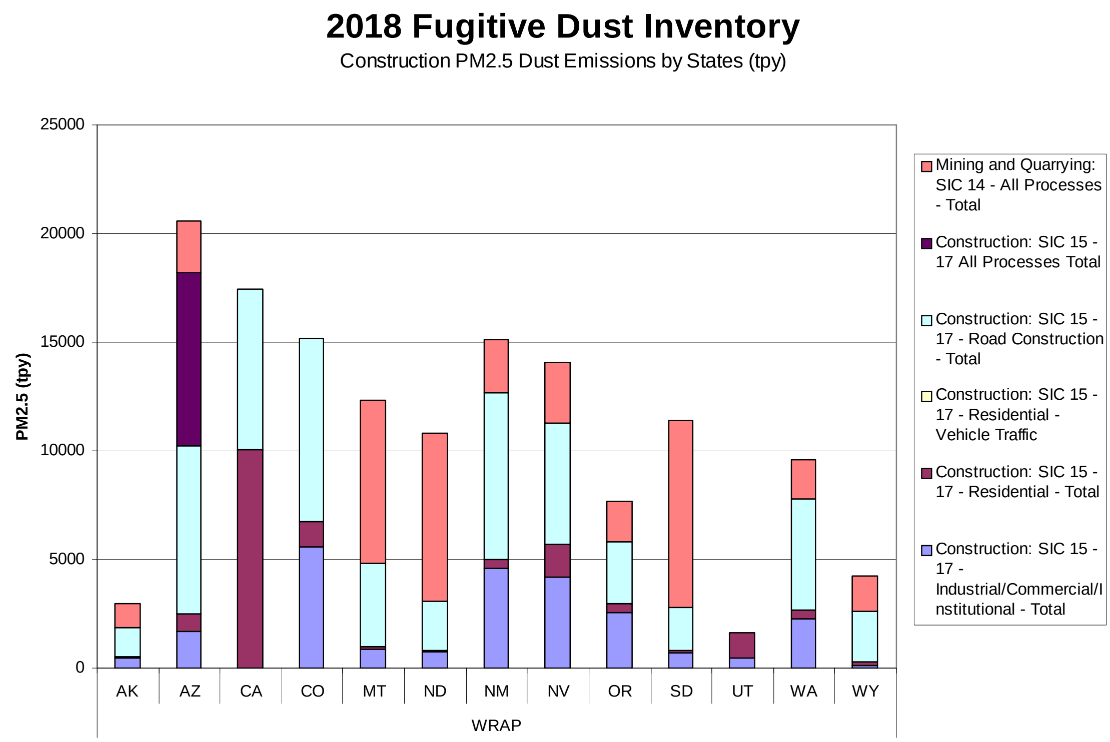

Figure 37. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

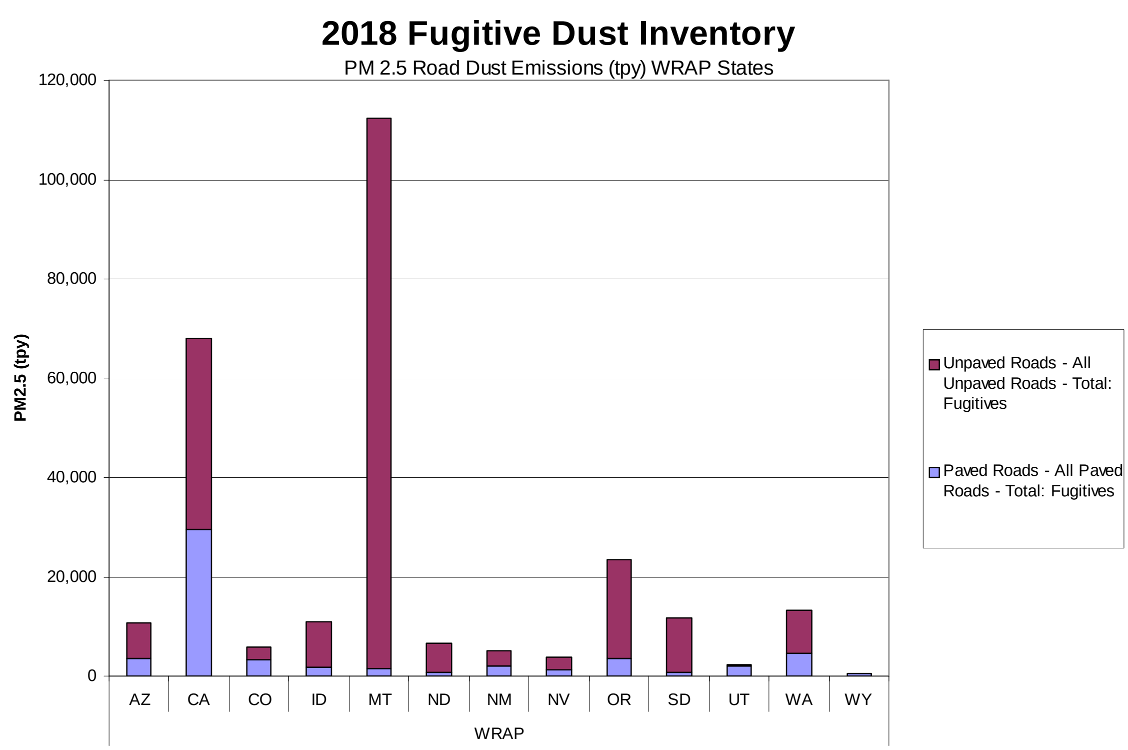

Figure 38. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

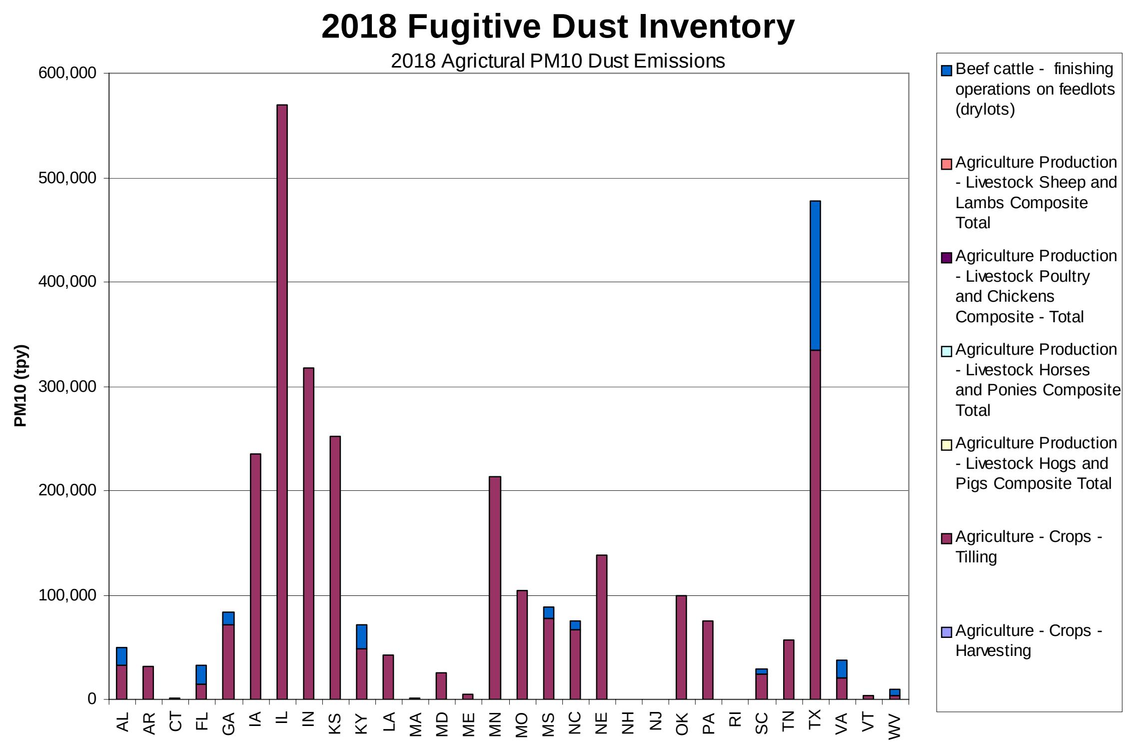

Figure 39. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

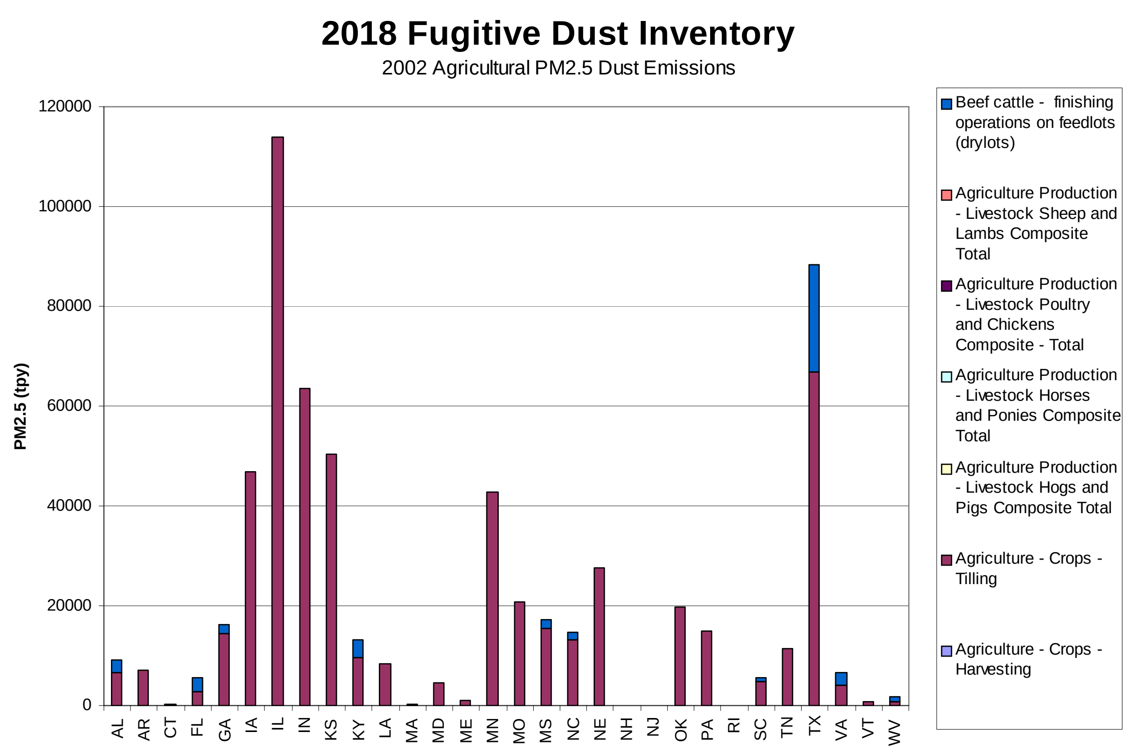

Figure 40. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

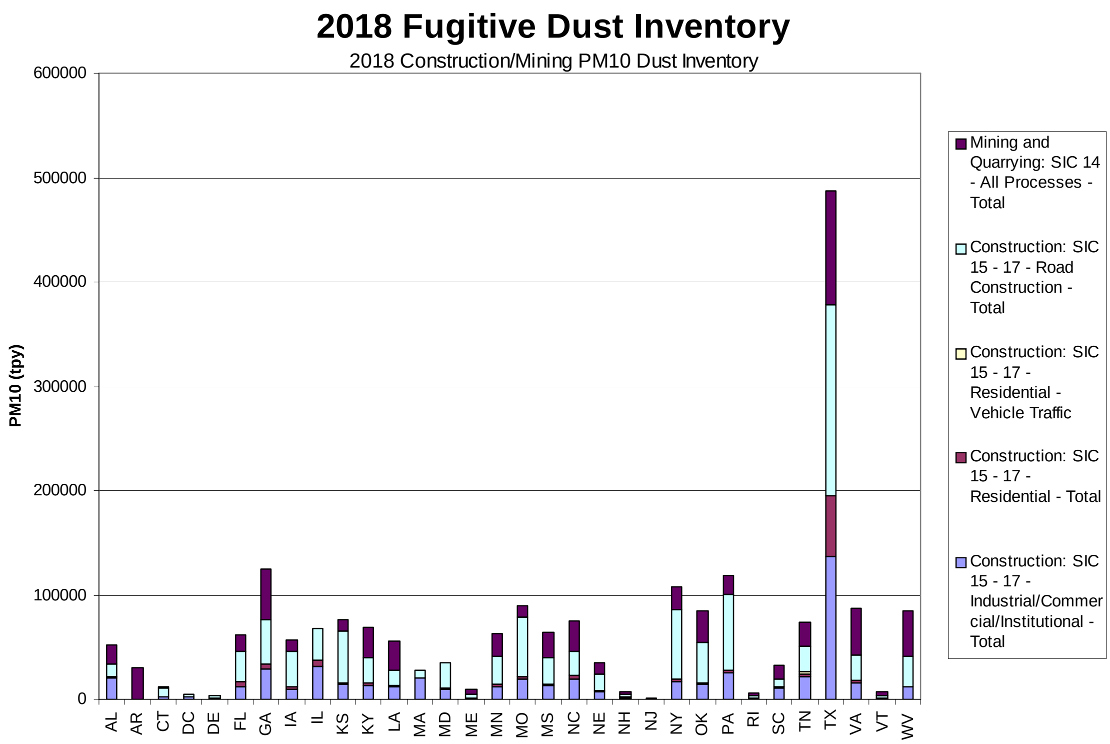

Figure 41. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

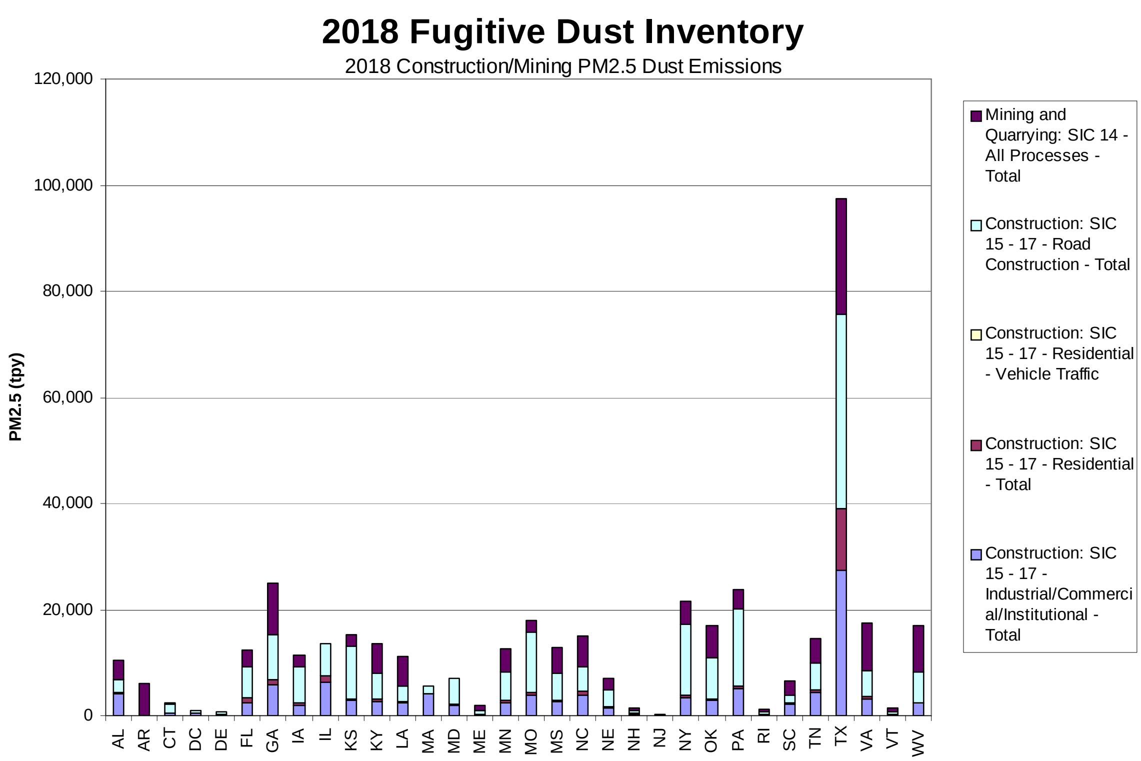

Figure 42. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

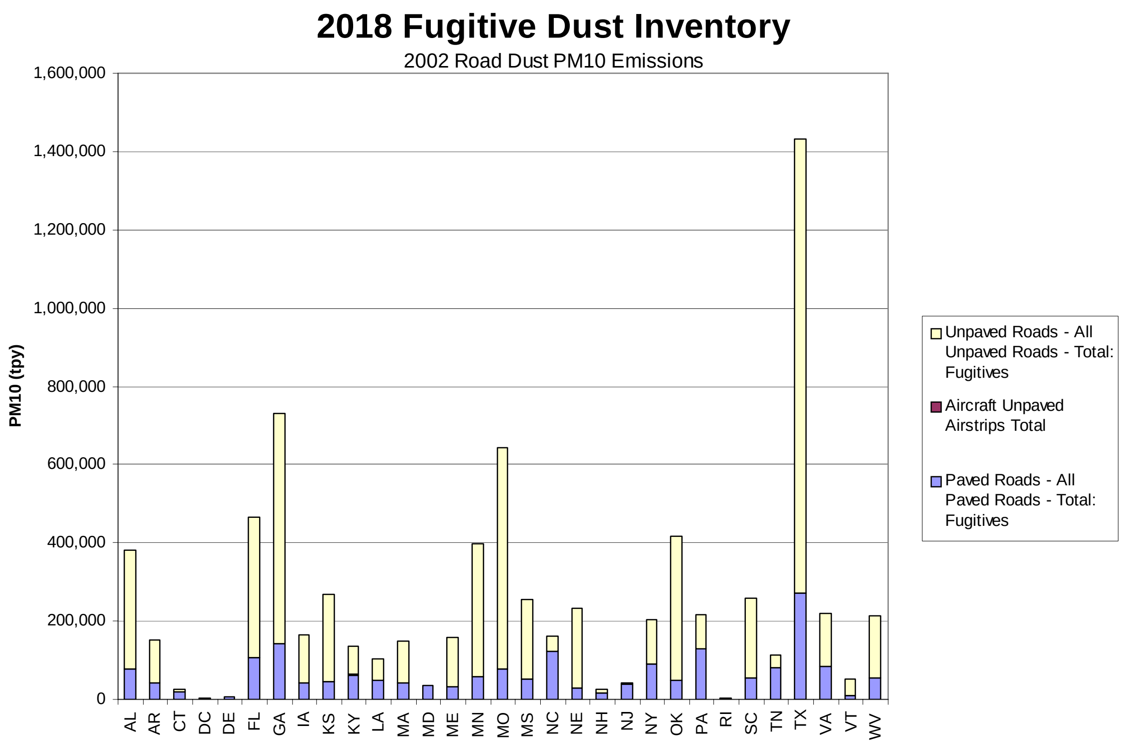

Figure 43. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

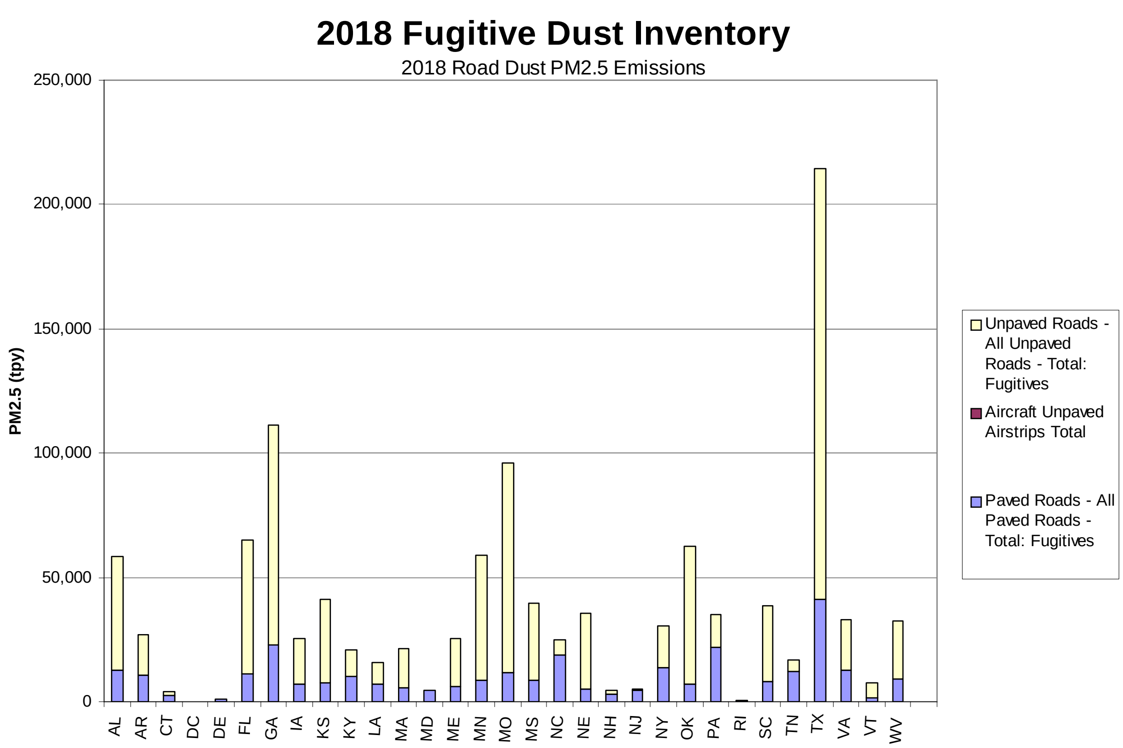

Figure 44. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

Gridded Fugitive Dust Emission Inventory Summaries

Summaries of the gridded fugitive dust PM emissions are presented below for the Base02b, Plan02b and Base18a inventories. The annual, county-level PM dust emission estimates were processed using the SMOKE emissions modeling system to spatial and temporally allocate the emission estimates to the modeling grid. As noted above, the data presented in the summaries below reflect the revise PM10/PM2.5 ratios developed by the Midwest Research Institute (MRI, 2005) as presented in Table 4 above, as well as the application of the fugitive dust transport fractions. With the exception of the windblown dust emissions, transport fractions are applied at the county-level using the growth and control modules of SMOKE. A discussion of fugitive dust transport fractions is provided below.

The concept of fugitive dust transport fractions has been considered and refined in recent years. It has been recognized that, due to various mechanisms, dust particles are subject to near source removal. These mechanisms include gravitational settling, particle deposition to the ground and impaction and removal due to particle capture by the surrounding vegetation canopy and other physical structures. The EPA for many years had promoted the “divide by four” approach for reducing the emission from fugitive dust sources to account for these processes. The idea is that only a limited amount of the dust emitted by a particular source is transported significantly to affect the total available emissions in the atmosphere for air quality grid modeling.

Recent research has shown that the amount of fugitive dust captured in the surround canopy or on physical structures can be related to the physical characteristics of the land surface, i.e., land use/land cover. The EPA recently developed county-level transport fractions for use in emissions inventory development for air quality modeling (Pace, 2003; 2005). The county-level transport fractions were based on the percentage of land use in each county. The transport fractions were calculated as a weighted sum of landuse-specific fractions for each landuse type. Previously, landuse percentages were derived from the BELD3 LULC database. In the WRAP fugitive dust emission inventory, transport fractions were revised to reflect a more current LULC database. The current gridded dust emissions for the WRAP are based on the 2000 North American Land Cover (2000 NALC) database. A description of the 2000 NALC database can be found in Mansell and Hoats, 2005.

For the windblown dust emissions, transport fractions were developed and applied within the wind blown dust model based on the gridded landuse data used in the estimation methodology. A discussion of the application of the transport fraction for windblown dust emissions can be found in Mansell, et al., 2006. The original and revised transport fractions for each of the relevant land use types are presented in Table 9.

Table 9. Fugitive dust transport fractions as a function of landuse.

Fugitive Dust Transport Fractions		
LULC Category	**Original**	**Revised**
Urban	0.30	0.00
Agriculture	0.85	0.75
Grassland	0.70	0.75
Shrubland	0.60	0.75
Forest	0.30	0.00
Barren/Water	0.97	1.00

Summaries of the gridded fugitive dust emission inventories are provides in Tables 10 through 12 for Base02b, Plan02b and Base18a, respectively. Presented in these tables are state totals for both PM10 and PM2.5 for fugitive dust (agricultural, construction, mining), road dust (paved and un-paved) and wind blown dust. Emission totals are obtained from the model-ready gridded data files through assignment of states to grid cells, at 36-km spatial resolution, using GIS processing in a manner similar to specification of source regions for source attribution simulations. Therefore, these numbers are slightly different than the state totals based on aggregation of county-level SMOKE input data files to the state level. Emission estimates summarized in Tables 10 through 12 also reflect the application of the fugitive dust transport fractions, and, in the case of the Plan02b and Base18a also reflect the revised PM10./PM2.5 ratios presented in Table 3.

Figures 45 and 46 display the Base02b fugitive dust emissions by county and major source category for PM10 and PM2.5, respectively. Figures 47 and 48 present these results for the Plan02b inventory while Base18a emission estimates are presented in Figure 49 and 50.

Corresponding displays of state-level fugitive dust PM10 and PM2.5 emission estimates by major source category for each WRAP state are presented in Figures 51 and 52 (Base02b), Figure 53 and 54 (Plan02b) and Figures 55 and 56 (Base18a).

Table 10. Annual gridded 2002 dust emissions (Base02b)

2002 Gridded Dust Emissions (tpy)						
	PM10			PM2.5		
State	Fugitive Dust	Road Dust	Windblown Dust	Fugitive Dust	Road Dust	Windblown Dust
AL	29,330	92,572	8,223	5,369	13,029	822
AZ	54,283	25,926	64,545	10,385	4,133	6,454
AR	26,589	65,934	37,842	5,479	10,089	3,784
CA	52,819	124,142	82,076	10,203	21,702	8,208
CO	81,367	10,664	160,597	15,488	1,748	16,060
CT	428	2,759	22	82	285	2
DE	1,755	2,607	22	333	325	2
FL	37,286	145,962	7,930	6,705	18,850	793
GA	55,051	141,759	2,473	10,382	19,963	247
ID	9,330	20,882	50,461	293	3,122	5,046
IL	271,276	8,967	53,079	51,633	1,215	5,308
IN	133,781	882	23,284	25,456	117	2,328
IA	193,663	130,029	460,870	36,904	18,367	46,087
KS	215,404	216,252	408,654	41,046	30,724	40,865
KY	61,217	38,199	26,844	11,239	5,239	2,684
LA	37,742	42,569	29,729	7,245	5,750	2,973
ME	2,364	35,522	1,054	420	4,402	105
MD	23,361	14,563	1,204	4,233	1,534	120
MA	6,827	34,590	108	1,300	4,362	11
MI	1,532	594	21,126	82	112	2,113
MN	176,674	256,563	147,922	33,710	35,997	14,792
MS	61,922	72,204	17,506	11,675	10,231	1,751
MO	87,707	342,721	136,654	16,736	48,351	13,665
MT	76,213	217,007	370,603	14,623	30,981	37,060
NE	122,915	195,217	364,255	23,442	27,751	36,425
NV	64,688	9,687	102,092	12,379	1,636	10,209
NH	839	5,027	72	162	709	7
NJ	5,145	16,407	502	982	1,661	50
NM	46,773	14,710	165,341	8,946	2,343	16,534
NY	31,473	77,518	16,216	5,976	10,246	1,622
NC	47,726	40,375	2,415	9,001	5,357	241
ND	198,573	33,640	179,266	37,973	4,925	17,927
OH	3,745	1,224	25,356	710	167	2,536
OK	101,246	253,463	169,449	19,338	35,658	16,945
OR	16,031	13,218	117,238	3,042	1,973	11,724
PA	48,837	64,614	3,732	9,334	9,021	373
RI	1,415	3,010	14	273	400	1
SC	19,025	63,248	1,321	3,584	8,725	132
SD	140,864	39,206	490,164	27,016	5,691	49,016
TN	59,144	37,489	15,694	11,239	4,981	1,569
TX	488,415	888,747	628,670	90,684	125,082	62,867
UT	8,752	3,205	76,000	1,393	588	7,600
VT	1,614	8,355	60	290	1,194	6
VA	23,110	28,218	4,604	4,330	3,678	460
WA	64,623	28,320	54,373	12,273	4,209	5,437
WV	4,583	7,453	756	865	1,035	76
WI	6,468	7,729	31,497	1,232	1,082	3,150
WY	12,450	2,123	56,524	2,449	368	5,652
Total	**3,216,376**	**3,886,072**	**4,618,439**	**607,934**	**549,109**	**461,844**

Table 11. Annual gridded 2002 dust emissions (Plan02b)

2002 Gridded Dust Emissions (tpy)						
	PM10			PM2.5		
State	Fugitive Dust	Road Dust	Windblown Dust	Fugitive Dust	Road Dust	Windblown Dust
AL	26,441	92,733	8,223	4,812	13,190	822
AZ	52,490	26,135	64,545	10,045	4,236	6,454
AR	21,974	66,098	37,842	4,530	10,253	3,784
CA	51,972	142,159	82,076	10,500	27,046	8,208
CO	72,295	10,796	160,597	13,761	1,816	16,060
CT	331	2,766	22	63	292	2
DE	1,414	2,630	22	268	349	2
FL	35,050	146,192	7,930	6,270	19,080	793
GA	46,899	142,013	2,473	8,814	20,216	247
ID	7,920	20,916	50,461	256	3,155	5,046
IL	227,080	8,987	53,079	43,221	1,235	5,308
IN	112,948	886	23,284	21,492	121	2,328
IA	161,689	130,254	460,870	30,808	18,592	46,087
KS	187,138	216,490	408,654	35,666	30,961	40,865
KY	52,561	38,363	26,844	9,576	5,403	2,684
LA	30,704	42,704	29,729	5,891	5,886	2,973
ME	2,019	35,620	1,054	334	4,500	105
MD	18,944	14,663	1,204	3,425	1,634	120
MA	5,286	34,674	108	1,007	4,446	11
MI	1,686	601	21,126	79	119	2,113
MN	147,967	256,772	147,922	28,193	36,206	14,792
MS	53,161	72,356	17,506	9,995	10,382	1,751
MO	72,123	342,931	136,654	13,761	48,562	13,665
MT	70,359	217,029	370,603	13,027	31,003	37,060
NE	102,674	195,374	364,255	19,580	27,908	36,425
NV	64,604	10,206	102,092	12,363	1,767	10,209
NH	666	5,051	72	126	733	7
NJ	3,998	16,507	502	763	1,761	50
NM	44,040	14,754	165,341	8,425	2,399	16,534
NY	24,984	77,852	16,216	4,635	10,581	1,622
NC	40,822	40,638	2,415	7,675	5,619	241
ND	173,173	33,672	179,266	32,929	4,957	17,927
OH	3,158	1,230	25,356	598	173	2,536
OK	89,918	253,631	169,449	17,181	35,826	16,945
OR	14,066	13,277	117,238	2,671	2,006	11,724
PA	38,993	64,995	3,732	7,451	9,402	373
RI	1,096	3,019	14	211	409	1
SC	16,842	63,369	1,321	3,163	8,847	132
SD	123,625	39,232	490,164	23,735	5,717	49,016
TN	52,212	37,696	15,694	9,920	5,187	1,569
TX	406,680	889,575	628,670	75,028	125,991	62,867
UT	7,750	3,235	76,000	1,252	617	7,600
VT	1,343	8,376	60	232	1,214	6
VA	20,642	28,322	4,604	3,846	3,782	460
WA	55,875	28,360	54,373	10,613	4,249	5,437
WV	4,134	7,473	756	776	1,055	76
WI	5,363	7,738	31,497	1,021	1,091	3,150
WY	12,124	2,138	56,524	2,382	383	5,652
Total	**2,769,233**	**3,910,488**	**4,618,439**	**522,372**	**560,358**	**461,844**

Table 12. Annual gridded 2018 dust emissions (Base18b)

2018 Gridded Dust Emissions (tpy)						
	PM10			PM2.5		
State	Fugitive Dust	Road Dust	Windblown Dust	Fugitive Dust	Road Dust	Windblown Dust
AL	27,318	108,158	8,223	4,993	15,382	822
AZ	78,535	37,043	64,545	15,393	6,005	6,454
AR	24,542	60,045	37,842	5,040	9,710	3,784
CA	58,404	160,961	82,076	11,776	28,247	8,208
CO	83,707	13,721	160,597	15,933	2,328	16,060
CT	2,906	8,890	22	556	1,209	2
DE	1,927	3,186	22	365	423	2
FL	34,908	198,234	7,930	6,270	25,922	793
GA	50,142	189,283	2,473	9,460	26,939	247
ID	8,324	27,381	50,461	275	4,133	5,046
IL	335,612	8,708	53,079	63,879	1,180	5,308
IN	167,742	1,078	23,284	31,920	147	2,328
IA	169,989	116,619	460,870	32,405	16,704	46,087
KS	199,345	187,982	408,654	38,012	27,002	40,865
KY	55,187	45,927	26,844	10,094	6,465	2,684
LA	36,899	42,904	29,729	7,097	5,856	2,973
ME	2,802	31,122	1,054	487	5,031	105
MD	25,436	17,641	1,204	4,573	1,962	120
MA	5,824	30,719	108	1,109	4,868	11
MI	1,792	601	21,126	100	119	2,113
MN	154,109	222,146	147,922	29,378	31,235	14,792
MS	51,573	81,704	17,506	9,717	11,725	1,751
MO	79,729	291,344	136,654	15,219	41,180	13,665
MT	78,165	253,320	370,603	14,548	36,208	37,060
NE	107,526	167,096	364,255	20,522	23,956	36,425
NV	55,950	15,387	102,092	10,729	2,683	10,209
NH	881	5,595	72	168	850	7
NJ	5,058	17,018	502	965	1,810	50
NM	54,804	18,631	165,341	10,490	3,043	16,534
NY	31,890	79,615	16,216	5,968	10,812	1,622
NC	41,119	52,676	2,415	7,752	7,280	241
ND	188,349	32,655	179,266	35,889	4,809	17,927
OH	4,384	1,415	25,356	831	198	2,536
OK	102,547	214,837	169,449	19,613	30,277	16,945
OR	16,508	18,224	117,238	3,142	2,751	11,724
PA	53,138	69,436	3,732	10,149	10,040	373
RI	1,560	3,452	14	301	466	1
SC	17,376	76,609	1,321	3,274	10,680	132
SD	134,746	49,318	490,164	25,903	7,191	49,016
TN	50,836	47,319	15,694	9,655	6,506	1,569
TX	488,259	790,262	628,670	89,375	111,584	62,867
UT	14,774	4,266	76,000	2,037	844	7,600
VT	1,869	9,784	60	334	1,411	6
VA	21,611	35,175	4,604	4,041	4,688	460
WA	58,925	29,483	54,373	11,198	4,465	5,437
WV	4,608	7,679	756	868	1,084	76
WI	7,324	6,778	31,497	1,395	953	3,150
WY	15,877	2,661	56,524	3,111	481	5,652
Total	**3,214,834**	**3,894,088**	**4,618,439**	**606,307**	**558,840**	**461,844**

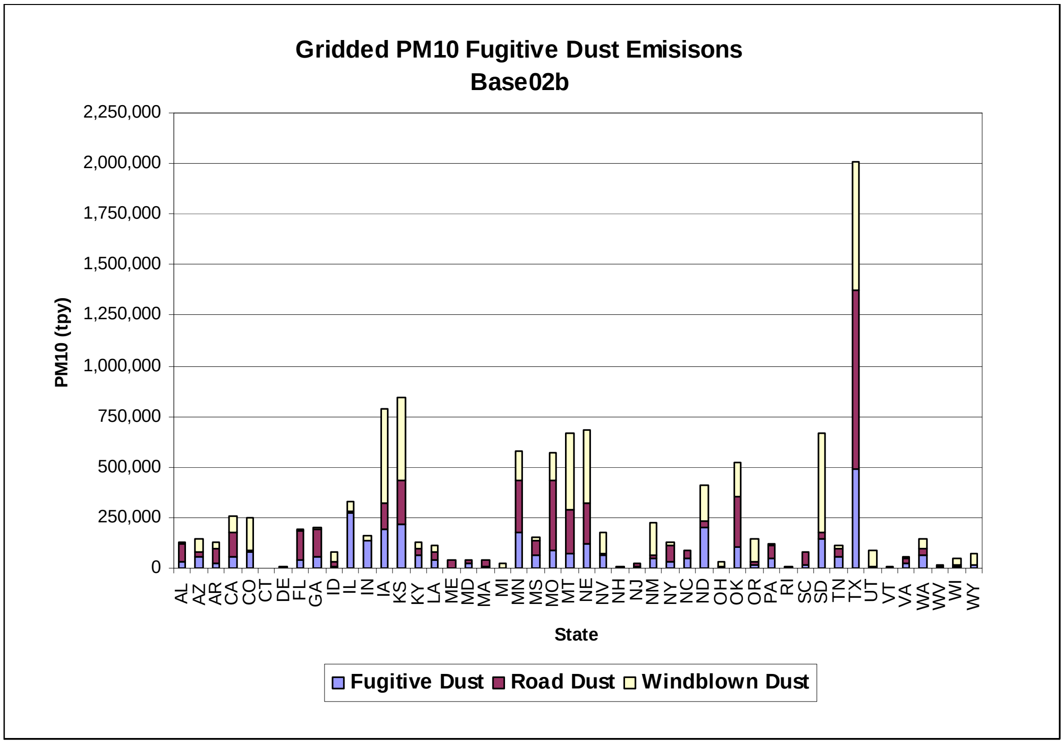

Figure 45. Annual 2002 PM10 dust emissions by major source category (Base02b; tpy)

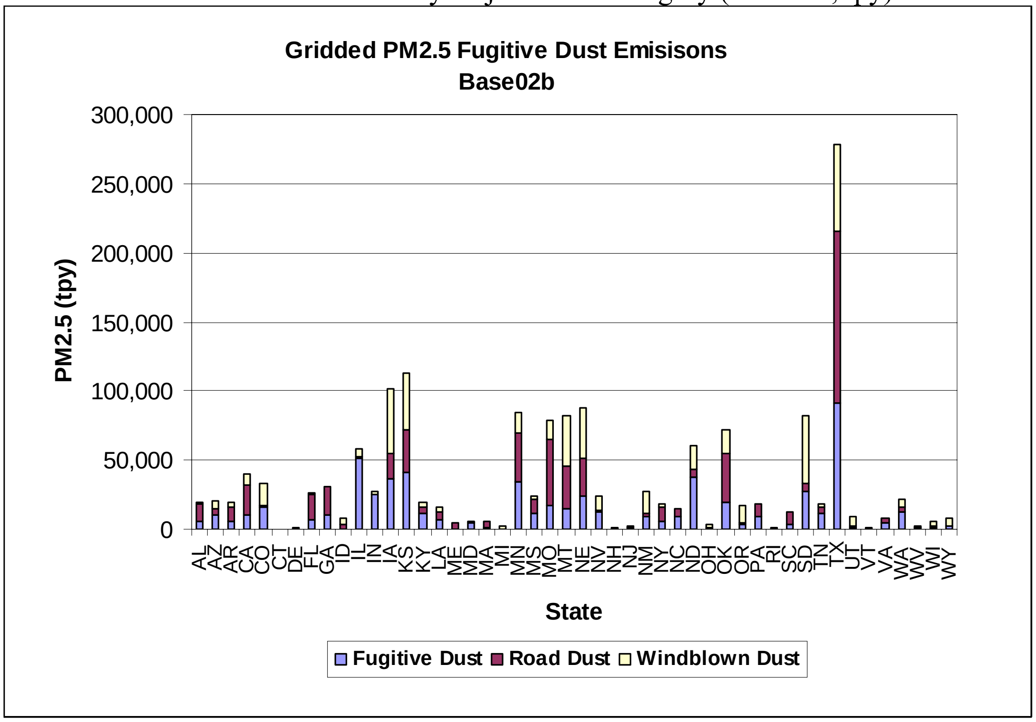

Figure 46. Annual 2002 PM2.5 dust emissions by major source category (Base02b; tpy)

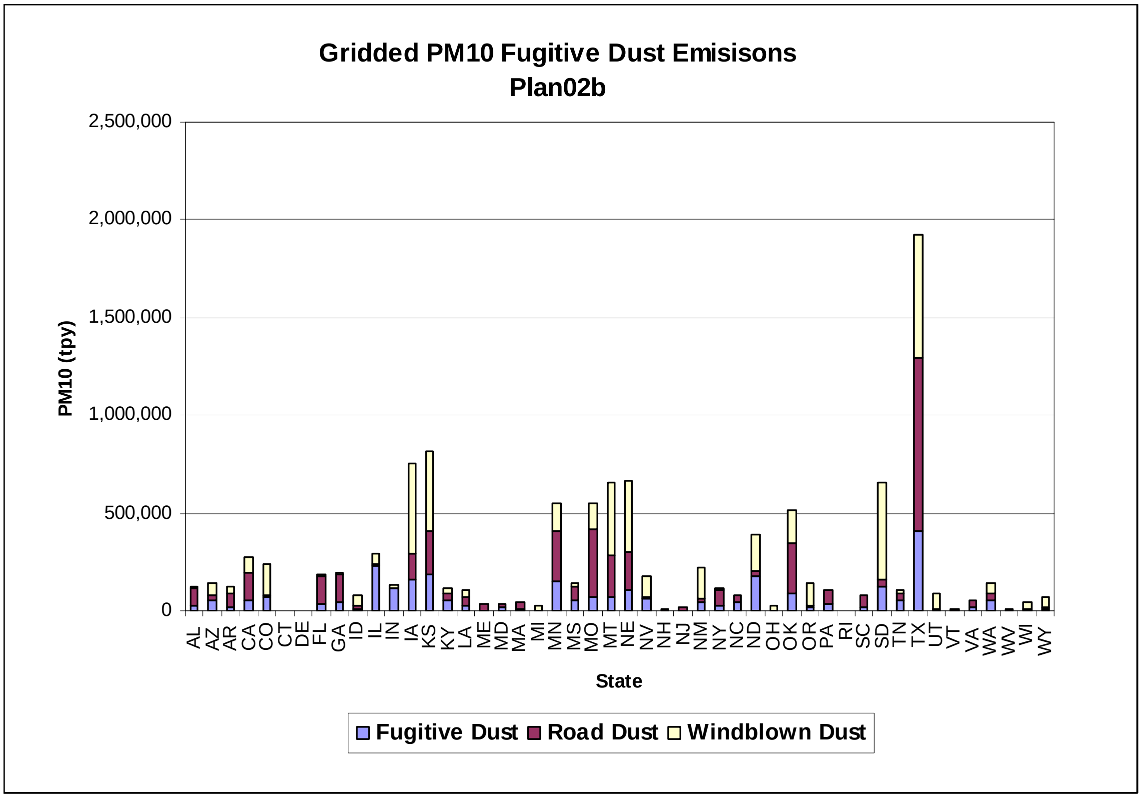

Figure 47. Annual 2002 PM10 dust emissions by major source category (Plan02b; tpy)

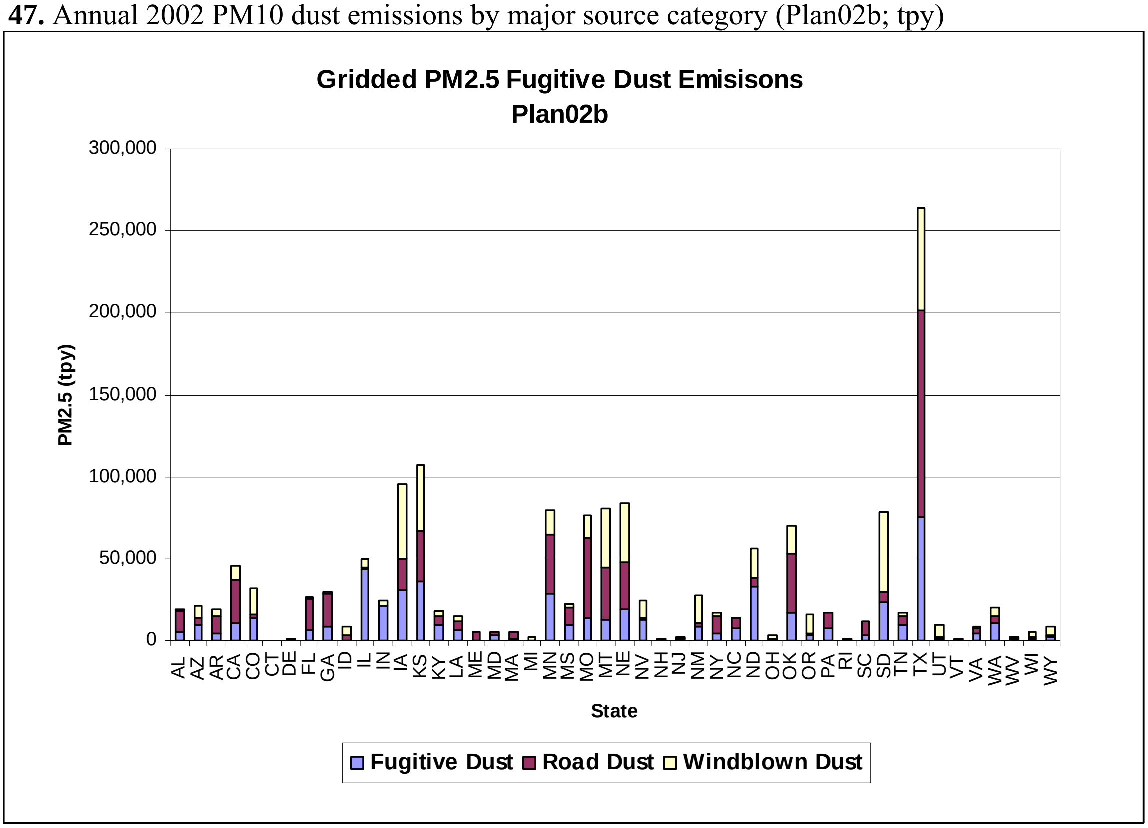

Figure 48. Annual 2002 PM2.5 dust emissions by major source category (Plan02b; tpy)

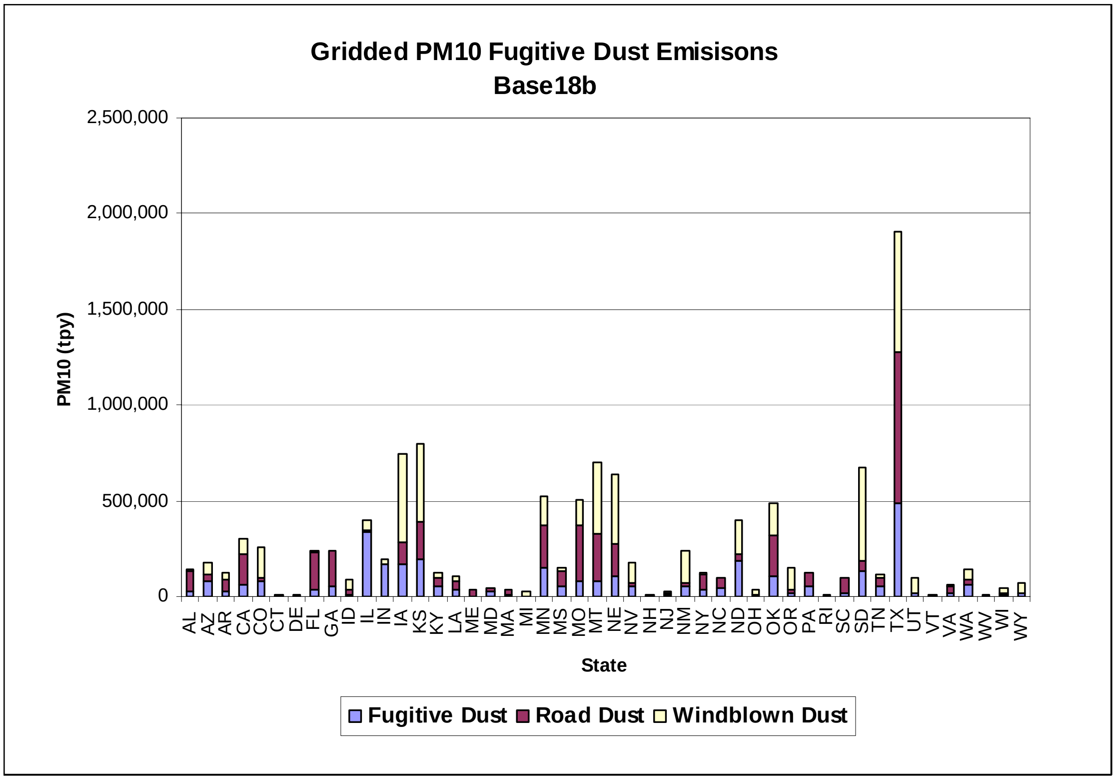

Figure 49. Annual 2018 PM10 dust emissions by major source category (Base18a; tpy)

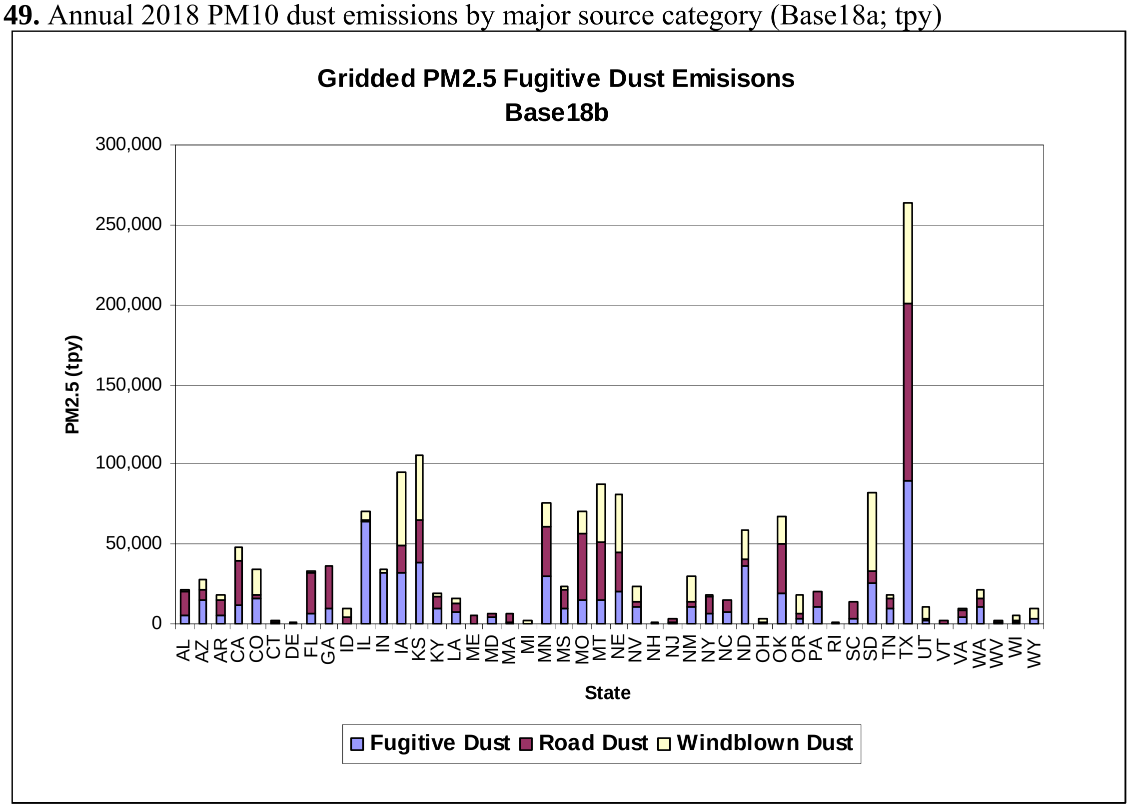

Figure 50. Annual 2018 PM2.5 dust emissions by major source category (Base18a; tpy)

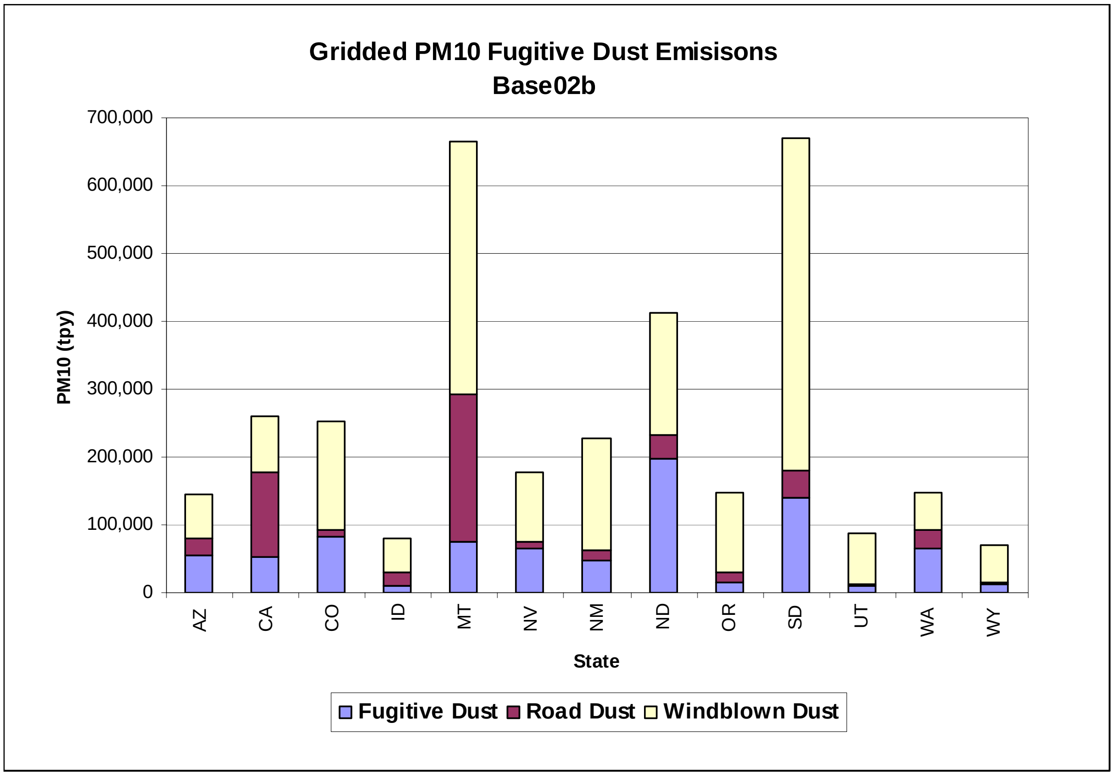

Figure 51. Annual 2002 PM10 dust emissions by major source category for WRAP States (Base02b; tpy)

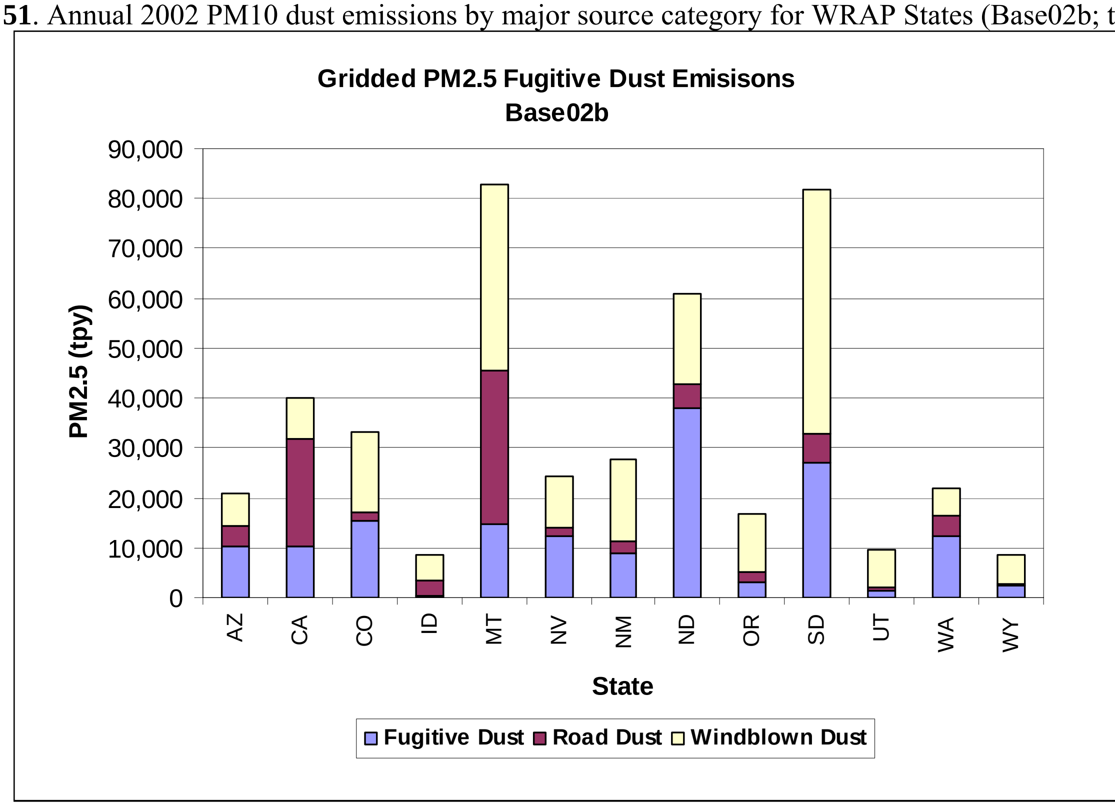

Figure 52. Annual 2002 PM2.5 dust emissions by major source category for WRAP States (Base02b; tpy)

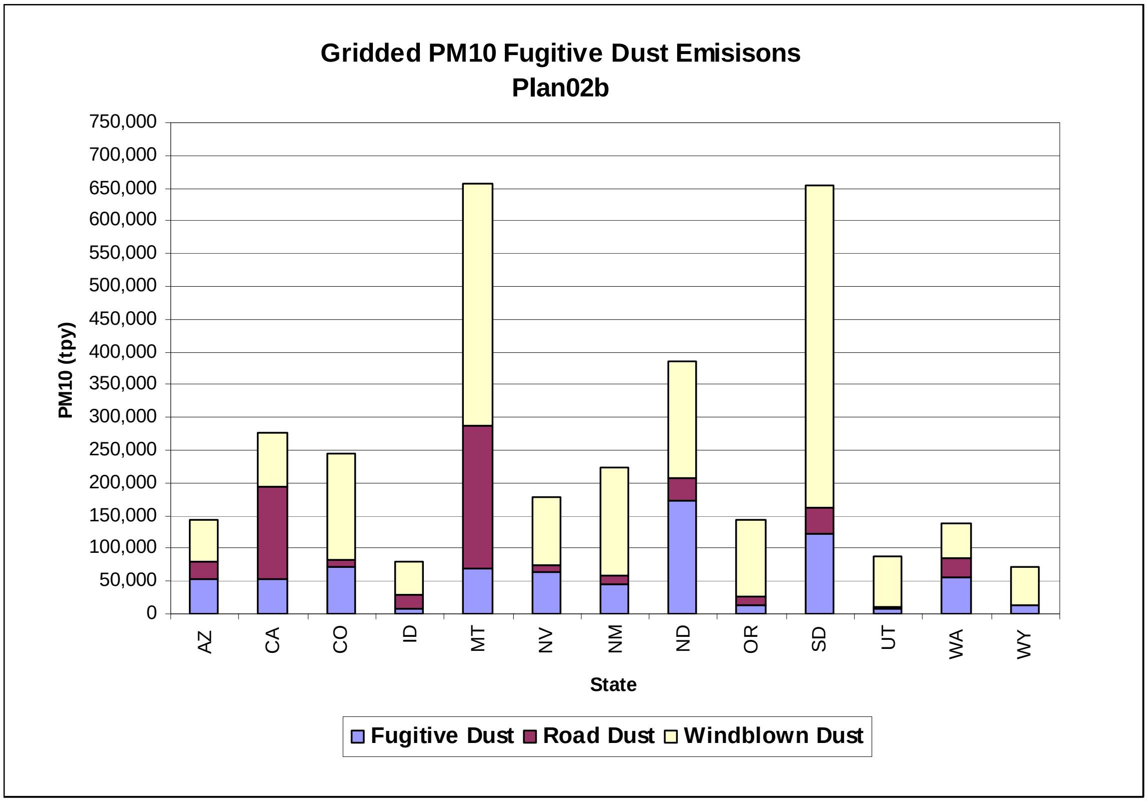

Figure 53. Annual 2002 PM10 dust emissions by major source category for WRAP States (Plan02b; tpy)

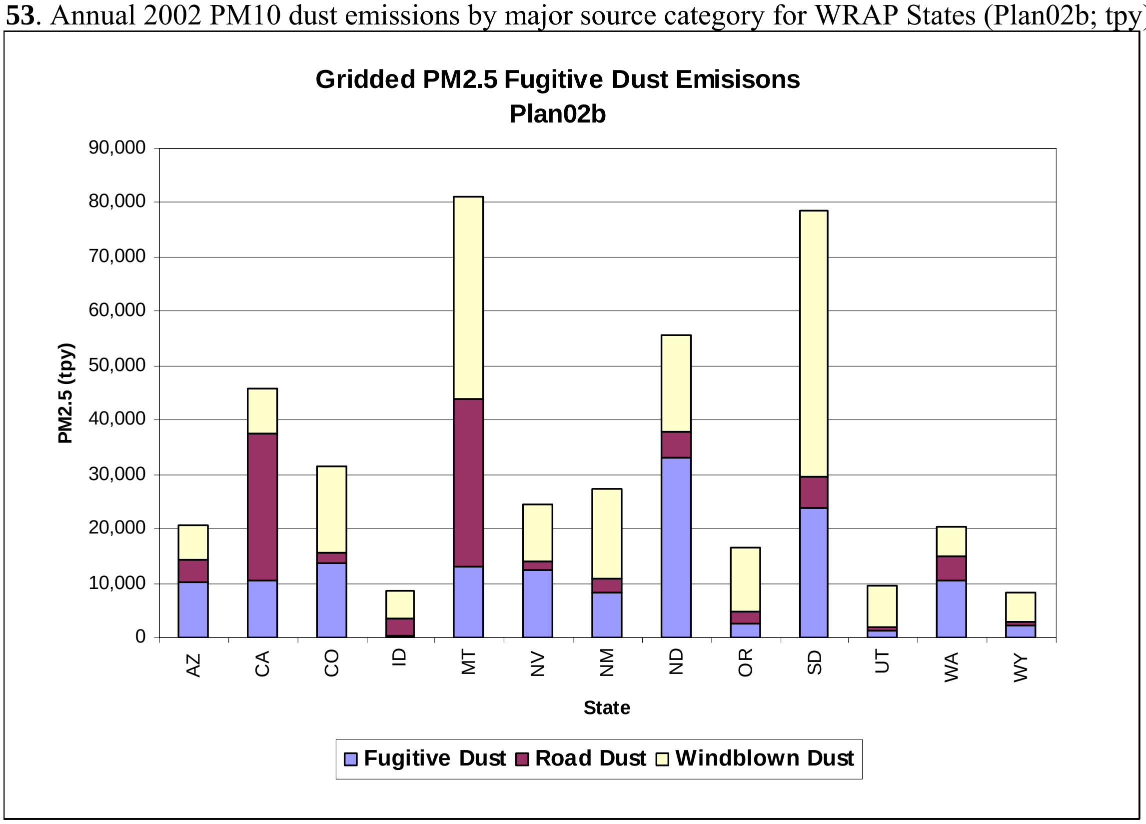

Figure 54. Annual 2002 PM2.5 dust emissions by major source category for WRAP States (Plan02b; tpy)

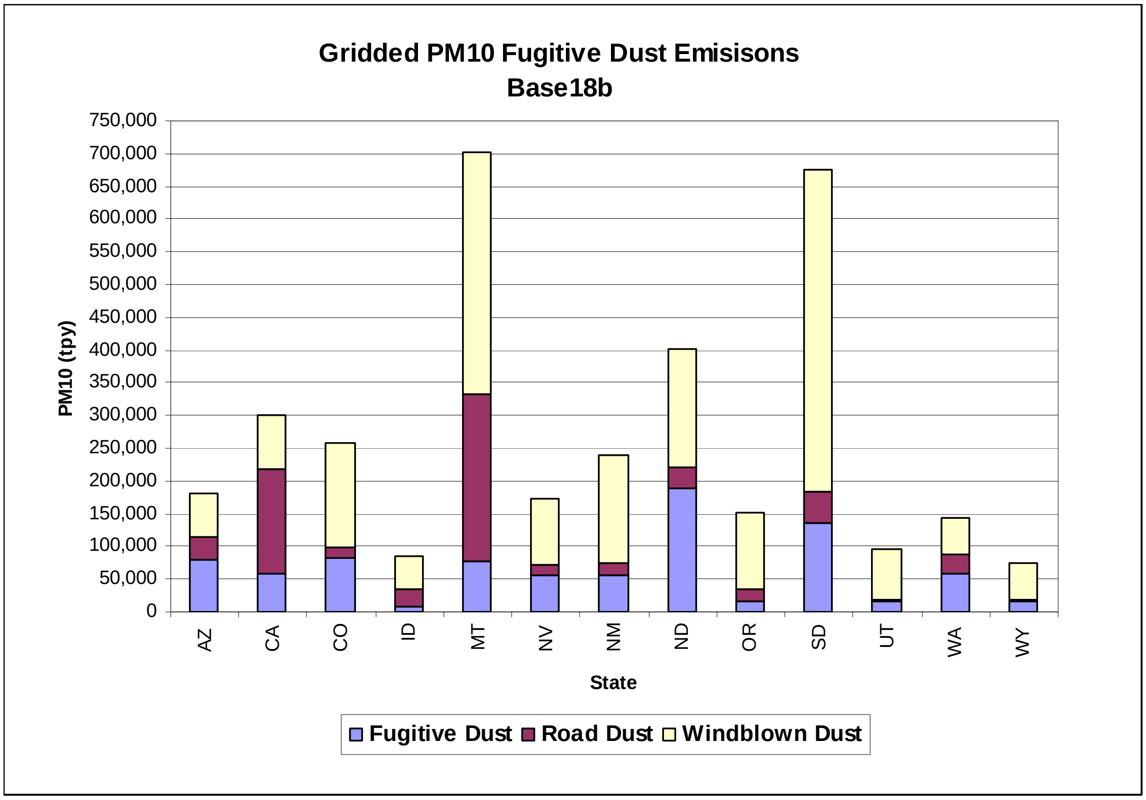

Figure 55. Annual 2018 PM10 dust emissions by major source category for WRAP States (Base18a; tpy)

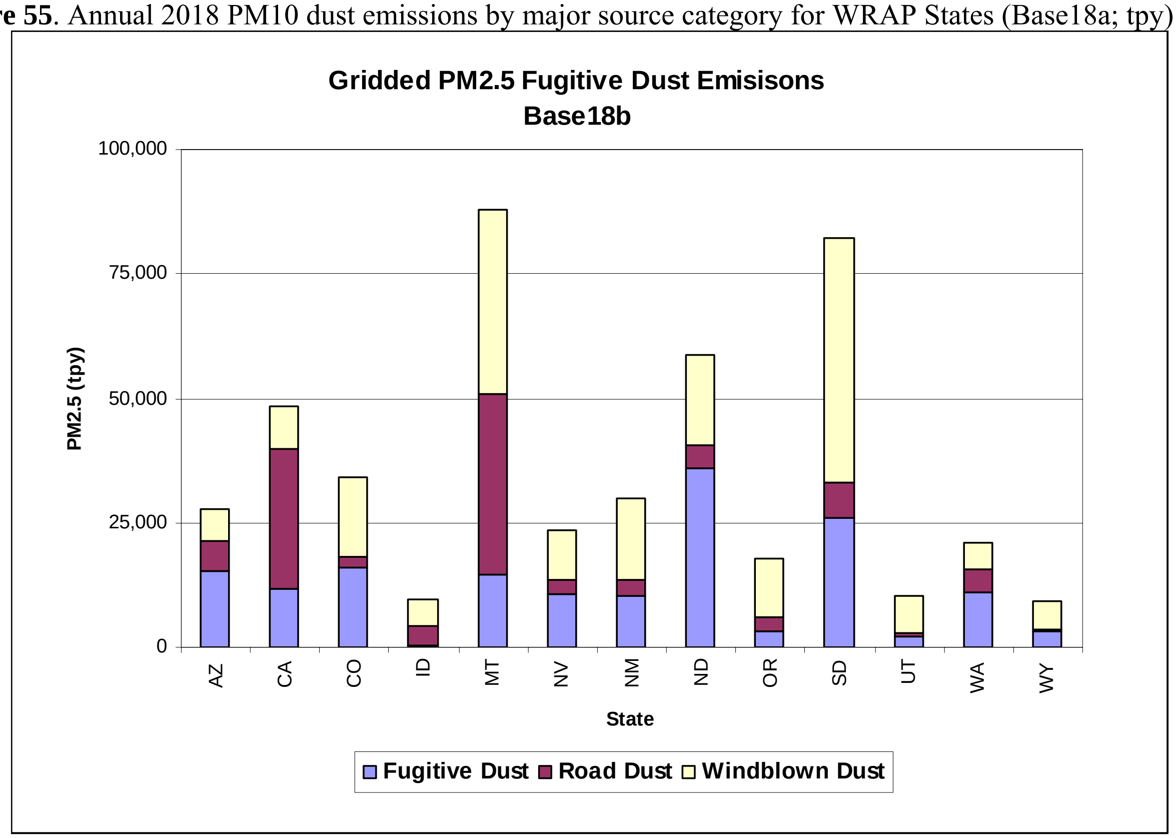

Figure 56. Annual 2018 PM2.5 dust emissions by major source category for WRAP States (Base18a; tpy)

Summary and Recommendations

Fugitive PM10 and PM2.5 dust emissions for the WRAP were reviewed and summarized. The Base02b, Plan02b and Base18a inventories were evaluated. The dust emission inventory data were obtained from the RMC as annual, county-level estimates as input to the SMOKE emissions processing system. Summaries were developed for each major source category as well as for detailed source categories specified by SCCs. Ratios of PM2.5 to PM10 were also evaluated and summarized by source category and county. The dust emissions source categories summarized as part of the work include:

- Agricultural Operations
- Construction and Mining Operations
- Road Dust
- Windblown Dust from Vacant lands

Summaries of the air quality model-ready gridded emissions were also provided. For the gridded inventory data, the application of fugitive dust transport fractions and, in the case of the Plan02b and Base18a inventories, revisions of the PM2.5/PM10 ratios are reflected in the summary data.

Based on the work performed for the project, a number of recommendations can be made with respect to future improvements in the fugitive dust emission estimates for air quality modeling. Note that as these data were reviewed and evaluated over the past several months, many of the recommendations present4ed below, have already been incorporated in to the inventories currently in use by the WRAP RMC in their ongoing modeling efforts. In addition, a number of revisions to later inventories (i.e., Plan02b and Base18a) were made based on preliminary results of this project.

The following recommendations with respect to estimation methodologies, reporting procedures and emissions modeling for air quality model applications are presented as a result of work on this task:

- A consistent estimation methodology should be used for each of the fugitive dust emission source categories. In the current inventories, differences in estimation approaches among the states and RPOs can lead to significant differences in the resulting emissions. These differences can be minimized through the application of common estimation approaches.
- To the extent possible, local activity data should be collected and used in the development of fugitive dust emission inventories.
- The most up-to-date emission factors and estimation methodologies should be applied for each dust emission source category. Recent work by Countess Environmental in the development of a Fugitive Dust Handbook for the WRAP (Countess Environmental, 2004) should be reviewed and applied as appropriate.
- All fugitive dust emissions source categories, as specified by the SCCs listed in Table 4 above, should be extracted from the inventory data files and processed separately.

This allows for more robust quality assurance procedures, avoids possible double-counting of source category emissions and allows the appropriate application of fugitive dust transport fractions. This recommendation has been implemented in the current modeling inventories for the WRAP.

- Whenever possible, emissions should be reported using the full, detailed SCCs.
- Fugitive dust transport fractions, as discussed above, should be applied consistently to all emission source categories, as listed ion Table 4. While there is currently some debate regarding which fugitive dust sources should be adjusted by transport fractions prior to use in grid-based air quality models, it is recommended that all sources should be subject to transport fractions. This recommendation has been implemented in the current modeling inventories for the WRAP.
- Fugitive dust transport fractions, which are a function of the surface characteristics, particularly landuse/landcover, should be developed and applied based on the most landuse/landcover databases available. In addition, the revised fugitive dust transport fraction estimation methodologies (Pace, 2005) should be used in development of regional dust emission inventories. This recommendation has been implemented in the current modeling inventories for the WRAP.
- All fugitive dust emission estimates should reflect the latest revisions to the PM2.5 to PM10 ratios as presented in Table 3 above. This recommendation has been implemented in the current modeling inventories for the WRAP.
- All dust emissions estimates should be summarized and reviewed on a county and source category basis before and after emissions modeling as a final step in the quality assurance procedures used in the development of regional air quality modeling inventories.

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