UPDATING IMPERIAL COUNTY $PM_{2.5}$ NAA WINDBLOWN DUST EMISSIONS

(*Revised and Updated by J. Spencer, March 2014*)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Fugitive Windblown Dust

EMISSION INVENTORY CODE (EIC) AND DESCRIPTION
650-650-5400-0000 Windblown Dust - Agricultural Lands (Non-Pasture)
650-651-5400-0000 Windblown Dust - Pasture Lands
650-652-5400-0000 Windblown Dust - Unpaved Roads

METHODS AND SOURCES

On November 13, 2009, the United States Environmental Protection Agency (USEPA) designated part of Imperial County as a nonattainment area (NAA) with respect to the 2006 24-hour Fine Particulate ($PM_{2.5}$) National Ambient Air Quality Standard (NAAQS), as indicated in 74 Federal Register (FR) 58688.[1] This update, prepared for the 2008 emissions inventory, partitions fugitive windblown particulate matter (PM) emissions, by EIC category, between the areas of Imperial County that occur inside the NAA and outside the NAA.

The California Air Resources Board (ARB) estimates windblown dust emissions for each air basin/county/air district unit using area source methodologies 7.12 (Windblown Dust - Agricultural Lands) and 7.13 (Windblown Dust - Unpaved Roads).[2,3] ARB recently developed estimates of 2008 windblown dust emissions for Imperial County's NAA based on 2005 emissions presented in the Final 2009 Imperial County State Implementation Plan for Particulate Matter Less than 10 Microns in Aerodynamic Diameter (PM_{10} SIP).[4] ARB used land use/land coverage emissions estimates developed for the NAA by ENVIRON International Corporation to allocate emissions to each of the three windblown dust categories.[5, ENVIRON Memo, see Appendix I.] Emissions were distributed to the NAA and non-NAA portions of Imperial County. Category-specific temporal profiles were developed using existing ARB profiles and profiles derived from the emissions estimates in the ENVIRON Memo.

EMISSIONS ESTIMATION METHODOLOGY

2008 emissions for the Imperial County NAA are estimated separately for each of three fugitive windblown dust categories: Agricultural Lands (Non-Pasture), Agricultural Pasture Lands and Unpaved Roads. ARB used county-wide and NAA-specific emissions estimates provided by ENVIRON to develop category-specific inventories for the three categories.[5] Table 1 presents average annual windblown dust PM_{10} emissions (tpd) for 2008 for Imperial County's NAA, based on the ENVIRON Memo, and ARB's allocation of the emissions to the three windblown dust EIC categories.

$PM_{2.5}$ Emissions

$PM_{2.5}$ emissions for windblown dust are calculated from PM_{10} emissions using particle size fraction data provided by the following ARB particle size profiles.[6] The size profile is based on California soil sampling conducted for the ARB.[7]
Profile #416, Windblown Dust - Unpaved Road/Area: $PM_{2.5}/PM_{10} = 0.132$
Profile #418, Windblown Dust - Agricultural Lands: $PM_{2.5}/PM_{10} = 0.173$

Table 1. 2008 Average Annual Windblown PM_{10} Emissions (tpd) in Imperial County's NAA and Allocation of ENVIRON Memo Emissions to ARB EIC Categories

ARB EIC Category	ENVIRON Memo Category	PM_{10} (tpd)	Data Source
Ag Lands, Non-Pasture	Agriculture	**5.13/a**	1
Pasture Lands	Pasture Lands	**1.07**	2
Unpaved Roads	Unpaved Roads and Open Areas		
	Unpaved Roads		
	City Roads	*0.03*	3
	County Roads <50 ADT	*1.00*	3
	County Roads <50 ADT	*1.14*	3
	Canal Roads	*9.79*	3
	Farm Roads	*3.60*	3
	Federal Roads (USFS/BLM)	*0*	3
	Total Unpaved Roads	*15.56/b*	
	Open Areas		
	Shrub/Grassland	*0.14*	1
	Desert - Dunes	*0*	1
	Desert - Other	*3.94/c*	1
	Open Areas - Urban	*0*	1
	Potential Off-Road Disturbance Impacts	*0.15*	2
	Total Open Areas	*4.20*	
	Total Unpaved Roads and Open Areas	19.79	
Total Windblown Dust		25.99	

1 ENVIRON Memo, Attachment 2, see page 12, annual average emissions for Inside PM2.5 NAA (NAA Inside OHV + NAA Outside OHV)
2 ENVIRON Memo, see page 8, column 4
3 ENVIRON Memo, see page 6, column 4
a ENVIRON Memo Attachment 2 presents incorrect average annual emissions of 5.07 tpd PM_{10}.
b ENVIRON Memo presents incorrect total of 15.57 tpd PM_{10}
c ENVIRON Memo Attachment 2 presents incorrect average annual emissions of 3.78 tpd PM_{10} for Outside OHV, Desert- Other.

Using the emissions in Table 1 divided by the 2008 windblown dust emissions for Imperial County from the ENVIRON Memo, ARB allocated emissions in the NAA for 2008 forward according to the fractions provided below in Table 2.

Table 2. Allocation of 2008 Windblown Dust Emissions in Imperial County to Imperial County's NAA

	2008 PM_{10} Emissions (tpd)		NAA
ARB EIC Category	Imperial County/a	NAA	Fraction
Agricultural Lands	10.81	5.13	0.47
Pasture Lands	1.79	1.07	0.60
Unpaved Roads	199.96/b	19.79	0.10

a Imperial County emissions from ENVIRON Memo, see page 8

b Sum of emissions from Open Areas - Urban, Open Areas - Other, and Unpaved Roads

TEMPORAL ACTIVITY

Windblown dust activity is assumed to occur 7 days a week and 24 hours a day, with variations in activity by month. Temporal profiles are used to allocate total annual emissions on a monthly basis to account for seasonal variation in activity. Previously, ARB distributed Imperial County windblown dust emissions using the temporal profiles contained in the respective ARB methodologies, as presented in Table 3.[2,3]

For this update, ARB developed new temporal profiles for ARB EIC categories Agricultural Lands and Unpaved Roads based on ENVIRON Memo data for the NAA. The new profiles, presented in Table 3, are applied to all of Imperial County from 2008 forward.

Agricultural Lands - ARB developed the Agricultural Lands temporal profile by dividing each month's total NAA emissions for Agriculture by the annual average of Agriculture emissions (see page 12, Attachment 2 of the ENVIRON Memo, (Inside OHV + Outside OHV).
Pasture Lands - ENVIRON did not provide monthly emissions for this category. Thus, the temporal profile contained in ARB Methodology 7.13 will continue to apply to all of Imperial County.
Unpaved Roads - ARB derived the Unpaved Roads temporal profile from two profiles developed using ENVIRON NAA emissions for Unpaved Roads and Open Areas. Since ENVIRON did not provide monthly emissions for unpaved roads, the annual unpaved roads NAA emissions (15.56 tpd PM10, Table 1) were distributed to each month using ARB's existing windblown dust from unpaved roads temporal profile (Table 3). A temporal profile for Open Areas was derived by dividing each month's total open areas NAA emissions (see page 12, Attachment 2 of the ENVIRON Memo) by the annual average of open area emissions (4.20 tpd PM_{10}, Table 1). The final Unpaved Roads temporal profile was derived by dividing summed monthly emissions for unpaved roads + open areas by the annual average of emissions for all unpaved roads and open areas (19.79 tpd PM_{10}, Table 1).

Table 3. ARB Temporal Profiles for Windblown Dust Emissions in Imperial County/a

Temporal Profiles 1993 - 2007												
ARB EIC Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agricultural Lands	0.006	0.039	0.056	0.108	0.176	0.146	0.131	0.127	0.097	0.066	0.037	0.012
Pasture Lands	0.002	0.016	0.026	0.055	0.097	0.087	0.065	0.072	0.049	0.247	0.273	0.011
Unpaved Roads	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
Temporal Profiles 2008 Forward												
ARB EIC Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agricultural Lands	0.057	0.095	0.175	0.219	0.107	0.128	0.057	0.000	0.068	0.004	0.048	0.042
Pasture Lands	0.002	0.016	0.026	0.055	0.097	0.087	0.065	0.072	0.049	0.247	0.273	0.011
Unpaved Roads	0.053	0.092	0.097	0.120	0.097	0.098	0.077	0.071	0.076	0.071	0.082	0.068

a Profiles used from 1993-2007 were based on county-wide monthly emissions. Profiles used for 2008 forward are based on monthly emissions in Imperial County's NAA

REFERENCES

1. United Sates Environmental Protection Agency, Air Quality Designations for the 2006 24-hour Fine Particulate (PM2.5) National Ambient Air Quality Standard. Nov. 13, 2009. Office of the Federal Register, document citation 74 FR 58688. https://www.federalregister.gov/articles/2009/11/13/E9-25711/air-quality-designations-for-the-2006-24-hour-fine-particle-pm25
2. Francis, S. ARB Miscellaneous Process Methodology 7.12, Windblown Dust - Agricultural Lands. California Air Resources Board. Revised July 1997. http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-12.pdf
3. Francis, S. Miscellaneous Process Methodology 7.13, Windblown Dust - Unpaved Roads. California Air Resources Board. Updated August 1997. http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-13.pdf
4. Final 2009 Imperial County State Implementation Plan for Particulate Matter Less than 10 Microns in Aerodynamic Diameter. ENVIRON International Corp. Aug, 11, 2009. http://www.co.imperial.ca.us/airpollution/attainment%20plans/final%20ic%202009%20pm10%20sip%20document.pdf
5. Memorandum: Windblown PM_{10} Emissions in the Imperial County $PM_{2.5}$ Nonattainment Area. J. Lester, ENVIRON International Corp. Feb. 26, 2014
6. Particle Size Fraction Data for Source Categories (PMSIZE link). Profiles #416 (Windblown dust - Unpaved Roads/Area) and #418 (Windblown Dust - Agricultural Lands). California Air Resources Board. http://www.arb.ca.gov/ei/speciate/dnldoptvv10001.php#specprof
7. 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. http://www.arb.ca.gov/ei/speciate/r01t20/rf20doc/refnum20.htm

February 26, 2014

MEMORANDUM

To: Reyes Romero, Deputy Air Pollution Control Officer
Imperial County Air Pollution Control District (ICAPCD)

From: Julia C. Lester, PhD, ENVIRON

Subject: Windblown PM_{10} Emissions in the Imperial County $PM_{2.5}$ Nonattainment Area

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Background and Purpose

On November 13, 2009, the United States Environmental Protection Agency (USEPA) designated part of Imperial County as a nonattainment area with respect to the 2006 24-hour Fine Particulate ($PM_{2.5}$) National Ambient Air Quality Standard (NAAQS), as indicated in 74 Federal Register (FR) 58688. Refer to Figure 1, which shows the nonattainment area on a map of Imperial County. The 2009 PM_{10} SIP inventory will be partitioned between those emissions that occur inside the $PM_{2.5}$ nonattainment area and those that occur outside that area by category. The method of partitioning is described below, and tabular results are included as attachments. The final results will be put into a format consistent with CEIDARS application, including the aggregation of specific windblown dust sub-categories.

Partitioning of Windblown Dust from Area Sources

The following methodology was used to estimate windblown dust emissions from the different land uses within the new $PM_{2.5}$ nonattainment area:

- Gridded emissions and land use shapefiles were the same as those used in the 2005 ENVIRON effort (provided by Gerard Mansell, Novato in 2009)
- The new $PM_{2.5}$ nonattainment area (NAA) was digitized in ArcGIS based on the written description in the Federal Register and the township information in the Public Land Survey System, obtained from ArcGIS online (USA Public Land Survey System (PLSS) from ESRI).
- The Ocotillo Wells (OW)/Off Highway Vehicle (OHV) shapefile was provided by ICAPCD in 2009 (OHV) and digitized OW based on area map in 2009.
- The emissions grid shapefile was intersected with the land use, new $PM_{2.5}$ NAA, and OW/OHV shapefiles. This resulted in emissions grid cells being split into different sized areas.
- Emissions in each of the smaller areas were calculated based on the portion of the smaller area (calculated in ArcGIS) compared to the original grid cell area (as calculated in ArcGIS) multiplied by the emissions of the original grid cell.
- Then the emissions of these smaller areas were summarized by land use category, inside/outside new $PM_{2.5}$ NAA, and inside/outside OW/OHV.
- The individual land uses were categorized into major land uses with the same categorization used in 2005.

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Partitioning of Windblown Dust from Unpaved Roads

The following methodology was used to estimate the emissions from windblown dust from unpaved roads within the new $PM_{2.5}$ nonattainment area:

- For City unpaved roads and County unpaved roads with greater than 50 average daily trips (ADT), ENVIRON assumed 100% of those roads (and thus, 100% of the emissions) were located within the new $PM_{2.5}$ nonattainment area.
- None of the federal unpaved roads (Bureau of Land Management [BLM], United States Forest Service [USFS]) were assumed to be within the new $PM_{2.5}$ nonattainment area. Therefore, 0% of the windblown dust from federal unpaved roads is assumed to be within the $PM_{2.5}$ nonattainment area.
- The windblown dust from unpaved County roads with less than 50 ADT was estimated by scaling the total emissions from those roads by the fraction of County area that is located within the $PM_{2.5}$ nonattainment area.
- The windblown dust from unpaved canal roads and unpaved farm roads was estimated by scaling the total emissions from those roads by the fraction of the agricultural land located within the $PM_{2.5}$ nonattainment area compared to the total agricultural land in Imperial County.
- Used area information ("% land fractions") from tables used to create 'Revised Draft Table 3.1.pdf'.

The following table summarizes the results of the partitioning:

Road type	Total Windblown Dust PM_{10} (tons/day)	In "$PM_{2.5}$ area"?	"$PM_{2.5}$ area" Unpaved Road Windblown Dust Emissions Estimate (tons/day)
City	0.03	100%	0.03
County < 50 ADT[1]	6.64	15%	1.00
County > 50 ADT	1.14	100%	1.14
Canal[2]	16.32	60%	9.79
Farm[2]	6.01	60%	3.60
Federal (BLM/USFS)	0.37	0%	0.00
Total unpaved road WBD	30.51		**15.57**

Notes:
[1] The emissions from the county unpaved roads with < 50 average daily trips are estimated by scaling the total emissions by the percentage of the county area that is within the new $PM_{2.5}$ area.

[2] The emissions from the canal and farm unpaved roads are estimated by scaling the total emissions by the percentage of the agricultural land that is within the new $PM_{2.5}$ area.

Partitioning of Additional Potential Windblown Dust from OHV Areas

As noted in Appendix III.B of the 2009 PM_{10} SIP, a portion of the vacant lands in Imperial County is open to OHV usage, and as such, there are additional potential windblown dust emissions from these areas due to anthropogenic soil disturbance. These additional emissions were added to the 2009 PM_{10} SIP inventory as follows:

- The vacant lands were divided up according to the state or federal agency that holds jurisdiction over that area; agencies include the BLM, the US Fish and Wildlife Service (USFWS), the Bureau of Reclamation, the State of California, and the US Military.
- For lands under the jurisdiction of BLM, BLM provided an estimate of percentage of the area that was disturbed by OHV usage. For the Arroyo Salado and Ocotillo Wells areas, ENVIRON conservatively assumed that up to 50% of those areas are disturbed by OHV activity.
- The soil characteristics of each area were used to evaluate whether OHV usage would change the windblown dust emissions from that area by causing a change in the level of stability of the soil or the vegetative canopy cover.
- The soil texture in the OHV areas generally consists of either sand or sandy loam soil. Conservative emissions estimates were obtained using the rate of emissions per acre predicted by the windblown dust model for the sand dune Land Use/Land Cover (LULC) category for areas with soil texture consisting mostly of sand; for areas with sandy loam soil, an emission rate ~20 times higher than the emissions estimated by the windblown dust model was used.
- Results were presented in Table III.B.3. The total additional emissions due to anthropogenic soil disturbance were about 12.1 tpd.

The following methodology was used to partition the emissions from the additional potential windblown dust from OHV areas within the new $PM_{2.5}$ nonattainment area:

- Based on the location of the $PM_{2.5}$ NAA, the OHV areas that are located at least partially within the $PM_{2.5}$ NAA are Plaster City, Superstition Mountains, and Heber Dunes.
- Heber Dunes is located completely inside the $PM_{2.5}$ NAA, but is a very small OHV area (334 acres, or less than 0.2% of all Imperial County OHV areas). In addition, the area is generally sandy and disturbance is not expected to result in any appreciable amount of windblown dust generation compared to the results of the Windblown Dust Model already in the inventory (see previous section). For comparison, the size of Heber Dunes is only about 2% of the size of the Superstition Mountains OHV area.
- Only a small fraction of the Plaster City OHV area and about one third of Superstition Mountains OHV area are within the $PM_{2.5}$ NAA. To be conservative, one half of the emissions for Superstition Mountains estimated in Table III.B.3 in Appendix III.B of the 2009 PM_{10} SIP (0.3 tons/day in Imperial County) will be assumed to be inside the NAA (total of ~0.15 tons/day).

Summary and CEIDARS Inputs

The partitioned windblown dust emissions for the area sources are summarized in a Revised Table 3.1. The California Air Resources Board (CARB) CEIDARS application aggregates the windblown dust emissions into three Emission Inventory Codes (EIC):

- dust from agricultural lands (non-pasture);
- dust from pasture lands; and
- dust from unpaved roads and associated areas.

Windblown dust emissions from agricultural lands (non-pasture) in the $PM_{2.5}$ NAA were taken from Attachment 2 (Revised Table 3.1). Windblown dust from pasture lands were allocated to the $PM_{2.5}$ NAA using the 60% agriculture in the $PM_{2.5}$ NAA fraction used in partitioning the unpaved windblown road dust emissions. The emissions inside the new $PM_{2.5}$ NAA from the rest of the categories were summed into and attributed to CARB's "dust from unpaved roads and associated areas." Windblown PM_{10} emissions from the $PM_{2.5}$ nonattainment area are summarized in the following table suggested by CARB:

Category	PM_{10} tpd (Imperial)	2009 SIP[1] Data Source	PM_{10} tpd ($PM_{2.5}$ NAA)	EIC Category
Open Areas - Urban	**0.01**	Table 3.1	**0.00**[2]	**19.76**
Open Areas - Others	**169.44**		**4.20**	
Shrub/Grassland	*98.75*	Table 3.1	*0.14*	
Desert - Dunes	*19.85*	Table 3.1	*0.00*	
Desert - Other	*38.74*	Table 3.1	*3.91*	
Potential Off-Road Disturbance Impacts[3]	*12.1*[3]	Table III.B.3	*0.15*[3]	
Unpaved Roads:	**30.51**		***15.56***	
City/County	*7.81*	Table 3.2	*2.17*	
Canal	*16.32*	Table 3.2	*9.79*	
BLM/USFS	*0.37*	Table 3.2	*0.00*	
Farm	*6.01*	Table 3.2	*3.60*	
Non-Pasture Ag Lands	**10.81**	Table 3.1	**5.07**	**5.07**
Pasture	**1.79**[4]	Table 3.3	**1.07**	**1.07**
Total Windblown Dust	***212.57***		***25.90***	**25.90**

Notes:

[1] 2009 Imperial County State Implementation Plan for Particulate Matter Less than 10 Microns in Aerodynamic Diameter. Final August 11, 2009.

[2] Although most urban areas are within the $PM_{2.5}$ NAA, the most emissive $PM_{2.5}$ urban open areas are outside the $PM_{2.5}$ NAA. See 2009 PM10 SIP, Appendix III.B, Figures III.B.3 and III.B.4, particularly to the west of the Salton Sea and east at the edge of the dune area.

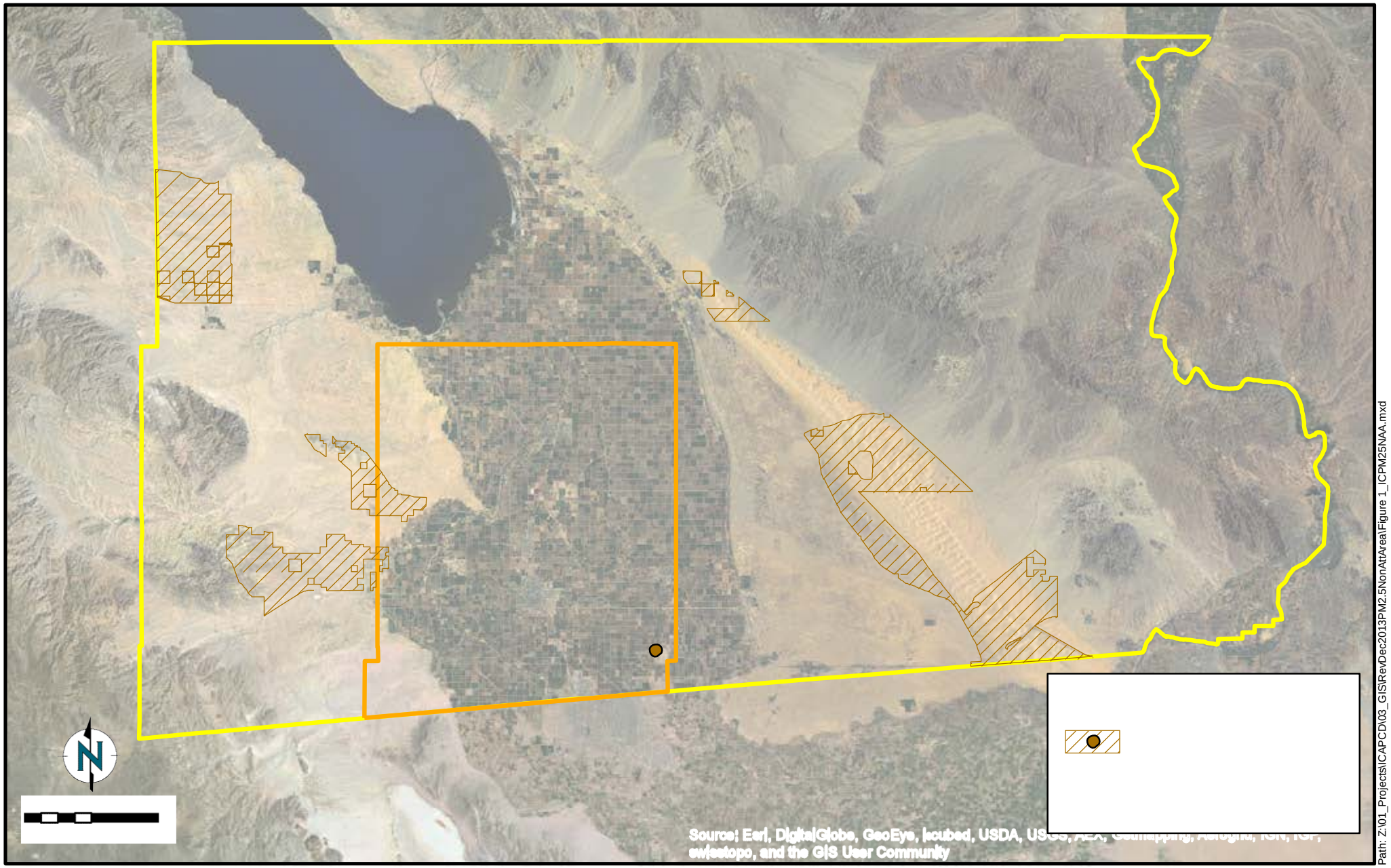
[3] These are potential additional emissions if off-road disturbances make the area significantly more emissive than represented in the windblown dust model for those areas. Actual additional emissions could be between 0 tons/day and the value in the table.
The EIC and Total emissions include these potential emissions, although the actual emissions may be smaller.

[4] Pasture land windblown dust estimated separately using the CARB methodology. See Draft Final Technical Memorandum Regulation VIII BACM Analysis (Dated October 2005, adopted as final November 2005), p. 10.

KAJ: ee
Attachments

Attachment 9

Figure 1



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Imperial County $PM_{2.5}$ Non-Attainment Area

Imperial County, California

Figure 1

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Table – Windblown Dust Model Estimates of PM_{10} Emissions in Imperial County

Appendix I, ENVIRON Memo, **Attachment 2: (based on 2009 PM_{10} SIP Table 3.1)**

Windblown Dust Model Estimates of PM_{10} Emissions (in tons/day) in Imperial County (Reported According to Land Use/Land Coverage)

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Summer	Winter
Inside $PM_{2.5}$ NAA	Inside OHV	Agriculture	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Shrub/Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Desert - Dunes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Desert - Other	0.12	0.28	0.25	0.32	0.17	0.21	0.03	0.00	0.03	0.06	0.09	0.05	0.13	0.08	0.18
		Urban Open Areas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Subtotal	0.12	0.29	0.26	0.33	0.18	0.21	0.03	0.00	0.03	0.06	0.09	0.06	0.14	0.08	0.19
	Outside OHV	Agriculture	3.50	5.83	10.79	13.50	6.57	7.88	3.50	0.02	4.16	0.26	2.97	2.56	5.07	3.66	6.51
		Shrub/Grassland	0.12	0.18	0.28	0.40	0.18	0.24	0.06	0.00	0.06	0.01	0.09	0.07	0.14	0.09	0.19
		Desert - Dunes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Desert - Other	2.56	4.87	6.60	11.30	6.00	6.32	1.54	0.36	1.40	0.13	2.63	1.97	3.78	2.62	4.97
		Urban Open Areas	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Subtotal	6.20	10.87	17.67	25.20	12.75	14.44	5.09	0.38	5.62	0.40	5.70	4.60	8.99	6.37	11.67
	Subtotal		6.32	11.16	17.93	25.53	12.92	14.65	5.12	0.38	5.65	0.45	5.78	4.66	9.13	6.45	11.86
Outside $PM_{2.5}$ NAA	Inside OHV	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Shrub/Grassland	0.85	1.17	1.46	2.36	1.05	0.21	0.57	0.41	0.54	0.01	0.44	0.44	0.80	0.47	1.12
		Desert - Dunes	8.36	12.44	14.05	24.02	9.69	1.82	6.94	4.82	3.38	0.00	3.62	4.53	7.77	4.46	11.12
		Desert - Other	0.27	0.95	1.75	2.98	2.57	2.48	0.54	1.71	1.01	0.34	0.51	0.47	1.30	1.44	1.15
		Urban Open Areas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Subtotal	9.48	14.57	17.26	29.37	13.31	4.51	8.05	6.95	4.93	0.35	4.57	5.44	9.86	6.37	13.39
	Outside OHV	Agriculture	5.09	5.49	9.13	14.98	6.38	8.37	3.87	4.31	5.60	0.12	3.63	1.86	5.74	4.80	6.70
		Shrub/Grassland	95.18	100.75	118.85	240.44	96.29	189.45	40.01	139.58	63.24	7.30	63.47	24.89	97.81	88.90	106.89
		Desert - Dunes	13.41	19.44	22.18	38.35	15.08	2.77	9.79	7.16	4.84	0.00	5.70	7.11	12.08	6.64	17.62
		Desert - Other	17.61	31.99	43.45	82.71	48.35	62.84	13.67	41.09	26.85	5.83	18.82	10.88	33.53	32.97	34.10
		Urban Open Areas	0.05	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
		Subtotal	131.33	157.66	193.61	376.50	166.11	263.43	67.34	192.14	100.53	13.26	91.62	44.73	149.17	133.30	165.32
	Subtotal		140.81	172.23	210.87	405.86	179.42	267.94	75.39	199.09	105.46	13.61	96.19	50.17	159.03	139.68	178.71
Grand Total			147	183	229	431	192	283	81	199	111	14	102	55	168	146	191

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1 Western Regional Climate Center data (http://www.wrcc.dri.edu/), average days per month with rainfall of 0.01 inch or greater, based on California meteorological station level rainfall data for years of record.

2 Non-San Joaquin Air Basin regions:
Normalized Rainfall per Month = 1- [Rain days per month/Annual rain days]
Monthly Rainfall Fraction = [Normalized Rainfall per Month]/[Total Normalized Rainfall]

3 San Joaquin Air Basin: Normalized Rainfall per Month = (365/12- Rain days per month)/365
Monthly Rainfall Fraction = Normalized Rainfall per Month/∑(Monthly Normalized Rainfall)