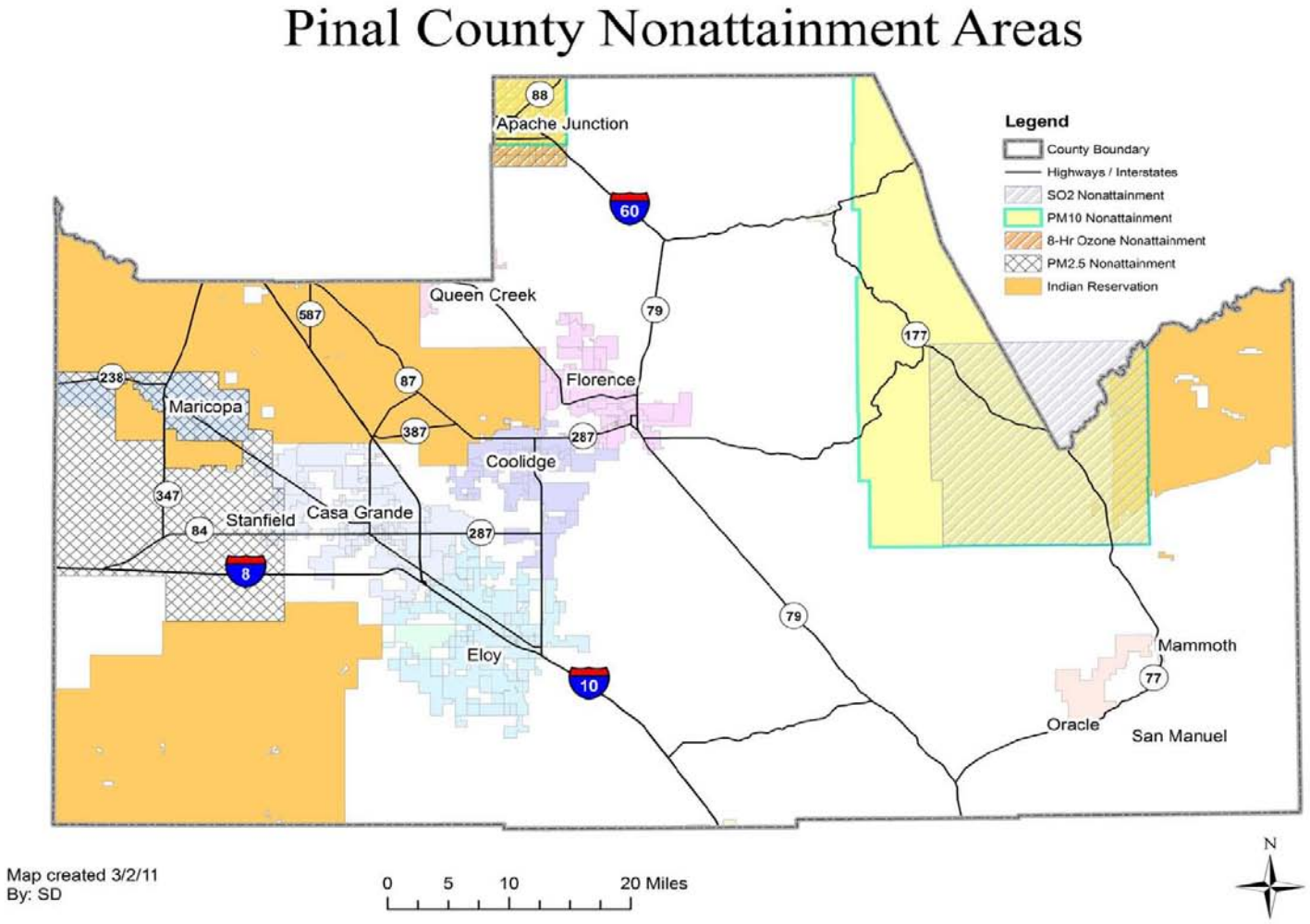
Particulate Matter Issues in Pinal County Arizona

By Bas Aja

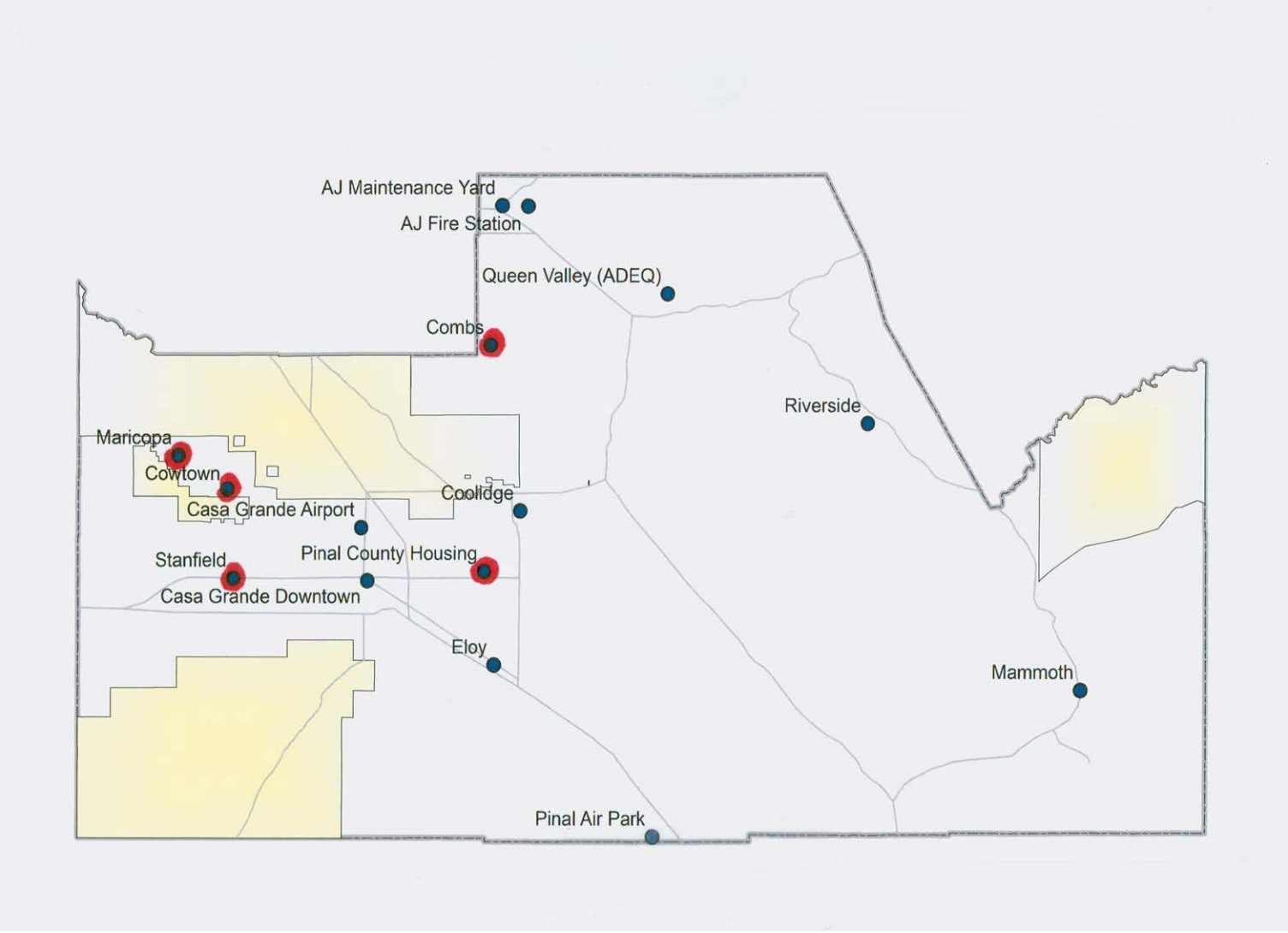
Arizona Cattle Feeders' Association

Non-Attainment Menus



PM Monitors

Where are we looking for problems?



2006 Maricopa Monitor

CITY OF MARICOPA PM_{10} 2006 TEOM Data

24 Hour Averages (ug/m^3)

	January	February	March	April	May	June	July	August	September	October	November	December
1	49.5	89.1	50.9	24.2	58.6	111.2	148.8	37.3	48.8	82.8	97.5	95.1
2	64.9	106.7		23.6	63.2	233.6	52.3	56.9	121.5	113.1	108.1	92.7
3	49.0	134.9	68.0	51.4	79.0	84.7	55.9		18.6	117.7	134.0	41.2
4	88.2	99.1	56.7	67.0	66.9	62.8	61.6	50.1	17.8	110.3	83.0	57.8
5	92.7	77.5	54.9	95.5	60.5	66.9		43.0	39.9	159.3	69.1	94.9
6	99.9	93.0		33.0	45.0			41.4	37.2		115.2	131.3
7	61.1	108.2	136.8	60.8	35.1	88.9		80.9	28.0	66.1	131.0	110.4
8	52.6	132.7	198.3	62.1	53.5	38.6	32.7		24.8	77.5	116.9	
9	90.2		50.5	43.3	61.7	51.0	42.8	47.5	49.3	33.6	90.8	59.1
10	84.9	63.0	285.5	47.2	70.5	44.3	72.9	60.1	26.1	53.3	86.2	98.6
11	124.9	57.8	19.3	40.1	78.5	43.3	70.4	42.9	61.7	76.7	86.1	90.1
12		43.7	12.5	60.5	65.4	101.8	55.1	14.7			48.0	84.1
13	174.8	127.5	21.9	89.2	42.0	90.6	75.0	25.4	41.2	90.1	115.8	107.0
14	118.2	131.5	24.7	321.7	45.5	60.2	67.0	97.4	58.6	25.2	83.2	140.8
15	59.4	389.6	40.9	146.3	79.9	103.5	203.4	30.9	51.3	34.9	85.4	158.2
16	80.0	68.0	46.5	41.1	193.0	55.2	118.4	52.4	41.9	45.1		207.9
17	117.1	99.0	41.4	74.0	115.0	58.0	48.5	72.3	43.1	40.3		38.1
18	145.3	58.9	31.7	42.8	79.7	49.5		77.3	77.4	69.0	156.6	46.5
19	195.6	35.3	14.5		48.5	64.5	72.4	55.3	97.5	49.8	80.1	62.7
20	69.8	63.2	15.4	59.4	41.6	109.9	69.9	48.1	101.6	97.7	100.1	53.5
21	53.1	53.1	24.1	92.6	95.1	78.4	94.6	220.6		82.8	112.3	74.3
22	53.2	60.5	18.1	85.6	171.5	84.7	72.8	23.4	77.6	73.6	171.6	70.1
23	93.6	82.2	31.1	36.5	47.1			46.2	43.4	97.6	91.6	45.2
24	76.7	93.7	38.9	34.3	52.3	202.8	96.9		38.1		82.7	34.9
25	98.3	105.9	31.2	68.3		333.6	127.6	44.9	70.1	32.2	70.9	40.3
26	89.6	96.6	25.2		98.5	429.8	25.5	34.9	108.7	48.1	47.1	61.1
27	118.0	118.9	24.2	114.7	84.8	103.5	26.9	39.4	72.7	73.9	78.6	148.8
28	60.5	115.0	33.1	38.7	49.5	71.6	45.2	82.4		95.3	53.0	43.5
29	71.2			39.1	59.5	89.9	23.8	78.9	146.2	97.4	251.1	20.9
30	123.6		31.0	46.2	73.0	107.2	32.2	75.2	83.7	85.7	47.1	23.5
31	120.6		37.7		99.7		39.2	56.5		82.8		26.0
	1st quarter average		81.72	2nd quarter average		83.41	3rd quarter average		62.90	4th quarter average		84.46
	# of valid samples		85	# of valid samples		86	# of valid samples		81	# of valid samples		86
	% of samples collected		94.44%	% of samples collected		94.51%	% of samples collected		88.04%	% of samples collected		93.48%
	# of 24 hr exceedances		5	# of 24 hr exceedances		7	# of 24 hr exceedances		2	# of 24 hr exceedances		6
										Annual Average		78.12

2006 Cowtown Monitor

CWTN 1400ab PM_{10} 2006 TEOM Data

24 Hour Averages (ug/m^3)

	January	February	March	April	May	June	July	August	September	October	November	December
1	76.1	160.7	109.1	111.5	226.0	221.3	211.5	84.9	210.9	456.1	315.9	289.1
2	151.2	171.3	138.1	84.2		461.3	157.1	154.3	170.5	438.5	333.3	302.4
3	188.9	354.5	187.4	157.8		312.5	208.7		14.6	240.3		58.9
4	260.6	196.9	249.1	138.4		256.0	146.7	59.2	25.7	402.8	343.9	183.5
5		132.2	182.9	173.1		349.2	144.2	178.2	53.8	254.2	402.6	418.1
6	282.4	152.9	301.4	118.4				166.6	92.2		540.5	531.4
7	286.6	184.1	468.1	136.1			113.8	146.9		172.3	641.0	271.9
8	288.8	352.1		250.1			65.6	99.7	43.2	205.8	393.2	
9	311.6	316.2	207.4	285.6		218.2	161.1		45.3	251.3	285.8	320.3
10	305.8			346.4	209.6	139.2	226.0	115.8	63.7	174.1	373.7	202.4
11	344.3	160.1		155.0	245.6	208.9	224.4	83.0	157.0	263.8	294.4	336.8
12	249.7	430.5		106.4	353.6	164.7	169.8	13.1			260.7	237.3
13		443.9		198.6	248.2	284.4	226.3	42.7	236.6	213.4	326.3	230.2
14	240.9	354.1	36.4	448.4	238.9	317.0	253.0	85.3	145.2	88.3	180.9	260.2
15	130.1	375.6	49.5	323.7	279.8	213.3	275.1	59.0	151.5	174.4		296.5
16	121.1	130.2	75.8	135.4	427.1	515.3	151.6	108.1	171.2	204.5		258.3
17	294.8	128.4	73.7		209.5	304.0	71.2		503.6	194.3	433.0	
18	264.3	218.6	56.8	370.3	237.5	294.2	200.3	224.0	394.9	322.0	473.4	137.7
19	306.2	139.3	16.9	328.6	307.6	297.4	90.4	200.9	353.1		252.4	110.7
20		121.7	9.6	353.0	348.1	323.4		114.6	277.4	765.4	319.2	102.3
21	204.0	137.3	28.3	510.5	279.2	245.4	167.8	356.1	796.4	481.9	492.1	92.5
22	159.5	387.5	14.2	324.8	479.8	295.5	178.1		246.4	359.1	436.2	
23	183.4	377.4	21.1	159.3	453.9		131.3	64.7	174.5	486.0	290.3	19.9
24	129.6		61.2	240.1	661.7	260.9	141.6		97.1			25.7
25	214.6		55.8	148.0		353.6	321.9		679.0	62.9	150.6	38.0
26	249.1		46.1		317.2	427.0		58.5	314.4	113.1	166.8	91.9
27	228.1		44.3	240.0	333.2	136.9	28.7	65.6	358.2	273.8	225.2	197.7
28	275.5		46.2	216.4	265.7	202.4	42.6	118.6		339.8	128.6	53.8
29	143.3			129.3	292.5	207.9	56.8	162.1	1050.8	372.4	472.3	17.2
30	273.8		57.8	394.1	314.6		24.9	136.8	515.3	253.4	96.4	16.7
31	292.8		129.4		260.7		107.1	120.0		197.3		15.4
	1st quarter average		193.99	**2nd quarter average**		274.45	**3rd quarter average**		183.24	**4th quarter average**		265.51
	# of valid samples		75	**# of valid samples**		75	**# of valid samples**		80	**# of valid samples**		81
	% of samples collected		83.33%	**% of samples collected**		82.42%	**% of samples collected**		86.96%	**% of samples collected**		88.04%
	# of 24 hr exceedances		43	**# of 24 hr exceedances**		64	**# of 24 hr exceedances**		37	**# of 24 hr exceedances**		62

2009 Maricopa Monitor

MARICOPA PM_{10} 2009 TEOM Data

24 Hour Averages (ug/m^3)

	January	February	March	April	May	June	July	August	September	October	November	December
1	31.9	AN	53.2	70.6	73.9	51.3	57.1	40.7	37.7	51.2	113.0	60.7
2	37.3	AN	76.6	49.4	93.6	53.4	49.0	45.3	34.0	65.1	122.1	81.9
3	32.3	69.1	73.4	116.4	41.2	55.3	42.2	50.3	306.2	45.2	119.8	61.8
4	17.3	90.2	60.6	38.6	55.6	82.2	16.8	125.0	33.8	54.5	191.4	38.8
5	17.2	79.7	55.8	29.1	55.9	47.6	26.2	89.7	22.8	58.3	114.7	101.0
6	22.2	46.7	42.6	39.5	57.0	35.3	39.1	71.7	17.4	63.0	133.1	52.0
7	35.0	40.0	30.4	52.9	AE	36.1	38.1	49.0	22.2	58.2	114.1	164.4
8	37.7	7.3	47.5	82.3	AE	46.1	45.7	66.3	40.1	76.1	68.0	34.1
9	38.3	29.5	42.4	42.1	46.0	68.0	AN	66.4	22.5	85.9	65.8	32.7
10	16.7	17.2	31.5	95.3	60.7	34.7	60.4	95.4	28.8	AE	106.5	42.2
11	23.6	21.4	74.8	17.5	57.6	45.8	48.4	89.1	40.9	AE	116.0	63.1
12	53.0	26.6	39.1	17.5	77.8	57.9	125.8	204.9	36.9	AE	109.2	56.9
13	37.4	29.9	38.7	28.2	73.8	43.0	64.0	32.6	38.3	AE	62.1	40.2
14	39.7	24.4	44.5	86.3	70.4	32.2	55.0	24.5	51.5	AE	37.0	27.7
15	48.3	27.8	35.2	170.5	54.4	58.2	83.6	33.7	63.7	73.9	22.1	26.2
16	50.6	34.6	51.5	30.8	51.7	82.3	58.8	28.1	56.5	81.4	37.7	29.5
17	41.3	13.9	81.6	34.5	107.7	55.8	607.2	43.9	60.1	72.0	55.3	44.7
18	26.7	21.0	70.7	44.8	62.2	45.4	454.2	53.1	39.4	51.1	64.2	75.3
19	17.7	20.7	72.6	45.9	99.4	91.1	162.8	46.4	56.2	66.5	56.4	41.7
20	41.0	29.0	AN	45.9	52.4	31.8	268.7	38.3	35.6	89.6	BA	33.3
21	61.7	39.1	AN	57.6	52.7	34.1	82.9	83.4	55.5	44.4	73.0	117.6
22	21.0	40.0	AN	52.5	14.6	61.6	36.5	18.0	33.9	80.5	64.1	141.4
23	22.5	54.7	AN	59.6	22.6	54.9	38.7	16.4	44.2	101.9	72.9	54.3
24	11.8	48.6	44.2	54.6	27.1	50.6	26.9	27.5	44.9	70.2	70.7	23.7
25	14.3	46.7	36.6	61.9	30.7	44.7	47.9	29.4	72.6	48.2	47.1	21.2
26	39.5	42.2	284.8	38.4	36.6	55.9	27.2	34.2	81.3	45.7	43.6	25.0
27	21.1	50.0	40.2	60.0	41.2	33.9	33.7	43.1	93.7	428.3	71.4	25.7
28	38.4	51.8	56.1	56.6	43.2	46.0	48.3	80.0	80.5	90.3	74.2	25.3
29	38.8		47.6	55.9	35.3	57.2	72.0	54.9	84.1	51.2	38.9	36.5
30	AN		49.3	58.1	44.7	54.1	51.1	64.8	90.6	69.4	30.5	36.9
31	AN		44.7		43.8		52.8	118.7		86.4		24.2
	1st quarter average		43.4	2nd quarter average		54.2	3rd quarter average		70.5	4th quarter average		70.3
	# of valid samples		82	# of valid samples		89	# of valid samples		91	# of valid samples		86
	% of samples collected		91.11%	% of samples collected		97.80%	% of samples collected		98.91%	% of samples collected		93.48%
	# of 24 hr exceedances		1	# of 24 hr exceedances		1	# of 24 hr exceedances		6	# of 24 hr exceedances		3

2009 Cowtown

COWTOWN PM_{10} 2009 TEOM Data

24 Hour Averages (ug/m^3)

	January	February	March	April	May	June	July	August	September	October	November	December
1	37.9	111.2	64.6	100.3	100.1	130.6	65.5	122.6	44.7	171.9	212.9	76.2
2	53.6	90.5	140.0	71.1	92.9	AN	64.3	82.3	73.9	136.6	155.4	74.5
3	30.8	128.6	106.7	199.4	67.0	AN	63.7	125.0	426.2	52.9	153.1	79.8
4	28.5	205.2	77.7	95.5	108.5	AN	16.4	199.6	34.0	98.1	286.1	70.8
5	21.9	182.6	77.2	72.5	131.1	108.5	24.1	158.7	23.4	242.4	136.5	121.5
6	31.1	78.3	103.0	71.1	135.5	101.7	53.7	114.2	26.5	146.9	189.6	50.1
7	27.3	59.0	72.9	109.6	104.1	92.0	45.2	112.7	27.5	87.3	121.9	305.9
8	31.1	9.8	125.1	105.4	109.1	117.6	60.7	90.3	43.5	176.9	62.0	48.0
9	45.4	33.7	55.1	74.0	110.3	112.4	60.0	81.5	58.3	107.0	98.9	29.1
10	24.4	14.8	78.0	94.9	119.5	57.0	128.5	122.1	55.9	101.2	137.7	39.4
11	39.3	22.2	97.2	21.4	114.0	87.5	98.9	159.8	87.3	193.8	163.9	67.1
12	55.0	53.8	78.3	44.0	113.8	88.6	131.0	235.3	60.6	92.1	165.1	54.6
13	53.8	40.4	86.2	38.6	160.1	117.8	130.2	35.2	51.6	108.2	102.1	36.8
14	60.1	34.5	86.2	70.3	111.1	154.2	84.5	38.0	79.3	71.2	64.9	37.4
15	96.6	40.3	67.1	138.4	90.8	87.0	74.1	92.1	89.1	155.4	31.2	70.5
16	145.1	57.9	62.6	57.9	168.2	154.8	65.9	52.0	91.3	226.2	43.1	76.1
17	135.8	23.4	124.2	67.5	98.8	115.9	631.0	124.5	108.2	91.1	114.8	87.5
18	76.5	26.5	112.3	92.5	72.2	131.0	252.1	148.0	57.6	88.0	90.2	126.9
19	42.2	40.7	82.8	179.5	90.5	103.0	87.2	86.8	97.9	133.1	92.7	79.6
20	64.3	43.1	132.8	136.7	73.6	59.9	300.0	96.3	115.1	144.5	98.8	83.7
21	93.8	45.1	82.6	84.3	43.9	119.8	268.3	204.7	128.7	212.8	72.4	111.1
22	20.0	50.2	332.1	118.1	23.7	106.8	79.6	21.4	69.7	135.0	73.8	114.4
23	22.7	82.3	134.4	84.0	23.9	151.2	65.4	45.1	111.1	235.1	163.7	60.3
24	19.7	80.0	75.7	138.8	57.0	135.3	59.0	91.1	184.4	141.7	125.6	24.5
25	20.7	66.7	94.0	157.3	119.0	104.8	53.0	AN	210.9	163.8	88.6	23.3
26	77.0	74.8	224.6	156.7	105.7	135.8	46.4	AN	212.8	178.7	97.9	36.6
27	74.4	72.2	79.7	159.4	77.9	118.4	90.8	123.3	130.8	626.3	98.3	49.1
28	108.1	71.7	109.3	96.8	82.0	76.5	141.4	479.1	154.1	242.3	108.9	46.2
29	59.7		94.1	129.9	98.5	81.8	122.5	135.6	118.8	219.2	71.6	57.6
30	82.3		158.3	124.6	82.2	96.5	114.6	152.2	242.0	174.9	55.6	57.0
31	134.1		85.5		165.2		88.5	224.8		174.6		31.8
	1st quarter average		77.3	2nd quarter average		103.3	3rd quarter average		117.1	4th quarter average		117.8
	# of valid samples		90	# of valid samples		88	# of valid samples		90	# of valid samples		92
	% of samples collected		100.00%	% of samples collected		96.70%	% of samples collected		97.83%	% of samples collected		100.00%
	# of 24 hr exceedances		5	# of 24 hr exceedances		9	# of 24 hr exceedances		16	# of 24 hr exceedances		23

What Caused the Reduction? We tested 3 Primary Measures

The test BMP's were:

- An average of 3 - 6 gallons of water per head/per day dispersed in occupied pens, roadways and other areas of the yards. These were monitored by a designated employee who directed efforts.

- All traveled roadways and feed alleys were monitored and received dust suppression techniques including water and monitored traffic regimes.

- Speed limits for internal traffic were applied and monitored.

We Monitored the Costs

Table 1.
Cost of PM_{10} Reduction Measures at
Two Feed Yards near the Cowtown Monitor
2/1/2009 thru 8/1/2010

Category	**Total Amount**	**Daily Amount**	**$ Cost**
Water Dispersed	2,116 acre feet	9.8 acre feet p/day	$703.00 p/day
Fuel	20,815 gallons	86 gals. p/day	227.90 p/day
Worker Hours	6,147 hours	25 total work hours p/day	350.00 p/day
Water Trucks	5 trucks	3 daytime – 2 night	150.00 p/day
Repairs			40.00 p/day
Total per day cost			$1,470.90 p/day

*This is for two feed yards (60,000 + 40,000 head). *The costs were approximately 2/3 for one and 1/3 for the other. *These costs will slightly vary based on the climate, meteorological conditions, and activities. *This timeframe was very dry and very little precipitation occurred.

2009-2010 Pinal County Conducted a Source Apportionment Study Course Results for Course

Table 1: Coarse Particle Chemical Composition

	Casa Grande	Cowtown	Pinal County Housing
Coarse Particle Mass	31 $\mu g/m^3$	67 $\mu g/m^3$	45 $\mu g/m^3$
Crustal	48%	42%	49%
Organic	12%	25%	9%
Nitrate	2%	1%	2%
Sulfate	1%	1%	1%
Ammonium	0.2%	0.2%	0.1%
Other Measured Species	9%	11%	8%
Unidentified	28%	20%	31%

2009-2010 Pinal County Conducted a Source Apportionment Study Results for Fine

Table 2: Fine Particle Chemical Composition

	Casa Grande	Cowtown	Pinal County Housing
Fine Particle Mass	10 $\mu g/m^3$	11 $\mu g/m^3$	9 $\mu g/m^3$
Crustal	17%	22%	30%
Organic	45%	45%	31%
Nitrate	3%	8%	6%
Sulfate	10%	9%	10%
Ammonium	4%	5%	4%
Other Measured Species	7%	8%	9%
Unidentified	14%	3%	10%

Study Average for Course at all 3 Monitors

Table 4: Average Coarse Particle Source Contribution at Each Sampling Site

	Casa Grande	Cowtown	Pinal County Housing
Primary Biological	23%	30%	22%
Crustal	16%	20%	24%
Road Dust	20%	7%	7%
Feed Lot	1%	11%	1%
Secondary	10%	7%	10%
Boron-Rich	9%	6%	15%
Transported Soil	5%	7%	6%
Ammonium Nitrate	4%	4%	3%
Salt	3%	2%	2%
Unidentified	9%	6%	10%

Study Average for Fine at all 3 Monitors

Table 5: Average Fine Particle Source Contribution at Each Sampling Site

	Casa Grande	Cowtown	Pinal County Housing
Motor Vehicle	45%	41%	25%
Road Dust	30%	29%	29%
Lead-rich	12%	8%	11%
Brake Wear	4%	3%	8%
Crustal	2%	3%	7%
Salt	3%	2%	3%
Unidentified	4%	14%	17%

Weaknesses

- In 2009 Pinal County was proposed to be designated Non-attainment for $PM_{2.5}$
- We now comply with the $PM_{2.5}$ standard before the designation process is complete – yet we have to dedicate resources to a solved problem when the focus should be on the problem not yet solved (PM_{10}).

Cowtown PM2.5	Annual Avg ug/m3	3 Year Avg ug/m3
2005	33.1	N/A
2006	22.7	N/A
2007	22.5	26
2008	19.6	21.6
2009	14.2	18.8
2010	**12.3**	**15.4**

Weaknesses Continued

- Chart below shows compliance with the 24 Hour $PM_{2.5}$ Standard

Year	Maximum Reading	24Hr Avg 98th Percentile	3 year average of the 98th percentile
2005	144.8	78.9	N/A
2006	69.4	48.9	N/A
2007	59.7	53.9	61
2008	41.7	40.7	48
2009	29.4	24	40
2010	**39.5**	**27.1**	**31**

- **39.5 was flagged for wind event

Challenges

- We clearly will struggle with gaining compliance with the PM_{10} standard (no more than 1 exceedance per year for 3 years) and we will be expending resources to deal with an already achieved $PM_{2.5}$ standard.
- We have been spending over $1,400 dollars per day and still had exceedances (by our standards we had 9 in 2009 that were not windblown/natural events).
- When tough markets or water shortages arrive we are unsure about maintaining such an effort which requires administering one of our scarcest natural resources “water” .
- We need a better more logical “windblown/natural events” policy from EPA.

Summary

- Better science/acceptance on the “oversampling” of course PM by the newer TEOM monitors (Texas AM Research demonstrates a 30% over sampling).
- Better and easily understood “windblown and natural events” policies to allow local authorities to flag the data from those days.
- Better monitor placement requirements and focus on population centers not rural areas near them.

Summary

- Continue Research on Course PM as necessary
- Adopt a course PM standard that comports with scientific evidence