ADEQ
Arizona Department
of Environmental Quality

Final

2012 State Implementation Plan
Nogales PM_{10} Nonattainment Area

August 24, 2012

This page is intentionally blank.

List of Figures

List of Figures Continued

List of Tables

List of Tables Continued

List of Appendices

EXECUTIVE SUMMARY

The Nogales PM_{10} Nonattainment Area (Nogales NA) is located 66 miles south of Tucson, covering approximately 76 square miles along the international border with Mexico in Santa Cruz County. The City of Nogales and portions of Rio Rico, an unincorporated community, occupy most of the nonattainment area, as depicted in Figure ES-1. Nogales, Arizona and Nogales, Sonora, Mexico, collectively referred to as Ambos Nogales, form a micropolitan area bisected by the international border.

Pursuant to the 1990 Clean Air Act (CAA) Amendments, by operation of law all areas where violations of the PM_{10} NAAQS had been recorded were designated as moderate nonattainment areas for PM_{10}, including the Nogales NA. Because Arizona did not submit a required moderate PM_{10} plan for the Nogales NA by the November 15, 1991, deadline, EPA issued a finding of failure to submit (57 FR 19906; May 8, 1992). The Arizona Department of Environmental Quality (ADEQ) subsequently submitted a State Implementation Plan (SIP) for the Nogales NA on June 14, 1993.[1] EPA found the SIP to be complete but did not take action on it.[2] One of the purposes of this document is to ultimately serve as a replacement of the 1993 Nogales NA SIP. This plan demonstrates that the annual expected exceedances are less than one but for emissions originating in Mexico.

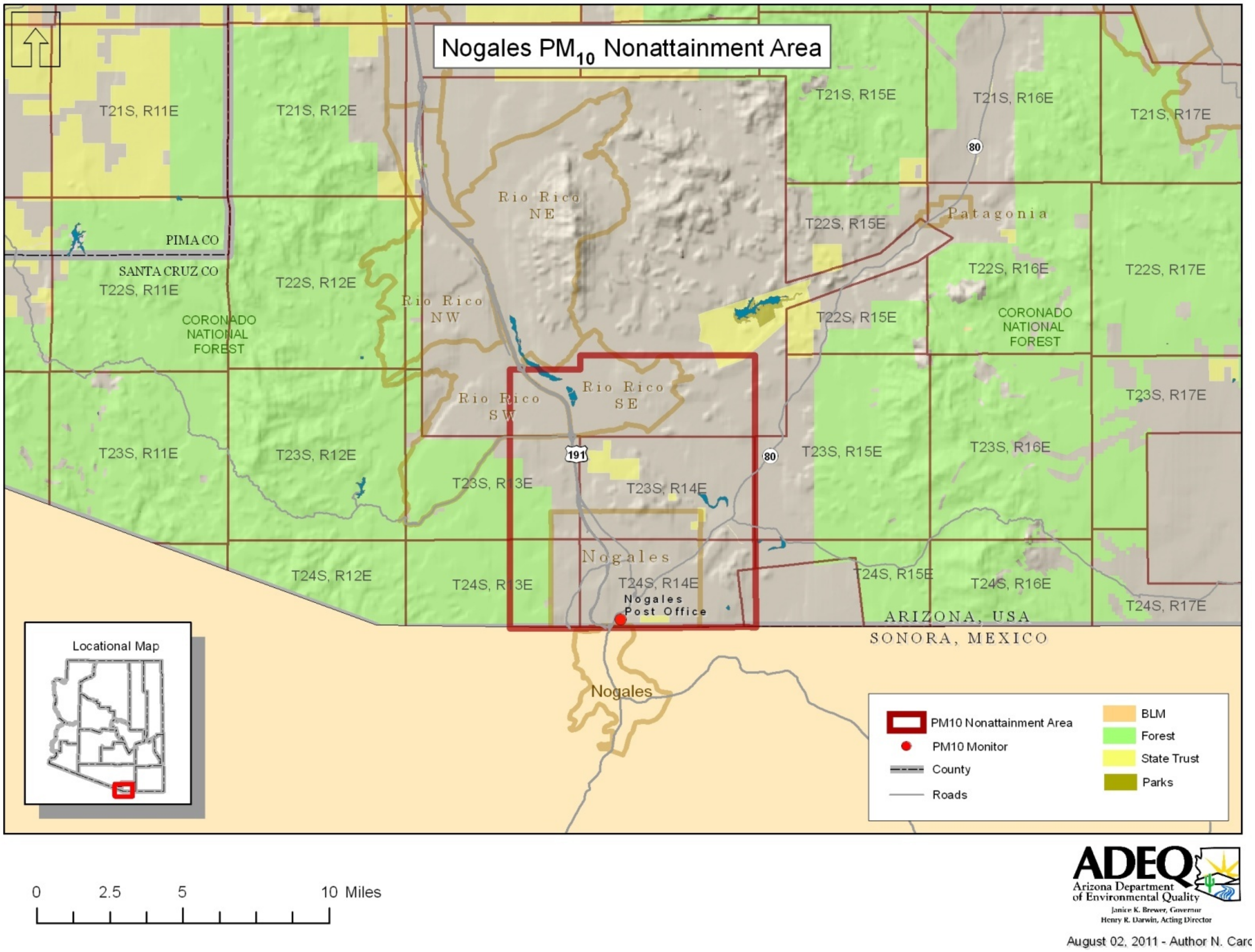
This PM_{10} SIP for the Nogales NA is organized as follows and is intended to meet the requirements established by the CAA for moderate PM_{10} nonattainment area plans.

Chapter 1 provides an overview of the Nogales NA and Santa Cruz County. It discusses the climate, physiography, population, and economy of the area and the impact each has on ambient PM_{10} concentrations. Chapter 1 also includes an account of the regulatory history of the PM_{10} NAAQS and the Nogales NA, and describes how this SIP meets all the regulatory requirements for a PM_{10} nonattainment area plans under CAA Sections 172, 189, and 179B.

[1] "Final State Implementation Plan for the Nogales PM_{10} Nonattainment Area." ADEQ. Submitted to EPA June 14, 1993. <http://www.azdeq.gov/environ/air/plan/download/nogpm10sip_061993.pdf>

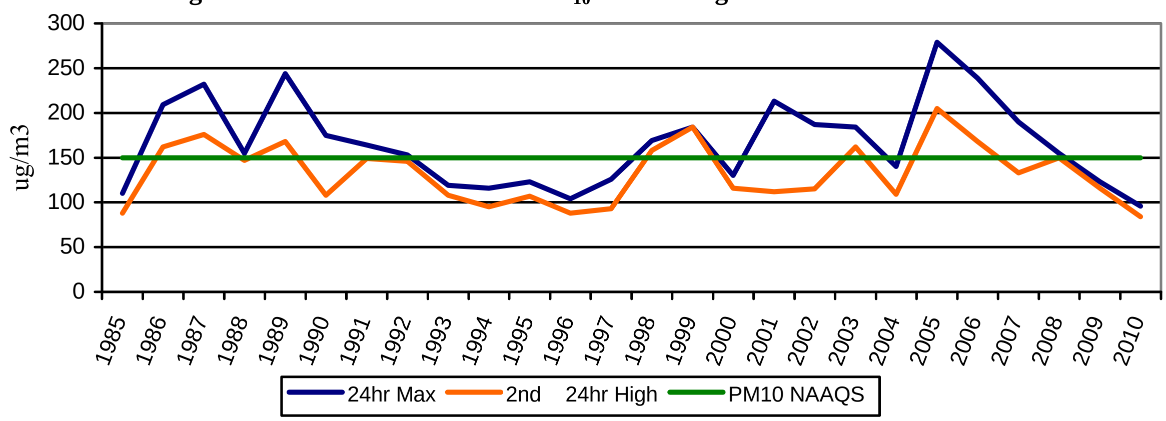
[2] Correspondence. Letter from EPA to ADEQ dated November 30, 1993. See Appendix F.4.

Figure ES-1


Nogales PM10 Nonattainment Area
T21S, R11E
T21S, R12E
T21S, R15E
T21S, R16E
T21S, R17E
Rio Rico NE
T22S, R15E
Patagonia
PIMA CO
SANTA CRUZ CO
T22S, R11E
T22S, R12E
Rio Rico NW
T22S, R15E
T22S, R16E
T22S, R17E
CORONADO NATIONAL FOREST
CORONADO NATIONAL FOREST
Rio Rico SE
Rio Rico SW
T23S, R17E
T23S, R11E
T23S, R12E
T23S, R14E
T23S, R15E
T23S, R16E
T24S, R12E
Nogales
T24S, R14E
T24S, R15E
T24S, R16E
T24S, R17E
Nogales Post Office
ARIZONA, USA
SONORA, MEXICO
Nogales
Locational Map
PM10 Nonattainment Area
PM10 Monitor
County
Roads
BLM
Forest
State Trust
Parks
0 2.5 5 10 Miles
ADEQ
Arizona Department of Environmental Quality
Janice K. Brewer, Governor
Henry R. Darwin, Acting Director
August 02, 2011 - Author N. Carc

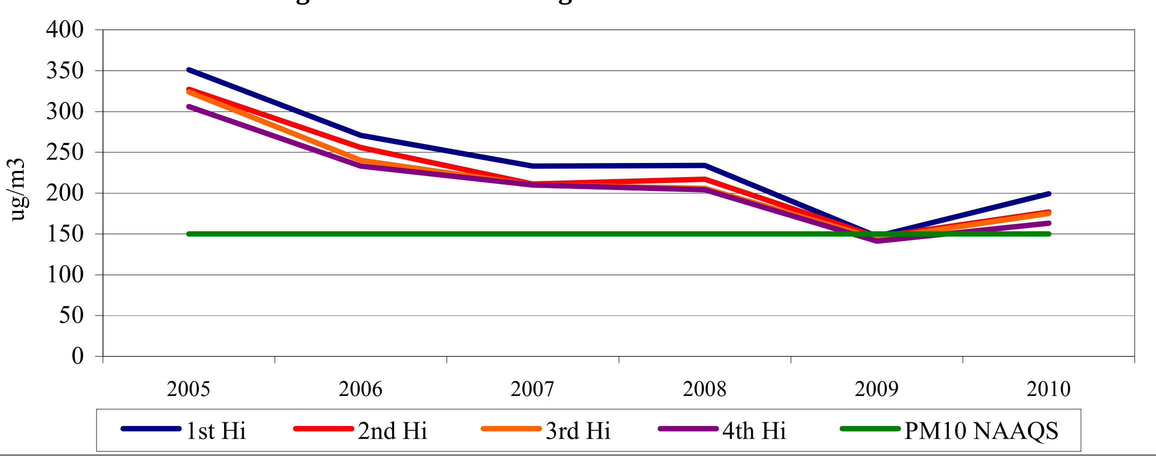
Chapter 2 describes how the Nogales NA ambient monitoring network meets CAA and EPA regulatory requirements, provides a description of the monitoring equipment, and includes a physical description of the monitor sites. This chapter provides PM_{10} monitoring data collected by monitors in the Nogales NA from 1985-2010. As shown in Figure ES-2, filter-based monitoring data from 2008-2010 showed observed concentrations below the PM_{10} NAAQS. Additional data collected during 2008-2010 at a co-located continuous monitor, however, showed observed concentrations above the NAAQS, as shown in Figure ES-3.[3] Although recent trends indicate a decline in ambient concentrations, based on preliminary monitoring data, the Nogales BAM monitor recorded exceedances in 2011; quality assured monitoring data for the Nogales NA will be certified and submitted to EPA in 2012.

Figure ES-2
Nogales Post Office Filter-Based PM_{10} Monitoring Data Trends 1985-2010



Source: EPA's AQS Database.

Figure ES-3
Nogales BAM Monitoring Data Trends 2005-2010

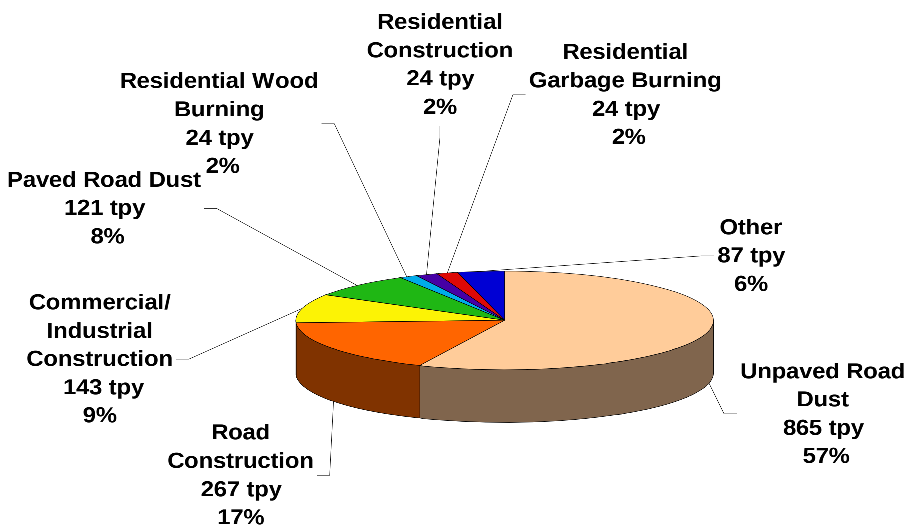


Source: Ibid.

[3] Due to data completeness deficiencies in 2010 BAM monitoring data, ADEQ reviewed, certified, and quality assured data for 2007-2009 collected by the Nogales BAM monitor and determined the Nogales NA did not meet the NAAQS during that period either.

Chapter 3 contains the 2008 base year PM_{10} emissions inventory; provides a summary of the inventory methodology; and identifies significant and insignificant emission sources in the Nogales NA. Figure ES-4 depicts the 2008 emissions inventory major source categories. Chapter 3 also includes a projected emissions inventory for 2011.

Figure 3.1
2008 Annual Emissions Inventory for the Nogales, Arizona
PM_{10} Nonattainment Area
1,531 tons per year total



Source: 2008 and 2011 PM_{10} Emissions Inventories for the Nogales NA, Santa Cruz County, Arizona (see Appendix B). Estimates rounded.

Chapter 4 includes a demonstration in accordance with CAA section 179B that but for emissions from Mexico, the Nogales NA would attain the PM_{10} standard. The demonstration includes analyses of population growth, sources of PM_{10}, ambient PM_{10} concentrations, and meteorology in the Ambos Nogales area.

Chapter 5 describes CAA requirements for reasonably available control measures (RACM) in moderate PM_{10} nonattainment areas. The chapter cites applicable State laws already approved into the Arizona SIP. Chapter 5 describes the selection process, implementation, and status of RACM required by the SIP submitted for the Nogales NA in 1993 and describes in detail the extensive road paving projects that have been completed since that time. This chapter includes a demonstration that the control measures meet CAA criteria to qualify as RACM and also includes supplemental control measures not intended for inclusion in the Arizona SIP.

Chapter 6 discusses CAA requirements for contingency measures that provide supplementary emissions reductions not included in a SIP attainment demonstration in the event of failure to make RFP or attainment by the prescribed attainment date.

Chapter 7 discusses requirements in the CAA to ensure potential emissions from federally funded transportation projects will not delay attainment of the standard in the Nogales NA or cause violations of the PM_{10} standards. To meet this obligation, the Transportation Conformity Rule (40 CFR Part 93) directs the State to establish a limit or "budget" for onroad emissions in the area. The emissions budget developed for this SIP assists in assuring transportation conformity requirements are met. Each new travel plan must be shown to conform with the motor vehicle emissions budget (MVEB) at least every four years and upon any amendments, including a new regional emissions analysis.

Chapter 8 summarizes the obligations and commitments the State is making with the submission of this SIP. Several of the applicable air quality sections of Arizona Revised Statutes have been amended and the numbering system has changed since the rules listed below in Table ES-1 were approved into the State Implementation Plan. The following rules have been submitted to EPA and approved into the Arizona SIP.

Table ES-1
Arizona Administrative Code Rules Approved into the Arizona SIP

Rule		FR Date	FR Citation
R9-3-404	Open Areas, Dry Washes, or Riverbeds	4/23/1982	47 FR 17485
R9-3-405	Roadways and Streets	4/23/1982	47 FR 17485
R9-3-406	Material Handling	4/23/1982	47 FR 17485
R9-3-407	Storage Piles	4/23/1982	47 FR 17485
R9-3-410	Evaluation of Nonpoint Source Emissions	4/23/1982	47 FR 17485
R9-3-502	Standards of Performance for Unclassified Sources	10/19/1984	49 FR 41026
R9-3-522	Standards of Performance for Existing Gravel and Stone Crushing Operations	9/28/1982	47 FR 42572
R18-2-702[4]	General Provisions	8/24/2004	69 FR 51952

[4] R18-2-702, General Provisions, reflects the current R18 Arizona Administrative Code numbering format. The R9 series of rules were subsequently renumbered as well, but have only been approved by EPA in the original numbering format.

1.0 INTRODUCTION

Chapter 1 provides a description and regulatory history of the Nogales Nonattainment Area (NA) and presents general regulatory requirements for PM_{10} nonattainment areas.

1.1 Physical, Demographic, and Economic Description of the Nogales NA

Section 1.1.1 describes the climate and physiography of the Nogales NA; Sections 1.1.2 and 1.1.3 provide an overview of the demographics and economy of the Nogales area.

1.1.1 Climate and Physiography

The Nogales NA is located on the U.S./Mexico border 66 miles southeast of Tucson. This region of the Sonoran Desert is characterized by north-south elongated valleys surrounded by mountain ranges. Nogales is located in a valley created by the Nogales Wash, a tributary of the nearby Santa Cruz River.

The mean elevation in Nogales, Arizona is 3,865 feet above sea level. Mountain ranges near Nogales include the Patagonia Mountains to the east and the Tumacacori, Atascosa, and Pajarito mountains to the west. Approximately twenty-five miles to the north are the Santa Rita Mountains and Madera Canyon in the Coronado National Forest where Mount Wrightson rises to an elevation of 9,432 feet. Northwest of Interstate 19 are the Cerro Colorado, Las Guijas, and Sierrita Mountain Ranges.

The mean elevation in Nogales, Sonora is 4,265 feet above sea level.[5] At 5,380 feet, the highest elevation in Nogales, Sonora is the Cerro de los Nogales (Nogales Hill), west of where the Obregón and Colosio routes meet, near the southern end of the city.

The elevation drops approximately 709 feet from the southernmost edge of the Nogales, Sonora urban boundary to the Nogales NA northern boundary line.

The average daily maximum temperature is 79.7 ºF, based on a 62-year average of meteorological data (see Table 1.1). The highest monthly daily maximum average temperature (94.1 ºF.) occurs in July, and the lowest monthly daily minimum average temperature (64.3 ºF.) occurs in January.

The yearly average total rainfall for the Nogales area is 17.21 inches, as shown in Table 1.1. The majority of this precipitation falls in July and August, when warm moist air penetrates Arizona from the Gulf of Mexico. The area receives approximately 8.5 inches of precipitation during this time. The area receives an average of only 0.22 inches of rain in May, the driest month of the year.

[5] "Statistical Municipal Workbook for Nogales, Sonora," 2005 edition, INEGI. <http://www.inegi.org.mx/>

Table 1.1 Climatological Data for Nogales, AZ (1952-2010)			
	Average Temperature ºF		Rain in Inches
Month	**Daily Max.**	**Daily Min.**	**Avg. Total**
January	64.3	27.3	1.14
February	66.7	29.6	0.86
March	70.7	33.7	0.87
April	78.1	38.6	0.38
May	86.3	45.0	0.22
June	95.3	54.5	0.46
July	94.1	63.9	4.38
August	91.7	62.7	4.03
September	90.2	55.5	1.57
October	82.4	43.9	1.29
November	71.7	33.0	.065
December	64.6	27.6	1.37
Annual Average	79.7	43.0	17.21

SOURCE: Western Regional Climate Center.[6]

1.1.2 Population

Table 1.2 includes historical and projected population estimates for the Nogales area. Estimates for 1990, 2000, 2008, and 2010 were obtained from the U.S. Census Bureau. The base year for the emissions inventory is 2008. According to 2008 population estimates, 55 percent of the County's population resides within the Nogales NA, which includes portions of Rio Rico and all of the City of Nogales. The Arizona Commerce Authority (ACA) population projections, shown in Table 1.3, were developed in 2006 based on the rate of growth during the peak of the housing market. Updated projections from the ACA based on 2010 Census data will not be published until December 31, 2012.

Table 1.2 Population of Nogales, Rio Rico, and Santa Cruz County 1990-2010				
	1990	**2000**	**2008**	**2010**
City of Nogales	19,489	20,878	19,752	20,837
Santa Cruz County	29,676	38,381	43,091	43,716
Portions of Rio Rico SE and SW in Nogales NA			3,983	4,042

Source: U.S. Census Bureau. Rio Rico population figures were estimated from U.S. Census data; see Appendix B for allocation calculations.

[6] "Nogales, Arizona." Western Regional Climate Center. n.d. June 28, 2011. < http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?az5924>.

Table 1.3 Population Projections for the Region		
	2020	**2030**
City of Nogales	24,783	26,356
Santa Cruz County	61,658	71,033

Source: Arizona Commerce Authority.

Nogales, Sonora, depicted in Figure ES-1, is Nogales, Arizona's much larger sister city. The Nogales Municipality's population in 2010 is estimated to be 220,292.[7] Table 1.4 contains population estimates and projections obtained from Mexico's Instituto Nacional de Estadistica y Geografía (INEGI).

Table 1.4 Population of Nogales Municipality, Sonora, Mexico				
	1995	**2000**	**2005**	**2010**
Nogales Municipality, Sonora	133,491	159,787	193,517	220,292

Source: INEGI.

1.1.3 Santa Cruz County and City of Nogales Economy

The City of Nogales was founded in 1880 when a trading post opened on the international border; two years later, a railway running through Nogales connected the U.S. and Mexico. Today the economies of Nogales, Arizona, and Nogales, Sonora are largely interdependent. According to the ACA, 47 percent of Santa Cruz County's annual sales tax revenue is generated from purchases made by residents of Mexico.[8] There are two ports of entry (POE) in the area, the DeConcini POE in downtown Nogales and the Mariposa POE 0.5 mile to the west. The DeConcini POE does not accept commercial trucks, all of which are required to cross the border at the Mariposa POE. From November through April, approximately 136,000 trucks haul produce from Mexico to warehouses in Nogales; approximately 200,000 U.S. trucks distribute the fresh produce to supermarkets in the United States and Canada.[7] The Nogales ports of entry serve as the gateway to 50 percent of all fresh fruits and vegetables shipped into the U.S. from Mexico.[8]

In 2008, 74 percent of Nogales Arizona's working population was employed in the private sector. The trade, transportation, and utilities industry accounted for 43 percent of all employment; 26 percent of the working population was employed in the public sector, with most working for the Department of Homeland Security, Santa Cruz County, the City of Nogales, and Cochise Community College. The County's unemployment rate was 13.1 percent in 2009, [9] higher than the State average, 10.6 percent.

[7] Instituto Nacional de Estadistica y Geografia. n.d. June 1, 2011. <http://www.inegi.org.mx/>.

[8] "Nogales Community Profile." Arizona Department of Commerce. September 10, 2009. June 1, 2011. <http://www.nogalesusa.com/commerce.html>

[9] Census Bureau. Santa Cruz County, AZ Census Statistics. <http://census-statistics.findthedata.org/l/111/Santa-Cruz-County-AZ>

The number of building permits in the City of Nogales has slowed considerably since 2000; the number of building permits issued in 2010 was 5, compared to 60 in 2000, as shown in Table 1.5. Home sales in the third quarter of 2011 were 74 percent lower than the market's peak in the first quarter of 2006.[10]

Table 1.5
Building Permits Issued in Nogales and Santa Cruz County 1990-2010

	1990	1996	2000	2010
City of Nogales	n/a	37	60	5
Unincorporated Santa Cruz County	n/a	265	301	47
Santa Cruz County	217	306	302	53

Source: U.S. Census Bureau.[11]

1.2 Nogales NA Regulatory Background

EPA promulgated a revised particulate matter NAAQS in 1987 (52 FR 24634; July 1, 1987). These primary and secondary standards apply to particulate matter 10 microns[12] or less in diameter (PM_{10}) and superseded the previous total suspended particulate (TSP) standards. ADEQ began monitoring PM_{10} in the Nogales NA in 1985.

As part of the implementation policy for the 1987 PM_{10} NAAQS, EPA created a tiered scale to designate nonattainment areas based on an area's probability of violating the standard. An area with a high probability of violating the standard was designated as a Group I area; an area with a moderate probability of violating was designated as a Group II area; and an area likely to attain the standard was designated as a Group III area. The Nogales planning area was subsequently classified as a Group II Area, with a moderate likelihood of violating the PM_{10} NAAQS. In accordance with Section 110 (a)(1) of the Clean Air Act (CAA), the State was required to submit a State Implementation Plan (SIP) within three years after promulgation of the NAAQS (52 FR 24672; July 1, 1987, and 52 FR 29383; August 7, 1987) by August 7, 1990.

With the CAA amendments of 1990, areas where previous violations of the PM_{10} standard had been recorded prior to January 1, 1989, were designated nonattainment for PM_{10} by operation of law and classified as "moderate"; these areas included all former Group II PM_{10} planning areas like the Nogales NA (55 FR 45799; October 31, 1990). On March 15, 1991, EPA published a list of the areas designated nonattainment for PM_{10} upon enactment of the 1990 amendments, including the Nogales nonattainment area (56 FR 11101; March 15, 1991). Later, EPA codified the PM_{10} nonattainment designations and moderate area classifications (56 FR 56694; November 6, 1991).

As stipulated in the 1990 amendments, by November 15, 1991, Arizona was required to submit a SIP for the Nogales NA demonstrating attainment of the PM_{10} NAAQS by December 31, 1994. Because

---

[10] Citydata.com. <http://www.city-data.com/zips/85621.html>

[11] U.S. Census Bureau. Web. <http://censtats.census.gov/bldg/bldgprmt.shtml?>

[12] One micron is one millionth of a meter, or 0.0004 inches.

Arizona did not submit a SIP for the Nogales NA by the November 15, 1991 deadline, EPA made a finding of failure to submit a PM_{10} SIP on December 16, 1991. In response, on June 14, 1993, Arizona submitted the *''Final State Implementation Plan for the Nogales PM_{10} Nonattainment Area.''* (1993 Nogales NA SIP) EPA found the plan to be complete by letter dated November 30, 1993, but did not act on the plan.[13]

On January 11, 2011, EPA promulgated a determination of attainment as of the applicable attainment date for the Nogales NA based on ambient air quality monitoring data from 1992-1994, retroactively affirming that the area had met the PM_{10} NAAQS by the December 31, 1994 deadline established by the 1990 amendments of the CAA (76 FR 1532; January 11, 2011).

1.2.1 EPA's Particulate Matter NAAQS

The CAA requires the EPA to assess the latest scientific information and review the particulate matter NAAQS every five years. On October 17, 2006, EPA revised the 1987 PM_{10} standards by retaining the existing 24-hour PM_{10} standard and revoking the annual PM_{10} standard effective December 18, 2006 (71 FR 61144; October 17, 2006). Therefore, this SIP revision addresses EPA's current primary and secondary 24-hour PM_{10} NAAQS. The PM_{10} NAAQS allows for a maximum 24-hour average of 150 $\mu g/m^3$. The 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration exceeding the standard is less than or equal to one (see 40 CFR 50.6 and 40 CFR Part 50, Appendix K). The primary standard was established to protect human health; the secondary standard was established to protect property, materials, and general welfare. Both NAAQS have a 24-hour average concentration limit of 150 $\mu g/m^3$. This plan addresses both the primary and secondary PM_{10} NAAQS.

1.2.2 Nogales Nonattainment Area Statutory Boundary

The Nogales NA in southern Arizona is within Santa Cruz County on the international border with Mexico, and includes the City of Nogales, portions of the Rio Rico community, and unincorporated portions of the County. It is shown in Figures ES-1. The nonattainment area is codified at 40 CFR 81.303 and is described by the townships and ranges listed below that are within the State of Arizona and lie east of 111 degrees longitude:

T23S, R13E
T23S, R14E
T24S, R13E
T24S, R14E

---

[13] Correspondence. Letter from EPA to ADEQ dated November 30, 1993. See Appendix F.4.

1.2.3 General SIP Approach – Regulatory Requirements and Guidance

The November 1990 CAA amendments were enacted by the United States Congress to improve air quality across the nation. One of the primary goals of this comprehensive revision to the CAA was to expand and clarify the planning provisions for those areas not currently meeting the NAAQS. The amendments identify specific emission reduction goals, require both a demonstration of reasonable further progress (RFP) and attainment, and incorporate more stringent sanctions for failure to attain or to meet interim milestones. Title I, Part A, and Title I Part D, Subparts 1 and 4 of the CAA are applicable to this SIP. Table 1.6 includes the SIP requirements and explains how this document meets them. The pollutant specific requirements for moderate PM_{10} nonattainment areas applied to the U.S. are found in section 189 of the CAA, and the general planning and control requirements for nonattainment area plans are found in CAA sections 110 and 172. The following excerpt from the CAA describes requirements of SIPs submitted for consideration under Section 179B - International Border Areas:

Sec. 179B. INTERNATIONAL BORDER AREAS

> ***"(a) IMPLEMENTATION PLANS AND REVISIONS.*** *— Notwithstanding any other provision of law, an implementation plan or plan revision required under this chapter shall be approved by the Administrator if—*
>
> ***(1)*** *such plan or revision meets all the requirements applicable to it under the Act other than a requirement that such plan or revision demonstrate attainment and maintenance of the relevant national ambient air quality standards by the attainment date specified under the applicable provision of this Act, or in a regulation promulgated under such provision, and*
>
> ***(2)*** *the submitting State establishes to the satisfaction of the Administrator that the implementation plan of such State would be adequate to attain and maintain the relevant national ambient air quality standards by the attainment date specified under the applicable provision of this chapter, or in a regulation promulgated under such provision, but for emissions emanating from outside of the United States...*
>
> ***(d) ATTAINMENT OF PM_{10} LEVELS -*** *Notwithstanding any other provision of law, any State that establishes to the satisfaction of the Administrator that, with respect to a PM_{10} nonattainment area in such State, such State would have attained the national ambient air quality standard for carbon monoxide [sic] by the applicable attainment date, but for emissions emanating from outside the United States, shall not be subject to the provisions of section 188 (b)(2).*" [14]

EPA issued administrative guidance in 1994 setting forth several types of information that could be used to evaluate the impact of emissions emanating from outside the U.S. and demonstrate that a

[14] Carbon monoxide is an apparent typographical error; the text should read "PM_{10}".

border area's inability to meet the NAAQS was due to emissions from outside the U.S.[15] Section 4.0 follows these guidelines to demonstrate that the Nogales NA would be in attainment of the 24-hour PM_{10} NAAQS "but for" emissions from Mexico.

Table 1.6 Clean Air Act (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 5.0 provides an explanation of RACM/RACT for PM_{10} sources in the Nogales NA.
172(c)(2) Reasonable Further Progress	Plan provisions shall demonstrate RFP or "annual incremental reductions in emissions…for the purpose of ensuring attainment of the applicable national ambient air quality standards by the applicable date."	In Chapter 4.0, the State demonstrates that the Nogales NA would be in attainment but for emissions from Nogales, Sonora and that RFP is not required.
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)..."	Base-year PM_{10} emission estimates are presented in Chapter 3.0.
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.	Table 5.2 in Chapter 5.0 lists permitted sources in the Nogales NA.

[15] *State Implementation Plans for Serious PM_{10} Nonattainment Areas, and Attainment Date Waivers for PM_{10} Nonattainment Areas Generally; Addendum to the General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990* (59 FR 41,998; August 16, 1994).

Table 1.6 Clean Air Act (CAA) Regulatory Requirements		
CAA Citation	**Action to Meet Requirement**	**Location in Document**
CAA Section 172(c), Nonattainment Plan Provisions		
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 sources in the Nogales NA are described in Chapter 5.0.
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.	Chapter 4.0 includes an analysis demonstrating but for emissions from Mexico, the Nogales NA would meet the PM_{10} standard.
172(c)(9) Contingency Measures	The plan "... shall provide for the implementation of specific measures to be undertaken if the area fails to make RFP 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."	Chapter 6.0 describes the State's contingency plan.
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 CAA.	Chapter 5.0 describes the measures implemented to reduce PM_{10} emissions and ensure future maintenance of the NAAQS.
CAA Section 179B – International Border Areas		
179B International Border Areas	Section 179B of the CAA provides the State with an option to demonstrate that a nonattainment area would meet the NAAQS but for emissions emanating from outside of the United States.	Chapter 4.0 demonstrates the Nogales NA would be in attainment but for emissions from Mexico.

2.0 AIR QUALITY MONITORING

The primary goal of PM_{10} monitoring in the Nogales Nonattainment Area (NA) is to collect the data necessary to determine compliance with the PM_{10} NAAQS and fulfill the regulatory requirements for PM_{10} monitoring in the nonattainment area. This chapter provides a general description of the Nogales NA monitoring network and historical PM_{10} air quality data for the years 1985 through 2010.

2.1 Monitoring Site, Equipment, and Quality Assurance Procedures

The Nogales NA monitors were installed and are maintained in accordance with federal siting and design criteria[16] and consistent with *ADEQ's State of Arizona Air Monitoring Network Plan for the Year 2011,* which was approved by EPA on December 1, 2011.[17] Presently ADEQ operates two PM_{10} monitors at the Nogales Post Office site in the center of the Nogales business district. ADEQ has operated a filter-based monitor at that location since 1985 that operates on a one-in-six day schedule. A single exceedance recorded by a monitor operating on this schedule counts as six exceedances and the area is in nonattainment of the PM_{10} NAAQS. A continuously operating Beta Attenuation Monitor (BAM) has been operating at the Post Office site since February 2004. ADEQ began operating a weather station at the site in June 2003.

The monitor site was selected in an effort to monitor the maximum PM_{10} impacts on the Nogales population. The PM_{10} monitors are middle-scale monitors suited to measure concentrations within a 1/3 of a mile radius (40 CFR 58, Appendix D). Table 2.1 features the locations, methods, and parameters measured at the site.

Table 2.1
Nogales Post Office Monitor Site Specifications

AQS ID Number	Latitude	Longitude	Device Types	Pollutants Measured	Address	Scale	Objective
04-023-0004	31.3372	-110.936	Partisol and BAM	PM_{10}, $PM_{2.5}$, Meteorology	300 N. Morley Ave	Neighbor-hood	Population

Source: State of Arizona Air Monitoring Network Plan for the Year 2011.

2.2 Air Quality Data

Monitoring for PM_{10} began within the Nogales NA in 1985. Since 1985, numerous exceedances of the 24-hour PM_{10} standard of 150 $\mu g/m^3$ have been recorded, with 24-hour average ambient PM_{10} values that exceed the standard ranging from 155 to 351 $\mu g/m^3$. Following the implementation of the control measures included in the 1993 Nogales NA SIP, a reduction was evident in both the maximum and second-highest 24-hour PM_{10} concentrations. The Nogales NA met the PM_{10} NAAQS by the

[16] 40 CFR Part 58, Appendices D and E.

[17] Correspondence. Letter from EPA to ADEQ dated December 1, 2011. See Appendix F.1.

December 31, 1994, deadline established by the 1990 CAA Amendments (76 FR 1532; January 11, 2011). The Nogales NA continued to meet the NAAQS until 1998.

Since that time, intermittent exceedances have been recorded by the filter-based and continuously operating monitors. Although there were no exceedances recorded by the filter-based monitor in 2009-2010, preliminary data indicate the filter monitor did violate in 2011. The BAM monitor did record six exceedances in 2010; however, the BAM monitor experienced significant technical malfunctions during 2010 resulting in four calendar quarters with incomplete data. Preliminary data for 2011 indicate exceedances were recorded. Quality assured and certified data for 2011 will be submitted to EPA in 2012.

Table 2.2 displays the maximum 24-hour values recorded by the filter-based PM_{10} monitor from 1985-2010, and Table 2.3 displays the maximum 24-hour values recorded by the continuously operating BAM monitor from 2005-2010.[18] Appendix H contains data for each quarter in the most recent three-year period during which quality-assured data is available, 2008-2010. To be in compliance with the NAAQS, the area can not exceed the standard more than once per year on average over a 3 year period. For 2008-2010, the Nogales NA did not meet the NAAQS (i.e., as show in Table 2.2, the rate of expected exceedances is greater than 1.)

Table 2.2
Nogales Filter-Based 24-hour PM_{10} Monitoring Data 1985-2010

Year	24-hour Max	24-hour 2nd High	24-hour 3rd High	24-hour 4th High	Percentage of Valid Observations	Expected Exceedances
1985	110	88	85	83	31	0
1986	**162**	152	126	124	64	**5.75**
1987	**232**	**166**	**160**	135	77	**18.33**
1988	**155**	147	143	133	74	**8.36**
1989	**244**	**168**	145	138	69	**15.33**
1990	**175**	108	107	106	85	**8.36**
1991	**164**	149	112	110	95	**6.1**
1992	153	146	134	101	87	0
1993	119	108	86	72	74	0
1994	116	95	91	72	85	0
1995	123	107	80	77	87	0
1996	104	88	92	88	69	0
1997	126	93	84	77	84	0
1998	**169**	**158**	116	90	82	**13.5**
1999	**184**	**184**	152	119	83	**15.5**

[18] The Nogales continuously operating Beta Attenuation Monitor (BAM) experienced significant technical difficulties in 2010 that resulted in the invalidation of half the year's monitoring data. The BAM was originally sited as a Special Purpose Monitor in 2005 that is now used to determine compliance with the PM_{10} NAAQS.

Table 2.2 Nogales Filter-Based 24-hour PM_{10} Monitoring Data 1985-2010						
Year	**24-hour Max**	**24-hour 2nd High**	**24-hour 3rd High**	**24-hour 4th High**	**Percentage of Valid Observations**	**Expected Exceedances**
2000	130	116	112	109	95	0
2001	**213**	112	96	95	93	**6.9**
2002	**187**	115	111	106	93	**6.1**
2003	**184**	**162**	125	119	100	**12.3**
2004	140	109	86	82	98	0
2005	**279**	**205**	**156**	144	97	**17.93**
2006	**239**	**168**	**163**	146	93	**20**
2007	**190**	133	122	115	97	**6.1**
2008	**155**	150	147	108	95	**6.6**
2009	123	116	109	105	95	0
2010	96	84	70	65	72	0
2008-2010 3-year Expected Annual Exceedances						**2.2**

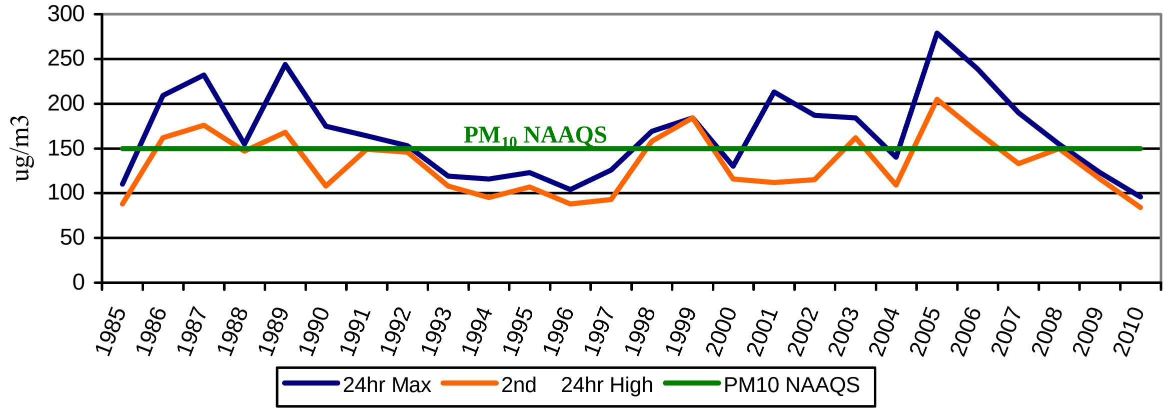
Source: EPA's Air Quality System database.

Table 2.3 Nogales Continuously Operating BAM Monitor PM_{10} Monitoring Data 2005-2010						
Year	**24-hour Max**	**24-hour 2nd High**	**24-hour 3rd High**	**24-hour 4th High**	**Percentage of Valid Observations**	**Expected Exceedances**
2005	**351**	**327**	**324**	**306**	80	**29**
2006	**271**	**256**	**240**	**233**	89	**42**
2007	**233**	**211**	**210**	**210**	98	**14**
2008	**234**	**217**	**206**	**204**	97	**13**
2009	**238**	**204**	147	146	94	**2**
2010	**191**	**177**	**175**	**163**	17*	**8.49**
2008-2010 3-year Expected Annual Exceedances						**7.83**

Source: Ibid. *2010 monitoring data does not meet completeness criteria.

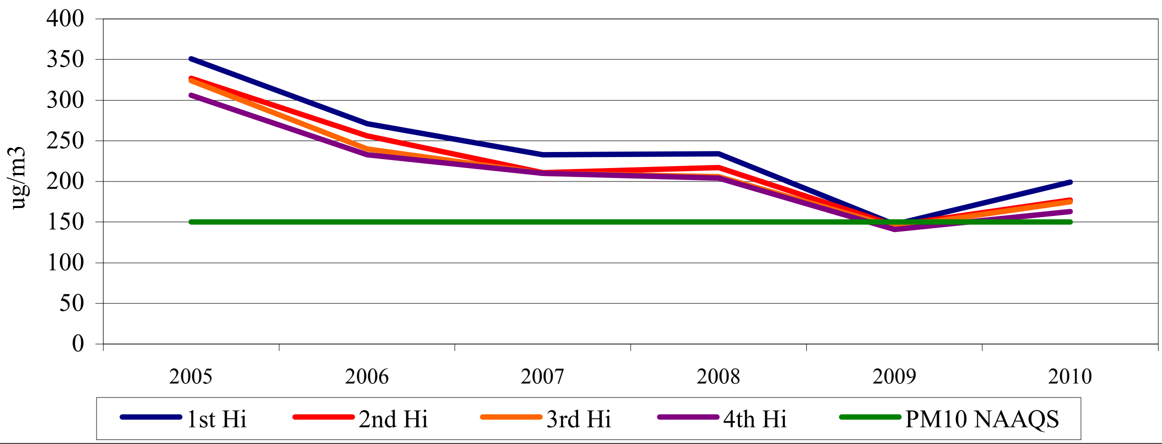
Figure 2.1 illustrates the complete ambient PM_{10} monitoring data history from 1985 through present for the filter monitor. This time period reflects ambient concentrations following the implementation of the control measures included in the 1993 Nogales NA SIP. As the data shows, the Nogales NA met the NAAQS by 1994 and showed values below the standard through 1998, after which exceedances of the standard were recorded. Since 1998, only 2000 and 2004 provided years with no observed exceedances of the NAAQS.

Figure 2-1
Nogales Post Office Filter-Based PM_{10} Monitoring Data Trends 1985-2010



Source: EPA's AQS Database.

Figure 2-2
Nogales BAM Monitoring Data Trends 2005-2010



Source: Ibid.

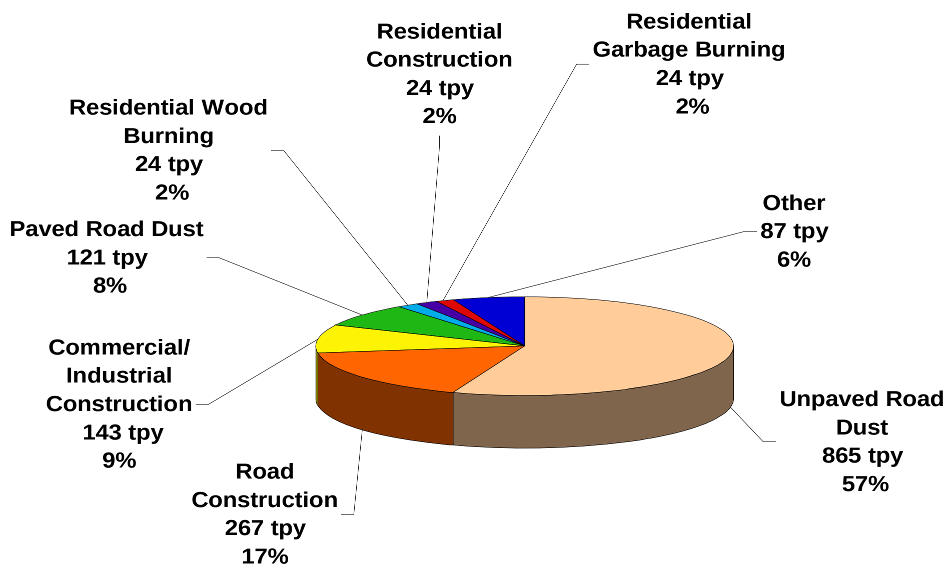
2.3 24-hour PM_{10} NAAQS Compliance

The primary (health) and secondary (welfare) 24-hour PM_{10} standards are met when the expected number of exceedances per year at each monitoring site is less than or equal to one. The expected number of exceedances per year is determined by recording the number of exceedances in each calendar year and averaging them over the past three years. Based on complete quality-assured data for 2008-2010, the number of expected exceedances of the 24-hour PM_{10} NAAQS for the Nogales NA is 2.2 for the filter-based monitor and 7.9 for the BAM monitor. Because the annual expected exceedance rate is greater than 1.0, the Nogales NA is not currently meeting the PM_{10} standard.

3.0 EMISSIONS INVENTORY

This chapter discusses the development of the emissions inventory required by the CAA Section 172(c)(3). The 2008 emissions inventory for the Nogales NA [19] was developed starting with the 2008 National Emissions Inventory (NEI) for Santa Cruz County. Then, county-level emissions estimates were apportioned to the Nogales NA based on population and land ratios, or actual location in the case of a stationary source. Figure 3.1 illustrates the major source categories in the Nogales NA in 2008.

Figure 3.1
2008 Annual Emissions Inventory for the Nogales, Arizona PM_{10} Nonattainment Area
1,531 tons per year total



Source: 2008 and 2011 PM_{10} Emissions Inventories for the Nogales NA, Santa Cruz County, Arizona (see Appendix B). Estimates are rounded.

3.1 Significant Emissions Sources

The annual PM_{10} emissions inventory for the Nogales NA in 2008 is 1,531 tons per year (tpy). The four largest source categories comprise 90 percent of emissions generated in the Nogales NA. Those categories are fugitive dust from unpaved and paved roads, and dust generated by road and building construction.

The greatest source of emissions in the nonattainment area is fugitive dust from unpaved roads, accounting for 57 percent of annual emissions and 865 tpy. The 2008 emissions inventory determined that emissions from Road Construction are the second greatest source of PM_{10} emissions in the Nogales NA, accounting for 18 percent of annual emissions and 267 tpy. Fugitive emissions from Commercial

[19] The more detailed 2008 and 2011 PM_{10} Emissions Inventories for the Nogales Nonattainment Area, Santa Cruz County, Arizona are found in Appendix B of this plan.

and Industrial sources are the third greatest source of PM_{10} emissions in the nonattainment area, accounting for nine percent of annual emissions and 143 tpy. Control measures for this source are discussed in Section 4.0. The fourth greatest source of PM_{10} emissions in the Nogales NA is dust from paved roads. Emissions for this category total eight percent of the 2008 emissions inventory and 121 tpy.

In total, the four emissions source categories discussed above account for 90 percent of annual emissions in the nonattainment area and 1,396 tons per year; see Table 3.1. The RACM implemented for these significant source categories and others are discussed in detail in Section 5.0.

Table 3.1
Significant PM_{10} Emissions Sources in the Nogales NA, 2008

PM_{10} Source Categories	TPY	Percentage of Annual Emissions
Fugitive Dust from Unpaved Roads	865	57
Road Construction Dust	267	18
Commercial and Industrial Construction Dust	143	9
Paved Road Dust	121	8
Total	**1,396**	**90**

Source: 2008 PM_{10} Emissions Inventory for the Nogales NA (see Appendix B). Estimates are rounded.

Residential construction, and residential wood and waste burning, each account for 2 percent of the 2008 annual emissions inventory. Those source categories are below the de minimis threshold, and therefore control measures are not required. Similarly, ADEQ determined that the emissions sources shown in Table 3.2 did not significantly contribute to ambient PM_{10} concentrations in the Nogales NA; therefore, control measures were not developed for these categories, which collectively account for three percent of the 2008 emissions inventory. The remaining minor source categories which contribute less than 2 tons of PM_{10} per year are included in Appendix B.

Table 3.2
PM_{10} Emissions Sources in the Nogales NA, 2008

PM_{10} Source Categories	TPY
Onroad Mobile - Diesel (includes exhaust, brake and tire wear)	19
Onroad Mobile - Gasoline (includes exhaust, brake and tire wear)	8
Commercial Cooking – Charbroiling	6
Agriculture/Livestock Dust	4
Prescribed Fires	3
Non-road Gasoline Equipment	3
Aircraft	2
Total	**45**

Source: Ibid. Estimates are rounded.

3.2 Nogales NA Future Year (2011) PM_{10} Emissions Projections

Projected emissions for 2011, shown in Table 3.3, were developed based on projected growth rates for population, industry, and motor vehicle activity for the Nogales NA. Motor vehicle emissions for 2011 are slightly lower than 2008 due to a newer cleaner fleet of vehicles and implementation of new fuel standards. The Federal Highway Administration's Highway Statistics statewide series data on Arizona shows a decline in Vehicle Miles Traveled (VMT) between 2007 and 2008, and no change in VMT between 2008 and 2009. This trend is consistent with economic conditions. As discussed in Section 1.0, population and economic growth is not expected between 2008 and 2011 due to current economic conditions. Accordingly, no increases in source categories affected by these factors are projected. The complete projected inventory and methodology for emissions projections are included in Appendix B.

Table 3.3
Projected PM_{10} Emissions 2008 and 2011 (tons per year)

Emissions Source Category	2008 tpy	2011 tpy	Projection Method
Dust - Unpaved Road Dust	864.9	864.9	No growth
Dust - Road Construction	267.0	267.0	No growth
Dust - Commercial/Industrial/Institutional Construction	142.6	142.6	No growth
Dust - Paved Road Dust	121.4	121.4	No growth
Fuel Comb - Residential - Wood	24.0	25.7	Population
Waste Disposal - Residential Garbage Burning	23.0	24.7	Population
Dust - Residential Construction	23.9	23.9	No growth
Mobile - Onroad Diesel (includes brake, tire, and exhaust)	19.4	13.2	Lower Emissions/MOVES
Mobile - Non-Road Equipment - Diesel	8.5	8.5	No growth
Mobile - Onroad Gasoline (includes brake, tire, and exhaust)	8.4	7.9	Lower Emissions/MOVES
Commercial Cooking - Charbroiling	6.3	6.7	Population
Fires - Prescribed Fires	3.4	3.4	No growth
Agriculture - Crops & Livestock Dust	4.3	4.3	No growth
Mobile - Non-Road Equipment - Gasoline	3.1	3.1	No growth
Mobile - Aircraft	2.3	2.3	No growth
Other (see Appendix B)	8.2	8.5	Various
TOTALS	**1530.7**	**1528.2**	

Source: 2011 PM_{10} Emissions Inventory for the Nogales NA, Santa Cruz County, Arizona (see Appendix B). Estimates are rounded.

4.0 Demonstration of Attainment in Accordance with Section 179B of the CAA

Section 179B of the Clean Air Act allows a State to demonstrate that exceedances of the PM_{10} NAAQS in the Nogales NA would not occur were it not for PM_{10} emissions from Nogales Municipality, Sonora, Mexico. In this section, the relevant data and observations taken from the following supporting analyses are reviewed:

- Clean Air Act, Section 179B Attainment Determination for the Nogales, Arizona PM_{10} Nonattainment Area;
- 2008 and 2011 Emissions Inventories for the Nogales NA;
- 2008 and 2011 Emissions Inventories for the Nogales Municipality, Sonora, Mexico; and,
- Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009.

This section provides a summary of these supporting analyses for this determination of attainment of the PM_{10} NAAQS, but for international emissions. These four analyses are provided in full and can be found in Appendices A through D of this Nogales Plan.[20]

Consistent with 40 CFR Part 50, appendix K, the standard used to determine attainment of the PM_{10} NAAQS in the Nogales NA, "but for" international emissions is as follows: the expected number of days per calendar year with a twenty-four hour average concentration above 150 µg/m3 must be equal to or less than one. Consequently, to determine that the Nogales NA has met the PM_{10} standard "but for" emissions from Mexico, the State must show through this analysis that no more than three exceedances (based on data completeness and every day sampling) over a three year period were due to emission sources arising within the Nogales NA, and that all other monitored exceedances of the NAAQS originate from Mexico.

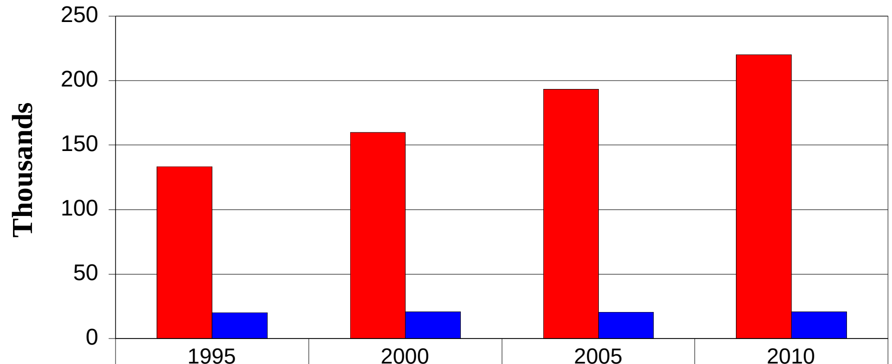
4.1 Population Growth in Nogales, Sonora

Population estimates provide an indication of anthropogenic PM_{10} emissions sources on both sides of the international border. The combined area of Nogales, Arizona, and the Nogales Municipality, Sonora, Mexico, is collectively known as Ambos Nogales. The Nogales Municipality, Sonora, Mexico

[20] The document "Clean Air Act, Section 179B Attainment Determination for the Nogales, Arizona PM_{10} Nonattainment Area" includes "2008 and 2011 Emissions Inventories for the Nogales NA", "2008 and 2011 Emissions Inventories for the Nogales Municipality, Sonora, Mexico", and "Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009" as supporting appendices A through C; therefore, all four analyses should be considered one document and when reading them one should keep in mind that they reference each other.
For ease of reference within this Nogales plan, however, these four documents have been split apart, are provided each with their individual appendix, and are cited as such herein. To avoid confusion, please keep in mind this difference as a frame of reference.

accounts for 90.2 percent of the 2010 population in the Ambos Nogales area.[21] Figure 4.1, below, depicts the rapid/regular population growth of the Nogales Municipality, Sonora, and the consistently low or no population growth of Nogales, Arizona.

Figure 4.1
Comparison of Ambos Nogales Population Growth 1995-2010



	1995	2000	2005	2010
Nogales Municipality, Sonora	133,491	159,787	193,517	220,292
Nogales, Arizona	20,184	20,878	20,421	20,837

4.2 Nogales, Sonora Emissions Inventories

The 2008 and 2011 Nogales Municipality, Sonora emissions inventories shown in Table 4.1 were derived from Mexico's 1999 National Emissions Inventory, using a methodology explained in detail within Appendix C. The Nogales, Sonora emissions inventories contain low and high estimates for point sources and paved and unpaved roads due to the relative uncertainty of scaling or calculating these estimates. Point source estimates are presented as a range because different calculation methods produced a difference in results. Paved and unpaved road estimates are presented as a range given the range of sample data used to calculate these source categories. Again, the methods and data used to develop these emissions estimates can be found in Appendix C. In both high and low inventories, fugitive emissions from paved and unpaved roads were identified as the greatest sources of the ambient PM_{10} concentrations in Nogales, Sonora. See Table 4.1.

[21] Table 1, "Clean Air Act, Section 179B Attainment Determination for the Nogales, Arizona PM_{10} Nonattainment Area" (see Appendix A).

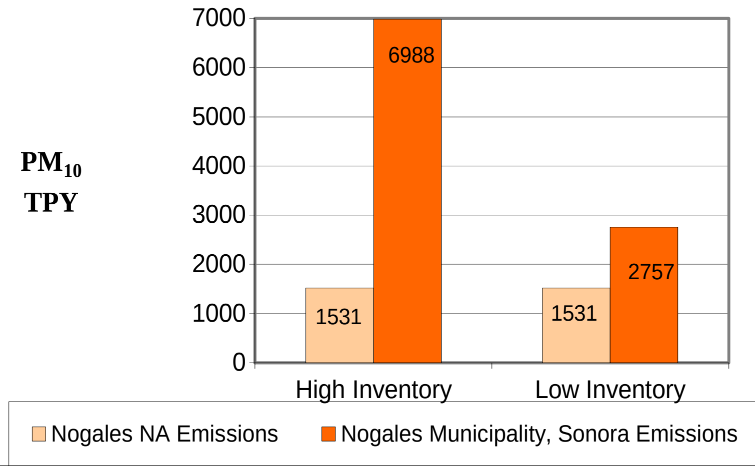
Table 4.1. 2008 and 2011 PM_{10} Emissions Inventories for Nogales Municipality, Sonora (tpy)[22]				
Source Category		**Range**	**2008**	**2011**
Point Sources		Low Estimate	1.1	1.1
		High Estimate	305	390
Area Sources	Unpaved Roads	Low Estimate	2,144	2,308
		High Estimate	5,521	5,944
	Paved Roads	Low Estimate	53	57
		High Estimate	646	696
	Agricultural Tilling		0.8	0.8
	Agricultural Burning		1.6	1.6
	Residential Wood Combustion		176	47
	Open Burning of Waste		55	56
	Construction Activities		23	24
	Remaining Area Sources		159	150
Mobile Sources			80	85
Nonroad Sources			20	27
Total		**Low Estimate**	**2,713**	**2,757**
Total		**High Estimate**	**6,987**	**7,420**

[22] Emissions are rounded to the nearest ton/year, or to the nearest tenth of a ton/year for emissions less than ten tons/year. Source: "2008 and 2011 PM_{10} Emissions Inventories, Nogales Municipality, State of Sonora, Mexico", March 2012. (See Appendix C).

4.3 Comparison of Ambos Nogales Emissions Inventories

Nogales NA, Arizona and Nogales Municipality, Sonora have similar sources of PM_{10}, primarily fugitive dust from unpaved and paved roads, as well as combustion sources and construction. A comparison of the Nogales, Sonora 2008 low emission inventory and the 2008 Nogales NA inventory concludes that there is a 64/36 percent split in total Ambos Nogales emissions between emissions from Sonora and Arizona; a comparison of the 2008 high emission inventory suggests that there is an 82/18 percent split between emissions from Sonora and Arizona. Figure 4.2 depicts the emissions split. A different metric comparing the emissions inventory data shows that for every one ton of PM_{10} produced in the Nogales NA, there were between 1.8 and 4.6 tons of PM_{10} emissions produced annually in the Nogales Municipality.

Figure 4.2
Nogales, Sonora 2008 High and Low Inventories Compared to Nogales NA 2008 Inventory



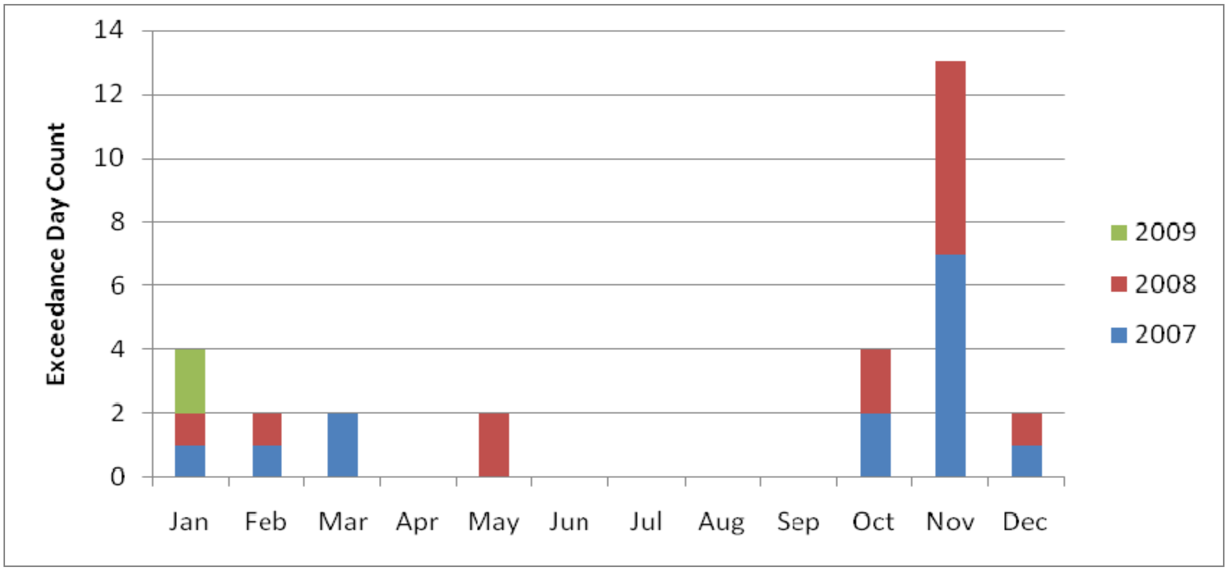
Source: Appendices B and C.

4.4 PM_{10} Exceedance Analyses – Ambient Monitoring Data, Wind Speed, and Temperature Changes

For these analyses, ambient monitoring data from 2007-2009 collected by the by the continuously operating Beta Attenuation Monitor (BAM) monitor was examined; data collected by the BAM in 2010 did not meet CAA completeness criteria, and 2011 data was not compiled and certified at the time of this analysis. Over the 2007-2009 timeframe, 29 exceedances of the NAAQS were recorded by the BAM at the Nogales, Arizona Post Office.[23] Data recorded by the BAM monitor was selected for the analysis because the monitor recorded the greatest number of exceedances at the monitoring site and records hourly ambient PM_{10} values. The meteorological monitor at the site also provides hourly wind speed and direction data. The majority of the 29 exceedance days in our 2007 to 2009 study timeframe, 23 exceedances (or 79 percent), occurred during October to January, mostly in November. See Figure 4.3.

[23] Arizona has not flagged any of these 2007 through 2009 exceedance days for potential exclusion from air quality planning considerations under EPA's Exceptional Events Rule.

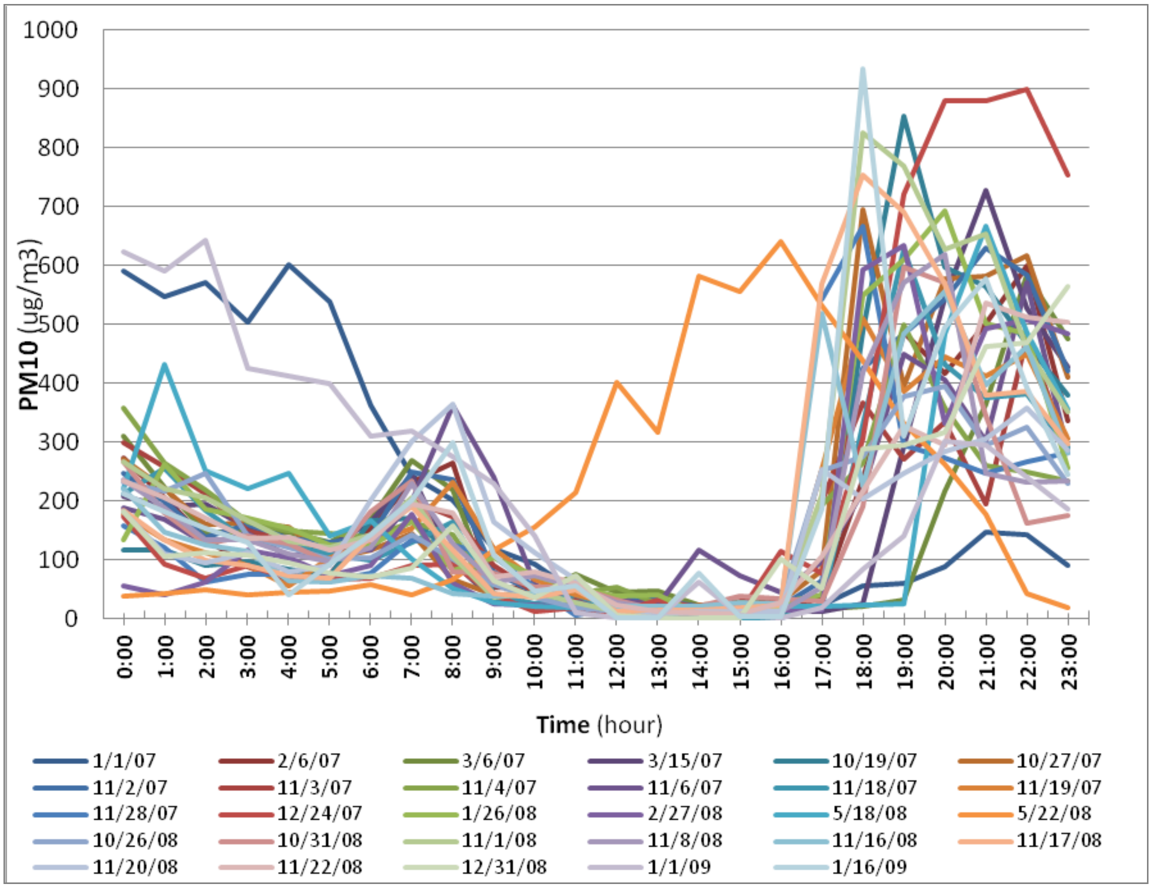
Figure 4.3
PM_{10} Exceedances at the Nogales, Arizona Post Office, by Month and Year



Source: EPA AQS database.

Analysis of ambient air quality data identified 26 of the 29 exceedances as having nearly identical hourly emission, wind speed and temperature profiles. As shown in Figures 4.4 and 4.5, the exceedance days began with a repeated pattern of declining PM_{10} concentrations in the early morning hours followed by a pronounced increase starting at 6:00 am and a decline around 9:00 a.m. Figures 4.6 and 4.7 demonstrate that wind speeds and temperatures rise, dispersing the spike in morning PM_{10} concentrations. As the day progresses, ambient PM_{10} concentrations reach their lowest points between 10:00 am and 4:00 pm. As temperatures drop by as much as 20 degrees Fahrenheit over 3 to 4 hours and wind speeds drop through the evening, a spike in PM_{10} concentrations between 4:00 pm and 6:00 pm is observed that may correspond with evening commute hours. Ambient concentrations remain high for several hours through the evening, before eventually declining around 10:00 pm.

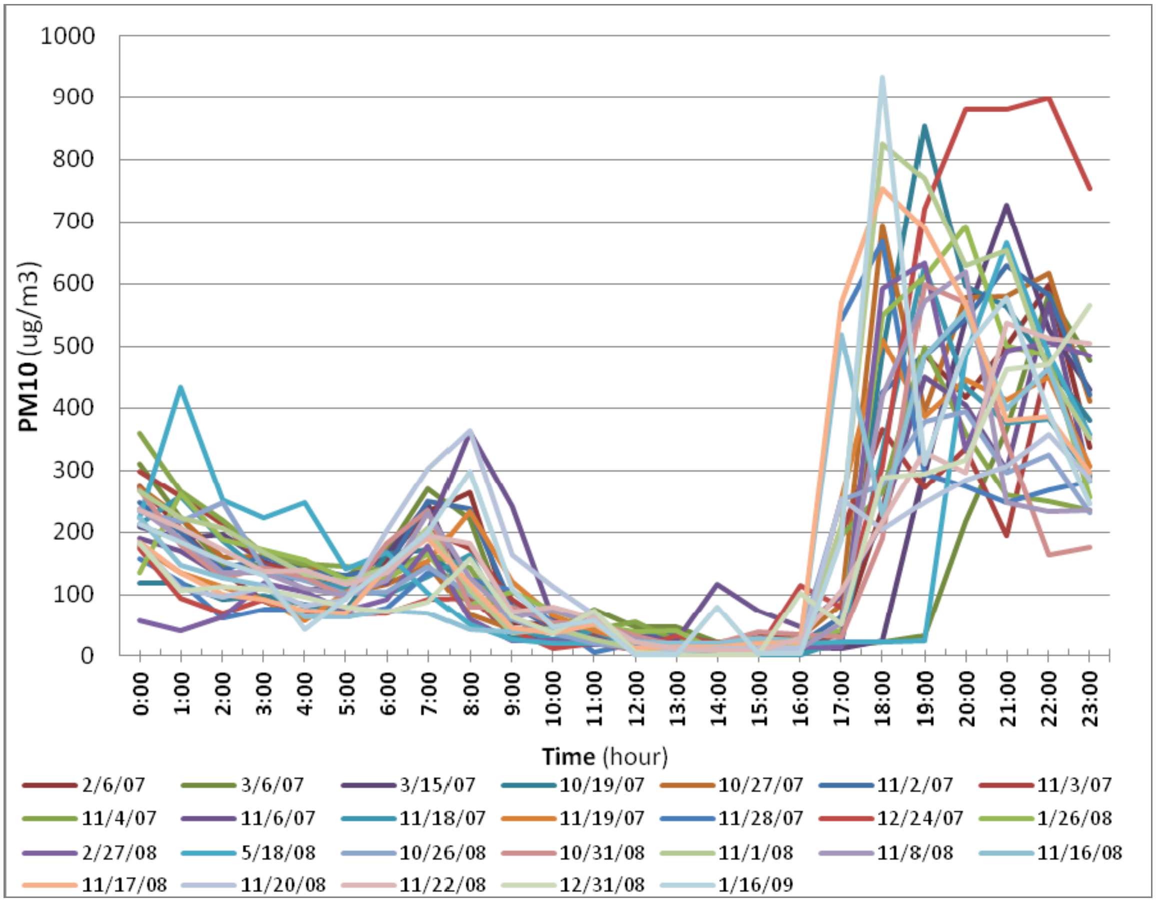
Figure 4.4
Hourly Ambient PM_{10} Concentrations on 29 Exceedance Days



Source: "Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009" (see Appendix D)

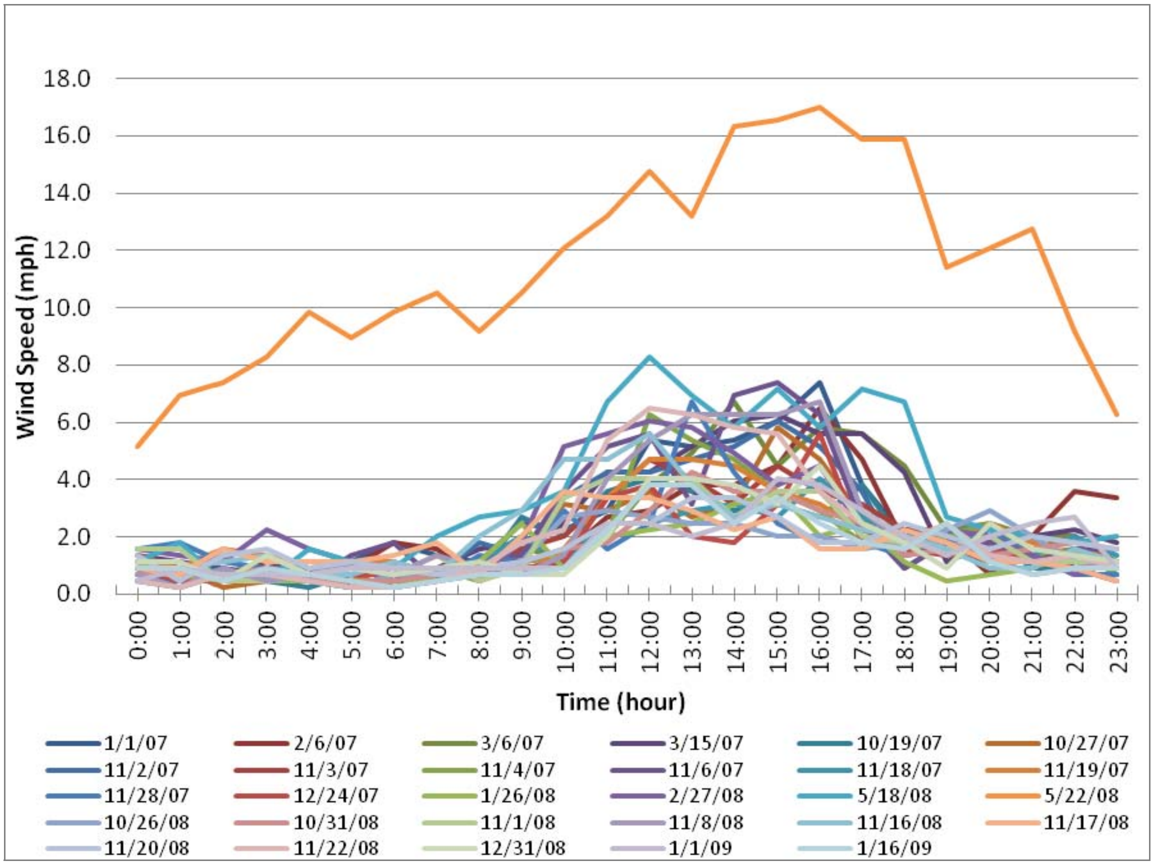
Figure 4.5

Hourly Ambient PM_{10} Concentrations on 26 Similar Exceedance Days, Excluding the Following Days: January 1, 2007; May 22, 2008; and January 1, 2009



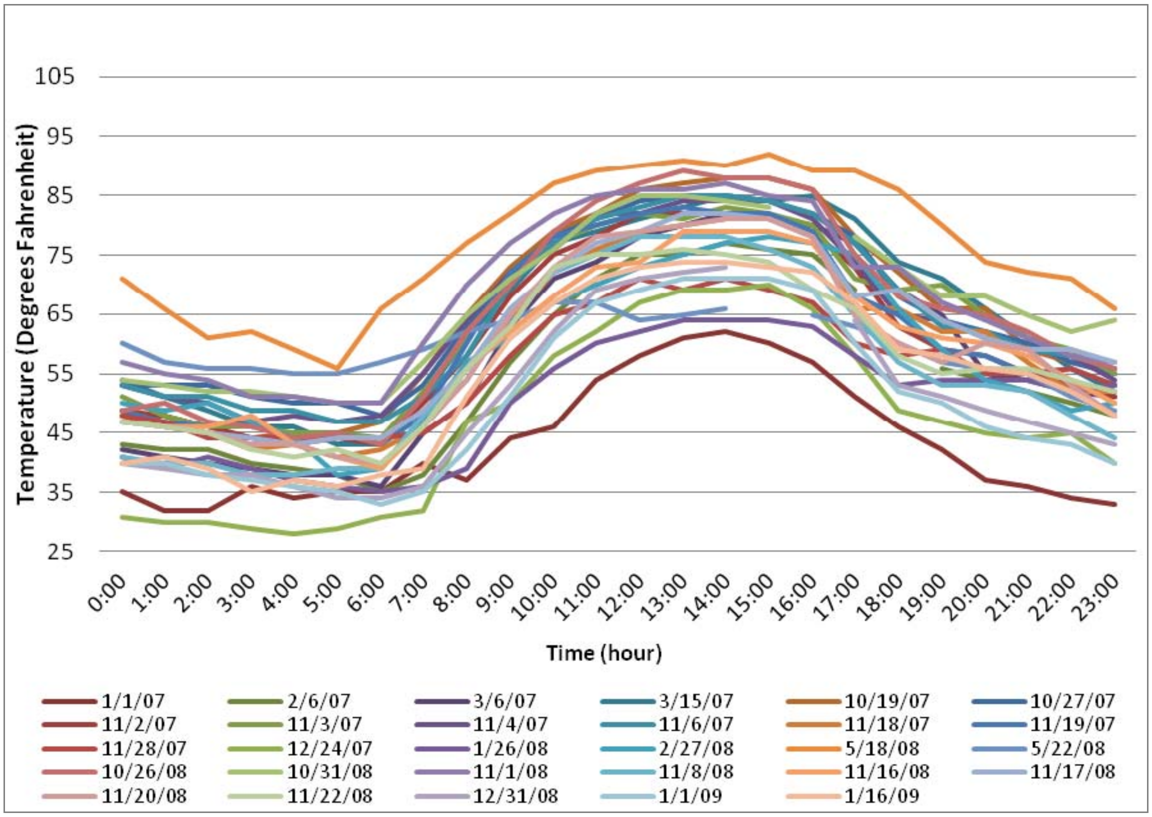
Source: Ibid.

Figure 4.6:
Hourly Wind Speed Variations on 29 Exceedance Days



Source: Ibid.

Figure 4.7:
Hourly Temperature Variations on 29 Exceedance Days

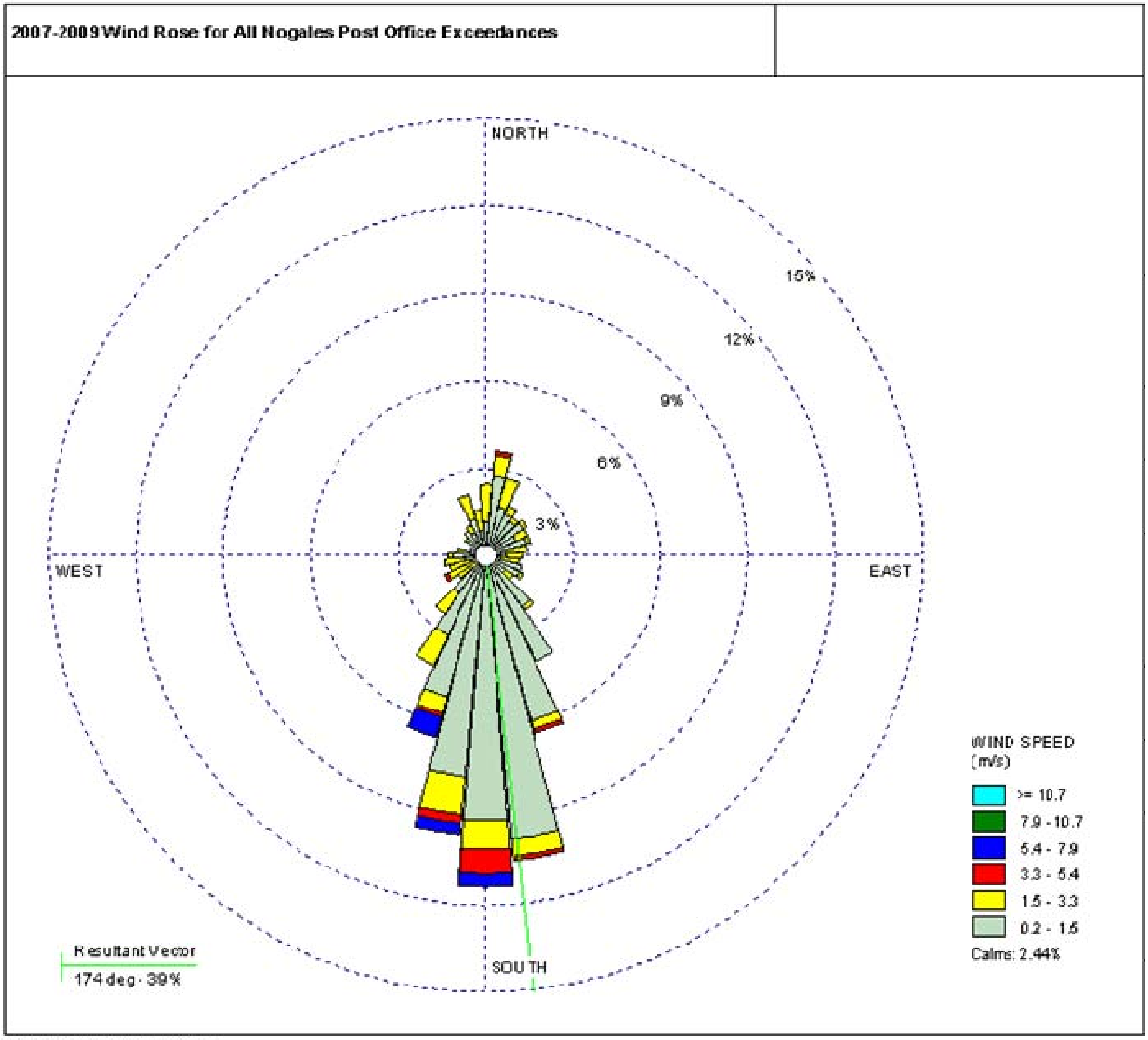


Source: Ibid.

4.5 Wind Direction and Pollution Rose Analyses

Wind roses were used to depict wind direction and speed on exceedance dates in Ambos Nogales. Wind roses depict hourly wind direction and wind speed values collected over 24 hours; the wind data is then sorted by direction so that the percentage of time that the wind was blowing from each direction can be determined. Wind speed data is then superimposed on each of the wind rose's twelve 30º segments to illustrate the average wind speed when the wind was blowing from that segment's direction. Figure 4.8 depicts the wind speeds and directions for all of the 29 PM_{10} exceedances analyzed. A clear pattern of winds from a southerly direction traveling at low speeds emerges on exceedance days.

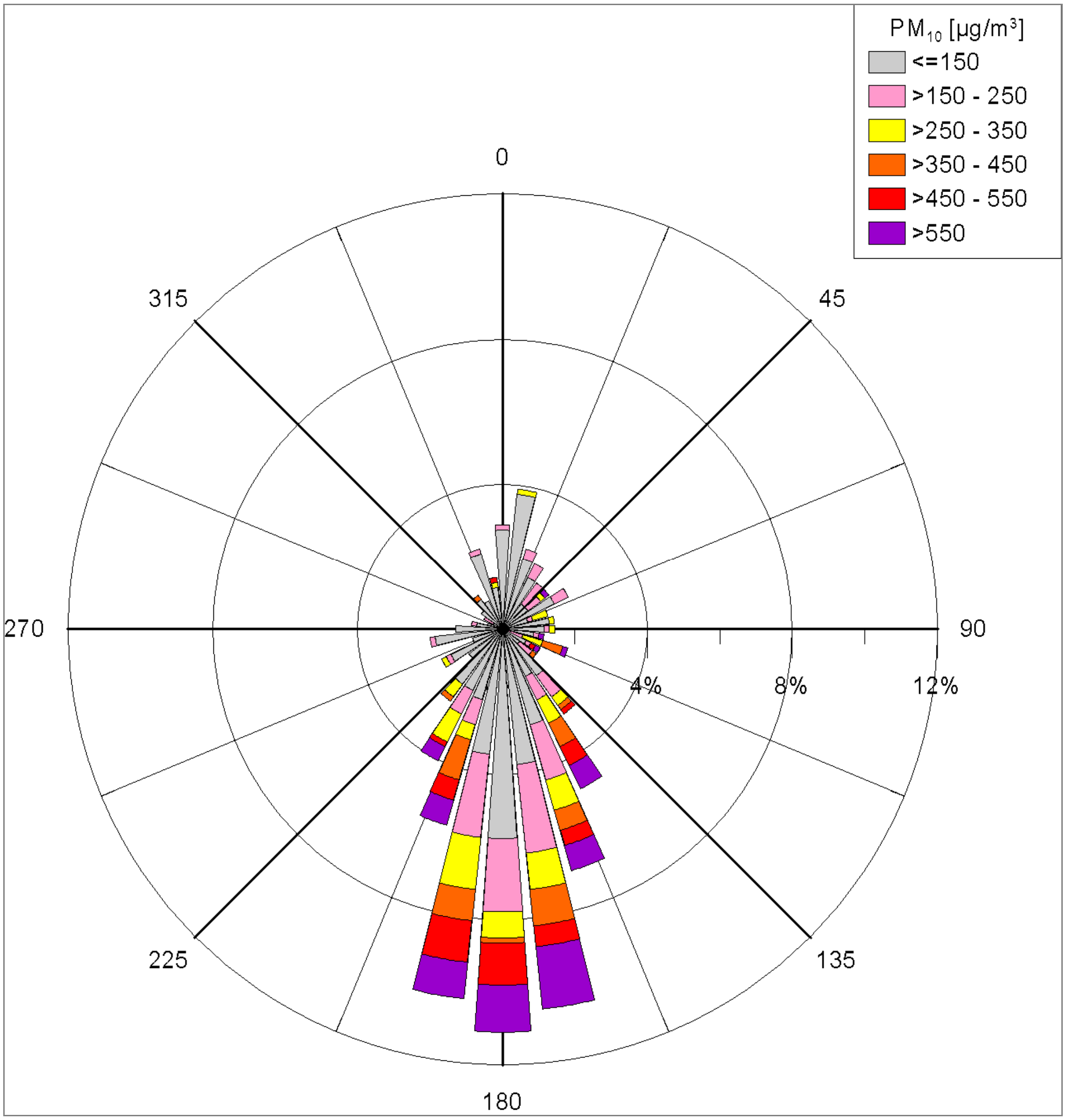
Figure 4.8
Wind Rose of Wind Speed vs. Wind Direction at the Nogales, Arizona Post Office BAM Monitor for all 29 Exceedance Days



Source: Appendix D - Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009

Pollution rose analyses substitute ambient hourly PM_{10} values for wind speed to provide a depiction of wind direction and correlated ambient concentrations. The result is a graphical representation of the possible directionality of pollution sources and the ambient concentration levels time-linked with those wind direction observations. See Figure 4.9. A review of the hourly ambient data shows that on exceedance days, 71-92 percent of hourly values exceeding 150 $\mu g/m^3$ and 92 percent of the highest observed PM_{10} concentrations (above 450 μg/m^3), are associated with a southerly wind direction (135-225 degrees).[24] Appendix D includes additional wind and pollution rose analyses.

Figure 4.9
Pollution Rose of PM_{10} Concentration vs. Wind Direction at the Nogales, Arizona Post Office BAM for all 29 Exceedance Days



Source: Appendix D - Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009.

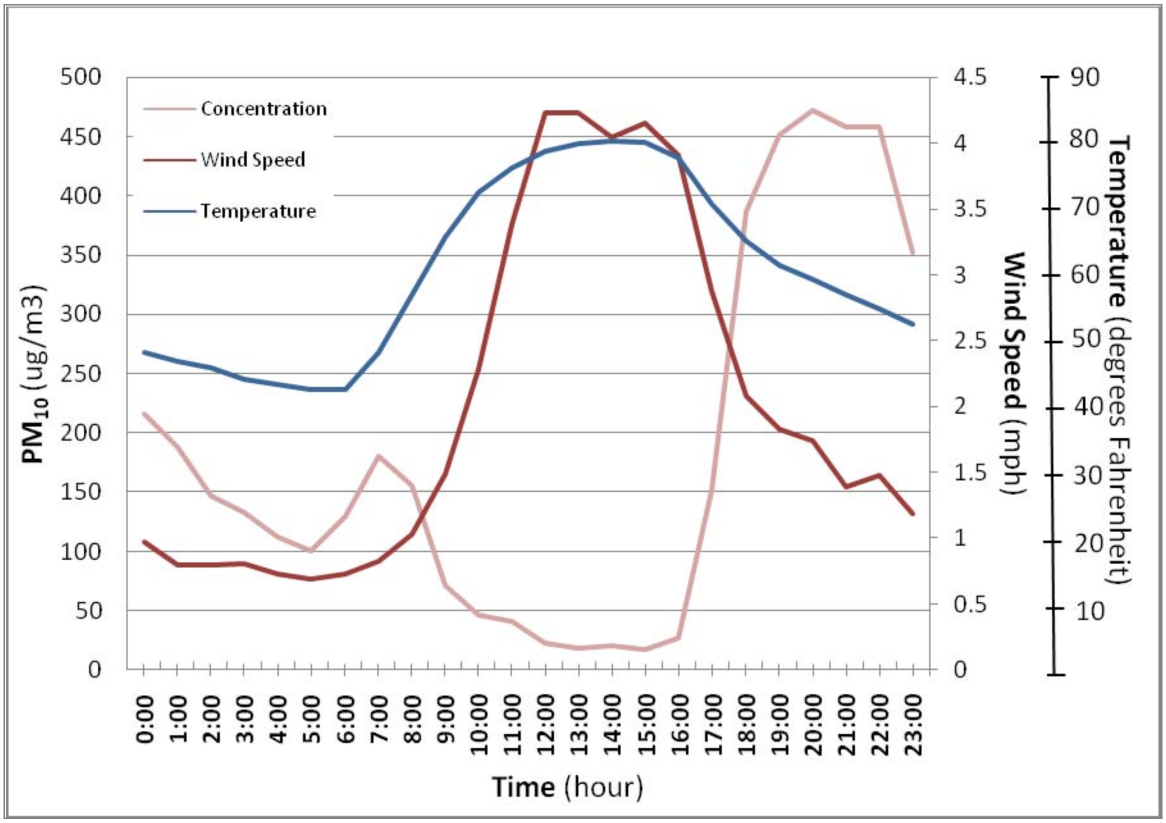
---

[24] See Table 11 in "Clean Air Act, Section 179B Attainment Determination for the Nogales, Arizona PM_{10} Nonattainment Area" (see Appendix A). Section 3.3.1 of that document provides additional analyses of ambient PM_{10} values and wind direction.

4.6 A Conceptual Model of 2007-2009 Exceedance Days

As described in Section 4.4, 26 of the 29 2007 - 2009 exceedances showed a similar pattern of ambient PM_{10} concentration, wind speeds, wind direction, and temperature variation over a twenty-four hour period. The three exceptions were the January 1, 2007, May 22, 2008, and January 1, 2009 exceedance days. Two of these days, January 1, 2007 and January 1, 2009, with higher early morning PM_{10} concentrations, only vary slightly from the diurnal profile of PM_{10} concentrations observed for the other exceedances, but these two days have similar meteorological and concentration patterns throughout the rest of the day. Also, two of the 29 exceedance days, January 1, 2007, and January 26, 2008, showed high average ambient concentrations during hours when the wind was from directions other than the southerly 90 degree quadrant (135-224 degrees on a compass). Thus, there are twenty-five exceedance days that are equivalent and can be considered here as a group, setting aside the dissimilar exceedance days listed above, January 1, 2007, January 26, 2008, May 22, 2008, and January 1, 2009. These remaining 25 similar exceedance days provide the basis for a daily conceptual model consistent with ambient concentrations, wind speed and direction, temperature changes, diurnal heating and cooling pattern, and relative pollution loads discussed in sections 4.2, 4.3, and 4.4 above. See Figure 4.10.

Figure 4.10
Average Hourly PM_{10} Concentration, Wind Speed, and Temperature at the Nogales, Arizona Post Office BAM vs. Time of Day for all Exceedances Excluding January 1, 2007, May 22, 2008, and January 1, 2009[25]



Source: Ibid.

To review the conceptual model and average PM_{10} concentration, wind speed, and temperature profiles in Figure 4.10, beginning at midnight and through the early morning hours, there is a strong pattern of decreasing PM_{10} concentrations from the previous day's high values. Then, in the morning hours, there is a pronounced PM_{10} increase and drop-off between 6:00 am and 9:00 am, suggesting an almost daily reproducible PM_{10} source, such as fugitive road dust from the morning commute. As morning temperatures rise, so does wind speed and wind direction changes from south to north dispersing the morning spike in PM_{10} concentrations. PM_{10} concentrations continue to fall through the afternoon and reach their lowest points between 10:00 am and 4:00 pm. The morning and afternoon increases in ambient temperature and wind speed can be attributed to the heating portion of a diurnal heating and cooling cycle where heated air flows from lower elevations to the north to the higher elevations to the south.

[25] The diurnal pattern shown in Figure 4.10 applies to 25 very similar exceedance days and also includes January 26, 2008 given this day's similar diurnal profile. Elements of the conceptual model discussion, however, may not apply to January 26, 2008 because of the higher observed PM_{10} concentrations when winds were from the east southeast and outside of the 90 degree southerly wind direction quadrant. For this reason, the January 26, 2008 exceedance day was examined in further detail along with the other three exceedance days, January 1, 2007, May 22, 2008, and January 1, 2009.

As evening approaches and night falls, the diurnal cooling cycle begins as ambient temperatures drop and lower elevation air masses no longer rise with convection causing wind speed to drop and wind direction to vary. As temperatures continue into the night, wind speeds drop and cold air masses flow down from higher elevations in Nogales, Sonora causing wind direction to shift from a variable/northerly direction to a southerly direction. A corresponding and pronounced spike in PM_{10} concentration is observed beginning between 4:00 pm and 6:00 pm, again suggesting an almost daily reproducible PM_{10} source, such as fugitive road dust from the evening commute. Concentrations remain high for several more hours into the night and gradually begin to decrease as midnight approaches. The highest concentrations of PM_{10} occur in these evening hours when dust from vehicle traffic on unpaved and paved roads may be captured by cold air flows from higher elevations and moving south to north. Also, home heating combustion may be part of the evening PM_{10} load and is captured in the evening northerly air flows.

Usually, this pattern of exceedances is observed during times when the general weather pattern allows for stagnation and a relatively still air mass subject to movement by the diurnal cooling and heating cycle. At other times of the year, frontal weather systems move through often enough and with enough energy to prevent a stagnant air mass and the diurnal heating and cooling cycle from exerting a strong influence on the local meteorology and from causing exceedances of the PM_{10} standard.

It should be noted that this conceptual model is consistent with the study by Arizona State University, "*Atmospheric, Hydroclimatic, and Anthropogenic Causes of Fugitive Dust in the Nogales, Arizona-Nogales, Sonora Airshed*."[26] In this study, the authors conclude that stagnant atmospheric conditions over a large scale are the most important factor in predicting high daily PM_{10} concentrations in the Ambos Nogales area.

Finally, for these similar 25 days, the ambient concentration attributed to the southerly wind direction quadrant (90 degrees) always exceeds the 150 $\mu g/m^3$ level, in most cases markedly. Conversely, the ambient concentration attributed to the all other wind direction quadrants (the remaining 270 degrees) never exceeds the 150 $\mu g/m^3$ level. Across all 25 exceedance days, the average concentration value for the southerly wind direction quadrant concentration is 264 $\mu g/m^3$, with the range for each day's average concentration being 163 to 369 $\mu g/m^3$. In comparison, the average concentration value across these 25 exceedance days for the all other wind direction quadrants is 80 $\mu g/m^3$, with the range for each day's average being 38 to 148 $\mu g/m^3$.[27]

4.7. Review of Exceedance Days Differing From 25-Day Conceptual Model

As described in Section 4.6, the data support the finding that at least 25 of 29 exceedances of the PM_{10} standard in the Nogales NA can be attributed to sources of PM_{10} originated from across the international border. There are, however, four exceedance days that differ in one or more ways from the conceptual model of PM_{10} exceedances in the Nogales NA: January 1, 2007; May 22, 2008; January 26, 2008; and January 1, 2009.

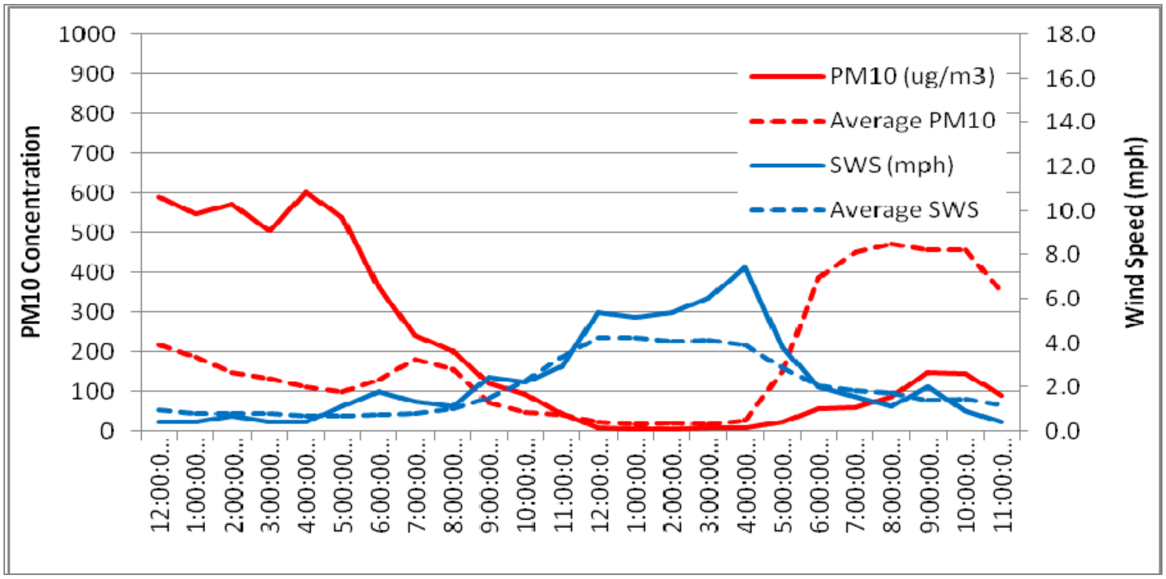
---

[26] Completed in 2002 by A.W. Ellis, the final report is available through The Southwest Center for Environmental Research and Policy at http://scerpfiles.org/cont_mgt/doc_files/A-02-2.pdf.

[27] See Table 12 of Appendix A for average hourly concentrations segregated into those attributed to the southerly wind quadrant and the 270 degree all other wind direction quadrant for all exceedance days.

January 1, 2007 and January 1, 2009 had a diurnal pattern that varied from the conceptual model and further analysis showed a higher $PM_{2.5}$ component compared to the remaining 27 exceedance days, suggesting a larger contribution from combustion sources such as residential wood burning.[28] See Figures 4.11 and Figure 4.12.

Figure 4.11
January 1, 2007 PM_{10} Concentrations and Wind Speeds Compared to 26 Exceedance Day Average PM_{10} Concentrations and Wind Speeds from Figure 4.10

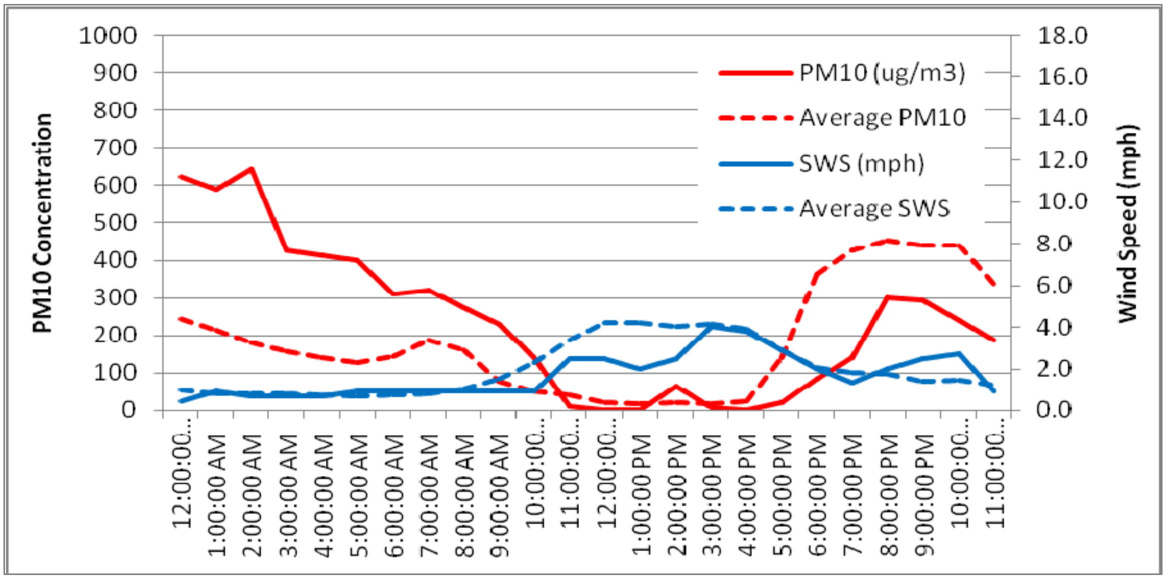


Source: Appendix D - Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009.

[28] See Section 4.4, of Appendix D for discussion of $PM_{2.5}$ concentrations relative to PM_{10} concentrations for the 29 exceedance days.

Figure 4.12

January 1, 2009 PM_{10} Concentrations and Wind Speeds Compared to 26 Exceedance Day Average PM_{10} Concentrations and Wind Speeds from Figure 4.10

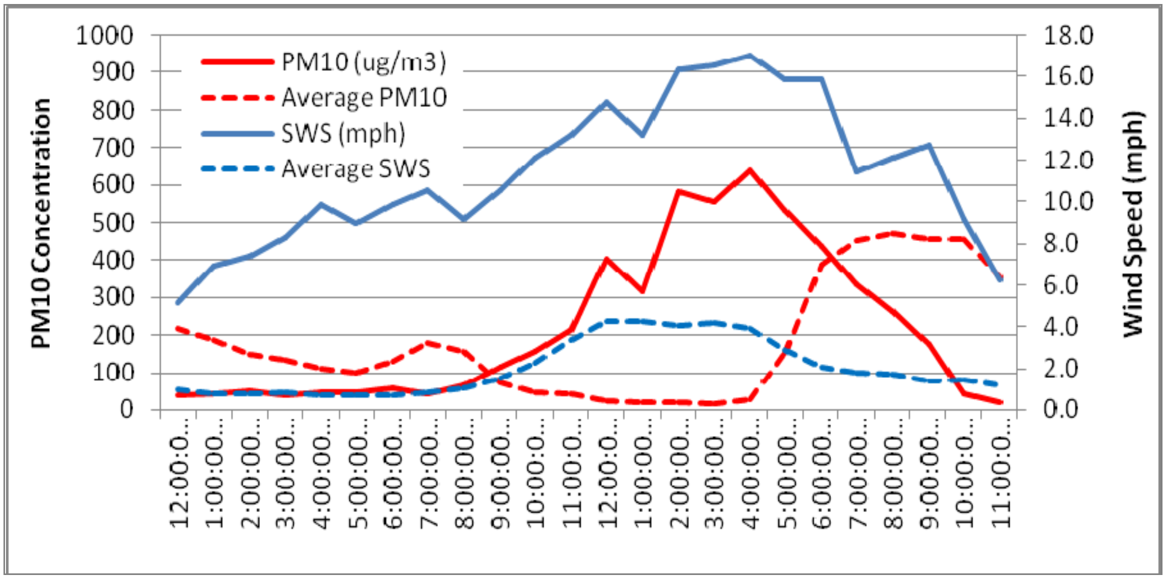


Source: Ibid.

The May 22, 2008 exceedance is associated with high winds. Most of the highest hourly concentrations in the 29 exceedance days occurred on May 22, 2008. The PM coarse component on this day was higher compared to the remaining 28 exceedance days suggesting a large contribution from fugitive dust sources such as open area, and unpaved and paved roads.[29] Furthermore, all wind direction observations were southerly. See Figure 4.13 below.

[29] See Section 4.4 of Appendix D for discussion of $PM_{2.5}$ concentrations relative to PM_{10} concentrations for the 29 exceedance days.

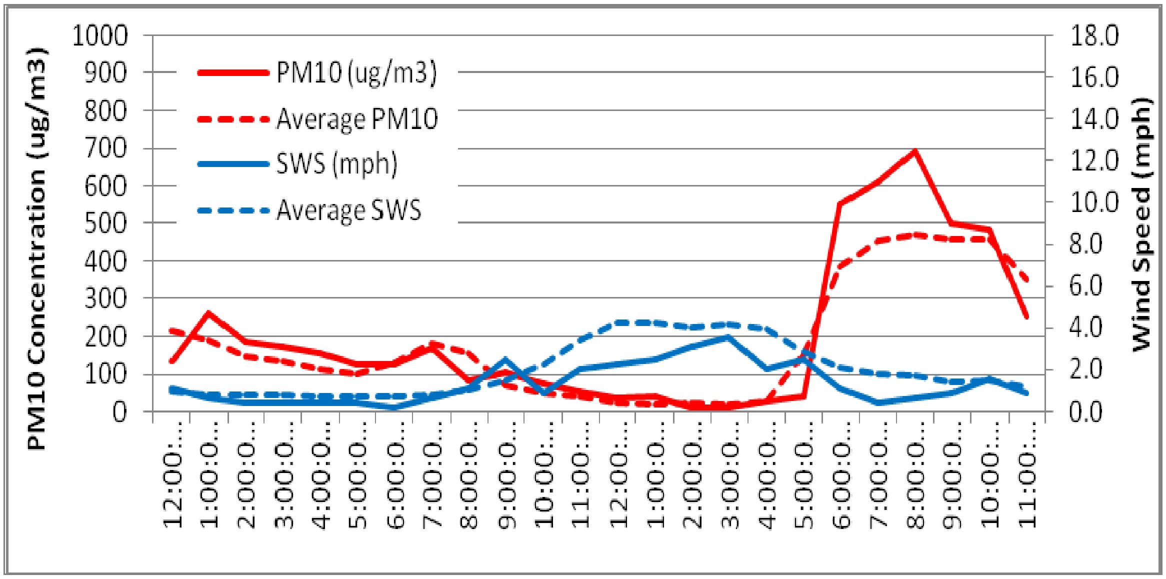
Figure 4.13
May 22, 2008 PM_{10} Concentrations and Wind Speeds Compared to 26 Exceedance Day Average PM_{10} Concentrations and Wind Speeds from Figure 4.10



Source: Appendix D - Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009.

As described earlier, January 26, 2008 has a similar diurnal pattern to the 25-day conceptual model. See Figure 4.14. Other elements of the conceptual model, however, may not apply to January 26, 2008 because of the higher observed PM_{10} concentrations when winds were from the east-southeast and outside of the 90-degree southerly wind direction quadrant. This results in high average concentrations for all the other wind direction quadrants. See Table 4.2 below.

Figure 4.14
January 26, 2008 PM_{10} Concentrations and Wind Speed Compared Average PM_{10} Concentrations and Wind Speeds from Figure 4.10



Source: Ibid.

In addition to diurnal patterns, high concentrations from the "all other wind direction" quadrants were examined for these four exceedance days. On all 29 exceedance days, the ambient PM_{10} concentration attributed to the southerly wind quadrants exceeds 150 µg/m^3. In contrast, two exceedance days from the "all other wind direction" quadrants show a value greater than 150 µg/m^3: January 1, 2007 and January 26, 2008. Only one of 29 exceedance days shows the concentration attributed to the "all other wind direction" quadrant greater than that of the concentration attributed to the southerly wind quadrant: January 1, 2007. See Table 4.2.

Table 4.2
24-hour Concentration and Hourly Concentrations Disaggregated by Southerly Wind Direction Quadrant for Exceedance Days Differing from Conceptual Model

Date	24-hour PM_{10} Concentration (µg/m^3)	Southerly Wind Quadrant PM_{10} Average Concentration (µg/m^3) (135 to 224 degrees)	All Other Wind Direction PM_{10} Average Concentration (µg/m^3) (225 to 134 degrees)
January 1, 2007	210	199 (15 of 24 values)	231 (9 of 24 values)
January 26, 2008	204	257 (7 of 24 values)	182 (17 of 24 values)
May 22, 2008	217	217 (24 of 24 values)	No Observed Values
January 1, 2009	238	323 (14 of 24 values)	119 (10 of 24 values)

Source: Air Quality System database.

4.8 Expected Exceedance Days "But For" International Transport from Mexico

Consistent with 40 CFR Part 50, appendix K, the standard used to determine attainment of the PM_{10} NAAQS in the Nogales NA, "but for" international emissions is as follows: the expected number of days per calendar year with a twenty-four hour average concentration above 150 µg/m^3 must be equal to or less than one. Consequently, to determine that the Nogales NA has met the PM_{10} standard "but for" emissions from Mexico, this analysis must show that no more than three exceedances (based on data completeness and every day sampling) in the 2007-2009 analysis period were due to emission sources arising within the Nogales NA, and that all other monitored exceedances of the NAAQS originate from Mexico. Two analyses were used to examine the issue of expected exceedances but for international emissions: a daily analysis reviewing selected exceedance days; and, an analysis of observed hourly concentrations designed to estimate a Nogales NA 24-hour average concentration after accounting for the influence of international emissions.

4.8.1 Daily Analysis of Expected Exceedances

From the day-by-day review above, it is possible to determine whether or not to assign the four exceedance days in question, January 1, 2007, January 26, 2008, May 22, 2008, and January 1, 2009 to the category of exceedance days having a significant contribution from sources on the Nogales, Sonora side of the international border.

The May 22, 2008 exceedance day is completely different from the conceptual model exceedance day because of the relative high wind speeds and higher than usual coarse PM (e.g., unpaved roads) component. As with total PM_{10} emissions, emissions of coarse PM are higher from Nogales, Sonora, than they are from the Nogales NA. The wind direction is from a southerly quadrant in all hourly concentration observations. Given this information, this day should be placed with the 25 other exceedance days in the conceptual model, because it is likely that the sources of PM_{10} causing the exceedance originated from the Nogales, Sonora side of the international border.

The January 1, 2009 exceedance day is different from the conceptual model exceedance day in the timing and distribution of observed ambient PM_{10} values and high $PM_{2.5}$ component most likely caused by a combustion source. As with total PM_{10} emissions, emissions of fine PM (e.g., combustion sources) are higher from Nogales, Sonora, than they are from the Nogales NA. The key factor for assigning this day is the contribution of high hourly ambient concentrations with a southerly wind direction quadrant compared to the remaining 270 degree wind direction quadrants (see Table 4.2 above). Consequently, this day should be placed with the 25 other exceedance days in the conceptual model, because it is likely that the sources of PM_{10} causing the exceedance originated from the Nogales, Sonora side of the international border.

Considering the January 1, 2007 exceedance day, it also differs from the conceptual model exceedance day in the timing and distribution of observed ambient PM_{10} values and high $PM_{2.5}$ component. What differs in the case of the January 1, 2007 exceedance is that the 270 degree wind direction quadrants contains enough high values to contribute disproportionately to the overall twenty-four hour average concentration (see Table 4.2). Although more detailed and different field studies might prove otherwise, with the information available, this analysis is inconclusive as to whether this exceedance can be attributed solely to a disproportionate international contribution from Nogales, Sonora.

Finally, the January 26, 2008 exceedance day is most like the conceptual model exceedance day in the timing and distribution of observed ambient PM_{10} values. While the southerly wind direction quadrant contains enough high values to contribute disproportionately to the overall twenty-four hour average concentration, there are enough remaining high values in the 17 of 24 hourly observations from the 270 degree wind direction quadrants to be above the 150 $\mu g/m^3$ level (see Table 4.2). Again, while specifically designed field studies might help determine the relative contributions to this exceedance, with the information available, this analysis is inconclusive as to whether this exceedance can be attributed solely to a disproportionate international contribution from Nogales, Sonora.

To summarize, two exceedance days, May 22, 2008 and January 1, 2009, should be categorized with the 25 exceedance days where there is a high likelihood of a large contribution of PM_{10} from sources on the Nogales, Sonora side of the international border across from the Nogales NA. The two remaining exceedance days, January 1, 2007 and January 26, 2008, may have a contribution from sources on the Nogales NA side of the international border such that one cannot say whether there is a high likelihood that the area would not have exceeded the PM_{10} standard but for PM_{10} emissions originating from the Nogales, Sonora side of the international border.

4.8.2 Hourly Analysis of Expected Exceedances

In this analysis, each hourly concentration value from the 29 exceedance days was classified based on the likely influence from Mexico according to four criteria or decision rules. An hourly concentration value that was classified by a given decision rule was then weighted by 0.36, representing the maximum proportion of Nogales NA emissions compared to the total Ambos Nogales regional emissions and equivalent to assuming a 36 percent contribution from U.S. sources during those hours.[30] Then, a 24-hour average concentration was recalculated to determine what concentration would have occurred but for international transport of PM_{10} emissions from Nogales, Sonora.

To review the decision rules for classifying the hourly values per Mexican influence, the first decision rule identified periods consistent with sustained high winds from the south carrying wind-blown dust, as discussed earlier concerning the May 22, 2008 exceedance day. The second and third decision rules identified daily periods influenced by downslope wind flow conditions usually occurring in the late afternoon and evening, indicative of sustained downslope air flows from higher elevations south of the international border. The fourth decision rule identified periods of sustained air mass stagnation usually found in the late night and early morning hours after the early evening downslope wind or air flow has ebbed and before sunrise, after which wind speeds begin to increase from their overnight low values.

To show the effects of each decision rule, an estimated 24-hour concentration was calculated after the application of Rule 1, Rules 2 and 3, Rules 1-3, and Rules 1-4. The results are summarized below.[31]

- The application of Rule 1 only removes one day, May 22, 2008; leaving 28 days showing a concentration value greater than 150 $\mu g/m^3$.
- The application of Rules 2 and 3 removes 27 days; leaving January 1, 2007 and January 26, 2008 showing a concentration value greater than 150 $\mu g/m^3$; 196.8 $\mu g/m^3$ and 244.1 $\mu g/m^3$, respectively.
- The application of Rules 1, 2, and 3 again removes 27 days; leaving January 1, 2007 and January 26, 2008 showing a concentration value greater than 150 $\mu g/m^3$; 196.1 $\mu g/m^3$ and 244.1 $\mu g/m^3$, respectively.
- The application of Rules 1, 2, 3, and 4 removes 29 days; leaving no estimated days with a value greater than 150 $\mu g/m^3$.

In conclusion, this analysis of hourly concentration values, demonstrates that at least 27 of 29, and possibly all 29 exceedances of the PM_{10} NAAQS observed in the Nogales NA during 2007 - 2009 can be attributed to sources of PM_{10} from across the international border.

---

[30] See the emission inventory comparisons of the Nogales NA and the Nogales Municipality in Section 4.3.

[31] See Section 3.7 of Appendix D "Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009" for a complete discussion of the decision rules and all estimated 24-hour concentrations.

4.9 Conclusion

A nonattainment area meets the national ambient air quality standard (NAAQS) for PM_{10} when the expected number of days per calendar year with a twenty-four hour average concentration above 150 $\mu g/m^3$ are less than or equal to one. To determine that the Nogales NA has met the PM_{10} standard "but for" emissions from Mexico, this analysis must show that no more than three exceedances of the standard in the 2007-2009 analysis period were due to sources within the Nogales NA and all other exceedances were caused by sources originating from across the international border. This analysis found that 27 of 29 exceedance days were due to transport of PM_{10} emissions from sources on the Nogales, Sonora side of the international border. Consequently, when considering a maximum of two remaining exceedances, the expected annual exceedance rate for 2007-2009 is 0.7 exceedances per year. Since the annual expected exceedance rate is less than one, the State has demonstrated that the Nogales NA would attain the PM_{10} NAAQS "but for" PM_{10} emissions originating in Mexico.

5.0 CONTROL MEASURES

This section discusses the selection, implementation, and results of reasonably available control measures (RACM) and technology (RACT) implemented in the Nogales Nonattainment Area (NA).

The Arizona Administrative Code (AAC) rules already approved in the State SIP and relied upon for this plan are listed in Table 5.1.

Table 5-1
Arizona Administrative Code Rules Approved into the Arizona SIP for PM_{10} Sources

Rule		FR Date	FR Citation
R9-3-404	Open Areas, Dry Washes, or Riverbeds	4/23/1982	47 FR 17485
R9-3-405	Roadways and Streets	4/23/1982	47 FR 17485
R9-3-406	Material Handling	4/23/1982	47 FR 17485
R9-3-407	Storage Piles	4/23/1982	47 FR 17485
R9-3-410	Evaluation of Non-point Source Emissions	4/23/1982	47 FR 17485
R9-3-502	Standards of Performance for Unclassified Sources	10/19/1984	49 FR 41026
R9-3-522	Standards of Performance for Existing Gravel and Stone Crushing Operations	9/28/1982	47 FR 42572
R18-2-702[32]	General Provisions	8/24/2004	69 FR 51952

5.1 Definition and Selection of RACM/RACT

EPA defines RACM/RACT as measures that a State finds are both reasonably available and contribute to attainment as expeditiously as practicable. When developing a SIP for a moderate PM_{10} nonattainment area, the State is required to provide an analysis identifying which of EPA's RACM and RACT are appropriate for controlling significant PM_{10} sources. The State is instructed to begin with EPA's suggested RACM and RACT for fugitive dust, prescribed burning, and residential wood burning (57 FR 13540; April 16, 1992). The CAA also directs the State to consider potential control measures proposed by the local community during the public comment period as well as RACM in other similar areas. The RACM selected by the State must provide emissions controls for sources identified in the emissions inventory as significant sources of PM_{10} emissions. RACM are not required for insignificant sources, controlled sources where additional measures would not expedite attainment of the NAAQS, or for sources not present in the nonattainment area.

The emissions inventory in the 1993 Nogales NA SIP and the 2008 emissions inventory in Section 3.0 cited the same significant PM_{10} emissions source categories for the Nogales NA. Accordingly, ADEQ is evaluating the implementation of control measures from the 1993 Nogales NA SIP within this plan.

[32] R18-2-702, General Provisions, reflects the current R18 Arizona Administrative Code numbering format. The R9 series of rules were subsequently renumbered as well, but have only been approved by EPA in the original numbering format.

5.1.2 RACM Analysis for the Nogales NA Area

The emissions inventory in ADEQ's 1993 Nogales NA SIP identified emissions from unpaved roads as the greatest source of PM_{10} emissions generated in the Nogales NA.[33] ADEQ accordingly consulted EPA guidance (57 FR 13540; April 16, 1992) to identify control measures for inclusion in the 1993 Nogales Nonattainment Area (NA) SIP. This subsection examines the selection process, implementation, current status and applicability of control measures required in ADEQ's 1993 SIP for the Nogales NA.

Because no new significant source categories were identified in the 2008 emissions inventory, ADEQ determined that the control measures from the 1993 Nogales NA SIP are still appropriate controls for the area. The following sections discuss why the RACM/RACT were initially selected and provides an explanation of their implementation status. The control measures selected in the 1993 Nogales NA SIP continue to be required in this SIP revision. Some of the 1993 control measures are not submitted for incorporation within the SIP and SIP credit because they are not enforceable by the State or have not been submitted to the Arizona SIP; those measures are clearly labeled as such.

5.2 Control Measures Adopted into the SIP and Implemented by ADEQ

The control measures implemented by ADEQ include the following:

1. Require RACT for stack and fugitive PM_{10} from permitted stationary sources;
2. Require RACT for haul roads and staging areas;
3. Require dust control measures for material storage piles;
4. Limit Use of Recreation Vehicles on Open Land.

Most of these control measures are listed in Table 5-1 and are discussed further below.

5.2.1 Require RACT for Stack and Fugitive PM_{10} from Permitted Stationary Sources/ Require RACT for Haul Roads and Staging Areas

In the 1993 Nogales NA SIP, ADEQ committed to implement the RACM/RACT for stack and fugitive emissions from permitted stationary sources, haul roads and staging areas, and material storage piles. The sources permitted by ADEQ shown in Table 5.2 were in operation during 2008. With the exception of the UNS Electric facility, which operates under a Title V permit, the sources below operate under one of ADEQ's general permits that require RACM/RACT appropriate for the source. In addition, R18-2-702, effective February 3, 2004 (69 FR 51592; August 28, 2004) establishes a 20 percent opacity standard for point sources in all moderate PM_{10} nonattainment and maintenance areas, including the Nogales NA, and qualifies as RACM. EPA states, "Where the sources affected by a particular measure

---

[33] See Table 3.1 on page 27 of the 1993 NA SIP. "Final State Implementation Plan for the Nogales PM_{10} Nonattainment Area." ADEQ. Submitted to EPA June 14, 1993. <http://www.azdeq.gov/environ/air/plan/download/nogpm10sip_061993.pdf>

contribute only negligibly to ambient concentrations that exceed the NAAQS, EPA's policy is that it would be unreasonable and therefore would not constitute RACM to require controls on the source."[34] Emissions from permitted sources meet these criteria and, therefore, do not require RACM.

Table 5.2 PM_{10} Generating Point Sources Operating in the Nogales NA in 2008			
Company Name	**Place Description**	**PM_{10} TPY**	**Type**
County Health Department	Boilers and Generators	0.019	Stationary
AT&T	Generator	0.002	Stationary
Steris Inc.	Medical Device Sterilization	N/A[35]	Stationary
UNS Electric Inc.	Utilities – Natural Gas	0.610	Stationary
Wash and Clean World	Dry Cleaners	0.011	Stationary
CEMEX Construction Materials South	Concrete Batch Plant	1.662	Portable
	Total	2.3 tpy	

Source: ADEQ.

5.2.2 Require Dust Control Measures for Material Storage Piles

AAC R9-3-407, approved into the Arizona SIP by EPA April 23, 1982 (47 FR 17485), prescribes the following requirements for storage piles:

A. No person shall cause, suffer, allow, or permit organic or inorganic dust producing material to be stacked, piled, or otherwise stored without taking reasonable precautions such as chemical stabilization, wetting, or covering to prevent excessive amounts of particulate matter from becoming airborne.

B. Stacking and reclaiming machinery utilized at storage piles shall be operated at all times with a minimum fall of material and in such manner, or with the use of spray bars and wetting agents, as to prevent excessive amounts of particulate matter from becoming airborne.

ADEQ officials are authorized to issue citations for violating the law.

5.2.3 Limit Use of Recreation Vehicles on Open Land

The City of Nogales is well-developed and city officials confirm there are no open public areas where off-highway vehicles (OHVs) can be used within its borders. The prohibition on OHV use is enforced by local law enforcement agencies. Portions of the Nogales NA with open areas are subject to

---

[34] EPA. PM_{10} Moderate Area SIP Guidance: Final Staff Work Product. April 2, 1991. <http://gate1.baaqmd.gov/pdf/1321_PM10_Moderate_Area_SIP_Guidance_Final_Staff_Work_Product_1991.pdf>

[35] Exact emissions for Steris Inc are not available as their emissions are below reporting requirements. If a source emits below one ton per year of any single pollutant or below two and one-half tons of combined pollutants, the source is not required to report their emissions to ADEQ.

Arizona Administrative Code (AAC) R9-3-404 - Open Areas, Dry Washes, or Riverbeds, approved into the Arizona SIP on October 19, 1984 (49 FR 41026), which establishes that "*No person shall operate a motor vehicle for recreational purposes in a dry wash, riverbed or open area in such a way as to cause or contribute to visible dust emissions which then cross property lines into a residential, recreational, institutional, educational, retail sales, hotel or business premises. For purposes of this subsection "motor vehicles" shall include, but not be limited to trucks, cars, cycles, bikes, buggies and 3-wheelers. Any person who violates the provisions of this subsection shall be subject to prosecution under A.R.S. § 49-463.*"[36] Enforcement of the law is provided by Arizona Department of Public Safety officers, sheriffs, police, and State and federal land managers. Violations of the law may lead to penalties reaching $500.00.

5.3. Status of 1993 Nogales NA SIP Control Measures Implemented by the City of Nogales and/or Santa Cruz County Meeting RACM

This section provides a status report on the control measures included in the 1993 Nogales NA SIP implemented by the City of Nogales and Santa Cruz County. These measures are included in this SIP revision and continue to be enforceable and implemented.

5.3.1 Pave or Chemically Stabilize Unpaved Roads; Pave, Vegetate or Chemically Stabilize Access Points Where Unpaved Traffic Surfaces Adjoin Paved Roads

All public roads in the City of Nogales have been paved and accepted into the City's Street Maintenance Program; therefore, there are no unpaved/paved road access points between adjoining public roads.[37] Santa Cruz County officials confirm the portions of Rio Rico within the nonattainment area boundaries include approximately 200 miles of paved/double chip-sealed roads, with approximately 40 miles of unpaved roads at present.[38] Because the map provided by the County does not differentiate between paved and unpaved roads, ADEQ created its own map of unpaved roads in the Nogales NA; the map is included in Appendix E.3. ADEQ's estimate for double chip-sealed roads in the Rio Rico portions of the nonattainment area is 134.4 miles; the estimate for unpaved roads is 53.5 miles.

Between 1992 and 2008, 17.5 combined miles of roadway were paved or double chip-sealed in the Rio Rico and Nogales portions of the Nogales NA. In Appendix E, the State presents two methods of calculating emission reductions for these chip sealed roadways. Method One assumes double chip-sealing provides 90 percent control efficiency of emissions; Method Two assumes double chip-sealing provides emissions rates equivalent to paving the roadways.

---

[36] Arizona Administrative Code. R18-2-604, formerly R9-3-404, approved by EPA in 1984 (49 FR 17485). <http://www.azsos.gov/public_services/Title_18/18-02.htm>

[37] Correspondence. Juan Guerra, Nogales City Engineer. See Appendix F.3.

[38] Correspondence. Jesus Valdez, P.E. Interim Public Works Director County Engineer, Santa Cruz County. See Appendix F.2.

Within the 1993 Nogales NA SIP, the City of Nogales committed to pave several roadways within the city limits by 1998.[39] In an implementation review using aerial photography, ADEQ identified eleven unpaved roads that were paved between 1992 and 1996 totaling 8.4 miles. Because traffic data could not be located for two of the eleven roadways (Hohokam and La Quinta Roads) emission reductions were not calculated for them. For the remaining 9 unpaved roads totaling 7.7 miles, the annual emission reduction associated with their paving is estimated to be 78.45 tons per year, as shown in Table 5.3.[40] See Appendix E for calculations.

In a similar implementation review using aerial photography[41] and data provided by Santa Cruz County,[42] ADEQ also reviewed 39.8 miles of road paving/double chip-sealing completed by the County in the Rio Rico community in and around the Nogales NA between 2002-2008. Of those, ADEQ identified four unpaved roads within the Nogales NA totaling 9.75 miles, as shown in Table 5.4.[43] The annual emission reductions associated with the paving of these four unpaved roads is estimated to be 107.4 tons per year. See Appendix E for calculations. While there was an additional estimated 40 miles of paving/double chip-sealing projects on unpaved roads in the Rio Rico community between 1994-2001, Santa Cruz County could not locate records detailed enough to allow ADEQ to calculate emission reductions for the subset of these projects located in the nonattainment area.[44] As a result, ADEQ did not claim emissions reductions for these projects.

As shown in Tables 5.3 and 5.4, within the Nogales NA, the City of Nogales and Santa Cruz County have paved 17.45 miles of unpaved roads resulting in 185.5 tpy of emissions reductions based on Method 2.

Table 5.3
Calculated PM_{10} Emissions for Roads in the City of Nogales, Arizona 1993-1996

Roadway	Miles Paved	VMT	Unpaved Emissions (tons)	Paved Emissions (tons)
Royal Rd	0.9	16178	4.55	0.0086
Vista del Cielo	2.2	160072	45.06	0.0848
Yucca Drive S.	2.0	13696	3.86	0.0073
Bristol Dr	0.4	7875	2.22	0.0042
Frank Reed Rd	0.95	62616	17.63	0.0332
Kino Rd	0.28	3835	1.08	0.0020
Kelsey Rd	0.27	6240	1.76	0.0033
West 1st St	0.4	6848	1.93	0.0036
Target Range Rd	0.2	1294	0.36	0.0007
Total	**7.7**	**278655**	**78.45**	**0.148**

---

39 Pages 31-32 of "Final State Implementation Plan for the Nogales PM_{10} Nonattainment Area." ADEQ. Submitted to EPA June 14, 1993. <http://www.azdeq.gov/environ/air/plan/download/nogpm10sip_061993.pdf>

40 See Appendix E, Table E.5.

41 Correspondence. Letter from EPA to ADEQ dated November 30, 1993. See Appendix E.4.

42 Correspondence. Jesus Valdez, Interim Public Works Director, Santa Cruz County Engineer. See Appendix F.2.

43 See Appendix E, Table E.1.

44 Correspondence. Jesus Valdez, Interim Public Works Director, Santa Cruz County Engineer. See Appendix F.5.

Table 5.4 Calculated PM_{10} Emissions for Roads in Rio Rico within the Nogales NA, 2002-2008				
Roadway	**Miles Paved**	**VMT**	**Unpaved Emissions (tons)**	**Paved Emissions (tons)**
Calle Arikara	1.09	22694	5.9	0.011
Paseo Mexico	4.03	195774	35.5	0.067
Calle Coyote-Annette Ct	1.92	65679	18.5	0.035
Paseo Guebabi	2.70	168746	47.5	0.089
Total	**9.75**	**452893**	**107.4**	**0.202**

ADEQ used the latest satellite images available to assess paved and unpaved road intersections in Rio Rico in 2011 and found that, typically, intersections provided adequate stabilization of unpaved roads to mitigate trackout. As shown in Figure 5.1, soil trackout from the typical unpaved road in Rio Rico visibly trails off as vehicles approach the main paved road due to the paved apron transition area, decreasing trackout and reentrained emissions. Figure 5.1 is only provided as a demonstration of a typical apron in Rio Rico located with Google Maps; the intersection of Calle Remedios and Calle Carmelita is an example of the County's efforts to mitigate trackout onto paved roads.

Figure 5.1
Typical Intersection of Paved and Unpaved Road in Rio Rico

Source: Google Maps.

As part of preventing track out on to paved roads, Section 8-8-2, Streets, of the City of Nogales Code requires curbing of paved roads and Section 8-9-5, General Parking Lot Design Requirements, requires paving of commercial parking lots; these measures are included as supplementary information in Appendix G and are not included for submittal with this SIP or for consideration as RACM.

5.4 Control Measure Implemented by Agencies but not included in the SIP for Credit

The control measures in this section provide additional emissions reductions in the Nogales NA but are not claimed for credit.

5.4.1 General Services Administration (GSA) Reduce Idling Time of Diesel-Powered Vehicular Traffic at Border Entrances

As reported by ADEQ in its 1996 Reasonable Further Progress report,[45] by 1994 the GSA expanded the number of northbound vehicle lanes at the DeConcini Port of Entry (POE) from four to eight, and added three northbound lanes at the Mariposa POE. These actions provided supplemental reductions in exhaust and brake wear emissions, vehicle stops and starts, and idling time.

5.4.2 Provide for Storm Water Drainage to Prevent Soil Erosion onto Paved Roads/ Provide for Traffic Rerouting or Rapid Clean Up of Temporary Sources of Dust on Paved Roads

Two problem storm drainage areas in the City of Nogales identified in the 1993 Nogales NA SIP (Meadow Hills, Yucca Drive) were repaired with box culverts and paved with concrete. The City owns two standard street sweepers; maintenance is performed on a 5-day, 40-hour weekly basis.[46] Santa Cruz County implemented an on-call program for Public Works Department employees to be on standby after normal working hours to respond to road emergencies and/or road blockage following a storm. Public Works crews immediately perform clean up after every storm event by removing debris and sweeping the road.[47] The County currently has two standard street sweepers. The County cleans roads on a routine, 5-day, 40-hour workweek basis. Section 8-6-6 of the City of Nogales Code, Surface Drainage and Storm Sewer System, and 8-16-23, Design Standards for On-site Retention of Storm Water, provide measures to prevent storm water and soil from flooding city streets. The County and City have local laws to prevent water erosion onto paved roads; these measures are included as supplementary information in Appendix G and are not included for submittal with this SIP.

---

[45] ADEQ. Nogales PM_{10} Nonattainment Area Quantitative Milestone/Reasonable Further Progress Report. June 12, 1996. See Appendix I.

[46] Correspondence. Juan Guerra, Nogales City Engineer. See Appendix F.3.

[47] Correspondence. Jesus Valdez, P.E. Interim Public Works Director, Santa Cruz County Engineer. See Appendix F.2.

5.4.3 Prohibit Permanent Unpaved Haul Roads, and Parking or Staging Areas at Commercial, Municipal, or Industrial Facilities

Section 8-9-5 of the Nogales City Building Code, General Parking Lot Design Requirements, and Article 11 of the Santa Cruz County Zoning Code provide regulations for this category and are included as supplementary information in Appendix G. RACM for haul roads required by the operating permits issued by ADEQ for sources in the Nogales NA is discussed in subsection 5.2.1.

5.4.4 Require Haul Trucks to be Covered

Arizona Revised Statute 28-1098, effective September 19, 2007, requires that *"For the purpose of highway safety or air pollution prevention, a person shall not drive or move a vehicle on a highway unless the vehicle is constructed or loaded in a manner to prevent any of its load from dropping, sifting, leaking or otherwise escaping from the vehicle…A person shall not operate a vehicle on a highway with a load unless the load and any covering on the load are securely fastened in a manner to prevent the covering or load from becoming loose, detached or in any manner a hazard to other users of the highway."* Department of Public Safety deputies and local law enforcement officials are authorized to issue citations for violating the law. [Emission reductions resulting from enforcement of ARS 28-1098 are supplemental for this plan.]

5.5 Nogales NA RACM/RACT Conclusion

The implementation of these measures ensured the Nogales NA attained the PM_{10} standard by the December 31, 1994 deadline established by the 1990 amendments of the CAA (76 FR 1532; January 11, 2011). Monitoring data following the implementation of these measures demonstrates emissions reductions were sufficient to attain the NAAQS through 1998. As discussed in Section 4.0, subsequent violations of the PM_{10} NAAQS can be attributed to emissions originating in Mexico. The RACM identified by ADEQ's 1993 Nogales NA PM_{10} SIP are still appropriate controls based on the 2008 base year emissions inventory included in Section 3.0.

The greatest emissions sources, fugitive emissions from unpaved roads, have been effectively controlled in the Nogales NA as discussed earlier in this chapter. All public roads within the City of Nogales have been paved. Approximately 80 miles of roads in Rio Rico have been double chip-sealed, although emission reduction credit is taken for only 9.75 miles within the Nogales NA that could be verified with documentation. Implementation analysis of road paving projects completed within the Nogales NA by the City of Nogales and Santa Cruz County over the period 1992-2008 show that a combined total of 17.45 miles of unpaved roads have been paved/double chip-sealed, resulting in a reduction of 185.5 tons per year in PM_{10} emissions.

To control fugitive emissions from paved roads, both the City of Nogales and Santa Cruz County own two standard street sweepers. The City and County clean roads on a routine, 5-day, 40-hour work week basis. Appendix G includes supplementary information on local ordinances and codes that help control emissions from this category.

In conclusion, paving project RACM/RACT implemented in the Nogales NA by the City of Nogales and Santa Cruz County are permanent and continue to produce emission reductions. State control measures supporting the plan have been incorporated within the SIP (see Table 5.1). Control measures implemented by the GSA, by Santa Cruz County, and by the City of Nogales provide additional emissions reductions toward attainment but are not credited in this plan.

6.0 REASONABLE FURTHER PROGRESS AND CONTINGENCY MEASURES

The federal Clean Air Act (CAA), Section 189(c), requires PM_{10} nonattainment areas to include reasonable further progress (RFP) milestones, which are to be achieved every three years until the area is redesignated attainment or meets the NAAQS.

On January 11, 2011, EPA promulgated a determination of attainment as of the applicable attainment date for the Nogales NA based on ambient air quality monitoring data from 1992-1994, retroactively affirming that the area had met the PM_{10} NAAQS by the December 31, 1994 deadline established by the 1990 amendments of the CAA (76 FR 1532; January 11, 2011) based on emissions reductions from control measures included in the 1993 Nogales NA SIP. EPA's retroactive acknowledgment that the Nogales NA had met the NAAQS by the 1994 deadline affirms RFP milestones were met.

In 59 FR 41998 (August 16, 1994) EPA stated that if such a border area failed to achieve RFP milestones reductions in PM_{10} emissions from sources within the U.S., then contingency measures would be required.[48] Because RFP milestones were met in the Nogales NA, contingency measures are not required.

In the same Federal Register notice, EPA also stated that if the area fails to obtain the emission reductions necessary to demonstrate attainment of the NAAQS "but for" emissions emanating from outside the U.S., contingency measures would not be required.

As demonstrated by Chapter 4 and the supporting analyses almost all of the observed exceedances of the PM_{10} standard are due to emissions from Mexico. Paving projects completed in the Nogales NA by the City of Nogales and Santa Cruz County have gone beyond what RFP milestones would have been required if the area had not met the NAAQS by the 1994 attainment date. Consistent with the EPA guidance cited above, the State is not including contingency measures or RFP milestones in this plan.

---

[48] 59 FR 41998 (August 16, 1994). "State Implementation Plans for Serious PM_{10} Nonattainment Areas, and Attainment Date Waivers for PM_{10}Nonattainment Areas Generally; Addendum to the General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990."

7.0 TRANSPORTATION CONFORMITY PROCEDURES AND MOTOR VEHICLE EMISSIONS BUDGET

Transportation conformity is a federal regulatory process that ensures coordination and consistency between transportation and air quality planning. The Clean Air Act (CAA) prohibits federal agencies from approving or funding transportation projects if they are not consistent with State air quality plans. Conforming to a SIP ensures that transportation projects are consistent with a SIP and do not delay attainment or cause violations of the PM_{10} standards in the nonattainment area. The Transportation Conformity Rule (40 CFR Part 93) also requires States to develop a limit or “budget” for on-road mobile source emissions in the nonattainment area. The motor vehicle emissions budget (MVEB) ensures that emissions associated with transportation projects will not result in an exceedance of the NAAQS. Transportation plans and programs produced by the transportation planning process are required to result in on-road emissions that are within the budget.

Normally, States are required to consult with local metropolitan planning organizations (MPOs) when developing a MVEB. The Nogales NA does not have an MPO. To develop the MVEB, ADEQ consulted with EPA and the Arizona Department of Transportation (ADOT). The State chose 2011 as the year for the MVEB.

EPA’s new MOVES2010 (MOVES) emissions model for onroad mobile sources was used to estimate the on-road motor vehicle portion of the 2011 MVEB. MOVES is used to estimate tailpipe emissions from cars, trucks, motorcycles, buses, as well as brake and tire wear. EPA based MOVES on analyses of millions of emission test results, considerable advances in EPA’s understanding of vehicle emissions, emissions reductions associated with new fleets of cleaner vehicles, and cleaner fuel specifications.

EPA ran the MOVES model for 2011 to produce countywide estimates for onroad mobile sources. The estimates were then scaled to the Nogales NA based on Census Bureau population data. To be conservative and to reflect the most current population data, a 0.569 ratio was used to allocate countywide emissions to the Nogales NA instead of the 0.551 ratio used for 2008 population-based allocations. Vehicular emissions calculated using MOVES account for just 1.4 percent of the Nogales NA 2011 projected year inventory and 1.7 percent of the MVEB.

The Federal Highway Administration's Highway Statistics statewide series data on Arizona shows a decline in Vehicle Miles Traveled (VMT) between 2007 and 2008, and no change in VMT between 2008 and 2009. This trend is consistent with economic conditions. Emission inventory estimates for 2011 show a slight decrease in VMT. While emissions from vehicles are insignificant in terms of the annual inventory, ADEQ is nevertheless including these categories in the MVEB for the Nogales NA.

Fugitive emissions from paved and unpaved roads are affected by the number of vehicle miles traveled (VMT), silt volume on paved roads, and other local factors. Emissions estimates for these categories were based on data obtained from State and federal agencies for the 2008 NEI. Estimates for Santa Cruz County were then apportioned to the Nogales NA based on population. The 2011 PM_{10} motor vehicle emissions budget for the Nogales NA was calculated to be 1,274.3 tons per year (tpy). Once EPA finds this budget adequate and/or approves the budget, ADOT and FHWA must use these budgets in transportation conformity determinations after the effective date of the approval or adequacy finding, whichever is earlier.

As established by the technical demonstrations in Chapter Four, emissions from Mexico are responsible for PM_{10} exceedances recorded in the Nogales NA. The emissions inventories in Chapter Three, based on estimates from EPA's 2008 National Emissions Inventory (NEI), cite road construction dust as the second-highest emissions source. The 2008 NEI estimates for road construction in the Nogales NA were based on statewide housing starts in a 2006 FHWA report when the housing market was robust, not actual conditions in the Nogales NA in 2008. A statewide estimate was then allocated to the county level based on population. As discussed in Chapter One, population growth in the Nogales NA has been low in recent years, much lower than other areas in the State where housing starts were thriving.

In addition, there have been no substantial road construction projects in the Nogales NA in the last five years and no projects are planned for the next five years; therefore, estimates for this category present a conservative worst-case scenario, not actual emissions.[49]

Table 7.1
2011 Nogales NA Motor Vehicle Emissions Budget

Sector	**PM_{10} tpy**
Dust – Unpaved Road Dust	864.9
Dust – Paved Road Dust	121.4
Dust – Road Construction	267.0
Mobile – Gasoline and Diesel (including Exhaust, Brake and Tire Wear)	21.0
2011 MVEB	**1274.3**

Source: 2011 PM_{10} Emissions Inventories for the Nogales NA, Santa Cruz County, Arizona (see Appendix B).

[49] Email, Beverly Chenausky, Arizona Department of Transportation. June 25, 2012.

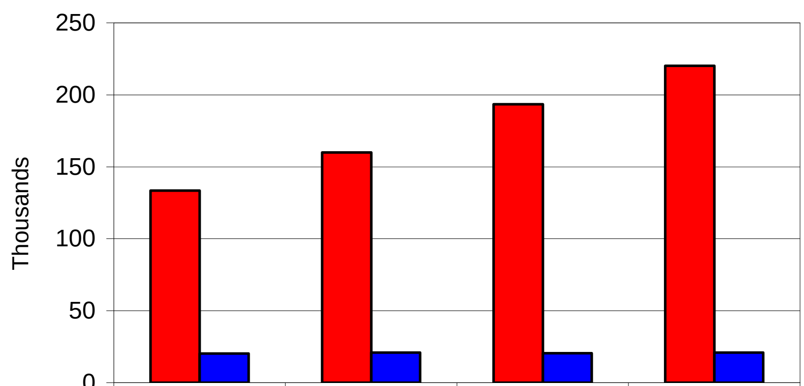
8.0 SUMMARY & CONCLUSIONS

The Nogales NA was designated as nonattainment following the 1990 amendments to the CAA, when all areas where violations of the PM_{10} NAAQS had been recorded were designated nonattainment for PM_{10} by operation of law and classified "moderate" upon enactment of the Amendments. The October 1987 PM_{10} emissions inventory for the Nogales NA estimated PM_{10} emissions on both sides of the U.S.-Mexico border. The 1987 emissions inventory estimated that 94 percent of PM_{10} emissions in Ambos Nogales are from Mexico, primarily from unpaved roads.[50]

ADEQ followed EPA guidance to select RACM/RACT for inclusion in 1993 Nogales NA SIP. These measures resulted in emissions reductions sufficient to meet the PM_{10} NAAQS by the December 31, 1994 deadline established by the 1990 amendments to the CAA, (See 76 FR 1532, January 11, 2011). A period of attainment followed through 1998, but the Nogales NA soon relapsed back into a pattern of intermittent exceedances of the NAAQS that has endured.

An analysis of the monitoring data from 1985-2010 demonstrates ambient concentrations fluctuate, based on activity in Nogales, Sonora, Mexico. The Nogales NA did not meet the NAAQS based on monitoring data from 2008-2010; preliminary data indicate exceedances of the NAAQS in 2011 were recorded in the Nogales NA. The population of the Nogales Municipality, Sonora, is approximately 10 times the population of Nogales, Arizona, as shown in Figure 8.1, and rapid growth is projected to continue.

Figure 8.1
Comparison of Ambos Nogales Population Growth 1995-2010



	1995	2000	2005	2010
Nogales Municipality, Sonora	133,491	159,878	193,517	220,292
Nogales, Arizona	20,184	20,878	20,421	20,837

Source: U.S. Census Bureau and INEGI.

[50] Engineering Science. "PM_{10} Emissions Inventory Data for the Nogales Planning Area." October, 1987. See Appendix C of ADEQ's 1993 Nogales NA PM_{10} SIP: <http://www.azdeq.gov/environ/air/plan/download/nogpm10sip_061993.pdf>

A nonattainment area meets the national ambient air quality standard for PM_{10} when the expected number of days per calendar year with a twenty-four hour average concentration above 150 $\mu g/m^3$ are less than or equal to one. To determine that the Nogales NA has met the PM_{10} standard "but for" emissions from Mexico, the State's Section 179B analysis must show that no more than three exceedances of the standard in a recent consecutive three-year period were due to sources within the Nogales NA and all other exceedances were caused by sources originating from across the international border. This analysis found that 27 of 29 exceedance days were due to transport of PM_{10} emissions from sources on the Nogales, Sonora side of the international border. Consequently, when considering the remaining two exceedances, the expected annual exceedance rate for 2007-2009 is 0.7 exceedances per year. Since the annual expected exceedance rate is less than one, the State has demonstrated that the Nogales NA would attain the PM_{10} NAAQS "but for" PM_{10} emissions originating in Mexico.

The 2008 base year emissions inventory showed emissions from unpaved roads are still the largest emission source in the Nogales NA. Because the significant sources have not changed since the implementation of RACM/RACT required by the 1993 Nogales NA SIP, ADEQ determined those measures are still appropriate for the Nogales NA. Local paving/double-chip sealing projects implemented in the City of Nogales and the Rio Rico area within the Nogales NA have resulted in an estimated 185.5 tons of PM_{10} reduced, annually (see Appendix E.)

8.1 Commitments

Section 110(a)(2)(A) of the CAA requires that States provide for enforceable emissions limitations and other control measures, means, or techniques, as well as schedules for compliance with the PM_{10} NAAQS. ADEQ commits to enforce the measures in this plan to attain the 24-hour average PM_{10} NAAQS for the duration of this plan.

ADEQ commits to continue to operate the monitors in the Nogales NA area according to the references and guidelines referenced below for the duration of this plan.

- 40 CFR Part 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the atmosphere;
- 40 CFR Part 50, Appendix K, Interpretation of the National Ambient Air Quality Standards for particulate matter; and
- 40 CFR Part 58, Appendix A, Quality Assurance Requirements for SLAMS
    - Section 2, Quality System Requirements
    - Section 3.3 and 3.4.1, Data Quality Assessment Requirements
    - Section 4.2, Annual Reports
    - Appendix D, Section 2.8, Particulate Matter Design Criteria for SLAMS
    - Appendix E, Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring, Section 8, Particulate Matter.

8.2 Conformity Commitments

ADEQ commits to work with ADOT and federal agencies, federal grant recipients, and federal licensees and permittees in the Nogales NA to ensure that requirements in CAA Sections 118 and 176 and Title 40 C.F.R. § 93 Subparts A and B will be met for applicable projects requiring federal funding and/or approval.

8.3 CAA Section 189 Continuing Commitments

ADEQ commits to continue to fulfill the permitting requirements of the CAA Section 189. This commitment will ensure that all new sources and modifications to existing sources in the Nogales NA are subject to preconstruction review and permitting. All new major sources and major modifications to existing major sources in the Nogales NA are subject to the New Source Review provisions, including New Source Review.

BLANK PAGE

List of Appendices

This page is intentionally blank.

Appendix A
Clean Air Act Section 179B Attainment Determination for the Nogales, Arizona PM_{10} Nonattainment Area

This page is intentionally blank.

Clean Air Act, Section 179B Attainment Determination for the Nogales, Arizona PM_{10} Nonattainment Area

U.S. Environmental Protection Agency
Region 9

Draft Final: July 20, 2012

Table of Contents

List of Figures

List of Tables

Appendices

1.0 Introduction

1.1 Purpose

This document reviews and integrates several analyses of PM_{10} pollution in and around Nogales, Arizona to determine if the Nogales nonattainment area would have attained the National Ambient Air Quality Standard (NAAQS) for PM_{10} but for sources of PM_{10} in nearby Nogales, Sonora, Mexico. The Arizona Department of Environmental Quality (ADEQ) requested that EPA provide this analysis to support ADEQ's work on a PM_{10} State Implementation Plan (SIP) for the Nogales nonattainment area (NAA), located in Santa Cruz County, Arizona.

1.2 Sources of PM_{10}

PM_{10} refers to particulate matter of ten microns or less in aerodynamic diameter. Another class of particles, denoted as $PM_{2.5}$, also called fine particulate, refers to particles of 2.5 microns or less in aerodynamic diameter. PM_{10} includes both $PM_{2.5}$ and the particulates with aerodynamic diameter between 2.5 and 10 microns. Sometimes referred to as $PM_{2.5-10}$, this larger fraction of particles between 2.5 and 10 microns is also called "coarse" particulate. While fine particles originate mostly from combustion sources and secondary aerosol generation processes, coarse particles usually originate from mechanical activities and fugitive source categories. Typical sources of PM_{10} include fugitive dust, open burning including wild fires, mineral crushing and grinding operations, agricultural activities such as land tilling, dust suspended from vehicle travel on paved and unpaved roads and, to a lesser extent, fuel combustion sources and mobile source exhaust.

1.3 Geography of the Ambos Nogales Area

The combined communities of Nogales, Arizona and Nogales, Sonora, or Ambos Nogales are located within the Sonoran Desert. This desert covers 120,000 square miles with a minimum elevation of 2,500 feet and is in the Basin and Range topographic province. This topography is characterized by north-south elongated valleys surrounded by mountain ranges. Ambos Nogales is located in such a north-south valley created by the Nogales Wash running north to the Santa Cruz River.

From south to north, Nogales Municipality is roughly analogous to a United States (U.S.) county and covers a 632.5 square mile area along the U.S./Mexico border.[1] The largest urban center in the municipality is the City of Nogales, Sonora. Nogales, Sonora, Mexico lies directly south of Nogales, Arizona across the international border. Collectively referred to as Ambos Nogales, the cities of Nogales, Arizona and Nogales, Sonora, Mexico comprise the largest international border community in Arizona, with a combined population of 232,550 inhabitants in 2010.[2] The majority of the population within the Nogales Municipality lives within the city of Nogales, Sonora. The mean elevation

---

[1] Nogales Municipality land area was calculated by EPA using GIS software.

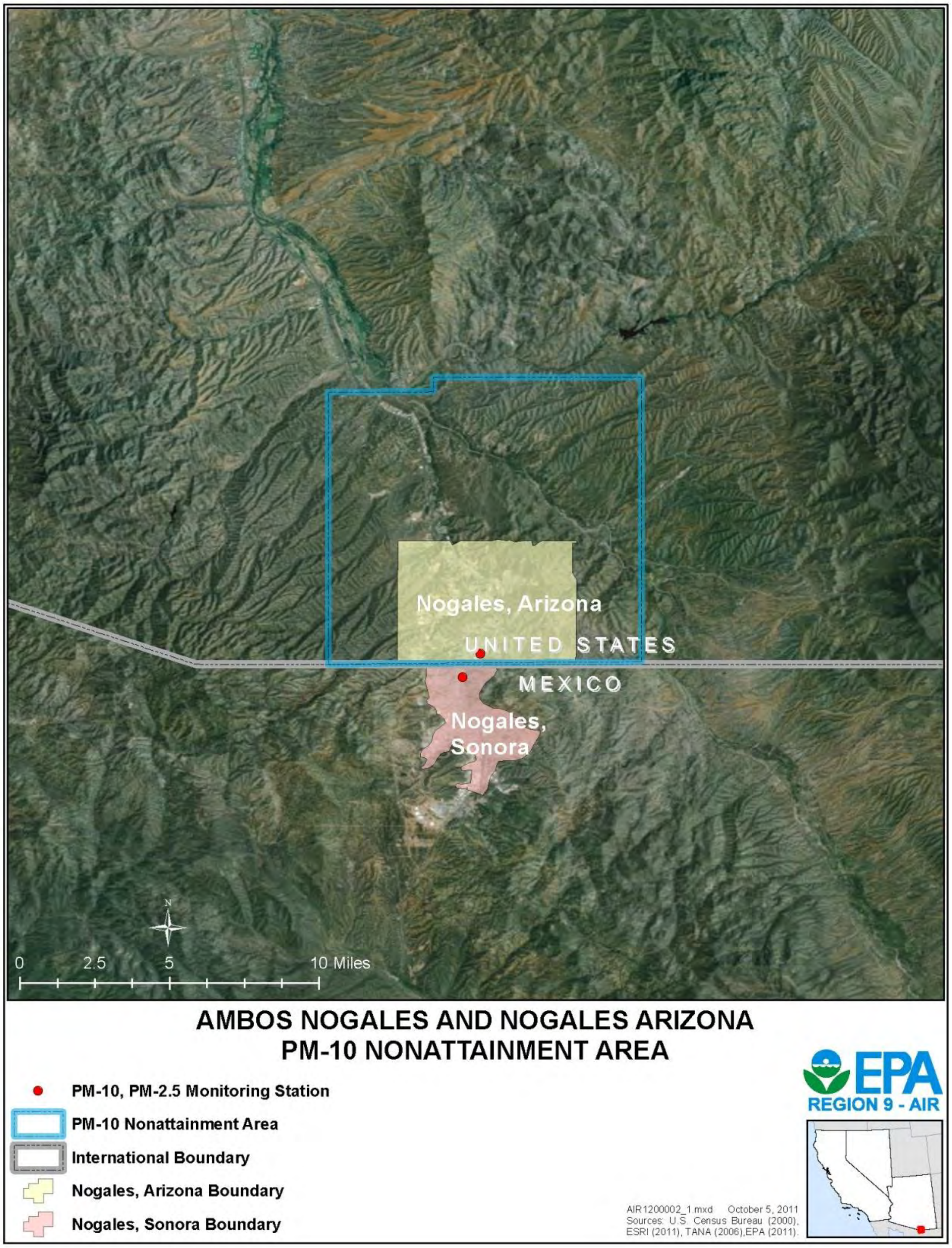
[2] Nogales, Arizona had 20,017 inhabitants and Nogales, Sonora, Mexico had 212,533 inhabitants. U.S. Census Bureau 2010 and Instituto Nacional de Estadistica Geografia e Informatica, (INEGI) 2010.

above sea level in Nogales, Sonora is 4,265 feet.[3] At 5,380 feet, the highest elevation area in Nogales, Sonora is in the Cerro de los Nogales (Nogales Hill), west of where the Obregón and Colosio routes meet, near the southern end of the city.

Proceeding northward, the U.S. and Mexico border forms the southern boundary of the Nogales NAA and Santa Cruz County, Arizona. Near the center of the Nogales NAA, the city of Nogales, Arizona is sixty miles south of Tucson, Arizona in the middle and southernmost portion of Santa Cruz County. The city of Nogales, Arizona is the largest city in the 76.1 square mile nonattainment area.[4] The mean elevation above sea level in Nogales, Arizona is 3,865 feet. Mountain ranges near Nogales include the Patagonia Mountains to the east and the Tumacacori, Atascosa, and Pajarito mountains to the west. Approximately 25 miles to the north are the Santa Rita Mountains and Madera Canyon in the Coronado National Forest where Mount Wrightson rises to an elevation of 9,432 feet. Northwest of Interstate 19 are the Cerro Colorado, Las Guijas, and Sierrita Mountain Ranges.

[3] "Statistical Municipal Workbook for Nogales, Sonora", 2005 edition, INEGI.
[4] Nogales NAA land area was calculated by EPA using GIS software.

Figure 1: Map of Ambos Nogales Area and Nogales, Arizona PM_{10} Nonattainment Area



2.0 Statutory Requirements, EPA Guidance, and Attainment Standard

Because the Nogales NAA lies along the international border with Mexico, there are specific statutory requirements in the Clean Air Act (CAA) that apply to the Nogales NAA. With a demonstration showing that the Nogales NAA would have attained the PM_{10} NAAQS but for international sources of PM_{10}, EPA may approve an attainment plan provided by the State. Such a "but for" attainment demonstration, however, must be consistent with statutory and regulatory requirements. First, we review the statutory basis for a "but for" attainment demonstration. Secondly, we will review EPA's published guidance on how such an analysis may be structured. Lastly, we will review the attainment standard applied to PM_{10} nonattainment areas, as stipulated in federal regulations.

2.1 Statutory Requirements

The Nogales NAA shares its southern border with Mexico. For international border areas, the Clean Air Act (CAA) section 179B(a) states that:

> "Notwithstanding any other provision of law, an implementation plan or plan revision required under this chapter shall be approved by the Administrator if—
> (1) such plan or revision meets all the requirements applicable to it under the chapter other than a requirement that such plan or revision demonstrate attainment and maintenance of the relevant national ambient air quality standards by the attainment date specified under the applicable provision of this chapter, or in a regulation promulgated under such provision, and
> (2) the submitting State establishes to the satisfaction of the Administrator that the implementation plan of such State would be adequate to attain and maintain the relevant national ambient air quality standards by the attainment date specified under the applicable provision of this chapter, or in a regulation promulgated under such provision, but for emissions emanating from outside of the United States."

As stated above, notwithstanding any other provision of law, should Arizona establish to the satisfaction of the EPA Administrator that the Nogales NAA would have attained the PM_{10} NAAQS by the applicable attainment date but for emissions emanating from outside the United States (U.S.), then the Nogales NAA shall not be subject to the provisions of CAA section 189(a)(1)(b), requiring a demonstration of attainment of the PM_{10} standard by the applicable attainment date.

Section 179B(d) goes on to state that should Arizona provide a demonstration showing that the Nogales NAA would have attained the PM_{10} NAAQS but for emissions emanating from outside the U.S., then the Nogales NAA shall not be subject to the provisions of CAA section 189(b)(2), as well, and should not be reclassified as a "serious" PM_{10} nonattainment area.

2.2 EPA Guidance

EPA has issued guidance relating to serious PM_{10} nonattainment areas (General Preamble); this guidance includes a discussion of the requirements applicable to international border areas.[5] The General Preamble reviews the information and methods that may be used to determine if an international border area qualifies for treatment under CAA section 179B and to demonstrate that the area would attain the relevant NAAQS but for emissions emanating from outside the U.S.

The General Preamble provides that "several types of information may be used to evaluate the impact of emissions emanating from outside the U.S." The EPA will consider the information "for individual nonattainment areas on a case-by-case basis in determining whether an area may qualify for treatment under section 179B." The General Preamble suggests five methods that may be used to determine the impact of emissions emanating from outside the U.S. and states that "the State may use one or more of these types of information or other techniques, depending on their feasibility and applicability, to evaluate the impact of emissions emanating from outside the U.S. on the nonattainment area." Below, we discuss the five methods and their applicability to the Nogales NAA.

Method 1: Place several ambient PM_{10} monitors and a meteorological station measuring wind speed and direction in the U.S. nonattainment area near the international border. Evaluate and quantify any changes in monitored PM_{10} concentrations with a change in the predominant wind direction.

We reviewed the ambient PM_{10} data, meteorology, and topography in the Ambos Nogales area. The State of Arizona maintains a monitor in Nogales, Sonora, as well as, three monitors in Nogales, Arizona. The Nogales, Arizona monitors are divided as follows: two monitor's measure ambient PM_{10} levels; and, one monitor measures ambient $PM_{2.5}$ levels. Arizona also has two reference monitors at increasing distances from the Nogales NAA. Our analysis of the ambient data, meteorology, and topography is provided in Appendix C and is discussed below in Section 3.3.

Method 2: Comprehensively inventory PM_{10} emissions within the U.S. in the vicinity of the nonattainment area and demonstrate that those sources, after application of reasonably available controls, do not cause the NAAQS to be exceeded. This analysis must include background PM_{10} in the area. Estimates of background PM_{10} levels could be based on concentrations measured in a similar area not influenced by emissions from outside the U.S.

This method implies the use of an air quality model to demonstrate that emissions within the U.S. do not create a violation of the NAAQS. Although a comprehensive, area-wide

[5] "State Implementation Plans for Serious PM_{10} Nonattainment Areas, and Attainment Date Waivers for PM_{10} Nonattainment Areas Generally; Addendum to the General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990," 59 FR 41998, August 16, 1994.

inventory of PM_{10} emissions is available for Nogales, Arizona, information about the spatial and temporal distribution of those emissions required to support air quality modeling is not readily available and would require significant effort to develop. Furthermore, given the complex topography of the Ambos Nogales area, it would be a challenging and expensive task to develop an adequate demonstration using available modeling tools.

Method 3: Analyze ambient sample filters for specific types of particles emanating from across the border. Although not required, characteristics of emissions from sources may be helpful so as to better demonstrate the causal relationship with and contribution to exceedances in the U.S. nonattainment area due to domestic and international sources.

This method is unlikely to produce useful information for Nogales because the large proportion of crustal PM sources on either side of the international border would far outweigh any specific stationary or combustion-based PM source contribution that may be discerned by a filter-based analysis. Also, we did not have specific local and international point source emissions information, such as source specific signature emissions compounds, with which to correlate the filter analyses results that Arizona might have provided.

Method 4: Inventory the sources on both sides of the border and compare the magnitude of PM_{10} emissions originating within the U.S. to those emanating from outside the U.S.

We produced two emissions inventories: the first inventory describes the PM_{10} sources in and around Nogales NAA, Arizona; and, the second inventory describes the PM_{10} sources in and around Nogales, Sonora, Mexico. Our Nogales NAA, PM_{10} Emissions Inventory is provided in Appendix A and our Nogales Municipality, Sonora, Mexico Emissions Inventory is provided in Appendix B. The results of both inventories are discussed below in Section 3.2. Also, as a basis for these analyses, we reviewed population estimates and will examine relative population differences in Section 3.1.

Method 5: Perform air dispersion and/or receptor modeling to quantify the relative impacts on the nonattainment area of sources located within the U.S. and of foreign sources of PM_{10} emissions.

As discussed above, the information necessary to support air dispersion or receptor modeling is not readily available for the Nogales, Arizona area, nor is it available for the Nogales, Mexico area. For example, we did not have available a gridded emissions inventory or a data set from an extensive monitoring array of ambient PM_{10} values and meteorological data derived from observations on multiple exceedance days.

We considered a backward wind trajectory analysis using the HYSPLIT model, based on Eta Data Assimilation System (EDAS) gridded meteorological data, but did not pursue this analysis.[6] Previously, we performed such an analysis for the Nogales, Arizona area

[6] The HYSPLIT model refers to the "Hybrid Single Particle Lagrangian Integrated Trajectory" model developed and maintained by the National Oceanic and Atmospheric Administration.

and found the resulting wind trajectories to be inconclusive. The EDAS has a 40-kilometer grid resolution; in contrast, the valley containing Nogales is 20 kilometers wide at its widest point. As a result, the EDAS data were not resolved enough to portray the south-to-north valley air drainage flows that are a key feature of local Nogales meteorology; consequently, we rejected further use of HYSPLIT model for purposes of this Section 179B analysis.

To summarize, we analyzed ambient PM_{10} levels in and around the Nogales NAA, the local meteorology associated with exceedances of the PM_{10} standard, and sources of PM_{10} emissions on either side of the international border. These analyses are consistent with Methods 1 and 4 described by the General Preamble. We examined Method 3, but did not pursue this avenue of investigation because it was unlikely that we would get definitive results given the large crustal source emissions on either side of the international border.

Initially, we did not pursue Methods 2 and 5 because we did not have the data and the models required for this type of analysis. Instead, we used the information at hand and, consistent with methods 1 and 4, determined if the Nogales NAA would have attained the standard, but for international emissions. Should these less resource intensive methods have proved inconclusive, we would have considered further analyses consistent with Methods 2 and 5.

As stated in the General Preamble, the EPA will consider the information "for individual nonattainment areas on a case-by-case basis in determining whether an area may qualify for treatment under section 179B." Because the individual circumstances surrounding a nonattainment area may differ widely whether by data, resources, or emissions sources, EPA anticipates that "the State may use one or more of these types of information or other techniques, depending on their feasibility and applicability, to evaluate the impact of emissions emanating from outside the U.S. on the nonattainment area." The analysis provided below for the Nogales NAA is specific to this nonattainment area only and the timeframe, data, and circumstances therein.

2.3 Guidance for Determining Attainment of the PM_{10} NAAQS

EPA determines whether an area's air quality is meeting the PM_{10} NAAQS based upon air quality data gathered at monitoring sites in the nonattainment area. Then, EPA reviews the data to determine the area's air quality status according to 40 CFR part 50, appendix K (the Attainment Guidance). Three consecutive years of clean air quality data (i.e., no more than one expected exceedance per year) is generally needed to show attainment of the twenty-four hour PM_{10} standard. As defined by 40 CFR part 50, appendix K, a complete year of air quality data is composed of all four calendar quarters with each quarter containing data from at least 75 percent of the scheduled sampling days.

Under the Attainment Guidance, a nonattainment area meets the twenty-four hour PM_{10} NAAQS when the expected number of days per calendar year with a twenty-four hour average concentration above 150 micrograms per cubic meter ($\mu g/m^3$) is equal to or less than one. In general, the number of expected exceedances at a site which samples every day is determined by recording the number of exceedances in each calendar year and then averaging them over the most recent three calendar years. For sites which do not sample every day, EPA requires adjusting the observed exceedances to account for days not sampled. The procedures for making this data adjustment are specified in 40 CFR part 50, appendix K.

For this review of the Nogales NAA and the contribution of international emissions, we are analyzing ambient air quality data from 2007-2009 as representing the most recent and complete three-year data set certified by Arizona. The 2010 data set is incomplete and the 2011 data set has yet to be submitted to EPA and certified as meeting the relevant quality control and quality assurance requirements. The standard we will use to determine attainment of the PM_{10} NAAQS, "but for" international emissions, is similar to the one described above: the expected number of days per calendar year with a twenty-four hour average concentration above 150 $\mu g/m^3$ must be equal to or less than one. To determine that the Nogales NAA has met the PM_{10} standard "but for" emissions from Mexico, the analysis must show that no more than three exceedances, based on data completeness and every day sampling, in the 2007-2009 analysis period were caused by emission sources on the U.S. side of the border.

3.0 Review of Data and Analyses

In this section, we review the relevant data and observations taken from the following supporting analyses described in Section 2.2:

- 2008 and 2011 Emissions Inventories for the Nogales NAA;
- 2008 and 2011 Emissions Inventories for the Nogales Municipality, Sonora, Mexico; and,
- Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009.

These analyses are summarized here and provided in their entirety within the appendices of this document.

3.1 Population Estimates

In producing emissions inventories, we reviewed recent 2010 population information from the U.S. Census Bureau and Mexican Census data from the Instituto Nacional de Estadistica Geografia e Informatica (INEGI). While population estimates, by themselves, are not proximal indicators of emissions activity, these estimates provide an indication of relative human activity and resulting PM_{10} emissions on either side of the international border.

Table 1: 2010 Population: Nogales NAA, Arizona and Nogales Municipality, Mexico

Area	Population	Percent
Nogales NAA, Arizona	24,059	9.8%
Nogales Municipality, Mexico	220,292	90.2%
Total	244,351	100%

Although the Nogales Municipality is a larger land area than the Nogales NAA, a large proportion of Municipality's population is concentrated within the City of Nogales, Sonora and the surrounding area. In sum, 90.2 percent of the 2010 population in the Ambos Nogales area can be attributed to the Mexican side of the international border.

We also examined population change since 1995, when the Nogales NAA had met the PM_{10} NAAQS.[7] Below, Tables 2 and 3 show population estimates for 1995, 2000, 2005, and 2010 beside the annual number of expected exceedances since 1995.

Table 2: Nogales, Arizona Exceedances of 24-hour NAAQS From 1995 - 2000 with 1995 and 2000 Ambos Nogales Population Data. [8]

	1995	1996	1997	1998	1999	2000
Expected Exceedances:						
1 in 6 day monitoring	0.0	0.0	0.0	13.5	15.5	0.0
Continuous monitoring*	---	---	---	---	---	---
Population:						
Nogales, Arizona	20,184	---	---	---	---	20,878
Nogales Municipality	133,491	---	---	---	---	159,787

*Continuous monitoring started in 2005; see table below.
Source for expected exceedance data: Air Quality System Database.
Source for 1995 and 2000 population data: INEGI & U.S. Census.

Table 3: Nogales, Arizona Exceedances of 24-hour NAAQS From 2000 - 2010 with Ambos Nogales 2000, 2005, 2010 Population Data.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Expected Exceedances:											
1 in 6 day monitoring	0.0	6.9	6.1	12.3	0.0	17.9	20.0	6.1	6.6	0.0	0.0
Continuous monitoring	---	---	---	---	---	29.6	47.9	14.0	13.2	2.0	8.5*
Population:											
Nogales, Arizona	20,878	---	---	---	---	20,421	---	---	---	---	20,837
Nogales Municipality	159,787	---	---	---	---	193,517	---	---	---	---	220,292

* There were no quarters in 2010 where there was a complete data set per 40 CFR part 50, appendix K; see Section 3.3.2 for discussion of 2010 data.
Source for expected exceedance data: Air Quality System Database.
Source for 2000, 2005, and 2010 population data: INEGI & U.S. Census.

7 76 FR 1532, January 11, 2011.

8 The 1995 Nogales, Arizona population estimate was interpolated from 1990 and 2000 U.S. Census figures; 1990 population was 19,489.

Between 1995 and 2010, Nogales Arizona population has increased slightly, approximately 3 percent, and has fallen since 2000. In contrast, the Nogales Municipality, Sonora population has increased 65 percent in the 1995-2010 timeframe. With exceptions of 2000 and 2004, exceedances of the PM_{10} standard have been recorded since 1997. The largest number of exceedances, 47.9, was recorded in 2006.

3.2 Emissions Inventories

Starting with information from EPA's 2008 National Emissions Inventory for Santa Cruz County, Arizona, we estimated 2008 and 2011 emissions inventories for the Nogales NAA.[9] Unfortunately, we did not have a readily available and comparable PM_{10} emissions data collection system from which to draw from when estimating emissions for the Nogales Municipality, Mexico. Consequently, using the best information publically available at the time of our analysis, we estimated and calculated a source-based emissions inventory for the Nogales Municipality based primarily on data and methodologies from the 1999 Mexico National Emissions Inventory and a subsequent update providing a 2012 Mexico emissions inventory.[10] Because there was a reasonable range of data inputs from which to select in estimating PM_{10} emissions, particularly for emissions from unpaved and paved roads, we calculated a low and high estimated range of PM_{10} emissions for the Nogales Municipality.

3.2.1 Nogales NAA, Arizona Emissions Inventory Estimates

As shown in Table 2 below, in 2008 the majority of PM_{10} emissions in the Nogales NAA came from fugitive dust from four source categories: unpaved road dust, road construction, commercial/industrial/institutional construction, and paved road dust. Our estimated emissions inventory for 2011 only differed slightly as total emissions decreased from 1,531 tons per year (tpy) in 2008 to 1,528 tpy in 2011, due primarily to new and cleaner engine standards for diesel engines. From 2008 to 2011, the emissions estimated for five of the top six source categories remain unchanged, except for residential wood burning which increases two tons per year. Again, as in 2008, these six source categories account for approximately 95 percent of all PM_{10} emissions in the Nogales NAA in 2011.

---

[9] See Appendix A: 2008 and 2011 Emissions Inventory for Nogales NAA.

[10] These two primary source documents are as follows: "Mexico National Emissions Inventory, 1999: Six Northern States", Final, April 30, 2004, prepared by Eastern Research Group (ERG), Acosta Y Asociados, and Transengineering, for the Secretariat of the Environment and Natural Resources and the National Institute of Ecology of Mexico, the United States Environmental Protection Agency, the Western Governors'Association, and the North American Commission for Environmental Cooperation. (1999 Mexico NEI); and, "Development of Mexico National Emissions Inventory Projections for 2008, 2012, and 2030", Final, January 9, 2009, prepared by Eastern Research Group, Inc. (ERG) for the Instituto Nacional de Ecologia, Mexico City, Mexico, the National Renewable Energy Laboratory, and the United States Environmental Protection Agency, with assistance from the Western Governors' Association. (2008-12 NEI Projections). See Appendix B: 2008 and 2011 Emissions Inventories for the Nogales Municipality, Sonora, Mexico for the complete discussion of the sources and methods use to develop this emissions inventory.

Table 4: 2008 Nogales NAA PM_{10} Emissions Inventory (tons per year)[11]

Source Category	PM_{10}	Percent
Dust - Unpaved Road Dust	865	56.5%
Dust - Road Construction	267	17.4%
Dust - Commercial/Industrial/Institutional Construction	143	9.3%
Dust - Paved Road Dust	121	7.9%
Fuel Combustion - Residential – Wood	24	1.6%
Dust - Residential Construction	24	1.6%
Waste Disposal - Residential Garbage Burning	23	1.5%
All other sources	64	4.2%
Total	1,531	100%

Note: All other sources include emissions from source categories such as all on-road mobile and off-road mobile, all commercial and industrial fuel combustion, agriculture, land clearing and burning activities.

3.2.2 Nogales, Sonora, Mexico Emissions Inventory Estimates

While less detailed than the Nogales NAA, Arizona emissions inventory, the Nogales, Sonora emissions inventory shows that the largest contributing sources of PM_{10} emissions are unpaved and paved road dust followed by residential wood combustion and other area sources. While the high estimate for point sources may be unlikely, we have included it because we did not have readily available source-specific information providing a precise estimate for stationary point sources of PM_{10} in the Municipality. The methods for calculating these estimates are discussed in Appendix B.

Table 5: PM_{10} Emissions Inventory for Nogales Municipality for 2008 and 2011 (tons)

Source Category		Range	2008	2011
Point Sources		Low Estimate	1.1	1.1
		High Estimate	305	390
Area Sources	Unpaved Road	Low Estimate	2,144	2,308
		High Estimate	5,521	5,944
	Paved Road	Low Estimate	53	57
		High Estimate	646	696
	Agricultural Tilling		0.8	0.8
	Agricultural Burning		1.6	1.6
	Residential Wood Combustion		176	47
	Open Burning of Waste		55	56
	Construction Activities		23	24
	Remaining Area Sources		159	150
Mobile Sources			80	85
Nonroad Sources			20	27
Total		Low Estimate	2,713	2,757
Total		High Estimate	6,987	7,420

Emissions are rounded to the nearest ton/year, or to the nearest tenth of a ton/year for emissions less than 10 tons/year.

[11] For all tables and throughout the text, emissions are rounded to the nearest ton/year, or to the nearest tenth of a ton/year for emissions less than 10 tons/year. Due to rounding, totals may not reflect exactly the sum of each category.

3.2.3 Review and Comparison

Both the Nogales NAA and the Nogales Municipality have similar sources of PM_{10}, primarily fugitive dust from unpaved and paved roads, as well as combustion sources and construction. A comparison of 2008 and 2011 low emission inventory estimates suggests that there is a 36/64 percent split in total Ambos Nogales emissions between emissions from the Nogales NAA, Arizona and Nogales Municipality, Mexico areas, respectively. To characterize the relative difference by ratio, for every one ton of PM_{10} emissions produced annually in Nogales NAA there is an estimated 1.8 tons produced in Nogales Municipality.

Table 6: 2008 PM_{10} Emission Inventories: Nogales NAA, Arizona and Nogales Municipality, Mexico (low estimate) (tons per year)

	PM_{10}	Percent
Nogales NAA, Arizona	1,531	36.1%
Nogales Municipality, Mexico	2,713	63.9%
Total	4,244	100%

Table 7: 2011 PM_{10} Emission Inventories: Nogales NAA, Arizona and Nogales Municipality, Mexico (low estimate) (tons per year)

	PM_{10}	Percent
Nogales NAA, Arizona	1,528	35.7%
Nogales Municipality, Mexico	2,757	64.3%
Total	4,285	100%

Similarly, a comparison of 2008 and 2011 high emission inventory estimates suggests that there is an 18/82 percent split in total Ambos Nogales emissions between emissions from the Nogales NAA, Arizona and Nogales Municipality, Mexico areas, respectively. Again, to characterize the relative difference by ratio, for every one ton of PM_{10} emissions produced annually in Nogales NAA there is an estimated 4.6 tons produced in Nogales Municipality.

Table 8: 2008 PM_{10} Emission Inventories: Nogales NAA, Arizona and Nogales Municipality, Mexico (high estimate) (tons per year)

	PM_{10}	Percent
Nogales NAA, Arizona	1,531	18%
Nogales Municipality, Mexico	6,987	82%
Total	8,518	100%

Table 9: 2011 PM_{10} Emission Inventories: Nogales NAA, Arizona and Nogales Municipality, Mexico (high estimate) (tons per year)

	PM_{10}	Percent
Nogales NAA, Arizona	1,528	17.1%
Nogales Municipality, Mexico	7,420	82.9%
Total	8,948	100%

To summarize, a comparison of our 2008 and 2011 emissions inventory data suggests that for every one ton of PM_{10} produced in the Nogales NAA, there were between 1.8 and 4.6 tons of PM_{10} emissions produced annually in the Nogales Municipality. The emissions sources appear to be similar with the majority of emissions from fugitive dust sources, such as reintrained unpaved and paved road dust.

3.3 Ambient PM_{10} Levels, Topography, and Meteorological Data

In our review and analyses, we found that the Ambos Nogales area's meteorology and topography are likely components of the observed exceedances of PM_{10} NAAQS and there is a definite south to north directional component to these exceedances; particularly, in reference to the international border between Nogales, Arizona and Nogales, Sonora, Mexico. Over the 2007-2009 timeframe, there were 29 exceedances at the Nogales, Arizona Post Office (Model: Met One BAM 1020) monitor. We are focusing on the data from this particular monitor for the following reasons: it is comparable to the NAAQS; it has recorded all the exceedances; it has recorded hourly ambient values; and, it has a sufficiently complete dataset for comparison to the NAAQS. Arizona has not flagged any of these 2007 through 2009 exceedance days for potential exclusion from air quality planning considerations under EPA's Exceptional Events Rule.

Our analysis of ambient concentration and meteorological data identified 26 of the 29 exceedances as having nearly identical diurnal patterns; the three exceptions were January 1, 2007, May 22, 2008, and January 1, 2009.[12] For each of the 26 days, there is a strong pattern of decreasing PM_{10} concentrations in the very early morning. The majority of days have a pronounced PM_{10} increase and drop-off between 6:00 am and 9:00 am, suggesting a reproducible direct PM_{10} source, noting the times correspond to a morning commute pattern. The PM_{10} concentrations reach their lowest points between 10:00 am and 4:00 pm, with corresponding increases in ambient temperature and wind speed observed during those times. As temperatures and wind speeds drop in the evening hours, a pronounced spike in PM_{10} concentration is then observed beginning between 4:00 pm and 6:00 pm, with concentrations remaining high for a couple of hours and gradually dropping off towards midnight. The afternoon spike in PM_{10} concentrations correlates with a significant drop in temperature and wind speed, and generally a shift to low and variable southerly (from the south) winds.

[12] See, in particular, Section 3 of Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.

Looking at topography from south to north, the highest elevation of a primary roadway transect is at 4,331 feet at the southern edge of Nogales, Sonora, falling to the international border at 3,933 feet, continuing to the northern edge of the Nogales, Arizona PM_{10} NAA at 3,425 feet, and elevation continues to fall along the Santa Cruz River watershed to the north to approximately 3100 feet.[13] Across this largest 48.5 mile local transect, the elevation falls approximately 1200 feet from south to north.

An examination of a smaller 14.8 mile transect along a similar primary roadway route shows elevation declines on a south to north axis. The Nogales, Sonora sub-transect shows an elevation drop of 201 feet over 4.8 miles to the international border where there is a slight leveling; starting at 4,134 feet at the Nogales, Sonora urban boundary and dropping to 3,933 feet at the international border. The Nogales, Arizona sub-transect shows an elevation drop of 508 feet over 10 miles, from the international border to the northern boundary of the Nogales NAA; starting at 3,933 feet and dropping to 3,425 feet.[14] In sum, looking at a south to north transect along the Nogales Wash, elevations fall from south to north with the highest elevations in the Nogales, Sonora area. Looking at the general topography of the Ambos Nogales area (from a northwest perspective, see Figure 2), there is a funnel created as the Nogales Wash falls from higher southern elevations to the international border along the route of the Alvaro Obregón Boulevard and into Nogales, Arizona. Small side canyons extend off of the Nogales Wash bottom and into the surrounding hills between the international border and south of the Nogales, Sonora city center, and to a lesser extent into Nogales, Arizona as elevations drop moving to the north.

[13] See Figure 18, Long Aerial and Elevation Transect of Nogales Arizona and Nogales, Sonora; Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.

[14] See Figure 19, Short Aerial and Elevation Transect of Nogales, Arizona and Nogales, Sonora; Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.

Figure 2: Elevated Topographical View of Ambos Nogales Area from Northwest Perspective with Nogales, Sonora Highlighted and International Border in Red Line.

3.3.1 Analyses of 2007 - 2009 Exceedance Days

In three analyses of ambient PM_{10} concentrations and wind direction on exceedance days, we found that high PM_{10} concentrations are associated with wind direction from a southerly quadrant, or southerly air flows more often than what is typically observed on non-exceedance days. Also, we found that the largest number of hourly ambient values above 150 $\mu g/m^3$ and the highest ambient values, including those markedly above 150$\mu g/m^3$, originated from a southerly wind direction quadrant.

In the first analysis, for the 26 exceedance days with nearly identical diurnal patterns, we examined the percent of the total observed 24-hour concentration that is attributable to winds out of specific directional quadrants by performing a weighted analysis of hourly concentrations. The weighted hourly analysis shows that, for non-exceedance days, the concentrations attributable to winds from a southerly wind quadrant are approximately 62 percent of the total observed PM_{10}. When we examine exceedance days, however, concentrations attributable to wind from a southerly wind quadrant increases to 80 percent of the total.

Table 10: Percentage of observed PM_{10} concentrations attributable to wind direction. January 1, 2007, May 22, 2008, and January 1, 2009 are excluded from the analysis of exceedance days.

Ambient Data Sample	Northerly (315 - 44°)	Easterly (45 - 134°)	Southerly (135 - 224°)	Westerly (225 - 314°)
All Days in 2007 - 2009	11%	16%	63%	10%
Non-Exceedance Days	12%	16%	62%	10%
Exceedance Days	7%	10%	80%	3%

In the second analysis, we examined all exceedance days using pollution roses, a method correlating wind direction observations with hourly ambient PM_{10} concentrations. We found that higher PM_{10} readings were observed when wind direction was from the southernmost quadrant; see Table 11 below. We found that the largest proportion of hourly values above 150 $\mu g/m^3$ and the highest hourly concentrations were found in the southerly wind direction quadrant. When ambient PM_{10} values above 150 $\mu g/m^3$ were sorted by 100 $\mu g/m^3$ increments to 550 $\mu g/m^3$ and greater, we found within each increment above 150 $\mu g/m^3$ that 71 to 92 percent of the ambient PM_{10} observations were from the southerly wind quadrant.[15]

Table 11: Hourly ambient PM_{10} concentrations sorted by concentration and wind direction, 2007 - 2009 exceedance days.

	Range of Ambient Concentration Values (microgram/m^3)						
Wind Direction Quadrant	< 150	150 - 250	250 - 350	350 - 450	450 - 550	>= 550	Share of All Wind Direction Observations
Northerly NW to NNE	27%	6%	3%	3%	3%	0%	17%
Easterly NE to ESE	15%	16%	16%	11%	3%	8%	14%
Southerly SE to WSW	41%	71%	72%	84%	92%	92%	57%
Westerly SW to WNW	18%	6%	8%	3%	3%	0%	12%
Total	100%	100%	100%	100%	100%	100%	100%

Finally, we examined the wind direction and hourly PM_{10} concentrations on each exceedance day to determine two average ambient values for each exceedance day: one value for the southerly wind quadrant and a second value representing all other wind directions. Table 12 below shows the results. Two exceedance days, January 1, 2007 and January 26, 2008, have an average ambient concentration greater than 150$\mu g/m^3$ for

[15] The 80 percent figure in Table 10 represents concentration-weighted hours from the southerly wind quadrant on exceedance days; whereas, the 57 percent figure in Table 11 represents a percentage of hourly observations from the southerly wind quadrant on exceedance days. To explain further, while 57 percent of the winds are from the southerly wind quadrant on exceedance days, there are much higher concentrations coming from those directions.

the "all other wind direction" quadrants. The ratio of the southerly quadrant concentration to the "all other direction" quadrant concentration ranges from 0.86 to 11, with an average ratio value of 3.83. Only one day, January 1, 2007, has a ratio value less than 1.0; i.e., the "all other direction" quadrants' share exceeds the southerly quadrant share.

Table 12: 2007 - 2009 Exceedance Days Concentration Values Disaggregated by Southerly Wind Quadrant versus All Other Wind Directions (μg/m^3).

Date	24-hour Concentration	Southerly Wind Quadrant Concentration (135 to 224 degrees)	All Other Wind Direction Concentration (225 to 134 degrees)	Concentration Ratio of Southerly Wind Quadrant to Other Wind Directions
1-Jan-2007	210	199	231	0.86
6-Feb-2007	180	228	100	2.28
6-Mar-2007	157	265	66	4.02
15-Mar-2007	175	360	65	5.54
19-Oct-2007	189	335	43	7.79
27-Oct-2007	210	301	133	2.26
2-Nov-2007	211	278	79	3.52
3-Nov-2007	170	213	128	1.66
4-Nov-2007	170	183	148	1.24
6-Nov-2007	186	209	119	1.76
18-Nov-2007	167	277	38	7.29
19-Nov-2007	177	216	63	3.43
28-Nov-2007	167	278	75	3.71
24-Dec-2007	233	368	45	8.18
26-Jan-2008	204	257	182	1.41
27-Feb-2008	166	251	66	3.80
18-May-2008	169	356	57	6.25
22-May-2008	217	217	No values observed	---
26-Oct-2008	156	219	53	4.13
31-Oct-2008	159	245	74	3.31
1-Nov-2008	234	369	76	4.86
8-Nov-2008	167	197	79	2.49
16-Nov-2008	171	273	69	3.96
17-Nov-2008	206	297	27	11.00
20-Nov-2008	161	225	56	4.02
22-Nov-2008	179	245	102	2.40
31-Dec-2008	155	163	117	1.39
1-Jan-2009	238	323	119	2.71
16-Jan-2009	204	247	119	2.08

To summarize, we analyzed hourly ambient values on exceedance days in three different ways. We found that high PM_{10} concentrations are associated with wind direction from a southerly quadrant, or southerly air flows more often than what is typically observed on non-exceedance days. We found that the largest number of hourly ambient values above 150 $\mu g/m^3$ and the highest ambient values, including those markedly above 150 $\mu g/m^3$, originated from a southerly wind direction quadrant. Our third analysis of the hourly ambient data confirms our general findings; however, the January 1, 2007 and January 26, 2008 exceedance days may be exceptions and are discussed in Section 4.2, below.

3.3.2 Review of 2010 and 2011 Exceedance Days

We did not use 2010 and 2011 data for our detailed meteorological analysis and attainment determination for two reasons. First, the 2010 dataset did not meet the completeness criteria specified in 40 CFR part 50, appendix K; no quarter in 2010 had complete data. This was due to a large data gap from March 16 to October 27 resulting from poor quality assurance and control results. Second, the 2011 dataset has yet to be entered completely into the Air Quality System database and certified by Arizona. As stated earlier, a complete year of air quality data, as defined by 40 CFR part 50, appendix K, comprises all four calendar quarters with each quarter containing data from at least 75 percent of the scheduled sampling days. While the 2010 and 2011 ambient data do not provide the basis for this attainment determination, we examined this data consistent with the analyses presented in this document and found no information to contradict our conclusions.[16]

While we did not use the data from 2010 and 2011 for our detailed meteorological analyses, we did review this most recent data to see how ambient PM_{10} levels compare generally to our 2007 - 2009 dataset. In 2010, the Nogales, Arizona Post Office (Model: Met One BAM 1020) monitor recorded six exceedances of the twenty-four hour PM_{10} NAAQS; these twenty-four hour average ambient values ranged from 159 $\mu g/m^3$ to 191 $\mu g/m^3$. There was one exceedance of the PM_{10} standard in 2011. Arizona has not flagged any of these 2010 or 2011 exceedances for potential exclusion from air quality planning considerations under EPA's Exceptional Events Rule.

4.0 Findings

From our three analyses, the Nogales NAA emissions inventory, the Nogales Municipality emissions inventory, and the 2007-2009 Meteorological Analysis, we find:

- The majority of exceedances, 79 percent, occur in the October to January timeframe, mostly in November.[17] Also, given the high desert environment and

[16] See Section 4.5 in Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.
[17] See Figure 3, Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.

winter light regime, temperatures usually drop dramatically, 20 degrees Fahrenheit over the 3-4 hours after sunset.[18]

- From the emission inventories, we estimate that pollution loads may differ by a ratio of 1.8 - 4.6 to one on a south-to-north basis in relation to the international border.

- The largest sources of PM_{10} emissions in the Ambos Nogales area are reintrained dust from unpaved and paved roads.

- Overall, elevations drop approximately 709 feet across the entire south to north local transect we examined, from the southernmost edge of the Nogales, Sonora urban boundary to the Nogales NAA northern boundary line.

- Of the 29 exceedance days in 2007 - 2009, 26 of those days showed a similar pattern of ambient PM_{10} concentration, wind speeds, wind direction, and temperature variation over a twenty-four hour period; the three exceptions were January 1, 2007, May 22, 2008, and January 1, 2009.

- On exceedance days, the largest proportions, 71-92 percent, of hourly values exceeding 150 $\mu g/m^3$ and almost all of the highest observed PM_{10} concentrations of observations above 450 $\mu g/m^3$, 92 percent, are associated with a southerly wind direction quadrant.[19]

- The ambient PM_{10} concentration attributed to the southerly wind quadrant exceeds 150 $\mu g/m^3$ on all 29 exceedance days. In contrast, two exceedance days from the "all other wind direction" quadrants show a value greater than 150 $\mu g/m^3$: January 1, 2007, and January 26, 2008.

- Only one of 29 exceedance days shows the concentration attributed to the "all other wind direction" quadrants greater than that of the concentration attributed to the southerly wind quadrant: January 1, 2007.

- On exceedance days, the average ratio of the southerly wind quadrant share of 24-hour ambient PM_{10} values to all other wind quadrants share of ambient values is 3.83 to 1. This ratio is relatively consistent with the estimated pollution loads ratio of 1.8 - 4.6 to one, from south-to-north across the international border.

---

[18] See Figures 7 and 14, Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.

[19] See Table 11 above. For a visual representation of this data, see the pollution roses in Figures 11 and 12, Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.

4.1 A Conceptual Model of 2007 - 2009 Exceedance Days

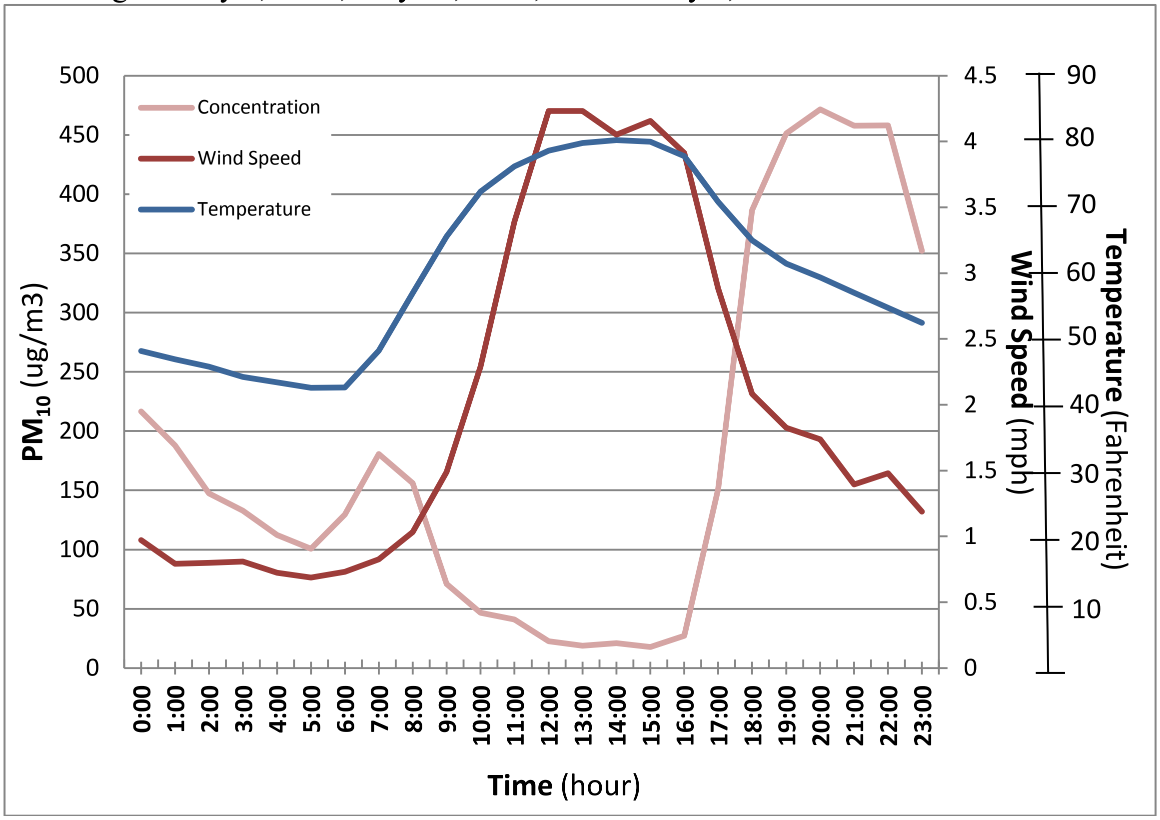
As described above in Section 3.3, 26 of the 29 2007 - 2009 exceedances showed a similar pattern of ambient PM_{10} concentration, wind speeds, wind direction, and temperature variation over a twenty-four hour period; the exceptions were January 1, 2007, May 22, 2008, and January 1, 2009. Two of these days, January 1, 2007, and January 1, 2009, with higher early morning PM_{10} concentrations, only vary slightly from the diurnal profile of PM_{10} concentrations observed for the other exceedances, but have similar meteorological and concentration patterns throughout the rest of the day. Two of the 29 exceedance days, January 1, 2007, and January 26, 2008, had high average ambient concentrations during hours when the wind was out of directions other than the south. Thus, there are twenty-five exceedance days that are equivalent and can be considered here as a group, setting aside the dissimilar exceedance days listed above, January 1, 2007, January 26, 2008, May 22, 2008, and January 1, 2009.

Considering these 25 similar exceedance days, we can postulate how the elements of pollution loads and sources, temperature changes, and wind direction may contribute to producing the majority of observed ambient PM_{10} values exceeding the NAAQS in Nogales, Arizona. We will review the data concerning January 1, 2007, January 26, 2008, May 22, 2008, and January 1, 2009 in more detail within Section 4.2.

As shown for the average PM_{10} concentration, wind speed, and temperature profiles in Figure 3, beginning at midnight, there is a strong pattern of decreasing PM_{10} concentrations from the previous day's high values into the early morning hours. Then, there is a pronounced PM_{10} increase and drop-off between 6:00 am and 9:00 am, suggesting a reproducible direct PM_{10} source, such as reintrained road dust from the morning commute. As morning temperatures rise, so does wind speed as wind direction changes from south to north dispersing the spike in morning PM_{10} concentrations. The PM_{10} concentrations continue to fall through the afternoon and reach their lowest points between 10:00 am and 4:00 pm. The morning and afternoon increases in ambient temperature and wind speed can be attributed to the heating portion of a diurnal heating and cooling cycle where heated air flows from lower elevations to the north to the higher elevations to the south.

As sunset approaches and night falls, the diurnal cooling cycle begins. Ambient temperatures drop and lower elevation air masses no longer rise with convection causing wind speed to drop and wind direction to be variable. As temperatures continue to drop after sunset, wind speeds drop and cold air masses flow down from higher elevations causing wind direction to shift from a variable/northerly direction to a southerly direction. A pronounced spike in PM_{10} concentration is then observed beginning between 4:00 pm and 6:00 pm; roughly corresponding with the evening commute hours. Concentrations remain high for several hours into the evening and gradually begin to decrease as midnight approaches. The highest concentrations of PM_{10} occur in these evening hours when reintrained dust from unpaved and paved roads may be captured by cold air flows moving south to north from higher elevations. Also, home heating combustion may add a component to the evening PM_{10} load and be captured in the evening southerly air flows.

Figure 3: Average hourly PM_{10} concentration, wind speed, and temperature at the Nogales, Arizona Post Office FEM monitor versus time of day for all exceedances, excluding January 1, 2007, May 22, 2008, and January 1, 2009. [20]



This pattern of exceedances is usually observed during times when the general weather pattern allows for stagnation and a relatively still air mass subject to movement by the diurnal cooling and heating cycle. At other times of the year, frontal systems move through often enough and with enough energy to prevent a stagnant air mass and the diurnal heating and cooling cycle from exerting a strong influence on the local meteorology.

The conceptual model we present is consistent with the study by Arizona State University, "Atmospheric, Hydroclimatic, and Anthropogenic Causes of Fugitive Dust in the Nogales, Arizona-Nogales, Sonora Airshed."[21] In this study – based on a regression analysis of 815 daily PM_{10} observations at Nogales, Arizona, and 457 daily PM_{10}

[20] The diurnal pattern shown in Figure 3 applies to 25 very similar exceedance days and also includes January 26, 2008. Elements of this discussion, however, may not apply to January 26, 2008 because of the higher observed PM_{10} concentrations when winds were from the east southeast. See Section 4.2.3 for a more detailed discussion of the January 26, 2008 exceedance day.

[21] Completed in 2002 by A.W. Ellis, the final report is available through The Southwest Center for Environmental Researcy and Policy at http://scerpfiles.org/cont_mgt/doc_files/A-02-2.pdf.

observations at Nogales, Sonora, and other information – the authors conclude that stagnant atmospheric conditions over a large scale (i.e., a stagnant synoptic atmosphere) is the most important factor in predicting high daily PM_{10} concentrations.[22]

As shown in Table 12 above, for these similar 25 days the ambient concentration attributed to the southerly wind direction quadrant always exceeds the 150 $\mu g/m^3$ level, in most cases markedly. Conversely, the ambient concentration attributed to the all other wind direction quadrants never exceeds the 150 $\mu g/m^3$ level. Across all 25 days, the average of the hourly concentration values for the hours with a southerly wind direction ranges from 163 to 369 $\mu g/m^3$ for each of the days, with an average value across the 25 days of 264 $\mu g/m^3$. In comparison, the average of the hourly concentration values for all other wind direction quadrants ranges from 38 to 148$\mu g/m^3$ for each of the days, with an average value across the 25 days of 80 $\mu g/m^3$.

In sum, for 25 of the 29 exceedance days, we have a conceptual model that explains how exceedances of the PM_{10} NAAQS occur in Nogales NAA. Moreover, for all of these 25 days, the origin and contribution of PM_{10} to exceedances of the standard at the Nogales, Arizona Post Office monitor has a very large southerly component. Given the wind direction, the proximity of the monitor to the border, and the comparison of the magnitude of emissions on either side of the border, the majority of the emissions that result in these exceedances most likely originate from the Nogales, Sonora side of the international border.

4.2 Review of Exceedance Days That Diverge From the Conceptual Model

The conceptual model of Mexican influence on Nogales NAA PM_{10} concentrations described above fits the observations on 25 of the 29 exceedance days in 2007-2009. We have identified, however, four specific exceedance days that differ in one or more ways from our conceptual model of PM_{10} exceedances in the Nogales NAA: January 1, 2007, May 22, 2008, January 26, 2008, and January 1, 2009. We will examine each of these days in further detail to explain the high ambient PM_{10} values that occurred on those days.

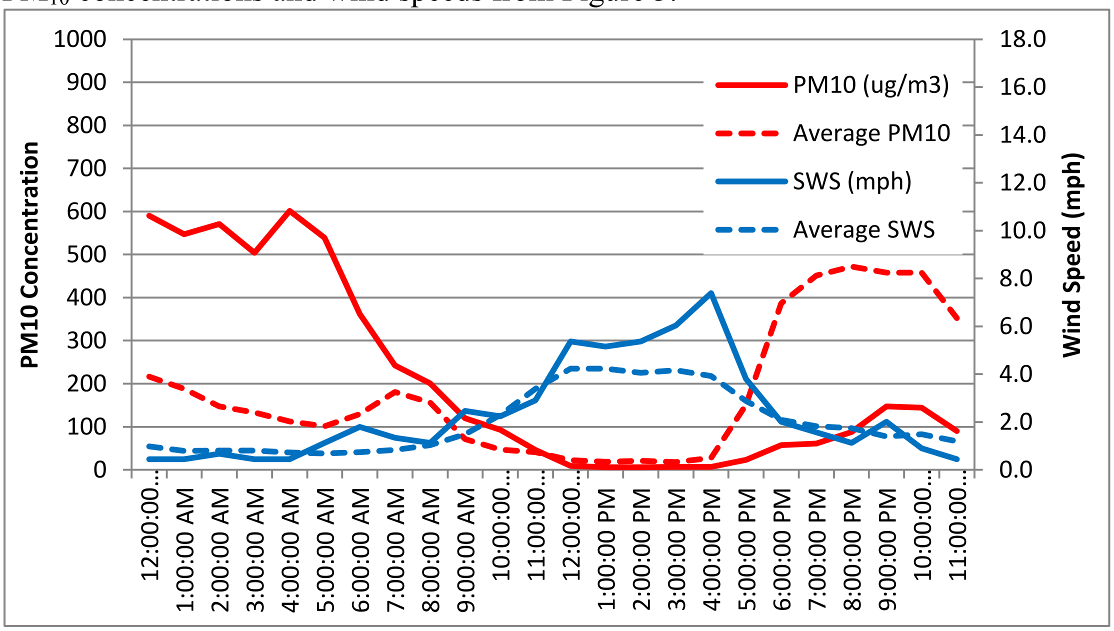
[22] With respect to soil moisture, this study noted a weak relationship between hydroclimatological conditions and high PM_{10} concentrations, i.e., while the soil is driest during the hot summer months of June through August, high PM_{10} concentrations typically occur during late fall through early spring months. In considering soil moisture related predictors of daily PM_{10} concentrations, the study did observe that the rate of daily drying is associated with higher observed PM_{10} concentrations, and that episodes of high PM_{10} were generally marked by more than twice the length of time since the last precipitation event when compared to episodes of low concentration. Despite these associations that soil moisture plays a role in high PM_{10} concentrations, the study concluded the following: overall conditions in the Nogales area are conducive to generating PM_{10} emissions throughout the year; and, meteorological conditions most strongly distinguish between high and low PM_{10} concentrations on a given day.

4.2.1 January 1, 2007 Exceedance Day Review

Table 13: January 1, 2007 PM_{10} Concentration: 24-hour value and hourly values disaggregated by southerly wind quadrant.

24-hour PM_{10} Concentration ($\mu g/m^3$)	Southerly Wind Quadrant PM_{10} Concentration ($\mu g/m^3$) (135 to 224 degrees)	All Other Wind Direction PM_{10} Concentration ($\mu g/m^3$) (225 to 134 degrees)
210	199 (15 of 24 values)	231 (9 of 24 values)

Figure 4: January 1, 2007 PM_{10} concentrations and wind speeds compared to average PM_{10} concentrations and wind speeds from Figure 3.[23]



As shown in Figure 4, with higher early morning PM_{10} concentrations contributing more strongly to the high 24-hour average, the PM_{10} diurnal pattern for January 1, 2007 varies from the average diurnal pattern for the 26 exceedance days. The diurnal pattern after mid-day looks similar to our conceptual model exceedance day, with an increase in hourly PM_{10} concentrations at 6:00 pm; however, this increase is less pronounced than our conceptual model exceedance day and the 24-hour exceedance is driven by the high early morning peaks. An examination of the hourly PM_{10} values shows high PM_{10} observations, from variable and backing wind directions, and very low wind speeds during the midnight to 8:00 am timeframe.

The average PM_{10}:$PM_{2.5}$ ratio of all 2007 - 2009 days with valid samples was 6.24 (standard deviation equals 2.89). The ratio observed on January 1, 2007 is the lowest in

[23] As discussed in Section 4.1 and shown in Figure 3, the average PM_{10} concentrations and windspeeds depicted in Figures 4, 5, 6, and 7 exclude observations from January 1, 2007, May 22, 2008, and January 1, 2009.

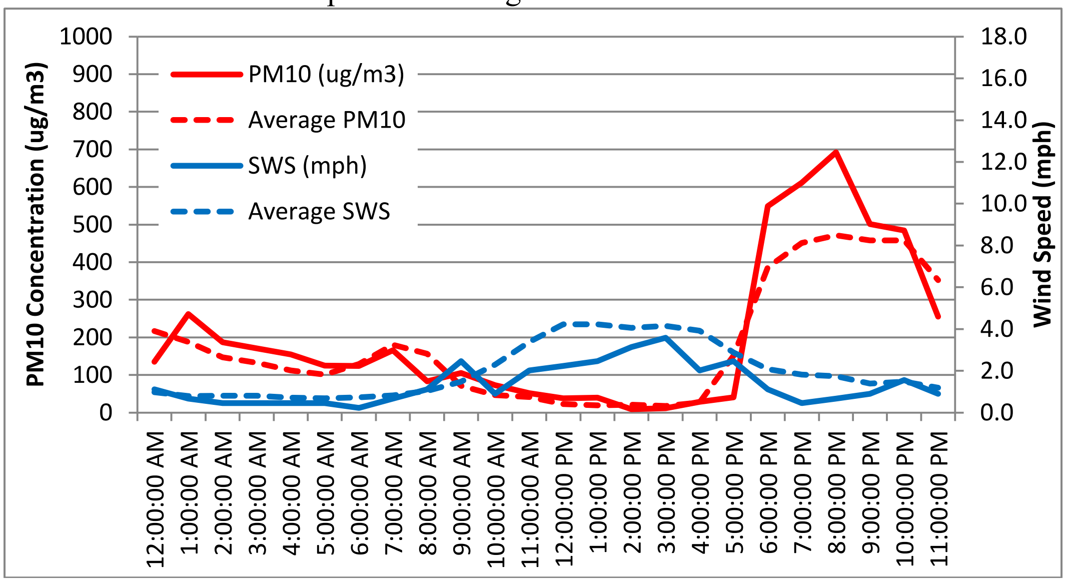
the 2007 - 2009 sample period (1.49), suggesting that the large early morning ambient PM_{10} values were caused by a combustion source such as residential wood burning.[24]

4.2.2 January 26, 2008 Exceedance Day Review

Table 14: January 26, 2008 PM_{10} Concentration: 24-hour value and hourly values disaggregated by southerly wind quadrant.

24-hour Concentration ($\mu g/m^3$)	Southerly Wind Quadrant Concentration ($\mu g/m^3$) (135 to 224 degrees)	All Other Wind Direction Concentration ($\mu g/m^3$) (225 to 134 degrees)
204	257 (7 of 24 values)	182 (17 of 24 values)

Figure 5: January 26, 2008 PM_{10} concentrations and wind speed compared average PM_{10} concentrations and windspeeds from Figure 3.



As shown in Figure 5, the PM_{10} diurnal pattern for January 26, 2008 is nearly the same as the conceptual model day and the other 25 exceedance days (excluding January 1, 2007, May 22, 2008, and January 1, 2009 from the 29 exceedances), with high evening PM_{10} concentrations contributing most to the high 24-hour average. The diurnal pattern during mid-day looks the same as our conceptual model exceedance day, with decreasing hourly PM_{10} concentrations from 9:00 am as wind speeds increase. There is a slight morning PM_{10} spike beginning at 6:00 am, but that is dispersed by rising low winds, again consistent with our conceptual model day. An examination of the hourly PM_{10} values shows the highest PM_{10} observations occurring in the evening (7:00-8:00 pm) from an east southeast direction (ESE); just outside of our defined southerly quadrant of 135-224 degrees. These two hourly values greater than 550 $\mu g/m^3$ are the only two from the ESE direction across all observed values on exceedance days. For further comparison, less

[24] For the complete discussion of coarse versus fine particulate matter on all exceedance days, see Section 4.4 and Table 8 of Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009, in Appendix C.

than 2 percent of hourly wind observations were from the ESE wind direction on all days, including non-exceedance days.

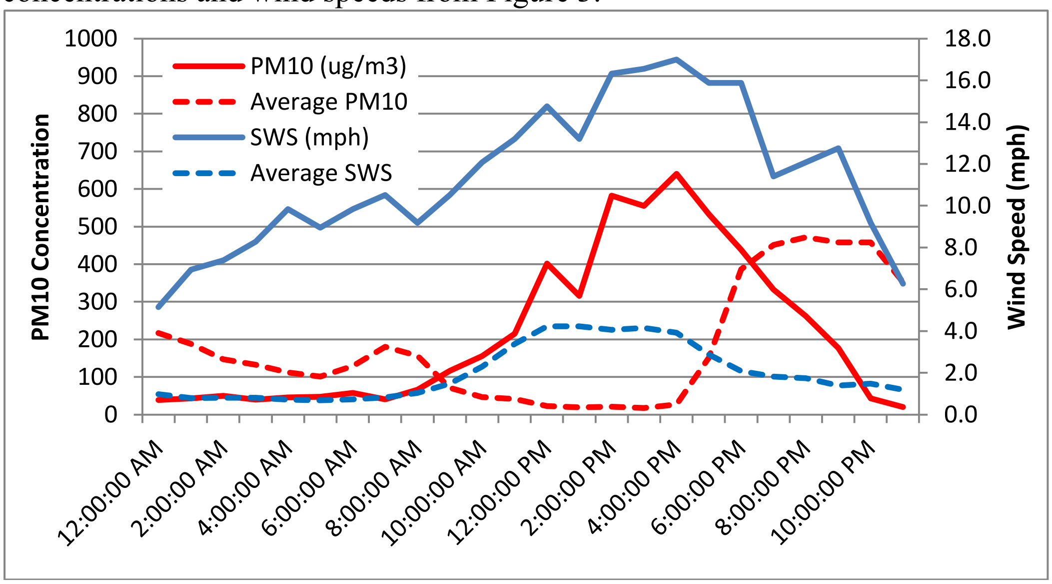
The average PM_{10}:$PM_{2.5}$ ratio of all 2007 - 2009 days with valid samples was 6.24 (standard deviation equals 2.89). The ratio observed on January 26, 2008 is near the average for the entire period (5.7), suggesting that ambient PM_{10} values were caused by emission sources similar to those on other exceedance days.

4.2.3 May 22, 2008 Exceedance Day Review

Table 15: May 22, 2008 PM_{10} Concentration: 24-hour value and hourly values disaggregated by southerly wind quadrant.

24-hour Concentration ($\mu g/m^3$)	Southerly Wind Quadrant Concentration ($\mu g/m^3$) (135 to 224 degrees)	All Other Wind Direction Concentration ($\mu g/m^3$) (225 to 134 degrees)
217	217 (24 of 24 values)	No Observed Values

Figure 6: May 22, 2008 PM_{10} concentrations and wind speeds compared to average PM_{10} concentrations and wind speeds from Figure 3.



Compared to the other twenty-eight exceedance days in our data set, May 22, 2008 is the only exceedance day associated with elevated windspeeds, some as high as 17 miles per hour (mph). See Figure 6. Also, the PM_{10} diurnal pattern for May 22, 2008 is not at all similar to the average of the 26 exceedance days as PM_{10} concentrations peak around 4:00 pm consistent with the daily high wind speed for the day of 17 mph, and PM_{10} levels continue to fall with decreasing wind speed. An examination of the wind direction shows that all winds originated from the southerly wind quadrant (135-224 degrees).

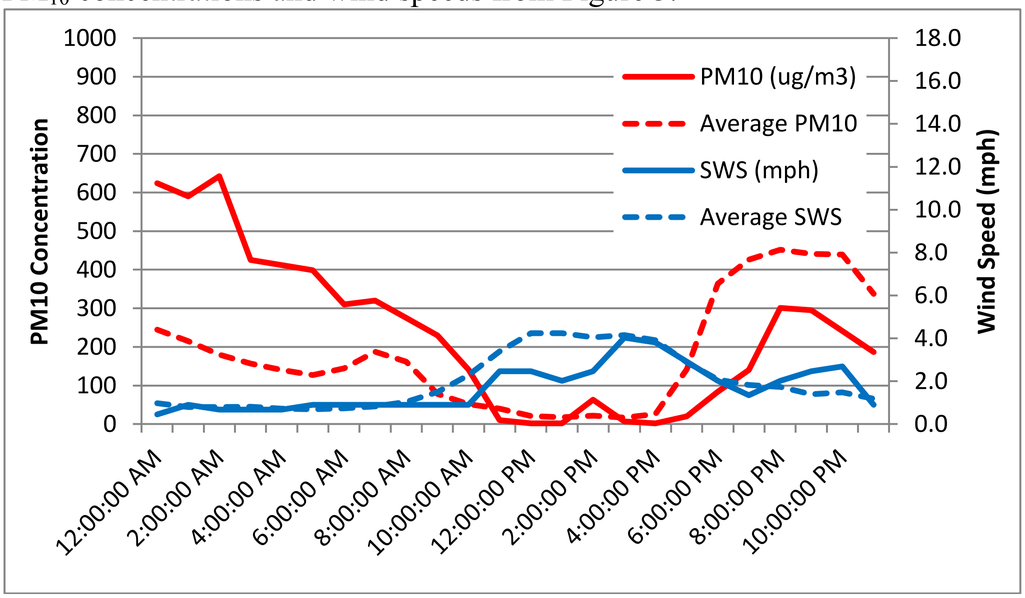
The average PM_{10}:$PM_{2.5}$ ratio of all 2007 - 2009 days with valid samples was 6.24 (standard deviation equals 2.89). Consistent with the high wind speeds, the ratio observed on May 22, 2008 is the highest in the 2007 - 2009 sample period (10.96), suggesting that the high late afternoon ambient PM_{10} values were caused by sources of coarse particulate matter and windblown dust, such as disturbed open areas and unpaved roads.

4.2.4 January 1, 2009 Exceedance Day Review

Table 16: January 1, 2009 PM_{10} Concentration: 24-hour value and hourly values disaggregated by southerly wind quadrant.

24-hour Concentration (µg/m^3)	Southerly Wind Quadrant Concentration (µg/m^3) (135 to 224 degrees)	All Other Wind Direction Concentration (µg/m^3) (225 to 134 degrees)
238	323 (14 of 24 values)	119 (10 of 24 values)

Figure 7: January 1, 2009 PM_{10} concentrations and wind speeds compared to average PM_{10} concentrations and wind speeds from Figure 3.



As shown above, with higher early morning PM_{10} concentrations contributing more strongly to the high 24-hour average, the PM_{10} diurnal pattern for January 1, 2009 varies from the average diurnal pattern for the 26 exceedance days. The diurnal pattern after mid-day looks similar to other days, with an increase in hourly PM_{10} concentrations at 6:00 pm; though the increase is less pronounced than the average of other exceedance days. An examination of the hourly PM_{10} values shows the highest PM_{10} observations from the southerly wind quadrant from midnight to 4:00 am and in the evening, 8:00-11:00 pm and very low wind speeds during these timeframes.

The average PM_{10}:$PM_{2.5}$ ratio of all 2007 - 2009 days with valid samples was 6.24 (standard deviation equals 2.89). The ratio observed on January 1, 2009 is the second lowest in the 2007 - 2009 sample period (1.67), suggesting that the large early morning ambient PM_{10} values were caused by a combustion source such as residential wood burning, similar to the January 1, 2007 exceedance day.

4.3 Estimate of Expected Exceedance Days “But For” International Transport

Consistent with the Attainment Guidance discussed in Section 2.3, the standard used to determine attainment of the PM_{10} NAAQS in the Nogales NAA, “but for” international emissions is as follows: the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ must be equal to or less than one. So, to determine that the Nogales NAA has met the PM_{10} standard “but for” emissions from Mexico, our analysis must show that no more than three exceedances (based on data completeness and every day sampling) in the 2007 - 2009 analysis period were due to emission sources within the Nogales NAA, and that all other monitored exceedances of the NAAQS originate from Mexico.

We used two analyses to estimate the expected exceedance days in the Nogales NAA “but for” international transport. In the first analysis of exceedance days, we estimated the number of exceedances of the NAAQS that would have occurred but for international sources by identifying those exceedance days for which the available information and analyses suggest a significant influence from Mexican emission sources and counting the exceedance days that remain. In our second analysis of hourly concentrations, we classified each hour of the exceedance days based on the likely influence from Mexico and then recalculated a 24-hour average concentration that would have occurred but for international transport of PM_{10} emissions from Nogales, Sonora. Both analyses are presented below.

4.3.1 Daily Analysis

As discussed in Section 4.1, we have a conceptual model that explains how exceedances of the PM_{10} NAAQS occur in the Nogales NAA on 25 of the 29 exceedance days in 2007 - 2009. From our day-by-day review above, we can decide, whether or not, to assign the four remaining exceedance days — January 1, 2007, January 26, 2008, May 22, 2008, and January 1, 2009—to the category of exceedance days having a significant contribution from sources on the Nogales, Sonora side of the international border.

First, the May 22, 2008 exceedance day is wholly different from our conceptual model exceedance day given the relative high windspeeds and higher than usual coarse PM component likely from disturbed surfaces. As with total PM_{10} emissions, emissions of coarse PM (e.g., unpaved roads) are higher from Nogales, Sonora, than they are from the Nogales NAA. The wind direction is from a southerly quadrant in all hourly observations. Given this information, we find that the day should be placed with the 25 other exceedance days in the conceptual model, because it is likely that the sources of PM_{10} causing the exceedance originated from the Nogales, Sonora side of the international border.

Second, the January 1, 2009 exceedance day is different from our conceptual model exceedance day in the timing and distribution of observed ambient PM_{10} values and high $PM_{2.5}$ component most likely caused by a combustion source. As with total PM_{10}

emissions, emissions of fine PM (e.g., combustion sources) are higher from Nogales, Sonora, than they are from the Nogales NAA. The key factor for assigning this day is the contribution of high hourly ambient concentrations with a southerly wind direction quadrant compared to the remaining 270 degree wind direction quadrants. Consequently, we find that the day should be placed with the 25 other exceedance days in the conceptual model, because it is likely that the sources of PM_{10} causing the exceedance originated from the Nogales, Sonora side of the international border.

Considering the January 1, 2007 exceedance day, it, too, is different from our conceptual model exceedance day in the timing and distribution of observed ambient PM_{10} values and high $PM_{2.5}$ component most likely caused by a combustion source. What differs in the case of the January 1, 2007 exceedance is that the 270 degree wind direction quadrants contains enough high values to contribute disproportionately to the overall twenty-four hour average concentration. Although more detailed and different field studies might prove otherwise, with the information available, our analysis is inconclusive as to whether this exceedance is attributable to a disproportionate international contribution and the Nogales NAA would not have exceeded the PM_{10} NAAQS but for emissions from Mexico. It is possible that the PM_{10} emissions originated south of the U.S.-Mexico border and were blown into the area, but then persisted during periods of calm and variable winds.

Finally, our review of the January 26, 2008 exceedance day suggests that this day is most like our conceptual model exceedance day in the timing and distribution of observed ambient PM_{10} values. While the southerly wind direction quadrant contains enough high values to contribute disproportionately to the overall twenty-four hour average concentration, there are enough remaining high values in the 17 of 24 hourly observations from the 270 degree wind direction quadrants to be above the 150 $\mu g/m^3$ level. Again, while specifically designed field studies might help adjudicate the relative contributions to this exceedance, with the information available, our analysis is inconclusive as to whether this exceedance is attributable to a disproportionate international contribution and the Nogales NAA would not have exceeded the PM_{10} NAAQS but for emissions from Mexico. It is possible that the PM_{10} emissions originated south of the U.S.-Mexico border and were blown into the area, but then persisted during periods of calm and variable winds.

To summarize, we find that two exceedance days, May 22, 2008 and January 1, 2009, should be categorized with the 25 exceedance days where we have found a high likelihood of a large contribution of PM_{10} from sources on the Nogales, Sonora side of the international border from the Nogales NAA. The two remaining exceedance days, January 1, 2007 and January 26, 2008, may have a contribution from sources on the Nogales NAA side of the international border such that we cannot say whether there is a high likelihood that the area would not have exceeded the PM_{10} standard but for PM_{10} emissions originating from the Nogales, Sonora side of the international border. Therefore, using this daily analysis, we find that at least 27 of 29 exceedances of the PM_{10} NAAQS observed in the Nogales NAA during 2007 - 2009 can be attributed to sources of PM_{10} from across the international border. Based on data completeness and every day sampling for the 2007 - 2009 timeframe, we calculated a maximum expected annual exceedance rate of 0.7 exceedances per year.

4.3.2 Hourly Analysis

In our second analysis, we classified each hourly PM_{10} concentration value from the 29 exceedance days based on the likely influence of emissions from Mexico and then recalculated the 24-hour average concentration that would have occurred but for international transport of PM_{10} emissions from Nogales, Sonora. To begin, we classified each hour of the 29 exceedance days based on the likelihood of significant international transport. An hourly concentration was classified as influenced by international transport if it met one of four criteria or decision rules related to hourly observations of wind direction, wind speed, and temperature change:

1) hours with sustained (more than one hour consecutively) southerly winds greater than 4.5 mph (2 meters/second (m/s)), suggesting the primary influence of wind-blown dust from across the international border;

2) hours with southerly winds or air flow and decreasing or stable temperatures preceded by <u>or</u> followed by hours with similar conditions, suggesting sustained downslope air flows from higher elevations south of the international border;

3) any hour preceded by <u>and</u> followed by hours with southerly wind or air flow and decreasing or stable temperatures, suggesting continued influence of downslope air flow from higher elevations south of the international border; and,

4) surface wind speed less than or equal to 1.1 mph (0.5 m/s), preceded by or followed by hours with similar conditions, suggesting sustained air mass stagnation where PM_{10} emissions suspended in previous hours remain suspended in the stagnant air mass.

The first criterion identifies periods consistent with sustained high winds from the south carrying wind-blown dust, as discussed in Section 4.2.3 concerning the May 22, 2008 exceedance day. The second and third criteria identify periods influenced by downslope wind flow conditions described in the conceptual model as usually occurring in the late afternoon and evening. The fourth criterion identifies periods of sustained air mass stagnation usually found in the late night and early morning hours after the early evening downslope wind or air flow has ebbed and before sunrise, after which wind speeds begin to increase from their overnight low values.

The analysis of emissions inventories discussed in section 3.2 concluded that U.S. sources are responsible for a maximum of 36 percent of PM_{10} emissions in the Ambos Nogales region. Therefore, for each hour that meets one of the four criteria listed above, instead of assuming that the concentration is due entirely to Mexican sources, a more conservative assumption is that up to 36 percent of the hourly concentrations may be due to contributions from U.S. emission sources. Therefore, in this next step, we weighted the observed hourly concentrations by 0.36 for each hour that meets any one of the four criteria listed above and used this weighted concentration to estimate the 24-hour average concentration that would have occurred in the Nogales NAA but for international transport.

To show the effects of each decision rule, an estimated 24-hour concentration was calculated after the application of Rule 1, Rules 2 and 3, Rules 1 - 3, and Rules 1 - 4. The results are summarized below.[25]

- The application of Rule 1 only removes one day, May 22, 2008, leaving 28 days showing a concentration value greater than 150 $\mu g/m^3$.

- The application of Rules 2 and 3 removes 27 days, leaving January 1, 2007 and January 26, 2008 showing a concentration value greater than 150 $\mu g/m^3$; 196.8 $\mu g/m^3$ and 244.1 $\mu g/m^3$, respectively.

- The application of Rules 1, 2, and 3 again removes 27 days, leaving January 1, 2007 and January 26, 2008 showing a concentration value greater than 150 $\mu g/m^3$; 196.1 $\mu g/m^3$ and 244.1 $\mu g/m^3$, respectively.

- The application of Rules 1, 2, 3, and 4 removes 29 days, leaving no estimated days with a value greater than 150 $\mu g/m^3$.

In sum, based on this analysis apportioning hourly concentration data using the four criteria to produce an estimated 24-hour average concentration but for international emissions, no exceedance days would have been expected to occur in the Nogales NAA, but for transport from Mexico.

Considering the relatively large differences in emissions inventories between the Nogales NAA and Nogales, Sonora and the meteorology described by our conceptual model, it is likely that observed pollution during southerly downslope wind flows originating from Nogales, Sonora also contributed to observed pollution during following hours of sustained stagnation. With the wind direction varying under low wind speeds and stable temperatures, it remains possible, however, that a greater proportion of PM_{10} pollution during hours of sustained stagnation may be coming from U.S. sources. Therefore, a slightly more conservative approach would be to relax our criteria by not considering sustained stagnation (Rule 4) and assign PM_{10} levels during these hours entirely to the Nogales NAA. Consequently, when we consider Mexican influence to only occur under conditions of relative high wind speeds (Rule 1) and sustained downslope wind flows from the south (Rules 2 and 3), two exceedance days would have been expected to occur but for international transport: January 1, 2007 and January 26, 2008. Given the finding that no more than two exceedance days would have occurred applying criteria one

[25] The observed concentrations and meteorological data for each hour of each exceedance day, the classification based on the criteria listed above, and the re-calculation of the estimated 24-hour average concentrations but for international transport are provided in Section 3.7 of Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009 in Appendix C.

through three, as determined by this hourly analysis of concentration data, the maximum expected number of annual exceedances is 0.7.

5.0 Conclusion

A nonattainment area meets the national ambient air quality standard for PM_{10} when the expected number of days per calendar year with a 24- hour average concentration above 150 $\mu g/m^3$ are less than or equal to one, based on data completeness and every day sampling. To determine that the Nogales NAA has met the PM_{10} standard "but for" emissions from Mexico, our analysis must show that no more than three exceedances of the standard in the 2007 - 2009 analysis period would have occurred in the absence of pollutant flows from Mexico.

Using two different analyses to estimate the expected number of exceedance days, we have concluded that no more than two of the exceedance days in 2007 - 2009 would have occurred but for transport from Mexican sources. Given that the annual expected exceedance rate, 0.7, is less than or equal to one, we conclude that the Nogales NAA attains the PM_{10} NAAQS "but for" PM_{10} emissions originating from across the international border.

This page is intentionally blank.

Appendix B
2008 and 2011 PM_{10} Emissions Inventories for the Nogales Nonattainment Area, Santa Cruz County, Arizona

This page is intentionally blank.

PM_{10} Emissions Inventories for 2008 and 2011

Nogales
Non-Attainment Area
Santa Cruz County, Arizona

U.S. Environmental Protection Agency
Region 9

Draft Final, July 20, 2012

This page is intentionally blank.

Table of Contents

This page is intentionally blank.

1. Introduction

1.1 Purpose

This document provides a PM_{10} emission inventory for all PM_{10} sources within the Nogales Nonattainment Area (NAA) and the details concerning the derivation of those emissions estimates. The Arizona Department of Environmental Quality (ADEQ) requested that EPA create this PM_{10} emissions inventory to support ADEQ's work on a PM_{10} State Implementation Plan (SIP) for the Nogales NAA, located in Santa Cruz County, Arizona.

1.2 Sources of PM_{10}

PM_{10} refers to particulate matter of ten microns or less in aerodynamic diameter. Another class of particles, denoted as $PM_{2.5}$, also called fine particulate, refers to particles of 2.5 microns or less in aerodynamic diameter. PM_{10} includes both $PM_{2.5}$ and the particulates with aerodynamic diameter between 2.5 and 10 microns. Sometimes referred to as $PM_{2.5\text{-}10}$, this larger fraction is called "coarse" particulate. While fine particles originate mostly from combustion sources and secondary aerosol generation processes, coarse particles usually originate from mechanical activities and fugitive source categories. Typical major sources of PM_{10} include fugitive dust, open burning including wild fires, mineral crushing and grinding operations, agricultural activities such as land tilling, dust suspended from vehicle travel on paved and unpaved roads and, to a lesser extent, fuel combustion sources and mobile source exhaust.

1.3 Emissions Inventory Overview

Most of the emissions data for this inventory came from version 1.5 of United States Environmental Protection Agency's (EPA) 2008 National Emissions Inventory (NEI) for Santa Cruz County, Arizona; any use of other data is noted. EPA prepares the NEI every three years. The NEI is a comprehensive and detailed estimate of air emissions of both criteria and hazardous air pollutants from all air emissions sources and is based primarily on emission estimates and emission model inputs provided by state, local, and tribal air agencies for sources in their jurisdictions, and supplemented by data developed by the EPA. More information about the 2008 NEI, including methodologies and assumptions used in producing this emissions inventory, may be found at the following URL: http://www.epa.gov/ttn/chief/net/2008inventory.html.

The NEI allocates emissions at the county level. To develop an inventory for the nonattainment area from the NEI, the county-level emissions estimates must be allocated to the nonattainment area. The methods used for allocating county level emission estimates to the nonattainment area are described in Section 3 of this document.

2. The Nogales Nonattainment Area

2.1 Overview of the Area

The southern boundary of the Nogales NAA and Santa Cruz County is the U.S./México border. At the lower center of the Nogales NAA, the city of Nogales, Arizona is sixty miles south of Tucson, Arizona in the middle and southernmost portion of Santa Cruz County. The city of Nogales, Arizona is the largest city in the nonattainment area. See Figure 1 below.

Regarding topography, the Nogales NAA is located within the Sonoran Desert. This desert covers 120,000 square miles with a minimum elevation of 2,500 feet and is in the Basin and Range topographic province. This topography is characterized by north-south elongated valleys surrounded by mountain ranges. Nogales is located in such a north-south valley created by the Nogales Wash running north to the Santa Cruz River. The mean elevation in Nogales, Arizona is 3,865 feet above sea level. Mountain ranges near Nogales include the Patagonia Mountains to the east and the Tumacacori, Atascosa, and Pajarito mountains to the west. Approximately 25 miles to the north are the Santa Rita Mountains and Madera Canyon in the Coronado National Forest, where Mount Wrightson rises to an elevation of 9,432 feet. Northwest of Interstate 19 are the Cerro Colorado, Las Guijas, and Sierrita Mountain Ranges.

Major highways in the Nogales, Arizona area are Arizona State Route 82, which connects Nogales, Arizona with Patagonia, Arizona (19 miles) and Sonoita (31 miles) to the northeast, and U.S. Interstate 19 which connects Tucson, Arizona to Nogales, Arizona and continues south into México, where it becomes Federal Highway 15.

Nogales, Sonora, Mexico lies directly south of Nogales, Arizona across the international border. Taken together and referred to as Ambos Nogales, the communities of Nogales, Arizona and Nogales, Sonora, México comprise the largest international border community in Arizona, with a combined population of 232,550 inhabitants in 2010.[1] The mean elevation in Nogales, Sonora is 4,265 feet above sea level.[2] At 5,380 feet, the highest elevation area in Nogales, Sonora are in the Cerro de los Nogales (Nogales Hill), west of where the Obregón and Colosio routes meet, near the southern end of the city.

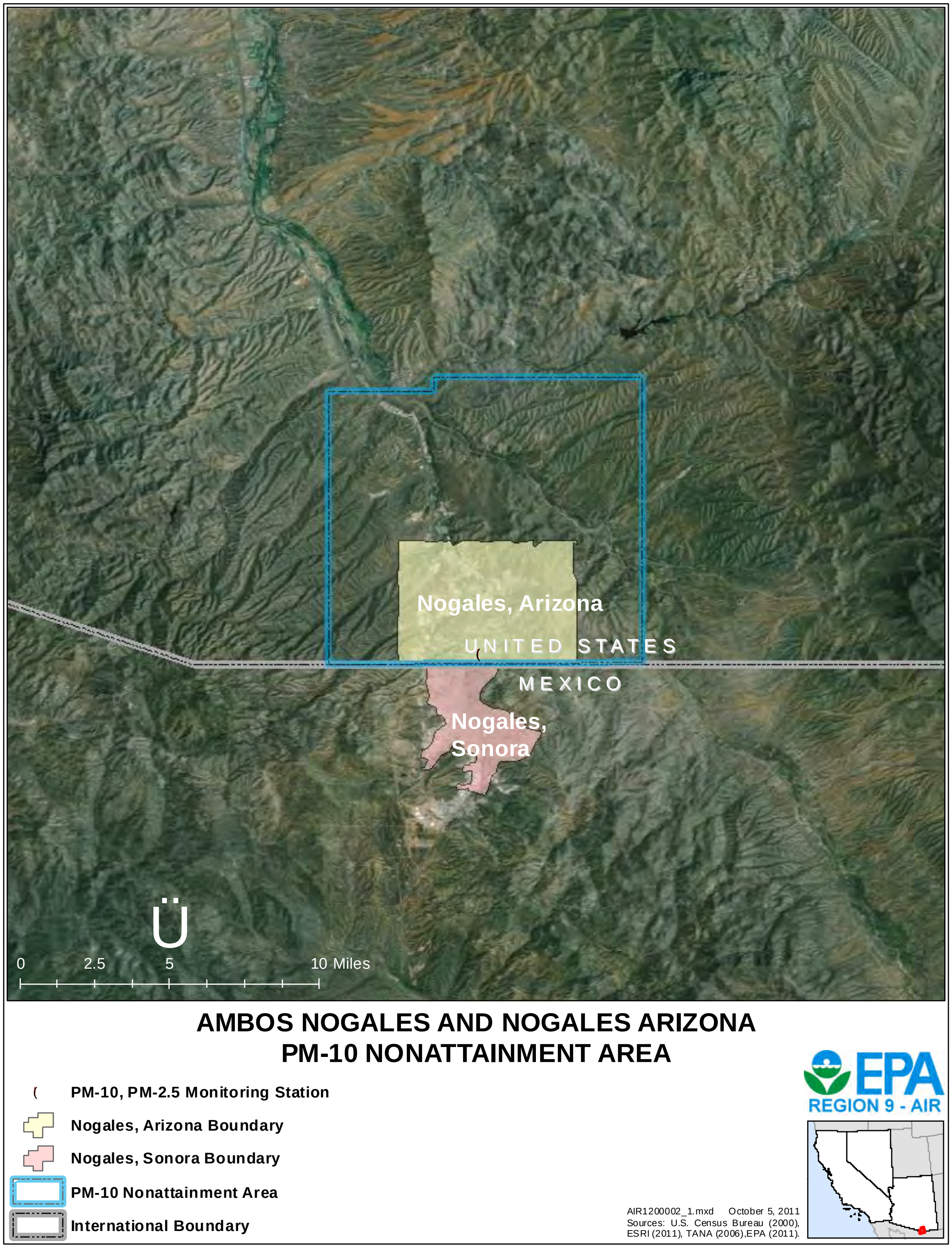
The Alvaro Obregón Boulevard, Luis Donaldo Colosio Boulevard, and the Corredor Fiscal toll road are the main transportation routes in Nogales, Sonora. The Alvaro Obregón Boulevard runs the length of the narrow Nogales Wash valley, and is a highly congested route used by local and some cross-border commercial traffic. The Corredor Fiscal is a toll road for cross-border commercial traffic; its on- and off-ramp access is limited to the border junction at Mariposa Road and a point just outside of the southern city limits of Nogales, Sonora. The Corredor Fiscal conducts the majority of the U.S. and Mexico cross-border commercial traffic.

---

[1] Nogales, Arizona had 20,017 inhabitants and Nogales, Sonora, Mexico had 212,533 inhabitants. U.S. Census Bureau 2010 and Instituto Nacional de Estadistica Geografia e Informatica, (INEGI) 2010.

[2] "Statistical Municipal Workbook for Nogales, Sonora," 2005 edition, INEGI.

Figure 1: Ambos Nogales and Nogales PM_{10} Nonattainment Area



2.2 Population and Urbanization

This section presents the population estimates for Santa Cruz County and the Nogales NAA. There are two population centers in Santa Cruz County and the Nogales NAA: the City of Nogales; and, Rio Rico. Only a portion of Rio Rico, however, lies within the Nogales NAA boundaries.

2.2.1 Santa Cruz County

In 2010, the U.S. Census estimated the Santa Cruz County population to be 43,716; up 1.45 percent from 43,091 in 2008.[3]

2.2.2 The City of Nogales, Arizona

In 2010, the U.S. Census estimated the population of Nogales to be 20,837; up 5.49 percent from 19,752 in 2008.[4] From 2000 to 2010, the population of Nogales decreased slightly, 0.2 percent; in comparison, the County population grew 13.9 percent.[5]

2.2.3 Rio Rico Community

Río Rico is an unincorporated community in Santa Cruz County located twelve miles north of the U.S./México border and 57 miles south of Tucson. The community resides on 39,000 acres in the foothills of the Santa Rita Mountains. Economic activities include light manufacturing, and produce staging and distribution in the industrial facilities of the Río Rico South Industrial Park.

Because a portion of the Rio Rico community is within the Nogales NAA, we developed an estimate of this population using the U.S. Census and allocation percentages from the Arizona Commerce Authority (ACA). In the 2000 U.S. Census, Río Rico was listed as four Census Designated Places (CDPs): Rio Rico Northeast, Rio Rico Northwest, Rio Rico Southeast, and Rio Rico Southwest. Most of Rio Rico Southeast CDP and a portion of Rio Rico Southwest CDP are in the Nogales NAA. Using a Geographic Information System to estimate the Rio Rico land areas within the Nogales NAA, ADEQ determined that 88.7 percent of Rio Rico Southeast and 19.1 percent of Rio Rico Southwest are in the Nogales NAA; the two remaining two Rio Rico communities are outside of the boundaries of the nonattainment area.

In 2010, the combined population of the four Rio Rico CDPs was estimated at 18,962 inhabitants, but the U.S. Census did not provide a separate population estimate for the four Rio Rico areas (U.S. Census 2010). Prior to the 2010 Census, the ACA provided a population estimate nearly equal to the 2010 Census figure and allocated this estimate across the four Rio Rico areas; we used the percentages derived from the 2010 ACA estimate to allocate the 2010

---

[3] U.S. Census, www.census.gov/popest.
[4] Ibid.
[5] U.S. Census, www.census.gov/popest ; population figures: Nogales in 2000, 20,878; Nogales in 2010, 20,837; Santa Cruz County in 2000, 38,381; Santa Cruz County in 2010, 43,716.

U.S. Census figure to the four Rio Rico areas. We then scaled the four area estimates back from 2010 to 2008 assuming the Rio Rico area grew consistent with the 2008 to 2010 Santa Cruz County U.S. Census estimates. Finally, using the land area allocations developed by ADEQ, we estimated population the 2008 contributions from Rio Rico Southeast and Rio Rico Southwest to the Nogales NAA population. Our calculations are shown below in Table 1.

Table 1: 2008 Population Contribution from Rio Rico Communities to the Nogales NAA.

Rio Rico CDP Area	2010 Census	2010 ACA Estimates	2010 ACA Allocations	2010 Census per ACA Allocation	2008 Estimate Scaled per County*	2008 Nogales NAA Contribution
Northeast	-	4,921	26 percent	4,912	4,841	Area outside NAA
Northwest	-	5,408	28 percent	5,398	5,320	Area outside NAA
Southeast	-	3,439	18 percent	3,433	3,383	3,001
Southwest	-	5,228	28 percent	5,219	5,143	982
Totals	18,962	18,996	100 percent	18,962	18,687	3,983

* Santa Cruz County grew 1.45 percent from 2008 to 2010; figures are reduced accordingly.
Source: U.S. Census, www.census.gov/popest

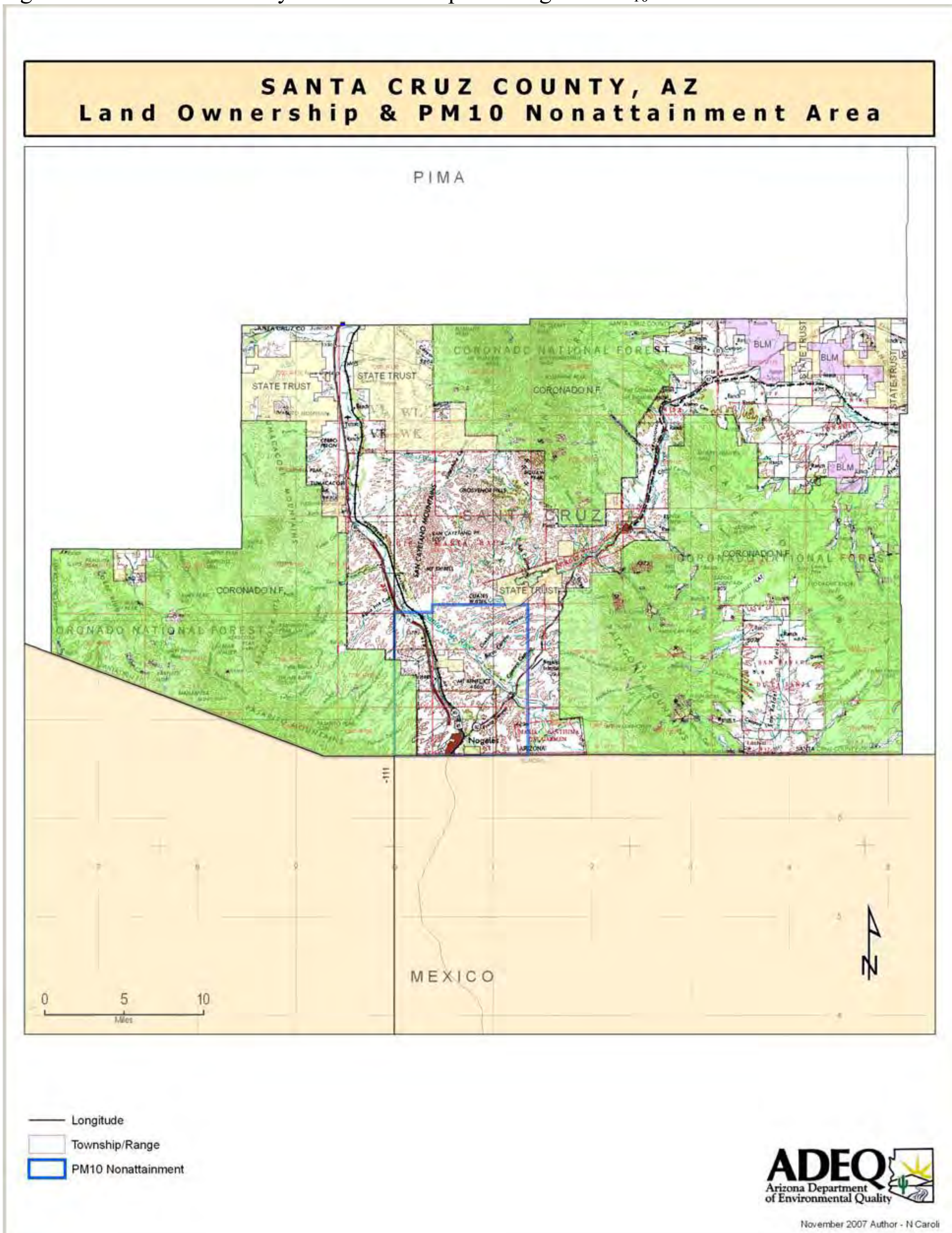
2.3 Land-Areas of Santa Cruz County and the Nogales NAA

Santa Cruz County comprises 1,237.6 square miles of land, or approximately 791,632 acres.[6] The majority of land ownership in Santa Cruz County is distributed between the U.S. Forest Service (52.7 percent), private land-owners (37.6 percent), State of Arizona Trust Land (7.8 percent), and the U.S. Bureau of Land Management (1.7 percent).[7] See Figure 2 below.

The Nogales NAA covers a land area of 76.1 square miles.[8] In comparison with the County, the majority of the land in the nonattainment area is privately owned. The codified boundaries of the Nogales NAA can be found at 40 CFR Part 81.303. The Nogales PM_{10} nonattainment area is delineated by the following townships and ranges within the State of Arizona that lie east of 111 degrees longitude: T23S, R13E; T23S, R14E; T24S, R13E; and, T24S, R14E.

[6] U.S. Census, Santa Cruz County Quickfacts, http://quickfacts.census.gov/qfd/states/04/04023.html
[7] Arizona State Land Department, Arizona Land Resource Information System (1994)
[8] EPA Geographic Information System estimate.

Figure 2: Santa Cruz County Land Ownership and Nogales PM_{10} Nonattainment Area.



3. Emissions Inventory Methodology

3.1 EPA's 2008 National Emissions Inventory

This Nogales NAA emissions inventory is based on modifications to version 1.5 of EPA's 2008 National Emission Inventory (NEI). EPA's NEI database contains information about sources that emit criteria air pollutants and their precursors, and hazardous air pollutants. The database includes estimates of annual air pollutant emissions from point, nonpoint, and mobile sources in the fifty states, the District of Columbia, Puerto Rico, and the Virgin Islands available at the county level. Collaborating with the states, EPA develops the emissions inventory and releases an updated version of the NEI database every three years.

Five of the six criteria air pollutants are included in the NEI database. Emissions of carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO2), lead (Pb), and particulate matter (PM_{10} and $PM_{2.5}$) are specifically reported in the NEI. Ozone, the sixth criteria air pollutant, arises from photochemical reactions in the atmosphere rather than direct emissions from sources.

EPA compiled the NEI database from the primary data sources listed below:

- emissions inventories compiled by state and local environmental agencies;
- databases related to EPA's Maximum Achievable Control Technology (MACT) programs to reduce emissions of hazardous air pollutants;
- Toxic Release Inventory (TRI) data;
- for electric generating units, EPA's Emission Tracking System / Continuous Emissions Monitoring data (ETS/CEM) and Department of Energy fuel use data;
- for on-road sources, the Federal Highway Administration's estimate of vehicle miles traveled and emission factors from EPA's MOVES2030a computer model;
- for non-road sources, EPA's NONROAD2008a computer model; and,
- previous emissions inventories, if states do not submit current data.

A complete description of the development of the 2008 NEI may be found at the following URL: http://www.epa.gov/ttn/chief/net/2008inventory.html.

3.2 On-Road Mobile Source Emissions

In the 2008 NEI, on-road mobile source emissions were calculated using EPA's MOBILE6 model. Since the 2008 NEI was developed, EPA's MOVES model has replaced MOBILE6 as the model for estimating emissions from cars, trucks, and motorcycles.[9] On March 2, 2010, EPA approved the availability of the Motor Vehicle Emissions Simulator model (MOVES2010a) in official SIP submissions to EPA regarding air quality and for certain transportation conformity analyses outside the state of California.[10] MOVES2010a is the state-of-the-art upgrade to EPA's modeling tools for estimating air emissions from cars, trucks, motorcycles, and buses, and is based on analyses of millions of emission test results and considerable advances in the Agency's

[9] http://www.epa.gov/otaq/models/moves/index.htm
[10] See 75 FR 9411 (March 2, 2010)

understanding of vehicle emissions. MOVES2010a was designed to replace the previous emissions model, MOBILE6.2, which was released in 2004.

3.2.1 Calculating Santa Cruz County PM_{10} Emissions Using MOVES.

EPA calculated the PM_{10} emissions from mobile sources in Santa Cruz County, Arizona using the MOVES2010a version dated September 23, 2010 (hereafter referred to as “MOVES”). This is the current version of the MOVES model. MOVES allows the use of county-specific data concerning factors such as the average speed distribution of on-road vehicles, daily vehicles miles traveled, and road types among others in place of national default values. The MOVES model requires the use of county specific data for SIP purposes. In this instance, the MOVES calculation was performed using input data from the 2008 NEI for Santa Cruz County.

With the county-specific data in place, EPA prepared a run specification to identify the characteristics of a MOVES model run such as: scale, time span, vehicle and road type, and pollutants. The run specifications used for the 2008 and 2011 PM_{10} calculations can be found in Appendices 1 and 2. Based on the run specification, MOVES produces various summaries and output tables in MySQL format. The MySQL database can then be used to import the MOVES output into a variety of formats. In this instance, EPA staff used MySQL to produce the PM_{10} calculation in an Excel spreadsheet format; the resulting 2008 and 2011 output files are reproduced in tables within Appendices 1 and 2.

3.3 Allocating the Santa Cruz County PM_{10} Emissions to the Nogales NAA

EPA has no guidance on assigning emission sources from a county level of analysis to a smaller subject area within that county. For the Nogales NAA emissions inventory, EPA used a combination of population ratios, land area ratios, and source locations within the Nogales NAA to determine the appropriate allocation of county-wide emissions to the Nogales NAA.

3.3.1 Emissions Scaling Based on Population

One way to allocate emissions from a county-level to a smaller nonattainment area is to scale those emissions by a population ratio. In some cases, it is logical to scale source categories by population, since the rate of activities causing the emissions is more closely related to the number of people than to other factors, such as a specific land area relationship.

As shown above, EPA used data from the U.S. Census Bureau was used to estimate the 2008 population of the Nogales NAA population and Santa Cruz County. There are two assumptions underlying these calculations: first, we assume that the City of Nogales and the allocated population of Rio Rico comprise nearly all of the population within the nonattainment area. The remainder of the Nogales NAA is assumed to be rural and minimally populated. Second, as described in section 2.2.3, the individual 2008 Rio Rico area populations were allocated using 2010 estimates from ACA and scaled back to 2008 according to the U.S. Census derived County-wide 2008 to 2010 growth rate.

When allocating emissions based on population, the county-level emissions for a given source category were multiplied by a factor of 55.1 percent to give the respective source category emissions for the Nogales NAA. See Table 2 below. If the likely magnitude of source category emissions varied with the activities of the population, it was allocated based on this population ratio.

Table 2: Summary of Santa Cruz County and Nogales NAA Population Data

Census Area	2008	2008 Percent of County	2010	2010 Percent of County
Santa Cruz County	43,091		43,716	
City of Nogales	19,752	45.8 %	20,837	47.7%
Rio Rico (allocated value from Table 1)	3,983	9.2%	4,042	9.2%
Nogales NAA totals	23,735	55.1%	24,059	56.9%

Source: 2010 U.S. Census and www.census.gov/popest

The population estimates for Nogales are from the following U.S. Census Bureau population source: http://www.census.gov/popest .

3.3.2 Emissions Scaling Based on Land Area

A land area weighted emission ratio was developed using U.S. Census geographic data and/or Arizona Commerce Authority data.[11] The land area for Santa Cruz County is 1,237.6 square miles. The land area for the Nogales NAA is 76.1 square miles. The ratio of Nogales NAA land area to the Santa Cruz County land area is calculated by dividing 76.1 by 1,237.6, which equals .061489 or 6.15 percent.

For a spatial allocation of county-level emissions to the nonattainment area based on weighting by land area, the county-level emissions were multiplied by 6.15 percent to give the emissions for the Nogales NAA. Some source categories, such as agricultural emissions, are likely to be proportional to land area; consequently, they are logically allocated by the land area ratio.

3.3.3 Source Emissions Identification Within the Nogales NAA.

To confirm whether specific sources in the Santa Cruz County emissions inventory should be included in the Nogales NAA inventory, EPA used visual inspections with location information, such as satellite photography using Google Earth. Also, EPA consulted with ADEQ.

3.4 Summary of Land Area and Population Allocation Ratios

Table 3: Summary of Land Area and 2008 Population Allocation Ratios.

	Santa Cruz County	Nogales NAA	Allocation Ratio
Area (square miles)	1,237.6[12]	76.1	6.15 percent
2008 Population	43,091[13]	23,735[14]	55.1 percent

[11] Arizona Department of Commerce Profile: Santa Cruz County Arizona, May 10, 2011, http://www.azcommerce.com/doclib/commune/Santa Cruzpercent20county.pdf.

[12] U.S. Census, Quickfacts, Santa Cruz County, Arizona.

[13] 2010 U.S. Census population estimates.

4. 2008 Emissions Inventory and Discussion

The Santa Cruz County emissions inventory and Nogales NAA allocation results are shown in Table 4. We discuss specific issues concerning the allocated emissions inventory in the sections following Table 4.

Table 4: Santa Cruz County and Nogales NAA 2008 PM-10 Emissions Inventories (tons).

Emissions Source Category	Santa Cruz County	Nogales NAA	Allocation Method
Agriculture - Crops and Livestock Dust	70.47	4.33	Area
Commercial Cooking - Charbroiling	11.36	6.26	Pop
Commercial Cooking - Frying	2.82	1.55	Pop
Dust - Paved Road Dust	220.39	121.43	Pop
Dust - Unpaved Road Dust	1,569.74	864.93	Pop
Dust - Road Construction	484.52	266.97	Pop
Dust - Commercial/Industrial/Institutional Construction	258.75	142.57	Pop
Dust - Residential Construction	43.45	23.94	Pop
Fires - Prescribed Fires	54.93	3.38	Area
Fuel Combustion - Electric Generation - Natural Gas	1.05	1.05	Loc
Fuel Combustion - Electric Generation - Oil	0.04	0.02	Pop
Fuel Combustion - Industrial Boilers, ICEs - Natural Gas	0.25	0.14	Pop
Fuel Combustion - Industrial Boilers, ICEs - Oil	1.04	0.57	Pop
Fuel Combustion - Industrial Boilers, ICEs - Coal	---	---	See Section 4.1
Fuel Combustion - Residential - Wood	43.55	23.99	Pop
Fuel Combustion - Residential - Natural Gas, Oil, Other	1.51	0.83	Pop
Fuel Combustion - Commercial/Institutional - Oil	0.29	0.16	Pop
Fuel Combustion - Commercial/Institutional - Natural Gas	0.72	0.40	Pop
Fuel Combustion - Commercial/Institutional - Coal	0.04	0.02	Pop
Fuel Combustion - Commercial/Institutional - Other	0.02	0.01	Pop
Industrial Processes - Mining	---	---	See Section 4.1
Mobile - Gasoline Vehicle - Off net roadways	1.22	0.67	Pop
Mobile - Gasoline Vehicle - Rural restricted access roads	1.76	0.97	Pop
Mobile - Gasoline Vehicle - Rural unrestricted access roads	2.59	1.43	Pop
Mobile - Gasoline Vehicle - Urban restricted access	1.33	0.73	Pop
Mobile - Gasoline Vehicle - Urban unrestricted access	8.37	4.61	Pop
Mobile - Diesel Vehicle - Off network roadways	1.1	0.61	Pop
Mobile - Diesel Vehicle - Rural restricted access roads	13.16	7.25	Pop
Mobile - Diesel Vehicle - Rural unrestricted access roads	5.51	3.04	Pop
Mobile - Diesel Vehicle - Urban restricted access	3.24	1.79	Pop
Mobile - Diesel Vehicle - Urban unrestricted access	12.15	6.69	Pop
Mobile - Non-Road Equipment - Diesel	15.48	8.53	Pop

[14] Ibid.

Mobile - Non-Road Equipment - Gasoline	5.66	3.12	Pop
Mobile - Non-Road Equipment - Other	0.13	0.07	Pop
Mobile - Locomotives	1.70	0.63	Loc
Mobile - Aircraft	2.31	2.31	Loc
Waste Disposal - Residential Garbage Burning	41.77	23.02	Pop
Waste Disposal - Open Burning for Land Clearing	24.23	1.49	Area
Waste Disposal - Residential Yard Waste Burning	1.21	0.67	Pop
Waste Disposal - Institutional Incineration	0.28	0.28	Loc
Miscellaneous Non-Industrial NEC	0.44	0.24	Pop
TOTALS	2,908.58	1,530.7	

Allocation method: Area = Land area ratio; Loc = Location; Pop = Population ratio.

4.1 Sources with Reported Locations

There are inventory source categories that include sources with known locations. Since the location and emission rates for these sources are known, it is possible to determine if the sources are inside or outside the nonattainment area using mapping software. These source categories are discussed below.

- Fuel Combustion - Electric Generation - Natural Gas. A power plant, Valencia Power, is located within the nonattainment area.
- Fuel Combustion - Industrial Boilers, ICEs – Coal, 11.68 tons per year. Upon consulting with ADEQ about the source of these emissions entry, we were informed that this county-wide entry was an error and ADEQ will work with EPA to correct the 2008 NEI data. Consequently, these emissions were not included in the non-attainment area estimates.
- Industrial Processes – Mining, 761.11 tons per year. Upon consulting with ADEQ about the source of these emissions, we were informed that this county-wide entry was an error and ADEQ will work with EPA to correct the 2008 NEI data. Consequently, these emissions were not included in the non-attainment area estimates.
- Mobile – Aircraft. The only airport in the County, Nogales International Airport, is within the nonattainment area.
- Mobile – Locomotives. An estimated 11.0 of 29.8 miles of County rail track are within the nonattainment area; consequently, county-wide locomotive emissions were allocated by a 0.369 ratio.
- Waste Disposal - Institutional Incineration. A medical waste incinerator is located within the nonattainment area.

4.2. Assessment of Emissions Estimates

The 2008 estimated rate of PM_{10} emissions from road and other construction may be high because the emissions estimate does not reflect the full magnitude of the downturn in the real estate sector of the economy. It is likely that this downturn is a temporary situation and it may be expected that these emissions would resume at a higher level than once the real estate economy improves. As a result, this emission rate is conservative and is based on the best estimates of construction activity available at this time.

Also, the EPA could not identify locations of agricultural activities, prescribed forest burning, raising a source of uncertainty. While it is appropriate to apply a land ratio method for assigning County-level agricultural emissions to the nonattainment area, this may underestimate emissions given that intensive agricultural activity is likely to occur on private land, located primarily in the nonattainment area, as opposed to the public lands composing a large proportion of the remaining County.

4.3 Overall Assessment

The NEI provides a complete, timely and sufficiently accurate inventory for Santa Cruz County based on the best methodology and source data available at the time the inventory was developed. In allocating these County-wide emissions to the Nogales NAA, EPA has used reasonable and conservative assumptions to produce a current, accurate, and comprehensive nonattainment area PM_{10} emissions inventory.

5. 2011 Emissions Inventory Projection

5.1 Overview

Because 2008 is the year of the most current and complete national emissions inventory, we chose it as the base year for the emissions inventory and the Nogales PM_{10} attainment plan. Unfortunately, the Nogales NAA did not meet the PM_{10} NAAQS in 2008. It becomes important that the attainment plan characterize future emissions levels as part determining whether or where future controls may be needed to meet the PM_{10} NAAQS. Consequently, we have provided an emissions inventory for the year 2011.

5.2 Methodology for Projecting the 2011 Emissions Inventory

PM_{10} emissions may rise or fall based on changes in three factors: economic conditions, population, and vehicle miles traveled (VMT). The accepted method for projecting emissions from base year inventories is to account for changes in these three factors as they may apply on a source sector basis. Below, we review each of these factors and their application to our 2008 base year inventory.

Considering economic conditions, there is an ongoing economic contraction in Arizona that began in 2007 and is projected to continue through 2011. Non-farm employment is projected to continue dropping through 2010 and 2011 according to the Economic and Business Research Center at the University of Arizona.[15]

[15] http://ebr.eller.arizona.edu/dataentry/forecast.aspx.

The U.S. Census has calculated moderate population growth overall in Santa Cruz County, from 43,091 in 2008 to 43,716 in 2010.[16] Extrapolating this trend yields an estimated population increase of about 2.18 percent for the County from 2008 to 2011. The Nogales NAA appears to have grown faster than the County from 2008 to 2010, at 4.82 percent; so, its estimated increase from 2008 to 2011 is higher at 7.23 percent. While it may look like the Nogales NAA is growing precipitously, recall that the City of Nogales's population decreased 0.2 percent between 2000 and 2010. A review of 2000-2010 City of Nogales population estimates shows slightly falling estimates after 2002, a large decrease in 2007, the lowest population estimate occurring in 2008, and a subsequent rebound through 2010. Given that we are only forecasting one year beyond 2010 census figures and most 2008-2011 population growth as already occurred, we are using the 7.23 percent growth factor to reflect actual population estimates for the 2008-11 period.

Regarding VMT, the Federal Highway Administration's Highway Statistics[17] series data on Arizona shows a decline in VMT between 2007 and 2008 and no change in VMT between 2008 and 2009. This is consistent with economic conditions. Given a continuing or slowing economic contraction, there doesn't appear to be a reason to assume that VMT will increase within Santa Cruz County. EPA estimates for 2011 show a slight decrease in VMT.

In summary, for our projection methodology and the 2011 emission inventory, we will assume the following:

- source categories tied to economic activity will not grow between 2008 and 2011;
- source categories that track with population growth will be estimated at the same rate as the Nogales NAA population growth, as opposed to the County growth rate, to reflect reported population change and to be conservative in estimating emissions; and,
- on-road mobile source will be estimated as discussed below.

PM_{10} emissions from on-road mobile sources fall into four categories: brake and tire wear, vehicle exhaust, paved road dust, and unpaved road dust. As old on-road vehicles are replaced with newer, cleaner vehicles, exhaust emissions are expected to go down. Also, changes to cleaner fuel specifications lead to lower exhaust emissions. The overall changes in vehicle exhaust emissions are captured in the EPA MOVES emission model. MOVES also produces emissions estimates for brake and tire wear. EPA ran the MOVES model for 2011 to produce County-wide estimates for exhaust, brake, and tire-wear. Then, EPA scaled these emissions by the non-attainment area population ratio to estimate the 2011 emissions for these source categories. To be conservative and to reflect 2010 Census figures, we used a 0.569 ratio instead of the 0.551 ratio used for 2008 population based allocations.

Other on-road PM_{10} emissions, such as paved and unpaved road emissions, do not vary with changes in the age of the vehicle fleet or changes in fuel. These emissions are affected primarily by VMT and local factors, such as dust loading on paved roads. This projection has estimated conservatively that these emissions will be constant from 2008 to 2011, despite a small anticipated decrease in VMT.

[16] http://www.census.gov/popest/eval-estimates/eval-est2010.html.
[17] http://www.fhwa.dot.gov/policyinformation/statistics.cfm.

5.3 2011 Emissions Inventory

The 2011 emissions inventory results are shown in the table below.

Table 5: Nogales NAA PM_{10} Emissions Inventories for 2008 and 2011 (tons per year).

Emissions Source Category	2008	2011	Projection Method
Agriculture - Crops and Livestock Dust	4.33	4.33	No growth
Commercial Cooking - Charbroiling	6.26	6.71	Population
Commercial Cooking - Frying	1.55	1.67	Population
Dust - Paved Road Dust	121.43	121.43	No growth
Dust - Unpaved Road Dust	864.93	864.93	No growth
Dust - Road Construction	266.97	266.97	No growth
Dust - Commercial/Industrial/Institutional Construction	142.57	142.57	No growth
Dust - Residential Construction	23.94	23.94	No growth
Fires - Prescribed Fires	3.38	3.38	No growth
Fuel Comb - Electric Generation - Natural Gas	1.05	1.05	No growth
Fuel Comb - Electric Generation - Oil	0.02	0.02	No growth
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	0.14	0.14	No growth
Fuel Comb - Industrial Boilers, ICEs - Oil	0.57	0.57	No growth
Fuel Comb - Residential - Wood	23.99	25.73	Population
Fuel Comb - Residential - Natural Gas, Oil, Other	0.83	0.89	Population
Fuel Comb - Commercial/Institutional - Oil	0.16	0.16	No growth
Fuel Comb - Commercial/Institutional - Natural Gas	0.40	0.40	No growth
Fuel Comb - Commercial/Institutional - Coal	0.02	0.02	No growth
Fuel Comb – Commercial/Institutional - Other	0.01	0.01	No growth
Mobile - Gasoline Vehicle - Off net roadway	0.67	0.56	MOVES
Mobile - Gasoline Vehicle - Rural restricted access roads	0.97	0.84	MOVES
Mobile - Gasoline Vehicle - Rural unrestricted access roads	1.43	1.33	MOVES
Mobile - Gasoline Vehicle - Urban restricted access	0.73	0.67	MOVES
Mobile - Gasoline Vehicle - Urban unrestricted access	4.61	4.47	MOVES
Mobile - Diesel Vehicle - Off network roads	0.61	0.40	MOVES
Mobile - Diesel Vehicle - Rural restricted access roads	7.25	4.73	MOVES
Mobile - Diesel Vehicle - Rural unrestricted access roads	3.04	2.09	MOVES
Mobile - Diesel Vehicle - Urban restricted access	1.79	1.22	MOVES
Mobile - Diesel Vehicle - Urban unrestricted access	6.69	4.72	MOVES
Mobile - Non-Road Equipment - Diesel	8.53	8.53	No growth

Mobile - Non-Road Equipment - Gasoline	3.12	3.12	No growth
Mobile - Non-Road Equipment - Other	0.07	0.07	No growth
Mobile - Locomotives	0.63	0.63	No growth
Mobile - Aircraft	2.31	2.31	No growth
Waste Disposal - Residential Garbage Burning	23.02	24.68	Population
Waste Disposal - Open Burning for Land Clearing	1.49	1.60	Population
Waste Disposal - Residential Yard Waste Burning	0.67	0.71	Population
Waste Disposal - Institutional Incineration	0.28	0.30	Population
Miscellaneous Non-Industrial NEC	0.24	0.26	Population
TOTALS	1,530.7	1,528.16	

5.4 Assessment of 2011 Inventory

Population growth is relatively small, keeping those increases in emissions to a minimum. The lack of economic growth also retards emissions inventory growth. There is a notable drop in on-road emissions due to fleet turnover and new fuel standards. There is, however, little overall change between the 2008 and 2011 emissions inventories.

Appendix 1: MOVES 2008 Output File and Run Specification

Output File: Definitions and Values

Category Field	Value	Description
State ID	4	ARIZONA
County ID	4023	Santa Cruz County
Fuel Type ID	1	Gasoline
Fuel Type ID	2	Diesel Fuel
Road Type ID	1	Off-Network
Road Type ID	2	Rural Restricted Access
Road Type ID	3	Rural Unrestricted Access
Road Type ID	4	Urban Restricted Access
Road Type ID	5	Urban Unrestricted Access

Output File: PM-10 Total and Break Out by Fuel and Roadway Type (units in pounds)

Fuel	Road	Run	Total PM10	Brake PM10	Elemental Carbon PM10	Organic Carbon PM10	Sulfate PM10	Tire PM10
1	1	1	2440	0	814	1627	0	0
1	2	1	2465	293	306	2159	0	757
1	3	1	1774	2171	218	1556	0	1228
1	4	1	1194	959	152	1042	0	500
1	5	1	3445	10449	437	3008	0	2848
2	1	1	2202	0	605	1597	0	0
2	2	1	25301	439	22555	2746	0	576
2	3	1	10053	681	7867	2187	0	281
2	4	1	5795	542	4565	1230	0	146
2	5	1	20558	3232	15062	5496	0	504
Totals			75227	18766	52581	22648	0	6840

Output File: Energy and Distance by Fuel and Roadway Type (units in MMBtu and miles)

Fuel	Road	Run	Total Energy	Distance
1	1	1	85644	
1	2	1	482862	91817600
1	3	1	530307	103452000
1	4	1	238446	44182600
1	5	1	1135807	183604000
2	1	1	31765	
2	2	1	494200	22257900
2	3	1	161149	9007850
2	4	1	93611	4440350
2	5	1	275949	12298100
Totals			3529740	471060400

MOVES 2008 Run Specification


```
<runspec>
	<description><![CDATA[2008 Santa Cruz County AZ]]></description>
	<modelscale value="Inv"/>
	<modeldomain value="SINGLE"/>
	<geographicselections>
		<geographicselection type="COUNTY" key="4023" description="ARIZONA - Santa Cruz County"/>
	</geographicselections>
	<timespan>
		<year key="2008"/>
		<month id="1"/>
		<month id="2"/>
		<month id="3"/>
		<month id="4"/>
		<month id="5"/>
		<month id="6"/>
		<month id="7"/>
		<month id="8"/>
		<month id="9"/>
		<month id="10"/>
		<month id="11"/>
		<month id="12"/>
		<day id="2"/>
		<day id="5"/>
		<beginhour id="1"/>
		<endhour id="24"/>
		<aggregateBy key="Year"/>
	</timespan>
	<onroadvehicleselections>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="62" sourcetypename="Combination Long-haul Truck"/>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="61" sourcetypename="Combination Short-haul Truck"/>
```

<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="41" sourcetypename="Intercity Bus"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="32" sourcetypename="Light Commercial Truck"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="54" sourcetypename="Motor Home"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="11" sourcetypename="Motorcycle"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="21" sourcetypename="Passenger Car"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="31" sourcetypename="Passenger Truck"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="51" sourcetypename="Refuse Truck"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="43" sourcetypename="School Bus"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="53" sourcetypename="Single Unit Long-haul Truck"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="52" sourcetypename="Single Unit Short-haul Truck"/>
<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="42" sourcetypename="Transit Bus"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="62" sourcetypename="Combination Long-haul Truck"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="61" sourcetypename="Combination Short-haul Truck"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="41" sourcetypename="Intercity Bus"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="32" sourcetypename="Light Commercial Truck"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="54" sourcetypename="Motor Home"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="11" sourcetypename="Motorcycle"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="21" sourcetypename="Passenger Car"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="31" sourcetypename="Passenger Truck"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="51" sourcetypename="Refuse Truck"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="43" sourcetypename="School Bus"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="53" sourcetypename="Single Unit Long-haul Truck"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="52" sourcetypename="Single Unit Short-haul Truck"/>
<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="42" sourcetypename="Transit Bus"/>
</onroadvehicleselections>
<offroadvehicleselections>
</offroadvehicleselections>
<offroadvehiclesccs>
</offroadvehiclesccs>
<roadtypes>
<roadtype roadtypeid="1" roadtypename="Off-Network"/>
<roadtype roadtypeid="2" roadtypename="Rural Restricted Access"/>

<roadtype roadtypeid="3" roadtypename="Rural Unrestricted Access"/>
<roadtype roadtypeid="4" roadtypename="Urban Restricted Access"/>
<roadtype roadtypeid="5" roadtypename="Urban Unrestricted Access"/>
</roadtypes>
<pollutantprocessassociations>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="106" pollutantname="Primary PM10 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="90" processname="Extended Idle Exhaust"/>

<pollutantprocessassociation pollutantkey="107" pollutantname="Primary PM10 - Tirewear Particulate" processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="116" pollutantname="Primary PM2.5 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
<pollutantprocessassociation pollutantkey="117" pollutantname="Primary PM2.5 - Tirewear Particulate" processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="90" processname="Extended Idle Exhaust"/>
</pollutantprocessassociations>
<databaseselections>
<databaseselection servername="" databasename="c04023y2008_in20110329" description=""/>
</databaseselections>
<internalcontrolstrategies>
<internalcontrolstrategy classname="gov.epa.otaq.moves.master.implementation.ghg.internalcontrolstrategies.rateofprogress.RateOfProgressStrategy"><![CDATA[
useParameters No

]]></internalcontrolstrategy>
</internalcontrolstrategies>
<inputdatabase servername="" databasename="" description=""/>
<uncertaintyparameters uncertaintymodeenabled="false" numberofrunspersimulation="0" numberofsimulations="0"/>
<geographicoutputdetail description="COUNTY"/>
<outputemissionsbreakdownselection>
<modelyear selected="false"/>
<fueltype selected="true"/>
<emissionprocess selected="false"/>
<onroadoffroad selected="true"/>
<roadtype selected="true"/>
<sourceusetype selected="false"/>
<movesvehicletype selected="false"/>
<onroadscc selected="false"/>
<offroadscc selected="false"/>
<estimateuncertainty selected="false" numberOfIterations="2" keepSampledData="false" keepIterations="false"/>
<sector selected="false"/>
<engtechid selected="false"/>
<hpclass selected="false"/>
</outputemissionsbreakdownselection>
<outputdatabase servername="" databasename="2008SantaCruzOP42911" description=""/>
<outputtimestep value="Year"/>
<outputvmtdata value="false"/>
<outputsho value="false"/>
<outputsh value="false"/>
<outputshp value="false"/>
<outputshidling value="false"/>
<outputstarts value="false"/>
<outputpopulation value="false"/>
<scaleinputdatabase servername="" databasename="c04023y2008_in20110329" description=""/>
<pmsize value="0"/>

```
	<outputfactors>
		<timefactors selected="true" units="Years"/>
		<distancefactors selected="true" units="Miles"/>
		<massfactors selected="true" units="U.S. Ton" energyunits="Million BTU"/>
	</outputfactors>
	<savedata>

	</savedata>

	<donotexecute>

	</donotexecute>

	<generatordatabase shouldsave="false" servername="" databasename="" description=""/>
		<donotperformfinalaggregation selected="false"/>
	<lookuptableflags scenarioid="" truncateoutput="true" truncateactivity="true"/>
</runspec>
```

Appendix 2: MOVES 2011 Output File and Run Specification

Output File: Definitions and Values

Category Field	Value	Description
State ID	4	ARIZONA
County ID	4023	Santa Cruz County
Fuel Type ID	1	Gasoline
Fuel Type ID	2	Diesel Fuel
Road Type ID	1	Off-Network
Road Type ID	2	Rural Restricted Access
Road Type ID	3	Rural Unrestricted Access
Road Type ID	4	Urban Restricted Access
Road Type ID	5	Urban Unrestricted Access

Output File: PM-10 Total and Break Out by Fuel and Roadway Type (units in pounds)

Fuel	Road	Run	Total PM10	Brake PM10	Elemental Carbon PM10	Organic Carbon PM10	Sulfate PM10	Tire PM10
1	1	1	1983	0	661	1321	0	0
1	2	1	1926	283	238	1688	0	734
1	3	1	1396	2104	172	1224	0	1191
1	4	1	941	930	119	822	0	485
1	5	1	2819	10137	359	2461	0	2764
2	1	1	1392	0	369	1022	0	0
2	2	1	15638	428	13642	1996	0	561
2	3	1	6394	665	4889	1505	0	274
2	4	1	3632	528	2794	838	0	142
2	5	1	12960	3149	9258	3702	0	492
Totals			**49081**	18224	32501	16579	0	6643

Output File: Energy and Distance by Fuel and Roadway Type (units in MMBtu and miles)

Fuel	Road	Run	Total Energy	Distance
1	1	1	83,885	
1	2	1	463,338	89,093,696
1	3	1	508,149	100,401,000
1	4	1	228,870	42,884,000
1	5	1	1,088,672	178,216,000
2	1	1	30,836	
2	2	1	481,052	21,702,200
2	3	1	157,447	8,825,700
2	4	1	91,302	4,341,050
2	5	1	269,850	12,053,900
Totals			3,403,401	457,517,546

MOVES 2011 Run Specification


```
<runspec>
	<description><![CDATA[2011 Santa Cruz County AZ test]]></description>
	<modelscale value="Inv"/>
	<modeldomain value="SINGLE"/>
	<geographicselections>
		<geographicselection type="COUNTY" key="4023" description="ARIZONA - Santa Cruz County"/>
	</geographicselections>
	<timespan>
		<year key="2011"/>
		<month id="1"/>
		<month id="2"/>
		<month id="3"/>
		<month id="4"/>
		<month id="5"/>
		<month id="6"/>
		<month id="7"/>
		<month id="8"/>
		<month id="9"/>
		<month id="10"/>
		<month id="11"/>
		<month id="12"/>
		<day id="2"/>
		<day id="5"/>
		<beginhour id="1"/>
		<endhour id="24"/>
		<aggregateBy key="Year"/>
	</timespan>
	<onroadvehicleselections>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="62" sourcetypename="Combination Long-haul Truck"/>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="61" sourcetypename="Combination Short-haul Truck"/>
```

```
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="41" sourcetypename="Intercity Bus"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="32" sourcetypename="Light Commercial Truck"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="54" sourcetypename="Motor Home"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="11" sourcetypename="Motorcycle"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="21" sourcetypename="Passenger Car"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="31" sourcetypename="Passenger Truck"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="51" sourcetypename="Refuse Truck"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="43" sourcetypename="School Bus"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="53" sourcetypename="Single Unit Long-haul Truck"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="52" sourcetypename="Single Unit Short-haul Truck"/>
			<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="42" sourcetypename="Transit Bus"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="62" sourcetypename="Combination Long-haul Truck"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="61" sourcetypename="Combination Short-haul Truck"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="41" sourcetypename="Intercity Bus"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="32" sourcetypename="Light Commercial Truck"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="54" sourcetypename="Motor Home"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="11" sourcetypename="Motorcycle"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="21" sourcetypename="Passenger Car"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="31" sourcetypename="Passenger Truck"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="51" sourcetypename="Refuse Truck"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="43" sourcetypename="School Bus"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="53" sourcetypename="Single Unit Long-haul Truck"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="52" sourcetypename="Single Unit Short-haul Truck"/>
			<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="42" sourcetypename="Transit Bus"/>
		</onroadvehicleselections>
		<offroadvehicleselections>
		</offroadvehicleselections>
		<offroadvehiclesccs>
		</offroadvehiclesccs>
		<roadtypes>
			<roadtype roadtypeid="1" roadtypename="Off-Network"/>
			<roadtype roadtypeid="2" roadtypename="Rural Restricted Access"/>
```

<roadtype roadtypeid="3" roadtypename="Rural Unrestricted Access"/>
<roadtype roadtypeid="4" roadtypename="Urban Restricted Access"/>
<roadtype roadtypeid="5" roadtypename="Urban Unrestricted Access"/>
</roadtypes>
<pollutantprocessassociations>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="106" pollutantname="Primary PM10 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="90" processname="Extended Idle Exhaust"/>

<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="107" pollutantname="Primary PM10 - Tirewear Particulate" processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="116" pollutantname="Primary PM2.5 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="117" pollutantname="Primary PM2.5 - Tirewear Particulate" processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="1" processname="Running Exhaust"/>

```
			<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="2" processname="Start Exhaust"/>
			<pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="90" processname="Extended Idle Exhaust"/>
		</pollutantprocessassociations>
		<databaseselections>
			<databaseselection servername="" databasename="c04023y2008_in20110329" description=""/>
		</databaseselections>
		<internalcontrolstrategies>
<internalcontrolstrategy classname="gov.epa.otaq.moves.master.implementation.ghg.internalcontrolstrategies.rateofprogress.RateOfProgressStrategy"><![CDATA[
useParameters	No

]]></internalcontrolstrategy>
		</internalcontrolstrategies>
		<inputdatabase servername="" databasename="" description=""/>
		<uncertaintyparameters uncertaintymodeenabled="false" numberofrunspersimulation="0" numberofsimulations="0"/>
		<geographicoutputdetail description="COUNTY"/>
		<outputemissionsbreakdownselection>
			<modelyear selected="false"/>
			<fueltype selected="true"/>
			<emissionprocess selected="false"/>
			<onroadoffroad selected="true"/>
			<roadtype selected="true"/>
			<sourceusetype selected="false"/>
			<movesvehicletype selected="false"/>
			<onroadscc selected="false"/>
			<offroadscc selected="false"/>
			<estimateuncertainty selected="false" numberOfIterations="2" keepSampledData="false" keepIterations="false"/>
			<sector selected="false"/>
			<engtechid selected="false"/>
			<hpclass selected="false"/>
		</outputemissionsbreakdownselection>
		<outputdatabase servername="" databasename="2008santacruzop42911v3" description=""/>
		<outputtimestep value="Year"/>
		<outputvmtdata value="true"/>
		<outputsho value="true"/>
		<outputsh value="true"/>
		<outputshp value="true"/>
		<outputshidling value="true"/>
		<outputstarts value="true"/>
		<outputpopulation value="true"/>
		<scaleinputdatabase servername="" databasename="c04023y2008_in20110329" description=""/>
		<pmsize value="0"/>
		<outputfactors>
			<timefactors selected="true" units="Years"/>
			<distancefactors selected="true" units="Miles"/>
			<massfactors selected="true" units="Pounds" energyunits="Million BTU"/>
		</outputfactors>
		<savedata>

		</savedata>
```

```
		<donotexecute>

		</donotexecute>

		<generatordatabase shouldsave="false" servername="" databasename="" description=""/>
			<donotperformfinalaggregation selected="false"/>
		<lookuptableflags scenarioid="" truncateoutput="false" truncateactivity="false"/>
</runspec>
```

Appendix C
2008 and 2011 PM_{10} Emissions Inventories, Nogales Municipality, State of Sonora, Mexico

This page is intentionally blank.

2008 and 2011 PM10 Emissions Inventories

Nogales Municipality
State of Sonora, Mexico

U.S. Environmental Protection Agency
Region 9

Draft Final, April 24, 2012

This page is intentionally blank.

Contents

1. Introduction

1.1 Purpose

This document provides an estimated PM10 emission inventory for all PM10 sources within the Nogales Municipality, State of Sonora, Mexico and the details concerning the derivation of those emissions estimates. EPA has created this PM10 emissions inventory to support the Arizona Department of Environmental Quality's (ADEQ) work on a PM10 State Implementation Plan (SIP) for the Nogales PM10 Non-attainment Area (NAA), located in Santa Cruz County, Arizona. Specifically, an estimate of PM10 emissions is needed to determine if the Nogales NAA would have attained the PM10 National Ambient Air Quality Standard (NAAQS) but for emissions emanating from sources in the Nogales Municipality.

1.2 Sources of PM10

PM10 refers to particulate matter of ten microns or less in aerodynamic diameter. Another class of particles, denoted as PM2.5 also called fine particulate, refers to particles of 2.5 microns or less in aerodynamic diameter. PM10 includes both PM2.5 and the particulates with aerodynamic diameter between 2.5 and 10 microns. Sometimes referred to as PM2.5-10, this larger fraction is called "coarse" particulate. While fine particles originate mostly from combustion sources and secondary aerosol generation processes, coarse particles usually originate from mechanical activities and fugitive source categories. Typical major sources of PM10 include fugitive dust, open burning including wild fires, mineral crushing and grinding operations, agricultural activities such as land tilling, dust suspended from vehicle travel on paved and unpaved roads and, to a lesser extent, fuel combustion sources and mobile source exhaust.

1.3 Emissions Inventory Overview

The emissions data for this inventory came from two primary sources and was estimated in part using data or methods from these and other cited sources:

1. "Mexico National Emissions Inventory, 1999: Six Northern States", Final, April 30, 2004, prepared by Eastern Research Group (ERG), Acosta Y Asociados, and Transengineering, for the Secretariat of the Environment and Natural Resources and the National Institute of Ecology of Mexico, the United States Environmental Protection Agency, the Western Governors' Association, and the North American Commission for Environmental Cooperation. (1999 Mexico NEI)
2. "Development of Mexico National Emissions Inventory Projections for 2008, 2012, and 2030", Final, January 9, 2009, prepared by Eastern Research Group, Inc. (ERG) for the Instituto Nacional de Ecologia, Mexico City, Mexico, the National Renewable Energy Laboratory, and the United States Environmental Protection Agency, with assistance from the Western Governors' Association. (2008-12 NEI Projections)

These sources were supplemented by emissions estimates using data from emissions inventories from other areas in the United States (U.S.)/Mexico border area and by calculated emissions estimates using EPA AP-42 emissions factors for unpaved and paved road emissions.[1] We describe

[1] See sections 4.3.2.1 and 4.3.2.2 for AP-42 emission factor equations and discussion of inputs.

in detail within Sections 3 and 4 the methodology used to compile emissions source category estimates. Mexico population data used in this emissions inventory was taken from census data at the Instituto Nacional de Estadistica Geografia e Informatica, (INEGI), www.inegi.mx.org. We used population data from 1995, 2000, 2005, and 2010.

2. The Nogales Municipality, Sonora, Mexico and the Nogales NAA, Arizona

2.1 Geography of the Area

The combined communities of Nogales, Arizona and Nogales, Sonora, or Ambos Nogales are located within the Sonoran Desert. This desert covers 120,000 square miles with a minimum elevation of 2,500 feet and is in the Basin and Range topographic province. This topography is characterized by north-south elongated valleys surrounded by mountain ranges. Ambos Nogales is located in such a north-south valley created by the Nogales Wash running north to the Santa Cruz River.

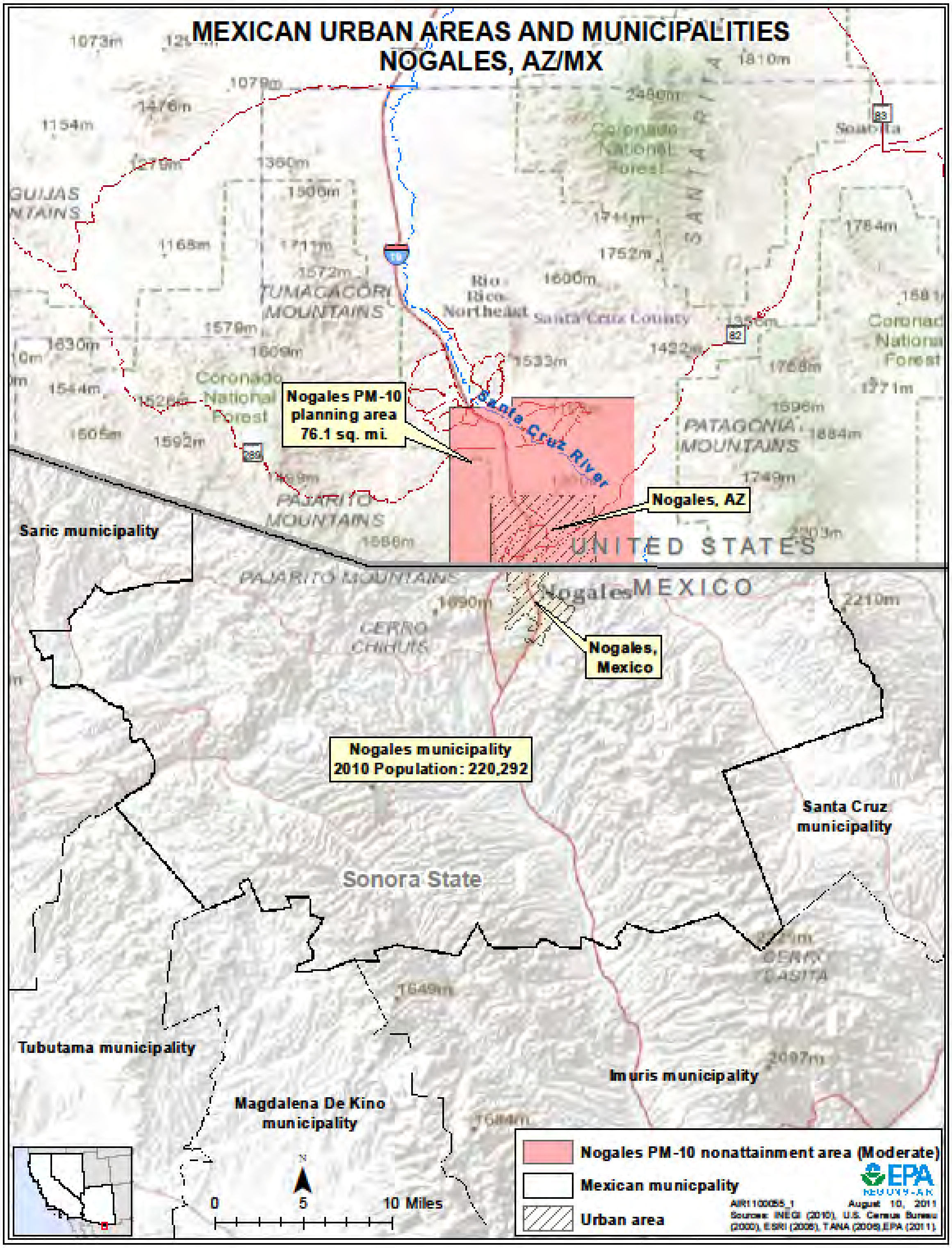
From south to north, Nogales Municipality is roughly analogous to a U.S. county and covers a 632.5 square mile area along the U.S./Mexico border.[2] The largest urban center in the municipality is the City of Nogales, Sonora. Nogales, Sonora, Mexico lies directly south of Nogales, Arizona across the international border. Collectively referred to as Ambos Nogales, the communities of Nogales, Arizona and Nogales, Sonora, Mexico comprise the largest international border community in Arizona, with a combined population of 232,550 inhabitants in 2010.[3] The majority of the Nogales Municipality population live within the city of Nogales, Sonora. The mean elevation in Nogales, Sonora is 4,265 feet above sea level.[4] At 5,380 feet, the highest elevation area in Nogales, Sonora are in the Cerro de los Nogales (Nogales Hill), west of where the Obregón and Colosio routes meet, near the southern end of the city.

The Alvaro Obregón Boulevard, Luis Donaldo Colosio Boulevard, and the Corredor Fiscal toll road are the main transportation routes in Nogales, Sonora. The Alvaro Obregón Boulevard runs the length of the narrow Nogales Wash valley, and is a highly congested route used by local and some cross-border commercial traffic. The Corredor Fiscal is a toll road for cross-border commercial traffic; its on- and off-ramp access is limited to the border junction at Mariposa Road and a point just outside of the southern city limits of Nogales, Sonora. The Corredor Fiscal conducts the majority of the U.S. and Mexico cross-border commercial traffic.

Proceeding northward, the U.S./Mexico border form the southern boundary of the Nogales NAA and Santa Cruz County, Arizona. Near the center of the Nogales NAA, the city of Nogales, Arizona is sixty miles south of Tucson, Arizona in the middle and southernmost portion of Santa Cruz County. The city of Nogales, Arizona is the largest city in the 76.1 square mile nonattainment area.[5] The mean elevation in Nogales, Arizona is 3,865 feet. Mountain ranges near Nogales include the Patagonia Mountains to the east and the Tumacacori, Atascosa, and Pajarito

[2] Municipality land area was calculated by EPA using GIS software.
[3] Nogales, Arizona had 20,017 inhabitants and Nogales, Sonora, Mexico had 212,533 inhabitants. U.S. Census Bureau 2010 and Instituto Nacional de Estadistica Geografia e Informatica, (INEGI) 2010.
[4] "Statistical Municipal Workbook for Nogales, Sonora," 2005 edition, INEGI.
[5] Nogales NAA land area was calculated by EPA using GIS software.

Figure 1: Nogales Municipality and Ambos Nogales Urban Areas.



mountains to the west. Approximately twenty-five miles to the north are the Santa Rita Mountains and Madera Canyon in the Coronado National Forest where Mount Wrightson rises to an elevation of 9,432 feet. Northwest of Interstate 19 are the Cerro Colorado, Las Guijas, and Sierrita Mountain Ranges.

Major highways in the Nogales, Arizona area are Arizona State Route 82, which connects Nogales, Arizona with Patagonia, Arizona (19 miles) and Sonoita (31 miles) to the northeast, and U.S. Interstate 19 which connects Tucson, Arizona to Nogales, Arizona and continues south into México, where it becomes Federal Highway 15.

3. Source Data Summary

3.1 The 1999 Mexico National Emissions Inventory

The Nogales Municipality emissions inventory developed here is based on modifications to the 1999 Mexico NEI estimate for the Nogales Municipality and allocations from the 2008-12 NEI Projections. For the Nogales Municipality, the 1999 Mexico NEI provided PM10 emissions estimates in four broad source categories: point, area, mobile, and non-road mobile; see Table 1 below. More individual source category detail was added at the State of Sonora and national scale of analysis; for example, detailed point and area source information was provided for the State of Sonora. For later use and comparison, the State of Sonora emissions estimates are provided below in Table 2. We have provided the PM2.5 estimates here for informational and comparison purposes only.

Table 1: Nogales Municipality PM10 and PM2.5 Emissions Inventory for 1999 (Mega-grams, Mg).

Source Category	PM10	PM2.5
Point	0.8	0.0
Area	7,815.8	1,407.2
Mobile	22.5	18.4
Nonroad	3.8	3.5
Total	7,842.9	1,429.1

Source: "1999 Mexico National Emissions Inventory: Six Northern States" Final, April 2004

Table 2: State of Sonora, Mexico Emissions PM10 and PM2.5 Inventory for 1999 (Mg).

Source Category	PM10	PM2.5
Point	30,880.6	14,737.2
Area	96,766.4	22,225.9
Mobile	236.2	193.5
Nonroad	1,157.9	1,065.3
Total	129,041.1	38,221.9

Source: "1999 Mexico National Emissions Inventory: Six Northern States," Final, April 2004

3.2 1999 Mexico National Emissions Inventory and 2008 and 2012 Projections

The 2008-12 NEI Projections provided national level emission estimates for the years 2008 and 2012, as well as aggregate detailed information on the source categories. The document also estimated 2030 emissions, but those were not relevant to this analysis. See Table 3 below.

Table 3: Mexico PM10 Emissions Inventory for 1999, 2008, and 2012 (Mg).

Source Category	1999	2008	2012
Point	297,264	359,919	388,825
Area	439,253	483,735	443,800
Mobile	20,567	31,890	34,019
Nonroad	37,240	40,447	42,734

Source: "Development of Mexico National Emissions Inventory Projections for 2008, 2012, and 2030"

3.3 Population

This section presents the population estimates for Mexico, the State of Sonora, and the Nogales Municipality. We used Mexico population data from the national census at the Instituto Nacional de Estadistica Geografia e Informatica, (INEGI) website, www.inegi.mx.org. Using population data from the 1995, 2000, 2005, and 2010 Mexico census, we interpolated population estimates for 1999, 2008, 2011, and 2012; these estimates are provided below in Table 1. The 1999 population estimates were interpolated using 1995 and 2000 census data. The 2008 population estimates were interpolated using 2005 and 2010 census data. The 2011 and 2012 population estimates were forecasted from the 2010 census data assuming the same increment of annual increment growth for the period 2005 to 2010.

Table 4: Population Data for Selected Years: 1995 to 2012.

Population Data for 1995, 2000, 2005, and 2010 with Interpolated or Projected Values for 1999, 2008, 2011, and 2012								
	1995	1999	2000	2005	2008	2010	2011	2012
Mexico	91,158,290	96,218,388	97,483,412	103,263,388	108,707,278	112,336,538	114,151,168	115,965,798
State of Sonora	2,085,536	2,190,682	2,216,969	2,394,861	2,555,432	2,662,480	2,716,004	2,769,528
Nogales Municipality	133,491	154,528	159,787	193,517	209,582	220,292	225,647	231,002

Source for 1995, 2000, 2005, and 2010 census data: INEGI

3.3.1 Population Based Allocation Ratios

Where applicable, we allocated 2008 and 2012 national emissions projections based on the Nogales Municipality's share of national population growth. The exceptions were the Nogales Municipality point source estimate and the area source estimates for paved and unpaved road emissions, agricultural burning, and agricultural tilling emissions. These exceptions are discussed in Section 4.

The population-based allocation values for scaling a municipality share of national emissions growth were as follows:
(1) for the period 1999-2008, 4.41×10^{-3}; and,
(2) for the period 2008-2012, 2.95×10^{-3}.

These ratios were calculated using the following formula:
Ratio 1999-2008 = (Nogales2008 - Nogales1999) / (Mexico2008 – Mexico1999);
Ratio 2008-2012 = (Nogales2012 – Nogales2008) / (Mexico2012 – Mexico2008);
where NogalesXXXX and MexicoXXXX are INEGI population estimates for the respective year.

4. Emissions Inventory Methodology

4.1 Overview of Source Category Emissions Estimates Development

The 1999 Mexico NEI provided PM10 emissions estimates for all four major source categories, point, area, mobile, and non-road at three levels of analysis: national, state, and municipality; and, it provided more detailed area source category emissions estimates at the national and state levels of analysis. The 2008-2012 NEI Projections provided national estimates in detail, but did not provide disaggregated data at the state or municipality level of analysis and did not provide estimates for unpaved and paved road emissions.

To summarize, we estimated emissions as follows:

- for point sources we used a combined scaling methodology to provide an estimated range;
- for area sources, we scaled most source categories by population; we calculated directly unpaved and paved road emissions; and, we scaled agricultural emissions by land area;
- for mobile and nonroad sources, we scaled by population.

Each section below describes in detail how we estimated municipality emissions for each of the major source categories using source document information and other cited source data.

4.2 Point Sources Estimate

The 1999 Mexico NEI estimated point source emissions for the Nogales Municipality at 0.8 Mg of PM10. The 1999 Mexico NEI and the 2008-12 Projections did not specify either the sources that composed this estimate, or their respective locations at the municipality level. The 1999 Mexico NEI provided specific point source data at the State of Sonora level, but no location information. For Sonora, the 1999 Mexico NEI showed 30,888.6 Mg of PM10 from 51 point sources: 97 percent of these emissions came from 11 mines, seven utilities, and three primary metal manufacturing facilities.[6] The remaining three percent of emissions came from 30 other sources, manufacturing facilities. This suggests that in 1999 it was unlikely that a large mining, utility, metal manufacturing source was located in the Nogales Municipality given the very low reported total municipality point source emissions (0.8 Mg), compared to the average individual source emissions in these three largest source categories, mining, utilities, and primary metal manufacturing (1,426.8 Mg).

Lacking existing source type or location data, we estimated a range of point source projections using two scaling calculations:

(1) scaling the same rate of national growth to the municipality level; and,
(2) scaling the relative national emissions increment by population ratios in Section 3.3.1.

[6] Page B-5, "1999 Mexico National Emissions Inventory: Six Northern States," Final, April 2004.

For example, for the period 1999 to 2008 national point source emissions grew 21.1 percent, so 0.8 Mg was multiplied by 1,211 to get 0.97 Mg. To apply a population growth ratio for the 1999-2008 period, we calculated the national point source emissions growth increment, 62,655 Mg and multiplied it by 0.00441, and added that municipal share of national point source emissions growth to 0.8 Mg. to get 277 Mg in 2008.

Table 5: Nogales Municipality 1999, 2008, and 2012 PM10 Emissions: Point Sources (Mg).

Scaling Method	1999	2008	2012
National Emissions Growth	0.8	0.97	1.04
Population Ratio	0.8	277	362.3

4.3 Area Sources Estimates

The 1999 Mexico NEI estimated area source emissions for the Nogales Municipality at 7815.8 Mg. Unfortunately, the 1999 Mexico NEI and the 2008-12 Projections did not specify the sources that composed this estimate at the municipality level. The 1999 Mexico NEI provided specific area source data at the State of Sonora level of analysis and we reviewed that information to see which sources composed this estimate; see Table 6 below.

Table 6: State of Sonora Area Source Category Emissions by Source, 1999 (Mg).

Area Source	PM10	Share
Unpaved Road Dust	61,049.3	63.1%
Paved Road Dust	26,516.5	27.4%
Agricultural Burning	4,120.0	4.3%
Agricultural Tilling	1,959.3	2.0%
Residential Fuel Combustion-Wood	1,529.3	1.6%
Open Burning - Waste	582.7	0.6%
Construction Activities	222.2	0.2%
All others/Remainder	787.1	0.8%
Total	96,766.4	

Source: "1999 Mexico National Emissions Inventory: Six Northern States," Final, April 2004

Three observations suggested our approach for estimating area source emissions for the Nogales Municipality. First, the Nogales Municipality area source estimate was an even larger proportion (99.7 percent) of total emissions compared to the same State of Sonora proportion (75 percent); see Tables 1 and 2 for area source estimates. Second, the 1999 Nogales Municipality distribution of area source types would not differ markedly and would be a subset of the known State of Sonora distribution of area source categories. Third, the largest proportion of area source emissions in either the State of Sonora or Nogales Municipality was in two source categories, unpaved and paved road dust. We, therefore, decided to do the following:

(1) estimate directly unpaved and paved road emissions for the Nogales Municipality;
(2) disaggregate to the municipality level the remaining State of Sonora area source categories in Table 6 and adjust them, where possible, by local information; and,
(3) allocate the 2008 and 2012 national emissions projections for our selected area source categories based on the Nogales Municipality's share of national population growth, except for agricultural emissions which were allocated by a land area scaling. Table 7 shows the national estimated emissions for the source categories analogous to those in Table 6.

Table 7: Selected Mexico Area Source Category Emissions: 1999, 2008, 2012 (Mg).

Source Category	1999	2008	2012
Agricultural Burning	13,975	14,059	14,059
Agricultural Tilling	109,866	119,206	119,206
Residential Fuel Combustion-Wood	226,897	238,550	199,340
Open Burning - Waste	20,425	22,432	23,122
Construction Activities	9,448	10,664	11,093
Remainder of Area Sources	58,642	78,824	76,980

Source: "Development of Mexico National Emissions Inventory Projections for 2008, 2012, and 2030"

4.3.1 Disaggregated 1999 Area Source Baseline Estimates for Nogales Municipality

Before proceeding with calculating unpaved and paved road emissions and estimating 2008 and 2012 emissions for the remaining area source categories, we developed the disaggregated 1999 area source baseline estimates for the Nogales Municipality.

To provide a 1999 baseline emissions estimate for use in calculating 2008 and 2012 emissions estimates for the agricultural burning and tilling source categories, we proportionally scaled the Sonora emissions for these source categories by the 2010 Nogales Municipality proportion (195) of Sonora (565,297) total harvested hectares[7], 0.000345, to get the following results:

- agricultural burning, 1.42 Mg;
- agricultural tilling, 0.676 Mg.

To the degree that the total harvested hectares in Nogales Municipality have grown from 1999 to 2010 relative to the Sonora total, then using a 2010 based ratio to estimate 1999 emissions may introduce some double-counting of these source category emissions.

To provide a Nogales Municipality 1999 baseline emissions estimate for the residential wood combustion, open burning of waste, construction activities, and the remaining area source categories, we proportionally scaled the State of Sonora emissions for these source categories by the 1999 Nogales Municipality proportion of the State of Sonora population, 0.071, to get the following results:

- residential wood combustion, 107.87 Mg;
- open burning of waste, 41.1 Mg;
- construction activities, 15.67 Mg; and,
- remaining area source categories, 55.52 Mg.

For comparison purposes, we calculated the Nogales Municipality 1999 unpaved and paved road emissions at 4,923.6 Mg and 2,648.1 Mg, respectively, using the same emission factor input data as the 1999 Mexico NEI and updated 2006 and 2011 EPA AP-42 emission factor equations for unpaved and paved road dust.

[7] Information was taken from the INEGI website: www.inegi.org.mx.

Finally, as a check against our area source category disaggregation calculations we compared the total of our disaggregated 1999 area source emissions estimate with the total area source estimate reported in the 1999 Mexico NEI:

- estimated 1999 area source baseline total, 7,793.97 Mg;
- 1999 Mexico NEI estimate, 7,815.8 Mg.

The difference between the two emissions estimates is 21.9 Mg., or 0.28 percent.

4.3.2 Unpaved and Paved Road Estimates Overview

Unpaved and paved road emissions estimates begin with an equation of the form:

PM10 emissions = [(Total VKT) (VKT percent paved or unpaved)] x EFpaved or unpaved,

where VKT is vehicle kilometers traveled and EF is the calculated emissions factor (grams/kilometer). A primary input to both unpaved and paved emissions estimates are VKT and the percentage of kilometers miles traveled on unpaved versus paved roads.

For the Nogales Municipality, we could not locate publically available VKT estimates derived from transportation demand modeling. Consequently, as was done in the 1999 Mexico NEI, we used a 4.3 VKT per person per day rate multiplied by population to get a daily VKT estimate. In the 1999 Mexico NEI, the 4.3 VKT per person per day rate was used to estimate VKT for cities ranging in size from 100,000-250,000 population, and represented the "large town rate".[8]

For the Nogales Municipality, the 1999 Mexico NEI used an unpaved/paved road VKT split of 8/92 percent estimated for the "large town" population category of 100,000-250,000.[9] We could not locate subsequent publicly available estimates of for unpaved/paved road mileage splits for the Nogales Municipality. Beginning in 2005, the City of Nogales, Sonora instituted a program to pave unpaved roads using funds provided to the Municipality by the North American Development Bank.[10] The "2005 Mexicali Emissions Inventory" (2005 Mexicali EI) provided the following unpaved/paved road VKT splits: urban road miles, 2/98; suburban road miles, 6.1/93.9; and rural road miles, 10.3/89.7.[11] To provide a consistent and conservative estimate of unpaved and paved road emissions, we used the 6/94 unpaved/paved percentage VKT as a midpoint value from the Mexicali information and to account for an increase in paved roads within the Nogales Municipality since 1999. For comparison, the 1999 Mexico NEI used a 3/97 VKT split for the next higher "small city" size category. Our estimated range of emissions for unpaved and paved roads

[8] pages 5-3 to 5-5 and Appendix A, "1999 Mexico NEI: Six Northern States," April 2004 Final. To summarize, per capita per day VKT estimates were developed using transportation engineering gravity modeling of seven representative urban areas varying by population size.

[9] "Estimation of Paved and Unpaved Road Dust in Mexico", presentation by Marty Wolf, Paula Fields, and Salvador Gonzalez-Ayala, at NARSTO Emissions Inventory Conference, October 14-17, 2003. Unpaved and paved road area and VKT splits were calculated for seven representative urban areas using GIS, field mapping, satellite images, or aerial photographs.

[10] The North American Development Bank provided $17million to pave 300,000 square meters of urban streets in residential areas. www.nadb.org.

[11] Table 10, page B-19, "2005 Mexicali Emissions Inventory", Final Report, February 27, 2009, Eastern Research Group, Inc. (ERG).

will be generated by the difference between the input data for the respective emission factor calculations; the input data and those differences are discussed below.

A third common input factor to each unpaved and unpaved emissions factor calculation is the mean number of precipitation days with greater than 0.1 inch of precipitation. For the Nogales Municipality estimate, we used 55 precipitation days, as reported by the National Weather Service for Nogales, Arizona.

4.3.2.1 Unpaved Road Estimate

To calculate unpaved road emissions, we used the EPA AP-42, Chapter 13.2.2, November 2006, Final, emissions factor equation:

EF (lb/VMT) = [(k((s/12)^1) ((S/30)^0.5) / (M/0.5)^0.2) -C] x [(365 - p)/365]

where k = 1.8 pound of PM10/Vehicle Mile Traveled (VMT), a constant supplied with the equation; s = silt content percentage; S = vehicle speed; M = moisture content; C = a constant for brake, tire wear, and exhaust emissions 0.00047; and p = precipitation days. Once we calculated an emissions factor in pounds/VMT, this was converted to grams/VKT for use with the metric units of measurement in our source documents; the conversion factor is 1 pound/VMT equals 281.9 gram/VKT.

Regarding vehicle speeds (S), we used 20.3 miles per hour (mph) as in the 1999 Mexico NEI. We did not find publically available road link vehicle speed estimates for the Nogales Municipality. As a check, we consulted the 2005 Mexicali EI and found that this study used the following: 11 mph, urban roads; 18 mph, suburban roads; and, 25 mph, rural roads.

For moisture content (M), we used 0.26 percent, as in the 1999 Mexico NEI. We did not find any publically available unpaved road silt moisture content studies for Nogales Municipality. To compare, the average silt moisture percentage used for the Mexicali and San Luis Rio Colorado Emission Inventories was 0.12 and 0.18, respectively. Also, Yuma, Arizona, near San Luis Rio Colorado, Mexico has 17 precipitation days as compared to the 55 in Nogales, Arizona, suggesting the use of a higher silt moisture percentage.

Because we held other emission factor input variables constant, silt content estimates produce the greatest variability in our unpaved road emissions factor. See Table 8 for a list of observed values we collected.

Table 8: Silt Content Percentages in U.S./Mexico Border Area PM10 Emissions Estimates.

Study or Source	Silt Content (%)	Variation Reported
1999 Mexico NEI	7.54	---
2005 Mexicali EI (avg)[12]	2.93	0.24 Minimum and 8.21 Maximum
WASBAQS: San Luis Rio Colorado (avg)[13]	0.76	0.34 Minimum and 1.85 Maximum
Nogales Planning Area (ADEQ)	7.05	---
Douglas /Paul Spur Planning Area (avg)(ADEQ)	4.7	Range reported, 1.3 to 7.0
Pima/Yuma/Pinal (avg) (ADEQ)	7.6	Range reported, 4.3-11.0

For our estimate range, we used 2.93 and 7.54 percent as minimum and maximum estimates for silt content percentage as they represent observed values in Mexico Border cities, Mexicali and Ciudad Juarez, respectively. For comparison. the average low of all studies was 3.46 percent and the average high of all studies was 7.11 percent; where no high or low was reported we used the point estimate in both averages. The ADEQ reported values were used in past air quality planning estimates for these areas, but we were unable to confirm the source data. Our calculation results are shown below:

- using the variables described above and a 2.93 percent silt content percentage, we calculate a 0.34956 lb/Vehicle Mile Traveled, or a 98.540 grams/VKT emissions factor; and,
- using the variables described above and a 7.54 percent silt content percentage, we calculate a 0.90017 lb/Vehicle Mile Traveled, or a 253.76 grams/VKT emissions factor.

Table 9: Nogales Municipality 1999, 2008, and 2011 PM10 Emissions: Unpaved Roads (Mg).

Silt Content Percentage	1999	2008	2011
Low Estimate: 2.93%	---	1,944.8	2,093.9
High Estimate: 7.54%	4,923.6	5,008.3	5,392.2

Note: the 1999 estimate used a 8/92 percent, unpaved/paved road VKT split per 1999 Mexico NEI.

4.3.2.2 Paved Road Estimate

To calculate paved road emissions, we used the EPA AP-42, Chapter 13.2.1, January 2011, Final, emissions factor equation:

EF (lb/VMT) = [(k(sL)^0.91) x (W^1.025)] x [1- (p/4N)]

where k = 0.0022 pound of PM10/Vehicle Mile Traveled (VMT), a particle size multiplier constant supplied with the equation; sL = silt loading in grams/square meter; W = vehicle weight (average); p = precipitation days; and N = days in period of interest, in this case 365 or one year. As stated above we used 55 for precipitation days. Once we calculated an emissions factor in pounds/VMT, this was converted to grams/VKT for use with the metric units of measurement in our source documents; the conversion factor is 1 pound/VMT equals 281.9 gram/VKT.

For vehicle weight (W), we used an average 2.4 tons per vehicle as used in the 1999 Mexico NEI.

[12] Raw data values supplied by Marty Wolf, Eastern Research Group, Inc.
[13] Raw data values supplied by Marty Wolf, Eastern Research Group, Inc. WASBAQS refers to the Western Arizona Sonora Border Air Quality Study.

Because we held other emission factor input variables constant, silt loading observations produce the greatest variability in our unpaved road emissions factor. See Table 10 below for a list of observed values we collected.

Table 10: Silt Loading in U.S./Mexico Border Area PM10 Emissions Estimates.

Study or Source	Silt Loading (gr/m2)	Variation Reported
1999 Mexico NEI	9.97	---
2005 Mexicali EI (avg)[14]	0.3106	0.0011 Minimum and 1.329 Maximum
WASBAQS: San Luis Rio Colorado (avg)[15]	0.22285	0.0857 Minimum and 0.6524 Maximum
Nogales, AZ Planning Area (ADEQ)	0.8	---

For our estimate range, we used 0.0857 and 1.329 grams per square meter (gr/m2) as minimum and maximum estimates for silt loading as they represent observed values in Mexico border cities, Mexicali and San Luis Rio Colorado, respectively. For comparison, the average low of all studies was 0.02956 gr/m2 and the average high of all studies was 0.92713 gr/m2; the 0.8 gr/m2 cited for Nogales, Arizona was incorporated in both averages. We did not incorporate the 9.97 value in these averages because it is so disparate from the other values; also, we could not obtain a copy of the Ciudad Juarez study so as to better understand the 9.97 gr/m2 figure to explain the large difference between it and other observed values. ADEQ provided values for Nogales, Arizona used in past air quality planning estimates for the area, but we are unable to confirm the source data and whether or not it derives from samples collected in Nogales, Arizona; consequently, we used a value of known derivation, 1.329 gr/m2. The results of our calculations are shown below:

- using the variables described above and a 0.0857 gr/m2 silt loading, we calculate a 0.00055523 lb/Vehicle Mile Traveled, or a 0.156520 grams/VKT emissions factor; and,
- using the variables described above and a 1.329 gr/m2 silt loading, we calculate a 0.06728 lb/Vehicle Mile Traveled, or a 1.897 grams/VKT emissions factor.

Table 11: Nogales Municipality 1999, 2008, and 2011 PM10 Emissions: Paved Roads (Mg).

Silt Loading	1999	2008	2011
Low Estimate: 0.0857 gr/m2	---	48.4	52.1
High Estimate: 1.329 gr/m2	2,648.1	586.4	631.4

Note: the 1999 estimate used a 8/92 percent, unpaved/paved road VKT split and 9.97 gr/m2 silt loading per the 1999 Mexico NEI.

4.3.3 Agricultural Burning and Tilling Estimates

The Nogales Municipality 1999 baseline emissions estimates are as follows:

- agricultural tilling, 0.676 Mg; and,
- agricultural burning, 1.42 Mg.

From 1990 to 2009, Mexico's harvested surface area increased 4.8 percent and cultivated surface area increased 11.5 percent[16]; or, 0.24 to 0.57 percent per year, respectively. It is unknown if a significant portion of this national increase in agricultural activity occurred on land within the Municipality, but rather than hold the 1999 emissions estimates constant, we increased them by

[14] Raw data supplied by Marty Wolf, Eastern Research Group, Inc.
[15] Raw data supplied by Marty Wolf, Eastern Research Group, Inc.
[16] "Mexico at at glance: 2010" INEGI.

these annual percentages through 2008. There are no projected emissions increases in 2012. The percentage increase in cultivation was applied to tilling, while the percentage increase in harvesting was applied to burning.

Table 12: Nogales Municipality 1999, 2008, and 2012 PM10 Emissions: Agricultural Tilling and Burning (Mg).

	1999	2008	2012
Agricultural Tilling	0.676	0.69	0.69
Agricultural Burning	1.42	1.49	1.49

4.3.4 Residential Wood Burning, Open Burning, and Construction Estimates

The Nogales Municipality 1999 baseline emissions estimates are as follows:

- residential wood burning, 107.87 Mg;
- open burning of waste, 41.1 Mg; and,
- construction activities, 15.67 Mg.

For these source categories, we allocated 2008 and 2012 national emissions projections based on the Nogales Municipality's share of national population growth. Residential wood burning emissions estimates decrease from 2008 to 2012 due to use of cleaner burning fuels; projections show fuel swapping to and increased use of natural gas. Construction activity emissions estimates may be overstated depending on the local impact of decreased activity within the housing and commercial construction markets in Nogales Municipality.

Table 13: Nogales Municipality 1999, 2008, and 2012 PM10 Emissions: Residential Wood Combustion, Open Burning of Waste, and Construction Activities (Mg).

	1999	2008	2012
Residential Wood Burning	107.87	159.24	43.53
Open Burning of Waste	41.1	49.95	51.99
Construction Activities	15.67	21.03	22.3

4.3.5 The Remaining Area Sources Estimate

The Nogales Municipality 1999 baseline emissions estimate is as follows:

- remaining area source categories, 55.52 Mg.

For this aggregation representing the twenty-four other area source categories within the 1999 Mexico NEI, we allocated 2008 and 2012 national emissions projections based on the Nogales Municipality's share of national population growth. The 2012 decrease can be attributed again to decreases in other residential fuel combustion source categories as fuel swapping to cleaner fuels is projected to occur (e.g., from coal to natural gas).

Table 14: Nogales Municipality 1999, 2008, and 2012 PM10 Emissions: Remaining Area Sources (Mg).

	1999	2008	2012
Remaining Area Sources	55.52	144.49	139.05

4.4 Mobile Sources Estimate

The Nogales Municipality 1999 baseline emissions estimate is as follows:

- mobile sources, 22.5 Mg.

For this source category, we allocated 2008 and 2012 national emissions projections based on the Nogales Municipality's share of national population growth.

The mobile source emissions estimate includes vehicle exhaust, tire wear, and brake wear emissions. In producing the mobile source emissions projections from 1999, the 2008-12 projections took into account the following parameters:

- changes in vehicle technologies and emissions due to fleet turnover;
- new Mexican gasoline and diesel vehicle fuel standards; and,
- implementation of Mexican emissions standards.

The mobile source emissions estimates were generated with a MOBILE6-Mexico emissions model.[17] Motor vehicle fuel demand projections provided the basis for estimating growth in vehicle usage in future year emissions.[18] As discussed earlier, we independently estimated VKT to calculate unpaved and paved road emissions. While there appears to be a difference in methodology concerning projected on-road motor vehicle usage, there is no overlap in the emissions sources being estimated, direct vehicle emissions versus reintrained road dust.

Table 15: Nogales Municipality 1999, 2008, and 2012 PM10 Emissions: Mobile Sources (Mg).

	1999	2008	2012
Mobile Sources	22.50	72.41	78.7

4.5 Nonroad Sources Estimate

The Nogales Municipality 1999 baseline emissions estimate is as follows:

- nonroad sources, 3.8 Mg.

For this source category, we allocated 2008 and 2012 national emissions projections based on the Nogales Municipality's share of national population growth.

The 1999 NEI emissions estimate addressed diesel powered agricultural and construction equipment, only. The 2008-12 Projections used disaggregated fuel demand projections to estimate emissions for the transportation, industrial, commercial, and agricultural sectors.

Table 16: Nogales Municipality 1999, 2008, and 2012 PM10 Emissions: Non-road Sources (Mg).

	1999	2008	2012
Nonroad Sources	3.80	17.94	24.69

[17] For a more detailed discussion of mobile source emissions modeling see the source document: "Development of Mexico National Emissions Inventory Projections for 2008, 2012, and 2030", Final, January 9, 2009, prepared by Eastern Research Group, Inc. (ERG).

[18] To estimate growth in on-road motor vehicle emissions over the 1999 to 2030 timeframe, the 2008-12 NEI Projections document relied on the "Long-range Energy Alternatives Planning System" (LEAP) to project gasoline and other vehicle fuel demand and use. For more information on the LEAP and its use, see 2008-12 NEI projections document and D. Cuatecontzi (2008) "Long-range Energy Alternatives Planning System (LEAP) fuel projections", National Autonomous University of Mexico, August 6.

5. Emissions Inventory Results and Discussion

The Nogales Municipality emissions inventory results are shown below in Tables 17 and 18. Table 17 aggregates the emissions estimates from Section 4. Table 18 provides 2008 and 2011 estimated PM10 emissions in tons.

Table 17: PM10 Emissions Inventory for Nogales Municipality, 1999, 2008, 2011, 2012 (Mg).

Source Category		Range	1999	2008	2011	2012
Point Sources		Low Estimate	0.8	0.97	1.02	1.04
		High Estimate	---	277	353.71	362.3
Area Sources	Unpaved Road	Low Estimate	---	1,944.8	2,093.9	
		High Estimate	4,923.6	5,008.3	5,392.2	
	Paved Road	Low Estimate	---	48.4	52.1	
		High Estimate	2,648.1	586.4	631.4	
	Agricultural Tilling		0.676	0.69	0.69	
	Agricultural Burning		1.42	1.49	1.49	
	Residential Wood Combustion		107.87	159.24	42.50	43.53
	Open Burning of Waste		41.1	49.95	50.76	51.99
	Construction Activities		15.67	21.03	21.77	22.3
	Remaining Area Sources		55.52	144.49	135.75	139.05
Mobile Sources			22.5	72.41	76.83	78.7
Nonroad Sources			3.8	17.94	24.10	24.69
Total		Low Estimate	---	2461.41	2500.92	
Total		High Estimate	7,821.06	6,338.94	6,731.22	

Note: The 1999 unpaved and paved road estimates were recalculated using current AP-42 emission factors equations and data inputs from the 1999 Mexico NEI; consequently, we did not generate 1999 high and low estimates. Please see section 4.3.2 and subsections for a complete discussion of unpaved and paved estimates.

Table 18: PM10 Emissions Inventory for Nogales Municipality for 2008 and 2011 (Tons).

Source Category		Range	2008	2011
Point Sources		Low Estimate	1.07	1.12
		High Estimate	305.34	389.90
Area Sources	Unpaved Road	Low Estimate	2,143.77	2,308.13
		High Estimate	5,520.70	5,943.88
	Paved Road	Low Estimate	53.35	57.43
		High Estimate	646.39	696.00
	Agricultural Tilling		0.76	0.76
	Agricultural Burning		1.64	1.64
	Residential Wood Combustion		175.53	46.85
	Open Burning of Waste		55.06	55.95
	Construction Activities		23.18	24.00
	Remaining Area Sources		159.27	149.64
Mobile Sources			79.82	84.69
Nonroad Sources			19.78	26.57
Total		Low Estimate	2,713.24	2,756.79
Total		High Estimate	6,987.48	7,419.89

Conversion factor: 1 Megagram = 1.10231 U.S. short tons (one short ton = 2000 pounds)

Because we started with 2012 national level projected estimates for most source categories, we scaled estimates to the municipal level first, then adjusted the municipal estimates consistent with the estimated decrease from 2012 to 2011 municipality population estimates, 2.37 percent. We calculated directly 2011 emission estimates for unpaved and paved roads; no adjustment was needed. Agricultural tilling and burning emissions estimates for 2011 reflected 2012 projections, no increase from 2008. We discuss specific issues concerning the allocated and estimated emissions inventory below.

5.1 Lack of Point Source Location Data

Neither source document, the 1999 Mexico NEI or the 2008-12 Projections, provided municipality-specific point source information, such as source category and location. Consequently, it is not possible to validate the 2008 or 2012 projections with specific source information or activity levels. This may not introduce a large range of uncertainty, however, because the beginning baseline emissions estimate, 0.8 Mg, is so small in comparison to the total emissions inventory. Even with a two orders of magnitude increase to 80 Mg, the point source emissions estimate remains very small (3.25 percent) compared to the 2008 total inventory low estimate of 2,461.41 Mg.

5.2. Use of Nogales Municipality Specific Data

Particularly for estimating unpaved and paved road emissions, Nogales Municipality specific data was not publically available. For instance, in calculating the 2008 and 2011 unpaved and paved road emission estimates, we used surrogate estimators for vehicle kilometers traveled and the unpaved/paved road split inputs. While we used reasonable and valid surrogates, having Nogales Municipality specific input information and activity levels would make these estimates less qualified. For other inputs to the unpaved and paved road emissions factor calculations, such as silt content and silt loading, any Nogales Municipality point estimate would result from of a range of samples from differently classified urban, suburban, rural areas or road way types. So, calculating a single emissions estimate from a range of silt content and silt loading inputs is not unusual, by itself. Also, where possible we used recent data collected from Mexican cities on the Mexico and U.S. border.

Consolidating and projecting the "remaining area sources" category is likely to introduce an over-estimate in that some of the sources may not exist in Nogales Municipality, or it may not be appropriate to scale all such sources by a population-based allocation. Again, only Nogales Municipality specific area source information would have adjudicated this issue.

The 1999 NEI did not estimate border crossing emissions and the 2008-12 projections did not estimate PM10 emissions at border crossings. Consequently, while aggregate emissions were accounted for in the source documents, the incremental and local PM10 emissions effects at the border crossing was not factored into this analysis.

Finally, the 2008 and 2012 estimated rate of PM10 emissions from road and other construction may be high because it is unclear whether the national emissions estimate reflected the full magnitude of the downturn in the local economy's real estate sector.

5.3 Estimated Range of Emissions

To allow for a lack of specific information for the point source category and a range of silt content and silt loading input variables in the unpaved and paved road categories, we generated a range of emissions estimates to get high and low estimates. As we explained for the silt content and silt loading values, any Nogales Municipality single emissions estimate would result from of a range of samples from differently classified urban, suburban, rural areas or road way types. So, calculating a single emissions estimate from a range of silt content and silt loading inputs is not unusual. The difference that might be anticipated would be that stratified sampling of different roadway areas and roadway types would contain the variability about the specific sample mean for each strata. Thus, depending on the sampling strategy and its execution, stratified sampling may provide for less variability around specific strata or overall mean point estimates.

5.4 Overall Assessment

This emissions inventory for Nogales Municipality provides a complete and sufficiently accurate inventory for the area based on the best methodology and source data publically available at the time the inventory was developed. Where Nogales Municipality specific data does not exist or could not be located, and we could not justify a singular data input, we reported a range of emissions estimates. In allocating national emissions to the Nogales Municipality or in estimating emissions, EPA has used reasonable and conservative assumptions to produce a current, comprehensive, and reasonably accurate PM10 emissions inventory. This emissions inventory is adequate for its intended use, providing an aggregate estimate of PM10 emissions originating from areas south of the Nogales, Arizona PM10 nonattainment area.

References

"Mexico National Emissions Inventory, 1999: Six Northern States", Final, April 30, 2004, prepared by Eastern Research Group (ERG), Acosta Y Asociados, and Transengineering, for the Secretariat of the Environment and Natural Resources and the National Institute of Ecology of Mexico, the United States Environmental Protection Agency, the Western Governors' Association, and the North American Commission for Environmental Cooperation. (1999 Mexico NEI).

"Development of Mexico National Emissions Inventory Projections for 2008, 2012, and 2030", Final, January 9, 2009, prepared by Eastern Research Group, Inc. (ERG) for the Instituto Nacional de Ecologia, Mexico City, Mexico, the National Renewable Energy Laboratory, and the United States Environmental Protection Agency, with assistance from the Western Governors' Association. (2008-12 NEI Projections).

"Technical Support Document for Recommendation that the Nogales, Arizona Area Be Designated as a PM2.5 Nonattainment Area", Arizona Department of Environmental Quality, December 3, 2007.

"Estimation of Paved and Unpaved Road Dust in Mexico", presentation by Marty Wolf, Paula Fields, and Salvador Gonzalez-Ayala, at NARSTO Emissions Inventory Conference, October 14-17, 2003.

"2005 Mexicali Emissions Inventory", Final Report, February 27, 2009, Eastern Research Group, Inc. (ERG).

This page is intentionally blank.

Appendix D
Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007-2009

This page is intentionally blank.

Analysis of Ambient PM_{10} Levels, Topography, and Meteorological Data in Nogales, Arizona: 2007 - 2009

U.S. Environmental Protection Agency
Region 9

Draft Final: July 20, 2012

Table of Contents

List of Tables

List of Figures

1.0 Introduction

1.1 Purpose

This document provides an analysis of ambient PM_{10} concentrations and meteorological data within the Nogales Nonattainment Area (NAA). The Arizona Department of Environmental Quality (ADEQ) requested that EPA provide this analysis to support ADEQ's work on a PM_{10} State Implementation Plan (SIP) for the Nogales NAA, located in Santa Cruz County, Arizona. The primary purpose of this analysis is to determine how the area's meteorology and topography have an effect on exceedances of PM_{10} National Ambient Air Quality Standard (NAAQS) and whether or not there is a south to north directional component to these exceedances; particularly, in reference to the international border between Nogales, Arizona and Nogales, Sonora, Mexico.

1.2 Sources of PM_{10}

PM_{10} refers to particulate matter with an aerodynamic diameter less than or equal to 10 micrometers. $PM_{2.5}$, also called fine particulate, refers to particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers. PM_{10} includes both $PM_{2.5}$ and the particulates with aerodynamic diameter between 2.5 and 10 micrometers, which is referred to as $PM_{10-2.5}$. This larger fraction is called "coarse" particulate. While fine particles originate mostly from combustion sources and secondary aerosol generation processes, coarse particles usually originate from mechanical activities and fugitive source categories. Typical sources of PM_{10} include fugitive dust, open burning including wild fires, mineral crushing and grinding operations, agricultural activities such as land tilling, dust suspended from vehicle travel on paved and unpaved roads and, to a lesser extent, fuel combustion sources and mobile source exhaust.

1.3 Geography of the Ambos Nogales Area

The combined communities of Nogales, Arizona and Nogales, Sonora, or Ambos Nogales are located within the Sonoran Desert. This desert covers 120,000 square miles with a minimum elevation of 2,500 feet and is in the Basin and Range topographic province. This topography is characterized by north-south elongated valleys surrounded by mountain ranges. Ambos Nogales is located in such a north-south valley created by the Nogales Wash running north to the Santa Cruz River.

From south to north, Nogales Municipality is roughly analogous to a United States (U.S.) county and covers a 632.5 square mile area along the U.S./Mexico border.[1] The largest urban center in the municipality is the City of Nogales, Sonora. Nogales, Sonora, Mexico lies directly south of Nogales, Arizona across the international border. Collectively referred to as Ambos Nogales, the communities of Nogales, Arizona and Nogales, Sonora, Mexico comprise the largest international border community in Arizona, with a

[1] Nogales Municipality land area was calculated by EPA using GIS software.

combined population of 232,550 inhabitants in 2010.[2] The majority of the population within the Nogales Municipality lives within the city of Nogales, Sonora. The mean elevation in Nogales, Sonora is 4,265 feet above sea level.[3] At 5,380 feet, the highest elevation area in Nogales, Sonora are in the Cerro de los Nogales (Nogales Hill), west of where the Obregón and Colosio routes meet, near the southern end of the city.

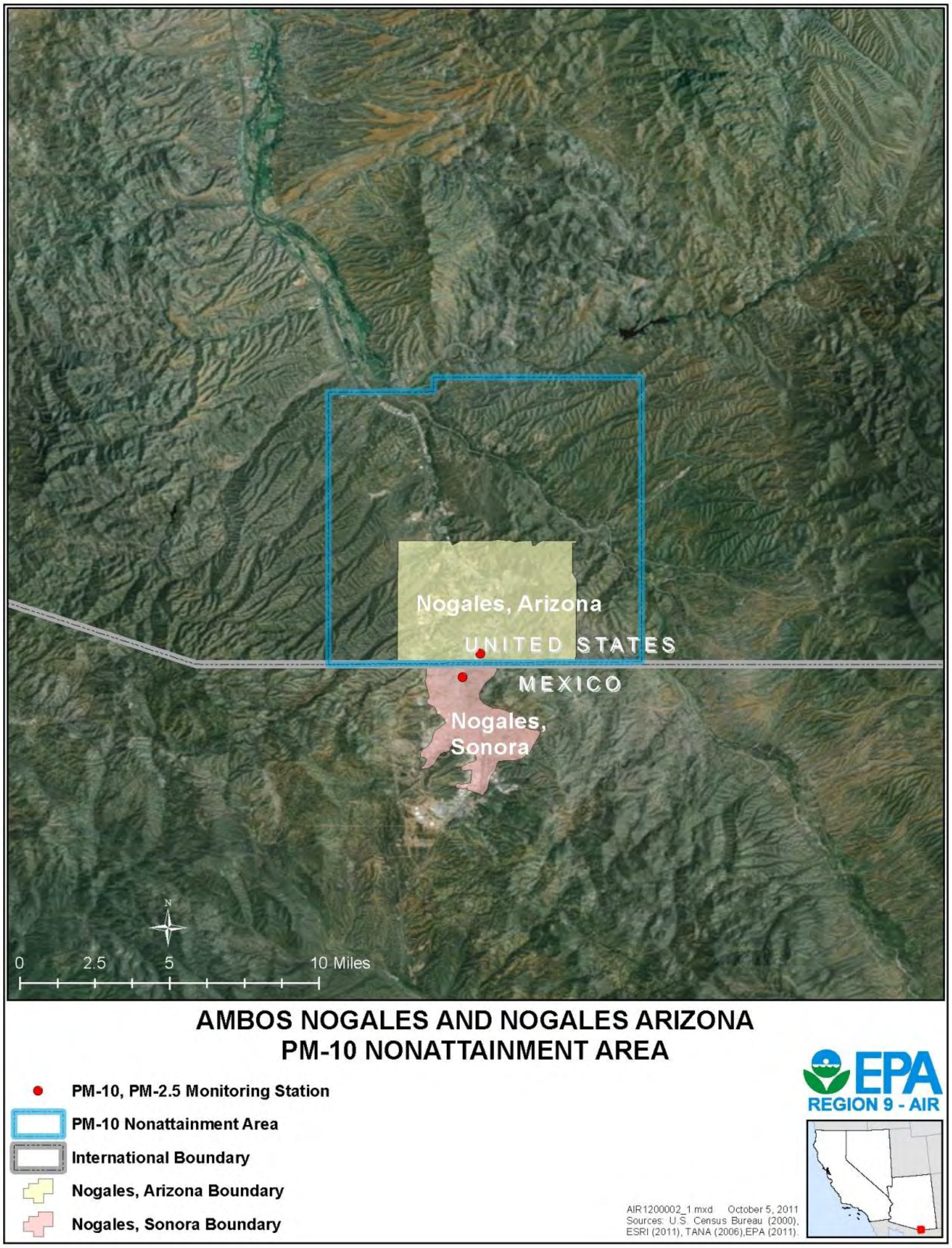
The Alvaro Obregón Boulevard, Luis Donaldo Colosio Boulevard, and the Corredor Fiscal toll road are the main transportation routes in Nogales, Sonora. The Alvaro Obregón Boulevard runs the length of the narrow Nogales Wash valley, and is a highly congested route used by local and some cross-border commercial traffic. The Corredor Fiscal is a toll road for cross-border commercial traffic; its on- and off-ramp access is limited to the border junction at Mariposa Road and a point just outside of the southern city limits of Nogales, Sonora. The Corredor Fiscal conducts the majority of the U.S. and Mexico cross-border commercial traffic.

Proceeding northward, the U.S. and Mexico border form the southern boundary of the Nogales NAA and Santa Cruz County, Arizona. At the lower center of the Nogales NAA, the city of Nogales, Arizona is sixty miles south of Tucson, Arizona in the middle and southernmost portion of Santa Cruz County. The city of Nogales, Arizona is the largest city in the 76.1 square mile nonattainment area.[4] The mean elevation in Nogales, Arizona is 3,865 feet above sea level. Mountain ranges near Nogales include the Patagonia Mountains to the east and the Tumacacori, Atascosa, and Pajarito mountains to the west. Approximately twenty-five miles to the north are the Santa Rita Mountains and Madera Canyon in the Coronado National Forest where Mount Wrightson rises to an elevation of 9,432 feet. Northwest of Interstate 19 are the Cerro Colorado, Las Guijas, and Sierrita Mountain Ranges.

Major highways in the Nogales, Arizona area are Arizona State Route 82, which connects Nogales, Arizona with Patagonia, Arizona (19 miles) and Sonoita (31 miles) to the northeast, and U.S. Interstate 19 which connects Tucson, Arizona to Nogales, Arizona and continues south into México, where it becomes Federal Highway 15.

[2] Nogales, Arizona had 20,017 inhabitants and Nogales, Sonora, Mexico had 212,533 inhabitants. U.S. Census Bureau 2010 and Instituto Nacional de Estadistica Geografia e Informatica, (INEGI) 2010.
[3] "Statistical Municipal Workbook for Nogales, Sonora," 2005 edition, INEGI.
[4] Nogales NAA land area was calculated by EPA using GIS software.

Figure 1: Map of Ambos Nogales area and Nogales PM-10 Nonattainment Area.



2.0 Ambient PM_{10} Monitoring in Nogales, Arizona and Nogales, Sonora

2.1 Ambient Monitors

Five ambient air monitors in the vicinity of Ambos Nogales were considered for this analysis. These monitors are described below and see Figure 2 for their locations. Within the nonattainment area, the Nogales, Arizona Post Office is the primary violating monitor location for PM_{10}. The Nogales, Arizona Post Office monitoring site is 0.3 miles north of the border and this monitoring site is 0.9 miles northeast of the Nogales, Sonora Fire Station monitoring site. The Green Valley and Corona de Tucson monitoring sites are approximately 35 and 45 miles away from the U.S./Mexico border, respectively.

Also, Arizona has operated a meteorological data collection station at the Nogales, Arizona Post Office monitoring site; wind speed observations discussed in our analyses were collected at that location. Temperature observations were collected at the Nogales International Airport, approximately six miles northeast of the Nogales, Arizona Post Office monitoring site.

Nogales, Arizona Post Office, Met One BAM 1020 (Method Code: 122) PM_{10} SPM-FEM (AQS ID: 04-023-0004, POC 3). The majority of the 24-hour PM_{10} exceedances measured in the Ambos Nogales area occurred at this monitor. This monitor operates continuously. Although this monitor is designated as a Special Purpose Monitor (SPM) monitor, the data that it produces is appropriate to consider for regulatory purposes since it has been operational for more than 24 months and has a Federal Equivalency Method (FEM) designation.

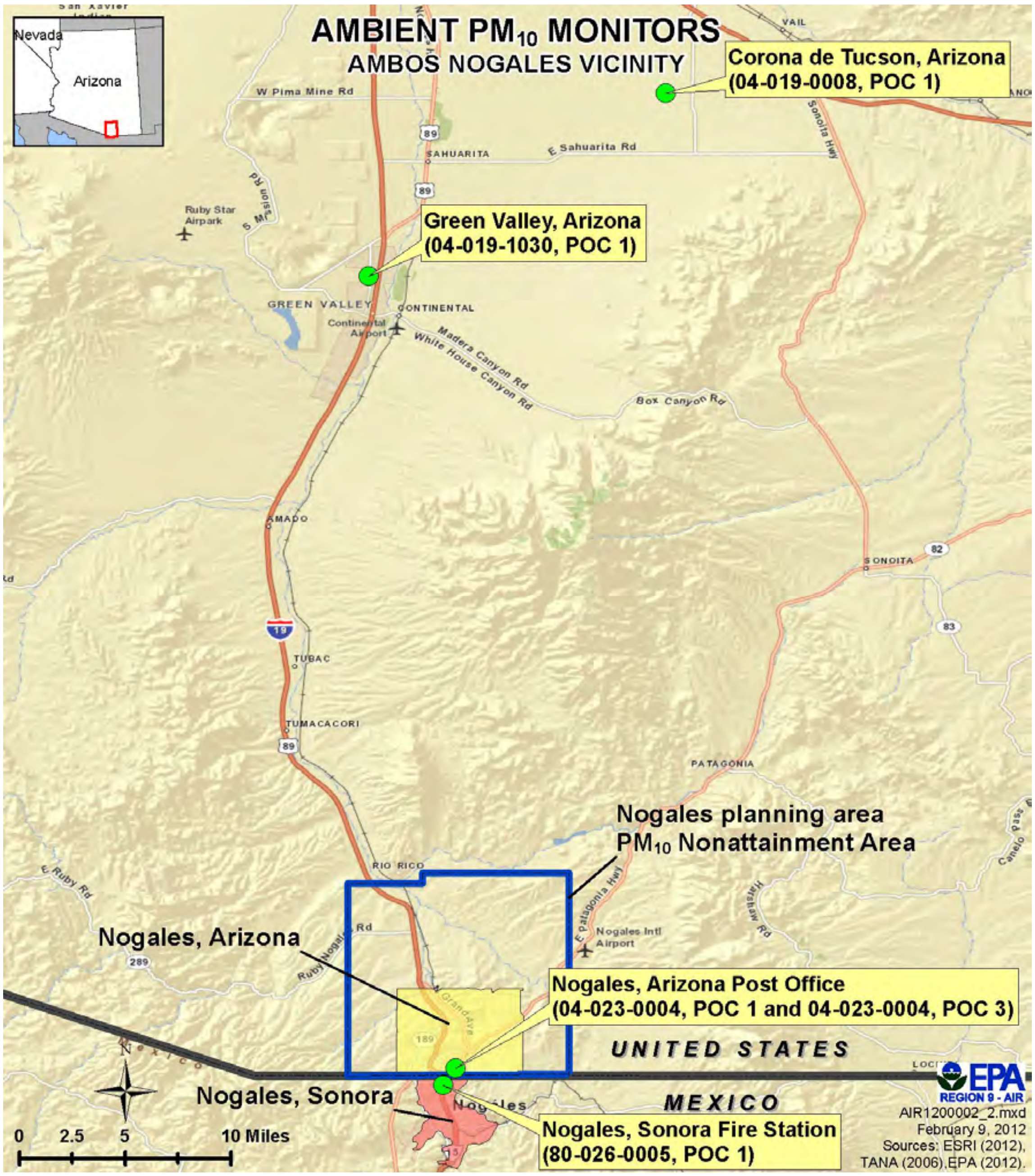
Nogales, Arizona Post Office, Rupprecht and Patashnick Partisol 2000 (Method Code: 126) PM_{10} SLAMS-FRM (AQS ID: 04-023-0004, POC 1). This monitor is placed at the same station as the primary violating monitor. Unlike the continuous FEM monitor operating at the Nogales, Arizona Post Office, this monitor is filter-based with samples collected once every six days (1:6) and is designated as a Federal Reference Method (FRM) monitor. For most of the days that the continuous FEM monitor is violating, the filter-based FRM monitor does not have sample information.

Nogales, Sonora Fire Station, Sierra Anderson Lo-Volume Dichot (Method Code: 073) PM_{10} Non-Regulatory-FRM (AQS ID: 80-026-0005, POC 1). The Nogales, Sonora Fire Station is the closest monitoring site to the Nogales, Arizona Post Office site. The PM_{10} monitor operating at this site is also a filter-based monitor with once in every six day sampling, but is designated as a non-regulatory FEM. This is the only PM_{10} monitor in Nogales, Sonora or the nearby vicinity south of the international border.

Green Valley, Arizona, Multiple Methods, Met One BAM 1020 (Method Code: 122) and Rupprecht and Patashnick TEOM (Method Code: 079) PM_{10} SPM-FEM (AQS ID: 04-019-1030, POC 1). This is the closest monitor to the Nogales, Arizona Post Office on the U.S. side with the same scale of representation (neighborhood scale) as the Post Office violating monitor. This monitor operates continuously and is a SPM-FEM.

Corona de Tucson, Arizona, Rupprecht and Patashnick Partisol 2000 (Method Code: 126) PM_{10} SLAMS-FRM Background (AQS ID: 04-019-0008, POC 1): This monitor represents the nearest background site to the Ambos Nogales area. This monitoring site is designated as a State and Local Air Monitoring Station (SLAMS) and the PM_{10} monitor is also an FRM with filter-based samples once every six days.

Figure 2: Map of ambient PM_{10} monitors near Nogales, Arizona.



2.2 Selected Timeframe for Review

The twenty-four hour PM_{10} NAAQS is based on the number of expected exceedances greater than 150 $\mu g/m^3$ averaged over three years[5]. For this analysis, we considered the most recent and most complete three year data range available. There was a large period of missing data at the Nogales, Arizona Post Office PM_{10} SPM between March 16 and October 27, 2010 because of poor quality assurance and quality control results. Consequently, we considered 2007 to 2009 to be the most appropriate timeframe for this analysis. At the Nogales, Arizona Post Office monitors, PM_{10} data completeness for each quarter within the 2007 - 2009 timeframe is greater than 75 percent.

2.3 Quality Assurance

The Corona de Tucson and the Green Valley monitors located near Tucson, Arizona are operated by the Pima County Department of Environmental Quality (PDEQ), while the Nogales Post Office and the Sonora Fire Station monitors are operated by ADEQ. PDEQ and ADEQ have an appropriate quality system in place for collecting ambient air monitoring data. EPA performed an independent Technical System Audit (TSA) of ADEQ's ambient air monitoring program in September 2009 and a TSA of PDEQ's ambient monitoring program in September 2011, per requirements in 40 CFR Part 58, Appendix A, Section 2.5. EPA assessed PDEQ and ADEQ's compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data and concluded that PDEQ and ADEQ have a robust ambient air monitoring program.

EPA reviewed and approved the 2011 ADEQ annual monitoring network plan on December 1, 2011. We found that the 2011 monitoring network plan was complete and met the requirements for annual network plans described in 40 CFR 58.10.

3.0 Analysis of 2007 - 2009 Exceedance Days

The measured twenty-four hour average PM_{10} concentrations on exceedance days during 2007 - 2009 for the Nogales, Arizona Post Office FEM, FRM (filter-based monitor at the same location), Nogales, Sonora Fire Station (closest monitor), Green Valley, (closest monitor in U.S.), and Corona de Tucson, (background monitor), are listed below in Tables 1-3.[6]

[5] The NAAQS for all pollutants can be found at www.epa.gov/air/criteria.html .
[6] Data was obtained via EPA's Air Quality System (AQS), www.epa.gov/ttn/airs/airsaqs/ .

Table 1: 24-hour PM_{10} concentrations on exceedance days in 2007.

Date (2007)	**Nogales, AZ Post Office FEM (μg/m^3)**	**Nogales, AZ Post Office FRM (μg/m^3)**	**Nogales, Sonora Fire Station (μg/m^3)**	**Green Valley, AZ (μg/m^3)**	**Corona de Tucson, AZ (μg/m^3)**
1-Jan	210	N/A	N/A	11.9	N/A
6-Feb	180	N/A	N/A	11.9	N/A
6-Mar	157	N/A	N/A	24.2	N/A
15-Mar	175	N/A	N/A	22.2	N/A
19-Oct	189	N/A	N/A	29.5	N/A
27-Oct	210	122	159	24.9	28
2-Nov	211	190	170	29.4	32
3-Nov	170	N/A	N/A	26.5	N/A
4-Nov	170	N/A	N/A	30.2	N/A
6-Nov	186	N/A	N/A	34.4	N/A
18-Nov	167	N/A	N/A	30.8	N/A
19-Nov	177	N/A	N/A	22.6	N/A
28-Nov	167	N/A	N/A	22.0	N/A
24-Dec	233	N/A	N/A	13.5	N/A

Table 2: 24-hour PM_{10} concentrations on exceedance days in 2008.

Date (2008)	**Nogales, AZ Post Office FEM (μg/m^3)**	**Nogales, AZ Post Office FRM (μg/m^3)**	**Nogales, Sonora Fire Station (μg/m^3)**	**Green Valley, AZ (μg/m^3)**	**Cornoa de Tucson, AZ (μg/m^3)**
26-Jan	204	N/A	N/A	11.8	N/A
27-Feb	166	N/A	N/A	14.6	N/A
18-May	169	147	126	22.2	21
22-May	217	N/A	N/A	77.5	N/A
26-Oct	156	N/A	N/A	25.7	N/A
31-Oct	159	N/A	N/A	34.5	N/A
1-Nov	234	N/A	N/A	26.3	N/A
8-Nov	167	155	119	22.5	16
16-Nov	171	N/A	N/A	33	N/A
17-Nov	206	N/A	N/A	25.4	N/A
20-Nov	161	150	126	26.4	23
22-Nov	179	N/A	N/A	25	N/A
31-Dec	155	N/A	N/A	10.7	N/A

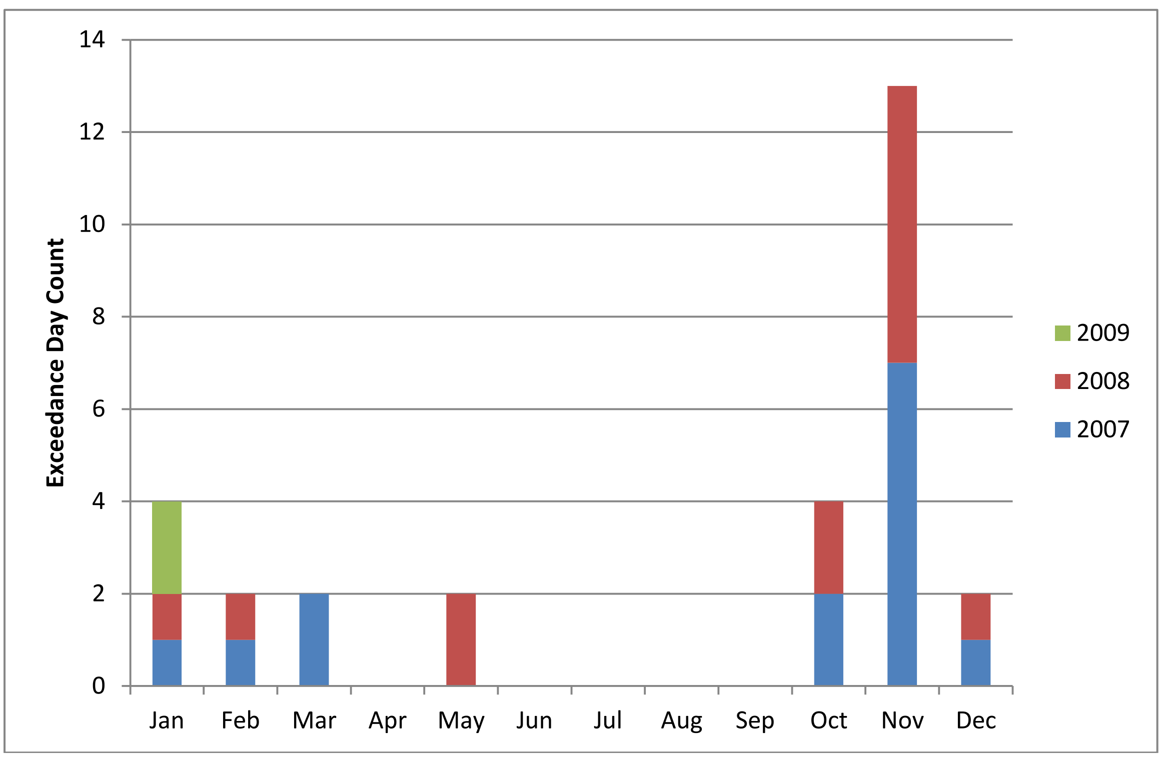
Table 3: 24-hour PM_{10} concentrations on exceedance days in 2009.

Date (2009)	Nogales, AZ Post Office FEM ($\mu g/m^3$)	Nogales, AZ Post Office FRM ($\mu g/m^3$)	Nogales, Sonora Fire Station ($\mu g/m^3$)	Green Valley, AZ ($\mu g/m^3$)	Cornoa de Tucson, AZ ($\mu g/m^3$)
1-Jan	238	NULL	129	12.9	12
16-Jan	204	N/A	N/A	17.8	N/A

There are no observed PM_{10} NAAQS exceedances at the Nogales, Arizona Post Office FRM on days when the FEM is not exceeding (i.e., days other than those shown in Tables 1 - 3).

Between 2007 and 2009, there were 29 exceedances of the PM_{10} NAAQS at the Nogales, Arizona Post Office monitoring location. See Figure 3. Of those exceedances, 14 occurred in 2007, 13 in 2008, and two in 2009; with 27 exceedances in the October through March annual timeframe. Twenty-four hour PM_{10} concentrations on exceedance days varied between 155 and 238 $\mu g/m^3$, with some hourly measurements reaching 900 $\mu g/m^3$. Finally, Arizona has not flagged any of these 2007 through 2009 exceedance days for potential exclusion from air quality planning considerations under EPA's Exceptional Events Rule.

Figure 3: PM_{10} exceedances at the Nogales, Arizona Post Office, by month and year.



3.1 Hourly PM_{10} Concentration, Wind Speed, and Wind Direction

Complete hourly information on PM_{10} concentrations, wind direction, and wind speed can be found in the file *Nogales PM10 – Concentration and Met Analysis.xlsx*. Hourly information on temperature and diurnal plots of PM_{10} concentrations and wind speed can be found in the file *Nogales PM10 – Concentration and Met Analysis.xlsx*. The most relevant information for this analysis is presented and discussed here.

A plot of hourly PM_{10} concentrations versus time of day for all exceedances is given in Figure 4. Three days were identified as having a significantly different diurnal pattern: January 1, 2007, May 22, 2008, and January 1, 2009 and are hereafter identified as "study days". Twenty-six of the twenty-nine observed exceedances between 2007 and 2009 have nearly identical diurnal patterns and are plotted separately in Figure 5.

Figure 4: Hourly PM_{10} concentrations at the Nogales, Arizona Post Office FEM monitor versus time of day for all 29 exceedances.

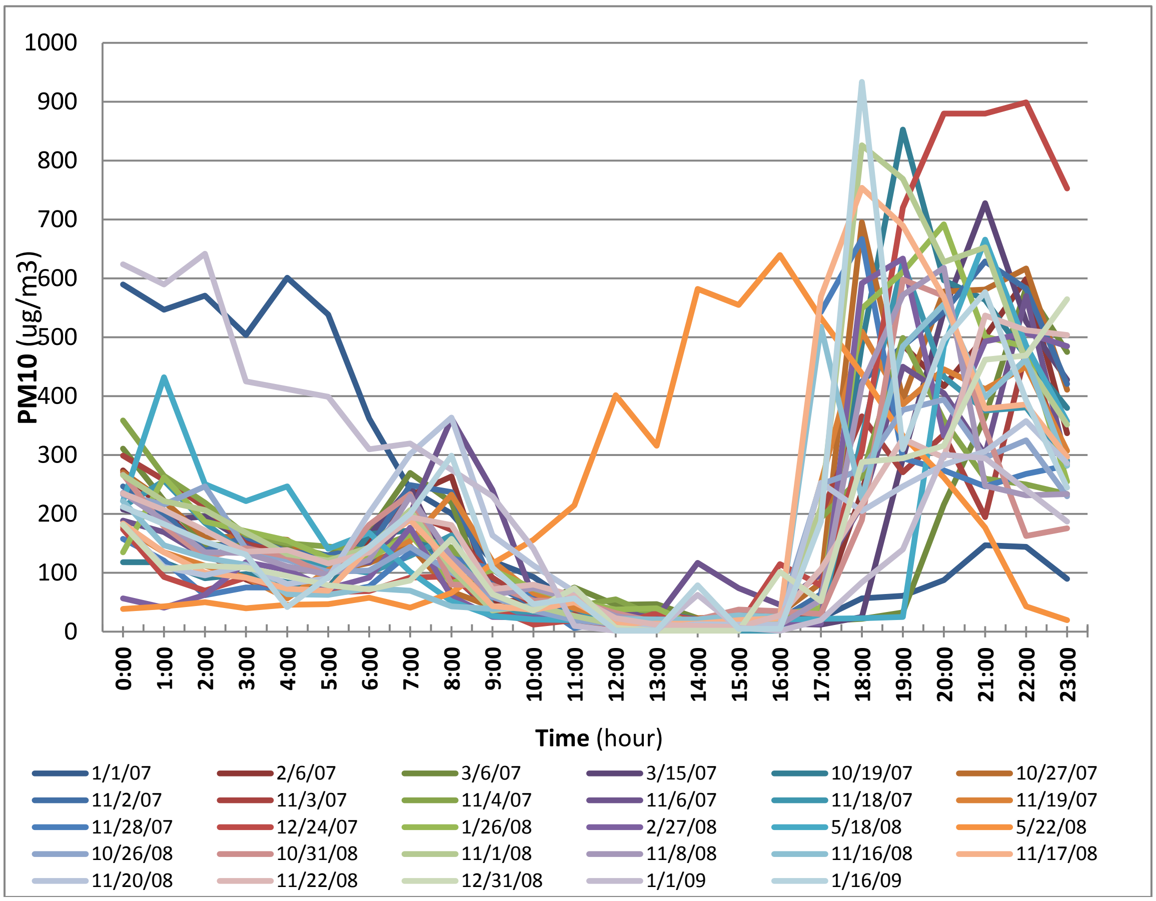
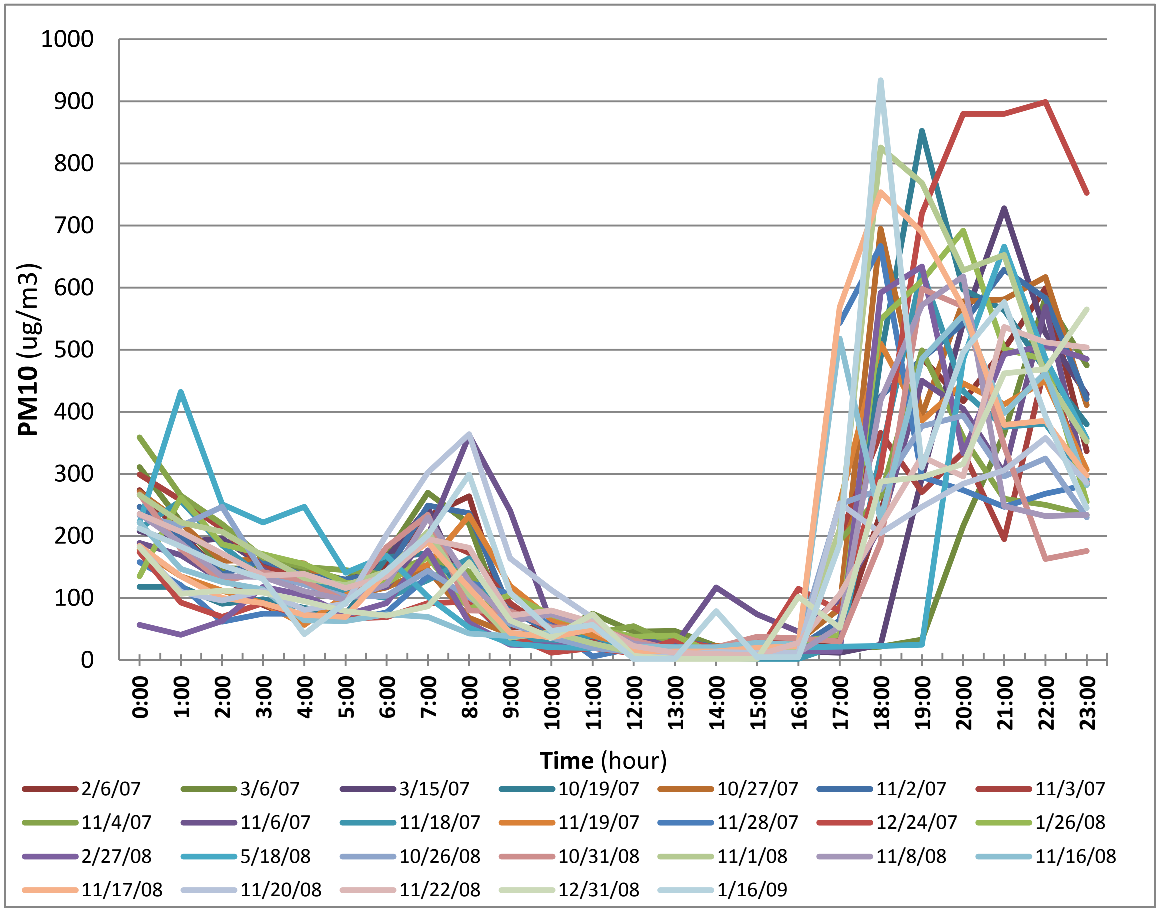


Figure 5: Hourly PM_{10} concentrations at the Nogales, Arizona Post Office FEM monitor versus time of day for all exceedances, excluding study days (26 days, see discussion in Section 3.4).



Plots of hourly synthetic wind speed and temperature versus time of day for all exceedance days are given as Figures 6 and 7, respectively. As is shown in Figure 6, wind speeds were eight miles per hour (mph) or below for all exceedance days, with the exception of May 22, 2008, when elevated wind speeds were observed. While only one other monitor in Arizona and a few monitors in California exceeded the 24-hour standard on May 22, 2008, on the previous day, May 21, 2008, there were eight exceedances throughout Arizona and numerous exceedances in California and Nevada associated with elevated wind speeds.

Figure 6: Hourly wind speed at the Nogales, Arizona Post Office FEM monitor versus time of day for all 29 exceedances.

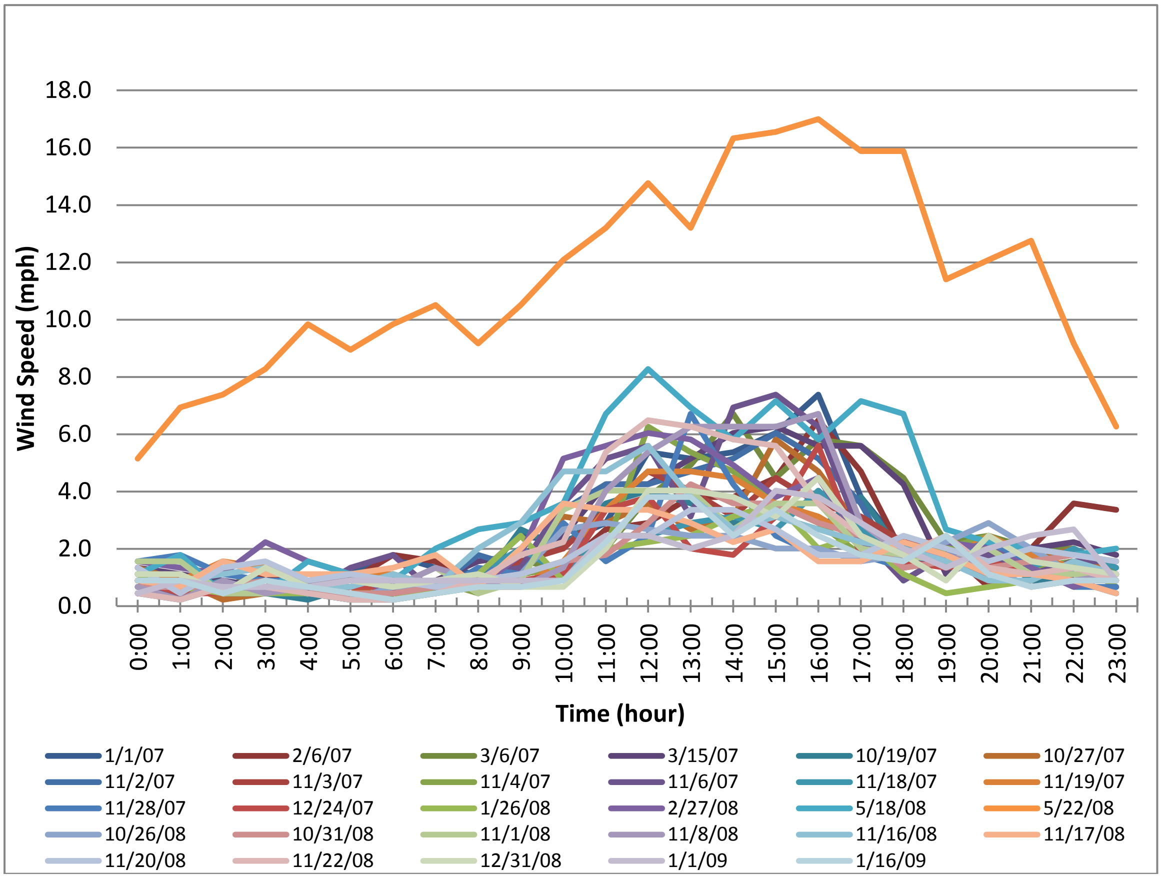
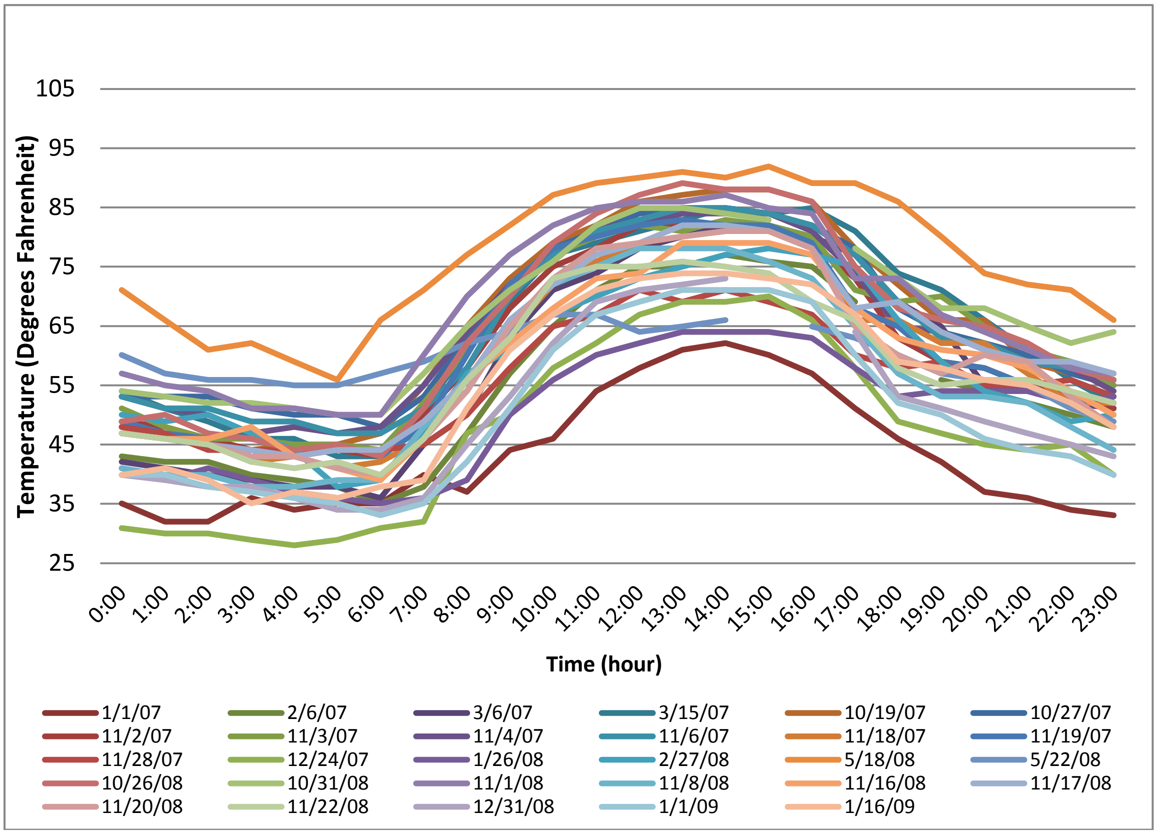


Figure 7: Hourly temperature at the Nogales, Arizona Post Office FEM monitor versus time of day for all 29 exceedances.



Note: Temperatures were recorded at Nogales International Airport (NIA), 7.6 miles northeast of Nogales, Arizona Post Office monitoring site. NIA is within the Nogales PM_{10} nonattainment area.

Wind roses[7] are provided for non-exceedance days, all exceedance days, and exceedance days excluding May 22, 2008 in Figures 8, 9, and 10, respectively. The May 22, 2008 exceedance is excluded from Figure 9 because it is the only day with observed winds greater than 8 mph.

PM_{10} pollution roses[8] for all exceedance days and exceedance days excluding the three study days identified in section 3.4 are given in Figures 11 and 12.

[7] A wind rose shows the frequency of wind speed plotted in a polar coordinate system versus wind direction.
[8] A pollution rose shows the frequency of ambient concentration plotted in a polar coordinate system versus wind direction.

Figure 8: Wind rose of wind speed versus wind direction at the Nogales, Arizona Post Office FEM monitor for non-exceedance days (2007 - 2009).

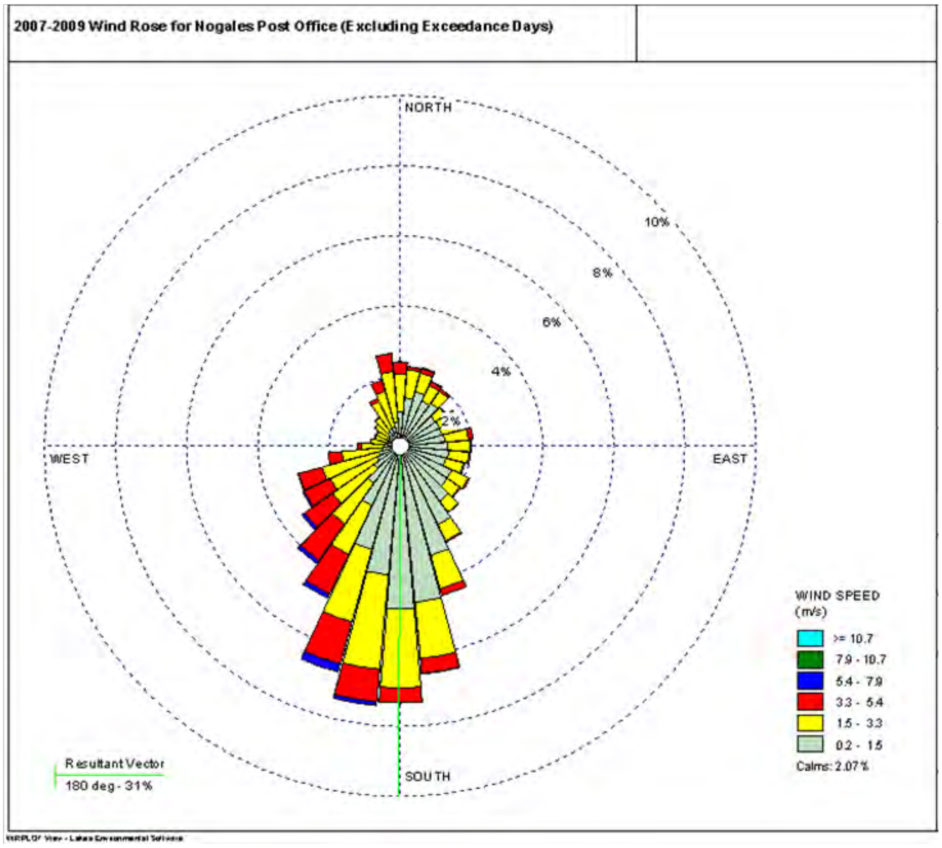


Figure 9: Wind rose of wind speed versus wind direction at the Nogales, Arizona Post Office FEM monitor for all 29 exceedance days.

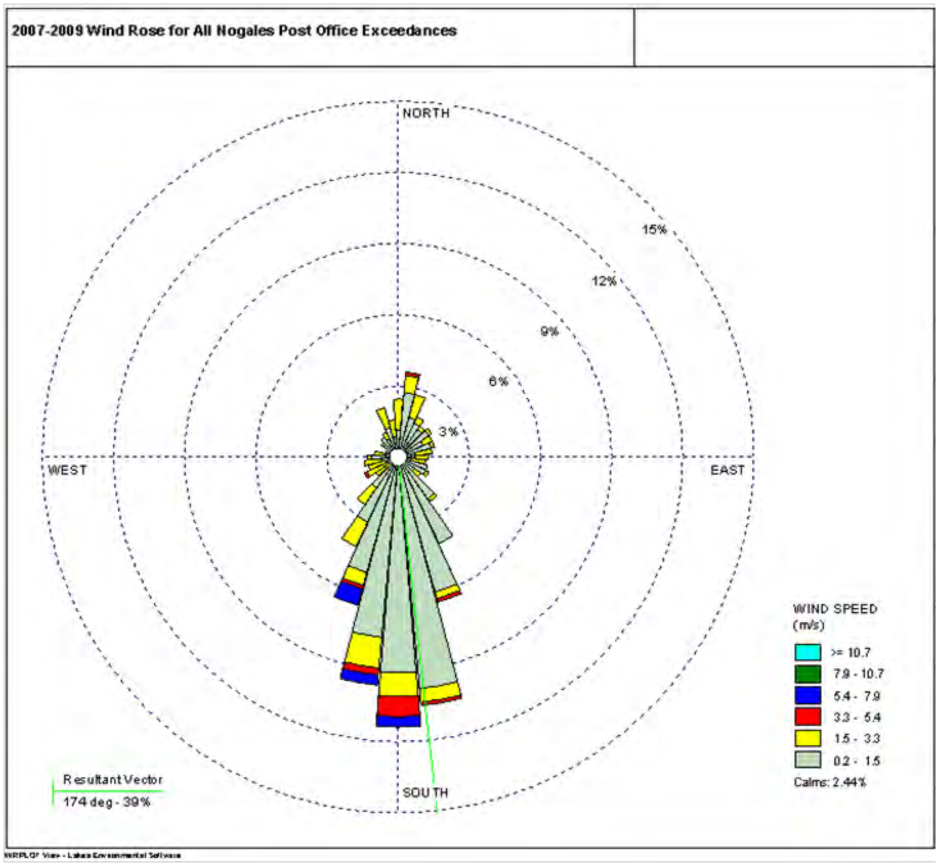


Figure 10: Wind rose of wind speed versus wind direction at the Nogales, Arizona Post Office FEM monitor for all exceedances, excluding May 22, 2008 (see section 3.1).

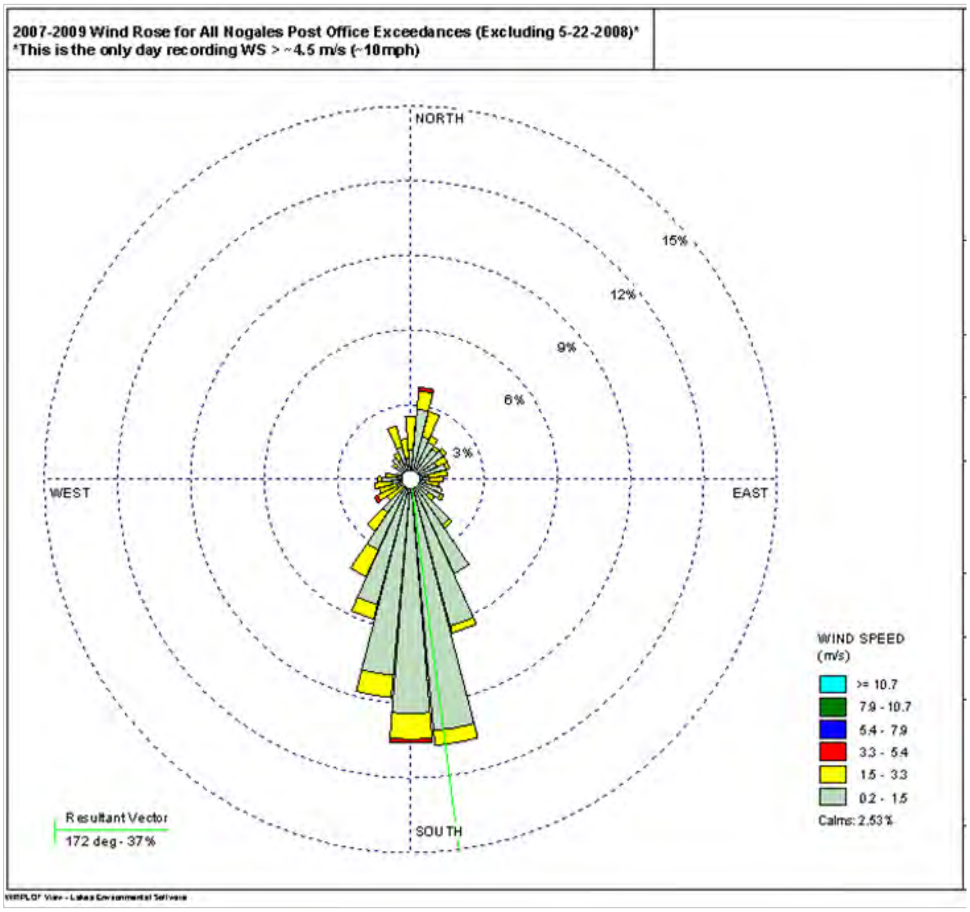
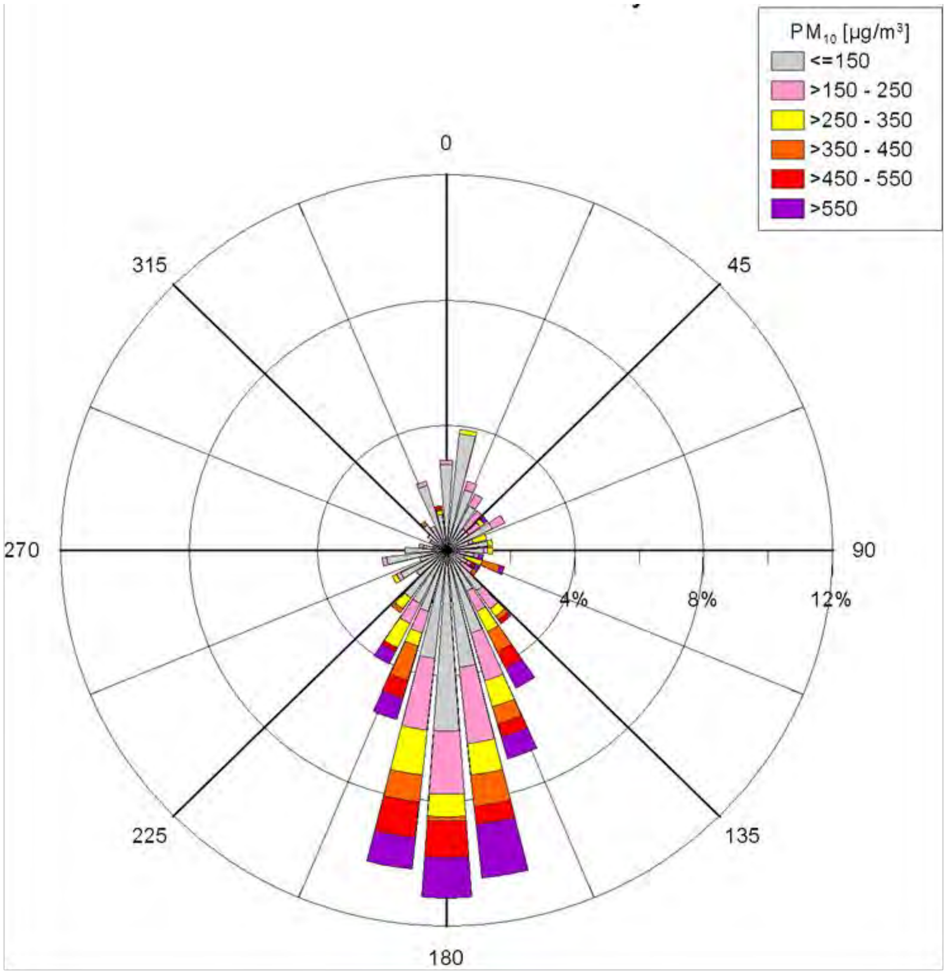
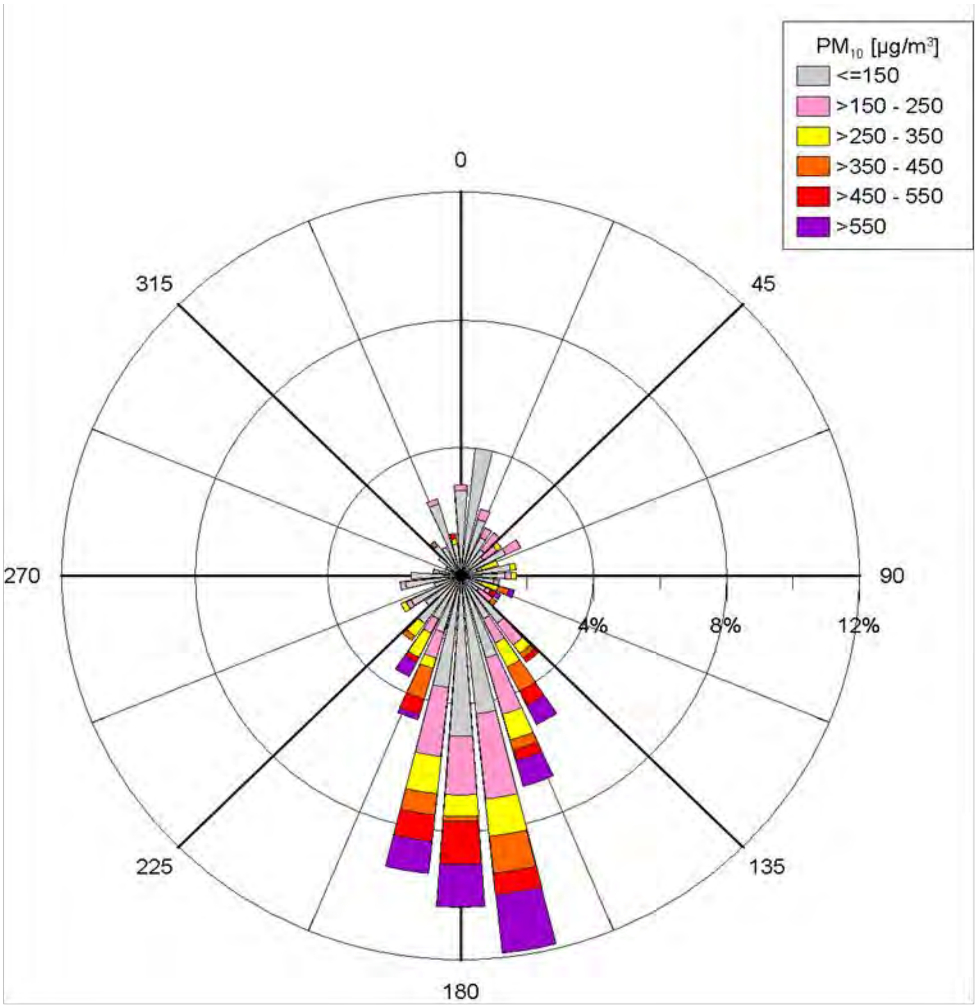


Figure 11: Pollution rose of PM_{10} concentration versus wind direction at the Nogales, Arizona Post Office FEM monitor for all 29 exceedance days.



2007-09 Nogales 29 day pollution rose

Figure 12: Pollution rose of PM_{10} concentration versus wind direction at the Nogales, Arizona Post Office FEM monitor for all exceedances, excluding study days (26 days).



2007-09 Nogales 26 day pollution rose

3.2 Representative Day

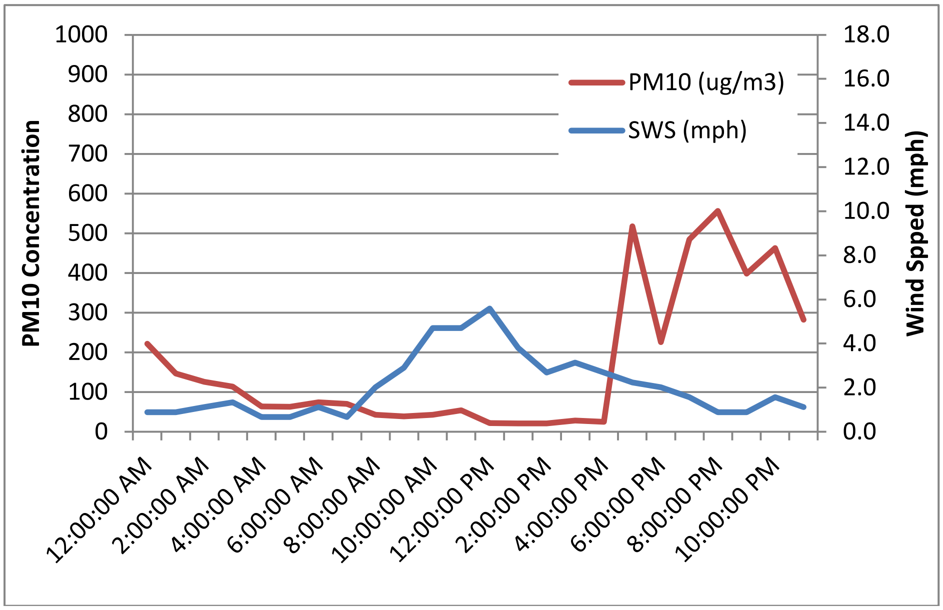
For illustration, we identified November 16, 2008 as representative of the concentration, wind speed, and wind direction pattern observed on 26 of the exceedance days (excluding January 1, 2007; May 22, 2008; and January 1, 2009). The synthetic wind direction (SWD; in degrees, where 0 degrees is wind from the north and 180 degrees is wind from the south, etc.), synthetic wind speed (SWS; in meters per second and miles per hour), and hourly PM_{10} concentration ($\mu g/m^3$) for November 16, 2008 is provided in Table 4 below.

Table 4: Hourly observations of wind direction, wind speed, and PM_{10} concentration at the Nogales, Arizona Post Office FEM monitor for November 16, 2008.

Hour	SWD (degrees)	SWS (m/s)	SWS (mph)	PM_{10} ($\mu g/m^3$)
12:00:00 AM	183	0.4	0.9	222
1:00:00 AM	163	0.4	0.9	147
2:00:00 AM	180	0.5	1.1	126
3:00:00 AM	159	0.6	1.3	114
4:00:00 AM	225	0.3	0.7	64
5:00:00 AM	216	0.3	0.7	63
6:00:00 AM	168	0.5	1.1	74
7:00:00 AM	296	0.3	0.7	70
8:00:00 AM	59	0.9	2.0	43
9:00:00 AM	12	1.3	2.9	39
10:00:00 AM	14	2.1	4.7	43
11:00:00 AM	64	2.1	4.7	54
12:00:00 PM	86	2.5	5.6	22
1:00:00 PM	74	1.7	3.8	21
2:00:00 PM	77	1.2	2.7	21
3:00:00 PM	34	1.4	3.1	28
4:00:00 PM	70	1.2	2.7	25
5:00:00 PM	141	1	2.2	518
6:00:00 PM	196	0.9	2.0	226
7:00:00 PM	173	0.7	1.6	485
8:00:00 PM	154	0.4	0.9	556
9:00:00 PM	113	0.4	0.9	398
10:00:00 PM	181	0.7	1.6	463
11:00:00 PM	162	0.5	1.1	282

A plot of hourly PM_{10} concentrations and wind speed for the same day, November 16, 2008 is shown in Figure 13.

Figure 13: Hourly PM_{10} concentrations and wind speed at the Nogales, Arizona Post Office FEM monitor versus time for November 16, 2008.

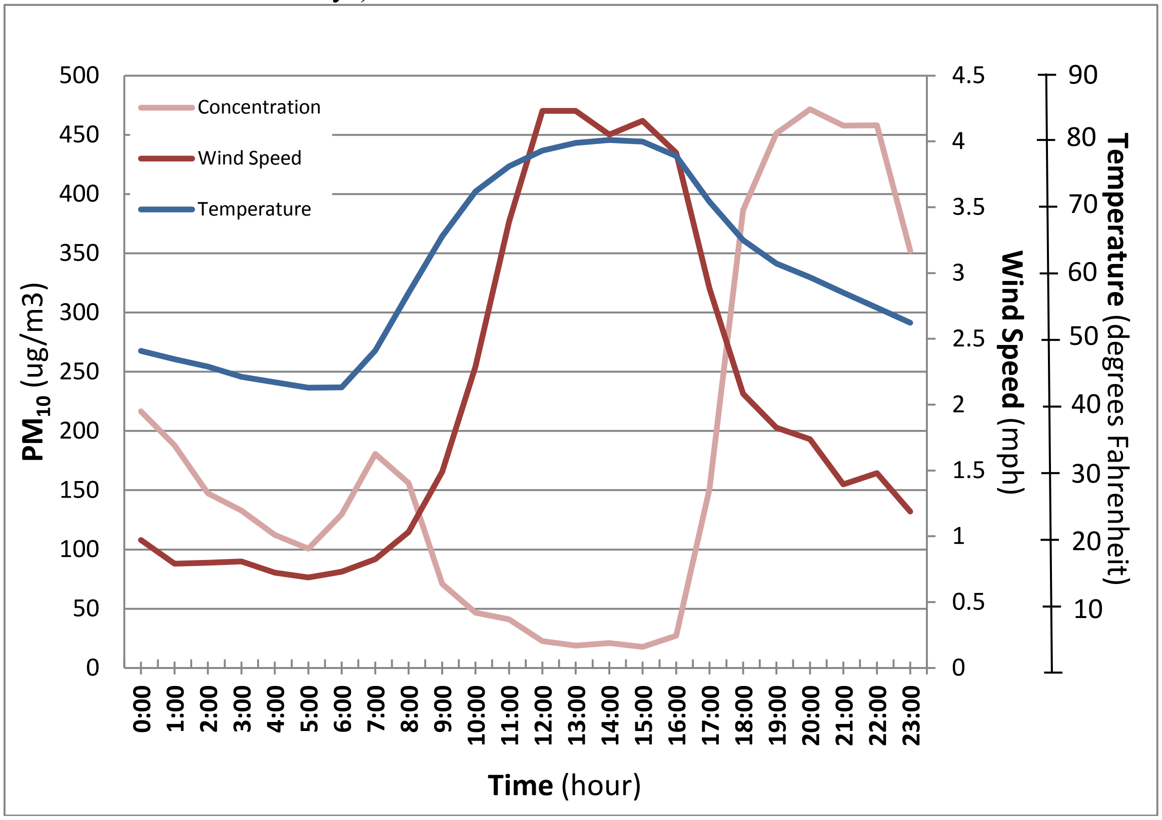


3.3 Pattern and Timing of Exceedances

3.3.1 Composite Day Using Aggregate Data

In Figure 14, a composite day is presented showing the average PM_{10} concentration, wind speed, and temperature for each hour at the Nogales, Arizona Post Office FEM monitor across all 2007 - 2009 exceedances, excluding the previously identified study days (January 1, 2007, May 22, 2008, and January 1, 2009).

Figure 14: Average hourly PM_{10} concentration, wind speed, and temperature at the Nogales, Arizona Post Office FEM monitor versus time of day for all exceedances, excluding January 1, 2007, May 22, 2008, and January 1, 2009 (see section 3.4 for discussion of excluded days).



3.3.2 Diurnal Pattern

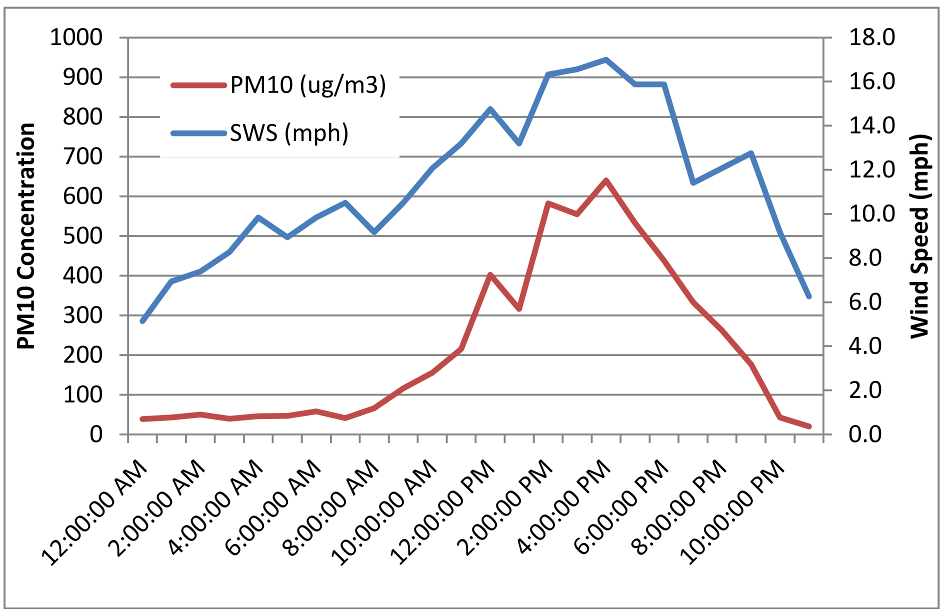
For the 26 exceedance days (29 exceedances, minus three study days), there is a strong pattern of decreasing PM_{10} concentrations in the early morning. The majority of days have a pronounced PM_{10} increase and drop-off between 6:00 am and 9:00 am, likely indicating a reproducible direct PM_{10} source, with the times generally corresponding to a morning commute pattern and mobile source impacts (the example day, November 16, 2008, does not show this morning increase, which may be attributable to being a Sunday, with a less pronounced morning commute). The PM_{10} concentrations then reach their lowest points between 10:00 am and 4:00 pm, with corresponding increases in temperature and wind speed observed during those times. A pronounced spike in PM_{10} concentration is then observed beginning between 4:00 pm and 6:00 pm, with concentrations remaining high for a couple of hours and gradually dropping off towards midnight. The afternoon spike in PM_{10} concentrations correlates with to a significant drop in temperature, drop in wind speed, and generally a shift to variable/calm southerly (out of the south) winds. This is illustrated in Table 4, for November 16, 2008, where the spike in PM_{10} concentration observed at 5:00 pm corresponds to a shift in wind from 70 degrees (out of the east northeast) to 141 degrees (out of the southeast) and a corresponding continuous, although slight, drop in wind speed between mid-day and evening.

3.4 Study Days

3.4.1 May 22, 2008

The PM_{10} diurnal pattern for May 22, 2008 varies substantially from the other twenty-six exceedance days, with a pronounced spike in the early afternoon. PM_{10} concentrations peak around 4:00 pm with corresponding wind speeds of 17 mph. May 22, 2008 is the only exceedance day associated with elevated winds and, as noted above, several monitors throughout the Region measured PM_{10} exceedances on the previous day during periods of elevated winds.

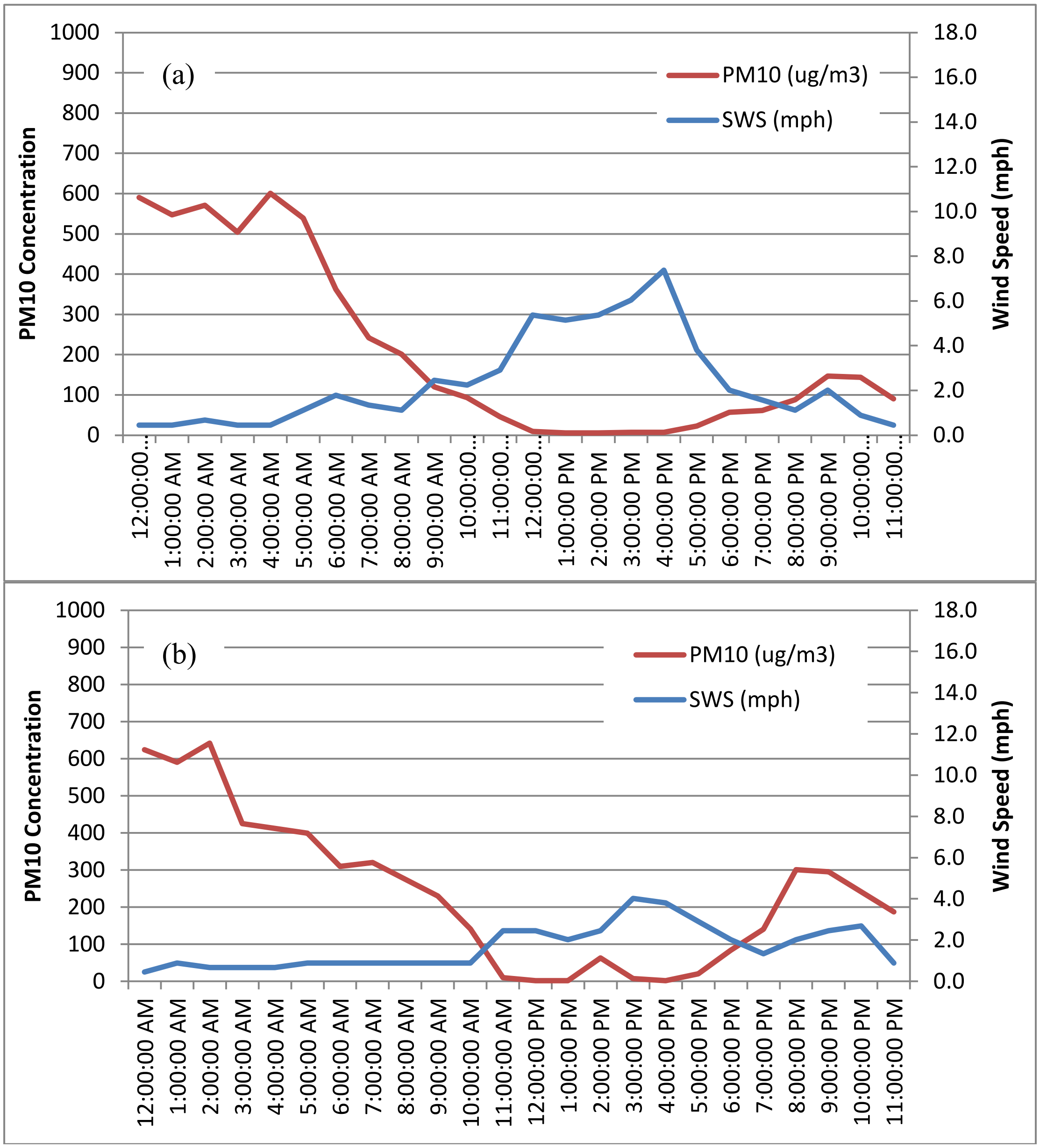
Figure 15: Hourly PM_{10} concentrations and wind speed at the Nogales, Arizona Post Office FEM monitor versus time for May 22, 2008.



3.4.2. January 1, 2007 and January 1, 2009

As noted above, the PM_{10} diurnal pattern for January 1, 2007 and January 1, 2009, varies significantly from the other twenty-six exceedance days, with higher early morning PM_{10} concentrations contributing more strongly to the high 24-hour average. In both cases, the diurnal pattern after mid-day looks similar to other days, with an increase in hourly PM_{10} concentrations at 6:00 pm (although less pronounced than other exceedance days).

Figure 16: Hourly PM_{10} concentrations and wind speed at the Nogales, Arizona Post Office FEM monitor versus time for (a) January 1, 2007 and (b) January 1, 2009.



3.4.3 Consideration of December 24, 2007 and December 31, 2008

Both December 24, 2007 and December 31, 2008 are notable because they are holidays. These two days are do not have distinctly different diurnal patterns, since their diurnal PM_{10} concentrations closely match the patterns of other days with an afternoon increase in PM_{10} beginning after 4:00 pm. Both days are notable for their later spikes in PM_{10}, however, late spikes in PM_{10} concentration are observed on other non-holiday exceedance days, such as March 6, 2007.

3.5 Local Topography and Landscape

Elevations in the Ambos Nogales area are highest just south of Nogales, Sonora and decrease from south to north towards Tucson as the watershed of the Nogales Wash proceeds north to the Santa Cruz River. The mean elevation in Nogales, Sonora is 4,265 feet.[9] At 5,380 feet, the highest elevation area in Nogales, Sonora is in the Cerro de los Nogales (Nogales Hill), west of where the Obregón and Colosio routes meet, near the southernmost end of the city. The City of Nogales, Arizona lies 3,865 feet above sea level. Nogales, Arizona rests in the Nogales Wash between the two mountain ranges, the Pajarito and Atascosa Mountains about seven miles west and the Patagonia Mountains roughly thirteen miles east. Figures 1 and 2 provide a general overview. Below, Figure 17 provides a topographical view looking southeast towards Nogales, Sonora from an elevated viewpoint northwest of Nogales, Arizona.

Figure 17, shows the urban outline of Nogales, Sonora overlying a topographical representation of the area. The Alvaro Obregón Boulevard runs the length of the Nogales Wash valley and is depicted in the figure as the longest yellow roadway running from the top right corner of the figure to the lower center of the figure at the international border (red line from running upper left to lower right) to connect with Business Interstate 19. There are four red markers in the figure: the two square red markers show the location of the Nogales, Arizona and Nogales, Sonora PM_{10} monitor sites; and, the two small circular markers show the location of the city centers of Nogales, Arizona and Nogales, Sonora. These four markers are also shown in Figures 18 and 19.

In general, the urban area of Nogales, Sonora follows the elevation contours of the southern Nogales Wash, as opposed to a grid or square. Looking at the general topography depicted in Figure 17 (northwest perspective), there is a funnel created as the Nogales Wash falls from the higher elevations to the international border along the route of the Alvaro Obregón Boulevard and to Nogales, Arizona. Small side canyons extend off of the Nogales Wash bottom and into the hills surrounding hills the Nogales, Sonora city center, and to a lesser extent into Nogales, Arizona as elevations drop moving south to north.

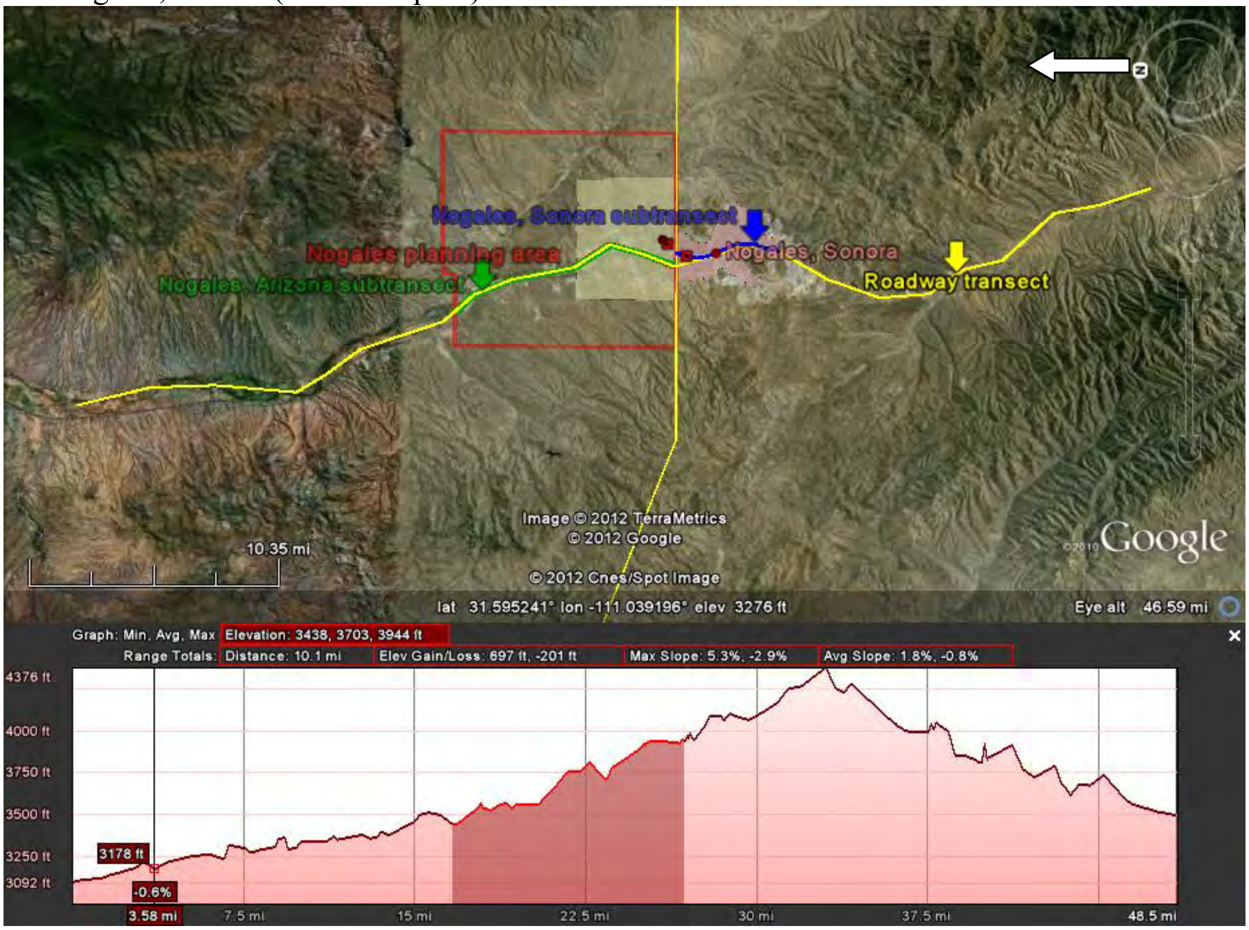
[9] "Statistical Municipal Workbook for Nogales, Sonora," 2005 edition, INEGI.

Figure 17: Elevated Topographical View of Ambos Nogales Area from Northwest Perspective, Nogales, Sonora Highlighted and International Border in Red Line.

To examine the local topography, within Figure 18, we ran a long south to north transect starting outside of the Nogales Wash watershed and extending northward to the Santa Cruz River (see the yellow arrow and line running right to left in Figure 18). A Nogales, Sonora subtransect is depicted by the blue arrow and line running to the vertical yellow line representing the international border. A Nogales, Arizona subtransect is depicted by the green arrow and line running from the international border to the northern edge of the Nogales NAA. The shaded area in the elevation graph below the aerial picture depicts the elevation change from the international border to the northern boundary of the Nogales NAA when following the green line in the aerial picture.

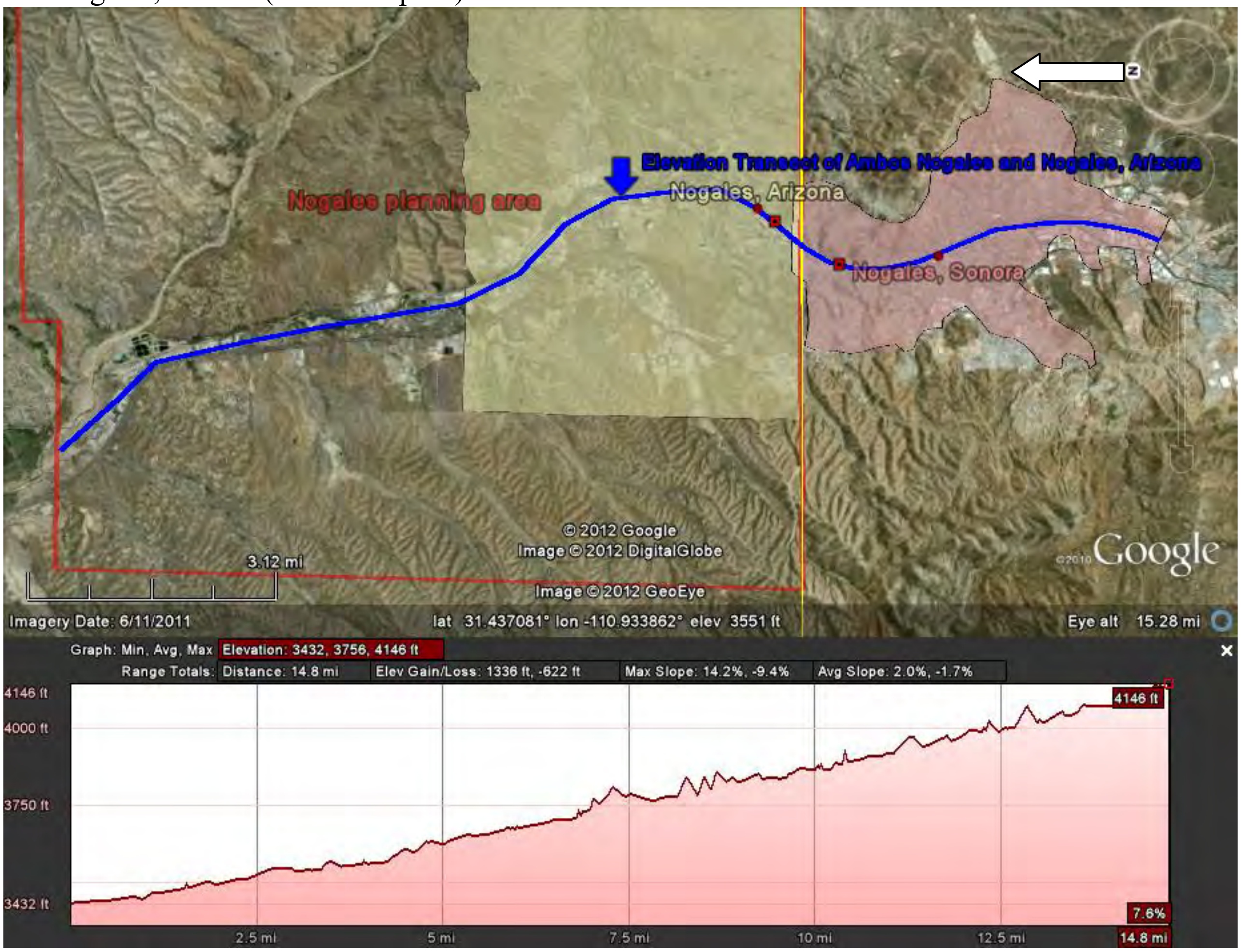
From south to north, the highest elevation of the long roadway transect is 4,331 feet at the southern edge of Nogales, Sonora, falling to the international border at 3,933 feet, continuing to the northern edge of the Nogales, Arizona PM_{10} nonattainment area at 3,425 feet. The elevation continues to fall to approximately 3,100 feet along the Santa Cruz River watershed to the north. From the 4,331 feet high point in the transect, the elevation falls approximately 1200 feet from south to north across 34 miles.

Figure 18: Long Aerial and Elevation Transect of Nogales Arizona (shaded in yellow) and Nogales, Sonora (shaded in pink).



In Figure 19, a short subtransect is depicted by combining the blue and green lines in Figure 18 to form the blue line in Figure 19. Two sections of this subtransect also shows elevation declines on a south to north axis. The Nogales, Sonora section of the subtransect, shown from right to center, has an elevation drop of 201 feet over 4.8 miles to the international border (vertical yellow line), starting at the Nogales, Sonora urban boundary at 4,134 feet and dropping to 3,933 feet. The Nogales, Arizona section of the subtransect, shown from center to left, has an elevation drop of 508 feet over 10 miles from the international border to the northern boundary of the Nogales NAA (vertical red line), starting at 3,933 feet and dropping to 3,425 feet.

Figure 19: Short Aerial and Elevation Transect of Nogales, Arizona (shaded in yellow) and Nogales, Sonora (shaded in pink).



3.6 Analyses of Wind Direction and PM_{10} Concentration

In addition to the pollution roses in Figures 11 and 12, three analyses were performed to examine the relationship between PM_{10} concentration and wind direction. The first analysis examined the percentage of the total observed 24-hour concentrations attributed to a given wind direction quadrant. The second analysis sorted hourly observed PM_{10} concentrations greater than 150 $\mu g/m^3$ into 100 $\mu g/m^3$ bins and determined the percentage of hourly observations associated with each wind speed quadrant. The third analysis averaged the observed PM_{10} concentration associated with winds from the south versus all other directions for each exceedance day.

In the first analysis, a weighted analysis of hourly concentration on exceedance days, excluding study days, January 1, 2007; May 22, 2008; and January 1, 2009, was performed to illustrate the percent of the total observed 24-hour concentration that is attributable to winds out of specific directional quadrants: northerly (315 degrees to 44 degrees), easterly (45 degrees to 134 degrees), southerly (135 degrees to 224 degrees), and westerly (225 degrees to 314 degrees). The analysis was performed by summing concentration data for observations corresponding to wind speeds in a given quadrant (equivalent to the sum of concentrations times time, in this case a one-hour increment) and dividing by the sum of all concentrations (again, equivalent to the sum of concentrations times one-hour increments). Interpretation of this analysis has substantial uncertainty, given the extremely low and variable wind speeds observed for the majority of high PM_{10} concentration hours; nonetheless, the analysis illustrates broad directional correlations over the exceedance days. The complete analysis can be found in the file *Nogales PM10 – Concentration and Met Analysis.xlsx*. Table 5 (below) gives the percentage of observed PM_{10} concentrations attributable to each wind direction quadrant for all days, all exceedance days excluding the three study days, and all non-exceedance days.

Table 5: Percentage of observed PM_{10} concentrations attributable to wind direction; January 1, 2007, May 22, 2008, and January 1, 2009 are excluded from the analysis of exceedance days (see Section 3.4 for discussion of "study days.").

Ambient Data Sample	Northerly (315 - 44°)	Easterly (45 - 134°)	Southerly (135 - 224°)	Westerly (225 - 314°)
All Days in 2007 - 2009	11%	16%	63%	10%
Non-Exceedance Days	11%	16%	61%	10%
Exceedance Days (minus three study days)	7%	10%	80%	3%

On all days, a large percentage (63 percent) of PM_{10} concentration is attributable to winds out of the south, which is expected given the high frequency of winds from the south (see the windroses in Figures 8-10), regardless of any other consideration of differences in population and emissions sources by wind direction. On exceedance days, the percentage of measured PM_{10} concentrations increases significantly, to approximately 80 percent attributable to winds from the south. This is consistent with the analysis presented above, where high afternoon PM_{10} concentrations on the exceedance days, excluding study days, was largely attributable to variable/slow winds out of the south. This also is consistent with the assertion that 24-hour PM_{10} concentrations observed on these days may not have exceeded the NAAQS if winds had not been out of the south.

In the second analysis, hourly PM_{10} concentrations above 150 $\mu g/m^3$ were grouped by increasingly higher 100 $\mu g/m^3$ increments to determine which wind quadrant the highest ambient values were correlated with for all exceedance days.

Table 6: Hourly ambient PM_{10} concentrations sorted by concentration and wind direction, 2007 - 2009 exceedance days.

	Range of Ambient Concentration Values (microgram/m^3)						
Wind Direction Quadrant	< 150	150 - 250	250 - 350	350 - 450	450 - 550	>= 550	Share of All Wind Direction Observations
Northerly NW to NNE	27%	6%	3%	3%	3%	0%	17%
Easterly NE to ESE	15%	16%	16%	11%	3%	8%	14%
Southerly SE to WSW	41%	71%	72%	84%	92%	92%	57%
Westerly SW to WNW	18%	6%	8%	3%	3%	0%	12%
Total	100 %	100%	100%	100%	100%	100%	100%

As shown in Table 6, the largest proportions of hourly values above 150 μg/m^3 in each ambient value increment are from the southerly wind direction quadrant. Also, the proportion of high ambient values in each concentration increment observed for the southerly quadrant exceed this quadrant's share of all wind direction observations by 14 to 35 percent. In contrast, the proportion of high ambient values in each concentration increment for the other three wind direction quadrants are approximately equal to or less than their respective overall share of wind direction observations. The complete analysis can be found in the file *Nogales PM10 – Concentration and Met Analysis.xlsx*.

In the third analysis, for each of the exceedance days, PM_{10} concentrations for hours associated with wind direction from the south (135 - 224 degrees) and all other directions (0 -134 degrees and 225-359 degrees) were averaged separately, with the results presented in Table 7. For one of the days, May 22, 2008, winds were entirely out of the southerly direction; therefore, no average concentration is calculated for the other direction assignment.

Table 7: Average PM_{10} concentration for hours associated with wind direction from the south (135 - 224 degrees) versus all other directions for all exceedance days.

Date	24-hour Concentration	Southerly Wind Quadrant Concentration (135 to 224 degrees)	All Other Wind Direction Concentration (225 to 134 degrees)	Concentration Ratio of Southerly Wind Quadrant to Other Wind Directions
1-Jan-2007	210	199	231	0.86
6-Feb-2007	180	228	100	2.28
6-Mar-2007	157	265	66	4.02
15-Mar-2007	175	360	65	5.54
19-Oct-2007	189	335	43	7.79
27-Oct-2007	210	301	133	2.26
2-Nov-2007	211	278	79	3.52
3-Nov-2007	170	213	128	1.66

4-Nov-2007	170	183	148	1.24
6-Nov-2007	186	209	119	1.76
18-Nov-2007	167	277	38	7.29
19-Nov-2007	177	216	63	3.43
28-Nov-2007	167	278	75	3.71
24-Dec-2007	233	368	45	8.18
26-Jan-2008	204	257	182	1.41
27-Feb-2008	166	251	66	3.80
18-May-2008	169	356	57	6.25
22-May-2008	217	217	No values observed	---
26-Oct-2008	156	219	53	4.13
31-Oct-2008	159	245	74	3.31
1-Nov-2008	234	369	76	4.86
8-Nov-2008	167	197	79	2.49
16-Nov-2008	171	273	69	3.96
17-Nov-2008	206	297	27	11.00
20-Nov-2008	161	225	56	4.02
22-Nov-2008	179	245	102	2.40
31-Dec-2008	155	163	117	1.39
1-Jan-2009	238	323	119	2.71
16-Jan-2009	204	247	119	2.08

Given that emissions and meteorological conditions may change throughout the day and we lack a continuous data stream of observations, this analysis examines whether it is possible that an exceedance would have occurred due to winds from directions other than from the southern quadrant. On two days, January 1, 2007 and January 26, 2008, average values from both the southern and all other wind quadrants exceed 150 $\mu g/m^3$, although on January 26, 2008, average concentrations from the southern quadrant remains higher than the other directions. It should be noted that winds on all of these days, especially during periods of high concentration, were slow and variable. As such, it is possible that ambient concentrations came into the area from one direction and persisted as the wind direction changed.

3.7 Estimated 24-Hour Average Concentrations for Nogales NAA Under Meteorological Conditions Contributing to International Transport

In this analysis, each hourly concentration value from the 29 exceedance days in the 2007 - 2009 study period was classified based on the likely influence from Mexico according to four criteria or decision rules. An hourly concentration value so classified was then weighted by 0.36, representing the maximum proportion of Nogales NAA emissions compared to the total Ambos Nogales regional emissions and equivalent to assuming a 36 percent contribution from U.S. sources during those hours. Then, a 24-hour average concentration was recalculated to determine what concentration would have occurred but for international transport of PM_{10} emissions from Nogales, Sonora.

To begin, we classified each hour of the 29 exceedance days based on the likelihood of significant international transport. An hourly concentration value was classified as influenced by international transport if it met one the following four criteria or decision rules related to hourly observations of wind direction, wind speed, and temperature change:

1) hours with sustained (more than one hour consecutively) southerly winds greater than 4.5 mph (two meters/second (m/s));

2) hours with southerly winds or air flow and decreasing or stable temperatures preceded by <u>or</u> followed by hours with similar conditions, suggesting sustained down slope air flows from higher elevations south of the international border;.

3) any hour preceded by <u>and</u> followed by hours with southerly wind or air flow and decreasing or stable temperatures, suggesting continued influence of down slope air flow from higher elevations south of the international border; and,

4) surface wind speed less than or equal to 1.1 mph (0.5 m/s), preceded by or followed by hours with similar conditions, suggesting sustained air mass stagnation where PM_{10} emissions suspended in previous hours remain suspended in the stagnant air mass.

The first rule identifies periods consistent with sustained high winds from the south carrying wind-blown dust, as discussed earlier concerning the May 22, 2008 exceedance day. The second and third rules identify daily periods influenced by down slope wind flow conditions usually occurring in the late afternoon and evening, indicative of sustained down slope air flows from higher elevations south of the international border. The fourth rule identifies periods of sustained air mass stagnation usually found in the late night and early morning hours after the early evening down slope wind or air flow has ebbed and before sunrise, after which wind speeds begin to increase from their overnight low values.

The analysis of the Ambos Nogales emissions inventories concluded that U.S. sources are responsible for 18 - 36 percent of PM_{10} emissions in the Ambos Nogales region, per the 2008 emission inventory figures shown below.[10]

[10] For a complete discussion of the Ambos Nogales emission inventories, see Appendix A: 2008 and 2011 Emissions Inventory for Nogales NAA and Appendix B: 2008 and 2011 Emissions Inventories for the Nogales Municipality, Sonora, Mexico.

Table 8: 2008 PM_{10} Emission Inventories: Nogales NAA, Arizona and Nogales Municipality, Mexico (low estimate) (tons per year)

	PM_{10}	Percent
Nogales NAA, Arizona	1,531	36 %
Nogales Municipality, Mexico	2,713	64 %
Total	4,244	100 %

Table 9: 2008 PM_{10} Emission Inventories: Nogales NAA, Arizona and Nogales Municipality, Mexico (high estimate) (tons per year)

	PM_{10}	Percent
Nogales NAA, Arizona	1,531	18 %
Nogales Municipality, Mexico	6,987	82 %
Total	8,518	100 %

Therefore, for each hour that meets one of the four criteria listed above, instead of categorizing that hourly concentration as due entirely to Mexican sources on the basis of a single variable such as wind direction, a more conservative assumption is that 36 percent of the hourly concentrations may be due to contributions from U.S. emission sources. For this analysis, we weighted the observed hourly concentrations by 0.36 for each hour that meets any one of the four criteria listed above and used this hourly weighted concentration to estimate the 24-hour average concentration that would have occurred in the Nogales NAA but for international transport.

To show the effects of each decision rule, an estimated 24-hour concentration was calculated after the application of Rule 1, Rules 2 and 3, Rules 1 - 3, and Rules 1 - 4. The results are summarized below and provided in their entirety for all exceedance days in the table that follows.

- The application of Rule 1 only removes one day, May 22, 2008; leaving 28 days showing a concentration value greater than 150 $\mu g/m^3$.

- The application of Rules 2 and 3 removes 27 days; leaving January 1, 2007 and January 26, 2008 showing a concentration value greater than 150 $\mu g/m^3$; 196.8 $\mu g/m^3$ and 244.1 $\mu g/m^3$, respectively.

- The application of Rules 1, 2, and 3 again removes 27 days; leaving January 1, 2007 and January 26, 2008 showing a concentration value greater than 150 $\mu g/m^3$; 196.1 $\mu g/m^3$ and 244.1 $\mu g/m^3$, respectively.

- The application of Rules 1, 2, 3, and 4 removes 29 days; leaving no estimated days with a value greater than 150 $\mu g/m^3$.

Table 10: Estimated 24-hour Average PM_{10} Concentrations ($\mu g/m^3$) for 29 Exceedance Days Weighted According to Decision Rules for Mexican Influence

Date	Observed	Rule 1	Rules 2 & 3	Rules 1, 2, & 3	Rules 1, 2, 3, & 4
1/1/2007	210.9	210.1	196.8	196.1	104.3
2/6/2007	180.3	180.3	115.4	115.4	106.9
3/6/2007	157.1	157.1	79.4	79.4	66.3
3/15/2007	176.0	176.0	94.4	94.4	76.8
10/19/2007	189.1	189.1	88.5	88.5	72.4
10/27/2007	210.1	208.6	114.2	114.2	88.2
11/2/2007	211.5	210.6	105.7	104.8	90.9
11/3/2007	170.9	170.9	110.7	110.7	77.9
11/4/2007	170.2	167.5	118.5	117.1	70.1
11/6/2007	186.6	180.3	101.9	101.9	77.4
11/18/2007	167.5	167.5	78.2	78.2	64.8
11/19/2007	177.6	176.5	100.7	99.7	78.4
11/28/2007	167.1	167.1	116.0	116.0	93.6
12/24/2007	233.3	233.3	124.3	124.3	89.5
1/26/2008	204.1	204.1	204.1	204.1	97.0
2/27/2008	166.0	166.0	99.1	99.1	63.9
5/18/2008	169.3	169.3	105.8	105.8	88.7
5/22/2008	217.4	78.3	145.7	78.3	78.3
10/26/2008	156.9	156.9	78.6	78.6	58.8
10/31/2008	159.7	159.7	89.9	89.9	64.9
11/1/2008	234.8	234.8	112.3	112.3	99.2
11/8/2008	167.7	166.3	85.8	85.1	70.5
11/16/2008	171.0	171.0	76.1	76.1	72.5
11/17/2008	206.7	206.7	107.3	107.3	107.3
11/20/2008	161.3	161.3	91.1	91.1	69.0
11/22/2008	179.6	177.3	95.8	93.6	69.5
12/31/2008	155.7	153.0	79.4	76.6	67.4
1/1/2009	238.4	238.4	122.7	122.7	88.7
1/16/2009	204.4	204.4	118.6	118.6	82.6
Values > 150 $\mu g/m^3$	29	28	2	2	0

Considering the relatively large differences in emissions inventories in the Nogales NAA and Nogales, Sonora and the meteorology described by our conceptual model, it is likely that observed pollution during southerly down slope wind flows originating from Nogales, Sonora also contributed to observed pollution during following hours of sustained stagnation. With the wind direction varying under low wind speeds and stable temperatures, it remains possible, however, that a greater proportion of PM_{10} pollution during those hours of sustained stagnation may be coming from U.S. sources. Therefore, a slightly more conservative approach would be to relax our criteria by not considering sustained stagnation (Rule 4) and assign PM_{10} levels during these hours entirely to the Nogales NAA. Consequently, when we consider Mexican influence to only occur under conditions of relative high wind speeds (Rule 1) and sustained down slope wind flows from the south (Rules 2 and 3), two exceedance days would have been expected to occur but for international transport: January 1, 2007 and January 26, 2008. In conclusion, this analysis demonstrates that at least 27 of 29, and possibly all 29 exceedances of the PM_{10} NAAQS observed in the Nogales NAA during 2007 - 2009 can be attributed to sources of PM_{10} from across the international border.

The observed concentrations and meteorological data for each hour of each exceedance day, the hourly concentration classification based on the criteria listed above, and the re-calculation of the estimated 24-hour average concentrations based on the application of the four decision criteria are provided in the file *Nogales PM10 – Concentration and Met Analysis.xlsx*.

4.0 Discussion

4.1 Disparity in Observed Ambient Values

4.1.1 Differences between Nogales, Arizona Post Office FEM and FRM

As is shown in Tables 1 - 3, PM_{10} concentrations reported by the Nogales, Arizona Post Office FRM on exceedance days are always lower than PM_{10} concentrations reported by the co-located FEM. It is likely that the observed concentration differences are attributable to differences in monitoring methods, rather than quality assurance issues (see Section 2.3 for discussion of quality assurance review of these monitors). Data from the FEM, however, remains appropriate for comparison to the NAAQS.

4.1.2 Differences between Nogales, Arizona Ambient Values and Nogales, Sonora Ambient Values

As is shown in Tables 1 - 3 above and Table 11 below, within the three-year dataset, there were six days with both observed exceedances at the Nogales, Arizona Post Office FEM monitor and measurements at the Nogales, Arizona Post Office FRM and Nogales, Sonora Fire Station monitors. Observed concentrations at the Nogales, Sonora monitor are always lower than observed concentrations at the Nogales, Arizona Post Office FEM and, with one exception, lower than the observed concentrations at the Nogales, Arizona Post Office FRM. It is unlikely that the observed concentration differences are attributable to quality assurance issues (see Section 2.3), but it is possible that some of the differences in observed concentration could be attributable to differences in monitoring method.

Table 11: Six Exceedance Days Where Observations Exist for Nogales, Arizona Monitors and Nogales, Sonora Monitor: 24-hour concentrations ($\mu g/m^3$).

Date	24-hour Concentration At Nogales/AZ FEM BAM 1020 Monitor	24-hour Concentration At Nogales/AZ FRM Partisol Monitor	24-hour Concentration At Nogales/Mexico Dicot Monitor
27-Oct-2007	210	122	159
2-Nov-2007	211	190	170
18-May-2008	169	147	126
8-Nov-2008	167	155	119
20-Nov-2008	161	150	126
1-Jan-2009	238	Null	129

Examining the six days of observations across the Arizona and Mexican monitors using the hourly observations at the Nogales, Arizona, FEM monitor we find the following: five of six days are consistent with the diurnal pattern observed for majority of exceedances (26 out of the 29); concentrations from the southerly wind $\mu g/m^3$quadrant range from 197-356 $\mu g/m^3$; concentrations from all other wind quadrants range from 56 - 133 $\mu g/m^3$; and, the concentration ratios are consistent with our estimated pollution load ratios. See Table 12, below.

Table 12: Six Exceedance Days Where Observations Exist for Nogales, Arizona Monitor and Nogales, Sonora Monitor: Concentration Values Disaggregated by Southerly Wind Quadrant versus All Other Wind Directions ($\mu g/m^3$).

Date	Consistent With Observed Diurnal Pattern?*	24-hour Concentration At Nogales, AZ FEM Monitor	Southerly Wind Quadrant Concentration (135 to 224 degrees)	All Other Wind Directions Concentration (225 to 134 degrees)	Concentration Ratio of Southerly Wind Quadrant to All Other Wind Directions
27-Oct-2007	Yes	210	301 (11 of 24 values)	133	2.26
2-Nov-2007	Yes	211	278 (16 of 24 values)	79	3.52
18-May-2008	Yes	169	356 (9 of 24 values)	57	6.25
8-Nov-2008	Yes	167	197 (18 of 24 values)	79	2.49
20-Nov-2008	Yes	161	225 (15 of 24 values)	56	4.02
1-Jan-2009	Varies	238	323 (14 of 24 values)	119	2.71

* The diurnal pattern used for comparison is depicted in Figure 14 and is based on the 26 exceedance day hourly averages for ambient concentration, temperature and wind speed.

Also, we examined elevation differences between the Nogales, Sonora monitoring site and the Nogales, Arizona monitoring site to determine if a difference might account for some of the observed differences in concentration. The two sites varied by approximately 45 feet in elevation with the Nogales, Sonora monitor at the higher elevation of 3920 feet. Because we are unable to visit the Nogales, Sonora monitoring site, we are unable to evaluate further whether smaller scale and more local topographic effects may be enhancing the disparity in observed values.

4.2 Long Range Transport

As shown in Tables 1 to 3, on days that the Nogales, Arizona Post Office monitor is exceeding, there are no observed PM_{10} exceedances at the Green Valley, Arizona monitor, located between Nogales and Tucson, Arizona. On all days except May 22, 2008, the PM_{10} concentrations observed at the Green Valley monitor are very low and did not exceed 35 $\mu g/m^3$. Thus, it is unlikely that long range transport of PM_{10} is occurring from the direction of Tucson on those days (noting that for May 22, 2008, winds were entirely from the south and thus not from the direction of the Green Valley, Arizona monitor).

4.3 Local Sources Near Nogales, Arizona Monitor

We examined satellite and overhead photographs of an area within four kilometers surrounding the Nogales, Arizona Post Office monitoring site to determine if there were any local emission sources near enough to the monitor to greatly influence ambient PM_{10} values. The aerial photographs showed vehicle track-out on to paved roads, unpaved roads and drives, and disturbed surfaces in open areas in the area surrounding the monitor; especially in areas to the east and south. We observed a small materials loading and storage operation very near to the monitor. With only contemporaneous aerial photography, however, we cannot confirm how long this operation has existed at this site, or the timing, duration, and magnitude of its operations during our 2007 - 2009 analysis period.

4.4 Observations of Coarse Versus Fine Particulate Matter

Examining the ratio of PM_{10} to $PM_{2.5}$ on exceedance days versus all monitored days provided information on the relative importance of sources that emit coarse particles ($PM_{10-2.5}$) versus fine particles ($PM_{2.5}$) on those days. In addition to the Nogales, Arizona Post Office PM_{10} SPM-FEM, a $PM_{2.5}$ SPM-FEM is operated at the same site (with the same AQS ID: 04-023-0004, POC 3). Monitored values from both monitors are compared in the file *Nogales PM10 – Concentration and Met Analysis.xlsx*. For 2007 through 2009, the average PM_{10}:$PM_{2.5}$ ratio on all days with valid samples was 6.24 (standard deviation equals 2.89). For comparison, the PM_{10}:$PM_{2.5}$ ratio for exceedance days is given in Table 13.

Table 13: Twenty-four Hour PM_{10} and $PM_{2.5}$ concentrations ($\mu g/m^3$), and the ratio of observed PM_{10}:$PM_{2.5}$ on exceedance days at the Nogales, Arizona Post Office monitoring site (2007 - 2009).

Sample Date	**PM_{10}** (A)	**$PM_{2.5}$** (B)	**PM_{10}/$PM_{2.5}$** (A/B)
1/1/2007	210	141	1.49
2/6/2007	180	28	6.43
3/6/2007	No paired data available		
3/15/2007	No paired data available		

10/19/2007	189	22	8.79
10/27/2007	210	26	8.20
11/2/2007	211	28	7.62
11/3/2007	170	25	6.85
11/4/2007	170	23	7.33
11/6/2007	186	23	8.05
11/18/2007	167	19	8.70
11/19/2007	177	21	8.31
11/28/2007	167	23	7.20
12/24/2007	233	72	3.26
1/26/2008	204	36	5.70
2/27/2008	166	17	9.88
5/18/2008	169	21	8.13
5/22/2008	217	20	10.96
10/26/2008	156	20	7.88
10/31/2008	No paired data available		
11/1/2008	234	28	8.33
11/8/2008	167	23	7.42
11/16/2008	171	24	7.18
11/17/2008	206	24	8.58
11/20/2008	161	23	7.00
11/22/2008	179	28	6.39
12/31/2008	155	62	2.48
1/1/2009	238	142	1.67
1/16/2009	204	29	7.06

With the exception of the four holidays (January 1 and December 24, 2007; December 31, 2008; and January 1, 2009) the ratio of PM_{10} to $PM_{2.5}$ stays approximately the same or increases (noting a slight decrease to 5.7 on January 26, 2008, which is within a standard deviation of the average and could be considered as staying the same). On the four holidays, the ratio of PM_{10} to $PM_{2.5}$ decreases by more than a standard deviation from the average ratio, suggesting an increase in a source of fine particles, such as increased wood combustion. The ratio of PM_{10} to $PM_{2.5}$ increases by the greatest amount on May 22, 2008, which suggests that more coarse particles and/or different sources may be contributing to this exceedance.

4.5 Review of 2010 and 2011 Exceedance Days

For reasons discussed in Section 2.2, we chose 2007 - 2009 for our study period. Nonetheless, we evaluated whether the exceedance days in 2010 and 2011 were consistent with the diurnal pattern we observed for exceedance days in our 2007 - 2009 analyses. Also we did two analyses to determine if we would observe a contribution of high hourly ambient values from the southerly wind direction quadrant similar to what we observed over the 2007 - 2009 exceedance days.

For the monitoring data reported as of the time of this analysis, i.e., through the third quarter of 2011, there were seven reported PM_{10} exceedance days in 2010 and 2011: December 2, 3, 4, 5, 8, and 13, 2010; and September 23, 2011. Figures 20 and 21 show the hourly PM_{10} concentration and wind speed, respectively, for those seven days versus the average PM_{10} concentration and wind speed for the 2007 - 2009 exceedances (from Figure 14). Wind speed data for 2011 is not yet available; consequently, September 23, 2011 was not included in Figure 21.

Figure 20: Hourly PM_{10} concentrations at the Nogales, Arizona Post Office FEM monitor versus time of day for all exceedances between January 1, 2010 and September 30, 2011 compared to average PM_{10} concentrations from Figure 14 (2007 - 2009).

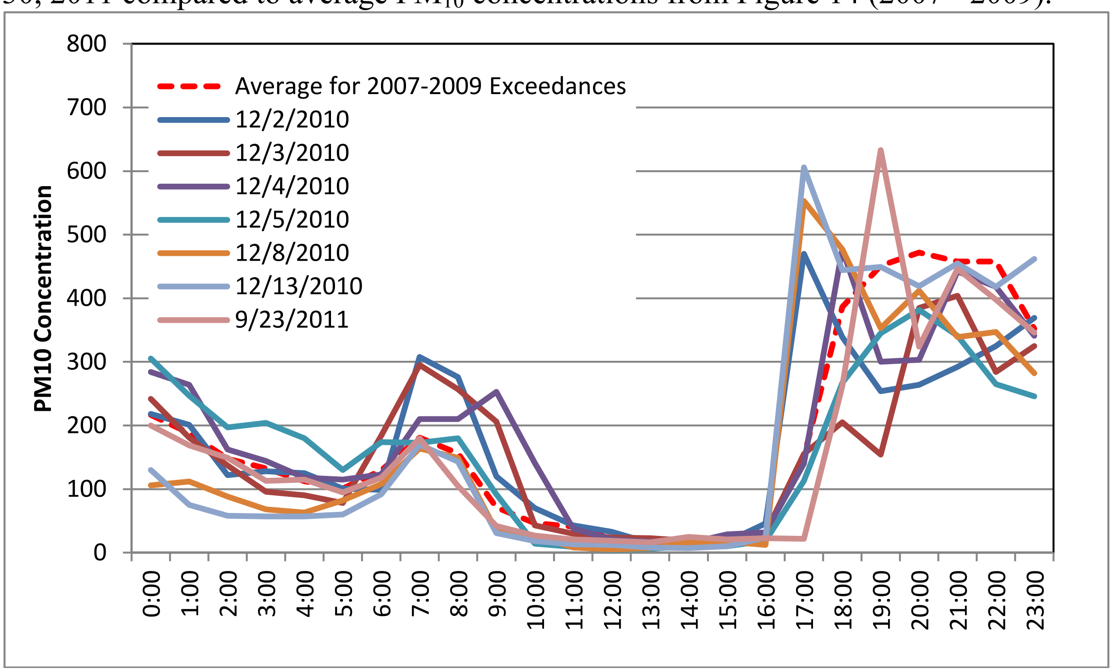
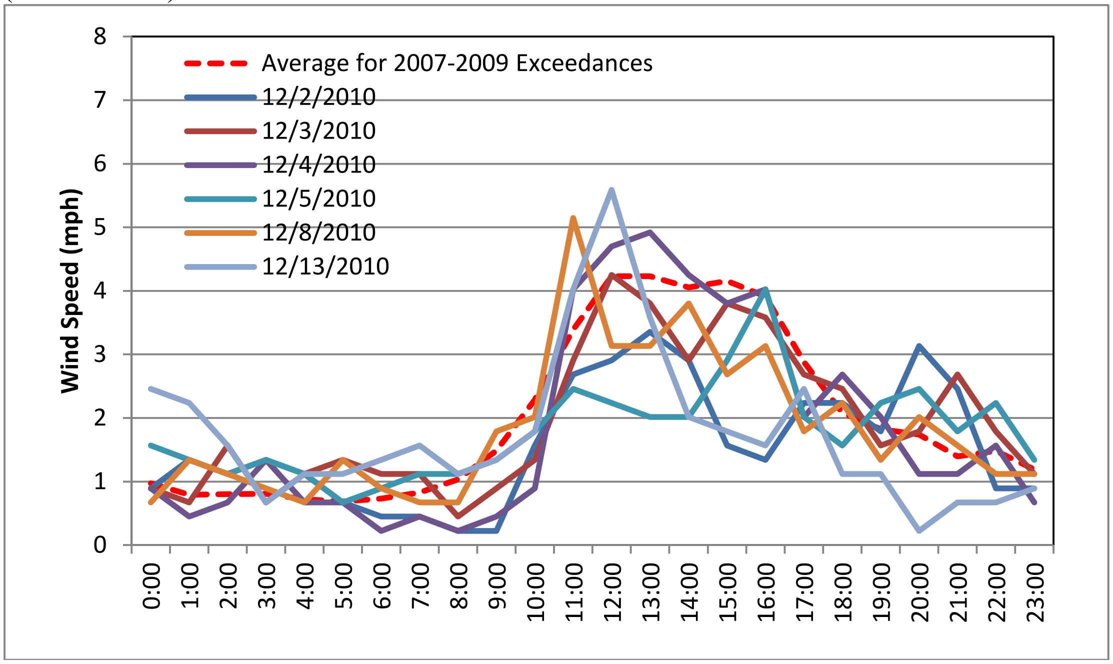


Figure 21: Hourly wind speed at the Nogales, Arizona Post Office FEM monitor versus time of day for all exceedances in 2010 compared to average wind speed from Figure 14 (2007 - 2009).



For the six 2010 exceedance days, we performed two additional meteorological analyses to determine if we would observe a contribution of high hourly ambient values from the southerly wind direction quadrant similar to what we observed over the 2007 - 2009 exceedance days. These analyses are similar to those described in Section 3.6 concerning hourly ambient concentrations and wind direction. Again, September 30, 2011 was not included in these analyses because wind speed and direction data are not yet available for 2011.

In the first analysis, on 2010 exceedance days, we determined that 87.6 percent of the observed 24-hour PM_{10} concentration is attributable to winds from the south, i.e., 135 - 224 degrees. The remainder of the 24-hour PM_{10} concentration is attributed to: east, 45 - 134 degrees, 5.9 percent; west, 225 - 314 degrees, 1.5 percent; and north, 315 - 44 degrees, 4.9 percent.

For the second analysis, we averaged the observed PM_{10} concentration associated with winds from the south versus all other directions for each exceedance day; see Table 14 below (comparable to Table 7 for 2007 - 2009). Only December 4, 2010 had an hourly average PM_{10} concentration above 150 $\mu g/m^3$ from directions other than southerly wind quadrant. A closer examination of hourly concentrations, wind speed, and wind direction on December 4, 2010, however, indicates that this is due largely to an anomaly of the mid-day low concentrations being attributable to southerly wind flow; an event not usually observed on most exceedance days. This results in the averaging of a relatively small number of hours for all other wind directions quadrant only during the high concentration, stagnant wind conditions in the early morning and late evening.

Table 14: Average PM_{10} concentration for hours associated with wind direction from the south (135 - 224 degrees) versus all other directions for 2010 exceedance days.

Date	24-hour Concentration	Southerly Wind Quadrant Concentration (135 to 224 degrees)	All Other Wind Direction Concentration (225 to 134 degrees)	Concentration Ratio of Southerly Wind Quadrant to Other Wind Directions
2-Dec-2010	177	188	57	3.33
3-Dec-2010	161	172	108	1.59
4-Dec-2010	191	184	215	0.86
5-Dec-2010	163	242	31	7.88
8-Dec-2010	159	245	40	6.19
13-Dec-2010	175	245	60	4.08

To conclude, the screening analysis of the seven reported exceedances between January 1, 2010 and September 30, 2011, shows that all of these exceedances are consistent with observed exceedances during the 2007 - 2009 period. Only December 4, 2010 potentially deviates from the majority of exceedance days. Again, we observed a small number of wind direction observations from the all other wind direction quadrants were associated with high PM_{10} concentrations, leading to an average 215 $\mu g/m^3$ PM_{10} concentration attributed to the non-southerly wind direction quadrants. However, even this exceedance is likely similar to the 2007 - 2009 observations and, with further analysis, may be attributable to emissions from Nogales, Sonora, Mexico. Therefore, the conclusions reached in the more sophisticated analysis of 2007 - 2009 exceedances are likely to be applicable to 2010 - 2011 exceedances as well, based on this screening analysis of the incomplete data during the later period.

5.0 Conclusions

From this review and analysis of the Nogales NAA ambient PM_{10} data, local meteorology, and topography, we draw the conclusions listed below.

- The majority of exceedances, 79 percent, occur in the October to January timeframe, mostly in November. Also, given the high desert environment and winter light regime, temperatures usually drop dramatically, 20 degrees Fahrenheit over the 3-4 hours after sunset.

- Elevations drop 709 feet over 14.8 miles across the south to north local transect we examined, from the southern boundary of Nogales, Sonora to the northern boundary of the Nogales NAA.

- Of the 29 exceedance days in 2007 - 2009, twenty-six of those days showed a similar pattern of ambient PM_{10} concentration, wind speeds, wind direction, and temperature variation over a twenty-four hour period; the three exceptions were January 1, 2007, May 22, 2008, and January 1, 2009.

- On exceedance days, the largest proportions, 71-92 percent, of hourly values exceeding 150 $\mu g/m^3$ and almost all of the highest observed PM_{10} concentrations, 92 percent of observations above 450 $\mu g/m^3$, are associated with a southerly wind direction.

- On all 29 exceedance days, the ambient PM_{10} concentration attributed to the southerly wind quadrant exceeds 150$\mu g/m^3$. In contrast, two exceedance days from the "all other wind direction" quadrants show a value greater than 150 $\mu g/m^3$: January 1, 2007, and January 26, 2008.

- Only one of 29 exceedance days shows a concentration attributed to the "all other wind direction" quadrants greater than that of the concentration attributed to the southerly wind quadrant: January 1, 2007.

- The average ratio of the southerly wind quadrant share of 24-hour ambient PM_{10} values to all other wind quadrants share of ambient values is 3.83 to one.

- Considering relative high wind speeds, sustained down slope wind flows from the south, and sustained air stagnation, an analysis of hourly concentration values shows that at least 27 of 29, and possibly all 29 exceedances of the PM_{10} NAAQS observed in the Nogales NAA during 2007 - 2009 can be attributed to sources of PM_{10} from across the international border. The two exceedance days that would have been expected to occur were January 1, 2007 and January 26, 2008.

- On most exceedance days, the ratio of PM_{10} to $PM_{2.5}$ increases or stays the same compared to the average ratio for all days in 2007 - 2009. The exceptions are four holidays where the ratio of PM_{10} to $PM_{2.5}$ on exceedance days decreases, indicating increased importance of a combustion source.

Appendix E
ADEQ Technical Support Document for Control Measure Emissions Reductions

This appendix contains ADEQ's Technical Support Document (TSD) and four supporting appendices. The TSD provides detailed explanation for estimated PM_{10} emissions reductions resulting from paving/double chip-sealing unpaved roads in the Nogales Nonattainment Area (Nogales NA). Appendix E.1 provides data used to estimate the number of annual vehicle miles traveled on applicable roads in the Nogales NA. Appendix E.2 includes paving/double chip-sealing documentation provided by Santa Cruz County. Appendix E.3 includes a map created by ADEQ using the latest geographic information systems (GIS) data to depict paved and unpaved roads in the Nogales NA that are not within Nogales' city limits, and ADEQ's estimated mileage for both road types. Appendix E.4 includes before and after aerial imagery of roads paved/double chip-sealed in the Nogales NA.

This page is intentionally blank.

Appendix E

ADEQ Technical Support Document for Control Measure Emission Reductions

E.1. Emissions Reductions from Roads Paved in Rio Rico, AZ from 2002-2008

When ADEQ submitted the 1993 SIP for the Nogales Nonattainment Area (NA), most roads in the portions of Rio Rico in the nonattainment area were paved, but the community grew at a steady pace from that point. From 1994-2001, Santa Cruz County double-chip sealed or paved approximately 40 miles of roads in Rio Rico, both in and near the Nogales NA.[1]

Santa Cruz County was able to provide records for 39.8 miles of roads chip sealed in Rio Rico between the years 2002-2008. Documentation provided by the County is in Appendix 2 of this document. Of these 39.8 miles of chip sealed roadways, 8.6 miles were found to be located within Rio Rico in the Nogales NA; Table E.1 includes the road names, year chip sealed, road length and mileage chip-sealed.

Table E.1
Road Mileage Chip Sealed in Rio Rico Since 2002

Roadway	Year Paved	Road Length [mi]*	Reported Mileage Paved **
Calle Arikara	2002	1.09	1
Paseo Mexico	2004	4.03	2.6
Calle Coyote- Annette Ct	2006	1.92	2
Paseo Guebabi	2006	2.70	3
	Total	**9.75**	**8.6**

* Calculated from aerial photography
**Provided by Santa Cruz County

To estimate the emission reductions provided by 8.6 miles of chip sealing in Rio Rico, ADEQ estimated Annual Average Daily Traffic (AADT) for unpaved roadways by using aerial photography of the region to digitize roadways and categorize them as paved or unpaved. The number of homes on each unpaved roadway was also determined from aerial photography. Utilizing U.S. Department of Transportation data, we estimated vehicle trips per household for the Rio Rico Area as 1981 trips per year. This was calculated using the following methodology:

$\mathbf{T_P}$ = Average Person trips by household = 3466 (U.S. Dpt. of Transportation, 2011, Table 5)
$\mathbf{T_V}$ = Average Vehicle trips by household = 2068 (U.S. Dpt. of Transportation, 2011, Table 6)

SF = Scaling Factor = T_V / T_P = 2068 / 3466 = 60%

Rio Rico CDP median household income = $43,805 (US Census State and County Quickfacts, median HH income for Santa Cruz County, Rio Rico CDP 2006-2010)

$\mathbf{T_{PHH}}$ = Person trips by household income = 3321 (U.S. Dpt. of Transportation, 2011, Table 8; per Rio Rico household income)

[1] Santa Cruz County is unable to locate chip sealing records for 1994-2002; ADEQ did receive written confirmation of the mileage estimation from County officials. See Appendix G – Supplementary Information

According to the U.S. Department of Transportation for a median income of $43,805 (median income of Rio Rico) the household has an income of 3321 trips per year.

Vehicle trips by household income = T_{PHH} * SF = 3321 * 60% = 1981

If we assume the national trips taken were approximately the same for the year 2008, we can estimate VMT for individual unpaved roads using the calculated vehicle trips by household by implementing the following methodology:

$$VMT_X = 0.5 * (L_X / 5280) * H_X * T_X$$

Where:

VMT_X = Vehicle Miles Traveled for a particular roadway, X [miles]
0.5 = Adjustment ratio to account for the location of houses along a road length and the distance needed to travel to exit the roadway. It is assumed that on average a vehicle must travel an average of one quarter of the road length before it exits the roadway and will make this trip 2 times (once upon leaving and once upon returning) to the residence.
L_X = Length of roadway X [ft]
5280 = conversion factor from feet to miles [ft/mile]
H_X = the number of homes located on roadway X
T_X = Average annual trips per household = 1981

Table E.2
Calculated VMT for Chip-Sealed Roadways in Rio Rico for 2009

Roadway	Road Length [mi]	Household Vehicle Trips Taken	Households	VMT
Calle Arikara	1.09	1981	21	22694
Paseo Mexico	4.03	1981	49	195774
Calle Coyote- Annette Ct	1.92	1981	46	65678
Paseo Guebabi	2.70	1981	63	168746
Total	**9.74**	**7924**	**179**	**452893**

Using the method outlined above, total VMT for unpaved roadways and chip-sealed roadways within the Rio Rico portion of the Nogales NA was found to be 968,460 miles (Appendix E.1) and 452,893 miles respectively (Table E.2). In order to calculate total PM_{10} emissions from unpaved roadways, ADEQ calculated unpaved road emission factors for a range of possible surface material silt contents within the Nogales NA using equations 1(b) and 2 from EPA AP-42 5th Ed. Volume 1 Chapter 13.2.2. A low surface material silt content value of 2.90% and a high surface material silt content value of 7.50% were utilized per EPA recommendation and based on the Mexican NEI (2004) and the Mexicali Emission Inventory (2005). These calculations are shown below:

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

Where:

E = PM_{10} emission factor (lb/VMT) = 0.248 lb/VMT (low value) & 0.642 lb/VMT (high value)

k = Empirical Constant = 1.8 lb/VMT (EPA AP-42 Chapter 13.2.2, 2006)
s = surface material silt content (%) = 2.90 % and 7.50 % (recommended by EPA and based on the Mexican NEI – 2004 and the Mexicali Emission Inventory - 2005).
M = surface material moisture content (%) = 5.23 % (No reliable surface soil moisture measurements are known for the area. Therefore, the average 2 inch depth soil moisture from Walnut Gulch, AZ NRCS Site # 2026 for the year of 2008 of 4.30% was adjusted for Nogales, AZ based on the average annual difference in rainfall between the two locations of 21.5% [Balling, 1988])
S = mean vehicle speed (mph) = 25 mph (Based on the typical unpaved road speed limit in Arizona)
a = Empirical Constant = 1 (EPA AP-42 Chapter 13.2.2, 2006)
c = Empirical Constant = 0.2 (EPA AP-42 Chapter 13.2.2, 2006)
d = Empirical Constant = 0.5 (EPA AP-42 Chapter 13.2.2, 2006)
C = 0.00047 lb/VMT (EPA AP-42 Chapter 13.2.2, 2006)

This emission factor was then corrected to only account for non-rainy days:

$$E_{est} = E\left[\left(365 - P\right)/365\right]$$

Where:

E_{est} = annual size-specific emission factor extrapolated for natural mitigation (lb/VMT) = 0.217 lb/VMT (low value) & 0.563 lb/VMT (high value)

E = the unadjusted emission factor = 0.248 lb/VMT (low value) & 0.642 lb/VMT (high value)
P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation = 45 days (EPA AP-42 Figure 13.2.2-1., 2006)

Using the above calculated emission factors of 0.217 lb/VMT and 0.563 lb/VMT, and the total VMT of 968,460 miles for all unpaved roadways in the Rio Rico portion of the Nogales NA, ADEQ calculated total emissions from unpaved roadways to be:

$$E_{Low} = VMT * E_{EST} / 2000 = \left(968{,}460\, miles\right) * \left(0.217 lb / VMT\right) / \left(2000 lb / ton\right) = \textbf{105 tons}$$
$$E_{High} = VMT * E_{EST} / 2000 = \left(968{,}460\, miles\right) * \left(0.563 lb / VMT\right) / \left(2000 lb / ton\right) = \textbf{273 tons}$$

Therefore, the total PM_{10} emissions from unpaved roads within the Rio Rico portion of the Nogales NA are estimated to be between 105 and 273 tons.

According to Santa Cruz County officials, a double layer of chip-seal was applied to the roadways in the Rio Rico portion of the Nogales NA listed in Table E.1. This type of paving has been estimated as having a control efficiency of approximately 90% if it is combined with paved shoulders, curbs and gutters (Engineering Science, 1987). In order to determine the PM_{10} emission reductions observed from the chip-sealing of the roadways previously mentioned, two separate methods of calculating emissions from chip sealed roadways are presented below. The two emission estimates differ in the control efficiency utilized for the chip-sealing with: *Method 1*) utilizing 90% control efficiency for chip-sealed areas and *Method 2*) utilizing a paved road emission factor for the chip-sealed areas where the paved road emission factor was calculated by utilizing Eq. 2 from AP 42: 13.2.1-5 (EPA, 2011).

METHOD 1 (M1)

Method 1 utilized 90% control efficiency for those roadways which have been chip-sealed. Table E.3 presents the calculated emissions from these roadways assuming no control measures were utilized (41 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and 107 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}High}$) and assuming all roadways were chip-sealed resulting in 90% control efficiency (4.1 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and 10.7 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}High}$). In those cases where the entire road length was not chip-sealed, VMT (and thus PM_{10} emissions) was adjusted for the percentage of roadway which was chip-sealed.

Table E.3
Calculated PM_{10} Emissions Assuming 90% Chip-Seal Efficiency

Roadway	VMT	Unpaved Emissions, Low [tons]	Unpaved Emissions, High [tons]	Chip-sealed Emissions, Low [tons]	Chip-sealed Emissions, High [tons]
Calle Arikara	22694	2.3	5.9	0.23	0.59
Paseo Mexico	195774	13.7	35.5	1.37	3.55
Calle Coyote-Annette Ct	65679	7.1	18.5	0.71	1.85
Paseo Guebabi	168746	18.3	47.5	1.83	4.75
Total	**452893**	**41.4**	**107.4**	**4.14**	**10.7**

METHOD 2 (M2)

Method 2 assumed double chip-sealed roadways would produce emission reductions to the same degree as asphalt paved roadways. Therefore, an emission factor was calculated for the paved roadways using Eq. 2 from AP 42: 13.2.1-5 (EPA, 2011). This calculation is shown below:

$$E = \left[k(sL)^{0.91} \times (W)^{1.02}\right]\left(1 - P/4N\right)$$

Where:

E = annual average emission factor = **0.000841 lbs/VMT**

k = particle size multiplier for particle size range and units of interest = 0.0022 lbs/VMT (Table 13.2.1-1. from AP-42, EPA 2011)
sL = road surface silt loading = 0.105 g/m^2 (Assumed to be comparable to an average silt loading value measured from local traffic roads in Table 3, page 28 of Phoenix Airshed Particulate Emissions study, Arizona State University 2006)
W = average weight of the vehicles traveling the road = 3 tons (Arizona State University 2006, pg. 27)
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period = 45 days (EPA AP-42 Figure 13.2.2-1., 2006)
N = number of days in the averaging period = 365 days

The calculated emission factor does not account for brake wear and tire wear emissions and thus, EPA's Motor Vehicle Emission Simulator (EPA MOVES2010a, 2009) was run for the year of 2008 for Santa Cruz County in order to estimate an emission factor for these processes at the county level. This emission factor was then added to the paved roadway emission factor above (0.000841 lbs/VMT). MOVES calculated an emission factor of 0.000220 lbs/VMT. When the 2 emission factors are summed a total emission factor of 0.00106 lbs/VMT is calculated for paved roads in the Nogales NA.

Table E.4 presents the emissions from these roadways assuming no control measures were utilized (41 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and 107 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}High}$) and assuming all roadways were chip-sealed with a paved road emission factor of 0.00106 lbs/VMT (0.202 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and $E_{EST\text{-}High}$). In those cases where the entire road length was not chip-sealed, VMT (and thus PM_{10} emissions) was adjusted for the percentage of roadway which was chip-sealed.

Table E.4
Calculated PM_{10} Emissions Assuming Paved Road Efficiency

Roadway	VMT	Unpaved Emissions, Low [tons]	Unpaved Emissions, High [tons]	Paved Road Emissions [tons]
Calle Arikara	22694	2.3	5.9	0.011
Paseo Mexico	195774	13.7	35.5	0.067
Calle Coyote-Annette Ct	65679	7.1	18.5	0.035
Paseo Guebabi	168746	18.3	47.5	0.089
Total	**452893**	**41.4**	**107.4**	**0.202**

From the results calculated in Methods 1 and 2 (Tables E.3 and E.4). We can assume that the application of chip-seal to the 5 roadways listed resulted in the reduction of PM_{10} emissions between 37.3 and 41.2 tons per year assuming low unpaved road silt content value of (2.90 %) and between 96.7 and 107 tons per year assuming a high unpaved road silt content value of (7.50 %). Conservatively, we can assume that chip-sealing the roadways reduced PM_{10} emissions within the region by 37.3 tons per year.

E.2. Emissions Reductions from Roads Paved in Nogales, AZ from 1987-1996

During analysis of aerial photography of the Nogales, AZ portion of the Nogales NA, ADEQ determined 11 roadways had been chip sealed between the years of 1992 and 1996. Those roadways identified are presented in Table E.5. PM_{10} emissions reductions due to the paving of these roadways are presented in this section. ADEQ did not include this measure to demonstrate attainment in the 1993 Nogales NA SIP; therefore, ADEQ is identifying this chip sealing as a control measure implemented in the Nogales NA.

Table E.5
Road Mileage Paved in Nogales Prior to 1996

Roadway	Year Paved	Road Length [mi]*
Royal Rd	92-96	0.9
Vista del Cielo	92-96	2.2
Hohokam	92-96	.17
La Quinta	92-96	.75
Yucca Drive S.	92-96	2.0
Bristol Dr	92-96	.40
Target Range Rd	92-96	0.2
Frank Reed Rd	92-96	.95
Kino Rd	92-96	.28
Kelsey Rd	92-96	.27
West 1st St	92-96	.32
	Total	**8.4 Miles**

* Calculated from aerial photography

To estimate the emission reductions provided by 8.4 miles of chip sealing in Nogales, Arizona, ADEQ estimated Annual Average Daily Traffic (AADT) for unpaved roadways by using aerial photography of the region to digitize roadways and categorize them as paved or unpaved. The number of homes on each unpaved roadway was also determined from aerial photography. Utilizing 2009 U.S. Department of Transportation data, we estimated vehicle trips per household for the Nogales Area as 1712 trips per year. This was calculated using the following methodology:

$\mathbf{T_P}$ = Average Person trips by household = 3466 (U.S. Dpt. of Transportation, 2011, Table 5)
$\mathbf{T_V}$ = Average Vehicle trips by household = 2068 (U.S. Dpt. of Transportation, 2011, Table 6)

SF = Scaling Factor = T_V / T_P = 2068 / 3466 = 60%

Nogales, AZ median household income = $29,442 (US Census State and County Quickfacts, median HH income for Nogales (City), 2010)

$\mathbf{T_{PHH}}$ = Person trips by household income = 2,854 (U.S. Dpt. of Transportation, 2011, Table 8; per Nogales household income)

According to the U.S. Department of Transportation for a median income of $29,442 (median income of Nogales) the household has an income of 2,854 trips per year.

Vehicle trips by household income = T_{PHH} * SF = 2854 * 60% = 1,712

If we assume the national trips taken were approximately the same for the year 2008, we can estimate VMT for individual unpaved roads using the calculated vehicle trips by household by implementing the following methodology:

$$VMT_X = 0.5 * (L_X / 5280) * H_X * T_X$$

Where:

VMT_X = Vehicle Miles Traveled for a particular roadway, X [miles]
0.5 = Adjustment ratio to account for the location of houses along a road length and the distance needed to travel to exit the roadway. It is assumed that on average a vehicle must travel an average of one quarter of the road length before it exits the roadway and will make this trip 2 times (once upon leaving and once upon returning) to the residence.
L_X = Length of roadway X [ft]
5280 = conversion factor from feet to miles [ft/mile]
H_X = the number of homes located on roadway X
T_X = Average annual trips per household = 1712

Table E.6
Calculated VMT for Chip-Sealed Roadways in Nogales Prior to 1996

Roadway	Road Length [mi]	Household Vehicle Trips Taken	Homes	VMT
Royal Rd	0.9	1,712	21	16178
Vista del Cielo	2.2	1,712	85	160072
Yucca Drive S.	2	1,712	8	13696
Bristol Dr	0.4	1,712	23	7875
Frank Reed Rd	0.95	1,712	77	62616
Kino Rd	0.28	1,712	16	3835
Kelsey Rd	0.27	1,712	27	6240
West 1st St	0.4	1,712	20	6848
		Total	**257**	**277360**
Roadway	**Road Length [mi]**	**AADT**		**VMT**
Target Range Rd	0.2	6468		1294
		Total		**278654**

Using the method outlined above, total VMT for residential chip-sealed roadways within Nogales was found to be 277,361 miles. Three other roadways were also identified as being chip sealed within Nogales. These roadways are listed below:

1. Hohokam Dr - Public Roadway (Commercial)
2. La Quinta Rd - Industrial Roadway
3. Target Range Road – Public Roadway (Commercial/Residential)

Due to incomplete AADT datasets for this region, only an AADT for Target Range Rd could be identified (6468). No AADT data was available for Hohokam Dr and La Quinta Rd. Since these roadways were commercial/industrial roadways, AADT could not be estimated in the same manner as the residential roadways. For these reasons, VMT was not calculated for Hohokam Dr. and La Quinta Rd. VMT calculation for Target Range Road can be accomplished by multiplying AADT by road segment length (0.2 miles) resulting in a VMT of 1294.

In order to calculate total PM_{10} emissions from unpaved roadways, ADEQ calculated unpaved road emission factors for a range of possible surface material silt contents within the Nogales NA using equations 1(b) and 2 from EPA AP-42 5th Ed. Volume 1 Chapter 13.2.2. A low surface material silt content value of 2.90% and a high surface material silt content value of 7.50% were utilized per EPA recommendation and based on the Mexican NEI (2004) and the Mexicali Emission Inventory (2005). These calculations are shown below:

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

Where:

E = PM_{10} emission factor (lb/VMT) = 0.248 lb/VMT (low value) & 0.642 lb/VMT (high value)

k = Empirical Constant = 1.8 lb/VMT (EPA AP-42 Chapter 13.2.2, 2006)
s = surface material silt content (%) = 2.90 % and 7.50 % (recommended by EPA and based on the Mexican NEI – 2004 and the Mexicali Emission Inventory - 2005).
M = surface material moisture content (%) = 5.23 % (No reliable surface soil moisture measurements are known for the area. Therefore, the average 2 inch depth soil moisture from Walnut Gulch, AZ NRCS Site # 2026 for the year of 2008 of 4.30% was adjusted for Nogales, AZ based on the average annual difference in rainfall between the two locations of 21.5% [Balling, 1988])
S = mean vehicle speed (mph) = 25 mph (Based on the typical unpaved road speed limit in Arizona)
a = Empirical Constant = 1 (EPA AP-42 Chapter 13.2.2, 2006)
c = Empirical Constant = 0.2 (EPA AP-42 Chapter 13.2.2, 2006)
d = Empirical Constant = 0.5 (EPA AP-42 Chapter 13.2.2, 2006)
C = 0.00047 lb/VMT (EPA AP-42 Chapter 13.2.2, 2006)

This emission factor was then corrected to only account for non-rainy days:

$$E_{est} = E\left[\left(365 - P\right)/365\right]$$

Where:

E_{est} = annual size-specific emission factor extrapolated for natural mitigation (lb/VMT) = 0.217 lb/VMT (low value) & 0.563 lb/VMT (high value)

E = the unadjusted emission factor = 0.248 lb/VMT (low value) & 0.642 lb/VMT (high value)
P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation = 45 days (EPA AP-42 Figure 13.2.2-1., 2006)

Using the above calculated emission factors of 0.217 lb/VMT and 0.563 lb/VMT, and the total VMT of 278,655 miles for public, chip sealed roadways in the Nogales, ADEQ calculated total emissions from unpaved roadways to be:

$$E_{Low} = VMT * E_{EST} / 2000 = (278{,}655 miles) * (0.217 lb / VMT) / (2000 lb / ton) = \mathbf{30.2\ tons}$$
$$E_{High} = VMT * E_{EST} / 2000 = (278{,}655\ miles) * (0.563 lb / VMT) / (2000 lb / ton) = \mathbf{78.4\ tons}$$

Therefore, the total PM_{10} emissions from public, chip sealed roadways in Nogales prior to paving are estimated to be between 30.2 and 78.4 tons.

A double layer of chip-seal was applied to those Nogales roadways listed in Table E.5. This type of paving has been estimated as having a control efficiency of approximately 90% if it is combined with paved shoulders, curbs and gutters (Engineering Science, 1987). In order to determine the PM_{10} emission reductions observed from the chip-sealing of the roadways previously mentioned, two separate methods of calculating emissions from chip sealed roadways are presented below. The two emission estimates differ in the control efficiency utilized for the chip-sealing with: *Method 1*) utilizing 90% control efficiency for chip-sealed areas and *Method 2*) utilizing a paved road emission factor for the chip-sealed areas where the paved road emission factor was calculated by utilizing Eq. 2 from AP 42: 13.2.1-5 (EPA, 2011).

METHOD 1 (M1)

Method 1 utilized 90% control efficiency for those roadways which have been chip-sealed. Table E.7 presents the calculated emissions from these roadways assuming no control measures were utilized (30.2 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and 78.4 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}High}$) and assuming all roadways were chip-sealed resulting in 90% control efficiency (3.02 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and 7.84 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}High}$).

Table E.7
Calculated PM_{10} Emissions Assuming 90% Chip-Seal Efficiency

Roadway	VMT	Unpaved Emissions, Low [tons]	Unpaved Emissions, High [tons]	Chip-sealed Emissions, Low [tons]	Chip-sealed Emissions, High [tons]
Royal Rd	16178	1.76	4.55	0.176	0.455
Vista del Cielo	160072	17.37	45.06	1.737	4.506
Yucca Drive S.	13696	1.49	3.86	0.149	0.386
Bristol Dr	7875	0.85	2.22	0.085	0.222
Frank Reed Rd	62616	6.79	17.63	0.679	1.763
Kino Rd	3835	0.42	1.08	0.042	0.108
Kelsey Rd	6240	0.68	1.76	0.068	0.176
West 1st St	6848	0.74	1.93	0.074	0.193
Target Range Rd	1294	0.14	0.36	0.014	0.036
Total	**278655**	**30.2**	**78.4**	**3.02**	**7.84**

METHOD 2 (M2)

Method 2 assumed double chip-sealed roadways would produce emission reductions to the same degree as asphalt paved roadways. Therefore, an emission factor was calculated for the paved roadways using Eq. 2 from AP 42: 13.2.1-5 (EPA, 2011). This calculation is shown below:

$$E = \left[k(sL)^{0.91} \times (W)^{1.02}\right]\left(1 - P/4N\right)$$

Where:

E = annual average emission factor = 0.000841 lbs/VMT

k = particle size multiplier for particle size range and units of interest = 0.0022 lbs/VMT (Table 13.2.1-1. from AP-42, EPA 2011)
sL = road surface silt loading = 0.105 g/m^2 (Assumed to be comparable to an average silt loading value measured from local traffic roads in Table 3, page 28 of Phoenix Airshed Particulate Emissions study, Arizona State University 2006)
W = average weight of the vehicles traveling the road = 3 tons (Arizona State University 2006, pg. 27)
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period = 45 days (EPA AP-42 Figure 13.2.2-1., 2006)
N = number of days in the averaging period = 365 days

The calculated emission factor does not account for brake wear and tire wear emissions and thus, EPA's Motor Vehicle Emission Simulator (EPA MOVES2010a, 2009) was run for the year of 2008 for Santa Cruz County in order to estimate an emission factor for these processes at the county level. This emission factor was then added to the paved roadway emission factor above (0.000841 lbs/VMT). MOVES calculated an emission factor of 0.000220 lbs/VMT. When the 2 emission factors are summed a total emission factor of 0.00106 lbs/VMT is calculated for paved roads in the Nogales NA.

Table E.8 presents the emissions from these roadways assuming no control measures were utilized (30.2 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and 78.4 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}High}$) and assuming all roadways were chip-sealed with a paved road emission factor of 0.00106 lbs/VMT (0.148 tons/yr PM_{10} emitted when utilizing $E_{EST\text{-}Low}$ and $E_{EST\text{-}High}$).

Table E.8 Calculated PM_{10} Emissions Assuming Paved Road Efficiency				
Roadway	**VMT**	**Unpaved Emissions, Low [tons]**	**Unpaved Emissions, High [tons]**	**Paved Road Emissions [tons]**
Royal Rd	16178	1.76	4.55	0.0086
Vista del Cielo	160072	17.37	45.06	0.0848
Yucca Drive S.	13696	1.49	3.86	0.0073
Bristol Dr	7875	0.85	2.22	0.0042
Frank Reed Rd	62616	6.79	17.63	0.0332
Kino Rd	3835	0.42	1.08	0.0020
Kelsey Rd	6240	0.68	1.76	0.0033
West 1st St	6848	0.74	1.93	0.0036
Target Range Rd	1294	0.14	0.36	0.0007
Total	**278655**	**30.2**	**78.4**	**0.148**

From the results calculated in Methods 1 and 2 (Tables E.7 & E.8). We can assume that the application of chip-sealing to the 9 roadways listed resulted in the reduction in PM_{10} emissions between 27.2 and 30.1 tons per year assuming low unpaved road silt content (2.90 %) and 70.6 and 78.3 tons per year assuming a high unpaved road silt content (7.50 %). Conservatively, we can assume that chip-sealing the roadways reduced PM_{10} emissions within Nogales, AZ by 27.2 tons per year.

Results

This Technical Support Document (TSD) presents control measures for the Nogales NA which are already implemented and calculates the resultant PM_{10} emission reductions of these measures. Between 1992 and 2008, 17.0 combined miles of roadway were chip sealed in the Rio Rico and Nogales portions of the Nogales NA. In this TSD, ADEQ presented 2 methods of calculating emission reductions for these chip sealed roadways, whereby emission reductions were calculated by: *Method 1*) Assuming chip sealing provides 90% control efficiency of emissions and *Method 2*) assuming chip sealing provides emissions rates equivalent to paving the roadways. Furthermore, emission rates were calculated for a range of surface silt contents between 2.9 % and 7.5 % to account for unknown and variable soil silt contents within the region. These calculations resulted in a range of PM_{10} emissions reductions for the Nogales NA (i.e. a combination of Rio Rico and Nogales emission reductions) of 64.5 - 71.3 tons/year assuming low surface soil silt content and 167 – 185 tons/year assuming high surface soil silt content for those areas surrounding the 14 chip sealed roadways identified in this study. Therefore, a conservative estimate of the emission reductions within the Nogales NA, due to chip sealing of these roadways, would be 64.5 tons/year.

REFERENCES

"2005 Mexicali Emissions Inventory", Final Report, February 27, 2009, Eastern Research Group, Inc. (ERG).

Arizona State University (ASU), 2006. A FIELD STUDY OF PARTICULATE EMISSIONS FOR MAJOR ROADWAYS IN THE PHOENIX AIRSHED Final Report 495.

Balling, R.C. 1988. The climatic impact of a Sonoran vegetation discontinuity. Climatic Change. 13(1): 99-109.

Engineering-Science. 1987. PM_{10} Emissions Inventory Data for the Douglas Planning Area. EPA Contract No. 68-02-3888.

"Mexico National Emissions Inventory, 1999: Six Northern States", Final, April 30, 2004, prepared by Eastern Research Group (ERG), Acosta Y Asociados, and Transengineering, for the Secretariat of the Environment and Natural Resources and the National Institute of Ecology of Mexico, the United States Environmental Protection Agency, the Western Governors'Association, and the North American Commission for Environmental Cooperation. (1999 Mexico NEI).

National Resource Conservation Service (NRCS), USDA. http://www.wcc.nrcs.usda.gov/nwcc/site?sitenum=2026&state=az. Site # 2026.

U.S. Department of Transportation, 2011. Summary of Travel Trends: 2009 National Household Travel Survey. http://nhts.ornl.gov/2009/pub/stt.pdf.

U.S. EPA., 1995. Compilation of air pollutant emission factors, Volume 1. AP 42, Fifth Edition, http://www.epa.gov/ttn/chief/ap42/index.html#toc.

U.S. EPA., 2009. Motor Vehicle Emission Simulator (MOVES) 2010 User Guide. EPA-420-B-09-041. http://www.epa.gov/otaq/models/moves/420b09041.pdf.

USGS. Binational Digital Soils Map of the Ambos Nogales Watershed, Southern Arizona and Northern Sonora, Mexico. Open-File Report 2004-1335.

Appendix E.1
Vehicle Miles Traveled Calculation

This appendix includes information used to calculate the emission reductions from double chip-sealing in the technical support document (TSD). ADEQ estimated the number of vehicle miles travelled (VMT) for roads in the Rio Rico portion of the Nogales NA with data provided by the following sources:

- double chip-sealed road lengths provided by Santa Cruz County
- the number of dwellings traveling on applicable paved roads was verified with aerial imagery
- the average number of trips per household per year was based on household income data for Rio Rico obtained from the 2010 U.S. Census

This page is intentionally blank.

Appendix E.1: VMT Calculation

Table A.1: This table presents individual roadway length, the number of houses observed on the roadway, and the average number of trips taken per household for the Rio Rico area of the Nogales NA. VMT is calculated by the product of these values multiplied by an adjustment ratio of 0.5 (average distance of each roadway travelled by residents) and divided by 5280 (conversion from feet to miles).

Roadway	Length (L) [ft]	Houses (H)	Trips/household (T)	VMT
Paseo Guebabi	14278	63	1981	168746
Paseo Mexico	21298	49	1981	195774
Calle Coyote	9008	38	1981	64217
River Rd	54910	31	1981	319323
Calle Arikara	5761	21	1981	22694
Circulo Tumbleweed	4442	15	1981	12500
Via Aloe Vera	4682	14	1981	12296
Camino Estrella	4891	13	1981	11928
Calle Cumpas	3587	11	1981	7402
Ceiba Ct	541	9	1981	913
Tala Ct	893	9	1981	1508
Ameca Ct	2817	8	1981	4228
Circulo Montana	24939	8	1981	37428
Circulo Mendez	1434	7	1981	1883
Annette Ct	1113	7	1981	1461
Gigi Ct	299	6	1981	336
Via Tecoripa	2115	6	1981	2380
Camino Estrella	4891	6	1981	5505
Campo Rd	1459	6	1981	1642
Padilla Ln	1128	6	1981	1270
Calle Ranuculo	2545	5	1981	2387
Cocula Ct	838	5	1981	786
Colmenar Ct	460	5	1981	432
Grillo Ct	475	5	1981	445
Batuc Ct	1131	5	1981	1061
Paseo Matamoros	7740	5	1981	7260
Calle Tepache	1089	5	1981	1021
Tuly Ct	264	5	1981	248
Corralitos Ln	906	5	1981	849
Via Dedal	1035	4	1981	776
Guaymas Ct	1360	4	1981	1021
Moneda Ct	212	4	1981	159
Lisboa Ct	820	4	1981	615
Cobra Ct	680	4	1981	510
Estoque Ct	818	4	1981	614
Forja Ct	532	4	1981	399
Camino Brizza Bonell	10183	4	1981	7641
Calle Cumpas	3587	4	1981	2692
Bacanora Ct	984	3	1981	554
Calle Remedios	6110	3	1981	3438
Corinto Ct	4176	3	1981	2350

Roadway	Length (L) [ft]	Houses (H)	Trips/household (T)	VMT
Llama Ct	408	3	1981	230
Via Italia	1042	3	1981	586
Arizpe Ct	259	3	1981	146
Meteoro Ct	228	3	1981	128
Cohete Ct	201	3	1981	113
Via Rita	1130	3	1981	636
Managua Ct	1893	3	1981	1065
Paseo Montura	2048	3	1981	1152
Fuego Ct	231	3	1981	130
Toltec Ct	284	2	1981	106
Beso Ct	212	2	1981	79
Boar Ln	391	2	1981	147
Copa Ct	356	2	1981	134
Suma Ct	101	2	1981	38
Uni Ln	261	2	1981	98
Soltar Ct	335	2	1981	126
Camino Loma	630	2	1981	236
Dosel Ct	580	2	1981	218
Toto Ct	202	2	1981	76
Adelita Ct	2271	2	1981	852
Payaso Ct	637	2	1981	239
Paseo Molango	4056	2	1981	1522
Trinity Ct	1458	2	1981	547
Hazel Ln	646	2	1981	242
Sunny Ln	685	2	1981	257
Via Papantla	2738	2	1981	1027
Via Pantera	2341	2	1981	878
Comoro Canyon Ln	2668	2	1981	1001
Kachina Dr	5498	2	1981	2063
Calle Coco	7706	2	1981	2891
Nikos Way	1846	2	1981	692
Via Fray Marcos	3932	1	1981	738
Calle Jamaica	4895	1	1981	918
Abanico Ct	451	1	1981	85
Inca Ct	349	1	1981	65
Avenida Reynosa	1624	1	1981	305
Calle Mora	2735	1	1981	513
Lost Ct	71	1	1981	13
Tata Ct	339	1	1981	64
Nutria Ct	635	1	1981	119
Silo Ln	306	1	1981	57
Song Dog Ct	171	1	1981	32
Johnson Ct	363	1	1981	68
Kite Ln	303	1	1981	57
Oro Ct	340	1	1981	64
Cuello Ct	298	1	1981	56
Dedo Ct	346	1	1981	65

Roadway	Length (L) [ft]	Houses (H)	Trips/household (T)	VMT
Donna Ct	350	1	1981	66
Ures Ct	557	1	1981	105
Zeus Ln	366	1	1981	69
Avenida Talanga	2515	1	1981	472
Jar Ct	77	1	1981	14
Tizimin Ct	2376	1	1981	446
Misa Ct	264	1	1981	49
Dandelion Ln	753	1	1981	141
Heno Ct	580	1	1981	109
Laguna Ct	403	1	1981	76
Mano Ct	286	1	1981	54
Purisima Ct	930	1	1981	174
Mia Ct	173	1	1981	33
Globo Ct	224	1	1981	42
Spices Ln	175	1	1981	33
Avenida Reynosa	1624	1	1981	305
Managua Ct	1893	1	1981	355
Paseo Matamoros	7740	1	1981	1452
Paseo Sombrilla	1666	1	1981	313
Mt Benedict Dr	1544	1	1981	290
Compostela Ct	724	1	1981	136
Gunsight Rd	4470	1	1981	838
Camino Vista Sonora	9721	1	1981	1824
Calle Jamaica	4895	1	1981	918
Duquesne Rd	160673	1	1981	30141
Amura Ln	2329	1	1981	437
Tree Ln	675	0	1981	0
Bola Ct	281	0	1981	0
Cacao Ct	398	0	1981	0
Belice Ct	256	0	1981	0
Cha Ct	173	0	1981	0
Adios Ct	256	0	1981	0
Paseo Sombrilla	1666	0	1981	0
Rum Ln	301	0	1981	0
Sahuarita Ct	1941	0	1981	0
Sana Ct	364	0	1981	0
Toluca Ct	1310	0	1981	0
Zaragoza Ct	1669	0	1981	0
Sodio Ct	259	0	1981	0
Acuna Ct	1363	0	1981	0
Del Ct	84	0	1981	0
Mescal Ct	820	0	1981	0
Compostela Ct	724	0	1981	0
Lazo Ct	366	0	1981	0
Leek Ct	137	0	1981	0
Luz Ct	325	0	1981	0
Maidu Ct	662	0	1981	0

Roadway	Length (L) [ft]	Houses (H)	Trips/household (T)	VMT
Marcarla Ct	1091	0	1981	0
Odisea Ct	594	0	1981	0
Salama Ct	1974	0	1981	0
Sauzal Ct	916	0	1981	0
Yard Ln	380	0	1981	0
Yuma Ct	110	0	1981	0
Calle Barril	2967	0	1981	0
Calle Granja	631	0	1981	0
Camino Cumbre	5343	0	1981	0
Camino Real	6824	0	1981	0
Fino Ct	1652	0	1981	0
Roble Ct	578	0	1981	0
Rosas Ct	450	0	1981	0
Calle Torreon	2888	0	1981	0
Nina Ct	228	0	1981	0
Circulo Huacana	2332	0	1981	0
Codo Ct	367	0	1981	0
Cola Ct	251	0	1981	0
Cono Ct	220	0	1981	0
Dividir Ct	2570	0	1981	0
Rey Ct	187	0	1981	0
Stable Ln	1072	0	1981	0
Tiarra Ct	230	0	1981	0
Calle Chivato	1171	0	1981	0
Cara Ct	312	0	1981	0
Hebilla Ct	921	0	1981	0
Kay Ct	1171	0	1981	0
Loreto Ct	723	0	1981	0
Tambor Ct	435	0	1981	0
Trono Ct	860	0	1981	0
Vereda Guadalajara	3286	0	1981	0
Paseo Montura	2048	0	1981	0
Tizimin Ct	2376	0	1981	0
Paseo Matamoros	7740	0	1981	0
Calle Cenote	990	0	1981	0
Stable Ln	1072	0	1981	0
Sonoita Creek Ranch Rd	15849	0	1981	0
Guajolote Ct	749	0	1981	0
Stoddard Way	5333	0	1981	0
Poppy Ct	4176	0	1981	0
Bodega Dr	1580	0	1981	0
Calle Barril	2967	0	1981	0
Calle Mandarina	6170	0	1981	0
Placita Verdura	907	0	1981	0
Garra Ct	350	0	1981	0
Wild Rose Ct	834	0	1981	0
Victorio Dr	3477	0	1981	0

Roadway	Length (L) [ft]	Houses (H)	Trips/household (T)	VMT
Pendleton Dr	76784	0	1981	0
Corinto Ct	4176	0	1981	0
Camino Real	6824	0	1981	0
Trono Ct	860	0	1981	0
Zaragoza Ct	1669	0	1981	0
Camino Las Barrancas	3102	0	1981	0
Camino Real	6824	0	1981	0
Calle Torreon	2888	0	1981	0
Paseo Riachuelo	6524	0	1981	0
Paseo Riachuelo	6524	0	1981	0
Circ Vista Del Lago	5022	0	1981	0
Circ Vista Del Lago	5022	0	1981	0
Cuates Buttes Ln	4020	0	1981	0
Del Rey David Blvd	5986	0	1981	0
Bravo Ln	1379	0	1981	0
		Total VMT		**968460**
		Total PM_{10} (ELow)		**105**
		Total PM_{10} (EHigh)		**273**

This page is intentionally blank.

Appendix E.2
Road Paving/Chip-Sealing Documentation Provided by Santa Cruz County for the Nogales NA

The documents in this appendix were provided by Santa Cruz County. County officials highlighted roads that had been double chip-sealed in the Rio Rico community from 2002-2008. ADEQ determined four roads totaling 8.6 miles were within the Nogales NA. This information was then used for the calculations in the technical support document.

This page is intentionally blank.

M E M O R A N D U M

TO: Dennis Ryan, Ergon Asphalt Products, Inc.

FROM: Henry Jimenez, Assistant Superintendent of Roads

DATE: March 21, 2002

REFERENCE: Chipseal Schedule for West side of County

DATE:	ROAD NAME	LENGTH:	SHOT:
Tubac Area:			
May 6, 2002	Amado-Montosa Road	3.0-miles	Single
May 7, 2002	Amado-Montosa Road	3.0-miles	Single
Rio Rico (North) Area:			
May 8, 2002	San Cayetano	2.0-miles	Single
May 8, 2002	Camino Mar		
May 8, 2002	Camino Panama		
May 9, 2002	Rio Rico Drive	2.0-miles	Single
Rio Rico (East) Area:			
May 13, 2002	Camino Canoa	2.0-miles	Single
May 13, 2002	Kent Avenue		
May 13, 2002	Panda Corte		
May 13, 2002	Duke Lane		
May 14, 2002	Calle Arikara	1.0-miles	Single
Rio Rico (West) Area:			
May 15, 2002	Via Papagayo	2.0-miles	Single
May 15, 2002	Tecla Corte		
May 15, 2002	Camino Caballo		
May 16, 2002	Circulo Golondrina	2.0-miles	Single
May 20, 2002	Camino Kansas	3.0 -miles	Single
May 20, 2002	Calle Reforma		
May 20, 2002	Arroz Lane		
	TOTAL:	19.6-miles	

RIO RICO CHIP SEAL 2005

Gutierrez

DATE	ROAD NAME	EMULSION	MILES
	RIO RICO EAST		
05/23/05	Rio Rico Dr/Eagel Ct/Camino Canoa	48 Tons	2.0
05/24/05	Camino Canoa/Avenida Gutierrez	48 Tons	2.0
05/25/05	Calle Carmelita/Via San Francisco	48 Tons	2.0
05/26/05	Back Nine Terrace/Calle Tiburon	48 Tons	2.0
	RIO RICO WEST		
05/31/05	Camino Providencia	48 Tons	2.0
06/01/05	Camino Providencia/Lúcia Ct/La Vista Ct	24 Tons	1.0
06/02/05	Avenida Tiemblo Via Patricia	24 Tons	1.0
	TOTAL	**288 Tons**	**12.0**

ANNUAL CHIP SEAL PROJECT

ITEM	TONS USED
3/8 - Cold Mix	
3/8 -Chips	2400 Tons

CHIP SEAL 2006

ROAD NAME		MILAGE
	RIO RICO NORTH EAST	
APOLENA	CANCELED	1
ANCLAR---TRIO	CANCELED	0.2
CHOLULA	CANCELED	0.4
VALLEY VIEW	CANCELED	1
PASTOR	CANCELLED	1
	RIO RICO SOUTH EAST	
RUBY ROAD		2
CALLE COYOTE		2
PASEO GUEVAVI		3
	PATAGONIA AREA	
HARSHAW ROAD		6
	TUBAC AREA	
CHAVEZ SIDING		0.4
CAMINO ESPLENDIDO		1
CALLE NOMADA		0.9
		TOTAL 15.3

CHIP SEAL 2008

ROAD NAME		MILEAGE	
	RIO RICO EAST		
Camino Caralampi		3.5	Single
Paseo Venado		0.8	Single
Circulo Sombreo		2.5	Single
Cocospera	CANCELED	0.5	Single
Arviso	CANCELED	1-Jan	Single
	RIO RICO WEST		
North Pendelton	CANCELED	2	Single
South Pendelton		2	Single
Valley View	CANCELED	1.3	Single
		TOTAL 9.2	
	ELGIN AREA		
Elgin Road		3	Single
Elgin --- Caneleo		3	Single
Kino Spings		2	Single
		TOTAL 8	

Annual Chip Sealing Project

2008 -2009 Road Maintenance Budget = $370,000

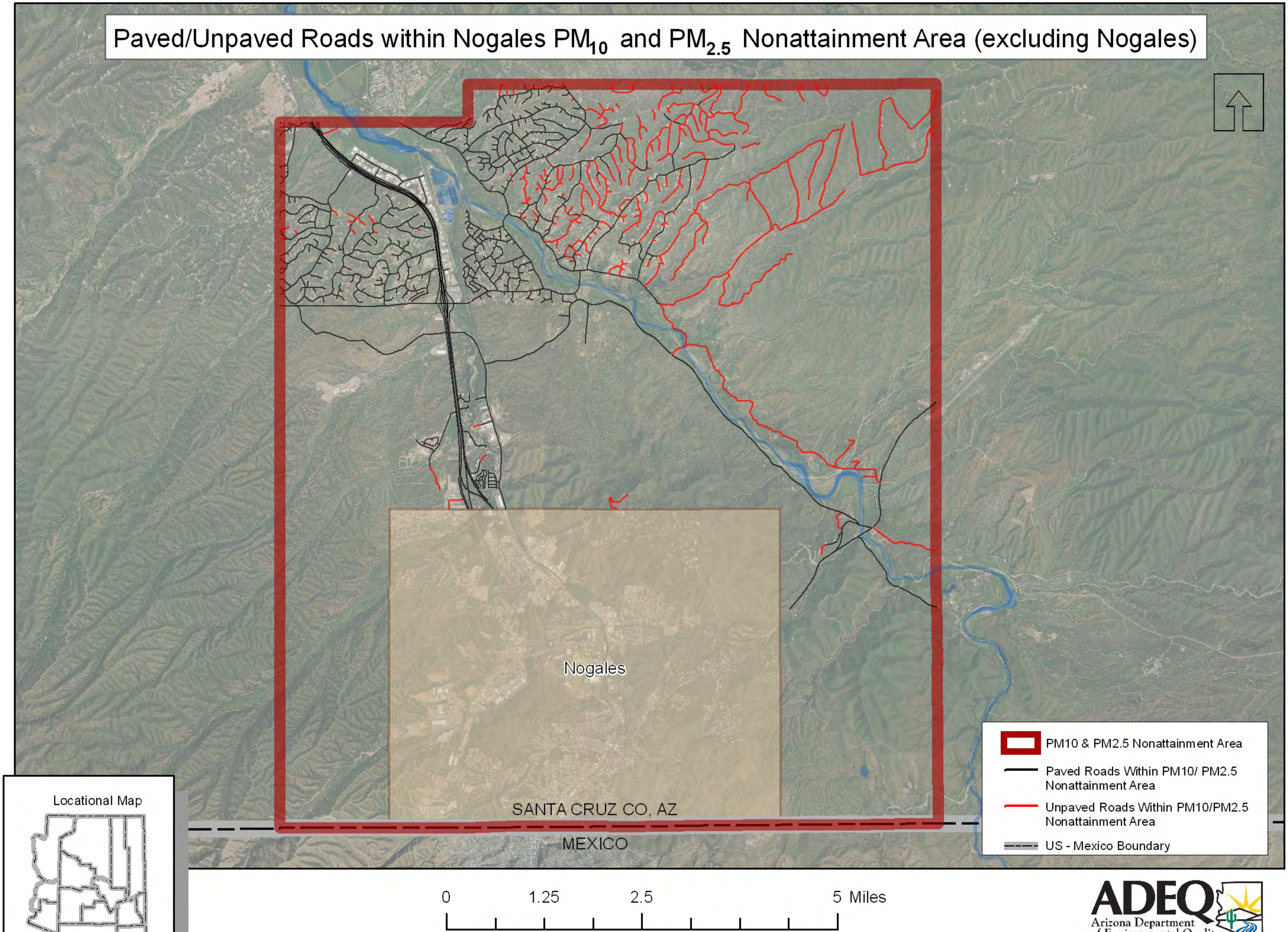
Crew	Location	Mileage (mi.)	Chips (tons)	Emulsions (tons)	Cold Mix (tons)	AB (tons)	Single (1)/Double (2)	Cost ($)
Jimenez Crew	Rosamorada	1.2	240.0	28.8	30.0	0.0	1	21,696.00
	Cienegita	0.3	60.0	7.2	7.5	0.0	1	5,424.00
	Calle Alabastro	0.3	60.0	7.2	7.5	0.0	1	5,424.00
	Paseo Comanche	0.3	60.0	7.2	7.5	0.0	1	5,424.00
	Los Mochis	0.5	100.0	12.0	12.5	0.0	1	9,040.00
	Via Orizaba	0.2	40.0	4.8	5.0	0.0	1	3,616.00
	Tabasco	0.4	80.0	9.6	10.0	0.0	1	7,232.00
	Calle Quintana	0.4	80.0	9.6	10.0	0.0	1	7,232.00
	Via Ensenada	0.3	60.0	7.2	7.5	0.0	1	5,424.00
	Via Savalza	0.4	80.0	9.6	10.0	0.0	1	7,232.00
	North Pendleton	2.0	400.0	48.0	50.0	0.0	1	36,160.00
	South Pendelton	2.2	440.0	52.8	55.0	0.0	1	39,776.00
	Via Puebla	2.3	460.0	55.2	57.5	0.0	1	41,584.00
	Aliso Springs	0.9	180.0	21.6	22.5	0.0	1	16,272.00
Turner Crew	Kino Springs Rd	4.0	800.0	96.0	100.0	0.0	1	72,320.00
	Los Encinos	1.2	240.0	28.8	30.0	0.0	1	21,696.00
	West Parking Lot	0.4	0.0	8.4	0.0	0.0	1	3,864.00
	TOTAL	17.3	3380.0	414.0	422.5	0.0		309,416.00

This page is intentionally blank.

Appendix E.3
ADEQ Map Displaying Paved and Unpaved Roads in the Rio Rico Section of the Nogales NA

This appendix contains a map developed by ADEQ using geographic information system (GIS) data to show which roads in the Nogales NA, excluding the City of Nogales, were paved and unpaved. ADEQ determined 134.4 miles of road were paved and 53.5 were unpaved in this section of the Nogales NA.

This page is intentionally blank.



Roads Source: AZ Dept of Transportation ATIS Roads 08/05/2010
http://www.azdot.gov/mpd/gis/about.asp

ADEQ
Arizona Department of Environmental Quality
Janice K. Brewer, Governor
Henry R. Darwin, Director

April 06, 2012 - Author N. Caroli

This page is intentionally blank.

Appendix E.4

Satellite Imagery used to Verify Road Paving/Double Chip-Sealing in the Nogales NA

This appendix contains before and after satellite imagery for each paved road cited in the TSD. The black and white 1992 images are blurry, typical of satellite imagery from that era, and somewhat difficult to discern. Some roads identified for paving in the 1993 Nogales NA SIP appear to have been paved when the 1992 satellite image was taken, likely due the development process for the 1993 Nogales NA SIP taking several years to complete. Satellite imagery is unavailable for years prior to 1992.

This page is intentionally blank.

Figure 1: Aerial photography of Calle Arikara road in Rio Rico from 1992 (left) and 2010 (right) confirming chip-seal paving of the roadway occurred between these dates.

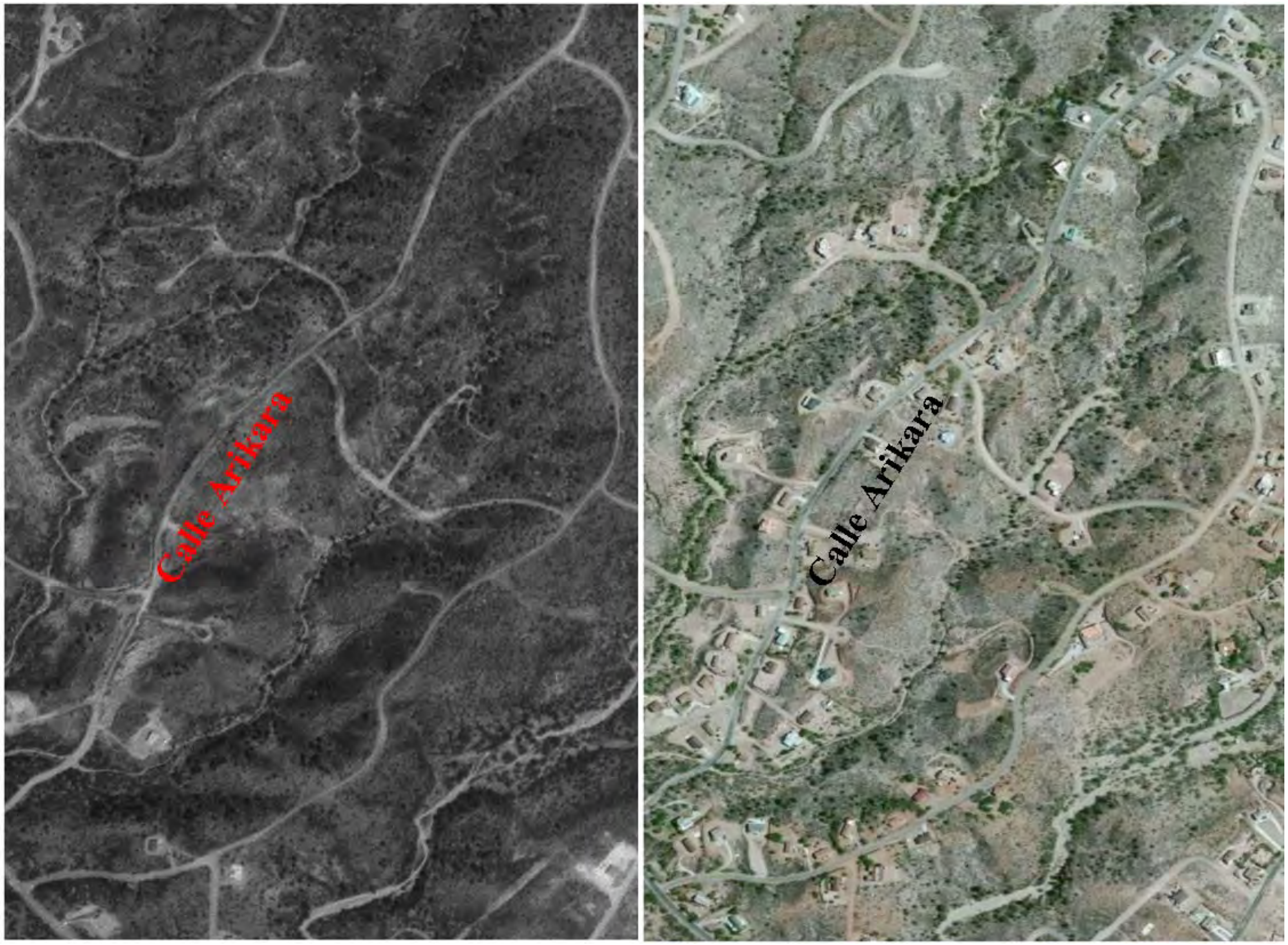


Figure 2: Aerial photography of Paseo Mexico road in Rio Rico from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 3: Aerial photography of Calle Coyote road in Rio Rico from 1992 (left) and 2010 (right) confirming chip-seal paving of the roadway occurred between these dates.

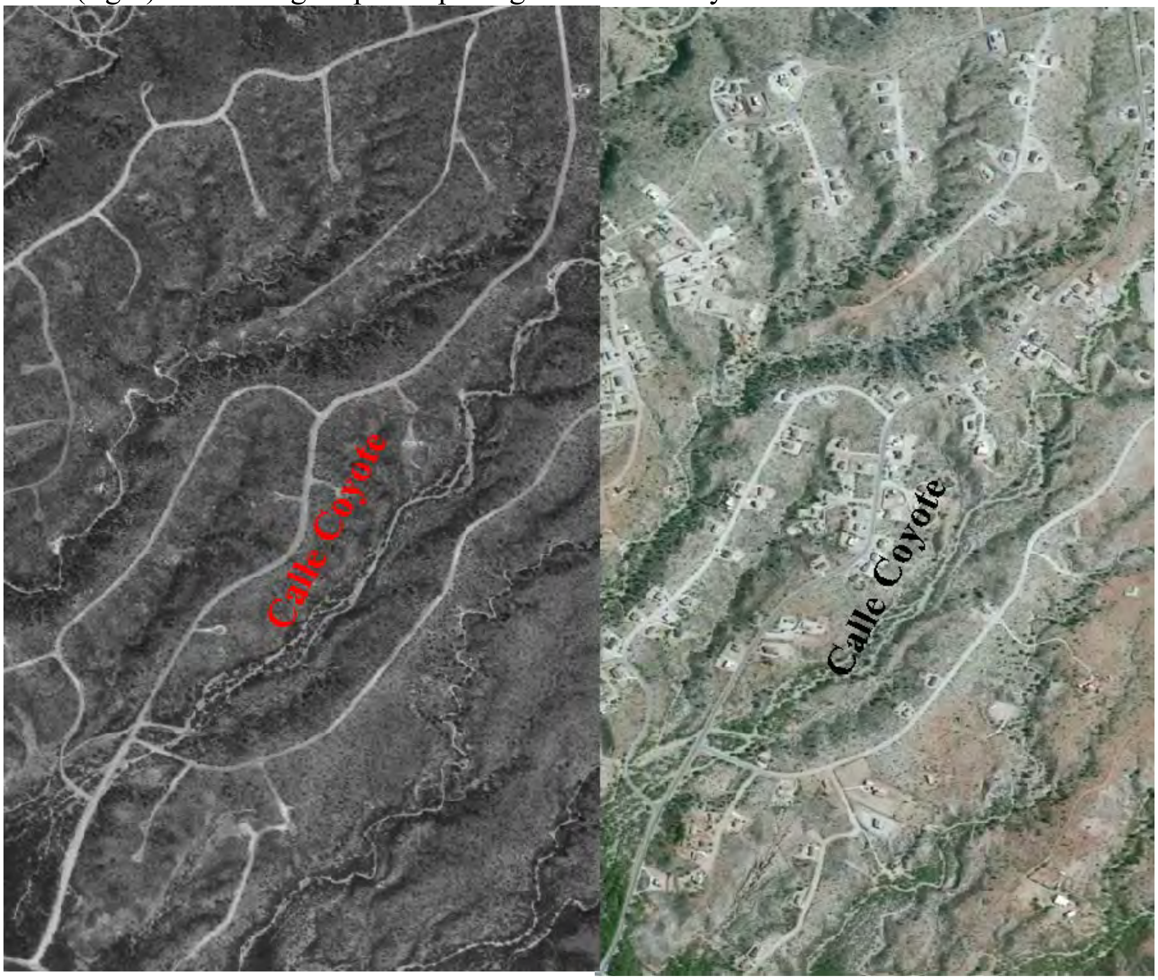


Figure 4: Aerial photography of Annette Ct. in Rio Rico from 1992 (left) and 2010 (right) confirming chip-seal paving of the roadway occurred between these dates.

Figure 5: Aerial photography of Paseo Guebabi road in Rio Rico from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 6: Aerial photography of Royal Road in Nogales from 1992 (left) and 2010 (right) confirming chip-seal paving of the roadway occurred between these dates.

Figure 7: Aerial photography of Hohokam Road in Nogales from 1992 (left) and 2010 (right) confirming chip-seal paving of the roadway occurred between these dates.

Figure 8: Aerial photography of La Quinta Road in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 9: Aerial photography of Yucca Dr. in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 10: Aerial photography of Bristol Dr. in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

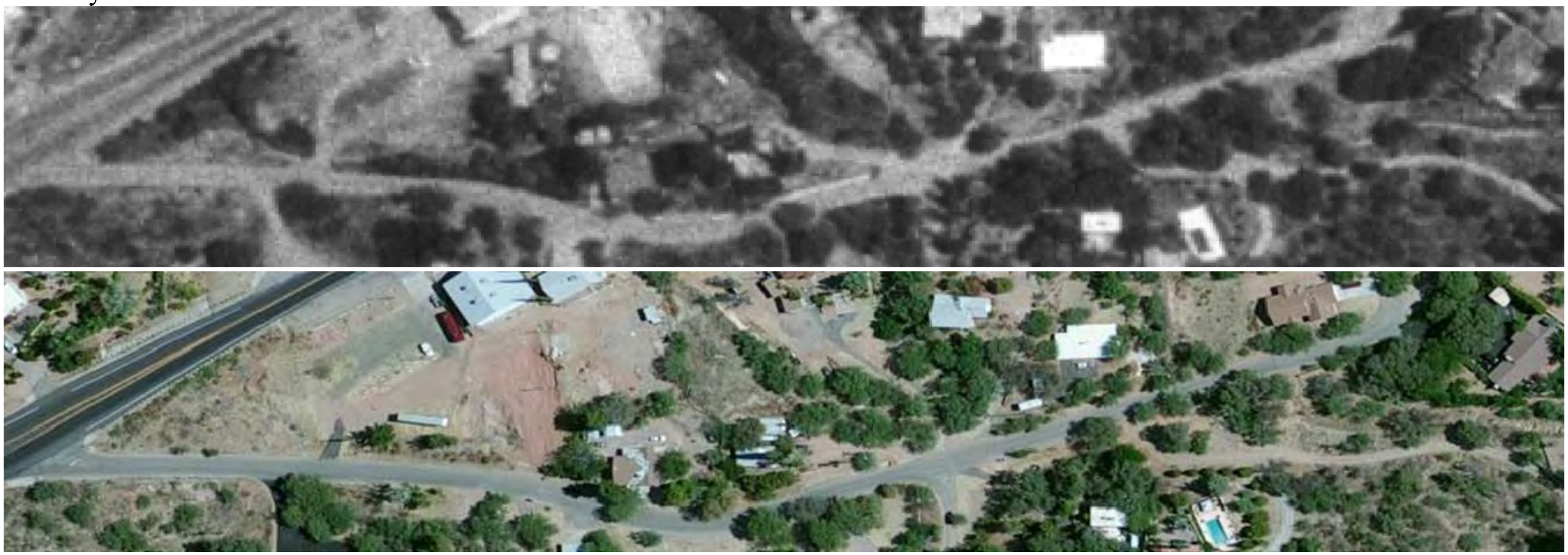


Figure 11: Aerial photography of Target Range Rd. in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

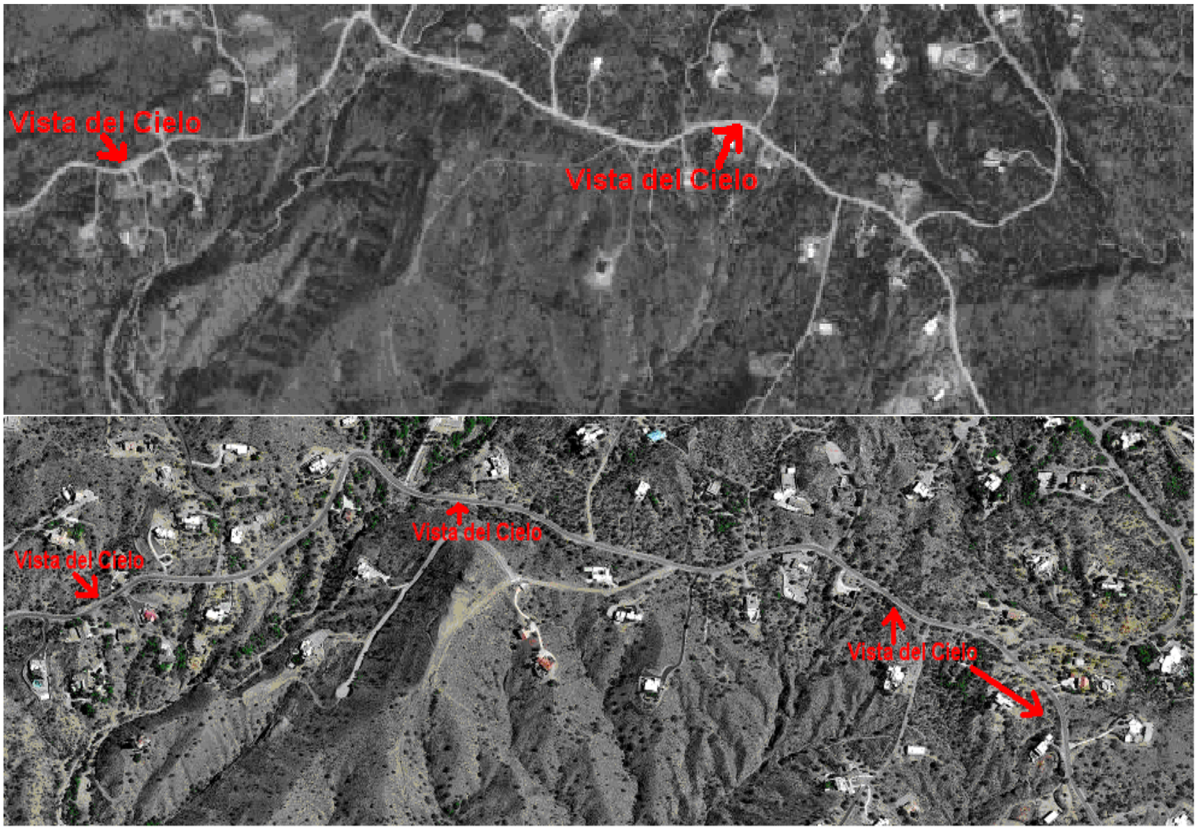
Figure 12: Aerial photography of Frank Reed Rd. in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 13: Aerial photography of Kino Rd. in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 14: Aerial photography of Kelsey Ave. in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 15: Aerial photography of W 1st Ave. in Nogales from 1992 (top) and 2010 (bottom) confirming chip-seal paving of the roadway occurred between these dates.

Figure 16: Aerial photography of Vista del Cielo - the main collector shown in the photographs below - in Nogales from 1992 (top) and 2012 (Bing Maps) confirming paving of the roadway occurred between these dates.



Appendix F
Correspondence

This page is intentionally blank.

Appendix F.1
Letter from EPA Approving Arizona's Air Monitoring Network Plan for 2011

This page is intentionally blank.

CTS 273796

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

DEC 0 1 2011

ADEQ
AIR QUALITY DIVISION

11 DEC -7 AM 11: 19

Eric Massey, Director
Air Quality Division
Arizona Department of Environmental Quality
1110 W. Washington St.
Phoenix, Arizona 85007

Dear Mr. Massey:

Thank you for your timely submission of the State of Arizona Air Monitoring Network Plan: For the Year 2011. We have reviewed the submitted document and have found that it is complete, informative, very detailed and meets all of the requirements for annual network plans as required by our regulations set forth under 40 CFR Part 58.10. We specifically acknowledge the discontinuation of the Bethune Elementary School PM_{10} SPM per 40 CFR Part 58.20 (f). While this letter serves as official approval of the annual network plan, it does not constitute approval of the system modifications that are proposed in the plan for the future. We will continue to work with your district to review system changes as they proceed.

If you have any questions regarding this letter or enclosed comments, please feel free to contact me at (415) 972-3851 or Michael Flagg at (415) 972-3372.

Sincerely,

Matthew Lakin, Manager
Air Quality Analysis Office
Air Division

Enclosure

cc: Theresa Rigney, ADEQ

Comments on 2011 State of Arizona Air Monitoring Network Plan

Please update next year's annual network plan to reflect the following comments:

- In order to better show that minimum monitoring requirements are being met, it would be beneficial for Section 4.0 to contain a table summarizing the number of monitors required in each of the six MSAs for each pollutant and the number of monitors operating within them.
- The plan should discuss the monitoring delegation to other agencies in the State when assessing $PM_{2.5}$ and PM_{10} minimum monitoring requirements in the Phoenix-Mesa-Scottsdale and Tucson MSAs.
- Section 4.1: $PM_{2.5}$ Monitoring Network Requirements discusses the required sampling frequency for all ADEQ-operated $PM_{2.5}$ SLAMS sites. The information presented suggests numerous sites throughout the State are not sampling at the required frequency. ADEQ should implement the required sampling schedules at the following sites: Douglas Red Cross, Flagstaff Middle School, Nogales Post Office, Prescott Valley, and Yuma Supersite.
- Section 4.2: PM_{10} Monitoring Network Requirements discusses the required sampling frequency for all ADEQ PM_{10} sites. The sampling frequency of PM_{10} monitors should be based on the "relative level of that monitoring site concentration", rather than the number of estimated exceedances (40 CFR 58.12 (3)(e)). EPA has interpreted this concentration to be the design concentration, as discussed in Section 6.3 of the PM_{10} SIP Development Guidance (EPA-450/2-86-001). The assessment of the required sampling frequency was performed with the appropriate concentration levels in Table 4.2-2 of the 2010 network plan. ADEQ should reassess the required sampling frequency for all PM_{10} monitors using the appropriate methodology.
- The NPAP and PEP audit monitor columns in Appendix C for O_3 and $PM_{2.5}$, respectively, should be updated to reflect current audit requirements (i.e. all SLAMS are required to participate in PEP and NPAP).

Appendix F.2
Email from Santa Cruz County Confirming Road Maintenance Procedures and Equipment

This page is intentionally blank.

James Wagner

From: Carlos Rivera [crivera@co.santa-cruz.az.us]
Sent: Monday, April 02, 2012 5:39 PM
To: James Wagner
Subject: FW: Nogales PM10 Nonattainment Area
Attachments: PM10 Non attainment area map.pdf

Mr. Wagner,

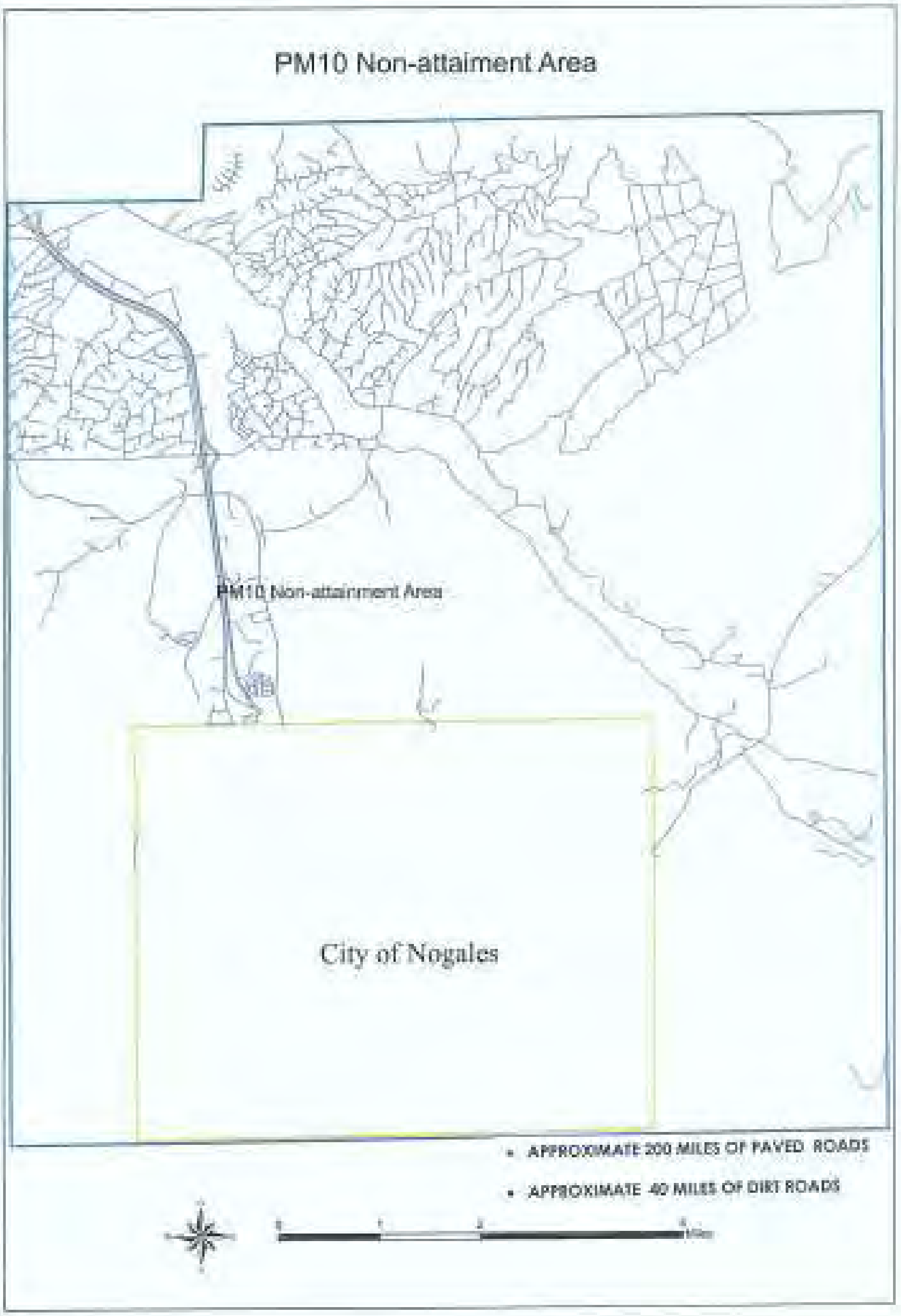
Attached and below is the response from our Public Works Director. If you should require any additional information please do not hesitate to contact me.

Carlos

From: Jesus J. Valdez
Sent: Monday, April 02, 2012 4:09 PM
To: Carlos Rivera
Subject: RE: Nogales PM10 Nonattainment Area

Carlos,
Attached is a map of the nonattainment area. The County has a total of 240 miles of roads: 40 miles of dirt roads & 200 miles of paved/double chip roads.
In addition, the County has implemented an on-call program that has PW employees on standby after regular working hours to respond to road emergencies and/or road blockage. PW crews also do clean up after every storm event by removing debris and sweeping the road. The PW department currently has two sweepers in the heavy equipment fleet.

Jesus Valdez, P.E.
Interim Public Works Director
County Engineer
Santa Cruz County
Ph. 520-375-7830
Fax. 520-375-7846


PM10 Non-attaiment Area
PM10 Non-attainment Area
City of Nogales
APPROXIMATE 200 MILES OF PAVED ROADS
APPROXIMATE 40 MILES OF DIRT ROADS

Appendix F.3
Email from City of Nogales Confirming Road Paving, Road Maintenance Procedures and Equipment

This page is intentionally blank.

From: Juan Guerra [mailto:jguerra@nogalesaz.gov]
Sent: Wednesday, April 11, 2012 3:24 PM
To: James Wagner
Cc: edelgado@nogalesaz.gov; abarcenas@nogalesaz.gov
Subject: Re: Nogales Street Sweepers

We are working on it to get the total length of paved roads. Although all public roads are paved some of them require significant improvements.

As you may be aware, there are some private roads and commercial properties not paved.

From: James Wagner [mailto:Wagner.James@azdeq.gov]
Sent: Wednesday, April 11, 2012 12:19 PM
To: Juan Guerra <jguerra@nogalesaz.gov>
Subject: FW: Nogales Street Sweepers

Hello again, Juan.

EPA would like us to get data layers for paved/unpaved roads in Nogales so that we can claim emissions reductions for unpaved roads identified in the 1987 emissions inventory for the Nogales area. Can you help us with that request?

Thanks,
Jim Wagner
EHS II
602.771.2388

From: Juan Guerra [mailto:jguerra@nogalesaz.gov]
Sent: Thursday, December 08, 2011 3:42 PM
To: James Wagner
Cc: Tony Santa Cruz
Subject: RE: Nogales State Implementation Plan

Hi Jim:
Please see below the answers to your questions. Let me know if you have any more questions.

1.- The City has two sweeper but only one is in operation (The other is broken).
2.-The two street sweepers are standard.
3.-The streets are cleaned from Monday-Friday (No weekends and holydays)
4.-The City does not block any private unpaved road.

Sincerely,

Juan Guerra, PE., CFM| City Engineer | City of Nogales, AZ | phone: 520-285-5753| fax: 520-287-8352 | 1450 N. Hohokam Drive, Nogales, AZ 85621 | jguerra@nogalesaz.gov
Office hours: Monday – Friday, 8 a.m. – 5 p.m.

From: James Wagner [mailto:Wagner.James@azdeq.gov]
Sent: Thursday, December 08, 2011 3:22 PM
To: Juan Guerra
Subject: Nogales State Implementation Plan

Hello Juan,

It was nice speaking with you earlier. We just need to know a few things for the update to the 1993 Nogales PM10 state implementation plan.

- How many street sweepers does the City own?
- Are they "PM10 certified" or standard sweepers?
- How often does the City clean the streets?

For those unpaved roads not accepted into the City's Street Maintenance Program, does the City try to block traffic, for example with boulders?

If you have any questions, please let me know.

Thanks,

Jim Wagner

ADEQ Air Quality Division
602.771.2388

NOTICE: This e-mail (and any attachments) may contain PRIVILEGED OR CONFIDENTIAL information and is intended only for the use of the specific individual(s) to whom it is addressed. It may contain information that is privileged and confidential under state and federal law. This information may be used or disclosed only in accordance with law, and you may be subject to penalties under law for improper use or further disclosure of the information in this e-mail and its attachments. If you have received this e-mail in error, please immediately notify the person named above by reply e-mail, and then delete the original e-mail. Thank you.

Appendix F.4
Completeness Letter from EPA for the 1993 Nogales PM_{10} Nonattainment Area State Implementation Plan

This page is intentionally blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105

November 30, 1993

Edward Z. Fox
Director
Arizona Department of Environmental Quality
3033 North Central Avenue
Phoenix, Arizona 85012

Dear Mr. Fox:

On June 14, 1993, you submitted a revision to the Arizona State Implementation Plan for achieving and maintaining the National Ambient Air Quality Standards for particulate matter 10 microns or less in aerodynamic diameter (PM10) in the Nogales nonattainment area.

We have reviewed this package for completeness and found that it conforms to the completeness criteria in 40 CFR Part 51, Appendix V. The complete submittal addresses the finding of nonsubmittal made by EPA on December 16, 1991, and thus stops the clock for mandatory sanctions under section 179(a) of the Clean Air Act.

The SIP revision found to be complete is now in the process of being reviewed. Once reviewed, we will prepare a rulemaking notice for submittal to our Headquarters office for publication in the Federal Register.

If you have any questions regarding our review, please call me or have your staff call Wallace Woo, Chief of the Plans Development Section in the Air Planning Branch at (415)744-1207.

Sincerely,

David P. Howekamp
Director
Air & Toxics Division

cc: Nancy Wrona, Arizona Department of Environmental Quality

This page is intentionally blank.

Appendix F.5
Santa Cruz County Email Regarding Paved Roads in Rio Rico

This page is intentionally blank.

From: Jesus J. Valdez [mailto:jjvaldez@co.santa-cruz.az.us]
Sent: Thursday, March 03, 2011 5:57 PM
To: Roxanne J. Linsley
Subject: FW: highlighted roads!

Attached is a pdf of the dirt roads that the County has chip seal since 2002, its roughly about 60 miles. From oral history, staff informed me that an additional 40 miles of dirt roads were chip seal from 1993 to 2001. Also, I research for a policy that the County had adopted regarding clean up after storm events, and was unsuccessful in finding one. Please give me a call if you have any questions.

Jesus Valdez, P.E.

Interim Public Works Director

County Engineer

Santa Cruz County

Ph. 520-375-7830

Fax. 520-375-7846

From: Norma Northcross
Sent: Thursday, March 03, 2011 5:44 PM
To: Jesus J. Valdez
Subject: highlighted roads!

Thanks

NORMA B. NORTHCROSS

Central Permits Coordinator

Right of Way Agent

Santa Cruz County

(520) 375-7869

APPENDIX G
SUPPLEMENTARY INFORMATION

The information included in this appendix is considered supplementary and not included for submittal with this SIP.

1. Require Dust Control Plans for Construction or Land Clearing Projects

Santa Cruz County Grading Ordinance 2001-06, adopted in 2001, was not included as a control measure in the 1993 Nogales SIP. The ordinance requires control measures for construction and land clearing projects. Permits are required for any grading activity exceeding 50 cubic yards. The grading ordinance requires dust control for all areas disturbed during grading or clearing of land.[1] The ordinance specifies that only land that will later be resurfaced, hydroseeded, landscaped, or developed may be disturbed. The ordinance further requires disturbed areas that are not landscaped or developed be hydroseeded. Officials are authorized to conduct site inspections to determine the adequacy of dust and erosion control methods and may require mitigation measures. Dust and erosion control methods must be completed within (30) days of clearing, unless waived by the County.

The City of Nogales Development Standards Code does not provide specific mitigation measures for land clearing and construction activity. Article 8, Section 8-5-6, however, requires *"land use to comply with State and federal regulations, and prohibits particulate emissions from creating public health concerns…No emission shall be permitted which can cause damage to health, to animals, or vegetation, or other forms of property…"* These provisions provide local agencies with authority to pursue air quality nuisances, including emissions related to construction or land clearing projects.[2]

2. Provide for Storm Water Drainage to Prevent Water Erosion onto Paved Roads/ Provide for Traffic Rerouting or Rapid Clean Up of Temporary Sources of Dust on Paved Roads

Section 8-6-6 of the City of Nogales building code, Surface Drainage and Storm Sewer System, requires that building permits will only be issued after provisions to control storm water run-off, including culverts or inlets, have been implemented. These provisions prevent sediment from washing onto paved streets and creating vehicle trackout emissions. Section 8-6-6 also requires detention basins or other means of preventing significant water run-off where applicable. Section 8-16-23, Design Standards for On-Site Retention of Storm Water, requires on-site storm water retention for all developments one acre or larger unless the site is served by a storm sewer, channel, or natural drainage way approved by the City Engineer.[3]

Santa Cruz County's Flood Control District established standards for private driveway crossings to prevent erosion onto paved roads.[4]

---

[1] Santa Cruz County Grading Ordinance 2001-06. Pgs. 6-7.
<http://www.co.santa-cruz.az.us/com_development/building/pdf/GradingOrdinanceRevised.pdf>
[2] City of Nogales, Arizona, Development Standards Code, Article 8. Pgs. 66-67.
<https://imageserv5.team-logic.com/mediaLibrary/78/Article_008.pdf>
[3] Ibid. Pg. 167.
[4] Santa Cruz Flood Control District. *"Driveway Crossing Standards."*
<http://www.co.santa-cruz.az.us/public_works/flood/pdf/DrivewayCrossingStandard.pdf>

3. Require Curbing and Pave or Stabilize Paved Road Shoulders

Section 8-8-2 of the Nogales City code requires that all *"streets shall have Portland Cement Concrete curbs and gutters along the pavement edge constructed to city minimum standards for construction...All streets shall have Portland Cement Concrete sidewalks behind the curb-gutter where curb-gutter is required."*[5]

Section 1504.5, effective October 5, 1973, of the County Zoning and Development Code states that *"…curbs and gutters shall be required in all Zoning Districts except GR (General Rural) and SR (Suburban Ranch) unless a variance is granted by the Planning Commission..."*[6] Curbing streets and stabilizing road shoulders in the sparsely populated rural districts of Rio Rico is not currently economically feasible.

4. Pave, Vegetate, or Chemically Stabilize Unpaved Parking Areas

Section 8-9-5 of the Nogales Development Standards Code, General Parking Lot Design Requirements, requires that *"A. Surfacing and Drainage: Every commercial parking lot, including display areas for vehicle parking, shall be paved with two (2) inches of asphaltic concrete over four (4) inches of aggregate base course or four (4) inches of Portland Cement Concrete reinforced with #8 six (6) inch by six (6) inch wire mesh over a sub-base compacted to ninety-five percent (95%) density and properly drained with a minimum grade of 0.5% and a maximum grade of six percent (6%). Every commercial parking lot shall be subject to approval by the Site Plan process of Section 8-18."* [7] The code also requires the owner or occupant of a building with a paved parking area to maintain the surface, lighting, and landscaping or face a violation.

As required by the 1993 NNA SIP, the County paved the Sheriff's station parking lot. In 2005, the County amended Article 11 of the County Zoning and Development Code to require paved parking lots and entrances for commercial buildings and multifamily residences.[8]

5. Pave, Vegetate, or Chemically Stabilize Unpaved Parking Areas

Section 8-9-5 of the Nogales Development Standards Code, General Parking Lot Design Requirements, requires that *"A. Surfacing and Drainage: Every commercial parking lot, including display areas for vehicle parking, shall be paved with two (2) inches of asphaltic concrete over four (4) inches of aggregate base course or four (4) inches of Portland Cement Concrete reinforced with #8 six (6) inch by six (6) inch wire mesh over a sub-base compacted to ninety-five percent (95%) density and properly drained with a minimum grade of 0.5% and a maximum grade of six percent (6%). Every commercial parking lot shall be subject to approval by the Site Plan process of Section 8-18."* [9] The code

---

[5] City of Nogales, Arizona, Development and Standards Code, Article 8. Pg. 89.
<https://imageserv5.team-logic.com/mediaLibrary/78/Article_008.pdf>

[6] Santa Cruz County Zoning and Development Code 2011. Pgs. 146-148.
<http://www.co.santa-cruz.az.us/com_development/pdf/ZoningandDevelopmentCode.pdf>

[7] City of Nogales, Arizona, Development and Standards Code, Article 8. Pgs. 127-134.
<https://imageserv5.team-logic.com/mediaLibrary/78/Article_008.pdf>

[8] Santa Cruz County Zoning and Development Code 2011. Pg. 112.
<http://www.co.santa-cruz.az.us/com_development/pdf/ZoningandDevelopmentCode.pdf>

[9] City of Nogales, Arizona, Development and Standards Code, Article 8. Pgs. 127-134.
<https://imageserv5.team-logic.com/mediaLibrary/78/Article_008.pdf>

also requires the owner or occupant of a building with a paved parking area to maintain the surface, lighting, and landscaping or face a violation.

As required by the 1993 NNA SIP, the County paved the Sheriff's station parking lot. In 2005, the County amended Article 11 of the County Zoning and Development Code to require paved parking lots and entrances for commercial buildings and multifamily residences.[10]

6. Require Revegetation, Chemical Stabilization, or other Abatement of Wind Erodible Soil

The City of Nogales Development Standards Code does not provide specific mitigation measures for revegetation or stabilization of unstabilized soil; however, Article 8, Section 8-5-6 requires *"land use to comply with State and federal regulations, and prohibits particulate emissions from creating public health concerns…No emission shall be permitted which can cause damage to health, to animals, or vegetation, or other forms of property…"* These provisions give local authorities power to pursue air quality nuisances, including emissions related to construction or land clearing projects.[11]

Santa Cruz County Ordinance 2001-06, Excavation and Grading, Section 3316-Erosion Control, requires that *"Dust and erosion control shall be required for all areas disturbed during grading, clearing, or brushing of land whether it requires a grading permit or not. Only areas which will later be resurfaced, hydroseeded, landscaped, or built on may be disturbed. All disturbed areas which are not resurfaced, landscaped, or built on shall be hydroseeded with plant species appropriate to the site and its surrounding native habitat...The Building Official may make site inspections to determine the adequacy of dust and erosion control methods and may require modified mitigation measures, such as, but not limited to, paving, rip-rap, and, or, erosion control blankets. Dust and erosion methods shall be completed within (30) days of clearing, unless waived by the Building Official."*[12]

7. Road Paving in Nogales, Sonora, Mexico

The North American Development Bank (NADB) has funded road paving projects in Nogales, Sonora. A study of the city conducted from 2004-2007 determined that 65 percent of the city was unpaved, with 35 percent having some type of hard surface. According to the NADB, as of 2010, 865 roads are surfaced. However, 1,065 roads extending 133 miles remained unpaved as of August 2010. In July 2004, the NADB announced 17 million U.S. in funding for street improvements.[13] In 2007, the NADB announced 9 million U.S. dollar funding for street improvements.[14] As of September 2011, the city was accepting bids on an additional 10 miles of road surfacing.[15] More paving projects are planned for the immediate future.

---

[10] Santa Cruz County Zoning and Development Code 2011. Pg. 112.
<http://www.co.santa-cruz.az.us/com_development/pdf/ZoningandDevelopmentCode.pdf>

[11] City of Nogales, Arizona, Development Standards Code, Article 8. Pgs. 66-67.
<https://imageserv5.team-logic.com/mediaLibrary/78/Article_008.pdf>

[12] Santa Cruz County Grading and Excavating Ordinance. Pgs. 6-7.
<http://www.co.santa-cruz.az.us/com_development/building/pdf/GradingOrdinanceRevised.pdf>

[13] North American Development Bank press release. July 2004.
<http://www.nadb.org/pdfs/state_projects/FS%20Nogales%20SON%20AQ%20Eng.pdf>

[14] North American Development Bank press release. January, 2007.
<http://www.nadb.org/Reports1/Press_Releases/english/2007/013007.htm>

[15]

This page is intentionally blank.

Appendix H

NNA Monitoring Data 2008-2010

This page is intentionally blank.

Appendix H Nogales Partisol Filter-Based Monitor Air Quality Data 2008-2010						
Year	**Quarter**	**# of Observations**	**% Data Completeness**	**Max 24-hour Concentration** ($\mu g/m^3$)	**2nd Highest Concentration** ($\mu g/m^3$)	**# of Estimated Exceedances**
2008	1	15	88	108.7	99.7	
	2	15	100	147.2	86.7	
	3	15	100	44	41.3	
	4	14	93	155.3	150.3	
	Annual	58	95	**155.3**	150.3	**6.6**
2009	1	13	87	116.4	105.5	
	2	16	100	57.9	51.8	
	3	14	93	72.8	67.1	
	4	15	100	123.8	109.7	
	Annual	58	95	123.8	116.4	0
2010	1	15	100	96.8	84.7	
	2	14	93	57.2	45.5	
	3	15	94	63.3	55.9	
	4	13	87	74.5	66.5	
	Annual	57	93	96.8	84.7	0
3-Year Average Estimated Number of Exceedances						**2.2**

Appendix H Nogales Continuously Operating BAM Monitor Air Quality Data 2008-2010					
Year	**# of Observations**	**% of Observations**	**Max 24-hour Concentration** ($\mu g/m^3$)	**2nd Highest Concentration** ($\mu g/m^3$)	**# of Estimated Exceedances**
2008	355	97	**234**	**217**	**13.2**
2009	343	94	**238**	**204**	**2.0**
2010	126	35*	**191**	**177**	**8.5**
3-Year Average Estimated Number of Exceedances					**7.9**

*2010 data does not meet completeness criteria.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

User ID: BNE

DESIGN VALUE REPORT

Report Request ID: 941451 | Report Code: AMP480 | Dec. 23, 2011

GEOGRAPHIC SELECTIONS

Tribal Code	State	County	Site	Parameter	POC	City	AQCR	UAR	CBSA	CSA	EPA Region	Method	Duration	Begin Date	End Date
	04	023	0004												

PROTOCOL SELECTIONS

Parameter Classification	Parameter	Method	Duration
	81102		

SELECTED OPTIONS

Option Type	Option Value
USER SITE METADATA	STREET ADDRESS
MERGE PDF FILES	YES
QUARTERLY DATA IN WORKFILE	NO
WORKFILE DELIMITER	,
SINGLE EVENT PROCESSING	EXCLUDE REGIONALLY CONCURRED EVENTS

GLOBAL DATES

Start Date	End Date
2010	2010

APPLICABLE STANDARDS

Standard Description
PM10 24-hour 2006

Notes:

1. Warning: Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

Pollutant: PM10 Total 0-10um STP(81102)
Standard Units: Micrograms/cubic meter (25 C)(001)
NAAQS Standard: PM10 24-hour 2006
Statistic: Annual Estimated Days > Standard **Level:** 150

Design Value Year: 2010
REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.
State Name: Arizona

			2010				2009				2008				3 - Year	
			Exceedances		#Complete		Exceedances		#Complete		Exceedances		#Complete		Estimated	Validity
Site ID	POC	STREET ADDRESS	Estimated	Count	Quarter	Cert.	Estimated	Count	Quarter	Cert.	Estimated	Count	Quarter	Cert.	Exceedances	Ind.
04-023-0004	1	300 N MORLEY AVE	0	0	4		0	0	4		6.6	1	4		2.2	Y
04-023-0004	3	300 N MORLEY AVE	8.5*	6	0		2	2	4		13.2	13	4		7.9	Y

Notes:
1. Warning: Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
2. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

Appendix I

Quantitative Milestone and Reasonable Further Progress Report for the Nogales PM_{10} Nonattainment Area

This page is intentionally blank.

NCW

AQPL N-96-136

AQD:DO96.269

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Fife Symington, Governor   Russell F. Rhoades, Director

June 12, 1996

Felicia Marcus, Regional Administrator
U.S. E.P.A. Region 9, Mail Code - RA
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Marcus:

SUBJECT: Nogales PM_{10} Nonattainment Area Quantitative Milestone/Reasonable Further Progress Report

Enclosed is the Quantitative Milestone/Reasonable Further Progress report for the Nogales, Arizona PM_{10} Nonattainment Area. This report is intended to satisfy the requirements of Section 189(c)(2) of the Clean Air Act (CAA).

This report indicates that all air quality control measures contained in the PM_{10} attainment state implementation plan (SIP) for the Nogales, Arizona nonattainment area have been fully implemented. As a result, all of the PM_{10} emission reduction milestones prescribed in the SIP for the last three years have been met.

If you have any questions regarding this milestone report for the Nogales, Arizona PM_{10} nonattainment area, please call Steve Bacs at (602) 207-4479.

Sincerely,

Russell F. Rhoades
Director

Enclosure

RFR:SJB:vjm

cc: Nancy Wrona
Ira Domsky

QUANTITATIVE MILESTONE
AND
REASONABLE FURTHER PROGRESS REPORT
FOR THE
NOGALES PM_{10} NONATTAINMENT AREA

Prepared by the Arizona Department of Environmental Quality
May, 1996

Introduction

The purpose of this report is to satisfy requirements of Section 189(c) the Federal Clean Air Act (CAA) applicable to moderate particulate matter (PM_{10}) nonattainment areas. The report demonstrates whether quantified and creditable air quality control measures contained in the State Implementation Plan (SIP) for the Nogales PM10 Nonattainment Area for Arizona have been fully implemented. The report must also show whether the December 31, 1994, emission reduction milestone for a PM_{10} area has been achieved.

CAA Requirements

According to Section 189(c)(1) of the CAA, attainment SIP revisions must contain quantitative milestones that:

1. Are to be achieved every three years until the area is designated attainment; and

2. Demonstrate reasonable further progress (RFP) toward attainment by the applicable attainment date. RFP is defined in Section 171(1) of the CAA as "such annual incremental reductions in emissions of the relevant air pollutant as are required by Part D of the CAA or may reasonably be required by the Administrator of the U. S. Environmental Protection Agency (EPA) for the purpose of ensuring attainment of the applicable national ambient air quality standard (NAAQS) by the applicable date."

A "milestone", therefore, is a prescribed level of emission reduction to be achieved over a three-year period that demonstrates RFP toward attainment. For all initial PM_{10} areas (i.e., those areas designated nonattainment by operation of law upon passage of the 1990 CAA amendments), EPA has set the milestone date at December 31, 1994, to coincide with the attainment datefor such areas.

Section 189(c)(2) of the CAA also requires that states shall submit a demonstration to EPA within 90 days after the end of each milestone which indicates whether:

1. All control measures in an approved SIP, which are applicable to a particular nonattainment area, have been implemented; and

2. The milestone prescribed in the SIP revision for emission reductions in the nonattainment area over the last three years has been met.

In order for a state to demonstrate that a milestone has been met, EPA guidance indicates that the state must show that all reasonably available control measures (RACM) contained in a SIP revision have been implemented, regardless of whether the revision has been approved by EPA. In addition, the state must show that the predicted emission reductions were achieved. EPA guidance has implicitly indicated that it will presume that predicted emissions reductions were achieved if RACM were fully implemented.

Attainment SIP for the Nogales PM_{10} Nonattainment Area

The Nogales PM_{10} Nonattainment Area, as a border area with air quality influenced by emissions emanating from Mexico, comes under the purview of Section 179(B) of the CAA. Therefore, the Nogales PM_{10} Nonattainment Area Plan (the Plan) must demonstrate that the area "would have attained the NAAQS by the applicable attainment date, but for emissions emanating from outside the United States". Field studies contained in the attainment SIP demonstrate that an estimated 94% of all PM_{10} emissions in the area originate from across the border in Mexico.

The Plan was adopted by the Arizona Department of Environmental Quality (ADEQ) and submitted to EPA for approval in June, 1993. Although the Plan demonstrates that the area would comply with Section 179(B) of the CAA without implementing additional control measures, enforceable RACM were adopted, but were not quantified.

Achieving the RFP/Milestone Requirement

All creditable RACM committed to in the Plan are shown in the first column of Table 1. All of the control measures have been implemented to the extent shown in the second column. Shown in the third column are comments pertaining to emission reductions expected by the end of the milestone period, December 31, 1994, and necessary to demonstrate RFP.

As shown in Table 1, all of the PM_{10} control measures committed to in the Plan have been fully implemented. Therefore, the December 31, 1994, emission reduction milestone showing RFP toward attainment has been met.

Monitoring Data

Monitoring data for Nogales, Arizona (Table 2) demonstrate there have been no exceedences of the 24-hour PM_{10} NAAQS since 1992. Monitored PM_{10} levels have consistently fallen since 1988. The improved monitored air quality trend in Nogales, Arizona, further supports the RFP demonstrated in this report.

TABLE 1
REASONABLE FURTHER PROGRESS
NOGALES, ARIZONA
PM10 NONATTAINMENT AREA

Control Measure	Percent Implementation Achieved	Comments
City of Nogales (NOG) NOG #1 - Pave, vegetate, or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.	100%	The city has exceeded its commitment to pave all unpaved roads by 1998 by completing that commitment in 1996.
NOG #2 - Require dust control plans for construction or land clearing projects.	100%	All land clearing permits require dust control plans. Random inspections are performed to ensure compliance.
NOG #3 - Require haul trucks to be covered.	100%	All haul trucks are required by ordinance to have covers.
NOG #4 - Provide for traffic rerouting or rapid clean up of mud/track out after storms.	100%	A new policy has been issued by the city manager requiring 24 hour cleanup response.
NOG #5 - Prohibit permanent unpaved haul roads and parking for commercial facilities.	100%	The diesel truck refueling area has been paved.
NOG #6 - Develop traffic reduction plans for unpaved roads.	100%	All unpaved roads will be paved by the end of 1996.
NOG #7 - Limit the use of recreational vehicles on open land.	100%	The city has no open areas used by off-road recreational vehicles.
NOG #8 - Reduce the usage of skid control sand and/or salt.	N/A - See Comments	Not reasonably available; no need for skid control in Nogales area.

TABLE 1
REASONABLE FURTHER PROGRESS
NOGALES, ARIZONA
PM10 NONATTAINMENT AREA

NOG #9 - Require curbing and pave or stabilize shoulders of paved roads.	100%	New law requires the MAG standard. The MAG standard refers to the Maricopa Association of Governments minimum design standard for curbs, gutters, and sidewalks. These standards also reflect USDOT and ADOT standards.
NOG #10 - Pave or chemically stabilize unpaved roads. See NOG #1.	100%	Accounted for in NOG #1.
NOG #11 - Pave, vegetate, or chemically stabilize unpaved parking areas. See NOG #5.	100%	Accounted for in NOG #5.
NOG #12 - Require dust control measures for material storage piles.	100%	Only ADEQ can regulate storage piles as an air pollution source.
NOG #13 - Provide for storm water drainage to prevent water erosion onto paved roads.	100%	City Code 8-16-23 is in effect. Meadow Hills and Yucca Drive have been repaired with box culverts and paved with concrete.
NOG #14 - Require vegetation, chemical stabilization, or other abatement of wind erodible soil (mines, farms, construction sites, etc.).	100%	City Code 8-16-10 in effect. Reseeding required within 180 days of any clearing project.
Santa Cruz County (SCC) SCC #1 - Pave, vegetate, or chemically stabilize access points where paved traffic surfaces adjoin paved roads.	100%	The county has paved all roads under its jurisdiction, including 4 miles of South River Road.

TABLE 1
REASONABLE FURTHER PROGRESS
NOGALES, ARIZONA
PM10 NONATTAINMENT AREA

SCC #2 - Require dust control plans for construction or land clearing projects.	100%	Article 19 replaced with updated article requiring dust control plans, hydro seeding, and inspection.
SCC #3 - Require haul trucks to be covered.	100%	County Manager issued policy for all haul trucks to be covered.
SCC #4 - Provide for traffic rerouting or rapid clean up of mud/track out after storms.	100%	Right-of-way control ordinance requires all contractors to cleanup within 24 hours.
SCC #5 - Prohibit permanent unpaved haul roads and parking for commercial facilities.	100%	Article 5 dealing with restrictions for unpaved roads goes in effect in 3rd quarter 1996. Meanwhile, the Sheriffs parking lot (only unpaved staging area) has been paved.
SCC #6 - Develop traffic reduction plans for unpaved roads.	100%	N/A - there are no unpaved roads in the County portion of the nonattainment area.
SCC #7 - Limit the use of recreational vehicles on open land.	100%	Article 10 will prohibit off-road recreational vehicles this year.
SCC # 8 - Reduce the usage of skid control sand and/or salt.	N/A - See Comments.	Not reasonably available; no need for skid control in Nogales area.
SCC #9 - Require curbing and pave or stabilize shoulders of paved roads.	100%	Article 5 requires MAG standards starting this year. (See NOG #9)
SCC #10 - Pave or chemically stabilize unpaved roads. See SCC #1.	100%	Accounted for in SCC #1.

TABLE 1 REASONABLE FURTHER PROGRESS NOGALES, ARIZONA PM10 NONATTAINMENT AREA		
SCC #11 - Pave, vegetate, or chemically stabilize unpaved parking areas. See SCC #5	100%	Accounted for in SCC #5.
SCC #12 - Require dust control measures for material storage piles.	N/A - See Comments.	Only ADEQ can regulate material storage piles as an air pollution source.
SCC #13 - Provide for storm water drainage to prevent water erosion onto paved roads.	100%	24 to 36 cross-road drainages are converted to box culverts every year.
SCC #14 - Require vegetation, chemical stabilization, or other abatement of wind erodible soil (mines, farms, construction sites, etc.).	100%	Article 19 will take effect in 3rd quarter 1996 requiring revegetation of cleared areas. See SCC #2.
Arizona Department of Environmental Quality (DEQ) DEQ #1 - Reasonably Available Control Technology (RACT)	100%	No policy in effect, however all large sources are complying with RACT.
DEQ #2 - Reasonably Available Control Technology	100%	See DEQ #1
DEQ #3 - EPA RACM 12, Require dust control measures for material storage piles.	100%	Inspection Full-Time Employees (FTEs) have increased to ensure compliance per Arizona Administrative Code (AAC) R-18-2-607.
Rio Rico #1 - EPA RACM #7, limit use of recreational vehicles on open land	100%	Lessor/Lessee agreement is in effect to prohibit off-road recreational vehicle use.

TABLE 1 REASONABLE FURTHER PROGRESS NOGALES, ARIZONA PM10 NONATTAINMENT AREA		
U.S. Customs Service #1, Reduce idling time of diesel-powered vehicular traffic at border entrances.	100%	Border entrance improvements to reduce wait times completed in 1993 and 1994.
U.S. Customs Service #2, Reduce idling time of diesel-powered vehicular traffic at border entrances.	100%	Line Release Program to provide expedited entry for repeat hauler with good records implemented in 1993.

TABLE 2

NOGALES 24-HOUR PARTICULATE CONCENTRATION (ug/m3)
PARTICULATE MATTER LESS THAN 10 MICRONS (PM10)
(NAAQS HEALTH STANDARDS: ANNUAL = 50 ug/m3

AIRS #	SITE NAME	YEAR	Q1 % DATA RECOVERY	Q2 % DATA RECOVERY	Q3 % DATA RECOVERY	Q4 % DATA RECOVERY	YEAR % DATA RECOVERY	1st MAX (ug/m3)	2nd MAX (ug/m3)	3rd MAX (ug/m3)	ANNUAL AVERAG (ug/m3)	EXPECTED EXCEED'S	3 YR. EXP EXCEED'S
04-023-0004	Nogales	1988	100	100	100	80	95	155	147	131	69	2.00	2.33
		1989	*46	*73	100	*73	73	244	168	145	63	1.00	2.33
		1990	100	100	*73	*73	68	175	108	104	52	1.00	1.33
		1991	100	100	86	86	93	164	149	112	50	1.00	1.00
		1992	93	93	*66	93	86	153	146	134	54	0.00	0.67
		1993	93	*73	*66	*73	76	119	108	72	42	0.00	0.33
		1994	86	93	93	*73	86	116	95	91	39	0.00	0.00
		1995	100	86	100	80	92	123	107	80	55	0.00	0.00

* = Data recovery less than 75% per quarter.

NATIONAL AMBIENT AIR QUALITY STANDARDS:

24 Hour = 150 ug/m3(due to rounding, a value of 155 ug/m3 or greater is necessary to be an exceedance of the standard.)

ANNUAL AVERAGE = 50 ug/m3 (due to rounding a value of 55 ug/m3 or greater is necessary to be considered to be an exceedance of the standard)

Source: Arizona Department of Environmental Quality\Monitoring Unit.

nogtlb

Appendix J
Potential New Source

A copper mine located approximately 20 miles southeast of Nogales is in the final stages of approval from the Mexican government. If approved, the facility will be in operation 24 hours per day, 365 days per year.

The following text was taken from the parent company's press release dated January 17, 2012:[1]

January 17, 2012
Mercator Minerals Provides an Update on El Pilar Activities

Vancouver, British Columbia -- January 17, 2012 - **Mercator Minerals Ltd. (TSX:ML)** ("Mercator" or the "Company") is pleased to provide an update on activities at its wholly owned El Pilar project. On January 12, 2012, the Company's subsidiary which holds the El Pilar project, made the final payment for the change of land use ("CUS") permit which allows mining to commence. Also, over the past few months, the final water concessions have been obtained, which along with the previously granted mineral concessions, surface rights, and construction permit, allows for the commencement of construction and mining operations at the El Pilar project. Detailed engineering, environmental studies and right of way on the power transmission line and access road have also been advanced. Detailed engineering work continues with major equipment sourcing and construction bid materials being prepared.

An updated feasibility study, which will incorporate shorter lift heights in the project's base case resulting in improved project economics, is expected to be released before the end of the first quarter 2012.

"As of today, we have all the necessary permits and agreements in place to commence construction and mining at El Pilar," said Bruce McLeod, Mercator's President and CEO. "Our immediate focus is to continue to de-risk the project, improve the project's economics and ensure the project is construction-ready once value-accretive financing is secured."

Quality Assurance/Quality Control
Mike Broch, BSc, Geology, MSc, Economic Geology, FAusIMM, Mercator's VP Exploration and Evaluations, a Qualified Person as defined by National Instrument 43-101, supervised the preparation of and verified the El Pilar technical information contained in this release.

About Mercator Minerals Ltd.
Mercator Minerals Ltd., a TSX listed Canadian mining company with one of the fastest growing base metal profiles in its peer group, is a leading copper, molybdenum and silver producer with a diversified portfolio of high quality operations and projects in the USA and Mexico. Mercator provides investors exposure to current copper, molybdenum and silver production from the large tonnage long life Mineral Park Mine in Arizona, as well as mid-term exposure to copper at the El Pilar deposit in Sonora in northern Mexico and longer term exposure of molybdenum and copper through the development of the El Creston deposit also in Sonora in northern Mexico.

[1] <http://www.mercatorminerals.com/s/NewsReleases.asp?ReportID=502199&_Type=News-Releases&_Title=Mercator-Minerals-Provides-an-Update-on-El-Pilar-Activities>

This page is intentionally blank.

Appendix K
Public Process Documentation

This appendix contains the public process documents for the first and second public comment periods for the 2012 Nogales PM_{10} SIP.

First Public Comment Period:

- Parallel Processing Request Letter
- Public Hearing Notice
- Affidavit of Publication for Notice of Public Hearing
- Hearing Agenda
- Hearing Sign-in Sheet
- Hearing Transcript
- Hearing Officer Certification
- Public Comments
- Responsiveness Summary

Second Public Comment Period:

- Second Parallel Processing Request
- Public Hearing Offer
- Hearing Cancellation Notice

This page is intentionally blank.

Janice K. Brewer
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.azdeq.gov

Henry R. Darwin
Director

MAY 29 2012

Jared Blumenfeld, Regional Administrator
EPA Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Re: Request for Parallel Processing for the Proposed State Implementation Plan for the Nogales PM_{10} Nonattainment Area

Dear Mr. Blumenfeld:

Consistent with the provisions of Arizona Revised Statutes §§ 49-104, 49-106, and 49-404 and Title 40 Code of Federal Regulations Part 51, the Arizona Department of Environmental Quality (ADEQ) hereby submits a proposed revision for approval into the Arizona State Implementation Plan (SIP) to meet the requirements of Sections 189 (d) and 179B of the Clean Air Act (CAA). ADEQ is proposing to adopt the enclosed Proposed State Implementation Plan for the Nogales PM_{10} Nonattainment Area and Appendices A through J.

In order to expedite review and approval, in accordance with Title 40 Code of Federal Regulations Part 51, Appendix V.2.3, ADEQ is requesting Environmental Protection Agency (EPA) propose approval of the submitted proposed Nogales PM_{10} SIP by parallel processing, a method used to expedite review of a plan. Parallel processing allows the State to submit the plan to EPA prior to actual adoption by the State and provides an opportunity for the State to consider EPA's comments prior to submittal of the final plan for final review and action.

The 30-day public comment period for the plan has been opened. The public hearing for the Nogales plan is scheduled for June 21, 2012. The schedule for final adoption of the plan by ADEQ is no later than June 22, 2012, with submittal to EPA of the final plan and appendices cited above by June 27, 2012.

If you have questions about this submittal, please contact me at (602) 771-2288.

Sincerely,

Eric C. Massey
Director, Air Quality Division

cc: Colleen McKaughan, EPA IX, w/o enclosures
Gregory Nudd, EPA IX, w/o enclosures
Jerald Wamsley, EPA IX, w/o enclosures

Enclosures

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
30 DAY PUBLIC COMMENT PERIOD AND HEARING ON
NOGALES MODERATE PM_{10} MAINTENANCE PLAN

The Arizona Department of Environmental Quality (ADEQ) is beginning a thirty day public comment period with the publication of this notice on May 18, 2012, for the proposed Nogales Moderate Area PM_{10} State Implementation Plan (SIP). The proposed SIP is an update of the plan submitted by ADEQ to the U.S. Environmental Protection Agency (EPA) for the Nogales Nonattainment Area (NNA) in 1993.

A public hearing on the proposed SIP revision to be submitted to the U.S. Environmental Protection Agency the will be held on Thursday, June 21, 2012, at 2:00 p.m. at the Nogales Chamber of Commerce, 123 West Kino Park Place, Nogales, AZ 85621. All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments may be submitted prior to or during the public hearing and must be postmarked or received by at ADEQ by 5:00 p.m. on June 21, 2012.

All written comments should be addressed, faxed, or e-mailed to:

Jim Wagner
Arizona Department of Environmental Quality - Air Quality Division
1110 West Washington Street, Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: JW3@azdeq.gov

Copies of the PM_{10} SIP proposal are available for review online at the following web address http://www.azdeq.gov/cgi-bin/vertical.pl and in hard copy at the following locations:

ADEQ Records Center
First Floor, 1110 W. Washington Street
Phoenix, Arizona 85007
Attention: Norlene Lara, (602) 771-4712

Nogales Library
777 E. Grand Avenue
Nogales, AZ 85621
Attention: Suzanne Haddock, (520) 287- 6571

This page is intentionally blank.

STATE OF ARIZONA)
: SS
COUNTY OF SANTA CRUZ)

AFFIDAVIT OF PUBLICATION

ELISA BERMUDEZ

Elisa Bermudez being first

Duly sworn, deposes and says: That (he) (she) is the Agent to the Publisher of the NOGALES INTERNATIONAL newspaper printed and published two days week in the City of Nogales, County of Santa Cruz, State of Arizona. That the notice, a copy of which is hereto attached, described as follows:

PM 10 MAINTENANCE
PLAN
PO#E0046221

was printed and published in the regular and entire issue of said

NOGALES INTERNATIONAL for 2 issues, that the first was

made on the 18th day of MAY 20 12

and the last publication thereof was made on the 22nd day of

MAY 20 12 that said publication

was made on each of the following dates, to wit:

05/18/12
05/22/12

COPY

Request of ADEQ ARIZONA DEPARTMENT O

NOGALES INTERNATIONAL

268 W VIEW POINT, NOGALES, AZ 85621 (520)375-5760

By Manuel C. Coppola

Subscribed sworn to before me this 22nd day of MAY

20 12

Manuel C. Coppola
Notary Public
Santa Cruz County, Arizona
My Comm. Expires 02-26-15

Notary Public in and for the County of Santa Cruz, State of Arizona

My Commission Expires: 2/26/15

PUBLIC NOTICE

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY 30 DAY PUBLIC COMMENT PERIOD AND HEARING ON NOGALES MODERATE PM10 MAINTENANCE PLAN

The Arizona Department of Environmental Quality (ADEQ) is beginning a thirty day public comment period with the publication of this notice on May 18, 2012, for the proposed Nogales Moderate Area PM10 State Implementation Plan (SIP). The proposed SIP is an update of the plan submitted by ADEQ to the U.S. Environmental Protection Agency (EPA) for the Nogales Nonattainment Area (NNA) in 1993.

A public hearing on the proposed SIP revision to be submitted to the U.S. Environmental Protection Agency the will be held on Thursday, June 21, 2012, at 2:00 p.m. at the Nogales Chamber of Commerce, 123 West Kino Park Place, Nogales, AZ 85621. All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments may be submitted prior to or during the public hearing and must be postmarked or received by at ADEQ by 5:00 p.m. on June 21, 2012.

All written comments should be addressed, faxed, or e-mailed to:
Jim Wagner
Arizona Department of Environmental Quality - Air Quality Division, 1110 West Washington Street, Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: JW3@azdeq.gov

Copies of the PM10 SIP proposal are available for review online at the following web address http://www.azdeq.gov/cgi-bin/vertical.pl and in hard copy at the following locations:
ADEQ Records Center
First Floor, 1110 W. Washington Street

This page is intentionally blank.

ADEQ
Arizona Department of Environmental Quality

Public Hearing Agenda

AIR QUALITY DIVISION

PUBLIC HEARING ON THE PROPOSED
ARIZONA AIR QUALITY
STATE IMPLEMENTATION PLAN (SIP)
for the
Nogales PM-10 Nonattainment Area

Nogales-Santa Cruz County Chamber of Commerce
123 West Kino Park Place
Nogales, AZ

2:00 PM Thursday June 21, 2012

Pursuant to 40 CFR § 51.102 notice is hereby given that the above referenced meeting is open to the public.

1. Welcome and Introductions
2. Purposes of the Oral Proceeding
3. Procedure for Making Public Comment
4. Brief Overview of the proposed SIP revision
5. Question and Answer Period
6. Oral Comment Period
7. Adjournment of Oral Proceeding

Copies of the proposal are available for review at the Arizona Department of Environmental Quality (ADEQ) Library, 1110 W. Washington St., Phoenix, Arizona; Nogales-Richlin Public Library at 518 N. Grand Avenue, Nogales, AZ; and on the web at www.azdeq.gov. For additional information regarding the hearing please call Diane Arnst, ADEQ Air Quality Division, at (602) 771-2375 or 1-800-234-5677, Ext. 771-2375. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Dan Flukas at (602) 771-4795 or 1-800-234-5677, Ext. 771-4795. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829.

This page is intentionally blank.

ADEQ
Arizona Department of Environmental Quality

Air Quality Division Sign-In Sheet

Please Sign In

SUBJECT Nogales PM_{10} Plan DATE 6/21/12

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	ALEJANDRO BARCENAS	CITY OF NOGALES	(520) 2876571		AGARCENAS@NOGALESAZ.GOV
2.					
3.					
4.					
5.					
6.					
7.					
8.					

This page is intentionally blank.

PROPOSED ARIZONA AIR QUALITY
STATE IMPLEMENTATION PLAN (SIP)
for the
Nogales PM-10 Nonattainment Area

Oral Proceeding
Hearing Officer Script
2:00 PM, June 21, 2012

Bruce Friedl: Good afternoon and thank you for coming. I now open this hearing on a proposed revision to the Arizona State Implementation Plan for the 2012 Nogales PM-10 State Implementation Plan for the Nogales PM-10 Nonattainment Area.

It is June 21, 2012, and the time is 2:24 PM. The location is the Nogales-Santa Cruz County Chamber of Commerce, 123 West Kino Park Place, Nogales, AZ. My name is Bruce Friedl, and I have been appointed by the Director of the Arizona Department of Environmental Quality (ADEQ) to preside at this proceeding.

The purposes of this proceeding are to provide the public an opportunity to:
(1) hear about the substance of the proposed air quality plan revision,
(2) ask questions regarding the revision, and
(3) present oral argument, data and views regarding the revision in the form of comments on the record.

Representing the Department is Diane Arnst.

Public notice appeared in the Nogales International on May 18 and 21, 2012, and on ADEQ's website. The documents subject to comment were made available online at www.azdeq.gov and in hard copy at the ADEQ Phoenix office and at the Nogales-Rochlin Public Library at 518 N. Grand Ave. Nogales, AZ.

The procedure for making a public comment on the record is straightforward. If you wish to comment, you need to fill out a speaker slip, which is available at the sign-in table, and give it to me. Using speaker slips allows everyone an opportunity to be heard and allows us to match the name on the official record with the comments. You may also submit written comments to me today. Please note, the comment period for the proposed SIP revision ends today, June 21, 2012 at 5:00 PM. All comments must be postmarked or received at ADEQ by 5:00 PM today, June 21, 2012 whether sent via U.S. mail or via e-mail or via FAX. Written comments can be mailed to Jim Wagner, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 W. Washington Street, Phoenix, Arizona 85007 or jw3@azdeq.gov. Comments may also be faxed to (602) 771-2366.

Comments made during the formal comment period are required by law to be considered by the Department when preparing the final state implementation plan. This is done through the preparation of a responsiveness summary in which the Department responds in writing to written and oral comments made during the formal comment period.

First, we will present a brief overview of the proposed revision to the state implementation plan.

Secondly, I will conduct a question and answer period. The purpose of the question and answer period is to provide information that may help you in making comments on the proposed revision.

Thirdly, I will conduct the oral comment period. At that time, I will begin to call speakers in the order that I have received speaker slips.

Please be aware that any comments at today's hearing that you want the Department to formally consider must be given either in writing by the deadline or on the record at today’s hearing during the oral comment period of this proceeding.

At this time, Diane Arnst will give a brief overview of the proposal.

* * * * *

The Nogales area was designated as a "moderate" nonattainment area for the 1987 24-hour PM-10 National Ambient Air Quality Standards (NAAQS) by operation of law upon enactment of the 1990 amendments to the Clean Air Act (CAA). The planning area includes all of the City of Nogales, and portions of the Rio Rico Southwest and Rio Rico Southeast communities.

As required by the 1990 amendments, Arizona submitted a State Implementation Plan for the Nogales PM-10 Nonattainment area in November 1993. The Environmental Protection Agency (or EPA) found the plan to be complete, but did not take final action on it. The plan included control measures that brought the Nogales area into attainment of the PM-10 standard by the December 31, 1994, deadline established by the 1990 Clean Air Act amendments. EPA published a Determination of Attainment by 1994 in the Federal Register on January 11, 2011. The Nogales area continued to meet the PM-10 standard through 1998. The area has been in and out of attainment since then.

The Proposed State Implementation Plan for the Nogales Nonattainment Area will ultimately serve as a replacement for the 1993 plan. Clean Air Act Section 179(B) provides that any area that establishes to the satisfaction of EPA that it would attain the PM-10 NAAQS “but for emissions emanating from outside the United States” shall not be subject to certain Clean Air Act requirements, including demonstrations of reasonable further progress in air quality, demonstrations of attainment, and contingency measures. The proposed plan includes four technical demonstrations that Nogales, Arizona would be in attainment of the PM-10 standard "but for" emissions originating in Nogales Municipality, Sonora, Mexico. ADEQ worked closely with EPA Region IX to develop the Emissions Inventory of sources in Arizona and sources in Sonora contributing PM-10 emissions to this air quality planning area and to develop the technical demonstrations. The most significant source category in Nogales, Arizona is fugitive dust from unpaved roads. All public roads in the City of Nogales have been paved and accepted into the City’s Street maintenance Program. ADEQ estimates that 134.4 miles of unpaved roads in the Rio Rico portion of the planning area have been double chip-sealed and approximately 53 miles of unpaved roads remain. The proposed plan also demonstrates that all other applicable requirements of the Clean Air Act have been met.

Mr. Friedl: Thank you, Diane. This concludes the explanation period of this proceeding on the proposed revision to the state implementation plan.

* * * * *

Mr. Friedl: Are there any questions before we move to the oral comment period?

QUESTIONS

This concludes the question and answer period of this proceeding on the proposed state implementation plan revision.

* * * * *

Mr. Friedl: I now open this proceeding for oral comments. Does anybody wish to make a comment?

COMMENTS

Mr. Friedl: This concludes the oral comment period of this proceeding on the proposed state implementation plan revision.

* * * * *

If you have not already submitted written comments, you may submit them to me at this time. Again, the comment period for this proposed revision to the state implementation plan ends at 5:00 PM MST today, June 21, 2012.

Thank you for attending.

The time is now 2:33 PM. I now close this oral proceeding.

ADEQ
Arizona Department
of Environmental Quality

Air Quality Division

Public Hearing Presiding Officer Certification

I, Bruce Friedl, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality for the 2012 Nogales PM_{10} State Implementation Plan (SIP) Revision, was conducted on June 21, 2012, at the Nogales Chamber of Commerce, 123 W. Kino Park Place, Nogales, Arizona, in accordance with public notice requirements by publication in the *Nogales International* on May 18 and May 22, 2012. I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 12 day of July 2012.

Bruce Friedl

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me on this 12 day of July 2012.

Notary Public State of Arizona
Maricopa County
Laura McFarland
My Commission Expires 04/02/2016

Laura McFarland
Notary Public

My commission expires: 4/02/16

This page is intentionally blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

June 21, 2012

Mr. Eric Massey, Division Director
Air Quality Division
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Re: EPA comments on the Proposed State Implementation Plan (SIP) for the Nogales PM10 Nonattainment Area

Dear Mr. Massey:

On June 20, 2012, Regional Administrator Blumenfeld signed a Federal Register Notice proposing approval of Arizona's "Proposed State Implementation Plan for the Nogales PM10 Nonattainment Area." As described in this notice, the U.S. Environmental Protection Agency's (EPA's) proposed approval of the plan's motor vehicle emissions budget (MVEB) is contingent on the submittal of a revised MVEB that includes road construction dust (see generally, 40 CFR 93.122(e)). We, therefore, request that the Arizona Department of Environmental Quality (ADEQ) submit a revised MVEB for the Nogales PM10 SIP that includes road construction dust, following the State's procedures for submitting a SIP revision to EPA. We request that the revised MVEB be submitted to EPA expeditiously, so we can resolve this issue in our final action which we expect to take in late July.

We regret our contribution to the omission of road construction dust from the MVEB and appreciate the extra time and effort it will take from your staff to make this correction. We look forward to continued collaboration with ADEQ. If you have any questions or concerns, please contact me at (415) 972-3854, or Jerry Wamsley at (415) 947-4111.

Sincerely,

Lisa Hanf

Lisa Hanf, Manager
Planning Office, Air Division

This page is intentionally blank.

James Wagner

From: Beverly Chenausky [bchenausky@azdot.gov]
Sent: Friday, June 15, 2012 1:35 PM
To: James Wagner
Subject: Comments provided on Draft Nogales PM10 Nonattainment Plan

Jim,

I have included a few comments on the proposed Nogales Moderate Area PM10 State Implementation Plan (SIP) for your review and consideration.

Page ES-5 – Last sentence first paragraph states "Each new travel plan" the word travel should be replaced with transportation. Additionally because Nogales is an isolated rural area and does not contain a MPO the frequency requirement of conformity with the MVEB of every four years is not applicable. In rural areas conformity done when an FHWA/FTA project needs approval not every four years, please remove reference to the four years in this sentence.

Page 2, Table 1.2 *(and elsewhere)* – General inquiry on why Census population is used instead of Department of Administration Population estimates? Please refer to Item 10 from The Governor's Executive Order 2011-04 Designating the Arizona Department of Administration as the State Agency Responsible for Preparing Official Population Estimates and Projections. http://azgovernor.gov/dms/upload/EO_2011-04.pdf

Page 24 – Wind Direction and Pollution Rose – it might be helpful for those not familiar with use of Wind Rose or meteorological terms to explain in more descriptive detail what the Wind Rose and Pollution Rose show as multiple features are displayed in one diagram, as an example describe what the length and thickness of the bar represents. The message is that the frequency of winds blowing (and pollution concentration) to Mexico from Arizona is small in comparison to the number of days the wind blows pollution to Arizona from Mexico, instead of referring to Appendix D maybe a summary of findings on what the data shows added to this section would be helpful. As a general observation, the SIP relies heavily on referring people to an appendix for further explanation, some of the information contained in the appendixes should be summarized or described in more detail throughout the SIP.

Page 48 – In relation to MVEB Table 7.1, is it necessary to split out the Mobile portion into Gasoline and Diesel categories? It is likely that the personal vehicle fleet (gasoline fleet) would increase at a greater rate than diesel, any savings in emissions from diesel should be able to be used to offset any increase in gasoline emissions; as such this category should be combined. Additionally, please explain what emissions are contained in the Mobile category directly in this section instead of referring to Appendix B and be consistent with the categories used. Specifically, **Page 15 of Appendix B -** States "EPA ran the MOVES model for 2011 to produce County-wide estimates for exhaust, brake, and tire-wear." the budget in Table 7.1 should thereby list exhaust, brake and tire-wear for clarity. The EPA continues to explain that they "used a .569 ratio to reflect the emissions in non-attainment area" this is an important point to make directly in the SIP document for ensuring consistent planning assumptions between the SIP and any necessary conformity analysis.

Thank you,

Beverly T. Chenausky

~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Multimodal Planning Division - Air Quality
Arizona Department of Transportation
206 South 17th Avenue, Mail Drop 320
Phoenix, AZ 85007
(602) 712-7487 Office
(602) 712-3046 Fax
bchenausky@azdot.gov
~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Arizona Department of Environmental Quality
Air Quality Division

July 23, 2012
RESPONSIVENESS SUMMARY
to
Testimony Taken at Oral Proceeding and Written Comments Received on
the Proposed Nogales PM_{10} State Implementation Plan Revision

The oral proceeding on the proposed Nogales PM_{10} State Implementation Plan (SIP) Revision was held at 2:00 p.m., Thursday, June 21, 2012, at the Nogales Chamber of Commerce, 123 West Kino Park Place, Nogales, Arizona. No oral comments were received. The Arizona Department of Environmental Quality (ADEQ) received two written comments from organizations during the public comment period, which ended June 21, 2012. The public comments and ADEQ's responses are described below.

Errata

EPA Region IX corrected minor miscalculations in emissions estimates for onroad mobile sources in Appendix B. The SIP was revised accordingly:

- On page ES-4, Figure ES-4, "Other" emissions and annual PM_{10} estimate were corrected.
- On page 13, paragraph 2, line 1, the annual PM_{10} estimate for 2008 was corrected.
- On page 13, Figure 3.1, the annual PM_{10} estimate for 2008 was corrected.
- On page 14, Table 3.2, the emissions estimates for onroad mobile sources were corrected.
- On page 15, Table 3.3, the emissions estimates for onroad mobile sources were corrected.
- On page 19, Figure 4.2, the annual PM_{10} estimate was corrected.
- On page 47, paragraph 4, lines 5 and 6, the percentages for onroad emissions were corrected.
- On page 48, paragraph 1, line 1, the 2011 Motor Vehicle Emissions Budget was corrected.
- On page 48, Table 7.1, road the estimates for onroad mobile sources were corrected.

The following typographical and grammatical errors have been corrected in the Final version:

- On page 1, paragraph 2, line 1 was corrected from "*Section 1.1.2 describes the climate and physiography of the Nogales NA; Sections 1.1.3 and 1.1.4 provide an overview of the demographics and economy of the Nogales area*" to "*Section 1.1.1 describes the climate and physiography of the Nogales NA; Sections 1.1.2 and 1.1.3 provide an overview of the demographics and economy of the Nogales area.*"
- On page 4, paragraph 1, line 2, a duplicate footnote 8 was removed.
- On page 6, line 7, "*Table 1.4*" was changed to "*Table 1.6*".
- On page 15, paragraph 1, line 7 was changed from *"As discussed in Section 2.0…"* to *"As discussed in Section 1.0,"*
- On page 16, footnote 20, line 2 was changed from "*2008 and 2011 Emissions Inventories for the Nogales NAA*" to "*2008 and 2011 Emissions Inventories for the Nogales NA*"
- Figure 4.1 was moved from page 18 to page 17. Table 4.1 was moved from page 17 to page 18. The Table of Contents was updated to reflect these changes.
- On page 35, bullets 2 and 3, the date of the exceedance was changed from 28 to 26.

- On page 38, paragraph 4, line 8 was changed from *“DPSNA, and…”* to *“Nogales NA, and…”*
- On Page 39, paragraph 3, line 2 was changed from *“…where OHV’s can be used within its borders”* to *“…where off-highway vehicles (OHVs) can be used within its borders…”*

Public Comments

Commenter #1:

Comment: Page E5, paragraph one, last sentence, the commenter stated that the term “travel plan” should be changed to “transportation plan”. The commenter also stated that because Nogales is an isolated rural area and does not have a metropolitan planning organization, the frequency requirement to determine conformity with the motor vehicle emission budget (MVEB) is not every four years, but determined when new federal projects take place.

Response: On page ES-5, paragraph one, the last sentence was changed from “*Each new travel plan must be shown to conform with the motor vehicle emissions budget (MVEB) at least every four years and upon any amendments, including a new regional emissions analysis”* to *“Each new transportation plan must be shown to conform with the motor vehicle emissions budget (MVEB) and upon any amendments, including a new regional emissions analysis.”*

Comment: The motor vehicle emissions budget (MVEB) on page 48 splits Mobile emissions into two categories, but it is likely that the personal vehicle fleet (gasoline fleet) would increase at a greater rate than diesel, and any savings in emissions from diesel should be able to be used to offset any increase in gasoline emissions; as such, this category should be combined. This section should explain what emissions are contained in the Mobile category directly instead of referring to Appendix B. The categories used should be consistent.

Response: The third paragraph on page 47 explains the sources included in MOVES projections. Table 7.1 on page 48 now combines diesel and gasoline emissions.

Comment: Page 15 of Appendix B states *“EPA ran the MOVES model for 2011 to produce county-wide estimates for exhaust, brake, and tire-wear."* The budget in Table 7.1 should thereby list Exhaust, Brake and Tire-wear for clarity.

Response: Table 7.1 now lists Exhaust, Brake and Tire-Wear as sources included in Onroad emission estimates.

Comment: In Appendix B, the EPA explains that in the 2011 emissions inventories EPA used a .569 ratio to allocate countywide emissions to the non-attainment area. This is an important point to make directly in the SIP document for ensuring consistent planning assumptions between the SIP and any necessary conformity analysis.

Response: On page 47, two sentences were added to paragraph four to address the commenter's concerns. *"The estimates were then scaled to the Nogales NA based on Census Bureau population data. To be conservative and to reflect the most current Census data, a 0.569 ratio was used instead of the 0.551 ratio used for 2008 population-based allocations."*

Comment: The commenter asked why Census population data was used instead of Arizona Department of Administration data, as required by Executive Order 2011-04.

Response: 40 CFR 93.110 requires transportation conformity determinations to be based on the latest planning assumptions. For some categories in the emissions inventories in Chapter Four, EPA scaled countywide estimates to the nonattainment area based on population. After reviewing both 2010 U.S. Census population data and Arizona Department of Administration (ADOA) annual official estimates released December 15, 2010, EPA opted to use Census data to allocate population-based emissions. For clarity and consistency, Census data is used throughout the SIP. The Arizona State Demographer's office approved the use of Census data in June 2011. ADOA is required to release new population projections based on U.S. Census data by December 31, 2012, to replace projections last issued by Arizona in 2006.

<u>Commenter #2</u>

Comment: The MVEB must include emissions from road construction projects to meet the requirements established in CFR 93.122(e).

Response: Road construction emissions estimates are now included in the MVEB.

This page is intentionally blank.

Documentation for the Second Public Comment Period for Revisions to the Proposed Nogales PM_{10} SIP

This page is intentionally blank.

ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.azdeq.gov

Janice K. Brewer
Governor

Henry R. Darwin
Director

JUL 2 3 2012

Jared Blumenfeld, Regional Administrator
EPA Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Re: Request for Parallel Processing for Revisions to the Proposed State Implementation Plan for the Nogales PM_{10} Nonattainment Area

Dear Mr. Blumenfeld:

Consistent with the provisions of Arizona Revised Statutes §§ 49-104, 49-106, and 49-404 and Title 40 Code of Federal Regulations Part 51, the Arizona Department of Environmental Quality (ADEQ) hereby submits a proposed revision for approval into the Arizona State Implementation Plan (SIP) to meet the requirements of Sections 189 (d) and 179B of the Clean Air Act (CAA). ADEQ is proposing to adopt the enclosed Proposed State Implementation Plan for the Nogales PM_{10} Nonattainment Area and Appendices A through K.

In order to expedite review and approval, in accordance with Title 40 Code of Federal Regulations Part 51, Appendix V.2.3, ADEQ is requesting Environmental Protection Agency (EPA) propose approval of the submitted proposed Nogales PM_{10} SIP by parallel processing, a method used to expedite review of a plan. Parallel processing allows the State to submit the plan to EPA prior to actual adoption by the State and provides an opportunity for the State to consider EPA's comments prior to submittal of the final plan for final review and action. This request supplements our May 29, 2012, parallel processing request.

ADEQ is submitting a parallel processing request during the thirty day public comment period for revisions to the proposed SIP. The revisions are in response to comments received during the initial thirty day comment period beginning on May 21, 2012, and June 21, 2012. The motor vehicle emissions budget (MVEB) was revised to include emissions from road construction and mathematical errors for onroad mobile sources were corrected in the emissions inventories and MVEB.

The schedule for final adoption of the plan by ADEQ is no later than August 26, 2012, with submittal to EPA of the final plan and appendices cited above by August 27, 2012.

If you have questions about this submittal, please contact me at (602) 771-2288.

Sincerely,

Eric C. Massey
Director, Air Quality Division

cc: Colleen McKaughan, EPA IX, w/o enclosures
Gregory Nudd, EPA IX, w/o enclosures
Jerald Wamsley, EPA IX, w/o enclosures

Enclosures

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY 30 DAY PUBLIC COMMENT PERIOD AND OPPORTUNITY TO REQUEST A HEARING ON REVISIONS TO THE NOGALES MODERATE PM_{10} MAINTENANCE PLAN

The Arizona Department of Environmental Quality (ADEQ) is holding 30 day public comment period beginning with the publication of this notice on July 24, 2012, for further revisions to the proposed Nogales Moderate Area PM_{10} State Implementation Plan (SIP). In response to comments received during the initial public comment period that began May 18, 2012, and ended June 21, 2012. The SIP was revised to include road construction dust in the Motor Vehicle Emissions Budget (MVEB) and correct mathematical errors in estimates for onroad mobile emissions in both the emissions inventory and MVEB.

If a request for a hearing is received by August 15, 2012, ADEQ will hold a hearing for the SIP revisions at 10:00 a.m., August 23, 2012, at ADEQ, 1110 W. Washington Street, Phoenix, Arizona, 85007. If no request is received, the hearing will be cancelled and a cancellation notice will be posted on ADEQ's calendar (http://www.azdeq.gov/cgi-bin/vertical.pl).The public may also call (602) 771-2388 to find out if the hearing has been cancelled.

All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments may be submitted prior to or during the public hearing and must be postmarked or received by at ADEQ by 5:00 p.m. on August 23, 2012.

All written comments should be addressed, faxed, or e-mailed to:

Jim Wagner
Arizona Department of Environmental Quality - Air Quality Division
1110 West Washington Street, Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: JW3@azdeq.gov

Copies of the revised PM_{10} SIP proposal are available for review online at the following web address http://www.azdeq.gov/cgi-bin/vertical.pl and in hard copy at the following locations:

ADEQ Records Center
First Floor, 1110 W. Washington Street
Phoenix, Arizona 85007
Attention: Norlene Lara, (602) 771-4712

Nogales Library
777 E. Grand Avenue
Nogales, AZ 85621
Attention: Suzanne Haddock, (520) 287- 6571

This page is intentionally blank.

ADEQ
Arizona Department of Environmental Quality
Janice K. Brewer, Governor
Henry R. Darwin, Director

PUBLIC NOTICE

CANCELLATION

On July 24, 2012, ADEQ offered to hold a public hearing on revisions to ADEQ's proposed State Implementation Plan for the Nogales PM_{10} Nonattainment Area if a request was received. ADEQ did not receive a hearing request; accordingly the hearing tentatively scheduled on August 23, 2012, has been cancelled.

For questions or more information please contact James Wagner (602) 771-2388 or via e-mail at jw3@azdeq.gov. All written comments should be addressed, faxed, or e-mailed to:

James Wagner
Arizona Department of Environmental Quality - Air Quality Division
1110 West Washington Street, Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: JW3@azdeq.gov

Copies of the revised PM_{10} SIP proposal are available for review online at the following web address http://www.azdeq.gov/cgi-bin/vertical.pl and in hard copy at the following locations:

ADEQ Records Center
First Floor, 1110 W. Washington Street
Phoenix, Arizona 85007
Attention: Norlene Lara, (602) 771-4712

Nogales Library
777 E. Grand Avenue
Nogales, AZ 85621
Attention: Suzanne Haddock, (520) 287- 6571

This page is intentionally blank.