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Air Quality Modeling for Pinal County PM10 Nonattainment Area – Preliminary 2008 Source Apportionment for Selected Design Days and Modeling Domains

prepared for:

Arizona Dept. of Environmental Quality

September 2013

prepared by:

Sierra Research, Inc.
1801 J Street
Sacramento, California 95811
(916) 444-6666

DRAFT REPORT

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Principal authors:

Robert G. Dulla
Wei Liu

Earl Withycombe
Consultant

Sierra Research, Inc.
1801 J Street
Sacramento, CA 95811
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1. INTRODUCTION

The goal of this analysis is to quantify each source's contribution in the base year, defined by the U.S. Environmental Protection Agency (EPA) to be 2008. Analysis of source contributions is needed to inform the development of control strategies designed to attain air quality standards. Subsequent steps towards control strategy development include meetings with stakeholders to discuss options for achieving emission reductions, assessing their cost effectiveness, and using modeling to assess progress towards attainment by implementing alternate packages of controls. Attainment progress will be made by projecting the 2008 emission inventory estimates for each of the selected monitors/design days to future years (after accounting for local growth and benefits of federal, state, and local controls). The attainment demonstration will be based on the percentage reduction in concentrations achieved between 2008 and a future year, applied to the base year monitored concentration. Attainment is demonstrated if the projected concentration resulting from the application of controls falls below the 24-hour PM10 standard of 150 $\mu g/m^3$.

Two different approaches were used in this analysis to assess source contributions. For stagnation day attainment demonstrations, air quality modeling was used to quantify impacts from individual sources on designated design days. Air quality modeling combines information on meteorological conditions (e.g., wind speed, wind direction, mixing height, etc.) with emission estimates to assess downwind pollutant concentrations at selected locations. For this analysis, AERMOD was selected to quantify the hourly contributions of each source represented within the stagnation day emissions inventory for the Cowtown, Stanfield, and Pinal County Housing monitors.

A different approach was selected to assess progress towards attainment on high wind days. It is based on the weighted rollback method employed in the Maricopa Association of Government's (MAG) Five Percent Plan. Through successive State Implementation Plans (SIPs), and in consultation with EPA, MAG determined that neither AERMOD nor photochemical grid models performed well in quantifying source contributions under high wind conditions, and that subsequent attainment demonstrations were not reliable. For this reason, an alternate approach was developed that weights the contribution of each source's emissions based on its distance to the monitor (i.e., assuming equivalent emissions, nearby source impacts are substantially greater than those located farther away). Source contributions can be determined through review of hourly and daily estimates of weighted emission values. Following meetings with stakeholders and selection of control strategies, attainment can be demonstrated by applying the effects of growth and control factors to the base year inventory to project values in future years. If the percentage reduction achieved in 24-hour values between the base and horizon years

reduces the design day value below the 24-hour PM10 National Ambient Air Quality Standard (NAAQS), attainment is demonstrated.

Following this introduction, Section 2 presents the results of the stagnation day modeling, and Section 3 presents the results of the high wind day modeling.

2. STAGNATION DAY MODELING

A review of EPA guidelines and related fugitive dust modeling employed in attainment demonstrations prepared for Maricopa County determined that AERMOD is the most suitable model for evaluating hourly source contributions to PM10 exceedances recorded at Pinal County monitors. AERMOD is a steady-state Gaussian plume dispersion model that assesses pollutant concentrations from a variety of sources. Adopted by EPA as a regulatory model on December 9, 2005, AERMOD contains improved algorithms for addressing low wind speed (near calm conditions) and can provide estimates for conditions when wind speeds are less than 1 m/sec,[1,2] which are common on the selected stagnation design days. Key inputs needed to apply AERMOD are summarized below.

- Emission Inventory – Hourly estimates of emissions were prepared using land parcel data provided by the Arizona Department of Environmental Quality (ADEQ) and Pinal County Air Quality Control District (PCAQCD), activity data collected through field surveys, contacts with stakeholders, etc., and cited fugitive dust emission factors.

- AERMET – AERMET is a preprocessor that converts raw meteorological measurements into formatted meteorological input files for AERMOD. The following data sources were used to configure AERMET to produce these input files:

  – On-site meteorological data with parameters for wind speed, wind direction, and temperature obtained from the Cowtown, Pinal County Housing, and Stanfield monitors;

  – Upper air meteorological data were derived from Tucson twice-daily sounding measurements; and

  – Cloud cover data came from Phoenix Sky Harbor International Airport.

The surface characteristics input to AERMET should be based on the topographic conditions in the vicinity of the meteorological tower used to provide meteorological

[1] "Revisions to the Guideline on Air Quality Models: Adoption of Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions," U.S. Environmental Protection Agency, Federal Register, Vol. 70, No. 216, p. 68218, November 9, 2005 (Attachment IV)
[2] User's Guide for AERMET, EPA-454/B-03-002, November 2004

data.[3,4] The values for the surface characteristics of albedo, Bowen Ratio, and surface roughness appropriate to the area around each meteorological monitoring station were obtained from AERSURFACE, designed to aid in obtaining realistic and reproducible surface characteristic values for AERMET, following EPA guidance.[5]

- The wind measurement height[6] for each monitor was input as the onsite site height parameter to AERMET. AERMOD adjusts the wind speed at these measurement heights to other heights based on the AERMOD profile equation for wind speed.[7]

- AERMOD Particle Deposition Algorithm was turned on to consider the deposition for the particles.

  – For the Concentrated Animal Feeding Operations (CAFOS), the following particle parameters were used in the modeling:[8]

Particle size (µm)	0 - 1.8	1.8 - 3.1	3.1 - 6.2	6.2 - 9.9
Mass Fraction	0.14	0.07	0.27	0.52
Particle Density (mg/m^3)	2.5	2.5	2.5	2.5

  – For other source categories, the particle parameters used in MAG 5% plan were adopted, as shown in the following table.

Particle size (µm)	0 – 2.5	2.5 - 5.0	5.0 – 7.5	7.5 – 10.0
Mass Fraction	0.145	0.177	0.278	0.400

Once AERMOD runs were complete, three additional steps were performed:

- Background – While wind speeds during stagnant periods are extremely low, they are sufficient to allow long-range transport of non-anthropogenic emissions from outside of the nonattainment to the three low wind modeling domains. To account for the impact of this transport, estimates of non-anthropogenic background concentrations were estimated from an analysis of PM10 concentrations recorded at Organ Pipe Cactus National Monument located southwest of Tucson. The location of the monitor has little anthropogenic activity and is located 68 miles from Tucson. The monitor is part of the IMPROVE

[3] Appendix W to Part 51—Guideline on air Quality Models, §8.3.c.
[4] U.S. EPA. AERMOD Implementation Guide, March 19, 2009.
[5] *http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf.*
[6] 3 meters, 3.5 meters, and 9.2 meters were reported as the wind measurement height for PCH, Cowtown, and Stanfield monitoring station, respectively.
[7] AERMOD Description of Model Formulation, Page 24, 4.1.1 Wind Speed Profiling. *http://www.epa.gov/ttn/scram/7thconf/aermod/aermod_mfd.pdf.*
[8] "Particulate matter emission rates from beef cattle feedlots in Kansas - Reverse dispersion modeling," H.F. Bonifacio et al, JAWMA Vol. 63, No. 3, p. 350-361.

monitoring network.[9] Filter measurements are collected every 3 days and measurements of both PM10 and PM2.5 concentrations are available (no hourly measurements are available). PM10 data were downloaded from the IMPROVE network for October and November 2008. Using meteorological measurements collected in Tucson (the closest representative monitoring site), the twenty Organ Pipe measurements were screened to eliminate days with high wind conditions. A review of the meteorological data found one day had 10 hours of winds exceeding the 12 mph high wind threshold and one day had one hour of winds exceeding the 12 mph threshold. Based on this finding one day out of the 20 days was excluded. The average 24-hour concentration for the remaining 19 days was 11.5 $\mu g/m^3$. This concentration was added to the average 24-hour concentration estimated by AERMOD to represent the daily average estimate of concentrations recorded at each of the stagnation monitors.

- Carryover – A comparison between the modeled concentrations (including background) and monitored concentrations found significant shortfalls in the modeled estimates. This is thought to be the result of extremely low wind speeds which promote carryover (i.e., particulate matter remaining in the atmosphere for multiple hours before particle deposition eliminates entrainment). AERMOD does not account for carryover; concentrations are estimated for each hour based on particulate mass emitted in that hour. To address the effect of carryover, concentrations from the previous hour were added to the succeeding hour. The carryover concentrations, however, were adjusted for the particle deposition that would occur over a one-hour period. Information on particle size distribution, mixing height, and particle deposition velocity was used to estimate the amount of deposition that would occur in a one-hour period. As noted above, two estimates of particle size distribution were used to configure AERMOD—values from the Salt River area confirmed by analysis of Aerodynamic Particle Sizer (APS) spectrometer measurements collected July 3-7, 2008 at Casa Grande, and CAFO estimates. A different distribution of mixing height estimates was prepared for each of the design days using AERMET. Estimates of settling distances by particle size range were calculated using an online deposition velocity model.[10] The results of the analysis showed that PM9 (i.e., particles 0 – 9 µm) would remain suspended and that only PM9-10 would settle out over the one-hour period. Because the fraction of material that settles out is dependent on the particle size distribution used to configure the source, separate estimates were prepared for CAFO and non-CAFO sources: 0.87 and 0.84 respectively.

- Normalize – A comparison between the diurnal profile of the estimated concentrations, after adjusting for background and carryover, showed the modeled estimates overestimated, and others underestimated hourly concentrations. To smooth out these differences and to match the overall estimated concentrations with design day measurements, the modeled values were normalized to the 24-hour monitored values. This was accomplished by calculating the % difference

[9] *http://vista.cira.colostate.edu/improve/default.htm*
[10] *http://www.filtration-and-separation.com/settling/settling.htm*, accessed in August, 2013.

between the 24-hour modeled and monitored concentration (after subtracting out background) and using the % difference to adjust each estimated hourly concentration.

Tabular summaries of estimated hourly concentrations are presented in Tables 1–3 for Cowtown, Pinal County Housing, and Stanfield, respectively. The tables provide information on monitored wind speed, wind direction, PM10 concentration, modeled mixing height, and source-specific concentrations. Also included are the total hourly estimated concentrations, total daily source concentration, overall source apportionment, and R^2 value assessing the hourly correlation between modeled and monitored concentrations. A visual display of monitored and modeled concentrations and mixing height is displayed in Figures 1–3.

Table 1
Stagnation Day Modeling Performance at Cowtown (CWT) on 10/29/2008, AERMOD Simulation of Monitored Concentrations (µg/m³)

											Agriculture		Unpaved Road					
Hour	WSPD (m/s)	WD	Mixing Height	PM10 Observation	Background	RailRoad	Point	Paved Road	Construction	CAFOs	Non-Tribal	Tribal	AG Road	Public Dirt	Private Dirt	Trail	Tribal Road	Total
1	1	153	45	402.3	11.5	2.0	0.2	1.5	0.0	86.1	0.0	0.0	0.0	8.3	0.1	0.0	0.0	109.6
2	1.3	178	102	343.0	11.5	2.3	0.2	2.0	0.0	78.6	0.0	0.0	0.0	8.9	0.1	0.0	0.3	103.8
3	1.5	133	145	417.8	11.5	1.4	0.1	1.4	0.0	8.8	0.0	0.0	0.0	3.6	0.1	0.0	0.4	27.5
4	1.7	153	210	125.4	11.5	1.2	0.1	1.2	0.0	48.5	0.0	0.0	0.0	3.3	0.1	0.0	0.1	66.0
5	0.9	152	56	248.4	11.5	2.7	0.3	4.3	0.0	516.7	0.0	0.0	0.0	20.9	0.2	0.0	0.0	556.6
6	0.5	198	12	156.5	11.5	5.0	1.5	24.2	0.0	493.5	0.0	0.0	0.0	79.0	0.1	0.0	2.5	617.4
7	1.3	198	105	294.2	11.5	3.3	1.1	25.4	0.0	93.8	10.8	6.3	39.7	83.1	0.0	0.0	4.7	279.7
8	1.3	182	159	171.8	11.5	1.0	0.1	10.4	0.0	28.9	13.1	8.1	60.2	48.2	0.0	0.0	3.1	184.8
9	1.1	184	190	136.3	11.5	0.5	0.1	4.5	0.0	5.8	4.6	4.1	34.4	24.9	0.1	0.0	1.6	92.1
10	0.5	252	251	219.5	11.5	0.2	0.3	1.7	0.2	41.2	4.8	1.9	24.2	12.1	1.1	0.0	1.0	100.2
11	0.7	327	541	165.8	11.5	0.1	2.9	0.7	7.6	35.6	4.2	0.4	21.4	6.5	1.5	0.0	0.2	92.7
12	1.1	348	891	103.2	11.5	0.0	3.4	0.2	6.7	0.5	1.0	0.0	10.8	0.5	0.7	0.0	0.0	35.4
13	1.2	13	1180	76.3	11.5	0.0	1.1	0.0	0.6	0.0	0.2	0.0	4.4	0.2	0.3	0.0	0.0	18.3
14	1.8	326	1391	61.7	11.5	0.0	2.0	0.1	1.4	0.1	0.2	0.0	5.2	1.4	0.3	0.0	0.0	22.1
15	1.4	328	1545	38.5	11.5	0.0	4.0	0.2	2.2	0.2	0.3	0.0	6.8	1.5	0.3	0.0	0.0	27.0
16	1.1	336	1636	41.5	11.5	0.0	2.0	0.4	1.8	0.2	0.3	0.0	8.1	4.1	0.4	0.0	0.0	28.8
17	0.8	4	1656	103.2	11.5	0.0	0.1	0.2	1.1	0.1	0.2	0.0	7.5	3.3	0.4	0.0	0.0	24.3
18	1.5	327	167	60.6	11.5	0.0	0.2	0.2	0.4	0.0	3.0	0.0	30.7	1.2	2.7	0.0	0.0	49.8
19	0.5	347	49	67.2	11.5	0.0	1.2	0.3	0.0	0.0	2.5	0.0	23.4	0.9	7.9	0.0	0.0	47.8
20	0.8	286	30	300.9	11.5	2.6	2.9	9.0	0.0	466.4	0.0	0.0	0.0	15.3	6.8	0.0	0.0	514.5
21	1.2	131	56	383.6	11.5	4.3	1.8	14.3	0.0	421.0	0.0	0.0	0.0	19.9	3.3	0.0	3.4	479.4
22	0.7	158	28	194.8	11.5	4.4	0.5	9.8	0.0	421.9	0.0	0.0	0.0	30.3	1.4	0.0	3.0	482.8
23	1.5	149	168	228.4	11.5	2.9	0.4	4.3	0.0	414.8	0.0	0.0	0.0	25.5	0.1	0.0	0.1	459.6
24	1.8	149	245	189.2	11.5	0.9	0.1	1.2	0.0	87.8	0.0	0.0	0.0	6.8	0.1	0.0	0.0	108.4
RSQR					N/A	0.35	0.08	0.11	0.10	0.16	0.00	0.00	0.05	0.05	0.00	0.29	0.09	0.16
Average			461.4	188.7	11.5	1.5	1.1	4.9	1.9	135.4	1.9	0.9	11.5	17.1	1.2	0.0	0.9	188.7
Percentage Contribution					6.1%	0.8%	0.6%	2.6%	1.0%	71.8%	1.0%	0.5%	6.1%	9.0%	0.6%	0.0%	0.5%	100.0%

Figure 1
Modeled vs Monitored Stagnation Day PM10 Concentrations (µg/m^3) at Cowtown (CTW)
10/29/2008

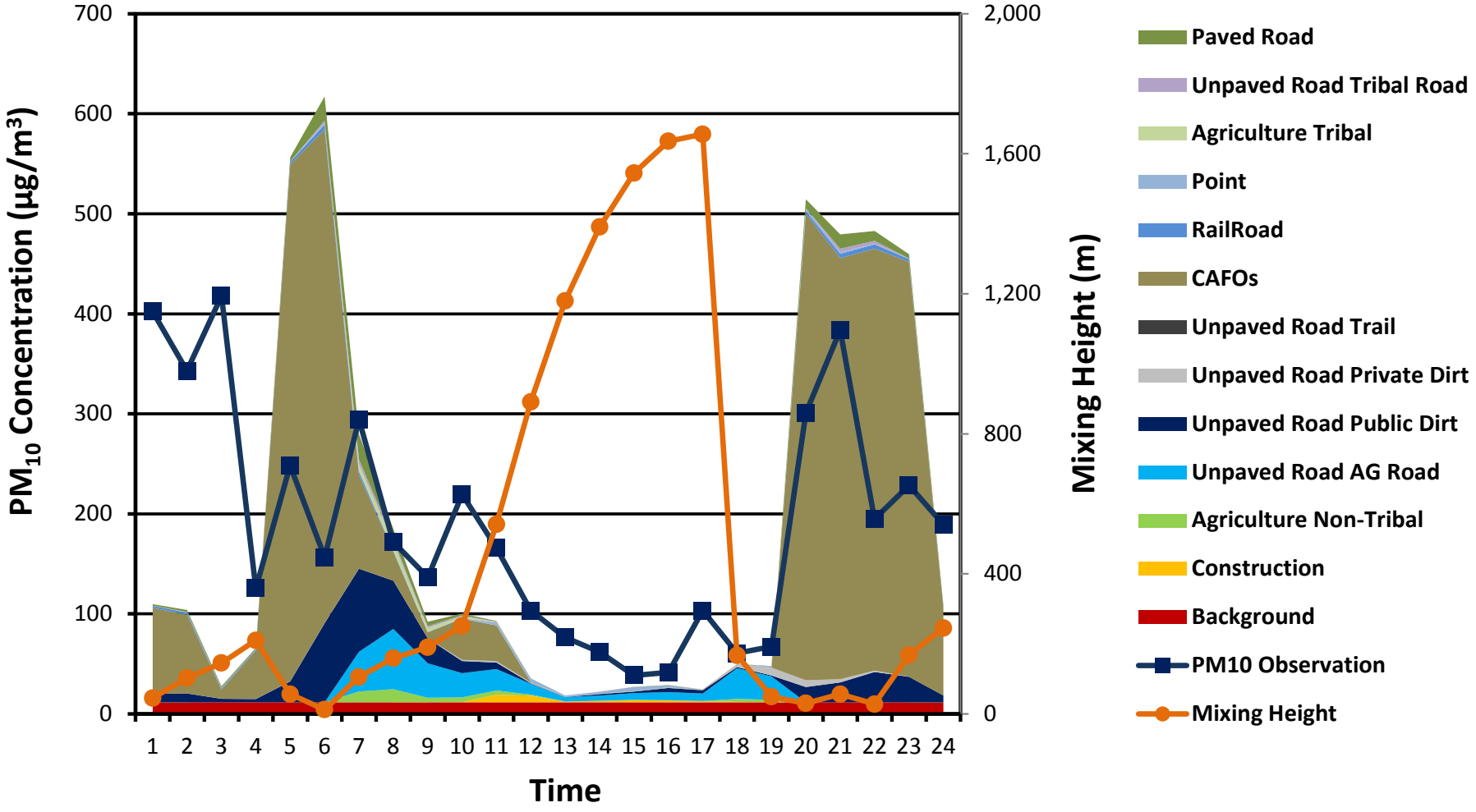


Table 2
Stagnation Day Modeling Performance at Pinal County Housing (PCH) on 10/29/2008, AERMOD Simulation of Monitored Concentrations (µg/m³)

Hour	WSPD	WD	Mixing Height	PM10	Background	Paved Road	Neighborhood UnPaved Road	Neighborhood Paved Road	Point	Construction	Nonroad	Dairy	Agriculture	Unpaved Road				Total
														AG Road	Public Dirt	Private Dirt	Trail	
1	1.0	100.2	49.0	91.4	11.5	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	1.6	0.0	19.1
2	0.6	122.1	24.0	86.1	11.5	0.1	8.9	0.1	0.0	0.0	0.1	0.0	0.0	0.0	13.8	19.9	0.0	52.2
3	0.5	73.5	19.0	72.5	11.5	0.2	8.3	0.2	0.0	0.0	0.1	0.0	0.0	0.0	46.3	15.6	0.0	81.9
4	0.5	144.0	19.0	67.8	11.5	0.3	1.3	0.3	0.0	0.0	0.1	0.0	0.0	0.0	32.4	0.0	0.0	49.2
5	0.5	246.0	19.0	76.6	11.5	0.2	1.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	14.6	23.3	0.0	48.5
6	0.5	142.8	19.0	60.1	11.5	1.3	7.0	1.3	0.0	0.0	0.1	0.0	0.0	0.0	12.2	53.1	0.0	86.4
7	0.5	189.5	19.0	145.8	11.5	1.1	19.5	1.1	0.0	0.0	0.1	0.0	17.3	0.0	0.0	114.4	10.2	168.3
8	0.5	276.0	36.0	287.0	11.5	0.0	17.3	0.0	0.3	0.0	0.1	0.0	68.7	32.6	132.4	104.7	13.8	370.7
9	0.7	133.5	146.0	179.2	11.5	0.1	6.5	0.1	1.9	0.0	0.0	0.0	64.1	53.8	119.0	32.5	4.4	309.9
10	0.5	300.9	273.0	455.2	11.5	0.1	9.1	0.1	6.7	0.0	0.0	0.0	33.8	45.0	48.4	10.1	0.2	161.9
11	0.6	18.9	601.0	234.8	11.5	0.0	13.3	0.0	6.2	0.0	0.0	0.0	20.0	32.1	41.9	5.8	0.2	136.3
12	0.7	259.9	956.0	85.6	11.5	0.0	8.7	0.0	2.5	0.1	0.1	0.1	6.7	14.0	9.7	5.5	0.1	60.3
13	0.6	308.7	1245.0	71.4	11.5	0.0	6.6	0.0	1.7	0.1	0.1	0.0	5.1	6.9	12.2	5.5	0.2	49.5
14	1.2	263.9	1458.0	62.7	11.5	0.0	5.9	0.0	1.1	0.1	0.0	0.0	3.5	4.9	10.0	5.4	0.2	43.6
15	1.0	292.9	1613.0	65.6	11.5	0.0	6.1	0.0	0.8	0.1	0.0	0.0	2.7	3.9	10.3	8.3	0.2	43.0
16	0.7	244.0	1705.0	54.5	11.5	0.0	5.4	0.0	1.2	0.0	0.0	0.2	2.9	4.8	8.7	9.2	0.4	45.0
17	0.7	294.0	1724.0	40.8	11.5	0.0	7.9	0.0	1.4	0.0	0.0	0.2	4.1	7.3	14.5	7.4	0.4	53.4
18	0.5	300.1	26.0	368.4	11.5	0.0	31.8	0.0	0.6	0.0	0.1	0.0	90.2	228.7	371.0	46.0	2.8	725.8
19	0.5	53.0	19.0	588.4	11.5	0.3	26.0	0.3	0.0	0.0	0.3	0.0	73.7	188.4	503.4	45.8	2.2	894.5
20	0.5	57.4	19.0	453.5	11.5	0.4	6.9	0.4	0.0	0.0	0.4	0.0	0.0	0.0	267.8	14.7	0.0	310.5
21	0.5	91.7	19.0	281.6	11.5	0.3	32.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	127.1	24.9	0.0	197.7
22	0.5	82.1	19.0	199.3	11.5	0.4	29.3	0.4	0.0	0.0	0.2	0.0	0.0	0.0	114.8	16.2	0.0	173.7
23	0.5	128.4	19.0	128.6	11.5	0.6	9.7	0.6	0.0	0.0	0.2	0.0	0.0	0.0	85.9	18.9	0.0	130.6
24	0.5	187.8	19.0	114.4	11.5	0.3	5.6	0.3	0.0	0.0	0.1	0.0	0.0	0.0	17.1	22.1	0.0	60.2
R Square					N/A	0.00	0.32	0.00	0.05	0.16	0.34	0.10	0.40	0.43	0.70	0.06	0.04	0.64
Average			419.4	178.0	11.5	0.2	11.5	0.2	1.0	0.0	0.1	0.0	16.4	25.9	84.1	25.4	1.5	178.0
Percentage Contribution					6.5%	0.1%	6.5%	0.1%	0.6%	0.0%	0.0%	0.0%	9.2%	14.6%	47.3%	14.3%	0.8%	100.0%

Figure 2
Modeled vs Monitored Stagnation Day PM10 Concentrations (µg/m^3) at Pinal County Housing (PCH)
10/29/2008

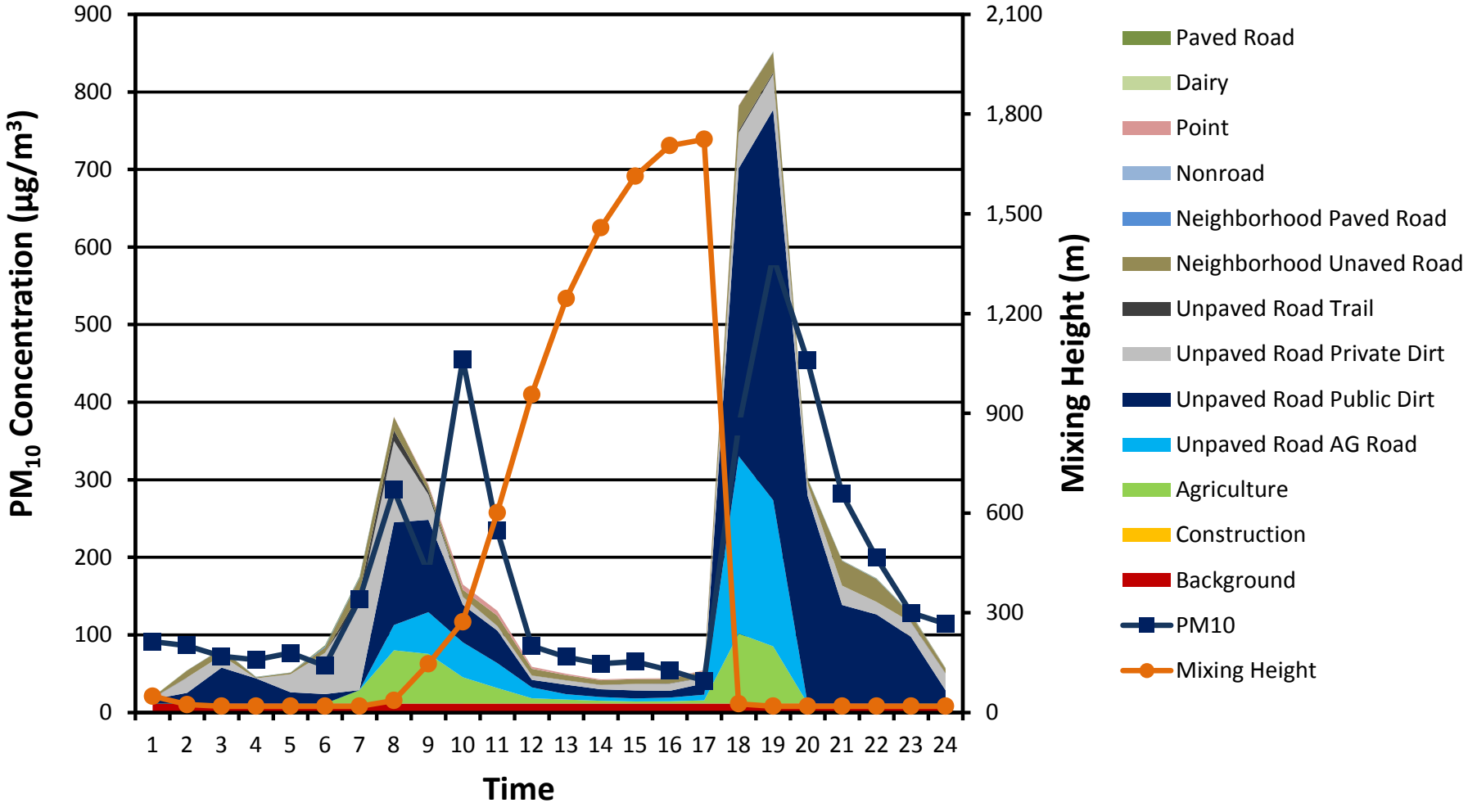
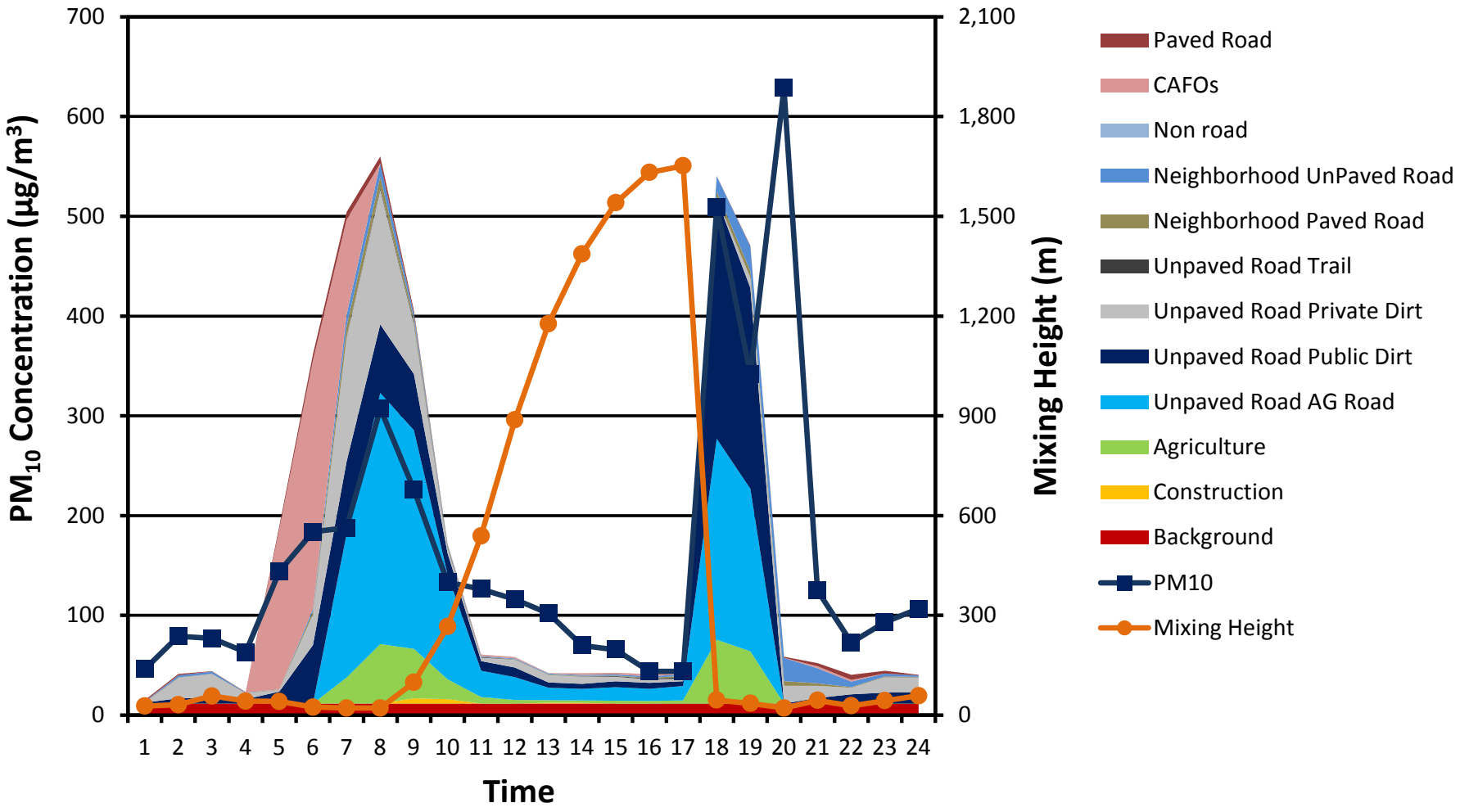


Table 3
Stagnation Day Modeling Performance at Stanfield (STF) on 10/29/2008, AERMOD Simulation of Monitored Concentrations (µg/m³)

Hour	WSPD (m/s)	WD	Mixing Height	PM10	Background	Paved Road	Neighborhood Paved Road	Neighborhood UnPaved Road	Construction	Non road	CAFOs	Agriculture	Unpaved Road				Total
													AG Road	Public Dirt	Private Dirt	Trail	
1	1.0	251.9	27.0	46.0	11.5	1.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	1.0	0.6	0.0	15.0
2	1.0	159.9	31.0	79.0	11.5	1.3	0.4	2.1	0.0	0.0	0.0	0.0	0.0	5.3	20.6	0.0	41.2
3	1.6	139.5	57.0	76.8	11.5	0.4	0.3	2.2	0.0	0.0	0.0	0.0	0.0	5.8	23.8	0.0	43.9
4	1.3	155.2	42.0	63.0	11.5	0.4	0.3	0.5	0.0	0.0	0.0	0.0	0.0	4.4	5.8	0.0	23.0
5	1.2	99.4	41.0	144.0	11.5	3.0	0.5	0.1	0.0	0.0	160.7	0.0	0.0	12.0	1.6	0.0	189.3
6	0.9	108.0	24.0	183.5	11.5	6.3	3.0	2.6	0.0	0.0	249.0	0.0	0.0	58.7	30.7	0.0	361.8
7	0.8	179.6	21.0	187.7	11.5	7.7	10.7	11.9	0.0	0.0	95.0	26.1	143.9	72.7	124.0	0.8	504.3
8	0.8	171.9	21.0	307.2	11.5	7.0	11.3	13.3	0.0	0.0	0.0	59.6	251.8	68.7	134.7	2.0	560.0
9	0.7	183.8	98.0	226.0	11.5	3.0	4.3	4.8	5.3	0.0	0.0	49.6	219.2	56.3	49.8	1.8	405.6
10	1.6	82.4	266.0	133.2	11.5	0.3	0.7	1.0	4.4	0.0	0.4	19.9	105.3	21.2	5.7	1.3	171.6
11	1.4	121.4	539.0	126.2	11.5	0.1	0.2	0.7	0.0	0.0	1.3	6.5	26.4	9.7	3.4	0.7	60.6
12	1.3	129.8	888.0	116.1	11.5	0.2	0.3	0.8	0.0	0.0	1.2	3.7	22.9	9.6	7.9	0.2	58.1
13	1.3	165.8	1177.0	101.7	11.5	0.1	0.4	0.8	0.8	0.0	0.2	2.5	12.5	5.3	7.6	0.1	42.0
14	0.9	112.1	1387.0	69.7	11.5	0.2	0.4	0.9	0.7	0.0	1.5	2.5	11.6	5.0	7.3	0.3	41.8
15	1.0	67.2	1541.0	65.5	11.5	0.1	0.5	1.2	0.0	0.0	1.4	2.9	13.6	5.9	4.6	0.7	42.3
16	1.1	94.3	1632.0	43.8	11.5	0.3	0.9	1.4	0.0	0.0	1.8	2.6	12.1	6.0	3.4	0.8	40.8
17	1.3	59.4	1652.0	43.8	11.5	0.2	1.4	1.8	0.0	0.0	1.4	3.1	14.5	4.8	2.4	1.4	42.6
18	1.2	5.3	45.0	509.1	11.5	0.3	5.8	15.1	0.0	0.0	0.0	64.0	201.5	241.1	0.2	1.0	540.4
19	1.1	297.8	35.0	341.7	11.5	0.8	6.6	24.6	0.0	0.0	0.0	52.4	163.0	201.3	10.3	0.1	470.6
20	0.8	296.4	21.0	628.5	11.5	1.1	4.7	23.3	0.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0	58.5
21	1.3	260.5	44.0	124.8	11.5	3.2	2.5	15.1	0.0	0.0	2.0	0.0	0.0	5.7	12.1	0.0	52.0
22	1.0	253.8	28.0	72.7	11.5	5.1	0.6	5.6	0.0	0.0	1.7	0.0	0.0	9.3	6.6	0.0	40.3
23	1.3	169.3	43.0	93.1	11.5	2.8	0.7	2.9	0.0	0.0	0.0	0.0	0.0	11.0	15.6	0.0	44.4
24	1.6	163.9	58.0	106.6	11.5	0.6	0.4	1.5	0.0	0.0	0.0	0.0	0.0	11.5	14.8	0.0	40.3
R Square					N/A	0.0	0.4	0.7	0.0	0.0	0.0	0.3	0.3	0.4	0.0	0.0	0.3
Average			404.9	162.1	11.5	1.9	2.4	5.6	0.5	0.0	21.6	12.3	49.9	34.7	21.3	0.5	162.1
Percentage Contribution					7.1%	1.2%	1.5%	3.5%	0.3%	0.0%	13.3%	7.6%	30.8%	21.4%	13.1%	0.3%	100.0%

Figure 3
Modeled vs Monitored Stagnation Day PM10 Concentrations (µg/m^3) at Stanfield (STF)
10/29/2008



3. HIGH WIND DAY MODELING

As discussed in the Inventory Preparation Plan (IPP) and the inventory documentation, high wind days are separated into low and high wind hours to account for differences in how PM10 is emitted (high wind re-entrainment versus low wind mechanical disturbance), based on whether average hourly wind speeds exceeded 12 mph. The method used to assess source apportionment and to provide a basis for demonstrating attainment is weighted rollback, a procedure employed in MAG's Five Percent Plan[11] and approved by EPA. As discussed in the Five Percent Plan:

> *The fundamental assumption underlying any rollback method is that pollutant concentrations are directly proportional to total emissions over the area of interest. A weighted rollback approach applies a distance reduction factor to the emissions of each source in the modeling domain to help assess the impact of emissions as distance from the monitor increases. The reduction factor is calculated based upon the distance between each source and the impacting monitor.*

The information used to develop this approach came from a saturation monitoring study in which Maricopa County placed a series of monitors at upwind locations from the Salt River monitors (e.g., West 43rd Ave, etc.). Data were collected for an extended period, and differences between sequential monitored concentrations were calculated during high wind hours when winds followed a path between the temporary and permanent monitors. The results of that analysis and the AERMOD analysis of alternate weighting factors determined that distance weighting (1/distance, where distance is measured from the centroid of the source to the monitor) was an appropriate mechanism to adjust PM10 emissions estimated within back trajectory domains (i.e., those presented in Chapter 2 of the Pinal County PM10 2008 base year inventory document). MAG used this approach to adjust all high wind hour emission estimates.

Due to the differences between windblown "fugitive" dust and low wind anthropogenic emissions, MAG chose not to weight low wind emissions produced within the high wind domain. After careful consideration, a decision was made to alter this approach for the Pinal County analysis. First, the low wind domain was restricted to a 45º arc (22.5º off of the back trajectory hourly wind direction for each hour) within the modeling domain presented in the Pinal County PM10 2008 base year inventory. The rationale was that the

[11] Chapter 6, Attainment Demonstration, "MAG Five Percent Plan for PM-10 for Maricopa County Nonattainment Area," May 2012

size of the selected domain should approximate the domain used in the high wind hour calculations. Second, the emissions within the hourly domain were weighted in proportion to their distance from the monitor and are referred to as distance weighted emissions in units of lbs.

- Background – Evaluations of meteorological conditions on these design days revealed that winds capable of entraining surface soil particles (i.e., having hourly average speeds ≥ 12 mph) were consistently from the northeast direction during each high wind design day. One of the closest PM10 monitors outside the boundaries of the Western Pinal County nonattainment area and generally to the northeast of the four high wind exceedance monitors is a station located in the small community of Queen Valley. The town of Queen Valley was recorded in the 2010 Census as having a permanent population of 788. The permanent population is augmented in winter by seasonal residents. Land use in the area is predominately residential, light commercial use, and recreation (e.g., the nearby golf course). The topography of the area is generally hilly or mountainous, with the Queen Creek wash running through the area from east to west. PM10 source emissions near the site are minimal, and are limited to vehicular traffic and residential and commercial activities. In general, roadways in Queen Valley are paved, with the exception of roads outside the populated area. The Queen Valley site was selected to represent PM10 concentrations near the upwind boundary of the nonattainment area during high wind hours.

  Because the Queen Valley monitor recorded 24-hour average PM10 concentrations on days representing a range of meteorological conditions, these concentrations were screened to isolate those recorded only on high wind days. Because the Queen Valley site does not record meteorological conditions, meteorological data were obtained from a monitoring station located in Superior, Arizona. The Queen Valley data was screened to eliminate days with less than 6 hours of high winds (> 12 mph), to be consistent with high wind design day conditions, and days when winds were from the west. This produced a 6-day data set, with an average concentration of 17.5 $\mu g/m^3$. An analysis of high wind days at Organ Pipe produced a 5-day data set with an average concentration of 18.5 $\mu g/m^3$. The monitored concentration was reduced by 17.5 to produce a concentration used in the rollback calculation outlined above.

A summary of the source contributions to overall weighted emissions is presented by hour for each monitor and design day in Tables 4–7 for Pinal County Housing, Cowtown, Maricopa, and Stanfield, respectively. Also presented is information on hourly wind speed, wind direction, mixing height, and monitored concentration. While these variables employ different units (e.g., degrees, miles/hour, $\mu g/m^3$, etc.), insight into source apportionment can be gained by contrasting the diurnal profiles. The high wind hours presented in each table are shaded gray so that the distinction between low and high wind hours is apparent. Visual displays of the source specific hourly distance weighted emission estimates and monitored concentrations (adjusted to net out non-

anthropogenic emissions) are displayed in Figures 4–7. Also displayed is a legend, which presents the color of each source category included in the figure.

Table 4
Distance Weighted Emissions (lbs) for the High wind Day at PCH on 1/1/2008

Hour	SPD mph (H=10m)	WD	PM10 Observation	Paved Road	CAFOs	Cleared Area	Desert Shrubland	Developed Rural Lands	Developed Urban Lands	Agriculture	Unpaved Road				Total
											AG Road	Public Dirt	Private Dirt	Trail	
100	1.6207	303.8	28.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.1	0.0	1.4
200	1.5262	318	21	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.8	0.0	2.9
300	1.9543	335.4	22.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.8	0.0	2.0
400	2.4771	333.7	24.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	1.3
500	5.9157	352.2	16.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.9	0.0	2.6
600	3.1574	299.6	19.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	1.5	0.0	5.1
700	3.8877	339.3	16.2	0.9	0.0	0.0	0.0	0.0	0.0	14.9	3.8	12.6	6.8	0.4	39.3
800	5.7161	4.98	22.7	1.0	0.0	0.0	0.0	0.0	0.0	17.4	5.2	13.3	3.8	0.0	40.5
900	4.7729	53.93	34.7	0.6	0.0	0.0	0.0	0.0	0.0	16.6	5.1	75.7	3.4	0.2	101.7
1000	16.2802	41.19	871.2	0.0	0.0	43.9	138.5	57.8	6.8	1300.8	106.6	30.9	18.8	4.6	1708.6
1100	21.4018	46.26	919.3	0.0	0.0	131.0	383.8	160.2	23.0	4186.2	359.8	104.2	63.6	15.4	5427.1
1200	25.0917	49.62	1136.1	0.0	0.0	236.3	692.5	289.0	41.5	7553.7	649.2	188.1	114.7	27.8	9792.8
1300	23.5873	48.5	790.7	0.0	0.0	101.5	297.5	124.2	17.8	3244.5	278.9	80.8	49.3	11.9	4206.3
1400	22.9061	48.27	946.1	0.0	0.0	49.8	146.0	60.9	8.7	1592.1	136.8	39.6	24.2	5.9	2064.1
1500	19.1963	47.62	320	0.0	0.0	24.1	76.2	31.8	3.7	682.6	58.7	17.0	10.4	2.5	907.0
1600	22.2817	53.58	397.9	0.0	0.0	32.3	94.7	39.5	5.7	1032.7	88.8	25.7	15.7	3.8	1338.9
1700	19.8974	53.58	281.9	0.0	0.0	29.5	93.1	38.9	4.6	834.3	71.7	20.8	12.7	3.1	1108.6
1800	15.0310	50.61	65.8	0.0	0.0	7.6	24.8	10.4	1.1	197.9	17.0	4.9	3.0	0.7	267.4
1900	15.5383	54.6	50.9	0.0	0.0	5.4	17.7	7.4	0.8	141.3	12.1	3.5	2.1	0.5	191.0
2000	19.3581	58.05	61.5	0.0	0.0	6.7	21.2	8.8	1.0	189.6	16.3	4.7	2.9	0.7	252.0
2100	19.2814	56.7	70.6	0.0	0.0	8.0	25.4	10.6	1.2	227.5	19.6	5.7	3.5	0.8	302.3
2200	19.1509	57.35	67.6	0.0	0.0	8.0	25.4	10.6	1.2	227.5	19.6	5.7	3.5	0.8	302.3
2300	17.2491	55.72	32.7	0.0	0.0	2.4	7.7	3.2	0.4	69.1	5.9	1.7	1.0	0.3	91.8
2400	14.9110	54.63	139.3	0.0	0.0	4.8	15.8	6.6	0.7	125.7	10.8	3.1	1.9	0.5	169.9
Rsqr				0.1	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.7
Average			264.9	0.1	0.0	28.8	85.8	35.8	4.9	902.3	77.7	27.0	14.4	3.3	1180.3
Percentage Contribution				0.0%	0.0%	2.4%	7.3%	3.0%	0.4%	76.4%	6.6%	2.3%	1.2%	0.3%	100.0%

Figure 4
Distance Weighted Emissions (lbs) for Pinal County Housing (PCH) Monitor on High Wind Day
1/1/2008

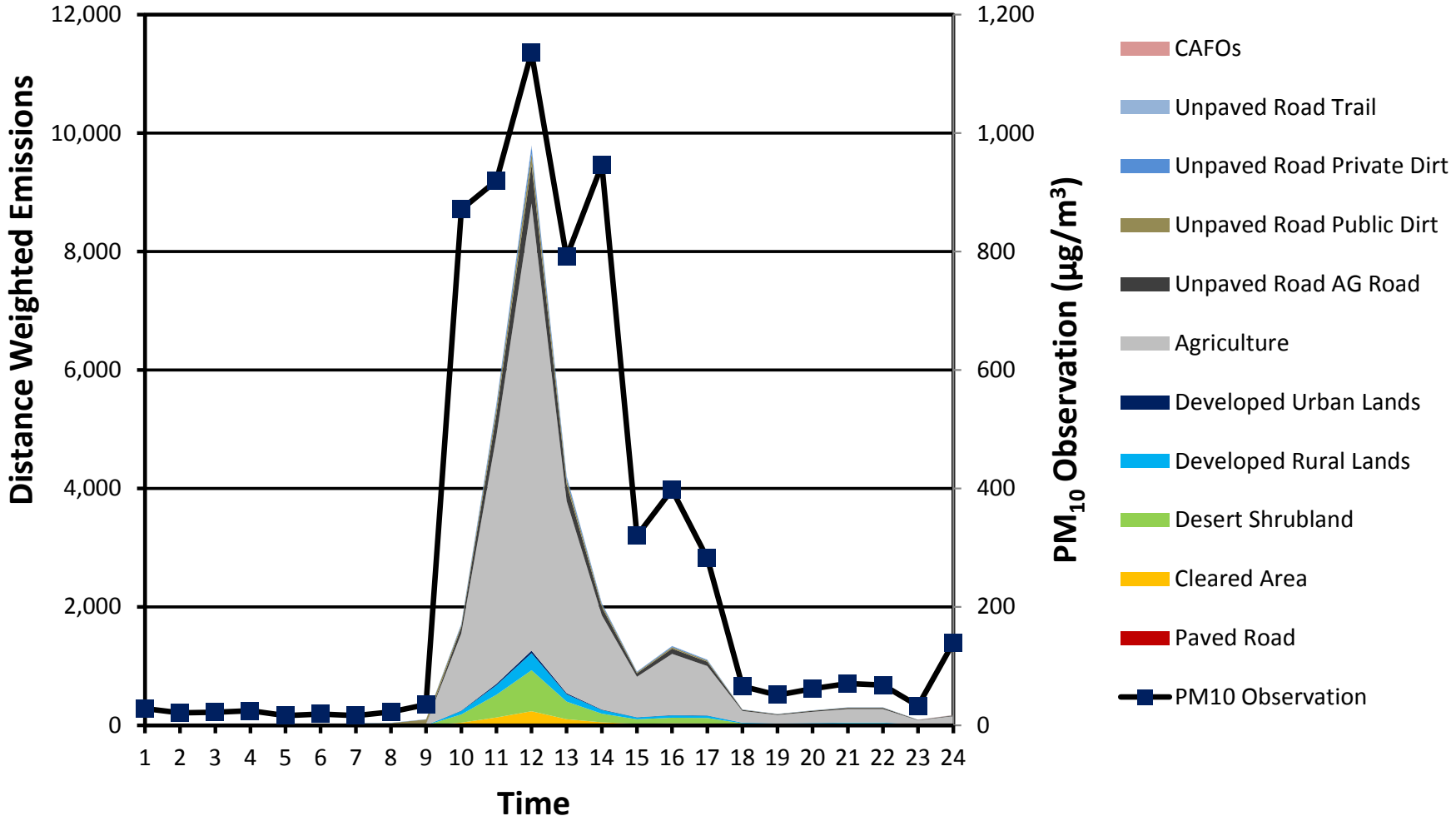


Table 5
Distance Weighted Emissions (lbs) for the High Wind Day Modeling Domain at Cowtown on 04/27/2008

Hour	SPD mph (H=10m)	WD	PM10 Observation	RailRoad	Point Sources	Paved Road	Construction	Cleared Area	Desert Shrubland	Developed Rural Lands	Developed Urban Lands	Unknown	CAFOs	Agriculture		Unpaved Road					Total
														Non Tribal	Tribal	AG Road	Public Dirt	Private Dirt	Trail	Tribal Road	
1.0	6.1	332.4	68.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.3
2.0	0.7	320.5	73.0	0.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.0	0.9	0.0	0.0	10.5
3.0	5.9	314.7	88.1	0.9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.2	0.3	0.0	0.0	10.2
4.0	3.9	84.4	59.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.7
5.0	2.2	25.7	92.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	1.7
6.0	2.4	156.6	492.9	0.0	9.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	111.2	0.0	0.0	0.0	20.4	0.0	0.0	0.3	141.8
7.0	1.6	229.1	326.4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	300.1	18.5	13.6	1.2	27.6	0.0	0.0	2.9	364.2
8.0	2.1	11.6	222.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.8	0.1	8.4	0.2	0.0	14.2
9.0	10.9	33.2	372.4	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	1.8	3.6	29.0	10.2	0.1	0.2	56.9
10.0	20.0	52.9	886.8	0.0	0.0	0.0	160.7	9.5	669.0	63.9	1.3	0.1	0.0	1006.4	0.0	17.1	2.9	15.2	0.2	0.0	1946.3
11.0	17.6	44.4	107.7	0.0	0.0	0.0	42.6	12.6	177.3	16.9	0.3	0.0	0.0	266.8	0.0	4.5	0.8	4.0	0.1	0.0	526.0
12.0	15.7	43.0	122.3	0.0	0.0	0.0	19.5	16.8	81.0	7.7	0.2	0.0	0.0	121.9	0.0	2.1	0.4	1.8	0.0	0.0	251.3
13.0	17.7	37.0	72.0	0.0	0.0	0.0	39.7	11.8	165.5	15.8	0.3	0.0	0.0	249.0	0.0	4.2	0.7	3.8	0.0	0.0	490.8
14.0	14.7	44.0	38.4	0.0	0.0	0.0	13.6	11.0	60.8	5.8	0.1	0.0	0.0	84.6	0.0	1.4	0.2	1.2	0.0	0.0	178.9
15.0	16.1	49.6	36.4	0.0	0.0	0.0	19.7	10.0	82.0	7.8	0.2	0.0	0.0	123.4	0.0	2.1	0.4	1.9	0.0	0.0	247.5
16.0	15.1	50.7	23.1	0.0	0.0	0.0	16.1	5.9	71.8	6.9	0.1	0.0	0.0	99.9	0.0	1.6	0.3	1.5	0.0	0.0	204.1
17.0	12.1	59.4	69.7	0.0	0.0	0.0	3.1	3.1	13.7	1.3	0.0	0.0	0.0	19.1	0.0	0.3	0.1	0.3	0.0	0.0	40.9
18.0	9.2	68.9	101.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1	0.5	2.6	35.7	4.1	0.2	0.9	54.1
19.0	5.2	40.9	230.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	4.8	0.0	0.2	19.0
20.0	4.0	8.0	72.9	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	9.8	0.0	0.0	10.2
21.0	2.9	37.2	79.7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	11.1	0.0	0.1	17.2
22.0	3.0	35.3	42.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	2.9	0.0	0.1	8.1
23.0	3.8	111.6	232.5	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.9	0.0	0.1	5.8
24.0	4.7	9.3	127.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.1
Rsqr				0.0	0.1	0.0	0.5	0.0	0.4	0.4	0.5	0.4	0.1	0.5	0.0	0.5	0.1	0.3	0.2	0.0	0.5
Average			168.3	0.1	0.4	0.1	13.1	3.4	55.0	5.3	0.1	0.0	17.9	83.8	0.7	1.9	6.2	3.6	0.0	0.2	191.7
Percentage Contribution				0.0%	0.2%	0.1%	6.8%	1.8%	28.7%	2.7%	0.1%	0.0%	9.3%	43.7%	0.4%	1.0%	3.2%	1.9%	0.0%	0.1%	100.0%

Figure 5
Distance Weighted Emissions (lbs) for Cowtown (CWT) Monitor on High Wind Day
4/27/2008

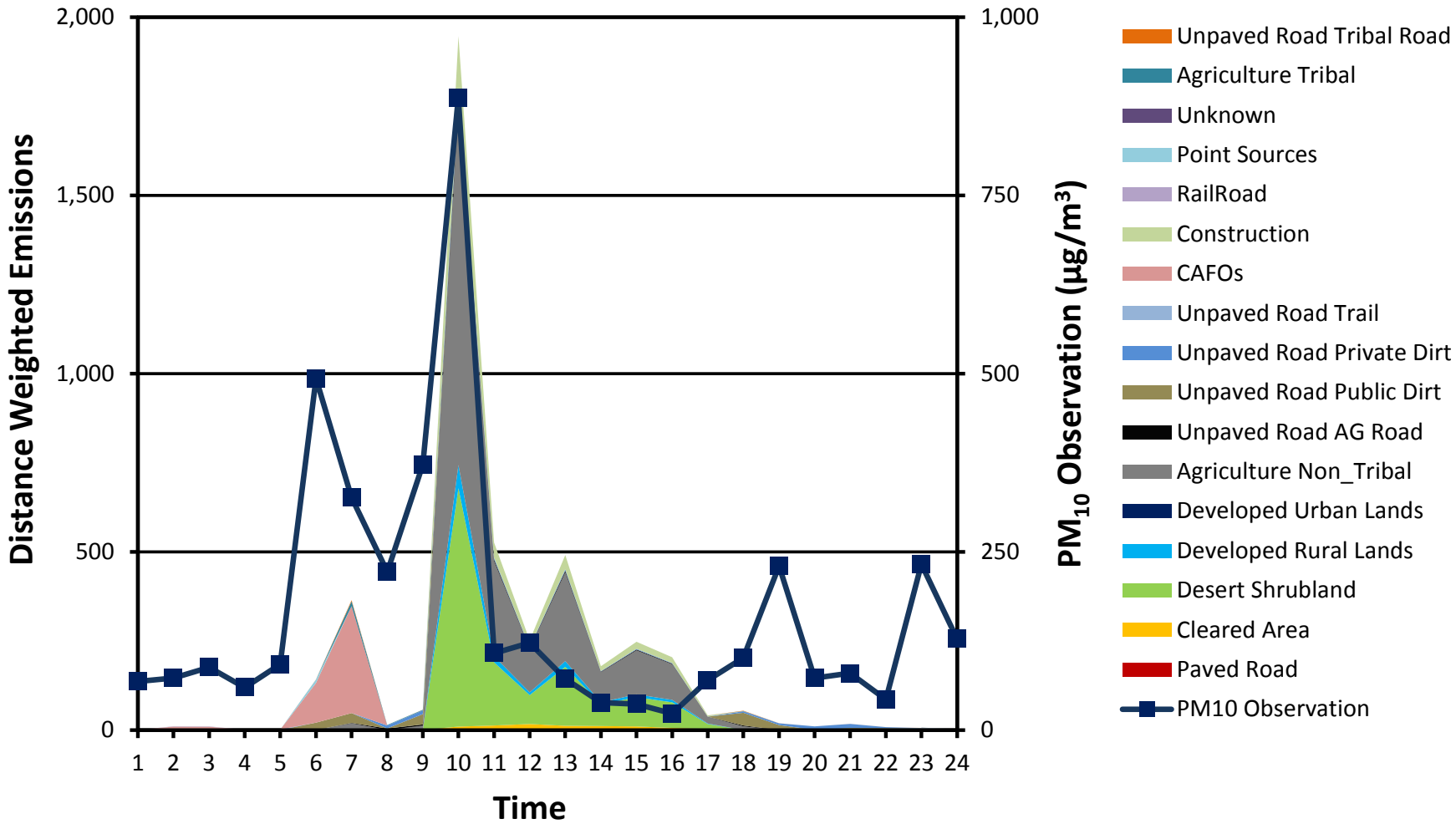


Table 6
Distance Weighted Emissions (lbs) for the High Wind Day Modeling Domain at Maricopa on 10/27/2008

Hour	SPD mph (H=10m)	WD	PM10 Observation	RailRoad	Paved Road	Construction	CAFOs	Cleared Area	Desert Shrubland	Developed Rural Lands	Developed Urban Lands	Unknown	Agriculture		Unpaved Road					Total
													County	Tribal Land	AG Road	Public Dirt	Private Dirt	Trail	Tribe Road	
1	3.8	160.0	239.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.4	0.0	0.0	1.2
2	2.0	106.0	143.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
3	1.3	6.0	70.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6
4	1.3	348.0	73.8	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
5	2.5	290.0	98.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	1.1
6	2.0	241.0	91.8	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.9
7	1.3	215.0	129.8	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	3.4	15.2
8	5.6	82.0	160.4	0.0	6.8	120.6	0.0	0.0	0.0	0.0	0.0	0.0	7.4	2.9	11.3	3.2	1.4	0.0	0.0	153.6
9	13.0	84.0	326.2	0.0	0.0	142.4	0.0	55.7	32.4	22.4	23.4	3.1	34.7	0.0	5.1	1.0	2.0	0.2	0.0	322.3
10	16.1	85.0	852.9	0.0	0.0	893.4	0.0	340.5	189.2	130.6	155.2	18.6	205.2	0.0	34.0	6.4	13.1	1.5	0.0	1987.5
11	18.3	81.0	496.5	0.0	0.0	798.0	0.0	304.1	169.0	116.6	138.6	16.6	183.2	0.0	30.4	5.7	11.7	1.3	0.0	1775.2
12	16.3	82.0	293.2	0.0	0.0	348.4	0.0	132.8	73.8	50.9	60.5	7.2	80.0	0.0	13.3	2.5	5.1	0.6	0.0	775.1
13	17.0	79.0	176.0	0.0	0.0	297.4	0.0	113.3	63.0	43.5	51.7	6.2	68.3	0.0	11.3	2.1	4.4	0.5	0.0	661.6
14	16.8	74.0	141.9	0.0	0.0	231.3	0.0	88.1	49.0	33.8	40.2	4.8	53.1	0.0	8.8	1.7	3.4	0.4	0.0	514.6
15	15.4	72.0	84.8	0.0	0.0	98.2	0.0	38.4	22.4	15.4	16.1	2.1	23.9	0.0	3.5	0.7	1.4	0.2	0.0	222.3
16	13.6	71.0	76.6	0.0	0.0	35.6	0.0	13.9	8.1	5.6	5.8	0.8	8.7	0.0	1.3	0.2	0.5	0.1	0.0	80.6
17	13.0	72.0	68.6	0.0	0.0	23.7	0.0	9.3	5.4	3.7	3.9	0.5	5.8	0.0	0.9	0.2	0.3	0.0	0.0	53.7
18	8.7	62.0	60.4	6.6	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	3.2	6.6	0.0	0.3	0.0	0.7	24.1
19	7.2	61.0	56.2	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4	3.0
20	7.4	68.0	45.1	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	2.1
21	9.6	70.0	36.1	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	2.4
22	9.8	80.0	30.8	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0	2.7
23	9.2	82.0	33.2	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.0	0.0	1.9
24	8.9	78.0	38.7	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	1.4
Rsqr				0.0	0.1	0.8	0.0	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.8	0.8	0.8	0.8	0.0	0.8
Average			159.4	0.3	1.1	124.5	0.0	45.7	25.5	17.6	20.6	2.5	28.0	0.6	5.3	1.1	1.9	0.2	0.3	275.2
Percentage Contribution				0.1%	0.4%	45.3%	0.0%	16.6%	9.3%	6.4%	7.5%	0.9%	10.2%	0.2%	1.9%	0.4%	0.7%	0.1%	0.1%	100.0%

Figure 6
Distance Weighted Emissions (lbs) for Maricopa Monitor on High Wind Day
10/27/2008

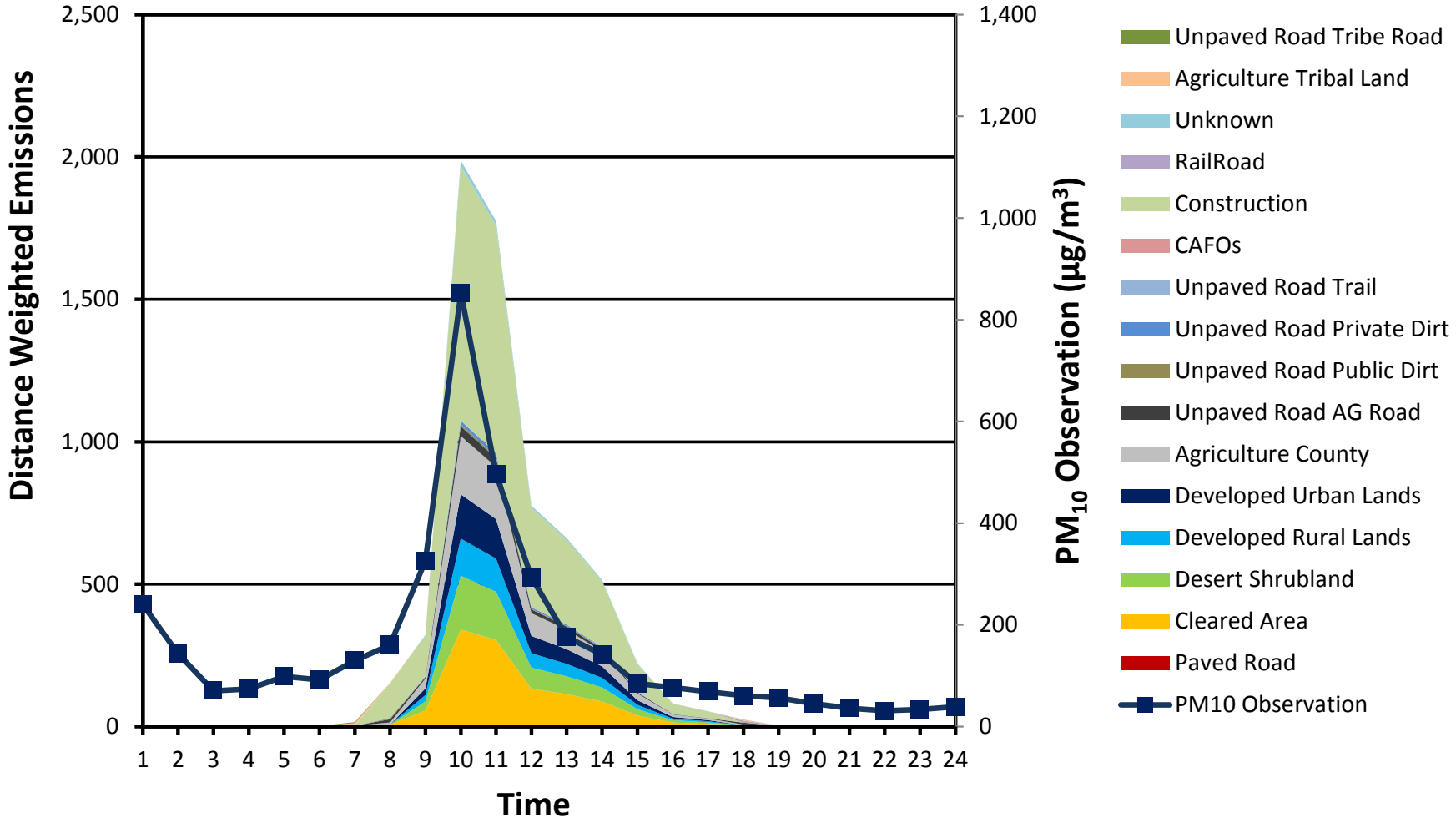


Table 7
Distance Weighted Emissions (lbs) for the High Wind Day Modeling Domain at STF on 11/21/2008

Hour	SPD mph (H=10m)	WD	PM10 Observation	Paved Road	Construction	CAFOs	Cleared Area	Desert Shrubland	Developed Rural Lands	Developed Urban Lands	Agriculture	Unpaved Road				Total
												AG Road	Public Dirt	Private Dirt	Trail	
100.0	4.1	119.2	112.4	0.1	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.3	0.0	6.0
200.0	3.5	161.6	59.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.8	0.0	2.1
300.0	3.9	117.3	157.4	0.1	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.7	0.0	6.3
400.0	4.3	125.4	158.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	1.4
500.0	3.7	274.2	102.3	0.1	0.0	27.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	27.8
600.0	4.0	240.9	234.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.1	0.0	3.8
700.0	15.9	85.5	357.4	0.0	0.0	32.4	10.8	66.3	4.1	0.9	393.0	20.2	4.2	1.1	2.6	535.5
800.0	18.3	81.9	326.6	0.0	0.0	53.1	17.8	108.7	6.7	1.5	644.4	33.0	6.8	1.8	4.2	878.0
900.0	20.4	82.2	584.6	0.0	0.0	233.1	78.0	477.6	29.4	6.7	2830.8	145.2	29.9	7.9	18.4	3856.9
1000.0	19.9	81.1	429.2	0.0	0.0	86.5	28.9	177.2	10.9	2.5	1050.3	53.9	11.1	2.9	6.8	1431.0
1100.0	20.0	80.2	334.3	0.0	0.0	58.8	19.7	120.5	7.4	1.7	714.2	36.6	7.5	2.0	4.6	973.1
1200.0	18.2	80.4	186.1	0.0	0.0	27.1	9.1	55.6	3.4	0.8	329.4	16.9	3.5	0.9	2.1	448.7
1300.0	14.7	79.2	93.9	0.0	0.0	9.4	3.3	21.1	1.3	0.3	112.4	5.7	1.2	0.3	0.7	155.7
1400.0	13.4	78.5	65.1	0.0	0.0	4.0	1.4	8.9	0.6	0.1	47.5	2.4	0.5	0.1	0.3	65.9
1500.0	12.3	75.3	64.8	0.0	0.0	1.6	0.6	3.6	0.2	0.0	25.0	1.0	0.2	0.1	0.1	32.5
1600.0	9.9	77.2	65.2	1.0	0.0	4.3	0.0	0.0	0.0	0.0	13.0	4.0	50.3	63.9	0.8	137.4
1700.0	7.1	74.7	87.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	13.6	4.1	46.9	46.5	0.8	113.0
1800.0	4.7	73.8	104.6	0.4	0.0	4.3	0.0	0.0	0.0	0.0	14.3	4.1	42.3	38.7	0.9	105.1
1900.0	6.3	75.1	88.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.8	40.7	0.0	64.7
2000.0	5.6	86.2	56.1	0.3	0.0	27.4	0.0	0.0	0.0	0.0	0.0	0.0	16.8	31.0	0.0	75.4
2100.0	2.6	158.4	98.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	2.8	0.0	8.3
2200.0	2.2	230.2	249.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.9	0.0	2.3
2300.0	2.9	270.1	171.6	0.1	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	11.5
2400.0	2.4	291.4	99.5	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	11.2
Rsqr				0.1	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.1	0.7	0.7
Average			178.6	0.1	0.0	25.0	7.1	43.3	2.7	0.6	257.8	13.6	10.8	10.3	1.8	373.1
Percentage Contribution				0.0%	0.0%	6.7%	1.9%	11.6%	0.7%	0.2%	69.1%	3.7%	2.9%	2.8%	0.5%	100.0%

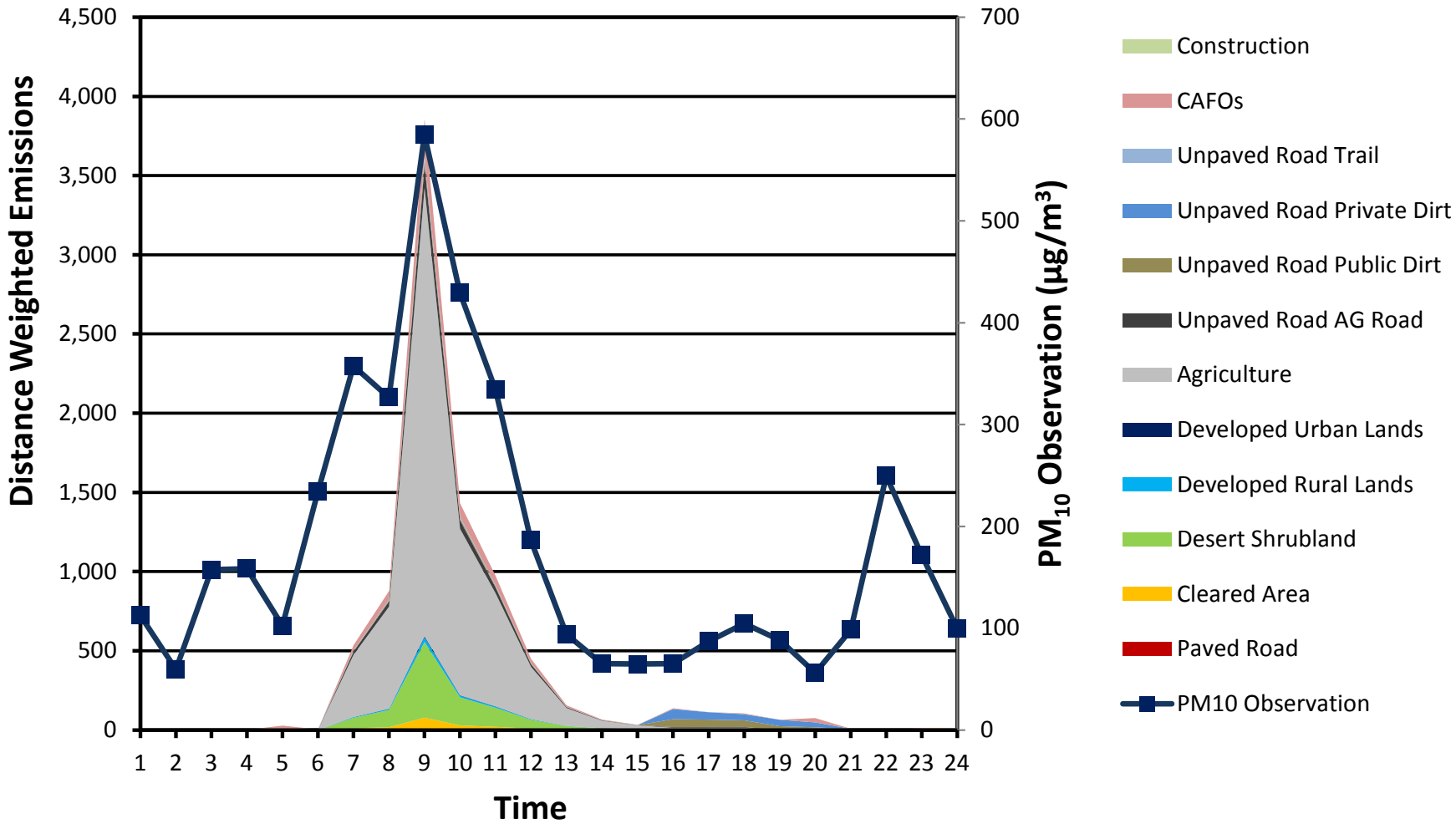



Figure 7
Distance Weighted Emissions (lbs) for Stanfield (STF) Monitor on High Wind Day
11/21/2008