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Final

Arizona State Implementation Plan

Rillito
PM_{10} Nonattainment Area

Air Quality Division
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EXECUTIVE SUMMARY

The community of Rillito and Arizona Portland Cement (APC) share an area northwest of Tucson alongside Interstate 10. Following the Clean Air Act (CAA) amendments of 1990, nine townships near APC were designated nonattainment of particulate matter equal to or less than 10 microns (PM10) National Ambient Air Quality Standard (NAAQS) by operation of law. The U.S. Environmental Protection Agency (EPA) based its decision on emissions from APC and high PM_{10} concentrations measured in the area. Based on several years of air quality data that are below the NAAQS, in October 2006, EPA determined the Rillito Nonattainment Area (RNA) met the first test for redesignation to attainment.

The CAA states that an area designated as nonattainment due to a violation of the NAAQS may be redesignated to attainment if the State submits and EPA approves a plan demonstrating that permanent emission controls that resulted in attainment will remain in place. This plan demonstrates that all CAA requirements for attainment and maintenance have been met and summarizes the progress of the area in attaining the PM_{10} standard. This plan also summarizes and demonstrates that the RNA qualified for EPA's Clean Data Policy and the Limited Maintenance Plan (LMP) option. The LMP option is a plan design approach that assures continued attainment without many of the burdens of a standard maintenance plan. To qualify for the LMP option the State must submit an approved maintenance plan, the area must be in attainment of the NAAQS for a minimum of five years, and expect only limited growth in motor vehicle traffic.

This document includes a formal request to EPA to redesignate the Rillito, Arizona PM_{10} nonattainment area to attainment for the health-based 24-hour average PM_{10} NAAQS. Chapter 1 includes the regulatory requirements for PM_{10} nonattainment area plans for areas that have attained the NAAQS, along with a detailed description of the economic and physical makeup of the RNA. Chapter 2 demonstrates that monitors in the RNA have not recorded an exceedance of the PM_{10} NAAQS since 1989.[1] Chapter 3 contains the emissions inventory and lists sources within the RNA. Chapter 4 describes the control measures that were implemented to achieve attainment of the PM_{10} NAAQS along with contingency measures designed to ensure continued maintenance of the NAAQS for the required ten year maintenance period (2010-2020) following redesignation of the area to attainment. Finally, Chapter 5 includes administrative commitments required under the LMP option.

With this submittal, ADEQ requests that EPA approve this LMP for the Rillito PM_{10} nonattainment area and redesignate the area to attainment for the 24-hour PM_{10} NAAQS.

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[1]On April 12, 2007, a statewide wind event triggered high readings at a number of air quality monitors across the state, including the Rillito monitor. The measurement recorded by the monitor, 123.6 $\mu g/m^3$, was not a violation of the NAAQS but above the standard criteria to qualify for a LMP, 98 $\mu g/m^3$. The measurement was flagged as an exceptional wind event and a technical demonstration was submitted to EPA in accordance with EPA's Exceptional Events Policy. On July 5, 2007, an intensive thunderstorm cell throughout the Tucson region triggered an exceedance of the NAAQS. The measurement was flagged as an exceptional wind event and a technical demonstration was submitted to EPA in accordance with EPA's Exceptional Events Policy.

1.0 BACKGROUND

The Rillito Nonattainment Area (RNA) was designated as nonattainment for PM_{10}. This means that in the past the area did not meet federal health-based standards for PM_{10}. Nonattainment status was attributed to nearby agricultural areas, emissions from Arizona Portland Cement (APC) and fugitive dust emissions from vehicular traffic. Since that time, the region has experienced significant growth, yet managed to attain the PM_{10} NAAQS. The current condition of the RNA and ADEQ's approach to redesignation are discussed in the following subsections.

1.1 Physical, Demographic, and Economic Description of the RNA

Sections 1.1.1 through 1.1.3 describe the climate, physiography, and economy of the RNA.

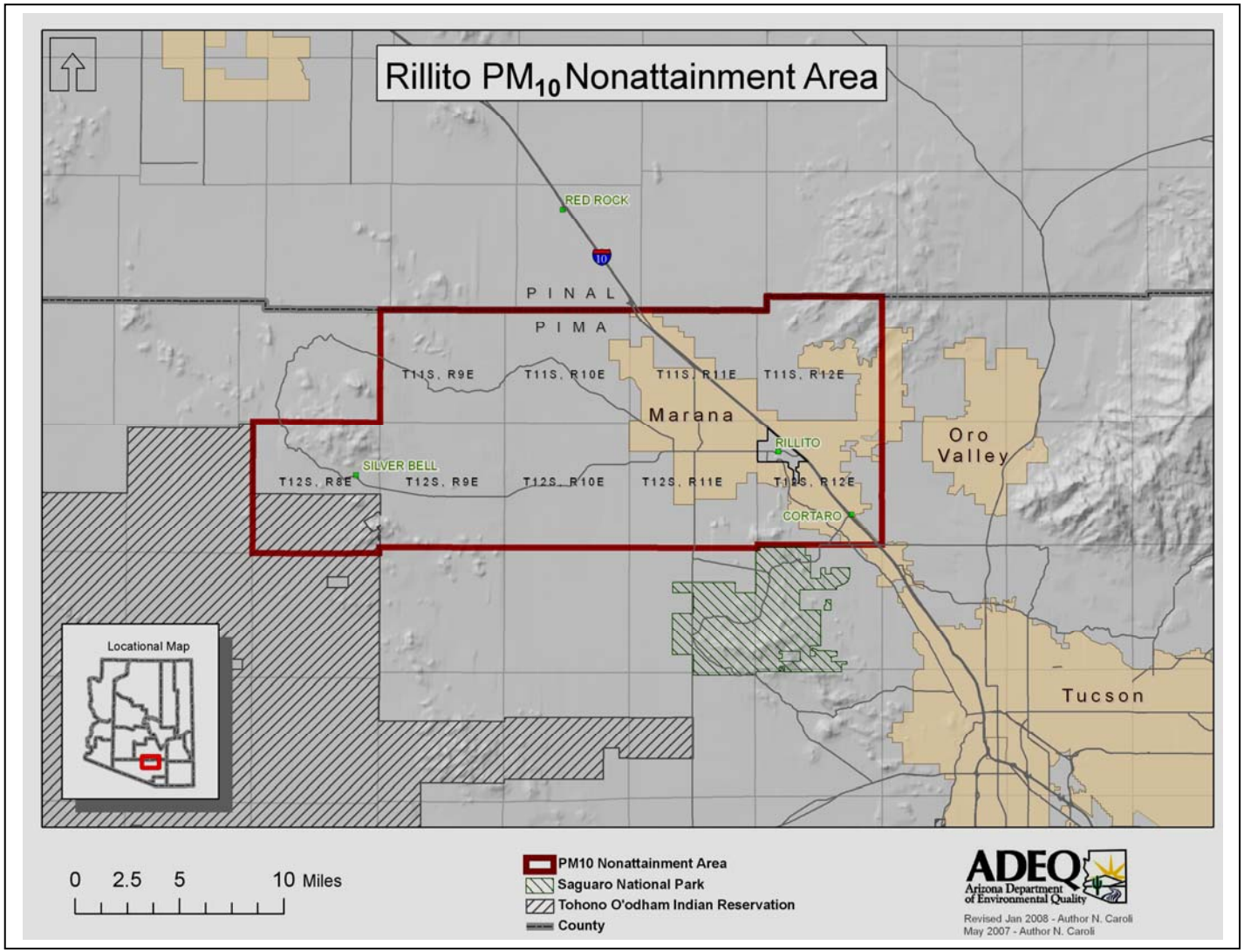
1.1.1 Climate and Physiography

The RNA is a 324 square mile area located in the Sonoran Desert region of Southern Arizona, 88 miles southeast of Phoenix and 15 miles northwest of Tucson. The small, unincorporated community known as Rillito is within a county island bordered on all sides by the Town of Marana. The RNA, as described in 40 CFR 81.303 contains the following townships and ranges: T11S, R9-R12E; T12S, R8-R12E, for a total of nine townships as shown in Figure 1.1.

Foothills of three small mountain ranges rise from the desert floor on the eastern, western, and southern boundaries of the nonattainment area. Vast sections are comprised of undeveloped land. Approximately 30 percent of the area consists of land cleared for agricultural purposes. Interstate 10 transverses the northeastern corner and the Silver Bell copper mine is situated in the southwestern corner of the area. Saguaro National Park borders the nonattainment area's southern boundary.

Prevailing winds are generally out of the southeast. Haboobs, intense sandstorms that develop during summer monsoon thunderstorms, can inundate the area with transported windblown dust. The warmest months of the year are July and August, when the daily maximum temperature averages 98° Fahrenheit (F). January is the coolest month with an average daily minimum temperature of 39° F. An annual average of 12 inches of rain falls within the region. Precipitation arrives in two distinct seasons: 52 percent falls during the summer monsoon season (July–September) and 28 percent from December through March.

Figure 1.1 – Map of Rillito PM_{10} Nonattainment Area



1.1.2 Population

The RNA has undergone a transformation since the 1994 SIP was submitted. What was a rural agricultural area became more urbanized with each passing year. The Town of Marana has annexed vast sections of the RNA and now encircles the Rillito community. Marana is predicted to grow by over 100 percent by 2015; projections are similar for neighboring Oro Valley. The population of the Rillito community has experienced some growth and is projected to modestly increase. Table 1.1 portrays the projected growth of Rillito, Marana, Oro Valley, the RNA, and Pima County in five-year increments from 2006 to 2015.

Table 1.1 – Historical Population Data and Projections for the Region

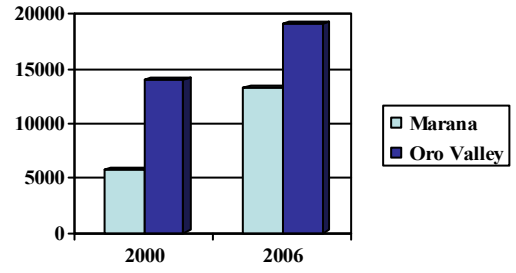
	1990	2000	2006	2010	2015
RNA	n/a	n/a	49,200	67,300	86,800
Rillito Community	n/a	n/a	330	405	455
Marana	2,187	13,556	30,345	43,352	60,809
Oro Valley	6,670	29,700	40,215	45,199	50,222
Pima County	666,880	843,746	981,280	1,070,723	1,175,967

Sources: Historical data and Pima County projections provided by Arizona Department of Economic Security; other data provided by Pima Association of Governments.

1.1.3 Economy

In pace with the increasing population, Marana has a growing economy as evidenced by taxable sales of $995.2 million in 2005, an increase of over 50 percent from the year 2000. Building permits issued in 2005 totaled 4,188 – more than twice the number issued in 2000. Housing units in Marana, as shown in Figure 1.2, have nearly tripled since 2000. Oro Valley has also experienced a marked increase in key growth indicators. Unemployment in the region was lower than the national average in 2007, 3.1 percent vs. 4.3 percent. Additional background economic information can be found in Table 1.2.

Figure 1.2 - Regional Housing Units in Thousands



Sources: U.S. Census Bureau, April, 2000 Census; Arizona Department of Economic Security, July, 2007.

Table 1.2 – Civilian Labor Force Data for the Region

City/County	1990	2000	2005
Marana	1,005	6,686	7,114
Oro Valley	3,201	13,471	14,591
Pima County	248,900	391,724	450,226

Source: Arizona Department of Economic Security.

1.2 Rillito Regulatory History

ADEQ began monitoring particulate matter in the RNA in 1971. The original measurement for particulate matter, known as total suspended particulate matter (TSP), included a size range of particles collected by hi-volume samplers, generally up to 40 microns in diameter. ADEQ began monitoring PM_{10} in 1985. In 1987, the U.S. Environmental Protection Agency (EPA) revised the standards to include only PM_{10} (52 FR 24634, July 1, 1987). As part of the implementation policy for the new standards, where insufficient PM_{10} data were available, EPA categorized areas of the country based on their probability of violating the standards. Group I areas were determined to have a high probability of violating the standards, Group II areas a moderate probability of violating, and Group III areas as likely to be attaining the standards. In EPA's published group descriptions, the Rillito area was listed as a "Group I Area" or one with a strong likelihood of violating the PM_{10} NAAQS. The State was required to submit a state implementation plan (SIP) within nine months of promulgation of the NAAQS (52 FR 24672, July 1, 1987, and 52 FR 29383, August 7, 1987).

Prior to the State's submission of a SIP, EPA updated the initial geographic descriptions for the Group I and Group II areas. Consistent with EPA's PM_{10} grouping scheme, the Rillito Group I Area was designated and classified as a moderate PM_{10} nonattainment area upon enactment of the 1990 Clean Air Act (CAA) amendments, effective November 15, 1990. This action included requirements for submittal of an attainment demonstration and reasonably available control measures (RACM) implementation provisions by November 15, 1991.

ADEQ submitted a moderate area PM_{10} plan for the Rillito area on November 14, 1991. In a letter dated May 14, 1992, EPA found this plan to be incomplete due to a lack of an emissions inventory. On April 22, 1994, ADEQ submitted a revised PM_{10} plan for Rillito. In a letter dated August 18, 1994, EPA found the plan to be incomplete due to a lack of reasonably available control measures (RACM). EPA has not taken any further action on the 1994 PM_{10} plan.

On October 10, 2006, EPA determined that the RNA had continued to meet the PM_{10} NAAQS and issued a clean data finding for the area. EPA's Clean Data Policy relieves the State from certain demonstrations of attainment, since by qualifying for a clean data finding, attainment has already been achieved.

1.2.1 EPA's Particulate Matter NAAQS

The CAA requires EPA to assess the latest scientific information and review the particulate matter NAAQS every five years. In September 2006, EPA reviewed the latest scientific information on the health effects of exposure to PM_{10}. During the 2006 review period, EPA received comments from external scientific advisors and the general public about the science and policy review reports. After reviewing over 120,000 written comments, on September 27, 2006, EPA revised the 1997 standards by retaining the existing 24-hour PM_{10} standard and revoking the Annual PM_{10} standard. Therefore, this LMP addresses EPA's current

policy for the 24-hour PM_{10} standard. The following table reviews the history of EPA's particulate matter NAAQS.

Table 1.3 –
History of EPA's Particulate Matter NAAQS

Date	EPA Action
1971	Established TSP Standard
1987	Established 24-hour and Annual PM_{10} Standards
1997	Established 24-hour and Annual $PM_{2.5}$ Standards
2006	Revoked the PM_{10} Annual Standard

1.3 Applicable CAA Requirements

Section 107(d)(3)(E) of the CAA, as amended, states that an area can be redesignated to attainment if the following conditions are met:

1. The PM_{10} NAAQS have been attained;
2. The applicable implementation plan has been fully approved under Section 110(k);
3. The improvement in air quality is due to permanent and enforceable reductions in emissions;
4. The State has met all applicable requirements for the area under Section 110 and Part D; and
5. A maintenance plan with contingency measures has been fully approved under Section 175A.

1.4 Requirements for Nonattainment Areas That Have Attained the NAAQS

EPA issued a clean data finding for the RNA on October 10, 2006 (71 FR 44920). EPA's Clean Data Policy applies to PM_{10} nonattainment areas that are meeting the NAAQS. Specifically, it addresses whether such areas must develop an attainment demonstration. The requirements for the approach and how the Rillito area meets them are described below in Table 1.3.

Table 1.3 - Requirements for Nonattainment Areas That Have Attained the NAAQS	
CAA Requirement	**Action to Meet Requirement**
The area must be attaining the 24-hour PM_{10} NAAQS based on the three most recent years of quality assured monitored air quality data.	Based on air quality data for the years 2004-2006, the three-year average number of exceedances was less than 1.0. Therefore, Rillito attained the 24-hour PM_{10} NAAQS.
The State must continue to operate an appropriate PM_{10} air quality monitoring network, in accordance with 40 CFR Part 58, in order to verify the attainment status of the area.	The State intends to continue to operate the Rillito monitoring network, in accordance with 40 CFR Part 58, in order to continue to verify the attainment status of the area. The Rillito monitoring network is described in Section 2.0 of this plan.
The control measures responsible for bringing the area into attainment must meet EPA standards for RACM and RACT requirements.	Control measures responsible for bringing the area into attainment are located in Section 4.0 of this plan and meet RACM and RACT requirements.
An emissions inventory must be developed for the area. The State may substitute an inventory developed for an area that is similar in overall composition.	The ambient monitoring data used to calculate the design values for this plan are contained in Section 3.0 of this plan.
EPA must make a finding that the area attained the 24-hour PM_{10} NAAQS, known as a "clean data finding".	On August 8, 2006, EPA issued a clean data finding for the RNA.

In addition to the above requirements, any requirements that are connected solely to designation or classification, such as new source review (NSR) and RACM/RACT, must remain in effect. Certain requirements under CAA Section 172(c), including modeling, attainment demonstrations, and reasonable further progress (RFP) demonstrations, are waived due to the fact that the areas which are eligible under this approach have already attained the PM_{10} NAAQS. General conformity requirements continue to apply, see Section 4.0 of this plan.

1.5 EPA's Limited Maintenance Plan (LMP) Option

The LMP option applies to qualified moderate PM_{10} nonattainment areas seeking redesignation to attainment. The option was established to readily redesignate nonattainment areas that present a low risk of future violations of the PM_{10} NAAQS. EPA determined that by qualifying for a LMP, a nonattainment area has demonstrated the ability to continue attainment of the PM_{10} NAAQS. Therefore, a nonattainment area seeking redesignation under an LMP is relieved of some requirements that are mandatory in a traditional maintenance plan. Among these requirements are emission inventory projections, modeling for maintenance and conformity analyses (for more information on conformity, see Section 4.5).

Under a LMP, the State is obligated to ensure the control measures responsible for helping the area reach attainment will remain in place through the duration of the LMP. Section Four of this plan provides details on control measures for the RNA. The State must also complete an emissions inventory, included in Section 3.0, as well as calculate a motor vehicle regional emissions analysis to project future growth in vehicle emissions, referenced in Table 1.5 of this section and shown in detail in Appendix C.1. Finally, the State must provide contingency measures to bring the area back into attainment should an exceedance occur. Section 4.0 contains a menu of contingency measures.

To qualify for the LMP option, an area should be attaining the NAAQS and the average PM_{10} design value for the area, based upon the most recent 5 years of air quality data at monitors in the area, should be less than 98 $\mu g/m^3$ for the 24-hr PM_{10} standard. If the area cannot meet this test, EPA offers another option to qualify for an LMP. To meet this qualification, the average design value (DV) of the site must be less than the area's site-specific Critical Design Value (CDV). When this calculation was performed, the RNA's average DV (119 $\mu g/m^3$) was less than the CDV (142 $\mu g/m^3$), indicating that the RNA has a very low probability of exceeding the NAAQS in the future and thus qualifies for the LMP option.

Tables 1.4 and 1.5 list EPA's LMP criteria and how the RNA qualifies. The analyses that determined the DV, CDV, and a detailed justification of the LMP option for the RNA appears in Appendix C.1.

In order to qualify for a LMP, an area should expect only limited growth in on-road motor vehicle PM_{10} emissions (including fugitive dust) and must pass EPA's motor vehicle regional emissions analysis test. The scientific analysis that determined the RNA meets this criterion appears in Appendix C.1.

Table 1.4 - 24-hour Design Values and Critical Design Value for Rillito PM_{10} Nonattainment Area

3-Year Period	24-hour Design Value ($\mu g/m^3$)
2002-2004	118
2003-2005	118
2004-2006	122
Average	119
Critical Design Value	142

Table 1.5 - Limited Maintenance Plan Option

Criteria	RNA Qualifications
1. The PM_{10} nonattainment area must comply with the 24-hour PM_{10} NAAQS based upon the most recent five years of air quality data for all monitors in the PM_{10} nonattainment area.	During the most recent five-year period from 2002 to 2006, monitors in the RNA measured 24-hour PM_{10} levels below the NAAQS (150 $\mu g/m^3$), thus, criterion #1 has been achieved.
2. A PM_{10} nonattainment area may qualify for the LMP option if the average 24-hour DV is less than its respective site-specific critical design value CDV.	Calculations conducted in accordance with EPA guidelines established the DV as 119 $\mu g/m^3$. The CDV for the area was determined to be 142 $\mu g/m^3$. Because the DV is less than the CDV, criterion #2 has been met.
3. The PM_{10} nonattainment area should expect only limited growth in on-road motor vehicle PM_{10} emissions (including fugitive dust) and must pass the motor vehicle regional emissions analysis test.	To pass the test, the projected increase of onroad motor vehicle PM_{10} emissions during the first ten-year period of the LMP must not cause the DV to exceed the CDV. The adjusted DV for the RNA (119.26 $\mu g/m^3$), is less than the CDV, therefore criterion #3 has been met.

1.6 Applicable EPA Guidance

EPA guidances consulted for this plan are listed in Appendix B.

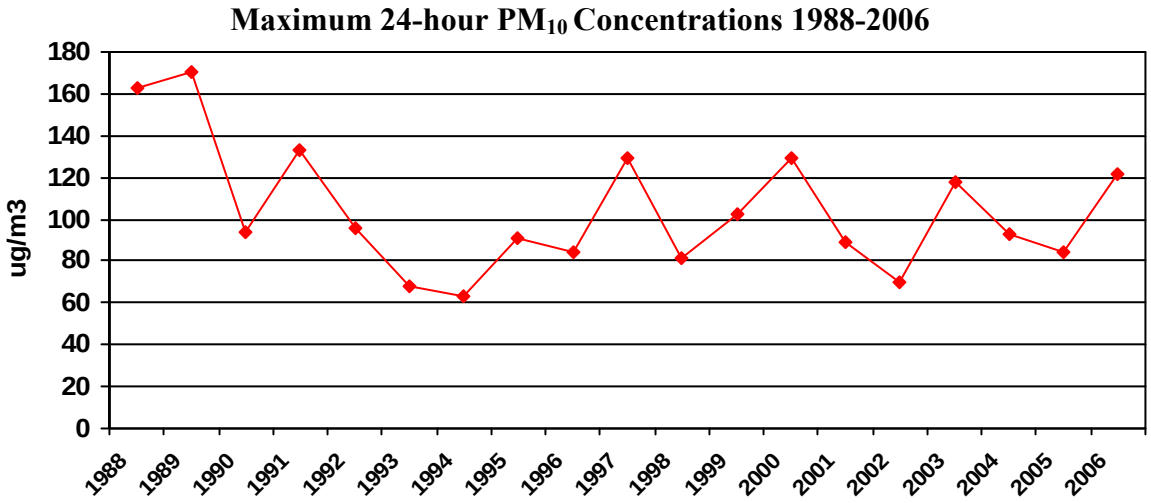
2.0 AIR QUALITY

2.1 Historical Air Quality Data

Monitoring for the Annual and 24-hour PM_{10} standards began in the Rillito Nonattainment Area (RNA) in 1985. EPA revoked the Annual standard in 2007 based on their assessment that there is a lack of evidence linking health problems to long-term exposure of coarse particle pollution; but retained the 24-hour PM_{10} standard. Therefore, this plan addresses only the 24-hour standard. The following table contains air quality data recorded at the Rillito monitor operated by ADEQ on a once in every six day sampling schedule.

Table 2.1 -
2002-2006 PM_{10} Summary Statistics for Rillito Nonattainment Area
PM_{10} Concentrations are for Standard Conditions and are in ug/m^3

Year	Quarter	# of Observations	Max 24-hour Concentration	2nd Highest Concentration	# of Exceedances
2002	1	15	43	40	0
	2	15	70	69	0
	3	16	65	43	0
	4	15	57	56	0
	Annual	61	70	69	0
2003	1	15	48	45	0
	2	15	118	72	0
	3	16	74	59	0
	4	13	76	70	0
	Annual	59	118	76	0
2004	1	14	48	43	0
	2	15	93	47	0
	3	15	62	41	0
	4	15	92	56	0
	Annual	59	93	92	0
2005	1	14	39	36	0
	2	15	73	72	0
	3	15	69	58	0
	4	15	84	78	0
	Annual	59	84	78	0
2006	1	13	95	71	0
	2	15	57	50	0
	3	14	47	46	0
	4	16	122	66	0
	Annual	58	122	95	0



2.2 Monitoring Network and Quality Assurance Procedures

The monitoring network was developed and is maintained in accordance with federal siting and design criteria set forth in 40 CFR Part 58, Appendices D and E, and consistent with ADEQ's State of Arizona Air Monitoring Network Plan. From 1988 to 1991, ADEQ operated a Sierra Anderson 321 B monitor at 8820 West Water Street in Rillito. In 1991, ADEQ began using a Dichot sampler at the same location. In July 2005, the location of the monitor was moved to 8840 West Robinson Street, less than 1,000 feet away from the Water Street site. Details appear in Table 2.2. The Robinson Street site is in close proximity to residential and industrial areas. Based upon the location and siting details, the site adequately represents general exposure of the Rillito population to PM_{10} emissions. The ADEQ data for Rillito have been collected and quality assurance procedures have been conducted in accordance with 40 CFR Part 58. Data from the monitor are entered into EPA's Air Quality System (AQS) database in accordance with federal guidelines.

Table 2.2 – Rillito PM_{10} Monitor History

Site Address	Began Operating	Latitude	Longitude	Pollutants Measured	Classification	Scale	Objective
8820 W. Water Street	1/1985 – 7/2005	32" 25'	111" 10'	PM_{10}	SLAMS[2]	Neighbor-hood	Source Impact
8840 W. Robinson Street	7/2005 – Current	32" 41'	112" 48'	PM_{10}	SLAMS	Neighbor-hood	Source Impact

[2] The Clean Air Act requires every state to establish a network of air monitoring stations for criteria pollutants, using criteria set by EPA for their location and operation. The monitoring stations in this network are called the State and Local Air Monitoring Stations (SLAMS). The states must provide EPA with an annual summary of monitoring results at each SLAMS monitor, and detailed results must be available to EPA upon request.

3.0 RILLITO NONATTAINMENT AREA (RNA) EMISSIONS INVENTORY

According to the LMP guidance, the State's maintenance plan should include an emissions inventory. The inventory should represent emissions during the same five-year period associated with the air quality data used to determine whether the area meets the applicability requirements of this policy (i.e., the most recent five years of air quality data). For the Rillito Nonattainment Area (RNA), 2004 was selected as the base year for the emissions inventory. March 21, 2004, was selected to be the emissions inventory design day based on the greatest potential for windblown dust, seasonal emissions from agriculture, and average precipitation. Table 3.1 features estimated emissions for the design day.

Table 3.1
Rillito Nonattainment Area Daily Emissions
Design Day March 21, 2004

	All Sources (tons/day)	**Vehicular (tons/day)**
Onroad Mobile - Exhaust, Brake, and Tire Wear	0.383	0.383
Nonroad Mobile	0.119	N/A
Fugitive Dust from Paved Roads	0.933	0.933
Fugitive Dust from Unpaved Roads	1.325	1.325
Fugitive Dust from Unpaved Road Shoulders	0.498	0.498
Fugitive Dust from Trackout	0.285	0.285
Windblown Dust March 21, 2004	936.000	N/A
Industrial Sources (Arizona Portland Cement Company)	1.317	N/A
Total	**940.860**	**3.424**

*This inventory addresses EPA's 24-hour PM_{10} standard; to calculate tons per year, multiply by 365. Note March 2, 2004, was selected to calculate windblown dust due to conditions that contribute to the greatest possible emissions.

For vehicular emissions, the PM_{10} emission factors from exhaust, brake and tire wear were estimated using EPA's MOBILE6 model. Fugitive PM_{10} emission factors were calculated based on the equations outlined in Chapter 13 of AP-42. The number of vehicle miles traveled (VMT) was obtained from the 2004 Highway Performance Monitoring System (HPMS).

Descriptions of emission estimation methods by source category are described under separate headings below.

Onroad Mobile – Exhaust, Brake and Tire Wear: Particulate matter and gaseous precursors generated by vehicles are termed primary and secondary emissions. Primary emissions are particles emitted by mobile sources which are distributed directly into the atmosphere, for example carbon particles originating from tire wear. Secondary emissions include gases and exhaust generated by vehicles that develop through chemical reactions and form particles in the atmosphere.

MOBILE6 requires a variety of inputs, including meteorological conditions, fuel properties, and local vehicle fleet and traffic information. The calculation also requires data from the HPMS, a database containing information on all public roads in the U.S. HPMS data categories include road classifications, speed limits, surface type, shoulder conditions, and the annual average daily traffic. The emission factors were calculated using MOBILE6 for each road segment reported in the 2004 HPMS for the nonattainment area. VMT for each road segment was determined by its segment length and average annual daily traffic. The PM_{10} emissions for each road segment were determined by multiplying the emission factor by the VMT. For the private roads in the nonattainment area, VMT was estimated based on population.

For the RNA, primary PM_{10} emissions are calculated to be .143 tons per day and secondary emissions are calculated to be .240 tons per day. The total of primary and secondary emissions is .383 tons per day. These figures were compared to the 2000 onroad mobile source emissions inventory developed by Pima Association of Governments (PAG) for Tucson Air Planning Area (TAPA), which includes the RNA. The comparison revealed primary and secondary emissions calculated by ADEQ for the RNA are equivalent to those in the TAPA emissions inventory. Analyses used to calculate emissions for this section of the inventory can be found in Appendices C.1 and C.2.

Unpaved Roads - Fugitive Dust: EPA's emission factor equation depends upon the surface material silt content, the average speed of vehicles traveling on the unpaved roads, the surface material moisture content, and the number of days with measurable precipitation.

The calculated emission factor is representative of a fleet average emission factor rather than a vehicle-specific emission factor. A value of 0.64% for the surface material moisture content was chosen to be representative of conditions in the RNA. A silt content value of 3.51% is representative for local unpaved road conditions. Precipitation data for unpaved roads are from a site within the RNA. Emissions from unpaved roads total 1.325 tons per day. The analysis for this emissions category is located in Appendix C.3.

Paved Roads - Fugitive Dust: Paved road emissions factors were calculated for each road segment reported in 2004 HPMS. The emission factors were then multiplied by the VMT to generate emissions. For the private roads in the nonattainment area, VMT was estimated based on population.

Using EPA's AP-42 model, the PM_{10} emission factor depends on road surface silt loading, vehicle weight, and precipitation. A silt loading of 0.085 g/m^2 was used for streets and roadways, and a loading of 0.02 g/m^2 was used for freeways. PM_{10} emissions from paved roads total .933 tons per day. The analysis for this emissions category is located in Appendix C.4.

Trackout – Fugitive Dust: ADEQ staff identified dust trackout during a field trip to the RNA and by using satellite images. While most roads within the nonattainment area have been paved, a significant number of residences do not have paved or stabilized driveways and therefore contribute to fugitive PM_{10} emissions in the area. Emissions due to trackout in the

RNA total .285 tons per day. The analysis for this emissions category is located in Appendix C.5.

Agricultural Activities: To estimate the contributions of agricultural to the 24-hour PM_{10} emissions inventory, hourly wind data for the base year, 2004, ADEQ's AAAQD database was filtered for values of wind speed equal to or greater than 15 mph. The results found there were a total of 16 hours of wind speed meeting that qualification. Two days in the spring with multiple hours of wind speed greater than 15 mph were identified. The wind data was then compared with the crop calendar to determine the date with the highest potential for windblown dust resulting from freshly tilled agricultural fields. That date is March 21, 2004, as shown in Table 5.1. The analysis for this emissions category is located in Appendix C.6.

Industrial Activities: Arizona Portland Cement Company (APC) is the only major source permitted by ADEQ operating in the RNA. ADEQ's air quality monitor is situated less than one-quarter of a mile north of the APC plant. Facilities associated with the plant are approximately four miles to the southwest. Production at the plant has remained constant in recent years. Pima Department of Environmental Quality permits sand and gravel operations in the area, as well as the Silver Bell copper mine, approximately twenty miles west of APC. Table 3.1 features average annual and daily PM_{10} emissions generated by APC for the most recent five years of monitoring data. More data on this emissions category are located in Appendix C.7.

Nonroad Mobile Sources: EPA's NONROAD model was used to estimate PM_{10} emissions from Nonroad Mobile Sources. The NONROAD model contains Total emissions for Pima County, which were then proportionally allocated to the estimated population of the RNA. Data from the NONROAD model were used for each category listed in Table 3.2, with the exceptions of Aircraft and Locomotive. Data from those categories were extracted from the respective EPA guidance on emissions factors for each. For the complete analysis on this section, see Appendix C.8.

Table 3.2
PM_{10} Emissions from Nonroad Mobile Sources (tons per day)

Category	Emissions
Lawn & Garden	.014
Aircraft	.030
Railway Maintenance	.0002
Locomotive	.034
Agricultural	.001
Recreational	.0001
Commercial	.003
Construction	.037
Total	**.1193**

4.0 CONTROL MEASURES

Sections 4.1 and 4.2 describe control measures for sources within the Rillito Nonattainment Area (RNA). Section 4.3 describes the contingency measures that will be considered if the predetermined trigger level is reached or if an exceedance of the Critical Design Value (CDV) occurs. Section 4.4 describes the trigger in further detail. Section 4.5 discusses conformity and the LMP option.

EPA's Limited Maintenance Plan (LMP) guidance requires areas seeking redesignation to demonstrate improvements in air quality are not due to temporary economic downturns. Chapter 2 contains economic and population data for the region. The data reveal that since 1970 the population of the RNA has steadily increased. Housing units in the region have nearly doubled. Key indicators point to a healthy economy. In addition, during this time, Arizona Portland Cement Company (APC) has been in operation without interruption.

The LMP guidance also requires the State to demonstrate air quality improvements are not due to favorable meteorological conditions. Pima County has experienced drought conditions for several years. In April 2007, the County declared a Stage 1 drought following several years of decreasing precipitation. Recent years have provided a worst-case scenario for PM_{10} monitors in the region, yet despite adverse conditions there has not been an exceedance of the NAAQS.

4.1 Reasonably Available Control Measures (RACM)

The Clean Air Act (CAA) requires moderate PM_{10} nonattainment area plans to ensure RACM will be implemented no later than four years after designation. The Act further requires the plan to provide for the implementation of controls reflecting reasonably available control technology (RACT) within the same time period. RACM and RACT are not required for sources which do not contribute significantly to violations of the 24-hour PM_{10} NAAQS or where additional controls on the sources would not expedite attainment of the NAAQS.

As discussed previously, the RNA was classified as a Group I area by EPA due to known PM_{10} emissions and preliminary monitoring data. EPA based this finding due emissions from Arizona Portland Cement (APC), industrial sand and gravel operations, and fugitive dust emissions resulting from extensive agricultural practices. In addition, monitors installed prior to promulgation of the standard measured several exceedances of the PM_{10} NAAQS. Permits issued for existing industrial sources ensure adequate controls are in practice. The permit for APC requires the implementation and maintenance of RACT, including: baghouses, dust collectors, spray bars, hoods, shrouds, and a continuously operating monitor system. The permit also includes record keeping requirements.

The 1994 SIP submitted to EPA contained a series of control measures designed to mitigate PM_{10} emissions. Since then, the area has become more urbanized and less agricultural. Some of the control measures included in the 1994 SIP have been discontinued or were one-time only actions. The following table provides the status of these measures.

Table 4.1 - Creditable Control Measures from the 1994 Rillito PM_{10} SIP			
	Control Measure	**Details**	**Status**
1	APC Plant and Quarry Operations	Comprehensive road stabilization plan to mitigate emissions.	In effect, included in the APC operating permit issued October 7, 2003.
2	Pima County Grading Ordinance, Chapter 18.81 of the Pima County Zoning Code (January 2001)	Permits for earth moving require stabilization to mitigate fugitive emissions.	In effect.
3	Bank Stabilization of Santa Cruz River	One time control measure implemented in 1988 during the development of nearby residential neighborhoods.	Complete.
4	Reduced Tillage Program	United States Department of Agriculture pilot program was discontinued.	Discontinued.
5	Dust Stabilization – Rillito Community	Approximately 1 mile of dirt roads within the community are now paved.	Complete.
6	Avra Valley Road Shoulder Dust Stabilization	2.5 miles will undergo blading and rolling followed by application of magnesium chloride once per year.	In effect on an as needed basis.

The implementation of these measures helped bring the area into timely attainment of the 24-hour standard, thus the measures meet the CAA requirement for RACM. In addition to these RACM controls, the Arizona Department of Transportation's (ADOT) Standard Specification Section 810 mandates that State contractors utilize a comprehensive series of control measures designed to mitigate airborne PM_{10} emissions during road construction projects. ADOT also implemented Encroachments in Highway Rights-of-Way, Arizona Administrative Code (AAC) R17-3-702, which authorizes ADOT to issue permits to allow private landowners and tenants to enter or exit the State Highway System but directs mitigation of trackout nuisances.

These supplemental strategies contributed to fugitive dust reductions and protection of the public health. Continued implementation of these measures will help ensure the Rillito area continues to meet the NAAQS.

4.2 Permanent and Enforceable Control Measures

The CAA requires that all types of maintenance plans demonstrate that measures credited with bringing the area into attainment are federally enforceable and continued into the future. Measures 1, 2, and 6 meet these requirements; measure 3 was discontinued by the United States Department of Agriculture and was not replaced; and measures 4 and 5 are no longer necessary because public roadways within the community have since been paved. These measures resulted in emissions reductions sufficient for attaining the PM_{10} standard in the Rillito Nonattainment Area. Therefore, measures 1, 2, and 6 meet the CAA requirement for permanent and enforceable control measures. The RACM included in this LMP are sufficient and the deficiencies of the attainment plan submitted by ADEQ in 1994 have been now been addressed.

New major sources or major modifications to existing sources located in nonattainment areas are subject to Arizona Administrative Code (AAC) R18-2-403 (Permits for Sources

Located in Nonattainment Areas). Following redesignation, AAC R18-2-406 (Permit Requirements for Sources Located in Attainment and Unclassifiable Areas) will apply for any major source or major modification to a source located within the maintenance area.

4.3 Contingency Measures

Section 175A of the CAA requires a maintenance plan's contingency provisions to be enacted should a violation of the PM_{10} standard occur following redesignation to attainment. EPA's memo, *Limited Maintenance Plan Option for Moderate PM_{10} Nonattainment Areas* (Lydia Wegman, August 9, 2001), states that contingency measures do not have to be fully adopted at the time of redesignation, but the LMP should identify measures to be implemented if necessary.

The State commits to act promptly if an exceedance of the area's design value occurs following redesignation to attainment. Specifically, the State commits to determine if an exceedance occurred within six months of the close of the calendar year. The State also commits to identify and implement the appropriate control measure(s) needed to remedy the situation by the end of the same calendar year.

A redesignated area with an LMP is also required to recalculate annually the average design value for the area to determine if the area has continued to meet the qualifications to be eligible for a LMP. If after performing the annual recalculation the State determines that the area no longer qualifies for a LMP, the State commits to take actions to reduce PM_{10} concentrations sufficiently to re-qualify for a LMP or prepare a Maintenance Plan.

4.4 Contingency Measure Trigger

The contingency measures featured in Table 4.2 will be considered for implementation by the State should an exceedance of the CDV occur. In order to prevent an exceedance from occurring, ADEQ opted to identify a specific indicator, or trigger, if PM_{10} concentrations reach a level that signals an exceedance may be imminent. The trigger will be used by ADEQ to determine if it is necessary to implement contingency measures in order to prevent an exceedance from occurring.

For this LMP, contingency measures will be considered if ambient concentrations reach the trigger activation level – in this case 95 percent of the area's CDV or 135 $\mu g/m^3$. The causes of the trigger activation will help the State determine the appropriate contingency measure or measures to be implemented. While not a requirement for a LMP, ADEQ believes that identifying a trigger will increase protection of the public health and help assure the area will continue to qualify for an LMP.

4.5 Conformity

The Transportation Conformity Rule (40 CFR parts 51 and 93) and General Conformity Rule (58 FR 63214; November 30, 1993) apply to nonattainment areas and maintenance areas

operating under maintenance plans. Under transportation conformity rules, one means of demonstrating conformity of federal actions is to indicate that expected emissions from planned actions are consistent with the emissions budget for the area. Emissions budgets in LMP areas may be treated as essentially non-constraining for the length of the maintenance period because it is unreasonable to expect that an LMP area would experience so much growth during that period of time that a violation of the PM_{10} NAAQS would result. This does not exempt an LMP area from the need to affirm conformity, but it does allow the area to demonstrate conformity without undertaking certain rule requirements. For transportation conformity purposes, EPA would most likely conclude that emissions in these areas do not require a cap for the duration of the maintenance period, and, therefore, a regional emissions analysis will not be required.

General Conformity requires that non-transportation based projects in areas that have air quality plans for either nonattainment or maintenance areas submit a description of the project to the State. The description must show either that the project will not increase the relevant emissions for the area, or that specific control measures will be applied for the duration of the project in order to prevent increased emissions, in this case, increased emissions of PM_{10}.

Table 4.2 - Contingency Measure Options

	Contingency Measures	Implementing Entity
1	If any PM_{10} generating source within the maintenance area is found to be contributing to monitored readings above the LMP allowable limits, ADEQ will review existing air quality permits and/or applicable rules to identify additional control measures that may be needed. If a PM_{10} source does not have a permit, ADEQ will determine if an air quality permit and PM_{10} controls are needed.	ADEQ
2	Review and revise dust control measures for material storage piles to determine if additional action is needed.	ADEQ
3	Pave any new unpaved public roads, vacant lots, and unpaved parking lots located in the PM_{10} maintenance area subject to limits of statutory authority.	Pima County
4	Review and revise existing grading ordinance, if necessary.	Pima County
5	Reduce particulate matter by paving or stabilizing unpaved or unimproved shoulders and alleys.	Town of Marana and Pima County
6	Review and revise standards for installation and maintenance of landscaping and screening, if necessary.	Pima County
7	Review and revise roadway maintenance practices following exceptional events, if necessary.	Pima County

5.0 LIMITED MAINTENANCE PLAN ADMINISTRATION

5.1 Commitment to Calculate PM_{10} Design Values Annually

The State commits to recalculate the area's PM_{10} design values annually to track the area's air quality levels. If the concentrations rise above the threshold or trigger that qualifies the area for the limited maintenance plan (LMP), the State will act to correct the problem. If the actions fail to restore eligibility for the LMP, the State commits to submit a full maintenance plan.

5.2 Discussion of Permitting Program to Ensure that New Sources Will Not Jeopardize Continued Maintenance

As previously discussed in Section 4.2, Arizona Administrative Code (AAC) R18-2-403 (Permits for Sources Located in Nonattainment Areas) and AAC R18-2-406 (Permit Requirements for Sources Located in Attainment and Unclassifiable Areas) will apply for any major source or major modification to a source located within the maintenance area.

5.3 CAA Section 175(A) Maintenance Plans

ADEQ commits to submit a limited maintenance plan for the second ten-year period (2020-2030) by 2017. ADEQ also commits to submit an annual attainment report and review the emissions inventory every three years to ensure emissions growth is incorporated in the attainment inventory.

LIST OF APPENDICES

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APPENDIX A: APPLICABLE CLEAN AIR ACT (CAA) REQUIREMENTS

Appendix A - CAA Regulatory Requirements		
CAA Citation	**Action to Meet Requirement**	**Location in Document**
CAA Section 172(c), Nonattainment Plan Provisions		
172(c)(1) General	"...Such plan provisions shall provide for the implementation of all reasonably available control measures (RACM) as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology (RACT)) and shall provide for attainment of the national primary ambient air quality standards."	Chapter 4 contains an explanation of applicable RACM/RACT for PM_{10} point sources in the nonattainment area.
172(c)(2) Reasonable Further Progress (RFP)	Plan provisions shall demonstrate reasonable further progress or "annual incremental reductions in emissions … for the purpose of ensuring attainment of the applicable national ambient air quality standards by the applicable date."	Chapter 4 of this submittal demonstrates that the RNA has attained and will maintain the PM_{10}NAAQS with current control measures.
172(c)(3) Emissions Inventory	The plan provisions "… shall include a comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant(s)..." ADEQ maintains a database of historical and current actual emissions from State permitted point and area sources. The Pima County Department of Environmental Quality maintains a similar database of actual emissions from County permitted sources. All non-permitted source emissions data (i.e.: mobile sources) are obtained from EPA's national emissions inventory.	Base-year emissions are contained in Chapter 3. In qualifying for the LMP option, the requirement for projecting emissions is waived.
172(c)(4) Identification and Quantification	Plan provisions "… shall expressly identify and quantify the emissions, if any, of any such pollutant or pollutants which will be allowed, in accordance with Section 173(a)(1)(B), from the construction and operation of major new or modified stationary sources in each such area. The plan shall demonstrate to the satisfaction of the Administrator that the emissions quantified for this purpose will be consistent with the achievement of reasonable further progress and will not interfere with attainment of the applicable national ambient air quality standard …" The permit requirements of CAA Section 173(a)(1)(B) are applicable to sources located in a targeted economic development zone as determined by the Administrator under consultation with the Secretary of Housing and Urban Development. No such zones exist within the Rillito Nonattainment Area.	

172(c)(5) Permits for New and Modified Major Stationary Sources	The plan provisions "…shall require permits for the construction and operation of new or modified major stationary sources anywhere in the nonattainment area…" All new sources and modifications to existing sources in Arizona are subject to state requirements for preconstruction review and permitting pursuant to AAC, Title 18, Chapter 2, Articles 3 and 4. All new major sources and major modifications to existing major sources in Arizona are subject to the New Source Review (NSR) provisions of these rules or Prevention of Significant Deterioration (PSD) for maintenance areas. ADEQ currently has full approval of its Title V permit program. Sources within Pima County jurisdiction are subject to the Pima County Air Quality Control District, NSR program in Code of Regulations, Chapter 17.20.	
172(c)(6) Other Measures	The plan "... shall include enforceable emissions limitations, and such other control measures, means or techniques …, as well as schedules and timetables for compliance, as may be necessary or appropriate to provide for attainment of such standard in such area by the applicable attainment date..."	Emissions limitations and control measures for PM_{10} sources in the nonattainment area may be found in Chapter 5.
172(c)(7) Compliance with Section 110(a)(2), Implementation Plans	The plan provisions "... shall also meet the applicable provisions of Section 110(a)(2)." The requirements of Section 110(a)(2) are detailed elsewhere in this Table.	
172(c)(8) Equivalent Techniques	The plan may include upon application by the state "... the use of equivalent modeling, emission inventory, and planning procedures …" as allowed by the administrator. Per the conditions of the Limited Maintenance Plan option, the obligation to model is waived.	
172(c)(9) Contingency Measures	The plan "... shall provide for the implementation of specific measures to be undertaken if the area fails to make reasonable further progress, or to attain the national primary ambient air quality standard … Such measures shall be included in the plan revision as contingency measures to take effect in any such case without further action by the State or the Administrator." As noted in 172(c)(2) above, this submittal includes monitoring data and source permit information that demonstrate that the applicable area has attained, and will maintain. Per the conditions of the Limited Maintenance Plan option, the obligation to model is waived. The RNA is meeting EPA's NAAQS with the control measures currently fully implemented. As such, the RFP requirement is met.	
CAA Section 175(A), Maintenance Plans		
175(A)(a) Plan Revisions	"Each State which submits a request under Section 107(d) for redesignation of a nonattainment area … shall also submit a revision of the applicable State implementation plan to provide for the maintenance of the national primary ambient air quality standard … for at least 10 years after the redesignation…" This submittal demonstrates attainment through 2019. ADEQ commits to submit a maintenance plan for the second ten year period (2019-2029) by 2018.	

175(A)(b) Subsequent Plan Revisions	"8 years after redesignation of any area as an attainment area under Section 107(d), the State shall submit to the Administrator an additional revision of the applicable State implementation plan for maintaining the national primary ambient air quality standard for 10 years after the expiration of the 10-year period referred to in subsection (a)." ADEQ commits to submit an additional SIP revision ten years after redesignation.	
175(A)(c) Nonattainment Requirements Applicable Pending Plan Approval	"Until such plan revision is approved and an area is redesignated as attainment for any area designated as a nonattainment area, the requirements of this part shall continue in force and effect with respect to such area." ADEQ commits to keeping all applicable measures in place.	
175(A)(d) Contingency Provisions	"Each plan revision submitted under this Section shall contain such contingency provisions as the Administrator deems necessary to assure that the State will promptly correct any violation of the standard which occurs after the redesignation of the area as an attainment area. Such provisions shall include a requirement that the State will implement all measures with respect to the control of the air pollutant concerned which were contained in the state implementation plan for the area before redesignation…" ADEQ commits to implementing all identified measures as necessary.	
CAA Section 110(a)(2) – Implementation Plans		
110(a)(2)(A) Control Measures and Emission Limits	Section 110(a)(2)(A) requires that states provide for enforceable emission limitations and other control measures, means, or techniques, as well as schedules for compliance necessary to meet applicable requirements of the CAA.	Chapter 4 includes the measures utilized to bring this area into attainment and ensure future maintenance of the PM_{10} NAAQS.
110(a)(2)(B) Ambient Monitoring	Section 110(a)(2)(B) requires that states provide for establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, compile, and analyze data on ambient air quality.	Chapter 2 includes ambient monitoring network information and data for the Rillito nonattainment area.

110(a)(2)(C) Permitting and Compliance	Section 110 (a)(2)(C) requires states to have permitting, compliance, and source reporting authority. Arizona Revised Statutes (ARS) 49-402 establishes ADEQ's permitting and enforcement authority. Under ADEQ's air permits program, stationary sources that emit regulated pollutants are required to obtain a permit before constructing, changing, replacing, or operating any equipment or process which may cause air pollution. This includes equipment designed to reduce air pollution. Permits are also required if an existing facility that causes air pollution transfers ownership, relocates, or otherwise changes operations. Under ADEQ's air quality compliance program, scheduled and unscheduled inspections are conducted at the major sources annually. The ADEQ Air Compliance Section also implements compliance assistance initiatives to address non-compliance issues (i.e., seminars and workshops for the regulated community explaining the general permit requirements, individual inspections of all portable sources within a geographical area, mailings, etc.). In addition, compliance initiatives are developed to address upcoming or future requirements and include such actions as training for inspectors; development of checklists and other inspection tools for inspectors; public education workshops; targeted inspections; mailings, etc. ADEQ's Air Compliance Section also has an internal performance measure to respond to all complaints as soon as possible, but within five working days. The Pima County Department of Environmental Quality has approved or delegated permitting programs and enforcement authority for sources under their jurisdiction.
110(a)(2)(D) Other States	Section 110 (a)(2)(D) requires adequate provisions to ensure that emissions activity within the state does not contribute significantly to nonattainment in or interfere with maintenance by any other state or interfere with any other state's required applicable implementation plan to prevent significant deterioration of air quality or to protect visibility. Also required are provisions to ensure compliance with Sections 126 and 115 relating to interstate and international pollution abatement. Analysis of the Rillito nonattainment area demonstrates attainment and maintenance of the PM_{10} air quality standards. Based on enforceable emission reductions, no significant contribution or interference with air quality in any other state is expected.
110(a)(2)(E) Adequate Resources	Section 110 (a)(2)(E) requires that states have adequate personnel, funding, and authority under state law to carry out the implementation plan. As authorized under ARS 49-104, 49-402, and 49-404, ADEQ retains adequate funding and employs adequate personnel to administer the air quality program. Appendix C includes the organization chart for ADEQ's Air Quality Division.

110(a)(2)(F) Emissions Monitoring and Reporting	Section 110 (a)(2)(F) requires, as prescribed by the Administrator, provision for emissions monitoring and reporting, by owners or operators of stationary sources and periodic reports on the nature and amounts of emissions as well as correlation of such reports by the state agency with any emission limitations or standards. AAC R18-2-327 requires that any source subject to a permit must complete and submit to the Director their responses to an annual emissions inventory questionnaire. A current air pollutant emissions inventory of both permitted and non-permitted sources within the state is necessary to properly evaluate the air quality program effectiveness, as well as determine appropriate emission fees for major sources. This inventory encompasses those sources subject to state permitting requirements emitting 1 ton per year or more of any individual regulated air pollutant, or 2.5 tons per year or more of any combination of regulated air pollutants. ADEQ is responsible for the preparation and submittal of an emissions inventory report to EPA for major sources and emission points prescribed in 40 CFR 51.322, and for sources that require a permit under ARS 49-426 for criteria pollutants. Pima County Air Quality Control District, Code of Regulations, Chapter 17, contains emissions monitoring and reporting requirements for sources under its jurisdiction.
110(a)(2)(G) Emergency Powers	Section 110(a)(2)(G) requires that states provide for authority to establish emergency powers and authority and contingency measures to prevent imminent endangerment. ARS 49-465 authorizes state actions to alleviate or prevent an emergency health risk to the public. AAC R18-2-220 prescribes the procedures the ADEQ Director shall implement in order to prevent the occurrence of ambient air pollution concentrations which would cause significant harm to the public health. In addition, as authorized by ARS 49-426.07, ADEQ may seek injunctive relief upon receipt of evidence that a source or combination of sources is presenting an imminent and substantial endangerment to public health or the environment.
110(a)(2)(H) Plan Revisions	Section 110(a)(2)(H) requires revisions to plans to take account of revised primary or secondary ambient air quality standards or the availability of improved or more expeditious methods of attaining such standards. This Section also requires states to provide for plan revisions to ensure the adequacy of the plan to attain the air quality standards or to otherwise comply with any additional requirements established under the CAA. ADEQ will revise this plan as necessary to comply with the requirements of the Clean Air Act.

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APPENDIX B

Applicable EPA Guidance Documents

PM_{10} SIP Development Guideline, U.S. Environmental Protection Agency, OAQPS, EPA-450/2-86-001, Research Triangle Park, NC, June 1987.

Procedures for Processing Requests to Redesignate Areas to Attainment, John Calcagni, Director, Air Quality Management Division, memorandum dated September 4, 1992.

PM_{10} Emission Inventory Requirements, U.S. Environmental Protection Agency, OAQPS, Research Triangle Park, NC, September 1994.

Reasonable Further Progress, Attainment Demonstration, and Related Requirements for Ozone Nonattainment Areas Meeting the Ozone National Ambient Air Quality Standard. John S. Seitz, Director, Office of Air Quality Planning and Standards (MD-10), May 15, 1995.

Limited Maintenance Plan Option for Moderate PM_{10} Nonattainment Areas, Lydia Wegman, Director, AQSSD (MD-15), memorandum dated August 9, 2001.

Clean Data Policy for the Fine Particulate National Ambient Air Quality Standards. St[illegible] D[illegible] Page, Director, Office of Air Quality Planning [illegible] Standards, December 14, 2004**.**

US EPA, AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Source, Chapter 13.2.1. November 2006.

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APPENDIX C

Appendix C - Emissions Inventory Analyses

C.1. Justification for LMP Option for the RNA
C.2. 24-hour Emissions Inventory
C.3. On-Road Mobile Source Emissions Inventory
C.4. Fugitive Emissions from On-Road Mobile Sources
C.5. PM_{10} Emissions from Trackouts in the RNA
C.6. Windblown Dust from Agricultural Fields
C.7. Arizona Portland Cement Company Emissions
C.8. Off-Road Mobile Source PM_{10} Emissions Inventory for the RNA

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APPENDIX C.1
Justification for Limited Maintenance Plan Option for
Rillito PM_{10} Nonattainment Area

BACKGROUND

1. No Violations of 24-hour PM_{10} Standard

- The PM_{10} nonattainment area must be in compliance with the 24-hour PM_{10} National Ambient Air Quality Standards (NAAQS) based upon the most recent five years of air quality data for all PM_{10} monitors in the PM_{10} nonattainment area (24-hour PM_{10} standard = 150 $\mu g/m^3$). Note: EPA revoked the annual PM_{10} NAAQS in 2006, thus it is not necessary to consider the annual PM_{10} NAAQS when qualifying for the LMP option as per e-mail correspondence with EPA Region 9.[2]

2. Average 24-Hour PM_{10} Design Value be At or Below 98 $\mu g/m^3$ or Otherwise Below Critical Design Value

- The average 24-hour PM_{10} design value (DV) for the PM_{10} nonattainment area must be at or below 98 $\mu g/m^3$. Note: EPA revoked the annual PM_{10} NAAQS in 2006, thus it is not necessary to consider the annual PM_{10} DV when qualifying for the LMP option as per e-mail correspondence with EPA Region 9.[2]

- If a PM_{10} nonattainment area cannot meet the DV test, it may still be able to qualify for the LMP option if the average 24-hour design value for the PM_{10} nonattainment area is less than its respective site-specific critical design valu (CDV).[1]

3. Pass Motor Vehicle Regional Emissions Analysis Test

- The PM_{10} nonattainment area should expect only limited growth in on-road motor vehicle PM_{10} emissions (including fugitive dust) and must have passed the motor vehicle regional emissions analysis test.[1]

LMP OPTION ANALYSES

The following section describes the data and calculations that ADEQ used to demonstrate that the Rillito PM_{10} Nonattainment Area meets the criteria for the LMP option.

Criterion #1 – 24-Hour PM_{10} Standard:
The Rillito PM_{10} Nonattainment Area has one PM_{10} monitor (AQS site ID: 04-019-0020) which measures 24-hour PM_{10} concentrations on a 1-in-6 day schedule. During the most recent 5-year period from 2002 to 2006, this monitor measured 24-hour PM_{10} levels below the 24-hour NAAQS (150 $\mu g/m^3$). Attainment of 24-hour PM_{10} NAAQS has been achieved, and the first criterion has been met.

Criterion #2 – Design Value / Critical Design Value:
Besides the requirement of attaining 24-hour PM_{10} NAAQS, the average 24-hour PM_{10} design value for the Rillito PM_{10} Nonattainment Area should be at or below 98 μg/m^3. ADEQ calculated the 24-hour PM_{10} design values following EPA's PM_{10} SIP Development Guideline.[3] The design values were determined by selecting the highest 24-hour PM_{10} concentration in a 3-year period. The 24-hour design values for the most recent five years (2002 – 2006) are listed in Table 1. The most recent five years of data consist of three consecutive 3-year periods (2002 – 2004, 2003 – 2005, and 2004 – 2006). The data in Table 1 indicate that the 24-hour design values for all these 3-year periods and the average of those three design values are all above the 24-hour design value of 98 μg/m^3.

EPA guidance states that if a PM_{10} nonattainment area's average 24-hour design value exceeds 98 μg/m^3, but is below the critical design value (CDV), then the PM_{10} nonattainment area can still qualify for the LMP option.[3]

Table 1
24-hour Design Values, Statistics and Critical Design Value for Rillito PM_{10} Nonattainment Area

3-Year Period	24-hour Design Value { μg/m^3 }
2002-2004	118
2003-2005	118
2004-2006	122
Average	119
Standard Deviation	2.3
Coefficient of Variation	0.02
Critical Design Value	142

ADEQ calculated a 24-hour PM_{10} CDV of 142 μg/m^{3}using the following formula:[4]

$$CDV = NAAQS/(1 + t_c \times CV) \quad (1)$$

where:

CDV	Critical Design Value in μg/m^3
NAAQS	National Ambient Air Quality Standards, which is 150 μg/m^3 for 24-hr PM_{10} concentration
t_c	Critical t value for the given n, and 95% confidence level; n is the degree of freedom
CV	Coefficient of Variation

All three design values listed in Table 1 were used in the calculation of the CDV, thus, the degree of freedom, n, is 2. The CDV is 142 μg/m^3 assuming a confidence level of 95%.

Details:

NAAQS = 150 μg/m^3
t_c = 2.919986
CV = 0.02

Then:

CDV = 150 μg/m^3 / (1 + 2.919986 × 0.02) = 142 μg/m^3

This result shows that although the 24-hour design values for all these 3-year periods and the average of these three design values are above 98 μg/m^3, they are well below the CDV. The Rillito PM_{10} Nonattainment Area has met the second criterion of the LMP analysis.

Criterion 3 – Motor Vehicle Regional Emissions Analysis Test:
This criterion is related to projected growth of mobile source emissions in a PM_{10} nonattainment area. The motor vehicle regional emissions analysis test is a test in which the projected increase in 24-hour PM_{10} concentrations resulting from an increase in vehicle miles traveled (VMT) by onroad mobile sources over the next 10-year period is added to the PM_{10} design values for a PM_{10} nonattainment area. This projected 24-hour PM_{10} design value must be less than 98 μg/m^3 or the site-specific CDV to qualify for a LMP.

ADEQ used the following equation for the motor vehicle regional emissions analysis,[5]

$$\text{Projected } DV = DV + \left(VMT_{pi} \times DV_{mv}\right) \leq MOS \qquad (2)$$

where:

DV	The area's average 24-hour PM_{10} design value based on the most recent 5 years of quality assured data in μg/m^3
VMT_{pi}	The projected % increase in vehicle miles traveled (VMT) over the next 10 years
DV_{mv}	Motor vehicle design value based on on-road mobile portion of the attainment year inventory in μg/m^3 calculated by multiplying DV by the percentage of the attainment year 24-hour PM_{10} emissions inventory represented by on-road mobile sources
MOS	Margin of safety for the 24-hour PM_{10} standard for a given area: 98 μg/m^3 (or using site-specific CDV)

The average 24-hour PM_{10} design value is 119 μg/m^3 according to Table 1. The projected VMT increase over the next ten years (2009 – 2019) was estimated from information provided by the Pima Association of Governments[6] as shown in Table 2.

Table 2 VMT for the Rillito PM_{10} Nonattainment Area	
Year	Daily VMT
2005	1,468,823
2009 (Interpolated)	1,954,449
2012	2,318,669
2019 (Interpolated)	3,144,823
2030	4,443,064

Year 2009 and year 2019 daily VMT were estimated by interpolation. The projected VMT increase (VMT_{pi}) from 2009 – 2019 is 60.9%. The motor vehicle portion of the 24-hour Rillito PM_{10} Emissions Inventory for March 21, 2004 was 0.364%.

Details:

$DV = 119\ \mu g/m^3$

$VMT_{pi} = 60.9\%$

$DV_{mv} = 119\ \mu g/m^3 \times 0.364\% = 0.433\ \mu g/m^3$

Then:

Projected $DV = 119\ \mu g/m^3 + (60.9\% \times 0.433\ \mu g/m^3) = 119.26\ \mu g/m^3$

The projected DV was calculated to be 119.26 $\mu g/m^3$, which is less than the CDV. Thus, the motor vehicle regional emissions analysis test has been satisfied and the third criterion has been met.

CONCLUSION

In conclusion, the Rillito PM_{10} Nonattainment Area qualifies for the LMP option because it meets the three criteria set forth by EPA: (1) No violations of 24-hour PM_{10} standard, (2) Average 24-Hour PM_{10} design value is at or below 98 $\mu g/m^3$ or otherwise below the critical design value, and (3) Projected growth in onroad mobile emissions does not cause 24-hour PM_{10} concentrations to be greater than 98 $\mu g/m^3$ or the critical design value.

REFERENCES

1. Lydia Wegman, Memorandum: Limited Maintenance Plan Option for Moderate PM_{10} Nonattainment Areas, 2001

2. Wienke Tax, USEPA R9, Personal Communications, 2007

3. USEPA, PM_{10} SIP Development Guideline, 1987

4. Shao-Hang Chu, Critical Design Value Estimation and Its Applications, Attachment A to the EPA Memorandum: Limited Maintenance Plan Option for Moderate PM_{10} Nonattainment Areas, 2001

5. Motor Vehicle Regional Analysis Methodology, Attachment B to the EPA Memorandum: Limited Maintenance Plan Option for Moderate PM_{10} Nonattainment Areas, 2001

6. Aichong Sun, Pima Association of Governments, Personal Communications, 2007

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APPENDIX C.2
RILLITO NONATTAINMENT AREA (RNA) DAILY EMISSIONS

Since ADEQ qualifies for a 24-hour PM_{10} Limited Maintenance Plan (LMP) for the Rillito Nonattainment Area (RNA), an annual inventory is not required. ADEQ has focused on a 24 hour emission inventory. A full year of hourly wind data was obtained for the area from ADEQ's Azurite database. The data was filtered for values of wind speed equal to or greater than 15 mph (≥ 15 mph or 33.6 meters/sec) and is shown in Table 1. The table shows a total of 16 hours with wind speed ≥ 15 mph and two days in the spring where the wind speed fits the category with multiple hours having wind speed ≥ 15 mph. All other windy days are outside the potential crop/windblown dust window.

Table 1 - Rillito 2004 Wind Speed and Direction Data for Wind Speed ≥ 15 mph

Date	Time	Wind Direction (from)	Wind Speed (miles per hour)
21-Mar-2004	9:00	134	15.9
21-Mar-2004	10:00	133	19.2
21-Mar-2004	11:00	135	18.3
21-Mar-2004	12:00	136	15.9
21-Mar-2004	13:00	140	15.7
29-Apr-2004	12:00	247	16.3
29-Apr-2004	13:00	246	16.6
29-Apr-2004	14:00	256	17.9
29-Apr-2004	15:00	268	17.7
17-Jul-2004	20:00	139	15.2
1-Aug-2004	17:00	143	17.2
1-Aug-2004	18:00	141	15.2
25-Sep-2004	18:00	64	15.2
13-Oct-2004	22:00	70	16.8
13-Oct-2004	23:00	67	15.9
14-Oct-2004	0:00	67	16.1

Comparing the wind data with the crop calendar shows that the highest potential for windblown dust from freshly tilled cotton fields is on March 21, 2004. This day was selected as the 24-hour PM_{10} design day. By April 29, the cotton plants would be sufficiently high to shield the soil from the strong wind.

WINDBLOWN DUST FROM AGRICULTURAL FIELDS

Estimation of Windblown PM10 Emissions from Bare Agricultural Fields in the Rillito PM10 Study Area

A description of the methods and data used to estimate PM10 emissions from wind erosion of agricultural land in the Rillito PM10 Study Area appears below.

Identification of Crops

The types of crops and the locations of the fields in the Rillito PM_{10} Study area were identified through a number of steps:

1. Field surveys – ADEQ staff located agricultural fields and identified some of the crop types using printouts of gridded satellite images (QuickBird and IKONOS, 2003/2004) of the Rillito PM10 Study Area.

2. Digitizing – ADEQ staff digitized the following crop areas on the gridded satellite images of the Rillito PM10 Study Area based on the field surveys done by ADEQ staff (see Figure 1):

   Cotton was the major crop grown in all fields in the Rillito PM10 Study Area

   Oats/wheat (Haylage), Alfalfa and Pasture represent a miniscule portion of the crops

3. GIS was used to calculate the area (square meters) of each of the above crop types in each grid cell of the Rillito PM10 Study Area.

Crop Calendar

A crop calendar (see Table 1) was developed to show the time period that agricultural tillage and harvesting occurred in the Rillito PM10 Study Area. The calendar was based on the following:

Meeting with University of Arizona Cooperative Extension Service.

ADEQ's analysis of aerial photography book for 2002/2004 ("Real Estate Photo Book for Tucson", Landiscor Aerial Information, 1710 East Indian School Road, Phoenix, AZ 85016, Phone: 602-248-8989) to define the months when the land use transition occurred.

University of Arizona Cooperative Extension Service website on crop budgets (http://www.ag.arizona.edu/arec/ext/budgets/Maricopa-map.html)

Agricultural Tillage and Harvest Days

The design days selected by ADEQ for 24-hour ambient PM10 concentrations in the Rillito PM_{10} Study Area were compared to the previously mentioned crop calendar (Table 1) to determine which design days may have had open agricultural fields.

The high wind design days that were compared to the crop calendar are listed below:

Primary Design Days

- March 21, 2004
- April 29, 2004

Optional Design Days

- July 17, 2004
- August 1, 2004
- September 25, 2004
- October 13/14, 2004

After reviewing the crop calendar, it was found that March 21, 2004 was the only design day that had a potential for open agricultural fields and high winds. The major crop that may have had open fields was cotton.

Table F-1 Year 2004 Crop Calendar for Rillito PM10 Study Area

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Cotton												
Oats (Haylage)												
Pasture/Alfalfa												
Alfalfa/Oats												
Alfalfa												
Pasture												
Design Days (red = high wind day)			**3/21/04**	4/29/04								
Design Days – Optional							**7/17/04**	**8/1/04**	9/25/07	10/13/04 10/14/04		
Legend:	**Source of Data:** o Meeting with U of A Cooperative Extension o Phone Calls with U of A Cooperative Extension **Note:** Wind erosion during planting months is reduced due to irrigation keeping topsoil moist. Harvesting crop as haylage produces minimal emissions since crop is harvested green. May not landplane every year.											

Tilling =		Planting =		Crop in Field =		Harvest =	

Wind Erosion from Agriculture

The two high wind design days (total high wind design days = 6) were compared to the crop calendar (Table 1) to determine which of these days have a potential for wind erosion of agricultural land and for which crops. The March 21, 2004, and April 29, 2004, design days have a potential for wind erosion of agricultural fields with cotton. The primary drawback from using the April 29, 2004 day is the fact that the cotton plants may be sufficiently tall to provide cover for the soil. This is also the case for the October 13/14, 2004, optional design day, since the crop calendar indicates that this is the time frame for harvesting leaving sufficient standing plant material to provide cover for the soil. In addition, the October 13/14, 2004, optional design day has a potential for wind erosion of agricultural fields with oats and other grains because it is in the time window for tilling/planting. It turns out that there are only two small fields in which grain oats or wheat had been planted.

In order to compute the PM_{10} 24 hour emission for the March 21, 2004, design day, ADEQ staff multiplied the total agricultural land area subject to wind erosion by the number of hours of wind by the windblown dust emission factor to determine the total windblown dust (tons/day) for the Rillito Study area. Agricultural fields are considered to be vulnerable to wind erosion when the topsoil has been disturbed (e.g., by tilling) and before the crop is tall enough to shield the soil from wind. However, irrigation and the development of a crust on the soil (in the Rillito PM_{10} Study Area) during the month a crop is planted will reduce wind erosion.

The fields for some crops are tilled after harvest, while other crops are not tilled until shortly before planting. This is reflected in the crop calendar. University of Arizona Cooperative Extension Service provided the information on the typical months for wind erosion for the crops present in the Rillito PM_{10} Study Area.

Summary

Of the six design days selected by the Evaluation Unit, following are the design days that have either potential agricultural tillage or harvesting activity.

- March 21, 2004 - agricultural tillage activity
- April 29, 2004 - agricultural planting activity
- October 13/14, 2004 - harvesting activity

Sources of Data:

- Year 2004 surface area of agricultural land from QuickBird and IKONOS satellite images digitized by ADEQ
- Year 2004 surface area of agricultural land from 2004/2005 field trips by ADEQ

Methodology for Calculating Agricultural Land Conversion:

- The amount of agricultural land in the Rillito PM10 Study Area was determined for Years 2003 through 2005 through satellite image analysis, field surveys, and discussions with the University of Arizona Cooperative Extension Service staff.

The daily emissions have been summarized and are tabulated in Table 3.

Table 3 - Rillito Nonattainment Area Daily Emissions (tons/day) Design day March 21, 2004			
		All sources	**Vehicular**
Onroad Mobile			
(Mobile6.2 including: exhaust, brakes and tires)			
Primary Emission	0.143		
Secondary Emission	0.240		
Subtotal		**0.383**	**0.383**
Nonroad Mobile			
Lawn & Garden	0.013		
Aircraft	0.030		
Railway Maintenance	0.000		
Airport Service	0.000		
Locomotive	0.034		
Recreational	0.000		
Commercial	0.003		
Construction	0.037		
Subtotal		**0.119**	
Fugitive PM10 Emissions from On-road Mobile Sources			
Paved roads	0.933		
Unpaved roads	1.325		
Unpaved shoulders	0.498		
Trackout	0.285		
Subtotal		**3.041**	**3.041**
Windblown Dust March 21, 2004			
Agricultural Fields (bare)	921.6		
Alluvial Area	14.4		
Subtotal		**936.0**	
Cement Plant			
	1.317		
Subtotal		**1.317**	
TOTAL		**940.9**	**3.424**

References

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Arizona Agricultural Statistics Service, 2001. *2001 Arizona Agricultural Statistics Bulletin,* July 2002. (http://www.nass.usda.gov/az/)

Fish and Clay, 2003. Meeting with Jeannette Fish, Maricopa County Farm Bureau, and Patrick Clay, University of Arizona Cooperative Extension, with Randy Sedlacek, Phil DeNee, Darlene Jenkins, ADEQ. May 21, 2003.

URS and ERG. *Technical Support Document for Quantification of Agricultural Best Management Practices.* June 18, 2001, 2001. Prepared for Arizona Department of Environmental Quality, ADEQ Contract No. 98-0159-BF, Task Assignment No. 00-0210-01.

APPENDIX C.3
2004 On-Road Mobile Source PM_{10} Emissions Inventory
for the Rillito Nonattainment Area

INTRODUCTION

This paper documents how the PM_{10} emissions from on-road mobile sources in Rillito Nonattainment Area were quantified.

Methodology

EPA's MOBILE6 model was used to calculate the emission factors. MOBILE6 requires a variety of input parameters, such as meteorological conditions, fuel properties, and vehicle information. Each required parameter can be found in Table 1 along with its value and estimation method. It also can be seen from Table 1 that the calculation requires a lot of information reported in the Highway Performance Monitoring System (HPMS).[1] HPMS is a database containing system information on all public roads in the country. The information includes road classifications, speed limit, surface type, shoulder type, and average annual daily traffic (AADT). As many as 31 fields for all the road segments in Rillito Nonattainment Area were extracted from 2004 HPMS database. There are 181 public road segments in the area.

Sensitivity Analysis

Before compiling the contents in Table 1, several sensitivity analyses were conducted to investigate the effects of temperature, fuel properties (Reid Vapor Pressure – RVP, oxygen content, gasoline and diesel sulfur level), Inspection/Maintenance programs, vehicle speed, and vehicle registration distribution on the PM_{10} emissions from onroad mobile vehicles. The conclusions from this study are as follows:

- PM_{10} emissions are insensitive to the changes in temperature, fuel RVP and oxygen content. The presence of I/M programs does not influence the emissions either.

- The emissions vary with the sulfur content in gasoline or diesel. Higher sulfur content will lead to higher emissions.

- Vehicle registration distribution influences the emissions. Maricopa County has a newer fleet than Pima County. For example, in 2005, 36.7% of vehicles in Maricopa County were less than 5 years old, but 30.8% in Pima County; 5.8% of vehicles in Maricopa County were aged 20 and older, but 10.0% in Pima County.[2] Fleets with a higher percentage of older vehicles tend to produce higher emissions because older vehicles have more miles and their emission control systems are not as effective as newer ones.

- Vehicle speed influences the level of emissions. In general, PM_{10} emissions drop as speed increases; however, this occurs only if the speed is between certain ranges. MOBILE6 defines two speed bins: 19.6 miles/hr and 34.8 miles/hr. [3] If the speed stays constantly below 19.6 miles/hr or over 34.8 miles/hr, the PM_{10} emissions will not change with speed.

Table 1 - MOBILE6 Input Analysis for Rillito Nonattainment Area		
Parameter	Value	Notes
Pollutants	PM_{10}	
Calendar year	2004	
Month of evaluation	--	Not necessary since season does not affect PM_{10} emissions.
Altitude	Low	Average elevation of Marana is 2561 ft[3]. Although a small portion of the study area in the mountains exceeds 4000 ft, e.g., 4550 ft around (32°16'23", 111°09'), low altitude was selected, which is consistent with the recommendation by EPA.[3]
Min/Max temperature	55.85/84.16°F	No influence on PM_{10} emissions. Average values for the whole year were chosen.
Humidity	--	Not included since it has no influence on PM_{10} emissions.
Barometric pressure	--	Not included since it has no influence on PM_{10} emissions.
Refueling	None	Only Area A (Phoenix) requires Stage II Refueling in Arizona.
Average percent cloud over, period of peak sun,	MOBILE6 default	EPA recommends using national averages for SIP purposes.[3]
Sunrise/sunset time	--	Not included since it has no influence on PM_{10} emissions.
Age distribution of vehicle registration	Pima County's January 2004 vehicle registration[5]	The vehicles traveling in the nonattainment area can come from local area (Pima County), other counties in the state such as Maricopa County, or even from other states. Majority of the non-local vehicles are from Maricopa County. Pima County has an older fleet than Maricopa County. An older fleet tends to emit more PM_{10} according to the sensitivity analysis. To be conservative, Pima County's vehicle registration is used to determine the vehicle registration distribution in the nonattainment area.
Annual mileage accumulation rate	MOBILE6 default	EPA recommends using national default if local data is unavailable.[3]
Diesel fractions	Local information[5] + national default[6]	MOBILE6 requires 350 diesel fractions for 25 ages of 14 composite vehicle types. Diesel fractions of light duty vehicles and bus were obtained from Motor Vehicle Division's vehicle registration report directly.[5] National default values were used for other 12 vehicle types.[6]
Natural gas vehicle	--	Neglect since the fraction is low.

VMT by vehicle class	Based on HPMS database[1]	EPA expects states to develop local estimates.[3] HPMS reports percentages of AADT by single truck unit (25 ~ 50 feet) and multi-truck unit (>50 feet). Vehicles longer than 25 feet are considered as heavy duty vehicles.[7] Based on this information, the split over light duty and heavy duty can be determined.
VMT by facility	--	Not necessary since each link or (similar links) will be modeled separately.
VMT by hour	MOBILE6 default	States may choose to use the default values instead of developing local values.[3] If local data is difficult to obtain, MOBILE6 defaults can be used.
VMT by speed	--	EPA expects states to develop local estimates.[3] At a minimum speeds should be estimated separately by roadway function class using 'Average Speed'.
Average speed		Average speed for each link was estimated based on the information in HPMS database. For all freeways, it is assumed that the average speed is 60 miles/hr; For arterials/collectors/rural local, the speed is assumed to be 35 miles/hr; For urban local roads, the speed is set to 12.9 miles/hr by MOBILE6; For unpaved roads, the speed is assumed to be 15 miles/hr.
Idle emission rates	--	Not necessary.
Vehicle engine starts per day, by hour of the day, vehicle soak time between engine starts, vehicle soak time after engine shut down, vehicle diurnal soak time, vehicle trip length (duration) distributions	MOBILE6 default	Local data is unavailable and they have negligible effect on overall emissions.
Weekday and weekend day activity	MOBILE6 default	Not necessary and local data is unavailable.
Fuel RVP	10.87 psi	It is a required input although it has no influence on PM_{10} emissions. Fuel properties were obtained from the 2004 inspection report provided by the Arizona Department of Weights and Measures.[8] Average value was chosen.

Fuel oxygen content	--	Not included since it has no influence on PM_{10} emissions.
Gasoline sulfur content	130.32 ppm	Average value was chosen.[8]
Diesel sulfur content	326.33 ppm	Average value was chosen.[8]
Inspection/Maintenances program Anti-tampering	--	Not included since it has no influence on PM_{10} emissions.

VMT by Vehicle Class

This input, VMT by vehicle class, is used to allocate VMT to 16 specific vehicle types. These 16 vehicle types can be found in Table B.1 in MOBILE6 User's Guide.[6] As mentioned in Table 1, EPA expects states to develop local estimates.[3] HPMS database[1] obtained from the Arizona Department of Transportation lists the percentages of annual average daily traffic counts (AADT) of single truck unit (25 ~ 50 feet) and multi-truck unit (> 50 feet) for several road segments. All single truck unit and multi-truck unit are considered as heavy duty vehicles; the rest (< 25 feet) are considered light duty vehicles, including motorcycles and light duty trucks.[1] MOBILE6 Technical Guidance[3] describes the method to calculate the VMT fraction for each vehicle type. Assume the percentage of heavy duty vehicles is x and that of light duty vehicles is (1-x). The calculations are as follows,

VMT fraction of each light duty type = national default of VMT fraction for this type * (1-x) / national default of percentage of light duty vehicles

VMT fraction of each heavy duty type = national default of VMT fraction for this type * x / national default of percentage of heavy duty vehicles

The national default of VMT fraction for each vehicle type can be found in Table 2.

Table 2. National Default VMT Fraction for Each Vehicle Type

Vehicle type	VMT fraction	Description
LDV	0.4858	Light duty vehicles (passenger cars)
LDT1	0.0671	Light duty trucks 1
LDT2	0.2230	Light duty trucks 2
LDT3	0.0690	Light duty trucks 3
LDT4	0.0321	Light duty trucks 4
HDV2b	0.0383	Class 2b heavy duty vehicles
HDV3	0.0038	Class 3 heavy duty vehicles
HDV4	0.0029	Class 4 heavy duty vehicles
HDV5	0.0022	Class 5 heavy duty vehicles
HDV6	0.0083	Class 6 heavy duty vehicles
HDV7	0.0099	Class 7 heavy duty vehicles
HDV8a	0.0109	Class 8a heavy duty vehicles
HDV8b	0.0389	Class 8b heavy duty vehicles
HDBS	0.0019	School buses
HDBT	0.0009	Transit and urban buses
MC	0.0051	Motorcycles

HPMS database does not provide the percentages of AADT of single truck unit and multi-truck unit for all the road segments. There are totally 181 road segments in the HPMS database in the nonattainment area. Only a handful of 20 segments have the information to directly determine VMT fractions. A lot of segments among those 20 segments share the same VMT fractions. There are 5 different sets of VMT fractions. VMT by vehicle type class (A, B, C, D, or E) is used to denote these different sets of VMT fractions. For other roads, satellite images were used to determine their locations and VMT by vehicle class of an adjacent road was assigned.

MOBILE6 Cases and Emission Factors

Each of the 181 road segments in the nonattainment area was modeled separately by MOBILE6.

After inspecting the HPMS database, it was discovered that there are 5 different combinations of VMT by vehicle class and 3 different roadway types. All the estimated speeds can be classified into two categories: > 34.8 miles/hr and < 19.6 miles/hr. Since PM_{10} emissions do not vary with speed when speed is below 19.6 miles/hr or over 34.8 miles/hr, only two speeds should be simulated in MOBILE6, 35 miles/hr (> 34.8 miles/hr, high speed) and 15 miles/hr (< 19.6 miles/hr, low speed). Along with combinations of VMT by vehicle class and roadway types, 12 different cases should be run to generate emission factors as shown in Table 3. The five combinations of VMT by vehicle class are denoted as A, B, C, D and E. The emission factors of both primary PM_{10} and total PM_{10} (including secondary PM_{10}) for each case are also shown in this table.

Table 3.MOBILE6 Cases and Emission Factors

Case ID	Description	Emission Factor – Primary (g/mile)	Emission Factor – Total (g/mile)
111	High speed, VMT-A, Freeway	0.125	0.3046
113	High speed, VMT-A, Arterial	0.125	0.3046
123	High speed, VMT-B, Arterial	0.0766	0.2323
133	High speed, VMT-C, Arterial	0.0437	0.1833
143	High speed, VMT-D, Arterial	0.0538	0.1984
153	High speed, VMT-E, Arterial	0.0716	0.2248
213	Low speed, VMT-A, Arterial	0.1254	0.3049
223	Low speed, VMT-B, Arterial	0.0772	0.2328
233	Low speed, VMT-C, Arterial	0.0444	0.1838
242	Low speed, VMT-D, Local	0.0545	0.1989
243	Low speed, VMT-D, Arterial	0.0545	0.1989
253	Low speed, VMT-E, Arterial	0.0722	0.2253

Calculation of Exhaust, Tire and Brake Wear Emissions from All Road Segments Reported by HPMS Database

For each link, HPMS database reports its AADT and length. Thus, the daily VMT of each link can be calculated by the following equation:

Daily VMT = Link length * Link AADT

Then, the emissions from each link are calculated as follows:

Daily PM_{10} emissions for each link = Daily VMT * Emission factor

HPMS database does not report AADT for all road segments. For example, the AADTs of some segments of I-10 frontage road were not reported. In this case, the average of 10 known AADTs from the I-10 frontage roads was used. The AADTs of some secondary road segments were not reported. Ten percent rule was employed here to estimate the AADTs of those roads; that is, 10% of AADT from an adjacent primary road. HPMS database reports AADT ranges for some segments and medium values were assumed for these segments.

The total PM_{10} emissions from HPMS reported roads are the sum of emissions from all the links in the nonattainment area. The primary PM_{10} emissions from HPMS reported road segments are calculated to be **0.141 tons/day**. The total PM_{10} (including secondary PM_{10}) are **0.373 tons/day**.

Calculation of Exhaust, Tire and Brake Wear Emissions from Road Segments not Reported by HPMS Database

After inspecting the HPMS database, it was discovered that some roads were not reported in the database. The majority of those roads are local ones in the residential area. The traffic on those roads was estimated using population.

In 2004, the estimated Pima County population was 931,835.[9] The number of private vehicles in 2004 was 580,130.[5] The ratio of the number of private vehicles to population is 0.623. That means, out of 1000 people, 623 own a vehicle.

It was estimated that the 2004 population of the nonattainment area was 45,600.[10] The number of vehicles owned by the residents in the Non-Attainment Area is then 45,600 × 0.623 = 28,409.

It is assumed that each vehicle would travel 4 times and average 0.5 miles from local residential roads to adjacent major roads or from adjacent major roads to local residential roads. Thus, the vehicle miles traveled can be calculated by the following equation,

Daily VMT = 28,409 × 4 (trips/day) × 0.5 (mile/trip) = 56,818 miles

MOBILE6 model was run to generate the emission factor. All the input parameters are same as those listed in Table 1 except VMT by vehicle class and average speed. It is assumed that the all the VMTs are generated by light duty vehicles. The average speed is assumed to be 15 miles/hr.

The primary PM_{10} emission factor is 0.0293 gram/mile and the total PM_{10} (including secondary PM_{10}) emission factor is 0.1611 gram/mile.

The primary PM_{10} emissions from those road segments not reported in HPMS database is,

56,818 (miles/day) × 0.0293 (gram/mile) / 1000000 (grams/tons) = .**002 tons/day**.

The total PM_{10} (including secondary PM_{10}) emissions from those road segments not reported in HPMS database is,

56,818 (miles/day) × 0.1611 (gram/mile) / 1000000 (grams/tons) = **.009 tons/day.**

Results and Discussions

The total primary PM_{10} emissions are calculated to be **0.143 tons/day**. The total primary and secondary PM_{10} emissions are **0.383 tons/day**. This number was checked against the 2000 emissions inventory developed by Pima Association of Governments (PAG).[11] PAG developed a 2000 on-road mobile source emissions inventory for Tucson Air Planning Area. The total PM_{10} emissions are 401.1 tons/yr for calendar year 2000. Rillito Nonattainment Area is part of Tucson Air Planning Area. The value of total PM_{10} emissions calculated for Rillito Nonattainment Area is reasonable in terms of magnitude compared to that of Tucson Air Planning Area.

Reference

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2. Arizona Department of Transportation, January 2005 MVD Vehicle Registration Report, 2005.
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8. Arizona Department of Weights and Measures, 2004 Pima County Fuel Inspection Report, 2004.
9. Arizona Department of Economic Security, July 1, 2004 Population Estimates for Arizona's Counties, Incorporated Places and Balance of County, February 2007.
10. David Lillie, 2004 Population in Rillito Nonattainment Area, 2007.
11. Pima Association of Governments, 2000 On-Road Mobile Source Emissions Inventory, September 2004.

APPENDIX C.4
2004 Fugitive PM_{10} Emissions from On-road Mobile Sources for the Rillito Nonattainment Area

The fugitive emissions include re-entrained road dusts from paved roads and unpaved roads, trackout onto the paved roads and unpaved shoulders of paved roads due to vehicle traveling. They are usually calculated using the methodologies outlined in Chapter 13 of AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Source.[1,2] The fugitive emissions must be calculated separately for paved and unpaved roads. The calculation for each category will be described next.

There is a field in HPMS (Highway Performance Monitoring System) database[3] that specifies the type of road surface, such as unpaved, low type, intermediate type, and high type flexible. HPMS database does not provide this information for all the road segments in the nonattainment area. Only 43 road segments have this value specified. For the rest of the road segments, satellite images were utilized to determine whether the road was paved or unpaved before the calculations were performed.

Paved roads:

The equation[1] to calculate reentrained emissions on paved road is:

$$E = k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C \qquad (1)$$

k is the particle size multiplier and is 7.3 grams/VMT.[1]

sL is the road silt loading (g/m^2). sL for different roads is estimated based a study[4] conducted by Engineering Science in 1987. A total of 9 samples were collected at different locations in Pima County, and their silt loadings were measured. The silt loading ranges between 0.02 and 1.82 grain/ft^2 as shown in Table 1.

It was observed during the field survey that the freeway (I-10) was very clean. The silt loading should be similar to that of a clean arterial, which is assumed to be 0.020 g/m^2. For other roads in the study area, average of 5 samples excluding top two and bottom two, 0.085 g/m^2, was used as the average silt loading.

W is the average weight (tons) of the vehicles traveling on the roads. It can be estimated by the vehicle mix traveling on the roads. HPMS reports percentages of AADT by single truck unit (25 ~ 50 feet) and multi-truck unit (>50 feet). Vehicles longer than 25 feet are considered as heavy duty vehicles.[3] Based on this information, the split over light duty and heavy duty can be determined. It is then assumed that the average weight of light duty vehicles is 2 tons and that of heavy duty vehicles is 10 tons. Thus,
W = 2 tons × percentage of light duty vehicles + 10 tons × percentage of heavy duty vehicles.

Table 1. Paved Street Silt Loading Measurement Results in Pima County[4]			
Location	**Street Type**	**Silt Loading (grain/ft^2)**	**Silt Loading (gram/m^2)**
6th Ave. at 28th St.	Collector	1.82	1.269
Speedway Blvd., E of Pantano	Arterial	0.57	0.398
22nd St., E. of Camino Seco	Arterial	0.04	0.028
Amklam Rd. near St. Mary's Road	Collector	0.02	0.014
Fort Lowell Rd., E. of Alvernon Way	Arterial	0.16	0.112
Oracle Rd., S. of Kanmar Pl.	Arterial	0.02	0.014
Ina Rd., E. of La Cholla Blvd.	Arterial	0.03	0.021
Orange Grove, E. of Camino de la Tierra	Arterial	0.23	0.160
La Canada, N. of Orange Grove	Arterial	0.15	0.105

HPMS database does not provide the percentages of AADT of single truck unit and multi-truck unit for all the road segments. There are totally 181 road segments in HPMS database[3] in the nonattainment area. Only a handful of 20 segments have the information to directly determine average weight. For other roads, satellite images were used to determine their locations and average weight of vehicles from an adjacent road was assigned.

C is the emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear. Its value is 0.2119 grams/VMT.[1]

The emission factor should be adjusted based on precipitation,

$$E = \left[k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C \right]\left(1 - \frac{P}{4N}\right) \qquad (2)$$

where P is the number of wet days with at least 0.254 mm of precipitation during the average period, and N is the number of days in the averaging period.

It was assumed that no control measures were implemented to reduce re-entrained road dust.

According to the measurements by AZMET – Marana Station,[5] in 2004, there was an average of 35 days with precipitation over 0.254 mm. Thus, P is 35 and N is 366.

The emissions from each road segment reported in HPMS database was calculated and then aggregated into the total emissions. The total emissions are **0.916 tons/day**.

For the roads that were not reported in HPMS database, it was determined during the field survey that the majority of those roads were the local roads in the residential areas. The VMT generated on those roads were due to private vehicles traveling from residents to major roads or from major

roads to residents. It was then assumed that each private vehicle would travel 4 times each day and 0.5 miles each time on those roads. Thus, the daily VMT generated by each vehicle is 2 miles.

In 2004, the estimated Pima County population was 931,835.[6] The number of private vehicles in 2004 was 580,130.[7] The ratio of the number of private vehicles to population is 0.623. That means, out of 1000 people, 623 own a vehicle.

It was estimated that the 2004 population of the nonattainment area was 45,600.[8] The number of vehicles owned by the residents in the nonattainment area is then 45,600 × 0.623 = 28,409.

Thus, the vehicle miles traveled can be calculated by the following equation,

Daily VMT = 28,409 × 4 (trips/day) × 0.5 (mile/trip) = 56,818 miles

It was assumed that 99% percent of VMT was generated on paved local residential roads, thus the VMT on paved local residential roads was 56,250 miles. The emission factor was calculated using equation (2), in which the silt loading was assumed to be 0.085 g/m^2 and the average weight of vehicles was assumed to be 2 tons. The emission factor then is 0.298 g/mile. The PM_{10} emissions from paved local residential roads are **0.017 tons/day.**

Unpaved roads:

The following equation calculates the emission factor in lb/VMT for vehicles traveling on publicly accessible roads,

$$E = \frac{k\left(\frac{s}{12}\right)^a \left(\frac{S}{30}\right)^d}{\left(\frac{M}{0.5}\right)^c} - C \qquad (4)$$

k is particle size multiplier and is 1.8 lb/VMT.[2]

a, c and d are constants and their values are 1, 0.2 and 0.5.[2]

C is the emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear and it is 0.00047 lb/VMT.[2]

s is the surface material silt content (%). s for different roads is estimated based a study[4] conducted by Engineering Science in 1987. Six values of silt content from bulk sample measurements on unpaved roads in Pima County were presented in Table 2. The silt content ranges from 0.104% to 5.710%. The average excluding top one and bottom one is 3.51% and used as the average silt content.

Table 2. Unpaved Street Silt Content Measurement Results in Pima County[4]	
Location	**Silt Content (%)**
La Cholla Blvd. at Canada del oro	5.710
Lambert Lane, W. of La Canada	4.459
Kelting Drive	0.104
Panorama Road	4.363
El Moraga Drive	4.397
El Camino de la Tierra at Rillito Creek	0.826

S is the mean vehicle speed in mph. The mean speed was estimated for each road segment in the nonattainment area.

M is the surface material moisture content (%). It is assumed to be 0.64%.[4]

The equation above should also be adjusted based on precipitation,

$$E_{ext} = E\left(\frac{(365 - P)}{365}\right) \quad (5)$$

where P is the number of days in a year with at least 0.254 mm of precipitation. Since 2004 was a leap year, the above equation is revised to reflect this situation.

$$E_{ext} = E\left(\frac{(366 - P)}{366}\right) \quad (6)$$

The emission from each unpaved road segment was calculated and then aggregated into the total emissions. The total emissions are **1.249 tons/day**.

The same method as paved roads was used to calculate fugitive emissions from those unpaved local residential roads that were not reported in HPMS database. It was assumed that only 1% of VMT (568 miles) was generated on unpaved local residential roads. The emission factor was calculated using equation (4), in which the speed is assumed to be 15 miles/hr. The emission factor then is 160.523 g/mile. The total emissions from unpaved local residential roads are **0.076 tons/day**.

Unpaved shoulders:

Unpaved shoulders on paved roads were determined based on the information from HPMS database. The database provides a field called "shoulder type". Many of the road segments are marked as "no shoulders or curbs". Satellite images were further utilized to identify what was

the meaning of "no shoulders or curbs". A field trip was conducted to verify the observations from the satellite images. In conclusion, although many of the road segments are marked as "no shoulders or curbs", most of them have in fact unpaved shoulders and some of them have semi-stable shoulders although unpaved.

After all the road segments with unpaved and unstable shoulders were identified, the emissions for each segment were calculated using the following equation,

$$\text{Emissions from unpaved shoulders (tons/yr)} = \text{AADT} \times \text{Length of Unpaved Shoulder} \times \text{Emission Factor}_{\text{road shoulder}} \quad (7)$$

The emission factor was extracted from a study by Moosmuller.[9] This study reported that high profile vehicles, traveling at 50 ~ 60 mph, had a PM_{10} emission factor of 12.88 ± 6.44 grams/VMT. The emission factor for the overall fleet is then 12.88 × percentage of high profile vehicle. It was assumed that high profile vehicles were heavy duty vehicles. Therefore,

$$\text{Emission Factor}_{\text{road shoulder}} = 12.88 \times \text{percentage of heavy duty vehicles} \quad (8)$$

The percentage of heavy duty vehicles were determined based on HPMS database as discussed in the section of Paved Roads.

The emission from each road segments was then calculated using equation (7) and aggregated to the total emissions, which are, **0.498 tons/yr**.

Trackout

The emissions from trackout were documented in a separate document.[10] The total emissions from this category are **0.285 tons/yr**.

Summary
The emissions for each category and total emissions are organized in Table 3.

Table 3 - 2004 Fugitive PM_{10} Emission Inventory

Category		Emissions (tons/day)
Paved roads	HPMS reported roads	0.916
	Local residential roads	0.016
Unpaved roads	HPMS reported roads	1.250
	Local residential roads	0.076
Unpaved shoulders		0.50
Trackout		0.285
Total		**3.041**

Reference

1. US EPA, AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Source, Chapter 13.2.1, November 2006.
2. US EPA, AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Source, Chapter 13.2.2, November 2006.
3. Arizona Department of Transportation, HPMS Database, 2004.
4. Final Report for Collection and Reduction of PM_{10} Emissions Inventory Data for the Maricopa and Pima Planning Areas, Engineering-Science, 1987.
5. Arizona Meteorological network, http://ag.arizona.edu/azmet/.
6. Arizona Department of Economic Security, July 1, 2004 Population Estimates for Arizona's Counties, Incorporated Places and Balance of County, February 2007.
7. Motor Vehicle Division, Arizona Department of Transportation, 2004 Vehicle Registration Report, 2004.
8. David Lillie, 2004 Population in Rillito Nonattainment Area, 2007.
9. Moosmuller et al., Particle Emission Rates for Unpaved Road Shoulders along a Paved Road, J. Air & Waste Management Associate, 48, 398 ~ 407, 1998.
10. Hui Chen, 2004 PM_{10} Emissions from Trackouts in Rillito Non-Attainment Area, 2008.

APPENDIX C.5
2004 PM_{10} Emissions from Trackout in the Rillito Nonattainment Area

Identification of Trackout

Trackout was identified using satellite images and verified during the field trip. During the field trip, it was observed that most of the trackout was from rural residential areas, agricultural areas, and construction areas. Numerous trackout was observed at a residential construction site. However, most of the trackout took place within the boundaries of the construction site where traffic was minimal. Little trackout occurred on public roads. In some rural residential areas, several access roads are unpaved and many of the homes do not have a paved driveway, causing trackout at almost every exit to paved public roads.

Observations for each township and range are organized as follows.

[11S 9E] The section is in an undeveloped mountainous area, where traffic is negligible.

[11S 10E] The categories and amount of trackout are shown in the following tables. The annual average daily traffic (AADT)[1] and VMT by vehicle class[2] are also featured in these tables.

Table 1 - Trackout in 11S, 10E

Road	Trackout Category	VMT by Vehicle Class	AADT	Incidence of Trackout
Trico Road Trico Marana ~ Hardin	Agricultural	C	999	2
Trico Road Trico Marana ~ Avra Valley	Private	C	999	2
Trico Marana Road Trico ~ Marana	Agricultural Private	C	2260	2 1
Silverbell Road Marana TB ~ Trico	Industrial	D	399	1
Silverbell Road Trico ~ Aguirre	Private	D	399	3
El Tiro Road Cicio ~ Anway	Private	D	540	4
El Tiro Road Anway ~ Trico	Private	D	540	3
Anway Road Avra Valley ~ El Tiro	Private	C	645	8

[11S 11E]

Table 2 - Trackout in 11S, 11E				
Road	**Trackout Category**	**VMT by Vehicle Class**	**AADT**	**Incidence of Trackout**
Luckett Road Imogene Pl ~ Marana Road	Agricultural	C	350	8
Sanders Road Marana ~ Moore	Agricultural	C	2782	7
Sanders Road Moore ~ Silverbell	Private Agricultural	C	2782	4 2
Marana Road I-10 frontage ~ Sanders	Private Agricultural	C	2181	3 1
Marana Road Sanders ~ Luckett	Private Agricultural	C	2181	4 1
Grier Road I-10 front ~ Sandario	Industrial	C	934	2
Grier Road Sandario ~ Sanders	Agricultural Private	C	934	3 3
Grier Road Sanders ~ Wentz	Agricultural Private	C	934	4 1
Barnett Road I-10 frontage ~ Sandario	Private	B	543	1
Barnett Road Sandario ~ Sanders	Construction Agricultural	B	543	1 1
Moore Road I-10 frontage ~ Postvale	Agricultural	B	870	2
Moore Road Postvale ~ Sanders	Agricultural Construction	B	870	1 2
Tangerine Road I-10 frontage ~ Postvale	Agricultural Industrial	B	1200	3 1
Sandario Road Moore ~ Barnett	Construction	B	2782	1
Sandario Road Moore ~ Silverbell	Construction	B	2782	4
Sandario Road Barnett ~ Grier	Private Agricultural	B	900	3 3
Sandario Road Grier ~ Marana	Private	B	900	4

[11S 12E]

Table 3 - Trackout in 11S, 12E				
Road	**Trackout Category**	**VMT by Vehicle Class**	**AADT**	**Incidence of Trackout**
Dove Mountain Blvd Tangerine ~ Gallery Canyon	Construction	B	662	4

[12S, 8E and 12S, 9E]

Table 4 - Trackout in 12S, 8E and 12S, 9E				
Road	**Trackout Category**	**VMT by Vehicle Class**	**AADT**	**Incidence of Trackout**
Avra Valley Road Begin/End/Culdesac ~ Pump Station	Industrial	B	5761	2

[12S, 10E]

Table 5 - Trackout in 12S, 10E				
Road	**Trackout Category**	**VMT by Vehicle Class**	**AADT**	**Incidence of Trackout**
Avra Valley Road Pump Station ~ Trico	Private	B	5761	3
Avra Valley Road Trico ~ Sanders	Private Agricultural	B	4961	2 3
Anway Road Manville ~ Avra Valley	Agricultural	C	430	4
Anway Road Avra Valley ~ El Tiro	Commercial Private	C	645	1 7
Trico Road Avra Valley ~ El Tiro	Private	C	999	1

[12S, 11E]

Table 6 - Trackout in 12S, 11E				
Road	**Trackout Category**	**VMT by Vehicle Class**	**AADT**	**Incidence of Trackout**
Avra Valley Road Trico ~ Sanders	Agricultural	B	4961	6
Avra Valley Road Sanders ~ Sandario	Private	B	6515	1
Avra Valley Road Sandario ~ Airline	Agricultural Industrial	B	7059	3 1
Twin Peaks Road Clayton ~ Sanders	Agricultural	E	648	3
Twin Peaks Road Sanders ~ Sandario	Agricultural	E	648	2
Twin Peaks Road Sandario ~ Silverbell	Agricultural	E	10718	3
Sanders Road Avra Valley ~ Silverbell	Agricultural	C	2782	1
Sanders Road Silverbell ~ Moore	Agricultural	C	2782	5
Sandario Road Ina ~ Emigh	Private Agricultural Commercial	B	5732	1 2 1
Sandario Road Ina ~ Picture Rock	Private	B	5732	1

[12S 12E]

Table 7 - Trackout in 12S, 12E				
Road	**Trackout Category**	**VMT by Vehicle Class**	**AADT**	**Incidence of Trackout**
Tangerine Road I-10 frontage ~ El Camino De Manana	Agricultural Private Industrial	B	6622	3 3 3
I-10 frontage	Agricultural	D	1496	4
Silverbell Road Lambert ~ Coachline	Private Industrial Agricultural	D	6776	5 2 1
Silverbell Road Coachline ~ Twin Peaks	Private	D	6776	3
Silverbell Road Cortaro ~ Ina	Construction	D	9269	2
Cortaro Road I-10 frontage ~ Ina	Industrial Private	E	1700	1 2
Wade Road Ina ~ Picture Rock	Private	E	7552	4
Twin Peaks Road Silverbell ~ Sandario	Agricultural Private Industrial	E	10718	2 1 1
Ina Road Cortaro ~ Wade	Private	E	4400	3
Ina Road Wade ~ Artesiano	Private	E	4400	5
Camino De Oeste Road Cortaro Farm ~ Linda Vista	Construction Private	B	9500	1 1
Camino De Oeste Road Linda Vista ~ Turkey	Private	B	1398	10
Cortaro Farm Road Hartman ~ Camino De Oeste	Private	E	17165	2
Hartman Lane Cortaro Farm ~ Linda Vista	Construction Private	E	1000	4 2
Linda Vista Blvd Marana TB ~ Hartman	Private Industrial	E	522	3 1
Linda Vista Blvd Hartman ~ Camino De Oeste	Private	E	1600	1

Emission Calculation

The calculation of PM_{10} emissions from trackout followed the procedures outlined in PM_{10} State Implementation Plan for the Salt River Area.[3] The emission factors were calculated using the equations from AP-42[4] shown as follows,

$$E = \left[k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C \right]\left(1 - \frac{P}{4N}\right) \quad (1)$$

k is the particle size multiplier and is 7.3 grams/VMT.[4]

sL is the road silt loading (g/m^2). sL for each trackout category was estimated based on the study[3] conducted for Salt River SIP in 2005.

W is the average weight (tons) of the vehicles traveling on the roads. It can be estimated by the vehicle mix traveling on the roads. HPMS database reports the percentages of AADT (annual average daily traffic) by single truck unit (25 ~ 50 feet) and multi-truck unit (>50 feet). Vehicles longer than 25 feet are considered as heavy duty vehicles[1]. Based on this information, the split over light duty and heavy duty can be determined. It is then assumed that the average weight of light duty vehicles is 2 tons and that of heavy duty vehicles is 10 tons. Thus,

W = 2 tons × percentage of light duty vehicles + 10 tons × percentage of heavy duty vehicles

HPMS database does not provide the percentages of AADT of single truck unit and multi-truck unit for all the road segments. There are totally 181 road segments in HPMS database[1] in the nonattainment area. Only a handful of 20 segments have the information to directly determine the average weight. For other roads, satellite images were used to determine their locations and average weight of vehicles from an adjacent road was assigned.

C is the emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear. Its value is 0.2119 grams/VMT.[1]

P is the number of wet days with at least 0.254 mm of precipitation during the average period, and N is the number of days in the averaging period. According to the measurements by AZMET – Marana Station,[5] in 2004, there was an average of 35 days with precipitation over 0.254 mm. Thus, P is 35 and N is 366.

The emissions from trackout for each involved road segment were then calculated by equation (2). Table 8[3] shows the trackout distance and silt loading for each trackout category.

Emissions (tons/yr) = Emission Factor × AADT × Trackout Distance × Incidence of Trackout × 0.000621371 mi/m × 1ton/1000000 grams (2)

Then the total emissions are the sum of those emissions from all involved road segments, which were calculated to be **0.285 tons/day**.

Table 8 - Trackout Distance and Silt Loading for Each Trackout Category		
Trackout Category	**Distance (m)**	**Silt Loading (g/m^2)**
Agricultural	100	1.90
Construction	200	1.67
Industrial	200	3.06
Private	50	0.75
Commercial	50	1.08

References

1. Arizona Department of Transportation, HPMS database, 2004.
2. Hui Chen, 2004 On-Road Mobile Source PM_{10} Emissions Inventory for Rillito Non-Attainment Area, 2008.
3. Arizona Department of Environmental Quality, Revised PM_{10} State Implementation Plan for the Salt River Area, Technical Support Document, June 2005.
4. US EPA, AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Source, Chapter 13.2.1, November 2006.
5. Arizona Meteorological network, http://ag.arizona.edu/azmet/.

APPENDIX C.6
WINDBLOWN DUST FROM AGRICULTURAL FIELDS

Estimation of Windblown PM10 Emissions from Bare Agricultural Fields in the Rillito PM10 Study Area

Following is a description of the methods and data used to estimate PM10 emissions from wind erosion of agricultural land in the Rillito PM10 Study Area.

Identification of Crops

The types of crops and the locations of the fields in the Rillito PM10 Study area were identified through a number of steps:

1. Field surveys – ADEQ staff located agricultural fields and identified some of the crop types using printouts of gridded satellite images (QuickBird and IKONOS, 2003/2004) of the Rillito PM10 Study Area.

2. Digitizing – ADEQ staff digitized the following crop areas on the gridded satellite images of the Rillito PM10 Study Area based on the field surveys done by ADEQ staff (see Figure 1):
   - Cotton was the major crop grown in all fields in the Rillito PM10 Study Area
   - Oats/wheat (Haylage), Alfalfa and Pasture represent a miniscule portion of the crops

3. GIS was used to calculate the area (square meters) of each of the above crop types in each grid cell of the Rillito PM10 Study Area.

Crop Calendar

A crop calendar (see Table 1) was developed to show the time period that agricultural tillage and harvesting occurred in the Rillito PM10 Study Area. The calendar was based on the following:

- Meeting with University of Arizona Cooperative Extension Service.
- ADEQ's analysis of aerial photography book for 2002/2004 ("Real Estate Photo Book for Tucson", Landiscor Aerial Information, 1710 East Indian School Road, Phoenix, AZ 85016, Phone: 602-248-8989) to define the months when the land use transition occurred.
- University of Arizona Cooperative Extension Service website on crop budgets
- (http://www.ag.arizona.edu/arec/ext/budgets/Maricopa-map.html)

Agricultural Tillage and Harvest Days

The design days selected by ADEQ for 24 hour ambient PM10 concentrations in the Rillito PM10 Study Area were compared to the previously mentioned crop calendar (Table 1) to determine which design days may have had open agricultural fields.

Following are the high wind design days that were compared to the crop calendar:

- Primary Design Days
  - March 21, 2004
  - April 29, 2004
- Optional Design Days
  - July 17, 2004
  - August 1, 2004
  - September 25, 2004
  - October 13/14, 2004

After reviewing the crop calendar, it was found that March 21, 2004 was the only design day that had a potential for open agricultural fields and high winds. The major crop that may have had open fields was cotton.

Table F-1 Year 2004 Crop Calendar for Rillito PM10 Study Area

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Cotton												
Oats (Haylage)												
Pasture/Alfalfa												
Alfalfa/Oats												
Alfalfa												
Pasture												
Design Days (red = high wind day)			**3/21/04**	4/29/04								
Design Days – Optional							**7/17/04**	**8/1/04**	9/25/07	10/13/04 10/14/04		

Legend:

Source of Data:
- o Meeting with U of A Cooperative Extension
- o Phone Calls with U of A Cooperative Extension

Note: Wind erosion during planting months is reduced due to irrigation keeping topsoil moist. Harvesting crop as haylage produces minimal emissions since crop is harvested green. May not landplane every year.

Tilling = Planting = Crop in Field = Harvest =

Wind Erosion from Agriculture

The two high wind design days (total high wind design days = 6) were compared to the crop calendar (Table 1) to determine which of these days have a potential for wind erosion of agricultural land and for which crops. The March 21, 2004 and April 29, 2004 design days have a potential for wind erosion of agricultural fields with cotton. The primary drawback from using the April 29, 2004 day is the fact that the cotton plants may be sufficiently tall to provide cover for the soil. This is also the case for the October 13/14, 2004, optional design day, since the crop calendar indicates that this is the time frame for harvesting thus there would be sufficient standing plant material to provide cover for the soil. In addition, the October 13/14, 2004 optional design day has a potential for wind erosion of agricultural fields with oats and other grains because it is in the time window for tilling/planting. It turns out that there are only two small fields in which grain oats or wheat had been planted.

In order to compute the PM10 24 hour emission for the March 21, 2004 design day, ADEQ staff multiplied the total agricultural land area subject to wind erosion by the number of hours of wind by the windblown dust emission factor to determine the total windblown dust (tons/day) for the Rillito Study area. Agricultural fields are considered to be vulnerable to wind erosion when the topsoil has been disturbed (e.g., by tilling) and before the crop is tall enough to shield the soil from wind. However, irrigation and the development of a crust on the soil (in the Rillito PM10 Study Area) during the month a crop is planted will reduce wind erosion.

The fields for some crops are tilled after harvest, while other crops are not tilled until shortly before planting. This is reflected in the crop calendar. University of Arizona Cooperative Extension Service provided the information on the typical months for wind erosion for the crops present in the Rillito PM10 Study Area.

Summary

Of the six design days selected by the Evaluation Unit, following are the design days that have either
potential agricultural tillage or harvesting activity in the Salt River PM10 Study Area:

- March 21, 2004 - agricultural tillage activity
- April 29, 2004 - agricultural planting activity
- October 13/14, 2004 - harvesting activity

Sources of Data:

- Year 2004 surface area of agricultural land from QuickBird and IKONOS satellite images digitized by ADEQ

- Year 2004 surface area of agricultural land from 2004/2005 field trips by ADEQ

Methodology for Calculating Agricultural Land Conversion:

- The amount of agricultural land in the Rillito PM10 Study Area was determined for Years 2003 through 2005 through satellite image analysis, field surveys, and discussions with the University of Arizona Cooperative Extension Service staff.

References

ARB, 1997. *Methods for Assessing Area Source Emissions*. California Environmental Protection Agency, Air Resources Board. October

Arizona Agricultural Statistics Service, 2001. *2001 Arizona Agricultural Statistics Bulletin,* July 2002. (http://www.nass.usda.gov/az/)

Fish and Clay, 2003. Meeting with Jeannette Fish, Maricopa County Farm Bureau, and Patrick Clay, University of Arizona Cooperative Extension, with Randy Sedlacek, Phil DeNee, Darlene Jenkins, ADEQ. May 21, 2003.

URS and ERG. *Technical Support Document for Quantification of Agricultural Best Management Practices.* June 18, 2001, 2001. Prepared for Arizona Department of Environmental Quality, ADEQ Contract No. 98-0159-BF, Task Assignment No. 00-0210-01.

APPENDIX C.7
Arizona Portland Cement (APC) Emissions

The following table contains data from Compliance Section concerning PM10 emissions from APC. The data was abstracted from ADEQ's Major Sources Emission Inventory.

Year	PM_{10} Emission tons/day
2006	1.294
2005	1.365
2004	1.317
2003	1.203
2002	1.535

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APPENDIX C.8
2004 Off-Road Mobile Source PM_{10} Emissions Inventory
for the Rillito Nonattainment Area

NONROAD Input

Fuel RVP: 10.87 psi (average from 2004 Pima County fuel survey).[8]
Oxygen content: 0% (it was assumed to be zero since it had no influence on PM_{10} emissions).
Average temperature: 20.14°C (68.25°F) (AZMET – Marana station).[5]
Min/Max temperature: 55.85/84.16°F (average for the whole year).
Gasoline/diesel sulfur: 130.32/326.33ppm (average from 2004 Pima County fuel survey.)[8]
CNG/LNG sulfur %: 30ppm (EPA NONROAD model default; WRAPMSEI2 2002 inputs).
Off-road diesel sulfur: same as on-road diesel (Arizona Department of Weights and Measures mentioned that in most of the state, off-road diesel is the same as on-road diesel with just red dye added).[3]
Marine diesel sulfur: same as off-road diesel.
Stage II control %: 0%.

Lawn & Garden

EPA's NONROAD model was used to estimate the PM_{10} emissions from this category for Pima County in 2004. The total emissions were estimated to be 0.284 tons/day. The total emissions for Pima County were then allocated to the nonattainment area using populations.

Staff at ADEQ estimated the 2004 population of the nonattainment area as 45,600.[8] Arizona Department of Economic Security estimated that the total population of Pima County in 2004 was 931,835.[5]

PM_{10} emissions (lawn & garden) = PM_{10} emissions in Pima County (lawn & garden) × population in the nonattainment area / Pima County populations = 103.72 (tons/year) × 45,600 / 931,835 = 5.076 / 365 = 0.014 tons/day.

Industrial

It is not necessary to calculate emissions from this category since the emissions were included in the permits.

Aircraft

The aircraft emissions are calculated by AEIS software. The emission factors were extracted from *National Emission Inventory, NEI: Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emission Inventory, Vol.1 – Methodology, Appendix A, 30 September 2002*.[6]

Marana Northwest Regional Airport is not equipped with control towers so that the traffic is not monitored. The numbers of landing and takeoffs (LTO) by different types of carriers are not available according to Charles Mangum,[7] Director of the Airport. The only information available is the estimated number of landing and takeoffs. In 2004, it had over 90,000 takeoffs and landings.

However, it was found that the latest operational counts reported to Federal Aviation Administration by the airport in 2005 indicates the number of LTOs for different types of carriers for 12 months operations ending in July 31, 2005 as shown in Table 1.[8]

Table 1.Activity Data and Emission Factors

	Number of LTOs	Emission Factor (lb/LTO)
Air taxi	8000	0.6033
General aviation, local	58000	0.2367
General aviation, itinerant	23950	0.2367
Military	50	0.6033

PM_{10} emissions (air craft) = **0.030 tons/day**

Airport Service

Marana Regional Airport is a non-commercial airport. Emissions from ground support equipment are negligible.

Railway Maintenance

According to the information obtained from Union Pacific Railroad Company, total length of railroad in Pima County was added up to 143.64 miles (including all the tracks). The length of railroad in the nonattainment area is assumed to be the length of I-10, which is 16.350237 miles estimated by ADEQ staff.

EPA's NONROAD model was used to estimate PM_{10} emissions from this category for Pima County. The total emissions were estimated to be 0.001 tons/day. The total emissions for Pima County were then allocated to the nonattainment area using lengths of railroad.

PM_{10} emissions (railway maintenance) = PM_{10} emissions in Pima County (railway maintenance) × 16.35 (miles) / 143.64 (miles) = 0.49 (tons/year) × 16.35 (miles) / 143.64 (miles) / 365 = **0.0002 tons/day**

Locomotive

The emission factors were extracted from *U.S. Environmental Protection Agency Form APR420-F-97-051, Emission Factors for Locomotives, for 1996 Table 9: Fleet Average Emission Factors for All Locomotives (Projected 1999), December 1997*.[9] The emissions from locomotive are related to its type (i.e., line haul class I, class I yard, line haul class II/III, passenger, and commuter) and engine type and distribution (2-stroke and 4-stroke). For PM_{10}, except class I yard, the emissions factors for all other locomotive types are 0.01477 lb/gallon (6.7 grams/gallon) for any types of engines. The activity data required is the amount of fuel oil consumed.

According to the information obtained from Union Pacific Railroad Company, Rillito is located at or near Milepost 96.74 on their Gila Subdivision, Track Segment 4958-0. It was calculated that the amount of fuel consumed per mile is 114,208 gallons/mile. The length of railroad in the nonattainment area was assumed to be the length of I-10, which is 16.350237 miles estimated by Juan Declet.

PM_{10} emissions (locomotive) = 6.7 (grams/gallon) × 114,208 (gallons/mile) × 16.35 (miles) = 12,510,915.36 grams /365 = **0.034 tons/year**

Agricultural

EPA's NONROAD model was used to estimate PM_{10} emissions from this category for Pima County. The total emissions were estimated to be 0.016 tons/day. The total emissions for Pima County were then allocated to the nonattainment area using area of agriculture field.

ADEQ staff estimated that there were 32.166 $mile^2$ agricultural fields in the nonattainment area and 345.519 $mile^2$ in Pima County using 2004 land use GIS cover.

PM_{10} emissions (agricultural) = 5.69 (tons/year) × area of agricultural field in Non-Attainment Area / Area of agricultural field in Pima County = 5.69 (tons/year) × 32.166 ($mile^2$) / 345.519 ($mile^2$) / 365 = **0.001 tons/day.**

Recreational

EPA's NONROAD model was used to estimate PM_{10} emissions from this category for Pima County. The total emissions were estimated to be 0.05 tons/day. Table 2 shows the emissions from different types of recreational equipment.

Table 2. PM_{10} Emissions from Recreational Equipment		
Recreational Equipment	**PM_{10} Emissions (tons/day)**	**Allocation Parameter**
Motorcycles: off-road (2 stroke)	0.020	Number of recreational vehicle park establishments
ATVs (2 stroke)	0.024	
Specialty vehicles/carts (2 stroke)	0.030	
Motorcycles: off-road (4 stroke)	0.0008	
ATVs (4 stroke)	0.003	
Golf carts (4 stroke)	0.0005	Number of golf courses
Specialty vehicles/carts (4 stroke)	0.00005	Number of recreational vehicle park establishments
Specialty vehicles/carts (diesel)	0.001	
Total	0.050	

The emissions for Pima County for each type of equipment were then allocated to the nonattainment area according to the allocation surrogates shown in Table 2.

Dan Catlin mentioned that there are no recreational vehicle park establishments in the nonattainment area, thus, the PM_{10} emissions from recreational vehicles were then zero. NONROAD model reports 19 golf courses in Pima County for 2002.

PM_{10} emissions (golf carts) = PM_{10} emissions in Pima County (golf carts) × number of golf course in the nonattainment area / number of golf courses in Pima County = 0.19 × 2 / 19 = **0.00005 tons/day.**

Commercial

EPA's NONROAD model was used to estimate PM_{10} emissions from this category for Pima County. The total emissions were estimated to be 0.059 tons/day. The total emissions for Pima County were then allocated to the nonattainment area using populations.

PM_{10} emissions (commercial) = PM_{10} emissions in Pima County (commercial) × population in the nonattainment area / Pima County populations = 21.38 (tons/day) × 45,600/ 931,835/ 365 = **0.003 tons/day.**

Construction

EPA's NONROAD model was used to estimate PM_{10} emissions from this category for Pima County. The total emissions were estimated to be 0.763 tons/day. The total emissions for Pima County are then allocated to the nonattainment area using populations.

PM_{10} emissions (construction) = PM_{10} emissions in Pima County (construction) × population in the nonattainment area / Pima County populations = 278.32 (tons/year) × 45,600/ / 931,835 / 365 = **0.038 tons/day**

Logging, Underground Mining and Marine Recreational

No logging, underground mining and marine recreational activities in the nonattainment area.

Summary

The emissions from each nonroad category and total nonroad emissions are summarized in Table 3.

Table 3. Emissions Summary

Category	Emissions (tons/day)
Lawn & Garden	0.014
Aircraft	0.030
Railway Maintenance	0.0001
Locomotive	0.034
Agricultural	0.002
Recreational	0.0001
Commercial	0.003
Construction	0.037
Total	**0.120**

Reference:

1. Arizona Department of Weights and Measures, 2004 Pima County Fuel Inspection Report, 2004.
2. Arizona Meteorological network, http://ag.arizona.edu/azmet/.
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4. David Lillie, 2004 Population in Rillito Nonattainment Area, 2007.
5. Arizona Department of Economic Security, July 1, 2004 Population Estimates for Arizona's Counties, Incorporated Places and Balance of County, February 2007.
6. US EPA, National Emission Inventory, NEI: Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emission Inventory, Vol.1 – Methodology, Appendix A, 30 September 2002.
7. Charles Mangum, Marana Northwest Regional Airport, Personal Communication, 2007.
8. http://www.gcr1.com/5010web/airport.cfm?Site=AVQ
9. US EPA, U.S. Environmental Protection Agency Form APR420-F-97-051, Emission Factors for Locomotives, for 1996 Table 9: Fleet Average Emission Factors for All Locomotives (Projected 1999), December 1997.

APPENDIX D

Public Process Documentation

D.1. Public Notice and Affidavit
D.2. Public Hearing Agenda
D.3. Public Hearing Sign-in Sheet
D.4. Public Hearing Presiding Officer Certification
D.5. Public Hearing Transcripts
D.6. Public Comments and Responsiveness Summary

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APPENDIX D.1.

Public Notice and Affidavit

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APPENDIX D.2.

Public Hearing Agenda

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APPENDIX D.3.

Public Hearing Sign-in Sheet

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APPENDIX D.4.

Public Hearing Presiding Officer Certification

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APPENDIX D.5.

Public Hearing Transcripts

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APPENDIX D.6.

Public Comments and Responsiveness Summary

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APPENDIX E

Arizona Department of Environmental Quality Organizational Chart