ADEQ
ARKANSAS
Department of Environmental Quality

Arkansas Department of Environmental Quality

**Appendices for the
State of Arkansas
Regional Haze Rule
State Implementation Plan**

Appendix Volume 2
Appendices 7.1A-7.1D

Appendix 7.1

Statewide 2002 Emissions Inventory

Parts A-D

APPENDIX
7.1-A

Point Source Emissions Breakdown By County

County	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
Arkansas Co									
	0500100021	RICE CAPITAL INC	0.45	9.20	2.38	35.00	0.00	2.30	0.10
	0500100008	RICELAND FOODS, INC., SOY DIVISION	625.78	471.70	27.70	124.49	0.00	56.30	65.50
			626.23	480.90	30.08	159.49	0.00	58.60	65.60
Ashley Co									
	0500300005	GEORGIA-PACIFIC STUDMILL AND PLY'	324.60	0.00	0.44	1.51	0.00	692.77	12.09
	0500300013	GEORGIA-PACIFIC CORP CROSSETT PAI	2,935.57	2,805.12	506.32	693.39	0.00	20,222.10	3,016.03
	0500300028	GEORGIA-PACIFIC RESINS, INC	98.85	40.03	10.50	22.51	0.00	60.49	182.17
	0500300065	MRT-FOUNTAIN HILL COMPRESSOR ST/	5.01	535.54	0.00	0.00	0.00	543.30	0.00
			3,364.02	3,380.69	517.26	717.41	0.00	21,518.66	3,210.29
Baxter Co									
	0500500081	BASS CAT BOATS	24.06	0.00	0.09	0.30	0.00	0.00	0.00
	0500500002	BAXTER HEALTHCARE CORPORATION	22.31	1.41	0.37	0.44	0.00	0.23	0.06
			46.38	1.41	0.45	0.74	0.00	0.23	0.06
Benton Co									
	0500700322	FM CORPORATION	38.98	0.00	0.00	0.00	0.00	0.00	0.00
	0500700255	SUPERIOR INDUSTRIES INTERNATIONA	54.42	51.58	3.94	4.99	0.00	27.25	2.60
	0500700247	MID-AMERICA CABINETS INC	91.50	0.00	2.94	10.00	0.00	0.00	0.00
	0500700120	KENNAMENTAL INC	135.66	0.00	3.12	3.76	0.00	0.00	0.00
	0500700111	GATES CORPORATION	6.28	7.59	0.00	0.00	0.00	4.34	0.08
	0500700100	GLAD MANUFACTURING CORPORATIOI	23.80	0.70	15.78	44.70	0.00	1.30	0.60
	0500700107	SWEPCO-FLINT CREEK POWER PLANT	69.32	5,110.00	30.66	119.83	0.00	563.80	11,231.00
			419.96	5,169.87	56.44	183.28	0.00	596.69	11,234.28
Boone Co									
	0500900022	WABASH NATIONAL WOOD PRODUCTS	22.01	2.14	38.04	87.69	0.00	30.60	0.85
	0500900066	TANKINETICS INC	18.20	0.00	0.00	0.00	0.00	0.00	0.00
			40.21	2.14	38.04	87.69	0.00	30.60	0.85
Bradley Co									
	0501100014	ROBBINS HARDWOOD FLOORING INC-V	32.57	5.72	29.84	38.65	0.00	51.86	0.29
	0501100004	POTLATCH CORP - SOUTHERN & BRADI	299.24	128.00	9.33	14.02	0.00	271.00	23.00
			331.81	133.72	39.16	52.67	0.00	322.86	23.29
Calhoun Co									
	0501300033	BAE SYSTEMS	547.24	2.11	27.56	27.56	0.00	0.60	0.00
	0501300035	AEROJET-GENERAL CORPORATION	16.17	2.28	40.25	60.02	0.00	22.27	0.15
	0501300212	GP-ORIENTED STRANDBOARD FACILIT'	29.24	5.80	92.22	150.80	0.00	127.20	9.60
			592.65	10.18	160.04	238.38	0.00	150.07	9.75
Clark Co									
	0501900005	INTERNATIONAL PAPER COMPANY-GUI	331.29	220.27	60.55	126.11	0.00	333.39	19.81
	0501900004	REYNOLDS METALS COMPANY	4.66	163.00	1.93	3.52	0.00	1.41	0.14

	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
			335.96	383.27	62.48	129.63	0.00	334.80	19.95
Clay Co									
	0502100075	PINNACLE FRAMES & ACCENTS, INC #2	186.81	0.00	0.00	0.00	0.00	0.00	0.00
	0502100067	L A DARLING COMPANY	35.21	0.00	0.00	0.00	0.00	0.00	0.00
	0502100070	PINNACLE FRAMES & ACCENTS, INC-W(	87.30	0.00	0.67	1.20	0.00	0.00	0.00
			309.32	0.00	0.67	1.20	0.00	0.00	0.00
Cleburne Co									
	0502300074	CALICO TRAILER MANUFACTURING CC	17.51	0.00	0.00	0.00	0.00	0.00	0.00
			17.51	0.00	0.00	0.00	0.00	0.00	0.00
Columbia Co									
	0502700040	AMFUEL - PLANT #1	75.50	0.00	0.00	0.00	0.00	0.00	0.00
	0502700145	SMI STEEL ARKANSAS	1.21	20.30	1.54	1.54	0.00	17.03	0.20
	0502700046	ALCOA	4.30	103.82	80.10	96.31	0.00	7.24	1.19
	0502700004	WHITING OIL AND GAS CORP-MAGNOLI	16.28	3.40	0.00	0.07	0.00	10.39	149.68
	0502700008	WEYERHAEUSER COMPANY-EMERSON	133.80	119.71	72.28	174.12	0.00	246.69	5.28
	0502700028	ALBEMARLE CORPORATION	321.49	89.56	47.58	128.54	0.00	33.23	955.45
	0502700037	DELTIC TIMBER CORP- WALDO	421.81	0.00	0.00	0.00	0.00	211.24	9.98
			974.39	336.79	201.50	400.58	0.00	525.82	1,121.77
Conway Co									
	0502900001	GREEN BAY PACKAGING - ARK KRAFT I	1,889.93	533.35	644.41	835.22	0.00	1,246.72	485.95
	0502900019	GREEN BAY PACKAGING INC-PINECRES	189.48	7.60	42.07	45.62	0.00	68.69	0.11
	1500309	WINNINGHAM, LEE/WINN CREST FRM	0.00	0.00	0.18	1.21	0.00	0.00	0.00
	1500315	STACKS, JOHN/ARK-TENN DAIRY	0.00	0.00	0.27	1.77	0.00	0.00	0.00
			2,079.41	540.95	686.92	883.81	0.00	1,315.41	486.06
Craighead Co									
	0503100412	JONESBORO CW&L-NW SUBSTATION	0.00	15.12	0.00	0.00	0.00	3.45	2.73
	0503100002	ACME BRICK-WHEELER PLANT	1.82	11.80	9.98	29.40	0.00	40.50	26.30
	0503100005	DELTA CONSOLIDATED INDUSTRIES,IN	18.96	4.29	0.27	0.33	0.00	3.60	0.02
	0503100061	ARKANSAS GLASS CONTAINER CORPOI	57.84	212.00	0.00	9.00	0.00	2.20	41.40
	0503100101	RICELAND FOODS-JONESBORO GRAIN I	2.17	118.26	8.92	94.81	0.00	11.26	43.90
	0503100181	QUEBECOR WORLD-JONESBORO DIV	151.71	0.00	7.12	8.58	0.00	0.00	0.00
			232.49	361.46	26.29	142.12	0.00	61.01	114.35
Crawford Co									
	0503300077	A E STALEY MANUFACTURING COMPAI	139.36	9.35	0.71	0.71	0.00	7.85	0.05
	0503300100	ARKANSAS POLY, INCORPORATED	190.37	1.80	0.18	0.22	0.00	0.38	0.01
			329.72	11.15	0.89	0.93	0.00	8.23	0.06
Crittenden Co									
	0503500054	TROJAN LUGGAGE COMPANY,DBA AMI	7.47	0.12	0.01	0.02	0.00	0.03	0.02
	0503500081	CIBA SPECIALTY CHEMICALS WATER T	322.99	50.85	5.01	5.07	0.00	17.62	0.32
	0503500082	GENERAL SHALE PRODUCTS CORPORA'	6.16	216.40	33.11	97.68	0.00	60.50	172.10
	0503500120	WILLIAMS WEST MEMPHIS TERMINAL	157.58	5.67	0.00	0.00	0.00	14.26	0.00

	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
	0503500148	AUTOMATED CONVEYOR SYSTEMS INC	25.00	0.00	0.00	0.00	0.00	0.00	0.00
	0503500230	PROFORM COMPANY,LLC	66.20	0.00	0.00	0.00	0.00	0.00	0.00
			585.40	273.04	38.13	102.77	0.00	92.41	172.43
Cross Co									
	0503700004	MUELLER COPPER TUBE PRODUCTS	71.06	12.84	4.27	4.79	0.00	274.50	0.30
			71.06	12.84	4.27	4.79	0.00	274.50	0.30
Dallas Co									
	0503900004	GEORGIA-PACIFIC FORDYCE PLYWOOD	94.94	104.00	93.04	131.45	0.00	453.00	3.44
	0503900017	IDAHO TIMBER CORPORATION OF CAR	116.58	39.90	80.20	80.20	0.00	93.20	2.30
	0503900058	RAY WHITE LUMBER COMPANY	80.72	7.20	105.49	122.50	0.00	124.40	1.40
			292.23	151.10	278.72	334.15	0.00	670.60	7.14
Desha Co									
	0504100036	POTLATCH CORPORATION-CYPRESS BE	1,197.03	888.90	162.04	186.40	0.00	536.94	26.90
	0504100079	HOLLAND USA, INC	15.05	0.00	0.17	0.58	0.00	0.00	0.00
	0504100067	ARKANSAS CITY TERMINAL	0.01	0.00	0.00	0.00	0.00	0.00	0.00
			1,212.09	888.90	162.21	186.98	0.00	536.94	26.90
Drew Co									
	0504300046	DREW FOAM COMPANIES, INCORPORAT	378.65	0.00	0.00	0.00	0.00	0.00	0.00
	0504300065	AKIN INDUSTRIES	54.54	0.00	0.15	0.50	0.00	0.03	0.00
			433.19	0.00	0.15	0.50	0.00	0.03	0.00
Faulkner Co									
	0504500237	SAN ANTONIO SHOE COMPANY	21.32	0.00	1.56	4.41	0.00	0.00	0.00
	0504500294	STEELE PLASTICS, INC.	19.86	0.00	0.12	0.20	0.00	0.00	0.00
	0504500084	CONWAY REGIONAL MEDICAL CENTER	0.27	2.67	0.30	0.30	0.00	0.60	3.33
	0504500007	BALDWIN PIANO INC	33.37	0.00	0.00	0.00	0.00	0.00	0.00
	0504500004	IC CORPORATION	240.06	0.00	0.00	0.00	0.00	0.00	0.00
	2300464	STRAIN, RICKY DR.	0.00	0.00	0.15	0.96	0.00	0.00	0.00
			314.88	2.67	2.12	5.87	0.00	0.60	3.33
Franklin Co									
	0504700068	AWG WOOLSEY COMPRESSOR STATION	247.04	58.08	0.00	0.00	0.00	47.31	0.00
	0504700094	AWG-SELLS COMPRESSOR STATION	203.02	32.46	0.00	0.00	0.00	58.62	0.00
	0504700092	SEECO - STOCKTON COMPRESSOR STAT	53.66	42.62	0.00	0.00	0.00	63.36	0.00
	0504700090	AWG-DAVIS COMPRESSOR STATION	78.93	99.82	0.00	0.00	0.00	10.12	0.00
	0504700088	CENTERPOINT-WEBB CITY COMPRESSC	2.05	193.68	0.00	0.00	0.00	16.61	0.00
	0504700083	OZARK GAS TRANSMISSION LLC-NOAR	81.38	11.35	0.00	0.00	0.00	20.15	0.00
	0504700071	AWG-DRAKE COMPRESSOR STATION	344.20	75.32	0.00	0.00	0.00	184.28	0.00
	0504700057	CORRELL INCORPORATED	77.67	0.80	11.07	13.34	0.00	0.12	0.00
	0504700014	SGL CARBON CORPORATION	15.17	80.59	41.54	41.54	0.00	425.38	147.53
	0504700012	THOMAS B FITZHUGH GENERATING ST.	2.36	68.60	18.66	18.66	0.00	0.40	171.60
	0504700081	CENTERPOINT-- WALKER COMPRESSOF	10.86	82.96	0.00	0.00	0.00	35.90	0.00
			1,116.33	746.28	71.26	73.53	0.00	862.25	319.13

	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
Garland Co									
	0505100002	STRATCOR INC	1.87	5.30	13.92	15.18	0.00	9.00	1.36
	0505100015	WEYERHAEUSER-MOUNTAIN PINE	171.92	120.20	73.36	80.69	0.00	294.96	7.04
	0505100022	CHEM-FAB CORPORATION	34.65	14.50	0.34	0.41	0.00	4.61	0.04
	0505100268	BUDDY BEAN LUMBER COMPANY,INCC	48.27	2.14	197.78	395.40	0.00	148.60	0.95
			256.71	142.14	285.41	491.68	0.00	457.17	9.39
Grant Co									
	0505300002	INTERNATIONAL PAPER - LEOLA LUMB	458.47	84.84	13.84	53.02	0.00	154.96	13.18
	0505300008	H G TOLER AND SON LUMBER COMPAN	84.76	2.20	37.08	37.08	0.00	37.68	0.43
			543.24	87.04	50.92	90.10	0.00	192.64	13.61
Greene Co									
	0505500251	AMERICAN RAILCAR INDUSTRIES,INCO	45.39	1.26	1.14	1.94	0.00	1.08	0.06
	0505500256	AMERICAN RAILCAR INDUSTRIES	22.43	1.81	1.28	4.00	0.00	1.52	0.01
	0505500002	EMERSON ELECTRIC COMPANY, MOTOI	489.50	136.76	1.80	2.16	0.00	23.74	2.89
			557.32	139.83	4.22	8.10	0.00	26.34	2.96
Hempstead Co									
	0505700090	SMI JOIST COMPANY	248.88	0.00	1.66	5.64	0.00	0.00	0.00
	0505700120	TEMPLE-INLAND FOREST PRODUCTS C(	132.06	95.44	97.23	98.11	0.00	150.66	8.65
	0505700121	BRENTWOOD INDUSTRIES, INCORPORA	27.00	0.00	0.00	0.00	0.00	0.00	0.00
	0505700124	HOPE FEED MILL/HUDSON FOODS	0.45	2.10	16.80	16.80	0.00	1.70	0.10
	0505700304	CT1-ARKANSAS ELECTRIC COOPERATIV	4.50	2.27	2.35	2.35	0.00	0.04	0.21
	0505700305	SMI STEEL PRODUCTS	9.96	0.00	0.08	0.08	0.00	0.00	0.00
	0505700016	MEYER'S BAKERIES	112.75	10.74	0.52	1.09	0.00	2.27	0.07
			535.59	110.55	118.63	124.07	0.00	154.67	9.03
Hot Spring Co									
	0505900071	PACTIV CORPORATION	429.20	0.00	3.43	3.43	0.00	0.00	0.00
	0505900229	DUKE ENERGY-HOT SPRINGS FACILITY	66.88	50.48	0.43	0.44	0.00	54.97	2.05
	0505900086	ACME BRICK COMPANY - OUACHITA PI	5.54	19.20	6.35	18.70	0.00	53.80	54.40
	0505900081	NORAM-MALVERN COMPRESSOR STAT	93.67	109.84	0.00	0.00	0.00	105.98	0.12
	0505900030	ALCOA-HOT SPRGS CONTINUOUS ROLL	328.41	85.75	16.58	18.66	0.00	14.56	0.29
	0505900015	WEYERHAEUSER-(MDF)	78.19	133.40	32.72	43.26	0.00	158.65	0.36
	0505900011	Entergy Arkansas - Lake Catherine	79.00	1,363.00	0.00	12.02	0.00	174.82	4.10
	0505900008	ACME BRICK CO -- PERLA PLANT	7.49	42.30	25.73	72.50	0.00	89.60	159.80
	0505900084	ANTHONY TIMBERLANDS	171.28	29.12	2.83	2.83	0.00	7.27	0.20
	0505900039	NGC-COMPRESSOR STATION-306	26.41	619.24	7.83	7.83	0.00	102.44	0.12
			1,286.07	2,452.33	95.91	179.68	0.00	762.10	221.43
Howard Co									
	0506100016	WEYERHAEUSER COMPANY--DIERKS M	1,045.33	169.08	20.69	54.35	0.00	216.49	10.13
	0506100023	ELECTROLUX HOME PRODUCTS	25.08	7.20	0.88	0.90	0.00	276.10	0.50
	0506100010	BPB GYPSUM,INC	247.95	280.80	19.77	57.20	0.00	111.70	1.60
			1,318.36	457.08	41.34	112.45	0.00	604.29	12.23

	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
Independence C									
	0506300014	ARKANSAS LIME COMPANY	0.00	0.00	8.22	66.21	0.00	29.00	49.70
	0506300036	EASTMAN CHEMICAL COMPANY-ARK E	1,108.44	787.80	163.56	334.98	0.00	1,849.70	6,308.10
	0506300038	GDX AUTOMOTIVE	140.12	2.90	0.00	0.29	0.00	2.50	0.02
	0506300042	ENTERGY ARK-INDEPENDENCE	233.56	15,702.00	317.85	580.56	0.00	1,580.80	25,180.27
	0506300007	WHITE-RODGERS DIVISION/EMERSON E	10.07	4.80	7.68	26.10	0.00	1.20	0.02
			1,492.19	16,497.50	497.30	1,008.15	0.00	3,463.20	31,538.11
Izard Co									
	0506500013	CENTURY FLOORING COMPANY	29.89	4.40	65.87	78.00	0.00	85.80	1.00
			29.89	4.40	65.87	78.00	0.00	85.80	1.00
Jackson Co									
	0506700111	MRT-TUCKERMAN COMPRESSOR STATI	1.31	36.44	0.00	0.00	0.00	1.84	0.00
	0506700010	Nordal USA Inc	846.88	0.00	0.00	0.00	0.00	0.00	0.00
	0506700033	ARKANSAS STEEL ASSOCIATES	19.67	70.42	60.27	84.40	0.00	263.26	21.97
	0506700109	MRT-DIAZ COMPRESSOR STATION	0.00	0.15	0.00	0.00	0.00	0.04	0.00
			867.86	107.01	60.27	84.40	0.00	265.14	21.97
Jefferson Co									
	0506900110	ENTERGY ARK-WHITE BLUFF	174.30	17,156.50	158.74	393.48	0.00	1,406.30	34,992.81
	0506900299	TYSON FOODS-PINE BLUFF FEED MILL	0.45	2.50	16.11	16.11	0.00	2.10	0.10
	0506900213	BERENFIELD CONTAINERS (SW) LIMITE	83.46	0.00	0.00	0.41	0.00	0.00	0.00
	0506900116	PINE BLUFF ARSENAL	31.42	2.27	1.97	1.97	0.00	1.70	0.02
	0506900409	PINE BLUFF ENTERGY CENTER	10.30	263.82	5.71	5.71	0.00	21.68	4.34
	0506900058	VP BUILDINGS INC	51.02	0.00	0.00	0.00	0.00	0.00	0.00
	0506900025	PLANTERS COTTON OIL MILL	256.12	23.18	86.69	226.42	0.00	16.95	0.19
	0506900017	DELTA NATURAL KRAFT & MID-AMERI	3,251.36	250.97	145.39	179.46	0.00	3,311.97	10.70
	0506900016	INTERNATIONAL PAPER COMPANY	2,757.84	1,343.52	908.71	908.71	0.00	3,970.20	331.63
	0506900013	CENTRAL MOLONEY, INC., AN ARKANS	66.96	6.01	18.26	27.32	0.00	5.04	0.04
	0506900117	ALLIED TUBE & CORPORATION	476.98	14.97	16.80	18.99	0.00	3.50	0.60
			7,160.21	19,063.74	1,358.38	1,778.57	0.00	8,739.44	35,340.43
Johnson Co									
	0507100155	TYSON FOODS-SPADRA FEED MILL	0.39	3.00	20.00	24.67	0.00	2.90	0.02
	0507100181	CROSS TIMBERS-MCMILLIAN COMPRES	3.98	124.02	0.04	0.04	0.00	172.65	0.00
	0507100161	AWG-BATSON COMPRESSOR STATION	218.01	184.90	0.00	0.00	0.00	103.62	0.00
	0507100015	GREENVILLE TUBE CORPORATION	55.53	0.00	0.00	0.00	0.00	0.00	0.00
	0507100004	ACME BRICK-CLARKSVILLE PLANT	14.92	19.20	7.54	22.19	0.00	54.09	54.99
	0507100005	KENNER MANUFACTURING COMPANY,	22.87	1.40	0.46	0.80	0.00	0.30	0.10
			315.70	332.52	28.04	47.70	0.00	333.56	55.11
Lafayette Co									
	0507300004	ENTERGY ARK-COUCH	10.49	248.55	1.26	1.31	0.00	44.31	0.32
	0507300005	LONGVIEW GAS COMPANY - STAMPS	17.52	13.94	0.58	0.60	0.00	52.68	607.44
			28.02	262.49	1.84	1.91	0.00	96.99	607.76

	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
Lee Co									
	0507700023	USA COE-W G HUXTABLE PUMPING STA	4.95	198.03	3.36	3.36	0.00	29.50	24.25
			4.95	198.03	3.36	3.36	0.00	29.50	24.25
Lincoln Co									
	0507900041	MRT-GLENDALE COMPRESSOR STATIO	0.38	100.97	0.00	0.00	0.00	122.67	0.00
			0.38	100.97	0.00	0.00	0.00	122.67	0.00
Little River Co									
	0508100001	Ash Grove Cement	81.26	3,944.62	123.32	359.26	0.00	668.67	910.80
	0508100002	DOMTAR INDUSTRIES INC-ASHDOWN M	1,368.88	3,727.04	444.05	677.59	0.00	4,059.20	2,260.13
			1,450.14	7,671.66	567.37	1,036.85	0.00	4,727.87	3,170.93
Logan Co									
	0508300119	PINE BLUFF SAND & GRAVEL CO	1.61	52.11	4.89	21.74	0.00	13.59	6.79
	0508300088	CENTERPOINT ENERGY-DUNN COMPRE	14.00	1,993.16	0.00	0.00	0.00	75.93	0.00
	0508300056	TYSON FOODS-RIVER VALLEY ANIMAL	8.26	74.00	5.00	5.71	0.00	62.19	0.43
			23.86	2,119.26	9.89	27.45	0.00	151.71	7.21
Lonoke Co									
	0508500093	MRT-CARLISLE COMPRESSOR STATION	1.14	200.97	0.00	0.00	0.00	228.31	0.00
			1.14	200.97	0.00	0.00	0.00	228.31	0.00
Marion Co									
	0508900008	RANGER BOATS/WOODS MANUFACTUR	158.90	0.00	12.23	16.90	0.00	0.00	0.00
			158.90	0.00	12.23	16.90	0.00	0.00	0.00
Miller Co									
	0509100005	THE COOPER TIRE COMPANY	155.99	24.19	4.21	6.57	0.00	26.42	0.34
	0509100150	NGP CO-STATION 305 - TEXARKANA	1.70	174.78	2.27	2.27	0.00	30.52	0.01
	0509100193	TYSON FOODS -RIVER VALLEY ANIMAL	3.63	18.60	2.61	3.02	0.00	23.50	0.24
			161.32	217.57	9.09	11.86	0.00	80.44	0.59
Mississippi Co									
	0509300233	NUCOR CORPORATION-(NUCOR STEEL,	91.91	573.72	69.67	84.04	0.00	1,576.04	272.52
	0509300251	MAVERICK TUBE CORPORATION	238.98	0.00	0.00	0.00	0.00	0.00	0.00
	0509300202	NUCOR-YAMATO STEEL	128.70	538.83	53.40	67.04	0.00	1,789.37	422.35
	0509300188	S-R OF ARKANSAS	239.58	18.90	0.07	0.08	0.00	8.00	0.08
	0509300115	VISKASE CORPORATION	1.25	16.37	1.23	1.57	0.00	13.56	0.12
	0509300093	BALL METAL FOOD CONTAINER CORP.	69.92	0.40	0.10	0.10	0.00	0.30	0.10
	0509300012	TERRA NITROGEN LIMITED PARTNERSI	109.07	1,670.11	72.65	104.52	0.00	325.60	28.21
	0509300009	NIBCO INCORPORATED-BLYTHEVILLE I	166.21	0.98	32.02	32.02	0.00	32.51	0.14
	0509300119	BUNGE CORPORATION	0.00	0.00	0.07	0.51	0.00	0.00	0.00
			1,045.62	2,819.31	229.21	289.87	0.00	3,745.37	723.51
Nevada Co									
	0509900058	TETCO-HOPE COMP STATION	6.88	10.59	0.05	0.05	0.00	1.29	0.00
	0509900001	POTLATCH CORPORATION	436.26	67.00	41.03	54.73	0.00	523.00	25.60

	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
			443.14	77.59	41.08	54.78	0.00	524.29	25.60
Ouachita Co									
	0510300055	JOHN L MCCLELLAN GENERATING STA'	9.27	271.68	38.79	38.79	0.00	13.45	440.89
	0510300035	BEARDEN LUMBER COMPANY	209.59	10.64	113.74	113.74	0.00	145.56	2.13
			218.86	282.32	152.53	152.53	0.00	159.01	443.02
Phillips Co									
	0510700132	AMERIMAX COATED PRODUCTS, INCOF	166.34	18.49	2.29	2.29	0.00	4.62	0.14
	0510700130	CYPRESS CHEMICAL COMPANY	31.09	9.16	5.67	6.83	0.00	8.49	0.06
	0510700120	RELIANT ENERGY-HELENA COMPRESS(	0.23	5.62	0.00	0.00	0.00	2.02	0.00
	0510700017	ENTERGY ARK-RITCHIE	18.04	296.23	2.71	2.71	0.00	120.37	0.90
	0510700110	TE PRODUCTS PIPELINE COMPANY	49.12	1.79	0.00	0.00	0.00	0.36	0.00
			264.83	331.29	10.67	11.83	0.00	135.87	1.11
Pike Co									
	0510900017	BEAN LUMBER COMPANY, INCORPORA	164.13	136.21	19.89	39.15	0.00	88.26	5.70
			164.13	136.21	19.89	39.15	0.00	88.26	5.70
Pope Co									
	0511500224	RELIANT ENERGY-PINEY COMPRESSOR	0.34	43.58	0.00	0.00	0.00	26.93	0.00
	0511500228	POTTSVILLE FEED MILL	0.25	2.10	16.96	19.76	0.00	1.75	0.01
	0511500223	RELIANT ENERGY-TATES ISLAND COMI	15.39	30.76	0.00	0.00	0.00	46.15	0.00
	0511500030	RUSSELLVILLE STEEL COMPANY INC	17.47	0.00	0.83	1.00	0.00	0.00	0.00
	0511500014	BIBLER BROTHERS COMPANY	251.03	14.71	0.96	2.24	0.00	17.71	0.28
	0511500011	DOW CHEMICAL-RUSSELLVILLE SITE	66.74	1.20	1.30	1.44	0.00	0.30	0.10
	0511500272	JW ALUMINUM COMPANY	123.05	10.75	9.80	11.20	0.00	6.45	0.05
	0511500050	RIVERSIDE FURNITURE CORPORATION-	1.95	7.10	38.15	94.50	0.00	64.30	0.10
			476.21	110.20	67.99	130.15	0.00	163.59	0.54
Pulaski Co									
	0511900440	ARKANSAS TERMINALING AND TRADIN	99.39	4.49	0.00	0.00	0.00	8.96	0.00
	0511900923	JASON INTERNATIONAL INC	7.67	0.00	0.00	0.00	0.00	0.00	0.00
	0511900532	UNION PACIFIC RAILROAD-JENKS FACI	11.30	0.04	3.38	4.16	0.00	0.03	0.00
	0511900410	GRANITE MOUNTAIN QUARRIES-MCGE(	0.00	0.00	6.19	36.71	0.00	0.00	0.00
	0511900118	SMITH FIBERCAST	30.60	0.00	0.00	0.00	0.00	0.00	0.00
	0511900107	SMURFIT-STONE CONTAINER	5.61	1.58	0.15	0.21	0.00	0.36	0.06
	0511900087	ENTERGY ARK-LYNCH	1.77	52.40	0.78	0.79	0.00	20.10	0.26
	0511900065	AFCO STEEL, INCORPORATED	64.99	0.00	0.00	0.00	0.00	0.00	0.00
	0511900683	WHEATLAND TUBE COMPANY - OMEGA	31.52	0.00	6.32	7.09	0.00	0.00	0.00
	0511900061	ARCHER DANIELS MIDLAND COMPANY	574.67	216.28	5.99	34.80	0.00	56.40	0.13
	0511900004	POROCEL CORPORATION	4.80	50.70	8.33	24.54	0.00	56.60	0.47
	0511900003	MINNESOTA MINING AND MANUFACTU	2.05	63.60	84.20	275.31	0.00	50.80	19.60
	0511900090	ENTERGY ARK-MABELVALE	0.00	0.12	0.00	0.00	0.00	0.03	0.00
			834.39	389.21	115.34	383.60	0.00	193.28	20.52
Randolph Co									

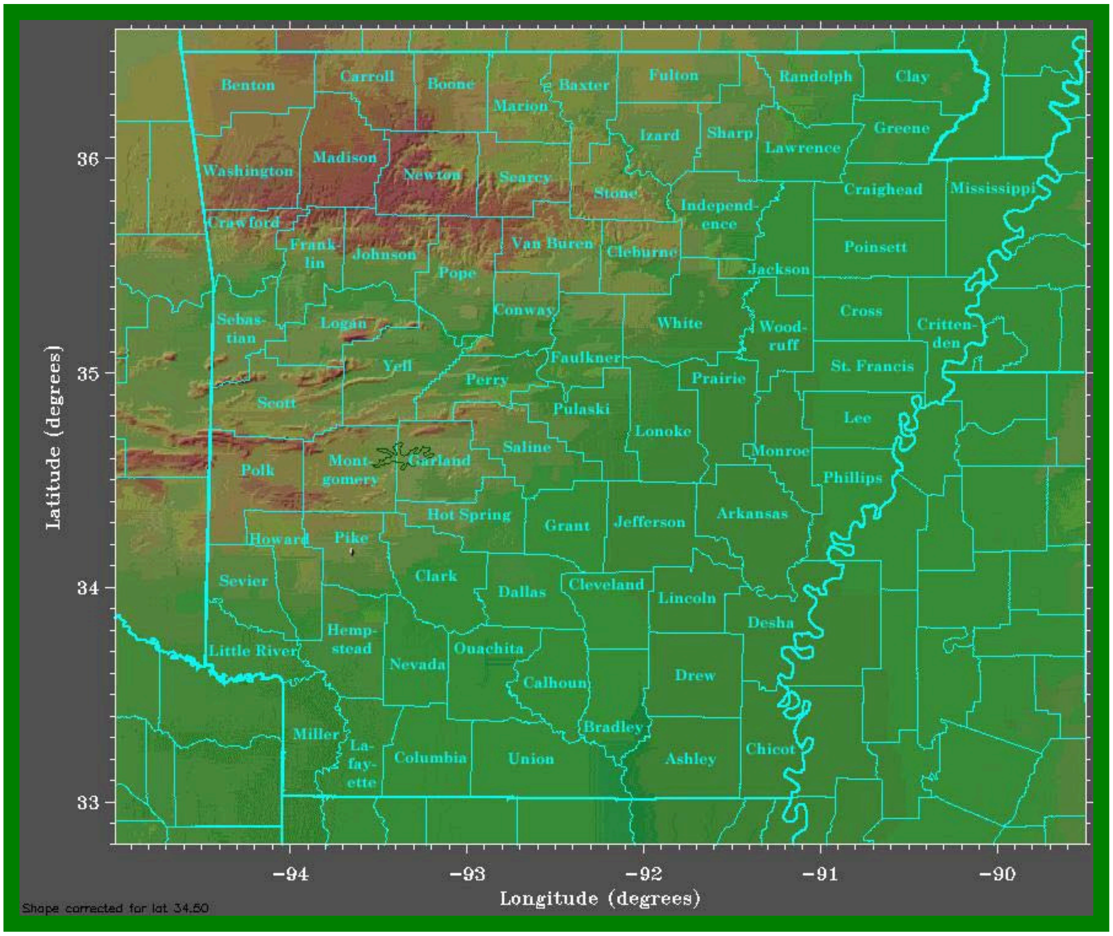
	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
	0512100031	NATURAL GAS PIPELINE COMPANY OF	85.15	550.49	7.39	7.39	0.00	100.33	0.11
	0512100076	MRT-BIGGER COMPRESSOR STATION	0.20	41.11	0.00	0.00	0.00	14.22	0.00
	0512100009	WATERLOO INDUSTRIES,INCORPORATI	126.42	6.16	0.39	0.47	0.00	5.17	0.04
	0512100001	MAGEE COMPANY	243.08	0.00	0.00	0.00	0.00	0.00	0.00
			454.85	597.76	7.78	7.86	0.00	119.72	0.15
St Francis Co									
	0512300010	ENTERGY ARK-MOSES	3.92	51.10	0.66	0.68	0.00	26.10	0.29
			3.92	51.10	0.66	0.68	0.00	26.10	0.29
Saline Co									
	0512500010	ALMATIS INC - BAUXITE	77.66	274.39	521.87	555.63	0.00	47.84	44.60
	0512500029	WABASH ALLOYS, LLC	17.10	31.05	21.53	21.53	0.00	23.08	9.47
			94.76	305.44	543.40	577.16	0.00	70.93	54.07
Scott Co									
	0512700049	TRAVIS LUMBER COMPANY,INCORPOR	165.07	21.40	22.72	33.65	0.00	21.40	2.08
			165.07	21.40	22.72	33.65	0.00	21.40	2.08
Sebastian Co									
	0513100150	RIVERSIDE FURNITURE	0.00	0.00	39.38	133.90	0.00	0.00	0.00
	0513100507	HICKORY SPRINGS MANUFACTURING C	36.76	0.00	0.12	0.12	0.00	0.86	0.02
	0513100352	AIR SYSTEMS INCORPORATED	99.04	0.00	0.94	3.20	0.00	0.00	0.00
	0513100640	RELIANT ENERGY-HOBBS COMPRESSOI	5.59	33.62	0.00	0.00	0.00	14.93	0.00
	0513100219	NORTON PROPPANTS DIVI OF SAINT-GC	4.45	51.38	33.26	80.13	0.00	43.19	0.30
	0513100048	WHIRLPOOL CORPORATION	39.30	59.22	5.82	5.82	0.00	14.82	0.30
	0513100041	BALDOR ELECTRIC COMPANY-FORT SM	141.80	3.06	3.32	4.00	0.00	1.07	0.01
	0513100030	STORE KRAFT MAN. CO., GREENWOOD	24.38	0.00	0.00	0.00	0.00	0.00	0.00
	0513100274	QUANEX CORPORATION -MACSTEEL DI	37.44	84.35	3.69	3.69	0.00	319.76	30.29
	0513100081	ACME BRICK COMPANY-FORT SMITH PI	301.68	10.26	15.11	44.48	0.00	265.20	114.18
			690.43	241.89	101.64	275.34	0.00	659.83	145.09
Union Co									
	0513900400	TEPPCO-EL DORADO #1 TERMINAL	58.72	0.00	0.00	0.00	0.00	0.00	0.00
	0513900543	UNION POWER STATION	0.50	14.50	3.20	3.20	0.90	1.55	0.12
	0513900473	ANTHONY FOREST PRODUCTS CO-EL D	148.50	72.19	79.48	124.42	0.00	125.53	4.55
	0513900101	GREAT LAKES CHEMICAL CORP-WEST I	10.03	42.60	4.37	4.40	0.00	120.10	0.70
	0513900098	TERIS, LLC	66.51	296.00	87.90	148.31	0.00	81.39	21.60
	0513900040	EL DORADO CHEMICAL COMPANY	2.03	1,136.59	105.78	169.66	0.00	13.72	1,689.22
	0513900036	COOPER-STANDARD AUTOMOTIVE	157.41	5.04	0.00	0.00	0.00	4.20	0.00
	0513900032	GEORGIA-PACIFIC-EL DORADO SAWMII	260.00	11.97	11.63	17.60	0.00	418.33	8.05
	0513900016	LION OIL COMPANY	4,567.59	742.10	354.51	597.39	0.00	563.22	767.40
	0513900013	West Fraser (South) - Huttig Mill	185.75	56.60	48.90	144.24	0.00	164.00	6.44
	0513900012	GREAT LAKES CHEMICAL	52.48	34.70	68.50	180.46	0.16	176.55	0.53
	0513900480	DEL-TIN FIBER LLC-EL DORADO	108.15	193.52	6.50	19.23	0.00	297.61	4.05
	0513900037	GREAT LAKES CORPORATION--SOUTH I	109.08	109.25	39.02	47.16	0.00	19.99	42.15

	Plant ID	Plant Name	VOC (TPY)	NOX (TPY)	PM2.5 (TPY)	PM10 (TPY)	NH3 (TPY)	CO (TPY)	SO2 (TPY)
			5,726.74	2,715.06	809.78	1,456.07	1.06	1,986.19	2,544.80
Washington Co									
	0514300205	KAWNEER COMPANY INCORPORATED	74.46	0.00	0.00	0.00	0.00	0.00	0.00
	0514300270	SUPERIOR INDUSTRIES INT INC-FAYETT	49.02	68.52	59.96	98.38	0.00	68.96	0.84
	0514300054	AMERICAN TUBING,INCORPORATED	16.36	0.00	0.00	0.00	0.00	0.00	0.00
	0514300048	BALL METAL FOOD CONTAINER CORPC	2,749.05	5.29	0.24	0.40	0.00	4.44	0.03
			2,888.89	73.81	60.19	98.78	0.00	73.40	0.87
White Co									
	0514500104	NGC-STATION #307	45.73	765.84	8.26	8.26	0.00	71.94	0.10
	0514500110	BRYCE CORPORATION	670.07	8.68	0.54	0.54	0.00	5.56	0.05
	0514500123	TETCO-BALD KNOB	44.22	97.41	1.20	1.20	0.00	24.19	0.08
	0514500127	CENTERPOINT ENERGY/W .POINT	1.95	176.69	0.00	0.00	0.00	216.87	0.00
	0514500150	SEARCY LAUNDRY PRODUCTS-MAYTA(	0.56	9.40	1.17	1.17	0.00	7.87	0.07
	0514500177	ROAD SYSTEMS, INC.	10.60	0.00	0.00	0.00	0.00	0.00	0.00
	0514500006	ROBBINS HARDWOOD FLOORING, INC.	18.34	6.96	11.54	28.67	0.00	56.62	0.70
			791.47	1,064.98	22.71	39.84	0.00	383.05	1.00
Woodruff Co									
	0514700024	AECC - Carl E Bailey Generating Sta	5.45	149.31	43.68	43.68	0.00	0.22	380.36
			5.45	149.31	43.68	43.68	0.00	0.22	380.36
Yell Co									
	0514900009	DELTIC TIMBER CORPORATION-OLA	143.14	0.00	0.88	2.81	0.00	133.21	4.68
			143.14	0.00	0.88	2.81	0.00	133.21	4.68
		Statewide Totals	**44,328.97**	**72,419.33**	**7,837.34**	**12,405.57**	**1.06**	**56,365.84**	**92,204.95**

ENVIRON

International Corporation — *Air Sciences*

Final Report
Arkansas 2002 Emission Inventory



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13 May 2004

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APPENDICES

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FIGURES

1. INTRODUCTION

The calendar year 2002 emission inventories described in this document were prepared by ENVIRON International Corporation and the Eastern Research Group for the Arkansas Department of Environmental Quality (ADEQ). This emission inventory will be combined with ADEQ's point source emission inventory and submitted to EPA as required by the Consolidated Emissions Reporting Rule (CERR), promulgated in June 2002. This section first describes the CERR requirements, and then provides the scope of the emission inventory work performed.

CONSOLIDATED EMISSIONS REPORTING RULE (CERR) REQUIREMENTS

Under the provisions of the final promulgated CERR (67 FR No. 111, 39602), states are required to submit certain emission inventory data to U.S. EPA by June 1, 2004. The base year for the emissions data to be reported in June 2004 is 2002. For area, onroad mobile, and nonroad mobile sources, the following pollutants must be included, as applicable and required for CERR submittal for a 2002 base year:

- Sulfur oxides (SO_x);
- Volatile organic compounds (VOC);
- Nitrogen oxides (NO_x);
- Carbon monoxide (CO);
- Lead (Pb) and lead compounds;
- Primary particulate matter ($PM_{10,}$ $PM_{2.5}$); and
- Ammonia (NH_3).

Emission estimates for area and mobile sources must be submitted for the entire state of Arkansas on a county level basis, regardless of the National Ambient Air Quality Standards (NAAQS) attainment status. Area sources are defined and inventoried according to the pollutant-specific reporting thresholds contained in the final CERR. These thresholds are 100 tons/year (tpy) of NO_x, SO_x, VOC, PM_{10}, $PM_{2.5}$, NH_3; 1,000 tpy of CO; and 5 tpy of Pb.

Although the CERR does not require the use of any specific emission estimation technique, for this project the ENVIRON/ERG team primarily used the methods contained in the Arkansas Quality Assurance Project Plan (QAPP). In some cases, alternative methods instead of preferred methods of inventory estimation were used in order to be able to complete the emissions estimates within the timeframe allotted.

The data elements to be reported for the 2002 inventory for area and onroad mobile sources (22 elements), and nonroad mobile sources (12 elements) are specifically defined in the CERR. These data fields for the appropriate category/pollutant combinations as listed in Table 1-1 are being provided in electronic data files to ADEQ in EPA's NIF3.0 format along with this report.

Table 1-1. CERR required data elements for area, nonroad mobile, and onroad mobile sources.

Required Data Element	Source Type		
	Area	Nonroad Mobile	Onroad Mobile
Inventory Year	●	●	●
Inventory Start Date	●	●	●
Inventory End Date	●	●	●
Inventory Type	●	●	●
State FIPS Code	●	●	●
County FIPS Code	●	●	●
SCC or PCC	●	●	●
Emission Factor	●	●	●
Annual Activity/Throughput Level	●	●	
VMT Activity by Roadway Class			●
Total Capture/Control Efficiency (%)	●	●	
Rule Effectiveness (%)	●	●	
Rule Penetration (%)	●	●	
Pollutant Code	●	●	●
Summer/Winter Work Weekday Emissions	●	●	●
Annual Emissions	●	●	●
Winter Throughput (%)	●	●	
Spring Throughput (%)	●	●	
Summer Throughput (%)	●	●	
Fall Throughput (%)	●	●	
Hours/Day in Operation	●	●	
Days/Week in Operation	●	●	
Weeks/Year in Operation	●	●	

FIPS = Federal Information Processing System
SCC = Source classification code
PCC = Process classification code
VMT = vehicle miles Traveled

EMISSIONS INVENTORY SCOPE

The scope of the Arkansas area, on-road and off-road mobile sources emissions inventory documented in this report is as follows:

- **Source Categories:** Emissions in this report are presented for area sources (e.g., solvent usage, open burning, fugitive dust), on-road mobile sources (e.g., cars and trucks), and off-road mobile sources (e.g., lawn and garden equipment, agricultural equipment, aircraft). The CERR 2002 point source emissions files are being prepared by ADEQ.

- **Pollutants:** The pollutants included in this analysis are the ozone precursors and additional visibility-related pollutants. The ozone precursors are volatile organic compounds (VOC), nitrogen oxides (NOx), and carbon monoxide (CO). The additional visibility-related pollutants are PM_{10}, $PM_{2.5}$, sulfur oxides (SOx), and ammonia (NH_3). As required by CERR, lead (Pb) emissions are also included.

- **Temporal Resolution:** Emissions for calendar year 2002 have been estimated on an annual total basis. As required by the CERR, average summer work weekday and average winter work weekday emissions have also been estimated for all area, on-road, and off-road source categories. Seasons are defined as three-month periods: Summer is June through August, and Winter is January/February/December of the same year (i.e., not contiguous months). Also following the CERR, ozone season daily emissions are the same as summer work weekday emissions.

- **Geographical Domain:** Emissions by source category are provided for each of the 75 counties in the State of Arkansas, and the State total. The summer weekday an winter weekday emissions were gridded at a resolution of 4 km; gridded emissions displays are provided.

2. AREA SOURCE EMISSIONS METHODOLOGY

This section describes the methods, data, and assumptions used to estimate emissions for area sources located in the state of Arkansas.

The area source inventory includes emitters of ozone pollutants (i.e., VOC, NO_x, and CO) such as devices that combust fuel (e.g., wood stoves, commercial and industrial boilers), disperse industrial and commercial VOC sources (e.g., dry cleaners, degreasing, and industrial surface coating), gasoline distribution, asphalt paving, and fires and open burning (e.g., agricultural burning, structural fires, wildfires, prescribed burning). In addition, area source categories contributing visibility pollutants (i.e., primary PM_{10}, $PM_{2.5}$, and NH_3) are also included in the area source emissions inventory (e.g., fugitive dust, agricultural operations, livestock ammonia, etc.).

Emissions were estimated for all of the area source categories shown in Table 3-2 of the ENVIRON/ERG Technical Proposal (November 18, 2003). For some source categories, the methodologies actually used in the Arkansas area source inventory are different than those originally proposed in the Technical Proposal due to newly developed methodologies. Also, because some data were not available, alternative sources of data for some source categories were used. In all cases, the actual methodologies and activity data used to estimate annual and seasonal emission estimates for the Arkansas area source inventory are clearly presented below, as well as in the supporting calculation spreadsheets.

The industrial fuel combustion categories in the Arkansas area source inventory were reconciled with industrial point source fuel use data in order to prevent potential double-counting of emissions. The industrial point source fuel data were obtained from ADEQ's Emission Inventory Questionnaires (EIQs) (ADEQ, 2004). The 2002 EIQs are currently being processed and could not be used; the 2001 EIQs were used instead. All EIQ fuel use data were directly input "as is" into a spreadsheet from the EIQ forms. The only adjustments made to the EIQ data were conversions to consistent units (i.e., natural gas to 10^6 ft^3, distillate and residual fuel oil to 10^3 gallons, and coal to tons) and corrections of obvious inconsistencies (e.g., wood combustion reported in units of 10^6 ft^3 for a natural gas boiler was switched to natural gas combustion, etc.). Facilities with ambiguous fuel types, quantities, or units were omitted from the reconciliation. The reconciliation was performed by subtracting state-level EIQ industrial point source fuel use from the area source inventory's state-level industrial combustion fuel use. Fuel use from utility facilities listed in the EIQ was not included in the EIQ fuel use totals. Distillate fuel oil, residual fuel oil, natural gas, and coal were included in the reconciliation; LPG use was not identified in the EIQ fuel use data. As a result of the reconciliation, state-level industrial fuel use in the area source inventory was adjusted (i.e., distillate fuel oil reduced by 4.3 percent, natural gas reduced by 45.0 percent, and coal reduced by 16.8 percent). For residual fuel oil, the EIQ fuel use data exceeded the industrial fuel combustion area source fuel use estimate. Therefore, industrial fuel combustion of residual fuel oil in the area source inventory was adjusted to zero. Reconciliation for other area source categories (i.e., industrial surface coating or degreasing) was not performed because data were unavailable on the EIQ forms.

The data collection and emissions inventory development methodologies described below were conducted in accordance with ADEQ's Quality Assurance Project Plan (QAPP), as well as the requirements of the Consolidated Emissions Reporting Rule. All data collected as part of the area sources inventory were thoroughly reviewed prior to use in emission calculations. In addition, all emission factors used in the inventory were reviewed to ensure that they were the most appropriate and up-to-date emission factors available. Finally, all equations used for emissions estimation were checked for calculational accuracy; equations used multiple times in spreadsheets were checked for proper replication.

RESIDENTIAL WOOD COMBUSTION

Annual Emissions

The residential wood combustion (RWC) area source category includes both fireplaces and woodstoves. Ideally, an RWC survey would provide local activity data (e.g., quantity of wood burned by household, devices used, etc.) to quantify emissions. Previously it was determined that an RWC survey has never been conducted for the Little Rock metropolitan area (McCorkle, 2002). In addition, it does not appear that an RWC survey has ever been conducted for any other counties in Arkansas.

In lieu of a local survey, a recently developed national RWC emissions inventory disaggregated to the county level was used (Moulis, 2004a). This inventory was prepared in support of U.S. EPA's National Emissions Inventory (NEI) and coincides with the Arkansas inventory year of 2002. The national 2002 RWC inventory included seven different types of devices: fireplaces, fireplaces with inserts (EPA certified catalytic, EPA certified non-catalytic, and non-EPA certified), and woodstoves (conventional, catalytic, and non-catalytic). These device types were aggregated into two general categories: fireplaces and woodstoves. The county-level estimates from the national 2002 RWC inventory were incorporated into the Arkansas area source inventory without changes or adjustments.

Seasonal Emissions

Because RWC is primarily used for space heating, the RWC emissions were temporally allocated based upon heating degree days (HDD). An average monthly HDD profile for Arkansas indicates that 2,070 HDDs out of the annual total of 3,172 HDDs occur during the winter (i.e., December through February) and that no HDDs occur during the summer (i.e., June, July, August) (NCDC, 2004). Winter residential wood combustion emissions were calculated by multiplying annual emissions by the ratio of winter HDDs over total HDDs (i.e., 2070/3172 or 0.6526). Average summer and winter weekday emissions were then calculated by dividing the seasonal emissions by the number of days in that season (i.e., 90).

OTHER STATIONARY SOURCE FUEL COMBUSTION

Annual Emissions

The other stationary source fuel combustion category includes all industrial, commercial/ institutional, and residential fuel combustion (except for RWC). The fuel types include natural gas, propane/liquid petroleum gas (LPG), fuel oil (i.e., distillate, residual, and kerosene), and coal.

Ideally, a fuel survey of local fuel dealers would provide local fuel consumption data. However, resources to conduct a fuel survey for the entire state were not available. In lieu of a local fuel survey, state-level fuel consumption data were obtained from State Energy Data Report published by the Energy Information Administration (EIA, 2004a). The most recent State Energy Data Report is for 2000; the state-level fuel consumption data from that report were used in the Arkansas area source inventory.

The 2000 state-level energy data were disaggregated to the county-level as described in the EIIP area source method abstracts (EIIP, 1999a; EIIP, 1999b; EIIP, 1999c):

- Residential fuel use was disaggregated to the county level based upon the number of households heating with a particular fuel and the number of HDD. Household heating information was obtained from the 2000 census (U.S. Census, 2000a). County-level heating degree day information was obtained from the national 2002 RWC inventory described in the residential wood combustion section (Moulis, 2004a).

- Commercial and institutional fuel use was disaggregated to the county level based upon the number of employees for Standard Industrial Classifications (SICs) 50-99 (now National American Industry Classification System [NAICS] 42, 44, 51-56, 61-62, 71-72, 81, 95, and 99) (U.S. Census, 2001) and number of HDD (Moulis, 2004a).

- Industrial fuel use was disaggregated to the county-level based upon the number of employees for SICs 20-39 and 49 (now NAICS 22 and 31) (U.S. Census, 2001). As described at the beginning of the area source inventory section, the industrial fuel combustion area source categories were reconciled with point source fuel combustion using data obtained from the EIQ forms.

Emission factors for natural gas, propane/LPG, fuel oil, and coal were obtained from AP-42, (Sections 1.4, 1.3, 1.5, and 1.1, respectively) (EPA, 1995) and the Factor Information Retrieval (FIRE) Data System (EPA, 2000).

Emissions for the other stationary source fuel combustion source category were calculated using the following equation:

$$E_{f,p} = U_f \times EF_{f,p} \times \left(\frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \right)$$

where $E_{f,p}$ = Emissions for fuel f and pollutant p (tons/year);
U_f = Fuel usage for fuel f (10^6 ft^3, 10^3 gal or ton); and

$EF_{f,p}$ = Emission factor for fuel f and pollutant p (lb/10^6 ft^3, lb/10^3 gal, or lb/ton).

A sample calculation using this equation for estimating VOC emissions for Pulaski County residential natural gas usage is as follows:

where U_{ng} = 7,776 MMscf (i.e., 10^6 ft^3);
$EF_{ng,VOC}$ = 5.5 lbs VOC/MMscf; and
$E_{ng,VOC}$ = 21.4 tons VOC/year.

Seasonal Emissions

Fuel use in the industrial sector is mainly related to industrial processes. It was assumed that the industrial sector operates year-round on a 5-day workweek schedule. It was also assumed that the industrial fuel combustion activity is relatively uniform throughout the year. The average summer and winter weekday emissions were calculated by dividing annual emissions by the total number of annual weekdays (i.e., 261).

Fuel use in the commercial/institutional and residential sector is divided into four main components: space heating, water heating, cooking, and other. Fuel use among these components was disaggregated by commercial/institutional and residential fuel consumption surveys conducted by the Energy Information Administration (EIA) (EIA, 2004b; EIA, 2004c).

Fuel combustion for space heating was allocated to seasons based upon HDD in the same manner as was used for RWC (described above). The other three components (i.e., water heating, cooking, and other) were assumed to be constant throughout the year. Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days. The average summer and winter weekday emissions for all four components were then summed together.

FUGITIVE ROAD DUST

Reentrained road dust emissions were estimated as the product of vehicle miles traveled (VMT) and an emission factor. Paved and unpaved roads were handled separately. Unpaved VMT were first estimated for 1996 and then projected to 2002 levels using growth factors developed as part of previous work for the Western Regional Air Partnership (WRAP). Statewide emissions were obtained first and subsequently allocated to the individual counties in the state also using WRAP allocation factors.

Unpaved road VMT is estimated as the product of the road mileage and the assumed average daily traffic volume (ADTV). The 1996 Federal Highway Administration's Highway Statistics Report (FHWA, 1996) was the source for the mileage estimate used in the current inventory. Data were reported separately for urban and rural roads.

The ADTV estimates for urban unpaved roads were based upon those in the Clark County, NV June 2001 PM_{10} SIP (available at http://www.co.clark.nv.us/Comprehensive_planning/Environmental/AirQuality/PM10SIP.htm). VMT estimates on urban unpaved roads were estimated using the average ADTV value for Clark

County (69.2), with adjustments for differences in population density. Urban unpaved road ADTV values for all counties were first estimated using the average Clark County ADTV and adjusting with the ratio of county population densities. Population densities were based upon 1990 U.S. Census Bureau population and land area data. The final ADTV was obtained by computing the arithmetic average of all the counties' volumes.

Roads managed by the National Forest Service constitute approximately one fourth of the total unpaved road mileage (10,013 miles out of 44,559 miles) in Arkansas. Given this information, it seemed prudent that rural volume estimates should specifically take into account the activity under this agency's jurisdiction; i.e. activity in national forests. The counties that have rural unpaved roads were first categorized into those with National Forests and those without. For the latter group, the Clark County-derived ADTV described above was assumed.

For the counties with NFS land (forests), the approach was based upon a methodology outlined by a NFS contact. Briefly, his approach is to spread a percentage of the annual number of forest visits upon a certain fraction of the NFS roads and over a certain portion of the year. This recommendation is consistent with the fact that 80 percent of their traffic occurs on about 15 percent of their roads. While this approach yields accurate local estimates, an enormous amount of geospatial data is required for its application. In order to be able to apply this approach within the available time and budget resources, the visits were spread over all NFS roads and over the entire year at the state level. The first part of the approach is in recognition that the NFS portion in the FHWA estimates does not distinguish those that have high and low activity level. The second portion is because seasonal allocation of VMT will take place in steps subsequent to this analysis.

For this approach, state level forest visitation (1996) data were obtained from the NFS web site (http://www.fs.fed.us/recreation/recinfo/recuse_93-96.shtml). County level unpaved road mileages were obtained from NFS staff. The average number of occupants per vehicle was estimated from surveys performed at various forests by the NFS (http://www.fs.fed.us/recreation/recuse/recuse.shtml). This number was used to convert the number of visitors to the number of vehicles. The result was then divided by the NFS unpaved mileage and by 365 to obtain the ADTV. The ADTV was multiplied by a factor of two according to the assumption that people will drive through the same roads twice to get in and out of the forest. These state average NFS ADTV were applied only to counties with National Forests (i.e., have NFS unpaved road mileage). Once the NFS estimates were obtained for each county, they were used in conjunction with the Clark County-based volumes as follows. The average of the NFS and Clark County-based ADTV were assumed for counties with National Forests, while the Clark County values alone were applied to counties without National Forests. Finally, these county-level ADTVs were combined to obtain an average value for the state using rural population as weighting factors. The resulting urban and rural state average ADTVs for Arkansas are 32 and 39, respectively.

Paved road VMT was estimated by subtracting the 2002 unpaved portion from the total, which was based upon data provided by Arkansas Highway and Transportation Department (AHDT). As mentioned above, both paved and unpaved road state-level VMT estimates were allocated to the individual counties using data from previous work for the WRAP. The summer and winter seasonal weekday estimates were estimated using AHDT seasonal adjustment factors in combination with the weekday/weekend adjustments. Both of these are discussed in more detail in the on-road section.

Emission factors for both road types were based upon the latest AP-42 guidance (available at http://www.epa.gov/ttn/chief/ap42/ch13/). Paved road fugitive dust emission rates were estimated for each facility class and season using state average silt loading and monthly urban area precipitation data. Unpaved emission factors were derived assuming a silt content of 3.9% and monthly rural area precipitation data. PM2.5 emissions were assumed to be 25% and 15% of PM10 emissions for paved and unpaved roads, respectively.

FUGITIVE DUST – CONSTRUCTION ACTIVITIES

Annual Emissions

Residential construction activities were estimated using single- and multi-unit housing permit data for some communities located in Arkansas (U.S. Census, 2004). The number of housing permits at the county-level was extrapolated based upon the populations of the counties and the communities with reported permit data (U.S. Census, 2000a).

A typical lot size of 8,500 ft^2 was previously identified for housing permits up to 4 units (Hoffpauer, 2002). A lot size of 2 acres was assumed for housing permits for 5 units and greater.

The PM_{10} fugitive construction dust emission factor was obtained from the best available control measure (BACM) document (MRI, 1996). A $PM_{2.5}$ size fraction was applied to the PM_{10} emission estimates in order to develop $PM_{2.5}$ emissions (ARB, 2002). It was assumed that the duration of construction that represents the level of activity characterized by the MRI emission factor was one month.

Emissions from construction activities were calculated using the following equation:

$$E = EF \times (A \times D)$$

Where E = PM_{10} emissions (tons/year);
EF = Emission factor (tons PM_{10}/acre-month);
A = Total area of residential construction for year (acres); and
D = Average duration of residential construction (months).

A sample calculation using this equation for estimating PM_{10} emissions for construction activities in Pulaski County is as follows:

Where EF = 0.42 tons PM_{10}/month-acre;
A = 361.82 acres;
D = 1 month;
E = 152.1 tons PM_{10}/year.

Seasonal Emissions

Construction activity was assumed to be constant throughout the year. Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

WINDBLOWN FUGITIVE DUST

The windblown fugitive dust PM emission inventory for the State of Arkansas was developed using the estimation methodology developed for the Western Regional Air Partnership (WRAP) by a team of contractors led by ENVIRON (ENVIRON, 2004). The methodology is based on the results of wind tunnel studies and a detailed characterization of vacant lands. Windblown dust emissions are estimated hourly on a gridded modeling domain using hourly averaged wind speeds and other meteorological parameters. Estimates are developed for every hour of the year 2002, and subsequently aggregated by county and summed across all hours to provide annual emissions estimates. Typical summer and winter day dust emissions are obtained by summing across the appropriate months (December, January, February for winter; June, July, August for summer) and dividing by the total number of days for each (92 for winter; 90 for summer)

The characterization of vacant lands is based on landuse/landcover (LULC), soil texture and the potential to emit fugitive dust. Vacant land disturbance potential is based on the assumed stability of the vacant land parcel as determined by the dominant LULC type within each grid cell. The total amount of erodible soil available for suspension through wind erosion is limited by the reservoir characteristics of the land parcel. A reservoir determination methodology was proposed for the WRAP Project and adopted for this study. Vegetation density, or canopy cover, will reduce the dust emission flux from that of a non-vegetative surface. Adjustments for vegetative cover are based on LULC classifications. Non-climatic effects are included to adjust emission from agricultural lands.

Wind Tunnel Studies

Field and wind tunnel experiments suggest that the emissions are proportional to wind friction speed and approximate theoretical model predictions, but the considerable scatter in the available data make it impossible to clearly define this dependence (Nickling and Gillies, 1993). Different surfaces appear to have different constants of proportionality for the flux versus wind friction velocity relationship, implying that the flux is predictable, but surface and soil properties affect the magnitude of the flux. A detailed discussion of wind tunnel studies, including various limitations and measured data, is provided in ENVIRON, 2003a; 2003b. The findings of the various wind tunnel studies are briefly summarized here.

Recently Alfaro *et al*. (2003) re-analyzed the Nickling and Gillies (1989) data and found that the tendency of a surface to emit dust depends not primarily on its textural qualities, but on the size distribution of the loose soil aggregates available for saltation, and the aerodynamic roughness length that conditions the emission threshold. The re-analysis was based in part on the work of Chatenet *et al*. (1996) in which they found that desert soils could be broadly divided into four populations based upon their soil aggregate populations. The differences between the four groups are based upon the estimated geometric mean diameter of the soil particles. The four size classes are 125 μm, 210 μm, 520 μm, and 690 μm, which are labeled FFS, FS, MS, and CS by Chatenet *et al*. (1996).

Using the Alfaro *et al*. (2003) approach, emissions of dust for soils can be confined to four different emission factors, depending on the geometric mean grain size, as determined by the methods of Chatenet *et al*. (1996). The model predictions were tested against the wind tunnel data set of Nickling and Gillies (1989) and found to fit the measured data satisfactorily. Of key importance is that Chatenet *et al*. (1996) established relationships between the 12 soil types that are defined in the classical soil texture triangle and their four dry soil types (silt [FSS], sandy silt [FS] silty sand [MS], and sand [CS]). The soil texture categorization and the relationships among texture assignments and soil groupings are discussed in the next section.

For the current methodology, the work of James et al. (2001) was considered, which reported emission rates as a function of wind speed and vacant land stability for a general soil type on surfaces free of vegetation and included the initial transient, or spike, emissions that occur at the onset of a wind event. Combining the relations of Alfaro and the emission rates of James et al., a hybrid methodology for the estimation of fugitive emissions from wind erosion was developed. The hybrid method uses the generic relations of James et al. and the soil texture specific relations of Alfaro to derive emission rates as a function of wind speed, soil texture and vacant land stability.

The result of combining the findings from these studies is presented in Figures 2-1 and 2-2. Figure 2-1 presents the emission rates for discreet wind speed bins for each of the five soil groups for disturbed, or unstable, vacant land parcels. The corresponding emission rates for undisturbed vacant lands are presented in Figure 2-2. The spike emissions for stable and unstable lands for each of the soil texture groups are presented in Tables 2-1 and 2-2, respectively. Note that the values presented here are applicable to land parcels with no vegetative cover.

In the WRAP methodology, dust emissions are initiated when the 10-meter wind speed exceeds the lower limit of the smallest wind speed bin for which data are available, as shown in Figures 2-1 and 2-2. The corresponding emission rates are then attenuated based on the percentage of vegetation canopy cover to account for the fact that the relations presented here are appropriate for a bare soil land parcel.

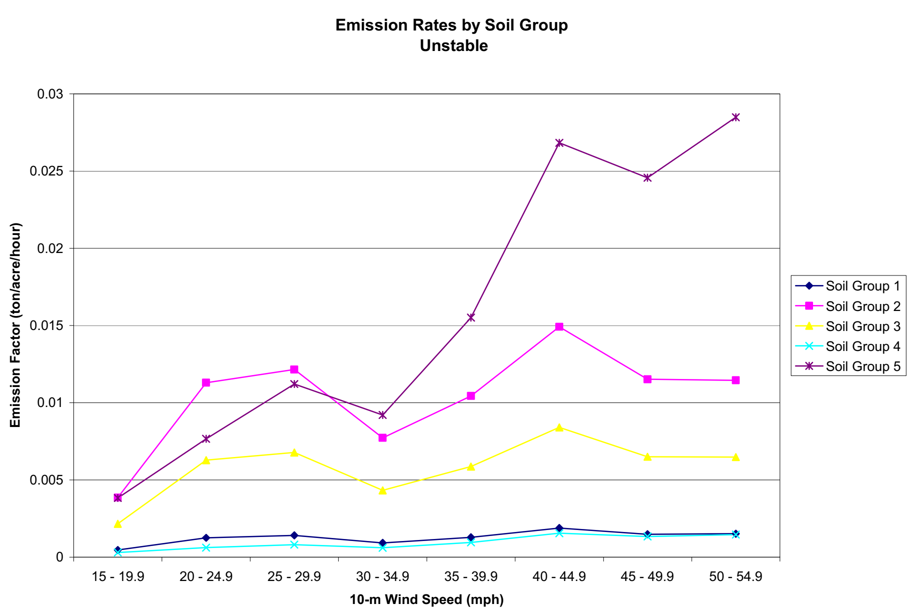


Figure 2-1. Emission factors by soil group for disturbed (unstable) soils.

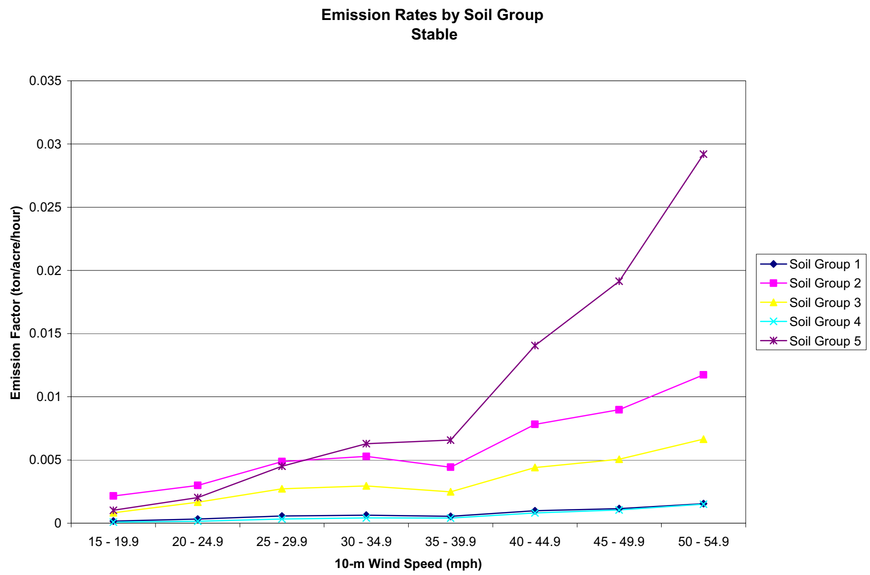


Figure 2-2. Emission factors by soil group for undisturbed (stable) soils.

Table 2-1. Spike emission by soil group for disturbed (unstable) soils.

			Spike Emission Unstable Soils (ton/acre)					
		10-m Wind Speed (mph)						
Soil Group	**15 - 19.9**	**20 - 24.9**	**25 - 29.9**	**30 - 34.9**	**35 - 39.9**	**40 - 44.9**	**45 - 49.9**	**50 - 54.9**
1	9.00E-05	2.34E-04	1.80E-04	3.90E-04	2.58E-04	6.36E-04	5.30E-04	6.36E-04
2	7.75E-04	2.09E-03	1.55E-03	3.24E-03	2.09E-03	5.02E-03	4.09E-03	4.80E-03
3	4.32E-04	1.16E-03	8.65E-04	1.82E-03	1.17E-03	2.83E-03	2.31E-03	2.72E-03
4	5.20E-05	1.15E-04	1.04E-04	2.57E-04	1.91E-04	5.21E-04	4.74E-04	6.16E-04
5	7.10E-04	1.42E-03	1.43E-03	3.87E-03	3.10E-03	9.02E-03	8.71E-03	1.19E-02

Table 2-2. Spike emission by soil group for undisturbed (stable) soils.

			Spike Emission Stable Soils (ton/acre)					
		10-m Wind Speed (mph)						
Soil Group	**15 - 19.9**	**20 - 24.9**	**25 - 29.9**	**30 - 34.9**	**35 - 39.9**	**40 - 44.9**	**45 - 49.9**	**50 - 54.9**
1	2.57E-05	5.13E-05	1.08E-04	1.18E-04	1.69E-04	2.85E-04	3.38E-04	3.64E-04
2	2.30E-04	4.60E-04	9.31E-04	9.83E-04	1.37E-03	2.24E-03	2.60E-03	2.75E-03
3	1.28E-04	2.55E-04	5.19E-04	5.51E-04	7.69E-04	1.26E-03	1.47E-03	1.56E-03
4	1.26E-05	2.52E-05	6.24E-05	7.80E-05	1.25E-04	2.33E-04	3.02E-04	3.53E-04
5	1.56E-04	3.12E-04	8.59E-04	1.17E-03	2.03E-03	4.04E-03	5.56E-03	6.85E-03

Soil Texture Categorization

Application of the emission factor relations described above requires the characterization of soil texture in terms of the 5 soil groups considered by the model. The characteristics, or type, of soil is one of the parameters of primary importance for the application of the emission estimation relations derived from wind tunnel study results. The State Soil Geographic Database (STATSGO) was used to determine the type of soils present in the modeling domain for which the emission inventory will be developed. The STATSGO database was developed by the Natural Resources Conservation Service of the U.S. Department of Agricultural (USDA) and provides detailed information concerning the taxonomy of the soils, including soil texture class, percentage of sand, silt and clay, and the available water capacity of the soil. While the complete STATSGO database available from the USDA includes numerous additional features, those features relevant for this project were considered to be the soils texture class. The soils data are available as geospatial coverages and associated attribute tables for each state in the US. Soils databases were obtained from the Earth System Science Center (ESSC) at Penn State University (http://www.essc.psu.edu/soil_info/).

The classification of soil textures and soil group codes is based on the standard soil triangle that classifies soil texture in terms of percent sand, silt and clay. Combining the soil groups defined by the work of Alfaro et al. (2003) and Chatenet et al. (1996) and the standard soil triangle provides the mapping of the 12 soil textures to the 4 soil groups considered in their study. Combining the data from these two soil texture/soil group mappings results in the unique mapping of soil textures to the soil groups for which emission factor data can be applied. Note that an additional soil group was added to distinguish loam soils defined by soil group code 3. The results of combining these soil texture definitions allows the assignment of the loam soil group in terms of standard soil texture. The soil texture mappings are summarized in Table 2-3.

Table 2-3. STATSGO soil texture and soil group codes.

STATSGO Soil Texture	Soil Texture Code	Soil Group Code
No Data	0	0
Sand	1	4
Loamy Sand	2	4
Sandy Loam	3	2
Silt Loam	4	1
Silt	5	5
Loam	6	3
Sandy Clay Loam	7	2
Silty Clay Loam	8	5
Clay Loam	9	3
Sandy Clay	10	2
Silty Clay	11	5
Clay	12	1

Vacant Land Stability

As shown in Figures 2-1 and 2-2 and Tables 2-1 and 2-2, the emission factors are a function of the stability of each land parcel. The stability refers to whether the land parcel is disturbed or undisturbed. The potential of each land parcel to emit fugitive dust increases dramatically for disturbed soils versus undisturbed soils. In general, the stability of the vacant land parcel is determined by the LULC categorization of each parcel.

Land use/Land cover was gridded at a resolution of 4-km and used in the determination of land cover types. The LULC data used in the study was based on the BELD3 LULC database as described in ENVIRON (2004). Data were processed at a gridded resolution of 4-km based on the 1-km resolution BELD3 LULC database. Within each 4-km grid cell, the percentages of each of the 29 BELD3 LULC categories were retained and used to determine the total area of each land use type within each 4-km grid cell.

The land use/land types, which can potentially emit wind-blown fugitive dust, are presented in Table 2-4. Note that this represents only a subset of the available land types within the database for use in the project. The land types, which are assumed not to emit fugitive dust, include water bodies, savanna, wetlands, tundra and snow and ice. Any land parcel for which soils data are missing or which are devoid of soils, i.e., bedrock, as determined by a soil group code of 0, are not included in the calculation of wind-blown fugitive dust. The classification of stability for urban lands is treated using a separate methodology as described below. Agricultural lands are also treated separately based on the agricultural adjustments discussed later.

Table 2-4. Stability of vacant land by LULC classification.

LULC Category	Stability
Urban	Stable/Unstable (see below)
Agricultural	--
Shrubland	Stable
Grassland	Stable
Forest	Stable
Barren	Unstable
Desert	Unstable

Treatment of Vacant Urban Lands

Urban lands are treated separately from other land use categories with respect to stability classification. Vacant urban land parcels are characterized as disturbed or undisturbed based on the percentage of land assumed to be core urban land versus boundary, or developing, urban land. Within urban areas a certain portion of the land is assumed to be vacant and disturbed, due either to new development or re-development, within the urban core. Within the boundary urban areas, there are generally more vacant disturbed areas than within the urban core, due to urban expansion and suburban development. Based on professional judgment and experience, an assumed constant percentage of disturbed versus undisturbed urban land is used for this study. Within the core urban areas, 8% of the land is assumed to be unstable, or disturbed, while 92% is stable. In urban boundary areas 70% of the land is assumed stable with 30% unstable. In each grid cell with urban lands, 8.33% of the urban land fraction is assumed to be boundary urban land while the remaining 91.67% of the area is considered core urban land. These assumptions are based on professional judgment and experience (Uhl, 2003).

Vegetative Cover Adjustments

The emission rates described above are based on vacant land parcels with no significant vegetation cover present. As noted above, increased canopy cover, or vegetation density affects emission rates of windblown fugitive dust. Increasing vegetation density decreases the overall emissive potential of vacant land parcels both by delaying the onset of saltation, as well as through a reduction in the shear stress in the intervening opening areas that drives the flux of soil particles at the surface. To account for these affects, the emission factors presented above are adjusted based on the percentage of vegetative canopy cover for each vacant land parcel.

A recent study White (2001) evaluated the emission flux rates of for soils under varying vegetation canopy cover percentages. Wind tunnel studies conducted by White for various wind speeds and percent vegetation cover indicate a significant reduction in average vertical flux of soils as the vegetation cover increases from 0% to 55% for all wind speeds considered. Attenuation factors based on average vertical flux data reported by White where developed for use in this study. Table 2-5 presents the relevant data from the White study and the emission rate reduction factors for vegetation cover percentages of 0, 11, 22 and 55%.

Table 2-5. Emission rates and attenuation factors by % vegetation cover.

Vegetation Cover %	ER by Formulation	Average Vertical Flux	ER by Raw Data	Attenuation Factor based on Avg. Vert. Flux
0	2989.17	2185.98	2064.95	1
11	1739.34	1530.76	1460.54	0.700263
23	459.86	427.11	541.21	0.195386
55	230.02	153.23	288.4	0.070097

The application of the attenuation factors displayed in Table 2-5 is dependent on the assumed vegetation density, or vegetation cover percentages, of each vacant land parcel. As discussed above, the LULC data for use in this project are based on the BELD3 database. This data set does not provide explicit information regarding vegetation density. Therefore, default vegetation cover percentages for each land use type available in the LULC data are assigned. The default vegetation densities, corresponding to the percentages shown in Table 2-5, for each land use type are presented in Table 2-6. Vegetation density assignments are based on information contained in the Vegetation Classification Standards of Federal Geographic Data Committee (FGDC, 1997). For agricultural lands, specific adjustments are applied to account for crop cover as discussed in the next section.

Table 2-6. Default vegetation cover percentages for each land use type.

LULC Category	Vegetation Cover %
Urban	55(stable)/0(unstable)
Agricultural	--
Shrubland	11
Grassland	23
Mixed Shrub/Grassland	17
Forest	55
Barren	0
Desert	0

Agricultural Land Adjustments

Unlike other types of vacant land, windblown dust emissions from agricultural land are subject to a number of non-climatic influences, including irrigation and seasonal crop growth. As a result, several non-climatic correction or adjustment factors were developed for applicability to the agricultural wind erosion emissions. These factors included:

- Long-term effects of irrigation (i.e., soil "clodiness");
- Crop canopy cover;
- Post-harvest vegetative cover (i.e., residue);
- Bare soil (i.e., barren areas within an agriculture field that do not develop crop canopy for various reasons, etc.); and
- Field borders (i.e., bare areas surrounding and adjacent to agricultural fields).

The methodology used to develop individual non-climatic correction factors was described in detail in ENVIRON, 2004. Most of these methods were based upon previous similar work performed by the California Air Resources Board (CARB) in their development of California-specific adjustment factors for USDA's Wind Erosion Equation (WEQ) (CARB, 1997). These correction factors were developed for specific soil textures, crop types, and geographic locations and then applied to the wind erosion estimates developed from the wind tunnel studies. Correction factors are developed only for the 17 field crops specifically identified in the BELD3.1 data set (i.e., alfalfa, barley, corn, cotton, grass, hay, oats, pasture, peanuts, potatoes, rice, rye, sorghum, soybeans, tobacco, wheat, and miscellaneous crops). Due to the insufficient characterization of the wind erosion emission processes for orchards and vineyards, correction factors for this type of agricultural land were not developed.

Meteorology

The application of the methodology described above requires the specification of meteorological fields, notably, wind speed, precipitation rates and soil temperatures. Hourly, gridded meteorological data was derived from CALMET simulations. CALMET was run at a 2-km horizontal spatial resolution. The model was configured vertically so as to generate 10-meter winds at layer 1. Options were used to simulate precipitation and soil temperatures. The meteorological model was run for the entire year 2002. The output data from CALMET was reformatted as NetCDF files with the appropriate meteorological fields required by the dust model including 10-meter wind speeds, soil temperature and precipitation rates.

<u>Wind Event Determination</u>

The determination of wind events follows the methodology of MacDougall, 2002. Following this approach, wind events are considered only when the 10-meter wind speeds reach or exceed the lowest defined wind speed bin for which emission factors are available, in this case 15 mph. Due to the limited availability of comprehensive wind tunnel studies, emission factors were derived only for 10-meter wind speeds of 15 mph or higher. The affect of stable versus unstable lands was incorporated using different emission factor relations for each type of vacant land parcel. The stability of vacant land parcels was based on LULC, as discussed previously. As detailed in MacDougall's methodology, a wind event may be defined as any time period for which the winds reach or exceed the threshold wind velocity separated by at least 12 hours.

Reservoir Determination

Because vacant land parcels do not have an endless reservoir of fugitive dust available for wind erosion, vacant lands must be characterized with respect to dust reservoirs. In addition, the reservoir designation of vacant lands will impact the potential for wind blown fugitive dust from the various land types present. Vacant land reservoirs were designated as limited or unlimited, based on the stability of land parcels, although a more accurate determination could be made if the soils database used for the study included more detail concerning the depth of the soil layer as discussed previously. Vacant land stability was defined based on the land use/land cover as discussed previously. Stable lands were assumed to have a limited reservoir available for wind erosion, while unstable lands were assumed to have unlimited reservoirs.

Stable, or undisturbed, land parcels are assumed to emit dust during the first hour of a wind event only, i.e., limited reservoirs are depleted within one hour. For unstable, or disturbed, land parcels, the reservoir will be depleted within 10 hours during any wind event. Reservoirs are recharged within 12 hours after a wind event, consistent with the assumption that a full 12 hours must elapse between wind events.

The assumed recharge characteristics for soil reservoirs under various conditions are summarized as follows:

- After a wind event, a reservoir will recharge within 12 hours.
- After rainfall event, a reservoir will recharge within 36 hours.
- After snow/ice cover has melted, a reservoir will recharge within 36 hours after the melt down.
- After a freeze period, a reservoir will recharge within 6 hours after the freeze period.

Precipitation Events

During precipitation events dust emissions are not generated. Precipitation events are determined by the rainfall rates available from the CALMET meteorological data. Given the limitations of the land use and soils databases used for the project, assumptions were made regarding the amount of rain necessary to decrease emission rates from wind erosion. Ideally, information concerning the soil moisture and available water capacity, and total rainfall over a specific time period would allow a more realistic treatment of precipitation events. For certain types of soils, dust may begin to emit due to wind erosion sooner than other soil types. In addition, the total amount of rain received over a given time period will have an affect on the amount of time required for the soils to dry out enough for wind erosion to initiate dust emissions. The resulting crusting of the soils after precipitation events is also a factor in determining the potential of a vacant land parcel to emit fugitive dust.

It is assumed that any amount of rain will prevent dust emissions due to wind erosion. The time required for these land parcels to begin emitting dust is assumed to be 36 hours after a precipitation event.

The presence of snow and freeze events were also considered in the development of the dust emission inventory. After the snow, or ice, cover has melted, as determined by the CALMET data, the reservoir will recharge within 36 hours after the meltdown. For freeze periods, as determined by the soil temperatures, reservoirs will recharge within 6 hours after the freeze period.

Summary of Methodology Implementation

For each grid cell, the land use and soil type are determined for each land parcel based on the soils and LULC databases. Stability and reservoir characteristics are then determined using the assumption described above. Hourly wind speeds are evaluated from the CALMET data. The appropriate emission factors as a function of wind speed, soil group and stability are obtained from Figures 2-1 and 2-2 and applied for each hour during the wind event. The emission factors are adjusted based on the assumed vegetation density using the attenuation factors given in Table 2-6. The spike emissions presented in Tables 2-1 and 2-2 are applied for the first hour only of each wind event. Based on the type of reservoir, i.e., limited or unlimited, dust emissions are generated for the duration of the wind event according to the assumptions described above concerning reservoir characteristics. Precipitation, soil surface freeze, and/or snow events are considered to determine whether the land parcel has the potential for dust emissions for any given hour and grid cell. Non-climatic agricultural adjustments are then applied to the agricultural land types, by county, crop type and month/season using the crop specific calendars and agricultural information assembled for the project. The recharge assumptions discussed above are considered and applied, as the data are processed hour by hour to generate the PM fugitive dust emission inventory.

The windblown fugitive dust model was applied for the calendar year 2002 at a spatial resolution of 4-km for the State of Arkansas. The model generates estimates of PM_{10} dust emissions. The fine fraction of dust is obtained by using a nominal $PM_{2.5}$ of 0.22, as used in the implementation of the model for the WRAP (ENVIRON, 2004). Hourly, gridded PM emissions were then aggregated to the county-level and summed for all hours of the year to obtain annual PM emission estimates. Typical summer weekday emissions were obtained by summing the results for June, July and August and dividing by the total number of days during that time. Likewise, typical winter weekday emissions are obtained by summing the results for December, January and February.

FUGITIVE DUST – AGRICULTURAL TILLAGE

Annual Emissions

Fugitive dust emissions from agricultural tillage were estimated using the quantity of total planted agricultural acreage for each of the six primary Arkansas field crops (i.e., corn, cotton, rice, sorghum, soybeans, and wheat). These acreages were obtained from statistics compiled by the Arkansas Agriculture Statistics Service (AASS, 2003a). Crop-specific acre-passes were obtained from crop budgets prepared by the University of Arkansas (UA, 2004). Crop-specific emission factors, based upon typical tillage practices, were obtained from recent work conducted in California's San Joaquin Valley (ARB, 2003). A $PM_{2.5}$ size fraction was applied to the PM_{10}

emission estimates in order to develop $PM_{2.5}$ emissions (ARB, 2002). Emissions from agricultural tillage were calculated using the following equation:

$$E_c = EF_c \times A_c \times AP_c \times \left(\frac{1\text{ ton}}{2{,}000\text{ lbs}} \right)$$

Where E_c = Emissions for crop c (tons PM_{10}/year);
EF_c = Emission factor for crop c (lbs PM_{10}/acre-pass);
A_c = Acreage for crop c (acres/year); and
AP_c = Acre-passes for crop c (acre-passes/acre).

A sample calculation using this equation for estimating agricultural tillage PM_{10} emissions from soybean fields in Pulaski County is as follows:

Where $A_{soybean}$ = 31,000 acres/year;
AP_{rice} = 2 acre-passes/acre;
EF = 1.48 lbs PM_{10}/acre-pass; and
$E_{soybean}$ = 45.9 tons PM_{10}/year.

Seasonal Emissions

Agricultural tilling operations occur only in certain months of the year. Arkansas crop budgets were examined to determine the occurrence period of tillage operations in Arkansas (UA, 2004). It was determined that there are no tillage operations associated with cotton, rice, sorghum, and wheat crops in Arkansas during the summer or winter seasons. Some tillage operations occur for corn in the winter and soybeans in the summer (i.e., approximately 20% of the total tillage operations for both corn and soybeans). Tillage operations were assumed to be uniform throughout the week.

FUGITIVE DUST – FEEDLOTS AND DAIRIES

Annual Emissions

Fugitive dust emissions from beef cattle feedlots and dairies were estimated using published livestock statistics (AASS, 2003a; AASS, 2003b; AASS, 2003c). Although there are nearly 2,000,000 head of beef cattle located in Arkansas, there are very few beef cattle feedlots located there (Mills, 2004). Most beef cattle are sent to out-of-state feedlots (i.e., Texas, Oklahoma, or Kansas) with in-state slaughter head counts totaling only 15,100 head (AASS, 2003b). The dairy cow population is approximately 33,000 head (AASS, 2003c). Beef cattle feedlot and dairy emission factors were obtained from recent work done in California's San Joaquin Valley (ARB, 2003). A $PM_{2.5}$ size fraction was applied to the PM_{10} emission estimates in order to develop $PM_{2.5}$ emissions (ARB, 2002). Average feedlot feeding period was assumed to be 120 days based upon various cattle feeding studies. Beef cattle feedlot and dairy cow populations were allocated to the county level based upon overall livestock populations.

Emissions from beef cattle feedlot and dairy cow fugitive dust emissions were calculated using the following equation:

$$E = EF \times P \times D \times \left(\frac{1\text{ ton}}{2{,}000\text{ lbs}} \right)$$

Where E = Emissions (tons PM_{10}/year);
EF = Emission factor for crop c (lbs PM_{10}/1000 head-day);
P = Population; and
D = Duration (days/year [120 days for feedlots; 365 days for dairies]).

A sample calculation using this equation for estimating fugitive dust emissions from dairies in Benton County is as follows:

Where EF = 4.4 lbs PM_{10}/1000 head-day;
P = 1,969 head;
D = 365 days; and
E = 1.6 tons PM_{10}/year.

Seasonal Emissions

Beef cattle feedlot and dairy activity was assumed to be constant throughout the year. Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

VOC SOURCES – PER CAPITA EMISSION FACTORS

Annual Emissions

Annual emissions for the following VOC source categories were estimated using per capita emission factors: architectural surface coatings, traffic markings, graphic arts, consumer solvents, and bakeries. Population statistics for 2002 were obtained from the Census Bureau (U.S. Census, 2003a). Per capita emission factors were obtained from EIIP guidance documents (EIIP, 1995; EIIP, 1997; EIIP, 1996a; EIIP, 1996b; EIIP, 1999d). National paint statistics were used to develop the per capita emission factors for architectural surface coatings and traffic markings (U.S. Census, 2003b). Per capita bread consumption statistics were used to develop the per capita emission factor for bakeries (EIIP, 1999d). A 20 percent reduction due to the promulgation of national VOC rules was applied to the architectural surface coating and consumer solvent use categories (i.e., the national VOC rules were promulgated after the date that the per capita emission factors were developed) (Federal Register, 1998a; Federal Register, 1998b).

The equation for estimating VOC source category emissions using per capita emission factors is:

$$E = EF \times P \times \left(\frac{1\,\text{ton}}{2{,}000\,\text{lbs}} \right) \times (1 - R)$$

where E = VOC emissions (tons/year);
EF = VOC per capita emission factor (lbs/person-year);
P = Population (people); and
R = Reduction due to national VOC rules (0.2 for architectural surface coatings and consumer products; 0 for graphic arts, traffic markings, and bakeries).

A sample calculation using this equation for estimating emissions for consumer solvent use in Pulaski County is as follows (the calculation is similar for the architectural surface coating, traffic markings, graphic arts and bakeries source categories):

where EF = 7.84 lbs VOC/person-year (from all consumer solvent product categories);
P = 364,381 people;
R = 0.2 and
E = 1,142.7 tons VOC year.

Seasonal Emissions

Architectural surface coating activity is temperature dependent with more activity in the summer and less in the winter. Summer and winter emissions were estimated based on national quarterly architectural coating shipments (U.S. Census, 2003b) where the 2nd and 3rd quarters were used for summer activity, and the 1st and 4th quarters were used for winter activity. Average summer and winter weekday emissions were calculated by dividing the seasonal emissions by the number of days in that season (i.e., 183 days for the 2nd and 3rd quarters and 182 days for the 1st and 4th quarters).

Traffic marking activity is based on the assumption that traffic paints are generally applied only when the temperature of the road surface is 50 ºF or higher. Therefore, it was assumed that there are no emissions from this source category in the winter season (i.e., December through February). The annual emissions were assumed to be uniform throughout the remaining active season. Activity was assumed to occur only during weekdays (EIIP, 1997a). Average summer weekday emissions were calculated by first estimating the summer season emissions (i.e., annual emissions multiplied by the ratio of summer season days over active season days) and then dividing by the number of summer weekdays (i.e., 65). Average winter weekday emissions were zero.

Graphic arts activity is assumed to have no seasonal fluctuations. However, activity is not uniform throughout the week (i.e., 75% of the activity occurs on weekdays, 20% on Saturdays, and 5% on Sundays) (EIIP, 1996a). Average weekday emissions were calculated by dividing annual weekday activity by the number of annual weekdays (i.e., 261); average weekday emissions for winter and summer were the same because of no seasonal fluctuations.

Consumer solvent and bakery activity is assumed to be constant throughout the year (EIIP, 1996b; EIIP, 1999d; EPA, 2002). Average summer and winter weekday emissions are assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

VOC SOURCES – PER EMPLOYEE EMISSION FACTORS

Annual Emissions

Annual emissions for the following VOC source categories were estimated using per employee emission factors: autobody refinishing, industrial surface coating, degreasing, and dry cleaning. County employee statistics for relevant NAICS codes (previously SIC codes) were obtained from the Census Bureau (U.S. Census, 2001). Per employee emission factors were obtained from EIIP guidance (EIIP, 2000a; EIIP, 1997b; EIIP, 1997c; EIIP, 1996c). A 33 percent reduction due to the promulgation of national VOC rules was applied to the autobody refinishing category (i.e., the national VOC rule was promulgated after the date that the per employee emission factors were developed) (Federal Register, 1998c).

The equation for estimating VOC source category emissions using per employee emission factors is:

$$E = EF \times EM \times \left(\frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \right) \times (1 - R)$$

where E = VOC emissions (tons/year);
EF = VOC per employee emission factor (lbs/employee-year);
EM = Number of employees (people);
R = Reduction due to national VOC rules (0.33 for autobody refinishing; 0 for industrial surface coating, degreasing, and dry cleaning).

A sample calculation using this equation for estimating emissions for dry cleaning in Pulaski County is as follows (the calculation is similar for the autobody refinishing, industrial surface coating, and degreasing):

where EF = 1,800 lbs VOC/employee-year;
EM = 435 employees;
R = 0; and
E = 391.5 tons VOC year.

Seasonal Emissions

Activity for the per employee VOC categories of autobody refinishing, industrial surface coating, degreasing, and dry cleaning do not appear to have any significant seasonal variations.

It was assumed that activity for autobody refinishing, industrial surface coating, and degreasing only occur during the weekdays (i.e., 5 days/week). For these categories, average summer and winter weekday emissions were calculated by dividing annual emissions by 261 (i.e., number of weekdays in 2002).

Dry cleaning activity was assumed to occur on weekdays and Saturdays (i.e., 6 days/week). Average summer and winter weekday emissions were calculated by dividing annual emissions by 313 (i.e., number of weekdays and Saturdays in 2002).

ASPHALT PAVING

Emissions from asphalt paving were estimated using cutback asphalt usage estimates provided by the Arkansas Highway and Transportation Department (Bennett, 2004). The quantity of cutback asphalt used in Arkansas is considerably less than the quantity of hot-mix asphalt used; however, emissions from hot-mix asphalt are typically considered to be negligible (EIIP, 2001a). Cutback asphalt is primarily used for repairs and patching. Detailed tracking of cutback asphalt quantities is not available; however, it was estimated that between 5 to 10 tons of cutback asphalt (i.e., aggregate and binder combined) are used in each county (Bennett, 2004). It was assumed that counties with a population greater than 50,000 would use 10 tons of cutback asphalt per year; while counties with a population less than 50,000 would use 5 tons of cutback asphalt per year.

It was assumed that all cutback asphalt used was rapid cure with a diluent content of 35 percent (by weight). This corresponds to an evaporative loss of 24 percent (by weight) of the total cutback asphalt use (EIIP, 2001a).

Emissions from asphalt paving were calculated using the following equation:

$$E = M_c \times w\%_e$$

where E = Emissions (tons VOC/year);
M_c = Mass of cutback binder applied (tons/year); and
$w\%_e$ = Weight percent of asphalt evaporated.

A sample calculation using this equation for estimating emissions from cutback asphalt in Pulaski County is as follows:

where M_c = 0.5 tons/year;
$w\%_e$ = 24%; and
E = 0.12 tons VOC/year.

Cutback asphalt paving activity was assumed to be constant throughout the year (Bennett, 2004). Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

GASOLINE DISTRIBUTION

Annual Emissions

The gasoline distribution source category includes four subcategories: Stage I (underground tank filling), Stage II (vehicle refueling), underground tank breathing, and tank truck transit.

County-level gasoline sales were estimated by disaggregating state-level fuel sales using state and county vehicle registrations; fuel use by vehicle classification was estimated using detailed vehicle registration statistics that were disaggregated by vehicle classification (Porta, 2004). Stage I and Stage II controls have not been implemented anywhere in Arkansas (Swafford, 2004). In general, gasoline is transported via pipeline or barge to Arkansas bulk terminals and then transported from the bulk terminals to retail gasoline stations via tank truck (i.e., the gasoline transportation adjustment [GTA] factor is 1.0) (Swafford, 2004; Bailey, 2004).

Emission factors for Stage I tank filling, underground tank breathing, and tank truck transit were obtained from EIIP guidance (EIIP, 2001b); annual emissions were estimated using annual throughput. Stage II vehicle refueling emission factors were developed on a monthly basis for the county-level as part of the on-road motor vehicle emissions inventory development (see Section 3); these monthly emission factors were used to estimate monthly emissions which were then summed to estimate annual emissions.

Emissions from gasoline distribution were calculated using the following equation:

$$E = EF \times T \times \left(\frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \right)$$

where E = Emissions (tons VOC/year or tons VOC/month);
EF = Emission factor (lbs/gal throughput); and
T = Annual fuel throughput (gal/year or gal/month).

A sample calculation using this equation for estimating emissions for Stage II refueling of light-duty gas vehicles in Arkansas County in January is as follows (annual emission estimates for Stage I, underground tank breathing, and tank truck transit are calculated in a similar manner):

where EF = 3.41 g VOC/gallon (7.52 lbs VOC/1000 gallons);
T = 567,070 gallons; and
E = 2.13 tons VOC.

Seasonal Emissions

As mentioned above, Stage II refueling emissions were initially estimated on a monthly basis. Stage I, underground tank breathing, and tank truck transit emissions were estimated on an annual basis and then allocated to each month based on statewide monthly gasoline sales (Porta, 2004). Seasonal emissions were then calculated by adding up the monthly emissions for the months in each season. Gasoline distribution activity was assumed to be constant throughout the week. Average summer/winter weekday emissions were calculated by dividing the seasonal emissions by the number of days in that particular season.

RESIDENTIAL OPEN BURNING

Annual Emissions

Residential open burning includes both burning of municipal solid waste (MSW) (i.e., trash/garbage) and yard waste (i.e., leaves and yard trimmings). Based upon regulations in Arkansas, open burning of MSW is prohibited (ADEQ Regulation 18.602) and open burning of yard waste is discouraged, but allowed (Act 1151 of 1997). However, open burning of both MSW and yard waste still occurs in many areas of Arkansas (Moore, 2004).

Initially, a mass balance approach was contemplated for estimating the amount of waste disposed of by open burning. However, available landfill and recycling statistics provided insufficient detail to accurately estimate emissions using this approach. Therefore, an alternative approach was used based on the U.S. National Emissions Inventory (NEI) methodology (Thesing and Huntley, 2001). Total quantities of generated MSW and yard waste were estimated using a national per capita waste generation rates. Arkansas-specific per capita waste generation rates have not been recently developed (Schneider, 2004). A per capita waste generation rate of 2.63 lbs/person-day was used for burnable MSW (i.e., paper, plastics, rubber/leather, textiles, and wood); while a per capita waste generation rate of 0.54 lbs/person-day was used for yard waste (Schneider, 2004; EPA, 2003). Nonburnable materials (i.e., glass, metal, miscellaneous organic wastes, and food scraps) were not considered in this approach.

A basic premise of this alternative approach is that residential open burning is only practiced by those portions of the population that live in rural areas as defined by the U.S. Census. Based upon the 2000 Census, Arkansas county rural fractions vary from 12.7% in Pulaski County to 100% in 16 counties (CSDC, 2004). These rural fractions were then applied to determine the quantity of rural waste generated. The alternative approach assumes that for rural populations, between 25 to 32 percent of all municipal waste is burned with a median value of 28 percent assumed as a national value. This value of 28 percent was applied to the quantity of rural waste generated to estimate the amount of rural waste burned.

Emission factors for residential yard waste and MSW were obtained from AP-42, Section 2.5 (EPA, 1995); recent studies have identified new PM_{10} and $PM_{2.5}$ emission factors for residential MSW burning (Thesing and Huntley, 2001). The emission factors for residential yard waste are weighted average emission factors which assume a yard waste composition of 50% grass clippings (not burnable), 25% leaves, and 25% brush.

Emissions from residential MSW and yard waste burning were calculated using the following equation:

$$E_p = EF_p \times P \times WG \times \left(\frac{365\text{ days}}{1\text{ year}}\right) \times \left(\frac{1\text{ ton waste}}{2{,}000\text{ lbs waste}}\right) \times RF \times BF \times \left(\frac{1\text{ ton}}{2{,}000\text{ lbs}}\right)$$

where E_p = Emissions for pollutant p (tons/year);
EF_p = Emission factor for pollutant p (lbs/ton);
P = Population;
WG = Per capita waste generation rate (lbs/person-day);
RF = Fraction of total population that is rural; and
BF = Fraction of rural waste that is burned.

A sample calculation using this equation for estimating CO emissions from the open burning of residential yard waste burning in Pulaski County is as follows (the calculation is similar for the open burning of MSW):

where EF_{CO} = 63 lbs CO/tons yard waste;
P = 364,381;
WG = 0.54 lbs waste/person-year;
RF = 0.127;
BF = 0.28; and
E_{CO} = 40.2 tons CO/year.

Seasonal Emissions

Emissions from open burning of yard waste or MSW do not demonstrate seasonal or weekly fluctuations (EPA, 2002). Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

WILDFIRES AND PRESCRIBED FIRES

Annual Emissions

Wildfire and prescribed fire statistics were provided by the Arkansas Forestry Commission (Russell, 2004; Holm, 2004). (Prescribed fires do not include agricultural fires). An average fuel loading of 9 tons/acre for Southern forests for wildfires was obtained from AP-42, Section 13.1 (EPA, 1995). Arkansas Forestry Commission estimated a fuel loading of 6 tons/acre for prescribed fires (Holm, 2002). Emission factors were obtained from AP-42, Section 13.1 (EPA, 1995).

Wildfire and prescribed fire emissions were calculated using the following equation:

$$E_p = EF_p \times AB \times FL \times \left(\frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \right)$$

where E_p = Emissions for pollutant p (tons/year);
EF_p = Emission factor for pollutant p (lbs/ton);
AB = Acreage burned (acres/year); and
FL = Fuel loading (tons/acre).

A sample calculation using this equation for estimating VOC emissions from Pulaski County wildfires is as follows (the calculation is similar for prescribed fires):

where EF_{VOC} = 24 lbs VOC/ton;
AB = 241 acres;
FL = 9 tons/acre; and
E_{VOC} = 26.0 tons VOC/year.

Seasonal Emissions

Wildfires and prescribed burning do not occur uniformly throughout the year. Seasonal emissions estimates were based on monthly burned acreages (Russell, 2004; Holm, 2004). It was assumed that wildfire and prescribed burning activity is uniform throughout the week. Average summer and winter weekday emissions were calculated by dividing the seasonal emissions by the number of days in that season.

AGRICULTURAL BURNING

Annual Emissions

Total harvested acreage of the six primary Arkansas field crops (i.e., corn, cotton, rice, sorghum, soybeans, and wheat) were obtained from the Arkansas Agricultural Statistics Service (AASS, 2003a). University of Arkansas Cooperative Extension Service staff were contacted to determine the level of agricultural burning for each of these crops. Significant fractions of wheat and rice fields are burned (i.e., 70 percent and 22 percent, respectively), while smaller fractions of corn and sorghum fields are also burned (i.e., 5 percent and 1 percent, respectively). Cotton and soybean fields are not burned because of insufficient levels of post-harvest residue (Kelley, 2004; Robertson, 2004; Tingle, 2004; Wilson, 2004). Appropriate fuel loadings and emission factors were obtained from AP-42, Section 2.5 (EPA, 1995).

Emissions from agricultural burning were calculated using the following equation:

$$E_{p,c} = EF_{p,c} \times A_c \times BF_c \times FL_c \times \left(\frac{1 \text{ ton}}{2{,}000 \text{ lbs}} \right)$$

where $E_{p,c}$ = Emissions for pollutant p and crop c (tons/year);
$EF_{p,c}$ = Emission factor for pollutant p and crop c (lbs/ton);
A_c = Acreage for crop c (acres/year);
BF_c = Burn fraction for crop c; and
FL_c = Fuel loading for crop c (tons/acre).

A sample calculation using this equation for estimating VOC emissions from Pulaski County rice is as follows:

where $EF_{VOC,rice}$ = 8 lbs VOC/ton;
A_{rice} = 5,100 acres;
BF_{rice} = 0.22;
FL_{rice} = 3.0 tons/acre; and
E_{VOC} = 13.5 tons VOC/year.

Seasonal Emissions

Agricultural burning of crop residues does not occur throughout the year. University of Arkansas Cooperative Extension Service staff indicated the following burning periods: corn – late August and early September; rice – September and October; sorghum – September through November; and wheat – June (Kelley, 2004; Robertson, 2004; Tingle, 2004; Wilson, 2004).

Based on this information, it was assumed that the only crops burned during the summer are corn (half of total burned residue) and wheat (all residue); no agricultural burning occurs during the winter.

Agricultural burning activity was assumed to be fairly uniform throughout the week. Average summer weekday emissions were calculated by dividing the summer seasonal emissions by the number of days in summer (i.e., 92).

STRUCTURAL FIRES AND VEHICLE FIRES

Annual Emissions

The number of structural and vehicle fires that occurred in the state in 2002 was obtained from the Arkansas Fire Academy (Harcrow, 2004). It should be noted that these statistics are based upon voluntary reporting for the National Fire Incident Reporting System (NFIRS). Consequently, not all fire departments provided fire statistics. In addition, the 2002 statistics provided have not been entirely finalized (i.e., some late additions are possible). As a result, the actual number of structural and vehicle fires is probably higher than reported. However, the data collected from the Arkansas Fire Academy was used in the area source inventory without any extrapolation or data gap filling.

Structural fires were allocated to the county-level based upon population data (U.S. Census, 2003a); vehicle fires were allocated to the county-level based upon vehicle registration data (Porta, 2004)

The amount of material burned in a typical structural or vehicle fire, as well as appropriate emission factors, was obtained from EIIP guidance documents (EIIP, 2001c; EIIP, 2000b).

Emissions from structural fires and vehicle fires were calculated using the following equation:

$$E_p = EF_p \times F \times PF \times M \times \left(\frac{1\text{ ton}}{2{,}000\text{ lbs}} \right)$$

where E_p = Emissions for pollutant p (tons/year);
EF_p = Emission factor for pollutant p (lbs/fire);
F = Annual state fires (fires/year);
PF = Population fraction; and
M = Material burned per fire (tons/fire).

A sample calculation using this equation for estimating VOC emissions from Pulaski County structure fires is as follows:

where EF_{VOC} = 11.0 lbs VOC/tons;
F = 3,626 structure fires/year;
PF = 0.13445;
M = 1.15 tons/fire; and
E_{VOC} = 3.1 tons VOC/year.

Seasonal Emissions

Residential fires are most common during the winter months (i.e., 27% of annual fires occur during the months of December, January, and February); while only 24% of annual fires occur during the summer (i.e., June, July, and August) (NFDC, 2001).

For purposes of the inventory, it was assumed that the incidence of structural fires is fairly uniform throughout the week. Average summer weekday emissions were calculated by multiplying annual emissions by the seasonal occurrence rate of 24% and then dividing by the number of days during the summer. Average winter weekday emissions were calculated in a similar manner, except for using a seasonal occurrence rate of 27%.

The incidence of vehicle fires was assumed to be constant throughout the year (EIIP, 2000b). Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

LIVESTOCK AMMONIA

Annual Emissions

Annual ammonia emission estimates for livestock were obtained from a draft animal husbandry inventory developed for U.S. EPA's NEI (EPA, 2004b). This inventory utilized various manure management trains (MMTs) to develop county-level emission estimates for eight different types of livestock: beef cattle, dairy cattle, goats, horses, sheep, swine, chickens, and turkeys.

Seasonal Emissions

Livestock ammonia activity is assumed to be constant throughout the year. Average summer and winter weekday emissions are assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

FERTILIZER APPLICATION

Annual Emissions

Total harvested acreage of the five primary Arkansas field crops (i.e., corn, cotton, rice, sorghum, soybeans, and wheat) were obtained from the Arkansas Agricultural Statistics Service (AASS, 2003a). Fertilizer application is not required for soybeans (a legume). Typical fertilizer application procedures, quantities, and nitrogen contents were obtained from crop budgets prepared by the University of Arkansas (UA, 2004). Only nitrogen-containing fertilizers were included in the emission calculations; other types of fertilizers do not produce ammonia. Fertilizer-specific emission factors were obtained from U.S. EPA's ammonia emission factor document (Battye et al., 1994).

Emissions from fertilizer application were calculated using the following equation:

$$E_{f,c} = A_c \times AR_{f,c} \times N_f \times \left(\frac{1\text{ ton N}}{2{,}000\text{ lbs N}}\right) \times EF_f \times \left(\frac{1\text{ ton }NH_3}{2{,}000\text{ lbs }NH_3}\right)$$

Where $E_{f,c}$ = Emissions for fertilizer type f on crop c(tons NH_3/year);
A_c = Acreage of crop c (acres/year);
$AR_{f,c}$ = Application rate for fertilizer type f on crop c (lbs fertilizer/acre);
N_f = Nitrogen content of fertilizer type f (%); and
EF_f = Emission factor for fertilizer type f (lb NH_3/ton total N).

A sample calculation using this equation for estimating NH_3 emissions for urea application on wheat in Pulaski County is as follows:

Where A_{wheat} = 15,000 acres/year;
$AR_{urea,wheat}$ = 250 lbs urea/acre;
N_{urea} = 46% nitrogen content;
EF_{urea} = 364 lb NH_3/ton total N; and
$E_{urea,wheat}$ = 157.0 tons NH_3/year.

Seasonal Emissions

Fertilizer application activities depend on individual crop cycles and are not uniform throughout the year for any crop type. The Arkansas crop budgets indicate that the only relevant seasonal fertilizer application is urea (one-fourth rice quantity used in the summer and one-half wheat quantity used in the winter) and liquid nitrogen (full corn quantity used in the summer) (UA, 2004).

Seasonal emissions for relevant crops and fertilizers were calculated based upon seasonal fertilizer use. It was assumed that fertilizer application activities are uniform throughout the week. Average summer and winter weekday emissions were calculated by dividing the seasonal emissions by the number of days in that season (i.e., 92 for summer and 90 for winter).

DOMESTIC AMMONIA

Annual Emissions

The domestic ammonia source category includes a number of ammonia sources that are relatively small, if considered individually. However, collectively, these sources are more significant. The ammonia sources include pets (i.e., dogs and cats), human respiration and perspiration, cigarette smoke, household ammonia use, diapers (i.e., cloth and disposable), and human waste (i.e., homeless and other).

In general, per capita emission factors were used for most of the ammonia sources within the overall domestic ammonia source category (Radian, 1997). Overall population statistics for 2002, as well as infant population statistics, were obtained from the Census Bureau (U.S. Census, 2003a, U.S. Census 2000a). Additional information regarding the smoking and homeless populations was also collected (CDC, 2004a; CDC, 2004b; NCH, 2002). It was assumed that the distribution of diapers was 90% disposable and 10% cloth.

The general equation for estimating most types of domestic ammonia sources is:

$$E = EF \times P \times \left(\frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \right)$$

where E = NH_3 emissions (tons/year);
EF = NH_3 per capita emission factor (lbs/person-year); and
P = Population (people).

A sample calculation using this equation for estimating household ammonia use emissions in Pulaski County is as follows:

where EF = 0.0507 lbs kg NH_3/person-year;
P = 364,381 people;
E = 9.2 tons NH_3 year.

The estimation of ammonia emissions from dogs and cats involves the use of "pet ratios" (i.e., the number of pets per 1,000 people in urban, suburban, and rural areas) (Radian, 1997). The estimation of ammonia emissions requires the fraction of the total population that smokes and a typical number of cigarettes smoked in a day (CDC, 2004a; CDC, 2004b).

Seasonal Emissions

The activities associated with domestic ammonia emissions were assumed to be constant throughout the year. Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

CHARBROILING

Annual Emissions

Emissions from charbroiling were estimated using a methodology previously employed in a PM_{10} inventory for Denver, Colorado (RAQC, 2001). The methodology was based upon annual per capita meat consumption and an estimated fraction of meals eaten away from home (RAQC, 2001). In addition, the estimated fraction of meat that is charbroiled was estimated from sales data of various types of restaurants (U.S. Census, 2000b). Population statistics were obtained from U.S. Census data (U.S. Census, 2003a).

Emissions from charbroiling were calculated using the following equation:

$$\text{E} = \text{P} \times \text{MC} \times \text{R} \times \text{CB} \times \text{EF} \times \frac{\text{ton PM}_{10}}{2{,}000\ \text{lbs PM}_{10}}$$

Where E = Emissions (tons PM_{10}/year);
P = Population (people);
MC = Meat consumption (lbs meat/person-year);
R = Fraction of meat consumed in restaurants (%);
CB = Fraction of restaurant meat that is charbroiled; and
EF = lbs PM_{10}/1000 lbs meat.

A sample calculation using this equation for estimating emissions in Pulaski County is as follows:

Where P = 364,381 people;
MC = 234 lbs meat/person-year;
R = 0.5;
CB = 0.1713;
EF = 24.07 lbs PM_{10}/1000 lbs meat; and
E = 87.9 tons PM_{10}/year.

Seasonal Emissions

Charbroiling activity was assumed to be constant throughout the year. Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

COLD STORAGE AMMONIA

Annual Emissions

County employee statistics for relevant NAICS codes 311 and 3121 (previously SIC code 20) were obtained from the Census Bureau (U.S. Census, 2001). A per employee emission factor was derived from national level employee statistics (U.S. Census, 2001) and national ammonia refrigerant use statistics (Battye et al., 1994; SRI, 2001).

The equation for estimating cold storage ammonia emissions using per employee emission factors is:

$$E = EF \times EM \times \left(\frac{1\ \text{ton}}{2{,}000\ \text{lbs}} \right)$$

Where E = NH_3 emissions (tons/year);
EF = NH_3 per employee emission factor (lbs/employee-year); and
EM = Number of employees (people).

A sample calculation using this equation for estimating emissions in Pulaski County is as follows:

Where EF = 248.6 lbs NH_3/employee-year;
EM = 1,521 employees; and
E = 189.0 tons NH_3 year.

Seasonal Emissions

Cold storage activity was assumed to be constant throughout the year. Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

MISCELLANEOUS LEAD SOURCES

Annual Emissions

Miscellaneous lead source emissions were obtained from the preliminary 2002 NEI (EPA, 2004a). For Arkansas, seven individual source categories were included:

- Animal cremation (Arkansas county only);
- Autobody refinishing (67 counties);
- Stage I aviation gasoline distribution (Benton, Pulaski, and Washington counties only);
- Commercial/institutional distillate fuel combustion (Benton, Craighead, Garland, Pulaski, Searcy, and Washington counties only);
- Commercial/instituation residual fuel combustion (Pulaski county only);
- Concrete, gypsum, and plaster products manufacturing (Independence, Union, and Washington counties only); and
- Industrial residual fuel combustion (Benton, Mississippi, Pulaski, Sebastian, and Washington counties only).

The Stage I aviation gasoline distribution source category was recalculated for 2002; all of the other source categories had been carried forward from the 1999 NEI. It is expected that these source categories will be developed for 2002 by U.S. EPA as data and resources become available.

The lead emissions for Stage I aviation gasoline distribution were for a specific lead compound (i.e., tetraethyl lead); all other categories are for unspeciated lead compounds.

Lead emissions for the three source categories that were already included in the Arkansas area source inventory (i.e., autobody refinishing, commercial/institutional distillate fuel combustion, and industrial residual fuel combustion) were added to emission summaries for those respective source categories. Lead emissions for the other four source categories (i.e., animal cremation; Stage I aviation gasoline distribution; commercial/institutional residual fuel combustion; and concrete, gypsum, and plaster products manufacturing) were aggregated together into the miscellaneous lead source category.

Seasonal Emissions

For those lead sources that were added to existing source category summaries, the seasonal emissions were calculated following the seasonal methodology used for other pollutants.

For the four lead sources categories that were aggregated together into the miscellaneous lead source category, it was assumed that activity was constant throughout the year. Average summer and winter weekday emissions were assumed to be equivalent to average daily emissions and were calculated by dividing annual emissions by 365 days.

3. 2002 ON-ROAD MOBILE SOURCE EMISSIONS

The category of on-road mobile source emissions includes emissions from vehicles certified for highway use – cars, trucks, and motorcycles. Emissions from these vehicles were estimated by combining EPA emission factors from the MOBILE6 model, expressed in grams per mile (g/mile), with vehicle miles traveled (VMT) activity data. For all of the Arkansas counties, county-level Highway Performance Monitoring System (HPMS) VMT data were used. This section describes details of the modeling procedures for estimating 2002 annual as well as summer and winter weekday emissions.

The data collection and emissions inventory development methodologies described below were conducted in accordance with ADEQ's Quality Assurance Project Plan (QAPP), as well as the requirements of the Consolidated Emissions Reporting Rule. All data collected as part of the on-road inventory were reviewed prior to use in emission calculations. All modeling inputs, data processing, and calculation spreadsheets were checked by a technical supervisor.

ACTIVITY DATA

Annual average daily HPMS VMT data were provided by the Arkansas Highway and Transportation Department (AHDT). These data were reported separately for urban and rural areas and within those categories, by county and HPMS facility class. The AHDT provided data for 2007 and 2010 and these were exponentially extrapolated back to 2002. To arrive at month-specific estimates, the annual average was adjusted using seasonal factors derived based upon data provided by AHDT. See Table 3-1. Finally, to obtain weekday VMT (for the summer and winter reporting requirements) the monthly values were corrected using Texas statewide average weekday/annual average daily factors: there are no default factors from EPA and these were considered to be the best, given the limited data available from only a few states. These are presented in Table 3-2.

Table 3-1. Seasonal VMT adjustment (from annual average daily basis) factors.

	Winter	Spring	Summer	Fall
Rural Interstate	0.912	1.028	1.057	1.002
Rural Other Principal Arterial	0.935	1.005	1.040	1.019
Rural Minor Arterial	0.905	1.014	0.991	1.089
Rural Major Collector	0.905	1.065	1.057	0.972
Rural Minor Collector	0.905	1.065	1.057	0.972
Rural Local	1.000	1.000	1.000	1.000
Urban Interstate	0.971	1.034	1.017	0.980
Urban Other Freeways and Expressways	0.991	1.005	0.981	1.023
Urban Other Principal Arterial	0.950	1.038	0.989	1.024
Urban Minor Arterial	0.984	1.015	0.994	1.008
Urban Collector	0.984	1.015	0.994	1.008
Urban Local	1.000	1.000	1.000	1.000

Table 3-2. Weekday/annual average day VMT correction factors.

Facility Class	Adjustment Factor
Rural Interstate	1.049
Rural Other Principal Arterial	1.041
Rural Minor Arterial	1.043
Rural Major Collector	1.040
Rural Minor Collector	1.027
Rural Local	1.043
Urban Interstate	1.049
Urban Other Freeways and Expressways	1.053
Urban Other Principal Arterial	1.041
Urban Minor Arterial	1.043
Urban Collector	1.027
Urban Local	1.043

MOBILE6 MODELING

General Approach

For each county, MOBILE6 emission factors were used in combination with the VMT data to estimate emissions by roadway type and vehicle class. National average speeds derived from HPMS data for each facility class were used. Monthly emissions were first estimated from which annual total, summer weekday, and winter weekday emissions were derived.

Overview of THE MOBILE6 Model

The EPA MOBILE6 model estimates emission factors (g/mile) by vehicle class, which are then multiplied by appropriate VMT estimates to estimate on-road vehicular emissions. The MOBILE6 model, released in January 2002, is the latest in a series of MOBILE models for estimating vehicular exhaust NOx, CO, and exhaust and evaporative VOC. Version 6.2, which is the latest publicly released version (February 2004) and available at http://www.epa.gov/otaq/m6.htm, was used in this work and includes emission factor estimates for SO_2, PM (at various size cutoffs), and NH_3. This version contains updated CO emission factors for light-duty vehicles certified to the National Low Emission Vehicle (NLEV) and Tier 2 standards.

The MOBILE6 model includes the effects of all currently promulgated Federal motor vehicle control programs:

- Tier 1 light-duty vehicle standards, beginning with the 1994 model year;
- National Low Emission Vehicle (NLEV) standards for light-duty vehicles, beginning with model year 2001;
- Tier 2 light-duty vehicle standards, beginning with model year 2004;
- Heavy-duty vehicle standards, beginning with model year 2004; and
- Heavy-duty vehicle standards (with low sulfur diesel), beginning with model year 2007.

MOBILE6 Inputs

MOBILE6 was run to generate the gram per mile emission factors. MOBILE6 can model either January 1st or July 1st of each calendar year. For this work, monthly emission factors were generated in accordance with EPA guidance. January through June were modeled as January while the remaining months were input as July. In this particular case, the specification of the month only affects the registration distribution. Details of the MOBILE6 inputs used are described below.

Speeds by Facility Type

MOBILE6 models four facility types: freeway, arterial, local, and ramp, each with a unique assumed driving cycle used for emission factor calculations. When modeling a freeway or arterial, the user can specify a speed ranging from 2.5 to 65mph. For modeling to be used with HPMS activity, a VMT-weighted average speed by facility class by area type (urban/rural) was calculated from EPA's average speeds by roadway and vehicle type (www.epa/otaq/reports/env-spds.htm), as shown in Tables 3-3 and 3-4.

Table 3-3. Urban roadway types and speeds used in MOBILE6 modeling.

Roadway Type	MOBILE6 Roadway Type	VMT-weighted Average speed (mph)
Interstate	Freeway	43.8
Freeways & Expressway	Freeway	43.8
Principal Arterial	Arterial	19.4
Minor Arterial	Arterial	19.4
Collector	Arterial	19.4
Local	Local	19.4

Table 3-4. Rural roadway types and speeds used in MOBILE6 modeling.

Roadway Type	MOBILE6 Roadway Type	VMT-weighted Average speed (mph)
Interstate	Freeway	55.6
Principal Arterial	Arterial	43.8
Minor Arterial	Arterial	38.8
Major Collector	Arterial	33.8
Minor Collector	Arterial	29.4
Local	Local	29.4

Fleet Characterization

From previous work, calendar year 2000 local registration distribution data were available for the four counties in the Little Rock area. In agreement with ADEQ and AHDT, these registration data were used in the 2002 MOBILE6 modeling as follows. The four counties for which data were available used these directly. For the remaining counties, ADEQ provided urban/rural designations. In general, rural counties were then assigned Lonoke County's distribution, suburban counties were assigned the average of Saline and Faulkner Counties, and the others used weighted averages. The local registration distribution data show that the fleet in Arkansas is older on average than the national default. Appendix Table A-3 provides the complete assignments. There were no local data on the VMT mix; the MOBILE6 default VMT mix was therefore used.

Temperature and Humidity

2002 monthly average daily minimum/maximum temperature and relative humidity data were obtained for each of nine regions comprising the state. This is described in more detail in the non-road section of this report. For on-road use, the relative humidity values were converted to absolute (grains/pound dry air) values using EPA's tool available at http://www.epa.gov/otaq/m6.htm#m60.

Altitude

Arkansas counties were modeled with the low altitude setting in MOBILE6.

Fuel Inputs

Summer (May through August) gasoline fuel volatility (Reid vapor pressure, RVP) was set at 7.6 psi, while winter months (November through February) were modeled using 12.7 psi. Spring (March and April) and autumn (September and October) were assumed to have gasoline with 9.6 psi RVP. These values are based upon a combination of information from the Arkansas Bureau of Standards and survey data from the National Institute for Petroleum and Energy Research (NIPER, 1994 and 1995). Sulfur content was set at 300 ppm and 500 ppm for gasoline and diesel, respectively. These are national conventional fuel averages. Neither reformulated gasoline nor oxygenated fuel was in use in Arkansas in 2002.

Inspection and Maintenance

Arkansas does not have an I/M or anti-tampering program.

Application of MOBILE6 Emission Factors

Gram-per-mile emission factors for VOC (total minus refueling), CO, NO_x, PM_{10}, $PM_{2.5}$, SO_2, and NH_3 were obtained for each county, month, roadway type, area type (urban/rural) and eight MOBILE5 vehicle classes. These were then multiplied with the corresponding VMT to estimate emissions. The annual total emissions were obtained by summing the monthly emissions. To obtain seasonal weekday emissions, the weekday-adjusted VMT were used to estimate emissions for the season's months and these were then averaged (with the number of weekdays in each month as the weighting factors).

4. OFF-ROAD EMISSIONS METHODOLOGY

This section describes the methods used to estimate off-road emissions for calendar year 2002. Off-road mobile sources encompass a wide variety of equipment types that either move under their own power or are capable of being moved from site to site. More specifically, these sources, which are not licensed or certified as highway vehicles, are defined as those that move or are moved within a 12-month period and are covered under the EPA's emissions regulations as nonroad mobile sources. Where feasible and appropriate, local activity data for specific source categories were gathered and used to develop the inventory.

US EPA's draft NONROAD2002 model (June 2003 version) was used to estimate emissions for most off-road sources. The NONROAD model estimates emissions from nonroad equipment in the following categories:

- agricultural equipment, such as tractors, combines, and balers;
- airport ground support, such as terminal tractors;
- construction equipment, such as graders and back hoes;
- industrial and commercial equipment, such as fork lifts and sweepers;
- residential and commercial lawn and garden equipment, such as leaf and snow blowers;
- logging equipment, such as shredders and large chain saws;
- recreational equipment, such as off-road motorbikes and snowmobiles; and
- recreational marine vessels, such as power boats.

Aircraft, commercial marine and locomotive emissions are also included in the off-road inventory, but these sources were estimated separately since they are not included in the NONROAD model. General EPA methodologies were followed to estimate emissions for these three categories.

For all source categories, annual average emissions have been estimated in tons per year, and ozone season and winter season daily emissions are estimated in tons per day.

The data collection and emissions inventory development methodologies described below were conducted in accordance with ADEQ's Quality Assurance Project Plan (QAPP), as well as the requirements of the Consolidated Emissions Reporting Rule. All data collected as part of the of-road sources emission inventory were thoroughly reviewed prior to use in emission calculations. In addition, all emission factors used in the inventory were reviewed to ensure that they were the most appropriate and up-to-date emission factors available. Finally, all modeling inputs, modeling output processing, and spreadsheet calculations used for emissions estimation for each off-road source category were checked for calculational accuracy by a technical supervisor.

NONROAD MODELING

The EPA NONROAD2002 model was used to estimate emissions for all off-road mobile source categories except locomotive, commercial marine and aircraft. The most recent draft version publicly released by EPA is the June 2003 version (core model version 2.1), available on the

NONROAD model web site at http://www.epa.gov/oms/nonrdmdl.htm; that version of the model was used in this effort. Although the NONROAD model is in draft form and is still evolving, it has been used to develop the EPA National Emissions Inventories for 1999 and 2002, and also in recent SIP modeling efforts which have been accepted by EPA.

The NONROAD model estimates emissions for six exhaust pollutants: VOC, NO_X, CO, CO_2, SO_X, and PM (both PM_{10} and PM2.5). The model also estimates emissions of non-exhaust HC for six modes — hot soak, diurnal, refueling, resting loss, running loss, and crankcase emissions. It provides emission estimates at the national, state, and county level. County-level emissions are determined by allocating the state level estimates using econometric or other activity indicators, such as employees, tilled acreage, and construction valuation. The NONROAD model can be directed to yield seasonal, monthly or annual emission estimates on a period total or typical day basis. The latter can also take into account weekday/weekend differences.

The NONROAD model incorporates the effects of equipment emission certification standards through a dynamic age distribution calculation. The national non-road emission standards included in the model are applicable to:

- Diesel engines
- Small gasoline engines (handheld and non-handheld equipment <25 hp)
- Recreational marine gasoline engines
- Recreational and commercial marine diesel engines

The model includes more than 80 basic and 260 specific types of nonroad equipment, and further stratifies equipment types by horsepower rating and fuel type. The basic equation for estimating emissions in the NONROAD model is as follows:

$$Emissions = (Pop)*(Power)*(LF)*(A)*(EF)$$

where

Pop = Engine Population
Power = Average Power (hp)
LF = Load Factor (fraction of available power)
A = Activity (hrs/yr)
EF = Emission Factor (g/hp-hr)

For national or state level emissions estimation, the corresponding engine population is determined and then multiplied by the average power, activity, and emission factors. National average engine power, load factor (the relative fraction of maximum available power that engine uses on average), annual activity, and emission factors can be directly used to calculate the national annual total emissions. For county level estimates, equipment population by county must first be estimated in the model by geographically allocating the correct state engine population through the use of econometric or physical indicators, such as construction valuation or water surface area. The manner in which the geographic allocation is performed is as follows:

$$(County\ Population)_i / (State\ Population)_i = (County\ Indicator)_j / (State\ Indicator)_j$$

where

i is an equipment application like construction or agriculture.
j is an indicator type associated with equipment i

Activity is temporally allocated with an analogous equation, but using monthly and day of week fractions of yearly activity.

The NONROAD model has default estimates for most variables and factors used in the calculations. All of these estimates are in model input files, and can be changed by the user if data more appropriate to the local area are available. The following sub-sections describe modifications to NONROAD model inputs that were made for this work.

Model Inputs and Application

The NONROAD model requires specification of several inputs. Fuel Reid vapor pressures from the Arkansas Bureau of Standards were provided by ADEQ. Table 4-1 shows the RVP standards for various periods of the year. However, locally measured values are more preferable since most refiners typically leave a margin of safety with respect to the standard. Thus NIPER fuel survey data from 1993-1994 (see Table 4-2) were used in conjunction with the above standards to arrive at the final RVP values. A RVP of 7.6 psi was assumed for summer (May – Aug). A RVP of 12.7 psi was used for the winter months (Nov – Feb) while 8.9 psi and 10.6 psi were used for the spring (Mar – Apr) and autumn (Sep – Oct), respectively. The spring and autumn values are weighted averages of the monthly RVP for the months contained in each season. Considering the base sulfur levels specified by the EPA at http://epa.gov/air/caaac/diesel_sulfur_w97.pdf and http://www.ntec.org/air/factsheet3.html, a gasoline sulfur content of 300 ppm and diesel sulfur content of 3400 ppm were proposed to ADEQ and used in the modeling.

Monthly minimum and maximum temperatures and relative humidity corresponding to year 2002 were obtained from the National Climate Data Center (NCDC) at http://www.cdc.noaa.gov/Timeseries/ and http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgrh.html, respectively. The data are available through the NCDC by region as defined for Arkansas at http://www.ncdc.noaa.gov/img/onlineprod/drought/ar.gif.

Data for each county corresponds to one of the 9 regions defined for Arkansas based on their geographic location. Appendix Table A-1 shows the listing of Arkansas counties under each of the 9 climatic regions.

Table 4-1. Fuel RVP from Arkansas Bureau of Standards.

Period of Year	RVP in psi
January 1-15	15.0
January 16 – March 15	13.5
March 16 – April 15	11.5
April 16 – September 15	9.0
September 16 - October 15	11.5
October 16 – December 31	15.0

Table 4-2. Fuel RVP from NIPER fuel surveys.

Period of Year	RVP in psi
Winter 1993-1994 (Dec 93-Feb 94)	12.7
Summer 1994 (Jun-Aug 1994)	7.6

Additionally, the default state recreational marine vessel population was updated using registration data obtained from the Arkansas Office of Motor Vehicles (OMV) (Beaver, 2004). These data report the total certificates of number issued as of January 4, 2003. Vessels are reported by length and engine location (inboard or outboard). Based on conversations with OMV staff, it was assumed that population listed as "Other Watercraft" is predominantly personal watercraft (PWC). Inboard, outboard and PWC populations were separately apportioned by fuel type, engine technology, and horsepower range using the existing default distributions. The results replaced the defaults in the NONROAD2002 population input file for Arkansas.

Both the annual and the seasonal modeling have been done for each county independently. Appendix Table A-2 shows the NONROAD inputs by season for the 75 counties of Arkansas. For annual emissions estimation, the NONROAD model was run for each season to obtain seasonal total emissions, and the annual emissions in tons per year were obtained by taking the sum of these seasonal VOC, NOx, CO, PM10, and SOx emissions. Seasonal NONROAD runs were also executed using the summer and winter fuel RVPs and temperatures and the weekday option to obtain summer and winter seasonal weekday emissions.

The NONROAD model does not estimate ammonia emissions. However, gasoline (non-catalyst) and diesel ammonia emission factors based on fuel consumption are available. These are to be used in EPA's emission inventory estimates for 2002 using EPA's new NMIM model information available at NMIM
ftp://ftp.epa.gov/EmisInventory/prelim2002nei/mobile/nmim_related/
For this effort, gasoline and diesel equipment are assumed to emit ammonia at a rate of 116 mg and 83.3 mg per gallon of fuel consumption, respectively. PM2.5 emissions were obtained by applying a factor of 0.92 to the diesel and gasoline emissions and a factor of 1.0 for CNG and LPG emissions.

Growth Factors

NONROAD default equipment populations are mostly based on either 1996 or 1998 data from Power Systems Research, a private marketing research company (EPA, 1998). ENVIRON decided not to use the default NONROAD growth factors because questions have been raised concerning their validity. Instead, ENVIRON developed alternative state-level growth factors using different surrogates for each non-road equipment category and assumed linear growth to forecast the 1996 or 1998 base year data to 2002. Table 4-3 shows the list of surrogate types and final growth factors used to project population/activity in each non-road equipment category. These growth factors were applied to the emission estimates obtained from the NONROAD model to produce emissions estimates for the year 2002.

Table 4-3. Growth indicators used to adjust NONROAD output emissions to 2002 levels.

Source Category	Growth Indicator (Reference)	Growth Factor
Airport GSE	Air Carrier Landing & Takeoff Cycles (FAA, 2002)	0.731
Agricultural	Agricultural GSP (BEA, 2001)	1.138
Agricultural Swathers	Agricultural GSP (BEA, 2001)	1.222
Commercial & Industrial	Total GSP (BEA, 2001)	1.117
Construction	Construction GSP (BEA, 2001)	1.148
Lawn & Garden	Human Population (Campbell, 1996), equipment base year 1996	1.066
Lawn & Garden	Human Population (Campbell, 1998,) equipment base year 1998	1.041
Logging	Lumber and Wood Products GSP (BEA, 2001), equipment base year 1998	1.005
Logging Chainsaws	Lumber and Wood Products GSP (BEA, 2001), equipment base year 1996	1.007
Oil Field	Oil & Gas GSP (BEA, 2001)	0.545
Pleasure Craft	Boat Registration, 2002*	1.000
Recreational	Human Population (Campbell, 1996)	1.041
Underground Mining	Mining GSP (BEA, 2001)	1.144

* Since year 2002 population was used, no additional growth adjustment is required.

LOCOMOTIVE

The locomotive source category includes engine exhaust emissions associated with freight line-haul, passenger, and switching locomotive activity. This source category is a significant off-road category for NOx, SO_2 and PM emissions. The major emissions in this category are from Class I railroads, the largest railroads: primarily Union Pacific (UP), Burlington Northern Santa Fe (BNSF), and Kansas City Southern (KCS), which are the largest freight railroads. Other smaller Class II/III railroads and AMTRAK passenger rail also operate within Arkansas.

Survey data were provided by the largest railroads operating in Arkansas, UP and BNSF. These are summarized in Table 4-4. In addition, the Little Rock Port Authority also provided an activity rate (Pinkerton, 2002). A summary of the other fuel consumption estimates, as described in more detail below, is provided for comparison and demonstrates that UP and BNSF are the primary railroads operating in Arkansas.

Table 4-4. Surveyed and estimated fuel consumption by railroad.

Railroad	Line-Haul	Switching
UP (survey)	75,368,389	2,045,350
BNSF (survey)	12,424,591	329,960
LRPA (survey)	---	8,280
KCS (estimate)	2,551,659	201,975
Class II/III other than LRPA (estimate)	4,590,000	500,000
AMTRAK (estimate)	526,659	---

One other larger railroad, Kansas City Southern (KCS), operates in western Arkansas. KCS operations were estimated by apportioning the national fuel consumption of KCS (51,256,604 gallons for line-haul and 4,057,180 gallons for switching) using the ratio of state (217) to national (4359) track mileage. The resulting estimated state fuel consumption is shown in Table 4-4.

In order to estimate potentially important small rail activity, the national fuel consumption per railroad employee was used and associated with local employment information. Benson (2004) prepared the national estimates of fuel consumption and employees shown in Table 4-5 from annual surveys conducted by ASLRRA (1999). Nationally, Class II/III rail is of lesser importance than the Class I rail, which consumes nearly 20 times the fuel that these smaller rail systems consume nationwide. The fuel consumption and employees estimates in Table 4-5 are national summary estimates, and correspond to 10,000 gallons per employee. By contrast, the Class I railroad fuel consumption per employee ranges from 16,000 to 31,000 gallons per employee, possibly due to longer haul trips where fewer employees are required per ton-mile of operation.

Table 4-5. Class II/III railroads national summary activity rates.

Year	Employees	Fuel Consumption (gallons)
1993	24,000	200,000,000
1994	25,000	225,000,000
1995	24,000	225,000,000
1996	24,000	200,000,000
1997	No data available	
1998	23,000	210,000,000
1999	23,000	220,000,000
2000	22,000	220,000,000
2001	22,000	220,000,000

This estimate of fuel consumption per employee was used in this work to estimate the smaller rail fuel consumption rates using estimates of the number of employees for each company as provided from a purchased database of Dun & Bradstreet (D&B). The AAR and D&B data also indicated whether the railroad was considered a typical (line-haul) railroad or only provided switching services, so that the appropriate emission factors for line-haul or switching operations were applied to the correct operation.

For AMTRAK, the routes and schedules were used to determine the number of trains through Arkansas. The number of trains and mileage was multiplied by 2.35 gallons per train-mile (based on an estimate provided by AMTRAK [Jurczak, 2003]) to estimate the fuel consumption for AMTRAK trains.

Emission factors used in this work were derived from EPA documents provided as support documentation for the 1997 locomotive emission standards (EPA, 1997). The emission rates per gallon of fuel consumed are higher with switching engines because the duty cycle is on average lower power with a significant amount of idle, so the engine does not operate as efficiently as possible. Emission rates are higher for smaller rail systems than Class I railroad operations because they have been expected to convert more slowly to lower emissions engines (EPA, 2004a). Harvey (2004) provided the ammonia emission rates using the latest available data. The emission factors used in this work are shown in Table 4-6.

Table 4-6. Emission factor estimates used in this work (grams per gallon).

Engine Type	HC	CO	NOx	PM	SOx[1]	NH3[2]
Precontrolled 1999 Line-haul	10	26.6	270	6.7	16.7	0.116
Precontrolled 1999 Switching	21	38.1	362	9.2	16.7	0.116
Including emission reductions expected with the EPA rulemaking (% Reduction)						
2002 Class I Line-haul	9.99 (0.1%)	26.6	238.3 (11.8%)	6.7	16.7	0.116
2002 Class I Switching	21	38.1	355.8 (1.7%)	9.2 (0.02%)	16.7	0.116
2002 Class II/III Line-haul	10	26.6	268.9 (0.4%)	6.7	16.7	0.116
2002 Class II/III Switching	21	38.1	360.5 (0.4%)	9.2	16.7	0.116
2002 Passenger	9.99 (0.1%)	26.6	253.0 (6.3%)	6.7	16.7	0.116

[1] Reported as SO_2 and derived from an average sulfur level of 2600 ppm (EPA, 2004c).
[2] Harvey (2004)

Multiplying the fuel consumption estimates and survey results by the emission factors produces emissions estimates. The state estimated locomotive emission totals by class are shown in Table 4-7.

Table 4-7. State emission totals (tons/year).

Railroad	HC tons/year	CO tons/year	NOx tons/year	PM tons/year	SOx tons/year	NH3 tons/year
Class I	1,060	2,773	24,889	697	1,720	12
Class II/III	62	156	1563	39	94	1
Total	1,123	2,929	26,452	736	1,814	12.6

The survey results from UP and BNSF (and LRPA) were provided as county specific emissions, so the county allocations were completed directly from the data provided. For other railroad emissions, the allocations were performed using the track mileage provided by BTS (2002) GIS files. AMTRAK trains run regular routes so the emissions were apportioned according to those routes by relative mileage through each county where AMTRAK operates.

COMMERCIAL MARINE

Commercial marine activity in Arkansas area occurs along the Mississippi, Arkansas (McClellan-Kerr navigation system), Ouachita, and White Rivers. The Red River is reported to be navigable in Arkansas, but no freight traffic along the Red in Arkansas could be found. The commercial marine traffic is exclusively due to barges pushed by tugs supplying the propulsion power.

Bray et al., 2002 and Drager, 2003 provided estimated total ton-miles and fuel consumption along each river using a sophisticated model accounting for wait times at locks, empty barges, and other variables to produce their estimates. The TVA fuel consumption estimates for the rivers of interest in this work are shown in Table 4-8.

Table 4-8. Barge and tug fuel consumption by river.

River	1999	2000	2001
Ouachita and Black	542,546	706,830	605,136
White River	115,683	69,989	100,308
Arkansas	5,767,800	4,933,280	5,954,795
Mississippi (Between Ohio Confluence and Baton Rouge)	205,685,090	215,788,544	192,157,145

Because the activity on the rivers and river segments were not wholly contained within the State of Arkansas for the Ouachita, Arkansas, and Mississippi Rivers, an allocation method was required to determine the fraction of the activity in Arkansas. For the rivers with locks, Ouachita and Arkansas Rivers, the ton-miles of freight above and below locks were estimated for the entire river, and the fuel consumption was apportioned according to the relative ton-miles of freight within Arkansas to the river total. For the Mississippi River where there are no locks in the long river segment, the river mileage was used to apportion the fuel consumption to the state and county as shown in Table 4-9. Only half of the emissions were allocated to Arkansas, assuming the rest would be counted in the emissions from the adjoining States of Tennessee and Mississippi. The White River activity, including canals, is wholly contained within Arkansas running between the Mississippi and Arkansas Rivers, so the river mileage was used to apportion 70 percent of the activity to Desha County with the remainder in Arkansas County.

Table 4-9. Mississippi River activity apportionment.

	Downstream Border	Upstream Border	Total in County	Percent of River (Baton Rouge - Ohio R.)	Percentage, Corrected for Border Issue
County	River Miles				
Baton Rouge		230			
Chicot	507	554	47	6.5%	3.3%
Desha	555	619	64	8.9%	4.4%
Phillips	620	673	53	7.3%	3.7%
Lee	674	696	22	3.0%	1.5%
Crittenden	697	753	56	7.7%	3.9%
Mississippi	755	828	73	10.1%	5.0%
Ohio River	953				

The Army Corps of Engineers records freight movements through the locks systems along the river (http://www.iwr.usace.army.mil/ndc/), which affords an estimate of activity in terms of ton-miles of transport. The 2001 tonnages (the latest year available) at each of the locks in Arkansas are shown in Tables 4-10 and 4-11 for the Ouachita and Arkansas Rivers with the river mileage associated with each lock. The freight traffic though each lock was converted to a ton-mile estimate using the freight movements and river mileage. The tonnage moved typically decreases at each lock up the river. The tonnage moving to and from the upper lock was multiplied by the distance between the locks and added to the difference in tonnage between the upper and lower lock multiplied by half the distance between the two locks. This method produced a ton-mile estimate for use in allocating the fuel consumption by river segment.

Table 4-10. Tonnage freight traffic at each lock and tons moved between locks on the Ouachita and Black Rivers.

River Point	River Mileage	Total Tons (1000)	Ton-Miles (1000)
Mississippi Confluence	0		41,200
Jonesville	25	1648	
			158,630
Columbia	117.2	1793	
			208,185
AR - LA Border			
Fesenthal	226.8	2006	
			117,843
HK Thatcher	281.7	2287	
			92,166
Camden	322	2287	
Highest Navigable Point			618,024
Arkansas Traffic Fraction of River Total			34%

Table 4-11. Tonnage freight traffic at each lock and tons moved between locks on the Arkansas River.

River Point	River Mileage	Total Tons (1000 tons)	Ton-Miles (1000)
Mississippi Confluence			89,579
Norrell	10.3	8697	
			26,082
#2	13.3	8691	
			309,536
Joe Hardin	50.2	8086	
			127,869
Emmet Sanders	66	8100	
			158,817
Lock #5	86.3	7547	
			163,936
David Terry Lock	108.1	7493	
			123,150
Murray Lock	125.4	6744	
			202,383

River Point	River Mileage	Total Tons (1000 tons)	Ton-Miles (1000)
Toad Suck Ferry Lock	155.9	6527	
			136,815
Arthur V. Ormond	176.9	6503	
			189,532
Dardanelle	205.5	6751	
			291,153
Ozark - Jeta Taylor	256.8	4600	
			165,798
James W. Trimble	292.8	4611	
			119,729
W.D. Mayo Lock	319.6	4324	
AR Border	330		71,911
Robert S. Kerr Lock	336.2	4340	
			129,565
Webber Falls Lock	366.6	4184	
			136,016
Chouteau Lock	401.4	3633	
			71,831
Newt Graham Lock	421.6	3479	
			63,309
Port of Catoosa	445	1932	
Highest Navigable Point			2,577,011
Arkansas State Traffic Fraction of River Total			83%

The fuel consumption estimates were converted to emissions using EPA (1999) emission factor estimates. The EPA (1999) emission factors in Table 4-12 were provided by engine type for those below and above 1000 kW rated power.

From the Coast Guard data (http://www.iwr.usace.army.mil/ndc/veslchar/veslchar.htm) the push boats registered in the State with installed propulsion power less than 2,680 hp (2000 kW), assuming two engines per boat, represented 62 percent of the push boat installed power. This figure was used to provide average emission factors for push boats in Arkansas. The emission factor was converted to grams per gallon using an average specific fuel consumption figure of 210 g/kW-hr (same figure as for locomotives) and a fuel density of 7.1 pounds/gallon.

Table 4-12. EPA (1999) emission factors for marine engines.

Engine	HC (g/kW-hr)	NOx (g/kW-hr)	CO (g/kW-hr)	PM10 (g/kW-hr)	SO2[1] (g/gal.)	NH3[1] (g/gal.)
<1000 kW	0.27	10	1.5	0.30	16.7	0.116
>1000 kW	0.27	13	2.5	0.30	16.7	0.116
Average emission rates in g/gallon						
Average 62% Engines <2500hp	4.14	170.8	28.8	4.60	16.7	0.116

[1] Using the same emission rates as for locomotives

Dredging contracts in the Little Rock District of the Army Corps were distributed along the Arkansas River (McClellan-Kerr Navigational System). Typical dredging activity along this river system has averaged approximately 1,000,000 cubic yards (http://www.iwr.usace.army.mil/ndc/drgcorps.htm) per year with the 1,667,000 cubic yards dredged in 2001, the latest year available for this study. Emission estimates are shown in Table 4-13 using an emission estimate from another study (Starcrest, 2000) where emissions were estimated and associated with tonnage of material dredged. The emissions were estimated based on total material dredged in Arkansas and were then distributed along the length of the river.

Table 4-13. Dredging activity and emissions estimates.

Area	Tonnage (cu. yards)	HC (tons/year)	NOx (tons/year)	CO (tons/year)	PM (tons/year)	SO2*	NH3*
Houston (Starcrest,2000)	5,667,000	1.8	143.3	25.7	3.6	-	-
2002 AR	1,667,000	0.5	42.2	7.6	1.1	22.9	0.18

* No direct estimates were available so a ratio of the NOx value was used for the SO2 and NH3 estimates.

Combining the river traffic and emission factors and adding dredging emissions, county level emissions estimates for commercial marine were prepared and are shown in Table 4-14. As would be expected, the counties bordering the Mississippi River exhibit the highest emissions.

Table 4-14. Commercial marine emissions (tons per year) by county.

County	HC	NOx	CO	PM – 10	SO2	NH3
Arkansas	2.0	83.4	14.1	2.2	9.5	0.1
Ashley	0.0	0.9	0.2	0.0	0.1	0.0
Bradley	0.0	1.5	0.3	0.0	0.1	0.0
Calhoun	0.1	2.9	0.5	0.1	0.3	0.0
Chicot	28.5	1176.1	198.5	31.7	115.0	0.8
Clark	0.1	2.9	0.5	0.1	0.3	0.0
Conway	1.4	58.2	9.9	1.6	6.9	0.0
Crawford	1.2	49.3	8.4	1.3	5.9	0.0
Crittenden	34.0	1401.4	236.5	37.7	137.0	1.0
Dallas	0.0	1.1	0.2	0.0	0.1	0.0
Desha	39.9	1644.5	277.5	44.3	160.9	1.1
Faulkner	0.9	37.7	6.4	1.0	4.4	0.0
Franklin	1.5	65.4	11.1	1.8	8.1	0.1
Jefferson	4.4	187.1	31.7	5.0	21.4	0.2
Johnson	0.9	39.1	6.6	1.1	4.7	0.0
Lee	13.3	550.5	92.9	14.8	53.8	0.4
Lincoln	1.5	64.2	10.9	1.7	7.3	0.1
Logan	1.0	44.3	7.5	1.2	5.4	0.0
Mississippi	44.3	1826.8	308.3	49.2	178.6	1.2
Ouachita	0.1	4.8	0.8	0.1	0.5	0.0
Perry	0.9	37.4	6.3	1.0	4.4	0.0
Phillips	32.1	1326.3	223.8	35.7	129.7	0.9
Pope	1.2	48.9	8.3	1.3	5.8	0.0
Pulaski	3.4	143.6	24.3	3.9	16.7	0.1
Sebastian	1.1	47.2	8.0	1.3	5.6	0.0

County	HC	NOx	CO	PM – 10	SO2	NH3
Union	0.1	3.7	0.6	0.1	0.4	0.0
Yell	1.0	43.7	7.4	1.2	5.2	0.0
State Total	*215.0*	*8893.1*	*1501.2*	*239.5*	*888.1*	*6.2*

AIRCRAFT

The method currently recommended by the Federal Aviation Administration (FAA) for estimating aircraft emission inventories of CO, HC, NOx and SOx at airports employs the FAA's Emissions and Dispersion Modeling System (EDMS). The EDMS model, an airport emissions and air dispersion modeling program (information available at http://www.aee.faa.gov/emissions/edms/EDMShome.htm), combines specified aircraft and activity levels with default emission factors in order to estimate annual inventories for a specific airport. Aircraft activity levels in EDMS are expressed in terms of landing and take-off cycles (LTOs), which consist of the four aircraft operating modes: taxi and idle, take-off, climb-out, and approach. Default values for the amount of time a specific aircraft spends in each mode, or the time-in-modes (TIMs), are included in EDMS (except for taxi/idle) but may be updated with airport-specific values where available. In addition, the model also includes updateable default settings for the mixing height and aircraft engine assignments. In order to use EDMS, a separate setup and model run for each airport is required, and each combination of aircraft model, engine type, and activity level to be considered in the modeling scenario must be explicitly specified. Due to this input-intensive procedure, and because the current version of the model lacks the capability to automate the setup for each model run, it was not possible to use EDMS to estimate emissions for all airfields in Arkansas given the available resources.

In addition, a review of available air traffic statistics from the FAA indicated that the aircraft model-specific activity data needed to support a detailed analysis of emissions from all flight categories are not currently available. Aircraft activity data in varying levels of detail may be obtained for all flight categories at airports with FAA managed traffic control towers, which only keep detailed activity records on air carrier traffic and less detailed records for the other flight categories. The different flight categories are:

- Air carriers (AC), which are larger turbine-powered commercial aircraft with at least 60 seats or 18,000 lbs payload capacity;
- Air taxis (AT), which are commercial turbine or piston-powered aircraft with less than 60 seats or 18,000 lbs payload capacity;
- General Aviation Aircraft (GA), which typically are small piston-powered, non-commercial aircraft; and
- Military Aircraft (MA).

Currently available fleet data are inadequate to run the EDMS model for air taxis and (in most cases) military aircraft since little detail are kept in control tower records, and for general aviation aircraft flights, which occur mostly at non-towered facilities. Non-towered facilities tend to have very limited information on activity levels and do not, as a normal practice, keep detailed records on airframe types for flights in and out of the facility.

In order to estimate emissions given these data inadequacies, a mixed methodology was used in developing the aircraft CO, HC, NOx, SOx, and PM10 emissions inventories. The methodology employed the EDMS model for airports/flight categories with detailed information on aircraft activity and used fleet-average (aggregate) emission factors for the rest of the analysis. A similar aggregate method of analysis has been employed by EPA to estimate aircraft emission inventories, such as in developing the 1996 National Toxics Inventory (NTI). Ammonia and lead emissions were estimated separately as discussed below.

Ninety-nine towered airports were identified in the state of Arkansas (from www.airnav.com/airports/us/AR). For 76 of these airports, flight category-specific aircraft activity data were obtained from FAA's Terminal Area Forecast (TAF). For 23 of the remaining smaller airports, activity data were obtained from the website www.airnav.com.

In addition, for a previous inventory developed for the Little Rock area, the ADEQ provided detailed activity data for military aircraft at the Little Rock Air Force Base (LRAFB) and an Army National Guard installation. In addition to LTO and fleet composition, estimates of TIMs were provided.

EDMS Modeling

For the five largest airports in Arkansas, EDMS modeling was used to estimate emissions from Air carriers and Air taxis:

- Adams Field (LIT), Little Rock
- Fort Smith Regional Airport (FSM), Fort Smith
- Drake Field Airport (FYV), Fayetteville
- Texarkana Regional Airport-Webb Field (TXK), Texarkana
- Northwest Arkansas Regional Airport (XNA), Fayetteville

Required taxi/idle time information was acquired from the Bureau of Transportation Statistics (BTS) at http://www.bts.gov/ntda/oai/SummaryStatistics. The taxi/idle time was estimated by summing the reported taxi-in and taxi-out times for each airport.

Fleet composition data were available from the Bureau of Transportation Statistics (BTS) for air carriers and air taxis at each of these five airports (1999 fleet mix data was scaled to 2002 using activity data from the TAF).

The taxi/idle time, airframe types and associated LTO in the fleet composition data were entered into the FAA EDMS model v4.12. Once executed, EDMS gave the HC, NOx, CO and SOx emissions that correspond to the total LTOs in the fleet composition data. These emissions were distributed to the air carrier and air taxi categories for each airport based upon LTO data.

The emissions for each of the military airfields were addressed previously using the EDMS. For this work, these emissions, which represented calendar year 2000, were scaled to 2002 levels using state military GSP available at http://www.bea.doc.gov/bea/regional/gsp/. HC emissions were converted to VOC using EPA (1992) conversion factors for commercial aircraft.

PM emissions for these aircraft were estimated using emission factors specific to each engine type from the 1997 Final Emissions Impact Report for the Oakland International Airport (Port of

Oakland, 1997). All other parameters (TIMs, engine assignments, etc...) were the same as used in the EDMS modeling.

Aggregate Approach

Flight category-specific criteria emission factors obtained from EPA (1992) were used to estimate the emissions by combining with the FAA activity data for air taxis (except for those five larger airports which were modeled by EDMS), general aviation and military aircraft. Table 4-15 shows the emission factors for VOC, NOx, CO and PM10 for each aircraft category. The FAA activity data were converted to LTO cycles by dividing by 2 as the criteria emissions factors are in lbs/LTO cycle.

Table 4-15. Aircraft emission factors (lbs/LTO unless otherwise noted).

Pollutant	Air Taxis	General Aviation	Military Aircraft
NOx	0.158	0.065	0.158
CO	28.13	12.014	28.13
VOC	1.223 (0.9914 times HC)	0.382 (0.9708 times HC)	1.363 (1.1046 times HC)
SOx	0.015	0.01	0.015
PM10	0.60333	0.2367	0.60333
NH3	~0	153.47 mg/gal	~0

Lead Emissions Estimation

Lead was estimated separately using an emission factor (1.5 g/gal) multiplied by the amount of aviation gas consumed. This methodology followed that which was used in the 1996 NTI. The amount of fuel consumed (at the airports) was calculated as described above.

Ammonia Emissions Estimation

Commercial and military aviation were assumed to be dominated by turbine-powered aircraft running lean, thus producing a negligible amount of ammonia. For general aviation, a fleet-average fuel consumption rate was first developed from EDMS data for three popular piston engines (O200, O320, and TSIO-360). The operational mode-specific fuel flowrates were weighted by the time spent in each mode; taxi/idle time was from BTS and the rest from EDMS. That rate was converted from kg/second to gallons/hour assuming a fuel density of 0.75 kg/liter. The total hours of operation (at the airports) were estimated using the TIM information (hours/LTO) and the GA LTO data from FAA TAF. The NH_3 emission factor for non-catalyst light-duty gasoline vehicles used in EPA's 1986-1999 emissions trends calculations (EPA, 2001) was then applied.

Seasonal Emission Estimation

Monthly emissions were obtained by using the ratios of monthly to annual total LTO data from the ATADS at http://www.apo.data.faa.gov/faaatadsall.HTM. Emissions for the June through August ozone season were summed and then divided by the number of days in this period to obtain the ozone season daily emissions. In a similar manner, the winter season daily emissions were estimated. (Note that no difference between weekday and weekend was assumed due to lack of data.) The monthly LTO data from the ATADS were only available specifically for six airports (ASG, FSM, FYV, LIT, TXK, and XNA) but an average profile calculated from these six was applied to the other airfields as well.

5. SUMMARY AND DISCUSSION OF EMISSION RESULTS

This section provides a summary and discussion of the estimated area, on-road, and off-road source emissions by pollutant for the eight pollutants required to be reported under CERR: VOC, NOx, CO, PM10, PM2.5, SOx, NH3, and Pb. Statewide emissions summaries are provided for each major source category for calendar year 2002, and for 2002 typical winter weekday and typical summer weekday. ENVIRON is providing to ADEQ along with this report a set of summary spreadsheets that tabulate emissions by detailed SCC for each county in the state.

This section also describes the data and procedures used to spatially allocate the area, on-road, and off-road emissions to develop the gridded emission inventories. Plots are provided that show the gridded emissions by major source category for each pollutant and for each of the three time periods (annual, summer weekday, and winter weekday).

AREA SOURCE EMISSIONS

Area source emissions estimates for the state for calendar year 2002 are presented by source category in Table 5-1. The 2002 summer weekday emission estimates are presented in Table 5-2, and the 2002 winter weekday emission estimates are shown in Table 5-3. Figures 5-1 through 5-7 show the relative contribution by source category grouping to annual area source emissions. The primary VOC sources are, in order of magnitude for the state as a whole: prescribed burning, industrial surface coatings, gasoline distribution, agricultural burning, solvent use, and residential wood combustion. The primary NOx sources are industrial fuel combustion and prescribed burning; these two categories account for about 60 percent of total NOx emissions. CO emissions are dominated by agricultural and prescribed burning; these two categories account for almost 90 percent of total CO emissions. About half of PM_{10} emissions are from fugitive road dust; other large sources of PM10 are windblown dust, agricultural tillage, and prescribed burning. For PM2.5, the largest contributors are prescribed burning, unpaved roads fugitives, and agricultural burning. SO_X emissions are almost completely from industrial fuel combustion. NH3 emissions are largely (92 percent) from livestock and fertilizer application.

OFF-ROAD EMISSIONS

Table 5-4 shows the 2002 annual off-road emissions by source category. Tables 5-5 and 5-6 show the off-road summer and winter weekday emissions, respectively, by source category. Figures 5-8 through 5-14 show the relative contribution by source category to annual off-road emissions. The relative emissions contributions by source category are similar in the annual, summer weekday, and winter weekday time periods. VOC emissions are dominated by recreational marine equipment and recreational equipment; these two categories account for more than half of the annual VOC emissions from off-road equipment. Three source categories account for about 75 percent of the annual NOx emissions – locomotives, commercial marine, and agricultural equipment. The largest source of CO emissions is from lawn and garden equipment (about 30 percent of annual emissions). Agricultural equipment is the largest source of particulate matter emissions, almost 40 percent of annual PM10 and PM2.5; locomotives and construction equipment account for another 32 percent of annual PM10 and PM2.5. SOx emissions from off-road sources are dominated by agricultural equipment and locomotives (together about 55 percent of annual emissions); other large sources of SOx emissions are construction equipment and commercial marine. Ammonia emissions from off-road engines and equipment are insignificant compared to area sources. The only lead from off-road sources is from general aviation, which used leaded gasoline.

ON-ROAD EMISSIONS

Table 5-7 shows the 2002 annual on-road emissions by vehicle class. Tables 5-8 and 5-9 show the summer and winter weekday emissions, respectively, by vehicle class. Figures 5-15 through 5-21 show the relative contribution by vehicle class to annual on-road emissions. The relative emissions contributions by vehicle class are similar in the annual, summer weekday, and winter weekday time periods. Almost all of the VOC and CO emissions (more than 90 percent) are from light-duty cars and trucks. About 42 percent of NOx emissions are from heavy-duty diesel vehicles, and about 50 percent of NOx emissions are from light-duty vehicles. For PM10, almost 60 percent of the on-road emissions are from heavy-duty diesel trucks, and about 35 percent are from light-duty vehicles. For PM2.5 emissions, the heavy-duty diesel fraction is even larger – almost 70 percent, and about 25 percent is from light-duty vehicles. Light-duty vehicles account for about 60 percent of SOx emissions, and heavy-duty diesel accounts for about 33 percent. Ammonia emissions from on-road vehicles are very small compared with area sources, and are almost all from light-duty vehicles.

GRIDDED EMISSIONS

Emission Gridding Surrogate Development

Spatial allocation of regional or county-level emission estimates is accomplished through the use of gridding surrogates or spatial allocation factors (SAFs) for each emission source category or group of source categories. Spatial surrogates are typically based on the proportion of a known region-wide characteristic variable that exists within the modeling domain grid cells. Traditionally the development of spatial gridding surrogates has been performed by a variety of methods depending on the emission source category being considered, the required spatial resolution, the geographic extent of the domain, and the particular characteristics of the geospatial data available. Spatial surrogates must define the percentage of regional or county level emissions from a particular source category that is to be allocated to some spatial region, typically a modeling grid cell. For most area and off-road sources, these percentages are based on areas of a particular land use/land cover type while for on-road mobile source categories, the percentages are usually based on total length of a certain road type or a transportation network. Often human population is also used as a spatial surrogate for certain emission source categories.

Gridding surrogates were developed from several sources of spatial data describing the Land Use/Land Cover (LULC), transportation networks and population characteristics.
Land use data were obtained from the USGS EROS Data Center web site (http://edcftp.cr.usgs.gov/pub/data/landcover/states) and are a subset of the National Land Cover Dataset (NLCD). This dataset provides dominant land use data for each state at a spatial resolution of 30 meters. The 21 LULC categories and codes utilized in the NLCD are presented in Table 1. More detailed descriptions of the NLCD land use types are available

from the USGS web site. These eight bit binary files were imported into the Arc/INFO geographic information system (GIS) as raster images and then converted to polygon coverages. Due to the high resolution of the LULC data, Arc/INFO cannot directly generate polygon coverages at this resolution. Therefore, the data were re-sampled at a resolution of 2 kilometers prior to conversion to polygons. The resulting polygon coverages could then be overlayed first with state and county boundary files and then with the appropriate grid file.

Population and housing statistics were obtained from the EPA's gridding surrogate GIS datasets. The EPA has recently assembled numerous datasets from a variety of sources for development of gridding surrogates for emissions processing. The housing and population data were derived from the 2000 US Census. Roadways and railways were derived from the US Census Bureau TIGER/Line data files. Additional spatial surrogate information, specifically information on airport and shipping port locations, were also obtained from spatial surrogate data developed by the EPA (ftp://ftp.epa.gov/EmisInventory/emiss_shp2003/).

The processing and development of gridding surrogates was performed using the Arc/INFO GIS. To develop gridding surrogates, or SAFs, the appropriate surrogate databases (i.e., land use, population, roadways, railways, etc), the modeling domain grid, and the regional/county boundaries are first imported into the GIS as geospatial coverages. Through intersecting, or overlaying, these coverages, the appropriate areal and/or linear percentages can be calculated as follows. The spatial data are first intersected with the regional boundaries to generate a new coverage that contains polygons, or arcs, with attribute associated with the spatial data and the regional boundaries. The total area, or length, of a particular land use, or roadway type, within each region or county can then be calculated. The resulting coverage is then overlaid with the modeling domain grid to associate the grid cell attributes (i and j cell indices) with the land use and regional boundary attributes. These procedures result in the generation of new polygons, each of which has all of these attributes as well as the corresponding areas, or lengths. The spatial allocation factors are then generated by forming ratios of the total area, or length, in each grid cell and county to the corresponding total area, or length of the particular spatial data type within each county. The resulting coverage was then exported as a text data file containing the fractional area, or length, for each spatial data type in each grid cell referenced by county FIPS codes. The resulting data were then reformatted using Perl to provide the required gridded surrogate data file input to the EPS2 emissions modeling system.

Spatial Surrogate Assignments

To apply the emissions processing system using the spatial gridding surrogates developed as described above, the LULC codes listed in Table 5-10 need to be aggregated and re-mapped to the surrogate codes recognized by EPS. Table 5-11 displays the mapping of NLCD codes to EPS gridding surrogate codes.

The US EPA's SCC-spatial surrogate cross-reference files were evaluated for use in the project. In most cases, the EPA's surrogate assignments are based on fairly broad surrogate categories (i.e., population, rural land, agricultural land, etc.). As EPS2 allows surrogates to be user-defined using more detailed categorization of LULC classifications for specific application, the EPA-defined surrogate assignments were compared with those typically used by ENVIRON when developing modeling inventories using EPS2. It was determined that the EPA's surrogate assignments were considerably less detailed than the most recent allocation assignments typically used by ENVIRON. Therefore, the more refined SCC-surrogate assignments developed by ENVIRON were used. The use of these assignments result in improved spatial allocation of various emission source, particularly off-road sources, which EPA's assignment allocates mostly to population, rather than specific land use types for which the activity data associated with these sources are more appropriate.

Table 5-12 summarizes the spatial allocation data for the treatment of area, on-road mobile and off-road mobile emission sources, and provides the description of each emission source category, the unique SCC code(s) assigned to each and the corresponding spatial surrogate category/codes.

Example displays of residential, agricultural and Industrial/Commercial land surrogates are presented in Figures 5-22 through 5-24, respectively.

Gridded Emission Results

The gridded emissions results for summer and winter weekday emissions are provided in a series of graphical displays as follows:

- Area sources, summer weekday – Figures 5-25 to 5-31
- Off-road sources, summer weekday – Figures 5-32 to 5-38
- On-road sources, summer weekday – Figures 5-39 to 5-45
- Area sources, winter weekday – Figures 5-46 to 5-52
- Off-road sources, winter weekday – Figures 5-53 to 5-59
- On-road sources, winter weekday – Figures 5-60 to 5-66

In each set, the pollutants are in the same order: VOC, CO, NOx, PM10, PM2.5, SOx, and NH3. For all of the displays, the scale is set to range from the minimum to the maximum emissions by source category and pollutant; i.e., the same scale is used for both summer and winter weekday emissions for each source category/pollutant combination. Because the emissions in the state by source category and pollutant can range from relatively small in rural areas to relatively large in urban areas, for some plots most of the shading is on the green lower end of the scale with only small areas in other colors for the urban areas. On-road emissions outside the urban areas are also on the green end of the scale outside the urban areas, but follow the major roadways in the state.

NIF FORMATTING OF EMISSIONS

The county-level emissions by detailed SCC are being provided in EPA NIF format to the ADEQ along with this report. EPA's NIF 3.0 has been developed to standardize submission of data for creating the 2002 National Emission Inventory (NEI), which integrates criteria pollutant data for VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, NH_3, and Pb with data for 188 hazardous air pollutants (HAPs). The format, instructions, and conventions for using the NIF are available on the EPA web site at http://www.epa.gov/ttn/chief/nif/. The NIF-formatted data files are Microsoft Access MDB files. Note that the tables in the off-road MDB file are named "area" because the current version of NIF includes off-road sources in with area sources (future versions of NIF may identify off-road emissions separately). All NIF files created were run through EPA's NIF Format and Content Checker (recently updated and released on May 18, 2004) to ensure compatibility for upload. The output files from this Checker are also being provided to ADEQ along with this report.

Table 5-1. AR 2002 Annual Area Source Emissions by Category in tons per year.

Category	VOC	NO_x	CO	PM_{10}	$PM_{2.5}$	SO_x	NH_3	Pb
Residential Wood Combustion	6,178	225	18,101	2,485	2,485	34	0	0
Industrial Fuel Combustion - Natural Gas	204	10,400	3,120	282	282	22	119	0
Industrial Fuel Combustion - LPG	25	1,387	236	41	41	1	0	0
Industrial Fuel Combustion - Distillate Fuel	17	2,089	435	87	22	8,201	70	0
Industrial Fuel Combustion - Residual Fuel	0	0	0	0	0	0	0	0
Industrial Fuel Combustion - Coal	8	1,193	954	954	350	18,127	0	0
Commercial Fuel Combustion - Natural Gas	91	1,650	1,386	125	125	10	8	0
Commercial Fuel Combustion - LPG	4	145	20	5	5	0	0	0
Commercial Fuel Combustion - Distillate Fuel	3	170	42	9	7	723	7	0
Residential Fuel Combustion - Natural Gas	116	1,974	840	160	160	13	10	0
Residential Fuel Combustion - LPG	20	824	114	26	26	1	0	0
Residential Fuel Combustion - Distillate Fuel	0	0	0	0	0	2	0	0
Residential Fuel Combustion - Kerosene	0	10	3	1	0	3	0	0
Paved Roads	0	0	0	30,305	7,576	0	0	0
Unpaved Roads	0	0	0	135,653	20,348	0	0	0
Fugitive Dust - Construction Activities	0	0	0	1,724	358	0	0	0
Windblown Dust	0	0	0	32,164	7,076	0	0	0
Fugitive Dust - Agricultural Tilling	0	0	0	31,668	7,021	0	0	0
Fugitive Dust - Cattle Feedlots	0	0	0	17	2	0	0	0
Fugitive Dust - Dairies	0	0	0	26	3	0	0	0
Architectural Surface Coating	3,503	0	0	0	0	0	0	0
Autobody Refinishing	523	0	0	0	0	0	0	1
Traffic Markings	623	0	0	0	0	0	0	0
Industrial Surface Coating	15,362	0	0	0	0	0	0	0
Solvent Cleaning/Degreasing	6,772	0	0	0	0	0	0	0
Dry Cleaning	2,313	0	0	0	0	0	0	0
Graphic Arts	1,762	0	0	0	0	0	0	0
Consumer and Commercial Solvent Use	8,499	0	0	0	0	0	0	0
Cutback Asphalt Paving	5	0	0	0	0	0	0	0
Gasoline Storage, Transport, and Distribution	11,103	0	0	0	0	0	0	0
Open Burning - Residential Yard Waste	208	0	1,117	244	244	0	0	0
Open Burning - Residential Household Waste	2,591	518	7,342	3,282	3,006	86	0	0
Wildfires	1,550	258	9,041	1,098	1,098	0	0	0
Prescribed Burning	17,558	5,853	196,066	27,508	27,508	0	0	0
Agricultural Burning	10,001	0	112,487	13,103	13,103	0	0	0
Structural Fires	23	3	125	23	23	0	0	0
Vehicle Fires	8	1	31	24	24	0	0	0
Livestock Ammonia	0	0	0	0	0	0	83,505	0
Fertilizer Ammonia	0	0	0	0	0	0	36,859	0
Domestic Ammonia	0	0	0	0	0	0	3,023	0
Charbroiling	0	0	0	654	654	0	0	0
Cold Storage Facilities	0	0	0	0	0	0	7,171	0
Bakeries	474	0	0	0	0	0	0	0
Miscellaneous Lead Area Sources	0	0	0	0	0	0	0	0
Grand Total	**89,543**	**26,699**	**351,460**	**281,667**	**91,547**	**27,223**	**130,773**	**1**

Table 5-2. AR 2002 Average Summer Weekday Area Source Emissions by Category in tons per day.

Category	VOC	NO_x	CO	PM_{10}	$PM_{2.5}$	SO_x	NH_3	Pb
Residential Wood Combustion	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA
Industrial Fuel Combustion - Natural Gas	0.78	39.84	11.95	1.08	1.08	0.09	0.46	NA
Industrial Fuel Combustion - LPG	0.09	5.31	0.90	0.16	0.16	0.00	0.00	NA
Industrial Fuel Combustion - Distillate Fuel	0.07	8.01	1.67	0.33	0.08	31.42	0.27	NA
Industrial Fuel Combustion - Residual Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial Fuel Combustion - Coal	0.03	4.57	3.66	3.66	1.34	69.45	0.00	NA
Commercial Fuel Combustion - Natural Gas	0.07	1.21	1.02	0.09	0.09	0.01	0.01	NA
Commercial Fuel Combustion - LPG	0.00	0.11	0.01	0.00	0.00	0.00	0.00	NA
Commercial Fuel Combustion - Distillate Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Fuel Combustion - Natural Gas	0.12	2.02	0.86	0.16	0.16	0.01	0.01	NA
Residential Fuel Combustion - LPG	0.02	0.63	0.09	0.02	0.02	0.00	0.00	NA
Residential Fuel Combustion - Distillate Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA
Residential Fuel Combustion - Kerosene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA
Paved Roads	NA	NA	NA	99.36	24.84	NA	NA	NA
Unpaved Roads	NA	NA	NA	459.57	68.94	NA	NA	NA
Fugitive Dust - Construction Activities	NA	NA	NA	4.72	0.98	NA	NA	NA
Windblown Dust	NA	NA	NA	4.31	0.95	NA	NA	NA
Fugitive Dust - Agricultural Tilling	NA	NA	NA	9.49	2.10	NA	NA	NA
Fugitive Dust - Cattle Feedlots	NA	NA	NA	0.05	0.01	NA	NA	NA
Fugitive Dust - Dairies	NA	NA	NA	0.07	0.01	NA	NA	NA
Architectural Surface Coating	10.52	NA	NA	NA	NA	NA	NA	NA
Autobody Refinishing	2.00	NA	NA	NA	NA	NA	NA	0.00
Traffic Markings	3.21	NA	NA	NA	NA	NA	NA	NA
Industrial Surface Coating	58.86	NA	NA	NA	NA	NA	NA	NA
Solvent Cleaning/Degreasing	25.95	NA	NA	NA	NA	NA	NA	NA
Dry Cleaning	7.39	NA	NA	NA	NA	NA	NA	NA
Graphic Arts	5.06	NA	NA	NA	NA	NA	NA	NA
Consumer and Commercial Solvent Use	23.28	NA	NA	NA	NA	NA	NA	NA
Cutback Asphalt Paving	0.01	NA	NA	NA	NA	NA	NA	NA
Gasoline Storage, Transport, and Distribution	31.44	NA	NA	NA	NA	NA	NA	NA
Open Burning - Residential Yard Waste	0.57	0.00	3.06	0.67	0.67	0.00	NA	NA
Open Burning - Residential Household Waste	7.10	1.42	20.12	8.99	8.24	0.24	NA	NA
Wildfires	1.72	0.29	10.04	1.22	1.22	0.00	NA	NA
Prescribed Burning	18.30	6.10	204.29	28.66	28.66	0.00	NA	NA
Agricultural Burning	63.16	NA	752.46	90.72	90.72	NA	NA	NA
Structural Fires	0.06	0.01	0.33	0.06	0.06	NA	NA	NA
Vehicle Fires	0.02	0.00	0.08	0.07	0.07	NA	NA	NA
Livestock Ammonia	NA	NA	NA	NA	NA	NA	228.78	NA
Fertilizer Ammonia	NA	NA	NA	NA	NA	NA	64.59	NA
Domestic Ammonia	NA	NA	NA	NA	NA	NA	8.28	NA
Charbroiling	NA	NA	NA	1.79	1.79	NA	NA	NA
Cold Storage Facilities	NA	NA	NA	NA	NA	NA	19.65	NA
Bakeries	1.30	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Lead Area Sources	NA	NA	NA	NA	NA	NA	NA	0.00
Grand Total	**261.13**	**69.51**	**1,010.54**	**715.26**	**232.19**	**101.22**	**322.04**	**0.00**

Table 5-3. AR 2002 Average Winter Weekday Area Source Emissions by Category in tons per day.

Category	VOC	NO_x	CO	PM_{10}	$PM_{2.5}$	SO_x	NH_3	Pb
Residential Wood Combustion	44.80	1.63	131.25	18.02	18.02	0.25	NA	NA
Industrial Fuel Combustion - Natural Gas	0.78	39.84	11.95	1.08	1.08	0.09	0.46	NA
Industrial Fuel Combustion - LPG	0.09	5.31	0.90	0.16	0.16	0.00	0.00	NA
Industrial Fuel Combustion - Distillate Fuel	0.07	8.01	1.67	0.33	0.08	31.42	0.27	NA
Industrial Fuel Combustion - Residual Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial Fuel Combustion - Coal	0.03	4.57	3.66	3.66	1.34	69.45	0.00	NA
Commercial Fuel Combustion - Natural Gas	0.55	9.97	8.38	0.76	0.76	0.06	0.05	NA
Commercial Fuel Combustion - LPG	0.02	0.88	0.12	0.03	0.03	0.00	0.00	NA
Commercial Fuel Combustion - Distillate Fuel	0.02	1.23	0.31	0.07	0.05	5.24	0.05	0.00
Residential Fuel Combustion - Natural Gas	0.64	10.98	4.67	0.89	0.89	0.07	0.06	NA
Residential Fuel Combustion - LPG	0.12	4.94	0.68	0.16	0.16	0.01	0.00	NA
Residential Fuel Combustion - Distillate Fuel	0.00	0.00	0.00	0.00	0.00	0.01	0.00	NA
Residential Fuel Combustion - Kerosene	0.00	0.07	0.02	0.00	0.00	0.02	0.00	NA
Paved Roads	NA	NA	NA	81.28	20.32	NA	NA	NA
Unpaved Roads	NA	NA	NA	359.27	53.89	NA	NA	NA
Fugitive Dust - Construction Activities	NA	NA	NA	4.72	0.98	NA	NA	NA
Windblown Dust	NA	NA	NA	136.78	30.09	NA	NA	NA
Fugitive Dust - Agricultural Tilling	NA	NA	NA	2.41	0.53	NA	NA	NA
Fugitive Dust - Cattle Feedlots	NA	NA	NA	0.05	0.01	NA	NA	NA
Fugitive Dust - Dairies	NA	NA	NA	0.07	0.01	NA	NA	NA
Architectural Surface Coating	8.70	NA	NA	NA	NA	NA	NA	NA
Autobody Refinishing	2.00	NA	NA	NA	NA	NA	NA	0.00
Traffic Markings	0.00	NA	NA	NA	NA	NA	NA	NA
Industrial Surface Coating	58.86	NA	NA	NA	NA	NA	NA	NA
Solvent Cleaning/Degreasing	25.95	NA	NA	NA	NA	NA	NA	NA
Dry Cleaning	7.39	NA	NA	NA	NA	NA	NA	NA
Graphic Arts	5.06	NA	NA	NA	NA	NA	NA	NA
Consumer and Commercial Solvent Use	23.28	NA	NA	NA	NA	NA	NA	NA
Cutback Asphalt Paving	0.01	NA	NA	NA	NA	NA	NA	NA
Gasoline Storage, Transport, and Distribution	30.42	NA	NA	NA	NA	NA	NA	NA
Open Burning - Residential Yard Waste	0.57	0.00	3.06	0.67	0.67	0.00	NA	NA
Open Burning - Residential Household Waste	7.10	1.42	20.12	8.99	8.24	0.24	NA	NA
Wildfires	3.74	0.62	21.80	2.65	2.65	0.00	NA	NA
Prescribed Burning	62.96	20.99	703.00	98.63	98.63	0.00	NA	NA
Agricultural Burning	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA
Structural Fires	0.07	0.01	0.38	0.07	0.07	NA	NA	NA
Vehicle Fires	0.02	0.00	0.08	0.07	0.07	NA	NA	NA
Livestock Ammonia	NA	NA	NA	NA	NA	NA	228.78	NA
Fertilizer Ammonia	NA	NA	NA	NA	NA	NA	54.82	NA
Domestic Ammonia	NA	NA	NA	NA	NA	NA	8.28	NA
Charbroiling	NA	NA	NA	1.79	1.79	NA	NA	NA
Cold Storage Facilities	NA	NA	NA	NA	NA	NA	19.65	NA
Bakeries	1.30	NA	NA	NA	NA	NA	NA	NA
Miscellaneous Lead Area Sources	NA	NA	NA	NA	NA	NA	NA	0.00
Grand Total	**284.56**	**110.48**	**912.05**	**722.60**	**240.51**	**106.86**	**312.42**	**0.00**

Table 5-4. AR 2002 Annual Off-road Source Emissions by Category in tons per year.

Category	VOC	NOx	CO	PM10	PM2.5	SOx	NH3	Pb
Agricultural Equipment	2,282	13,785	18,649	1,875	1,725	2,019	8	0
Airport Ground Support Equipment	3	25	34	2	2	4	0	0
Commercial Equipment	1,847	1,056	39,872	109	100	115	1	0
Construction Equipment	1,540	8,567	13,974	875	805	1,430	6	0
Industrial Equipment	2,407	4,984	25,848	166	154	278	1	0
Lawn and Garden Equipment	4,395	575	69,599	120	110	46	2	0
Logging Equipment	234	428	1,618	43	39	83	0	0
Oil Field Equipment	37	28	349	1	1	3	0	0
Railroad Maintenance Equipment	8	33	95	5	5	5	0	0
Recreational Equipment	6,219	138	22,289	11	10	24	2	0
Recreational Marine Equipment	12,094	937	30,832	595	547	97	3	0
Underground Mining Equipment	0	0	0	0	0	0	0	0
Aircraft	855	835	9,380	197	182	76	0	5
Locomotives	1,123	26,452	2,929	736	677	1,814	13	0
Commercial Marine	215	8,893	1,501	239	220	888	6	0
Grand Total	**33,260**	**66,736**	**236,969**	**4,975**	**4,579**	**6,880**	**43**	**5**

Table 5-5. AR 2002 Average Summer Weekday Off-road Source Emissions by Category in tons per day.

Category	VOC	NOx	CO	PM10	PM2.5	SOx	NH3	Pb
Agricultural Equipment	9.77	59.26	81.51	8.07	7.42	8.69	0.04	0.00
Airport Ground Support Equipment	0.01	0.07	0.09	0.01	0.01	0.01	0.00	0.00
Commercial Equipment	5.76	3.21	131.10	0.35	0.32	0.36	0.00	0.00
Construction Equipment	6.42	35.85	59.65	3.67	3.37	5.99	0.02	0.00
Industrial Equipment	7.57	15.53	83.22	0.51	0.47	0.85	0.00	0.00
Lawn and Garden Equipment	14.11	1.87	238.57	0.40	0.37	0.17	0.01	0.00
Logging Equipment	0.74	1.35	5.25	0.14	0.12	0.26	0.00	0.00
Oil Field Equipment	0.11	0.08	1.11	0.00	0.00	0.01	0.00	0.00
Railroad Maintenance Equipment	0.03	0.11	0.34	0.02	0.02	0.02	0.00	0.00
Recreational Equipment	18.88	0.38	69.21	0.03	0.03	0.07	0.01	0.00
Recreational Marine Equipment	28.55	1.99	68.07	1.30	1.20	0.21	0.01	0.00
Underground Mining Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aircraft	3.03	2.93	29.32	0.61	0.57	0.26	0.00	0.01
Locomotives	3.05	71.88	7.96	2.00	1.84	4.93	0.03	0.00
Commercial Marine	0.58	24.17	4.08	0.65	0.60	2.41	0.02	0.00
Grand Total	**98.61**	**218.68**	**779.47**	**17.76**	**16.34**	**24.24**	**0.14**	**0.01**

Table 5-6. AR 2002 Average Winter Weekday Off-road Source Emissions by Category in tons per day.

Category	VOC	NOx	CO	PM10	PM2.5	SOx	NH3	Pb
Agricultural Equipment	1.82	10.75	14.20	1.46	1.34	1.57	0.01	0.00
Airport Ground Support Equipment	0.01	0.07	0.09	0.01	0.01	0.01	0.00	0.00
Commercial Equipment	6.04	3.57	125.34	0.35	0.32	0.37	0.00	0.00
Construction Equipment	4.04	22.38	35.71	2.28	2.10	3.73	0.02	0.00
Industrial Equipment	7.81	16.09	82.51	0.52	0.48	0.86	0.00	0.00
Lawn and Garden Equipment	4.52	0.44	43.83	0.15	0.14	0.03	0.00	0.00
Logging Equipment	0.76	1.39	5.13	0.14	0.13	0.27	0.00	0.00
Oil Field Equipment	0.11	0.08	0.95	0.00	0.00	0.01	0.00	0.00
Railroad Maintenance Equipment	0.03	0.12	0.33	0.02	0.02	0.02	0.00	0.00
Recreational Equipment	8.19	0.21	28.02	0.01	0.01	0.03	0.00	0.00
Recreational Marine Equipment	7.40	0.33	9.81	0.19	0.18	0.03	0.00	0.00
Underground Mining Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aircraft	1.70	1.72	21.76	0.46	0.42	0.16	0.00	0.01
Locomotives	3.08	72.67	8.05	2.02	1.86	4.98	0.03	0.00
Commercial Marine	0.59	24.43	4.12	0.66	0.61	2.44	0.02	0.00
Grand Total	**46.10**	**154.23**	**379.86**	**8.27**	**7.62**	**14.52**	**0.09**	**0.01**

Table 5-7. AR 2002 Annual Onroad Source Emissions by Vehicle Class in tons per year.

Category	Category - short name	VOC	NOx	CO	PM10	PM2.5	SOx	NH3
Light Duty Gasoline Vehicle	LDGV	33,406	24,636	395,606	437	233	1,013	1,475
Light Duty Gasoline Truck 1&2	LDGT12	21,507	16,627	300,173	314	177	856	964
Light Duty Gasoline Truck 3&4	LDGT34	9,284	7,266	131,983	154	89	461	393
Heavy Duty Gasoline Vehicle	HDGV	3,150	6,111	41,664	136	97	194	51
Light Duty Diesel Vehicle	LDDV	34	66	72	12	11	4	0
Light Duty Diesel Truck	LDDT	69	115	120	16	14	14	0
Heavy Duty Diesel Vehicle	HDDV	2,068	40,529	10,860	1,491	1,319	1,247	70
Motor Cycle	MC	437	283	2,893	8	4	7	2
Total	**Total**	**69,955**	**95,632**	**883,371**	**2,567**	**1,943**	**3,795**	**2,955**

Table 5-8. AR 2002 Average Summer Weekday Onroad Source Emissions by Vehicle Class in tons per day.

Category	VOC	NOx	CO	PM10	PM2.5	SOx	NH3
Light Duty Gasoline Vehicle	91.98	59.32	973.88	1.28	0.68	2.96	4.31
Light Duty Gasoline Truck 1&2	58.38	39.31	715.55	0.92	0.52	2.50	2.82
Light Duty Gasoline Truck 3&4	25.74	17.03	342.22	0.45	0.26	1.35	1.15
Heavy Duty Gasoline Vehicle	9.47	17.59	125.60	0.40	0.28	0.57	0.15
Light Duty Diesel Vehicle	0.10	0.19	0.21	0.03	0.03	0.01	0.00
Light Duty Diesel Truck	0.20	0.34	0.35	0.05	0.04	0.04	0.00
Heavy Duty Diesel Vehicle	6.00	118.53	31.50	4.35	3.85	3.65	0.20
Motor Cycle	1.33	0.60	9.14	0.02	0.01	0.02	0.01
Grand Total	**193.21**	**252.92**	**2198.45**	**7.49**	**5.67**	**11.10**	**8.64**

Table 5-9. AR 2002 Average Winter Weekday Onroad Source Emissions by Vehicle Class in tons per day.

Category	VOC	NOx	CO	PM10	PM2.5	SOx	NH3
Light Duty Gasoline Vehicle	94.97	78.83	1320.00	1.17	0.63	2.72	3.97
Light Duty Gasoline Truck 1&2	62.54	53.58	1010.79	0.85	0.48	2.30	2.59
Light Duty Gasoline Truck 3&4	26.60	23.42	422.57	0.41	0.24	1.24	1.06
Heavy Duty Gasoline Vehicle	8.04	16.86	115.39	0.37	0.26	0.52	0.14
Light Duty Diesel Vehicle	0.09	0.18	0.19	0.03	0.03	0.01	0.00
Light Duty Diesel Truck	0.19	0.31	0.32	0.04	0.04	0.04	0.00
Heavy Duty Diesel Vehicle	5.61	109.23	29.54	4.02	3.56	3.35	0.19
Motor Cycle	1.09	0.95	7.87	0.02	0.01	0.02	0.01
Grand Total	**199.13**	**283.36**	**2906.68**	**6.92**	**5.24**	**10.21**	**7.94**

Table 5-10. Land use categories and codes utilized in the NLCD.

NLCD Category Code	NLCD Category Description
11	Open Water
12	Perennial Ice/Snow
21	Low Intensity Residential
22	High Intensity Residential
23	Commercial/Industrial/Transportation
31	Bare Rock/Sand/Clay
32	Quarries/Strip Mines/Gravel Pits
33	Transitional
41	Deciduous Forest
42	Evergreen Forest
43	Mixed Forest
51	Shrubland
61	Orchards/Vineyards/Other
71	Grasslands/Herbaceous
81	Pasture/Hay
82	Row Crops
83	Small Grains
84	Fallow
85	Urban/Recreational Grasses
91	Woody Wetlands
92	Emergent Herbaceous Wetlands

Table 5-11. Mapping of EPS2 surrogate codes to NLCD LULC codes.

Surrogate Name	EPS2 Surrogate Code	NLCD LULC Codes
Population	1	2000 US Census (EPA Surrogate Database)
Households	2	2000 US Census (EPA Surrogate Database)
County area	3	Sum all LULC codes
Residential	4	Sum LULC codes 21 and 22
Commercial/Industrial	5	Sum LULC codes 22, 23 and 85
Agricultural	6	Sum LULC codes 61 and 81-84
Range	7	Sum LULC codes 51 and 71
Forest	8	Sum LULC code 41-43
Bodies of Water	9	Sum LULC codes 11 and 12
Barren	10	Sum LULC codes 31-33
Commercial/Industrial /Transportation	11	LULC code 23
Rural	12	Sum LULC codes 31-33, 41-43, 51, 61, 71, 81-84 and 91-92
Ports	13	Ports from EPA's surrogate database
Airports	14	Airports from EPA's surrogate database
Urban primary roads	15	Urban primary roads from EPA's surrogate database
Rural primary roads	16	Rural primary roads from EPA's surrogate database
Urban secondary roads	17	Urban secondary roads from EPA's surrogate database
Rural secondary roads	18	Rural secondary roads from EPA's surrogate database
All roads	19	All roads from EPA's surrogate database
Rural	20	Sum LULC codes 31-33, 41-43, 51, 61, 71, 81-84 and 91-92

Table 5-12. Source category codes and spatial surrogate assignments.

Source Category	Gridding Surrogate Code	SCC	Surrogate Description
Area			
Other Fuel Combustion (Industrial Coal)	5	2102002000	Urban Commercial/Industrial Land
Other Fuel Combustion (Industrial Distillate)	5	2102004000	Urban Commercial/Industrial Land
Other Fuel Combustion (Industrial Residual)	5	2102005000	Urban Commercial/Industrial Land
Other Fuel Combustion (Industrial Natural Gas)	5	2102006000	Urban Commercial/Industrial Land
Other Fuel Combustion (Industrial Propane)	5	2102007000	Urban Commercial/Industrial Land
Other Fuel Combustion (Industrial Kerosene)	5	2102011000	Urban Commercial/Industrial Land
Other Fuel Combustion (Comm/Inst Coal)	5	2103002000	Urban Commercial/Industrial Land
Other Fuel Combustion (Comm/Inst Distillate)	5	2103004000	Urban Commercial/Industrial Land
Other Fuel Combustion (Comm/Inst Residual)	5	2103005000	Urban Commercial/Industrial Land
Other Fuel Combustion (Comm/Inst Natural Gas)	5	2103006000	Urban Commercial/Industrial Land
Other Fuel Combustion (Comm/Inst Propane)	5	2103007000	Urban Commercial/Industrial Land
Other Fuel Combustion (Comm/Inst Kerosene)	5	2103011000	Urban Commercial/Industrial Land
Other Fuel Combustion (Residential Coal)	2	2104002000	Housing
Other Fuel Combustion (Residential Distillate)	2	2104004000	Housing
Other Fuel Combustion (Residential Residual)	2	2104005000	Housing
Other Fuel Combustion (Residential Natural Gas)	2	2104006000	Housing
Other Fuel Combustion (Residential Propane)	2	2104007000	Housing
Residential Wood Combustion (Fireplaces)	2	2104008001	Housing
Residential Wood Combustion (Woodstoves)	2	2104008010	Housing
Other Fuel Combustion (Residential Kerosene)	2	2104011000	Housing
Paved Road Fugitive Dust	19	2294000000	All roads
Unpaved Road Fugitive Dust	12	2296000000	Rural Land
Cold Storage Ammonia	9	2302080002	Water
Construction Activities	1	2311000000	Population
Mining and Quarrying	10	2325000000	Barren
Architectural Surface Coating	2	2401001000	Housing
Autobody Refinishing	5	2401005000	Urban Commercial/Industrial Land
Traffic Markings	19	2401008000	All roads
Surface Coating (Factory Finished Wood)	5	2401015000	Urban Commercial/Industrial Land
Surface Coating (Furniture)	5	2401020000	Urban Commercial/Industrial Land
Surface Coating (Metal Cans)	5	2401040000	Urban Commercial/Industrial Land
Surface Coating (Misc. Finished Metals)	5	2401050000	Urban Commercial/Industrial Land
Surface Coating (Machinery and Equipment)	5	2401055000	Urban Commercial/Industrial Land
Surface Coating (Appliances)	5	2401060000	Urban Commercial/Industrial Land
Surface Coating (Electronic/Electrical)	5	2401065000	Urban Commercial/Industrial Land
Surface Coating (Motor Vehicles)	5	2401070000	Urban Commercial/Industrial Land
Surface Coating (Marine)	5	2401080000	Urban Commercial/Industrial Land
Surface Coating (Railroad)	5	2401085000	Urban Commercial/Industrial Land
Surface Coating (Misc. Manufacturing)	5	2401090000	Urban Commercial/Industrial Land
Surface Coating (High Perf. Ind. Maint. Coatings)	5	2401100000	Urban Commercial/Industrial Land
Surface Coating (Other Special Purpose Coatings)	5	2401200000	Urban Commercial/Industrial Land
Solvent Degreasing (Vapor and In-Line Cleaning - Electronics and Electrical)	5	2415230000	Urban Commercial/Industrial Land
Solvent Degreasing (Vapor and In-Line Cleaning - Other)	5	2415245000	Urban Commercial/Industrial Land
Solvent Degreasing (Cold Cleaning - Manufacturing)	5	2415345000	Urban Commercial/Industrial Land
Solvent Degreasing (Cold Cleaning - Automobile Repair)	5	2415360000	Urban Commercial/Industrial Land
Dry Cleaning	5	2420000000	Urban Commercial/Industrial Land
Graphic Arts	5	2425000000	Urban Commercial/Industrial Land
Consumer Solvent Use	2	2460000000	Housing
Asphalt Paving	19	2461020000	All roads
Pesticides	6	2461850000	Agricultural
Gasoline Distribution (Stage I)	5	2501060050	Urban Commercial/Industrial Land
Gasoline Distribution (Stage II)	5	2501060100	Urban Commercial/Industrial Land

Source Category	Gridding Surrogate Code	SCC	Surrogate Description
Gasoline Distribution (Underground Tank)	5	2501060200	Urban Commercial/Industrial Land
Gasoline Distribution (Tank Truck Transit)	5	2505030120	Urban Commercial/Industrial Land
Open Burning (Residential Yard Waste)	2	2610000100	Housing
Open Burning (Residential MSW)	2	2610030000	Housing
Agricultural Windblown Dust	6	2730100000	Agricultural
Agricultural Tillage	6	2801000003	Agricultural
Agricultural Burning	6	2801500000	Agricultural
Fertilizer Application	6	2801700000	Agricultural
Livestock Ammonia	6	2805000000	Agricultural
Wildfires	8	2810001000	Forest
Prescribed Fires	8	2810015000	Forest
Charbroiling	5	2810025000	Urban Commercial/Industrial Land
Structural Fires	2	2810030000	Housing
Vehicle Fires	1	2810050000	Population
commercial charbroiling	5	2302002000	Urban Commercial/Industrial Land
cutback asphalt commercial	5	2461021000	Urban Commercial/Industrial Land
domestic ammonia aggregated	2	2806020000	Housing
industrial bakery	5	2302050000	Urban Commercial/Industrial Land
industrial surface coatings aggregated	5	2401300000	Urban Commercial/Industrial Land
miscellaneous lead aggregated	3	2999999999	County Area
open burning yard waste aggregated	2	2610000050	Housing
solvent utilization	5	2415000000	Urban Commercial/Industrial Land
gas service stations	5	2501060000	Urban Commercial/Industrial Land
residential wood combustion	2	2104008000	Housing
Off-Road Mobile			
Agricultural Equipment	6	2200005000	Agricultural
Aircraft	14	2275000000	Airports
Aircraft	14	2275075000	Airports
Airport Equipment	14	2200008000	Airports
gse	14	2200008005	Airports
Commercial Equipment	5	2200006000	Urban Commercial/Industrial Land
underground mining equipment	10	2200009000	Barren
Commercial Marine	9	2280002000	Water
Construction and Mining Equipment	1	2200002000	Population
Industrial Equipment	5	2200003000	Urban Commercial/Industrial Land
Lawn and Garden Equipment	2	2200004000	Housing
Locomotives	20	2285002005	Railways
Logging Equipment	8	2200007000	Forest
oil field equipment	12	2200010000	Rural Land
Pleasure Craft	9	2282000000	Water
recreational marine equipment	9	2282010005	Water
Railroad Equipment	20	2285000015	Railways
Railroad Equipment	20	2285004000	Railways
Railroad maintenance Equipment	20	2285004015	Railways
Recreational Equipment	12	2200001000	Rural Land
On-Road Mobile			
All on-road mobile sources	19	22xxxxxxxx	All roads

Figure 5-1.
Arkansas 2002 Annual VOC Emissions from Area Sources

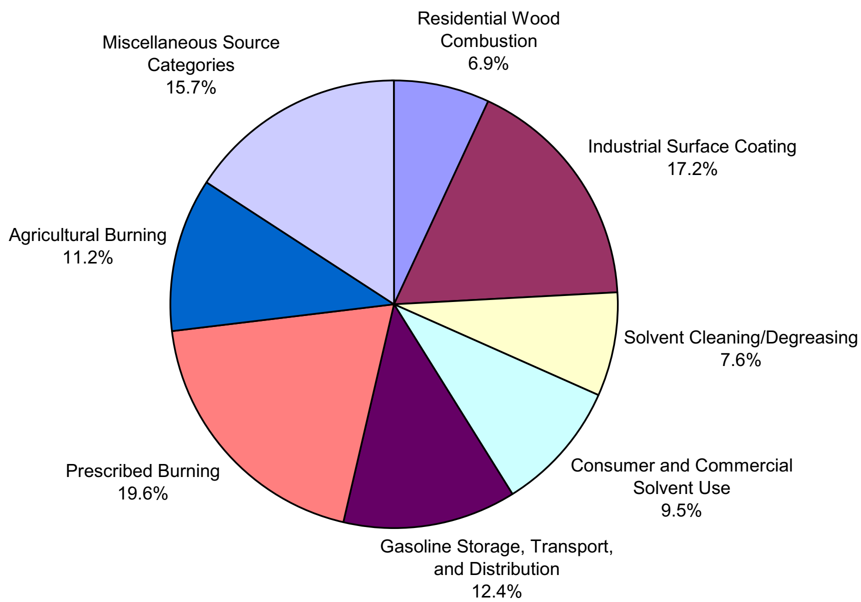


Figure 5-2.
Arkansas 2002 Annual NO_x Emissions from Area Sources

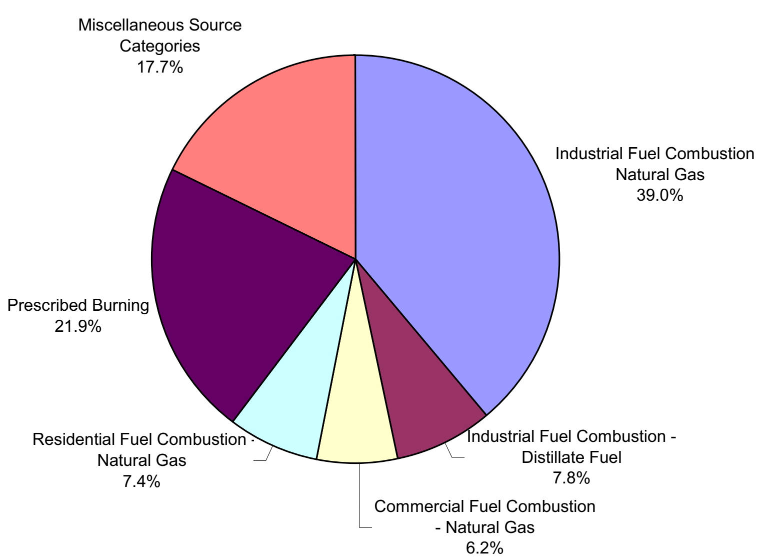


Figure 5-3.
Arkansas 2002 Annual CO Emissions from Area Sources

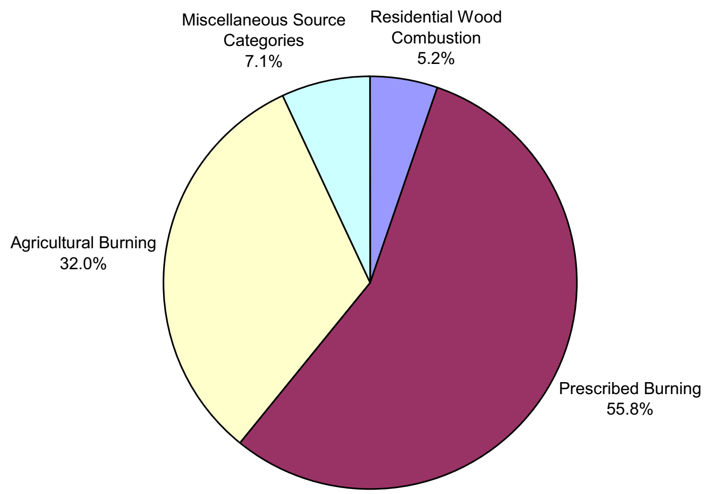


Figure 5-4.
Arkansas 2002 Annual PM_{10} Emissions from Area Sources

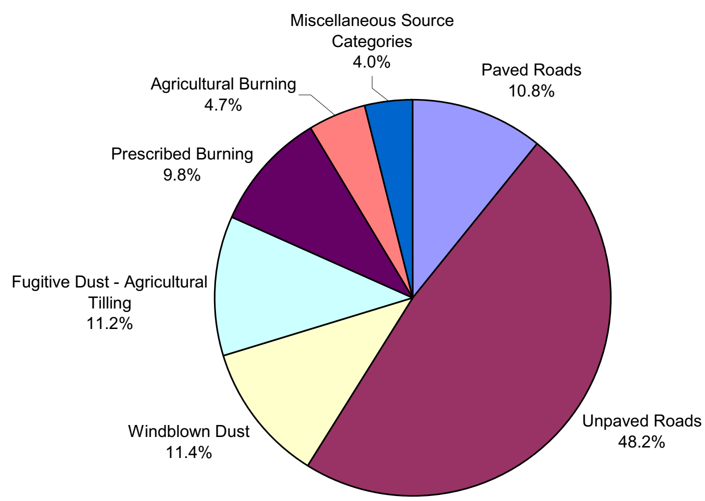


Figure 5-5.
Arkansas 2002 Annual $PM_{2.5}$ Emissions from Area Sources

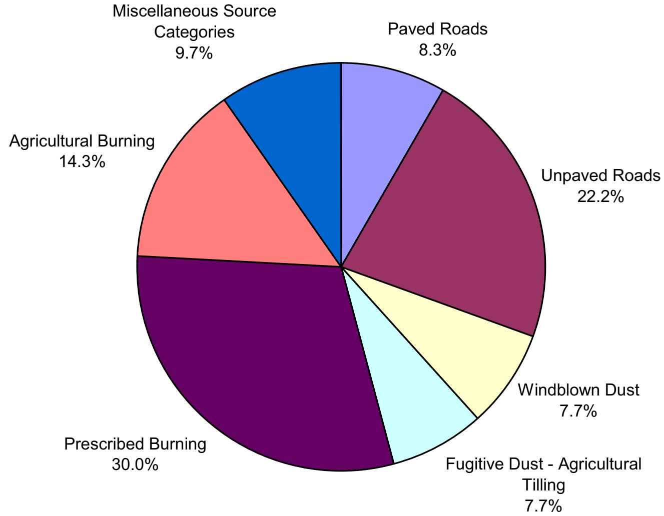


Figure 5-6.
Arkansas 2002 Annual SO_x Emissions from Area Sources

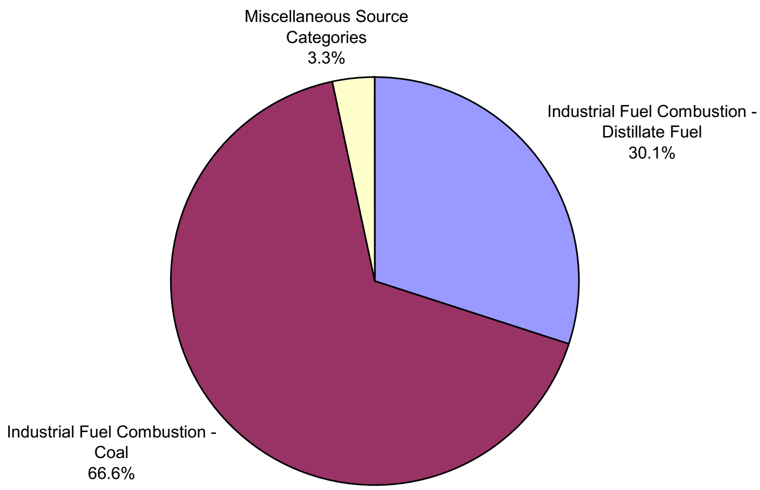


Figure 5-7.
Arkansas 2002 Annual NH_3 Emissions from Area Sources

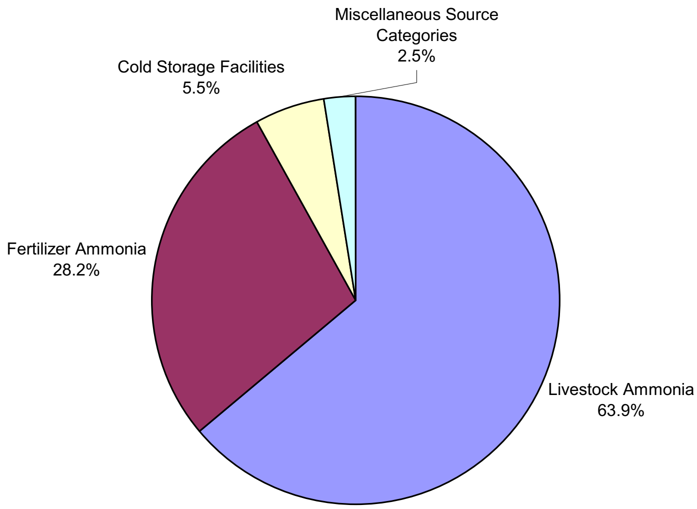


Figure 5-8.
Arkansas 2002 VOC Emissions from Off-Road Mobile Sources

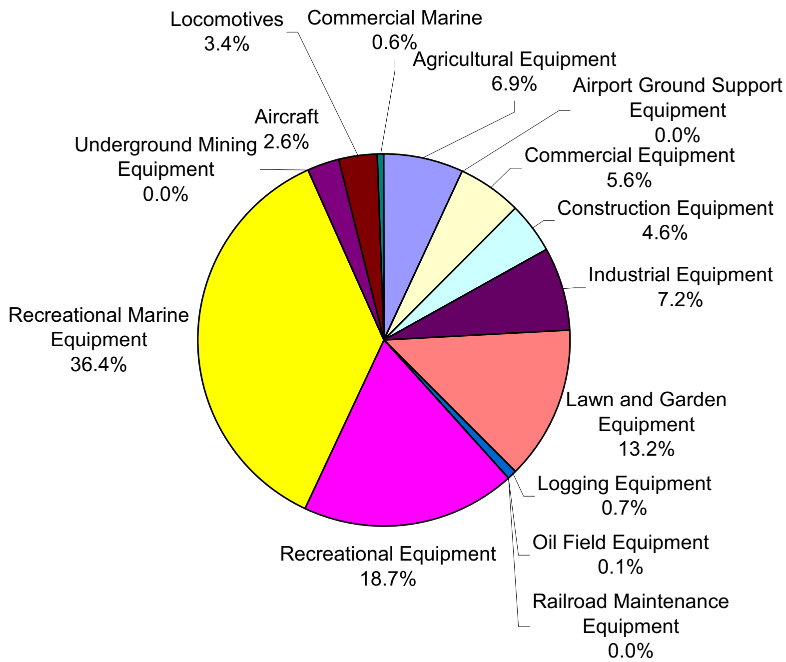


Figure 5-9.
Arkansas 2002 NOx Emissions from Off-Road Mobile Sources

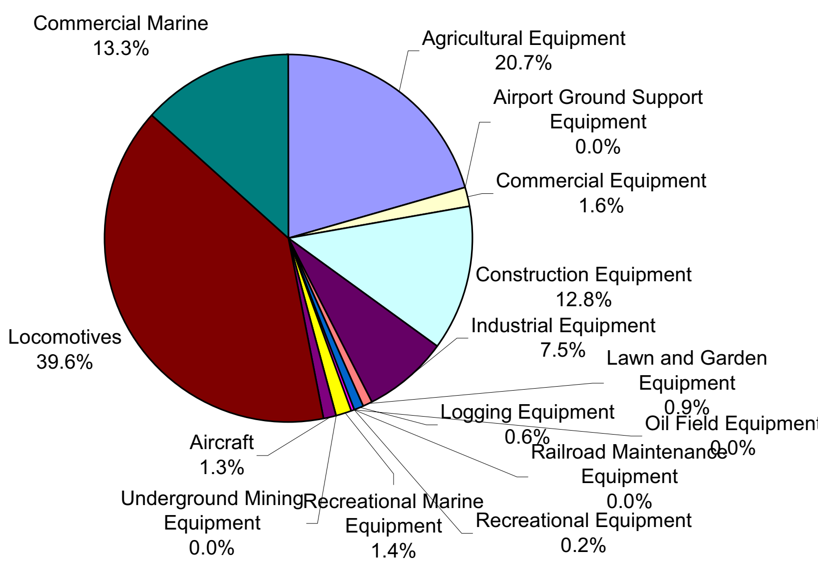


Figure 5-10.
Arkansas 2002 CO Emissions from Off-Road Mobile Sources

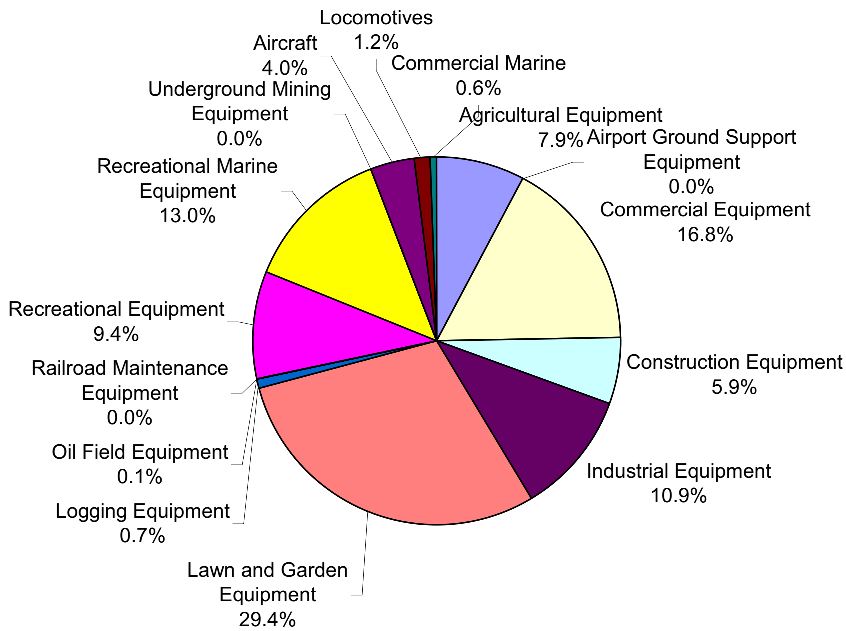


Figure 5-11.
Arkansas 2002 PM_{10} Emissions from Off-Road Mobile Sources

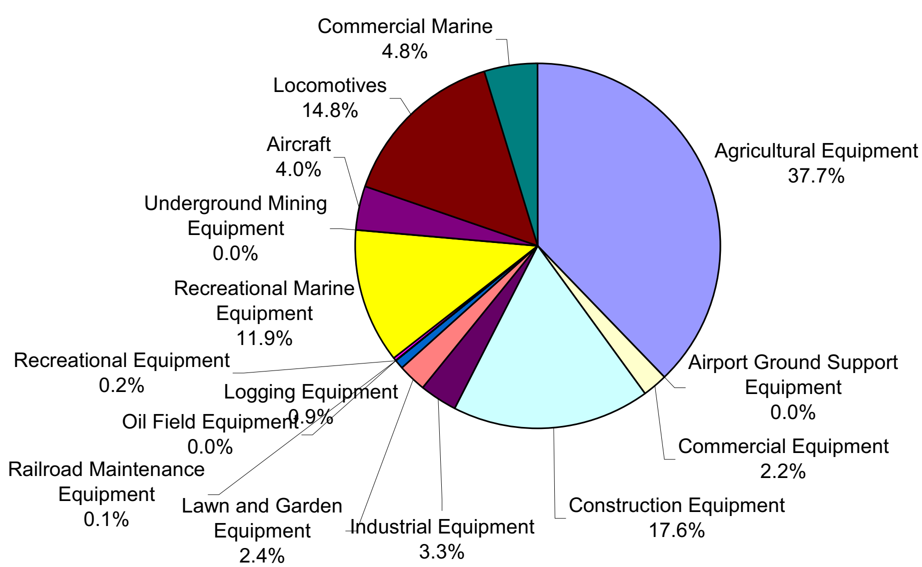


Figure 5-12.
Arkansas 2002 $PM_{2.5}$ Emissions from Off-Road Mobile Sources

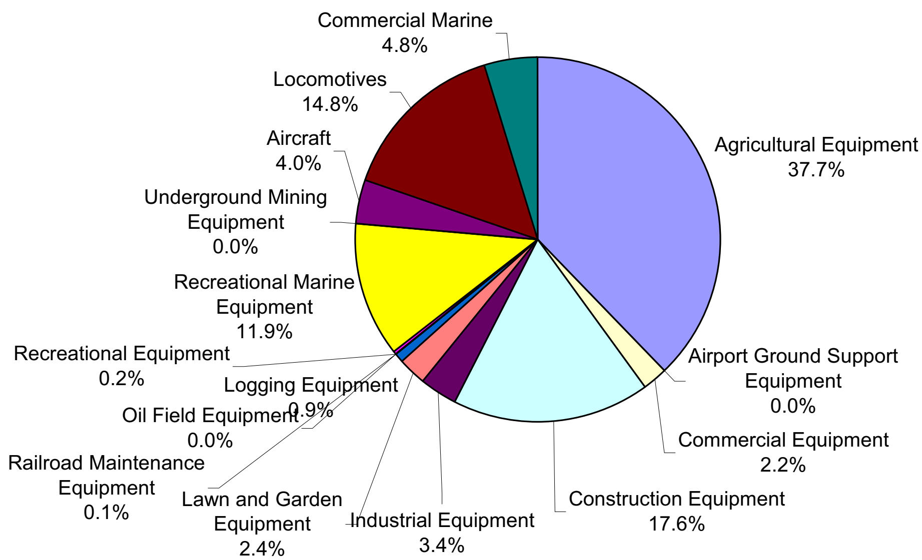


Figure 5-13.
Arkansas 2002 SOx Emissions from Off-Road Mobile Sources

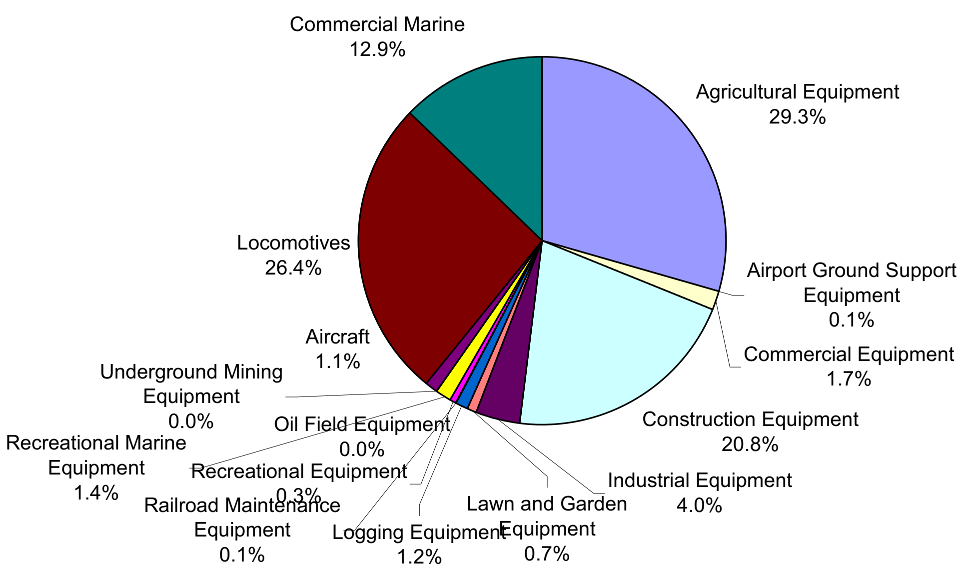


Figure 5-14.
Arkansas 2002 NH_3 Emissions from Off-Road Mobile Sources

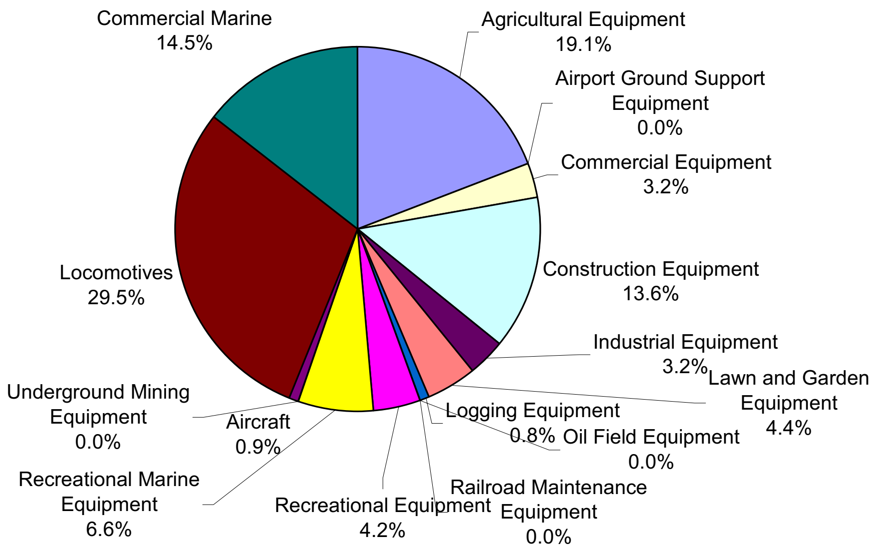


Figure 5-15.
Arkansas 2002 VOC Emissions from On-Road Mobile Sources

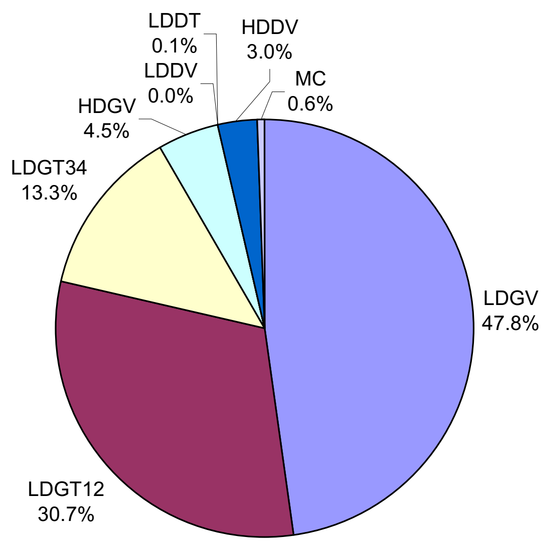


Figure 5-16.
Arkansas 2002 NOx Emissions from On-Road Mobile Sources

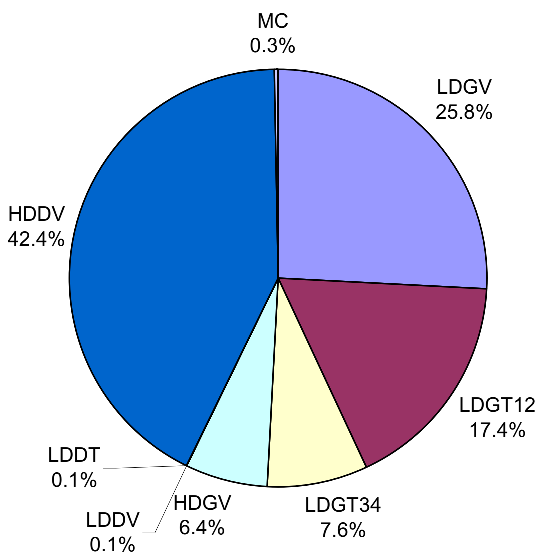


Figure 5-17.
Arkansas 2002 CO Emissions from On-Road Mobile Sources

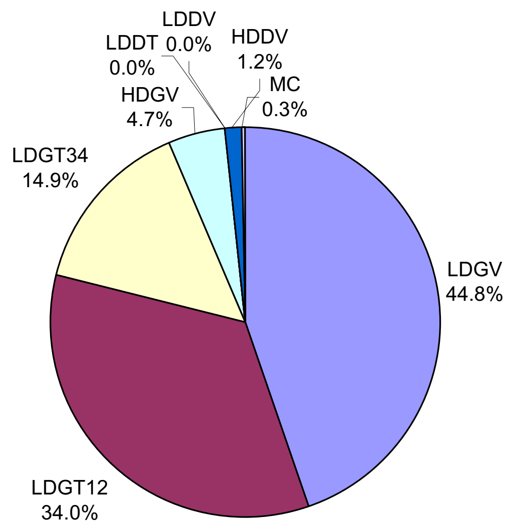


Figure 5-18.
Arkansas 2002 PM_{10} Emissions from On-Road Mobile Sources

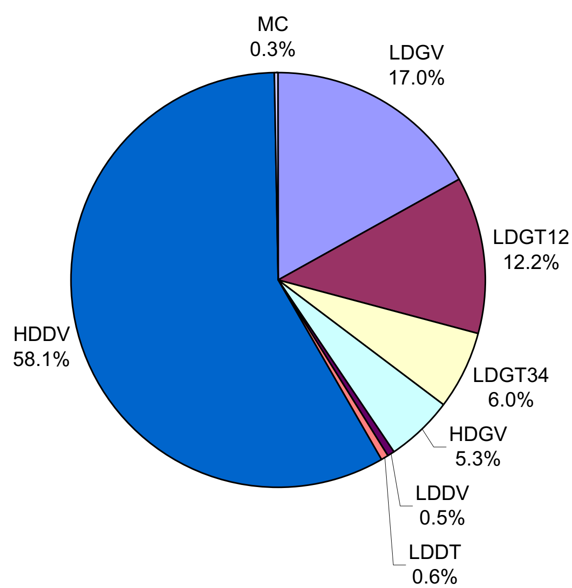


Figure 5-19.
Arkansas 2002 $PM_{2.5}$ Emissions from On-Road Mobile Sources

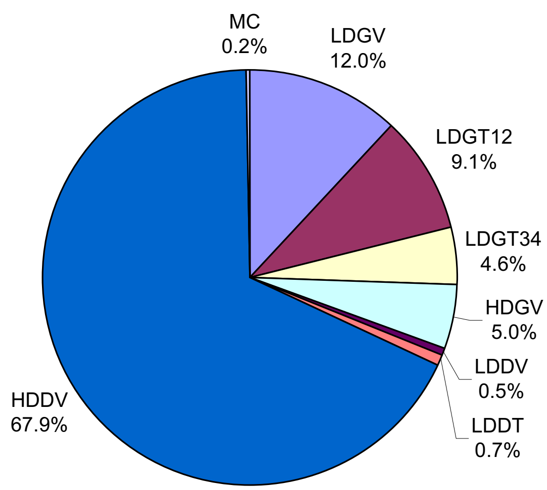


Figure 5-20.
Arkansas 2002 SOx Emissions from On-Road Mobile Sources

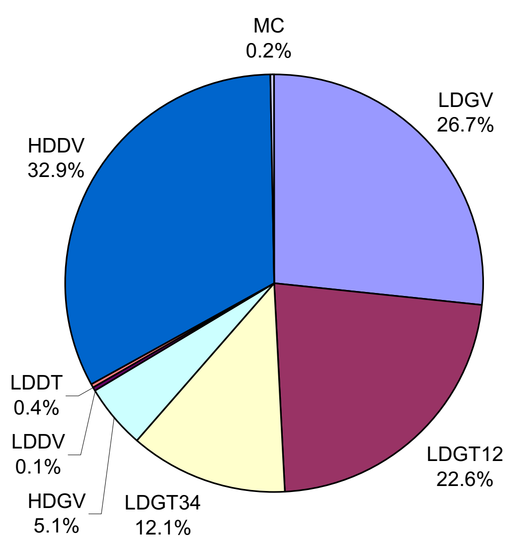


Figure 5-21.
Arkansas 2002 NH_3 Emissions from On-Road Mobile Sources

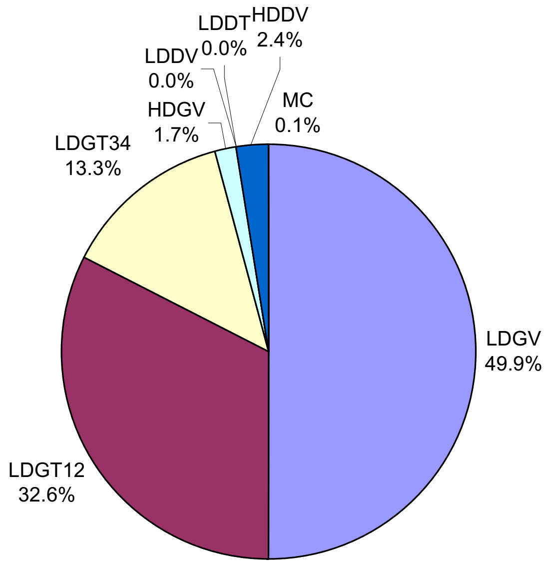


Figure 5-22
Residential land surrogate

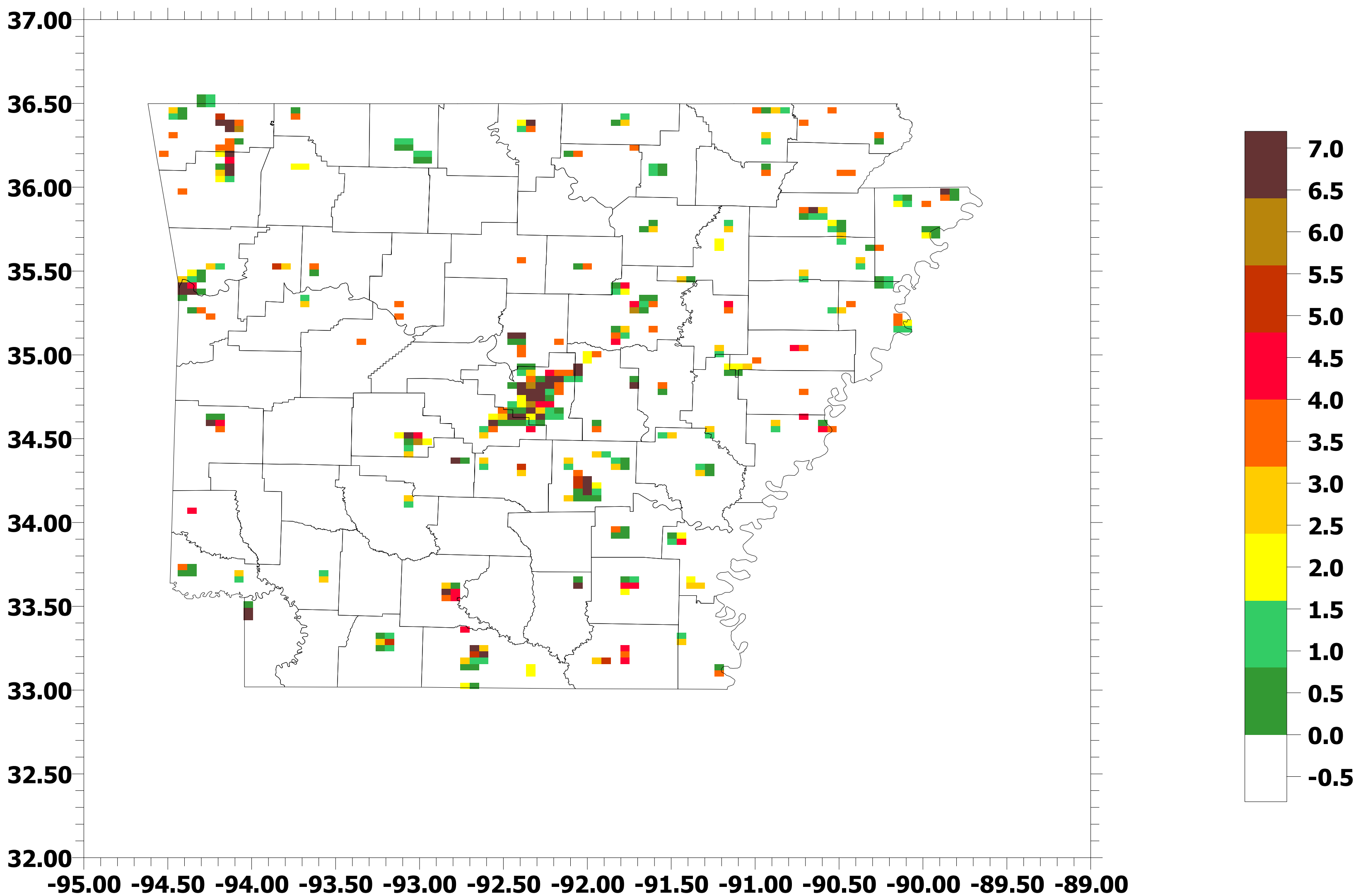


Figure 5-23

Agricultural land surrogate

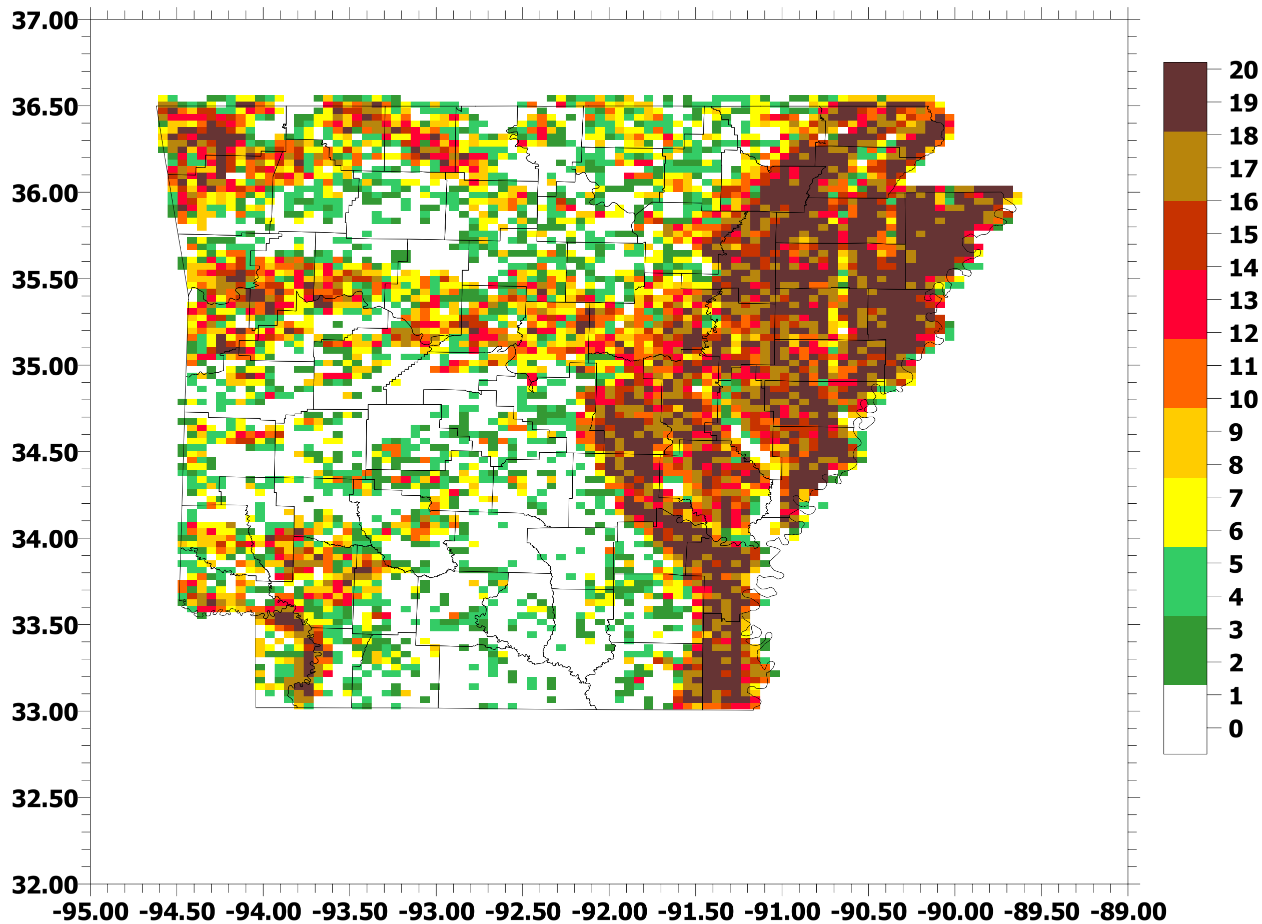


Figure 5-24

Industrial/Commercial land surrogate

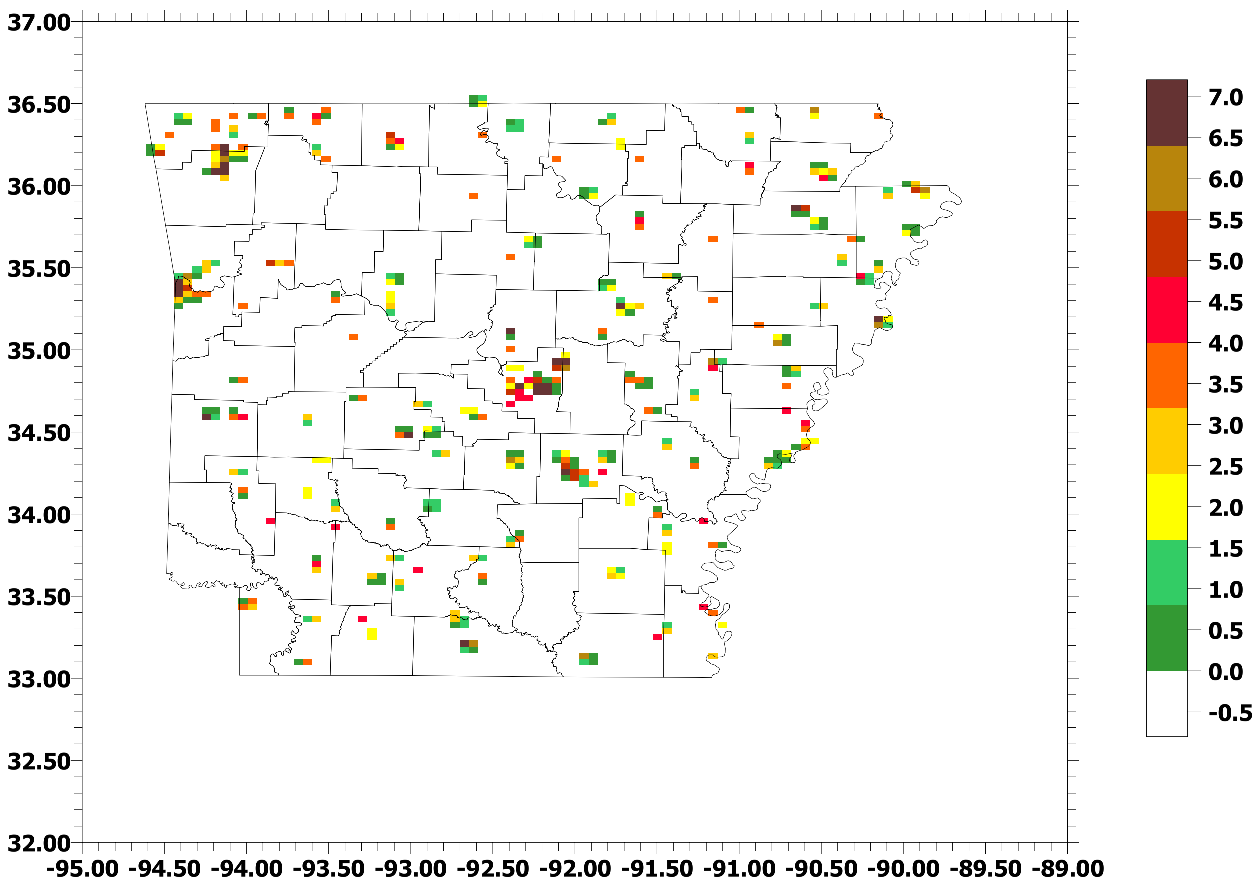


Figure 5-25.

Arkansas Area Sources Summer Weekday VOC Emissions (tpd)

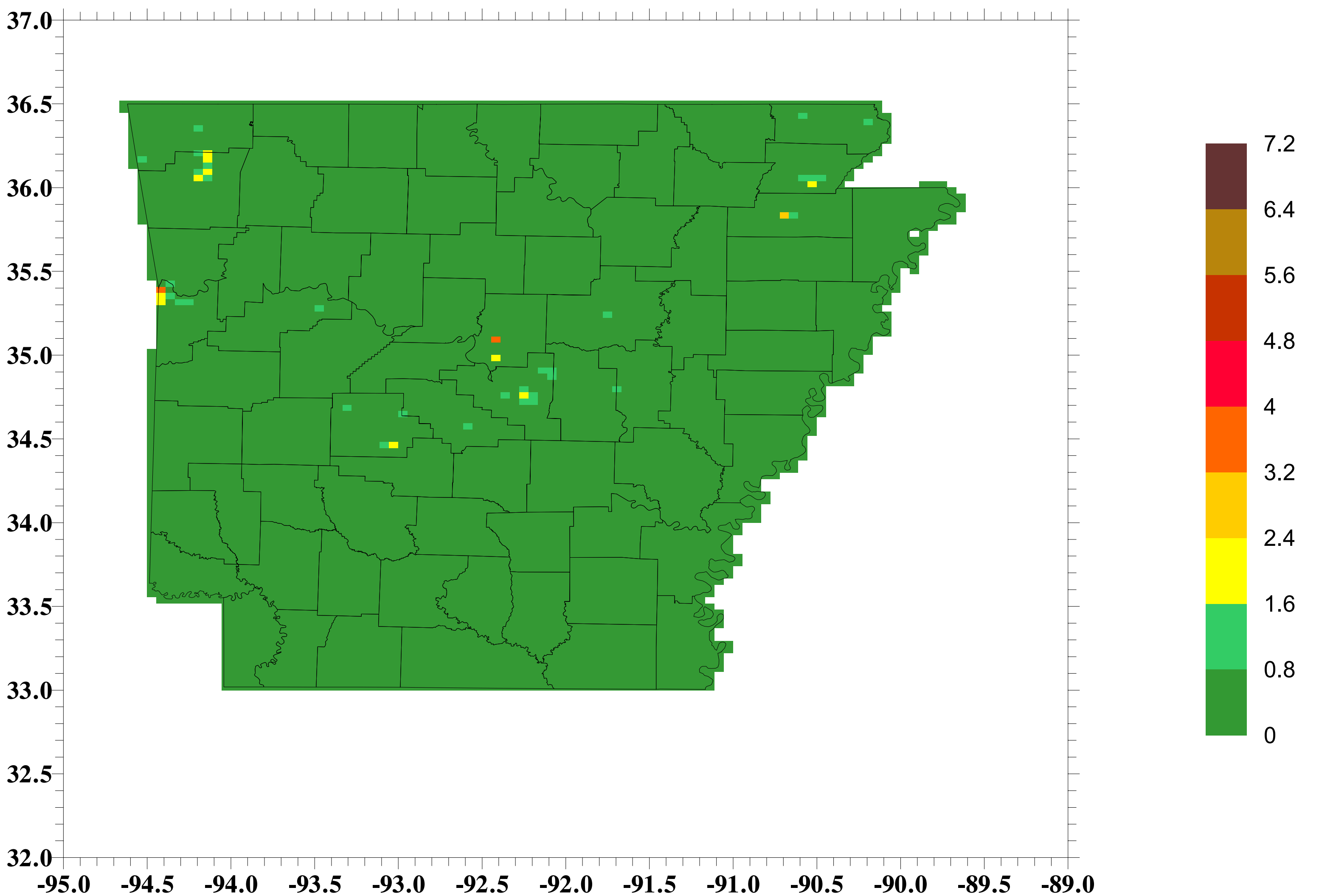


Figure 5-26.

Arkansas Area Sources Summer Weekday NOx Emissions (tpd)

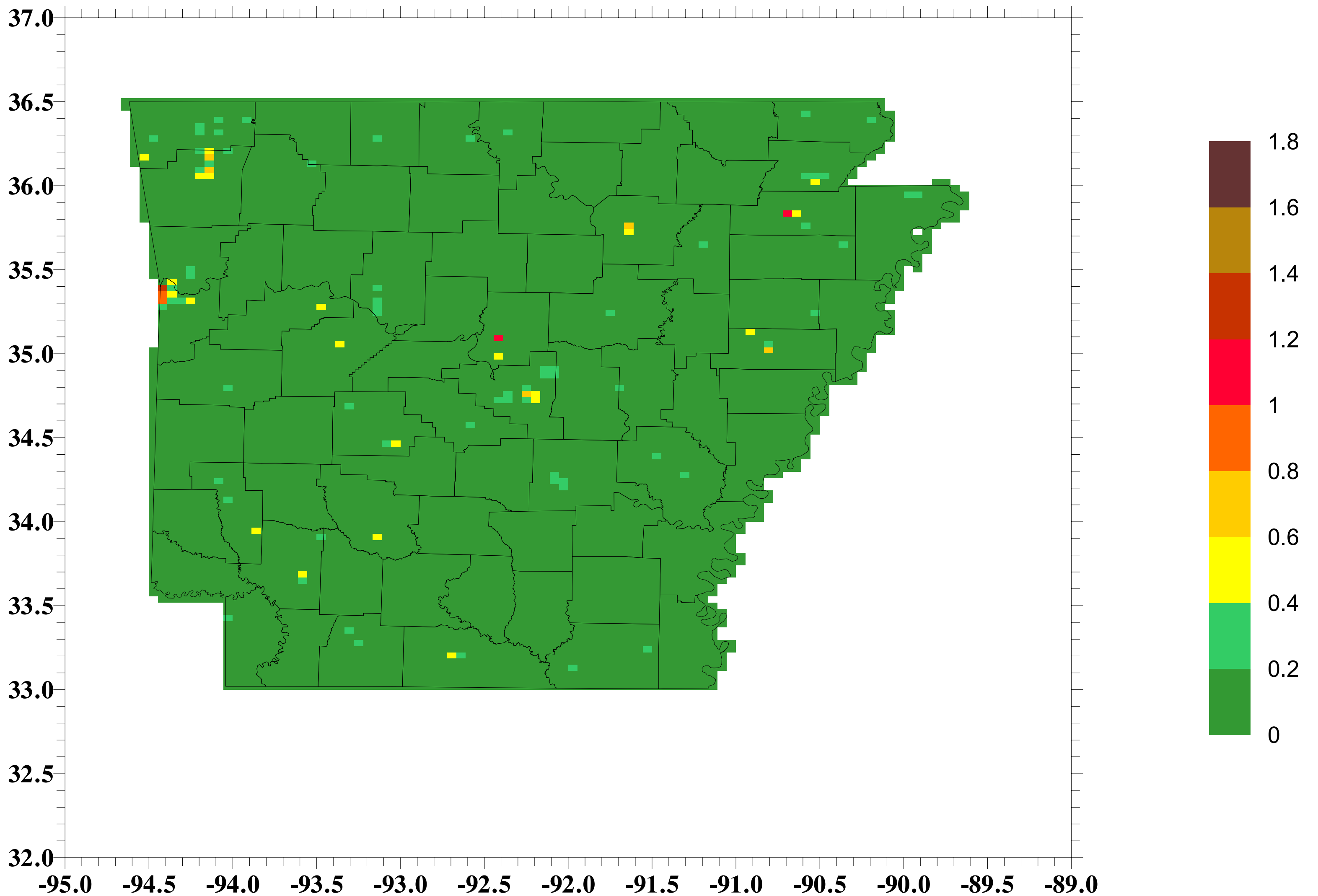


Figure 5-27.
Arkansas Area Sources Summer Weekday CO Emissions (tpd)

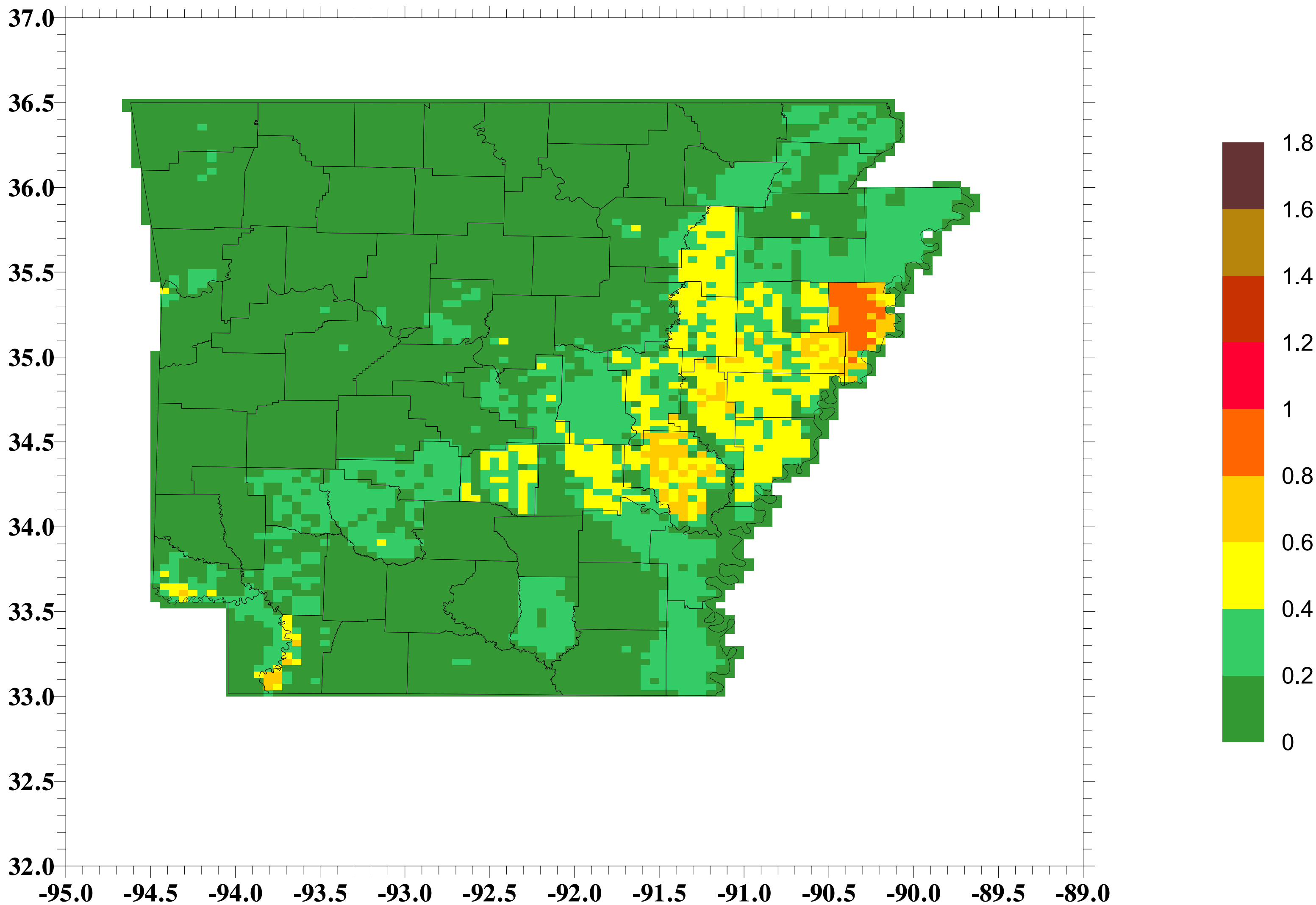


Figure 5-28.

Arkansas Area Sources Summer Weekday PM10 Emissions (tpd)

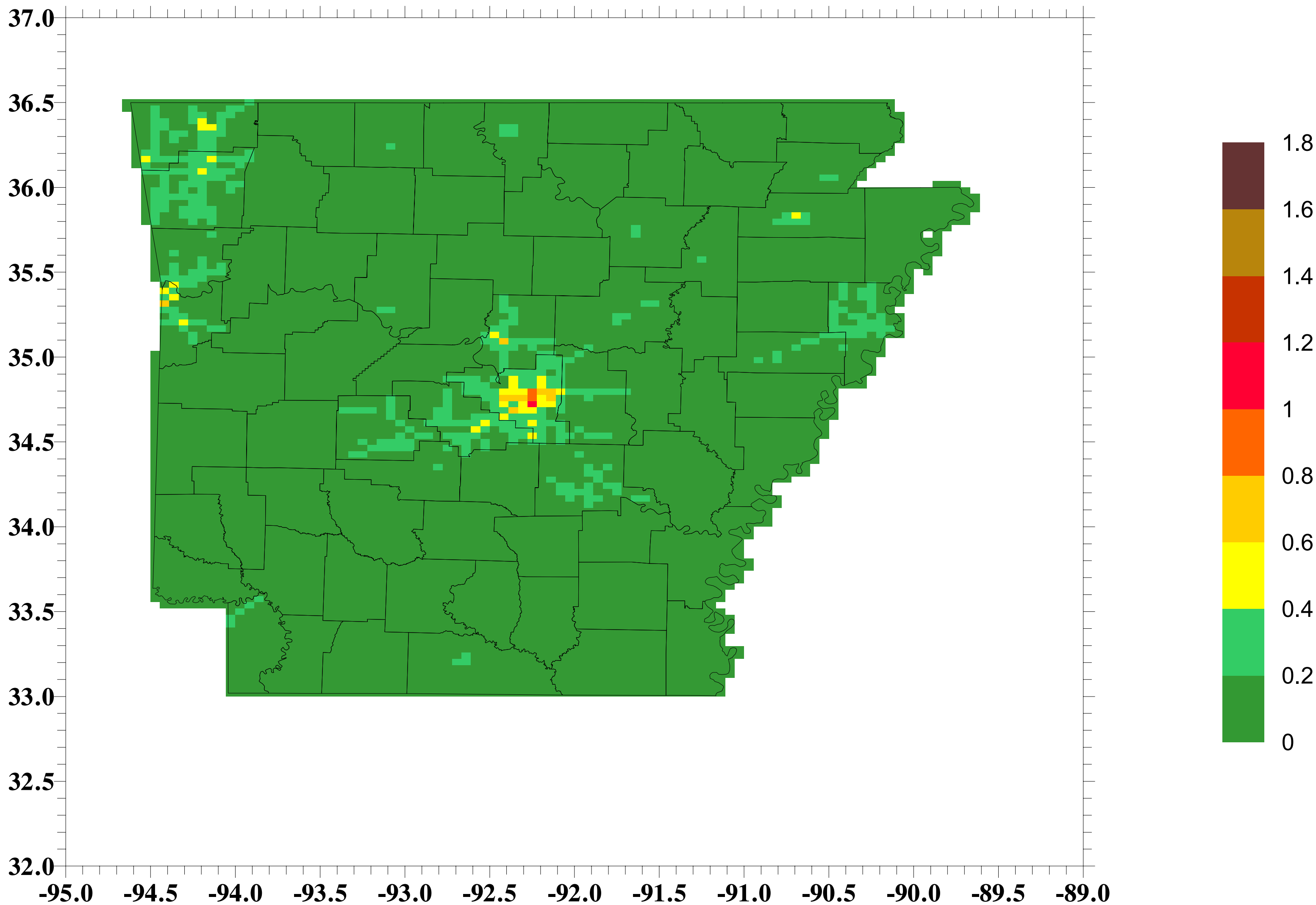


Figure 5-29.
Arkansas Area Sources Summer Weekday PM2.5 Emissions (tpd)

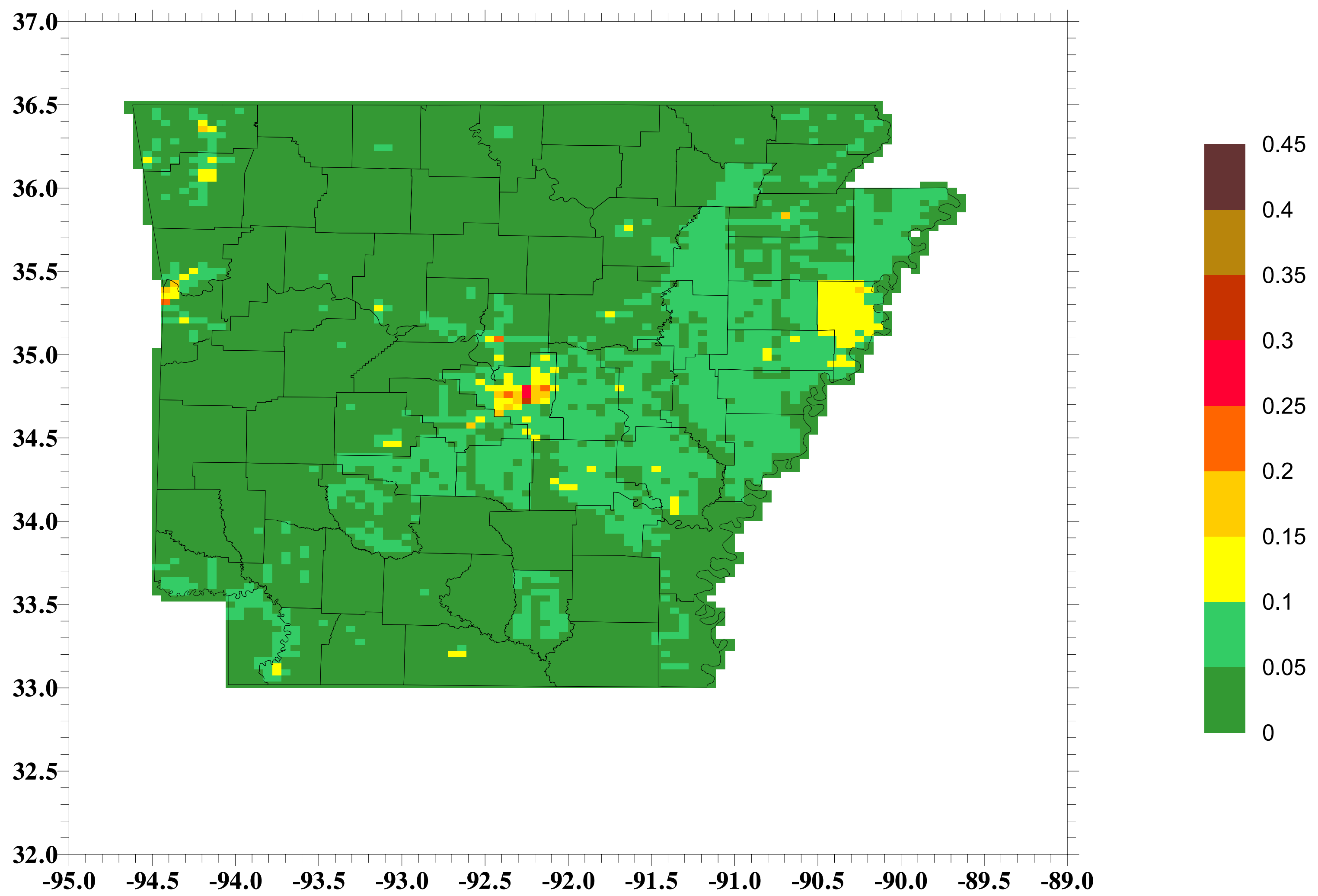


Figure 5-30.

Arkansas Area Sources Summer Weekday SOx Emissions (tpd)

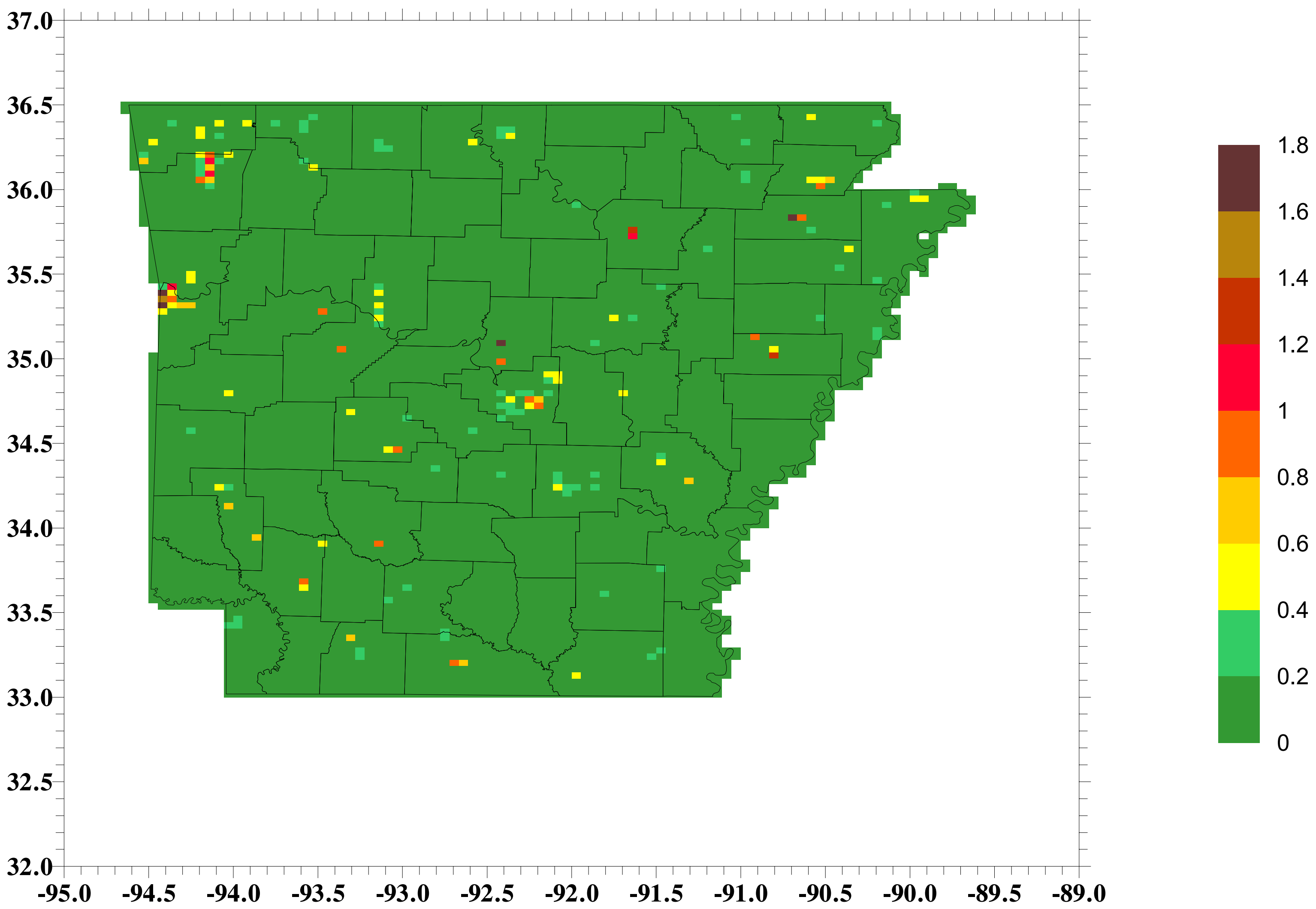


Figure 5-31.
Arkansas Area Sources Summer Weekday NH3 Emissions (tpd)

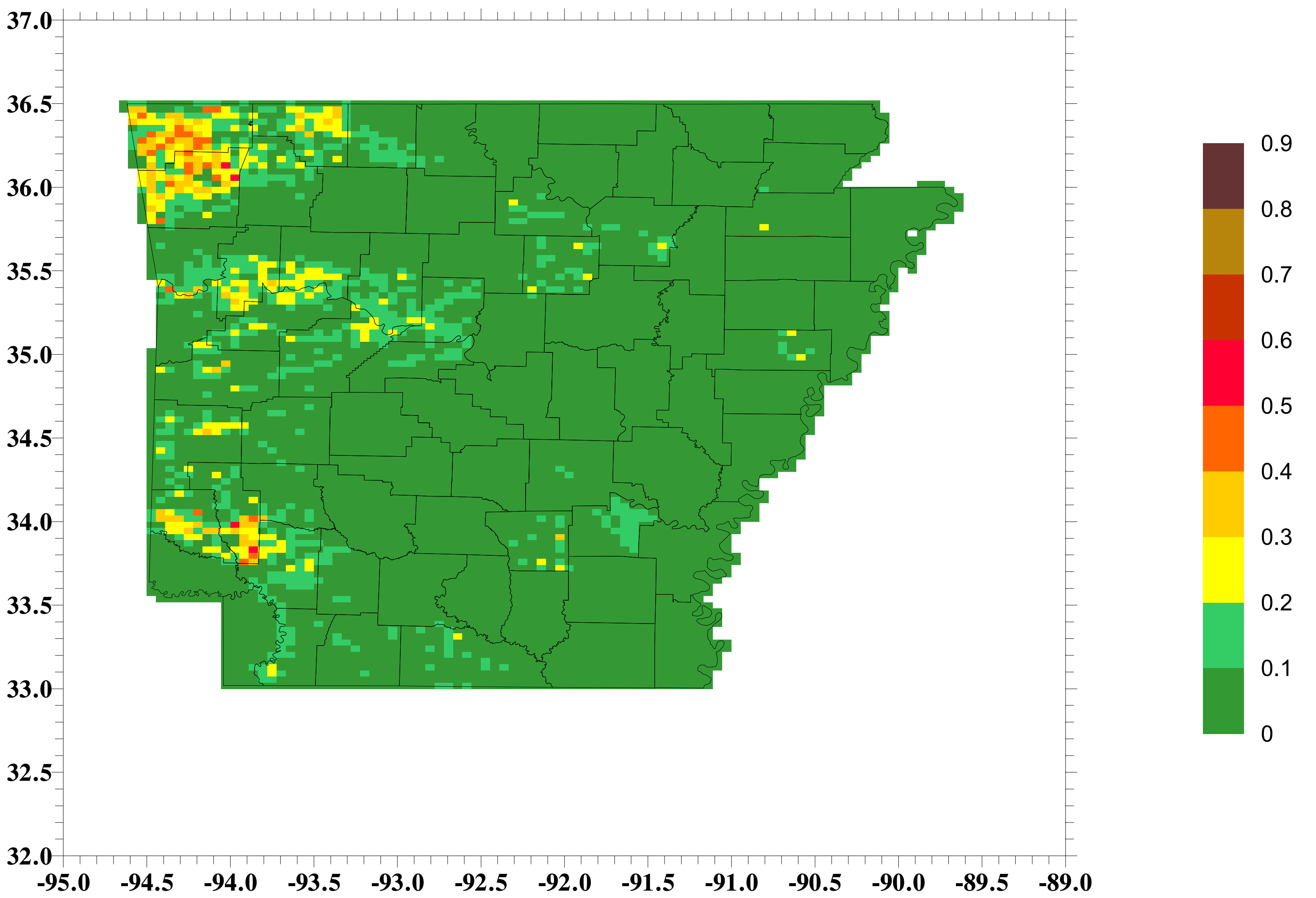


Figure 32.
Arkansas Off-road Sources Summer Weekday VOC Emissions (tpd)

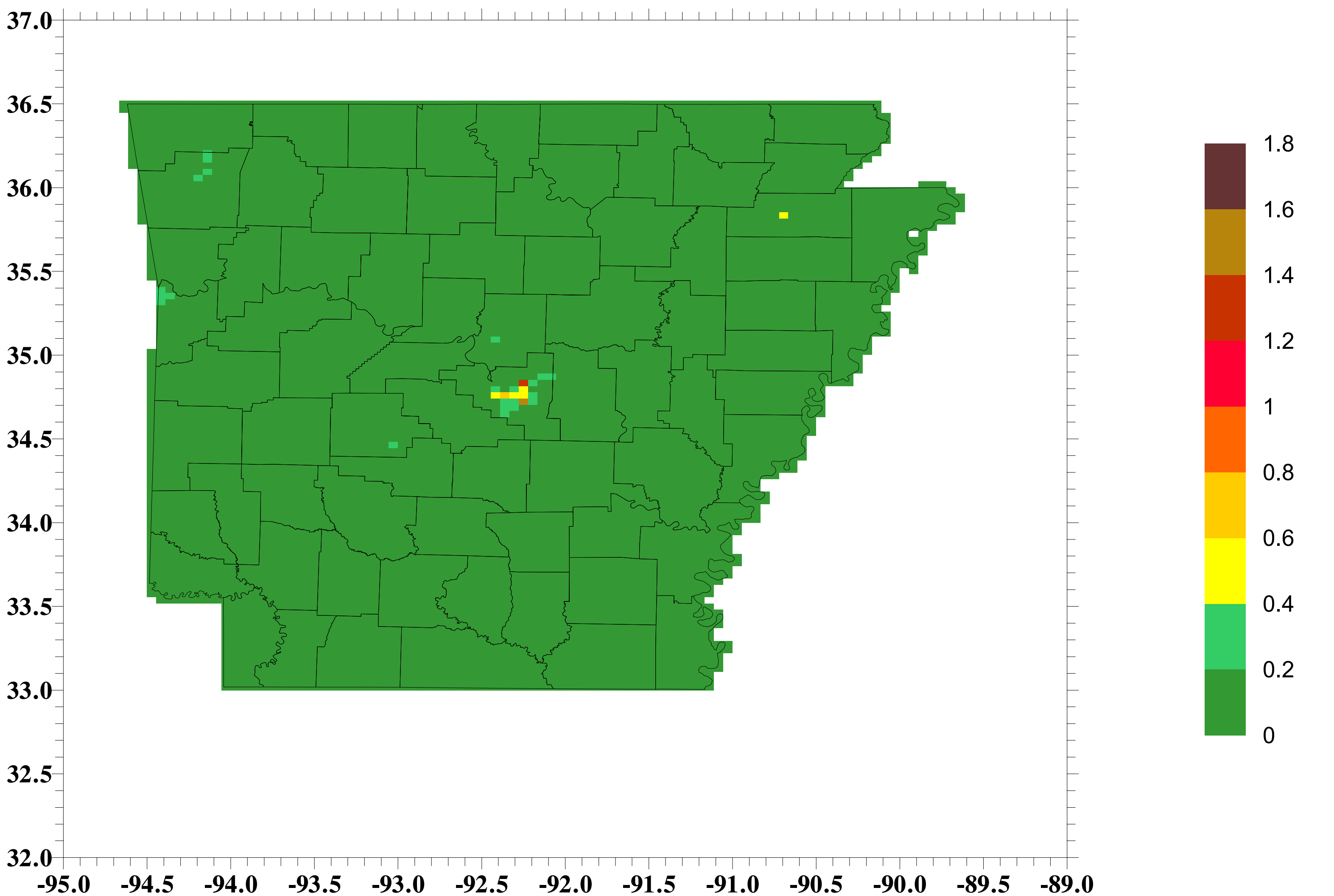


Figure 5-33.
Arkansas Off-road Sources Summer Weekday NOx Emissions (tpd)

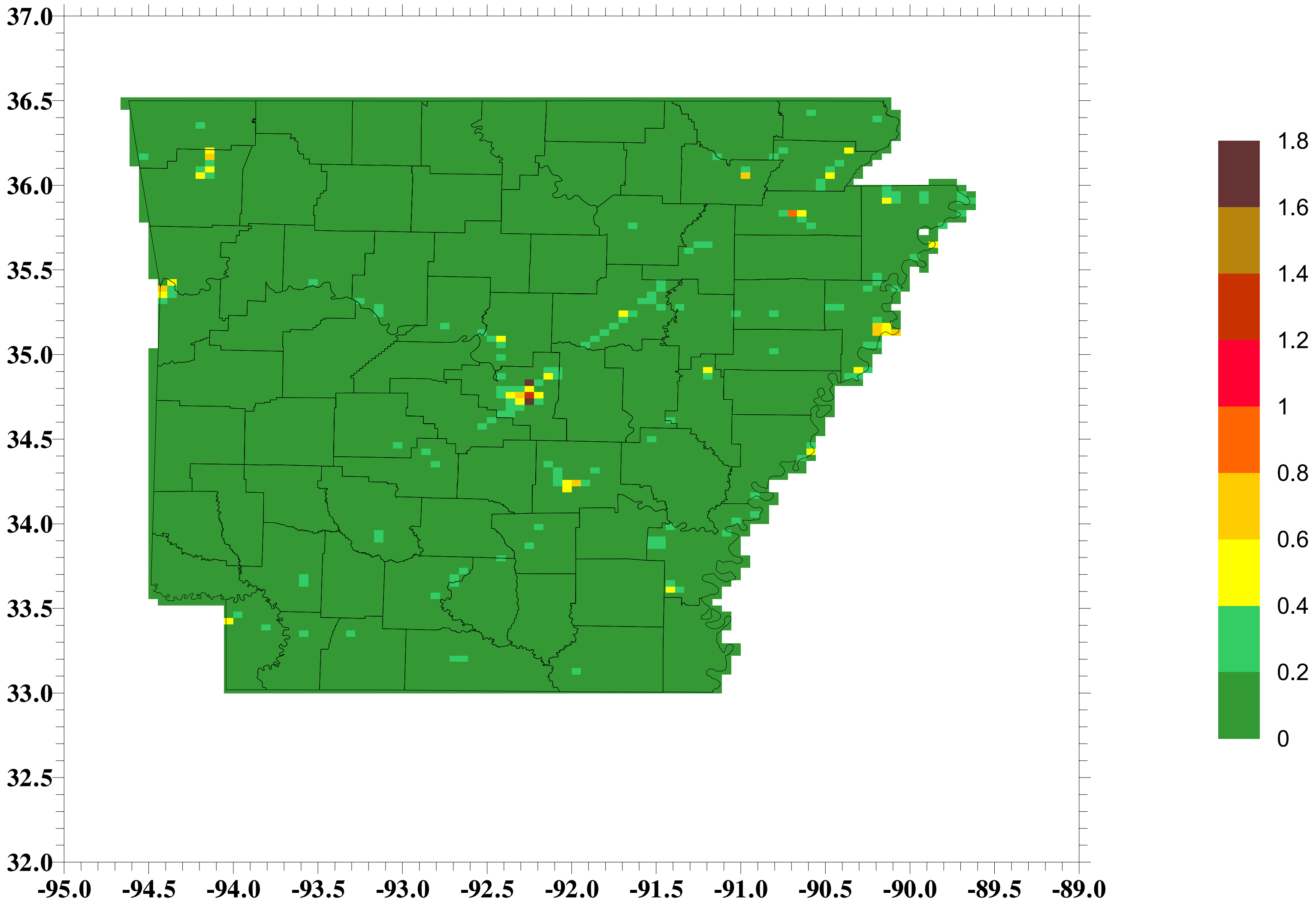


Figure 5-34.
Arkansas Off-road Sources Summer Weekday CO Emissions (tpd)

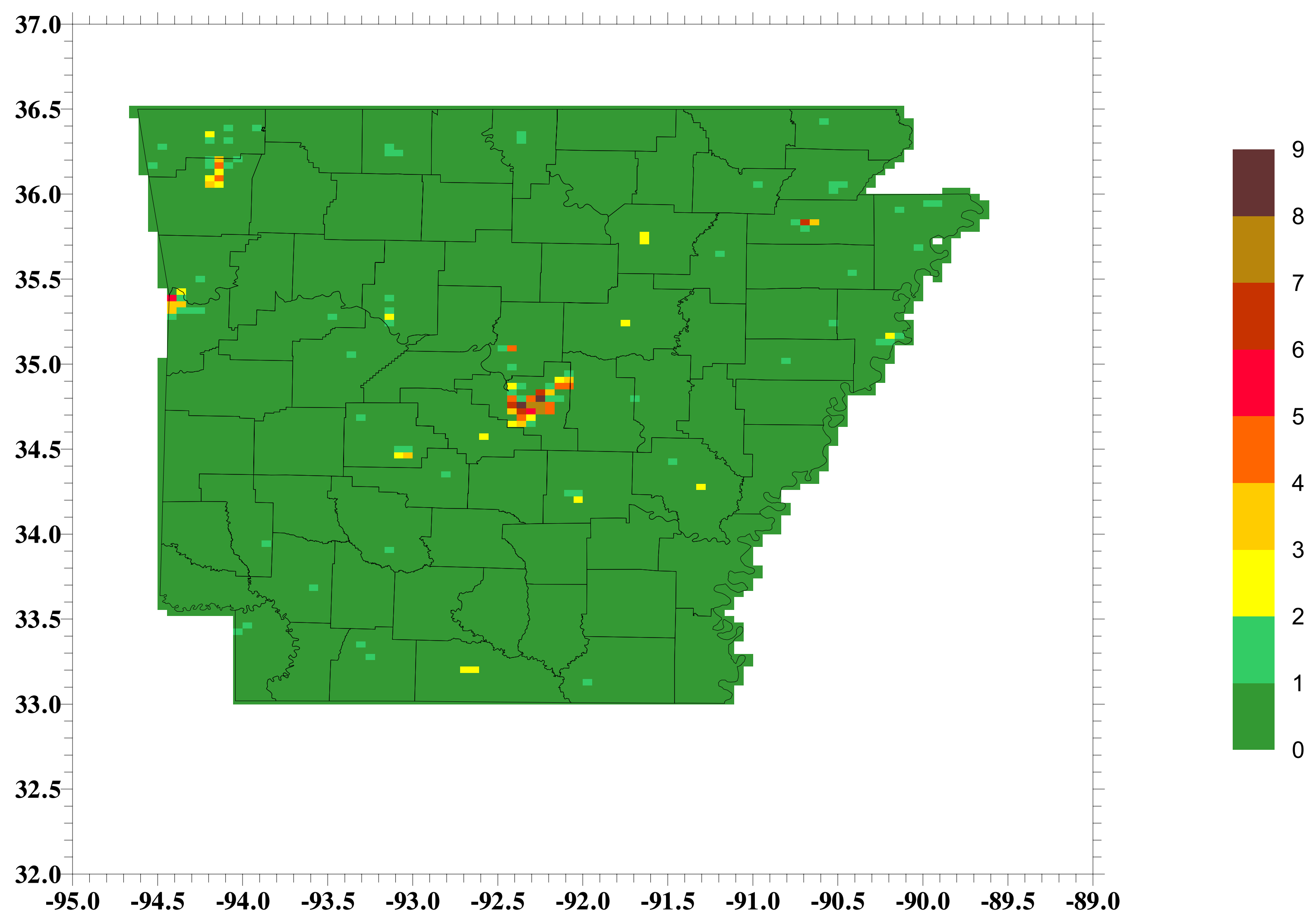


Figure 5-35.
Arkansas Off-road Sources Summer Weekday PM10 Emissions (tpd)

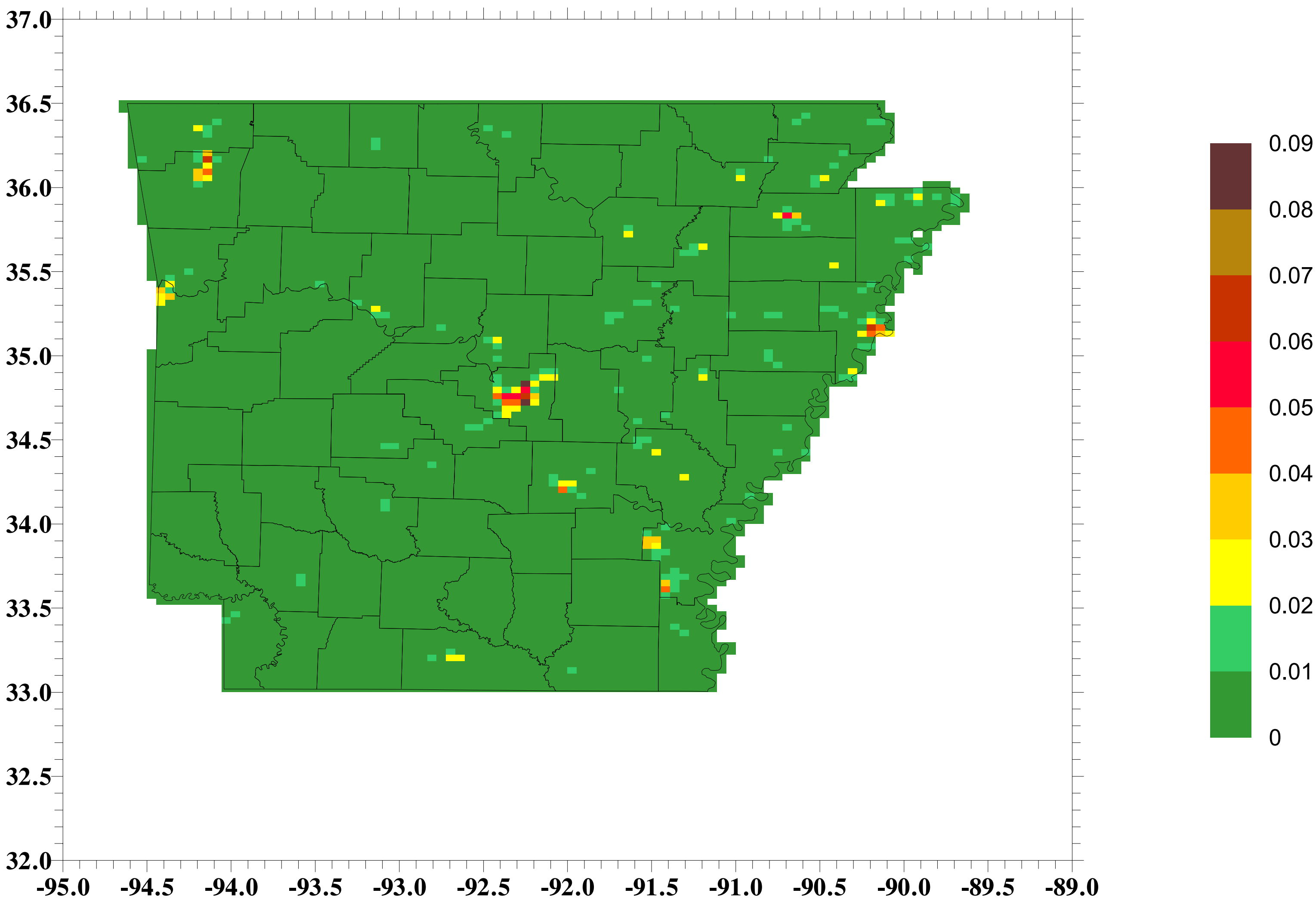


Figure 5-36.
Arkansas Off-road Sources Summer Weekday PM2.5 Emissions (tpd)

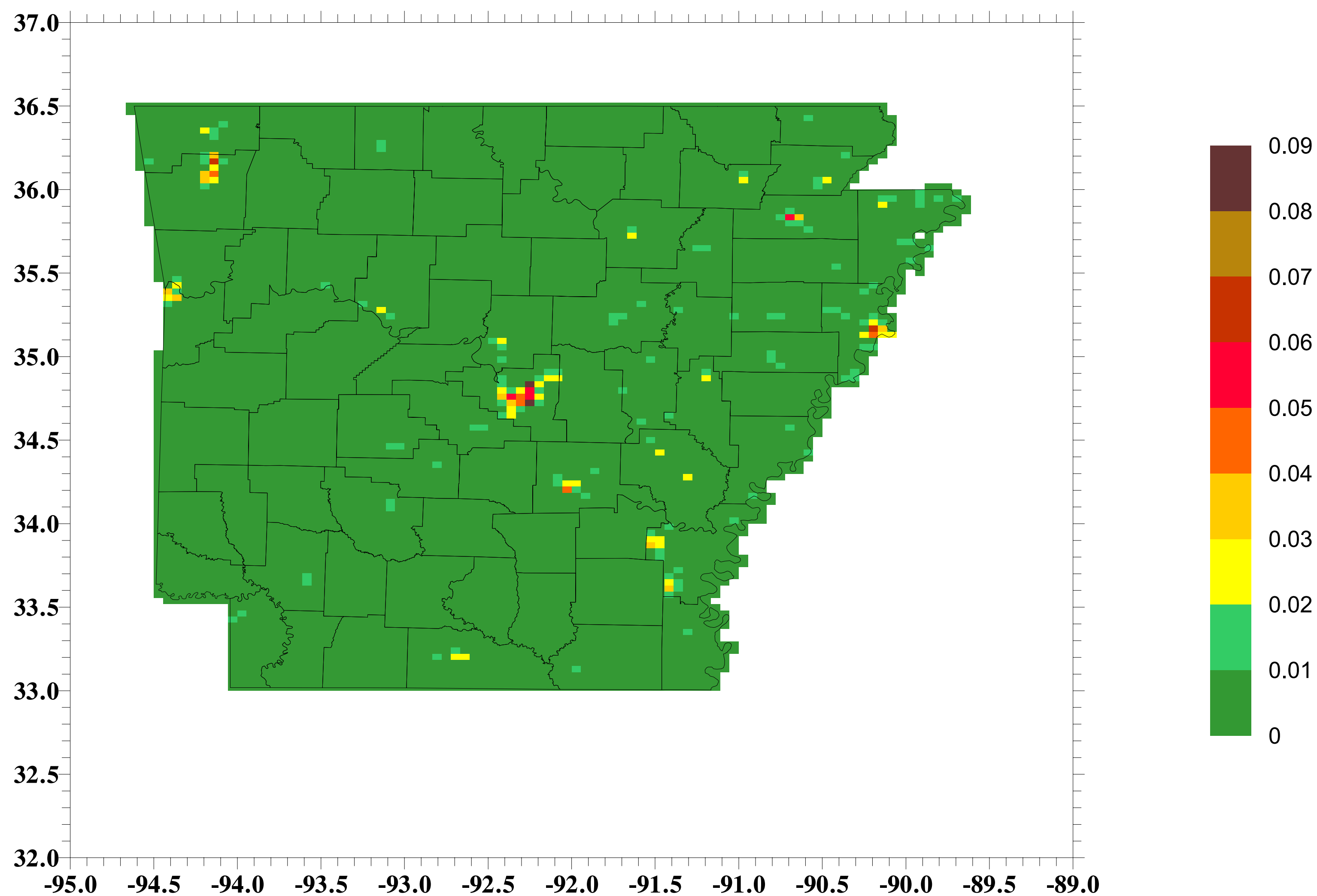


Figure 5-37.

Arkansas Off-road Sources Summer Weekday SOx Emissions (tpd)

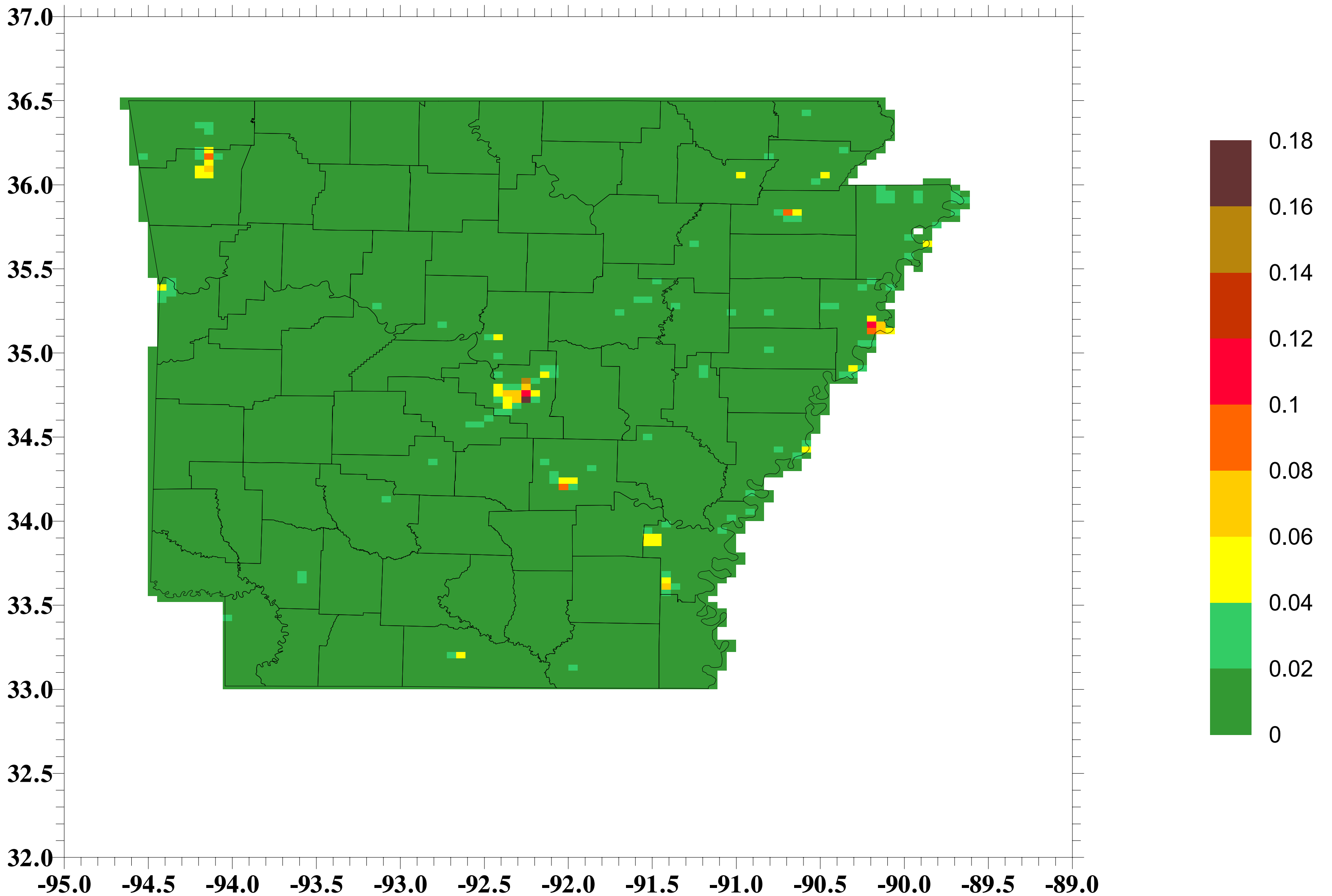


Figure 5-38

Arkansas Off-road Sources Summer Weekday NH3 Emissions (tpd)

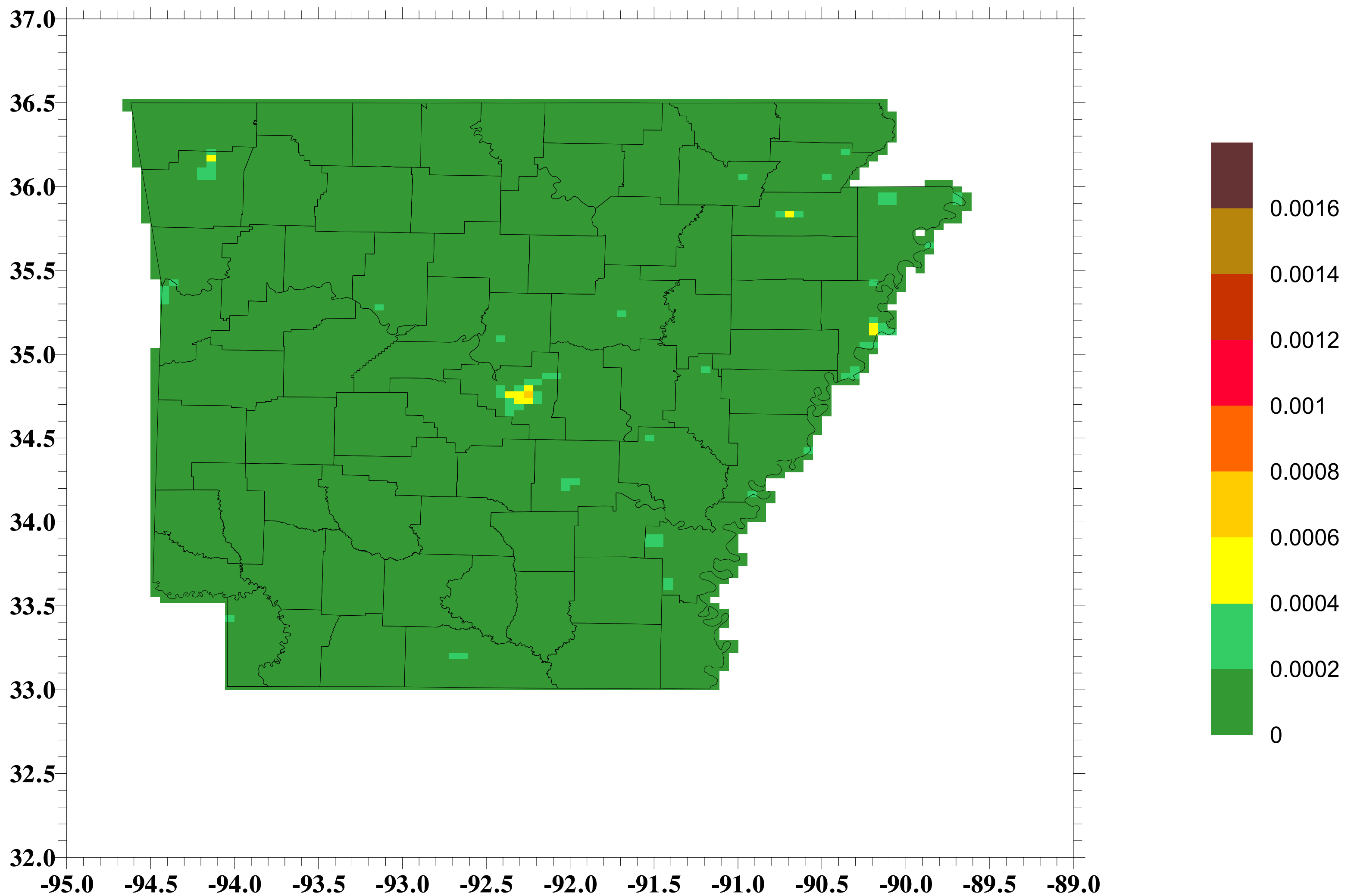


Figure 5-39.
Arkansas On-road Sources Summer Weekday VOC Emissions (tpd)

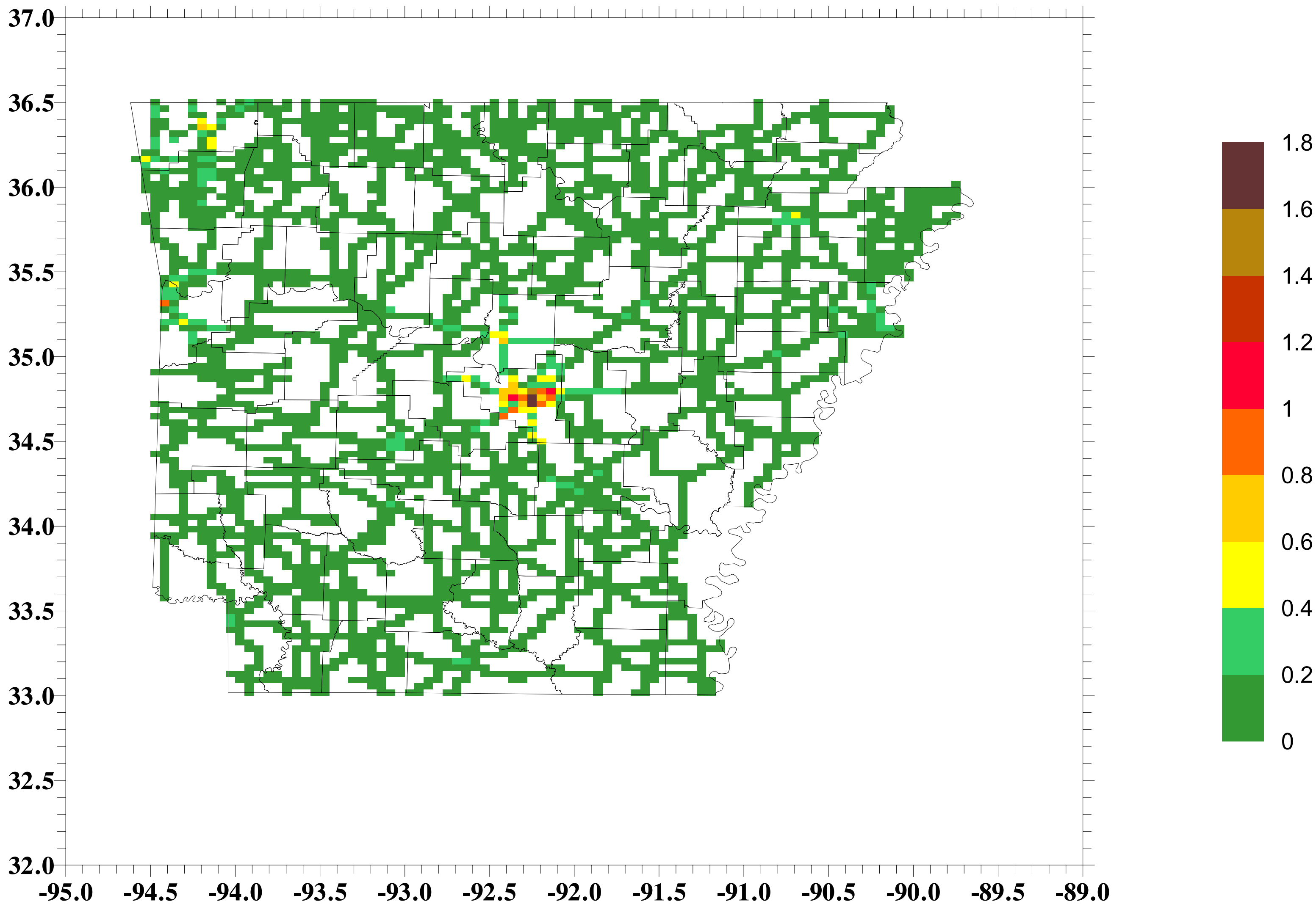


Figure 5-40.
Arkansas On-road Sources Summer Weekday NOx Emissions (tpd)

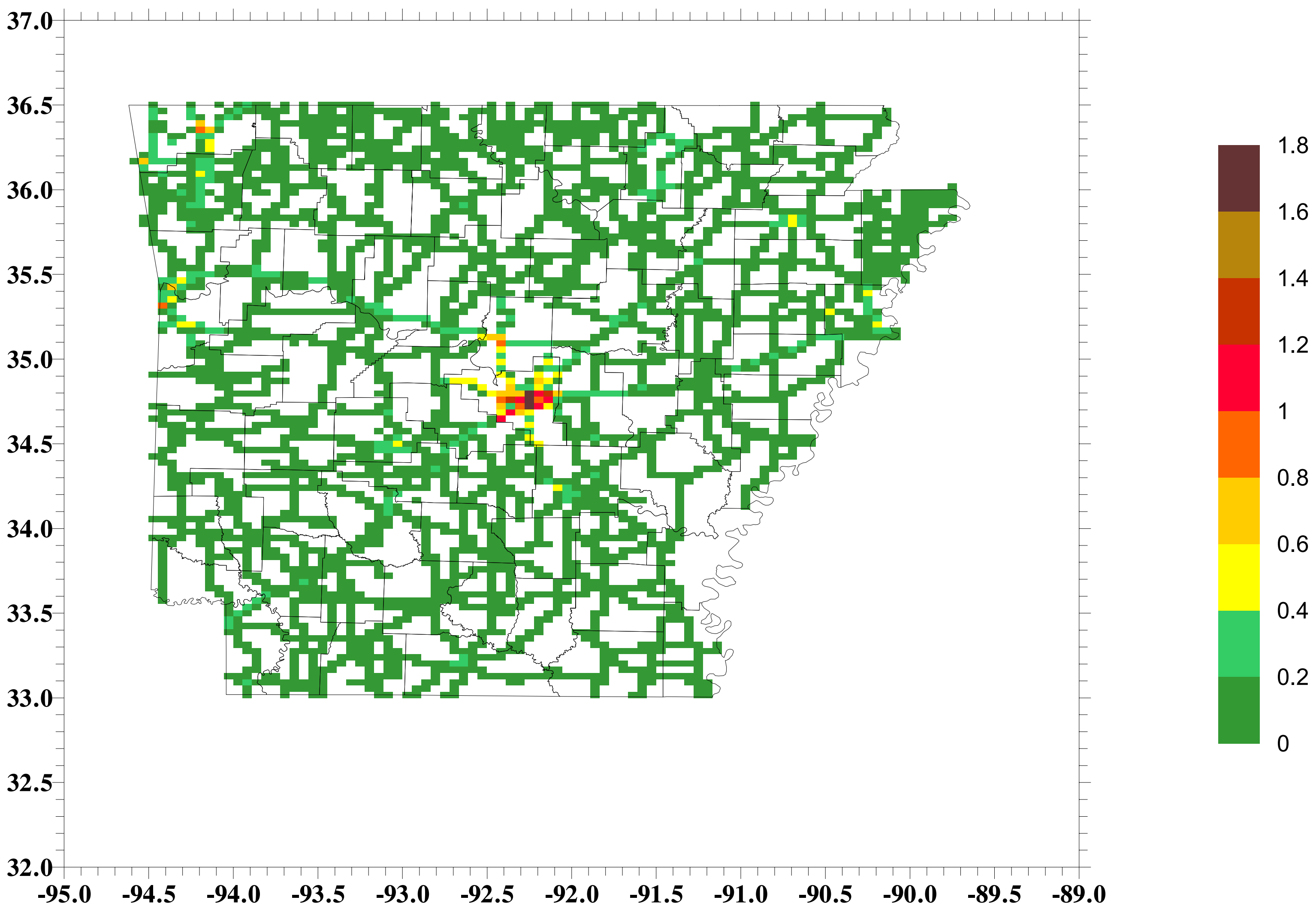


Figure 5-41.

Arkansas On-road Sources Summer Weekday CO Emissions (tpd)

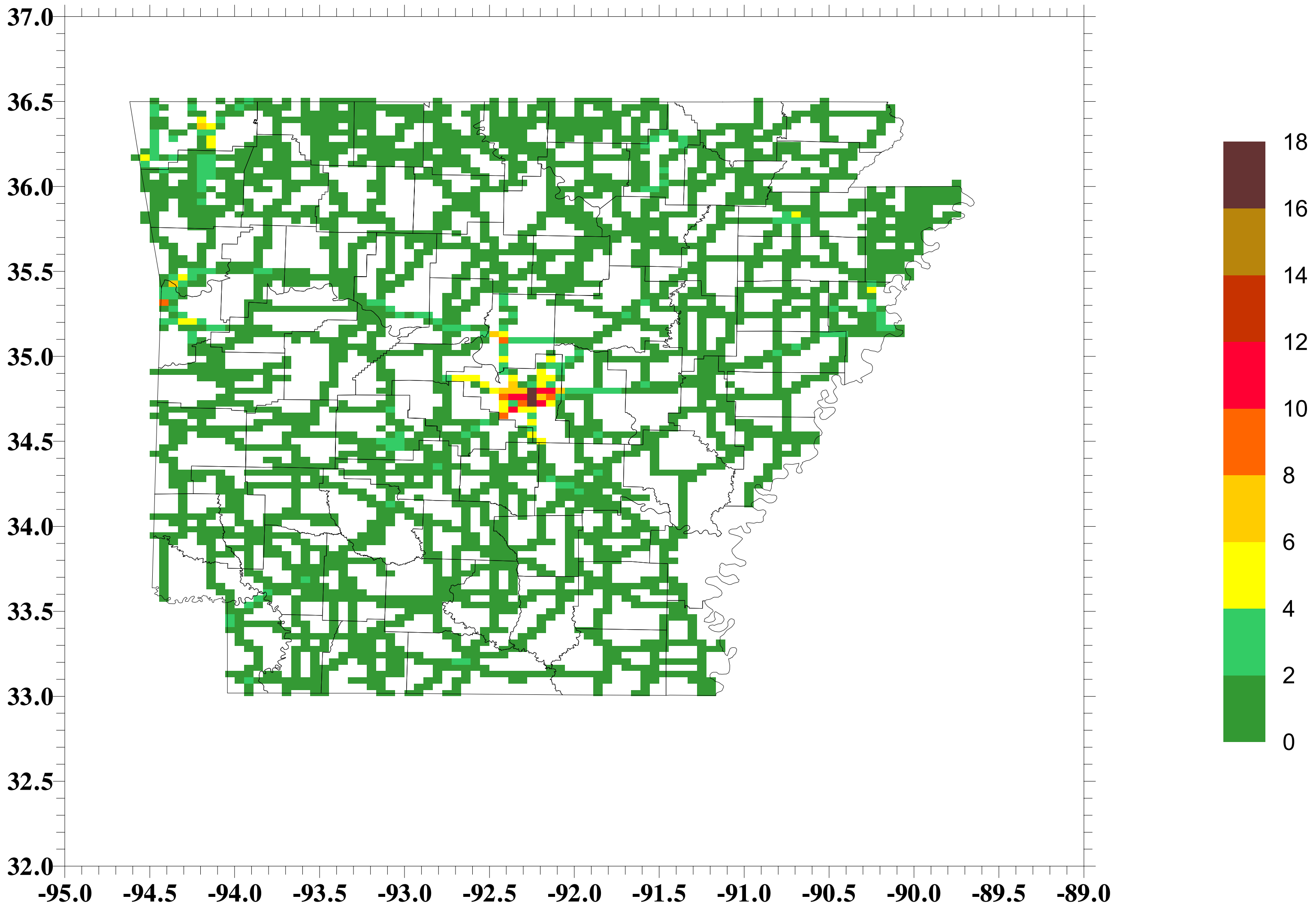


Figure 5-42.
Arkansas On-road Sources Summer Weekday PM10 Emissions (tpd)

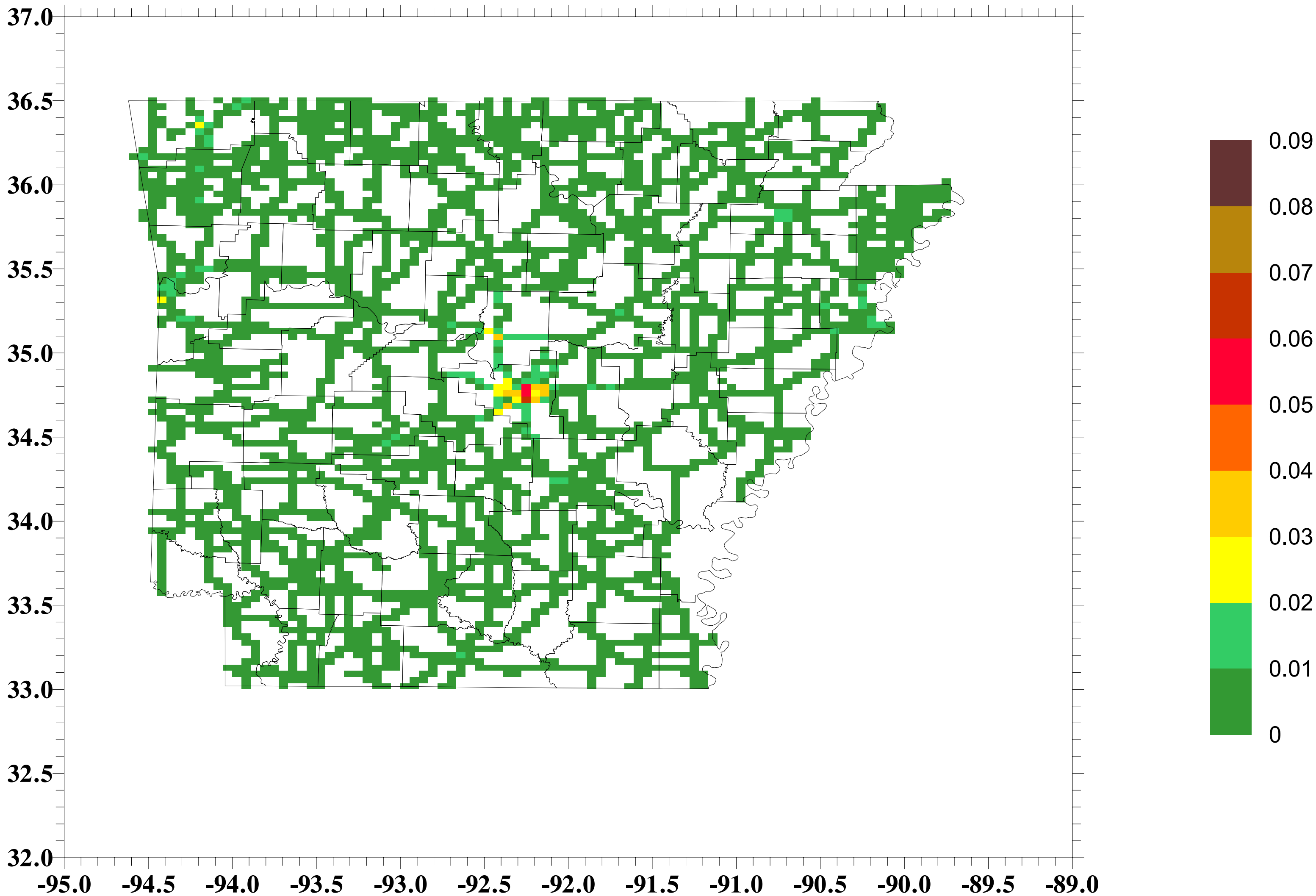


Figure 5-43.
Arkansas On-road Sources Summer Weekday PM2.5 Emissions (tpd)

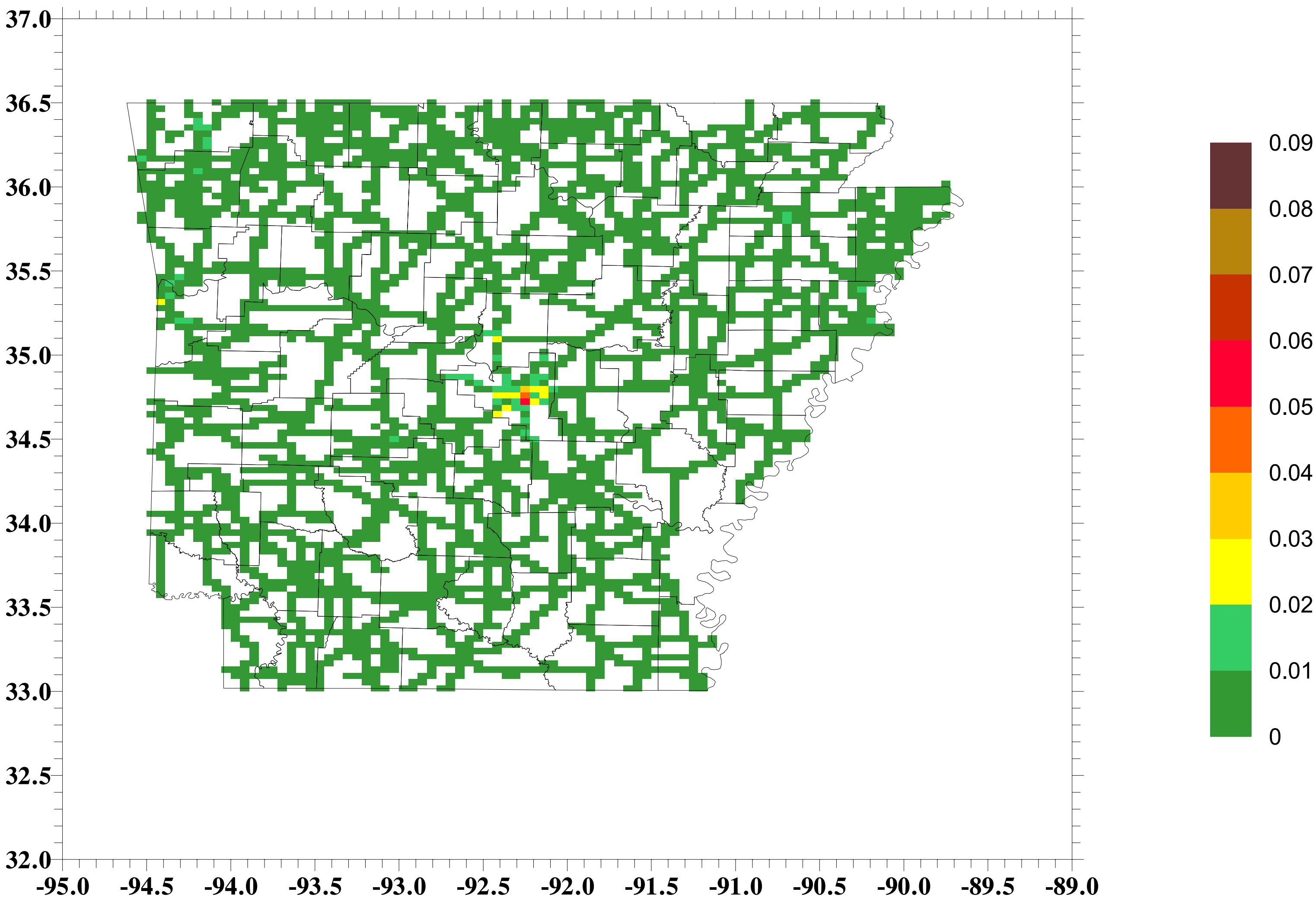


Figure 5-44.
Arkansas On-road Sources Summer Weekday SOx Emissions (tpd)

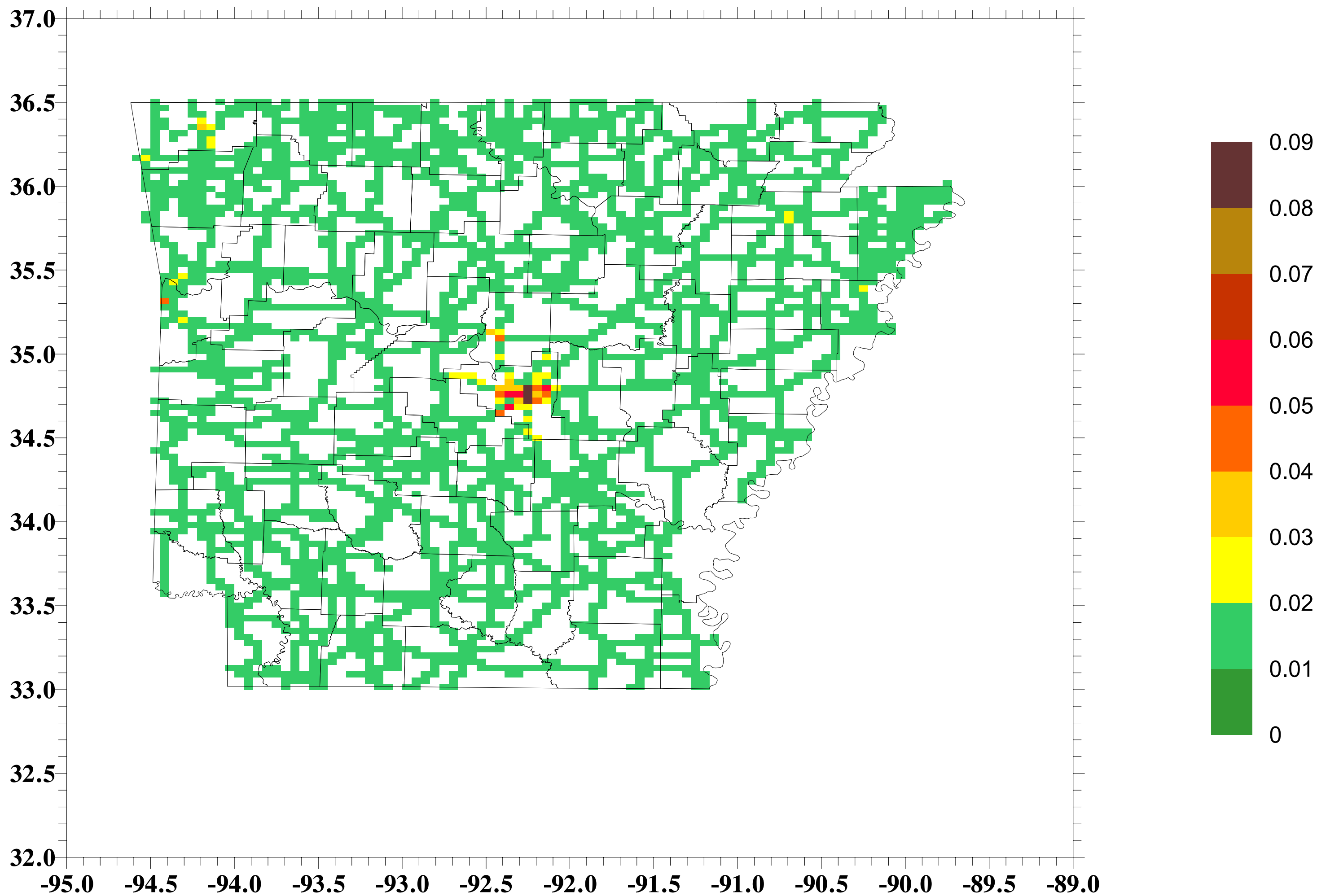


Figure 5-45.

Arkansas On-road Sources Summer Weekday NH3 Emissions (tpd)

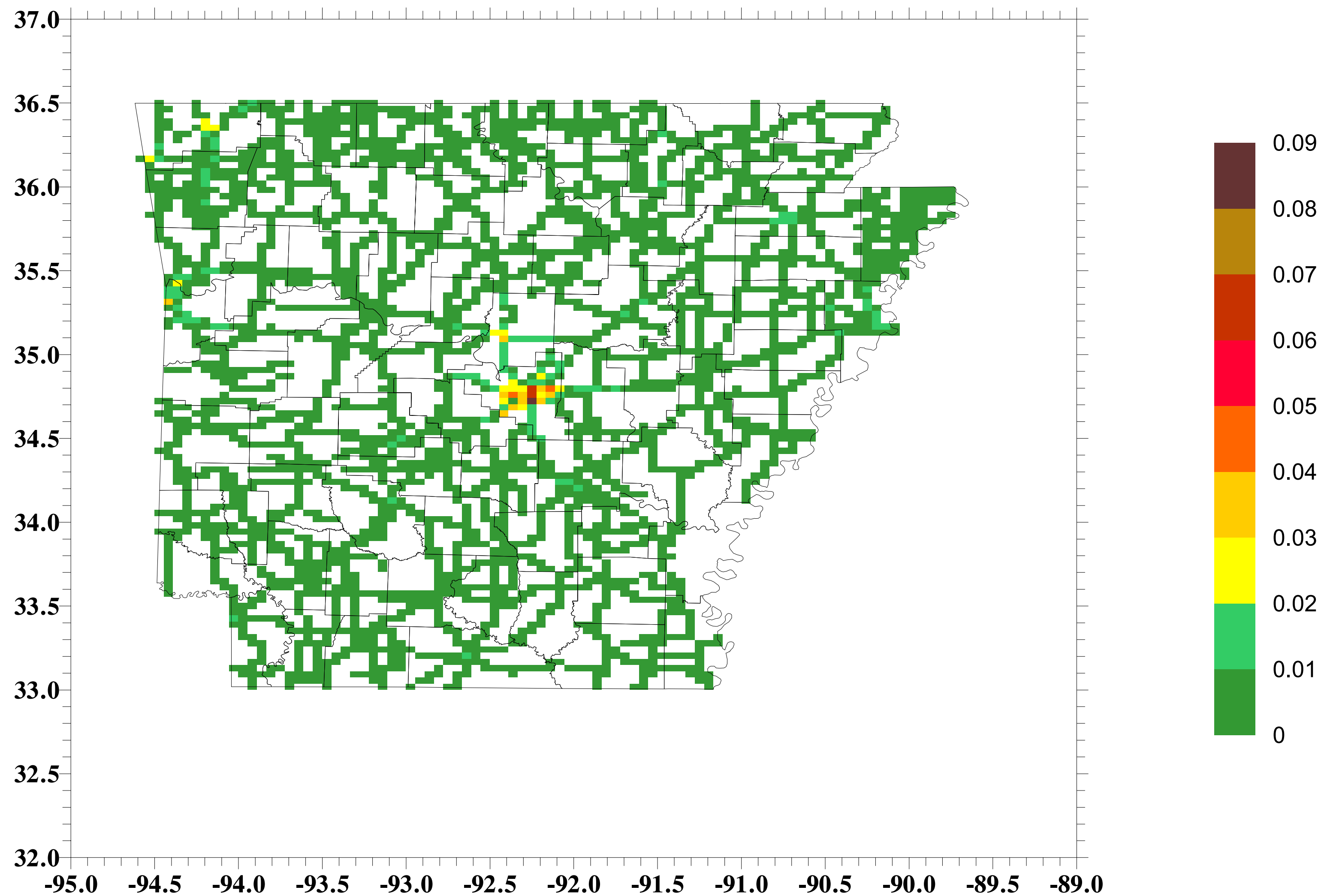


Figure 5-46.

Arkansas Area Sources Winter Weekday VOC Emissions (tpd)

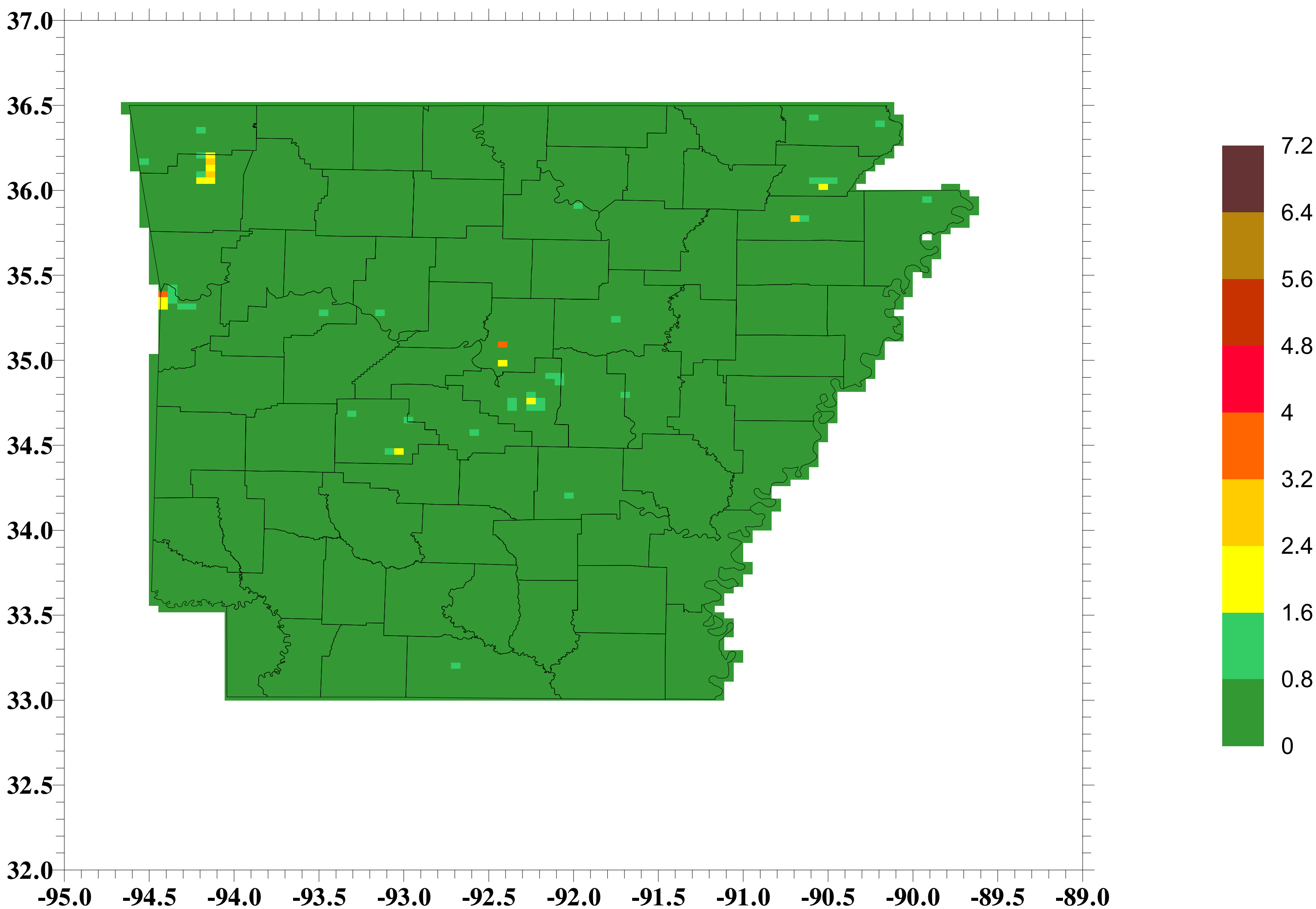


Figure 5-47.
Arkansas Area Sources Winter Weekday NOx Emissions (tpd)

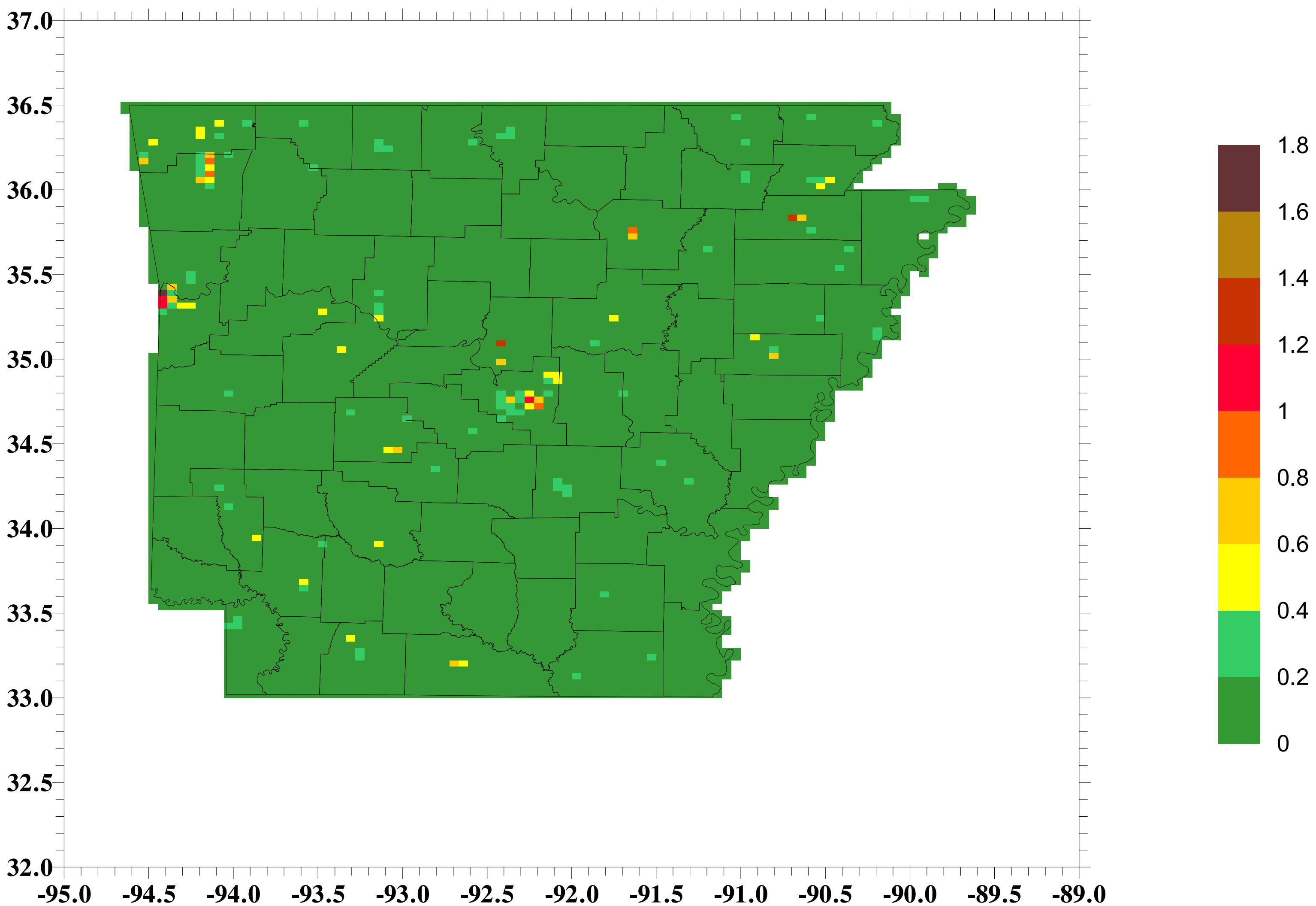


Figure 5-48.
Arkansas Area Sources Winter Weekday CO Emissions (tpd)

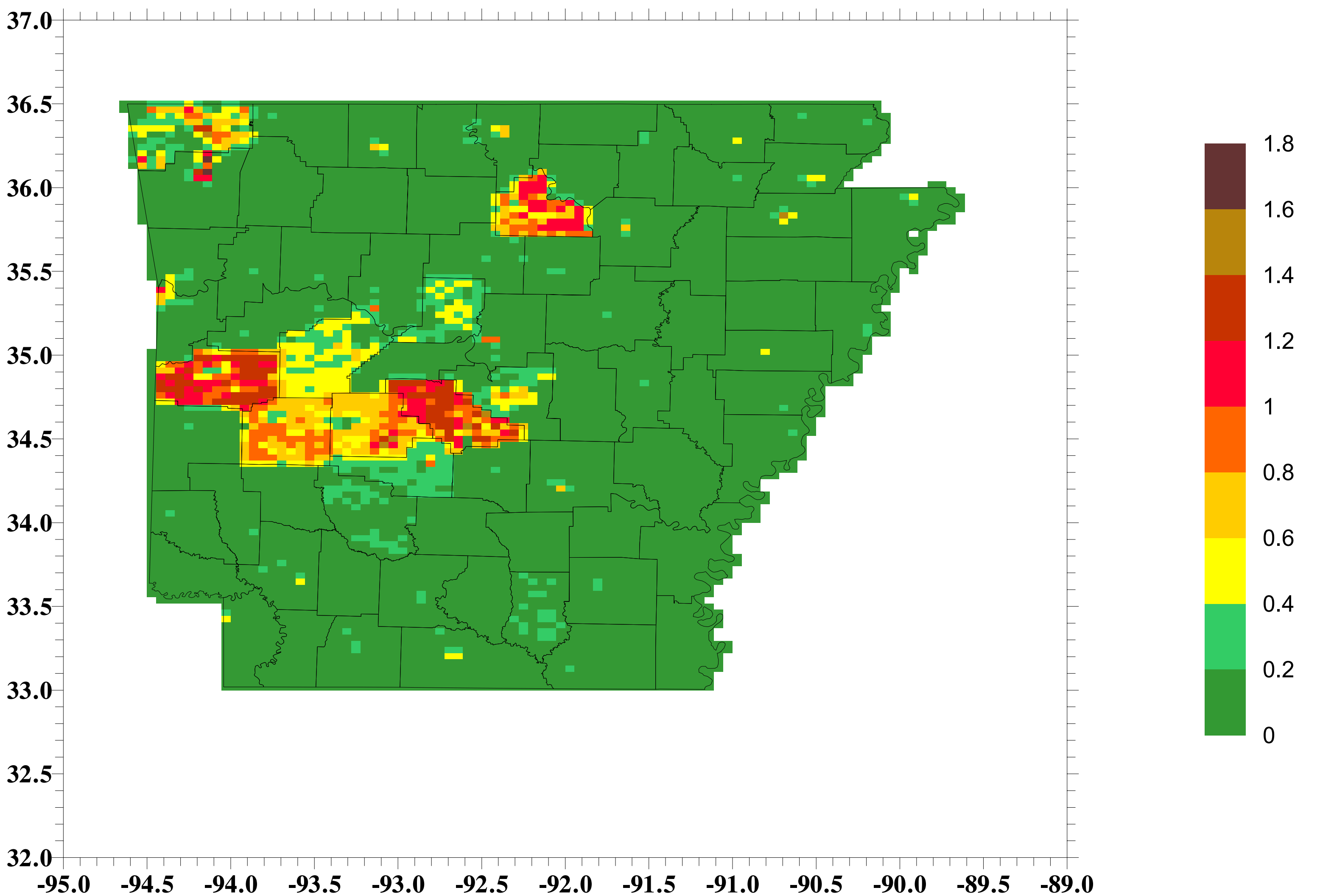


Figure 5-49.

Arkansas Area Sources Winter Weekday PM10 Emissions (tpd)

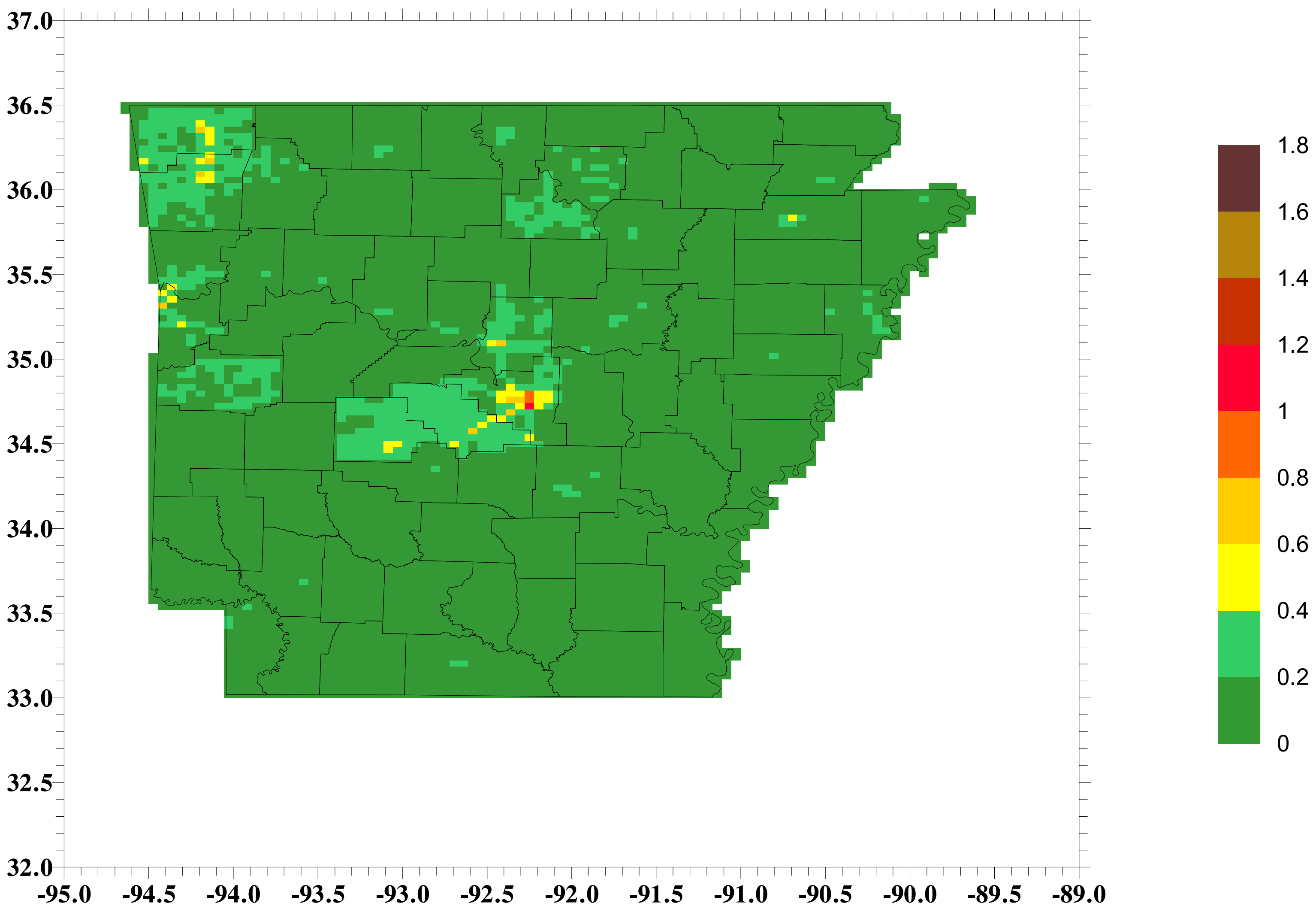


Figure 5-50.

Arkansas Area Sources Winter Weekday PM2.5 Emissions (tpd)

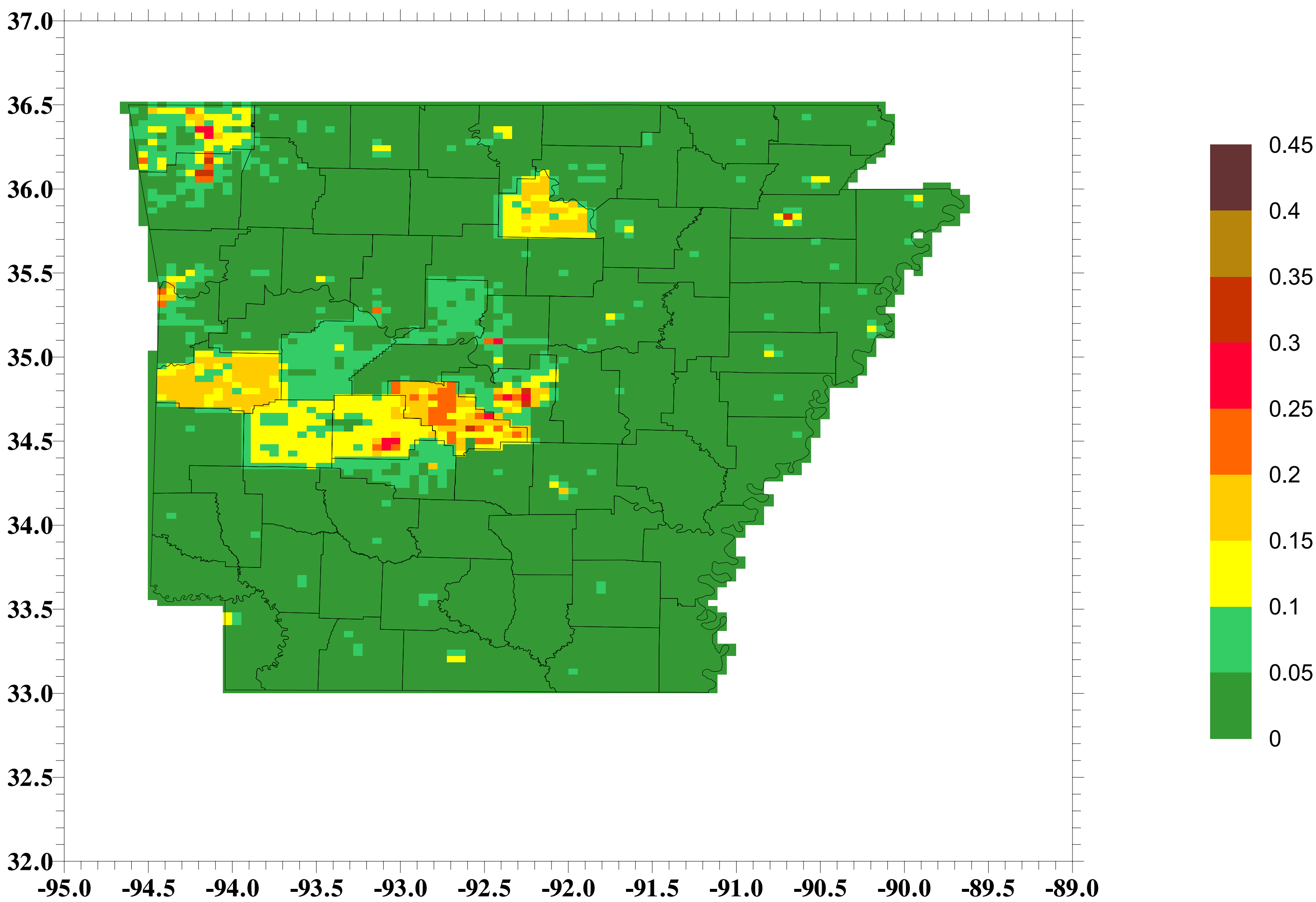


Figure 5-51.
Arkansas Area Sources Winter Weekday SOx Emissions (tpd)

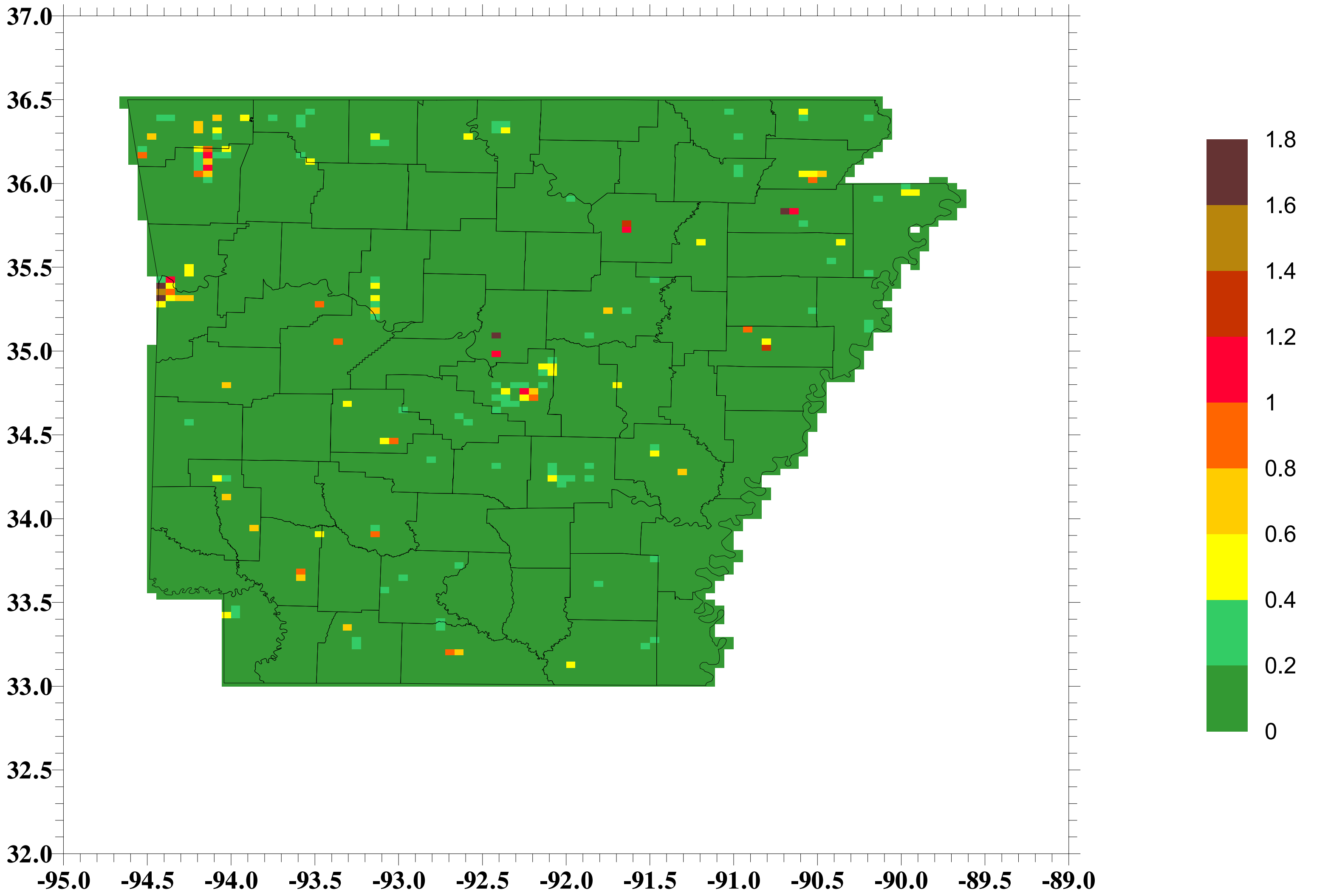


Figure 5-52.

Arkansas Area Sources Winter Weekday NH3 Emissions (tpd)

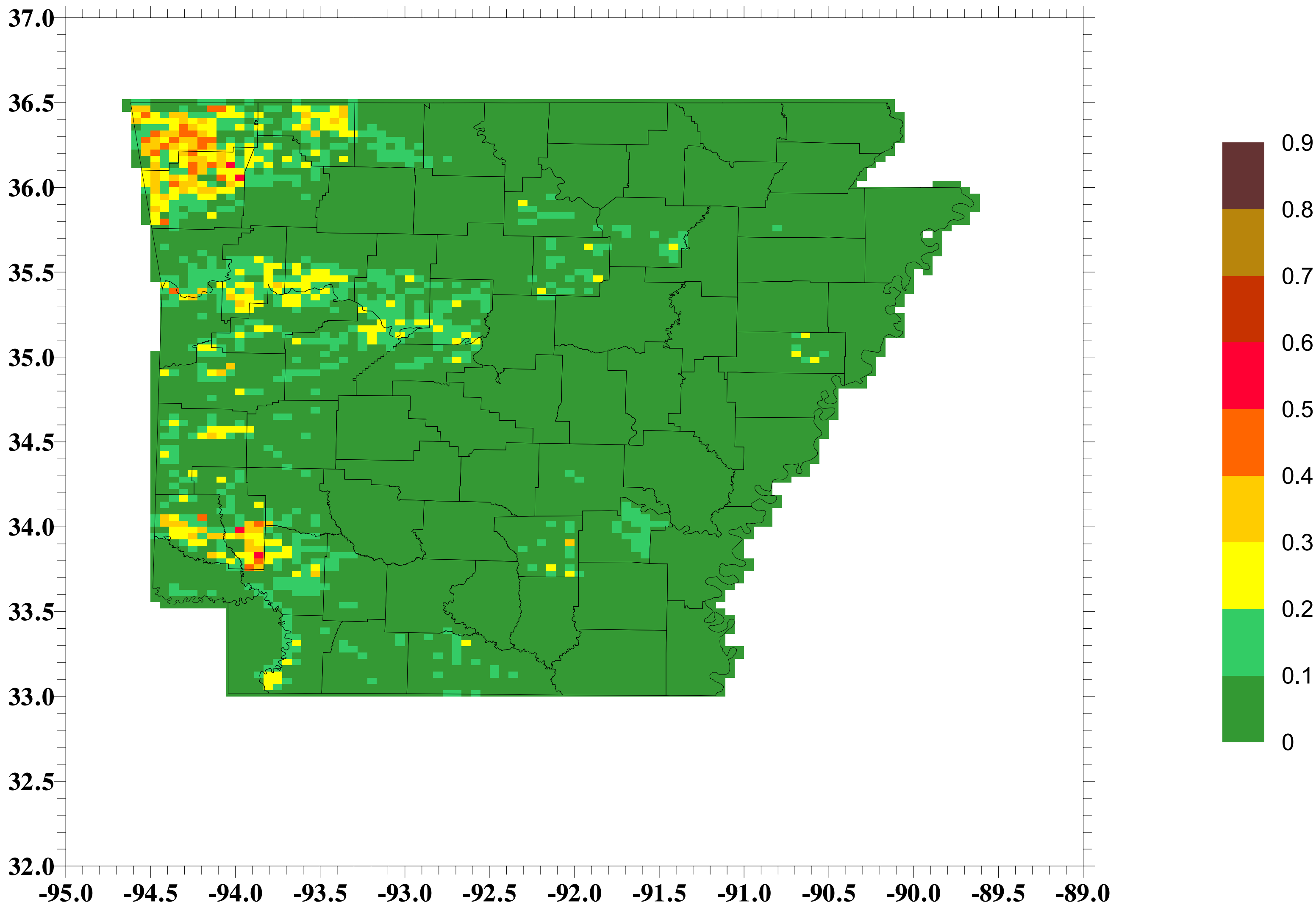


Figure 53.

Arkansas On-road Sources Winter Weekday VOC Emissions (tpd)

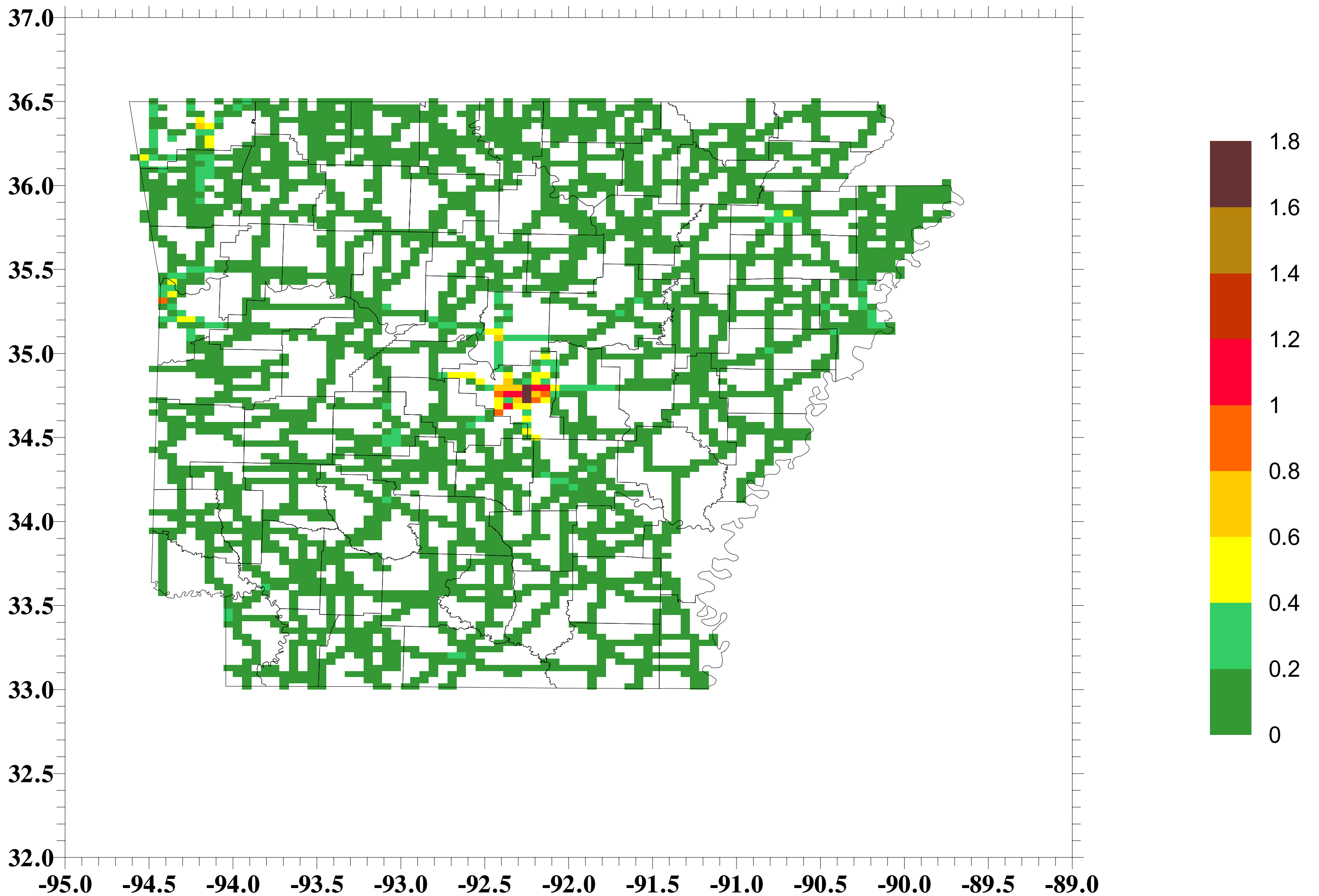


Figure 5-54.
Arkansas On-road Sources Winter Weekday NOx Emissions (tpd)

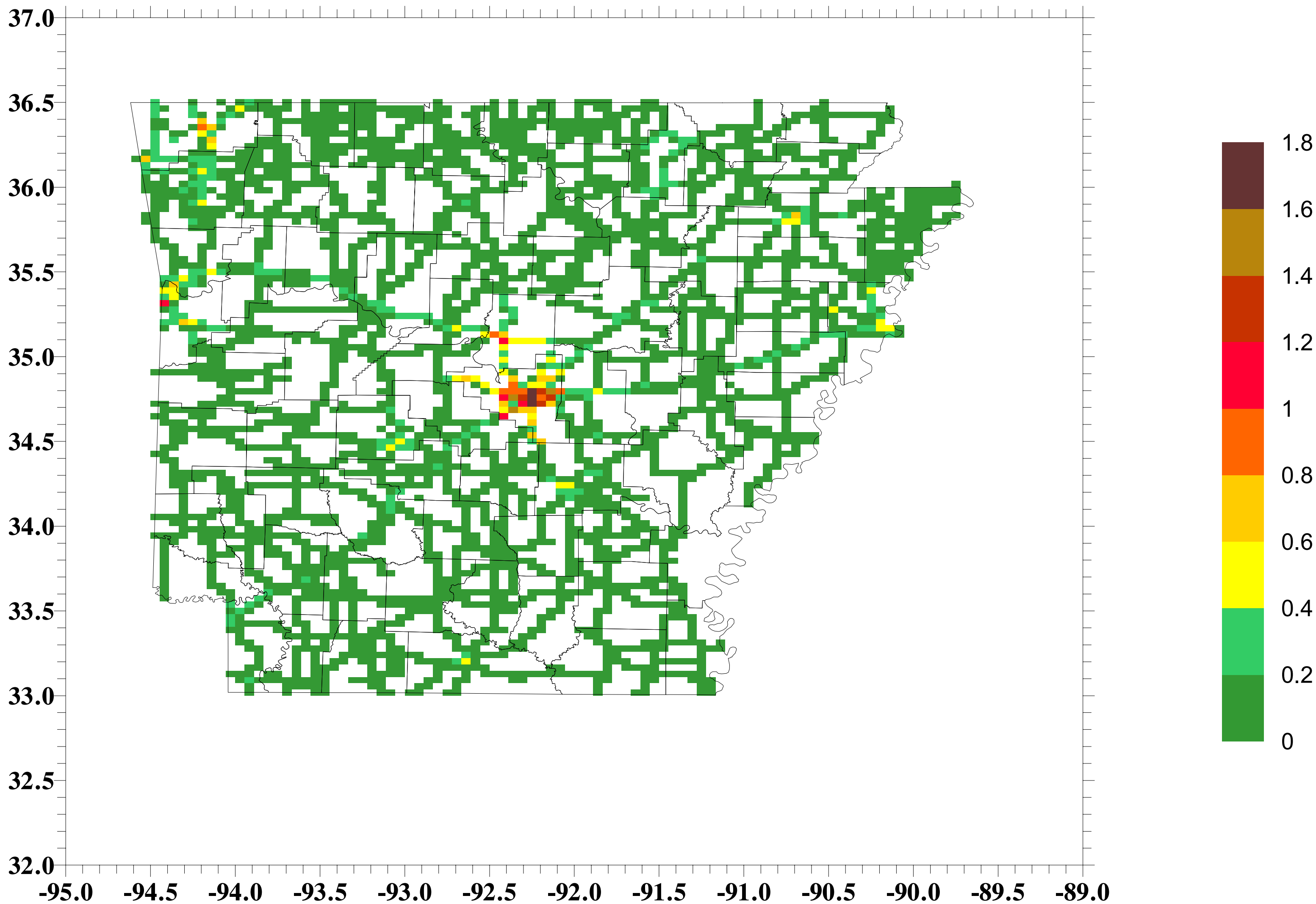


Figure 5-55.

Arkansas On-road Sources Winter Weekday CO Emissions (tpd)

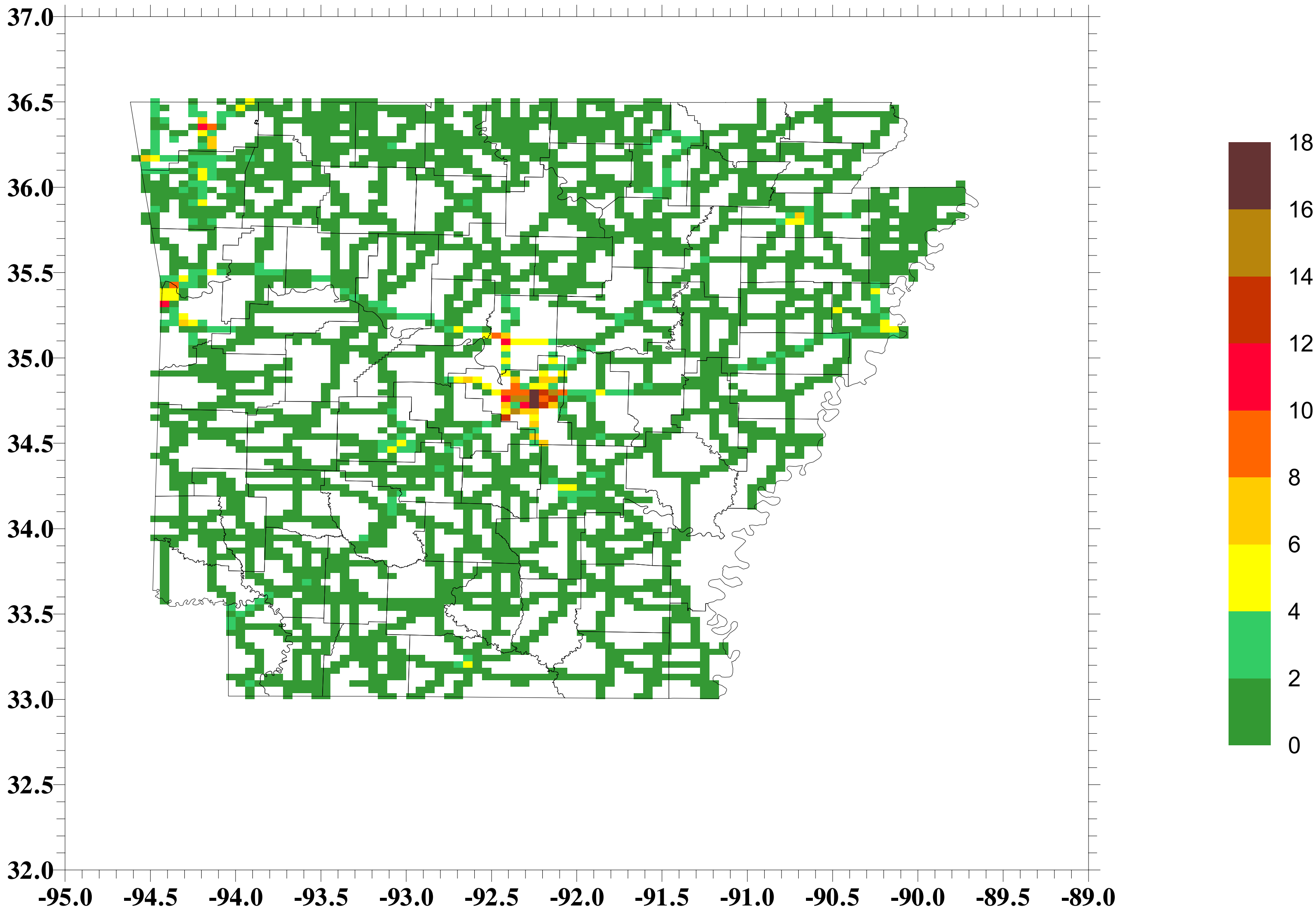


Figure 5-56.
Arkansas On-road Sources Winter Weekday PM10 Emissions (tpd)

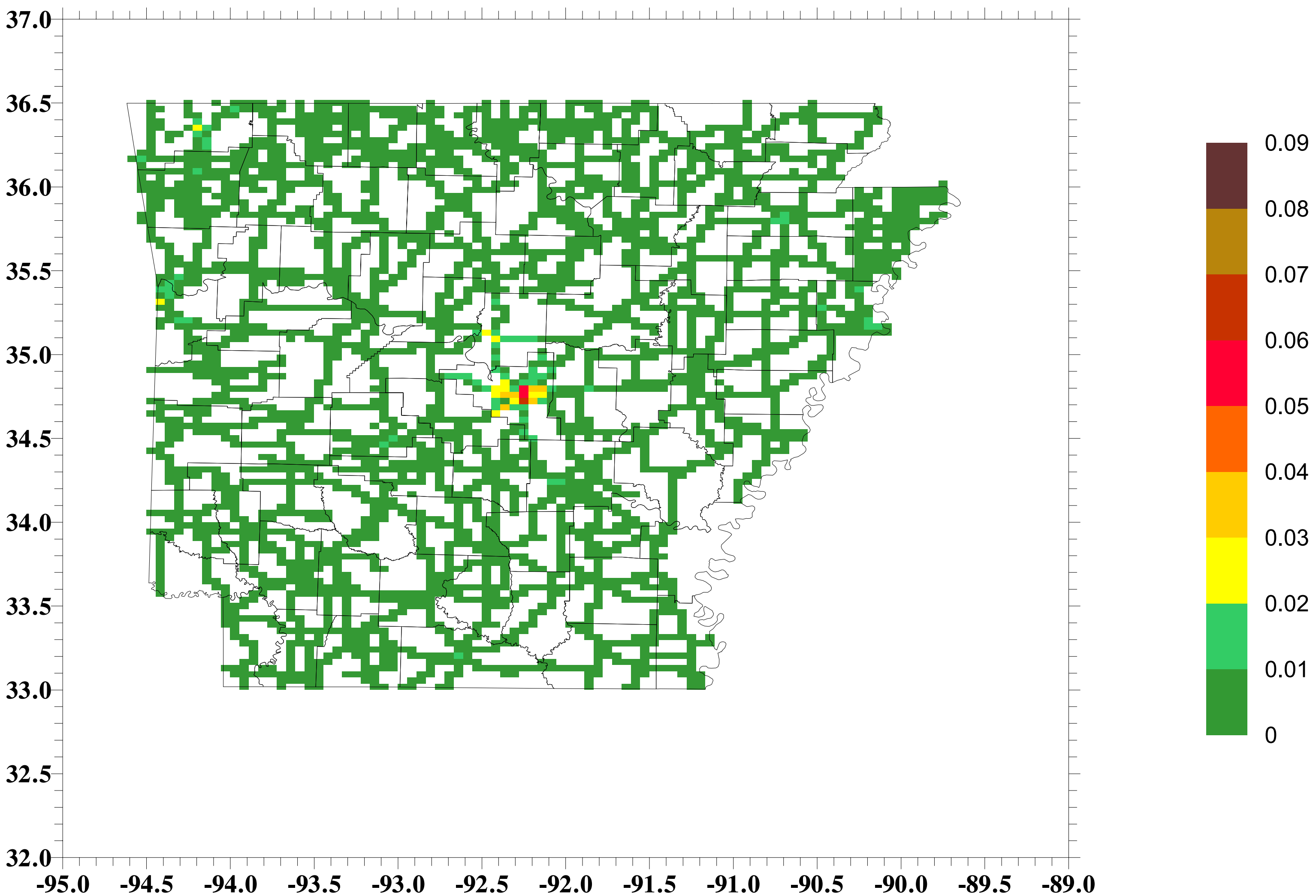


Figure 5-57.

Arkansas On-road Sources Winter Weekday PM2.5 Emissions (tpd)

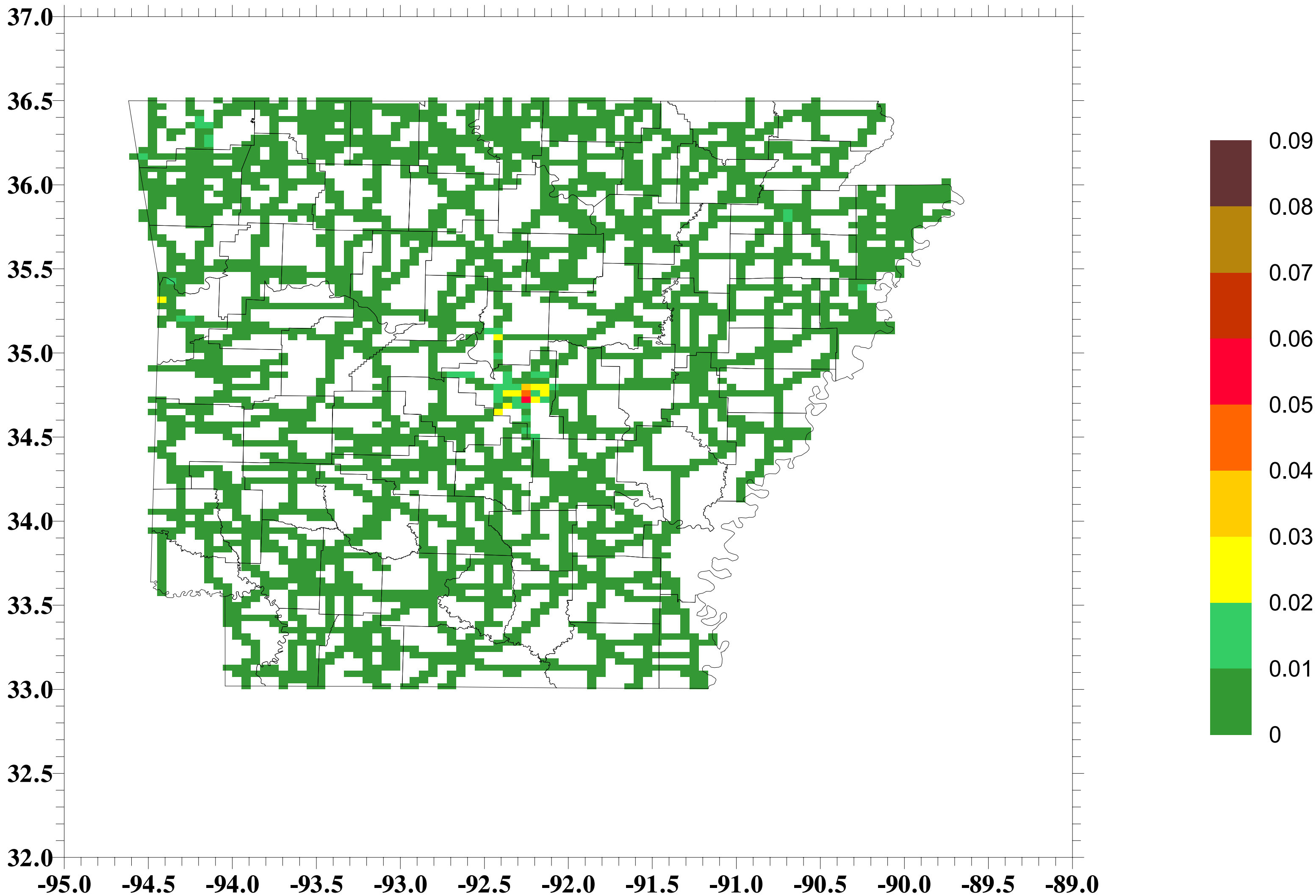


Figure 5-58.

Arkansas On-road Sources Winter Weekday SOx Emissions (tpd)

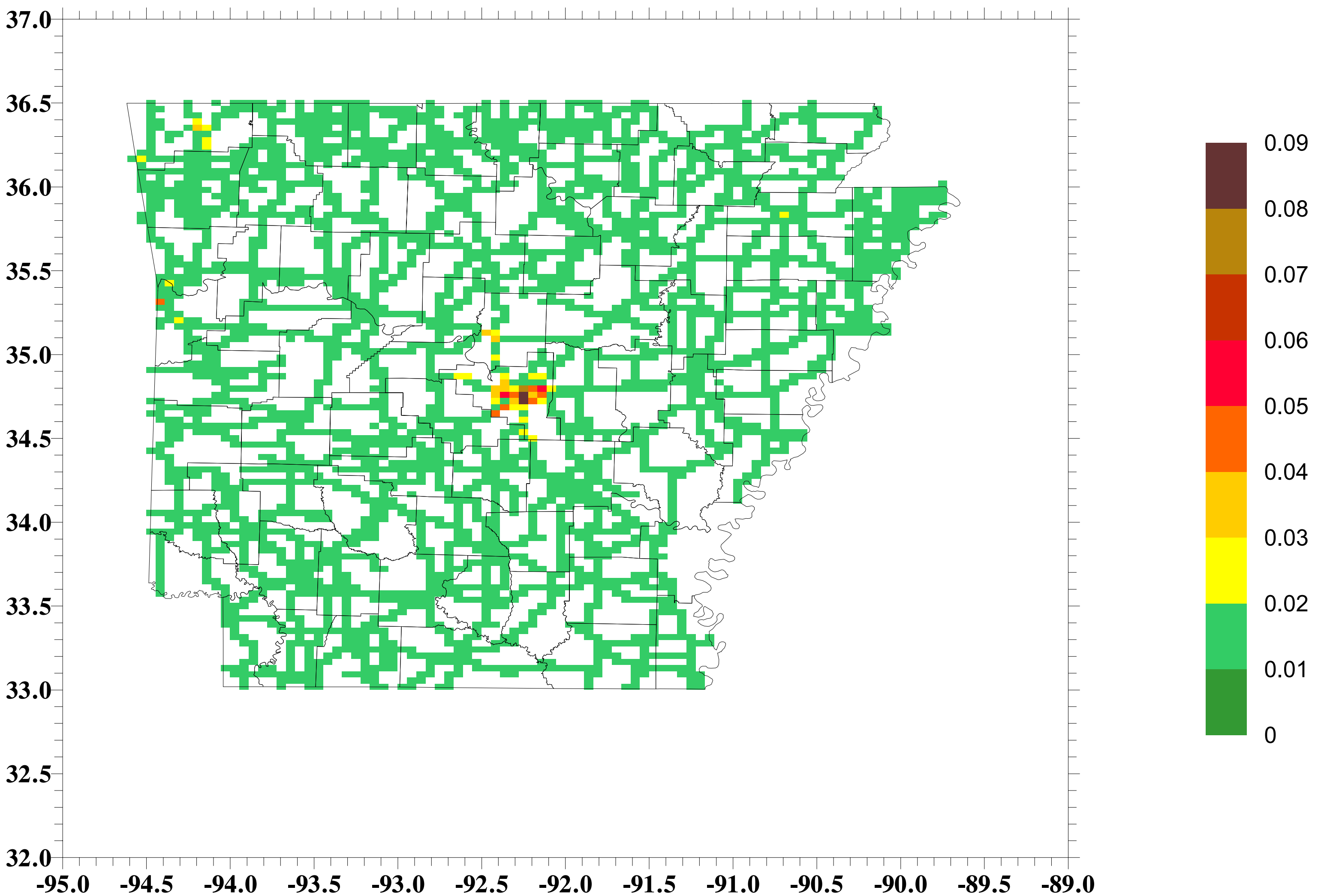


Figure 5-59.
Arkansas On-road Sources Winter Weekday NH3 Emissions (tpd)

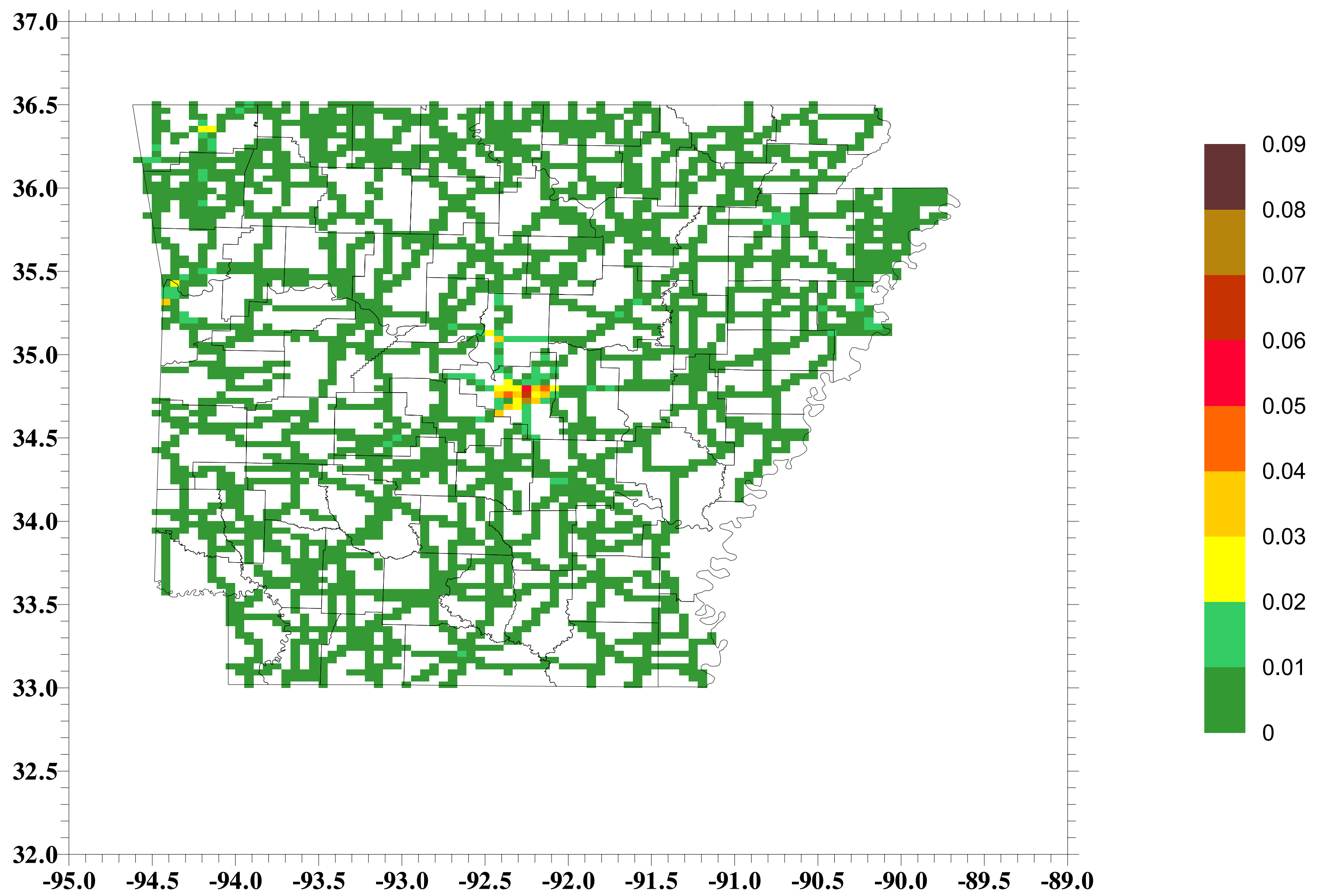


Figure 5-60.

Arkansas Off-road Sources Winter Weekday VOC Emissions (tpd)

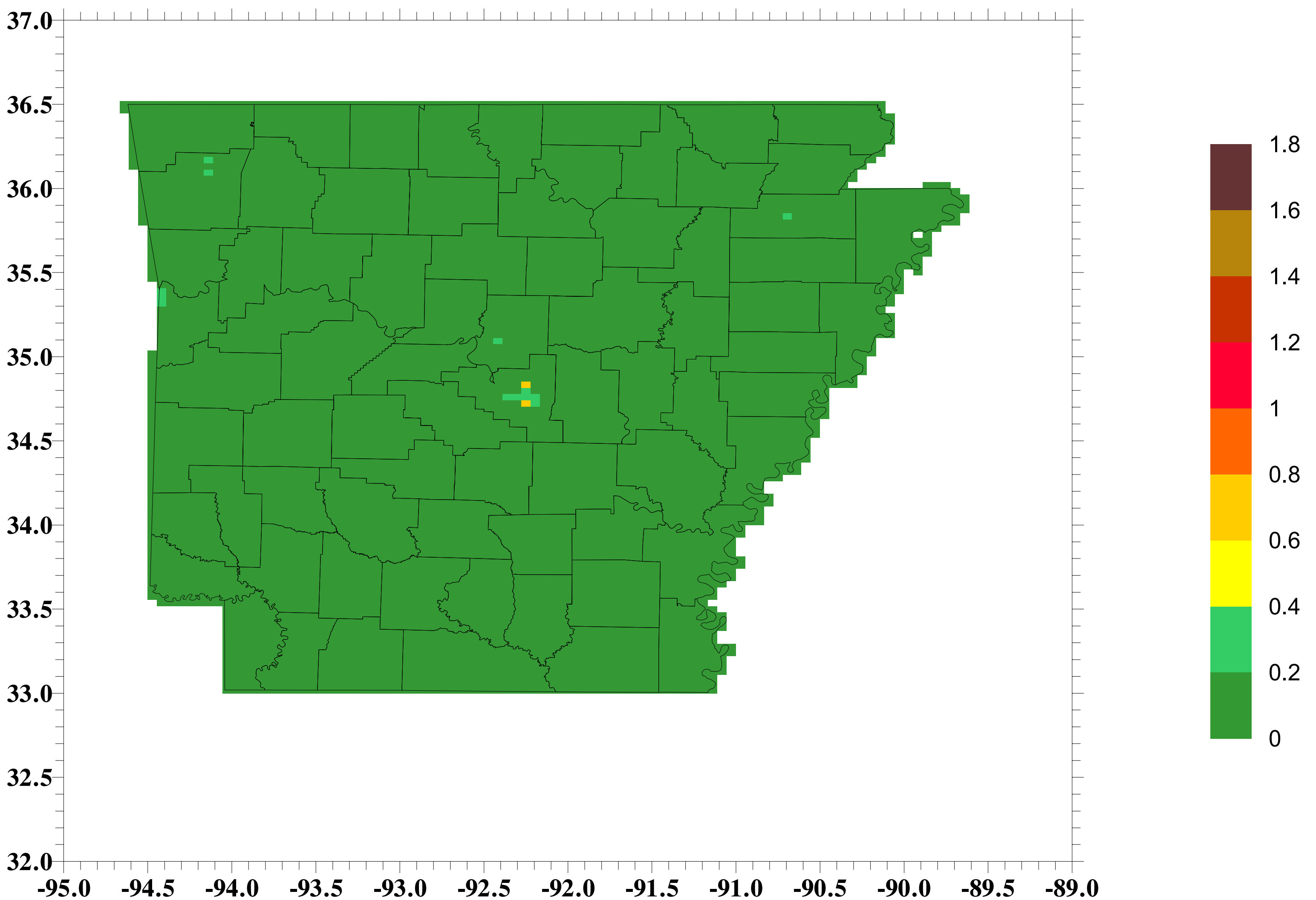


Figure 5-61.
Arkansas Off-road Sources Winter Weekday NOx Emissions (tpd)

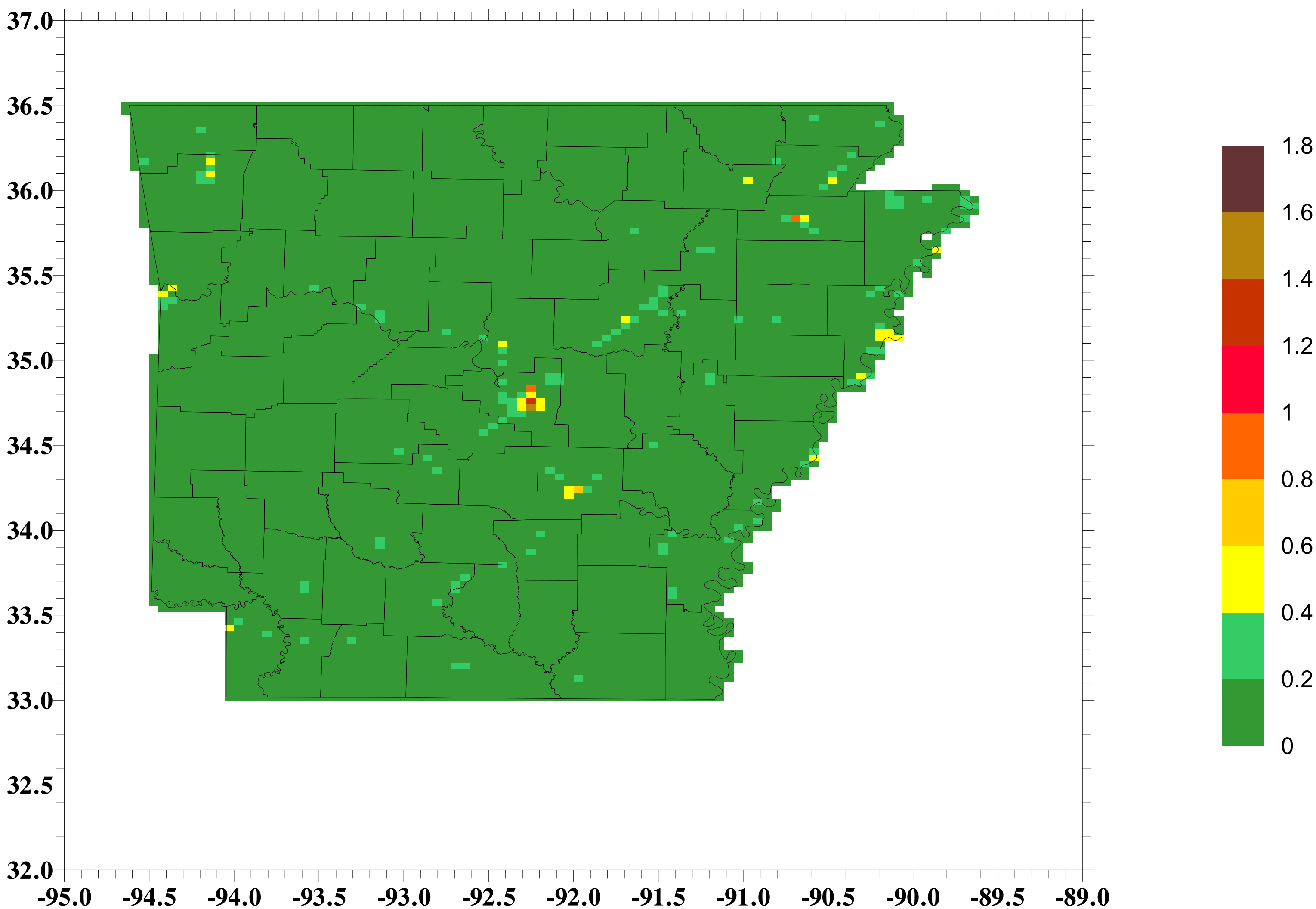


Figure 5-62.

Arkansas Off-road Sources Winter Weekday CO Emissions (tpd)

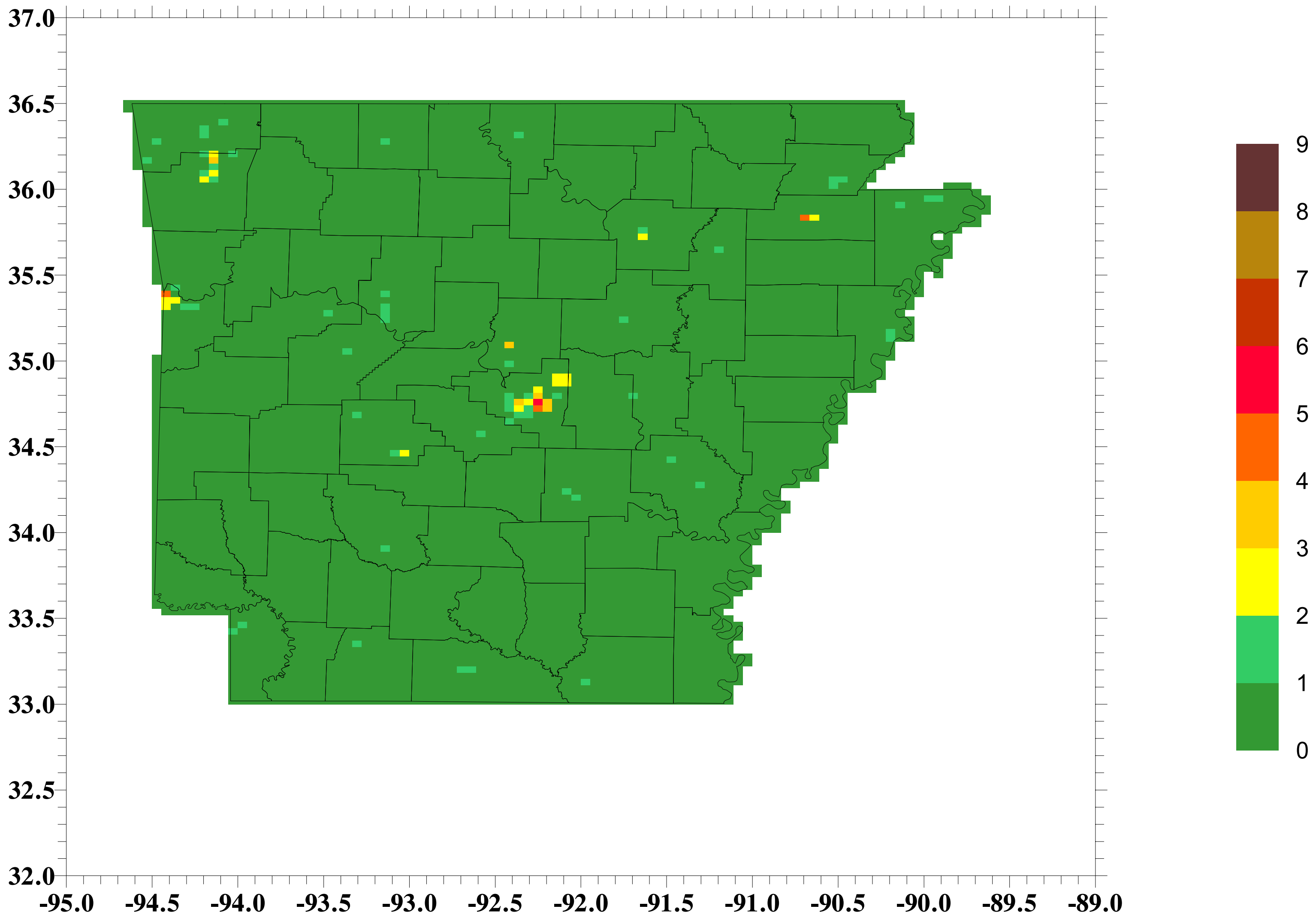


Figure 5-63.

Arkansas Off-road Sources Winter Weekday PM10 Emissions (tpd)

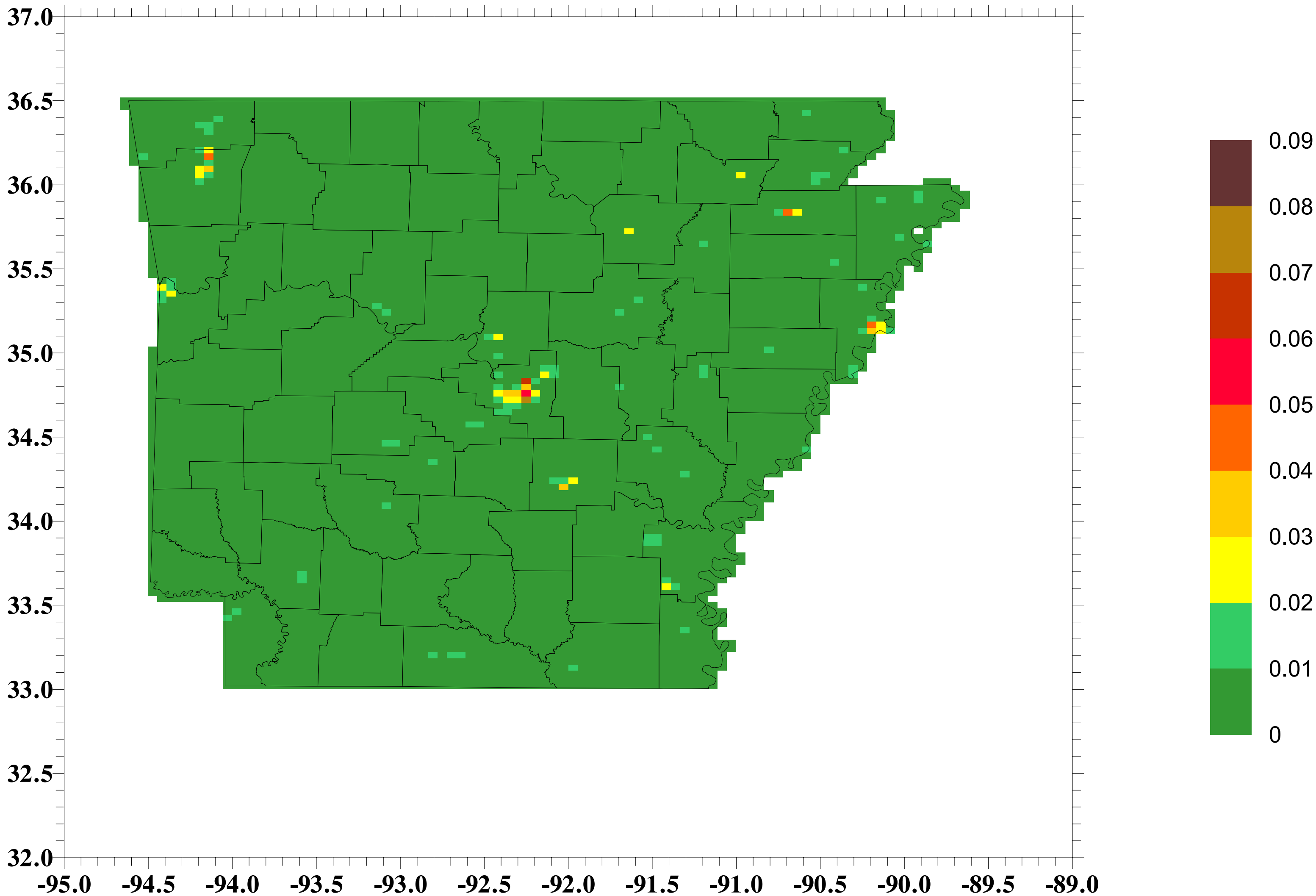


Figure 5-64.

Arkansas Off-road Sources Winter Weekday PM2.5 Emissions (tpd)

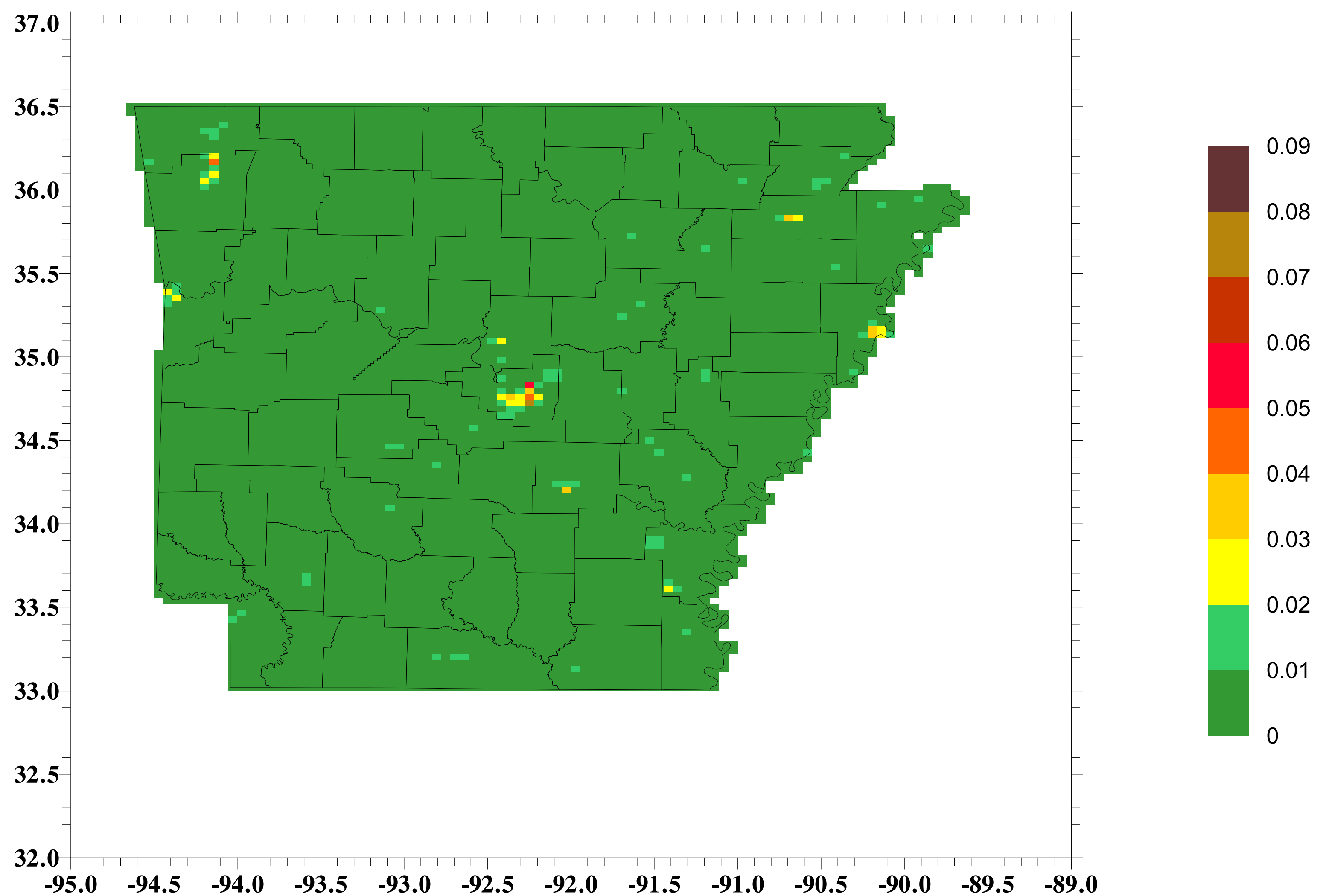


Figure 5-65.

Arkansas Off-road Sources Winter Weekday SOx Emissions (tpd)

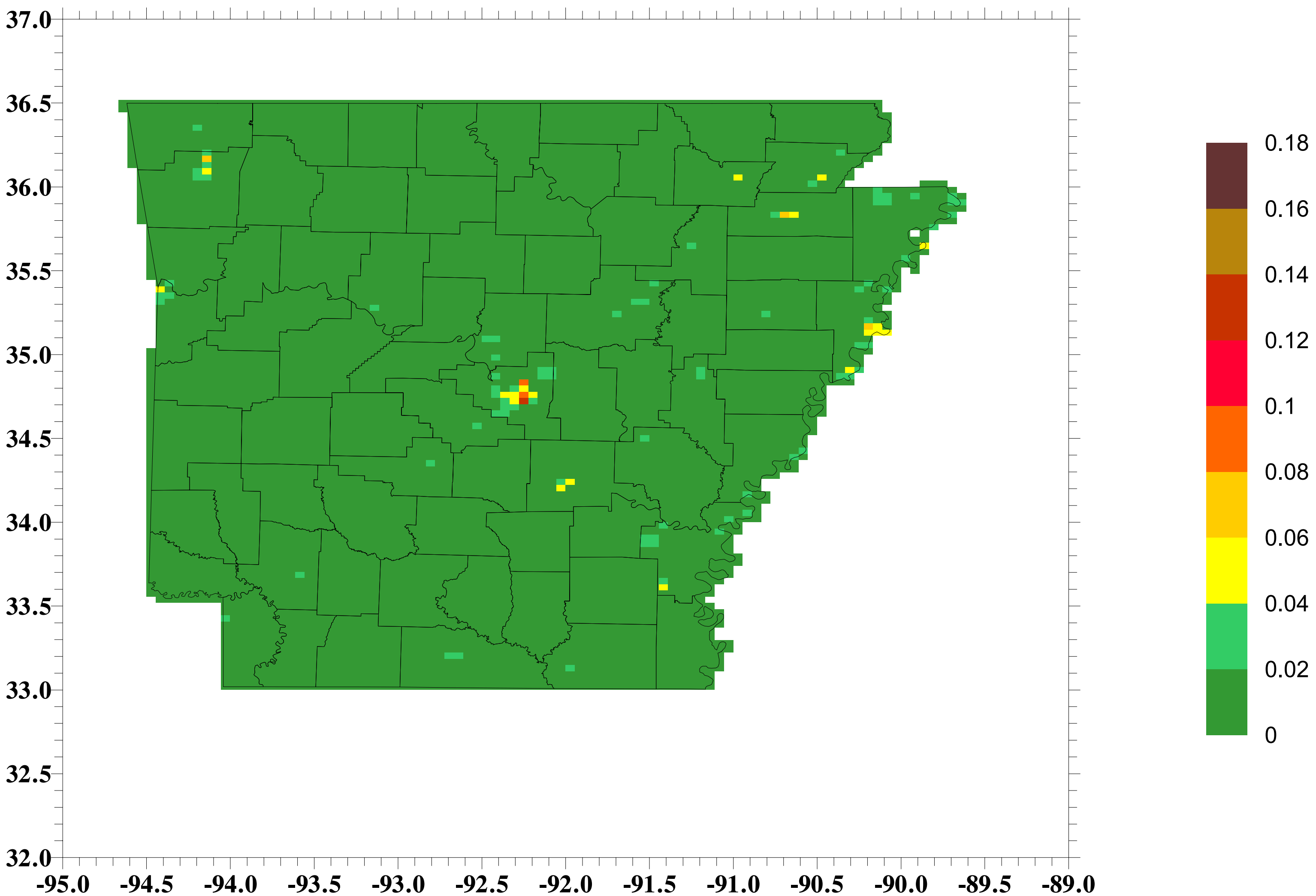
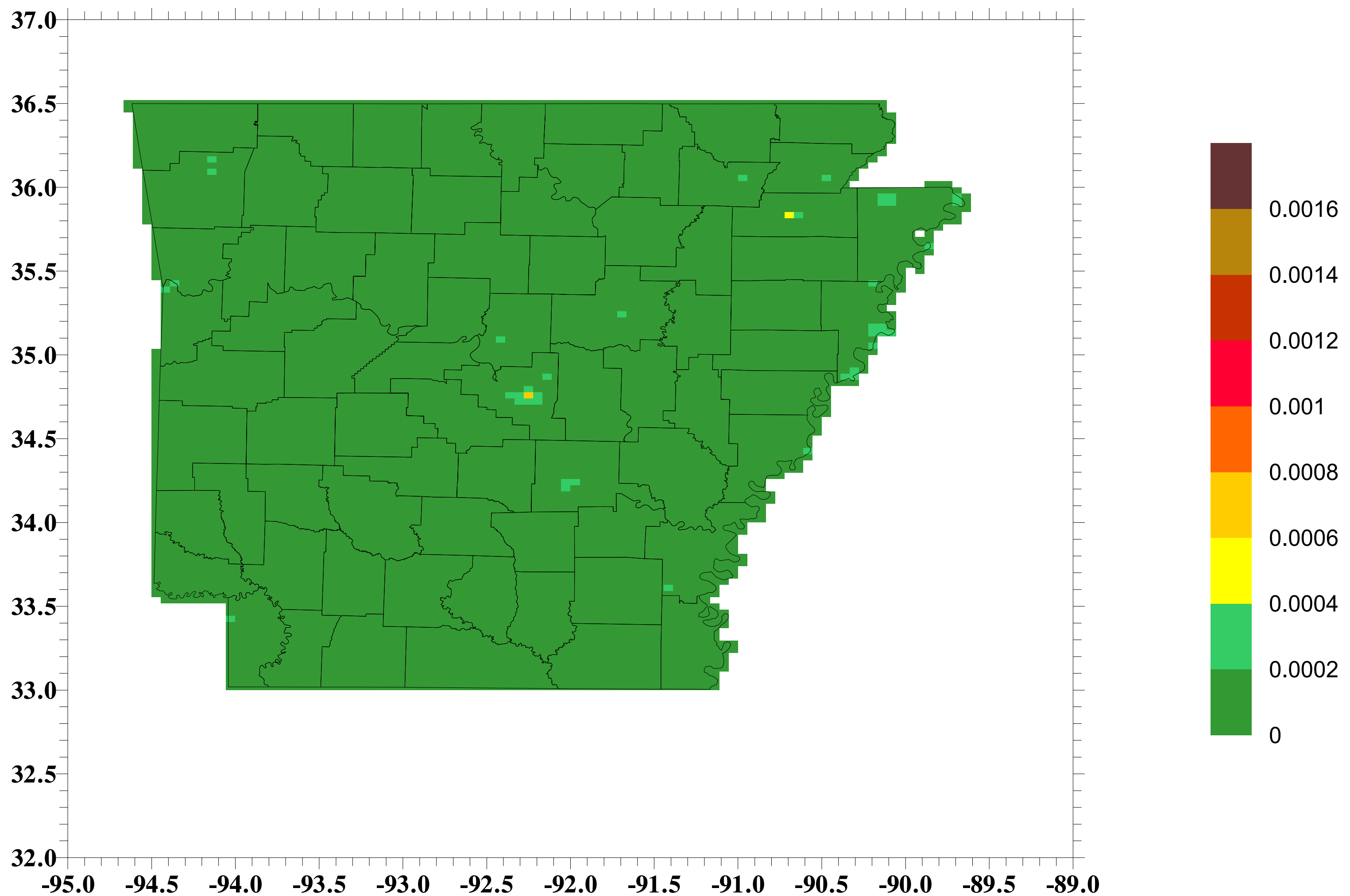


Figure 5-66.
Arkansas Off-road Sources Winter Weekday NH3 Emissions (tpd)



6. REFERENCES

AASS, 2003c. "Arkansas Milk Production, Disposition, and Income". Arkansas Agricultural Statistics Service, Little Rock, Arkansas. Internet address: http://www.nass.usda.gov/ar/lvskmilk.pdf.

AASS, 2003b. "Arkansas Commercial Red Meat Production and Livestock Slaughter". Arkansas Agricultural Statistics Service, Little Rock, Arkansas. Internet address: http://www.nass.usda.gov/ar/lvskslau.pdf.

AASS, 2003a. "Arkansas County Estimates 2002-2003". Arkansas Agricultural Statistics Service, Little Rock, Arkansas. Internet address: http://www.nass.usda.gov/ar/cropcoes.htm.

ADEQ, 2004. Emission Inventory Questionnaire (EIQ) fuel use data provided by Arkansas Department of Environmental Quality, Little Rock, Arkansas. May 3.

Alfaro, S.C., J.L. Rajot, and W.G. Nickling, 2003. Estimation of PM20 emissions by wind erosion: main sources of uncertainties. *Geomorphology* (in press).

Alfaro, S.C. and L. Gomes, 2001. Modeling mineral aerosol production by wind erosion: emission intensities and aerosol size distributions in source areas. *J. Geophys. Res.* **106** (16): 18075-18084.

ASLRRA, 1999. "1999 Annual Data Profile of the American Short Line & Regional Railroad Industry". Developed by the American Short Line & Regional Railroad Association and the Upper Great Plains Transportation Institute, North Dakota State University. Available online at: http://www.shortlinedata.com/

ARB, 2003. "Detailed Documentation for Fugitive Dust and Ammonia Emission Inventory Changes for the SJVU APCD Particulate Matter SIP". California Air Resources Board, Planning and Technical Support Division. April.

ARB, 2002. "California Emission Inventory and Reporting System (CEIDARS) Particulate Matter (PM) Speciation Profiles". California Air Resources Board, Sacramento, California. September 26. Internet address: http://www.arb.ca.gov/emisinv/speciate/PMSIZE_09_26_02.xls.

Bailey, 2004. Gasoline distribution information provided by Tom Bailey (Arkansas Office of Excise Tax Administration, Little Rock, Arkansas; 501-682-4805). March.

Battye, R., W. Battye, C. Overcash, and S. Fudge, 1994. "Development and Selection of Ammonia Emission Factors". Prepared for U.S. Environmental Protection Agency, Atmospheric Research and Exposure Assessment Laboratory by EC/R Incorporated, Durham, North Carolina. August. Internet address: http://www.epa.gov/ttn/chief/efdocs/ammonia.pdf

Bennett, 2004. Cutback asphalt information provided by Gary Bennett (Arkansas State Highway and Transportation Department, Little Rock, Arkansas; 501-569-2377). April.

Benson, 2004. Personal communication with Doug Benson. February. (See also ASLRRA 1999).

Bray, L.G., C.A. Dager, R.L., Henry, and M.C. Koroa, 2002. "River Efficiency, Fuel Taxes, and Modal Shift". *TR News*, Tennessee Valley Authority, Transportation Research Board, July – August.

BTS, 2002 "National Transportation Atlas Data Shapefile Download Center". Bureau of Transportation Statistics, Washington, D.C. Internet address: http://websas.bts.gov/website/ntad02/.

CARB, 1997. "Supplemental Documentation for Windblown Dust – Agricultural Lands". *Section 7.11 California Air Resources Board, Emission Inventory Analysis Section*, Sacramento, California. April.

CDC, 2004b. Health Behaviors of Adults: United States, 1999 – 2001. *Vital and Health Statistics, Series 10, Number 219*. Centers for Disease Control and Preventation, National Center for Health Statistics, Atlanta, Georgia. February. Internet address: http://www.cdc.gov/nchs/data/series/sr_10/sr10_219.pdf.

CDC, 2004a. "State-Specific Prevalence of Current Cigarette Smoking Among Adults – United States, 2002." *Morbidity and Mortality Weekly Report (MMWR)*. Volume 52, Number 53. Centers for Disease Control and Prevention, Tobacco Information and Prevention Source, Atlanta, Georgia. January. Internet address: http://www.cdc.gov/tobacco/research_data/adults_prev/mmwr5253.htm.

Chatenet, B., B. Marticorena, L. Gomes, and G. Bergametti, 1996. "Assessing the microped size distributions of desert soils erodible by wind". *Sedimentology* 43: 901-911.

CSDC, 2004. "Urban and Rural Population by County". Census State Data Center, Little Rock, Arkansas. Internet address: http://www.aiea.ualr.edu/census/censusdata/census2000/County/UrbanRurCo.html.

Dager, 2003. Updated fuel consumption estimates provided by Chrisman Dager, Tennessee Valley Authority.

EIA, 2004c. "1997 Residential Energy Consumption Survey – Forms EIA-457 A-G". Energy Information Administration, Washington D.C. Internet address: http://www.eia.doe.gov/emeu/recs/byfuels/byfuels.html.

EIA, 2004b. "1999 Commercial Buildings Energy Consumption Survey – Preliminary End-Use Consumption Estimates". Energy Information Administration, Washington D.C. Internet address: http://www.eia.doe.gov/emeu/cbecs/enduse_consumption/intro.html.

EIA, 2004a. "State Energy Data Report 2000 – Arkansas". Energy Information Administration, Washington D.C. Internet address: http://www.eia.doe.gov/emeu/states/sep_use/

total/pdf/use_ar.pdf.

EIIP, 2001c. "Structure Fires", Volume III: Chapter 18. Emission Inventory Improvement Program, Area Sources Committee. January. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii18_apr2001.pdf.

EIIP, 2001b. "Gasoline Marketing (Stage I and Stage II)", Volume III: Chapter 11. Emission Inventory Improvement Program, Area Sources Committee. January. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii11_apr2001.pdf.

EIIP, 2001a. "Asphalt Paving". Volume III: Chapter 17. Emission Inventory Improvement Program, Area Sources Committee. January. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii17_apr2001.pdf.

EIIP, 2000b. "Area Source Category Method Abstract – Vehicle Fires". Emission Inventory Improvement Program, Area Sources Committee. May. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/vehclf13.pdf.

EIIP, 2000a. "Auto Body Refinishing", Volume III: Chapter 13. External Review Draft. Emission Inventory Improvement Program, Area Sources Committee. May. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii13.zip.

EIIP, 1999d. "Area Source Category Method Abstract – Bakeries". Emission Inventory Improvement Program, Area Sources Committee. June. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/bakeries.pdf.

EIIP, 1999c. "Area Source Category Method Abstract – Residential and Commercial/ Institutional Coal Combustion". Emission Inventory Improvement Program, Area Sources Committee. April. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/coal.pdf.

EIIP, 1999b. "Area Source Category Method Abstract – Residential and Commercial/ Institutional Fuel Oil and Kerosene Combustion". Emission Inventory Improvement Program, Area Sources Committee. April. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/fueloil.pdf.

EIIP, 1999a. "Area Source Category Method Abstract – Residential and Commercial/ Institutional Natural Gas and Liquefied Petroleum Gas (LPG) Combustion". Emission Inventory Improvement Program, Area Sources Committee. April. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/ng.pdf.

EIIP, 1997c. "Solvent Cleaning", Volume III: Chapter 6. Emission Inventory Improvement Program, Area Sources Committee. September. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii06fin.pdf.

EIIP, 1997b. "Industrial Surface Coating", Volume III: Chapter 8. Emission Inventory Improvement Program, Area Sources Committee. September. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii08.pdf.

EIIP, 1997a. “Traffic Markings”, Volume III: Chapter 14. Emission Inventory Improvement Program, Area Sources Committee. May. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii14.pdf.

EIIP, 1996c. “Dry Cleaning”. Volume III: Chapter 4. Emission Inventory Improvement Program, Area Sources Committee. May. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii04fn2.pdf.

EIIP, 1996b. “Consumer and Commercial Solvent Use”, Volume III: Chapter 5. Emission Inventory Improvement Program, Area Sources Committee. August. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii05.pdf.

EIIP, 1996a. “Graphic Arts”, Volume III: Chapter 7. Emission Inventory Improvement Program, Area Sources Committee. November. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii07.pdf.

EIIP, 1995. “Architectural Surface Coating”, Volume III: Chapter. Emission Inventory Improvement Program, Area Sources Committee. November. Internet address: http://www.epa.gov/ttn/chief/eiip/techreport/volume03/archsfc.pdf.

ENVIRON, 2004. “Determining Fugitive Dust Emissions from Wind Erosion”. Prepared for Western Governors’ Association by ENVIRON International Corporation, Novato, California; ERG, Inc., Sacramento, California; Desert Research Institute, Reno, Nevada, MACTEC Engineering & Consulting, Gainsville, Florida and University of California Riverside, Riverside, California. March.

ENVIRON, 2003b. “Determining Fugitive Dust Emissions from Wind Erosion – Task 1: Analysis of Wind Tunnel Study Results, Meteorological and Land Use Data”. Technical Memorandum. Prepared for Western Governors’ Association by ENVIRON International Corporation, Novato, California; ERG, Inc., Sacramento, California; Desert Research Institute, Reno, Nevada, MACTEC Engineering & Consulting, Gainsville, Florida and University of California Riverside, Riverside, California. January.

ENVIRON, 2003a. “Determining Fugitive Dust Emissions from Wind Erosion – Task 2: Development of Emission Inventory Specific Emission Factors”. Draft Technical Memorandum. Prepared for Western Governors’ Association by ENVIRON International Corporation, Novato, California; ERG, Inc., Sacramento, California; and Desert Research Institute, Reno, Nevada. March.

EPA, 2004b. “National Emission Inventory – Ammonia Emissions from Animal Husbandry Operations”. Draft report. U.S. Environmental Protection Agency. January 30. Internet address: ftp://ftp.epa.gov/EmisInventory/prelim2002nei/nonpoint/documentation/nh3inventorydraft_jan2004.pdf.

EPA, 2004a. “Documentation for the 2002 Nonpoint Area Source National Emission Inventory for Criteria and Hazardous Air Pollutants (Version 1.0).” U.S. Environmental Protection Agency, Emission Factors and Inventory Group. Research Triangle Park, North Carolina. Internet address: ftp://ftp.epa.gov/EmisInventory/prelim2002nei/nonpoint/documentation/2002prelimneinonpt_032004.pdf.

EPA, 2003. "Municipal Solid Waste in the United States: 2001 Facts and Figures". EPA530-R-03-011. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington D.C. October. Internet address: http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/msw2001.pdf

EPA, 2002. "Emissions Modeling Clearinghouse (EMCH) Temporal Allocation Profiles". U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factor and Inventory Group, Research Triangle Park, North Carolina. April 29. Internet address: http://www.epa.gov/ttn/chief/emch/temporal/

EPA, 2000. "Factor Information Retrieval (FIRE) Data System", Version 6.23. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. October. Internet address: http://www.epa.gov/ttn/chief/Software/fire/index.html.

EPA, 1999. "Final Regulatory Impact Analysis: Control of Emissions from Compression-Ignition Marine Engines". EPA420-R-99-026, November.

EPA, 1997. "Locomotive Emission Standards. Regulatory Support Document, United States Environmental Protection Agency, Office of Mobile Sources, April", and "Emission Factors for Locomotives". Environmental Protection Agency, EPA420-F-97-051, December.

EPA, 1995. "Compilation of Air Pollution Emission Factors (AP-42) – Volume I: Stationary Point and Area Sources", Fifth Edition (various updates). U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. January. Internet address: http://www.epa.gov/ttn/chief/ap42/.

Federal Register, 1998c. "National Volatile Organic Compound Emission Standards for Automobile Refinish Coatings". Final rule. 63 FR 48806-48818. September.

Federal Register, 1998b. "National Volatile Organic Compound Emission Standards for Consumer Products". Final rule. 63 FR 48819-48847. September

Federal Register, 1998a. "National Volatile Organic Compound Emission Standards for Architectural Coatings". Final rule. 63 FR 48848-48887. September.

FGDC. 1997. Vegetation Classification Standard. Vegetation Subcommittee, Federal Geographic Data Committee

Harcrow, 2004. Structure and vehicle fire statistics provided by Terry Harcrow (Arkansas Fire Academy, Camden, Arkansas; 870-574-1521). March.

Harvey, 2004. Personal communication with Craig Harvey, U.S. Environmental Protection Agency. March.

Hoffpauer, 2002. Typical lot size information provided by John Hoffpauer (Metroplan, Little Rock, Arkansas; 501-372-3300). October.

Holm, 2004. Prescribed fire acreage database provided by Lawrence Holm (Arkansas Forestry Commission, Malvern, Arkansas; 501-332-2000). January.

Holm, 2002. Average prescribed fire fuel loading provided by Lawrence Holm (Arkansas Forestry Commission, Malvern, Arkansas; 501-332-2000). August.

James, D.E. et al. 2001. "Development of Vacant Land Emission PM-10 Factors in the Las Vegas Valley, Civil and Environmental Engineering". UNLV, Las Vegas.

Jurczak, 2003. Personal communication with E. Jurczak. September.

Kelley, 2004. Corn, sorghum, and wheat field burn fractions provided by Jason Kelley (University of Arkansas Cooperative Extension Service, Little Rock, Arkansas; 501-671-2164). March.

McCorkle, 2002. Response to inventory-related questions provided by Mark McCorkle (Arkansas Department of Environmental Quality, Little Rock, Arkansas; 501-682-0736). August.

Mills, 2004. Beef cattle feedlot and dairy information provided by Kevin Mills (Arkansas Agricultural Statistics Service, Little Rock, Arkansas; 501-228-9926). March.

Moore, 2004. Open burning information provided by Lindsay Moore (Arkansas Department of Environmental Quality, Little Rock, Arkansas; 501-682-0056). March.

Moulis, 2004. Personal communication with Charles Moulis. U.S. Environmental Protection Agency, March.

MRI, 1996. "Improvement of Specific Emission Factors (BACM Project No. 1)". Final Report. Prepared for South Coast Air Quality Management District by Midwest Research Institute, Kansas City, Missouri. March.

NCDC, 2004. "Normal Monthly Heating Degree Days (Base 65)". National Climatic Data Center, Asheville, North Carolina. Internet address: http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmhdd.html.

NFDC, 2001. *Fire in the United States, 1989-1998, 12th Edition*. United States Fire Administration, National Fire Data Center. August. Internet address: http://www.usfa.fema.gov/downloads/pdf/publications/fa-214.pdf

Nickling, W.G. and J.A. Gillies, 1993. Dust emission and transport in Mali, West Africa. *Sedimentology* 40: 859-868.

Nickling, W.G. and J.A. Gillies, 1989. Emission of fine-grained particulate from desert soils. In: M. Leinen and M. Sarnthein (Editors), *Paleoclimatology and Paleometeorology: Modern and Past Patterns of Global Atmospheric Transport*. Kluwer Academic Publishers, pp. 133-165.

NIPER, 1995. "Motor Gasolines, Summer 1994." BDM – Oklahoma, Inc. NIPER-188 PPS 95/1. February.

NIPER, 1994. "Motor Gasolines, Winter 1993-94." BDM - Oklahoma, Inc. NIPER-185 PPS 94/3. August.

Pinkerton, 2002. Personal communication with Will Pinkerton, LRPA. August

Porta, 2004. State gasoline consumption, and state and county vehicle registration statistics provided by Virginia Porta (Arkansas Highway and Transportation Department, Little Rock, Arkansas; 501-569-2108). January.

Radian, 1997. "Mexico Emissions Inventory Program Manuals: Volume V – Area Source Inventory Development". Prepared for the Western Governors' Association by Radian International LLC, Sacramento, California. March.

RAQC, 2001. "Charbroiling Emissions Estimation Methodology". Regional Air Quality Council, Denver, Colorado. September.

Robertson, 2004. Cotton field burn fractions provided by William Robertson (University of Arkansas Cooperative Extension Service, Little Rock, Arkansas; 501-671-2186). March.

Russell, 2004. Wildfire acreage statistics provided by Sherry Russell (Arkansas Forestry Commission, Malvern, Arkansas; 501-332-2000). April.

Schneider, 2004. Per capita waste generation information provided by Shelly Schneider (Franklin Associates, Prairie Village, Kansas; 913-649-2225 x224). February.

SRI, 2001. "Chemical Economics Handbook – Ammonia". SRI International, Menlo Park, California. March.

Starcrest, 2000. "Houston-Galveston Area Vessel Emissions Inventory". Prepared by Starcrest Consulting for the Port of Houston and the Texas Natural Resource Conservation Commission, November. Also "Appendix C of HGA Post-1999 ROP/Attainment Demonstration SIP", Texas Natural Resources Conservation Commission, December.

Swafford, 2004. Stage I, Stage II, and tank truck information provided by Bill Swafford (Arkansas Department of Environmental Quality, Little Rock, Arkansas; 501-682-0746). March.

Thesing, K.B. and R. Huntley, 2001. "Open Burning and Construction Activities: Improved PM Fine Emission Estimation Techniques in the National Emissions Inventory". Presented at the 10th International Emission Inventory Conference, Denver, Colorado; May. Internet address: http://www.epa.gov/ttn/chief/conference/ei10/pm/huntley.pdf.

Tingle, 2004. Soybean field burn fractions provided by Chris Tingle (University of Arkansas Cooperative Extension Service, Little Rock, Arkansas; 501-671-2278). March.

UA, 2004. "2004 Crop Budgets". University of Arkansas Cooperative Extension Service, Little Rock, Arkansas. Internet address: http://www.aragriculture.org/ farm planning/ Budgets/default.asp.

Uhl, 2003. Personal communication with Mike Uhl, Department of Air Quality Management, Clark County, NV. September.

U.S. Census, 2004. "Building Permit Database". U.S. Census Bureau, Washington D.C. Internet address: http://censtats.census.gov/bldg/bldgprmt.shtml.

U.S. Census, 2003b. 'Current Industrial Reports – Paint and Allied Products: 2002". MA325F(02)-1. U.S. Census Bureau, Washington D.C. July. Internet address: http://www.census.gov/ftp/pub/industry/1/ma325f02.pdf.

U.S. Census, 2003a. "Arkansas County Population Estimates: April 1, 2000 to July 1, 2002". Table CO-EST2002-01-05. U.S. Census Bureau, Population Division, Washington D.C. Internet address: http://eire.census.gov/popest/data/counties/tables/CO-EST2002/ CO-EST2002-01-05.php.

U.S. Census, 2001. "County Business Patterns". U.S. Census Bureau, Washington D.C. Internet address: http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl.

U.S. Census, 2000b. "1997 Economic Census – Miscellaneous Subjects (Accommodation and Foodservices Subject Series"). EC97R72S-SB(RV). U.S. Census Bureau, Washington D.C. December. Internet address: http://www.census.gov/prod/ec97/97r72-sb.pdf.

U.S. Census, 2000a. "American Fact Finder" – Census 2000. U.S. Census Bureau, Washington D.C. Internet address: http://factfinder.census.gov/servlet/BasicFactsServlet.

White, 2000. Development of Predictive Formula for PM10 Emission Rate as A Function of Vegetation Cover.

Wilson, 2004. Rice field burn fractions provided by Chuck Wilson (University of Arkansas Cooperative Extension Service, East Stuttgart, Arkansas; 870-673-2661). March 29.

APPENDIX
7.1-B

CONSOLIDATION OF EMISSIONS INVENTORIES
(SCHEDULE 9; WORK ITEM 3)

FINAL

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TABLES

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ACRONYMS AND ABBREVIATIONS

BRAVO	Big Bend Regional Aerosol and Visibility Observational
CAFO	Concentrated Animal Feeding Operations
CAP	criteria air pollutant
CE	Control Equipment (NIF 3.0 table)
CEM	Continuous Emissions Monitoring
CENRAP	Central Regional Air Planning Association
CERR	Consolidated Emissions Reporting Rule
CMU	Carnegie Mellon University
CO	carbon monoxide
CO_2	carbon dioxide
CH_4	methane
CMV	commercial marine vessel
CVS	Concurrent Versions System
EC	elemental carbon
EFIG	Emission Factor and Inventory Group
EI	Emission Inventory
EM	Emission (NIF 3.0 table)
EP	Emission Process (NIF 3.0 table)
EPA	U.S. Environmental Protection Agency
EPS	Emissions Preprocessor System
ER	Emission Release Point (NIF 3.0 table)
ERG	Eastern Research Group
ERP	Emission Release Point (NIF 3.0 field in ER table)
EU	Emission Unit (NIF 3.0 table)
FIPS	Federal Information Processing Standard
FIRE	Factor Information and REtrieval
GIS	geographic information system
GWEI	Gulfwide Emissions Inventory
HAP	hazardous air pollutant
ID	identification
IDA	Inventory Data Analyzer format
LPG	liquefied petroleum gas
MACT	maximum achievable control technology
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MMS	Minerals Management Services
NAAQS	National Ambient Air Quality Standard
NAICS	North American Industrial Classification System
NEI	National Emissions Inventory
NH_3	ammonia
NIF 3.0	NEI Input Format Version 3.0
NO_x	oxides of nitrogen
OC	organic carbon
ORIS	Office of Regulatory Information Systems
PD	primary device
PE	Emission Period (NIF 3.0 table)
Pechan	E.H. Pechan & Associates, Inc.

PM	total particulate matter
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
PM10-FIL	filterable PM_{10}
PM10-PRI	primary PM_{10}
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
PM25-FIL	filterable $PM_{2.5}$
PM25-PRI	primary $PM_{2.5}$
PM-CON	condensible PM
QA	quality assurance
QAPP	Quality Assurance Project Plan
RPO	Regional Planning Organization
SCC	Source Classification Code
SD	secondary device
SI	Site (NIF 3.0 table)
SIC	Standard Industrial Classification
SIP	State Implementation Plan
S/L/T	State, Local, and Tribal
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	sulfur dioxide
TCEQ	Texas Commission on Environmental Quality
TR	Transmittal (NIF 3.0 table)
UCAR	University of California, Riverside
UNC-CEP	University of North Carolina, Chapel Hill – Carolina Environmental Program
U.S.	United States
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VOC	volatile organic compound
WRAP	Western Regional Air Partnership

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I. INTRODUCTION

A. Overview

This report documents the data sources, methods, and results for preparing the 2002 base year criteria air pollutant (CAP) and ammonia (NH_3) emissions inventories for point, area, and nonroad sources for the Central Regional Air Planning Association (CENRAP) Regional Planning Organization (RPO). The CENRAP region includes the states and tribal jurisdictions of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. CENRAP (and other RPOs) will use these inventories to support air quality modeling, State Implementation Plan (SIP) development, and implementation activities for the regional haze rule and fine PM and ozone National Ambient Air Quality Standards (NAAQS).

The inventories and supporting data prepared include the following:

(1) Comprehensive, county-level, mass emissions and modeling inventories for point, area, and nonroad sources of 2002 emissions for the CAPs and NH_3 for the State, Local, and Tribal (S/L/T) agencies included in the CENRAP region;
(2) The temporal, speciation, and spatial allocation profiles for the CENRAP region inventories; and
(3) Inventories for other RPOs, Canada, and Mexico.

The mass emissions inventory files were prepared in the National Emissions Inventory (NEI) Input Format Version 3.0 (NIF 3.0). The modeling inventory files were prepared in the Sparse Matrix Operator Kernel Emissions/Inventory Data Analyzer (SMOKE/IDA) format. Ancillary files (holding spatial, temporal, and speciation profile data) were prepared in SMOKE/IDA compatible format.

The inventories include annual emissions for sulfur dioxide (SO_2), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), NH_3, and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$). The inventories included summer day, winter day, and average day emissions. However, not all agencies included daily emissions in their inventories, and, for the agencies that did, the temporal basis for the daily emissions varied between agencies. Consequently, the inventories did not contain a complete and consistent set of daily emissions for all source categories and pollutants. Therefore, daily emissions prepared by S/L/T agencies were maintained in the NIF files if they met quality assurance (QA) review requirements. However, CENRAP requested that the daily emissions not be included in the SMOKE input files. The temporal profiles prepared for this project will be used to calculate daily emissions. If needed, the daily emissions prepared by the agencies may be retrieved from the NIF database files.

The consolidated inventories were prepared using the inventories that S/L/T agencies submitted to the United States (U.S.) Environmental Protection Agency (EPA) from May through July of 2004 as a requirement of the Consolidated Emissions Reporting Rule (CERR). The EPA's format and content QA programs (and other QA checks not included in EPA's QA software) were run on each inventory to identify format and/or data content issues (EPA, 2004a).

E.H. Pechan & Associates, Inc. (Pechan) and the University of North Carolina, Chapel Hill – Carolina Environmental Program (UNC-CEP) worked with the CENRAP's Emission Inventory (EI) Workgroup and the S/L/T agencies to resolve QA issues and augment the inventories to fill data gaps in accordance with the Methods Plan and Quality Assurance Project Plan (QAPP) prepared for this project (CENRAP, 2004a; CENRAP, 2004b). The EI Workgroup and S/L/T agencies reviewed the draft inventory and ancillary files from December 2004 through February 2005. The inventories and SMOKE input files were revised to incorporate the review comments.

B. Summary of the 2002 Base Year Inventories

This section of the report provides a brief summary of the consolidated 2002 base year inventories for the CENRAP region. Table 1 shows total annual emissions for CAPs and NH_3 for point, area, nonroad, and onroad sources. The sector contributing the highest emissions varies by pollutant. Point sources account for the highest percentage of total NO_x (36%) and SO_2 (87%) emissions. Area sources account for the highest percentage of total VOC (50%), primary PM_{10} (PM10-PRI (93%)), primary $PM_{2.5}$ (PM25-PRI (81%)), and NH_3 (86%) emissions. Onroad sources account for the highest percentage of CO (53%) emissions. Onroad and nonroad sources each account for 18% of total VOC emissions. Onroad sources account for 29% and nonroad sources account for 19% of total NO_x emissions.

Table 2a shows total annual emissions by state/tribe and pollutant for all four sectors combined. Tables 2b through 2e show total annual emissions by state/tribe and pollutant for area, point, nonroad, and onroad sources, respectively. Tables A-1 through A-6 in Appendix A provide summaries of annual emissions by source category and sector for VOC, NO_x, CO, SO_2, PM10-PRI and PM25-PRI, and NH_3, respectively. The emissions in each table are sorted in descending order with the highest emitting categories listed at the top of the table. The tables also show annual emissions as a percentage of total emissions from all sectors, and the cumulative percentage contribution. Chapter III of this report identifies additional summaries of emissions, including county-level summaries that contain the data source codes that identify the origin and year of emissions data.

In addition to the CAPs and NH_3, emissions for carbon dioxide (CO_2), methane (CH_4), elemental carbon (EC), organic carbon (OC), total primary and filterable particulate matter (PM-PRI/-FIL), filterable PM-10 (PM10-FIL), and filterable $PM_{2.5}$ (PM25-FIL) were carried in the mass emissions inventory files. However, these pollutants are not included in the summaries since the emissions for these pollutants were not consistently reported by all S/L/T agencies for a given sector. In addition, AR included wind-blown fugitive dust emissions in its area source inventory, and some but not all S/L/T agencies included NH_3 emissions associated with natural sources (e.g., domestic and wild animals) in their area source inventories. These emissions were kept in the area miscellaneous sources inventory, and are included in the sector-level summaries (as geogenic and natural/biogenic sources) described in Chapter III of this report.

C. Organization of the Report

In Chapter II of this report, section A provides an introduction to the chapter and sections B through D present the data sources and methods applied to prepare the mass emissions inventory and SMOKE input files for point, area, and nonroad sources within the CENRAP region.

Section E explains the data sources and methods applied to prepare 2002 Continuous Emissions Monitoring (CEM) data for the entire CENRAP modeling domain in the SMOKE and the RPO data exchange protocol formats. Section F explains the data sources and methods for developing temporal, speciation, and spatial allocation profiles for the point, area, and nonroad source categories included in the CENRAP region inventories. Section G provides documentation of the SMOKE and RPO data exchange protocol files prepared under this project.

Chapter III and Appendix A provide summaries of the 2002 emissions inventories for point, area, nonroad, and onroad sources within the CENRAP region. Chapter IV identifies the inventory and supporting data files compiled for areas outside of the CENRAP region, and Chapter V provides the references for this report.

Table 1. Summary of Annual Emissions for the CENRAP Region by Sector and Pollutant

Sector	VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total
Point	618,130	14	1,835,970	36	1,891,315	8	2,198,712	87	396,154	5	248,416	13	197,771	12
Area	2,167,263	50	850,491	16	3,778,511	17	218,259	9	6,923,304	93	1,486,600	81	1,468,741	86
Nonroad	806,173	18	982,061	19	4,933,745	22	65,812	3	90,721	1	83,964	5	1,335	0
Onroad	792,310	18	1,483,668	29	11,834,984	53	44,678	2	33,066	0	23,529	1	47,869	3
Totals	**4,383,876**	**100**	**5,152,190**	**100**	**22,438,555**	**100**	**2,527,461**	**100**	**7,443,244**	**100**	**1,842,509**	**100**	**1,715,717**	**100**
Dominant Sector[1]	**Area**		**Point**		**Onroad**		**Point**		**Area**		**Area**		**Area**	

[1] Identifies the sector accounting for the majority of the emissions for each pollutant.

Table 2a. Summary of All Sector Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
		Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total
05	Arkansas	342,534	7.8	285,782	5.6	1,630,938	7.3	127,291	5.0	328,922	4.4	134,913	7.3	138,272	8.1
19	Iowa	283,064	6.5	325,187	6.3	1,579,578	7.0	166,914	6.6	517,816	7.0	122,174	6.6	253,441	14.8
20	Kansas	264,217	6.0	376,362	7.3	2,191,899	9.8	161,064	6.4	783,946	10.5	227,427	12.3	183,539	10.7
22	Louisiana	387,577	8.8	680,322	13.2	2,263,916	10.1	388,280	15.4	332,720	4.5	157,447	8.6	88,930	5.2
27	Minnesota	540,978	12.3	463,302	9.0	2,800,101	12.5	153,978	6.1	833,308	11.2	202,666	11.0	183,354	10.7
29	Missouri	381,944	8.7	476,260	9.2	2,614,860	11.7	419,985	16.6	1,000,506	13.4	207,942	11.3	157,100	9.2
31	Nebraska	145,701	3.3	250,823	4.9	905,317	4.0	90,954	3.6	469,741	6.3	96,356	5.2	169,847	9.9
40	Oklahoma	386,157	8.8	445,487	8.7	2,118,993	9.4	167,292	6.6	740,852	10.0	174,007	9.4	133,245	7.8
48	Texas	1,651,699	37.7	1,848,165	35.9	6,332,252	28.2	851,703	33.7	2,423,179	32.6	517,686	28.1	407,989	23.8
405	Fond du Lac Tribe	3	0.0	501	0.0	700	0.0	0	0.0	12,254	0.2	1,892	0.1	0	0.0
	Totals	4,383,876	100	5,152,190	100	22,438,555	100	2,527,461	100	7,443,244	100	1,842,509	100	1,715,717	100

Table 2b. Summary of Area Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
		Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total
05	Arkansas	92,676	4.3	27,552	3.2	379,881	10.1	27,236	12.5	273,217	4.0	91,735	6.2	130,773	8.9
19	Iowa	111,851	5.2	6,920	0.8	102,183	2.7	3,290	1.5	477,093	6.9	97,987	6.6	247,156	16.8
20	Kansas	143,905	6.6	43,114	5.1	875,433	23.2	14,084	6.5	728,377	10.5	194,959	13.1	116,884	8.0
22	Louisiana	124,311	5.7	99,060	11.7	530,135	14.0	83,253	38.1	245,162	3.5	84,068	5.7	75,382	5.1
27	Minnesota	176,118	8.1	56,740	6.7	146,623	3.9	14,783	6.8	749,605	10.8	146,883	9.9	148,588	10.1
29	Missouri	133,818	6.2	34,749	4.1	269,007	7.1	48,317	22.1	962,807	13.9	182,266	12.3	120,341	8.2
31	Nebraska	69,986	3.2	15,023	1.8	81,169	2.2	7,748	3.6	447,703	6.5	83,852	5.6	137,406	9.4
40	Oklahoma	212,669	9.8	115,788	13.6	465,631	12.3	11,779	5.4	714,805	10.3	157,444	10.6	104,587	7.1
48	Texas	1,101,929	50.8	451,545	53.1	927,878	24.6	7,769	3.6	2,312,288	33.4	445,522	30.0	387,626	26.4
405	Fond du Lac Tribe	0	0.0	0	0.0	571	0.02	0	0.0	12,246	0.18	1,883	0.13	0	0.0
	Totals	2,167,263	100	850,491	100	3,778,511	100	218,259	100	6,923,304	100	1,486,600	100	1,468,741	100

Table 2c. Summary of Point Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
		Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total
05	Arkansas	158,982	25.7	75,925	4.1	360,537	19.1	93,210	4.2	46,882	11.8	35,484	14.3	5,166	2.6
19	Iowa	39,156	6.3	122,124	6.7	51,236	2.7	156,706	7.1	28,788	7.3	13,650	5.5	3,366	1.7
20	Kansas	27,458	4.4	165,284	9.0	83,307	4.4	140,371	6.4	47,081	11.9	25,073	10.1	63,914	32.3
22	Louisiana	89,025	14.4	312,634	17.0	285,395	15.1	286,050	13.0	73,333	18.5	60,899	24.5	9,237	4.7
27	Minnesota	70,415	11.4	159,324	8.7	361,952	19.1	132,773	6.0	64,645	16.3	38,954	15.7	29,726	15.0
29	Missouri	36,109	5.8	181,675	9.9	136,914	7.2	361,548	16.4	20,949	5.3	11,079	4.5	31,120	15.7
31	Nebraska	7,274	1.2	58,619	3.2	11,008	0.6	73,487	3.3	13,105	3.3	4,638	1.9	30,731	15.5
40	Oklahoma	36,987	6.0	158,972	8.7	78,430	4.2	148,852	6.8	18,009	4.6	9,776	3.9	24,256	12.3
48	Texas	152,720	24.7	600,912	32.7	522,407	27.6	805,714	36.6	83,354	21.0	48,855	19.7	255	0.1
405	Fond du Lac Tribe	3	0.00	501	0.03	129	0.01	0	0.00	8	0.00	8	0.00	0	0
	Totals	618,130	100	1,835,970	100	1,891,315	100	2,198,712	100	396,154	100	248,416	100	197,771	100

Table 2d. Summary of Nonroad Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
		Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total
05	Arkansas	51,339	6.4	64,336	6.6	285,282	5.8	3,299	5.0	5,850	6.5	5,382	6.4	49	3.7
19	Iowa	61,562	7.6	97,835	10.0	421,453	8.5	3,921	6.0	10,056	11.1	9,225	11.0	57	4.3
20	Kansas	28,009	3.5	85,234	8.7	273,433	5.5	3,913	6.0	6,770	7.5	6,196	7.4	115	8.6
22	Louisiana	109,598	13.6	117,250	11.9	549,031	11.1	14,324	21.8	10,663	11.8	9,791	11.7	563	42.2
27	Minnesota	213,527	26.5	108,293	11.0	963,290	19.5	3,834	5.8	15,946	17.6	14,657	17.5	87	6.5
29	Missouri	130,522	16.2	102,312	10.4	781,749	15.8	5,214	7.9	13,162	14.5	12,076	14.4	74	5.5
31	Nebraska	27,540	3.4	121,496	12.4	213,112	4.3	7,900	12.0	7,721	8.5	6,997	8.3	59	4.4
40	Oklahoma	49,763	6.2	51,410	5.2	331,901	6.7	2,407	3.7	5,405	6.0	4,946	5.9	280	21.0
48	Texas	134,314	16.7	233,896	23.8	1,114,495	22.6	20,999	31.9	15,149	16.7	14,695	17.5	52	3.9
405	Fond du Lac Tribe	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
	Totals	806,173	100	982,061	100	4,933,745	100	65,812	100	90,721	100	83,964	100	1,335	100

Table 2e. Summary of Onroad Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
		Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total
05	Arkansas	39,537	5.0	117,969	8.0	605,238	5.1	3,545	7.9	2,973	9.0	2,311	9.8	2,284	4.8
19	Iowa	70,494	8.9	98,308	6.6	1,004,707	8.5	2,997	6.7	1,879	5.7	1,312	5.6	2,863	6.0
20	Kansas	64,846	8.2	82,730	5.6	959,725	8.1	2,695	6.0	1,718	5.2	1,200	5.1	2,626	5.5
22	Louisiana	64,643	8.2	151,378	10.2	899,355	7.6	4,653	10.4	3,563	10.8	2,689	11.4	3,748	7.8
27	Minnesota	80,918	10.2	138,946	9.4	1,328,236	11.2	2,588	5.8	3,111	9.4	2,172	9.2	4,953	10.4
29	Missouri	81,495	10.3	157,523	10.6	1,427,190	12.1	4,907	11.0	3,589	10.9	2,521	10.7	5,565	11.6
31	Nebraska	40,902	5.2	55,685	3.8	600,028	5.1	1,818	4.1	1,212	3.7	869	3.7	1,651	3.5
40	Oklahoma	86,738	11.0	119,317	8.0	1,243,031	10.5	4,253	9.5	2,633	8.0	1,840	7.8	4,122	8.6
48	Texas	262,737	33.2	561,811	37.9	3,767,472	31.8	17,222	38.6	12,388	37.5	8,615	36.6	20,057	41.9
405	Fond du Lac Tribe	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
	Totals	792,310	100	1,483,668	100	11,834,984	100	44,678	100	33,066	100	23,529	100	47,869	100

II. CRITERIA AIR POLLUTANT AND NH_3 INVENTORIES FOR THE CENRAP REGION

A. Introduction

The inventory data were taken from the following sources in priority order:

a. The inventories that S/L/T agencies submitted to EPA from May through July 2004;
b. Supplemental data supplied by the S/L/T agencies (e.g., data that have been finalized or revised after an agency submitted its inventory to EPA);
c. Inventories developed by CENRAP; and
d. The 2002 preliminary NEI.

Table 3 provides a summary of the S/L/T point, area, and nonroad source inventories that the S/L/T agencies submitted to EPA. The EPA performed some limited QA review of the S/L/T inventories to identify format, referential integrity, and duplicate record issues. The EPA revised the inventories to address these issues and made the files available to the S/L/T agencies on August 6, 2004. These inventory files were used as the starting point for the CENRAP inventory. Pechan then performed QA review of the inventories to identify (1) remaining QA issues that needed to be resolved through consultation with the EI Workgroup, and (2) missing data that needed to be added to the inventories to support air quality modeling studies.

Table 3. Summary of 2002 Inventories that S/L/T Agencies Submitted to EPA [1]

State/Local/Tribal Agency	Point	Area	Commercial Marine Vessels	Railroad Locomotives	Aircraft
AR	x	x	x	x	x
IA	x	x[3]			
KS	x[2]	x[3]		x[3]	
LA	x	x[3]		x[3]	
MN	x[2]	x		x	x[4]
Fond du Lac Band of the Minnesota Chippewa Tribe	x	x			
MO	x[2]	x[3]		x[3]	
NE-State	x	x			
NE-Lincoln (Lancaster County)	x	x			
NE-Omaha (Douglas County)	x				
OK	x	x			
TX	x	x	x	x	x

[1] An “x” identifies the sector for which a S/L/T agency submitted a CAP inventory to EPA.
[2] State submitted separate inventories for the criteria air pollutants and NH_3.
[3] State submitted only an NH_3 inventory.
[4] State included its inventory for commercial and military aircraft and auxiliary power units in its point source inventory.

After resolving the QA issues, the files were updated to revise or add data provided by the S/L/T agencies. Inventories developed by CENRAP were added to the inventories as directed by the S/L/T agencies. Then, the inventories were compared to the 2002 preliminary NEI to identify categories that existed in the NEI but not the S/L/T inventories. The NEI data were added to the S/L/T inventories as directed by the EI Workgroup.

The following sections B, C, and D provide the methods for preparing the consolidated emissions inventories for point, area, and nonroad sources, respectively. Each section discusses the QA review that was conducted on the S/L/T inventories to identify QA issues that were corrected to support air quality modeling. Then, each section discusses the augmentation procedures that were applied to fill in missing data. These procedures identify supplemental data that S/L/T agencies provided to add to or replace data in their inventories, the CENRAP-sponsored inventories that were added to the inventories as approved by the S/L/T agencies, and the 2002 NEI categories that S/L/T agencies requested to be added to their inventories. The augmentation procedures also explain how missing PM emissions were estimated and added to the inventories after incorporating inventory data supplied by S/L/T agencies, the CENRAP-sponsored inventory data, and data from the 2002 NEI.

For point sources that are subject to CEM requirements, section E discusses the data sources and procedures for preparing the 2002 CEM data and temporal profiles to support air quality modeling. For point, area, and the non-NONROAD model source categories, Section F discusses the data sources and procedures for preparing temporal, speciation, and spatial allocation profiles needed to support air quality modeling. Section G discusses the formats in which the final emissions, temporal, speciation, and allocation data were prepared.

B. Point Source Inventory Methods

1. Data Sources

For each S/L/T inventory submitted to EPA, Table 4 provides a summary of the pollutants included in each inventory, and compares the number of counties in the inventory to the number of counties in the 2002 preliminary NEI and in each S/L/T agency. The table also compares the number of facilities in the S/L/T inventory to the number of facilities in the 2002 preliminary NEI.

The inventories obtained from EPA are in Access 2000 databases in NIF 3.0. Each inventory was loaded into an Oracle database in NIF 3.0 to combine the inventories into a single data set. Then, after loading the inventories into Oracle in NIF 3.0, the following updates were performed on the consolidated data set, if necessary:

Table 4. Summary of Pollutants, Number of Counties, and Number of Facilities in Point Source Inventories

State/Local/ Tribal Agency	CO	NH_3	NO_x	PM-PRI	PM10-PRI	PM25-PRI	PM10-FIL	PM25-FIL	PM-CON	SO_2	VOC	Number of Counties in 2002 S/L/T Inventory	Number of Counties in 2002 Preliminary NEI	Number of Counties in State	Number of Facilities in 2002 S/L/T Inventory	Number of Facilities in 2002 Preliminary NEI
AR	x	x	x							x	x	57	60	75	227	324
IA	x	x	x	x	x	x				x	x	74	26	99	270	67
KS[1]	x	x	x		x	x	x	x		x	x	97	96	105	708	705
		x										104	16	105	3,319	20
LA	x	x	x				x	x		x	x	59	60	64	906	1,033
MN[1]	x	x	x		x	x		x		x	x	87	82	87	2,628	836
		x										77	13	87	542	14
Fond du Lac Band of the Minnesota Chippewa Tribe	x		x	x	x					x	x	NA[2]	NA	NA	5	NA
MO[1,3]	x	x	x		x					x	x	109	103	115	1,646	720
		x										105	16	115	1,181	20
NE-State	x		x			x				x	x	27	72	93	36	634
NE-Lincoln (Lancaster County)	x		x		x					x	x	1	1	93	17	100
NE-Omaha (Douglas County)	x	x	x	x	x	x				x	x	1	1	93	68	87
OK	x	x	x	x	x	x				x	x	66	69	77	397	1,046
TX	x		x		x	x				x	x	201	203	254	1,914	3,268

[1]State submitted separate inventories for the criteria pollutants and NH_3. The NH_3 inventory was prepared under a CENRAP-sponsored project. The number of counties and facilities in the 2002 preliminary NEI are for facilities with annual NH_3 emissions. Note that the number of counties and facilities with annual NH_3 emissions in KS and MO in the 2002 preliminary NEI are the same.

[2] NA = Not Applicable.

[3] The data for MO are from its original inventory submittal to EPA.

- Hazardous air pollutant (HAP) records were removed since the inventory will support regional haze, fine PM, and ozone modeling.

- Pollutant codes were corrected to make them NIF 3.0 compliant (e.g., update PMPRI pollutant code to PM-PRI). Additionally, other codes were identified for remediation on a case-by-case basis.

- Records with a submittal flag indicating deletions (submittal_flag = 'D' or 'RD') were removed from the inventory.

- Null values in the tribal code field were updated to '000' since this field is a part of the data key that defines records as unique in all eight NIF tables.

- The following NIF plus fields were added to the Transmittal (TR), Site (SI), Emission Unit (EU), Emission Release Point (ER), Emission Process (EP), Emission Period (PE), Emission (EM), and Control Equipment (CE) tables:

    - Data Source Codes:

Code	**Description**
S	State agency-supplied data.
L	Local agency-supplied data.
R	Tribal agency-supplied data.
P	Regional Planning Organization.
SC	S/L/T agency Corrected.
AUG-A	PM Augmentation: ad-hoc change.
AUG-C	PM Augmentation: standard augmentation method.
AUG-O	PM Augmentation: set PMxx-FIL = PMxx-PRI where for SCCs starting with 10 (external fuel combustion) and 20 (internal fuel combustion). Note: emission factors and particle-size data for estimating condensible emissions for fuel combustion SCCs starting with 30 were not available; therefore, condensible emissions were not estimated for these processes if an agency provided filterable and not primary emissions for these processes.
AUG-Z	PM Augmentation: automated fill-in of zero values where all PM for a particular process is zero.
GENPARENT	Data source where a parent record was system generated.

    - Revision Date: This field indicates the month and year during which the last revision was made to a record.

    - State Federal Information Processing Standard (FIPS): This field indicates the state FIPS code of the submittal.

    - County FIPS: This field indicates the county FIPS code of the submittal.

- The following NIF plus fields were added to the EM table:
    - Emission Ton Value: This field indicates the values of the emissions in tons. This field was used to prepare summaries of emissions on a consistent emission unit basis.
    - Emission Type Period: This field indicates the period of the Emission Type – either ANNUAL or NONANNUAL. This field was used to prepare summaries of annual emissions.
    - CAP_HAP: This field identifies records for CAP versus records for HAPs. For the CENRAP inventory, the flag is CAP for all records.
    - Year: This field indicates the year of the data; for this inventory, it is 2002.

2. QA Review

QA review on the inventories was conducted in accordance with the QA procedures specified in the QAPP for this project (CENRAP, 2004b). The following discusses the QA diagnoses that were run on the consolidated point source inventory data set. The QA issues identified were communicated to the S/L/T agencies through a set of QA Summary Reports in Excel Workbook files. The agencies provided corrections to the data in the Excel files and the inventory was updated with the corrections.

a. County and Facility Coverage

S/L/T agencies for which the number of counties in their point source inventory submittal to EPA declined relative to the number of counties in the NEI include AR (-3 counties), LA (-1 parish), OK (-3 counties), TX (-2 counties), and NE (-45 counties) (see Table 2). NE moved its small point sources from its area source inventory to its point source inventory; therefore, this increased the county coverage in its point source inventory. States for which the number of counties in their point source inventory submittal to EPA increased relative to the number of counties in the NEI included IA (+48 counties), MO (+6 counties), MN (+5 counties), and KS (+1 county). The NEI did not contain any tribal data for the CENRAP region.

As shown in Table 4, the number of facilities included in the inventories for AR, LA, NE, NE – Omaha, NE – Lincoln, OK, and TX is lower than the number of facilities included in the 2002 preliminary NEI. An electronic match was conducted on the state and county FIPS and facility identification (ID) code between the two inventories to identify facilities and their emissions in the 2002 preliminary NEI but not in the S/L/T agency inventories. However, due to changes that S/L/T agencies made to facility ID codes in their inventories, the electronic matching did not work well as this procedure identified facilities that are in both inventories but with different facility ID codes. The results of this comparison were provided to the agencies for review and all of the agencies confirmed that there were no missing facilities in the point source inventories they submitted to EPA.

b. Pollutant Coverage

As shown in Table 4, all of the S/L/T inventories contain emissions for CO, NO_x, SO_2, and VOC. The inventories for TX; NE state; Lancaster County, NE; and the Fond du Lac Band of the Minnesota Chippewa Tribe did not include NH_3 emissions. KS, MN, and MO submitted NH_3 inventories prepared under a CENRAP-sponsored project. These NH_3 inventories were merged with the CAP inventories for these three states. Pechan worked with these three agencies to resolve facility matching and duplicate records that occurred in the Transmittal (TR), Site (SI), Emission Release Point (ER), Emission Unit (EU), and EP tables.

Except for AR, all S/L/T agencies included one or more forms of PM, PM_{10}, and/or $PM_{2.5}$ in their inventories. AR subsequently provided a new inventory that included PM_{10} and $PM_{2.5}$ emissions data. The modeling inventory needs to include a complete set of PM10-PRI and PM25-PRI pollutants for all sources of PM_{10} and $PM_{2.5}$. Therefore, based on the data the S/L/T agencies included in their inventories, procedures were developed and applied to fill in missing pollutant data needed to prepare a complete PM10-PRI and PM25-PRI inventory. The QA review of the PM data is discussed further in the following section, and the augmentation procedure is discussed in section II.B.4.

c. Particulate Matter (PM) Emissions Consistency and Completeness Review

The following consistency checks were performed at the EM table data key level (for annual emissions) to compare PM emissions:

- If a process was associated with a PM emission record, but was missing one or more of the following (as appropriate for the Source Classification Code [SCC] [i.e., condensible PM (PM-CON) is associated with fuel combustion only]): PM10-FIL, PM10-PRI, PM25-FIL, PM25-PRI, or PM-CON, the record was flagged for review.

- The following equations were used to determine consistency:

  PM10-FIL + PM-CON = PM10-PRI
  PM25-FIL + PM-CON = PM25-PRI
  PM-FIL + PM-CON = PM-PRI (as appropriate)

- The following comparisons were applied to determine consistency:

  PM10-PRI >= PM10-FIL
  PM25-PRI >= PM25-FIL
  PM10-PRI >= PM-CON
  PM25-PRI >= PM-CON
  PM10-FIL >= PM25-FIL
  PM10-PRI >= PM25-PRI
  PM-PRI >= PM10-PRI (as appropriate)
  PM-PRI >= PM25-PRI (as appropriate)

PM-FIL >= PM10-FIL (as appropriate)
PM-FIL >= PM25-FIL (as appropriate)

If the data failed one of these checks it was diagnosed as an error. If a S/L/T agency did not provide corrections to these errors, the errors were corrected/filled in according to the augmentation procedure discussed in section II.B.4.

d. Emission Release Point (ERP) Coordinate Review

Location coordinates for point sources were evaluated using geographic information system (GIS) mapping to determine if the coordinates were within 0.5-kilometers of the boundary of the county in which the source was located. If not, the S/L/T agency was asked to review the coordinates and provide corrections to either the coordinates or the state and county FIPS codes. The 0.5-kilometer test resulted in a large number of ERPs for review by the agencies. Therefore, to assist S/L/T agencies in prioritizing their review of coordinates, ERP records with coordinates located more than 0.5, 1, 2, 3, 5, 7, and 10 or more kilometers from their county boundary, and coordinates that mapped outside of their state boundary were identified. Annual emissions summed to the ERP level were included in the QA Summary Report to identify records with zero emissions for all pollutants and to identify the highest emitting stacks.

e. ERP Parameter Review

The EPA's QA guidance for diagnosing ERP issues for the point source NEI (EPA, 2004b) was applied to identify QA issues in the S/L/T point source inventories. The QA guidance involved diagnosing the correct assignment of the ERP type (i.e., stack or fugitive), parameters with zero values, parameters not within the range of values specified in the EPA's QA procedures, and consistency checks (i.e., comparing calculated values against expected values). In many cases errors were due to defaulted zeros, and submitting agencies were requested to provide the value. In other cases, out-of-range errors were caused by unit conversion issues (e.g., stack parameters were in ft, ft/sec, cu ft/sec or degrees Fahrenheit). The agencies were asked to provide corrections or additions to ERP parameters, or note in the QA Summary Report that records flagged with potential QA issues were corrected. If an agency did not provide corrections for out-of-range or missing values, the data were corrected or filled in according to the ERP augmentation procedure discussed in section II.B.4.

f. Control Device Type and Control Efficiency Data Review

The CE codes in the "Primary Device Type Code" and "Secondary Device Type Code" fields were reviewed to identify invalid codes (i.e., codes that did not exist in the NIF 3.0 reference table) and missing codes (e.g., records with a null or uncontrolled code of 000 but with control efficiency data).

QA review of control efficiency data involved diagnosis of two types of errors. First, records were reviewed to identify control efficiency values that were reported as a decimal rather than as a percent value. Records with control efficiencies with decimal values were flagged as a potential error (although not necessarily an error, since the real control efficiency may be less than 1 percent).

The second check identified records where 100% control was reported in the CE table, but the emissions in the EM table were greater than zero and the rule effectiveness value in the EM table was null, zero, or 100% (implying 100 percent control of emissions). Because many agencies did not populate the rule effectiveness field or a default value of zero was assigned, records with null or zero rule effectiveness values were included where the CE was 100% and emissions were greater than zero. For records that met these criteria, the records were reviewed by the S/L/T agency to provide corrections, if necessary.

g. Start and End Date Checks

QA review was conducted to identify start date and end date values in the PE and EM tables to confirm consistency with the inventory year in the transmittal table, and to confirm that the end date reported is greater than the start date reported.

h. Annual and Daily Emissions Comparison

The following QA checks were conducted to identify potential errors associated with the incorrect reporting of daily and/or annual emissions:

- Any “DAILY” type record that is greater than its associated “ANNUAL”. Only TX and MO sent DAILY records. While TX did have DAILY records greater than annual (due to the TX original database rounding of TON vs. LB records). For the CENRAP point source inventory it was determined that the most efficient approach was to use only the ANNUAL records.

3. Responses from S/L/T Agencies

The point source inventories were revised to incorporate the corrections that the S/L/T agencies provided in response to the QA issues identified in their inventories. Where responses from the S/L/T agencies were not provided, standard procedures were used to default or augment the data. Section II.4 describes in more detail the gap filling and augmentation procedures. Additionally, included with this report is a set of S/L/T-specific files indicating responses to specific QA issues and defaults that were implemented with remaining QA issues. An example of a default implemented would be the correction of TONS to TON in a unit field. Each S/L/T set of files is accompanied by a Read_me.txt file that describes the files in further detail. The files included with each S/L/T documentation set (if the QA issue existed) are the following (based on the QA Issues discussed above):

- PM Augmentation QA Summary
- PM Augmentation Preliminary Review
- Stack Parameter QA Summary
- Stack Coordinates QA Summary
- Stack Parameter and Coordinate Augmentation

- SCC QA Summary
- Control Device/Efficiency Summary

In addition, the listing of state QA files also includes the output of the EPA QA checker as run on the final CENRAP inventory, and the PM ratio factor table (as described in section II.B.4.b) as developed for the CENRAP SCC and control devices.

4. Gap Filling and Augmentation

The following discusses the augmentation procedures that were used to fill in missing data that were not supplied by the S/L/T agencies.

a. CENRAP Sponsored Inventories

The CENRAP inventory includes data generated from CENRAP sponsored source type oriented inventories. The following inventories (and the relevant S/L/T agencies) were included with the CENRAP inventory:

- CENRAP NH_3 Inventory (IA, KS, MO, MN, NE, OK)
- MN Fires Inventory (MN)
- CENRAP Prescribed Burning Inventory (all states)
- CENRAP Concentrated Animal Feeding Operations (CAFO) Dust Inventory (all states)

b. PM Augmentation

The PM augmentations process gap-fills missing PM pollutant complements. For example, if a S/L/T agency provided only PM10-PRI pollutants the PM augmentation process filled in the PM25-PRI pollutants. The steps in the PM augmentation process were as follows:

- Initial QA and remediation of S/L/T provided PM pollutants;
- Development of PM factor ratios based on factors from FIRE (Factor Information REtrieval) version 6.2 and the PM Calculator (EPA, 2003; EPA, 2004c);
- Implementation of the ratios developed in step 2.; and
- Presentation of PM augmentation results to S/L/T agencies for review and comment

Note: There are two Access databases that accompany this documentation. The first database is the *Reference Tables for PM Augmentation*. This database contains the SCC Control Device Ratio table, the Emission Factors table and Emission Factors Crosstab table discussed in Step 2. The PM Calculator ratio table can be provided upon request – it contains all possible combinations for SCC and Control Device types that are available in the PM Calculator.

An additional database (*PM Augmentation Draft*) that contains the PM crosstab table with the preliminary PM Augmentation results and a QA table (which may be empty) was provided. This database will be discussed in Step 3 and Step 4.

These steps are further detailed below.

1. Initial QA and Remediation of PM Pollutants

S/L/T agencies were initially presented with files that detailed potential inconsistencies and missing information in their PM pollutant inventory. Inconsistencies in PM pollutants include the following:

- PM-PRI less than PM10-PRI, PM25-PRI, PM10-FIL, PM25-FIL, or PM-CON
- PM-FIL less than PM10-FIL, PM25-FIL
- PM10-PRI less than PM25-PRI, PM10-FIL, PM25-FIL or PM-CON
- PM10-FIL less than PM25-FIL
- PM25-PRI less than PM25-FIL or PM-CON
- The sum of PM10-FIL and PM-CON not equal to PM10-PRI
- The sum of PM25-FIL and PM-CON not equal to PM25-PRI

Potential missing information was summarized in a table which detailed the variety of cases provided by the S/L/T agency. For example, a S/L/T agency might have provided PM10-FIL and PM25-FIL for some processes, but for other processes only PM10-FIL was provided.

S/L/T agencies were asked to review this information and provide corrections where possible. In general, corrections (or general directions) were provided in the case of the potential inconsistency issues. An example of a general direction provided by a S/L/T agency was to remove PM25-FIL where greater than PM10-FIL because the PM10-FIL was (in their particular case) known to be more reliable. In other cases, the agency-provided specific process level pollutant corrections. In general, if specific direction was not provided by the agency, priority was given to the PM_{10} number.

2. Development of PM Factor Ratio

The primary deliverable of this step of the process was the development of a table keyed by SCC, primary control device, and secondary control device. This table is called the SCC Control Device Ratios table. The table structure follows the discussion below.

This table was filled according to the following steps:

- Ratios (both condensible and noncondensible) were added from FIRE for SCCs starting with 10* (external fuel combustion) and 20* (internal fuel combustion) where there was a direct match between the provided SCC, and primary and secondary control devices.
- Ratios (non-condensable) were added from the PM Calculator for SCCs starting with 10* and 20* where there was not a direct match between the provided SCC, and primary and secondary control devices. Condensible ratios were added from the PM Calculator based on the uncontrolled SCC for these SCCs. In some cases, it was necessary to map the SCC and control devices to the PM calculator to find a match

for the noncondensible ratios. In some cases, it was necessary to map the SCC to FIRE to find a match for condensible ratios.

Table 5. Description of the Field Names and Descriptions for the SCC Ratio Table

Field Name	Field Description
PM Calculator	A “Yes” in this field indicates that at least some of the information was retrieved from the PM Calculator
FIRE	A “Yes” in this field indicates that at least some of the information was retrieved from the Emission Factors table. A “Condensible Ratios” in this field indicates that the condensible ratios factors were retrieved from this table.
Other	A field to indicate other sources as necessary.
SCC	Source category code from the S/L/T agency-provided data.
SCC_DESC	Description of source category code from the S/L/T agency-provided data.
maptoSCC	This field equals SCC unless the SCC provided was not found in the appropriate source table. In that case, the SCC was mapped using the closest available appropriate mapping choice.
maptoSCC_DESC	Description of the maptoSCC.
mapSCCNote	Any notes related to the mapping of the SCC. A “Yes” in this field indicates that the SCC was mapped.
PD	Primary device type from the S/L/T agency provided data.
PD_DESC	Description of the primary device (PD).
maptoPD	This field equals PD unless the PD provided was not found in the appropriate source table. In that case, the PD was mapped using the closest available appropriate mapping choice.
maptoPD_DESC	Description of the maptoPD.
mapPDNote	Any notes related to the mapping of the PD. A “Yes” in this field indicates that the PD was mapped.
SD	Secondary device type from the S/L/T agency provided data.
SD_DESC	Description of the secondary device (SD).
maptoSD	This field equals SD unless the SD provided was not found in the appropriate source table. In that case, the SD was mapped using the closest available appropriate mapping choice.
maptoSD_DESC	Description of the maptoSD.
mapSDNote	Any notes related to the mapping of the SD. A “Yes” in this field indicates that the SD was mapped.
PM-FIL/PM10-FIL	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-FIL/PM25-FIL	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-FIL/PM-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-PRI/PM10-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-PRI/PM25-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM10-FIL/PM25-FIL	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM10-PRI/PM25-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-CON/PM10-FIL	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM10-PRI	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM25-FIL	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM25-PRI	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM-FIL	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM-PRI	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
RPO Specific Note	Indicates SCC and control device combinations are in the RPO inventory.
Additional Notes	Any notes regarding assumptions about ratios.

- For natural gas, process gas and liquefied petroleum gas SCCs starting with 10* and 20*, it was assumed (based on FIRE emission factors trend) that the PM-PRI/PM10-PRI/PM25-PRI ratio was equal to 1. It was also assumed that the PM-FIL/PM10-FIL /PM25- FIL was equal to 1. Condensible ratios were calculated from uncontrolled FIRE emission factors based for these SCCs. In some cases it was necessary to map the SCC to FIRE to find a match for condensible ratios.
- Ratios for SCCs not like 10* and 20* were obtained from the PM Calculator. It was assumed that the condensible component was zero.

Accompanying this document is a database containing the SCC Control Device Ratios table. Additionally, the Emission Factors and Emission Factors Crosstab table (which are derived from FIRE) are provided. The Emission Factors Crosstab table contains the ratios developed from the Emission Factors table. The Emission Factors table contains detailed information on the emission factors used to develop the ratios.

Note: Ratios from the PM calculator were developed using a standard input of 100 TONS of uncontrolled PM-FIL emissions.

3. Implementation of the QA Ratios

In order to calculate the additional PM pollutants based on the SCC Control Device ratio table developed in the above step, a crosstab table was created from the EM table based on the following fields:

- State FIPS
- County FIPS
- Tribal Code
- Emission Unit ID
- Process ID
- Start Date
- End Date
- Emission Type
- SCC
- Primary Device Type
- Secondary Device Type

The primary and secondary device type fields were added based on information from the CE table. If control equipment information was not available these fields were defaulted to 000 (“UNCONTROLLED”). In the few cases where there was a conflict between the control devices reported for the same process for PM pollutants (for example, a PM10-PRI is listed as controlled, but PM-PRI did not have control information), the control device type was selected based on the controlled pollutant.

In addition to the fields listed above, the crosstab included the PM emission amounts for the particular process and a field that indicated whether those emissions existed in the inventory. These fields are as follows:

- PM_PRI
- PM_FIL
- PM10_PRI
- PM10_FIL
- PM25_PRI
- PM25_FIL
- PM_CON
- PM_PRI_EXISTS
- PM_FIL_EXISTS
- PM10_PRI_EXISTS
- PM10_FIL_EXISTS
- PM25_PRI_EXISTS
- PM25_FIL_EXISTS
- PM_CON_EXISTS

The emission values are in the PM_PRI, PM_FIL, PM10_PRI, PM10_FIL, PM25_PRI, PM25_FIL, PM_CON fields. The _EXISTS field indicates whether the pollutant was provided by the S/L/T agency. A zero indicates that the pollutant was not provided; a number greater than zero (usually one) indicates that it was provided by the S/L/T agency.

Prior to the development of this crosstab, the EM table was filled in as much as possible using basic assumptions. For example, if the S/L/T agency provided emissions that were equal to zero for PMs for a particular process, it was assumed that all PMs for that process were zero and they were filled in accordingly. Since that assumption was that for non 10* and 20* SCCs, the condensible value was zero – that would lead to PM10-FIL = PM10-PRI and PM25-FIL = PM25-PRI and PM-FIL = PM-PRI. Given that assumption, values for these pollutants were also filled in. After this data insertion, a subset of the crosstab was created. This subset only contained processes that required additional augmentation. The SCC control device type ratio table described in step 2 was based on only those SCC and control device types that required augmentation.

The next step was to fill in the missing information in this crosstab using the information found in the SCC Control Device Ratio table.

In calculating PM complement pollutants, priority was given to calculating –PRI and –CON pollutants. FIL pollutants were only calculated if necessary to calculate other pollutants or if it was a by-product of this calculation.

In augmenting the PM pollutants the non 10* and 20* SCCs were augmented first, with order given to augmenting based on PM_{10} where available, PM_{25} where available, and then PM .

Augmenting the PM pollutants for the 10* and 20* SCCs is more complicated, but the basic approach was to augment based on PM_{10} (FIL or PRI) where available, $PM_{2.5}$ (FIL or PRI) where available, and then PM (FIL or PRI) if PM_{10} or $PM_{2.5}$ variations were not available. Where both PM_{10} (FIL or PRI) and $PM_{2.5}$ (FIL or PRI) variations were both available, the calculation for

PM-CON was generally driven from the PM_{10} number and the complements as necessary were back calculated. Where a –PRI emission factor ratio was required and was not available the –FIL emission factor ratio was used.

After calculations, the data was QA checked to ensure that the calculations resulted in consistent values for the PM complement. On a few occasions, the mix of ratio value and the pollutants and values provided by the S/L/T agency resulted in negative values when –FIL was back-calculated. In this case the negative –FIL value was set to zero and the –PRI value was readjusted.

The resultant PM table has the format described in Table 6.

4. Presentation of PM Augmentation for S/L/T Agencies to Review and Comment

The table described in Step 3 was provided for the S/L/T agency to review in the *PM Augmentation Draft*) . In addition to this table, if there were any remaining QA issues these were listed in the QA table in this database.

Note: There are some high condensible ratios that were calculated for some SCC device type combinations. In most cases these high condensible ratios were the result of the back calculation of PM-CON from PM10-PRI or PM25-PRI records. Since the state had already provided the PMxx-PRI records, these PM-CON values were not added to the inventory.

The data source code field was used to identify records that were added to the inventory to complete the set of PM10-PRI and PM25-PRI emissions.

c. ERP Coordinates

If a S/L/T agency did not provide corrections for ERP coordinates that map more than 5 kilometers outside of the county boundary, or provide coordinates for ERP records that did not have any coordinates in the S/L/T inventory, the following procedures were applied to replace the coordinates:

- Coordinates for other ERPs at the same facility, if available, that map within the county;
- Coordinates for the centroid of the zip code for a facility if a valid zip code is provided or can be obtained from the agency if it is not valid; or
- County centroid coordinates.

Table 6. Description of the Field Names and Descriptions for the Resulting PM Augmentation Table

Field Name	Field Description
Augment	A "Yes" in this field indicates that the process PM was augmented.
Condensible Note	If condensible information was added this field will note that.
STATE_FIPS	State FIPS
COUNTY_FIPS	County FIPS
STATE_FACILITY_IDENTIFIER	Site ID
EMISSION_UNIT_ID	Emission Unit
PROCESS_ID	Process
START_DATE	Start Date
END_DATE	End Date
EMISSION_TYPE	Emission type
SCC	Source Category Code
SCC_DESC	SCC description
PRIMARY_DEVICE_TYPE	Primary Device Type
PRIMARY_DEVICE_TYPE_DESC	PDT description
SECONDARY_DEVICE_TYPE	Secondary Device Type
SECONDARY_DEVICE_TYPE_DESC	SDT description
EMISSION_TYPE_PERIOD	Emission Type Period
EMISSION_RELEASE_POINT_ID	Emission Release Point ID
FACILITY_NAME	Facility Name
ORIS_FACILITY_CODE	ORIS facility Code
SIC_PRIMARY	SIC
ACTUAL_THROUGHPUT	Actual Throughput
THROUGHPUT_UNIT_NUMERATOR	Throughput Unit Numerator
PM_PRI	Emission ton value for PM-PRI
PM_FIL	Emission ton value for PM-FIL
PM10_PRI	Emission ton value for PM10-PRI
PM25_PRI	Emission ton value for PM25-PRI
PM10_FIL	Emission ton value for PM10-FIL
PM25_FIL	Emission ton value for PM25-FIL
PM_CON	Emission ton value for PM-CON
PM_PRI_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM_FIL_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM10_PRI_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM25_PRI_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM10_FIL_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM25_FIL_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM_CON_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
RECORD_COUNT	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
System Update Note	This field contains system codes related to the update queries used to calculate the record.

The zip code was taken from the SI NIF 3.0 table. The zip code was compared to a reference table of valid zip codes to verify that it is an active zip code and exists in the state and county reported in the inventory. If a valid zip code for a facility was not identified, the centroid for the facility's county was used as a last resort. In some cases, the S/L/T agency provided confirmation that the S/L/T coordinates were correct even if the analysis indicated that the coordinates were outside of the county boundary (generally in the case of offshore facilities). These coordinates were not changed. Additionally, all coordinates were converted to latitude/longitude measurements.

d. ERP Parameters

If valid ERP parameters were not provided by the S/L/T agency, Pechan applied the ERP augmentation procedures for the 2002 point source NEI (EPA, 2004b). It has been determined that the augmentation procedures in this document regarding SCC-specific ERP types and temperatures may be difficult to resolve. When this situation occurred, preference was given to the S/L/T agency-supplied ERP type and SCC. For example, the procedures did not account for cases where an emission unit had two processes with one defined as a stack source and the other as a fugitive source. Therefore, the S/L/T-supplied ERP type was used when this situation occurred. If the ERP type was null, and information was not available from the S/L/T agency, the stack height information was used as a guide. If stack height information was available, the ERP was treated as a stack, or, if stack height information was not available, the ERP type was treated as a fugitive. Additionally, there were occasional typographical errors resolved where the ERP type digits were transposed '20' instead of '02'; these were resolved. An additional modification to the augmentation procedure was also implemented. Since, in many cases, null values were filled in with zeros by S/L/T agency databases when comparing out-of-range velocities and flows (after it was determined that the stack and diameter information was correct) – null and zero values were treated in the same manner to prevent inappropriate replacement of stack parameter values. Additionally, stack parameter values were rounded to 1 decimal place when compared to range values (just for the purposes of comparison) to prevent replacement of S/L/T parameter values based on negligible decimal differences.

e. Control Device Type and Control Efficiency Data

Control efficiency values of 100% and rule effectiveness values of 100% with non-zero emissions were diagnosed as potential errors and sent to the S/L/T agencies. Where possible the data were updated with S/L/T corrections. Decimal control efficiencies were also diagnosed and sent to the S/L/T agencies. A decimal control efficiency value usually indicated that the control efficiency was not entered as a percentage value as is required by NIF 3.0. Where possible the data were updated with S/L/T corrections (See Section II.B.2 above).

f. SCC Data

S/L/T agencies were provided with lists of invalid or inactive SCCs. Where the S/L/T agencies were able to provide valid SCC information this was updated with S/L/T agency information. Where S/L/T agencies were unable to provide valid SCC information, the proposed mapping information provided was used to update the S/L/T agency information.

In some cases, the SCC issues were not forthcoming until further into the processing than the initial QA stages. This occurred in cases of late data submissions, and the generation of parent EP records for EM records. In this case, SCCs were replace with the following approach:

- Where the SCC was invalid and mapping was available the SCC was changed to the mapping SCC;
- Where the mapping SCC was not available a more generic code was selected;
- Where the SCC was truncated a generic code was selected;

- Where the SCC was still unavailable the NEI 1999 Version 3 was used as a source;
- Where still unavailable – the most generic of the existing SCCs for the emission unit was used; or
- Where still unavailable – the most generic of the existing SCCs for the facility was used.

This second approach affected 529 records.

g. SIC Data

There were some overall changes made to SIC data – for SICs that had been provided as 0200 these were changed to 02 which is considered a valid SIC by the EPA QA program. Also, in order to provide a better basis for the stack augmentation procedure, missing SIC codes were filled in using the lowest numerical value based on the NAICS to SIC code crosswalk.

5. Revisions to Address Comments

The following items were revised per state instruction during S/L/T agency review of the draft point source inventory:

a. Missouri

Missouri supplied new stack parameter information. Their stack parameters were updated and the stack augmentation procedure was reapplied. The Access database "Missouri_Stack_Updates_200501.mdb" contains the changes.

b. Nebraska-Omaha

NH_3 emissions were revised from 584.78 tons per year to 1.57 tons per year for Nebraska-Omaha facility 0002 - the Omaha Public Power District - North Omaha Power Station.

c. Minnesota

Per Minnesota's request, SCC 30302301 (- crushing) was changed to SCC 30302312 (-pellet induration) for the following facility, emission unit, and processes:

Facility Name: Ispat Inland Mining Company
State Facility ID: 2713700062
Emission Unit ID: EU026
Process IDs: 001, 004, 007, and 010

d. Texas and Missouri Daily Emissions

State daily emissions data for Texas and Missouri are included in the SMOKE input files for the CENRAP inventory. For the NIF 3.0 files, the daily emissions are provided in a file called "CENRAP_Point_Daily_Missouri_Texas_20050216.mdb." A daily emissions record **was** included in the file only if it had an associated annual emissions record. In addition to the Daily EM and PE records, a table called "Daily Values GT Accompanying Annual Values" was included in the database that lists records with a daily emission value that is greater than the annual emission value. In the overwhelming majority of cases this situation occurred when the daily emission value was very small and recorded in pounds and the annual value was zero and recorded in tons. In many cases, in the originating emission inventory application, emission values are rounded. Therefore, the annual ton value was rounded to zero.

6. QA Review of Final Inventory

Final QA checks were run on the revised point source inventory data set to ensure that all corrections provided by the S/L/T agencies were incorporated into the S/L/T inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory in Oracle to an Access database in NIF 3.0, the EPA QA program was run on the Access database and the QA output was reviewed to verify that all QA issues that could be addressed were resolved (EPA, 2004a)

This file accompanies this documentation with the specific details included. The following summarizes the remaining QA issues that could not be addressed during the duration of this project (listed by table):

CE

Primary device type codes were not provided by all of the modeled inventories, specifically CAFOs and prescribed burning; it should be determined if there is an appropriate generic primary device type to be used or whether the CE records should be removed.

In the MN prescribed burning inventory, a NIF 3.0 formatting error resulting in a shift of the data which place the submittal flag of A in the third primary device column (as well as other shifts). This has no effect on the data performance, but it is noted as a potential cleanup issue.

EM

The EPA QA checker indicated that some emissions were outside the normal expected range. While this is a guideline and not a specific fault, this listing could be reviewed for specifically high values.

CH_4, EC, and OC were flagged as errors since these values are not in the EPA pollutant code table.

PE

There are a few records with the units M2 and MASS that were not in the EPA QA checker table. It could be determined if these values should be added, or whether there are appropriate substitutes.

There are a few remaining records with operating times outside the EPA QA Checker ranges.

EP

There are a few remaining records with operating parameters and seasonal sums outside the normal expected range.

The SCC 30202000 has not yet been added to the EPA QA Checker SCC database.

ER

A significant number of records are missing the supplementary coordinate reference information (Horizontal data measure, horizontal data accuracy, horizontal collection method code).

A number of records indicate coordinates outside of county boundaries – the reasons why this may occur were explained in the coordinate augmentation section earlier in this document.

A number of records also indicate stack parameters outside of ranges expected by the EPA QA checker. This is due either to the S/L/T agency specifically requesting not to change the values or to default values in the EPA table which fall outside of the EPA QA Checker ranges.

EU

SIC code 3041 is not in the SIC codes table.

SI

The modeled inventories (particularly the NH_3 and CAFO inventories) did not provide zip code information with the site data. This accounts for a tremendous number of the invalid zip code errors found when running the EPA QA checker. There are other records with zip code errors in addition to these; however, these inventories are the source of the majority of these errors.

NAICs codes are missing on some records.

TR

REPORT_CERTIFIER should be corrected to REPORT CERTIFIER.

Some records are missing the transaction creation date information.

C. Area Source Inventory Methods

1. Data Sources

For each S/L/T inventory submitted to EPA, Table 7 provides a summary of the number of counties and the pollutants included in each S/L/T inventory. For comparison purposes, the table shows the number of counties in each area source inventory included in the 2002 preliminary NEI and the number of counties in each state.

The states of IA and LA did not submit an area source inventory for the CAPs. For the state of NE, the data shown in Table 7 are from its area source inventory submittal to EPA. However, NE's area source inventory contained emissions for small point sources and NE subsequently moved the small point sources to the its point source inventory. IA, LA, NE, and OK requested that the 2002 preliminary NEI be used for their area source inventory for the CAPs except for categories (i.e., prescribed burning, agricultural burning, and agricultural dust) for which they requested that the CENRAP-sponsored inventory be used instead of the NEI. The NH_3 inventories that IA and LA submitted to EPA were maintained in the CENRAP inventory. In addition, Omaha did not submit an area source inventory; therefore, the 2002 preliminary NEI was used as the area source data for the CENRAP inventory for Omaha. OK's original inventory submittal to EPA was a copy of the 2002 preliminary NEI, but the emission values were rounded to two decimal places. OK's inventory was updated with the unrounded emission values in the 2002 preliminary NEI (February 2004 version).

The area source inventories obtained from EPA were loaded into Oracle in NIF 3.0 into one data set. Then, the following updates were performed on the consolidated data set, if necessary:

- HAP records were removed since the inventory will support regional haze, fine PM, and ozone modeling.

- Pollutant codes were corrected to make them NIF 3.0 compliant (e.g., update PMPRI pollutant code to PM-PRI). Additionally, other codes were identified for remediation on a case-by-case basis.

- Records with a submittal flag indicating deletions (submittal_flag = 'D' or 'RD') were removed from the inventories.

- Null values in the tribal code field were updated to '000' since this field is a part of the data key that defines records as unique in all five NIF tables.

Table 7. Summary of Pollutants and Number of Counties Included in Area Source Inventories

State/Local/Tribal Agency	CO	NH_3	NO_x	PM-PRI	PM10-PRI	PM25-PRI	PM10-FIL	PM25-FIL	PM-CON	SO_2	VOC	Number of Counties in 2002 S/L/T Inventory	Number of Counties in 2002 Preliminary NEI	Number of Counties in State
AR	x	x	x		x	x				x	x	75	75	75
IA		x										99	99	99
KS	x	x	x		x	x				x	x	105	105	105
LA		x										64	64	64
MN	x	x	x		x					x	x	87	87	87
Fond du Lac Band of the Minnesota Chippewa Tribe	x		x	x	x					x	x	NA[1]	NA	NA
MO	x	x	x		x	x				x	x	115	115	115
NE-State	x	x	x		x		x			x	x	79	93	93
NE-Lincoln (Lancaster County)	x	x	x		x	x				x	x	1	1	93
NE-Omaha (Douglas County)[2]												1	1	93
OK	x	x	x		x	x	x	x	x	x	x	77	77	77
TX	x	x	x		x	x	x	x	x	x	x	254	254	254

[1] NA = Not Applicable.

[2] Omaha's area source inventory is included in the state of NE's inventory submittal. Omaha did not submit its own area source inventory to EPA.

The following NIF plus fields were added to the EP, PE, EM, and CE tables:

- Data Source Codes:

For the area and nonroad inventory data, the data source codes were based on the following 9-character format:

[Data Origin]-[Year]-[Grown/Not Grown/Carried Forward]-[PM Augmentation Code]

Code	Field Length
Data Origin	1
Year	3 (including leading hyphen)
Grown/Not Grown/Carried Forward	2 (including leading hyphen)
PM Augmentation	3 (including leading hyphen)

Data Origin Codes

Code	Description
S	State agency-supplied data
L	Local agency-supplied data
R	Tribal agency-supplied data
P	Regional Planning Organization-generated data
E	EPA/Emission Factor and Inventory Group (EFIG)-generated data

Year Codes

Year for which data were supplied (e.g., Year = -02 for 2002), or from which prior year data were taken (e.g., Year = -99 for 1999; -01=2001).

Grown/Carried Forward/Not Grown Codes

Code	Description
-G	Used when emissions in a pre-2002 inventory were grown to represent 2002 emissions.
-F	Used when emissions in a pre-2002 inventory were carried forward and included in the 2002 inventory without adjustment for growth.
-X	Used when the emissions were not grown or were not carried forward. For example, X was used when emissions were calculated for the 2002 inventory using 2002 activity, or when data were replaced with 2002 S/L/T data.

PM Augmentation Codes

-PA	PM Augmented Emissions: Record for PM_{10}/$PM_{2.5}$ emissions that were updated or added using ad-hoc updates.

-PC PM Augmented Emissions: Record added for PM_{10}/$PM_{2.5}$ emissions estimated using the PM Calculator.

-PR PM Augmented Emissions: Record added for PM_{10}/$PM_{2.5}$ emissions estimated using ratios of PM_{10}-to-PM or $PM_{2.5}$-to-PM_{10}. If PM_{10} and $PM_{2.5}$ emissions were equal and one of the pollutants was assigned this code, the ratio was assumed to be 1.

2 QA Review

QA review was conducted on the S/L/T area source inventories in accordance with the QA procedures specified in the QAPP for this project (CENRAP, 2004b). The following discusses the QA checks that were completed during preparation of the consolidated data set.

a. County and SCC Coverage

The county coverage in the state inventories appeared to be reasonable for all states. The SCC coverage was difficult to evaluate simply by showing a count of the number of SCCs by state. Each S/L/T inventory was compared to the preliminary 2002 NEI, and area source categories in the NEI but not in a S/L/T inventory was sent to each agency for review. Each S/L/T agency then selected the NEI categories that were then added to the CENRAP inventory.

b. Pollutant Coverage

The pollutant coverage in the S/L/T inventories was complete for all pollutants except for PM_{10} and $PM_{2.5}$. Diagnosis and resolution of PM_{10} and $PM_{2.5}$ pollutant emissions is discussed later in section II.C.4.

c. EPA QA Summaries Sent to S/L/T Agencies

Under a separate project with EPA, Pechan performed QA review of the S/L/T area source inventories. This QA review involved running EPA's QA program on each data set to identify and resolve QA issues. Using the results of this QA work, Pechan prepared two sets of QA summaries that EPA sent to the S/L/T agencies. Pechan contacted each S/L/T agency with QA issues. The following explains these two summaries:

High-level Summary of S/L/T Inventories Submitted to EPA:

The first summary was an Excel workbook file with four spreadsheets that provided the following information:

- 2002 Nonpoint File Names: This spreadsheet documented names and formats of the files that EPA received from the S/L/T agencies and the dates on which they were transferred to Pechan.

- 2002 Nonpoint Summary: This spreadsheet documented the jurisdiction of the submitting agency (i.e., S/L/T agency), type of inventory (i.e., criteria, HAP, or both), a comparison of the number of the counties in the inventory to the total number of counties in the state to identify the geographic coverage of the inventory, a unique list of CAP codes, and the total number of area source SCCs. This spreadsheet also indicated if any nonroad or onroad emissions data were moved from the agency's area source inventory to its nonroad or onroad inventory).

- 2002 Nonpoint Emission Sums: This spreadsheet summarized emissions by start date, end date, and emission type and assigned the appropriate code to the emission type period NIF plus field.

- 2002 Nonpoint Error Summary: This spreadsheet provided a copy of the "SummaryStats" table from the EPA QA program (EPA, 2004a). This table provided the count of records for each NIF 3.0 table and identified the number of records with errors by type of error.

Detailed Summary of QA Issues:

This summary (sent to S/L/T agencies on August 11) was prepared in a text file that listed by state and NIF table the number of records with errors, and provided corrections for the errors. To support documentation of corrections to some of the errors in the text file, Pechan prepared an Excel workbook file that summarized the following errors and corrections by state: invalid pollutants codes; invalid units; invalid maximum achievable control technology (MACT) codes; and invalid and inactive SCCs. A spreadsheet was also included to show the mapping of Standard Industrial Classification (SIC) codes to North American Industrial Classification System (NAICS) codes. This crosswalk was used to correct invalid NAICS codes if a valid SIC code was available in the S/L/T inventories and vice versa.

d. Additional QA for the CENRAP Area Source Inventory

The following explains additional QA and data tracking that was performed for the CENRAP inventory. The following data elements were reviewed to identify QA issues:

- Range Errors;
- PM Emissions Consistency and Completeness;
- Control Device Codes and Control Efficiency Values;
- Start and End Dates;
- Annual and Daily Emissions Comparison; and
- Comparison of S/L/T Inventories to the 2002 Preliminary NEI.

For each S/L/T inventory for which QA issues were identified, a separate QA Summary Report was prepared in an Excel Workbook file, and sent to each S/L/T agency for review. The S/L/T agencies provided directions in the Excel Workbook file, via e-mail, or by submitting revised records in NIF 3.0 in an Access database to correct the inventories. The QA reports are discussed under section II.C.3.

Range Errors

The EPA's QA program contains routines that compare annual emission values, numeric fields in the PE and EP tables, and other temporal numeric fields against a range of values. The QA program flags records that are less than or greater than the range of values for review. Pechan summarized the range errors for the S/L/T agencies to review and provide corrections. According to EPA, the ranges to which values in inventories are compared represent "normal" ranges that are based on percentiles from previous inventories. The range values are conservative in that EPA wants to identify suspicious values even though the values may be real (Thompson, 2002).

PM Emissions Consistency and Completeness Review

The following consistency checks were performed at the EM table data key level (for annual emissions) to compare PM emissions:

- If an SCC was associated with a PM emission record, but was missing one or more of the following (as appropriate for the SCC [i.e., PM-CON is associated with fuel combustion only]): PM10-FIL, PM10-PRI, PM25-FIL, PM25-PRI, or PM-CON, the record was flagged for review.

- The following equations were used to determine consistency:

  PM10-FIL + PM-CON = PM10-PRI
  PM25-FIL + PM-CON = PM25-PRI

- The following comparisons were made to determine consistency:

  PM10-PRI >= PM10-FIL
  PM25-PRI >= PM25-FIL
  PM10-PRI >= PM-CON
  PM25-PRI >= PM-CON
  PM10-FIL >= PM25-FIL
  PM10-PRI >= PM25-PRI

If the data failed one of these checks it was diagnosed as an error. If a S/L/T agency did not provide corrections to these errors, the errors were corrected/filled in according to an augmentation procedure explained in section II.C.4.

For information purposes, all PM-PRI and PM-FIL records were flagged to indicate that these pollutants were included instead of, or in addition to, the standard PM_{10}, $PM_{2.5}$, and PM-CON pollutants.

Control Device Type and Control Efficiency Data Review

The control equipment codes in the "Primary Device Type Code" and "Secondary Device Type Code" fields were reviewed to identify invalid codes (i.e., codes that did not exist in the NIF 3.0 reference table) and missing codes (e.g., records with a null or uncontrolled code of 000 but with control efficiency data).

QA review of control efficiency data involved diagnosis of two types of errors. First, records were reviewed to identify control efficiency values that were reported as a decimal rather than as a percent value. Records with control efficiencies with decimal values were flagged as a potential error (although not necessarily an error, since the real control efficiency may be less than 1 percent). Records with a 1% control efficiency value were also identified for review by the S/L/T agency to determine if the value was reported as a decimal in its internal data system but rounded to 1% when the data were converted to NIF 3.0.

The second check identified records where 100% control was reported in the CE table, but the emissions in the EM table were greater than zero and the rule effectiveness value in the EM table was null, zero, or 100% (implying 100 percent control of emissions). Because many agencies did not populate the rule effectiveness field or a default value of zero was assigned, records with null or zero rule effectiveness values were included where the CE was 100% and emissions were greater than zero. For records that met these criteria, Pechan consulted with the S/L/T agency to determine if corrections were needed to any of the fields.

Start and End Date Checks

QA review was conducted to identify start and end date values in the PE and EM tables to confirm consistency with the inventory year in the transmittal table, and to confirm that the end date reported was greater than the start date reported.

Annual and Daily Emissions Comparison

The S/L/T inventories were reviewed to determine if any of the following conditions existed:

- Multiple records coded at the SCC level as emission type 30, but with different start and end dates. While not a true duplicate, this may indicate an error or inclusion of both annual and seasonal values.

- Multiple records coded at the SCC level as a daily emission type (27, 29, etc.) but with different start and end dates. While not a true duplicate, this may indicate an error or just inclusion of additional types of daily emissions.

- Multiple records coded at the SCC level with the same start and end date, but different emission types. While not a true duplicate, this may indicate an error or just inclusion of additional types of daily emissions.

- Any "DAILY" type record that was missing its associated "ANNUAL" record was flagged for review.

- Any "DAILY" type record that was greater than its associated "ANNUAL" record was flagged for review.

3. Responses from State, Local, and Tribal (S/L/T) Agencies

QA Summary Reports were sent to the S/L/T agencies to review the QA issues identified. The S/L/T agencies were asked to return these reports to CENRAP with their corrections documented in the reports. These reports were then used to document revisions to the S/L/T inventories. The QA Summary Reports containing the revisions provided by the S/L/T agencies are provided in Excel Workbook files with this report. The names of the files are provided in Table 8. Note that a QA Summary Report was not prepared for NE and OK since the area source inventory for these two states is a copy of the 2002 NEI. OK provided an inventory for SCC 2310000000 (Industrial Processes / Oil and Gas Production: SIC 13 / All Processes / Total: All Processes) for VOC, NO_x, and CO that was incorporated into the CENRAP inventory.

Table 8. QA Summary Reports for S/L/T Area Source Inventories

S/L/T Agency	Excel Workbook File Name of QA Summary Report
AR	AR_NP_QA_Report_092404.xls
Fond du Lac Band of the Minnesota Chippewa Tribe	Fonddulac_NP_QA_Report_083004.xls
IA	IA_NP_QA_Report_090204.xls
KS	KS_NP_QA_Report_090104.xls
LA	LA_NP_QA_Report_090304.xls
MN	MN_NP_QA_Report_092304.xls
MO	MO_NP_QA_Report_091704.xls
NE - Lancaster County (Lincoln)	NE_Lancaster_NP_QA_Report_082704-approved.xls
TX	TX_NP_QA_Report_090904_v3.xls

The first spreadsheet in each QA Summary Report defines the remaining spreadsheets in the Excel Workbook file and provides instructions for communicating revisions. Table 9 provides a list of the QA summaries (note that a spreadsheet was not included in an agencies report if there were no QA issues).

Table 9. Summary of Spreadsheets Provided in QA Summary Reports for Area Source Inventories

Name of Spreadsheet	Content/Instructions
Summary Stats	This spreadsheet is a copy of the "SummaryStats" table generated by the EPA's QA program. This shows the results of running the QA program on the August 6 version of the area source inventory files EPA provided to the S/L/T agencies after correcting referential integrity and duplicate record issues.
Lookup Errors	This spreadsheet provides a unique list of NIF 3.0 reference table "Lookup Errors" identified by the EPA's QA program. The S/L/T agency should provide corrections to the lookup errors or indicate in the "Approved" column in this spreadsheet if it accepts the correction provided in the "Correction" Column.
Range Errors	This spreadsheet details the range errors identified by the EPA's QA program.
Emission Type Period	This spreadsheet identifies EM table records as containing annual, seasonal, or daily emissions in the NIF plus field named "Emission Type Period." This NIF plus field, once populated, will be used to prepare emissions summaries on a consistent temporal basis.
PMx Issues1	This spreadsheet documents the results of QA review conducted on PM10 and PM2.5 emissions as required by the Quality Assurance Project Plan (QAPP) and Draft Methods Document for this project.
PMx Issues2	This spreadsheet provides additional details regarding PM10 and PM2.5 QA issues referred to in the "PMx Issues1" spreadsheet.
NEI Categories not in State EI	The spreadsheet provides a unique list of the SCCs in the preliminary 2002 NEI that did not appear in the agency's inventory submittal to EPA. The spreadsheet shows the number of counties in which the SCC appears in the NEI, and provides the NEI annual emissions in tons. See the "State to NEI Comparison" spreadsheet for detailed comparison at state level to help identify the NEI categories to add or exclude from your inventory in this "NEI Categories not in State EI" spreadsheet. This spreadsheet does not include: 1. SCCs in the NEI that electronically match on the state and county FIPS and SCC in the agency's inventory; and 2. SCCs in the NEI that are different than the agency's SCC but for the same category. For example, if an agency uses a general SCC for a category and the NEI uses SCCs that provide more detail, the SCCs in the NEI are not included in this spreadsheet. The agency should review the spreadsheet to make sure that all double counting of emissions between the agency's inventory and the NEI has been eliminated.
State to NEI Comparison (provides additional data to supplement the data in the "NEI Categories not in State EI" spreadsheet)	This spreadsheet compares the SCCs in the S/L/T inventory to the SCCs in the 2002 preliminary NEI at the state-level. The number of counties that appear for each SCC in your state is also provided. This spreadsheet should be used to help make decisions on the NEI categories you want added and excluded from the list provided in the "NEI Categories not in State EI" spreadsheet.

4. Gap Filling and Augmentation

The following discusses the augmentation procedures that were applied to the S/L/T inventories to improve the inventories or to fill in missing data not supplied by the S/L/T agencies.

a. CENRAP-Sponsored Inventories

CENRAP sponsored inventory development for source categories of NH_3 and planned burning (i.e., prescribed burning, rangeland burning, and agricultural field burning) and agricultural dust area source categories. For each of these categories, each S/L/T agency was requested to complete a table to indicate if it (1) included the CENRAP-sponsored inventory in the inventory it submitted to EPA; (2) included its own estimates for a category in the inventory it submitted to EPA; or (3) if it did not include a category in its inventory, if the CENRAP-sponsored inventory or the 2002 preliminary NEI should be used as the source of data for the category. The results of this request are summarized in Table 10.

Table 10. Summary of CENRAP-Sponsored Inventories Included in the Area Source Consolidated Emissions Inventory

Area Source Category	SCCs	CENRAP Inventory Included in S/L/T Inventory Submitted to EPA	S/L/T Inventory Used Instead of CENRAP Inventory			CENRAP Inventory Added to S/L/T Inventory	Preliminary NEI Used Instead of CENRAP Inventory
		Monthly	Annual	Summer Day	Winter Day	Annual	Annual
Planned Burning Inventories (pollutants included in S/L/T inventories are listed at the bottom of this table)[1]							
Prescribed Burning for Forest Management	2810015000		AR; TX; Lancaster County, NE; Tribal	AR, TX	AR, TX	IA, KS, LA, MN, MO, NE (state), OK	
Prescribed Burning of Rangeland	2810020000		TX; Lancaster County, NE	TX		IA, KS, LA, MN, MO, NE (state), OK	
Agricultural Field Burning	28015001xx; 28015002xx		AR; TX; Lancaster County, NE	TX		IA, KS, LA, MN, MO, NE (state), OK	
Fugitive Dust Inventories For PM10-PRI and PM25-PRI							
Agricultural Crop Tilling, Harvesting, and Other Activities	2801000003		AR	AR	AR	IA, KS, LA, MN, MO, NE (state), OK, TX	
NH_3 Inventories[2]							
Animal Husbandry (Livestock)	28050xxxxx	IA, KS, LA, MO	AR, TX	TX	TX	MN; NE (state); Lancaster County, NE; OK	
Agriculture Fertilizer Application	28017000xx	IA, KS, LA, MO	AR, TX			MN; NE (state); Lancaster County, NE; OK	
Food and Kindred Products - Refrigeration	2302080002	IA, KS, LA, MO	AR			MN, NE (state), OK	
Municipal Landfills	2620030000	IA					
Public Owned Treatment Works	2630020000	KS, MO	TX	TX		MN; NE (state); Lancaster County, NE; OK	IA, LA
Other Combustion - Forest Wildfires	2810001000	MO	KS, TX	KS, TX		MN	IA; LA; NE (state); Lancaster County, NE; OK

Table 10 (continued)

Area Source Category	SCCs	CENRAP Inventory Included in S/L/T Inventory Submitted to EPA	S/L/T Inventory Used Instead of CENRAP Inventory			CENRAP Inventory Added to S/L/T Inventory	Preliminary NEI Used Instead of CENRAP Inventory
		Monthly	Annual	Summer Day	Winter Day	Annual	Annual
Other Combustion - Human Perspiration and Respiration	2810010000	IA, KS, LA, MO	AR, TX	AR, TX	AR	MN; NE (state); Lancaster County, NE; OK	
Domestic Animals Waste	280601xxxx	IA, KS, LA, MO	TX	TX		MN; NE (state); Lancaster County, NE; OK	
Wild Animals Waste	28070xxxxx	IA, KS, LA, MO	TX	TX		MN; NE (state); Lancaster County, NE; OK	
Natural Sources/Biogenic (Vegetation/Forests /Land Use)	2701xxxxxx	IA, KS, LA	TX	TX		NE (state), OK	
Light Duty Gasoline Vehicles	2201001000	IA, KS, LA					
Light Duty Diesel Vehicles	2230001000	IA, KS, LA					

[1] The following identifies the pollutants included in the planned burning inventories by S/L/T agency:

Prescribed Burning for Forest Management
AR: CO, NO_x, VOC, PM10-PRI, PM25-PRI
Fond du Lac Band of the MN Chippewa Tribe: CO, PM-PRI, PM10-PRI, PM25-PRI
IA, KS, LA, MN, MO, OK; NE (state); Lancaster County, NE: CO, NO_x, NH_3, SO_2, VOC, PM10-PRI, PM25-PRI
TX: CO, NO_x, NH_3, SO_2, VOC, PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL

Prescribed Burning of Rangeland
IA: CO, NO_x, SO_2, VOC, PM10-PRI, PM25-PRI
KS; LA; MN; MO; OK; NE (state); Lancaster County, NE: CO, NO_x, NH_3, SO_2, VOC, PM10-PRI, PM25-PRI
Lancaster County, NE: CO, NO_x, PM10-PRI, PM25-PRI
TX: CO, NO_x, NH_3, VOC, PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL

Agricultural Field Burning
AR: CO, VOC, PM10-PRI, PM25-PRI
IA, KS, LA, MN, MO, OK; NE (state); Lancaster County, NE: CO, NO_x, NH_3, SO_2, VOC, PM10-PRI, PM25-PRI
TX: CO, NO_x, NH_3, VOC, PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL

[2] The CENRAP-sponsored NH_3 inventories were prepared for monthly emissions. The monthly emissions were summed to calculate annual emissions. The annual emission records were added to the area source inventory to support preparation of emission summaries.

b. PM Augmentation

Procedures were developed to estimate missing pollutant data from data provided by the S/L/T agencies in order to develop a complete set of PM10-PRI and PM25-PRI emissions to support air quality modeling. The following discusses the procedures for fossil fuel combustion and residential wood combustion sources first followed by the procedures for all other area sources of PM emissions.

Fossil Fuel Combustion Sources

Fossil fuel combustion sources include industrial, commercial/institutional, and residential anthracite coal, bituminous/subbituminous coal, distillate oil and kerosene, residual oil, natural gas, and liquefied petroleum gas (LPG). All of these sources emit both filterable and condensible emissions. The QA review of the PM emissions data for these sources focused on verifying that the emissions reported in the S/L/T inventories included both filterable and condensible emissions. The emissions for these pollutants can be reported individually (i.e., as filterable and condensible separately) or as primary emissions (i.e., the sum of the filterable and condensible emissions). The QA review also focused on evaluating the emission factors reported in the S/L/T inventories to determine if they were reasonable.

To support the QA review effort, the uncontrolled PM emission factors shown in Table 11 were compiled from AP-42. The emission factors reported in the S/L/T inventories were compared to the emission factors in this table. Emission factors that appeared too high or too low were flagged for review by the S/L/T agency. In addition, inventory data were flagged for review by the S/L/T agency if the emissions were reported under the primary PM pollutant codes but the emission factors matched with the emission factors for filterable PM in Table 11. Finally, if emission factors were not reported in the S/L/T agency inventory, the emission factors were back-calculated using the throughput data (if available), emissions, rule effectiveness values, and control efficiency data (if available). The back-calculated emission factors were compared to the factors in Table 11 to identify data with major difference between the factors. It is emphasized that the uncontrolled emission factors in Table 11 were used as a reference for reviewing S/L/T inventory data. The emission factors in this table should not be construed to be the best available for all S/L/T agencies since the emission factors will vary depending on the composition of the boiler population in an agency's area source inventory.

The states of IA, KS, LA, NE, and OK used the fossil fuel combustion inventory in the preliminary 2002 NEI for the CENRAP inventory. Revisions to the NEI for residential LPG and kerosene were completed after the preliminary 2002 NEI was released in February 2004; the revised inventories for these two categories were included in the CENRAP inventory for IA, KS, LA, NE, and OK.

AR, MN, and TX provided their own inventory for all fossil fuel combustion categories. AR's inventory reported filterable emissions under the primary pollutant code, but AR corrected its inventory and provided updates to the CENRAP inventory.

Table 11. Area Source Industrial, Commercial/Institutional, and Residential Fossil Fuel Combustion Uncontrolled Emission Factors for PM10-PRI/FIL, PM25-PRI/FIL, and PM-CON

Pollutant[1]	Uncontrolled Emission Factor (EF)	EF Numerator	EF Denominator	Calculated Uncontrolled EF	Reference
Industrial Boilers: Anthracite Coal (SCC 2102001000)					
PM10-FIL	2.3	LB	TON	30.77	AP-42 Table 1.2-4 EF calculated from formula of 2.3 * % Ash Content (13.38%). Reference for ash content is EPA, 2002.
PM25-FIL	0.6	LB	TON	8.03	AP-42 Table 1.2-4 EF calculated from formula of 0.6 * % Ash Content (13.38%) (used Commercial/Institutional emission factors). Reference for ash content is EPA, 2002.
PM-CON	0.08	LB	TON	1.07	AP-42 Table 1.2-3 Used formula for SCC 10300101, EF calculated from formula of .08 * % Ash Content (13.38%). Reference for ash content is EPA, 2002.
PM10-PRI		LB	TON	31.84	
PM25-PRI		LB	TON	9.10	
Industrial Boilers: Bituminous/Subbituminous Coal (SCC 2102002000)					
PM10-FIL	13.2	LB	TON	13.2	AP-42 Table 1.1-9 EF (used Commercial/Institutional emission factors)
PM25-FIL	4.6	LB	TON	4.6	AP-42 Table 1.1-9 EF (used Commercial/Institutional emission factors)
PM-CON	1.04	LB	TON	1.04	AP-42 Table 1.1-5 (used Commercial/Institutional emission factors)
PM10-PRI		LB	TON	14.24	
PM25-PRI		LB	TON	5.64	
Industrial Boilers and IC Engines: Distillate Oil (SCC 2102004000)					
PM10-FIL	1	LB	E3GAL	1	AP-42 Table 1.3-6
PM25-FIL	0.25	LB	E3GAL	0.25	AP-42 Table 1.3-6
PM-CON	1.3	LB	E3GAL	1.3	AP-42 Table 1.3-2
PM10-PRI		LB	E3GAL	2.30	
PM25-PRI		LB	E3GAL	1.55	
Industrial Boilers: Residual Oil (SCC 2102005000)					
PM10-FIL	7.17	LB	E3GAL	10.683	AP-42 Table 1.3-5. EF calculated from formula of 7.17(A); where A=1.12(S)+0.37; Assumed S=1% for purpose of calculating EF ratios.
PM25-FIL	4.67	LB	E3GAL	6.958	AP-42 Table 1.3-5. EF calculated from formula of 7.17(A); where A=1.12(S)+0.37; Assumed S=1% for purpose of calculating EF ratios.
PM-CON	1.5	LB	E3GAL	1.5	AP-42 Table 1.3-2
PM10-PRI		LB	E3GAL	12.18	
PM25-PRI		LB	E3GAL	8.46	
Industrial Boilers and IC Engines: Natural Gas (SCC 2102006000)					
PM10-FIL	1.9	LB	E6FT3	1.9	AP-42 Table 1.4-2
PM25-FIL	1.9	LB	E6FT3	1.9	AP-42 Table 1.4-2
PM-CON	5.7	LB	E6FT3	5.7	AP-42 Table 1.4-2
PM10-PRI	7.6	LB	E6FT3	7.60	
PM25-PRI	7.6	LB	E6FT3	7.60	

Table 11 (continued)

Pollutant[1]	Uncontrolled Emission Factor (EF)	EF Numerator	EF Denominator	Calculated Uncontrolled EF	Reference
Industrial Boilers - Liquified Petroleum Gas (SCC 2102007000)					
PM10-FIL	0.6	LB	E3GAL	0.6	AP-42 Table 1.5-1
PM25-FIL	0.6	LB	E3GAL	0.6	AP-42 Table 1.5-1
PM-CON	0.506	LB	E3GAL	0.506	Used natural gas PM-CON emission factor of 5.7 lb/Million Cubic Feet (for all PM controls and uncontrolled). Used factor of 0.0887 to convert emission factor from lb/Million Cubic Feet of natural gas to lb/1,000 gallons of propane. Reference: AP-42, Table 1.4-2. Conversion factor assumes 1020 Btu/scf for natural gas (AP-42, Table 1.4-2) and 90,500 Btu/gallon for propane (AP-42, Appendix A, page A-5).
PM10-PRI		LB	E3GAL	1.11	
PM25-PRI		LB	E3GAL	1.11	
Industrial Boilers: Kerosene (SCC 2102011000)					
PM10-FIL	1	LB	E3GAL	1	AP-42 Table 1.3-6
PM25-FIL	0.25	LB	E3GAL	0.25	AP-42 Table 1.3-6
PM-CON	1.3	LB	E3GAL	1.3	AP-42 Table 1.3-6
PM10-PRI		LB	E3GAL	2.30	
PM25-PRI		LB	E3GAL	1.55	
Commercial/Institutional Heating: Anthracite Coal (SCC 2103001000)					
PM10-FIL	2.3	LB	TON	30.77	AP-42 Table 1.2-4 EF calculated from formula of 2.3 * % Ash Content (13.38%). Reference for ash content is EPA, 2002.
PM25-FIL	0.6	LB	TON	8.03	AP-42 Table 1.2-4 EF calculated from formula of 0.6 * % Ash Content (13.38%). Reference for ash content is EPA, 2002.
PM-CON	0.08	LB	TON	1.07	AP-42 Table 1.2-3 Used formula for SCC 10300101, EF calculated from formula of 0.08 * % Ash Content (13.38%). Reference for ash content is EPA, 2002.
PM10-PRI		LB	TON	31.84	
PM25-PRI		LB	TON	9.10	
Commercial/Institutional Heating: Bituminous and Lignite (SCC 2103002000)					
PM10-FIL	13.2	LB	TON	13.2	AP-42 Table 1.1-9 EF
PM25-FIL	4.6	LB	TON	4.6	AP-42 Table 1.1-9 EF
PM-CON	1.04	LB	TON	1.04	AP-42 Table 1.1-5 (0.04 lb/MMBtu * 26MMBtu/ton=1.04)
PM10-PRI		LB	TON	14.24	
PM25-PRI		LB	TON	5.64	
Commercial/Institutional Heating: Distillate Oil (SCC 2103004000)					
PM10-FIL	1.08	LB	E3GAL	1.08	AP-42 Table 1.3-7
PM25-FIL	0.83	LB	E3GAL	0.83	AP-42 Table 1.3-7
PM-CON	1.3	LB	E3GAL	1.3	AP-42 Table 1.3-2
PM10-PRI		LB	E3GAL	2.38	
PM25-PRI		LB	E3GAL	2.13	

Table 11 (continued)

Pollutant[1]	Uncontrolled Emission Factor (EF)	EF Numerator	EF Denominator	Calculated Uncontrolled EF	Reference
Commercial/Institutional Heating: Residual Oil (SCC 2103005000)					
PM10-FIL	5.17	LB	E3GAL	7.703	AP-42 Table 1.3-7. EF calculated from formula of 5.17(A); where A=1.12(S)+0.37; Assumed S=1% for purpose of calculating EF ratios.
PM25-FIL	1.92	LB	E3GAL	2.861	AP-42 Table 1.3-7. EF calculated from formula of 5.17(A); where A=1.12(S)+0.37; Assumed S=1% for purpose of calculating EF ratios.
PM-CON	1.5	LB	E3GAL	1.5	AP-42, Table 1.3-2
PM10-PRI		LB	E3GAL	9.20	
PM25-PRI		LB	E3GAL	4.36	
Commercial/Institutional Heating: Natural Gas (SCC 2103006000)					
PM10-FIL	1.9	LB	E6FT3	1.9	AP-42 Table 1.4-2
PM25-FIL	1.9	LB	E6FT3	1.9	AP-42 Table 1.4-2
PM-CON	5.7	LB	E6FT3	5.7	AP-42 Table 1.4-2
PM10-PRI		LB	E6FT3	7.60	
PM25-PRI		LB	E6FT3	7.60	
Commercial/Institutional Heating: Liquified Petroleum Gas (SCC 2103007000)					
PM10-FIL	0.4	LB	E3GAL	0.4	AP-42 Table 1.5-1 (Propane for Commercial Boilers)
PM25-FIL	0.4	LB	E3GAL	0.4	AP-42 Table 1.5-1 (Propane for Commercial Boilers)
PM-CON	0.506	LB	E3GAL	0.506	Used natural gas PM-CON emission factor of 5.7 lb/Million Cubic Feet (for all PM controls and uncontrolled). Used factor of 0.0887 to convert emission factor from lb/Million Cubic Feet of natural gas to lb/1,000 gallons of propane. Reference: AP-42, Table 1.4-2. Conversion factor assumes 1020 Btu/scf for natural gas (AP-42, Table 1.4-2) and 90,500 Btu/gallon for propane (AP-42, Appendix A, page A-5).
PM10-PRI		LB	E3GAL	0.91	
PM25-PRI		LB	E3GAL	0.91	
Commercial/Institutional Heating: Kerosene (SCC 2103011000)					
PM10-FIL	1.08	LB	E3GAL	1.08	AP-42 Table 1.3-7 Used EF for Distillate Oil (per EIIP)
PM25-FIL	0.83	LB	E3GAL	0.83	AP-42 Table 1.3-7 Used EF for Distillate Oil (per EIIP)
PM-CON	1.3	LB	E3GAL	1.3	AP-42 Table 1.3-2 Used EF for Distillate Oil (per EIIP)
PM10-PRI		LB	E3GAL	2.38	
PM25-PRI		LB	E3GAL	2.13	
Residential Heating: Anthracite Coal (SCC 2104001000)					
PM10-FIL	10	LB	TON	10	EPA, 2002.
PM25-FIL	0.6	LB	TON	8.03	EF calculated from formula of 0.6 * % Ash Content (13.38%). Reference for EF and ash content is EPA, 2002.
PM-CON	0.08	LB	TON	1.07	EF calculated from formula of 0.08 * % Ash Content (13.38%). Reference for EF and ash content is EPA, 2002.
PM10-PRI		LB	TON	11.07	
PM25-PRI		LB	TON	9.10	

Table 11 (continued)

Pollutant[1]	Uncontrolled Emission Factor (EF)	EF Numerator	EF Denominator	Calculated Uncontrolled EF	Reference
Residential Heating: Bituminous and Lignite Coal (SCC 2104002000)					
PM10-FIL	6.2	LB	TON	6.2	AP-42 Table 1.1-11
PM25-FIL	3.8	LB	TON	3.8	AP-42 Table 1.1-11
PM-CON	1.04	LB	TON	1.04	AP-42 Table 1.1-5 (0.04 lb/MMBtu * 26 MMBtu/ton=1.04)
PM10-PRI		LB	TON	7.24	
PM25-PRI		LB	TON	4.84	
Residential Heating: Distillate Oil (SCC 2104004000)					
PM10-FIL	1.08	LB	E3GAL	1.08	AP-42 Table 1.3-7 (Commercial/Institutional EF)
PM25-FIL	0.83	LB	E3GAL	0.83	AP-42 Table 1.3-7 (Commercial/Institutional EF)
PM-CON	1.3	LB	E3GAL	1.3	AP-42 Table 1.3-2
PM10-PRI		LB	E3GAL	2.38	
PM25-PRI		LB	E3GAL	2.13	
Residential Heating: Natural Gas - All types (SCC 2104006000)					
PM10-FIL	1.9	LB	E6FT3	1.9	AP-42 Table 1.4.2
PM25-FIL	1.9	LB	E6FT3	1.9	AP-42 Table 1.4.2
PM-CON	5.7	LB	E6FT3	5.7	AP-42 Table 1.4.2
PM10-PRI		LB	E6FT3	7.60	
PM25-PRI		LB	E6FT3	7.60	
Residential Heating: Liquefied Petroleum Gas (SCC 2104007000)					
PM10-FIL	0.4	LB	E3GAL	0.4	AP-42 Table 1.5-1 (Same factor used for Propane for Commercial Boilers; based on EIIP)
PM25-FIL	0.4	LB	E3GAL	0.4	AP-42 Table 1.5-1 (Same factor used for Propane for Commercial Boilers; based on EIIP)
PM-CON	0.506	LB	E3GAL	0.506	Used natural gas PM-CON emission factor of 5.7 lb/Million Cubic Feet (for all PM controls and uncontrolled). Used factor of 0.0887 to convert emission factor from lb/Million Cubic Feet of natural gas to lb/1,000 gallons of propane. Reference: AP-42, Table 1.4-2. Conversion factor assumes 1020 Btu/scf for natural gas (AP-42, Table 1.4-2) and 90,500 Btu/gallon for propane (AP-42, Appendix A, page A-5).
PM10-PRI		LB	E3GAL	0.91	
PM25-PRI		LB	E3GAL	0.91	
Residential Heating: Kerosene (SCC 2104011000)					
PM10-FIL	1.08	LB	E3GAL	1.08	AP-42 Table 1.3-7 Used EF for Distillate Oil (per EIIP)
PM25-FIL	0.83	LB	E3GAL	0.83	AP-42 Table 1.3-7 Used EF for Distillate Oil (per EIIP)
PM-CON	1.3	LB	E3GAL	1.3	AP-42 Table 1.3-2 Used EF for Distillate Oil (per EIIP)
PM10-PRI		LB	E3GAL	2.38	
PM25-PRI		LB	E3GAL	2.13	

[1] PM10-PRI EF = sum of PM10-FIL and PM-CON EFs; PM25-PRI EF = sum of PM25-FIL and PM-CON EFs.

MO used the NEI data for industrial residual oil combustion, commercial/institutional residual oil combustion, and residential anthracite coal combustion. MO's inventory contained several PM QA issues, and MO provided corrections (using AP-42 emission factors) that were incorporated into the CENRAP inventory. MO did not provide any PM_{10} or $PM_{2.5}$ emissions data for forest wildfires (SCC 2810001000).

MN provided corrections to PM QA issues that were incorporated into the CENRAP inventory. Lancaster County, NE provided its own inventory for residential natural gas fired furnaces, and requested that no other industrial, commercial/institutional, or residential fossil fuel combustion categories in the NEI be added to its inventory. The tribal inventory did not contain any fossil fuel combustion inventory data.

TX's inventory was revised to address the PMx QA issues listed in the QA Summary Report (TX_NP_QA_Report_090904_v3.xls). Most of the QA issues in TX's inventory were associated with the sum of the filterable and condensible emissions not equaling the primary emissions. This issue was corrected by replacing the primary emissions with the sum of the filterable and condensible emissions. Many of the QA issues were associated with daily emissions. Since daily emissions are not needed to support regional haze air quality modeling, TX and CENRAP agreed to remove the daily PMx emissions from TX's inventory.

Residential Wood Combustion

The states of IA, LA, NE, and OK (including Lancaster County) used the residential wood combustion inventory in the preliminary 2002 NEI for the CENRAP inventory. Revisions to the NEI for residential wood combustion were completed after the preliminary 2002 NEI was released in February 2004; the revised inventories for this category was were included in the CENRAP inventory for IA, LA, NE, and OK.

The states of AR, KS, MN, MO, and TX prepared their own residential wood combustion inventories. KS and MO provided replacement inventories that disaggregated the emissions in more detail (i.e., by separate SCCs for fireplaces and woodstoves) than provided in their original inventory submittal to EPA. In addition, KS, MO, and MN revised the emission factors and provided updated emissions for CO and PM10-PRI and PM25-PRI that originate from the NEI method for this category to address a unit conversion issue identified with the NEI emission factors.

Other Sources of PM Emissions

For states that provided only PM10-FIL and PM25-FIL emissions, PM10-PRI emissions were set equal to PM10-FIL emissions and PM25-PRI emissions were set equal to PM25-FIL emissions. The PM10-PRI and PM25-PRI emissions that were added to the inventory were assigned a data source code of S-02-X-PR where S-02-X code represents the code assigned to the PM10-FIL and PM25-FIL emissions provided by the S/L/T agency and the "-PR" indicates that the ratio was applied to estimate the primary emissions (in this case, the ratio of primary to filterable emissions is "1").

PM25-PRI emissions missing from S/L/T inventories were estimated by applying a ratio of PM25-PRI to PM10-PRI emissions to the PM10-PRI emissions provided by the S/L/T agency. Table 12 identifies the agencies with SCCs for which ratios were applied to estimate PM25-PRI emissions. This table also shows the ratios and the reference for the ratios.

TX's inventory for agricultural tilling (SCC 2801000000) contained records where the filterable emissions exceeded the primary emissions. These emissions were grown from Version 3 of the 1999 NEI. This issue was corrected by setting the PM10-PRI and PM25-PRI emissions equal to the PM10-FIL and PM25-FIL emissions.

Table 12. SCCs for which PM25-PRI Emissions were Estimated by Applying a Ratio to the PM10-PRI Emissions in the S/L/T inventory

SCC	SCC Description	Agency	Ratio of PM25-PRI to PM10-PRI	Reference
2294000000	Mobile Sources : Paved Roads : All Paved Roads : Total: Fugitives	Fond du Lac Band of the Minnesota Chippewa Tribe	0.25	NEI Method
2296000000	Mobile Sources : Unpaved Roads : All Unpaved Roads : Total: Fugitives	Fond du Lac Band of the Minnesota Chippewa Tribe	0.15	NEI Method
2505020000	Storage and Transport : Petroleum and Petroleum Product Transport : Marine Vessel : Total: All Products	MO	1	No data available; assumed PM25-PRI equals PM10-PRI
2535010000	Storage and Transport : Bulk Materials Transport : Rail Car : Total: All Products	Lancaster County, NE	1	No data available; assumed PM25-PRI equals PM10-PRI
2810015000	Miscellaneous Area Sources : Other Combustion : Prescribed Burning for Forest Management : Total	Fond du Lac Band of the Minnesota Chippewa Tribe	1	No data available; assumed PM25-PRI equals PM10-PRI
2810020000	Miscellaneous Area Sources : Other Combustion : Prescribed Burning of Rangeland : Total	KS, LA, and NE	0.8	Based on average ratio of PM25-PRI to PM10-PRI for emissions data provided by other CENRAP states
2810030000	Miscellaneous Area Sources : Other Combustion : Structure Fires : Total	MO	0.91	NEI Method
2810050000	Miscellaneous Area Sources : Other Combustion : Motor Vehicle Fires : Total	MO, TX	0.91	NEI Method

c. 2002 NEI

Merging of NEI Data into S/L Inventories

The area source inventory provided by each S/L agency was compared to the 2002 NEI to identify categories in the NEI that were not in each S/L inventory. The list of categories identified was provided to each S/L agency and each agency then selected the NEI categories to be added to their inventory. Identification of categories included in the 2002 NEI but not in a S/L inventory involved a two-step process. First, Pechan identified the categories in the NEI that did not have an electronic match on the data key of the EM table between the S/L inventory and the NEI. Then, Pechan manually compared the NEI categories without an electronic match to the S/L inventory to identify and eliminate NEI categories that were in the S/L inventory but had a different SCC. For example, a state inventory may use a general SCC for a category while the NEI may use different SCCs to breakout emissions at a finer detail. Examples of categories where this typically occurred include residential wood combustion, open burning of land clearing debris, solvent utilization, and petroleum marketing and transportation categories. In addition, if a S/L agency requested that a CENRAP-sponsored inventory be added to its inventory, the NEI categories that overlapped with the CENRAP-sponsored categories were removed from the list of NEI categories considered for incorporation into a S/L inventory.

Note that the preliminary 2002 NEI did not contain any data for the Fond du Lac Band of the Minnesota Chippewa Tribe. Therefore, a comparison of the tribal inventory to the NEI was not made.

The source categories in the 2002 NEI that were added to a S/L/T inventory can be identified where the data source code starts with “E”. These categories can be identified using the data source code field in the NIF 3.0 files or in the summary of area source emissions that contains the data source code.

<u>Revisions to the Preliminary 2002 NEI</u>

During preparation of the CENRAP inventory, EPA completed revisions to the emissions for six categories in the preliminary 2002 NEI released in February 2004. As agreed to with each S/L agency, the revised emissions were used in the CENRAP inventory in lieu of the preliminary 2002 NEI emissions if the agency requested that the category be included.

1. Non-Residential Construction (SCC 2311020000): 2002 emissions data replaced data in preliminary 2002 NEI that were carried forward from 1999 NEI.

2. Highway Construction (SCC 2311030000): 2002 emissions data replaced data in preliminary 2002 NEI that were carried forward from 1999 NEI.

3. Open Burning of Land Clearing Debris (SCC 2610000500): 2002 emissions data replaced data in preliminary 2002 NEI that were carried forward from 1999 NEI. The activity for this category was based on activity prepared for the non-residential and highway construction categories. For 2002, emissions were set to zero for counties with a population that was 80% urban or more based on 2000 Census data. This was not done for the 1999 NEI. For the NEI method, it was assumed that highly urban counties do not allow this activity to take place. Note that 2002 emissions data were already included in the preliminary 2002 NEI for the open burning of residential municipal solid waste, open burning of yard waste, and the residential construction categories.

4. Residential LPG Combustion (SCC 2104007000): 2000 emissions data replaced data in the preliminary 2002 NEI that were carried forward from 1999 NEI.

5. Residential Kerosene Combustion (SCC 2104011000): 2000 emissions data replaced data in the preliminary 2002 NEI that were carried forward from 1999 NEI.

6. Residential Wood Combustion (SCCs starting with 2104008xxx; 4 SCCs for fireplaces and 3 SCCs for woodstoves): The preliminary 2002 NEI emissions were revised to:
   (a) correct the CO, PM10-PRI, and PM25-PRI emission factors for fireplaces without inserts (this change doubled the emission factors associated with correcting an error in converting the values from g/kg to lb/ton);
   (b) correct the climate zone map for allocating national activity to states;
   (c) replace 1997 total residential wood consumption with 2001 estimates (this change reduced wood consumption for fireplaces with inserts and woodstoves);
   (d) update urban/rural population data to reflect 2002 estimates based on year 2002 total county population and year 2000 county ratios of urban/rural population to total population; and
   (e) change the data source code from E-02-X (this was incorrect) to E-01-X to reflect 2001 activity data adjusted to 2002.

5. Revisions to Address Comments

The following items were revised per state instruction during S/L/T agency review of the draft area source inventory:

a. Missouri

Missouri provided revisions to annual VOC emissions for the following surface coating categories to correct for double-counting of emissions in the draft inventory.

SCC	SCC Description
2401015000	Solvent Utilization : Surface Coating : Factory Finished Wood: SIC 2426 thru 242 : Total: All Solvent Types
2401020000	Solvent Utilization : Surface Coating : Wood Furniture: SIC 25 : Total: All Solvent Types
2401040000	Solvent Utilization : Surface Coating : Metal Cans: SIC 341 : Total: All Solvent Types
2401050000	Solvent Utilization : Surface Coating : Miscellaneous Finished Metals: SIC 34 - (341 + 3498) : Total: All Solvent Types
2401055000	Solvent Utilization : Surface Coating : Machinery and Equipment: SIC 35 : Total: All Solvent Types
2401060000	Solvent Utilization : Surface Coating : Large Appliances: SIC 363 : Total: All Solvent Types
2401065000	Solvent Utilization : Surface Coating : Electronic and Other Electrical: SIC 36 - 363 : Total: All Solvent Types
2401070000	Solvent Utilization : Surface Coating : Motor Vehicles: SIC 371 : Total: All Solvent Types

2401080000	Solvent Utilization : Surface Coating : Marine: SIC 373 : Total: All Solvent Types

For these SCCs, MO did not provide any daily emissions. The daily emissions in the draft inventory originated from the 1999 NEI. The daily emissions for some of the SCCs were greater than the annual emissions after incorporating the revised inventory supplied by MO. After discussing this issue with Missouri, the following revisions were made to the daily emissions:

(1) For records where Missouri's revised annual emissions were zero, the daily emissions were set to zero and the data source code was set to S-02-X; and
(2) For records where Missouri's revised annual emissions were greater than zero, the daily emissions were removed from the CENRAP inventory.

b. Minnesota

Minnesota provided a new inventory of annual VOC emissions for asphalt paving (SCC 2461021000) that was added to the final inventory. Minnesota provided revisions to annual CO, NH_3, NOX, PM10-PRI, PM25-PRI, SO_2, and VOC for the following commercial/institutional fossil fuel and wood combustion categories:

SCC	SCC Description
2103002000	Stationary Source Fuel Combustion : Commercial/Institutional : Bituminous/Subbituminous Coal : Total: All Boiler Types
2103004000	Stationary Source Fuel Combustion : Commercial/Institutional : Distillate Oil : Total: Boilers and IC Engines
2103005000	Stationary Source Fuel Combustion : Commercial/Institutional : Residual Oil : Total: All Boiler Types
2103006000	Stationary Source Fuel Combustion : Commercial/Institutional : Natural Gas : Total: Boilers and IC Engines
2103007000	Stationary Source Fuel Combustion : Commercial/Institutional : Liquified Petroleum Gas (LPG) : Total: All Combustor Types
2103008000	Stationary Source Fuel Combustion : Commercial/Institutional : Wood : Total: All Boiler Types
2103011000	Stationary Source Fuel Combustion : Commercial/Institutional : Kerosene : Total: All Combustor Types

c. Oklahoma

Daily VOC emissions for oil and gas exploration were removed. Oklahoma's area source inventory was taken from the preliminary 2002 NEI except that Oklahoma provided an inventory of annual VOC, NOX, and CO emissions for natural gas exploration that replaced the annual emissions from the preliminary NEI (that originated from Version 3 of the 1999 NEI). Oklahoma did not provide revisions to the old daily emissions. Given that the old daily emissions were not calculated from the new annual emissions supplied by Oklahoma, the daily emissions were removed from the CENRAP inventory.

d. Texas

Replaced emissions with more recent emissions estimates from the 2002 NEI for the following categories:

SCC	SCC Description
Residential Stationary Source Fuel Combustion	
2104002000	Bituminous/Subbituminous Coal / Total: All Combustor Types
2104004000	Distillate Oil / Total: All Combustor Types
2104006000	Natural Gas / Total: All Combustor Types
2104007000	Liquified Petroleum Gas (LPG) / Total: All Combustor Types
2104008001	Wood / Fireplaces: General
2104008002	Fireplaces: Insert; non-EPA certified
2104008003	Fireplaces: Insert; EPA certified; non-catalytic
2104008004	Fireplaces: Insert; EPA certified; catalytic
2104008010	Woodstoves: General
2104008030	Catalytic Woodstoves: General
2104008050	Non-catalytic Woodstoves: EPA certified
2104011000	Kerosene Combustion
Fugitive Dust from Roads	
2294000000	All Paved Roads / Total: Fugitives
2296000000	All Unpaved Roads / Total: Fugitives
Fugitive Dust from Construction	
2311010000	Residential / Total
2311020000	Industrial/Commercial/Institutional / Total
2311030000	Highway Construction
Storage and Transport / Petroleum and Petroleum Product Storage	
2501000000	All Storage Types: Breathing Loss / Total: All Products
2501080050	Airports : Aviation Gasoline / Stage 1: Total
2501080100	Airports : Aviation Gasoline / Stage 2: Total
Open Burning	
2610000100	Yard Waste - Leaf Species Unspecified
2610000400	Yard Waste - Brush Species Unspecified
2610000500	Land Clearing Debris
2610030000	Residential / Household Waste
Miscellaneous Area Sources / Agriculture Production - Crops	
2801000000	Cotton Ginning

e. *Agricultural Tilling*

The CENRAP-sponsored inventory for fugitive dust emissions from agricultural tilling (SCC 2801000003 - Miscellaneous Area Sources : Agriculture Production - Crops : Agriculture - Crops : Tilling) was updated on October 27, 2004. However, the timing of the revision was too late to incorporate into the December 8, 2004 draft CENRAP inventory. Therefore, the agricultural tilling emissions were updated to match those in the revised CENRAP-sponsored inventory for the states that elected to use the CENRAP-sponsored inventory.

f. *Open Burning Categories*

For the following open burning emissions categories that originate from the 2002 NEI (Data Source Code = E-02-X), removed CE records where the primary device type for miscellaneous controls (code 099) were associated with uncontrolled emissions in the emission table.

SCC	SCC Description
2610000100	Yard Waste - Leaf Species Unspecified
2610000400	Yard Waste - Brush Species Unspecified
2610000500	Land Clearing Debris
2610030000	Residential / Household Waste

6. QA Review of Final Inventory

Final QA checks were run on the revised data set to ensure that all corrections provided by the S/L/T agencies were incorporated into the S/L/T inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory in Oracle to an Access database in NIF 3.0, the EPA's QA program was run on the Access database and the QA output was reviewed to verify that all QA issues that could be addressed were resolved (EPA, 2004a).

One remaining issue that was not addressed concerns double counting of NH_3 emissions in the onroad inventory. The area miscellaneous source inventory for Iowa, Kansas, and Louisiana include NH_3 emissions for the following two SCCs that originate from the CENRAP-sponsored NH_3 inventory:

SCC	SCC Description
2201001000	Mobile Sources / Highway Vehicles - Gasoline / Light Duty Gasoline Vehicles (LDGV) / Total: All Road Types)
2230001000	Mobile Sources / Highway Vehicles - Diesel / Light Duty Diesel Vehicles (LDDV) / Total: All Road Types)

The onroad inventory includes NH_3 emissions for these source categories as well. Thus, if the area source inventory is revised in the future, these two SCCs should be removed from the area source inventory. For all three states and the two SCCs combined, the NH_3 emissions total to 8,735 annual tons. In each of the three states, the light-duty gasoline vehicles category accounts for 24 to 31 percent of the total area miscellaneous inventory for the state, but only 1 to 4 percent when compared to total NH_3 emissions in the area and area miscellaneous inventories combined. At the CENRAP-region level, the percentages are less than 1 percent of total NH_3 emissions from all sources.

The output file from the EPA's QA program run on the area source inventory and the area miscellaneous source inventory is provided in an Access 2000 database along with the Access database containing the area and area miscellaneous inventory in NIF 3.0. The following lists the remaining QA issues that were not addressed during the duration of this project:

Area Source Inventory

Range Errors: There are 1,418 records in the EM table with emissions that exceed the maximum emissions in the QA program for the specified pollutant.

Lookup Errors: There are 333 records in the PE table and 6,548 records in the EM table with lookup errors. The look-up errors in both the PE and EM tables are associated with units that are not in the NIF 3.0 reference table, but EPA has indicated that the units will be added to the NIF 3.0 reference table.

Area Miscellaneous Source Inventory

Lookup Errors: There are 216,372 records in the PE table and 199,728 records in the EM table with lookup errors. The look-up errors in both the PE and EM tables are associated with units that are not in the NIF 3.0 reference table, but EPA has indicated that the units will be added to the NIF 3.0 reference table.

D. Nonroad Source Inventory Methods

Initially, work on the nonroad inventory was to be limited to the non-NONROAD Model categories for commercial and military aircraft, commercial marine vessel, and railroad locomotives. The CENRAP-sponsored inventory for the NONROAD Model categories was to be used to support air quality modeling and planning. However, during the project TX updated its inventory for the NONROAD Model categories and requested that this inventory be used instead of the CENRAP-sponsored inventory for the NONROAD Model categories. Since Pechan obtained the CENRAP-sponsored inventory for the NONROAD Model categories to support the preparation of emissions summaries, the CENRAP-sponsored inventory for the NONROAD Model categories in TX was replaced with TX's NONROAD Model inventory. Then, the inventories for aircraft, commercial marine vessel, and railroad locomotives were added to the NONROAD Model inventory for all S/L agencies to create a consolidated nonroad inventory for CENRAP.

The following discusses the QA that was completed on the inventories for aircraft, commercial marine vessel, and railroad locomotives and explains the data sources used to compile the inventories for these non-NONRAOD Model categories. QA review of the NONROAD Model inventory was completed under a separate CENRAP-sponsored project.

1. Data Sources

For each S/L/T inventory submitted to EPA, Table 13 provides a summary of the pollutants included in each inventory, and the number of counties for which data were provided for the aircraft, commercial marine vessel, and railroad locomotive categories. The table also shows the number of counties in the 2002 preliminary NEI for the aircraft, commercial marine vessel, and railroad locomotive categories and the number of counties in each state.

AR and TX provided emissions data for all three of the non-NONROAD Model categories. For the railroad locomotive category, KS, LA, MN, and MO included NH_3 emissions based on Carnegie Mellon University (CMU) model estimates in their inventories. MN also included CAP emissions in the inventory it submitted to EPA.

- The nonroad source inventories obtained from EPA were loaded into Oracle in NIF 3.0 into one data set. Then, the following updates were performed on the consolidated data set, if necessary:

- HAP records were removed since the inventory will support regional haze, fine PM, and ozone modeling.

- Pollutant codes were corrected to make them NIF 3.0 compliant (e.g., update PMPRI pollutant code to PM-PRI). Additionally, other codes were identified for remediation on a case-by-case basis.

- Records with a submittal flag indicating deletions (submittal_flag = 'D' or 'RD') were removed from the inventory.

- Null values in the tribal code field were updated to '000' since this field is a part of the data key that defines records as unique in all eight NIF tables.
- Added and populated the NIF plus fields listed in the previous discussion for the area source inventory.

- The CENRAP-sponsored inventory did not contain S/L agency contact information in the TR table. In addition, the TR table for the data taken from the preliminary 2002 NEI contained the contact information for EPA. Therefore, the TR table was updated to include the contact information that S/L agencies provided in their area source inventories.

Table 13. Summary of Pollutants and Number of Counties Included in Nonroad Source Inventories

State/Local/Tribal Agency	Sector	CO	NH_3	NO_x	PM10-PRI	PM25-PRI	PM10-FIL	PM25-FIL	PM-CON	SO_2	VOC	Number of Counties in 2002 S/L/T Inventory	Number of Counties in 2002 Preliminary NEI	Number of Counties in State
AR	Commercial Marine Vessels (CMV)	x	x	x	x	x				x	x	27	25	75
	Railroad Locomotives	x	x	x	x	x				x	x	75	75	75
	Aircraft	x	x	x	x	x				x	x	68	41	75
KS	Railroad Locomotives		x									2	105	105
LA	Railroad Locomotives		x									3	64	64
MN	Railroad Locomotives	x	x	x	x					x	x	81	87	97
MO	Railroad Locomotives		x									2	115	115
TX	CMV	x		x	x	x	x	x		x	x	19	19	254
	Railroad Locomotives	x	x	x	x	x				x	x	254	254	254
	Aircraft	x		x	x	x	x			x	x	167	124	254

2. QA Review

QA review was conducted on the inventories in accordance with the QA procedures specified in the QAPP for this project (CENRAP, 2004b). The following discusses the QA checks that were completed during preparation of the consolidated data set.

a. County and SCC Coverage

For the agencies that submitted inventories to EPA, the county coverage in the inventories appeared to be reasonable. However, the NH_3 inventories for KS, LA, MN, and MO covered significantly fewer counties than what the preliminary 2002 NEI covered. The differences in the county coverage for NH_3 emissions were due to differences in the methods used to prepare the state NH_3 inventory and the NEI.

b. Pollutant Coverage

The pollutant coverage in the S/L/T inventories was complete for all pollutants except that MN did not include PM25-PRI emissions for railroad locomotives in its inventory, and TX did not provide NH_3 emissions for commercial marine vessels and aircraft in its inventory. MN provided PM25-PRI emissions to fill this data gap. TX did not provide any NH_3 emissions for commercial marine vessels or aircraft.

c. Additional QA for the CENRAP Area Source Inventory

The QA procedures discussed previously for the S/L/T area source inventories were applied to the S/L inventories for aircraft, commercial marine vessels, and railroad locomotives.

3. Responses from S/L/T Agencies

The nonroad source inventories were revised to incorporate updates from MN and to incorporate TX's NONROAD Model inventory. No other QA issues were identified in the state inventories for the non-NONROAD Model categories.

4. Gap Filling and Augmentation

Table 14 provides a summary of the sources of data used to prepare the consolidated inventory for aircraft, commercial marine vessels, and railroad locomotives. For commercial marine vessels and railroad locomotives, the CENRAP-sponsored inventory was used for all states except for AR, MN, and TX who provided their own inventories. Note that the CMU Model NH_3 emissions that KS, LA, and MO included in their inventory submittals to EPA for railroads were replaced with NH_3 emissions in the CENRAP-sponsored inventory.

Table 14. Summary of Data Sources Used to Prepare the Consolidated Nonroad Inventory for Aircraft, Commercial Marine Vessels, and Railroad Locomotives

State/Local Agency	Source of Inventory Data	Notes
Commercial and Military Aircraft (SCC 227500xxxx - 227507xxxx)		
AR	State	
IA	2002 NEI	
KS	State	State inventory is based on the 2002 NEI
LA	2002 NEI	
MN	State	Included in point source inventory
MO	2002 NEI	
NE - Lancaster County	2002 NEI	
NE - State	2002 NEI	
OK	2002 NEI	
TX	State	
Commercial Marine Vessels (SCC 228000xxxx)		
AR	State	
IA	CENRAP Inventory	
KS	CENRAP Inventory	
LA	CENRAP Inventory	
MN	State	
MO	CENRAP Inventory	
NE - Lancaster County	CENRAP Inventory	
NE - State	CENRAP Inventory	
OK	CENRAP Inventory	
TX	State	
Railroad Locomotives (SCC 2285002006 - 2285002010)		
AR	State	
IA	CENRAP Inventory	
KS	CENRAP Inventory	
LA	CENRAP Inventory	
MN	State	
MO	CENRAP Inventory	
NE - Lancaster County	CENRAP Inventory	
NE - State	CENRAP Inventory	
OK	CENRAP Inventory	
TX	State	

AR, KS, MN, and TX included aircraft emissions in the inventories they submitted to EPA. However, MN included aircraft emissions in its point source inventory that were included in the point source inventory for CENRAP. KS' inventory was based on the aircraft inventory included in the preliminary 2002 NEI. CENRAP did not sponsor development of an inventory for commercial and military aircraft. Therefore, the 2002 NEI was used as the source of aircraft inventory data for the states that did not provide an inventory for this source category. QA review of PM emissions did not find any missing data after updating MN's inventory for railroad locomotives. Therefore, no PM augmentation was performed on the nonroad inventories.

5. Revisions to Address Comments

The nonroad inventory was revised for Minnesota to remove double-counting of emissions for SCC 2265008005 (Mobile Sources / Off-highway Vehicle Gasoline, 4-Stroke / Airport Ground Support Equipment / Airport Ground Support Equipment). Minnesota included emissions for this SCC in its point source inventory. The nonroad inventory contained only annual emissions for this SCC, which came from the CENRAP-sponsored nonroad inventory. The annual emissions removed from the nonroad inventory are as follows:

Pollutant	Annual Emissions (tons/year)	Counties Affected (State and County FIPS code)
VOC	8.65	27007, 27037, 27041, 27053, 27091, 27109, 27123, 27137, 27145, 27163
NOX	7.6	27007, 27037, 27041, 27053, 27091, 27109, 27123, 27137, 27145, 27163
CO	212.7	27007, 27037, 27041, 27053, 27091, 27109, 27123, 27137, 27145, 27163
SO_2	0.04	27053
PM10-PRI	0.07	27053
PM25-PRI	0.06	27053
NH_3	0.01	27053

6. QA Review of Final Inventory

Final QA checks were run on the revised data set to ensure that all corrections provided by the S/L/T agencies were incorporated into the S/L/T inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory in Oracle to an Access database in NIF 3.0, the EPA's QA program was run on the Access database and the QA output was reviewed to verify that all QA issues that could be addressed were resolved. The QA output is provided in an Access 2000 database along with the Access database containing the inventory in NIF 3.0.

The following lists the remaining QA issues that were not addressed during the duration of this project:

Range Errors: There are 260 records in the EM table with emissions that exceed the maximum emissions in the QA program for the specified pollutant.

Lookup Errors: There are 105,667 records in the EM table with CO_2 emissions that caused this error. CO_2 is not included in the reference table for valid NIF 3.0 pollutant codes. At the request of CENRAP, CO_2 emissions were kept in the inventory.

E. 2002 CEM Data Methods and Results

1. Introduction

The 2002 CEM data for the entire CENRAP modeling domain were collected and converted to SMOKE and the RPO data exchange protocol formats. A crosswalk file was developed in order to process CEM data for all four quarters of 2002 into the formats required by CENRAP.

CEM data were also compiled for the CENRAP Region for the years 2000, 2001, and 2003. The data for these years were combined with the 2002 CEM data to develop three (3) sets of temporal profiles. The sets of profiles generated include seasonal profiles, daily profiles by season, and hourly profiles by season. National Weather Service temperature data that were readily available were analyzed. Recommendations were made on whether or not to generate temporal profiles based on these parameters. Additional recommendations were made on the best approaches for assigning temporal profiles to individual units.

2. Data Sources

The data source for the CEM data for the years 2000 through 2003 is the EPA's website, specifically the following websites were used for acquiring raw data and reports to QA the CEM data:

- http://www.epa.gov/airmarkets/emissions/raw/index.html (Clean Air Markets data)
- http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select (Emissions data and reports)
- http://www.epa.gov/airmarkets/emissions/prelimarp/ (more emissions reports)

The CEM units in the raw data sets were mapped to the appropriate source(s) in the consolidated 2002 point source inventory. We worked together with Pechan and the CENRAP states by soliciting feedback on the CEM units that we were not able to initially match up with the 2002 inventory. The mapping entailed matching a CEM unit (Office of Regulatory Information Systems [ORIS] ID and unit ID) to the state and county FIPS, Plant, Stack, and Segment identifier. The data were formatted into hour-specific emissions that are readable by the SMOKE modeling system and also in the RPO data exchange format.

CEM data for year 2002 for areas outside of the CENRAP were obtained from RPOs and EPA when the data were available. CEM data for the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) states were obtained from the VISTAS RPO via the Alpine Geophysics ftp site (ftp agftp.com). The data consisted of hour-specific CEM data for the year 2002. The other RPOs (Midwest, Western Regional Air Partnership [WRAP] and Mid-Atlantic/Northeast Visibility Union [MANE-VU]) did not have CEM data readily available and/or correct and updated crosswalks for the CEM units for a current year 2002 inventory for their particular region. Only VISTAS met these requirements. The Midwest and MANE-VU RPOs are still generating their updated year 2002 point source inventories (September-November 2004), therefore updated crosswalks had not been generated. Several RPOs (e.g., Midwest) indicated that they may rely on EPA to create the CEM crosswalk data for their particular region. We acquired the raw CEM data for the year 2002 for the entire United States region from EPA (Marc Houyoux). If and when the crosswalks become available for the other RPOs regions, CENRAP can then use these crosswalk data along with the raw data for the United States to implement hour-specific CEM data throughout their entire modeling domain.

Software was generated to process the CEM data for years 2000 through 2003 and generate monthly, weekly, and hourly profiles for each of the four seasons in SMOKE-ready format. National Weather Service temperature data were obtained from the University of California, Riverside (UCAR) website at http://dss.ucar.edu/datasets/ds472.0. Meteorological data from years 2000-2002 were obtained from UCAR. Plants subject to EPA CEM requirements are not required to report hourly stack flow rates to EPA. We were unable to find a reliable, consistent source of stack flow data that could be used in generating recommendation for temporal profiles for the year 2002.

Table 15 provides a summary of the CEM crosswalk files and documentation acquired for this project.

Table 15. CEM Crosswalk Files and Documentation

Data	Source	Date acquired or generated	Time Period of Data	Known deficiencies
Year 2000-2003 CEM data for CENRAP states	EPA website	27-Aug-04	Year 2000 thru 2003	None known at time of analysis
Year 2000-2003 CEM reports for CENRAP states	EPA website	15-Sep-04	Year 2000 thru 2004	None known at time of analysis
2002 point source inventory data in draft format	Pechan	19-Aug-04	Year 2002	Updates were received up through the month of Sept 2004.
CEM crosswalk for CENRAP states (final version)	UNC-CEP	27-Oct-04	Year 2002	Missing crosswalk data for some CEM units. Used 2002 point source inventory data for mapping information instead of final SMOKE IDA or inventory file used in emissions modeling
VISTAS RPO CEM data	Alpine Geophysics	24-Aug-04	Year 2002	None known at time of analysis
Year 2002 CEM data for all United States	EPA (Marc Houyoux)	03-Sep-04	Year 2002	None known at time of analysis
NWS 2000-2002 temperature data	UCAR	17-Sep-02	Year 2000 thru 2002	None known at time of analysis

3. QA Review

Carolina Environmental Program (CEP) analyzed the CEM crosswalk generated to match up CEM units with a source in the 2002 point source inventory along with the raw CEM databases to determine which units/sources were not being used due to the lack of crosswalk data and/or bad or no CEM data. There were data for a total of 775 CEM units in the CENRAP states. We informed CENRAP of all CEM units where we lacked sufficient crosswalk data that emitted over 40 tons per year of NO_x or SO_2. It was also recommended to CENRAP that those units that, (1) emitted less than 40 tons per year, and (2) for which no crosswalk record was available, be omitted. A total of 293 units emitted less than less than 40 tons of NO_x in year 2002. A total of 570 units emitted less than 40 tons of SO_2 in year 2002. Some crosswalk data for these "minor-emitting" units were easily obtainable from the 2002 point source inventory. Initial QA review revealed that CEP would most likely be able to map about 500 CEM units (64% of the total number of the units or about 90% of the total emissions) to the inventory data.

We also compared the CEM data in these raw datasets and versus the reports available at (http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select and http://www.epa.gov/airmarkets/emissions/prelimarp/) to ensure that the data we were going to use to create hour-specific emissions were consistent with these reporting tools.

Software was developed to process the CEM data for years 2000 through 2003 to generate monthly, weekly, and hourly profiles for each of the four seasons in SMOKE-ready format. CEP used the same CEM crosswalk created for the 2002 inventory for these years. If the 2002 CEM crosswalk was not able to match up a major-emitting unit from any of the other three years, this unit would have been flagged and been brought to CENRAP's attention. None of these instances were found. It should be noted that this was a temporal profile analysis task and not a task where SMOKE-ready hour-specific emissions data needed to be created. We spot-checked some of the profiles generated from these raw datasets versus the reports available at EPA websites to ensure that the data reformat process had not introduced any errors.

4. Supplemental Data/Augmentation Procedures

UNC-CEP examined the crosswalks generated at CEP and the raw CEM databases acquired from EPA and determined no changes/augmentations to the raw CEM databases were necessary. We did however inform CENRAP via email on October 12, 2004 of the CEM units we were unable to match to the CENRAP 2002 inventory. We did receive feedback from IA, TX, and MN and were able to create crosswalk records to enable more CEM data to be used for these particular states. If we did not enough information to map a CEM unit to a particular source and we did not receive feedback from CENRAP states, then the emissions data for these CEM units were not used to generate hour-specific emissions data for SMOKE. To help keep track of the changes to the CEM crosswalks and other ancillary data used for the processing of the CEM data, these data were checked into Concurrent Versions System (CVS).

The year 2000, 2001 and 2003 CEM data were also examined and spot-check comparisons were carried out using the CEM unit reports also available on the EPA website. It was determined that the CEM data did not need any changes/augmentations in order to perform the temporal profile analysis.

5. QA Review of Final Data Set

CEP analyzed the CEM crosswalk generated after receiving feedback from the CENRAP states to ensure that only changes made were due to new information received. We also determined again which units/sources were not being used due to the lack of crosswalk data and/or bad or no CEM data. Table 16 lists the CEM units that emitted over 40 tons per year of NO_x or SO_2 that could not be identified in the 2002 point source inventory.

Table 16. CEM Units for which Matches to Emission Units could not be Identified in State Inventories

ORISPL ID	Plant Name	STATE	REGION	UNITID	2002 SO_2	2002 NOx
000202	Carl Bailey	AR	6	01	380.3	147.8
000170	Lake Catherine	AR	6	1	0.1	43.5
000170	Lake Catherine	AR	6	2	0.1	53.1
000170	Lake Catherine	AR	6	3	0.2	52.4
000170	Lake Catherine	AR	6	4	3.8	1421.0
055075	Pine Bluff Energy Ce	AR	6	CT-1	11.1	228.0
001175	Pella	IA	7	CS67	413.7	281.7
055117	R S Cogen	LA	6	RS-5	0.7	53.5
055117	R S Cogen	LA	6	RS-6	0.6	48.8
002241	C W Burdick	NE	7	B-3	0.2	76.3
002291	North Omaha	NE	7	CS000A	5,030.0	2661.3
002291	North Omaha	NE	7	4	2,604.8	1,530.4
002291	North Omaha	NE	7	5	3,874.4	1,916.3
055098	Frontera Power Facil	TX	6	1	1.6	87.8
055098	Frontera Power Facil	TX	6	2	1.4	76.2
	Total				**12,323.0**	**8,678.1**

The CEM data associated with the CEM units in the table above could not be used due to insufficient mapping information. This represents a very small portion of the total emissions emitted in year 2002 by the units in the CENRAP states. According to EPA CEM emissions reports, about 1.50 million tons of SO_2 and 0.90 million tons of NO_x were emitted by the CEM units in the CENRAP states. In summary, CEP was able to map 567 of the total 775 units (or 73%) to the inventory data. This translated to successfully mapping 1.49 millions tons of SO_2 emissions (or 99.3% of the total SO_2 emissions) and 0.89 million tons of NOx emissions (or 98.9% of the total NO_x emissions). However, it should be noted that the initial mapping was carried out using the draft point source inventory. During December 2004, the SMOKE IDA inventory files became available to CENRAP. The CENRAP Emissions Modeling contractors began using the SMOKE IDA point source inventory with the SMOKE-formatted hour-specific data created at UNC-CEP. A few CEM (hour-specific) sources were found to be incorrectly mapped during SMOKE processing and, therefore, the hour-specific data could not be used. UNC-CEP corrected the identification information in the hour-specific data so these sources will be correctly mapped to the SMOKE IDA point source inventory. UNC-CEP delivered a new version of the SMOKE hour-specific files to CENRAP on January 27, 2005.

We also carried out spot-checks of the CEM data in the raw datasets and the hourly-emissions files generated (SMOKE hour-specific and RPO formatted files) versus the reports available at (http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select and http://www.epa.gov/airmarkets/emissions/prelimarp/) to ensure that the data created were consistent with these reporting tools.

The final version of the SMOKE-ready and RPO formatted hour-specific files for all days in the year 2002 were sent and received at CENRAP on October 28, 2004. The data were sent via CD and also included the VISTAS RPO and EPA CEM data for the year 2002.

6. Temporal Profile Analysis

UNC-CEP obtained year 2000, 2001 and 2003 CEM data from USEPA (http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select) and also used the year 2002 CEM data mentioned in section E-1 to develop three (3) sets of temporal profiles for each individual unit. The sets of profiles are seasonal profiles, daily profiles by season, and hourly profiles by season. This analysis was performed for units in the CENRAP region that includes the following states: AR, IA, KS, LA, MN, MO, NE, OK, and TX. These profiles could then be used by CENRAP in future emission inventory/modeling applications.

Since emissions preprocessors can now support many thousand different temporal profiles (e.g., SMOKE can handle 99999 different profiles), we prepared individual boiler emission profiles for each of the CEM units in the states listed above. A total of 568 units were included in the preliminary analysis. At CENRAP's request, these individual unit emission profiles were prepared based on combined CEM data from years 2000, 2001 and 2002. We also included year 2003 CEM data to add more relevant and recent data to the analysis. The emission profiles were all based on the NO_x emissions only. There was little difference between the NO_x and SO_2 profiles, with the exception that a good percentage of number of the units had zero SO_2 emissions. We also targeted the analysis on the major-emitting units which was defined as units emitting at least 1 ton of NO_x per average day. This limitation allowed us to focus the analysis on the 344 "major-emitting" units (see Table 17). Three sets of individual unit profiles were prepared: emission fractions by month, emission fractions by day of the week, and emission fractions by hour of the day for a weekday, Saturday, Sunday, and weekend (Saturday and Sunday combined). Software was created to generate these profiles for each of the four seasons in SMOKE-ready format.

Table 17. Number of Units In Each State Where Temporal Profiles Were Generated

State	CEM units
Arkansas	12
Iowa	30
Kansas	21
Louisiana	30
Minnesota	26
Missouri	36
Nebraska	13
Oklahoma	30
Texas	146
Total	**344**

For the monthly emission profiles, the NO_x emissions were totaled by unit and month. The NO_x emissions from each unit for a given month were then divided by the total of the year 2000-2003 NO_x emissions from that unit. For the day of week profiles, the Gregorian date for each hourly CEM data record was converted to the corresponding Julian date. Then, I/OAPI libraries were used to assign day of the week (Monday, Tuesday, etc.) based on the Julian date. Next, NO_x emissions were totaled by day of the week for each unit. The NO_x emission totals at a given unit for each day of the week were normalized by dividing by the sum of the year 2000 through 2003 NO_x emission total for that unit. Similarly, NO_x emissions were totaled by hour and unit for all weekdays, Saturdays, Sundays and weekend days. The hourly profiles were also normalized by dividing by the sum of each hour for each particular day of interest for the 4-year CEM dataset. All profiles were based on local standard time data. This normalization technique was carried out for each of the four seasons (winter, spring, summer and fall) were the seasons were defined as follows:

- Winter–January, February; and March
- Spring–April, May and June
- Summer–July, August and September
- Fall– October, November and December

Previous CEM/temporal analysis studies (Pechan, 2003) have strived to generate a small set of temporal profiles to use for all units over a certain geographical area. While this is possible for this task, we recommend the profiles for the individual units be used. Each unit has many factors that effect temporal allocation of emissions including geographical region, seasonal demands and controls, population and technology changes, costs, and variations in weather from year to year. Emissions preprocessors can handle thousands of different profiles, therefore we recommend that these various factors be captured using the profiles for the individual units.

Figures 1 and 2 give examples of the monthly profiles generated from the 2000-2003 CEM data for the states of AR and NE. Figure 3 is an example of the weekly profiles generated for Arkansas for all four seasons. Figures 4 and 5 give example hourly profiles for Big Brown unit #1, TX and Dolet Hills unit #1, LA respectively. These are just samples of the numerous profiles generated. All profiles delivered to CENRAP can easily be displayed by importing to MS Excel or other spreadsheet software.

National Weather Service temperature data were also obtained from UCAR (http://dss.ucar.edu/datasets/ds472.0/) for the time period of year 2000-2003. UNC-CEP continues to carry out the analysis of this data in order to determine its usefulness and/or its ability to provide better profile data than the individual unit profiles. We will provide our feedback on this analysis in the next version of this report. UNC-CEP also searched for reliable hourly stack flow databases. Hourly stack flow is not a required element to be reported to USEPA. Therefore, we did not find it on USEPA websites. We were also unable to find an hourly stack flow database that covered the desired years and region of interest.

F. Temporal, Speciation, and Spatial Allocation Profiles

1. Temporal Profiles for Point, Area, and Nonroad Sources

a. Data Sources (e.g., CEM)

CEP obtained the best available temporal profile data for emissions modeling from EPA (see also http://www.epa.gov/ttn/chief/emch/temporal/index.html), RPOs (e.g., MANE-VU), and other source-specific reports/databases (e.g., CEM data). A similar review of temporal profiles for the MANE-VU RPO and the EPA yielded the temporal profiles to be used in the review of the CENRAP emissions inventory dataset. This subsection describes the profile databases used for each component of the CENRAP emission inventory.

Point Sources

A similar review was carried out using the latest temporal profile dataset acquired from EPA on the MANE-VU inventory. Additional profiles were added during this review to support MANE-VU state- or county-specific point sources. We began the CENRAP review using the product (temporal profiles) of this MANE-VU EI review.

Additionally, the CEM data for the years 2000, 2001, 2002 and 2003 were used to come up with 4-year average temporal profiles for each major emitting unit (see also section E of this report). The CEM data were acquired from the following EPA website: http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select.

The CENRAP emissions inventory was provided to us by Pechan in NIF 3.0. Additional data acquired from Pechan included periodic updates to the CENRAP inventory and complete listing of the SCCs in the inventory databases.

Figure 1. Arkansas CEM unit monthly profiles based on year 2000-2003 data.

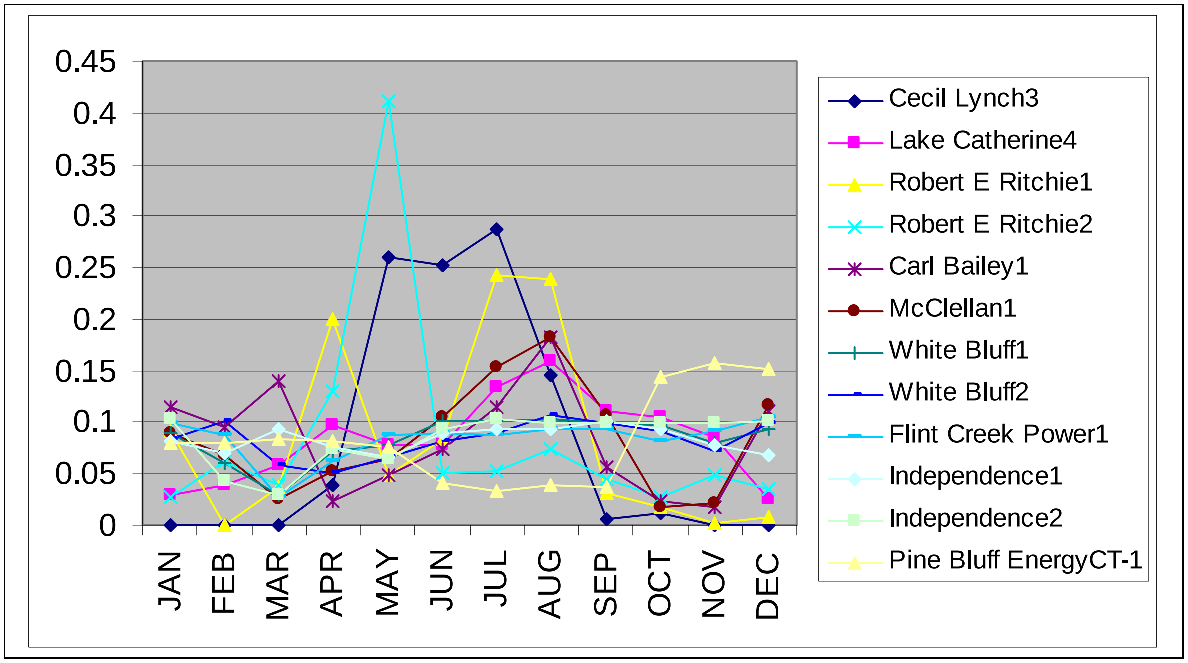


Figure 2. Nebraska CEM unit monthly profiles based on year 2000-2003 data.

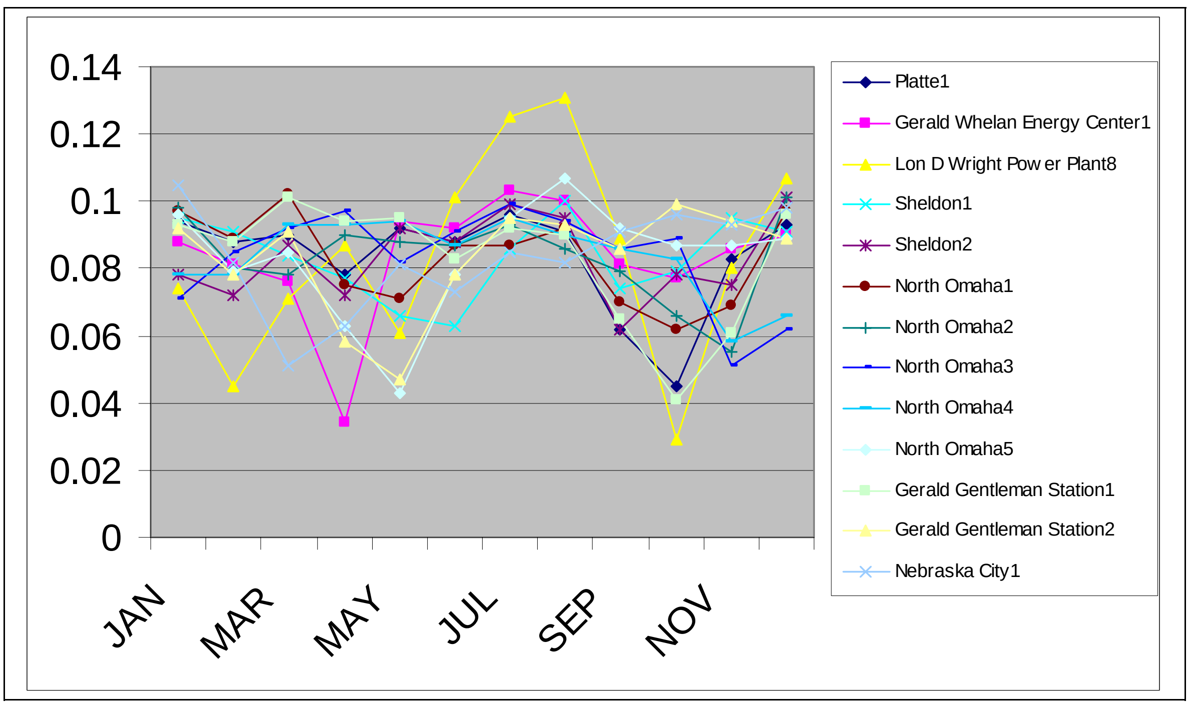


Figure 3. Arkansas weekly profiles for (a) winter, (b) spring, (c) summer and (d) autumn using the 2000-2003 data.

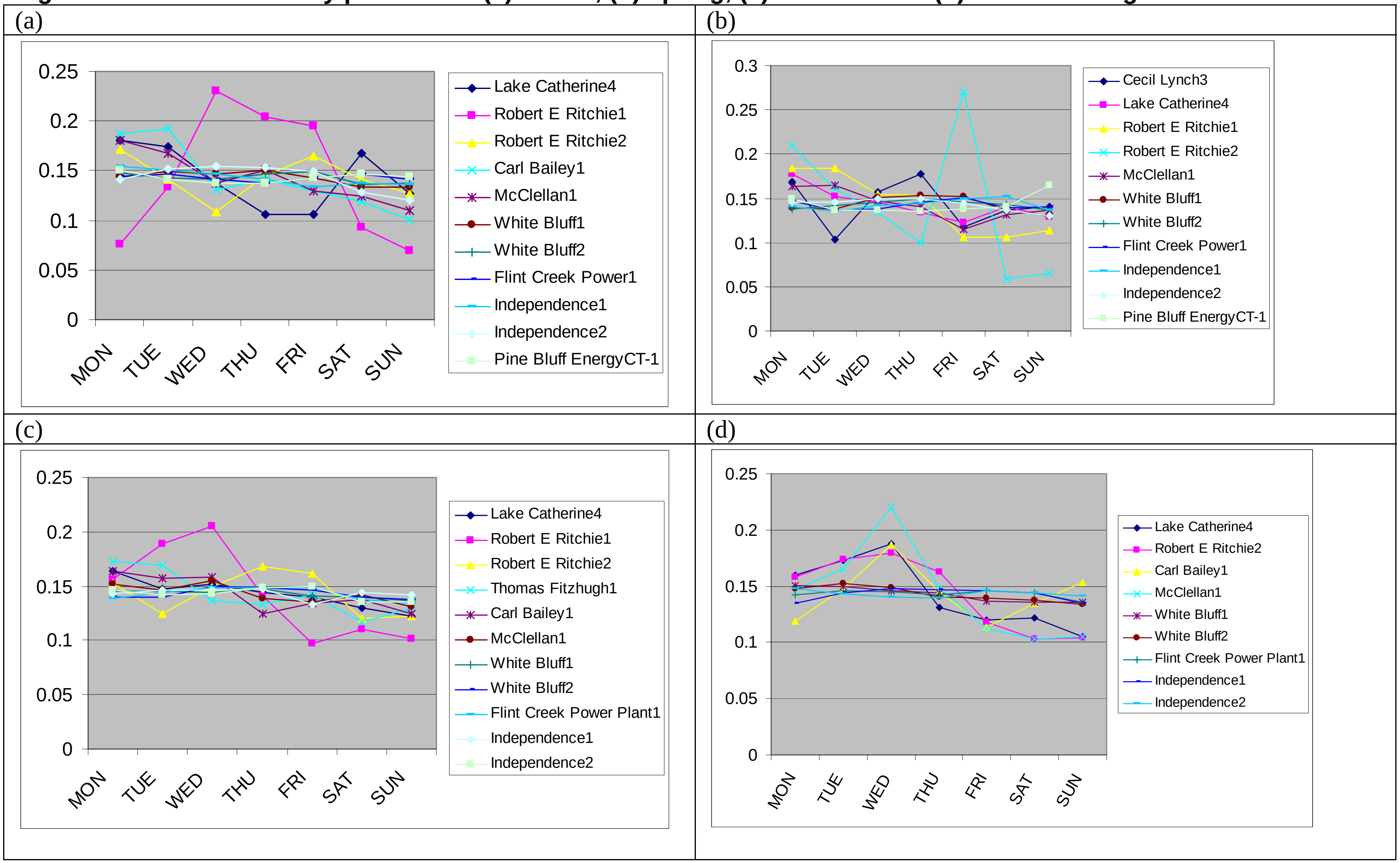


Figure 4. Big Brown Unit 1, Texas hourly profiles for winter for 2000-2003 data.

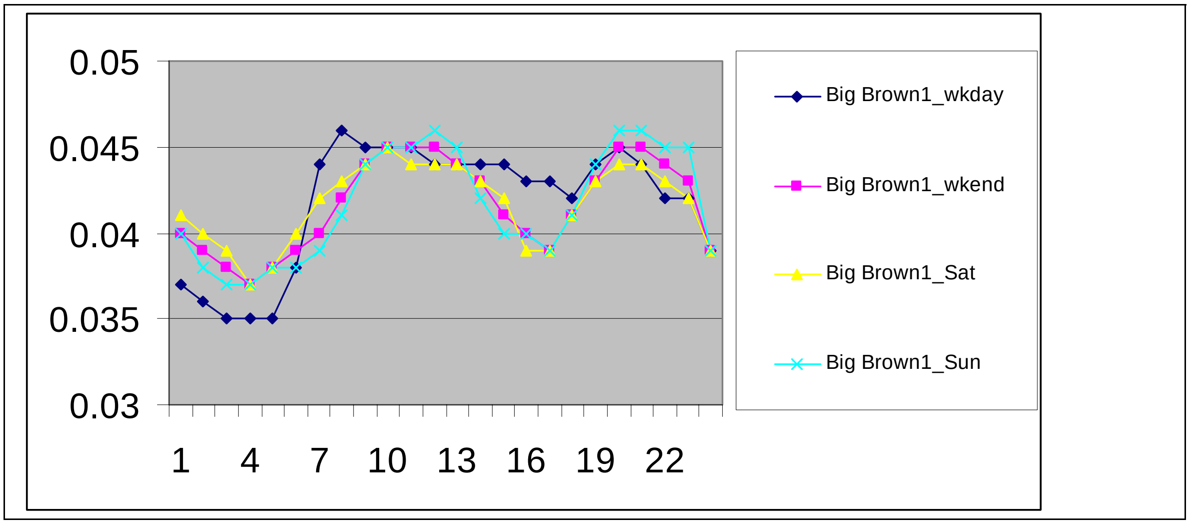
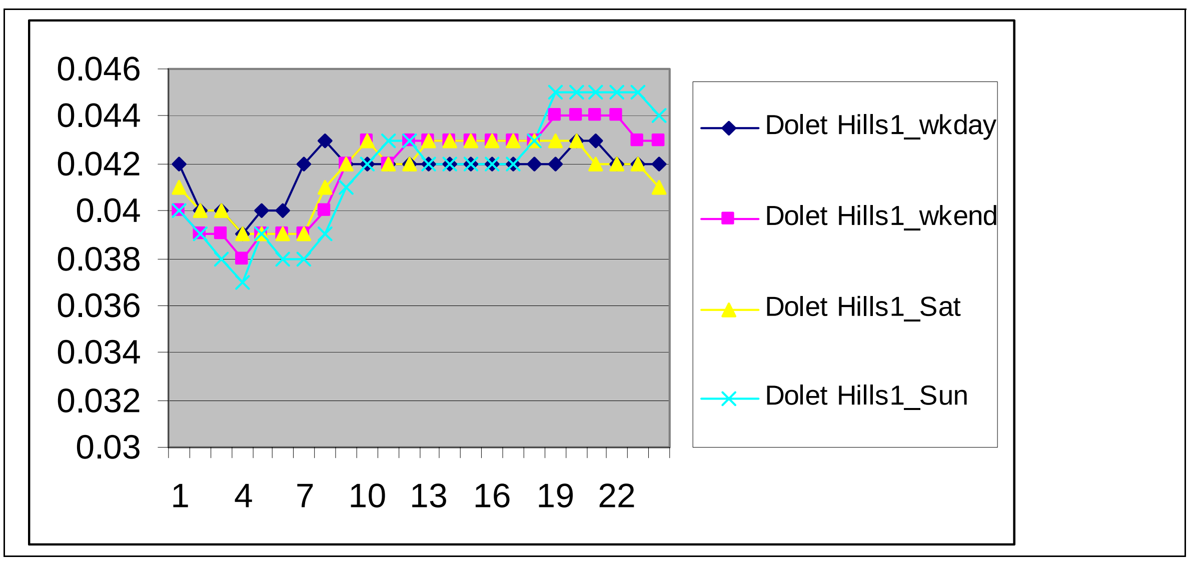


Figure 5. Dolet Hills Unit 1, Louisiana hourly profiles for autumn for 2000-2003 data.



Area and Nonroad Sources

A similar review was carried out using the latest temporal profile dataset acquired from EPA on the MANE-VU inventory. Additional profiles were added during this review to support MANE-VU state- or county-specific area and nonroad sources. We began the CENRAP review using the product (temporal profiles) of this MANE-VU EI review.

Additionally, we used the final report (STI, 2003) generated for NH_3 emissions inventories to aide in the coming up with applicable temporal profiles for use with the CENRAP emissions inventory.

b. Supplemental Data/Augmentation Procedures

A cross-reference table is necessary in order to appropriately apply the desired temporal profile to a certain emission source. This assignment or cross-reference is typically made by SCC, but can also be made for a specific FIPS-SCC combination or all SCCs in a FIPS region combination. For point sources, emissions modelers can also assign a specific temporal profile by a specific unit, stack, and/or facility identification. We conducted the review of CENRAP emissions inventory using the most recent temporal cross-reference table available that was the table generated during the MANE-VU review.

CEP identified SCCs that did not have a specific temporal profile assigned in the temporal cross-references file used in recent EPA and RPO applications. CEP created a new temporal cross-reference to an existing profile in the default SMOKE profiles for SCCs in the CENRAP; the cross-reference did not previously exist in the cross-reference file used at the beginning of the review (see Data Sources section) but the profile did exist.

All of the improvements to the SMOKE temporal cross-reference file and profiles that are summarized in this memo are included in the files *amptref.m3.cenrap.102804.txt* and *amptpro.m3.us+can.cenrap.102804.txt*, which were included as an electronic docket and delivered on October 28, 2004.

Table 18 summarizes the updates to entries in the default SMOKE cross-reference file for point sources and Table 19 for area/nonroad sources. The commonly assigned monthly profile is monthly profiles is 262 = uniform monthly. The most common weekly profiles are 7 = 'uniform emissions throughout the week' weekly and 5 = 'emit weekdays only' profile. The most common diurnal profiles are 12 = 12 hours per day during daylight hours and 26= maximum middle of the day; minimum early in morning. See the *amptpro.m3.us+can.cenrap.102804.txt file* for specific definitions of each profile.

These changes to the temporal cross-reference file have allowed us to apply a non-flat temporal profile (262= uniform monthly, 7=uniform weekly and 24=uniform diurnal) to ~90% of the SCCs in the point source inventory and ~95% of the SCCs in the area/nonroad source inventory. This is the best we could do with the information available to us at the time of the analysis.

Table 18. New Temporal Profile Assignments for CENRAP Point Source SCCs

State	SCC	Recommended Monthly, Weekly, and Diurnal Profiles			Method of Assignment	SCC Description
MN	30500245	262	7	6	30500242	Industrial Processes;Mineral Products;Asphalt Concrete;Mixers: Drum Mix Process ** (use 3-05-002-005 and subtypes)
MN	30500246	262	7	6	30500242	Industrial Processes;Mineral Products;Asphalt Concrete;Mixers: Drum Mix Process ** (use 3-05-002-005 and subtypes)
MN	30500247	262	7	6	30500242	Industrial Processes;Mineral Products;Asphalt Concrete;Mixers: Drum Mix Process ** (use 3-05-002-005 and subtypes)

Table 19. New Temporal Profile Assignments for CENRAP Area Source SCCs

SCC	Description	Month	Week	Diurnal	Recommendation Based on Profile Data for SCC	Description of Similar SCC used to Recommend Profiles
2310001000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes : On-shore;Total: All Processes	262	7	26	2310000000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes;Total: All Processes
2310002000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes : Off-shore;Total: All Processes	262	7	26	2310000000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes;Total: All Processes
2461870999	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: Non-Agricultural;Not Elsewhere Classified	258	7	26	2461800000	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: All Processes;Total: All Solvent Types
2805009200	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - broilers;Manure handling and storage	1500	7	26	2805009300	Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - broilers;Land application of manure
2805021100	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - scrape dairy;Confinement	1500	7	26	2805021300	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - scrape dairy;Land application of manure
2805021200	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - scrape dairy;Manure handling and storage	1500	7	26	2805021300	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - scrape dairy;Land application of manure
2805023100	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - drylot/pasture dairy;Confinement	1500	7	26	2805023300	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - drylot/pasture dairy;Land application of manure
2805023200	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - drylot/pasture dairy;Manure handling and storage	1500	7	26	2805023300	Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - drylot/pasture dairy;Land application of manure
2810020000	Miscellaneous Area Sources;Other Combustion;Prescribed Burning of Rangeland;Total	3	11	13	2810015000	Miscellaneous Area Sources;Other Combustion;Prescribed Burning for Forest Management;Total

We will augment the temporal profiles and cross-references delivered on Oct 28, 2004 with NH_3-specific temporal profiles using the STI final report on NH_3 sources. This will include monthly profiles for Texas and Arkansas and diurnal profiles for all states for applicable SCCs. The delivery of these profiles/cross-references is scheduled for early January 2005. The temporal profiles for each major emitting CEM unit based on a 4-year average (data from 2000 through 2003) were also delivered to CENRAP in January 2005.

2. Speciation Profiles for Point, Area, and Nonroad Sources

a. Data Sources

CEP obtained the best available speciation profile data for emissions modeling from EPA for the CB-IV with PM mechanism (see also http://www.epa.gov/ttn/chief/emch/speciation/index.html). The CENRAP emissions inventory was provided to us by Pechan in the NIF 3.0. Additional data acquired from Pechan included periodic updates to the CENRAP EI and complete listing of the SCCs in the inventory databases.

b. Supplemental Data/Augmentation Procedures

A cross-reference table is necessary in order to appropriately apply the desired speciation profile to a certain emission source. This assignment or cross-reference is typically made by SCC, but can also be made for a specific FIPS-SCC combination or all SCCs in a FIPS region combination. For point sources, emissions modelers can also assign a specific temporal profile by a specific unit, stack, and/or facility identification. We conducted the review of CENRAP emissions inventory using the most recent speciation cross-reference table available which was the table generated during the MANE-VU review.

Several SCCs in the CENRAP EI did not have chemical speciation profile assignments for the CB-IV with PM mechanism in the default SMOKE chemical cross-reference file. CEP added assignments for VOC speciation for the SCCs listed in Table 20 (area/nonroad sources) and Table 21 (point sources) to the speciation cross-reference file for compatibility with the CENRAP EI. The recommendations for these assignments are based on the speciation profile codes assigned to similar SCCs. We attempted to match the SCCs as accurately as possible, i.e. we looked for the closest SCC possible to supplement the missing assignment. The new chemical profile assignments were added to the file *gsref.cmaq.cb4p25.cenrap.102804.txt.* We did not make any changes to the speciation profiles file.

Please note that we understand that Pechan will soon be delivering some new PM and VOC profiles to EPA that are being incorporated into SPECIATE. Since some of these will have important implications for regional haze modeling, CENRAP may want to consider having these included in the modeling inventory. These profiles would take additional effort not already in the planned scope of work to implement. Some of the more important profiles will cover:

- Commercial Cooking (PM and VOC);
- Distillate and Natural Gas Fired Boilers (PM);
- Paved and Unpaved Road Dust;

- Motor Vehicle Exhaust/Tire Wear/Brake Wear; and
- Wildfires/Prescribed Burns.

Table 20. VOC Speciation Profiles Assigned to Area Source SCCs

SCC	Description	VOC	Recommendation Based on Profile Data for SCC	Description of Similar SCCs used to Recommend Profiles
2310001000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes : On-shore;Total: All Processes	9015	2310000000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes;Total: All Processes
2310002000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes : Off-shore;Total: All Processes	9015	2310000000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes;Total: All Processes
2461870999	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: Non-Agricultural;Not Elsewhere Classified	0076	2461850000	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: Agricultural;All Processes
2810020000	Miscellaneous Area Sources;Other Combustion;Prescribed Burning of Rangeland;Total	0307	2810015000	Miscellaneous Area Sources;Other Combustion;Prescribed Burning for Forest Management;Total

Table 21. VOC Speciation Profiles Assigned to Point Source SCCs

State	SCC	Recommended Profiles VOC	Method of Assignment	SCC Description (Complete Description not Always Available)
MN	30500245	0025	Use SCC=3050024X profiles	Industrial Processes;Mineral Products;Asphalt Concrete;Batch Mix Plant: Hot Elevators, Screens, Bins, Mixer & NG Rot Dryer
MN	30500246	0025	Use SCC=3050024X profiles	Industrial Processes;Mineral Products;Asphalt Concrete;Batch Mix Plant: Hot Elevators, Screens, Bins, Mixer& #2 Oil Rot Dryer
MN	30500247	0025	Use SCC=3050024X profiles	Industrial Processes;Mineral Products;Asphalt Concrete;Batch Mix Plant: Hot Elevs, Scrns, Bins, Mixer& Waste/Drain/#6 Oil Rot

3. Spatial Allocation Profiles for Area and Nonroad Sources

a. Data Sources

CEP obtained the best available spatial profile data for emissions modeling from EPA for the geographical area covered by the CENRAP 36-kilometer modeling domain (http://www.epa.gov/ttn/chief/emch/spatial/newsurrogate.html). A detailed description of this surrogate dataset is available at: http://www.epa.gov/ttn/chief/emch/spatial/new/surrogate_documentation_workbook052804.xls.

The CENRAP emissions inventory was provided to us by Pechan in the NIF 3.0. Additional data acquired from Pechan included periodic updates to the CENRAP EI and complete listing of the SCCs in the inventory databases.

b. *Supplemental Data/Augmentation Procedures*

A cross-reference table is necessary in order to appropriately apply the desired spatial allocation profile to a certain emission source. This assignment or cross-reference is typically made by SCC, but can also be made for a specific FIPS-SCC combination or all SCCs in a FIPS region combination. We conducted the review of CENRAP emissions inventory using the most recent speciation cross-reference table available which was the table generated during the MANE-VU review.

Several SCCs in the CENRAP area source EI did not have surrogate assignments in the default SMOKE gridding cross-reference file. These SCCs would be assigned the default surrogate which is population when spatially allocating emissions in emissions processing applications. CEP added spatial profile assignments for the SCCs listed in Table 22 to the gridding cross-reference file for compatibility with the CENRAP EI. The recommendations for these assignments are based on matching surrogate descriptions from the EPA surrogate data descriptions (see http://www.epa.gov/ttn/chief/emch/spatial/new/surrogate_documentation_workbook052804.xls) with the SCC descriptions. The new surrogate assignments were added to the file *amgref.m3.us+can+mex.cenrap.102804.txt* and included as part of the electronic docket delivered on October 28, 2004. CENRAP contractors already have a surrogate dataset for the 36-kilometer modeling domain using the EPA surrogate database. We are awaiting final definition of the CENRAP 12-kilometer domain(s) before delivering spatial surrogates to CENRAP.

Table 22. Surrogate profiles assigned to SCCs to support CENRAP EI

SCC	Description	Surrogate profile	Surrogate Description
2310001000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes : On-shore;Total: All Processes	585	Metals and Minerals Industrial (IND4)
2310002000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes : Off-shore;Total: All Processes	585	Metals and Minerals Industrial (IND4)
2311000000	Industrial Processes;Construction: SIC 15 - 17;All Processes;Total	140	Housing Change and Population
2461022999	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Emulsified Asphalt;Solvents: NEC	140	Housing Change and Population
2461870999	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: Non-Agricultural;Not Elsewhere Classified	515	Commercial plus Institutional Land
2535010000	Storage and Transport;Bulk Materials Transport;Rail Car;Total: All Products	260	Total Railroad Miles
2810040000	Miscellaneous Area Sources;Other Combustion;Aircraft/Rocket Engine Firing and Testing;Total	700	Airport Area

4. QA Review of Final Data Sets

Table 23 lists the spatial, temporal and speciation allocation profiles and cross-reference tables, technical memoranda and other ancillary data delivered to CENRAP on October 28, 2004. Table 24 lists the sources and other attributes of the ancillary data collected and reviewed including the temporal profiles generated using the CEM data for years 2000-2003. All of the data files were QA reviewed twice by ensuring that no default profiles are being used and the data are in the correct format for use in the emissions models. The following data may be updated in early 2005 to incorporate more recent information:

- NH_3 temporal profile updates
- Spatial surrogates for the 12- kilometer modeling domain(s) once defined by CENRAP
- 4-year average temporal profiles for each major emitting CEM unit

These data will also be quality assured in a similar manner (no default profiles being used, correct format, etc.). Most of the data presented in this section have been delivered with a few additional data sets to be delivered in January 2005. These additional data sets are mentioned in this section. The next version of this report will include any necessary documentation associated with the supplemental deliverables.

Table 23. Spatial, Temporal and Speciation Allocation Data and Memos

Bytes	Date Created	Time Created	Filename
90209	10/28/2004	10:55	task8_final/amgref.m3.us+can+mex.cenrap.102804.txt
115493	10/28/2004	10:55	task8_final/amptpro.m3.us+can.cenrap.102804.txt
650073	10/28/2004	10:55	task8_final/amptref.m3.cenrap.102804.txt
75776	10/28/2004	10:54	task8_final/CENRAP_AreaEI_profile_review_task8_final.doc
135810	10/28/2004	10:55	task8_final/CENRAP_AreaEI_profile_review_task8_final.pdf
48640	10/28/2004	10:54	task8_final/CENRAP_PointEI_profile_review_task8_final.doc
146830	10/28/2004	10:55	task8_final/CENRAP_PointEI_profile_review_task8_final.pdf
142013	9/16/2004	18:14	task8_final/gspro.cmaq.cb4p25.txt
754816	10/28/2004	10:55	task8_final/gsref.cmaq.cb4p25.cenrap.102804.txt
501	10/28/2004	10:56	task8_final/README.txt
1324273	9/16/2004	18:13	task8_final/scc_desc.txt

Table 24. Ancillary Data Descriptions

File Name	Purpose	Format	Source	Possible Deficiencies	Date Delivered
amgref.m3.us+can+mex.cenrap.102804.txt	Spatial profile cross-reference	SMOKE	USEPA, MANE-VU and other reviews/applications	NH3 specific surrogates could be developed using landuse databases like BELD3	28-Oct-04
amptpro.m3.us+can.cenrap.102804.txt	Temporal profiles	SMOKE	USEPA, MANE-VU and other reviews/applications.	NH3 specific temporal profiles will be added soon	28-Oct-04
amptref.m3.cenrap.102804.txt	Temporal profile cross-reference	SMOKE	USEPA, MANE-VU and other reviews/applications	NH3 specific temporal profiles will be added soon	28-Oct-04
gspro.cmaq.cb4p25.txt	Speciation profiles for CB-IV with PM	SMOKE	USEPA: SMOKE v2 release	SPECIATE 4 data could be available soon	28-Oct-04
gsref.cmaq.cb4p25.cenrap.102804.txt	Speciation cross-references for CB-IV with PM	SMOKE	USEPA, MANE-VU and other reviews/applications	SPECIATE 4 data could be available soon	28-Oct-04
scc_desc.txt	SCC description	SMOKE	USEPA: SMOKE v2 release	Could be missing some SCC descriptions	28-Oct-04
amgref.m3.us+can+mex.cenrap.102804.rpo	Spatial profile cross-reference	RPO	USEPA, MANE-VU and other reviews/applications	NH3 specific surrogates could be developed using landuse databases like BELD3	Coming soon
amptpro.m3.us+can.cenrap.102804.rpo	Temporal profiles	RPO	USEPA, MANE-VU and other reviews/applications.	NH3 specific temporal profiles will be added soon	Coming soon
amptref.m3.cenrap.102804.rpo	Temporal profile cross-reference	RPO	USEPA, MANE-VU and other reviews/applications	NH3 specific temporal profiles will be added soon	Coming soon
gspro.cmaq.cb4p25.rpo	Speciation profiles for CB-IV with PM	RPO	USEPA: SMOKE v2 release	SPECIATE 4 data could be available soon	Coming soon
gsref.cmaq.cb4p25.cenrap.102804.rpo	Speciation cross-references for CB-IV with PM	RPO	USEPA, MANE-VU and other reviews/applications	SPECIATE 4 data could be available soon	Coming soon
ptpro.cem_winter.cenrap.2000-03.txt	Temporal profiles for CEM units	SMOKE	http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select	Based on 4 yr (2000-2003) average profiles	Coming soon
ptpro.cem_spring.cenrap.2000-03.txt	Temporal profiles for CEM units	SMOKE	http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select	Based on 4 yr (2000-2003) average profiles	Coming soon
ptpro.cem_summer.cenrap.2000-03.txt	Temporal profiles for CEM units	SMOKE	http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select	Based on 4 yr (2000-2003) average profiles	Coming soon
ptpro.cem_autumn.cenrap.2000-03.txt	Temporal profiles for CEM units	SMOKE	http://cfpub.epa.gov/gdm/index.cfm?fuseaction=prepackaged.select	Based on 4 yr (2000-2003) average profiles	Coming soon

G. Preparation of SMOKE/IDA and RPO Data Exchange Protocol (NIF 3.0) Formats

This section describes the inventory and SMOKE emission processor files prepared under this project. The Excel Workbook file named "CENRAP Inventory File Documentation _030405.xls" provides the names of the files delivered, as well as other file information useful for transferring data to air quality modeling centers. This Excel Workbook file is provided along with this report. The following Table 25 provides a summary of the files delivered.

The ancillary data (described in section F) that are necessary input for emissions preprocessors have been formatted for use in SMOKE and in the RPO Data Exchange Protocol format. Table 26 lists the profiles, cross-reference tables, and other ancillary data (SCC descriptions) that have been provided to CENRAP. The data have undergone a review which is described in section F and in technical memoranda sent to CENRAP on October 28, 2004.

Table 25. Summary of Mass Emissions and SMOKE Input Files

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
Point Source Inventory					
AR, IA, KS, LA, MN, MO, NE, OK, TX, Local, and Tribal	CENRAP_2002_Point_021605.mdb	Annual	CENRAP_POINT_SMOKE_INPUT_ANNUAL_DAILY_021805.txt	Annual for all agencies; Daily for MO and TX	Includes all sectors supplied by S/L/T agencies. Tribal inventory is for Fond du Lac Band of the Minnesota Chippewa Tribe. Local inventories include Lancaster County (Lincoln) and Douglas County (Omaha), NE
MO and TX	CENRAP_2002_Point_Daily_Missouri_Texas_20050216.mdb	Daily	CENRAP_POINT_SMOKE_INPUT_ANNUAL_DAILY_021805.txt	"	Daily emissions for MO and TX are included in the SMOKE/IDA file containing annual emissions for all CENRAP agencies, but placed in a NIF 3.0 file separate from the NIF 3.0 file containing the annual emissions.
Nonroad Source Inventory					
AR, IA, KS, LA, MN, MO, NE, OK, TX	CENRAP_2002_Nonroad_030305.mdb	Annual and Daily	CENRAP_NONROAD_SMOKE_INPUT_ANN_STATE_030405.txt	Annual	Includes NONROAD Model Categories and Aircraft, Commercial Marine Vessels, and Railroad Locomotives. NONROAD Model inventory is from CENRAP-sponsored inventory except for TX who supplied its own NONROAD Model Inventory. MN included commercial and military aircraft and auxiliary power units in its point source inventory; therefore, the nonroad inventory does not contain emissions for these categories in MN.
Area Source Inventory					
AR, IA, KS, LA, MN, MO, NE, OK, TX	CENRAP_2002_Area_022205.mdb	Annual, Daily, and Monthly	CENRAP_AREA_SMOKE_INPUT_ANN_STATE_022205.txt	Annual	Includes all sectors except for those included in the Area Misc files. Planned burning emissions from CENRAP-sponsored area source inventory are excluded for IA, KS, LA, MN, MO, OK, and NE (except for Lancaster County [FIPS 31109]); the SMOKE files for the CENRAP planned burning inventory will be used for these states.
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_JAN_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_FEB_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_MAR_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).

Table 25 (continued)

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
Area Source Inventory (continued)					
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_APR_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_MAY_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_JUN_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_JUL_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_AUG_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_SEP_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_OCT_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_NOV_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_DEC_120304.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
Fond du Lac Band of the Minnesota Chippewa Tribe	"	"	CENRAP_AREA_SMOKE_INPUT_ANN_TRIBE_120704.txt	Annual	Includes emissions for the paved and unpaved road and prescribed burning area source categories.
AR, TX, and Lancaster County, NE	"	"	CENRAP_AREA_BURNING_SMOKE_ INPUT_ANN_TX_AR_NELI_120704.txt	Annual	Includes state and local prepared planned burning emissions. SMOKE input files for area source planned burning emissions for all other states are available from CENRAP-sponsored inventory.

Table 25 (continued)

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
Area Miscellaneous Source Inventory					
AR, IA, KS, LA, MN, MO, NE, OK, TX	CENRAP_2002_Area_Misc_120804.mdb	Annual, Daily, and Monthly	CENRAP_AREA_MISC_SMOKE_INPUT_ANN_STATE_120704.txt	Annual	Natural Sources and Two On-road Mobile SCCs from CMU Model
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_JAN_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_FEB_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_MAR_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_APR_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_MAY_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_JUN_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_JUL_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_AUG_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_SEP_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_OCT_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	“	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_NOV_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	“	”	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_DEC_120304.txt	Monthly Emissions x 12	Natural Sources and Two On-road Mobile SCCs from CMU Model. Monthly emissions are multiplied by 12 (months).

Table 26. Profiles, Cross-Reference Tables, and Other Ancillary Data Provided to CENRAP that can be used with Emissions Preprocessors/Models (e.g. SMOKE, CONCEPT)

Filename	Purpose	Format[1]
amgref.m3.us+can+mex.cenrap.102804.txt	Spatial profile cross-reference	SMOKE
amptpro.m3.us+can.cenrap.102804.txt	Temporal profiles	SMOKE
amptref.m3.cenrap.102804.txt	Temporal profile cross-reference	SMOKE
gspro.cmaq.cb4p25.txt	Speciation profiles for CB-IV with PM	SMOKE
gsref.cmaq.cb4p25.cenrap.102804.txt	Speciation cross-references for CB-IV with PM	SMOKE
scc_desc.txt	SCC description	SMOKE
amgref.m3.us+can+mex.cenrap.102804.rpo	Spatial profile cross-reference	RPO
amptpro.m3.us+can.cenrap.102804.rpo	Temporal profiles	RPO
amptref.m3.cenrap.102804.rpo	Temporal profile cross-reference	RPO
gspro.cmaq.cb4p25.rpo	Speciation profiles for CB-IV with PM	RPO
gsref.cmaq.cb4p25.cenrap.102804.rpo	Speciation cross-references for CB-IV with PM	RPO

[1] RPO = Regional Planning Organization (PRO) Data Exchange Protocol.

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III. SUMMARIES OF EMISSIONS INVENTORIES FOR THE CENRAP REGION

Summaries of emissions were prepared from the emission inventory files for each sector and for all sectors combined. The summaries are provided in an Access 2000 database named "CENRAP Emission Summaries_030805.mdb". Table 27 identifies and briefly describes the contents of the emissions summary tables included in the database. The nonroad source sector summaries include emissions for aircraft, commercial marine vessels, and locomotives as well as the emissions from the NONROAD model categories. The onroad summaries were prepared from the CENRAP-sponsored inventory for onroad sources. Tables 1G, 2C, 3C, 4C, and 5C include the data source code for the area, point, nonroad, and onroad sectors to assist in identifying the origin and year of emissions inventory data. The data source codes were defined previously in Chapter II of this report.

The summaries in Appendix A of this report are taken from the emissions summary Table 2D. However, emissions summary Table 2D includes natural sources/biogenic NH_3 emissions and geogenic PM10-PRI and PM25-PRI emissions. The biogenic and geogenic emissions were excluded from the summary tables included in Chapter I of the report. Thus, the biogenic and geogenic emissions were excluded from the NH_3 and PM10-PRI and PM25-PRI summaries in Appendix A so that the total emissions in the Appendix A summaries match the total emissions in the summaries in Chapter I of the report.

Table 27. Emissions Summaries

Summary Table Name	Description
All Sector Summaries	
Table 1A_All Sectors	Summary of Annual Emissions by Pollutant and Sector for the CENRAP Region
Table 1B_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/Pollutant and Sector
Table 1C_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/Pollutant and Sector
Table 1D_All Sectors	Summary of Annual Emissions by Category/Sector and Pollutant for the CENRAP Region
Table 1E_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/ Source Category Name and Number/Sector and Pollutant
Table 1F_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/Source Category Name and Number/Sector and Pollutant
Table 1G_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/SCC and SCC Description/Source Category Name and Number/ Sector/Pollutant and Data Source Code

Table 27 (continued)

Summary Table Name	Description
Area Source and Biogenic/Natural Source Sector Summaries	
Table 2A_Area Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name and Pollutant
Table 2B_Area Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name and Pollutant
Table 2C_Area Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 2D_Area Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State/Tribe
Table 2E_Area Sources	Summary of Annual Emissions by Pollutant and State/Tribe
Point Source Sector Summaries	
Table 3A_Point Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name and Pollutant
Table 3B_Point Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name and Pollutant
Table 3C_Point Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 3D_Point Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State/Tribe
Table 3E_Point Sources	Summary of Annual Emissions by Pollutant and State/Tribe
Table 3F_Point Sources	Facility-level Summary
Nonroad Source Sector Summaries	
Table 4A_Nonroad Sources	Summary of Annual Emissions by State FIPS/State Name and Pollutant
Table 4B_Nonroad Sources	Summary of Annual Emissions by State FIPS/State Name/County FIPS/County Name and Pollutant
Table 4C_Nonroad Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/State Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 4D_Nonroad Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State
Table 4E_Nonroad Sources	Summary of Annual Emissions by Pollutant and State
Onroad Source Sector Summaries	
Table 5A_Onroad Sources	Summary of Annual Emissions by State FIPS/State Name and Pollutant
Table 5B_Onroad Sources	Summary of Annual Emissions by State FIPS/State Name/County FIPS/County Name and Pollutant
Table 5C_Onroad Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/State Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 5D_Onroad Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State
Table 5E_Onroad Sources	Summary of Annual Emissions by Pollutant and State

IV. METHODS FOR AREAS OUTSIDE OF THE CENRAP REGION

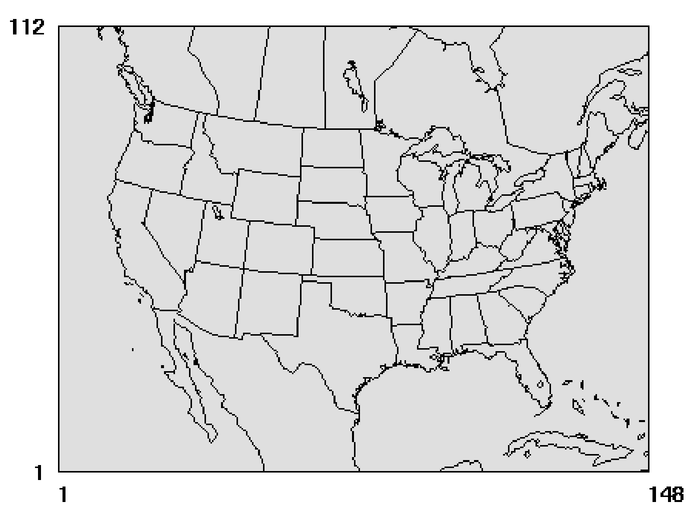
A. Data Sources

This task involved gathering and consolidating point and area source emissions data for areas outside the CENRAP region. The sources of data included emissions inventories compiled by the other RPOs, the EPA, Environment Canada, Texas Commission on Environmental Quality (TCEQ), and other applications (e.g., Big Bend Regional Aerosol and Visibility Observational (BRAVO)). CENRAP indicated to UNC-CEP the definition of the 36-kilometer modeling domain would have the following definition:

NCOLS = 148
NROWS = 112
GDTYP = 2 (Lambert conformal)
P_ALP = 33.
P_BET = 45.
P_GAM = -97.
XCENT = -97.
YCENT = 40.
XORIG = -2736000.
YORIG = -2088000.
XCELL = 36000.
YCELL = 36000.

This modeling domain definition is also illustrated in Figure 6.

Figure 6. The CENRAP 36-kilometer modeling domain.



We used this 36-kilometer domain definition to come up with the geographical areas outside of the CENRAP states where inventory data are needed for CENRAP modeling applications.

We contacted the VISTAS and WRAP RPOs and were able to acquire year 2002 point, area and nonroad inventory data for their respective states. The data acquired was being used in their most recent modeling applications, however they did inform us that updates to the 2002 inventory are likely in near future. As of late December 2004, the Midwest RPO did not have a "final" version of their 2002 inventory to release for use by other RPOs. MANE-VU RPO's point, area, onroad, and nonroad inventories were finalized at the end of January 2005 and made available to other RPOs in February 2005.

The Mexican inventory databases available were the 1999 inventory used in the BRAVO modeling application and an updated inventory being developed by another contractor (Eastern Research Group [ERG]). We were not able to obtain the updated inventory from ERG. Moreover, the point source inventory will most likely be proprietary and could require a non-discloser agreement. Since we could not obtain this data, we recommend using the BRAVO inventories for the areas of the CENRAP modeling domain(s) that includes regions of Mexico.

The Canadian inventory databases from Environment Canada available are a 1995 inventory and a recently release year 2000 inventory. The point source data are proprietary, therefore, the data for year 2000 were not immediately available and the 1995 point source inventory can't be used by CENRAP unless their contractors get permission from Environment Canada to do so. However, we were able to obtain the area, nonroad, and mobile source inventories for the year 2000 from Environment Canada. We were able to reformat the data for use in SMOKEv2 and produce emissions total reports. These reports did not match up with the emission inventory totals Environment Canada provided with the data. The EPA and UNC-CEP found many problems with the year 2000 data including a lack of subprovince codes for better spatial allocation of emissions and different set of SCCs in the ASCII version of the inventory vs. the Microsoft Access version of the inventory. We reported these issues to Environment Canada and very recently (late December 2004) received another version of this inventory. We are now beginning to QA this new version. However, we recommend using the year 1995 area, nonroad and mobile source inventories until confidence in the year 2000 data can be acquired.

The Minerals Management Services (MMS) recently released a year 2000 Gulfwide Emissions Inventory (GWEI) which is available at the following website:

http://www.gomr.mms.gov/homepg/regulate/environ/airquality/gulfwide_emission_inventory/2000GulfwideEmissionInventory.html

This inventory dataset includes platform (treated as point sources) and non-platform (treated as area sources) sources for most of the Gulf of Mexico. TCEQ and other contractors (Environ and ERG) provided UNC-CEP with ancillary and sample MMS inventories for an average August 2000 day in Emissions Preprocessor System version 3 (EPS3) format. UNC-CEP was able to use these ancillary data and the raw MMS data to create annual inventory in SMOKE IDA format for the non-platform sources and an average August 2000 inventory in SMOKE IDA format for the platform sources. Generating an annual platform inventory will require additional ancillary data to be acquired from TCEQ. TCEQ is working on providing this data. UNC-CEP will generate the year 2000 annual inventory for platform sources as soon as this ancillary data are acquired. Additional ancillary data necessary in order to use the MMS SMOKE IDA inventories in emissions modeling were also generated. This ancillary data includes spatial surrogates for the CENRAP 36-kilometer grid (Figure 6), temporal profiles, and spatial and temporal cross-references. These data have been provided to CENRAP for use in emissions modeling applications for both the non-platform and platform inventories. Additional technical details about these MMS inventories were provided with the data to help emissions modelers understand and properly apply the inventory and ancillary data.

All of the data and associated emissions summaries described in this section were delivered to CENRAP on December 27, 2004. Table 28 provides a list of the deliverables, the date acquired, the sources used to assemble the data, the contractor(s) and/or organizations that assembled the data, possible deficiencies of the data, time period of the data (e.g., year 2002), and other necessary information needed to enable CENRAP to best understand the databases that are available. Draft summaries of point and area source emissions data for these data obtained for areas outside of CENRAP were generated and provided with the December 27, 2004 deliverables.

B. Supplemental Data/Augmentation Procedures

The supplemental data needed to run SMOKE were provided to CENRAP and described in detail in section F of this report. Additional ancillary data to support the data sets described in the previous section (IV.A) were provided to CENRAP on December 27, 2004. This mainly included specific spatial profile and cross-references and temporal cross-references for the Minerals Management Service (MMS) inventories, but also included better default stack parameters for Mexican point sources. Table 29 includes a listing of all files provided to CENRAP on December 27, 2004.

Table 28. Description of Inventory Data Provided to CENRAP

Geographic Region/RPO	Raw Data	Time Period	Raw Data Format	Date Received	Source of Data	Source of Ancillary Data	Possible Deficiencies	Date Data and Summaries Delivered to CENRAP
VISTAS	Point, area and nonroad	2002	SMOKE IDA	24-Aug-04	Gregory Stella, Alpine Geophysics	Gregory Stella, Alpine Geophysics	Possibly updated inventory coming soon	27-Dec-04
WRAP	Point, area and nonroad	2002	SMOKE IDA	1-Dec-04	Tom Moore, Colorado St and Zac Adelman, UNC-CEP	Tom Moore, Colorado St and Zac Adelman, UNC-CEP	Possibly updated inventory coming soon	27-Dec-04
Mexico	Point, area, nonroad and mobile	1999	SMOKE IDA	Early 2002	Hampden Kuhns, Desert Research Institute	Jeff Vukovich, UNC-CEP	1999 specific; updated Mexican inventory available from ERG soon?	27-Dec-04
Canada	Area, nonroad and mobile	2000	SMOKE IDA	Jan 12, 2005	ftp://ftp.epa.gov/pub/EmisInventory/canada_2000inventory/. USEPA via Env. Canada	UNC-CEP	New inventory; not well tested in AQ modeling applications.	12-Jan-05
Gulf of Mexico	Point, area and nonroad	2000	MS Access	18-Oct-04	MMS website: http://www.gomr.mms.gov/homepg/regulate/environ/airquality/gulfwide_emission_inventory/2000GulfwideEmissionInventory.html	Jim MacKay and Ron Thomas, TCEQ and Richard Billings, ERG	2000 specific; platform inventory is based on average August day	27-Dec-04
MARAMA	Area, nonroad and point	2002	SMOKE IDA	Last updated Feb 15, 2005	http://www.marama.org/visibility/Inventory%20Summary/2002EmissionsInventory.htm	MARAMA website/ EH Pechan	Unknown since updated recently.	15-Feb-05

Table 29. Listing of Supplemental Data Files

Bytes	Date created	Time created	File Name
506780	12/6/2004	13:41:58	task4b/CN/arinv.ca95_v3_nrd+stat+onrd.ida.gz
991	12/6/2004	13:41:08	task4b/CN/summaries/a.county.can95.rpt.gz
7201	12/6/2004	13:41:08	task4b/CN/summaries/a.scc.can95.rpt.gz
878	12/6/2004	13:41:08	task4b/CN/summaries/a.state.can95.rpt.gz
34248	12/6/2004	13:41:08	task4b/CN/summaries/a.state_scc.can95.rpt.gz
125146	12/17/2004	18:47:50	task4b/MMS/ge_dat/agpro.nonplatform.US36_148X112.txt.gz
143	12/17/2004	18:47:51	task4b/MMS/ge_dat/amgref.m3.nonplatform.goads.txt.gz
540	12/17/2004	18:47:51	task4b/MMS/ge_dat/amptpro.m3.goads.txt.gz
261	12/17/2004	18:47:51	task4b/MMS/ge_dat/amptref.m3.goads.txt.gz
90692	12/17/2004	18:47:51	task4b/MMS/ge_dat/costcy.goads.txt.gz
1125	12/17/2004	18:48:46	task4b/MMS/ge_dat/GRIDDESC
20783	12/17/2004	18:47:51	task4b/MMS/ge_dat/gspro.cmaq.cb4p25.txt.gz
329	12/17/2004	18:47:51	task4b/MMS/ge_dat/gsref.goads.cmaq.cb4p25.txt.gz
122488	12/17/2004	18:47:52	task4b/MMS/ge_dat/scc_desc.goads.txt.gz
449	12/20/2004	15:47:12	task4b/MMS/non-platform/arinv.goads.lst
156569	12/20/2004	15:47:12	task4b/MMS/non-platform/CO.nonplatform_2000EI.ida.sort.gz
172086	12/20/2004	15:47:13	task4b/MMS/non-platform/NOX.nonplatform_2000EI.ida.sort.gz
200071	12/20/2004	15:47:13	task4b/MMS/non-platform/PM.nonplatform_2000EI.ida.sort.gz
160729	12/20/2004	15:47:13	task4b/MMS/non-platform/SO2.nonplatform_2000EI.ida.sort.gz
258715	12/20/2004	15:47:39	task4b/MMS/non-platform/summaries/a.county.goads.rpt.gz
1101	12/20/2004	15:47:40	task4b/MMS/non-platform/summaries/a.scc.goads.rpt.gz
2245	12/20/2004	15:47:40	task4b/MMS/non-platform/summaries/a.state.goads.rpt.gz
13071	12/20/2004	15:47:40	task4b/MMS/non-platform/summaries/a.state_scc.goads.rpt.gz
1123	12/20/2004	15:47:40	task4b/MMS/non-platform/summaries/ag.scc.us36.goads.rpt.gz
2267	12/20/2004	15:47:40	task4b/MMS/non-platform/summaries/ag.state.us36.goads.rpt.gz
13095	12/20/2004	15:47:40	task4b/MMS/non-platform/summaries/ag.state_scc.us36.goads.rpt.gz
476760	12/20/2004	15:47:40	task4b/MMS/non-platform/summaries/ag.us36.goads.ncf
201639	12/20/2004	15:47:14	task4b/MMS/non-platform/VOC.nonplatform_2000EI.ida.sort.gz
120226	12/20/2004	15:46:35	task4b/MMS/platform/CO.afs.gwei2000.20000801.latlong.ida.gz
122429	12/20/2004	15:46:35	task4b/MMS/platform/NOX.afs.gwei2000.20000801.latlong.ida.gz
100504	12/20/2004	15:46:36	task4b/MMS/platform/PM10.afs.gwei2000.20000801.latlong.ida.gz
99235	12/20/2004	15:46:36	task4b/MMS/platform/PM2_5.afs.gwei2000.20000801.latlong.ida.gz
584	12/20/2004	15:46:37	task4b/MMS/platform/ptinv.goads.lst
1052	12/20/2004	15:46:37	task4b/MMS/platform/SO2.afs.gwei2000.20000801.latlong.ida.gz
891	12/20/2004	15:47:56	task4b/MMS/platform/summaries/p.county.goads.rpt
9566	12/20/2004	15:47:56	task4b/MMS/platform/summaries/p.scc.goads.rpt
811	12/20/2004	15:47:57	task4b/MMS/platform/summaries/p.state.goads.rpt
10358	12/20/2004	15:47:57	task4b/MMS/platform/summaries/p.state_scc.goads.rpt

Table 29 (continued)

Bytes	Date created	Time created	File Name
500856	12/20/2004	15:46:39	task4b/MMS/platform/VOC.afs.gwei2000.20000801.latlong.ida.gz
12093	12/20/2004	16:11:18	task4b/MMS/README.04dec20.mms
281244	12/6/2004	13:43:49	task4b/MX/arinv.mx.ver7.txt.gz
412	12/6/2004	13:44:42	task4b/MX/pstk.mx.m3.txt.gz
8219	12/6/2004	13:44:14	task4b/MX/ptinv_mx_dat.txt.dos.gz
19497	12/6/2004	13:45:45	task4b/MX/summaries/a.county.mexico.rpt.gz
3313	12/6/2004	13:45:45	task4b/MX/summaries/a.scc.mexico.rpt.gz
750	12/6/2004	13:45:46	task4b/MX/summaries/a.state.mexico.rpt.gz
11251	12/6/2004	13:45:46	task4b/MX/summaries/a.state_scc.mexico.rpt.gz
1896	12/6/2004	13:45:53	task4b/MX/summaries/p.county.mexico.rpt.gz
1136	12/6/2004	13:45:53	task4b/MX/summaries/p.scc.mexico.rpt.gz
793	12/6/2004	13:45:53	task4b/MX/summaries/p.state.mexico.rpt.gz
2595	12/6/2004	13:45:53	task4b/MX/summaries/p.state_scc.mexico.rpt.gz
1543109	12/1/2004	16:06:30	task4b/VISTAS/ida_ar_2002_24mar04.emis.onlyVISTAS.cep.gz
5653943	12/1/2004	16:06:30	task4b/VISTAS/ida_nr_2002_23mar04.emis.onlyVISTAS.cep.gz
2963335	12/1/2004	16:06:31	task4b/VISTAS/ptinv_vistas_2002_041504.ida.onlyVISTAS.cep.gz
36041	12/1/2004	15:34:56	task4b/VISTAS/summaries/a.county.onlyvistas.rpt.gz
6836	12/1/2004	15:34:56	task4b/VISTAS/summaries/a.scc.onlyvistas.rpt.gz
773	12/1/2004	15:34:56	task4b/VISTAS/summaries/a.state.onlyvistas.rpt.gz
38118	12/1/2004	15:34:56	task4b/VISTAS/summaries/a.state_scc.onlyvistas.rpt.gz
38973	12/1/2004	15:47:05	task4b/VISTAS/summaries/n.county.onlyvistas.rpt.gz
11112	12/1/2004	15:47:05	task4b/VISTAS/summaries/n.scc.onlyvistas.rpt.gz
766	12/1/2004	15:47:05	task4b/VISTAS/summaries/n.state.onlyvistas.rpt.gz
92264	12/1/2004	15:47:05	task4b/VISTAS/summaries/n.state_scc.onlyvistas.rpt.gz
30334	12/1/2004	15:23:06	task4b/VISTAS/summaries/p.county.onlyvistas.rpt.gz
95552	12/1/2004	15:23:06	task4b/VISTAS/summaries/p.scc.onlyvistas.rpt.gz
739	12/1/2004	15:23:06	task4b/VISTAS/summaries/p.state.onlyvistas.rpt.gz
265922	12/1/2004	15:23:06	task4b/VISTAS/summaries/p.state_scc.onlyvistas.rpt.gz
493742	12/2/2004	17:27:40	task4b/WRAP/area/arinv.WRAP2002_v3_ida.txt.onlyWRAP.cep.gz
564251	12/2/2004	17:26:16	task4b/WRAP/nonroad/nrinv.Environ_WRAP_aut03_v2_ida.txt.gz
564198	12/2/2004	17:26:17	task4b/WRAP/nonroad/nrinv.Environ_WRAP_spr03_v2_ida.txt.gz
579653	12/2/2004	17:26:19	task4b/WRAP/nonroad/nrinv.Environ_WRAP_sum03_v2_ida.txt.gz
539663	12/2/2004	17:26:21	task4b/WRAP/nonroad/nrinv.Environ_WRAP_win03_v2_ida.txt.gz
5111	12/2/2004	17:26:22	task4b/WRAP/nonroad/nrinv.WRAP_shipping03_v1_ida.txt.gz
3135152	12/2/2004	17:26:52	task4b/WRAP/point/ptinv.WRAP2002_v1_WRAPonly_ida.txt.gz
21717	12/2/2004	11:10:58	task4b/WRAP/summaries/a.county.onlywrap.rpt.gz
8872	12/2/2004	11:10:58	task4b/WRAP/summaries/a.scc.onlywrap.rpt.gz
887	12/2/2004	11:10:58	task4b/WRAP/summaries/a.state.onlywrap.rpt.gz
28653	12/2/2004	11:10:58	task4b/WRAP/summaries/a.state_scc.onlywrap.rpt.gz
24690	12/2/2004	17:17:02	task4b/WRAP/summaries/n.county.aut_wrap.rpt.gz
2768	12/2/2004	17:19:44	task4b/WRAP/summaries/n.county.shp_wrap.rpt.gz
24725	12/2/2004	17:13:30	task4b/WRAP/summaries/n.county.spr_wrap.rpt.gz
25009	12/2/2004	17:15:16	task4b/WRAP/summaries/n.county.sum_wrap.rpt.gz
24516	12/2/2004	17:10:29	task4b/WRAP/summaries/n.county.win_wrap.rpt.gz
1900	12/2/2004	17:17:02	task4b/WRAP/summaries/n.scc.aut_wrap.rpt.gz
462	12/2/2004	17:19:44	task4b/WRAP/summaries/n.scc.shp_wrap.rpt.gz
1922	12/2/2004	17:13:30	task4b/WRAP/summaries/n.scc.spr_wrap.rpt.gz
1909	12/2/2004	17:15:16	task4b/WRAP/summaries/n.scc.sum_wrap.rpt.gz
1893	12/2/2004	17:10:29	task4b/WRAP/summaries/n.scc.win_wrap.rpt.gz
952	12/2/2004	17:17:02	task4b/WRAP/summaries/n.state.aut_wrap.rpt.gz
453	12/2/2004	17:19:44	task4b/WRAP/summaries/n.state.shp_wrap.rpt.gz
964	12/2/2004	17:13:30	task4b/WRAP/summaries/n.state.spr_wrap.rpt.gz
956	12/2/2004	17:15:16	task4b/WRAP/summaries/n.state.sum_wrap.rpt.gz
958	12/2/2004	17:10:29	task4b/WRAP/summaries/n.state.win_wrap.rpt.gz

Table 29 (continued)

Bytes	Date created	Time created	File Name
12790	12/2/2004	17:17:02	task4b/WRAP/summaries/n.state_scc.aut_wrap.rpt.gz
706	12/2/2004	17:19:44	task4b/WRAP/summaries/n.state_scc.shp_wrap.rpt.gz
12857	12/2/2004	17:13:30	task4b/WRAP/summaries/n.state_scc.spr_wrap.rpt.gz
12913	12/2/2004	17:15:16	task4b/WRAP/summaries/n.state_scc.sum_wrap.rpt.gz
12480	12/2/2004	17:10:29	task4b/WRAP/summaries/n.state_scc.win_wrap.rpt.gz
15361	12/2/2004	11:03:55	task4b/WRAP/summaries/p.county.onlywrap.rpt.gz
70477	12/2/2004	11:03:55	task4b/WRAP/summaries/p.scc.onlywrap.rpt.gz
879	12/2/2004	11:03:55	task4b/WRAP/summaries/p.state.onlywrap.rpt.gz
161640	12/2/2004	11:03:55	task4b/WRAP/summaries/p.state_scc.onlywrap.rpt.gz

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V. REFERENCES

CENRAP, 2004a: Methods for Consolidation of Emission Inventories (Schedule 9; Work Item 3), Draft. Prepared by E.H. Pechan & Associates, Inc. and Carolina Environmental Program for the Central Regional Air Planning Association (CENRAP). August 23, 2004.

CENRAP, 2004b: Quality Assurance Project Plan (QAPP) for Consolidation of Emissions Inventories (Schedule 9; Work Item 3), Final. Prepared by E.H. Pechan & Associates, Inc. and Carolina Environmental Program for the Central Regional Air Planning Association (CENRAP). September 13, 2004.

EPA, 2002: Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion, U.S. Environmental Protection Agency, Emission Factor and Inventory Group, Emissions Monitoring and Analysis Division, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. September 2002. (http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html)

EPA, 2003: Enhanced Particulate Matter Controlled Emissions Calculator, User's Manual, U.S. Environmental Protection Agency, Emission Factor and Inventory Group, Emissions Monitoring and Analysis Division, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. September 2003.

EPA, 2004a: Basic Format & Content Checker 3.0 (Formerly known as the Quality Assurance / Quality Control Software 3.0) - March 2004; Extended Quality Control Tool - Updated May 18, 2004. Available at the following EPA website: http://www.epa.gov/ttn/chief/nif/index.html#nei

EPA, 2004b: NEI Quality Assurance and Data Augmentation for Point Sources, U.S. EPA, Emissions Monitoring and Analysis Division, Emission Factor and Inventory Group, May 26, 2004.

EPA, 2004c: Factor Information and REtrieval (FIRE) Data System, Version 6.24, located on the Technology Transfer Network Clearinghouse for Inventories & Emission Factors Web Site at http://www.epa.gov/ttn/chief/software/fire/index.html. March 2004.

Pechan, 2003: Analysis of Utility Emissions Tracking System/Continuous Emissions Monitoring (ETS/CEM) Data, Final Report. Prepared by E.H. Pechan & Associates, Inc., (Pechan Report #03.07.003/9411.000) for the Lake Michigan Air Directors Consortium. July 2003.

STI, 2003: Coe, D. and S. Reid, Sonoma Technology Inc., "Research and Development of Ammonia Emission Inventories for the CENRAP," Final Report STI-902501-2241-FR, October 30, 2003.

Thompson, 2002: Thompson, Rhonda L., “A Demonstration of the Quality Assurance (QA) software specifically developed for the National Emission Inventory (NEI),” presented at the International Emission Inventory Conference “Emission Inventories - Partnering for the Future,” Atlanta, GA, April 15-18, 2002, (http://www.epa.gov/ttn/chief/conference/ei11/qa/thompson.pdf).

APPENDIX A

SUMMARIES OF ANNUAL EMISSIONS BY SOURCE CATEGORY, SECTOR, AND POLLUTANT

Table A-1. Summary of Annual VOC Emissions for the CENRAP Region by Category, Sector, and Pollutant

Category	Category Number	Sector	VOC Tons/Year	VOC Percent of Total	VOC Cumulative Percent
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	765,838	17.47	17.47
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA	731,153	16.68	34.15
Mobile Sources-Pleasure Craft	2282	NONROAD	418,585	9.55	43.7
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	208,980	4.77	48.47
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA	189,313	4.32	52.79
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA	167,832	3.83	56.62
Industrial Surface Coating	2401015000	AREA	153,472	3.5	60.12
Stationary Source Fuel Combustion-Residential	2104	AREA	143,710	3.28	63.4
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA	128,915	2.94	66.34
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	102,575	2.34	68.68
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	101,968	2.33	71.01
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	95,121	2.17	73.18
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	87,696	2	75.18
Architectural Coatings	2401001000	AREA	78,767	1.8	76.98
Gas Marketing Stage II	25010601	AREA	74,667	1.7	78.68
Miscellaneous Area Sources-Other Combustion	2810	POINT	69,037	1.57	80.25
Miscellaneous Area Sources-Other Combustion	2810	AREA	68,527	1.56	81.81
Industrial Processes-Chemical Manufacturing	301	POINT	68,030	1.55	83.36
Industrial Processes-Petroleum Industry	306	POINT	65,784	1.5	84.86
Degreasing	2415	AREA	58,013	1.32	86.18
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	48,208	1.1	87.28
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA	45,775	1.04	88.32
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	40,923	0.93	89.25
Gas Marketing Stage I	25010600	AREA	39,759	0.91	90.16
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	29,257	0.67	90.83
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	26,471	0.6	91.43
Industrial Processes-Oil and Gas Production	310	POINT	25,917	0.59	92.02
Internal Combustion Engines-Industrial	2020	POINT	25,671	0.59	92.61
Graphic Arts	2425	AREA	21,610	0.49	93.1
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	21,313	0.49	93.59
Industrial Processes-Food and Agriculture	302	POINT	19,039	0.43	94.02
Solvent Utilization-Dry Cleaning	2420	AREA	18,967	0.43	94.45
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA	17,119	0.39	94.84
Mobile Sources-Railroad Equipment	2285	NONROAD	16,523	0.38	95.22
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	15,417	0.35	95.57
Auto Refinishing	2401005000	AREA	12,277	0.28	95.85
External Combustion Boilers-Electric Generation	1010	POINT	11,693	0.27	96.12
Mobile Sources-LPG	2267	NONROAD	11,266	0.26	96.38
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA	9,790	0.22	96.60
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	8,855	0.2	96.80
Traffic Markings	2401008000	AREA	8,694	0.2	97.00
External Combustion Boilers-Industrial	1020	POINT	8,680	0.2	97.20
Industrial Processes-Mineral Products	305	POINT	8,366	0.19	97.39
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	8,203	0.19	97.58
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	8,167	0.19	97.77

Table A-1 (continued)

Category	Category Number	Sector	VOC		
			Tons/Year	Percent of Total	Cumulative Percent
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	7,998	0.18	97.95
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	7,394	0.17	98.12
Mobile Sources-CNG	2268	NONROAD	6,458	0.15	98.27
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	6,215	0.14	98.41
Industrial Processes-Secondary Metal Production	304	POINT	5,912	0.13	98.54
Stationary Source Fuel Combustion-Industrial	2102	AREA	5,408	0.12	98.66
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA	5,347	0.12	98.78
Mobile Sources-Aircraft	2275	NONROAD	5,337	0.12	98.90
Industrial Processes-Cooling Tower	3850	POINT	4,751	0.11	99.01
Rubber/Plastics	2430000000	AREA	4,256	0.1	99.11
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	3,605	0.08	99.19
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	3,120	0.07	99.26
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	2,996	0.07	99.33
Industrial Processes-Primary Metal Production	303	POINT	2,625	0.06	99.39
Internal Combustion Engines-Commercial/Institutional	2030	POINT	2,349	0.05	99.44
Industrial Processes-Industrial Processes: NEC	2399	AREA	2,097	0.05	99.49
Waste Disposal-Solid Waste Disposal-Government	501	POINT	2,076	0.05	99.54
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	1,684	0.04	99.58
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA	1,678	0.04	99.62
Internal Combustion Engines-Electric Generation	2010	POINT	1,576	0.04	99.66
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	1,531	0.03	99.69
Industrial Processes-Fabricated Metal Products	309	POINT	1,528	0.03	99.72
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA	1,254	0.03	99.75
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	1,146	0.03	99.78
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA	1,009	0.02	99.80
Industrial Processes-In-process Fuel Use	390	POINT	742	0.02	99.82
External Combustion Boilers-Commercial/Institutional	1030	POINT	682	0.02	99.84
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	650	0.01	99.85
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	606	0.01	99.86
Mobile Sources-Aircraft	2275	POINT	599	0.01	99.87
Industrial Processes-Textile Products	330	POINT	567	0.01	99.88
Internal Combustion Engines-Fugitive Emissions	2888	POINT	508	0.01	99.89
Industrial Processes-Electrical Equipment	313	POINT	502	0.01	99.90
Internal Combustion Engines-Engine Testing	2040	POINT	455	0.01	99.91
Industrial Processes-Machinery, Miscellaneous	3129	POINT	455	0.01	99.92
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA	450	0.01	99.93
Industrial Processes-Transportation Equipment	314	POINT	378	0.01	99.94
Mobile Sources-Aircraft	2275	AREA	285	0.01	99.95
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	283	0.01	99.96
MACT Source Categories : Vinyl-based Resins	6463	POINT	256	0.01	99.97
MACT Source Categories : Cellulose-based Resins	644	POINT	221	0.01	99.98
External Combustion Boilers-Space Heaters	1050	POINT	207	0	99.98
Industrial Processes-Leather and Leather Products	3209	POINT	130	0.00	99.98
Bulk Materials Transport & Transport	253	AREA	108	0.00	99.99
Petroleum and Solvent Evaporation-	4250	POINT	101	0.00	99.99
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	79	0.00	99.99
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT	67	0.00	99.99
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	51	0.00	99.99
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	45	0.00	99.99
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT	39	0.00	99.99

Table A-1 (continued)

Category	Category Number	Sector	VOC Tons/Year	VOC Percent of Total	VOC Cumulative Percent
Waste Disposal-Site Remediation	504	POINT	35	0.00	100.0
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	20	0.00	100.0
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	16	0.00	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT	16	0.00	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT	12	0.00	100.0
Industrial Processes-Building Construction	3110	POINT	11	0.00	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT	3.1	0.00	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT	2.1	0.00	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT	1.0	0.00	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT	0.7	0.00	100.0
Miscellaneous Area Sources-Agricultural Production-Crops	2801	POINT	0.5	0.00	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT	0.0	0.00	100.0
Mobile Sources-Unpaved Roads	2296	POINT		0.00	100.0
Mobile Sources-Paved Roads	2294	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT		0	100.0
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Mobile Sources-Highway Vehicles-Gasoline	2201	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Totals for All Categories			4,383,876	100	

Table A-2. Summary of Annual NOx Emissions for the CENRAP Region by Category, Sector, and Pollutant

Category	Category Number	Sector	NOx		
			Tons/Year	Percent of Total	Cumulative Percent
External Combustion Boilers-Electric Generation	1010	POINT	895,606	17.38	17.38
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	746,948	14.5	31.88
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	736,720	14.3	46.18
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA	476,029	9.24	55.42
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	407,557	7.91	63.33
Internal Combustion Engines-Industrial	2020	POINT	380,352	7.38	70.71
Mobile Sources-Railroad Equipment	2285	NONROAD	331,556	6.44	77.15
Stationary Source Fuel Combustion-Industrial	2102	AREA	194,842	3.78	80.93
External Combustion Boilers-Industrial	1020	POINT	184,597	3.58	84.51
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	123,773	2.4	86.91
Industrial Processes-Mineral Products	305	POINT	91,544	1.78	88.69
Industrial Processes-Petroleum Industry	306	POINT	69,805	1.35	90.04
Industrial Processes-Chemical Manufacturing	301	POINT	60,933	1.18	91.22
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	54,497	1.06	92.28
Stationary Source Fuel Combustion-Residential	2104	AREA	50,950	0.99	93.27
Mobile Sources-LPG	2267	NONROAD	42,269	0.82	94.09
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	33,852	0.66	94.75
Internal Combustion Engines-Electric Generation	2010	POINT	33,598	0.65	95.4
Industrial Processes-In-process Fuel Use	390	POINT	31,703	0.62	96.02
Mobile Sources-Pleasure Craft	2282	NONROAD	30,029	0.58	96.6
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	22,128	0.43	97.03
Industrial Processes-Oil and Gas Production	310	POINT	16,082	0.31	97.34
Mobile Sources-Aircraft	2275	NONROAD	15,299	0.3	97.64
Miscellaneous Area Sources-Other Combustion	2810	AREA	14,089	0.27	97.91
Industrial Processes-Primary Metal Production	303	POINT	13,450	0.26	98.17
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	11,920	0.23	98.4
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	10,482	0.2	98.6
Miscellaneous Area Sources-Other Combustion	2810	POINT	8,248	0.16	98.76
Internal Combustion Engines-Commercial/Institutional	2030	POINT	7,898	0.15	98.91
External Combustion Boilers-Commercial/Institutional	1030	POINT	7,260	0.14	99.05
Mobile Sources-CNG	2268	NONROAD	6,468	0.13	99.18
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA	4,941	0.1	99.28
Industrial Processes-Secondary Metal Production	304	POINT	3,897	0.08	99.36
Waste Disposal-Solid Waste Disposal-Government	501	POINT	3,717	0.07	99.43
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	3,697	0.07	99.5
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	3,563	0.07	99.57
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	2,981	0.06	99.63
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	2,758	0.05	99.68
Bulk Materials Transport & Transport	253	AREA	2,354	0.05	99.73
Industrial Processes-Food and Agriculture	302	POINT	2,267	0.04	99.77
Mobile Sources-Aircraft	2275	POINT	1,825	0.04	99.81
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	1,725	0.03	99.84
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	1,289	0.03	99.87
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	1,227	0.02	99.89
Internal Combustion Engines-Engine Testing	2040	POINT	868	0.02	99.91
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	627	0.01	99.92
Industrial Processes-Industrial Processes: NEC	2399	AREA	616	0.01	99.93

Table A-2 (continued)

Category	Category Number	Sector	NOx Tons/Year	NOx Percent of Total	NOx Cumulative Percent
External Combustion Boilers-Space Heaters	1050	POINT	586	0.01	99.94
Waste Disposal-Site Remediation	504	POINT	535	0.01	99.95
Industrial Processes-Fabricated Metal Products	309	POINT	480	0.01	99.96
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	219	0.00	99.96
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	209	0.00	99.96
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	208	0.00	99.96
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	188	0.00	99.96
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	187	0.00	99.96
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	157	0.00	99.96
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	111	0.00	99.96
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	97	0.00	99.96
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	90	0.00	99.96
Industrial Processes-Electrical Equipment	313	POINT	82	0.00	99.96
Industrial Processes-Machinery, Miscellaneous	3129	POINT	68	0.00	99.96
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	48	0.00	99.96
Internal Combustion Engines-Fugitive Emissions	2888	POINT	26	0.00	99.96
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	18	0.00	99.96
MACT Source Categories : Vinyl-based Resins	6463	POINT	11	0.00	99.96
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA	10	0.00	99.96
Petroleum and Solvent Evaporation-	4250	POINT	6	0.00	99.96
Industrial Processes-Transportation Equipment	314	POINT	5	0.00	99.96
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT	4	0.00	99.96
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	4	0.00	99.96
Industrial Processes-Textile Products	330	POINT	3	0.00	99.96
Miscellaneous Area Sources-Agricultural Production-Crops	2801	POINT	2	0.00	99.96
Industrial Processes-Building Construction	3110	POINT	1	0.00	99.96
MACT Source Categories : Cellulose-based Resins	644	POINT	0	0.00	99.96
Industrial Processes-Cooling Tower	3850	POINT	0	0.00	99.96
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0.00	99.96
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT	0	0.00	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT		0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	POINT		0	100.0
Mobile Sources-Paved Roads	2294	POINT		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Gas Marketing Stage II	25010601	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0
Graphic Arts	2425	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0

Table A-2 (continued)

Category	Category Number	Sector	NOx		
			Tons/Year	Percent of Total	Cumulative Percent
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Industrial Processes-Leather and Leather Products	3209	POINT		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Mobile Sources-Highway Vehicles-Gasoline	2201	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Totals for All Categories			5,152,190	100	

Table A-3. Summary of Annual CO Emissions for the CENRAP Region by Category, Sector, and Pollutant

Category	Category Number	Sector	CO Tons/Year	CO Percent of Total	CO Cumulative Percent
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	11,701,959	52.15	52.15
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	2,603,360	11.6	63.75
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	1,401,805	6.25	70
Mobile Sources-Pleasure Craft	2282	NONROAD	1,325,323	5.91	75.91
Miscellaneous Area Sources-Other Combustion	2810	AREA	1,024,320	4.57	80.48
Miscellaneous Area Sources-Other Combustion	2810	POINT	815,770	3.64	84.12
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	445,995	1.99	86.11
Stationary Source Fuel Combustion-Residential	2104	AREA	399,828	1.78	87.89
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	324,217	1.44	89.33
External Combustion Boilers-Electric Generation	1010	POINT	275,840	1.23	90.56
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA	250,117	1.11	91.67
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	247,871	1.1	92.77
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	247,141	1.1	93.87
Industrial Processes-Chemical Manufacturing	301	POINT	169,464	0.76	94.63
Mobile Sources-LPG	2267	NONROAD	165,799	0.74	95.37
Internal Combustion Engines-Industrial	2020	POINT	153,390	0.68	96.05
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	133,025	0.59	96.64
External Combustion Boilers-Industrial	1020	POINT	121,221	0.54	97.18
Industrial Processes-Primary Metal Production	303	POINT	96,722	0.43	97.61
Industrial Processes-Mineral Products	305	POINT	63,534	0.28	97.89
Mobile Sources-Aircraft	2275	NONROAD	58,554	0.26	98.15
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	55,100	0.25	98.4
Industrial Processes-Petroleum Industry	306	POINT	52,513	0.23	98.63
Stationary Source Fuel Combustion-Industrial	2102	AREA	44,836	0.2	98.83
Mobile Sources-Railroad Equipment	2285	NONROAD	43,426	0.19	99.02
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	39,842	0.18	99.2
Mobile Sources-CNG	2268	NONROAD	26,035	0.12	99.32
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	19,902	0.09	99.41
Industrial Processes-Secondary Metal Production	304	POINT	19,676	0.09	99.5
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	18,111	0.08	99.58
Industrial Processes-Food and Agriculture	302	POINT	13,602	0.06	99.64
Industrial Processes-Oil and Gas Production	310	POINT	10,021	0.04	99.68
Internal Combustion Engines-Electric Generation	2010	POINT	10,003	0.04	99.72
Mobile Sources-Aircraft	2275	POINT	9,552	0.04	99.76
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	7,992	0.04	99.8
Industrial Processes-In-process Fuel Use	390	POINT	6,917	0.03	99.83
External Combustion Boilers-Commercial/Institutional	1030	POINT	6,566	0.03	99.86
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	5,540	0.02	99.88
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	4,282	0.02	99.9
Waste Disposal-Solid Waste Disposal-Government	501	POINT	4,094	0.02	99.92
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	3,687	0.02	99.94
Internal Combustion Engines-Commercial/Institutional	2030	POINT	3,660	0.02	99.96
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	1,368	0.01	99.97
Internal Combustion Engines-Engine Testing	2040	POINT	1,325	0.01	99.98
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	842	0	99.98
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	733	0	99.98

Table A-3 (continued)

Category	Category Number	Sector	CO Tons/Year	CO Percent of Total	CO Cumulative Percent
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	540	0	99.98
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	390	0	99.98
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	340	0	99.98
Bulk Materials Transport & Transport	253	AREA	305	0	99.98
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	279	0	99.98
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	277	0	99.98
External Combustion Boilers-Space Heaters	1050	POINT	258	0	99.98
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	204	0	99.98
Industrial Processes-Fabricated Metal Products	309	POINT	191	0	99.98
Industrial Processes-Industrial Processes: NEC	2399	AREA	140	0	99.98
Internal Combustion Engines-Fugitive Emissions	2888	POINT	134	0	99.98
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	128	0	99.98
Waste Disposal-Site Remediation	504	POINT	116	0	99.98
Industrial Processes-Machinery, Miscellaneous	3129	POINT	72	0	99.98
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	66	0	99.98
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	56	0	99.98
Industrial Processes-Electrical Equipment	313	POINT	51	0	99.98
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	48	0	99.98
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	31	0	99.98
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT	20	0	99.98
Petroleum and Solvent Evaporation-	4250	POINT	9	0	99.98
MACT Source Categories : Vinyl-based Resins	6463	POINT	9	0	99.98
Industrial Processes-Transportation Equipment	314	POINT	2	0	99.98
Industrial Processes-Leather and Leather Products	3209	POINT	2	0	99.98
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT	2	0	99.98
Industrial Processes-Textile Products	330	POINT	2	0	99.98
Miscellaneous Area Sources-Agricultural Production-Crops	2801	POINT	2	0	99.98
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	1	0	99.98
Industrial Processes-Cooling Tower	3850	POINT	0	0	99.98
MACT Source Categories : Cellulose-based Resins	644	POINT	0	0	99.98
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0	100.0
Industrial Processes-Building Construction	3110	POINT		0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	POINT		0	100.0
Mobile Sources-Paved Roads	2294	POINT		0	100.0
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA		0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Gas Marketing Stage II	25010601	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0

Table A-3 (continued)

Category	Category Number	Sector	CO		
			Tons/Year	Percent of Total	Cumulative Percent
Graphic Arts	2425	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Mobile Sources-Highway Vehicles-Gasoline	2201	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Totals for All Categories			22,438,555	100	

Table A-4. Summary of Annual SO2 Emissions for the CENRAP Region by Category, Sector, and Pollutant

Category	Category Number	Sector	SO_2 Tons/Year	SO_2 Percent of Total	SO_2 Cumulative Percent
External Combustion Boilers-Electric Generation	1010	POINT	1,494,256	59.12	59.12
External Combustion Boilers-Industrial	1020	POINT	206,419	8.17	67.29
Stationary Source Fuel Combustion-Industrial	2102	AREA	167,312	6.62	73.91
Industrial Processes-Chemical Manufacturing	301	POINT	144,828	5.73	79.64
Industrial Processes-Petroleum Industry	306	POINT	109,937	4.35	83.99
Industrial Processes-Mineral Products	305	POINT	76,034	3.01	87
Industrial Processes-Primary Metal Production	303	POINT	67,869	2.69	89.69
Industrial Processes-Oil and Gas Production	310	POINT	30,484	1.21	90.9
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	29,525	1.17	92.07
Mobile Sources-Railroad Equipment	2285	NONROAD	21,802	0.86	92.93
Industrial Processes-Secondary Metal Production	304	POINT	21,051	0.83	93.76
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	20,861	0.83	94.59
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	19,342	0.77	95.36
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	19,033	0.75	96.11
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	18,473	0.73	96.84
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	15,153	0.6	97.44
Industrial Processes-In-process Fuel Use	390	POINT	11,995	0.47	97.91
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	8,586	0.34	98.25
Stationary Source Fuel Combustion-Residential	2104	AREA	7,063	0.28	98.53
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	6,439	0.25	98.78
External Combustion Boilers-Commercial/Institutional	1030	POINT	5,781	0.23	99.01
Miscellaneous Area Sources-Other Combustion	2810	POINT	4,699	0.19	99.2
Miscellaneous Area Sources-Other Combustion	2810	AREA	4,287	0.17	99.37
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	1,589	0.06	99.43
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	1,585	0.06	99.49
Industrial Processes-Food and Agriculture	302	POINT	1,558	0.06	99.55
Mobile Sources-Aircraft	2275	NONROAD	1,511	0.06	99.61
Mobile Sources-Pleasure Craft	2282	NONROAD	1,180	0.05	99.66
Internal Combustion Engines-Industrial	2020	POINT	1,176	0.05	99.71
Waste Disposal-Solid Waste Disposal-Government	501	POINT	1,164	0.05	99.76
Internal Combustion Engines-Electric Generation	2010	POINT	994	0.04	99.8
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	821	0.03	99.83
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	749	0.03	99.86
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	711	0.03	99.89
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	680	0.03	99.92
Waste Disposal-Site Remediation	504	POINT	635	0.03	99.95
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	328	0.01	99.96
Industrial Processes-Industrial Processes: NEC	2399	AREA	307	0.01	99.97
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	204	0.01	99.98
Mobile Sources-Aircraft	2275	POINT	183	0.01	99.99
Bulk Materials Transport & Transport	253	AREA	172	0.01	100.0
Internal Combustion Engines-Commercial/Institutional	2030	POINT	151	0.01	100.0
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	99	0	100.0
Mobile Sources-LPG	2267	NONROAD	71	0	100.0
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	62	0	100.0
Internal Combustion Engines-Engine Testing	2040	POINT	53	0	100.0
Industrial Processes-Fabricated Metal Products	309	POINT	52	0	100.0

Table A-4 (continued)

Category	Category Number	Sector	SO_2		
			Tons/Year	Percent of Total	Cumulative Percent
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	48	0	100.0
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	47	0	100.0
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	30	0	100.0
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	13	0	100.0
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	13	0	100.0
External Combustion Boilers-Space Heaters	1050	POINT	12	0	100.0
Industrial Processes-Electrical Equipment	313	POINT	9	0	100.0
Mobile Sources-CNG	2268	NONROAD	7	0	100.0
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	5	0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	5	0	100.0
Industrial Processes-Transportation Equipment	314	POINT	4	0	100.0
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	4	0	100.0
Industrial Processes-Machinery, Miscellaneous	3129	POINT	3	0	100.0
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	1	0	100.0
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	1	0	100.0
Internal Combustion Engines-Fugitive Emissions	2888	POINT	1	0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops	2801	POINT	0	0	100.0
MACT Source Categories : Vinyl-based Resins	6463	POINT	0	0	100.0
Industrial Processes-Cooling Tower	3850	POINT	0	0	100.0
Petroleum and Solvent Evaporation-	4250	POINT	0	0	100.0
MACT Source Categories : Cellulose-based Resins	644	POINT	0	0	100.0
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT		0	100.0
Industrial Processes-Textile Products	330	POINT		0	100.0
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT		0	100.0
Industrial Processes-Building Construction	3110	POINT		0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT		0	100.0
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA		0	100.0
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA		0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT		0	100.0
Industrial Processes-Leather and Leather Products	3209	POINT		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	POINT		0	100.0
Mobile Sources-Paved Roads	2294	POINT		0	100.0
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA		0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Gas Marketing Stage II	25010601	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0

Table A-4 (continued)

Category	Category Number	Sector	SO_2		
			Tons/Year	Percent of Total	Cumulative Percent
Graphic Arts	2425	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Mobile Sources-Highway Vehicles-Gasoline	2201	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Totals for All Categories			2,527,461	100	

Table A-5. Summary of Annual PM10-PRI and PM25-PRI Emissions for the CENRAP Region by Category, Sector, and Pollutant

Category	Category Number	Sector	PM10-PRI Tons/Year	PM10-PRI Percent of Total	PM10-PRI Cumulative Percent	PM25-PRI Tons/Year	PM25-PRI Percent of Total	PM25-PRI Cumulative Percent
Mobile Sources-Unpaved Roads	2296	AREA	3,882,376	52.16	52.16	580,684	31.52	31.52
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	1,296,636	17.42	69.58	264,667	14.36	45.88
Industrial Processes-Construction: SIC 15-17	2311	AREA	514,614	6.91	76.49	102,936	5.59	51.47
Mobile Sources-Paved Roads	2294	AREA	474,749	6.38	82.87	76,386	4.15	55.62
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	177,533	2.39	85.26	141,020	7.65	63.27
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA	175,633	2.36	87.62	35,123	1.91	65.18
Miscellaneous Area Sources-Other Combustion	2810	AREA	112,081	1.51	89.13	99,695	5.41	70.59
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA	96,895	1.3	90.43	14,534	0.79	71.38
Miscellaneous Area Sources-Other Combustion	2810	POINT	77,277	1.04	91.47	65,532	3.56	74.94
External Combustion Boilers-Electric Generation	1010	POINT	72,073	0.97	92.44	47,444	2.57	77.51
Industrial Processes-Food and Agriculture	302	POINT	61,143	0.82	93.26	11,534	0.63	78.14
Stationary Source Fuel Combustion-Residential	2104	AREA	56,646	0.76	94.02	56,465	3.06	81.2
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	53,903	0.72	94.74	51,277	2.78	83.98
External Combustion Boilers-Industrial	1020	POINT	48,724	0.65	95.39	41,768	2.27	86.25
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	43,537	0.58	95.97	40,617	2.2	88.45
Industrial Processes-Mineral Products	305	POINT	36,258	0.49	96.46	14,499	0.79	89.24
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	32,949	0.44	96.9	27,910	1.51	90.75
Mobile Sources-Pleasure Craft	2282	NONROAD	26,735	0.36	97.26	24,696	1.34	92.09
Stationary Source Fuel Combustion-Industrial	2102	AREA	19,639	0.26	97.52	12,136	0.66	92.75
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	19,429	0.26	97.78	16,766	0.91	93.66
Industrial Processes-Chemical Manufacturing	301	POINT	16,165	0.22	98	11,402	0.62	94.28
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	15,078	0.2	98.2	14,041	0.76	95.04
Industrial Processes-Primary Metal Production	303	POINT	13,927	0.19	98.39	3,318	0.18	95.22
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	13,637	0.18	98.57	6,763	0.37	95.59
Internal Combustion Engines-Industrial	2020	POINT	13,364	0.18	98.75	13,054	0.71	96.3
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	13,155	0.18	98.93	7,724	0.42	96.72
Industrial Processes-Petroleum Industry	306	POINT	12,654	0.17	99.1	10,403	0.56	97.28
Mobile Sources-Railroad Equipment	2285	NONROAD	8,989	0.12	99.22	8,108	0.44	97.72
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	7,247	0.1	99.32	6,699	0.36	98.08
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	6,923	0.09	99.41	6,529	0.35	98.43

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI			PM25-PRI		
			Tons/Year	Percent of Total	Cumulative Percent	Tons/Year	Percent of Total	Cumulative Percent
Industrial Processes-Cooling Tower	3850	POINT	6,403	0.09	99.5	5,470	0.3	98.73
Industrial Processes-Secondary Metal Production	304	POINT	6,101	0.08	99.58	3,787	0.21	98.94
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA	3,465	0.05	99.63	92	0	98.94
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	3,310	0.04	99.67	1,921	0.1	99.04
Industrial Processes-In-process Fuel Use	390	POINT	3,264	0.04	99.71	1,187	0.06	99.1
Internal Combustion Engines-Electric Generation	2010	POINT	3,262	0.04	99.75	3,176	0.17	99.27
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	2,798	0.04	99.79	2,574	0.14	99.41
Industrial Processes-Industrial Processes: NEC	2399	AREA	2,637	0.04	99.83	1,827	0.1	99.51
External Combustion Boilers-Commercial/Institutional	1030	POINT	1,587	0.02	99.85	1,183	0.06	99.57
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	1,454	0.02	99.87	1,200	0.07	99.64
Industrial Processes-Fabricated Metal Products	309	POINT	1,254	0.02	99.89	501	0.03	99.67
Waste Disposal-Solid Waste Disposal-Government	501	POINT	976	0.01	99.9	508	0.03	99.7
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	854	0.01	99.91	609	0.03	99.73
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	753	0.01	99.92	703	0.04	99.77
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	636	0.01	99.93	264	0.01	99.78
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	568	0.01	99.94	471	0.03	99.81
Mobile Sources-Aircraft	2275	NONROAD	441	0.01	99.95	349	0.02	99.83
Industrial Processes-Oil and Gas Production	310	POINT	440	0.01	99.96	419	0.02	99.85
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	436	0.01	99.97	301	0.02	99.87
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA	387	0.01	99.98	387	0.02	99.89
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	276	0	99.98	174	0.01	99.9
Internal Combustion Engines-Commercial/Institutional	2030	POINT	220	0	99.98	219	0.01	99.91
Mobile Sources-LPG	2267	NONROAD	192	0	99.98	190	0.01	99.92
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	185	0	99.98	151	0.01	99.93
Mobile Sources-Aircraft	2275	POINT	160	0	99.98	113	0.01	99.94
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	158	0	99.98	126	0.01	99.95
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA	131	0	99.98	131	0.01	99.96
MACT Source Categories : Vinyl-based Resins	6463	POINT	118	0	99.98	77	0	99.96
Waste Disposal-Site Remediation	504	POINT	102	0	99.98	65	0	99.96
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA	91	0	99.98	91	0	99.96
Internal Combustion Engines-Fugitive Emissions	2888	POINT	84	0	99.98	80	0	99.96
Industrial Processes-Machinery, Miscellaneous	3129	POINT	64	0	99.98	54	0	99.96

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI			PM25-PRI		
			Tons/Year	Percent of Total	Cumulative Percent	Tons/Year	Percent of Total	Cumulative Percent
Internal Combustion Engines-Engine Testing	2040	POINT	60	0	99.98	54	0	99.96
Bulk Materials Transport & Transport	253	AREA	56	0	99.98	56	0	99.96
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	53	0	99.98	44	0	99.96
Industrial Processes-Transportation Equipment	314	POINT	51	0	99.98	31	0	99.96
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	41	0	99.98	34	0	99.96
External Combustion Boilers-Space Heaters	1050	POINT	36	0	99.98	35	0	99.96
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	30	0	99.98	25	0	99.96
Mobile Sources-CNG	2268	NONROAD	28	0	99.98	27	0	99.96
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA	26	0	99.98	3	0	99.96
Industrial Processes-Electrical Equipment	313	POINT	23	0	99.98	21	0	99.96
Mobile Sources-Unpaved Roads	2296	POINT	21	0	99.98	21	0	99.96
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	12	0	99.98	11	0	99.96
Industrial Processes-Leather and Leather Products	3209	POINT	6	0	99.98	1	0	99.96
Industrial Processes-Building Construction	3110	POINT	5	0	99.98	1	0	99.96
MACT Source Categories-Miscellaneous Processes	6824	POINT	4	0	99.98	1	0	99.96
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	3	0	99.98	2	0	99.96
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	2	0	99.98	2	0	99.96
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT	2	0	99.98	1	0	99.96
Industrial Processes-Textile Products	330	POINT	2	0	99.98	2	0	99.96
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	2	0	99.98	2	0	99.96
Mobile Sources-Paved Roads	2294	POINT	1	0	99.98	1	0	99.96
Miscellaneous Area Sources-Agricultural Production-Crops	2801	POINT	1	0	99.98	1	0	99.96
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	1	0	99.98	0	0	99.96
MACT Source Categories : Agricultural Chemicals Production	631	POINT	0	0	100.0	0	0	99.96
Industrial Processes-Printing and Publishing	3600	POINT	0	0	100.0	0	0	99.96
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0	100.0	0	0	99.96
Petroleum and Solvent Evaporation-	4250	POINT	0	0	100.0	0	0	99.96
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT	0	0	100.0	0	0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT		0	100.0		0	100.0

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI			PM25-PRI		
			Tons/Year	Percent of Total	Cumulative Percent	Tons/Year	Percent of Total	Cumulative Percent
MACT Source Categories : Cellulose-based Resins	644	POINT		0	100.0		0	100.0
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT		0	100.0		0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT		0	100.0		0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT		0	100.0		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0		0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0		0	100.0
Mobile Sources-Highway Vehicles-Gasoline	2201	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0		0	100.0
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA		0	100.0		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0		0	100.0
Architectural Coatings	2401001000	AREA		0	100.0		0	100.0
Gas Marketing Stage II	25010601	AREA		0	100.0		0	100.0
Degreasing	2415	AREA		0	100.0		0	100.0

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI			PM25-PRI		
			Tons/Year	Percent of Total	Cumulative Percent	Tons/Year	Percent of Total	Cumulative Percent
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0		0	100.0
Graphic Arts	2425	AREA		0	100.0		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0		0	100.0
Traffic Markings	2401008000	AREA		0	100.0		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0		0	100.0
Totals for All Categories			7,443,244	100		1,842,509	100	

Table A-6. Summary of Annual NH3 Emissions for the CENRAP Region by Category, Sector, and Pollutant

Category	Category Number	Sector	NH_3 Tons/Year	NH_3 Percent of Total	NH_3 Cumulative Percent
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	564,046	32.88	32.88
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA	243,489	14.19	47.07
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA	187,598	10.93	58
Industrial Processes-Food and Agriculture	302	POINT	157,951	9.21	67.21
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA	138,222	8.06	75.27
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA	118,941	6.93	82.2
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	46,621	2.72	84.92
Industrial Processes-Industrial Processes: NEC	2399	AREA	33,960	1.98	86.9
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA	33,663	1.96	88.86
Miscellaneous Area Sources-Other Combustion	2810	AREA	32,201	1.88	90.74
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA	22,407	1.31	92.05
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	20,511	1.2	93.25
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA	19,428	1.13	94.38
Industrial Processes-Chemical Manufacturing	301	POINT	14,199	0.83	95.21
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	12,727	0.74	95.95
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA	10,750	0.63	96.58
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA	8,483	0.49	97.07
Mobile Sources-Highway Vehicles-Gasoline	2201	AREA	8,295	0.48	97.55
Miscellaneous Area Sources-Other Combustion	2810	POINT	7,907	0.46	98.01
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	4,521	0.26	98.27
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA	4,247	0.25	98.52
External Combustion Boilers-Electric Generation	1010	POINT	4,126	0.24	98.76
External Combustion Boilers-Space Heaters	1050	POINT	3,752	0.22	98.98
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	3,343	0.19	99.17
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA	3,211	0.19	99.36
Stationary Source Fuel Combustion-Industrial	2102	AREA	1,824	0.11	99.47
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	1,249	0.07	99.54
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	1,188	0.07	99.61
Industrial Processes-Petroleum Industry	306	POINT	1,062	0.06	99.67
Waste Disposal-Solid Waste Disposal-Government	501	POINT	974	0.06	99.73
Mobile Sources-CNG	2268	NONROAD	838	0.05	99.78
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA	587	0.03	99.81
Industrial Processes-Primary Metal Production	303	POINT	539	0.03	99.84
Mobile Sources-Highway Vehicles-Diesel	2230	AREA	443	0.03	99.87
External Combustion Boilers-Industrial	1020	POINT	376	0.02	99.89
Internal Combustion Engines-Electric Generation	2010	POINT	323	0.02	99.91
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	258	0.02	99.93
Industrial Processes-Mineral Products	305	POINT	215	0.01	99.94
External Combustion Boilers-Commercial/Institutional	1030	POINT	197	0.01	99.95
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	168	0.01	99.96
Mobile Sources-Railroad Equipment	2285	NONROAD	147	0.01	99.97

Table A-6 (continued)

Category	Category Number	Sector	NH_3		
			Tons/Year	Percent of Total	Cumulative Percent
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	126	0.01	99.98
Mobile Sources-Pleasure Craft	2282	NONROAD	96	0.01	99.99
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	93	0.01	100.0
Stationary Source Fuel Combustion-Residential	2104	AREA	86	0	100.0
Internal Combustion Engines-Industrial	2020	POINT	77	0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	36	0	100.0
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	33	0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	32	0	100.0
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	28	0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	25	0	100.0
Inorganic Chemical Storage & Transport	252	AREA	22	0	100.0
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	19	0	100.0
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	17	0	100.0
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	16	0	100.0
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	14	0	100.0
Industrial Processes-Secondary Metal Production	304	POINT	4	0	100.0
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	3	0	100.0
Industrial Processes-In-process Fuel Use	390	POINT	2	0	100.0
MACT Source Categories : Vinyl-based Resins	6463	POINT	1	0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA	1	0	100.0
Industrial Processes-Oil and Gas Production	310	POINT	0	0	100.0
Mobile Sources-Aircraft	2275	NONROAD	0	0	100.0
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	0	0	100.0
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	0	0	100.0
Industrial Processes-Fabricated Metal Products	309	POINT	0	0	100.0
Industrial Processes-Electrical Equipment	313	POINT	0	0	100.0
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	0	0	100.0
Industrial Processes-Leather and Leather Products	3209	POINT	0	0	100.0
Internal Combustion Engines-Engine Testing	2040	POINT	0	0	100.0
Internal Combustion Engines-Commercial/Institutional	2030	POINT	0	0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops	2801	POINT	0	0	100.0
Internal Combustion Engines-Fugitive Emissions	2888	POINT		0	100.0
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT		0	100.0
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA		0	100.0
Waste Disposal-Site Remediation	504	POINT		0	100.0
Mobile Sources-Aircraft	2275	POINT		0	100.0
Bulk Materials Transport & Transport	253	AREA		0	100.0
Mobile Sources-LPG	2267	NONROAD		0	100.0
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT		0	100.0
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA		0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT		0	100.0
Industrial Processes-Transportation Equipment	314	POINT		0	100.0
Industrial Processes-Machinery, Miscellaneous	3129	POINT		0	100.0
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT		0	100.0
Industrial Processes-Cooling Tower	3850	POINT		0	100.0

Table A-6 (continued)

Category	Category Number	Sector	NH3 Tons/Year	Percent of Total	Cumulative Percent
Petroleum and Solvent Evaporation-	4250	POINT		0	100.0
MACT Source Categories : Cellulose-based Resins	644	POINT		0	100.0
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT		0	100.0
Industrial Processes-Textile Products	330	POINT		0	100.0
Industrial Processes-Building Construction	3110	POINT		0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT		0	100.0
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA		0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	POINT		0	100.0
Mobile Sources-Paved Roads	2294	POINT		0	100.0
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA		0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Gas Marketing Stage II	25010601	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0
Graphic Arts	2425	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT		0	100.0
Totals for All Categories			1,715,717	100	

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APPENDIX
7.1-C

REFINEMENT OF
CENRAP'S 2002 EMISSIONS INVENTORIES
(SCHEDULE 9; WORK ITEM 3)

FINAL

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August 31, 2005

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Pechan Report No. 05.08.005/9500-004

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CONTENTS

TABLES

ACRONYMS AND ABBREVIATIONS

CAP	criteria air pollutant
CE	Control Equipment (NIF 3.0 table)
CENRAP	Central Regional Air Planning Association
CMU	Carnegie Mellon University
CO	carbon monoxide
CO_2	carbon dioxide
EF	emission factor
EFIG	Emission Factor and Inventory Group
EI	Emission Inventory
EM	Emission (NIF 3.0 table)
EP	Emission Process (NIF 3.0 table)
EPM	Emission Production Model
EPA	U.S. Environmental Protection Agency
ER	Emission Release Point (NIF 3.0 table)
ERP	Emission Release Point (NIF 3.0 field in ER table)
EU	Emission Unit (NIF 3.0 table)
FIPS	Federal Information Processing Standard
FIRE	Factor Information and REtrieval
GIS	geographic information system
HAP	hazardous air pollutant
ID	identification
IDA	Inventory Data Analyzer format
IPM	Integrated Planning Model
LPG	liquefied petroleum gas
MACT	maximum achievable control technology
NAAQS	National Ambient Air Quality Standard
NEI	National Emissions Inventory
NH_3	ammonia
NIF 3.0	NEI Input Format Version 3.0
NO_x	oxides of nitrogen
ORIS	Office of Regulatory Information Systems
PD	primary device
PE	Emission Period (NIF 3.0 table)
Pechan	E.H. Pechan & Associates, Inc.
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
PM10-FIL	filterable PM_{10}
PM10-PRI	primary PM_{10}
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
PM25-FIL	filterable $PM_{2.5}$
PM25-PRI	primary $PM_{2.5}$
PMC	coarse PM
PM-CON	condensible PM
ppm	parts per million
QA	quality assurance
QAPP	Quality Assurance Project Plan

RPO	Regional Planning Organization
SCC	Source Classification Code
SD	secondary device
SI	Site (NIF 3.0 table)
SIC	Standard Industrial Classification
SIP	State Implementation Plan
S/L/T	State, Local, and Tribal
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	sulfur dioxide
TOG	total organic gases
TR	Transmittal (NIF 3.0 table)
U.S.	United States
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VOC	volatile organic compound

I. INTRODUCTION

A. Overview

This report documents the data sources, methods, and results for updating the 2002 base year criteria air pollutant (CAP) and ammonia (NH_3) emissions inventories for point, area, and nonroad sources for the Central Regional Air Planning Association (CENRAP) Regional Planning Organization (RPO). The "Base A" 2002 inventory files completed during February 2005 were updated to incorporate comments provided by the CENRAP State, Local, and Tribal (S/L/T) agencies and the Emissions Inventory (EI) and Modeling Workgroups. As a result of the updates, the new inventory files are termed "Base B". Additional work completed under this work order include the development of Sparse Matrix Operator Kernel Emissions/Inventory Data Analyzer (SMOKE/IDA) input files for a 2018 projection year inventory for electricity generating units (EGUs) and for fires that occurred in Ontario during 2002.

The CENRAP region includes the states and tribal jurisdictions of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. CENRAP (and other RPOs) will use these inventories to support air quality modeling, State Implementation Plan (SIP) development, and implementation activities for the regional haze rule and fine particulate matter (PM) and ozone National Ambient Air Quality Standards (NAAQS).

The inventories and supporting data prepared include the following:

(1) Comprehensive, county-level, mass emissions and modeling inventories for point, area, and nonroad sources of 2002 emissions for the CAPs and NH_3 for the S/L/T agencies included in the CENRAP region;
(2) Modeling inventory files containing 2018 projection year emissions for EGUs; and
(3) A modeling inventory for Ontario fires during 2002.

The mass emissions inventory files were prepared in the National Emissions Inventory (NEI) Input Format Version 3.0 (NIF 3.0). The modeling inventory files were prepared in the SMOKE/IDA format. The revisions to the Base A point, area, and nonroad inventories did not result in adding any new SCCs that were not already included in the temporal, speciation, and spatial allocation profiles for the CENRAP inventories. Therefore, there were no revisions to the ancillary files containing the spatial, temporal, and speciation profile data.

The inventories include annual emissions for sulfur dioxide (SO_2), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), NH_3, and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$). The inventories included summer day, winter day, and average day emissions. However, not all agencies included daily emissions in their inventories, and, for the agencies that did, the temporal basis for the daily emissions varied between agencies. Consequently, the inventories did not contain a complete and consistent set of daily emissions for all source categories and pollutants. Therefore, daily emissions prepared by S/L/T agencies were maintained in the NIF files if they met quality assurance (QA) review requirements. However, CENRAP requested that the daily emissions not be included in the SMOKE input files. The temporal profiles prepared for this project will be used to calculate daily emissions. If needed, the daily emissions prepared by the agencies may be retrieved from the NIF database files.

The following data sources were used to update CENRAP's Base A inventories:

(1) S/L/T agency comments on the "Base A" inventories;
(2) S/L/T agency comments on the draft 2002 NEI;
(3) Revisions to CENRAP-sponsored inventories; and
(4) Comments from CENRAP's EI and Modeling Workgroups.

The United States (U.S.) Environmental Protection Agency's (EPA's) format and content QA programs (and other QA checks not included in EPA's QA software) were run on each inventory to identify format and/or data content issues (EPA, 2004a). E.H. Pechan & Associates, Inc. (Pechan) worked with the CENRAP's EI and Modeling Workgroups and the S/L/T agencies to resolve QA issues and augment the inventories to fill data gaps in accordance with the Methods Plan and Quality Assurance Project Plan (QAPP) prepared for this project (CENRAP, 2005a; CENRAP, 2005b). The EI Workgroup and S/L/T agencies reviewed the draft inventory files after updating the inventories, and the files were updated to address their comments.

B. Summary of the 2002 Base Year Inventories

This section of the report provides a brief summary of the consolidated 2002 Base B inventories for the CENRAP region. Table 1 shows total annual emissions for CAPs and NH_3 for point, area, nonroad, and onroad sources. The sector contributing the highest emissions varies by pollutant. Point sources account for the highest percentage of total NO_x (35 percent) and SO_2 (83 percent) emissions. Area sources account for the highest percentage of total VOC (44 percent), primary PM_{10} (PM10-PRI (93 percent)), primary $PM_{2.5}$ (PM25-PRI (81 percent)), and NH_3 (83.5 percent) emissions. Onroad sources account for the highest percentage of CO (57 percent) emissions. Onroad sources account for 24.5 percent and nonroad sources account for 17 percent of total VOC emissions. Onroad sources account for 33 percent and nonroad sources account for 18.5 percent of total NO_x emissions.

Table 2a shows total annual emissions by state and pollutant for all four sectors combined. Tables 2b through 2e show total annual emissions by state and pollutant for area, point, nonroad, and onroad sources, respectively. Tables A-1 through A-6 in Appendix A provide summaries of annual emissions by source category and sector for VOC, NO_x, CO, SO_2, PM10-PRI and PM25-PRI, and NH_3, respectively. The emissions in each table are sorted in descending order with the highest emitting categories listed at the top of the table. The tables also show annual emissions as a percentage of total emissions from all sectors, and the cumulative percentage contribution. Chapter III of this report identifies additional summaries of emissions, including county-level summaries that contain the data source codes that identify the origin and year of emissions data.

The Fond du Lac Band of the Minnesota Chippewa Tribe and the Leech Lake Band of Ojibwe Tribe each provided point and area source inventories. The point source inventories are included in the Base B inventory; however, the area source inventories are not because SMOKE is not currently programmed to process tribal area source data. Thus, the tribal area source inventories are included in a separate NIF 3.0 database and the area source emissions are summarized in Table 2f (note that these area source emissions are not included in Tables 1, 2a, and 2b).

The nonroad Base B inventory includes carbon dioxide (CO_2) emissions, the point source inventory includes total primary and filterable particulate matter (PM-PRI/-FIL) emissions, and the point and area source inventories include filterable PM_{10} (PM10-FIL), filterable $PM_{2.5}$ (PM25-FIL), and condensible PM (PM-CON) emissions. The emissions for these pollutants were carried in the mass emissions inventory files. However, these pollutants are not included in the summaries since the emissions for these pollutants were not consistently reported by all S/L/T agencies for a given sector. In addition, AR is the only state that included PM10-PRI and PM25-PRI emissions for fugitive wind-blown dust emissions in its area source inventory. The wind-blown dust emissions are stored in the area miscellaneous sources inventory, and are included in the sector-level summaries (as geogenic and natural/biogenic sources) described in Chapter III of this report.

C. Organization of the Report

In Chapter II of this report, section A provides an introduction to the chapter and sections B through D present the data sources and methods applied to prepare the mass emissions inventory and SMOKE input files for point, area, and nonroad sources within the CENRAP region. Section E explains the data sources and methods applied to prepare SMOKE IDA files for a 2018 projection year inventory for electricity generating units (EGUs) in the CENRAP region. Section F provides documentation of the SMOKE and RPO data exchange protocol files prepared under this project.

Chapter III and Appendix A provide summaries of the 2002 emissions inventories for point, area, nonroad, and onroad sources within the CENRAP region. Chapter IV presents the data sources and methods applied to prepare SMOKE input files for 2002 fires in Ontario, Canada. Chapter V provides the references for this report.

D. Project Work Plan and Methods Document

At the beginning of this project, a draft work plan and methods document was prepared and reviewed by the CENRAP EI and Modeling Workgroups (CENRAP, 2005a; CENRAP, 2005c). The Workgroups did not provide any comments on these two deliverables. Thus, the draft work plan and methods document was not revised. However, during the duration of the project, the Workgroups requested additional revisions to the Base A point, area, and nonroad inventories after the draft work plan and methods document was prepared and reviewed by the Workgroups. This final report for the Base B inventory details all of the updates and refinements completed on the Base A inventory. However, due to time and resource constraints, the draft work plan and methods document was not revised to reflect this additional work.

Table 1. Summary of Annual Emissions for the CENRAP Region by Sector and Pollutant

	VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
Sector	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total	Tons/Year	Percent of Total
Point	532,229	14.0	1,825,128	35.1	1,761,327	7.8	2,222,998	82.7	375,842	4.9	233,070	12.7	194,467	11.1
Area	1,680,228	44.2	679,931	13.1	3,617,995	16.1	321,222	12.0	7,100,109	93.1	1,498,076	81.3	1,466,292	83.5
Nonroad	659,316	17.3	964,071	18.5	4,340,598	19.3	95,304	3.6	82,916	1.1	76,798	4.2	1,365	0.1
Onroad	930,704	24.5	1,735,738	33.4	12,782,810	56.8	47,644	1.8	37,649	0.5	27,231	1.5	50,317	2.9
Natural Sources	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	44,688	2.5
Geogenic	0	0.0	0	0.0	0	0.0	0	0.0	32,164	0.4	7,076	0.4	0	0.0
Totals	3,802,477	100	5,204,868	100	22,502,730	100	2,687,169	100	7,628,680	100	1,842,252	100	1,757,129	100
Dominant Sector[1]	**Area**		**Point**		**Onroad**		**Point**		**Area**		**Area**		**Area**	

[1] Identifies the sector accounting for the majority of the emissions for each pollutant.

Table 2a. Summary of All Sector Source Emissions by State and Pollutant

		VOC		NO_x		CO		SO_2		PM10-PRI		PM25-PRI		NH_3	
State FIPS/ Tribal Code	State/Tribal Name	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total	Tons/ Year	Percent of Total
05	Arkansas	272,607	7.2	298,625	5.7	1,445,276	6.4	128,033	4.8	292,586	3.9	100,826	5.5	145,323	8.5
19	Iowa	284,276	7.5	331,391	6.4	1,613,636	7.2	199,941	7.4	517,601	6.8	121,979	6.7	250,688	14.6
20	Kansas	261,263	6.9	381,986	7.3	2,176,490	9.7	165,373	6.2	783,815	10.3	227,308	12.4	181,081	10.6
22	Louisiana	385,686	10.1	707,068	13.6	2,330,169	10.4	391,312	14.6	333,116	4.4	157,745	8.6	85,593	5.0
27	Minnesota	396,648	10.4	487,033	9.4	2,531,648	11.3	158,555	5.9	826,338	10.9	196,427	10.7	179,814	10.5
29	Missouri	387,390	10.2	488,085	9.4	2,607,987	11.6	424,088	15.8	1,000,608	13.2	208,035	11.3	157,003	9.2
31	Nebraska	142,037	3.7	255,060	4.9	870,962	3.9	94,069	3.5	469,576	6.2	96,205	5.2	169,810	9.9
40	Oklahoma	388,347	10.2	466,748	9.0	2,222,719	9.9	170,113	6.3	740,953	9.8	174,044	9.5	133,558	7.8
48	Texas	1,284,200	33.8	1,787,975	34.4	6,702,571	29.8	955,686	35.6	2,631,794	34.6	552,511	30.1	409,564	23.9
405	Fond du Lac Tribe	3	0.0	501	0.0	129	0.0	0	0.0	8	0.0	8	0.0	0	0.0
407	Leech Lake Band of Ojibwe	18	0.0	397	0.0	1,145	0.0	0	0.0	121	0.0	88	0.0	4	0.0
	Totals[1]	3,802,477	100	5,204,868	100	22,502,730	100	2,687,169	100	7,596,517	100	1,835,175	100	1,712,437	100

[1] PM10-PRI and PM25-PRI emissions from biogenic sources and NH_3 emissions from natural sources are not included in the area source emissions totals shown in this table.

Table 2b. Summary of Area Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC Tons/ Year	VOC Percent of Total	NO_x Tons/ Year	NO_x Percent of Total	CO Tons/ Year	CO Percent of Total	SO_2 Tons/ Year	SO_2 Percent of Total	PM10-PRI Tons/ Year	PM10-PRI Percent of Total	PM25-PRI Tons/ Year	PM25-PRI Percent of Total	NH_3 Tons/ Year	NH_3 Percent of Total
05	Arkansas	71,371	4.3	25,392	3.7	145,859	4.0	27,873	8.7	243,378	3.4	61,352	4.1	139,882	9.5
19	Iowa	105,563	6.3	6,920	1.0	102,183	2.8	3,290	1.0	477,093	6.7	97,987	6.5	244,446	16.7
20	Kansas	137,821	8.2	43,114	6.3	875,433	24.2	14,084	4.4	728,377	10.3	194,959	13.0	114,482	7.8
22	Louisiana	113,241	6.7	99,060	14.6	530,135	14.7	83,253	25.9	245,162	3.5	84,068	5.6	71,756	4.9
27	Minnesota	169,918	10.1	59,536	8.8	276,964	7.7	15,550	4.8	762,279	10.7	157,752	10.5	145,736	9.9
29	Missouri	133,784	8.0	34,749	5.1	269,007	7.4	48,317	15.0	962,807	13.6	182,266	12.2	120,341	8.2
31	Nebraska	66,769	4.0	15,023	2.2	81,169	2.2	7,748	2.4	447,703	6.3	83,852	5.6	137,406	9.4
40	Oklahoma	201,758	12.0	115,788	17.0	465,631	12.9	11,779	3.7	714,805	10.1	157,444	10.5	104,587	7.1
48	Texas	680,004	40.5	280,349	41.2	871,616	24.1	109,329	34.0	2,518,505	35.5	478,396	31.9	387,657	26.4
	Totals[1]	1,680,228	100	679,931	100	3,617,995	100	321,222	100	7,100,109	100	1,498,076	100	1,466,292	100

[1] PM10-PRI and PM25-PRI emissions from biogenic sources and NH_3 emissions from natural sources are not included in the area source emissions totals shown in this table.

Table 2c. Summary of Point Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC Tons/ Year	VOC Percent of Total	NO_x Tons/ Year	NO_x Percent of Total	CO Tons/ Year	CO Percent of Total	SO_2 Tons/ Year	SO_2 Percent of Total	PM10-PRI Tons/ Year	PM10-PRI Percent of Total	PM25-PRI Tons/ Year	PM25-PRI Percent of Total	NH_3 Tons/ Year	NH_3 Percent of Total
05	Arkansas	102,508	19.3	68,867	3.8	357,578	20.3	90,769	4.1	39,983	10.6	31,467	13.5	2,911	1.5
19	Iowa	39,156	7.4	122,124	6.7	51,236	2.9	184,664	8.3	28,788	7.7	13,650	5.9	3,366	1.7
20	Kansas	27,458	5.2	165,284	9.1	83,307	4.7	140,371	6.3	47,081	12.5	25,073	10.8	63,914	32.9
22	Louisiana	89,025	16.7	312,634	17.1	285,395	16.2	286,050	12.9	73,333	19.5	60,899	26.1	9,237	4.8
27	Minnesota	40,970	7.7	155,143	8.5	233,778	13.3	131,542	5.9	51,111	13.6	27,537	11.8	28,673	14.7
29	Missouri	36,109	6.8	181,675	10.0	136,914	7.8	361,548	16.3	20,949	5.6	11,079	4.8	31,120	16.0
31	Nebraska	7,274	1.4	58,619	3.2	11,008	0.6	73,487	3.3	13,105	3.5	4,638	2.0	30,731	15.8
40	Oklahoma	36,987	7.0	158,972	8.7	78,430	4.5	148,852	6.7	18,009	4.8	9,776	4.2	24,256	12.5
48	Texas	152,720	28.7	600,912	32.9	522,407	29.7	805,714	36.2	83,354	22.2	48,855	21.0	255	0.1
405	Fond du Lac Tribe	3	0.0	501	0.0	129	0.0	0	0.0	8	0.0	8	0.0		0.0
407	Leech Lake Band of Ojibwe	18	0.0	397	0.0	1,145	0.1		0.0	121	0.0	88	0.0	4	0.0
	Totals	532,229	100	1,825,128	100	1,761,327	100	2,222,998	100	375,842	100	233,070	100	194,467	100

Table 2d. Summary of Nonroad Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC Tons/ Year	VOC Percent of Total	NO_x Tons/ Year	NO_x Percent of Total	CO Tons/ Year	CO Percent of Total	SO_2 Tons/ Year	SO_2 Percent of Total	PM10-PRI Tons/ Year	PM10-PRI Percent of Total	PM25-PRI Tons/ Year	PM25-PRI Percent of Total	NH_3 Tons/ Year	NH_3 Percent of Total
05	Arkansas	49,246	7.5	62,472	6.5	272,626	6.3	5,490	5.8	5,673	6.8	5,220	6.8	49	3.6
19	Iowa	58,021	8.8	92,893	9.6	363,341	8.4	9,070	9.5	9,746	11.8	8,939	11.6	80	5.9
20	Kansas	26,400	4.0	82,697	8.6	261,770	6.0	8,101	8.5	6,549	7.9	5,993	7.8	115	8.4
22	Louisiana	106,422	16.1	114,710	11.9	531,424	12.2	16,961	17.8	10,410	12.6	9,558	12.5	563	41.4
27	Minnesota	83,419	12.7	100,479	10.4	446,922	10.3	8,719	9.2	9,343	11.3	8,576	11.2	90	6.6
29	Missouri	126,923	19.3	99,306	10.3	754,272	17.4	9,351	9.8	13,064	15.8	11,985	15.6	74	5.4
31	Nebraska	24,882	3.8	119,568	12.4	175,694	4.1	11,011	11.6	7,491	9.0	6,785	8.8	59	4.3
40	Oklahoma	47,863	7.3	49,396	5.1	324,391	7.5	4,773	5.0	5,085	6.1	4,652	6.1	280	20.6
48	Texas	136,139	20.7	242,551	25.2	1,210,158	27.9	21,828	22.9	15,556	18.8	15,090	19.7	52	3.8
	Totals	659,316	100	964,071	100	4,340,598	100	95,304	100	82,916	100	76,798	100	1,361	100

Table 2e. Summary of Onroad Source Emissions by State and Pollutant

State FIPS/ Tribal Code	State/Tribal Name	VOC Tons/ Year	VOC Percent of Total	NO_x Tons/ Year	NO_x Percent of Total	CO Tons/ Year	CO Percent of Total	SO_2 Tons/ Year	SO_2 Percent of Total	PM10-PRI Tons/ Year	PM10-PRI Percent of Total	PM25-PRI Tons/ Year	PM25-PRI Percent of Total	NH_3 Tons/ Year	NH_3 Percent of Total
05	Arkansas	49,483	5.3	141,894	8.2	669,213	5.2	3,902	8.2	3,551	9.4	2,786	10.2	2,480	4.9
19	Iowa	81,535	8.8	109,454	6.3	1,096,877	8.6	2,916	6.1	1,975	5.2	1,403	5.2	2,797	5.6
20	Kansas	69,584	7.5	90,891	5.2	955,979	7.5	2,816	5.9	1,808	4.8	1,284	4.7	2,570	5.1
22	Louisiana	76,998	8.3	180,664	10.4	983,215	7.7	5,047	10.6	4,212	11.2	3,219	11.8	4,037	8.0
27	Minnesota	102,342	11.0	171,875	9.9	1,573,984	12.3	2,744	5.8	3,605	9.6	2,562	9.4	5,315	10.6
29	Missouri	90,574	9.7	172,355	9.9	1,447,795	11.3	4,873	10.2	3,789	10.1	2,704	9.9	5,469	10.9
31	Nebraska	43,113	4.6	61,850	3.6	603,091	4.7	1,822	3.8	1,277	3.4	930	3.4	1,614	3.2
40	Oklahoma	101,740	10.9	142,592	8.2	1,354,266	10.6	4,708	9.9	3,054	8.1	2,171	8.0	4,434	8.8
48	Texas	315,337	33.9	664,163	38.3	4,098,390	32.1	18,815	39.5	14,379	38.2	10,171	37.4	21,601	42.9
	Totals	930,704	100	1,735,738	100	12,782,810	100	47,644	100	37,649	100	27,231	100	50,317	100

Table 2f. Summary of Tribal Area Source Emissions

Tribal Code	Tribal Name	VOC Tons/ Year	NO_x Tons/ Year	CO Tons/ Year	SO_2 Tons/ Year	PM-PRI Tons/ Year	PM10-PRI Tons/ Year	PM25-PRI Tons/ Year	NH_3 Tons/ Year
405	Fond du Lac Band of the Minnesota Chippewa Tribe	0	0	571	0	1,883	12,246	1,883	0
407	Leech Lake Band of Ojibwe	22	8.2	105	1	20	0	0	0.95
	Totals	22	8	676	1	1,903	12,246	1,883	1

II. REFINEMENT OF THE CRITERIA AIR POLLUTANT AND NH_3 INVENTORIES FOR THE CENRAP REGION

A. Introduction

The following data sources were used to update CENRAP's 2002 Base A inventories:

(5) S/L/T agency comments on the "Base A" inventories;
(6) S/L/T agency comments on the draft 2002 NEI;
(7) Revisions to CENRAP-sponsored inventories; and
(8) Comments from CENRAP's EI and Modeling Workgroups.

Table 3 provides a summary of the S/L/T agency data received for updating CENRAP's Base A inventories. Prior to using the data to update the Base A inventories, Pechan performed QA review of the inventories to identify (1) remaining QA issues that needed to be resolved through consultation with the agency and/or the EI and Modeling Workgroups, and (2) missing data that needed to be added to the inventories to support air quality modeling studies. As a result of the QA review, and after consulting with KS and MO, it was agreed that the point source inventory data they provided would not be used in the Base B point source inventory (see section II.B for additional details).

Table 3. Summary of S/L/T Agencies that Provided Data for Updating CENRAP's Inventories [1]

State/Local/Tribal Agency	Point	Area	Nonroad
AR	x[2]	x[3]	
Fond du Lac Band of the Minnesota Chippewa Tribe			
IA	x[4]		
KS	x[4,5]		
LA			
Leech Lake Band of Ojibwe Tribe	x[6]	x[6]	
MN	x[4]	x[3]	
MO	x[4,5]		
NE-State			
NE-Lincoln (Lancaster County)			
NE-Omaha (Douglas County)			
OK			
TX		x[4]	x[3]

[1] An "x" identifies the sector for which a S/L/T agency provided data to revise the Base A inventory.
[2] Agency provided inventory that completely replaced its Base A inventory data.
[3] Agency provided comments on CENRAP's Base A inventory.
[4] Agency provided comments on draft 2002 NEI that were used to update the Base A inventory.
[5] Agency provided comments but comments not used per agreement with the agency.
[6] Agency provided a new inventory not included in the Base A inventory.

After resolving the QA issues, the files were updated to revise or add data provided by the S/L/T agencies. In addition, the CENRAP's Base A NONROAD model inventory was revised to correct input data for the oxygen content of fuels and the SO_2 content of diesel fuel. Thus, the nonroad inventory for the NONROAD model categories was updated for all states that elected to use this inventory in the CENRAP inventory. Also, revisions were completed on all sectors to address comments from the EI and Modeling Workgroups.

The following sections B, C, and D provide the methods for updating CENRAP's 2002 Base A inventories for point, area, and nonroad sources, respectively. Each section discusses the QA review that was conducted on the S/L/T inventories to identify QA issues that were corrected to support air quality modeling. Then, each section discusses the augmentation procedures that were applied to fill in missing data. These procedures identify supplemental data that S/L/T agencies provided to add to or replace data in their inventories, the CENRAP-sponsored inventories that were added to the inventories as approved by the S/L/T agencies, and the 2002 NEI categories that S/L/T agencies requested to be added to their inventories. The augmentation procedures also explain how missing PM emissions were estimated and added to the inventories after incorporating inventory data supplied by S/L/T agencies, the CENRAP-sponsored inventory data, and data from the 2002 NEI.

Section E presents the data sources and methods for preparing the 2018 projection year inventory for EGUs. Section F documents the SMOKE and RPO data exchange protocol files prepared under this project.

B. Point Source Inventory Methods

1. Data Sources

For each S/L/T inventory that provided updates, Table 4 provides a summary of the pollutants included in each inventory, and compares the number of counties in the inventory to the number of counties in the 2002 preliminary NEI and in each S/L/T agency. The table also compares the number of facilities in the S/L/T inventory to the number of facilities in the 2002 preliminary NEI.

The inventories obtained from EPA are in Access 2000 databases in NIF 3.0. Each inventory was loaded into an Oracle database in NIF 3.0 to combine the inventories into a single data set. Then, after loading the inventories into Oracle in NIF 3.0, the following updates were performed on the consolidated data set, if necessary:

Table 4. Summary of Pollutants, Number of Counties, and Number of Facilities in Point Source Inventories

State/Local/ Tribal Agency	CO	NH_3	NO_x	PM-PRI	PM10-PRI	PM25-PRI	PM10-FIL	PM25-FIL	PM-CON	SO_2	VOC	Number of Counties in 2002 S/L/T Inventory Comments	Number of Counties in 2002 CENRAP Inventory[2]	Number of Counties in State	Number of Facilities in 2002 S/L/T Inventory Comments	Number of Facilities in 2002 CENRAP Inventory[2]
AR	x	x	x	x	x	x				x	x	57	70	75	231	1281
IA[1]										x		5	99	99	7	1871
KS[1]	x	x	x				x	x		x	x	4	105	105	4	5046
MN[1]	x	x	x		x	x		x		x	x	72	87	87	542	6095
Leech Lake Band of the Minnesota Ojibwe Tribe	x	x	x	x	x						x	-[3]	-[3]	-[3]	2	0

[1] State submitted comment records ("A" and "D" submittal flags). Therefore, entries will refer only to the "A" (Add) or "RA" (Revise Add) records. Note, ultimately KS inventory comments were not used to update the Base A inventory.

[2] Refers to the counties in the 2002 CENRAP modeling inventory which could include CENRAP-sponsored inventories for NH_3, fires, and confined animal feeding operations.

[3] NA = Not Applicable.

- Hazardous air pollutant (HAP) records were removed since the inventory will support regional haze, fine PM, and ozone modeling.

- Pollutant codes were corrected to make them NIF 3.0 compliant (e.g., update PMPRI pollutant code to PM-PRI). Additionally, other codes were identified for remediation on a case-by-case basis.

- The NIF 3.0 submittal flag field, when populated by an agency, provides the directions needed to determine how to revise the 2002 inventory. For this project, comment files obtained from EPA reflected comments on the draft NEI and not on CENRAP's 2002 inventory. Therefore, Pechan reviewed the submittal flag codes, compared the comment file to the CENRAP inventory, and consulted with the S/L/T agency to verify what records in the comment file were to be used to revise the CENRAP inventory. Pechan adjusted the submittal flags as necessary to document the records in the comment file that replaced records in CENRAP's 2002 inventory.

- Null values in the tribal code field were updated to '000' since this field is a part of the data key that defines records as unique in all eight NIF tables.

- The following NIF plus fields were added to the Transmittal (TR), Site (SI), Emission Unit (EU), Emission Release Point (ER), Emission Process (EP), Emission Period (PE), Emission (EM), and Control Equipment (CE) tables:

  - Data Source Codes:

Code	Description
S	State agency-supplied data.
L	Local agency-supplied data.
R	Tribal agency-supplied data.
P	Regional Planning Organization.
SC	S/L/T agency Corrected.
AUG-A	PM Augmentation: ad-hoc change.
AUG-C	PM Augmentation: standard augmentation method.
AUG-O	PM Augmentation: set PMxx-FIL = PMxx-PRI where for SCCs starting with 10 (external fuel combustion) and 20 (internal fuel combustion). Note: emission factors and particle-size data for estimating condensible emissions for fuel combustion SCCs starting with 30 were not available; therefore, condensible emissions were not estimated for these processes if an agency provided filterable and not primary emissions for these processes.
AUG-Z	PM Augmentation: automated fill-in of zero values where all PM for a particular process is zero.
GENPARENT	Data source where a parent record was system generated.

    - Revision Date: This field indicates the month and year during which the last revision was made to a record. For the Base B inventory, for new or updated records, it is 0705.

    - State Federal Information Processing Standard (FIPS): This field indicates the state FIPS code of the submittal.

    - County FIPS: This field indicates the county FIPS code of the submittal.

- The following NIF plus fields were added to the EM table:

    - Emission Ton Value: This field indicates the values of the emissions in tons. This field was used to prepare summaries of emissions on a consistent emission unit basis.

    - Emission Type Period: This field indicates the period of the Emission Type – either ANNUAL or NONANNUAL. This field was used to prepare summaries of annual emissions.

    - CAP_HAP: This field identifies records for CAP versus records for HAPs. For the CENRAP inventory, the flag is CAP for all records.

    - Year: This field indicates the year of the data; for this inventory, it is 2002.

2. QA Review

QA review on the inventories was conducted in accordance with the QA procedures specified in the QAPP for this project (CENRAP, 2005b).

The following data elements were reviewed to identify QA issues:

- Emission Release Point (ERP) or Stack Coordinates;
- ERP (Stack) Parameters;
- PM Emissions Consistency and Completeness;
- Control Devices and Efficiencies;
- Start and End Dates; and
- Annual and Daily Emissions Comparison.

As appropriate, individual S/L/T agencies were contacted with QA questions in order to receive direction on corrections.

a. County and Facility Coverage

S/L/T agencies which submitted complete replacement inventories or replacement facility information (Arkansas, Leech Lake) were compared to their previous year's submittal as appropriate to determine if there is a significant change in county coverage, facility coverage, or emissions.

b. Pollutant Coverage

S/L/T agencies which submitted complete replacement inventories (Arkansas, Leech Lake) were reviewed for pollutant coverage and other potential issues. Arkansas' Base A inventory included emission data from the CENRAP-sponsored inventories for confined animal feeding operations and planned burning. The CENRAP-sponsored emissions data were merged with Arkansas' new inventory.

Arkansas, Minnesota, and Leech Lake include replacements and/or revisions to their PM data. On processes where the PM data were replaced or revised with new data, the PM augmentation routine was applied. The QA review of the PM data is discussed further in the following section, and the augmentation procedures are discussed in section II.B.4.

c. Particulate Matter (PM) Emissions Consistency and Completeness Review

The following consistency checks were performed at the EM table data key level (for annual emissions) to compare PM emissions:

- If a process was associated with a PM emission record, but was missing one or more of the following (as appropriate for the Source Classification Code [SCC] [i.e., condensible PM (PM-CON) is associated with fuel combustion only]): PM10-FIL, PM10-PRI, PM25-FIL, PM25-PRI, or PM-CON, the record was flagged for review.

- The following equations were used to determine consistency:

  PM10-FIL + PM-CON = PM10-PRI
  PM25-FIL + PM-CON = PM25-PRI
  PM-FIL + PM-CON = PM-PRI (as appropriate)

- The following comparisons were applied to determine consistency:

  PM10-PRI >= PM10-FIL
  PM25-PRI >= PM25-FIL
  PM10-PRI >= PM-CON
  PM25-PRI >= PM-CON
  PM10-FIL >= PM25-FIL
  PM10-PRI >= PM25-PRI
  PM-PRI >= PM10-PRI (as appropriate)
  PM-PRI >= PM25-PRI (as appropriate)
  PM-FIL >= PM10-FIL (as appropriate)
  PM-FIL >= PM25-FIL (as appropriate)

If the data failed one of these checks it was diagnosed as an error. If a S/L/T agency did not provide corrections to these errors, the errors were corrected/filled in according to the augmentation procedure discussed in section II.B.4.

d. Emission Release Point (ERP) Coordinate Review

Location coordinates for new point sources were evaluated using geographic information system (GIS) mapping to determine if the coordinates were within 0.5-kilometers of the boundary of the county in which the source was located. ERP records with coordinates located more than 0.5, 1, 2, 3, 5, 7, and 10 or more kilometers from their county boundary, and coordinates that mapped outside of their state boundary were identified. Arkansas' new point source inventory contained what appeared to be new coordinates not included in its Base A inventory. However, Arkansas indicated that the ERP information had not changed significantly since the original submittal was submitted for ERP coordinate review. Coordinates for the Leech Lake submittal were manually reviewed and it was verified that the coordinates fell within the tribal area boundaries.

e. ERP Parameter Review

The EPA's QA guidance for diagnosing ERP issues for the point source NEI (EPA, 2004b) was applied to identify QA issues in the S/L/T point source inventories. The QA guidance involved diagnosing the correct assignment of the ERP type (i.e., stack or fugitive), parameters with zero values, parameters not within the range of values specified in the EPA's QA procedures, and consistency checks (i.e., comparing calculated values against expected values). In many cases errors were due to defaulted zeros, and submitting agencies were requested to provide the value. In other cases, out-of-range errors were caused by unit conversion issues (e.g., stack parameters were in ft, ft/sec, cu ft/sec or degrees Fahrenheit). The data were corrected or filled in according to the ERP parameter augmentation procedure discussed in section II.B.4.

f. Control Device Type and Control Efficiency Data Review

The CE codes in the "Primary Device Type Code" and "Secondary Device Type Code" fields were reviewed to identify invalid codes (i.e., codes that did not exist in the NIF 3.0 reference table) and missing codes (e.g., records with a null or uncontrolled code of 000 but with control efficiency data).

QA review of control efficiency data involved diagnosis of two types of errors. First, records were reviewed to identify control efficiency values that were reported as a decimal rather than as a percent value. Records with control efficiencies with decimal values were flagged as a potential error (although not necessarily an error, since the real control efficiency may be less than 1 percent).

The second check identified records where 100 percent control was reported in the CE table, but the emissions in the EM table were greater than zero and the rule effectiveness value in the EM table was null, zero, or 100 percent (implying 100 percent control of emissions). Because many agencies did not populate the rule effectiveness field or a default value of zero was assigned, records with null or zero rule effectiveness values were included where the CE was 100 percent and emissions were greater than zero. All new data submitted for updating CENRAP's point source inventory passed these QA checks.

g. Start and End Date Checks

QA review was conducted to identify start date and end date values in the PE and EM tables to confirm consistency with the inventory year in the transmittal table, and to confirm that the end date reported is greater than the start date reported. This check did not identify any QA issues with the data used to update the Base A inventory.

h. Annual and Daily Emissions Comparison

The following QA checks were conducted to identify potential errors associated with the incorrect reporting of daily and/or annual emissions:

- Multiple records coded at the process level as emission type 30, but with different start and end dates. While not a true duplicate, this may indicate an error or an inclusion of both annual and seasonal values. Only one record can be identified as the "ANNUAL" record.

- Multiple records coded at the process level (or SCC, in the case of area) as a daily emission type (27, 29, etc.) but with different start and end dates. While not a true duplicate, this may indicate an error or just an inclusion of additional types of daily emissions.

- Multiple records coded at the process level (or SCC, in the case of area) with the same start and end date, but different emission types. While not a true duplicate, this may indicate an error or just an inclusion of additional types of daily emissions.

All new data submitted for updating CENRAP's point source inventory passed these QA checks.

3. Responses from S/L/T Agencies

The S/L/T agencies provided responses to questions about their data. When necessary, QA issues were summarized in Excel spreadsheets and sent to the agencies and the EI and Modeling Workgroups for review. The agencies or the Workgroups then provided direction for correcting the issues either by telephone or by e-mail.

4. Gap Filling and Augmentation

The following discusses the augmentation procedures that were used to fill in missing data that were not supplied by the S/L/T agencies.

a. PM Augmentation

Pechan implemented procedures to estimate missing pollutant data from data provided by the S/L/T agencies in order to develop a complete set of PM10-PRI and PM25-PRI emissions to support air quality modeling.

The PM augmentation process gap-filled missing PM pollutant complements. For example, if a S/L/T agency provided only PM10-PRI pollutants the PM augmentation process filled in the PM25-PRI pollutants. The steps in the PM augmentation process were as follows:

- Initial QA and remediation of S/L/T provided PM pollutants;
- Development of PM factor ratios based on factors from the Factor Information and REtrieval (FIRE) Data System (Version 6.2) and the PM Calculator (EPA, 2003; EPA, 2004c);
- Implementation of the ratios; and
- Presentation of PM augmentation results to S/L/T agencies for review and comment.

Note: An Access database accompanies this documentation - *Reference Tables for PM Augmentation*. This database contains the SCC Control Device Ratio table, the Emission Factors table and Emission Factors Crosstab table discussed in Step 2. The PM Calculator ratio table can be provided upon request – it contains all possible combinations for SCC and Control Device types that are available in the PM Calculator.

These steps are further detailed below.

1. Initial QA and Remediation of PM Pollutants

S/L/T agencies were initially presented with files that detailed potential inconsistencies and missing information in their PM pollutant inventory. Inconsistencies in PM pollutants include the following:

- PM-PRI less than PM10-PRI, PM25-PRI, PM10-FIL, PM25-FIL, or PM-CON
- PM-FIL less than PM10-FIL, PM25-FIL
- PM10-PRI less than PM25-PRI, PM10-FIL, PM25-FIL or PM-CON
- PM10-FIL less than PM25-FIL
- PM25-PRI less than PM25-FIL or PM-CON
- The sum of PM10-FIL and PM-CON not equal to PM10-PRI
- The sum of PM25-FIL and PM-CON not equal to PM25-PRI

Potential missing information was summarized in a table which detailed the variety of cases provided by the S/L/T agency. For example, a S/L/T agency might have provided PM10-FIL and PM25-FIL for some processes, but for other processes only PM10-FIL was provided.

S/L/T agencies were asked to review this information and provide corrections where possible. In general, corrections (or general directions) were provided in the case of the potential inconsistency issues. An example of a general direction provided by a S/L/T agency was to remove PM25-FIL where greater than PM10-FIL because the PM10-FIL was (in their particular case) known to be more reliable. In other cases, the agency-provided specific process level pollutant corrections. In general, if specific direction was not provided by the agency, priority was given to the PM_{10} number.

2. Development of PM Factor Ratio

The primary deliverable of this step of the process was the development of a table keyed by SCC, primary control device, and secondary control device. This table is called the SCC Control Device Ratios table. The table structure is shown in Table 5 which follows the discussion below.

This table was filled according to the following steps:

- Ratios (both condensible and noncondensible) were added from FIRE for SCCs starting with 10* (external fuel combustion) and 20* (internal fuel combustion) where there was a direct match between the provided SCC, and primary and secondary control devices.
- Ratios (non-condensable) were added from the PM Calculator for SCCs starting with 10* and 20* where there was not a direct match between the provided SCC, and primary and secondary control devices. Condensible ratios were added from the PM Calculator based on the uncontrolled SCC for these SCCs. In some cases, it was necessary to map the SCC and control devices to the PM calculator to find a match for the noncondensible ratios. In some cases, it was necessary to map the SCC to FIRE to find a match for condensible ratios.
- For natural gas, process gas and liquefied petroleum gas SCCs starting with 10* and 20*, it was assumed (based on FIRE emission factors trend) that the PM-PRI/PM10-PRI/PM25-PRI ratio was equal to 1. It was also assumed that the PM-FIL/PM10-FIL /PM25- FIL was equal to 1. Condensible ratios were calculated from uncontrolled FIRE emission factors based for these SCCs. In some cases it was necessary to map the SCC to FIRE to find a match for condensible ratios.
- Ratios for SCCs not like 10* and 20* were obtained from the PM Calculator. It was assumed that the condensible component was zero.

Accompanying this document is a database containing the SCC Control Device Ratios table. Additionally, the Emission Factors and Emission Factors Crosstab table (which are derived from FIRE) are provided. The Emission Factors Crosstab table contains the ratios developed from the Emission Factors table. The Emission Factors table contains detailed information on the emission factors used to develop the ratios.

Note: Ratios from the PM calculator were developed using a standard input of 100 TONS of uncontrolled PM-FIL emissions.

Table 5. Description of the Field Names and Descriptions for the SCC Ratio Table

Field Name	Field Description
PM Calculator	A "Yes" in this field indicates that at least some of the information was retrieved from the PM Calculator
FIRE	A "Yes" in this field indicates that at least some of the information was retrieved from the Emission Factors table. A "Condensible Ratios" in this field indicates that the condensible ratios factors were retrieved from this table.
Other	A field to indicate other sources as necessary.
SCC	Source category code from the S/L/T agency-provided data.
SCC_DESC	Description of source category code from the S/L/T agency-provided data.
maptoSCC	This field equals SCC unless the SCC provided was not found in the appropriate source table. In that case, the SCC was mapped using the closest available appropriate mapping choice.
maptoSCC_DESC	Description of the maptoSCC.
mapSCCNote	Any notes related to the mapping of the SCC. A "Yes" in this field indicates that the SCC was mapped.
PD	Primary device type from the S/L/T agency provided data.
PD_DESC	Description of the primary device (PD).
maptoPD	This field equals PD unless the PD provided was not found in the appropriate source table. In that case, the PD was mapped using the closest available appropriate mapping choice.
maptoPD_DESC	Description of the maptoPD.
mapPDNote	Any notes related to the mapping of the PD. A "Yes" in this field indicates that the PD was mapped.
SD	Secondary device type from the S/L/T agency provided data.
SD_DESC	Description of the secondary device (SD).
maptoSD	This field equals SD unless the SD provided was not found in the appropriate source table. In that case, the SD was mapped using the closest available appropriate mapping choice.
maptoSD_DESC	Description of the maptoSD.
mapSDNote	Any notes related to the mapping of the SD. A "Yes" in this field indicates that the SD was mapped.
PM-FIL/PM10-FIL	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-FIL/PM25-FIL	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-FIL/PM-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-PRI/PM10-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-PRI/PM25-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM10-FIL/PM25-FIL	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM10-PRI/PM25-PRI	This field and the following are ratios calculated from emission factors found either in FIRE or the PM calculator.
PM-CON/PM10-FIL	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM10-PRI	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM25-FIL	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM25-PRI	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM-FIL	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
PM-CON/PM-PRI	Condensible ratios were calculate from FIRE if available for 10* and 20* SCCs. If condensible ratios were not found in FIRE for 10* and 20* these ratios were set to zero.
RPO Specific Note	Indicates SCC and control device combinations are in the RPO inventory.
Additional Notes	Any notes regarding assumptions about ratios.

3. *Implementation of the QA Ratios*

In order to calculate the additional PM pollutants based on the SCC Control Device ratio table developed in the above step, a crosstab table was created from the EM table based on the following fields:

- State FIPS
- County FIPS
- Tribal Code
- Emission Unit identification (ID)
- Process ID
- Start Date
- End Date
- Emission Type
- SCC
- Primary Device Type
- Secondary Device Type

The primary and secondary device type fields were added based on information from the CE table. If control equipment information was not available these fields were defaulted to 000 ("UNCONTROLLED"). In the few cases where there was a conflict between the control devices reported for the same process for PM pollutants (for example, a PM10-PRI is listed as controlled, but PM-PRI did not have control information), the control device type was selected based on the controlled pollutant.

In addition to the fields listed above, the crosstab included the PM emission amounts for the particular process and a field that indicated whether those emissions existed in the inventory. These fields are as follows:

- PM_PRI
- PM_FIL
- PM10_PRI
- PM10_FIL
- PM25_PRI
- PM25_FIL
- PM_CON
- PM_PRI_EXISTS
- PM_FIL_EXISTS
- PM10_PRI_EXISTS
- PM10_FIL_EXISTS
- PM25_PRI_EXISTS
- PM25_FIL_EXISTS
- PM_CON_EXISTS

The emission values are in the PM_PRI, PM_FIL, PM10_PRI, PM10_FIL, PM25_PRI, PM25_FIL, PM_CON fields. The _EXISTS field indicates whether the pollutant was provided by the S/L/T agency. A zero indicates that the pollutant was not provided; a number greater than zero (usually one) indicates that it was provided by the S/L/T agency.

Prior to the development of this crosstab, the EM table was filled in as much as possible using basic assumptions. For example, if the S/L/T agency provided emissions that were equal to zero for PMs for a particular process, it was assumed that all PMs for that process were zero and they were filled in accordingly. Since the assumption was that for non 10* and 20* SCCs, the condensible value was zero – that would lead to PM10-FIL = PM10-PRI and PM25-FIL = PM25-PRI and PM-FIL = PM-PRI. Given that assumption, values for these pollutants were also filled in. After this data insertion, a subset of the crosstab was created. This subset only contained processes that required additional augmentation. The SCC control device type ratio table described in step 2 was based on only those SCC and control device types that required augmentation.

The next step was to fill in the missing information in this crosstab using the information found in the SCC Control Device Ratio table.

In calculating PM complement pollutants, priority was given to calculating –PRI and –CON pollutants. FIL pollutants were only calculated if necessary to calculate other pollutants or if it was a by-product of this calculation.

In augmenting the PM pollutants the non 10* and 20* SCCs were augmented first, with order given to augmenting based on PM_{10} where available, PM_{25} where available, and then PM .

Augmenting the PM pollutants for the 10* and 20* SCCs is more complicated, but the basic approach was to augment based on PM_{10} (FIL or PRI) where available, $PM_{2.5}$ (FIL or PRI) where available, and then PM (FIL or PRI) if PM_{10} or $PM_{2.5}$ variations were not available. Where both PM_{10} (FIL or PRI) and $PM_{2.5}$ (FIL or PRI) variations were both available, the calculation for PM-CON was generally driven from the PM_{10} number and the complements as necessary were back calculated. Where a –PRI emission factor ratio was required and was not available the –FIL emission factor ratio was used.

After calculations, the data was QA checked to ensure that the calculations resulted in consistent values for the PM complement. On a few occasions, the mix of ratio value and the pollutants and values provided by the S/L/T agency resulted in negative values when –FIL was back-calculated. In this case the negative –FIL value was set to zero and the –PRI value was readjusted.

The resultant PM table has the format described in Table 6.

Note: **There are some high condensible ratios that were calculated for some SCC device type combinations. In most cases these high condensible ratios were the result of the back calculation of PM-CON from PM10-PRI or PM25-PRI records. Since the state had**

already provided the PMxx-PRI records, these PM-CON values were not added to the inventory.

Table 6. Description of the Field Names and Descriptions for the Resulting PM Augmentation Table

Field Name	Field Description
Augment	A "Yes" in this field indicates that the process PM was augmented.
Condensible Note	If condensible information was added this field will note that.
STATE_FIPS	State FIPS
COUNTY_FIPS	County FIPS
STATE_FACILITY_IDENTIFIER	Site ID
EMISSION_UNIT_ID	Emission Unit
PROCESS_ID	Process
START_DATE	Start Date
END_DATE	End Date
EMISSION_TYPE	Emission type
SCC	Source Category Code
SCC_DESC	SCC description
PRIMARY_DEVICE_TYPE	Primary Device Type
PRIMARY_DEVICE_TYPE_DESC	PDT description
SECONDARY_DEVICE_TYPE	Secondary Device Type
SECONDARY_DEVICE_TYPE_DESC	SDT description
EMISSION_TYPE_PERIOD	Emission Type Period
EMISSION_RELEASE_POINT_ID	Emission Release Point ID
FACILITY_NAME	Facility Name
ORIS_FACILITY_CODE	ORIS facility Code
SIC_PRIMARY	SIC
ACTUAL_THROUGHPUT	Actual Throughput
THROUGHPUT_UNIT_NUMERATOR	Throughput Unit Numerator
PM_PRI	Emission ton value for PM-PRI
PM_FIL	Emission ton value for PM-FIL
PM10_PRI	Emission ton value for PM10-PRI
PM25_PRI	Emission ton value for PM25-PRI
PM10_FIL	Emission ton value for PM10-FIL
PM25_FIL	Emission ton value for PM25-FIL
PM_CON	Emission ton value for PM-CON
PM_PRI_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM_FIL_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM10_PRI_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM25_PRI_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM10_FIL_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM25_FIL_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
PM_CON_EXISTS	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
RECORD_COUNT	0 if the S/L/T agency did not provide, > 0 if S/L/T agency did provide
System Update Note	This field contains system codes related to the update queries used to calculate the record.

The data source code field is used to identify records that are added to the inventory to complete the set of PM10-PRI and PM25-PRI emissions needed to support modeling.

b. ERP Coordinates

If a S/L/T agency did not provide corrections for ERP coordinates that map more than 5 km outside of the county boundary, or provide coordinates for ERP records that did not have any coordinates in the S/L/T inventory, the following procedures were applied to replace the coordinates:

- Coordinates for other ERPs at the same facility, if available, that map within the county;
- Coordinates for the centroid of the zip code for a facility if a valid zip code is provided or can be obtained from the agency if it is not valid; or
- County centroid coordinates.

The zip code was taken from the SI NIF 3.0 table. The zip code was compared to a reference table of valid zip codes to verify that it is an active zip code and exists in the state and county reported in the inventory. For example, a zip code may be invalid if it is for the mailing address or address of a facility's parent company rather than the address of the facility's location. If a valid zip code for a facility was not identified, Pechan used the centroid for the facility's county as a last resort.

c. ERP Parameters

If valid ERP parameters were not provided by the S/L/T agency, Pechan applied the ERP augmentation procedures for the 2002 point source NEI (EPA, 2004b). It has been determined that the augmentation procedures in this document regarding SCC-specific ERP types and temperatures are difficult to resolve. When this situation occurs, preference was given to the state-supplied ERP type and SCC. For example, the procedures do not account for cases where an emission unit has two processes with one defined as a stack source and the other as a fugitive source. Therefore, the S/L/T-supplied ERP type was used when this situation occurred.

d. Control Device Type and Control Efficiency Data

If a S/L/T agency did provide valid control device type codes to replace invalid codes identified in the inventory, Pechan changed the valid NIF 3.0 code of 099 for miscellaneous control devices. In the case of modeled data where no control device information was provided, the records were left unchanged.

Pechan expected that control equipment data issues would be resolved through consultation with the S/LT Agencies. Default augmentation procedures were developed and applied to resolve control efficiency issues. In the event that control efficiency issues were not resolved, Pechan documented the QA issues in the final report.

5. Revisions to Address Comments

The following items were revised per S/L/T agency instructions:

a. Arkansas

Arkansas sent a complete replacement inventory. Arkansas confirmed that they revised the SCCs and emissions in this new inventory. Therefore, the previous Base A inventory was used as a guide for correcting ER coordinates and stacks and other QA issues.

County 777 information was removed from the entire inventory (4 facilities with 34 emission records).

CE

It was noted by Arkansas that they had not sent any CE records. They confirmed this as intentional.

EM

Removed PM-PRI and PM-FIL with emission numeric values of 0 (2,437 records) and 8 PM10-FIL/PRI records where the remaining PMxx-FIL/PRI information was non-zero.

Updated emission calculation method code from 4 to 04 (1,706 records).

Material codes of "0" were nulled out (44 records).

Material IO codes of "U" were nulled out (44 records).

Nulled out the invalid factor unit denominator value of "UNK", or nulled out the factor unit denominator value if the factor unit numerator was null (44 records).

Where PM25-PRI values were greater than PM10-PRI values, the PM25-PRI values were set equal to PM10-PRI values per instruction from the state.

Note: The NH_3 emissions in Arkansas' new inventory decreased considerably from the emissions in the Base A inventory. A comparison of the emissions was provided to Arkansas for review and confirmation that the revised emissions are correct.

PE

Material codes of "0" were nulled out (6 records).

Material IO codes of "U" were nulled out (6 records).

Nulled out throughput unit numerator where noted as "UNK" (6 records).

EP

The Arkansas inventory contained six inactive SCCs (i.e., SCCs in EPA's February 2004 master list that are identified as no longer used by EPA) that were changed to active SCCs as follows:

- 28888802 was replaced by 28888801
- 30800197 was replaced by 30800199
- 30703096 was replaced by 3070399
- 30703098 was replaced by 3070399
- 30699998 was replaced by 30699999
- 30700798 was replaced by 30700799

Updated one EP record to reset its operating percentages for the 4 seasons from all 24s to all 25s in order to make the sum of activity consistent.

ER

Where EP was parentless, ER records were added to the inventory. The ERP type was set to "01" if total stack emissions for all pollutants combined was less than or equal to 100 tons per year, or to "02" if total stack emissions for all pollutants combined was more than 100 tons per year.

21 invalid ER types were updated based on the Base A inventory.

Updated 107 of Arkansas coordinates based on Base A inventory.

Stack augmentation and coordinate augmentation was implemented on any remaining missing or invalid values.

EU

One emission unit record was generated in order to maintain referential integrity.

SI

Two site records were generated in order to maintain referential integrity.

TR

The affiliation type "report_certifier" was changed to "Report Certifier".

b. Iowa

Iowa provided additions and revisions to their SO_2 emissions. These revisions were applied to their submittal.

EM

Emission revisions were made to records where the data keys in the comments matched those in the inventory. Emission records were added to the Base B inventory where there was no data key match. In order to maintain referential integrity, records in the comment file were added to the ER, EU, EP, and PE tables. In addition, a correction was made to the start and end dates to ensure that they all started with 2002, in some cases, 2003 was used.

c. Kansas

Kansas provided comments to the EPA; however, after an initial incorporation of emission comments into the inventory – it was determined through state review that the comments did not apply to the CENRAP inventory. These emissions were restored to their original values. Essentially, the Kansas inventory remained unchanged.

d. Minnesota

Minnesota submitted new information for municipal airport emissions as well as revisions to their PM data.

ER

When inserting the new municipal airport emissions, 236 fugitive records were defaulted to the fugitive defaults. Eight records noted as stacks were defaulted to stack defaults. Coordinates were compared manually either to the previous Minnesota submittal which had been QA checked or manually compared to known county boundaries.

EM

When incorporating the new municipal airport information, it was determined that there were 13 duplicate records and one inconsistent ER-EU combination for NH_3. The new information submitted was selected over the previous information.

Minnesota included updates to their PM information. Where the PM values were new, they were added to the inventory (after removing previously augmented data). Where the PM values were revisions, the records were revised (after removing previously augmented data). When the PM QA check indicated that there were significant discrepancies between the relative values of PM10-PRI and PM25-PRI, it was determined through consultation with the state there was a problem in the export program that the state used to create the NIF 3.0 text file. Essentially, it was truncating the exponential part of the emission numeric value in the file. Minnesota provided a corrected file. This corrected file was used to update the PM25-FIL/PRI values. After these values were incorporated, there were still several comparative problems. Upon review, it was determined that a number of these comparative problems were due to rounding –

essentially comparing numbers in this fashion - PM10-PRI = 0.01999 and PM25-PRI = 0.02. The program would flag an error, even though it was a result of rounding. In these cases, the values were rounded appropriately. For 55 records, the PM25-PRI values were set to the calculated value in order to resolve this type of issue. After resolving these values, the PM augmentation procedure was run.

Wildfires and Agricultural Field Burning

For the Base A modeling effort, the Midwest RPO's point source inventory for wildfires (SCC 2810001000) and agricultural field burning (SCC 2801500000) was to be used for Minnesota. The point source inventory was included in the NIF 3.0 file for Minnesota to support development of emissions summaries (the Midwest RPO provided the inventory in point source SMOKE input format). However, it was learned that the Midwest RPO point source inventory was not being used for modeling so the 2002 point source wildfire and agricultural field burning emissions data were removed from the Base B point source inventory and restored to the Base B area source inventory.

e. Leech Lake

Leech Lake provided a new inventory that was not included in the Base A inventory.

ER

Leech Lake did not provide stack information for a fugitive ERP. This was defaulted to the stated default fugitive ERP values.

Leech Lake did not provide exit velocity and exit flow information for two ERPs. These were defaulted according to the methods document.

EM

Leech Lake did not provide PM25-PRI emissions. For the point source SCCs, PM25-PRI emissions were estimated based on the PM augmentation methods. For the single area source SCC for prescribed burning, the PM25-PRI emissions were estimated by dividing the PM10-PRI emissions by a ratio of 1.14. This ratio is the lower of two values (1.18 and 1.14) most commonly used by the Midwest RPOduring the development of the Minnesota prescribed burning inventory.

An examination of duplicates between tribal information and state information yielded one potential site duplicate – the Cloquet County municipal airport is listed in both the Minnesota (27017-000-27017XCOQ) and Leech Lake (00000-407- 05) inventories. The airport emissions in the two inventories are significantly different (29 tons of CO for Minnesota and .04 tons of CO for the tribe – the largest emission set) and there was insufficient information to determine if the emissions were duplicated when combined into the Base B inventory. The prescribed burning emissions for Leech Lake were also compared to the Minnesota prescribed burning inventory, and it was determined that there were no common ERP coordinates or other information to indicate duplication of data. Thus, the airport emissions and prescribed burning emissions in Leech Lake's inventory were included in the Base B point source inventory.

f. Missouri

Missouri provided a complete replacement inventory; however, upon further discussion and agreement with Missouri, the replacement inventory was not use to update the Base A inventory.

g. All CENRAP S/L/T agencies - Office of Regulatory Information Systems (ORIS) and ORIS Boiler ID Updates

The ORIS identifiers in the SI and EU table were updated based on the crosswalk entitled CENRAPxwalk051005.mdb with modifications made for some emission unit identifier changes made by Arkansas. The revised crosswalk including the Arkansas changes was delivered to CENRAP on August 11, 2005.

h. Stack Parameter updates per CENRAP instructions

In addition to individual state submittals of data, stack parameter corrections were supplied to Pechan through CENRAP. These stack parameter comments affected 20 ERP records (4 in Iowa, 6 in Kansas, 5 in Louisiana, and 5 in Oklahoma) in one set of comments, and 15 records for Arkansas in another set of comments. There were some initial QA issues with the flow rate calculation; however, these issues were resolved by CENRAP and the revised comments were used to update the Base A inventory.

6. QA Review of Final Inventory

Final QA checks were run on the revised point source inventory data set to ensure that all corrections provided by the S/L/T agencies were incorporated into the Base B inventory and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory in Oracle to an Access database in NIF 3.0, the EPA QA program was run on the Access database and the QA output was reviewed to verify that all QA issues that could be addressed were resolved (EPA, 2004a)

This file accompanies this documentation with the specific details included. The following summarizes the remaining QA issues that could not be addressed during the duration of this project (listed by table):

<u>CE</u>

Primary device type codes are null for the confined animal feeding operations and planned burning (forest and rangeland). The data originates from the CENRAP-sponsored inventories for these categories. Missouri also has null primary device types for the majority of the CE records it provided for NH_3 emissions.

<u>EM</u>

The EPA QA program indicated that some emissions were outside the expected range. While this is a guideline and not a specific error, this listing could be reviewed for high values.

PE

There are a few (32) records with the units M2 and MASS that were not yet in the EPA QA program units reference table.

There are a few (8) remaining records with operating times outside the EPA QA program ranges.

EP

There are a few (9) remaining records with operating parameters and seasonal sums outside the expected range.

The SCC 30202000 has not yet been added to the EPA QA program SCC reference table.

ER

A significant number of records are missing the supplementary coordinate reference information (Horizontal data measure, horizontal data accuracy, horizontal collection method code).

Several records indicate coordinates outside of county boundaries – the reasons why this may occur were explained in the coordinate augmentation section earlier in this document.

Several records also indicate stack parameters outside of ranges expected by the EPA QA program. This is due either to the S/L/T agency specifically requesting not to change the values or to default values in the EPA table which fall outside of the EPA QA program ranges.

EU

Standard industrial classification (SIC) code 3041 is not in the SIC code table.

SI

The inventories (particularly the NH_3 inventory for confined animal feeding operations) did not provide zip code information with the site data. This accounts for a tremendous number of the invalid zip code errors found when running the EPA QA program. There are other records with zip code errors in addition to these; however, these inventories are the source of the majority of these errors.

NAICs codes are missing or invalid on some records (470), primarily in Nebraska and Oklahoma which did not provide comments during this time. The location address is missing for some records in Minnesota and Nebraska.

TR

Some records are missing the transaction creation date information.

C. Area Source Inventory Methods

1. Data Sources

The states of AR, TX, and MN provided comments for updating the Base A inventory. AR and MN provided comments on the Base A inventory, and TX provided comments on the draft 2002 nonpoint NEI that were applied to update the Base A inventory. The Leech Lake Band of Ojibwe Tribe provided a new area source inventory. In addition, the EI and Modeling Workgroups provided several comments resulting in revisions to the area source inventory. Documentation of the revisions made to the Base A inventory are provided in section II.C.5.

The data files that the states provided for updating the Base A inventory were loaded into Oracle in NIF 3.0 into one data set. Then, the following updates were performed on the consolidated data set, if necessary:

- HAP records were removed since the inventory will support regional haze, fine PM, and ozone modeling.

- Pollutant codes were corrected to make them NIF 3.0 compliant (e.g., update PMPRI pollutant code to PM-PRI). Additionally, other codes were identified for remediation on a case-by-case basis.

- The NIF 3.0 submittal flag field, when populated by an agency, provides the directions needed to determine how to revise the 2002 inventory. TX's comment file reflected comments on the draft NEI and not on CENRAP's 2002 inventory. Therefore, Pechan reviewed the submittal flag codes, compared the comment file to the CENRAP inventory, and consulted with TX to verify what records in the comment file were to be used to revise the CENRAP inventory. Pechan adjusted the submittal flags as necessary to document the records in the comment file that replaced records in CENRAP's 2002 inventory.

- Null values in the tribal code field were updated to '000' since this field is a part of the data key that defines records as unique in all five NIF tables.

The following NIF plus fields were added to the EP, PE, EM, and CE tables:

- Data Source Codes:

For the area and nonroad inventory data, the data source codes were based on the following 9-character format:

[Data Origin]-[Year]-[Grown/Not Grown/Carried Forward]-[PM Augmentation Code]

Code	Field Length
Data Origin	1
Year	3 (including leading hyphen)
Grown/Not Grown/Carried Forward	2 (including leading hyphen)
PM Augmentation	3 (including leading hyphen)

Data Origin Codes

Code	Description
S	State agency-supplied data
L	Local agency-supplied data
R	Tribal agency-supplied data
P	Regional Planning Organization-generated data
E	EPA/Emission Factor and Inventory Group (EFIG)-generated data

Year Codes

Year for which data were supplied (e.g., Year = -02 for 2002), or from which prior year data were taken (e.g., Year = -99 for 1999; -01=2001).

Grown/Carried Forward/Not Grown Codes

Code	Description
-G	Used when emissions in a pre-2002 inventory were grown to represent 2002 emissions.
-F	Used when emissions in a pre-2002 inventory were carried forward and included in the 2002 inventory without adjustment for growth.
-X	Used when the emissions were not grown or were not carried forward. For example, X was used when emissions were calculated for the 2002 inventory using 2002 activity, or when data were replaced with 2002 S/L/T data.

PM Augmentation Codes

-PA	PM Augmented Emissions: Record for $PM_{10}/PM_{2.5}$ emissions that were updated or added using ad-hoc updates.
-PC	PM Augmented Emissions: Record added for $PM_{10}/PM_{2.5}$ emissions estimated using the PM Calculator.
-PR	PM Augmented Emissions: Record added for $PM_{10}/PM_{2.5}$ emissions estimated using ratios of PM_{10}-to-PM or $PM_{2.5}$-to-PM_{10}. If PM_{10} and $PM_{2.5}$ emissions were equal and one of the pollutants was assigned this code, the ratio was assumed to be 1.
-VR	Missing pollutant estimated by multiplying the ratio of the missing pollutant emission factor to the VOC emission factor by the VOC emissions supplied by the S/L/T agency. This method was applied to estimate missing pollutant emissions in the 2002 NEI only. Records with this data source code in

CENRAP's Base B inventory indicate that the data were copied from the NEI as directed by CENRAP agency comments.

-NR Missing pollutant estimated by multiplying the ratio of the missing pollutant emission factor to the NO_x emission factor by the NO_x emissions supplied by the S/L/T agency. This method was applied to estimate missing pollutant emissions in the 2002 NEI only. Records with this data source code in CENRAP's Base B inventory indicate that the data were copied from the NEI as directed by CENRAP agency comments.

2 QA Review

QA review was conducted on the S/L/T area source inventories in accordance with the QA procedures specified in the QAPP for this project (CENRAP, 2005b). The following discusses the QA checks that were completed during preparation of the Base B inventory.

a. County and SCC Coverage

The county coverage in the state inventories appeared to be reasonable for all states. The SCC coverage was difficult to evaluate simply by showing a count of the number of SCCs by state. The EI and Modeling Workgroups reviewed summaries comparing the Base B to the Base A inventory and provided comments that are explained under section II.C.5.

b. Pollutant Coverage

The pollutant coverage in the S/L/T inventories was complete for all pollutants except for PM_{10} and $PM_{2.5}$. Diagnosis and resolution of PM_{10} and $PM_{2.5}$ pollutant emissions is discussed later in section II.C.5.

d. Additional QA for the CENRAP Area Source Inventory

The following explains additional QA that was performed for the CENRAP inventory. The following data elements were reviewed to identify QA issues:

- Range Errors;
- PM Emissions Consistency and Completeness;
- Control Device Codes and Control Efficiency Values;
- Start and End Dates;
- Annual and Daily Emissions Comparison; and
- Comparison of Base B to the Base A inventory.

As appropriate, individual S/L/T agencies were contacted with QA questions in order to receive direction on corrections.

Range Errors

The EPA's QA program was run on MN's and TX's comment files. The range errors identified by the QA program were deemed acceptable. Note that according to EPA, the ranges to which values in inventories are compared represent "normal" ranges that are based on percentiles from previous inventories. The range values are conservative in that EPA wants to identify suspicious values even though the values may be real (Thompson, 2002).

PM Emissions Consistency and Completeness Review

The following consistency checks were performed at the EM table data key level (for annual emissions) to compare PM emissions:

- If an SCC was associated with a PM emission record, but was missing one or more of the following (as appropriate for the SCC [i.e., PM-CON is associated with fuel combustion only]): PM10-FIL, PM10-PRI, PM25-FIL, PM25-PRI, or PM-CON, the record was flagged for review.

- The following equations were used to determine consistency:

  PM10-FIL + PM-CON = PM10-PRI
  PM25-FIL + PM-CON = PM25-PRI

- The following comparisons were made to determine consistency:

  PM10-PRI >= PM10-FIL
  PM25-PRI >= PM25-FIL
  PM10-PRI >= PM-CON
  PM25-PRI >= PM-CON
  PM10-FIL >= PM25-FIL
  PM10-PRI >= PM25-PRI

If the data failed one of these checks it was diagnosed as an error. If a S/L/T agency did not provide corrections to these errors, the errors were corrected/filled according to an augmentation procedure explained in sections II.C.4 and II.C.5.

For information purposes, all PM-PRI and PM-FIL records were flagged to indicate that these pollutants were included instead of, or in addition to, the standard PM_{10}, $PM_{2.5}$, and PM-CON pollutants.

TX's area source inventory had many records that did not meet the PM consistency and completeness. Many of the errors occurred as a result of TX providing revisions on filterable emissions and not revising the primary emissions. Also, TX added daily filterable emissions for many categories but did not provide daily primary emissions. TX was consulted on how to resolve the PM issues and TX provided directions on how to correct the issues.

Control Device Type and Control Efficiency Data Review

The control equipment codes in the "Primary Device Type Code" and "Secondary Device Type Code" fields were reviewed to identify invalid codes (i.e., codes that did not exist in the NIF 3.0 reference table) and missing codes (e.g., records with a null or uncontrolled code of 000 but with control efficiency data).

QA review of control efficiency data involved diagnosis of two types of errors. First, records were reviewed to identify control efficiency values that were reported as a decimal rather than as a percent value. Records with control efficiencies with decimal values were flagged as a potential error (although not necessarily an error, since the real control efficiency may be less than 1 percent). Records with a 1 percent control efficiency value were also identified for review by the S/L/T agency to determine if the value was reported as a decimal in its internal data system but rounded to 1 percent when the data were converted to NIF 3.0.

The second check identified records where 100 percent control was reported in the CE table, but the emissions in the EM table were greater than zero and the rule effectiveness value in the EM table was null, zero, or 100 percent (implying 100 percent control of emissions). Because many agencies did not populate the rule effectiveness field or a default value of zero was assigned, records with null or zero rule effectiveness values were included where the CE was 100 percent and emissions were greater than zero. For records that met these criteria, Pechan consulted with the S/L/T agency to determine if corrections were needed to any of the fields.

Start and End Date Checks

The year in the start and end date values in the PE and EM tables were reviewed to confirm consistency with the inventory year in the transmittal table, and to confirm that the end date reported was greater than the start date reported.

Annual and Daily Emissions Comparison

The S/L/T inventories were reviewed to determine if any of the following conditions existed:

- Multiple records coded at the SCC level as emission type 30, but with different start and end dates. While not a true duplicate, this may indicate an error or inclusion of both annual and seasonal values.

- Multiple records coded at the SCC level as a daily emission type (27, 29, etc.) but with different start and end dates. While not a true duplicate, this may indicate an error or just inclusion of additional types of daily emissions.

- Multiple records coded at the SCC level with the same start and end date, but different emission types. While not a true duplicate, this may indicate an error or just inclusion of additional types of daily emissions.

- Any "DAILY" type record that was missing its associated "ANNUAL" record was flagged for review.

- Any "DAILY" type record that was greater than its associated "ANNUAL" record was flagged for review.

3. Responses from S/L/T Agencies

The S/L/T agencies provided responses to questions about their data. The agencies or the Workgroups then provided direction for correcting the issues either by telephone or by e-mail. For AR and TX, QA issues were summarized in Excel spreadsheets and sent to the agencies, and the agencies provided their responses to the issues in the Excel spreadsheets. Table 7 identifies the files that document the QA issues and agency responses. The first spreadsheet in each QA Summary Report defines the remaining spreadsheets in the Excel Workbook file and provides instructions for communicating revisions.

Table 7. QA Summary Reports for S/L/T Area Source Inventories

S/L/T Agency	Excel Workbook File Name of QA Summary Report
AR	AR_QA_Report_060705.xls
TX	TX_QA_Report_071405.xls

4. Gap Filling and Augmentation

CENRAP-sponsored inventory data were added to the inventories as requested either by the S/L agencies or by the EI and Modeling Workgroups. Procedures for resolving issues with PM emissions in the comment files or to add PM emissions missing from the comment and Base A inventory files were resolved through consultation with the S/L agencies.

5. Revisions to Address Comments

The following details the revisions made to the Base A inventory:

a. Arkansas

NH_3 Emissions

To be consistent with the NH_3 categories included for the other CENRAP states, the following NH_3 categories in the CENRAP-sponsored area source inventory were added to the 2002 Base B inventory for AR:

SCC	SCC Description
2630020000	Wastewater Treatment : Public Owned : Total Processed;
2620030000	Landfills : Municipal : Total;
2806010000	Domestic Animals Waste Emissions : Cats;
2806015000	Domestic Animals Waste Emissions : Dogs;
2807020001	Wild Animals Waste Emissions : Bears : Black Bears;

2807020002 Wild Animals Waste Emissions : Bears : Grizzly Bears;
2807025000 Wild Animals Waste Emissions : Elk; and
2807030000 Wild Animals Waste Emissions : Deer.

Emissions for grizzly bears are zero; but were included in the inventory for completeness.

Agricultural Field Burning (SCCs starting with 2801500xxx)

The Base A inventory contained VOC, CO, PM10-PRI, and PM25-PRI emissions provided by AR. At AR's request, AR's state inventory was replaced with the CENRAP-sponsored inventory. The activity data for the CENRAP-sponsored inventory were developed by surveying local agricultural extension service agents which are believed to provide better spatial and temporal resolution of agricultural field burning activity than the methods that were used for AR's inventory. This change provided data for SO_2, NO_x, and NH_3 not included in AR's inventory, but removed emissions from two counties (05017 and 05125) that had emissions in AR's inventory.

Prescribed Burning for Forest Management (SCC 2810015000)

The Base A inventory contained VOC, CO, PM10-PRI, and PM25-PRI emissions for this category. At AR's request, AR's state inventory was removed from the Base B area source inventory and replaced with the point source inventory developed by CENRAP. The CENRAP-sponsored planned burning inventory did not include any emissions for area sources. This change provided data for SO_2, NO_x, and NH_3 not included in AR's inventory

Prescribed Burning of Rangeland (SCC 2810020000)

The CENRAP-sponsored planned burning inventory contains point source emissions for VOC, CO, SO_2, NO_x, NH_3, PM10-PRI, and PM25-PRI for 17 counties. This inventory was added to the Base B point source inventory.

Wildfires (SCC 2810001000)

The Base A inventory contained VOC, NO_x, CO, PM10-PRI, and PM25-PRI emissions provided by AR, and NH_3 emissions estimated using a separate methodology based on the Carnegie Mellon University (CMU) Model (Version 6.1) defaults. AR decided to remove the NH_3 emissions from the area source inventory since the NH_3 emissions were not based on their state methodology.

b. Minnesota

MN provided an area source inventory on June 3, 2005. This inventory was used to update the Base A inventory for records where there was a match on the data key between the Base A inventory and MN's June 3 file.

In addition, for the Base A modeling effort, the Midwest RPO point source inventory for wildfires (SCC 2810001000) and agricultural field burning (SCC 2801500000) was to be used for MN, and, therefore, the area source emissions data for these two categories were removed. However, it was learned that the Midwest RPO point source inventory was not being used for modeling so the 2002 area source wildfire and agricultural field burning inventories were restored to the Base B inventory. The wildfire inventory included in the Base B area source inventory originates from the 2002 NEI. The agricultural field burning inventory included in the Base B area source inventory originates from the CENRAP-sponsored planned burning inventory.

c. Texas

TX provided comments on the draft 2002 NEI and requested that this comment file be used to update the CENRAP inventory. The comment file was obtained from EPA. The comment file was compared to both the CENRAP Base A inventory and the draft 2002 NEI. As a result, there were many issues identified for which TX provided clarification on how to resolve. The QA issues, comparison of the comments to the Base A inventory and the NEI, and TX's directions for resolving the QA issues are provided is several spreadsheets in the Excel workbook file (named TX_QA_Report_071405.xls) provided with this report. After receiving TX's direction for resolving the QA issues, the submittal flags in the comments file were adjusted in order to apply the comments to the CENRAP's Base A inventory. The following provides a summary of the effects of TX's comments on the area source inventory:

- TX's comments file requested that the categories for unpaved roads (SCC 2296000000) and human perspiration (SCC 2810010000) be removed from the Base A inventory. However, since all of the other states include emissions for these categories, TX agreed that the categories should be kept in the inventory so these categories were removed from TX's comments file. The exception is that the area source inventory contained CO and VOC emissions for human perspiration for three counties that originated from the 1999 NEI. The NH_3 emissions for human perspiration are from the CENRAP-sponsored inventory and occur in all of TX's 254 counties. Therefore, per TX's request, the CO and VOC emissions were removed from the three counties.

- TX provided emissions for Mobile Sources : Highway Vehicles - Diesel : All HDDV including Buses (use subdivisions -071 thru -075 if possible) : Total: All Road Types (SCC 2230070000) that were not in the Base A inventory. The emissions for this category were added to the Base B inventory. It is not clear if the emissions for this category represent idling emissions or not. If they represent idiling emissions, these emissions are not accounted for in the nonroad inventory, thus, there would be no double counting of emissions.

- For the Base A inventory, daily PM emissions were excluded from the area source inventory because of many PM consistency issues with the daily emissions. TX provided revisions to the daily emissions; however, after adding the daily emissions to the CENRAP inventory, many PM consistency issues were identified. In addition, for several categories it was discovered that TX revised the annual and/or daily filterable emissions but not the primary emissions resulting in the primary emissions being less than the filterable emissions. A separate Excel workbook file is provided with this report that details the issues identified and explains how TX's PM emissions were adjusted to correct for inconsistencies in the reporting of PM emissions.

d. EI and Modeling Workgroup Comments

The EI and Modeling Workgroups requested the following revisions to the area source inventory:

Natural Sources of NH_3 Emissions (SCCs starting with 27014xxxxx)

To provide consistent source category coverage across the CENRAP states for natural sources of NH_3, the emissions in the CENRAP-sponsored inventory for natural sources of NH_3 were added to the Base B inventory for AR, MN, and MO. The monthly emissions were summed to calculate annual emissions that were also added to the inventory for these three states. The emissions for these categories were already included in the area source inventory for the other CENRAP states.

Onroad NH_3 Emissions

Onroad NH_3 emissions for SCCs 2201001000 (Light Duty Gasoline Vehicles) and 2230001000 (Light Duty Diesel Vehicles) for IA, KS, and LA were removed from the area source inventory because the emissions for this category are included in CENRAP's onroad inventory.

Stage II Refueling Emissions

CENRAP revised the onroad inventory to include VOC emissions associated with Stage II refueling. Therefore, these emissions were removed from the area source inventory to avoid double-counting of emissions. The Stage II emissions removed from the area source inventory were classified under the following SCCs:

SCC	SCC Description
2501060100	Storage and Transport : Petroleum and Petroleum Product Storage : Gasoline Service Stations : Stage 2: Total
2501060101	Storage and Transport : Petroleum and Petroleum Product Storage : Gasoline Service Stations : Stage 2: Displacement Loss/Uncontrolled
2501060102	Storage and Transport : Petroleum and Petroleum Product Storage : Gasoline Service Stations : Stage 2: Displacement Loss/Controlled
2501060103	Storage and Transport : Petroleum and Petroleum Product Storage : Gasoline Service Stations : Stage 2: Spillage

PM Consistency Issues

It was discovered that the Oracle scripts run on the Base A area source inventory to identify cases where the PM10-PRI (PM25-PRI) emissions were less than the PM10-FIL (PM25-FIL) emissions did not work correctly. The scripts were corrected and tested and run on the Base B inventory. As a result, for the agricultural tilling emissions (SCC 2801000003) originating from the CENRAP-sponsored inventory, it was learned that when the Base A inventory was updated with the revised CENRAP-sponsored agricultural tilling inventory, the primary emissions got revised but the filterable emissions did not. Thus, in the Base B inventory, the filterable emissions have been revised to match the primary emissions.

6. QA Review of Final Inventory

Final QA checks were run on the revised data set to ensure that all corrections provided by the S/L/T agencies were incorporated into the S/L/T inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory in Oracle to an Access database in NIF 3.0, the EPA's QA program was run on the Access database and the QA output was reviewed to verify that all QA issues that could be addressed were resolved (EPA, 2004a).

The output file from the EPA's QA program run on the area source inventory and the area miscellaneous source inventory is provided in an Access 2000 database along with the Access database containing the area and area miscellaneous inventory in NIF 3.0. The following lists the remaining QA issues that were not addressed during the duration of this project:

Area Source Inventory

Range Errors: There are 1,408 records in the EM table with emissions that exceed the maximum emissions in the QA program for the specified pollutant.

Area Miscellaneous Source Inventory

Range Errors: There is one EM record in MN for SCC 2701443000 with NH3 emissions that are significantly higher than the expected maximum emissions.

D. Nonroad Source Inventory Methods

1. Data Sources

CENRAP revised its Base A inventory for the NONROAD model categories to correct the oxygen content model inputs as well as the default values used for the sulfur content of diesel. In addition, MN requested that the Midwest RPO Base J inventory be used in the revised CENRAP inventory. IA also requested that the Midwest RPO Base J inventory be used for agricultural equipment categories instead of the revised CENRAP inventory. TX, who is using its own inventory for both the Base A and B inventories, added emissions for oil field equipment. The inventories for the categories not included in the NONROAD model (i.e., aircraft, commercial marine vessels, and locomotives) remained essentially unchanged from the Base A to the Base B inventory except for some revisions provided by TX.

The data files that the states provided for updating the Base A inventory were loaded into Oracle in NIF 3.0 into one data set. Then, the following updates were performed on the consolidated data set, if necessary:

- HAP records were removed since the inventory will support regional haze, fine PM, and ozone modeling.

- Pollutant codes were corrected to make them NIF 3.0 compliant (e.g., update PMPRI pollutant code to PM-PRI). Additionally, other codes were identified for remediation on a case-by-case basis.

- Records with a submittal flag indicating deletions (submittal_flag = 'D' or 'RD') were removed from the inventory.

- Null values in the tribal code field were updated to '000' since this field is a part of the data key that defines records as unique in all eight NIF tables.

- Added and populated the NIF plus fields listed in the previous discussion for the area source inventory.

- The CENRAP-sponsored inventory did not contain S/L agency contact information in the TR table. Therefore, the TR table was updated to include the contact information that S/L agencies provided in their area source inventories.

2. QA Review

QA review was conducted on the inventories in accordance with the QA procedures specified in the QAPP for this project (CENRAP, 2005b). The following discusses the QA checks that were completed during preparation of the consolidated data set.

a. County and SCC Coverage

The county coverage in the state inventories appeared to be reasonable for all states. The SCC coverage was difficult to evaluate simply by showing a count of the number of SCCs by state. The EI and Modeling Workgroups reviewed summaries comparing the Base B to the Base A inventory.

b. Pollutant Coverage

The pollutant coverage in the S/L/T inventories was complete for all pollutants after incorporating S/L comments.

c. Additional QA for the CENRAP Nonroad Source Inventory

The QA procedures discussed previously for the S/L/T area source inventories were applied to the nonroad inventory.

3. Responses from S/L/T Agencies

The S/L/T agencies provided responses to questions about their data. The agencies or the Workgroups then provided direction for correcting the issues either by telephone or by e-mail.

4. Gap Filling and Augmentation

CENRAP-sponsored inventory data were added to the inventories as requested either by the S/L agencies or by the EI and Modeling Workgroups.

5. Revisions to Address Comments

The following discusses the revisions made to the Base A nonroad inventory:

a. Minnesota

For the NONROAD model categories, MN elected to use the Base J inventory prepared by the Midwest RPO. This inventory includes monthly emissions. The monthly emissions were summed to calculate annual emissions, and records were added to the inventory to hold the annual emissions for supporting the development of emission summaries. The monthly emissions are used in the SMOKE IDA files for modeling.

The Midwest RPO Base J NONROAD model inventory was prepared by the state of WI. As a result, MN requested that the contact information for WI be listed in the TR table for MN.

b. Iowa

IA elected to use the CENRAP-sponsored inventory for all of the nonroad categories except for the following agricultural equipment categories:

SCC	SCC Description
22600050xx	Off-highway Vehicle Gasoline, 2-Stroke : Agricultural Equipment (2 SCCs);
22650050xx	Off-highway Vehicle Gasoline, 4-Stroke : Agricultural Equipment (11 SCCs);
22670050xx	LPG : Agricultural Equipment (3 SCCs);
22680050xx	CNG : Agricultural Equipment (3 SCCs); and
22700050xx	Off-highway Vehicle Diesel : Agricultural Equipment (11 SCCs).

For the agricultural equipment categories, IA elected to use the Midwest RPO Base J inventory because this inventory provided improvements to the temporal allocation of emissions for the agricultural sector. The Base J inventory includes monthly emissions. The monthly emissions were summed to calculate annual emissions, and records were added to the inventory to hold the annual emissions for supporting the development of emission summaries. The monthly emissions are used in the SMOKE IDA files for modeling.

c. Texas

Oil Field Equipment Emissions

TX provided annual and daily emissions for CO, CO_2, NO_x, VOC, SO_2, PM10-FIL, and PM25-FIL for the following oil field equipment categories:

SCC	SCC Description
2265010010	Off-highway Vehicle Gasoline, 4-Stroke : Industrial Equipment : Other Oil Field Equipment;
2268010010	CNG : Industrial Equipment : Other Oil Field Equipment; and
2270010010	Off-highway Vehicle Diesel : Industrial Equipment : Other Oil Field Equipment

These emissions were added to the Base B inventory. However, primary PM emissions are needed for the inventory. TX provided authorization to change the pollutant codes from PM10-FIL to PM10-PRI and PM25-FIL to PM25-PRI.

Commercial Marine Vessels (SCC 2280000000)

TX provided revisions to the NH_3 emissions for commercial marine vessels for 17 counties and the inventory was updated with the revised emissions.

Railroad Locomotive Emissions (SCC 2285000000)

The Base A inventory did not contain NH_3 emissions for this category in TX. TX provided the NH_3 emissions that were added to the Base B inventory.

d. EI and Modeling Workgroup Comments

Correction for Double Counting of Emissions in Lancaster County, Nebraska

Lancaster County provided its own nonroad inventory for SCC 2260000000 (Off-highway Vehicle Gasoline, 2-Stroke : 2-Stroke Gasoline except Rail and Marine: All). In the Base A inventory, the CENRAP-sponsored inventory provided emissions for the more detailed SCCs and were included in the Base A inventory. After reviewing the data and consulting with the local agency, the Workgroups decided to remove the CENRAP-sponsored inventory for SCCs starting with 226 in Lancaster County to remove double-counting of emissions.

Revisions to the CENRAP-Sponsored Inventory

For the categories included in the NONROAD model, all of the states elected to use the CENRAP-sponsored inventory in the Base B inventory except for MN and TX; IA for agricultural equipment; and Lancaster County, NE for 2-stroke gasoline vehicles. The following discusses the changes made to the CENRAP-sponsored inventory.

Revisions to Oxygen Content

The CENRAP-sponsored inventory for the NONROAD model categories was updated during March 2005 to correct the fuel oxygenate content from decimal fraction to percentage values. As a result, the NONROAD model inventory for the states that elected to use the CENRAP-sponsored inventory was replaced with the new inventory.

Revisions to Diesel Sulfur Content

The input values used for the sulfur content of diesel fuel used in the revised CENRAP NONROAD model inventory were determined to be too low and the Workgroups decided to revise the input values for this parameter to be based on the default values used by the NONROAD model. The following explains the methods applied to adjust the SO_2, PM10-PRI, and PM25-PRI emissions in the CENRAP-sponsored inventory based on adjustments to the sulfur content in diesel fuel.

The SO_2 emissions were adjusted by using the ratio of the new versus the original diesel sulfur content values, since the relationship of SO_2 to diesel fuel sulfur levels is linear. However, for PM10-PRI and PM25-PRI emissions, the adjustment is not a linear relationship. To estimate the impact of higher diesel fuel sulfur levels on PM10-PRI and PM25-PRI emissions for each state, national runs of the NONROAD model were performed using the original and new diesel fuel sulfur input values for each state.

Table 8 provides the original diesel fuel sulfur content values for seven of the CENRAP states. The NONROAD inventories for Minnesota and Texas and the agricultural equipment categories for IA were not revised because these States based their nonroad inventories on model runs that include the NONROAD model default sulfur values. The new diesel sulfur values are based on the NONROAD model default values. For diesel recreational marine engines (SCC 2282020005 and 2282020010), the NONROAD model uses a diesel sulfur content of 2,765 parts per million (ppm). For all other land-based diesel equipment, NONROAD incorporates a default diesel sulfur content of 2,457 ppm.

Table 8. Original Diesel Fuel Content

State	Original DIESEL SULFUR content, ppm
KS	330.0
AR	360.0
IA	360.0
NE	360.0
OK	360.0
LA	380.0
MO	390.0

National NONROAD model runs were performed using the four unique sulfur levels in Table 8 (i.e., 330, 360, 380, and 390), and then two national NONROAD runs were performed using the default diesel fuel sulfur content values. The results of these runs were used to develop state-specific SCC-level ratios based on the resulting PM10-PRI and PM25-PRI emissions. The SCCs to which these ratios were applied to adjust emissions are shown in Table 9.

6. QA Review of Final Inventory

Final QA checks were run on the revised data set to ensure that all corrections provided by the S/L/T agencies were incorporated into the S/L/T inventories and that there were no remaining QA issues that could be addressed during the duration of the project. After exporting the inventory in Oracle to an Access database in NIF 3.0, the EPA's QA program was run on the Access database and the QA output was reviewed to verify that all QA issues that could be addressed were resolved. The QA output is provided in an Access 2000 database along with the Access database containing the inventory in NIF 3.0.

The following lists the remaining QA issues that were not addressed during the duration of this project:

Range Errors: There are 230 records in the EM table with emissions that exceed the maximum emissions in the QA program for the specified pollutant.

Lookup Errors: There are 106,472 records in the EM table with CO_2 emissions that caused this error. CO_2 is not included in the reference table for valid NIF 3.0 pollutant codes. At the request of CENRAP, CO_2 emissions were kept in the inventory.

E. EGU 2018 Projection Year Inventory

1. Introduction

Pechan received from the Midwest RPO the 2018 IPM scenario file and extracted the data for each of the nine CENRAP states to post-process. Pechan post-processed the 2018 Integrated Planning Model (IPM) scenario data to create the mass emissions inventory for the SMOKE/IDA files. The post-processing procedure includes estimating emissions for CO, VOC, NH_3, PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL, and PM-CON. Emissions for 21 temporal-pollutant combinations are estimated since there are seven pollutants and three temporal periods (summer season, winter season, July day). Note that annual SO_2 and annual, summer season, and July day NO_x emission values are provided in the initial IPM scenario file. First, annual emission are estimated by applying an SCC-based pollutant-specific uncontrolled emission factor (that may include sulfur and/or ash content factor) to fuel quantity (that is obtained from the annual heat input provided in the IPM run and default fuel-based heat contents), control removal efficiency, and a units conversion factor.

Table 9. NONROAD Diesel SCCs in the CENRAP-Sponsored Inventory for which the Sulfur Value will be adjusted to the NONROAD Model Default Value

SCC*	SCC Description	NONROAD Model Default Diesel Fuel S level, ppm**
2270001060	Mobile Sources : Off-highway Vehicle Diesel : Recreational Equipment : Specialty Vehicles/Carts	2457
2270002003	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Pavers	2457
2270002006	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Tampers/Rammers	2457
2270002009	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Plate Compactors	2457
2270002015	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Rollers	2457
2270002018	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Scrapers	2457
2270002021	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Paving Equipment	2457
2270002024	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Surfacing Equipment	2457
2270002027	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Signal Boards/Light Plants	2457
2270002030	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Trenchers	2457
2270002033	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Bore/Drill Rigs	2457
2270002036	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Excavators	2457
2270002039	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Concrete/Industrial Saws	2457
2270002042	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Cement and Mortar Mixers	2457
2270002045	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Cranes	2457
2270002048	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Graders	2457
2270002051	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Off-highway Trucks	2457
2270002054	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Crushing/Processing Equipment	2457
2270002057	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Rough Terrain Forklifts	2457
2270002060	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Rubber Tire Loaders	2457
2270002066	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Tractors/Loaders/Backhoes	2457
2270002069	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Crawler Tractor/Dozers	2457
2270002072	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Skid Steer Loaders	2457
2270002075	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Off-highway Tractors	2457
2270002078	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Dumpers/Tenders	2457
2270002081	Mobile Sources : Off-highway Vehicle Diesel : Construction and Mining Equipment : Other Construction Equipment	2457
2270003010	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : Aerial Lifts	2457
2270003020	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : Forklifts	2457
2270003030	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : Sweepers/Scrubbers	2457
2270003040	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : Other General Industrial Equipment	2457
2270003050	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : Other Material Handling Equipment	2457
2270003060	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : AC\Refrigeration	2457

Table 9 (continued)

SCC*	SCC Description	NONROAD Model Default Diesel Fuel S level, ppm**
2270003070	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : Terminal Tractors	2457
2270004031	Mobile Sources : Off-highway Vehicle Diesel : Lawn and Garden Equipment : Leafblowers/Vacuums (Commercial)	2457
2270004036	Mobile Sources : Off-highway Vehicle Diesel : Lawn and Garden Equipment : Snowblowers (Commercial)	2457
2270004046	Mobile Sources : Off-highway Vehicle Diesel : Lawn and Garden Equipment : Front Mowers (Commercial)	2457
2270004056	Mobile Sources : Off-highway Vehicle Diesel : Lawn and Garden Equipment : Lawn and Garden Tractors (Commercial)	2457
2270004066	Mobile Sources : Off-highway Vehicle Diesel : Lawn and Garden Equipment : Chippers/Stump Grinders (Commercial)	2457
2270004071	Mobile Sources : Off-highway Vehicle Diesel : Lawn and Garden Equipment : Turf Equipment (Commercial)	2457
2270004076	Mobile Sources : Off-highway Vehicle Diesel : Lawn and Garden Equipment : Other Lawn and Garden Equipment (Commercial)	2457
2270005010	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : 2-Wheel Tractors	2457
2270005015	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Agricultural Tractors	2457
2270005020	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Combines	2457
2270005025	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Balers	2457
2270005030	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Agricultural Mowers	2457
2270005035	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Sprayers	2457
2270005040	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Tillers > 6 HP	2457
2270005045	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Swathers	2457
2270005050	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Hydro-power Units	2457
2270005055	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Other Agricultural Equipment	2457
2270005060	Mobile Sources : Off-highway Vehicle Diesel : Agricultural Equipment : Irrigation Sets	2457
2270006005	Mobile Sources : Off-highway Vehicle Diesel : Commercial Equipment : Generator Sets	2457
2270006010	Mobile Sources : Off-highway Vehicle Diesel : Commercial Equipment : Pumps	2457
2270006015	Mobile Sources : Off-highway Vehicle Diesel : Commercial Equipment : Air Compressors	2457
2270006025	Mobile Sources : Off-highway Vehicle Diesel : Commercial Equipment : Welders	2457
2270006030	Mobile Sources : Off-highway Vehicle Diesel : Commercial Equipment : Pressure Washers	2457
2270007015	Mobile Sources : Off-highway Vehicle Diesel : Logging Equipment : Forest Eqp - Feller/Bunch/Skidder	2457
2270008005	Mobile Sources : Off-highway Vehicle Diesel : Airport Ground Support Equipment : Airport Ground Support Equipment	2457
2270009010	Mobile Sources : Off-highway Vehicle Diesel : Underground Mining Equipment : Other Underground Mining Equipment	2457
2270010010	Mobile Sources : Off-highway Vehicle Diesel : Industrial Equipment : Other Oil Field Equipment	2457
2282020005	Mobile Sources : Pleasure Craft : Diesel : Inboard/Sterndrive	2765
2282020010	Mobile Sources : Pleasure Craft : Diesel : Outboard	2765
2285002015	Mobile Sources : Railroad Equipment : Diesel : Railway Maintenance	2457

* Unique list of SCCs is from CENRAP-sponsored inventory for all States except MN and TX.
** Marine diesel fuel S level assumed higher than land-based diesel fuel.

To obtain the needed temporal emissions, summer season emissions are estimated by multiplying the annual emissions by a ratio of the summer season to annual heat input; winter season emissions are estimated by subtracting the summer season emissions from the annual emissions; and summer day emissions are estimated by multiplying the annual emissions by a ratio of the July day to annual heat input.

Table 10 presents the CO, VOC, NH_3, PM10-FIL, and PM25-FIL emission factors by SCC. Table 11 presents the PM-CON emission factors by SCC. For PM10-FIL and PM25-FIL, control efficiencies (that are obtained using an EPA-approved method) are applied to the uncontrolled emissions. PM-CON is estimated using heat input (included in the IPM run) and emissions factors. PM10-PRI (and PM25-PRI) are obtained by summing PM-CON and PM10-FIL (PM-CON and PM25-FIL) emissions.

The post-processing methodology also includes the following steps:

Step 1: Adding data for all units.

SCCs were assigned for all units; unit/fuel/firing/bottom type data were used for existing units' assignments, while only unit and fuel type were used for generic units' assignments. Latitude-longitude coordinates were assigned, first using the EPA-provided data files, secondly using the September 17, 2004 Pechan in-house latitude-longitude file, and lastly using county centroids. These data were only used when the data were not provided in the 2002 NIF files. Stack parameters were attached, first using the EPA-provided data files, secondly using a March 9, 2004 Pechan in-house stack parameter file based on previous EIA-767 data, and lastly using an EPA June 2003 SCC-based default stack parameter file. These data were only used when the data were not provided in the 2002 NIF files. Plant ID (within State and county), point ID, process ID, and stack ID were then attached, first using the EPA-provided data files, or secondly using Pechan-generated defaults: the point ID is assigned the value of the given boiler ID preceded by '#', unless the boiler ID has a length of six [the length for the point ID], in which case the left-most character is replaced with '#'); and the default Pechan process ID is '01'. Default stack IDs within a plant are assigned for each unique stack height-diameter combination; the default Pechan stack ID is of the form '4N'. The process ID and stack ID default data were only used when the data were not provided.

Table 10. SCC-Based Uncontrolled Emission Factors (EF) for Electricity Generating Units

SCC	CO EF	VOC EF	NH3 EF	PM10-FIL EF	PM25-FIL EF	PM FLAG[1]
10100101	0.6000	0.0700	0.030000	2.3000	0.6000	A
10100102	0.6000	0.0700	0.030000	4.8000	2.5000	
10100201	0.5000	0.0400	0.030000	2.6000	1.4800	A
10100202	0.5000	0.0600	0.030000	2.3000	0.6000	A
10100203	0.5000	0.1100	0.030000	0.2600	0.1100	A
10100204	5.0000	0.0500	0.030000	13.2000	4.6000	
10100205	6.0000	0.0500	0.030000	6.0000	2.2000	
10100211	0.5000	0.0400	0.030000	2.6000	1.4800	A
10100212	0.5000	0.0600	0.030000	2.3000	0.6000	A
10100215	0.5000	0.0600	0.030000	2.3000	0.6000	A
10100217	18.0000	0.0500	0.030000	12.4000	1.3640	
10100218	18.0000	0.0500	0.030000	12.4000	1.3640	
10100221	0.5000	0.0400	0.030000	2.6000	1.4800	A
10100222	0.5000	0.0600	0.030000	2.3000	0.6000	A
10100223	0.5000	0.1100	0.030000	0.2600	0.1100	A
10100224	5.0000	0.0500	0.030000	13.2000	4.6000	
10100225	6.0000	0.0500	0.030000	6.0000	2.2000	
10100226	0.5000	0.0600	0.030000	2.3000	0.6000	A
10100235	0.5000	0.0600	0.030000	2.3000	0.6000	A
10100237	18.0000	0.0500	0.030000	16.1000	4.2000	
10100238	18.0000	0.0500	0.030000	16.1000	4.2000	
10100300	-9.0000	-9.0000	0.030000	-9.0000	-9.0000	
10100301	0.2500	0.0700	0.030000	1.8170	0.5214	A
10100302	0.6000	0.0700	0.030000	2.3000	0.6600	A
10100303	0.6000	0.0700	0.030000	0.8710	0.3690	A
10100304	6.0000	0.0700	0.030000	1.0700	0.4066	A
10100306	5.0000	0.0700	0.030000	1.6000	0.5600	A
10100316	0.1500	0.0300	0.030000	12.0000	1.4000	
10100317	0.1500	0.0300	0.030000	12.0000	1.4000	
10100318	0.1500	0.0300	0.030000	12.0000	1.4000	
10100401	5.0000	0.7600	0.800000	See Footnote 2	See Footnote 3	
10100404	5.0000	0.7600	0.800000	See Footnote 2	See Footnote 3	
10100405	5.0000	0.7600	0.800000	5.9000	4.3000	A
10100406	5.0000	0.7600	0.800000	5.9000	4.3000	A
10100501	5.0000	0.2000	0.800000	1.0000	0.2500	
10100504	5.0000	0.7600	0.800000	5.9000	4.3000	A
10100505	5.0000	0.7600	0.800000	5.0000	3.6000	
10100601	84.0000	5.5000	3.200000	1.9000	1.9000	
10100602	84.0000	5.5000	3.200000	1.9000	1.9000	
10100604	24.0000	5.5000	3.200000	1.9000	1.9000	
10100602	81.0400	5.3062	3.200000	1.8330	1.8330	
10100701	6.5718	0.4303	1.200000	0.1486	0.1486	
10100702	6.5718	0.4303	1.200000	0.1486	0.1486	
10100702	67.5644	4.4239	1.200000	1.5282	1.5282	
10100703	66.9620	4.3844	1.200000	1.5146	1.5146	
10100704	6.8064	0.4457	1.200000	0.1540	0.1540	
10100707	41.0024	2.6847	1.200000	0.9274	0.9274	
10100711	32.0274	2.0970	1.200000	0.7244	0.7244	
10100712	49.8809	3.2660	1.200000	1.1283	1.1283	

Table 10 (continued)

SCC	CO EF	VOC EF	NH3 EF	PM10-FIL EF	PM25-FIL EF	PM FLAG[1]
10100801	0.6000	0.0700	0.397000	7.9000	4.5000	A
10100818	18.0000	0.0500	0.397000	12.4000	1.3640	
10100901	6.8459	0.1940	0.086000	5.7049	4.9062	
10100902	6.8459	0.1940	0.086000	5.7049	4.9062	
10100903	6.8459	0.1940	0.086000	4.1075	3.5370	
10100911	13.6000	0.1940	0.086000	5.7049	4.9062	
10100912	1.4000	0.1940	0.086000	5.7049	4.9062	
10101001	3.6000	0.2600	-9.000000	0.6000	0.6000	
10101001	269.6000	17.6524	-9.000000	6.0981	6.0981	
10101002	67.5644	4.4239	-9.000000	4.6867	4.6867	
10101002	207.2000	13.5667	-9.000000	0.1636	0.1636	
10101101	2.0000	2.0000	-9.000000	12.3200	7.0200	
10101201	1.2992	0.7218	1.190000	22.8089	12.9924	
10101201	0.0165	2.0000	1.190000	11.4000	7.8000	
10101202	3.6000	2.0000	1.190000	63.2000	36.0000	
10101204	0.5000	0.0600	1.190000	2.3000	0.6000	A
10101205	0.3958	0.2199	1.190000	6.9484	3.9580	
10101206	0.6000	0.1700	1.190000	15.6000	15.6000	
10101207	0.8741	0.4856	1.190000	15.3452	8.7408	
10101208	6.8459	0.1940	1.190000	5.7049	4.9062	
10101301	3.7232	0.1489	-9.000000	0.7446	0.1862	
10101301	5.0000	1.0000	-9.000000	51.0000	13.0000	A
10101301	0.2857	0.0114	-9.000000	0.0571	0.0143	
10101302	5.0000	1.0000	-9.000000	33.1500	18.7200	
10101304	0.7627	0.4237	-9.000000	13.3898	7.6271	
10101305	1.1179	0.0447	-9.000000	0.2236	0.0559	
10101306	1.6071	0.0643	-9.000000	0.3214	0.0804	
10101307	4.4571	0.1783	-9.000000	0.8914	0.2229	
10101308	1.1316	0.0453	-9.000000	0.2263	0.0566	
10101601	0.3464	0.0139	-9.000000	0.0693	0.0173	
10101801	0.0000	0.0000	-9.000000	0.0000	0.0000	
10101901	0.5000	0.0600	0.030000	2.3000	0.6000	A
10102001	0.2500	0.0700	0.030000	1.8170	0.5214	A
10102018	0.1500	0.0300	0.030000	12.0000	1.4000	
10102101	5.0000	0.2000	-9.000000	1.0000	0.2500	
20100101	0.4598	0.0571	6.620000	0.6020	0.6020	
20100102	130.0000	0.0570	6.620000	6.8000	6.5500	
20100201	83.8628	2.1477	6.560000	1.9380	1.9380	
20100202	399.0000	116.0000	0.600000	10.0000	10.0000	
20100301	34.6500	2.2050	6.560000	11.5500	11.5500	
20100901	0.4455	2.3800	-9.000000	8.5400	8.5400	
20100902	128.2500	49.3000	-9.000000	41.8500	41.8500	

[1] A means the ash content (percentage value) of the fuel is multiplied by the emission factor value shown in this table.
[2] From Factor Information and REtrieval (FIRE) 6.24, the equation for this PM10-FIL EF is [5.9*(1.12*S+0.37)].
[3] From FIRE 6.24, the equation for this PM25-FIL EF is [4.3*(1.12*S+0.37)].
Note that (1) -9 indicates that an emission factor is not available for the SCC and pollutant combination; and (2) for SCCs beginning with 101001, 101002, or 101003 (coal), 101008 (coke), 101009 (wood), 101011 (bagasse), 101012 (solid waste), 101019 (synfuel), 101020 (waste coal), or 101012 (agr. byproduct), emission factors are in pounds per ton; for SCCs beginning with 101004, 101005, and 201001 (oil), 101010 (propane/butane), 101013 (liquid waste), 101016 (methanol), 101021 (other oil), or 201009 (kerosene/jet fuel), emission factors are in pounds per thousand gallons; for SCCs beginning with 101006 or 201002 (natural gas), 101007 (process gas), 101018 (hydrogen), or 201003 (IGCC) emission factors are in pounds per million cubic feet.

Table 11. PM Condensable Emissions Factors (EF) for Electricity Generating Units

Fuel	Applicable Source Classification Codes	PM Condensable Emission Factor (PMCDEF) in lb/MMBtu
Coal (including waste coal and syn coal)*	10100204, 10100205, 10100224, 10100225, 10100304, 10100306	0.0400
	10100217, 10100218, 10100237,10100238, 10100317, 10100318, 10102018	0.0100
	10100201, 10100202, 10100203, 10100212, 10100221, 10100222, 10100223, 10100226, 10100301, 10100302, 10100303, 10101901, 10102001	0.02**
	10100201, 10100202, 10100203,10100212, 10100221, 10100222,10100223, 10100226, 10100301, 10100302, 10100303, 10101901, 10102001	(0.1 * sulfur content [as a decimal] - .03)***
Light Oil (Distillate, Diesel)	10100401 - 10100499	0.0100
Heavy Oil (Residual)	10100501 - 10100599	0.0090
Natural Gas	10100601 - 10100699	0.0057
Other Process Gases	10100701 - 10100799	0.0056
Petroleum Coke	10100801 - 10100899	0.0100
Wood, Biomass (including Black Liquor), Waste/Refuse	10100901 - 10100999, 10101201 - 10101299, 10101304	0.0170
LPG (Propane, Butane)	10101001 - 10101099	0.0056
Other Liquid Waste/Oil, Methanol	10101301, 10101302, 10101305, 10101306, 0101307, 10101308, 10102101, 10101601	0.0090

* If the emission factor is less than 0.01, then it is set equal to 0.01.
** AND there is either an SO2 FGD or a PM wet scrubber.
*** And there is any PM control other than a wet scrubber and there is no SO_2 control, OR SCC = 10100222 and there is no PM control.
Note that PM10-PRI = PM10-FIL + PM-CON and PM25-PRI = PM25-FIL + PM-CON.

Step 2: Siting generic units using an EPA-approved electronic method.

Generic aggregates, which consist of IPM-designated "planned/committed" units as well as "new" units produced by the IPM model are transformed into units similar to the existing units in terms of the available data. The generic aggregates are split into smaller generic units based on their unit types and capacity, are provided a dummy ORIS unique plant and boiler ID, and are given a county FIPS code based on an algorithm that sites each generic by assigning a sister plant that is in a county based on its attainment/nonattainment status. Within a state, plants (in county then ORIS plant code order) in attainment counties are used first as sister sites to generic units, followed by plants in PM nonattainment counties (as of January 2004), followed by plants in 8-hour ozone nonattainment counties (as of April 2004).

Step 3: Deriving defaults using the same methodology previously approved by the Midwest RPO and Visibility Improvement State and Tribal Association of the Southeast (VISTAS).

Additional data were required for estimating VOC, CO, PM10-FIL, PM25-FIL, PM-CON, and NH_3 emissions for all units. Thus, ash and sulfur contents were assigned by first using 2002 EIA-767 values for existing units or SCC-based defaults; PM10-FIL and PM25-FIL efficiencies were obtained from the 2002 EGU NEI that were based on 2002 EIA-767 control data and the PM Calculator program (a default of 99.2 percent is used for coal units if necessary); fuel use was back calculated from the given heat input and a default SCC-based heat content; and emission factors were obtained from an EPA-approved October 7, 2004 Pechan emission factor file based on AP-42 emission factors. Note that this updated file is not the one used for estimating emissions for previous EPA post-processed IPM files.

Step 4: Adding in S/L agency emissions inventory identifiers from the updated CENRAP crosswalk.

The previous crosswalk file was compared to the Base B point source inventory and updated to as needed to ensure correct matching of the codes in the IPM file to state IDs in the NIF 3.0 inventory file. The revised crosswalk file was then used to obtain state and county FIPS codes, plant IDs (within State and county), and point IDs. If the state and county FIPS codes, plant IDs and point IDs were in the 2002 NIF tables, then the process IDs and stack IDs were obtained from the NIF; otherwise, defaults, described above, were used.

Step 5: Transforming the data into annual SMOKE/IDA formatted text files for use by the modelers (see section II.E.4).

2. Data Sources

There are several data sources used during the post-processing procedure. These include the following:

$ Records from the nine CENRAP states from one Midwest RPO/VISTAS IPM "second round" parsed file, VISTASII_PC_1f_FossilUnits_2018 (To Client).xls

- The updated CENRAP crosswalk

- Two EPA-approved emissions factor in-house file (Tables 10 and 11) for estimating annual VOC, CO, NH_3, PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL, and PM-CON emissions

- Other files used in previous IPM run post-processing (e.g., power plant latitude-longitude file, SCC assignment file, fuel-based heat content file, EIA-767-based stack parameters file, and EPA-approved default stack parameters file).

3. QA Review

Pechan performed QA of the inventory by extracting the records for the CENRAP states from the 2018 IPM run and then checking to verify that all of the records are included in the CENRAP crosswalk and, if not, flagging them so that they are properly accounted for in the post-processing. After the post-processing was completed, and the data were transformed into their proper format, Pechan compared the initial (from the IPM file) and final (from the SMOKE/IDA files) NO_x emission tons -- annual [summer plus winter season], summer season, summer day -- and SO_2 annual [summer plus winter season] emission tons -- for each State and for the nine State total to ascertain that they did not change values; they did not.

4. SMOKE/IDA Files

The 2018 inventory was formatted as SMOKE/IDA summer and winter files. The file structures are delineated in Tables 12 and 13.

5. Emissions Summary

Table 14 provides a summary of the summer season, summer day, and winter season emissions calculated for the 2018 EGU inventory and included in the SMOKE IDA files.

Table 12. CENRAP SMOKE/IDA Summer Season File Structure

Position	Name	Type	Description	Width	Max Decimals	Blanked
1-2	STID	Int	State Code	2		
3-5	CYID	Int	County Code	3		
6-20	PLANTID	Char	Plant Identification Code (default value = "ORIS" + value of ORISID)	15		
21-35	POINTID	Char	Point Identification Code (default value = "#" + value of BLRID)	15		
36-47	STACKID	Char	Stack Identification Code[1]	12		
48-53	ORISID	Char	DOE Plant ID	6		
54-59	BLRID	Char	Boiler Identification Code	6		
60-61	SEGMENT	Char	DOE ID[2]	2		
62-101	PLANT	Char	Plant Name	40		
102-111	SCC	Char	SCC (SCC used in IPM to calculate emissions)	10		If summed units
112-115	BEGYR	Int	Beginning Year of Unit Operation	4		Y
116-119	ENDYR	Int	Ending Year of Unit Operation	4		Y
120-123	STKHGT	Real	Stack Height (ft)	4	3	
124-129	STKDIAM	Real	Stack Diameter (ft)	6	5	
130-133	STKTEMP	Real	Stack Gas Exit Temperature (degree F)	4	3	
134-143	STKFLOW	Real	Stack Gas Flow Rate (ft^3/s)	10	9	
144-152	STKVEL	Real	Stack Gas Exit Velocity (ft/s)	9	8	
153-160	BOILCAP	Real	Design Capacity (MMBtu/hr)	8	0	Y
161-161	CAPUNITS	Char	Capacity Unit Code	1		Y
162-163	WINTHRU	Real	Winter throughput (% of Annual)	2	0	Y
164-165	SPRTHRU	Real	Spring throughput (% of Annual)	2	0	Y
166-167	SUMTHRU	Real	Summer throughput (% of Annual)	2	0	Y
168-169	FALTHRU	Real	Fall throughput (% of Annual)	2	0	Y
170-171	HOURS	Int	Normal Operating Time (hr/day)	2		Y
172-173	START	Int	Normal Operation Start Time	2		Y
174-174	DAYS	Int	Normal Operating Time (days/wk)	1		Y
175-176	WEEKS	Int	Normal Operating Time (wk/yr)	2		Y
177-187	THRUPUT	Real	Throughput Rate (SCC units/yr)	11	0	Y
188-199	MAXRATE	Real	Maximum O_3 Season Rate (units/day)	12	0	Y
200-207	HEATCON	Real	Heat Content (MMBtu/SCC unit)	8	0	Y
208-212	SULFCON	Real	Sulfur Content (mass percent)	5	0	Y
213-217	ASHCON	Real	Ash Content (mass percent)	5	0	Y
218-226	NETDC	Real	Maximum Nameplate Capacity (MW)	9	0	Y
227-230	SIC	Int	Standard Industrial Classification Code (SIC)[3]	4		
231-239	LATC	Real	Latitude (decimal degrees)	9	4	
240-248	LONC	Real	Longitude (decimal degrees)	9	4	
249-249	OFFSHORE	Char	Offshore Flag	1		Y
250-262	SUMCO	Real	CO Summer Season Emissions (short tons/season)	13	12	
263-275	AVDCO	Real	CO Average Summer Day Emissions (short tons/average season day)	13	12	
276-282	CE1	Real	CO Control Efficiency	7	0	Y
283-285	RE1	Real	CO Rule Effectiveness	3	0	Y
286-295	EMF1	Real	CO Emission Factors (SCC units)	10	0	Y
296-298	CPRI1	Int	CO Primary Control Equipment Code	3		Y
299-301	CSEC1	Int	CO Secondary Control Equipment Code	3		Y
302-314	SUMNH3	Real	NH_3 Summer Season Emissions (short tons/season)	13	12	
315-327	AVDNH3	Real	NH_3 Average Summer Day Emissions (short tons/average season day)	13	12	
328-334	CE2	Real	NH_3 Control Efficiency	7	0	Y
335-337	RE2	Real	NH_3 Rule Effectiveness	3	0	Y
338-347	EMF2	Real	NH_3 Emission Factors (SCC units)	10	0	Y
348-350	CPRI2	Int	NH_3 Primary Control Equipment Code	3		Y
351-353	CSEC2	Int	NH_3 Secondary Control Equipment Code	3		Y
354-366	SUMNOX	Real	NO_x Summer Season Emissions (short tons/season)	13	12	

Table 12 (continued)

Position	Name	Type	Description	Width	Max Decimals	Blanked
367-379	AVDNOX	Real	NO_x Average Summer Day Emissions (short tons/average season day)	13	12	
380-386	CE3	Real	NO_x Control Efficiency	7	0	Y
387-389	RE3	Real	NO_x Rule Effectiveness	3	0	Y
390-399	EMF3	Real	NO_x Emission Factors (SCC units)	10	0	Y
400-402	CPRI3	Int	NO_x Primary Control Equipment Code	3		Y
403-405	CSEC3	Int	NO_x Secondary Control Equipment Code	3		Y
406-418	SUMPM10	Real	Primary PM_{10} Summer Season Emissions (short tons/season)	13	12	
419-431	AVDPM10	Real	Primary PM_{10} Average Summer Day Emissions (short tons/average season day)	13	12	
432-438	CE4	Real	Primary PM_{10} Control Efficiency	7	0	Y
439-441	RE4	Real	Primary PM_{10} Rule Effectiveness	3	0	Y
442-451	EMF4	Real	Primary PM_{10} Emission Factors (SCC units)	10	0	Y
452-454	CPRI4	Int	Primary PM_{10} Primary Control Equipment Code	3		Y
455-457	CSEC4	Int	Primary PM_{10} Secondary Control Equipment Code	3		Y
458-470	SUMPM25	Real	Primary $PM_{2.5}$ Summer Season Emissions (short tons/season)	13	12	
471-483	AVDPM25	Real	Primary $PM_{2.5}$ Average Summer Day Emissions (short tons/average season day)	13	12	
484-490	CE5	Real	Primary $PM_{2.5}$ Control Efficiency	7	0	Y
491-493	RE5	Real	Primary $PM_{2.5}$ Rule Effectiveness	3	0	Y
494-503	EMF5	Real	Primary $PM_{2.5}$ Emission Factors (SCC units)	10	0	Y
504-506	CPRI5	Int	Primary $PM_{2.5}$ Primary Control Equipment Code	3		Y
507-509	CSEC5	Int	Primary $PM_{2.5}$ Secondary Control Equipment Code	3		Y
510-522	SUMSO2	Real	SO_2 Summer Season Emissions (short tons/season)	13	12	
523-535	AVDSO2	Real	SO_2 Average Summer Day Emissions (short tons/average season day)	13	12	
536-542	CE6	Real	SO_2 Control Efficiency	7	0	Y
543-545	RE6	Real	SO_2 Rule Effectiveness	3	0	Y
546-555	EMF6	Real	SO_2 Emission Factors (SCC units)	10	0	Y
556-558	CPRI6	Int	SO_2 Primary Control Equipment Code	3		Y
559-561	CSEC6	Int	SO_2 Secondary Control Equipment Code	3		Y
562-574	SUMVOC	Real	VOC Summer Season Emissions (short tons/season)	13	12	
575-587	AVDVOC	Real	VOC Average Summer Day Emissions (short tons/average season day)	13	12	
588-594	CE7	Real	VOC Control Efficiency	7	0	Y
595-597	RE7	Real	VOC Rule Effectiveness	3	0	Y
598-607	EMF7	Real	VOC Emission Factors (SCC units)	10	0	Y
608-610	CPRI7	Int	VOC Primary Control Equipment Code	3		Y
611-613	CSEC7	Int	VOC Secondary Control Equipment Code	3		Y

1. Selected from the NIF EM table using corresponding segment ID from using the segment ID selection process. Defaults taken from IPM process and are either from EPA approved files or are Pechan defaults (41, 42, 43, etc).
2. Segment ID selection process used to determine which ID is used. Process consists of taken the segment ID from the NIF EM table with the highest emissions. Only the seven relevant pollutants are used and follow a hierarchy of NO_x+SO_2 first, Primary PM_{10}+Primary $PM_{2.5}$ second, and CO+NH_3+VOC last.
3. Selected from the NIF SI table using a plant's STID+CYID+PLANTID or a default of 4911.

Table 13. CENRAP SMOKE/IDA Winter Season File Structure

Position	Name	Type	Description	Width	Max Decimals	Blanked
1-2	STID	Int	State Code	2		
3-5	CYID	Int	County Code	3		
6-20	PLANTID	Char	Plant Identification Code (default value = "ORIS" + value of ORISID)	15		
21-35	POINTID	Char	Point Identification Code (default value = "#" + value of BLRID)	15		
36-47	STACKID	Char	Stack Identification Code[1]	12		
48-53	ORISID	Char	DOE Plant ID	6		
54-59	BLRID	Char	Boiler Identification Code	6		
60-61	SEGMENT	Char	DOE ID[2]	2		
62-101	PLANT	Char	Plant Name	40		
102-111	SCC	Char	SCC (SCC used in IPM to calculate emissions)	10		If summed units
112-115	BEGYR	Int	Beginning Year of Unit Operation	4		Y
116-119	ENDYR	Int	Ending Year of Unit Operation	4		Y
120-123	STKHGT	Real	Stack Height (ft)	4	3	
124-129	STKDIAM	Real	Stack Diameter (ft)	6	5	
130-133	STKTEMP	Real	Stack Gas Exit Temperature (1F)	4	3	
134-143	STKFLOW	Real	Stack Gas Flow Rate (ft^3/s)	10	9	
144-152	STKVEL	Real	Stack Gas Exit Velocity (ft/s)	9	8	
153-160	BOILCAP	Real	Design Capacity (MMBtu/hr)	8	0	Y
161-161	CAPUNITS	Char	Capacity Unit Code	1		Y
162-163	WINTHRU	Real	Winter throughput (% of Annual)	2	0	Y
164-165	SPRTHRU	Real	Spring throughput (% of Annual)	2	0	Y
166-167	SUMTHRU	Real	Summer throughput (% of Annual)	2	0	Y
168-169	FALTHRU	Real	Fall throughput (% of Annual)	2	0	Y
170-171	HOURS	Int	Normal Operating Time (hr/day)	2		Y
172-173	START	Int	Normal Operation Start Time	2		Y
174-174	DAYS	Int	Normal Operating Time (days/wk)	1		Y
175-176	WEEKS	Int	Normal Operating Time (wk/yr)	2		Y
177-187	THRUPUT	Real	Throughput Rate (SCC units/yr)	11	0	Y
188-199	MAXRATE	Real	Maximum O_3 Season Rate (units/day)	12	0	Y
200-207	HEATCON	Real	Heat Content (MMBtu/SCC unit)	8	0	Y
208-212	SULFCON	Real	Sulfur Content (mass percent)	5	0	Y
213-217	ASHCON	Real	Ash Content (mass percent)	5	0	Y
218-226	NETDC	Real	Maximum Nameplate Capacity (MW)	9	0	Y
227-230	SIC	Int	Standard Industrial Classification Code (SIC)[3]	4		
231-239	LATC	Real	Latitude (decimal degrees)	9	4	
240-248	LONC	Real	Longitude (decimal degrees)	9	4	
249-249	OFFSHORE	Char	Offshore Flag	1		Y
250-262	WINCO	Real	CO Winter Season Emissions (short tons/season)	13	12	
263-275	AVDCO	Real	CO Average Winter Day Emissions (short tons/average season day) (zero per EPA)	13	0	Y
276-282	CE1	Real	CO Control Efficiency	7	0	Y
283-285	RE1	Real	CO Rule Effectiveness	3	0	Y
286-295	EMF1	Real	CO Emission Factors (SCC units)	10	0	Y
296-298	CPRI1	Int	CO Primary Control Equipment Code	3		Y
299-301	CSEC1	Int	CO Secondary Control Equipment Code	3		Y

Table 13 (continued)

Position	Name	Type	Description	Width	Max Decimals	Blanked
302-314	WINNH3	Real	NH_3 Winter Season Emissions (short tons/season)	13	12	
315-327	AVDNH3	Real	NH_3 Average Winter Day Emissions (short tons/average season day) (zero per EPA)	13	0	Y
328-334	CE2	Real	NH_3 Control Efficiency	7	0	Y
335-337	RE2	Real	NH_3 Rule Effectiveness	3	0	Y
338-347	EMF2	Real	NH_3 Emission Factors (SCC units)	10	0	Y
348-350	CPRI2	Int	NH_3 Primary Control Equipment Code	3		Y
351-353	CSEC2	Int	NH_3 Secondary Control Equipment Code	3		Y
354-366	WINNOX	Real	NO_x Winter Season Emissions (short tons/season)	13	12	
367-379	AVDNOX	Real	NO_x Average Winter Day Emissions (short tons/average season day) (zero per EPA)	13	0	Y
380-386	CE3	Real	NO_x Control Efficiency	7	0	Y
387-389	RE3	Real	NO_x Rule Effectiveness	3	0	Y
390-399	EMF3	Real	NO_x Emission Factors (SCC units)	10	0	Y
400-402	CPRI3	Int	NO_x Primary Control Equipment Code	3		Y
403-405	CSEC3	Int	NO_x Secondary Control Equipment Code	3		Y
406-418	WINPM10	Real	Primary PM_{10} Winter Season Emissions (short tons/season)	13	12	
419-431	AVDPM10	Real	Primary PM_{10} Average Winter Day Emissions (short tons/average season day) (zero per EPA)	13	0	Y
432-438	CE4	Real	Primary PM_{10} Control Efficiency	7	0	Y
439-441	RE4	Real	Primary PM_{10} Rule Effectiveness	3	0	Y
442-451	EMF4	Real	Primary PM_{10} Emission Factors (SCC	10	0	Y
452-454	CPRI4	Int	Primary PM_{10} Primary Control Equipment Code	3		Y
455-457	CSEC4	Int	Primary PM_{10} Secondary Control Equipment Code	3		Y
458-470	WINPM25	Real	Primary $PM_{2.5}$ Winter Season Emissions (short tons/season)	13	12	
471-483	AVDPM25	Real	Primary $PM_{2.5}$ Average Winter Day Emissions (short tons/average season day) (zero per EPA)	13	0	Y
484-490	CE5	Real	Primary $PM_{2.5}$ Control Efficiency	7	0	Y
491-493	RE5	Real	Primary $PM_{2.5}$ Rule Effectiveness	3	0	Y
494-503	EMF5	Real	Primary $PM_{2.5}$ Emission Factors (SCC	10	0	Y
504-506	CPRI5	Int	Primary $PM_{2.5}$ Primary Control Equipment Code	3		Y
507-509	CSEC5	Int	Primary $PM_{2.5}$ Secondary Control Equipment Code	3		Y
510-522	WINSO2	Real	SO_2 Winter Season Emissions (short tons/season)	13	12	
523-535	AVDSO2	Real	SO_2 Average Winter Day Emissions (short tons/average season day) (zero per EPA)	13	0	Y
536-542	CE6	Real	SO_2 Control Efficiency	7	0	Y
543-545	RE6	Real	SO_2 Rule Effectiveness	3	0	Y
546-555	EMF6	Real	SO_2 Emission Factors (SCC units)	10	0	Y
556-558	CPRI6	Int	SO_2 Primary Control Equipment Code	3		Y
559-561	CSEC6	Int	SO_2 Secondary Control Equipment Code	3		Y

Table 13 (continued)

Position	Name	Type	Description	Width	Max Decimals	Blanked
562-574	WINVOC	Real	VOC Winter Season Emissions (short tons/season)	13	12	
575-587	AVDVOC	Real	VOC Average Winter Day Emissions (short tons/average season day) (zero per EPA)	13	0	Y
588-594	CE7	Real	VOC Control Efficiency	7	0	Y
595-597	RE7	Real	VOC Rule Effectiveness	3	0	Y
598-607	EMF7	Real	VOC Emission Factors (SCC units)	10	0	Y
608-610	CPRI7	Int	VOC Primary Control Equipment Code	3		Y
611-613	CSEC7	Int	VOC Secondary Control Equipment Code	3		Y

1. Selected from the NIF EM table using corresponding segment ID from using the segment ID selection process. Defaults taken from IPM process and are either from EPA approved files or are Pechan defaults (41, 42, 43, etc).
2. Segment ID selection process used to determine which ID is used. Process consists of taken the segment ID from the NIF EM table with the highest emissions. Only the seven relevant pollutants are used and follow a hierarchy of NO_x+SO_2 first, Primary PM_{10}+Primary $PM_{2.5}$ second, and CO+NH_3+VOC last.
3. Selected from the NIF SI table using a plant's STID+CYID+PLANTID or a default of 4911.

Table 14. Summary of Summer Season, Summer Day, and Winter Season Emissions for 2018 EGU Inventory

State FIPS	State Name	CO	NH_3	NO_x	PM10-PRI	PM25-PRI	SO_2	VOC
Summer Season (Tons)								
5	Arkansas	5,052	359	14,836	1,725	1,472	36,566	309
19	Iowa	3,776	244	22,252	4,370	3,757	64,384	335
20	Kansas	3,484	227	37,207	3,795	3,037	36,070	361
22	Louisiana	5,396	438	14,240	1,798	1,631	32,873	313
27	Minnesota	2,648	166	17,940	3,562	3,086	36,647	302
29	Missouri	6,289	392	34,350	8,182	7,440	123,128	707
31	Nebraska	1,622	98	22,524	1,019	850	32,592	200
40	Oklahoma	13,611	664	36,695	2,559	2,240	50,321	500
48	Texas	56,832	3,574	79,449	18,154	14,916	150,220	2,661
	Totals	98,710	6,163	279,493	45,164	38,430	562,802	5,688
Winter Season (Tons)								
5	Arkansas	6,377	456	18,261	2,172	1,854	46,039	387
19	Iowa	4,982	324	28,867	5,663	4,859	82,921	435
20	Kansas	3,719	234	46,126	4,725	3,770	45,416	437
22	Louisiana	5,648	481	16,192	2,169	1,958	41,390	347
27	Minnesota	2,916	176	23,089	4,599	3,948	49,200	372
29	Missouri	6,876	407	43,310	10,274	9,330	157,759	871
31	Nebraska	1,968	118	28,256	1,277	1,064	41,037	250
40	Oklahoma	14,571	691	39,353	3,001	2,600	63,359	508
48	Texas	45,750	2,849	74,388	20,798	16,714	189,213	2,326
	Totals	92,807	5,738	317,843	54,678	46,098	716,333	5,935
Summer Day (Tons)								
5	Arkansas	36	3	107	12	11	262	2
19	Iowa	37	3	167	33	28	472	3
20	Kansas	27	2	268	27	22	257	3
22	Louisiana	38	3	93	13	11	235	2
27	Minnesota	20	1	128	25	22	259	2
29	Missouri	51	3	249	59	53	874	5
31	Nebraska	12	1	166	8	6	240	1
40	Oklahoma	100	5	264	18	16	353	4
48	Texas	409	26	559	125	103	1,034	19
	Totals	731	46	2,001	320	273	3,987	41

F. Preparation of SMOKE/IDA and RPO Data Exchange Protocol (NIF 3.0) Formats

This section describes the inventory and SMOKE emission processor files prepared under this project. The Excel Workbook file named "CENRAP Inventory File Documentation 08225.xls" provides the names of the files delivered, as well as other file information useful for transferring data to air quality modeling centers. This Excel Workbook file is provided along with this report. Table 15 provides a summary of the files delivered.

Table 15. Summary of Mass Emissions and SMOKE Input Files

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
Point Source Inventory for 2002					
AR, IA, KS, LA, MN, MO, NE, OK, TX, Fond du Lac Band of the Minnesota Chippewa Tribe (Tribal Code 405), and the Leech Lake Band of the Ojibwe Tribe (407)	CENRAP_2002_Point_082205.mdb	Annual	CENRAP_POINT_SMOKE_INPUT_ANNUAL_DAILY_072505.txt	Annual for all agencies; Daily for MO and TX	Includes all sectors supplied by S/L/T agencies. Tribal inventories include Fond du Lac Band of the Minnesota Chippewa and the Leech Lake Band of the Ojibwe. Local inventories include Lancaster County (Lincoln) and Douglas County (Omaha), NE.
MO and TX	CENRAP_2002_Point_Daily_Missouri_Texas_071405.mdb	Daily	CENRAP_POINT_SMOKE_INPUT_ANNUAL_DAILY_072505.txt	"	Daily emissions for MO and TX are included in the SMOKE/IDA file containing annual emissions for all CENRAP agencies, but placed in a NIF 3.0 file separate from the NIF 3.0 file containing the annual emissions.
Point Source Inventory for 2108					
AR, IA, KS, LA, MN, MO, NE, OK, TX	None		CENRAP_2018_Summer_081105.txt, CENRAP_2018_Winter_081105.txt	Summer season, Winter season	2018 EGU summer season and winter season emissions.
Nonroad Source Inventory for 2002					
AR, IA, KS, LA, MN, MO, NE, OK, TX	CENRAP_2002_Nonroad_071305.mdb	Annual, Monthly, and Daily	CENRAP_NONROAD_SMOKE_INPUT_ANN_071305.txt	Annual	Includes NONROAD Model Categories and Aircraft, Commercial Marine Vessels, and Railroad Locomotives. NONROAD Model inventory is from revised CENRAP-sponsored inventory except for TX (who supplied its own NONROAD Model Inventory), MN (who used the Midwest RPO Base J inventory for all NONROAD Model categories), and IA (who used the Midwest RPO Base J inventory for agricultural equipment). MN included commercial and military aircraft and auxiliary power units in its point source inventory; therefore, the nonroad inventory does not contain emissions for these categories in MN.
MN and IA	"	"	CENRAP_NONROAD_SMOKE_INPUT_MONTH_JAN_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
Nonroad Source Inventory for 2002 (continued)					

Table 15 (continued)

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_FEB_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_MAR_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_APR_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_MAY_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_JUN_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_JUL_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_AUG_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	“	“	CENRAP_NONROAD_SMOKE_INPUT_MONTH_SEP_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
Nonroad Source Inventory for 2002 (continued)					

Table 15 (continued)

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
MN and IA	"	"	CENRAP_NONROAD_SMOKE_INPUT_MONTH_OCT_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	"	"	CENRAP_NONROAD_SMOKE_INPUT_MONTH_NOV_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
MN and IA	"	"	CENRAP_NONROAD_SMOKE_INPUT_MONTH_DEC_071305.txt	Monthly Emissions x 12	Includes monthly emissions for MN (all NONROAD Model categories) and IA (agricultural equipment categories) from the Midwest RPO Base J inventory. Monthly emissions are multiplied by 12 (months).
Area Source Inventory for 2002					
AR, IA, KS, LA, MN, MO, NE, OK, TX	CENRAP_2002_Area_082205.mdb	Annual, Daily, and Monthly	CENRAP_AREA_SMOKE_INPUT_ANN_STATE_081705.txt	Annual	Includes all sectors except for those included in the Area Misc files. Planned burning emissions from CENRAP-sponsored area source inventory are excluded for AR, IA, KS, LA, MN, MO, OK, and NE (except for Lancaster County [FIPS 31109]); the SMOKE files for the CENRAP planned burning inventory will be used for these states.
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_JAN_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_FEB_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_MAR_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).

Table 15 (continued)

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
Area Source Inventory for 2002 (continued)					
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_APR_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_MAY_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_JUN_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_JUL_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_AUG_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_SEP_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_OCT_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_NOV_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
AR, IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_SMOKE_INPUT_NH3_MONTH_DEC_071905.txt	Monthly Emissions x 12	All sectors except for those included in the Area Misc files. Monthly emissions are multiplied by 12 (months).
TX and Lancaster County, NE	"	"	CENRAP_AREA_BURNING_SMOKE_INPUT_ANN_TX_NELI_071905.txt	Annual	Includes state and local prepared planned burning emissions. SMOKE input files for area source planned burning emissions for all other states are available from CENRAP-sponsored inventory.
Fond du Lac Band of the Minnesota Chippewa Tribe	CENRAP Area Tribal Inventories_082205.mdb	Annual	CENRAP_AREA_SMOKE_INPUT_ANN_TRIBE_120704.txt	Annual	The NIF file includes the data provided by both tribes. The SMOKE file Includes emissions for the paved and unpaved road and prescribed burning area source categories provided by the Fond du Lac Tribe. The SMOKE file was not revised to add the data provided by the Leech Lake Tribe since SMOKE is not programmed to process tribal area source inventory data.

Table 15 (continued)

S/L/T Agencies Included in Files	NIF 3.0 File Name Containing Mass Emissions Inventory (Access 2000 Database Files)	Temporal Period of Mass Emissions Inventory	SMOKE/IDA File Name	Temporal Period of Emissions in SMOKE/IDA File	Notes
Area Miscellaneous Source Inventory for 2002					
AR, IA, KS, LA, MN, MO, NE, OK, TX	CENRAP_2002_Area_Misc_082205.mdb	Annual, Daily, and Monthly	CENRAP_AREA_MISC_SMOKE_INPUT_ANN_STATE_071905.txt	Annual	NH_3 emissions from natural sources for all states, and PM10-PRI and PM25-PRI emissions for geogenic wind erosion for AR.
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_JAN_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_FEB_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_MAR_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_APR_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_MAY_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_JUN_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_JUL_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_AUG_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_SEP_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_OCT_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_NOV_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).
IA, KS, LA, MN, MO, NE, OK	"	"	CENRAP_AREA_MISC_SMOKE_INPUT_NH3_MONTH_DEC_072805.txt	Monthly Emissions x 12	NH_3 emissions from natural sources. Monthly emissions are multiplied by 12 (months).

III. SUMMARIES OF EMISSIONS INVENTORIES FOR THE CENRAP REGION

Summaries of emissions were prepared from the emission inventory files for each sector and for all sectors combined. The summaries are provided in an Access 2000 database named "CENRAP Base B Emission Summaries_082205.mdb". The same summaries are also provided in an Access 97 database named "CENRAP Base B Emission Summaries_082205_Acc97.mdb".

Table 16 identifies and briefly describes the contents of the emissions summary tables included in the database. The nonroad source sector summaries include emissions for aircraft, commercial marine vessels, and locomotives as well as the emissions from the NONROAD model categories. The onroad summaries were prepared from the revised CENRAP-sponsored inventory for onroad sources. Tables 1G, 2C, 3C, 4C, and 5C include the data source code for the area, point, nonroad, and onroad sectors to assist in identifying the origin and year of emissions inventory data. The data source codes were defined previously in Chapter II of this report.

The summaries in Appendix A of this report are taken from the emissions summary Table 1D. These summaries include natural sources NH_3 emissions and the biogenic wind erosion PM10-PRI and PM25-PRI emissions; thus, the emission totals in Appendix A match the totals in Chapter I, Table 1 of this report. Note, however, that the emissions for natural sources and wind erosion are excluded from Tables 2a through 2e of Chapter I.

A second Access 2000 database named "CENRAP Emission Summaries_Compare Base B to A_082205.mdb" provides summaries that compare the emissions in the Base B inventory to the Base A inventory. These summaries are provided for the "All Sector" Tables 1A through 1F series of summaries. These summaries are useful for identifying the states and sectors where annual emissions changed significantly as a result of the comments received on the Base A inventories for all of the sectors. This database is also provided in Access 97 format (named "CENRAP Emission Summaries_Compare Base B to A_082205_Acc97.mdb").

Table 16. Emissions Summaries

Summary Table Name	Description
All Sector Summaries	
Table 1A_All Sectors	Summary of Annual Emissions by Pollutant and Sector for the CENRAP Region
Table 1B_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/Pollutant and Sector
Table 1C_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/Pollutant and Sector
Table 1D_All Sectors	Summary of Annual Emissions by Category/Sector and Pollutant for the CENRAP Region
Table 1E_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/ Source Category Name and Number/Sector and Pollutant

Table 16 (continued)

Summary Table Name	Description
Area Source and Biogenic/Natural Source Sector Summaries	
Table 1F_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/Source Category Name and Number/Sector and Pollutant
Table 1G_All Sectors	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/SCC and SCC Description/Source Category Name and Number/ Sector/Pollutant and Data Source Code
Table 2A_Area Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name and Pollutant
Table 2B_Area Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name and Pollutant
Table 2C_Area Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 2D_Area Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State/Tribe
Table 2E_Area Sources	Summary of Annual Emissions by Pollutant and State/Tribe
Point Source Sector Summaries	
Table 3A_Point Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name and Pollutant
Table 3B_Point Sources	Summary of Annual Emissions by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name and Pollutant
Table 3C_Point Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/Tribal Code/State Name/Tribal Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 3D_Point Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State/Tribe
Table 3E_Point Sources	Summary of Annual Emissions by Pollutant and State/Tribe
Table 3F_Point Sources	Facility-level Summary
Nonroad Source Sector Summaries	
Table 4A_Nonroad Sources	Summary of Annual Emissions by State FIPS/State Name and Pollutant
Table 4B_Nonroad Sources	Summary of Annual Emissions by State FIPS/State Name/County FIPS/County Name and Pollutant
Table 4C_Nonroad Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/State Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 4D_Nonroad Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State
Table 4E_Nonroad Sources	Summary of Annual Emissions by Pollutant and State
Onroad Source Sector Summaries	
Table 5A_Onroad Sources	Summary of Annual Emissions by State FIPS/State Name and Pollutant
Table 5B_Onroad Sources	Summary of Annual Emissions by State FIPS/State Name/County FIPS/County Name and Pollutant
Table 5C_Onroad Sources	Summary of Annual Emissions and Data Source Codes by State FIPS/State Name/County FIPS/County Name/SCC/SCC Description and Pollutant
Table 5D_Onroad Sources	Summary of Annual Emissions by SCC/SCC Description/Pollutant and State
Table 5E_Onroad Sources	Summary of Annual Emissions by Pollutant and State

IV. METHODS FOR AREAS OUTSIDE OF THE CENRAP REGION

A. Data Sources and Augmentation Procedures

This task involved calculating fire emissions and source parameters given fuel, location, and time period information for the Province of Ontario, Canada. CENRAP made the "raw" data for these fires available at http://www.cenrap.org/emission_document.asp. The names of the specific files made available include the following:

"Ontario Fires over 100 ha 1992- 2002 WFR.xls"
"Ontario Fires over 100 ha 1992 -2002 WFR-EXPLAIN.xls"

The files contain data for 54 fires that occurred in Ontario during the year 2002. Information on the data code abbreviations, data definitions, and data units used in the raw data files was obtained from Mr. Rob Luik (Data Management Specialist) at the Ontario Ministry of Natural Resources (Rob.Luik@MNR. gov.on.ca). Tables 17 and 18 provide definitions of the fuel types and other data provided in the raw data files.

B. Development of BlueSky Inputs

Emissions for each fire were estimated using the Emission Production Model (EPM)/CONSUME within the BlueSky framework. To run EPM/CONSUME, the following information was needed for each fire:

- Fire identification code;
- Latitude and longitude of the fire;
- Start and end dates of the fire;
- Daily size of the fire; and
- Fuel loading information.

A fire identification code is needed to track individual fires throughout the processing. The unique fire identification code was created for each fire by concatenating the FIRE_NUMBER and CUR_DIST fields of the original data. The fire identification code also contains the FIPS code of the fire; this information is not used by BlueSky but is needed by BlueSky2Inv, the utility program that converts the BlueSky output to the SMOKE inventory format. The FIPS code 135000 was used for all fires with longitudes east of –90°, and FIPS code 135059 was used for fires west of –90°. These FIPS codes were used to ensure that the fires would be assigned the correct time zones in later SMOKE processing.

The DISC_DATE field (discovery date) was used as the start date for each fire. While the original data did provide start dates earlier than the discovery date for some fires, the discovery date was used for all fires for consistency. Similarly, the OUT_DATE field was used from the original data as the end date for each fire. Some of the dates provided in the original data included hourly information. In all cases, the hourly information was not used leaving all data at a daily resolution.

Table 17. Fuel Type Definitions Provided by the Ontario Ministry of Natural Resources

FUEL_TYPE	CODEDESC
C1	C1 Spruce Lichen Woodland
C2	C2 Boreal Spruce
C3	C3 Mature Jack Pine
C4	C4 Immature Jackpine
C5	C5 Red and White Pine
C6	C6 Conifer Plantation
M125	M1 Boreal Mixedwood Leafless 25% Conifer
M150	M1 Boreal Mixedwood Leafless 50% Conifer
M175	M1 Boreal Mixedwood Leafless 75% Conifer
M225	M2 Boreal Mixedwood Green 25% Conifer
M250	M2 Boreal Mixedwood Green 50% Conifer
M275	M2 Boreal Mixedwood Green 75% Conifer
M325	M3 Dead Balsam Fir/Mixed Wood Leafless 30% Dead Balsam
M350	M3 Dead Balsam Fir/Mixed Wood Leafless 60% Dead Balsam
M375	M3 Dead Balsam Fir/Mixed Wood Leafless 100% Dead Balsam
M425	M4 Dead Balsam Fir/Mixedwood Green 30% Dead Balsam
M450	M4 Dead Balsam Fir/Mixedwood Green 60% Dead Balsam
M475	M4 Dead Balsam Fir/Mixedwood Green 100% Dead Balsam
O1A100	O1a Matted Grass 100% cured
O1A50	O1a Matted Grass 50% cured
O1A75	O1a Matted Grass 75% cured
O1B100	O1b Standing Grass 100% cured
O1B50	O1b Standing Grass 50% cured
O1B75	O1b Standing Grass 75% cured
S1	S1 Jackpine Slash
S2	S2 White Spruce Balsam Slash
S3	S3 Coastal Cedar/Hemlock/Douglas-fir slash
GRA	Grass
SLA	Slash
SHR	Shrubs, Hwd Brush
CON	Conifer
IKC	Insect Killed Conifer
MIX	Mixed Wood
HAR	Hard Wood
BLO	Blowdown
PLA	Plantation
OTH	Other

Table 18. Other Data Definitions Provided by the Ontario Ministry of Natural Resources

START_DATE	Start Date
DISC_DATE	Discovered date
F_REP_DATE	First Reported date
S_REP_DATE	Second Reported date
GETAWAY_DATE	Getaway date
ATTACK_DATE	Attack date
BHE_DATE	Being Held date
UCO_DATE	Under Control date
OUT_DATE	Out date

The total number of days each fire burned was determined using the start and end date for each fire. For each fire, the size of the area burned each day was estimated. The original data included the final size of each fire which was used to determine the total area burned by each fire. Rather than introduce additional assumptions about the daily fire size, it was assumed that the area burned each day was constant over all days. Therefore, the total size of the fire was divided by the total days the fire burned to get an estimate of the daily fire size. The area burned by each fire was converted from hectares to acres as needed by EPM/CONSUME.

For each fire, fuel loading data must be provided to indicate the type of fuels available for burning so that the emissions can be estimated. The original data included fuel type information for each fire using the Canadian Forest Fire Danger Rating System (CFFDRS) fuel types. Descriptions of each fuel type are available at http://fire.cfs.nrcan.gc.ca/research/environment/ cffdrs/fbpfuels_e.htm. Detailed fuel information for these types could not be identified; therefore, the CFFDRS types were mapped to the types used by the National Fire Danger Rating System (NFDRS). Information about these fuel types is available at http://www.fs.fed.us/fire/planning/ nist/nfdr.htm. Table 19 shows how the CFFDRS fuel types in the original data were mapped to the NFDRS fuel types, and shows the total number of fires for each fuel type. Table 20 shows the default fuel loading factors included in BlueSky for each NFDRS fuel type.

Table 19. Mapping of Canadian to National Fire Danger Rating System Fuel Types

Canadian Forest Fire Danger Rating System	National Fire Danger Rating System	Number of Fires
C2: Boreal Spruce	Q: Dense Alaskan black spruce and shrubs	36
C3: Mature Jack Pine	C: Open pine perennial grass understory	4
C4: Immature Jack Pine	G: Dense conifer with heavy downed and duff	1
C6: Conifer Plantation	U: Closed western long-needled pines	4
M2: Boreal Mixedwood – Green	R: Hardwoods after leafout	2
M3: Dead Balsam Fir Mixedwood – Leafless	G: Dense conifer with heavy downed and duff	1
M4: Dead Balsam Fir Mixedwood - Green	G: Dense conifer with heavy downed and duff	1

Table 20. Default Fuel Loading Factors Associated with National Fire Danger Rating System Fuel Types

	Tons/Acre of Fuel by Fuel Size in Inches					
Type	*0 – 0.25*	*0.25 – 1*	*1 – 3*	*3 – 9*	*9 – 20*	*20+*
C: Open pine	1.0	2.2	0.0	0.0	0.0	0.0
G: Dense conifer	2.9	2.3	5.6	13.2	0.0	0.0
Q: Dense spruce	3.0	3.5	3.0	1.0	0.0	0.0
R: Hardwoods	0.6	0.6	0.6	0.0	0.0	0.0
U: Closed pines	1.5	1.5	1.0	0.0	0.0	0.0

Three of the 54 fires in the raw data files did not have any latitude and longitude coordinates or any fuel type data. Therefore, the three fires were excluded from the inventory. The three fires combined accounted for less than 1 percent of the total area burned by all 54 fires. The raw data files did not contain any fuel type data for two other fires. The coordinates provided for these two fires were matched with the BELD3 database to determine the dominant vegetation type at the location of each fire. In both cases, the vegetation type was USGS conifer, which was mapped to NFDRS Type U (closed western long-needled pines).

All other inputs to EPM/CONSUME including meteorology-based parameters used the BlueSky defaults.

C. Development of SMOKE Inventory Files

After running BlueSky with the prepared inputs, the SMOKE utility program "BlueSky2Inv" was used to convert the EPM/CONSUME output to the inventory files needed by SMOKE. Since the EPM/CONSUME output is daily, BlueSky2Inv creates a PTHOUR file containing the daily emissions for each fire. The data included in the PTHOUR file are daily values for the fire's area (AREA), heat flux (HFLUX), $PM_{2.5}$, PMC (calculated as $PM_{10} – PM_{2.5}$), CO, and total organic gases (TOG) (calculated as methane + non-methane hydrocarbons).

BlueSky2Inv also creates an annual IDA inventory file. This file does not contain any emissions data but serves as a master list of sources. The annual inventory also contains the latitude and longitude of each fire. For all sources, BlueSky2Inv assigned the SCC 2810001000 (Miscellaneous Area Sources; Other Combustion; Forest Wildfires; Total).

Since BlueSky2Inv was developed for US inventories; therefore, the "#COUNTRY" headers in both output inventories were changed to CANADA.

D. SMOKE Input Files

The draft inventory files were provided to CENRAP via email on July 19, 2005. The following files were delivered:

- ptinv.ontario_fires.2002.txt: annual fire event inventory in IDA format
- ptday.ontario_fires.2002.txt: daily fire emissions inventory
- monthly.ontario.2002.txt: a report file summarizes the emissions by fire and by month. This report could be used to build monthly or annual fire emissions inventories if needed.

E. Emissions Summary

Table 21 provides a summary of monthly emissions calculated for 2002 Ontario fires. Emissions were estimated for CO, $PM_{2.5}$, coarse PM (PMC) and TOG. Note that the modeling framework selected for estimating emissions does not include factors for estimating NO_x, SO_2, and NH_3.

Table 21. Summary of 2002 Ontario Fire Emissions by Month

Month	Number of Fires	Area Burned (Acres)	CO (tons)	$PM_{2.5}$ (Tons)	PMC (Tons)	TOG (Tons)
May	2	247	41.5	4.3	0.5	3.7
June	9	13,436	12,368.8	1,140.8	118.3	743.6
July	51	209,954	183,407.5	16,807.9	1,734.3	10,810.4
August	39	170,831	146,623.3	13,445.3	1,386.7	8,649.9
September	10	27,950	23,709.5	2,169.1	223.2	1,397.8
October	1	993	878.3	80.0	8.2	51.5
Totals		**423,411**	**367,028.8**	**33,647.4**	**3,471.3**	**21,656.8**

V. REFERENCES

CENRAP, 2005a: Methods for Refinement of CENRAP's 2002 Emissions Inventories (Schedule 9; Work Item 3), Draft. Prepared by E.H. Pechan & Associates, Inc. and Carolina Environmental Program for the Central Regional Air Planning Association (CENRAP). May 23, 2005.

CENRAP, 2005b: Quality Assurance Project Plan (QAPP) for Refinement of CENRAP's 2002 Emissions Inventories (Schedule 9; Work Item 3), Final. Prepared by E.H. Pechan & Associates, Inc. and Carolina Environmental Program for the Central Regional Air Planning Association (CENRAP). May 20, 2005.

CENRAP, 2005c: Work Plan for Refinement of CENRAP's 2002 Emissions Inventories (Schedule 9; Work Item 3), Draft. Prepared by E.H. Pechan & Associates, Inc. and Carolina Environmental Program for the Central Regional Air Planning Association (CENRAP). May 20, 2005.

EPA, 2003: Enhanced Particulate Matter Controlled Emissions Calculator, User's Manual, U.S. Environmental Protection Agency, Emission Factor and Inventory Group, Emissions Monitoring and Analysis Division, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. September 2003.

EPA, 2004a: Basic Format & Content Checker 3.0 (Formerly known as the Quality Assurance / Quality Control Software 3.0) - March 2004; Extended Quality Control Tool - Updated May 18, 2004. Available at the following EPA website: http://www.epa.gov/ttn/chief/nif/index.html#nei

EPA, 2004b: NEI Quality Assurance and Data Augmentation for Point Sources, U.S. EPA, Emissions Monitoring and Analysis Division, Emission Factor and Inventory Group, May 26, 2004.

EPA, 2004c: Factor Information and REtrieval (FIRE) Data System, Version 6.24, located on the Technology Transfer Network Clearinghouse for Inventories & Emission Factors Web Site at http://www.epa.gov/ttn/chief/software/fire/index.html. March 2004.

Thompson, 2002: Thompson, Rhonda L., "A Demonstration of the Quality Assurance (QA) software specifically developed for the National Emission Inventory (NEI)," presented at the International Emission Inventory Conference "Emission Inventories - Partnering for the Future," Atlanta, GA, April 15-18, 2002, (http://www.epa.gov/ttn/chief/conference/ei11/qa/thompson.pdf).

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APPENDIX A

SUMMARIES OF ANNUAL EMISSIONS BY SOURCE CATEGORY, SECTOR, AND POLLUTANT

Table A-1. Summary of Annual VOC Emissions for the CENRAP Region by Category, Sector, and Pollutant: Base B Inventory

Category	Category Number	Sector	VOC		
			Tons/Year	Percent of Total	Cumulative Percent
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	900,621	23.69	23.69
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA	413,569	10.88	34.57
Mobile Sources-Pleasure Craft	2282	NONROAD	342,086	9	43.57
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA	165,299	4.35	47.92
Industrial Surface Coating	2401015000	AREA	160,593	4.22	52.14
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	146,802	3.86	56
Stationary Source Fuel Combustion-Residential	2104	AREA	144,946	3.81	59.81
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA	126,217	3.32	63.13
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	98,828	2.6	65.73
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA	96,513	2.54	68.27
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	95,174	2.5	70.77
Architectural Coatings	2401001000	AREA	82,943	2.18	72.95
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	82,678	2.17	75.12
Industrial Processes-Chemical Manufacturing	301	POINT	67,995	1.79	76.91
Industrial Processes-Petroleum Industry	306	POINT	65,746	1.73	78.64
Degreasing	2415	AREA	63,065	1.66	80.3
Miscellaneous Area Sources-Other Combustion	2810	AREA	54,195	1.43	81.73
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	49,880	1.31	83.04
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	45,829	1.21	84.25
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA	45,538	1.2	85.45
Gas Marketing Stage I	25010600	AREA	41,726	1.1	86.55
Miscellaneous Area Sources-Other Combustion	2810	POINT	39,592	1.04	87.59
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	33,986	0.89	88.48
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	30,083	0.79	89.27
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	27,726	0.73	90
Industrial Processes-Oil and Gas Production	310	POINT	25,924	0.68	90.68
Internal Combustion Engines-Industrial	2020	POINT	25,559	0.67	91.35
Graphic Arts	2425	AREA	22,948	0.6	91.95
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA	21,400	0.56	92.51
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	21,313	0.56	93.07
Solvent Utilization-Dry Cleaning	2420	AREA	19,075	0.5	93.57
Industrial Processes-Food and Agriculture	302	POINT	18,378	0.48	94.05
Mobile Sources-Railroad Equipment	2285	NONROAD	16,523	0.43	94.48
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	15,379	0.4	94.88
Auto Refinishing	2401005000	AREA	12,437	0.33	95.21
External Combustion Boilers-Electric Generation	1010	POINT	11,695	0.31	95.52
Mobile Sources-LPG	2267	NONROAD	10,752	0.28	95.8
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	9,097	0.24	96.04
External Combustion Boilers-Industrial	1020	POINT	8,994	0.24	96.28
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA	8,985	0.24	96.52
Traffic Markings	2401008000	AREA	8,631	0.23	96.75
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	8,499	0.22	96.97
Industrial Processes-Mineral Products	305	POINT	8,280	0.22	97.19
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	8,228	0.22	97.41

Table A-1 (continued)

Category	Category Number	Sector	VOC		
			Tons/Year	Percent of Total	Cumulative Percent
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	8,144	0.21	97.62
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	7,325	0.19	97.81
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA	6,452	0.17	97.98
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	6,215	0.16	98.14
Mobile Sources-CNG	2268	NONROAD	6,189	0.16	98.3
Industrial Processes-Secondary Metal Production	304	POINT	5,912	0.16	98.46
Stationary Source Fuel Combustion-Industrial	2102	AREA	5,610	0.15	98.61
Mobile Sources-Aircraft	2275	NONROAD	5,337	0.14	98.75
Rubber/Plastics	2430000000	AREA	5,200	0.14	98.89
Industrial Processes-Cooling Tower	3850	POINT	4,751	0.12	99.01
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	3,974	0.1	99.11
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	3,120	0.08	99.19
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	2,830	0.07	99.26
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA	2,733	0.07	99.33
Industrial Processes-Primary Metal Production	303	POINT	2,490	0.07	99.4
Industrial Processes-Industrial Processes: NEC	2399	AREA	2,097	0.06	99.46
Waste Disposal-Solid Waste Disposal-Government	501	POINT	2,073	0.05	99.51
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	1,685	0.04	99.55
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA	1,678	0.04	99.59
Internal Combustion Engines-Electric Generation	2010	POINT	1,602	0.04	99.63
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	1,529	0.04	99.67
Industrial Processes-Fabricated Metal Products	309	POINT	1,483	0.04	99.71
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA	1,057	0.03	99.74
Industrial Processes-In-process Fuel Use	390	POINT	742	0.02	99.76
External Combustion Boilers-Commercial/Institutional	1030	POINT	653	0.02	99.78
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	650	0.02	99.80
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	634	0.02	99.82
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	606	0.02	99.82
Mobile Sources-Aircraft	2275	POINT	599	0.02	99.84
Industrial Processes-Textile Products	330	POINT	567	0.01	99.85
Industrial Processes-Machinery, Miscellaneous	3129	POINT	529	0.01	99.86
Internal Combustion Engines-Fugitive Emissions	2888	POINT	508	0.01	99.87
Industrial Processes-Electrical Equipment	313	POINT	495	0.01	99.88
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA	459	0.01	99.89
Internal Combustion Engines-Engine Testing	2040	POINT	455	0.01	99.90
Industrial Processes-Transportation Equipment	314	POINT	379	0.01	99.91
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	283	0.01	99.92
MACT Source Categories : Vinyl-based Resins	6463	POINT	256	0.01	99.93
Internal Combustion Engines-Commercial/Institutional	2030	POINT	230	0.01	99.94
MACT Source Categories : Cellulose-based Resins	644	POINT	221	0.01	99.95
External Combustion Boilers-Space Heaters	1050	POINT	207	0.01	99.96
Industrial Processes-Leather and Leather Products	3209	POINT	128	0	99.96
Bulk Materials Transport & Transport	253	AREA	108	0	99.96
Petroleum and Solvent Evaporation-	4250	POINT	104	0	99.96
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	79	0.00	99.96
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT	67	0.00	99.96
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	66	0.00	99.97
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	51	0.00	99.97

Table A-1 (continued)

Category	Category Number	Sector	VOC Tons/Year	VOC Percent of Total	VOC Cumulative Percent
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT	39	0.00	99.97
Mobile Sources-Highway Vehicles-Diesel	2230	AREA	38	0.00	99.97
Waste Disposal-Site Remediation	504	POINT	35	0.00	99.97
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	18	0.00	99.97
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	16	0.00	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT	16	0.00	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT	12	0.00	100.0
Industrial Processes-Building Construction	3110	POINT	11	0.00	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT	3	0.00	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT	2	0.00	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT	1.0	0.00	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT	0.7	0.00	100.0
Mobile Sources-Aircraft	2275	AREA	0.1	0.00	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT	0.0	0.00	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT	0.0	0.00	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT	0.0	0.00	100.0
Mobile Sources-Paved Roads	2294	POINT	0.00	0.00	100.0
Mobile Sources-Unpaved Roads	2296	POINT	0.0	0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Natural Sources, Biogenic	2701	BIOGENIC		0	100.0
Natural Sources, Geogenic	2730	GEOGENIC		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Totals for All Categories			3,802,477	100	

Table A-2. Summary of Annual NO_x Emissions for the CENRAP Region by Category, Sector, and Pollutant: Base B Inventory

Category	Category Number	Sector	NO_x Tons/Year	Percent of Total	Cumulative Percent
External Combustion Boilers-Electric Generation	1010	POINT	895,567	17.21	17.21
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	890,699	17.11	34.32
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	845,039	16.24	50.56
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	392,833	7.55	58.11
Internal Combustion Engines-Industrial	2020	POINT	378,374	7.27	65.38
Mobile Sources-Railroad Equipment	2285	NONROAD	331,552	6.37	71.75
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA	277,190	5.33	77.08
Stationary Source Fuel Combustion-Industrial	2102	AREA	222,299	4.27	81.35
External Combustion Boilers-Industrial	1020	POINT	182,295	3.5	84.85
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	123,773	2.38	87.23
Industrial Processes-Mineral Products	305	POINT	91,145	1.75	88.98
Industrial Processes-Petroleum Industry	306	POINT	69,932	1.34	90.32
Industrial Processes-Chemical Manufacturing	301	POINT	60,691	1.17	91.49
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	58,189	1.12	92.61
Stationary Source Fuel Combustion-Residential	2104	AREA	50,497	0.97	93.58
Mobile Sources-LPG	2267	NONROAD	40,521	0.78	94.36
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	33,940	0.65	95.01
Internal Combustion Engines-Electric Generation	2010	POINT	33,854	0.65	95.66
Industrial Processes-In-process Fuel Use	390	POINT	31,703	0.61	96.27
Mobile Sources-Pleasure Craft	2282	NONROAD	25,375	0.49	96.76
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	23,558	0.45	97.21
Industrial Processes-Oil and Gas Production	310	POINT	16,172	0.31	97.52
Mobile Sources-Aircraft	2275	NONROAD	15,299	0.29	97.81
Industrial Processes-Primary Metal Production	303	POINT	13,009	0.25	98.06
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	12,342	0.24	98.3
Miscellaneous Area Sources-Other Combustion	2810	AREA	10,653	0.2	98.5
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	9,875	0.19	98.69
Mobile Sources-CNG	2268	NONROAD	8,392	0.16	98.85
External Combustion Boilers-Commercial/Institutional	1030	POINT	7,118	0.14	98.99
Internal Combustion Engines-Commercial/Institutional	2030	POINT	5,919	0.11	99.1
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA	4,941	0.09	99.19
Miscellaneous Area Sources-Other Combustion	2810	POINT	4,068	0.08	99.27
Industrial Processes-Secondary Metal Production	304	POINT	3,867	0.07	99.34
Waste Disposal-Solid Waste Disposal-Government	501	POINT	3,717	0.07	99.41
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	3,702	0.07	99.48
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	3,563	0.07	99.55
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	2,767	0.05	99.6
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	2,758	0.05	99.65
Bulk Materials Transport & Transport	253	AREA	2,354	0.05	99.7
Industrial Processes-Food and Agriculture	302	POINT	2,057	0.04	99.74
Mobile Sources-Aircraft	2275	POINT	1,825	0.04	99.78
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	1,743	0.03	99.81
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	1,386	0.03	99.84
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	1,289	0.02	99.86
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA	1,190	0.02	99.88
Internal Combustion Engines-Engine Testing	2040	POINT	863	0.02	99.9

Table A-2 (continued)

Category	Category Number	Sector	NO$_x$		
			Tons/Year	Percent of Total	Cumulative Percent
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	691	0.01	99.91
Industrial Processes-Industrial Processes: NEC	2399	AREA	616	0.01	99.92
External Combustion Boilers-Space Heaters	1050	POINT	586	0.01	99.93
Waste Disposal-Site Remediation	504	POINT	535	0.01	99.94
Industrial Processes-Fabricated Metal Products	309	POINT	480	0.01	99.95
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	285	0.01	99.96
Mobile Sources-Highway Vehicles-Diesel	2230	AREA	283	0.01	99.97
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	209	0.00	99.97
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	208	0.00	99.97
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	188	0.00	99.97
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	157	0.00	99.97
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	152	0.00	99.97
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	109	0.00	99.97
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	98	0.00	99.97
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	90	0.00	99.97
Industrial Processes-Electrical Equipment	313	POINT	82	0.00	99.97
Industrial Processes-Machinery, Miscellaneous	3129	POINT	66	0.00	99.97
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	48	0.00	99.97
Internal Combustion Engines-Fugitive Emissions	2888	POINT	26	0.00	99.97
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	18	0.00	99.97
MACT Source Categories : Vinyl-based Resins	6463	POINT	11	0.00	99.97
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA	10	0.00	99.97
Industrial Processes-Transportation Equipment	314	POINT	6	0.00	99.97
Petroleum and Solvent Evaporation-	4250	POINT	4	0.00	99.97
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT	4	0.00	99.97
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	4	0.00	99.97
Industrial Processes-Textile Products	330	POINT	3	0.00	99.97
Industrial Processes-Building Construction	3110	POINT	1	0.00	99.97
Industrial Processes-Cooling Tower	3850	POINT	1	0.00	99.97
MACT Source Categories : Cellulose-based Resins	644	POINT	0	0.00	99.97
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0.00	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA	0	0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT	0	0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT	0	0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT	0	0	100.0
Mobile Sources-Paved Roads	2294	POINT	0	0	100.0
Mobile Sources-Unpaved Roads	2296	POINT	0	0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT	0	0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	0	0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0
Graphic Arts	2425	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0

Table A-2 (continued)

Category	Category Number	Sector	NO$_x$		
			Tons/Year	Percent of Total	Cumulative Percent
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA		0	100.0
Industrial Processes-Leather and Leather Products	3209	POINT		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Natural Sources, Biogenic	2701	BIOGENIC		0	100.0
Natural Sources, Geogenic	2730	GEOGENIC		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0
Totals for All Categories			5,204,868	100	

Table A-3. Summary of Annual CO Emissions for the CENRAP Region by Category, Sector, and Pollutant: Base B Inventory

Category	Category Number	Sector	CO Tons/Year	CO Percent of Total	CO Cumulative Percent
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	12,622,725	56.09	56.09
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	2,488,595	11.06	67.15
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	1,363,848	6.06	73.21
Mobile Sources-Pleasure Craft	2282	NONROAD	1,030,752	4.58	77.79
Miscellaneous Area Sources-Other Combustion	2810	AREA	904,171	4.02	81.81
Miscellaneous Area Sources-Other Combustion	2810	POINT	688,449	3.06	84.87
Stationary Source Fuel Combustion-Residential	2104	AREA	404,209	1.8	86.67
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	324,217	1.44	88.11
External Combustion Boilers-Electric Generation	1010	POINT	275,860	1.23	89.34
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	268,369	1.19	90.53
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA	240,677	1.07	91.6
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	238,628	1.06	92.66
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	236,540	1.05	93.71
Industrial Processes-Chemical Manufacturing	301	POINT	169,431	0.75	94.46
Mobile Sources-LPG	2267	NONROAD	162,171	0.72	95.18
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	160,085	0.71	95.89
Internal Combustion Engines-Industrial	2020	POINT	152,398	0.68	96.57
External Combustion Boilers-Industrial	1020	POINT	120,770	0.54	97.11
Industrial Processes-Primary Metal Production	303	POINT	97,211	0.43	97.54
Industrial Processes-Mineral Products	305	POINT	63,408	0.28	97.82
Mobile Sources-Aircraft	2275	NONROAD	58,554	0.26	98.08
Stationary Source Fuel Combustion-Industrial	2102	AREA	56,095	0.25	98.33
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	55,100	0.24	98.57
Industrial Processes-Petroleum Industry	306	POINT	52,733	0.23	98.8
Mobile Sources-Railroad Equipment	2285	NONROAD	43,352	0.19	98.99
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	38,549	0.17	99.16
Mobile Sources-CNG	2268	NONROAD	34,154	0.15	99.31
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	19,925	0.09	99.4
Industrial Processes-Secondary Metal Production	304	POINT	19,360	0.09	99.49
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	18,111	0.08	99.57
Industrial Processes-Food and Agriculture	302	POINT	13,552	0.06	99.63
Industrial Processes-Oil and Gas Production	310	POINT	10,508	0.05	99.68
Internal Combustion Engines-Electric Generation	2010	POINT	10,049	0.04	99.72
Mobile Sources-Aircraft	2275	POINT	9,552	0.04	99.76
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	7,992	0.04	99.8
Industrial Processes-In-process Fuel Use	390	POINT	6,918	0.03	99.83
External Combustion Boilers-Commercial/Institutional	1030	POINT	6,390	0.03	99.86
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	5,540	0.02	99.88
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	4,292	0.02	99.9
Waste Disposal-Solid Waste Disposal-Government	501	POINT	4,096	0.02	99.92
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	3,687	0.02	99.94
Internal Combustion Engines-Commercial/Institutional	2030	POINT	3,243	0.01	99.95
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	1,367	0.01	99.96
Internal Combustion Engines-Engine Testing	2040	POINT	1,306	0.01	99.97
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	999	0	99.97

Table A-3 (continued)

Category	Category Number	Sector	CO Tons/Year	CO Percent of Total	CO Cumulative Percent
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	733	0	99.97
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	510	0	99.97
Mobile Sources-Highway Vehicles-Diesel	2230	AREA	454	0	99.97
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	386	0	99.97
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	340	0	99.97
Bulk Materials Transport & Transport	253	AREA	305	0	99.97
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	278	0	99.97
External Combustion Boilers-Space Heaters	1050	POINT	258	0	99.97
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	237	0	99.97
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	213	0	99.97
Industrial Processes-Fabricated Metal Products	309	POINT	191	0	99.97
Industrial Processes-Industrial Processes: NEC	2399	AREA	140	0	99.97
Internal Combustion Engines-Fugitive Emissions	2888	POINT	135	0	99.97
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	128	0	99.97
Waste Disposal-Site Remediation	504	POINT	116	0	99.97
Industrial Processes-Machinery, Miscellaneous	3129	POINT	72	0	99.97
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	66	0	99.97
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	56	0	99.97
Industrial Processes-Electrical Equipment	313	POINT	51	0	99.97
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	48	0	99.97
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	30	0	99.97
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT	20	0	99.97
Petroleum and Solvent Evaporation-	4250	POINT	9	0	99.97
MACT Source Categories : Vinyl-based Resins	6463	POINT	9	0	99.97
Industrial Processes-Transportation Equipment	314	POINT	3	0	99.97
Industrial Processes-Leather and Leather Products	3209	POINT	2	0	99.97
Industrial Processes-Textile Products	330	POINT	2	0	99.97
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT	2	0	99.97
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	1	0	99.97
Industrial Processes-Cooling Tower	3850	POINT	1	0	99.97
MACT Source Categories : Cellulose-based Resins	644	POINT	0	0	99.97
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0	100.0
Industrial Processes-Building Construction	3110	POINT	0	0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT	0	0	100.0
Mobile Sources-Paved Roads	2294	POINT	0	0	100.0
Mobile Sources-Unpaved Roads	2296	POINT	0	0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT	0	0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0
Graphic Arts	2425	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0

Table A-3 (continued)

Category	Category Number	Sector	CO		
			Tons/Year	Percent of Total	Cumulative Percent
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Natural Sources, Biogenic	2701	BIOGENIC		0	100.0
Natural Sources, Geogenic	2730	GEOGENIC		0	100.0
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0
Totals for All Categories			22,502,730	100	

Table A-4. Summary of Annual SO_2 Emissions for the CENRAP Region by Category, Sector, and Pollutant: Base B Inventory

Category	Category Number	Sector	SO_2 Tons/Year	SO_2 Percent of Total	SO_2 Cumulative Percent
External Combustion Boilers-Electric Generation	1010	POINT	1,507,468	56.1	56.1
Stationary Source Fuel Combustion-Industrial	2102	AREA	268,450	9.99	66.09
External Combustion Boilers-Industrial	1020	POINT	213,271	7.94	74.03
Industrial Processes-Chemical Manufacturing	301	POINT	144,912	5.39	79.42
Industrial Processes-Petroleum Industry	306	POINT	109,962	4.09	83.51
Industrial Processes-Mineral Products	305	POINT	79,767	2.97	86.48
Industrial Processes-Primary Metal Production	303	POINT	67,735	2.52	89
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	49,754	1.85	90.85
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	31,090	1.16	92.01
Industrial Processes-Oil and Gas Production	310	POINT	30,483	1.13	93.14
Mobile Sources-Railroad Equipment	2285	NONROAD	21,825	0.81	93.95
Industrial Processes-Secondary Metal Production	304	POINT	20,993	0.78	94.73
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	19,669	0.73	95.46
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	19,342	0.72	96.18
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	18,546	0.69	96.87
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	16,555	0.62	97.49
Industrial Processes-In-process Fuel Use	390	POINT	11,995	0.45	97.94
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	8,586	0.32	98.26
Stationary Source Fuel Combustion-Residential	2104	AREA	7,817	0.29	98.55
External Combustion Boilers-Commercial/Institutional	1030	POINT	7,470	0.28	98.83
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	6,432	0.24	99.07
Miscellaneous Area Sources-Other Combustion	2810	AREA	4,776	0.18	99.25
Miscellaneous Area Sources-Other Combustion	2810	POINT	3,468	0.13	99.38
Mobile Sources-Pleasure Craft	2282	NONROAD	1,773	0.07	99.45
Industrial Processes-Food and Agriculture	302	POINT	1,673	0.06	99.51
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	1,595	0.06	99.57
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	1,589	0.06	99.63
Mobile Sources-Aircraft	2275	NONROAD	1,511	0.06	99.69
Waste Disposal-Solid Waste Disposal-Government	501	POINT	1,164	0.04	99.73
Internal Combustion Engines-Industrial	2020	POINT	1,163	0.04	99.77
Internal Combustion Engines-Electric Generation	2010	POINT	1,004	0.04	99.81
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	748	0.03	99.84
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	731	0.03	99.87
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	694	0.03	99.9
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	680	0.03	99.93
Waste Disposal-Site Remediation	504	POINT	635	0.02	99.95
Industrial Processes-Industrial Processes: NEC	2399	AREA	307	0.01	99.96
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	277	0.01	99.97
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	204	0.01	99.98
Mobile Sources-Aircraft	2275	POINT	183	0.01	99.99
Bulk Materials Transport & Transport	253	AREA	172	0.01	100.0
Internal Combustion Engines-Commercial/Institutional	2030	POINT	150	0.01	100.0
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	99	0	100.0
Mobile Sources-LPG	2267	NONROAD	76	0	100.0
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	61	0	100.0
Internal Combustion Engines-Engine Testing	2040	POINT	53	0	100.0

Table A-4 (continued)

Category	Category Number	Sector	SO2 Tons/Year	Percent of Total	Cumulative Percent
Industrial Processes-Fabricated Metal Products	309	POINT	52	0	100.0
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	48	0	100.0
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	47	0	100.0
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	30	0	100.0
Mobile Sources-CNG	2268	NONROAD	16	0	100.0
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	13	0	100.0
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	13	0	100.0
External Combustion Boilers-Space Heaters	1050	POINT	12	0	100.0
Industrial Processes-Electrical Equipment	313	POINT	9	0	100.0
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	5	0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	5	0	100.0
Industrial Processes-Transportation Equipment	314	POINT	4	0	100.0
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	4	0	100.0
Industrial Processes-Machinery, Miscellaneous	3129	POINT	3	0	100.0
Industrial Processes-Cooling Tower	3850	POINT	2	0	100.0
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	1	0	100.0
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	1	0	100.0
Internal Combustion Engines-Fugitive Emissions	2888	POINT	1	0	100.0
MACT Source Categories : Vinyl-based Resins	6463	POINT	0	0	100.0
MACT Source Categories : Cellulose-based Resins	644	POINT	0	0	100.0
Industrial Processes-Building Construction	3110	POINT	0	0	100.0
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0	100.0
Industrial Processes-Textile Products	330	POINT	0	0	100.0
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT	0	0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT	0	0	100.0
Petroleum and Solvent Evaporation-	4250	POINT	0	0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT	0	0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0
Graphic Arts	2425	AREA		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA		0	100.0
Industrial Processes-Leather and Leather Products	3209	POINT		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT		0	100.0

Table A-4 (continued)

Category	Category Number	Sector	SO_2		
			Tons/Year	Percent of Total	Cumulative Percent
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Mobile Sources-Paved Roads	2294	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Mobile Sources-Unpaved Roads	2296	POINT		0	100.0
Natural Sources, Biogenic	2701	BIOGENIC		0	100.0
Natural Sources, Geogenic	2730	GEOGENIC		0	100.0
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0
Totals for All Categories			2,687,169	100	

Table A-5. Summary of Annual PM10-PRI and PM25-PRI Emissions for the CENRAP Region by Category, Sector, and Pollutant: Base B Inventory

Category	Category Number	Sector	PM10-PRI Tons/Year	PM10-PRI Percent of Total	PM10-PRI Cumulative Percent	PM25-PRI Tons/Year	PM25-PRI Percent of Total	PM25-PRI Cumulative Percent
Mobile Sources-Unpaved Roads	2296	AREA	3,870,203	50.73	50.73	578,858	31.42	31.42
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	1,465,743	19.21	69.94	298,347	16.19	47.61
Industrial Processes-Construction: SIC 15-17	2311	AREA	528,340	6.93	76.87	105,681	5.74	53.35
Mobile Sources-Paved Roads	2294	AREA	474,726	6.22	83.09	76,380	4.15	57.5
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA	183,304	2.4	85.49	36,660	1.99	59.49
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	175,202	2.3	87.79	138,145	7.5	66.99
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA	96,895	1.27	89.06	14,534	0.79	67.78
Miscellaneous Area Sources-Other Combustion	2810	AREA	83,356	1.09	90.15	71,092	3.86	71.64
External Combustion Boilers-Electric Generation	1010	POINT	72,057	0.94	91.09	47,369	2.57	74.21
Miscellaneous Area Sources-Other Combustion	2810	POINT	63,909	0.84	91.93	54,160	2.94	77.15
Industrial Processes-Food and Agriculture	302	POINT	60,785	0.8	92.73	11,460	0.62	77.77
Stationary Source Fuel Combustion-Residential	2104	AREA	57,225	0.75	93.48	57,036	3.1	80.87
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA	54,806	0.72	94.2	52,111	2.83	83.7
External Combustion Boilers-Industrial	1020	POINT	47,521	0.62	94.82	40,584	2.2	85.9
Stationary Source Fuel Combustion-Industrial	2102	AREA	47,280	0.62	95.44	17,361	0.94	86.84
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	43,478	0.57	96.01	40,576	2.2	89.04
Industrial Processes-Mineral Products	305	POINT	35,961	0.47	96.48	14,426	0.78	89.82
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	32,949	0.43	96.91	27,910	1.51	91.33
Natural Sources, Geogenic	2730	GEOGENIC	32,164	0.42	97.33	7,076	0.38	91.71
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	23,157	0.3	97.63	19,984	1.08	92.79
Mobile Sources-Pleasure Craft	2282	NONROAD	20,637	0.27	97.9	19,085	1.04	93.83
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	15,078	0.2	98.1	14,041	0.76	94.59
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	14,492	0.19	98.29	7,247	0.39	94.98
Industrial Processes-Primary Metal Production	303	POINT	13,492	0.18	98.47	3,183	0.17	95.15
Internal Combustion Engines-Industrial	2020	POINT	13,373	0.18	98.65	13,064	0.71	95.86
Industrial Processes-Chemical Manufacturing	301	POINT	13,220	0.17	98.82	10,340	0.56	96.42
Industrial Processes-Petroleum Industry	306	POINT	12,597	0.17	98.99	10,358	0.56	96.98
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	12,382	0.16	99.15	7,219	0.39	97.37
Mobile Sources-Railroad Equipment	2285	NONROAD	8,991	0.12	99.27	8,110	0.44	97.81
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	6,937	0.09	99.36	6,543	0.36	98.17
Industrial Processes-Cooling Tower	3850	POINT	6,403	0.08	99.44	5,469	0.3	98.47

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI Tons/Year	PM10-PRI Percent of Total	PM10-PRI Cumulative Percent	PM25-PRI Tons/Year	PM25-PRI Percent of Total	PM25-PRI Cumulative Percent
Industrial Processes-Secondary Metal Production	304	POINT	6,103	0.08	99.52	3,804	0.21	98.68
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	5,586	0.07	99.59	5,171	0.28	98.96
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA	3,626	0.05	99.64	96	0.01	98.97
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	3,310	0.04	99.68	1,922	0.1	99.07
Internal Combustion Engines-Electric Generation	2010	POINT	3,271	0.04	99.72	3,177	0.17	99.24
Industrial Processes-In-process Fuel Use	390	POINT	3,264	0.04	99.76	1,187	0.06	99.3
Industrial Processes-Industrial Processes: NEC	2399	AREA	2,815	0.04	99.8	1,950	0.11	99.41
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	2,798	0.04	99.84	2,574	0.14	99.55
External Combustion Boilers-Commercial/Institutional	1030	POINT	1,587	0.02	99.86	1,048	0.06	99.61
Industrial Processes-Fabricated Metal Products	309	POINT	1,235	0.02	99.88	490	0.03	99.64
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	1,186	0.02	99.9	978	0.05	99.69
Waste Disposal-Solid Waste Disposal-Government	501	POINT	976	0.01	99.91	507	0.03	99.72
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA	935	0.01	99.92	664	0.04	99.76
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	756	0.01	99.93	707	0.04	99.8
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	604	0.01	99.94	254	0.01	99.81
Mobile Sources-Aircraft	2275	NONROAD	441	0.01	99.95	349	0.02	99.83
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	438	0.01	99.96	302	0.02	99.85
Industrial Processes-Oil and Gas Production	310	POINT	433	0.01	99.97	413	0.02	99.87
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA	387	0.01	99.98	387	0.02	99.89
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	275	0	99.98	173	0.01	99.9
Industrial Processes-Machinery, Miscellaneous	3129	POINT	258	0	99.98	215	0.01	99.91
Internal Combustion Engines-Commercial/Institutional	2030	POINT	214	0	99.98	214	0.01	99.92
Mobile Sources-LPG	2267	NONROAD	190	0	99.98	188	0.01	99.93
Mobile Sources-Aircraft	2275	POINT	160	0	99.98	113	0.01	99.94
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	158	0	99.98	126	0.01	99.95
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA	131	0	99.98	131	0.01	99.96
MACT Source Categories : Vinyl-based Resins	6463	POINT	118	0	99.98	77	0	99.96
Waste Disposal-Site Remediation	504	POINT	102	0	99.98	65	0	99.96
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA	91	0	99.98	91	0	99.96
Internal Combustion Engines-Engine Testing	2040	POINT	61	0	99.98	55	0	99.96
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	57	0	99.98	40	0	99.96
Bulk Materials Transport & Transport	253	AREA	56	0	99.98	56	0	99.96
Internal Combustion Engines-Fugitive Emissions	2888	POINT	49	0	99.98	47	0	99.96

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI Tons/Year	PM10-PRI Percent of Total	PM10-PRI Cumulative Percent	PM25-PRI Tons/Year	PM25-PRI Percent of Total	PM25-PRI Cumulative Percent
Industrial Processes-Transportation Equipment	314	POINT	46	0	99.98	28	0	99.96
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	41	0	99.98	34	0	99.96
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	40	0	99.98	33	0	99.96
Mobile Sources-CNG	2268	NONROAD	39	0	99.98	38	0	99.96
External Combustion Boilers-Space Heaters	1050	POINT	36	0	99.98	35	0	99.96
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	30	0	99.98	25	0	99.96
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA	26	0	99.98	3	0	99.96
Industrial Processes-Electrical Equipment	313	POINT	23	0	99.98	21	0	99.96
Mobile Sources-Unpaved Roads	2296	POINT	21	0	99.98	21	0	99.96
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT	12	0	99.98	11	0	99.96
Industrial Processes-Leather and Leather Products	3209	POINT	7	0	99.98	2	0	99.96
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	7	0	99.98	6	0	99.96
Industrial Processes-Building Construction	3110	POINT	5	0	99.98	1	0	99.96
MACT Source Categories-Miscellaneous Processes	6824	POINT	4	0	99.98	1	0	99.96
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT	3	0	99.98	3	0	99.96
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	3	0	99.98	2	0	99.96
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT	2	0	99.98	1	0	99.96
Industrial Processes-Textile Products	330	POINT	2	0	99.98	2	0	99.96
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT	2	0	99.98	2	0	99.96
Mobile Sources-Paved Roads	2294	POINT	1	0	99.98	1	0	99.96
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA	1	0	99.98		0	99.96
MACT Source Categories : Agricultural Chemicals Production	631	POINT	0	0	100.0	0	0	99.96
Industrial Processes-Printing and Publishing	3600	POINT	0	0	100.0	0	0	99.96
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0	100.0	0	0	99.96
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT	0	0	100.0	0	0	99.96
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT	0	0	100.0	0	0	100.0
MACT Source Categories : Cellulose-based Resins	644	POINT	0	0	100.0	0	0	100.0
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT	0	0	100.0	0	0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT	0	0	100.0	0	0	100.0

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI Tons/Year	PM10-PRI Percent of Total	PM10-PRI Cumulative Percent	PM25-PRI Tons/Year	PM25-PRI Percent of Total	PM25-PRI Cumulative Percent
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT	0	0	100.0	0	0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT	0	0	100.0	0	0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT	0	0	100.0	0	0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT	0	0	100.0	0	0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	0	0	100.0	0	0	100.0
Architectural Coatings	2401001000	AREA		0	100.0		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0		0	100.0
Degreasing	2415	AREA		0	100.0		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0		0	100.0
Graphic Arts	2425	AREA		0	100.0		0	100.0
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA		0	100.0		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0		0	100.0
Inorganic Chemical Storage & Transport	252	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA		0	100.0		0	100.0
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA		0	100.0		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0		0	100.0
Natural Sources, Biogenic	2701	BIOGENIC		0	100.0		0	100.0
Petroleum and Solvent Evaporation-	4250	POINT		0	100.0		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0		0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA		0	100.0		0	100.0

Table A-5 (continued)

Category	Category Number	Sector	PM10-PRI			PM25-PRI		
			Tons/Year	Percent of Total	Cumulative Percent	Tons/Year	Percent of Total	Cumulative Percent
Traffic Markings	2401008000	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0		0	100.0
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA		0	100.0		0	100.0
Totals for All Categories			7,628,680	100		1,842,252	100	

Table A-6. Summary of Annual NH_3 Emissions for the CENRAP Region by Category, Sector, and Pollutant: Base B Inventory

Category	Category Number	Sector	NH_3 Tons/Year	Percent of Total	Cumulative Percent
Miscellaneous Area Sources-Agricultural Production-Crops	2801	AREA	561,194	31.94	31.94
Miscellaneous Area Sources-Agriculture Production-Livestock-Cattle and Calves Waste Emissions	280502	AREA	243,489	13.86	45.8
Miscellaneous Area Sources-Agriculture Production-Livestock-Swine	2805025	AREA	187,598	10.68	56.48
Industrial Processes-Food and Agriculture	302	POINT	158,370	9.01	65.49
Miscellaneous Area Sources-Agriculture Production-Livestock-Poultry	2805030	AREA	138,222	7.87	73.36
Miscellaneous Area Sources-Agriculture Production-Livestock-Beef Cattle	280500	AREA	118,941	6.77	80.13
Mobile Sources-Highway Vehicles-Gasoline	2201	ON-ROAD	48,820	2.78	82.91
Natural Sources, Biogenic	2701	BIOGENIC	44,688	2.54	85.45
Miscellaneous Area Sources-Domestic Animals Waste Emissions	2806	AREA	36,178	2.06	87.51
Industrial Processes-Industrial Processes: NEC	2399	AREA	33,960	1.93	89.44
Miscellaneous Area Sources-Other Combustion	2810	AREA	32,051	1.82	91.26
Miscellaneous Area Sources-Wild Animals Waste Emissions	2807	AREA	23,443	1.33	92.59
Miscellaneous Area Sources-Agricultural Production-Crops-Field Burning	28015	AREA	22,612	1.29	93.88
Miscellaneous Area Sources-Agriculture Production-Livestock-Dairy Cattle	280501	AREA	22,407	1.28	95.16
Industrial Processes-Chemical Manufacturing	301	POINT	13,390	0.76	95.92
Industrial Processes-Food and Kindred Products: SIC 20	2302	AREA	12,727	0.72	96.64
Miscellaneous Area Sources-Agriculture Production-Livestock-Horses and Ponies	2805035	AREA	10,750	0.61	97.25
Miscellaneous Area Sources-Agriculture Production-Livestock-Goats	2805045	AREA	8,483	0.48	97.73
Miscellaneous Area Sources-Other Combustion	2810	POINT	6,116	0.35	98.08
Waste Disposal-Solid Waste Disposal-Commercial/Institutional	502	POINT	4,521	0.26	98.34
Miscellaneous Area Sources-Agriculture Production-Livestock-Sheep and Lambs	2805040	AREA	4,247	0.24	98.58
External Combustion Boilers-Electric Generation	1010	POINT	4,172	0.24	98.82
External Combustion Boilers-Space Heaters	1050	POINT	3,752	0.21	99.03
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	AREA	3,343	0.19	99.22
Waste Disposal, Treatment, and Recovery-Wastewater Treatment	2630	AREA	3,216	0.18	99.4
Stationary Source Fuel Combustion-Industrial	2102	AREA	1,951	0.11	99.51
Mobile Sources-Highway Vehicles-Diesel	2230	ON-ROAD	1,497	0.09	99.6
Waste Disposal, Treatment, and Recovery-Landfills	2620	AREA	1,061	0.06	99.66
Industrial Processes-Pulp and Paper and Wood Products	307	POINT	1,015	0.06	99.72
Industrial Processes-Petroleum Industry	306	POINT	1,003	0.06	99.78
Waste Disposal-Solid Waste Disposal-Government	501	POINT	974	0.06	99.84
Mobile Sources-CNG	2268	NONROAD	838	0.05	99.89
Stationary Source Fuel Combustion-Commercial/Institutional	2103	AREA	307	0.02	99.91
Industrial Processes-Mineral Products	305	POINT	249	0.01	99.92
Mobile Sources-Off-highway Vehicle Diesel	2270	NONROAD	217	0.01	99.93
External Combustion Boilers-Commercial/Institutional	1030	POINT	209	0.01	99.94
Internal Combustion Engines-Electric Generation	2010	POINT	164	0.01	99.95
Mobile Sources-Railroad Equipment	2285	NONROAD	147	0.01	99.96
External Combustion Boilers-Industrial	1020	POINT	142	0.01	99.97
Petroleum and Solvent Evaporation-Organic Chemical Storage	407	POINT	126	0.01	99.98
Stationary Source Fuel Combustion-Residential	2104	AREA	91	0.01	99.99
Waste Disposal-Solid Waste Disposal-Industrial	503	POINT	87	0	99.99

Table A-6 (continued)

Category	Category Number	Sector	NH3 Tons/Year	Percent of Total	Cumulative Percent
Mobile Sources-Pleasure Craft	2282	NONROAD	79	0	99.99
Internal Combustion Engines-Industrial	2020	POINT	62	0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	NONROAD	37	0	100.0
Waste Disposal, Treatment, and Recovery-Landfills	2620	POINT	36	0	100.0
Mobile Sources-Marine Vessels, Commercial	2280	NONROAD	32	0	100.0
Inorganic Chemical Storage & Transport	252	AREA	22	0	100.0
Industrial Processes-Miscellaneous Manufacturing Industries	399	POINT	19	0	100.0
Petroleum and Solvent Evaporation-Surface Coating Operations	402	POINT	16	0	100.0
Miscellaneous Area Sources-Prescribed Rangeland Burning	2810020	POINT	16	0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 2-Stroke	2260	NONROAD	15	0	100.0
Industrial Processes-Rubber and Miscellaneous Plastics Products	308	POINT	14	0	100.0
Industrial Processes-Secondary Metal Production	304	POINT	4	0	100.0
Petroleum and Solvent Evaporation-Petroleum Product Storage at Refineries	403	POINT	3	0	100.0
Industrial Processes-In-process Fuel Use	390	POINT	2	0	100.0
Petroleum and Solvent Evaporation-Organic Solvent Evaporation	401	POINT	1	0	100.0
Industrial Processes-Electrical Equipment	313	POINT	1	0	100.0
MACT Source Categories : Vinyl-based Resins	6463	POINT	1	0	100.0
Stationary Source Fuel Combustion-Electric Utility	2101	AREA	1	0	100.0
Industrial Processes-Oil and Gas Production	310	POINT	0	0	100.0
Mobile Sources-Aircraft	2275	NONROAD	0	0	100.0
Petroleum and Solvent Evaporation-Organic Chemical Transportation	4089	POINT	0	0	100.0
Petroleum and Solvent Evaporation-Transportation and Marketing of Petroleum Products	406	POINT	0	0	100.0
Industrial Processes-Fabricated Metal Products	309	POINT	0	0	100.0
Petroleum and Solvent Evaporation-Printing/Publishing	405	POINT	0	0	100.0
Internal Combustion Engines-Engine Testing	2040	POINT	0	0	100.0
Internal Combustion Engines-Commercial/Institutional	2030	POINT	0	0	100.0
Industrial Processes-Photo Equip/Health Care/Labs/Air Condit/SwimPools	3150	POINT	0	0	100.0
Industrial Processes-Primary Metal Production	303	POINT	0	0	100.0
Internal Combustion Engines-Fugitive Emissions	2888	POINT	0	0	100.0
Mobile Sources-LPG	2267	NONROAD	0	0	100.0
Architectural Coatings	2401001000	AREA		0	100.0
Auto Refinishing	2401005000	AREA		0	100.0
Bulk Materials Transport & Transport	253	AREA		0	100.0
Degreasing	2415	AREA		0	100.0
Gas Marketing Stage I	25010600	AREA		0	100.0
Graphic Arts	2425	AREA		0	100.0
Industrial Processes-Building Construction	3110	POINT		0	100.0
Industrial Processes-Construction: SIC 15-17	2311	AREA		0	100.0
Industrial Processes-Cooling Tower	3850	POINT		0	100.0
Industrial Processes-Leather and Leather Products	3209	POINT		0	100.0
Industrial Processes-Machinery, Miscellaneous	3129	POINT		0	100.0
Industrial Processes-Mining and Quarrying: SIC 14	2325	AREA		0	100.0
Industrial Processes-Oil and Gas Production: SIC 13	2310	AREA		0	100.0
Industrial Processes-Printing and Publishing	3600	POINT		0	100.0
Industrial Processes-Textile Products	330	POINT		0	100.0
Industrial Processes-Transportation Equipment	314	POINT		0	100.0
Industrial Surface Coating	2401015000	AREA		0	100.0
Internal Combustion Engines-Off-highway Diesel Engines	2700	POINT		0	100.0
MACT Source Categories : Agricultural Chemicals Production	631	POINT		0	100.0
MACT Source Categories : Cellulose-based Resins	644	POINT		0	100.0

Table A-6 (continued)

Category	Category Number	Sector	NH_3 Tons/Year	NH_3 Percent of Total	NH_3 Cumulative Percent
MACT Source Categories : Consumer Product Manufacturing Facilities	6818	POINT		0	100.0
MACT Source Categories : Food and Agricultural Processes	6258	POINT		0	100.0
MACT Source Categories : Styrene or Methacrylate Based Resins	6413	POINT		0	100.0
MACT Source Categories-Inorganic Chemicals Manufacturing	6513	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6824	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes	6828	POINT		0	100.0
MACT Source Categories-Miscellaneous Processes (Chemicals)	6848	POINT		0	100.0
MACT Source Categories-Miscellaneous Resins	6452	POINT		0	100.0
Miscellaneous Area Sources-Agricultural Production-Crops-Tilling & Harvesting	28010	AREA		0	100.0
Miscellaneous Area Sources-Aircraft/Rocket Engine Firing and Testing	2810040	AREA		0	100.0
Miscellaneous Area Sources-Catastrophic/Accidental Releases	2830	AREA		0	100.0
Mobile Sources-Aircraft	2275	AREA		0	100.0
Mobile Sources-Aircraft	2275	POINT		0	100.0
Mobile Sources-Highway Vehicles-Diesel	2230	AREA		0	100.0
Mobile Sources-Off-highway Vehicle Diesel	2270	POINT		0	100.0
Mobile Sources-Off-highway Vehicle Gasoline, 4-Stroke	2265	POINT		0	100.0
Mobile Sources-Paved Roads	2294	AREA		0	100.0
Mobile Sources-Paved Roads	2294	POINT		0	100.0
Mobile Sources-Unpaved Roads	2296	AREA		0	100.0
Mobile Sources-Unpaved Roads	2296	POINT		0	100.0
Natural Sources, Geogenic	2730	GEOGENIC		0	100.0
Open Burning-Waste Disposal, Treatment, and Recovery	261	AREA		0	100.0
Petroleum and Petroleum Product Storage & Transport-Other	250	AREA		0	100.0
Petroleum and Solvent Evaporation-	4250	POINT		0	100.0
Petroleum and Solvent Evaporation : Dry Cleaning	410	POINT		0	100.0
Petroleum and Solvent Evaporation : Organic Chemical Transportation	4088	POINT		0	100.0
Petroleum and Solvent Evaporation-Petroleum Liquids Storage (non-Refinery)	4040	POINT		0	100.0
Rubber/Plastics	2430000000	AREA		0	100.0
Solvent Utilization-Dry Cleaning	2420	AREA		0	100.0
Solvent Utilization-Miscellaneous Industrial	2440020000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Commercial	24610 - 24	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer	2465000000	AREA		0	100.0
Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial	24600 - 24	AREA		0	100.0
Traffic Markings	2401008000	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-Leaking Underground Storage Tanks	2660	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-On-site Incineration	2601	AREA		0	100.0
Waste Disposal, Treatment, and Recovery-TSDFs	2640	AREA		0	100.0
Waste Disposal-Site Remediation	504	POINT		0	100.0
Totals for All Categories			1,757,129	100	

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APPENDIX 7.1-D

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EMISSION INVENTORY DEVELOPMENT FOR MOBILE SOURCES AND AGRICULTURAL DUST SOURCES FOR THE CENTRAL STATES

DRAFT FINAL REPORT
STI-903574-2611-DFR

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October 28, 2004

QUALITY ASSURANCE STATEMENT

This report was reviewed and approved by the project Quality Assurance (QA) Officer or his delegated representatives, as provided in the project QA Plan (Sullivan, 2004).

Lyle R. Chinkin
Project QA Officer

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EXECUTIVE SUMMARY

The Central States Regional Air Planning Association (CENRAP) is researching visibility-related issues for its region and is developing a regional haze plan in response to the U.S. Environmental Protection Agency's (EPA) mandate to protect visibility in Class I areas. Mobile sources (both on- and off-road) and agricultural dust sources contribute to episodes of impaired visibility in the CENRAP region. Therefore, in support of the CENRAP's need to develop a regional haze plan, Sonoma Technology, Inc. (STI) developed emission inventories for on-road and off-road mobile sources and agricultural fugitive dust.

Appendix A, Emission Estimation Methods for Mobile Sources and Agricultural Dust Sources in the Central States, details the methods used throughout inventory development. Methods were based on EPA-accepted emissions models (e.g., NONROAD, SMOKE, and MOBILE6), emission factors gathered from EPA guidance documents or published literature, and geographic information systems (GIS) databases. Activity data sets were prepared using bottom-up methods or region-specific information whenever possible. Examples of bottom-up and region-specific data include the following:

- Facility-level estimates of cattle populations for confined animal feeding operations (CAFOs)
- Activity data gathered through telephone surveys to describe recreational boating and agricultural tilling activities
- Local activity data for commercial marine vessels and locomotives gathered directly from local agencies and industry sources, such as individual port operators and rail lines
- MOBILE6 inputs and vehicle activity data acquired from state and local information sources, including vehicle miles traveled (VMT), fleet characteristics, regulatory controls, and fuels characteristics (see Appendix C)
- Fuels characteristics acquired from state and local information sources and used as inputs for NONROAD 2004 when appropriate (see Appendix C)

Figures ES-1 and ES-2 illustrate highlights of the resultant emission inventories for on-road mobile sources, non-road mobile sources, and agricultural fugitive dust. The inventories are also tabulated in Appendix B, provided in electronic form in Appendix D, and illustrated in greater detail throughout the body of the report. In many respects, the CENRAP inventories represent substantial improvements and differ significantly from existing inventories, such as the 1999 National Emissions Inventory (NEI) and preliminary 2002 NEI, which were prepared with default guidance, national average activity data, or top-down disaggregation techniques. Some of the most important improvements include the spatial and temporal allocations of the CENRAP inventories, which are more representative and could significantly enhance efforts to perform photochemical modeling. In addition, the use of bottom-up data will lend credibility to any scientific conclusions that may be based on the CENRAP's emission inventories.

Figure ES-1 compares the CENRAP inventory to the preliminary 2002 NEI. Emissions totals of selected pollutants are plotted for the entire CENRAP region. Large revisions to the region-wide annual emissions for specific source categories produced only minor *apparent* changes in the region-wide annual totals for all source categories. However, the use of region-wide annual totals as the basis of comparison masks the importance of large changes in state-level inventories and spatial and temporal distributions. It also underrates the disproportionate influences of certain source types on visibility in Class I areas. Class I areas are often remote and far removed from the urban areas that contribute most to region-wide inventories. Sources that tend to concentrate away from urban areas—e.g., recreational boating, agricultural activities, etc.—are likely to affect visibility in Class I areas to a greater degree than might be expected if only the relative magnitudes of their emissions are considered.

The most significant revision to the $PM_{2.5}$ emission inventory—a 22% reduction in estimated annual emissions for agricultural fugitive dust sources—was due mostly to improvements in the activity data for tilling operations. As a result of this and other more modest revisions, total $PM_{2.5}$ emissions in the CENRAP inventory are 4% less than those estimated for the preliminary 2002 NEI. Annual NO_x emissions from commercial marine vessels were estimated to be 69% less than those estimated for the preliminary 2002 NEI; and primarily as a result of this, total NO_x emissions estimated for the CENRAP are 4% less than those recorded in the preliminary 2002 NEI. Annual VOC emissions estimated for the CENRAP were 8% greater than those estimated for the preliminary 2002 NEI—a difference mostly due to improved activity data for recreational boating. The CENRAP's VOC inventory for recreational boating is more than a factor of two larger than that incorporated in the preliminary 2002 NEI. Total SO_x emissions estimated for the CENRAP are 2% less than those estimated for the preliminary 2002 NEI. This difference was due to the use of region-specific measurements of fuel sulfur contents rather than default guidance assumptions, and it corresponds primarily to 42% and 85% reductions in SO_x emissions from commercial marine vessels and "other" non-road mobile sources, respectively.[1]

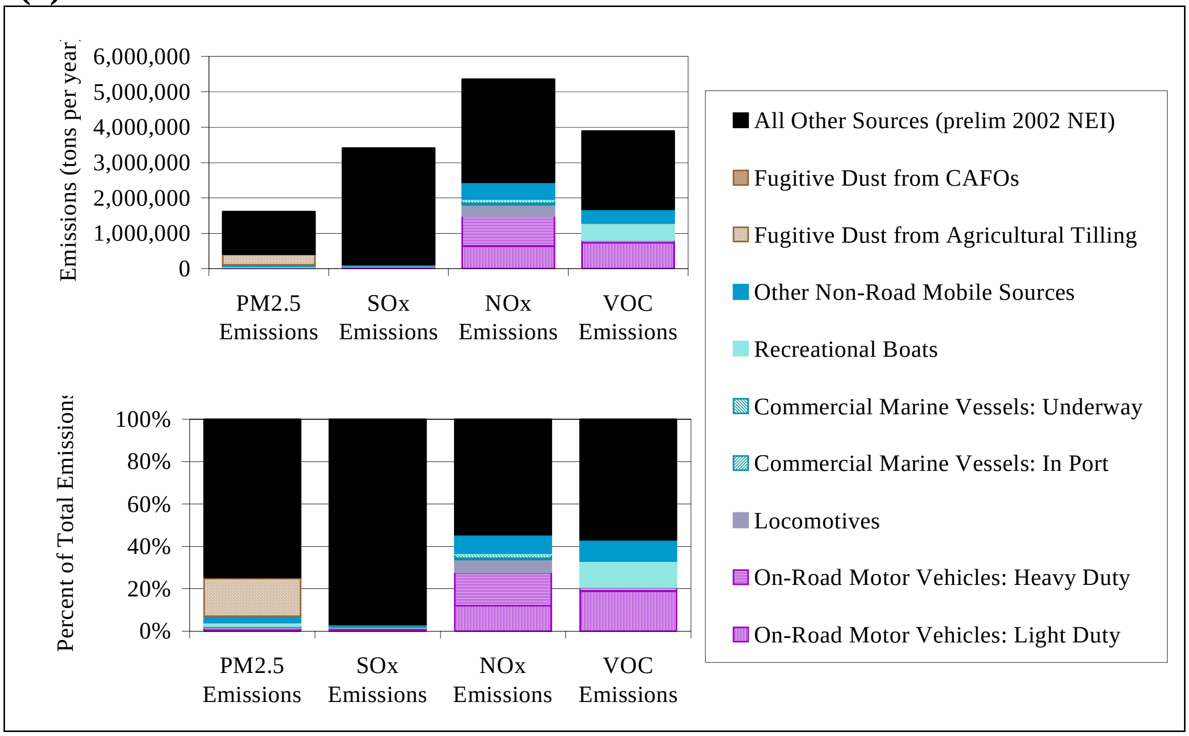
Figure ES-2 illustrates selected temporal profiles developed for or applied to the CENRAP inventories. Recent research has demonstrated that emissions from on-road mobile sources follow dramatically different patterns on weekend days than on weekdays, that patterns for light-duty vehicles are unique compared to those of heavy-duty vehicles, and that activities in rural areas differ from those in urban areas (Chinkin et al., 2003; Lawson, 2003; Croes et al., 2003). The CENRAP inventories reflect this latest understanding of weekday-weekend activity patterns for on-road mobile sources. The weekday-weekend activity patterns for recreational boating, which were based on surveys of representative groups of recreational boat owners in the CENRAP region, are even more dramatic than those of on-road mobile sources. Recreational boating activities tend to be extremely concentrated on weekends (whereas the reverse is true for on-road mobile sources and to a more moderate degree) and to vary diurnally and seasonally by type of boat and geographic area. Seasonal patterns for commercial marine vessels and agricultural tilling operations—also based on bottom-up data collection efforts—are related to the climates and crop types prevalent in different geographic areas.

In summary, the CENRAP inventories of mobile sources and agricultural fugitive dust are highly region-specific, or even county-specific, and adhere closely to EPA's recommended guidance for inventory development. Additional refinements and improvements should be

[1] "Other" non-road mobile sources include all non-road mobiles sources other than locomotives, commercial marine vessels, recreational boats, and aircraft.

incorporated as better information become available. Recommended areas for future efforts and further research include (1) development of information to support day-of-week inventories (i.e., Sunday, Monday, Tuesday, etc.), rather than weekday-weekend inventories; (2) development and/or acquisition of local data as they become available (e.g., metropolitan VMT data, fuels testing programs); (3) investigation of state motor vehicle departments' records of vehicle registrations, including duplicate records and unusual age distributions; (4) use of vehicle registration records to adjust and refine VMT distributions by vehicle type; (5) continuation of bottom-up activity data acquisition for additional types of non-road mobile sources and sources of agricultural fugitive dust (such as agricultural equipment, construction and mining equipment, recreational all-terrain vehicles (ATVs), lawn and garden equipment, cotton ginning operations, and/or crop transport); and (6) development of process-based methods or emission factors to improve inventories of agricultural fugitive dust emissions.

(a)



(b)

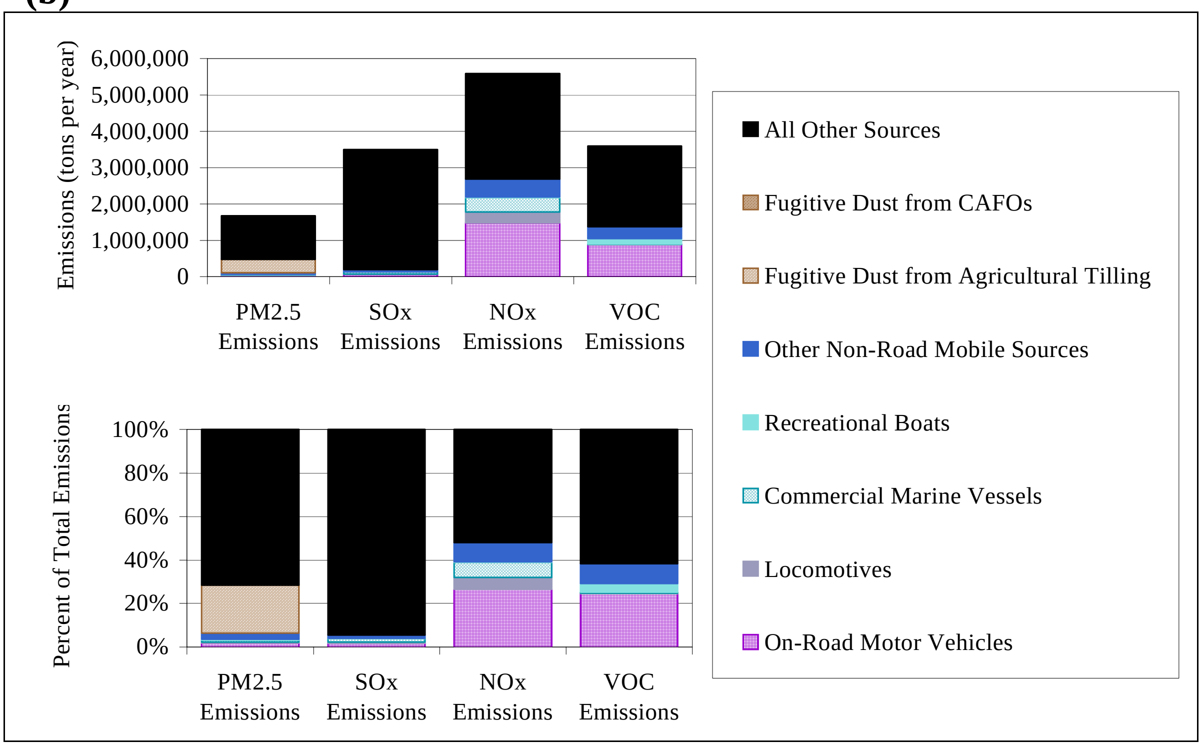


Figure ES-1. Annual emissions in the CENRAP region of selected pollutants as (a) calculated for the CENRAP for year 2002, and (b) recorded in the 1999 NEI or 2002 preliminary NEI.

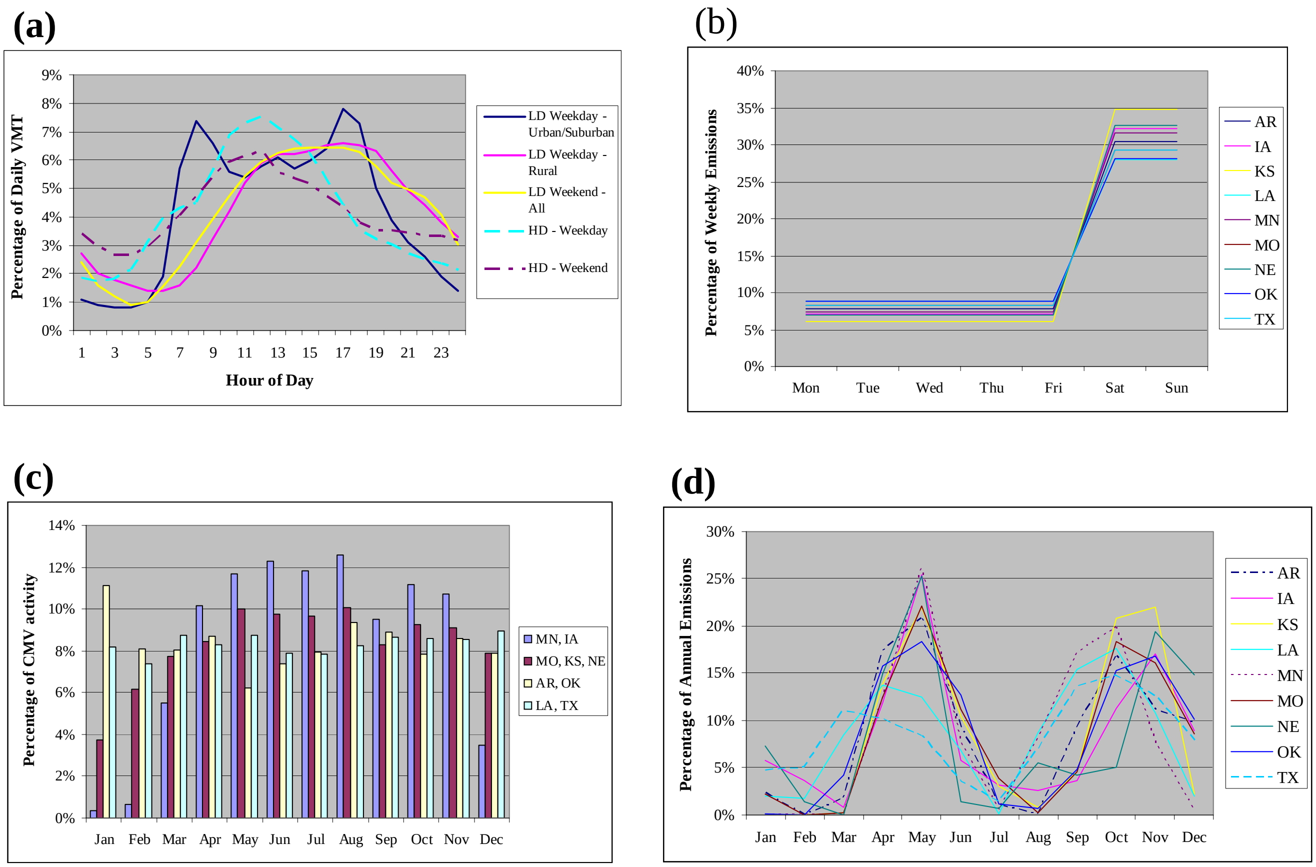


Figure ES-2. Selected temporal patterns, including (a) diurnal patterns for on-road mobile sources, (b) day-of-week patterns for recreational boats, (c) monthly patterns for commercial marine vessels by state, and (d) monthly patterns for agricultural tilling dust.

1. INTRODUCTION

The Central States Regional Air Planning Association (CENRAP) is developing a regional haze plan in response to the U.S. Environmental Protection Agency's (EPA) mandate to protect visibility in Class I areas.[2] To develop an effective regional haze plan, the CENRAP ultimately must develop a conceptual model of the phenomena that lead to episodes of low visibility in the CENRAP region. Thus, the CENRAP is researching visibility-related issues for its region, which includes Texas, Oklahoma, Louisiana, Arkansas, Kansas, Missouri, Nebraska, Iowa, and Minnesota. Both primary particulate matter (which is emitted directly to the atmosphere in particulate form) and the formation of secondary particulate matter (which is generated from chemical transformations in the atmosphere of gaseous precursor species such as ammonia, nitrogen oxides, sulfur oxides, and volatile organic compounds) contribute to regional haze issues in the CENRAP region. In recognition of these issues, the CENRAP sponsored the development of improved emission inventories for mobile sources and sources of agricultural dust.

In support of the CENRAP's need to develop a regional haze plan, Sonoma Technology, Inc. (STI) conducted CENRAP Work Assignment Number 03-0214-RP-003-004, "Mobile Source and Agricultural Dust Emission Inventory Development for the Central States." Consistent with the project goals presented in the Work Plan and Methods Document (Sullivan, 2004; Reid et al., 2004b), emissions were calculated for on-road mobile sources, off-road mobile sources, and sources of fugitive agricultural dust throughout the CENRAP region. Bottom-up or region-specific activity data were developed to model emissions from these source categories. These data were developed for compatibility with the MOBILE6 and NONROAD models; SMOKE 1.5 (which runs MOBILE6 internally); and the latest version of the National Emission Inventory Input Format (NIF).

1.1 BACKGROUND AND KEY ISSUES

1.1.1 Prior Status of the Emission Inventories

As a whole, few areas of the CENRAP region have experienced significant air quality problems in the past. Therefore, emission inventories and regionally representative activity data are relatively incomplete or scarce. In most areas of the CENRAP, existing emission inventories are based on the EPA's nationally representative defaults, which could be greatly improved with local or region-specific data, such as region-specific or state-specific fleet characteristics and improved vehicle miles traveled (VMT) estimates for rural areas. Prior to the completion of this project, the most comprehensive source of emissions estimates available for the CENRAP region was the EPA's National Emissions Inventory (NEI), which is used as the basis of the EPA's National Emission Trends (NET) document series and analyses (U.S. Environmental Protection Agency, 2003a, 2004a). In the NEI, estimates of emissions from mobile sources and sources of agricultural dust in the CENRAP region amount to 4% to 49% of the total inventories of nitrogen

[2] Class I areas include national parks, wilderness areas, and national monuments. These areas have been granted special air quality protections under the federal Clean Air Act.

oxides (NO_x), volatile organic compounds (VOC), particulate matter of 2.5 microns aerodynamic diameter or less ($PM_{2.5}$), sulfur dioxide (SO_2), and ammonia (NH_3) for the region (see **Table 1-1**). The NEI indicates that fugitive dust from agricultural tilling operations is a significant $PM_{2.5}$ source, particularly in of Iowa, Kansas, and Nebraska. Mobile sources are a significant source of NO_x and VOC, particularly in Minnesota and Missouri.

The most significant sources of uncertainties in the NEI are associated with the national-scale representativeness and top-down methods that were applied to generate the inventory (approaches that were dictated by resource constraints). The results of this project substantially address these weaknesses of the NEI for the CENRAP region. As a result, the emission inventories produced through this project differ significantly from the emissions estimates in the NEI in a number of areas.

Table 1-1. Estimates of emissions in the CENRAP region from the preliminary 2002 NEI (U.S. Environmental Protection Agency, 2004a).

Page 1 of 2

	NO_x		VOC		PM_{25}		SO_2		NH_3	
State	tons/year	percent	tons/year	percent	tons/year	percent	tons/year	percent	tons/year	percent
Arkansas										
On-road Mobile	88,781	38%	49,525	9%	1,869	2%	3,610	2%	3,005	2%
Non-road Mobile	63,117	27%	30,343	5%	4,068	5%	6,665	3%	41	0%
Ag Dust (Tilling)	0	0%	0	0%	26,577	32%	0	0%	0	0%
Stationary Sources	83,253	35%	484,229	86%	50,494	61%	201,450	95%	129,188	98%
All Sources	235,151	100%	564,098	100%	83,008	100%	211,725	100%	132,234	100%
Iowa										
On-road Mobile	91,840	29%	50,816	23%	1,894	2%	3,520	1%	3,065	1%
Non-road Mobile	85,277	27%	34,771	16%	7,125	6%	8,735	4%	77	0%
Ag Dust (Tilling)	0	0%	0	0%	53,054	44%	0	0%	0	0%
Stationary Sources	135,678	43%	135,757	61%	57,649	48%	233,916	95%	223,502	99%
All Sources	312,796	100%	221,344	100%	119,722	100%	246,171	100%	226,644	100%
Kansas										
On-road Mobile	82,475	23%	48,692	25%	1,680	1%	3,192	2%	2,889	2%
Non-road Mobile	81,868	23%	24,426	13%	6,048	4%	7,598	5%	65	0%
Ag Dust (Tilling)	0	0%	0	0%	67,217	42%	0	0%	0	0%
Stationary Sources	198,667	55%	120,478	62%	85,377	53%	146,752	93%	135,475	98%
All Sources	363,010	100%	193,595	100%	160,322	100%	157,542	100%	138,429	100%
Louisiana										
On-road Mobile	119,067	16%	72,130	22%	2,488	2%	4,868	1%	4,220	6%
Non-road Mobile	230,407	31%	55,827	17%	11,342	10%	33,028	9%	52	0%
Ag Dust (Tilling)	0	0%	0	0%	12,649	11%	0	0%	0	0%
Stationary Sources	398,375	53%	193,623	60%	87,899	77%	347,159	90%	61,320	93%
All Sources	747,849	100%	321,581	100%	114,379	100%	385,054	100%	65,591	100%
Minnesota										
On-road Mobile	153,145	35%	87,926	23%	3,010	2%	4,168	3%	5,482	3%
Non-road Mobile	113,288	26%	97,023	25%	9,469	5%	12,395	8%	99	0%
Ag Dust (Tilling)	0	0%	0	0%	50,009	25%	0	0%	0	0%
Stationary Sources	171,536	39%	196,362	51%	136,045	69%	135,908	89%	160,447	97%
All Sources	437,969	100%	381,311	100%	198,534	100%	152,471	100%	166,028	100%

Table 1-1. Estimates of emissions in the CENRAP region from the preliminary 2002 NEI (U.S. Environmental Protection Agency, 2004a).

	NO_x		VOC		PM_{25}		SO_2		NH_3	
State	tons/year	percent	tons/year	percent	tons/year	percent	tons/year	percent	tons/year	percent
Missouri										
On-road Mobile	188,404	36%	109,927	31%	3,877	2%	6,845	2%	6,958	6%
Non-road Mobile	117,011	22%	55,279	15%	7,363	4%	12,034	3%	71	0%
Ag Dust (Tilling)	0	0%	0	0%	27,251	14%	0	0%	0	0%
Stationary Sources	216,722	42%	193,867	54%	163,294	81%	353,408	95%	112,354	94%
All Sources	522,137	100%	359,073	100%	201,784	100%	372,287	100%	119,383	100%
Nebraska										
On-road Mobile	55,284	25%	31,291	24%	1,131	1%	2,094	2%	1,850	1%
Non-road Mobile	89,946	41%	18,882	15%	5,323	5%	7,394	8%	49	0%
Ag Dust (Tilling)	0	0%	0	0%	38,068	38%	0	0%	0	0%
Stationary Sources	73,046	33%	77,809	61%	55,683	56%	83,563	90%	133,536	99%
All Sources	218,276	100%	127,982	100%	100,204	100%	93,051	100%	135,435	100%
Oklahoma										
On-road Mobile	126,710	30%	77,579	30%	2,615	2%	5,756	3%	4,468	4%
Non-road Mobile	51,962	12%	30,513	12%	3,940	3%	4,736	2%	45	0%
Ag Dust (Tilling)	0	0%	0	0%	27,732	19%	0	0%	0	0%
Stationary Sources	242,264	58%	150,107	58%	111,473	76%	182,502	95%	110,303	96%
All Sources	420,937	100%	258,199	100%	145,759	100%	192,994	100%	114,815	100%
Texas										
On-road Mobile	577,082	25%	349,211	30%	11,778	2%	23,343	1%	22,340	7%
Non-road Mobile	377,155	16%	153,570	13%	21,998	4%	42,373	3%	210	0%
Ag Dust (Tilling)	0	0%	0	0%	67,342	12%	0	0%	0	0%
Stationary Sources	1,377,264	59%	661,726	57%	453,992	82%	1,622,787	96%	278,886	93%
All Sources	2,331,502	100%	1,164,507	100%	555,111	100%	1,688,503	100%	301,436	100%
All States										
On-road Mobile	1,482,789	27%	877,097	24%	30,342	2%	57,397	2%	54,277	4%
Non-road Mobile	1,210,032	22%	500,634	14%	76,677	5%	134,957	4%	708	0%
Ag Dust (Tilling)	0	0%	0	0%	369,899	22%	0	0%	0	0%
Stationary Sources	2,896,806	52%	2,213,958	62%	1,201,905	72%	3,307,446	95%	1,345,010	96%
All Sources	5,589,626	100%	3,591,689	100%	1,678,823	100%	3,499,799	100%	1,399,995	100%

1.1.2 Current Status of the CENRAP Emission Inventories

As detailed in the attached Methods Document (Appendix A), emissions estimates were prepared for mobile sources and sources of agricultural dust throughout the CENRAP region. These emission inventories were prepared with EPA-accepted emissions models (e.g., NONROAD, SMOKE, and MOBILE6), emission factors gathered from EPA guidance documents or published literature, and geographic information systems (GIS) databases of land cover. All activity data sets were prepared using bottom-up methods or region-specific information whenever possible.

The MOBILE6 emissions model, the EPA's approved emission factor model for on-road mobile sources, was operated within SMOKE 1.5 to produce emission factors for January and July at the county level. Spatially and temporally distributed MM5 temperature fields for each day in January and July 2002 were averaged and used as inputs for these MOBILE6 runs so that outputs would represent an entire month rather than a specific episode date. The MOBILE6 outputs were matched with region-specific, county-level estimates of VMT, which also were distributed seasonally and by day of week according to temporal profiles, to estimate county-level emissions for the winter and summer runs. January and July emissions were averaged to estimate annual emissions at the county level. MOBILE6 inputs were prepared at the county level to represent region-specific fleet distributions, fuels characteristics (which can also vary by season), and local regulations (e.g., inspection and maintenance programs, etc.).

The latest version of the NONROAD emissions model (NONROAD 2004), the EPA's approved emission factor model for most off-road mobile sources, was used to produce emissions estimates at the county level for most off-road sources. In addition, EPA guidance documents were consulted for emissions estimation methods for locomotives and commercial marine vessels (U.S. Environmental Protection Agency, 1999c, 1998b, 2000, 2003b, 1999a, 1997, 1992). Bottom-up activity data were gathered for recreational boats, locomotives, and commercial marine vessels—considered to be the most important or uncertain off-road mobile sources affecting regional haze in the CENRAP region. For other source categories, NONROAD default activity data were used in conjunction with region-specific fuels information to estimate emissions. Emissions from aircraft were considered to be a lower priority than other nonroad mobile sources and were not included in the scope of this project.

The Emission Inventory Improvement Program and recent research findings from the University of California at Davis and Texas A&M University were consulted for emission factors and emissions estimation methods for agricultural fugitive dust sources (U.S. Environmental Protection Agency, 2004b; Goodrich et al., 2002; Flocchini and James, 2001). County-level annual emission inventories were prepared for agricultural tilling operations and confined animal feeding operations (CAFOs). Bottom-up activity data included facility-specific animal populations developed for CAFOs in the CENRAP region (Coe and Reid, 2003), agricultural tilling activity information developed through systematic telephone surveys of county agricultural extension services (AES) throughout the CENRAP region (Reid et al., 2004a), and county-level estimates of crop-acreages in 2002 from the National Agricultural Statistics Service (NASS).

The resulting emission inventories are illustrated in **Figures 1-1 through 1-6** and tabulated in Appendix B. In all cases, the inventories were based on generally accepted emission factors and the most complete and up-to-date activity data sets that could be identified and acquired. However, we recognize that available emission factors are uncertain and continue to be the subject of research. In anticipation of future efforts to improve emissions estimation techniques and to further develop or improve the CENRAP's inventories, the deliverables of this project include systems of data files that can be updated with revised emission factors, activity data, and/or emissions estimates as new information becomes available (see Appendix D).

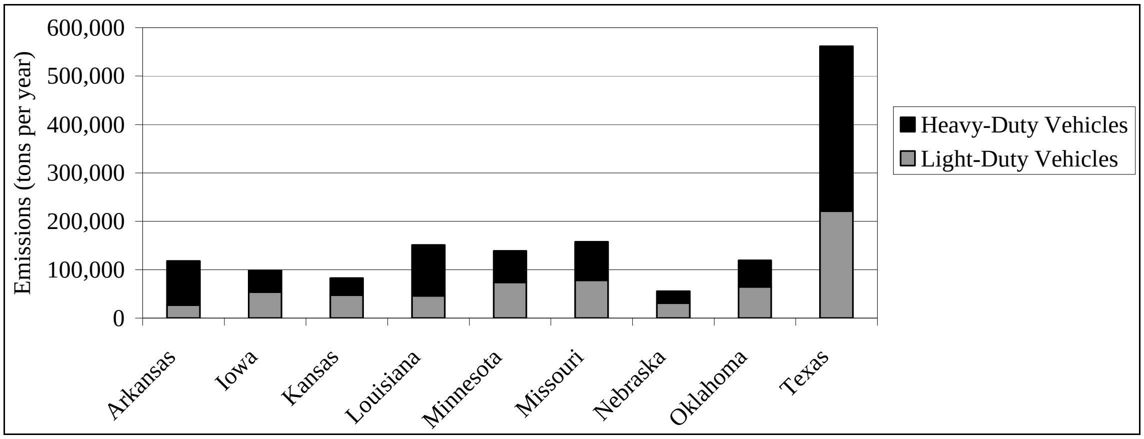


Figure 1-1. Year-2002 emissions of NO_x from on-road mobile sources in the CENRAP region.

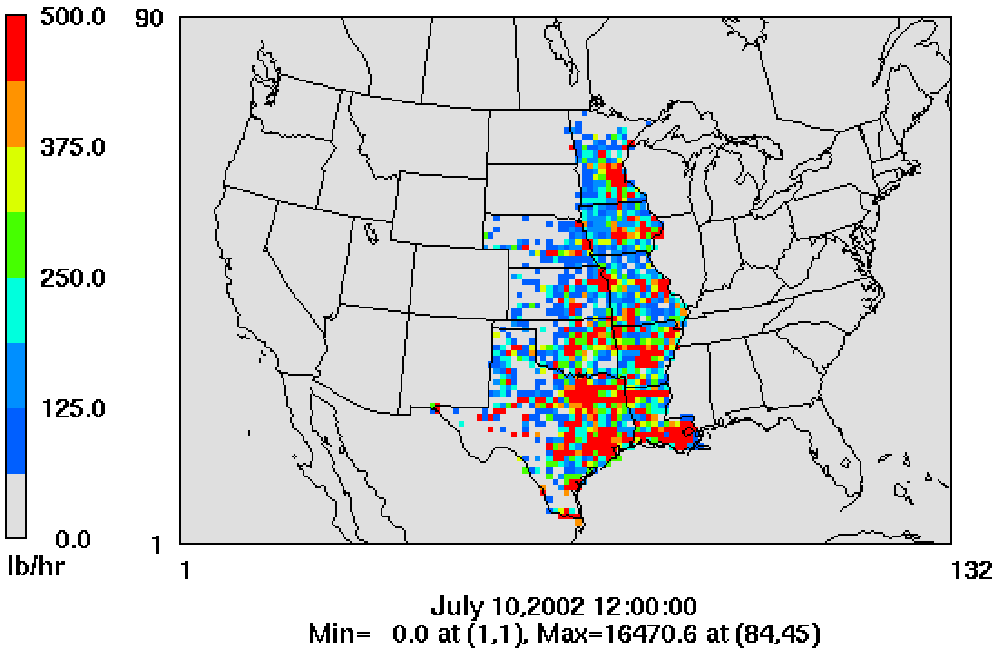


Figure 1-2. Geographic distribution of on-road mobile source emissions of NO_x in the CENRAP states on July 10, 2002.

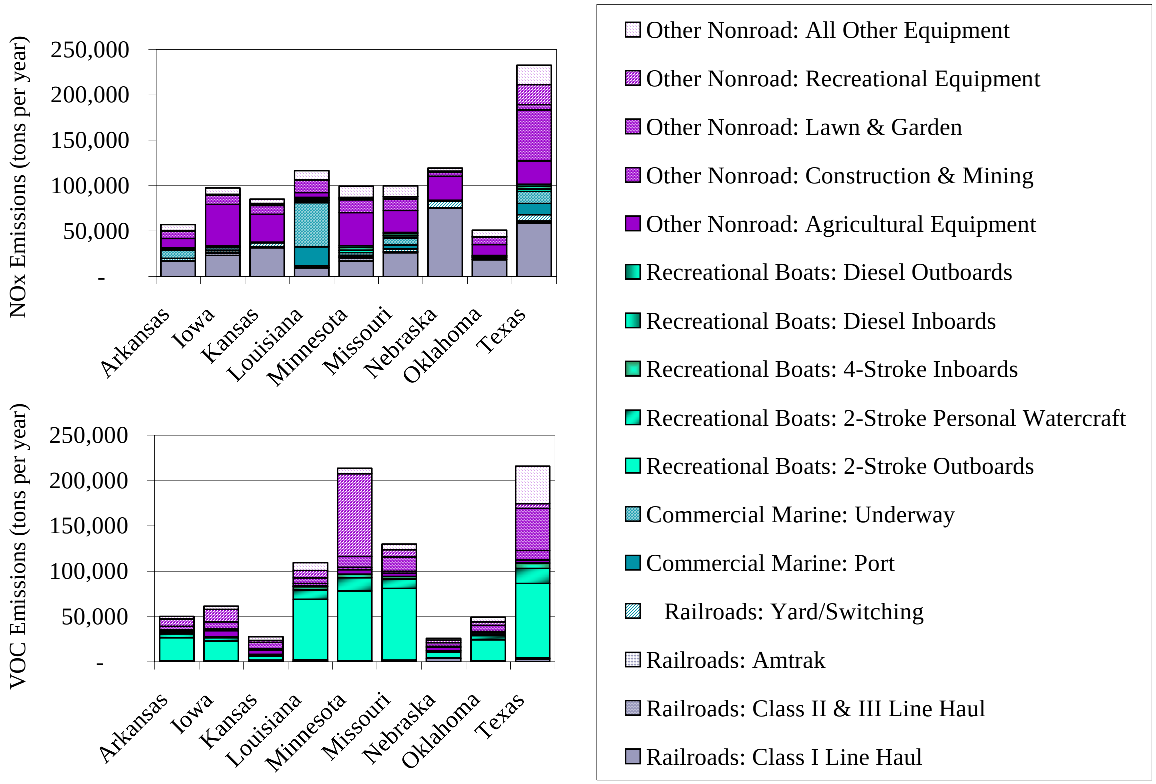


Figure 1-3. Year-2002 emissions of NO_x and VOC from non-road mobile sources in the CENRAP region.

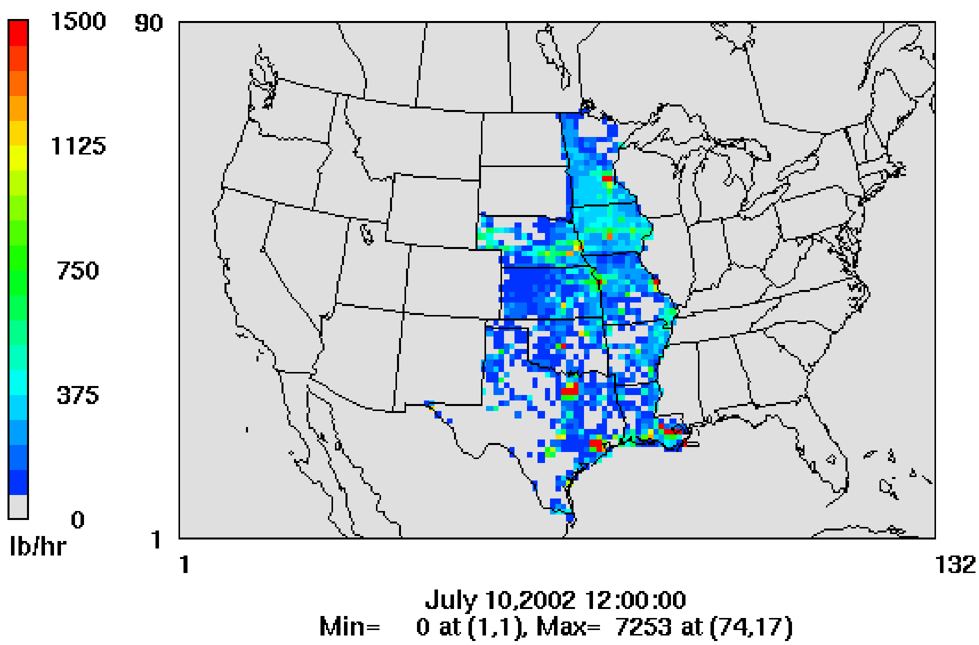


Figure 1-4. Geographic distribution of non-road mobile source NO_x in the CENRAP states on July 10, 2002.

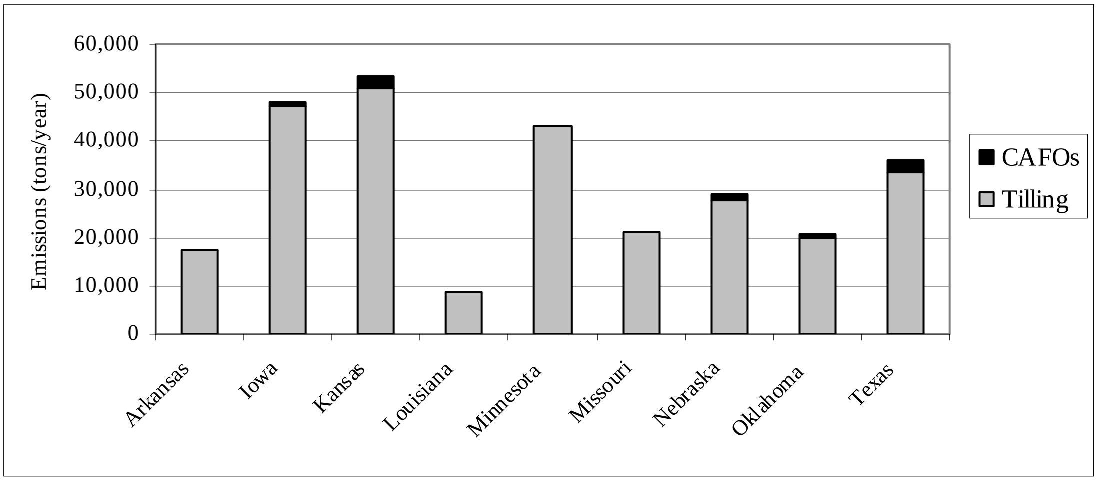


Figure 1-5. Year-2002 emissions of $PM_{2.5}$ from sources of fugitive agricultural dust in the CENRAP region.

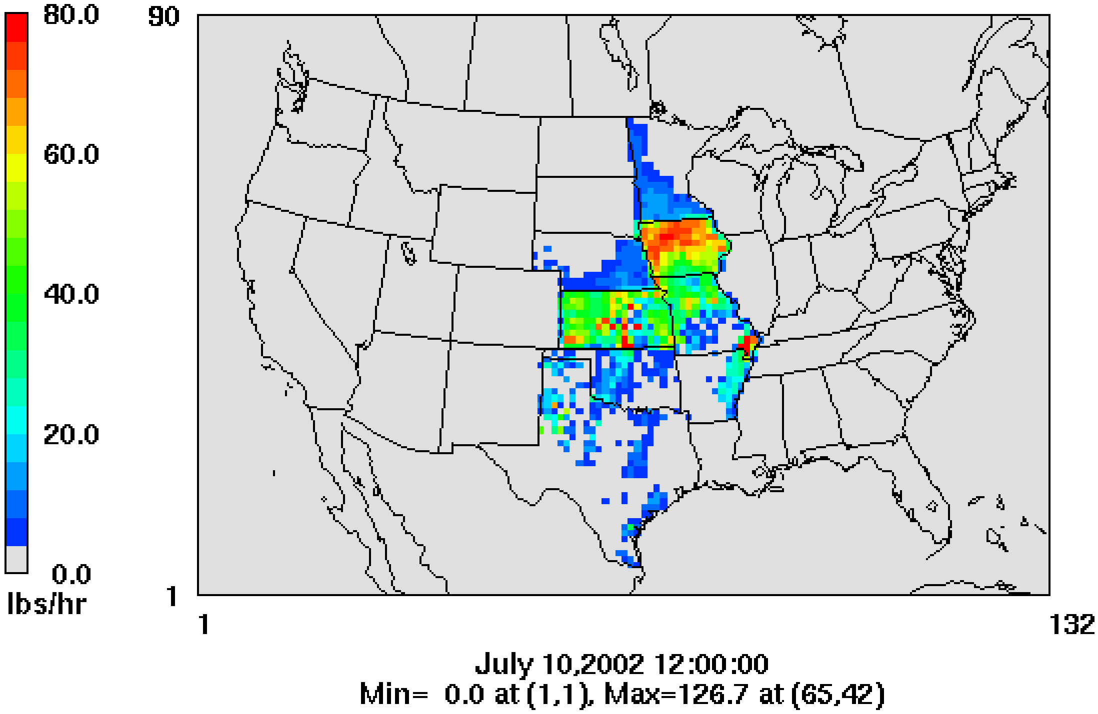


Figure 1-6. Geographic distribution of $PM_{2.5}$ emissions from sources of agricultural fugitive dust in the CENRAP states on July 10, 2002.

Of the mobile and agricultural fugitive dust sources discussed throughout this report, those that we qualitatively consider to contribute the greatest degrees of uncertainty to the emissions for the CENRAP region are agricultural fugitive dust sources and “other” non-road mobile sources.[3] The most effective strategies to improve these components of the inventory in the future would be to develop process-based emissions estimation techniques for agricultural fugitive dust sources and to prioritize and gather bottom-up activity data for “other” non-road mobile sources (as was done through this project for recreational boating). These recommendations are discussed in more detail in Section 3.

[3] “Other” non-road mobile sources include all non-road mobiles sources other than locomotives, commercial marine vessels, recreational boats, and aircraft.

2. SUMMARY AND ASSESSMENT OF THE INVENTORIES

STI calculated emissions as detailed in Appendix A, Emission Estimation Methods for Mobile Sources and Agricultural Dust Sources in the Central States, with results tabulated in Appendix B, Annual Emissions by State and Source Category. In addition, STI carried out quality assurance procedures as provided in the Quality Assurance Project Plan (QAPP) (Sullivan, 2004) and as detailed in this section. In summary, emissions from on-road mobile sources were estimated to contribute 20% and 28% of total annual emissions of VOCs and NO_x in the CENRAP region, while non-road mobile sources were estimated to contribute 23% and 18%, respectively. Agricultural dust sources were estimated to contribute 17% of total annual $PM_{2.5}$ emissions. Emissions for many of these source categories vary seasonally, daily, and hourly. Emissions of NO_x and VOC from on-road mobile sources peak in the summer with somewhat increased vehicle activity (VMT); however, emissions of CO from on-road mobile sources peak in the winter due to colder ambient temperatures. In addition, diurnal and day-of-week patterns of emissions from on-road mobile sources vary. On-road mobile emissions are generally greater on weekdays than on weekend days; and weekday driving activities track the morning and afternoon commute patterns, while weekend driving activities do not. The variation of seasonal, diurnal, and day-of-week patterns for recreational boats is even more pronounced than that for on-road mobile sources. Emissions from recreational boats are highly concentrated in the summer months (except in the warmest, most southern states) and on weekend days. Recreational boating activities peak sharply between 0700 and 1000 and decline gradually throughout the day. Emissions from commercial marine vessels also follow a seasonal pattern (except in the warmest, most southern states). Emissions from locomotives vary minimally or negligibly by season, day of week, and hour of day. Emissions from agricultural tilling operations follow seasonal patterns that are unique to each state and dependent on the climatic conditions and types of crops grown in each state.

2.1 EMISSIONS FROM ON-ROAD MOBILE SOURCES

2.1.1 Summary of Emissions from On-Road Mobile Sources

Over 525 billion VMT were estimated to have occurred in 2002 in the CENRAP region, with consequent emissions as shown in **Table 2-1** and **Figure 2-1**. **Figure 2-2** illustrates the geographic distribution of on-road mobile source emissions for a selected date.

Appendix C provides graphical and tabular summaries of the activity data that were prepared for the emission inventories of on-road mobile sources, including VMT, fleet distributions, fuels characteristics, and regulatory controls. Whenever possible, VMT were acquired from local air quality agencies or metropolitan planning organizations and HPMS data were used as defaults for areas without local VMT estimates. VMT data were provided by local agencies for approximately 25% of the counties in the CENRAP region, while the remainder are from the HPMS data. Areas that were able to provide local estimates of VMT included Houston/Galveston, Texas; Beaumont/Port Arthur, Texas; Dallas-Ft. Worth, Texas; Baton Rouge, Louisiana; New Orleans, Louisiana; St. Louis, Missouri; and Lincoln, Nebraska. Metropolitan areas that have recently produced local estimates of VMT (or will do so very shortly) include Kansas City, Minneapolis-St. Paul, and Little Rock. In the future, these locally generated VMT estimates should be used to improve the emission inventories for the CENRAP region.

Fleet distributions were developed by acquiring records of vehicle registrations from the departments of motor vehicles in each CENRAP state. These records were decoded using the Eastern Research Group (ERG) Vehicle Identification Number (VIN) Decoder program. Fleet distributions by vehicle type, vehicle age, and fuel type were calculated on the basis of the ERG VIN Decoder outputs. In several states, the fleet distributions differed significantly from national average distributions, which correspond to MOBILE6 model defaults.

Table 2-1. 2002 VMT and emissions (tons) for on-road mobile sources in CENRAP states.

State	Annual VMT (10^6 miles)	$PM_{2.5}$	CO	NO_x	SO_2	NH_3	VOC
Arkansas							
Light-Duty	19,224	235	502,991	27,137	1,383	1,971	29,752
Heavy-Duty	9,955	2,076	102,247	90,833	2,163	313	9,786
Iowa							
Light-Duty	27,664	381	973,854	53,702	2,113	2,755	67,501
Heavy-Duty	3,701	931	30,853	44,607	884	107	2,993
Kansas							
Light-Duty	25,424	345	930,039	47,210	1,938	2,528	61,867
Heavy-Duty	3,401	855	29,686	35,520	758	98	2,979
Louisiana							
Light-Duty	34,246	416	824,585	45,929	2,396	3,485	57,283
Heavy-Duty	9,049	2,272	74,770	105,449	2,257	263	7,361
Minnesota							
Light-Duty	46,880	595	1,285,076	73,656	1,274	4,771	75,663
Heavy-Duty	6,271	1,577	43,160	65,290	1,314	182	5,255
Missouri							
Light-Duty	53,030	680	1,375,126	77,916	3,120	5,356	76,004
Heavy-Duty	7,238	1,841	52,065	79,607	1,787	209	5,491
Nebraska							
Light-Duty	15,957	246	581,402	30,649	1,229	1,581	38,788
Heavy-Duty	2,449	624	18,626	25,037	589	71	2,115
Oklahoma							
Light-Duty	39,569	509	1,194,649	64,504	2,989	3,968	81,676
Heavy-Duty	5,293	1,331	48,382	54,812	1,265	154	5,062
Texas							
Light-Duty	190,132	2,339	3,653,523	220,819	10,555	19,365	248,680
Heavy-Duty	25,989	6,276	113,949	340,992	6,667	692	14,057
Total	525,473	23,529	11,834,984	1,483,668	44,678	47,870	792,310

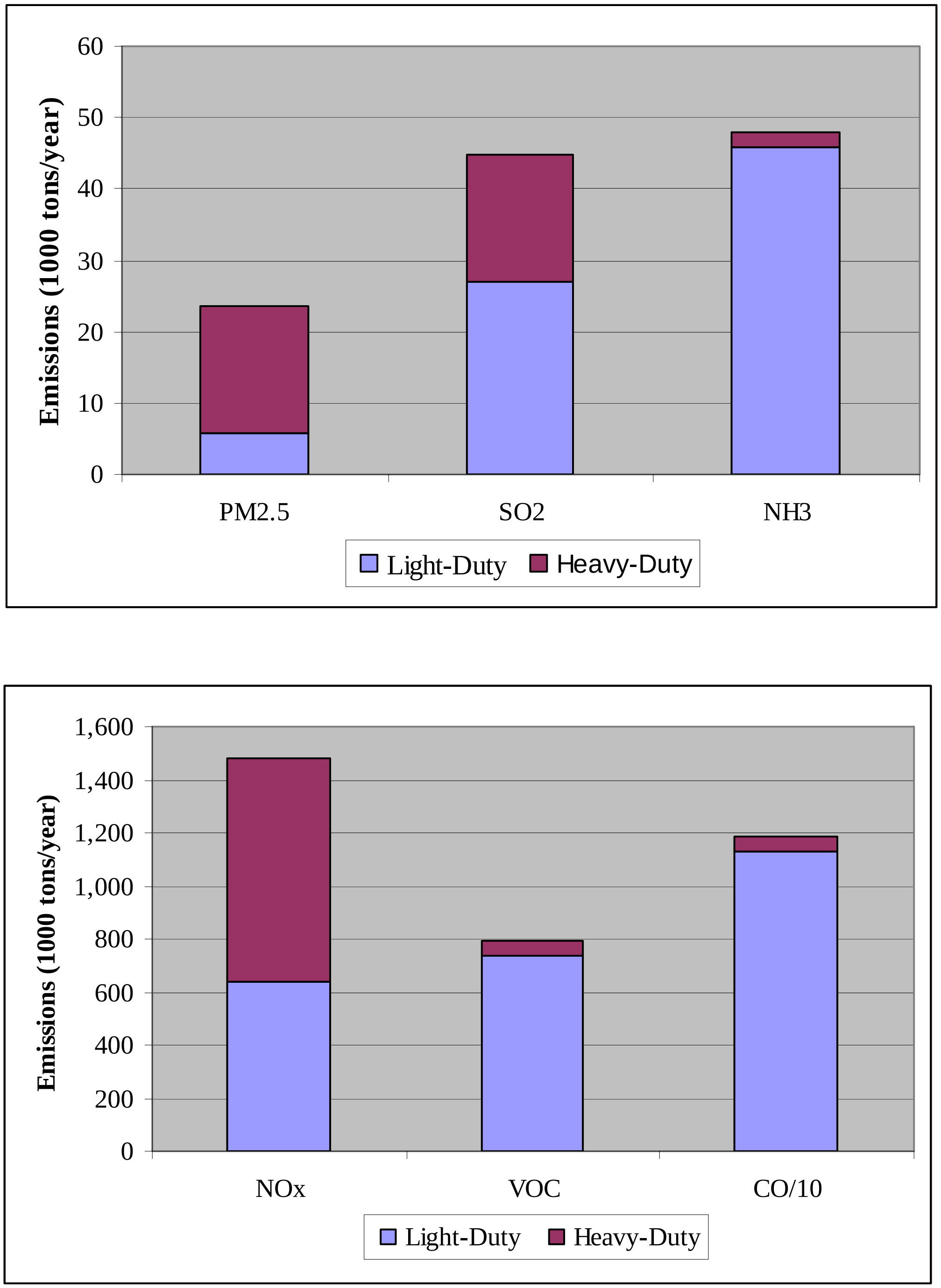


Figure 2-1. Annual on-road mobile emissions by pollutant and vehicle type (note: CO emissions have been divided by 10 for scaling purposes).

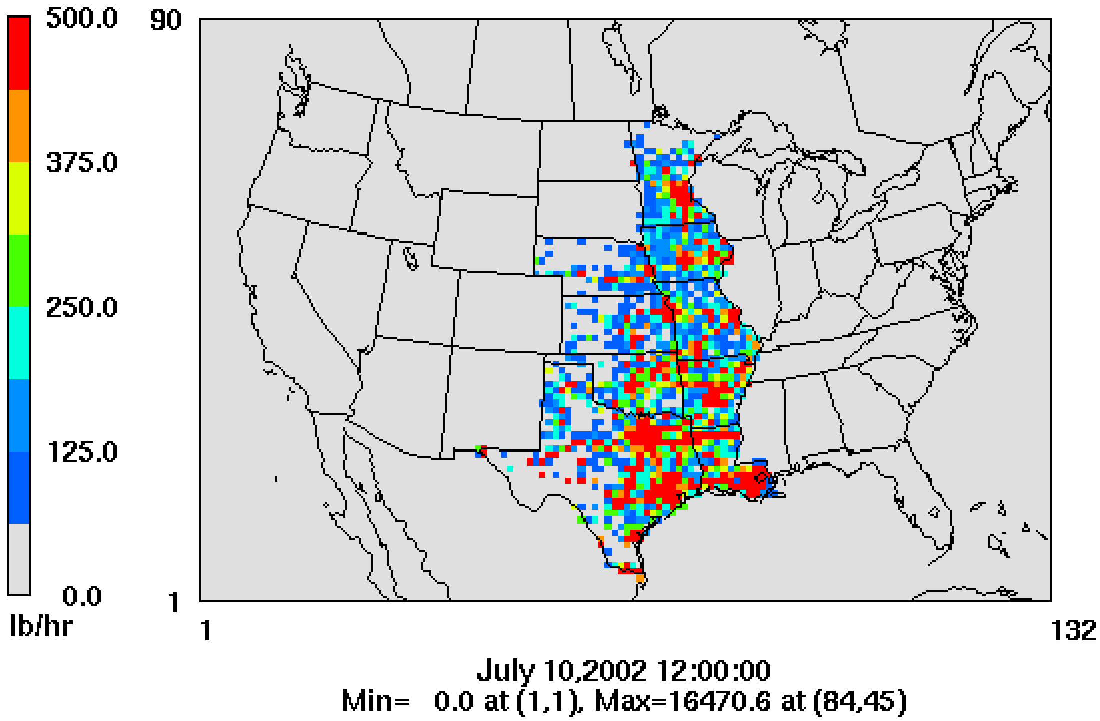


Figure 2-2. Geographic distribution of on-road mobile source emissions of NO_x in the CENRAP states on July 10, 2002.

Fuels characteristics (e.g., sulfur content, volatility, and oxygenate content) required by MOBILE6 were acquired for most CENRAP states from Northrop Grumman. However, for Kansas, Minnesota, and Missouri, data from state departments of agriculture were used because they proved to be more extensive than the Northrop Grumman data. Information on regulatory programs (such as inspection and maintenance programs) was acquired by contacting the state and local personnel involved with these programs.

MOBILE6 was run in SMOKE using gridded, hourly temperature data from meteorological files created by the Meteorology Chemistry Interface Processor (MCIP), a mesoscale model (MM5) post-processing program. Meteorological data files for all of January and July, 2002 were provided by the CENRAP Modeling Work Group, and these files were used to derive monthly average temperatures by hour so that MOBILE6 runs would be representative of entire months rather than specific episode dates.

On-road mobile source emissions were temporally allocated using temporal profiles derived from a variety of sources (see **Figures 2-3 through 2-5**). The monthly profiles for light-duty vehicles and heavy-duty vehicles were derived from national-level sales of gasoline and diesel fuels during 2002 (Energy Information Administration, 2003). SMOKE default weekly temporal profiles were used for light-duty vehicles because they were considered to be consistent with the latest research on weekday-weekend activity patterns. The weekly profile for heavy-duty vehicles was derived from traffic counts conducted in California's South Coast Air Basin

(Coe et al., 2004). County-specific data obtained from the Texas Transportation Institute and the East-West Gateway Coordinating Council were used to develop diurnal profiles for light-duty vehicles in Texas and five counties in the St. Louis area of Missouri. For the remainder of Missouri and all other states, a default SMOKE/EPA diurnal profile for weekdays was used for light-duty vehicles in urban and suburban areas, and a weekday rural profile was developed from the Texas data and applied to counties not associated with a Metropolitan Statistical Area (MSA). A weekend diurnal profile for light-duty vehicles and both a weekend and weekday profile for heavy-duty vehicles were derived from traffic counts conducted in California's South Coast Air Basin (Coe et al., 2004) and used for all CENRAP states. **Figure 2-5** shows all diurnal profiles used except county-specific profiles used for Texas and Missouri, which are detailed in Appendix C.

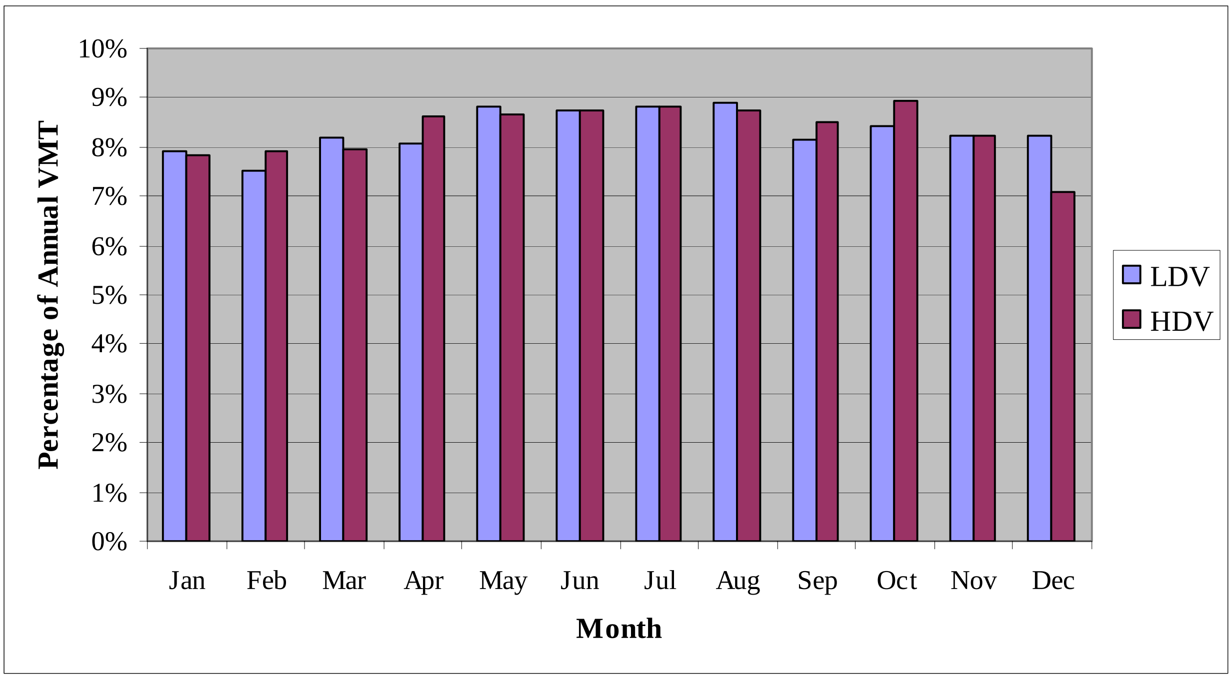


Figure 2-3. Monthly variation in on-road mobile source activity by vehicle type.

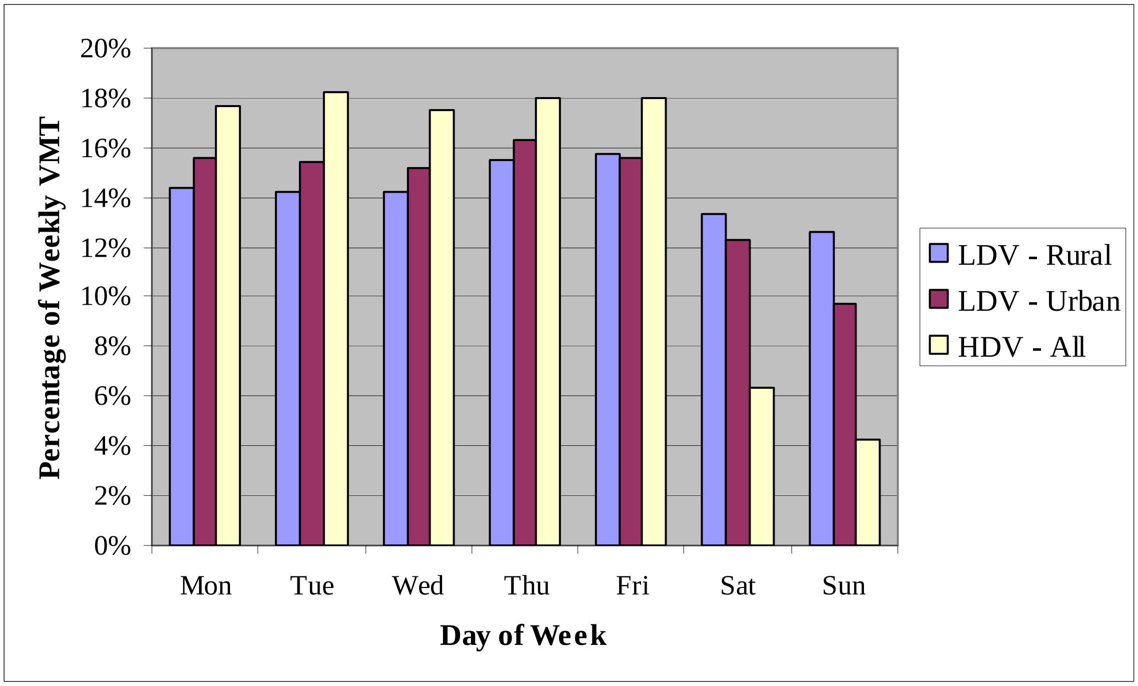


Figure 2-4. Weekly variation in on-road mobile source activity by vehicle type.

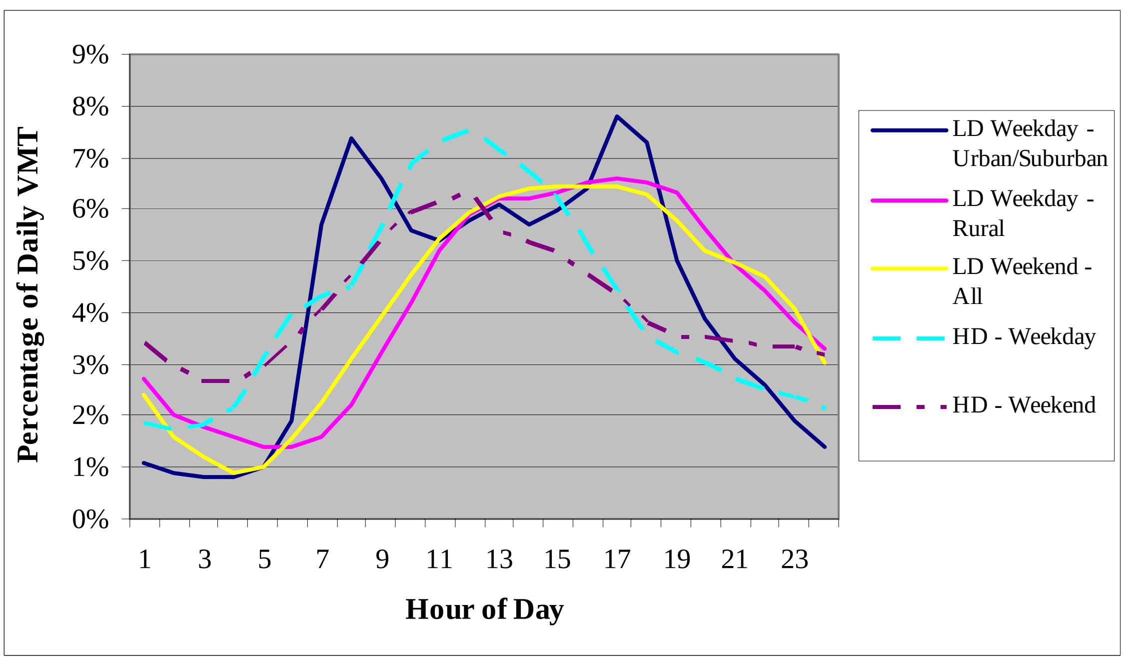


Figure 2-5. Diurnal variation in on-road mobile source emissions by vehicle type.

2.1.2 Assessment of On-Road Mobile Source Emissions

The emission inventories for on-road mobile sources are based on extensive region-specific information, including VMT data, fleet characteristics, temporal distributions, and regulatory program descriptions. These estimates were also strengthened by the use of gridded, hourly temperature data. The importance of using state and county-specific data can be seen in a comparison of the CENRAP's inventory with the preliminary 2002 NEI. As **Figure 2-6** shows, both inventories estimate 1.5 million tons of NO_x from on-road mobile sources for the CENRAP region as a whole. However, significant differences exist at the state level. For example, Louisiana's NO_x emissions are 27% higher than the estimates from the NEI, while Missouri's NO_x emissions are 16% lower. Differences are apparent at the CENRAP region-wide scale for VOC emissions, which are about 10% lower than those in the NEI, while region-wide $PM_{2.5}$ and SO_2 estimates are about 20% lower. These differences seem to arise primarily from the use of more localized temperature data, fuel volatility data, and fuel sulfur contents. For example, the 2002 NEI assumes an across-the-board diesel sulfur content of 500 ppmw (the regulatory limit), whereas the state-specific data used in this inventory ranged from 330-390 ppmw for the various CENRAP states. Further improvements could be made by continuing to acquire and incorporate local data. For example, improved VMT data are now available for the Kansas City metropolitan area and should be incorporated into future inventory efforts.

Further improvements to the VMT distributions for light-duty vehicle types may be feasible by applying vehicle registration data in novel ways. Many light-duty and/or diesel trucks (e.g., SUVs) are driven for similar purposes as passenger vehicles—a trend that was established in the 1990s and that continues to strengthen. Therefore, the ratio of registered SUVs to registered light-duty autos is likely to be proportional to the VMT traveled by these vehicle types. Alternatively, the VMT mix could be calculated from registration data using vehicle type-specific assumptions about annual mileage accumulation rates (AMAR), which are inherent to the MOBILE6 model. Such adjustments to the VMT distributions may be beneficial because emission factors vary significantly by light-duty vehicle class and fuel type and because MOBILE6 default VMT distributions may be out-of-date due to the rapidly increasing popularity of SUVs and light trucks.

Finally, it should be noted that an "annualized" on-road mobile source inventory was assembled as an average of SMOKE/MOBILE6 runs performed for January and July—a necessity given the current availability of meteorological data. The inventory could be improved by performing runs for all 12 months of the year as new meteorological inputs become available. However, this would likely produce only minor or insignificant changes in annual total emissions.

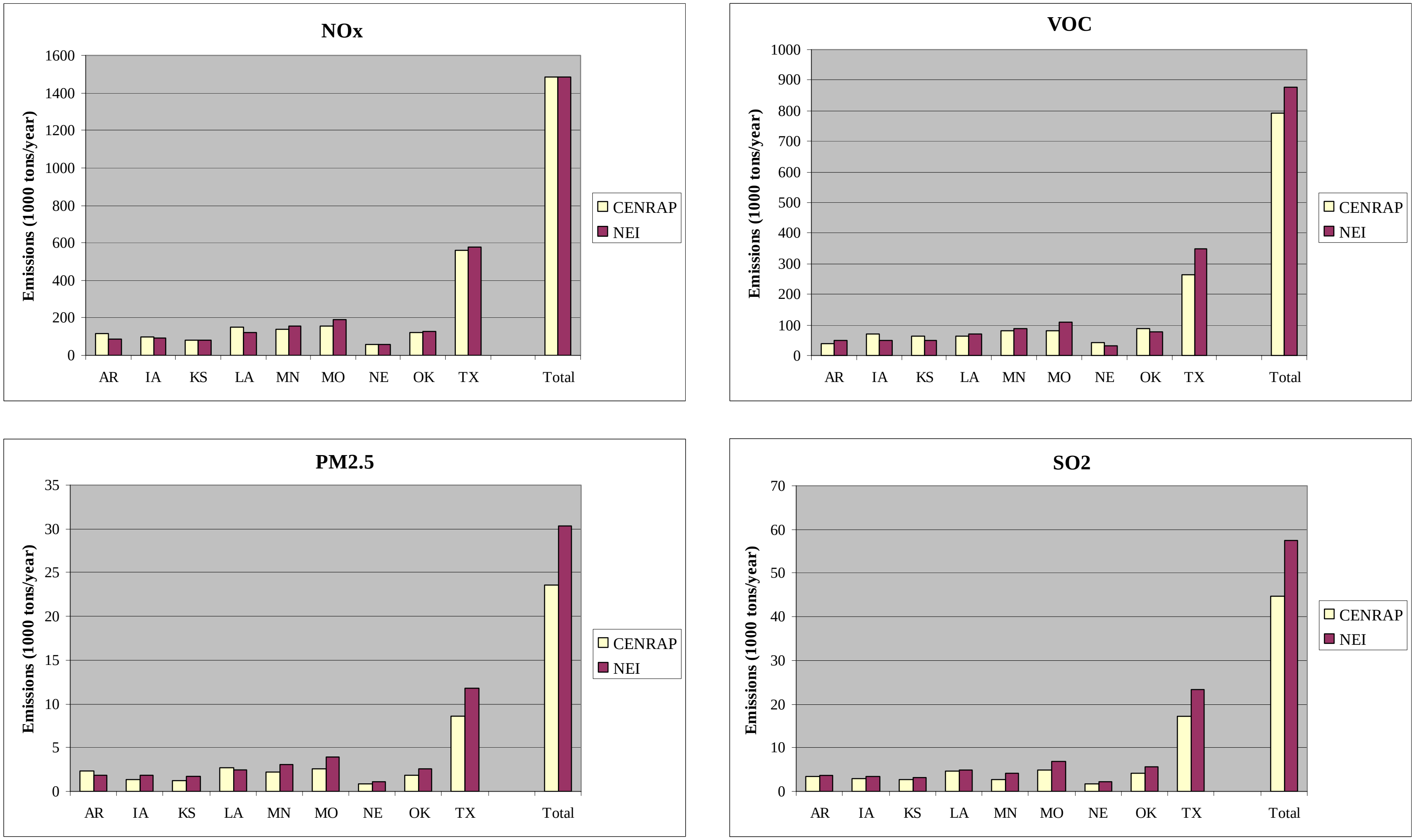


Figure 2-6. Comparison of CENRAP's emission inventories for on-road mobile source to the 2002 preliminary NEI.

2.2 EMISSIONS FROM NON-ROAD MOBILE SOURCES

2.2.1 Summary of Emissions from Locomotives

Emission estimates were generated for Class I line haul, Class II and III[4] line haul, and yard (or switching) locomotives throughout the CENRAP region using fuel consumption and traffic density data obtained from individual railroads, federal agencies, and other sources. Almost 1.5 billion gallons of diesel fuel were estimated to have been consumed by locomotives in the CENRAP region in 2002, with consequent emissions as shown in **Table 2-2** and **Figure 2-7**. **Figure 2-8** illustrates the geographic distribution of locomotive emissions for a selected date, and **Figure 2-9** shows the monthly variability in locomotive activity, which is based on weekly summaries of carloads of freight moved nationally during 2002.

Table 2-2. 2002 fuel consumption and emissions (tons) for locomotives in CENRAP states.

Page 1 of 2

State	Fuel Consumption (1000 gallons)	$PM_{2.5}$	CO	NO_x	SO_2	VOC	NH_3
Arkansas							
Class I Line Haul	79,645	530	2,334	16,769	1,434	880	7
Class II & III Line Haul	2,058	14	60	433	37	23	0
Amtrak	1,050	7	32	221	20	12	0
Yard/Switching	7,912	73	333	2,408	200	184	0
Iowa							
Class I Line Haul	110,685	738	3,243	23,304	1,992	1,224	10
Class II & III Line Haul	11,186	74	328	2,355	201	124	1
Amtrak	1,050	7	31	221	20	12	0
Yard/Switching	9,283	86	389	2,825	235	216	0
Kansas							
Class I Line Haul	150,063	1,000	4,397	31,596	2,702	1,659	14
Class II & III Line Haul	6,518	43	191	1,372	117	72	1
Amtrak	1,050	6	31	221	20	11	0
Yard/Switching	12,594	115	529	3,832	318	293	0
Louisiana							
Class I Line Haul	45,878	305	1,345	9,659	826	507	4
Class II & III Line Haul	576	4	17	121	10	6	0
Amtrak	1,500	10	43	315	27	16	0
Yard/Switching	5,556	50	233	1,691	139	129	0
Minnesota							
Class I Line Haul	80,483	536	2,358	16,946	1,449	890	7
Class II & III Line Haul	17,646	118	517	3,715	318	195	2
Amtrak	1,050	8	31	221	19	12	0
Yard/Switching	3,499	31	147	1,065	87	82	0

[4] Class I railroads operate over large areas of the country, serving many states. Class II railroads are regional in scope and serve only a few states, while Class III railroads are local and typically operate in only one state.

Table 2-2. 2002 fuel consumption and emissions (tons) for locomotives in CENRAP states.

Page 2 of 2

State	Fuel Consumption (1000 gallons)	$PM_{2.5}$	CO	NO_x	SO_2	VOC	NH_3
Missouri							
Class I Line Haul	124,524	830	3,649	26,218	2,241	1,376	11
Class II & III Line Haul	3,352	22	98	706	60	37	0
Amtrak	2,400	15	70	504	42	25	0
Yard/Switching	9,463	86	398	2,880	239	220	0
Nebraska							
Class I Line Haul	357,167	2,379	10,465	75,201	6,429	3,948	33
Class II & III Line Haul	1,379	9	40	290	25	15	0
Amtrak	750	4	22	158	13	8	0
Yard/Switching	24,553	225	1,032	7,471	618	572	1
Oklahoma							
Class I Line Haul	86,879	578	2,545	18,293	1,564	961	8
Class II & III Line Haul	1,826	12	54	384	34	20	0
Amtrak	1,050	7	31	221	19	12	0
Yard/Switching	5,276	48	222	1,606	134	123	0
Texas							
Class I Line Haul	279,022	1,858	8,176	58,748	5,023	3,084	25
Class II & III Line Haul	5,539	37	162	1,166	100	61	1
Amtrak	5,250	34	155	1,105	94	57	0
Yard/Switching	23,723	220	996	7,217	600	551	1
Total	1,481,435	10,118	44,703	321,460	27,402	17,616	126

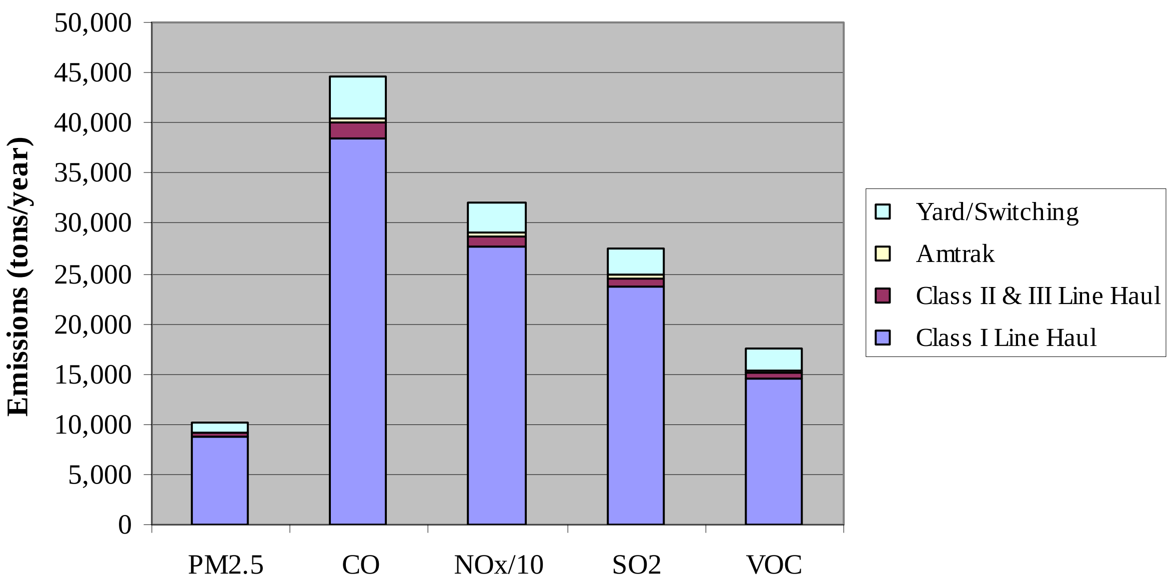


Figure 2-7. Annual locomotive emissions by pollutant and locomotive type for the CENRAP region (note: NO_x emissions have been divided by 10 for scaling purposes).

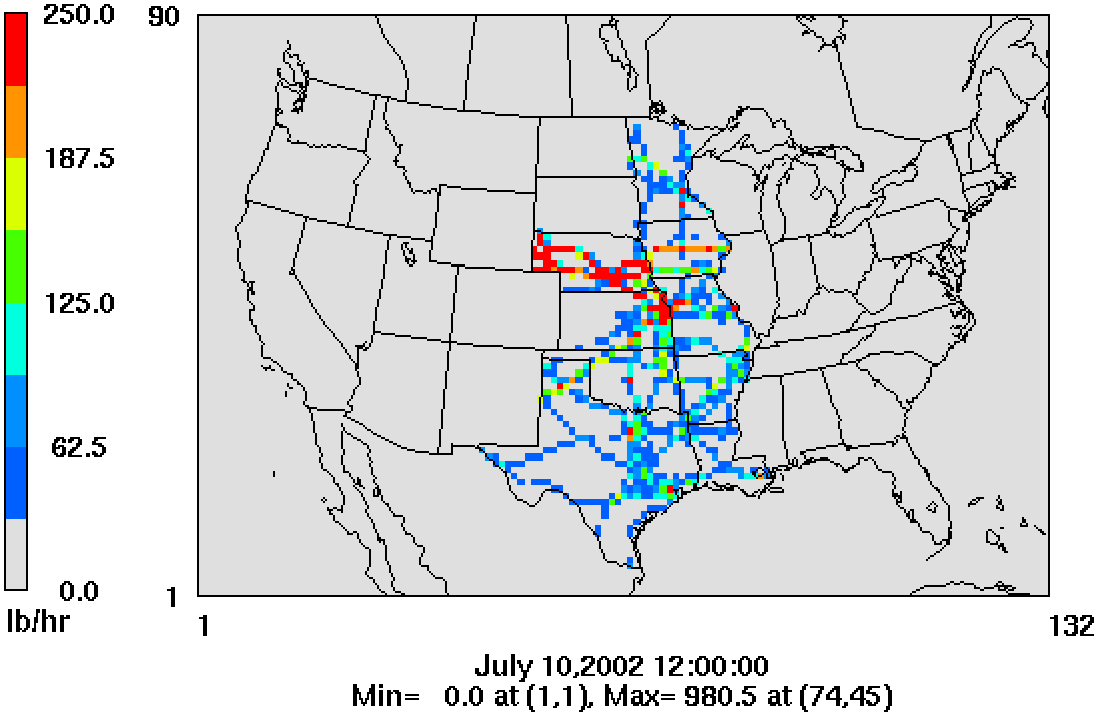


Figure 2-8. Geographic distribution of locomotive emissions of NO_x on July 10, 2002.

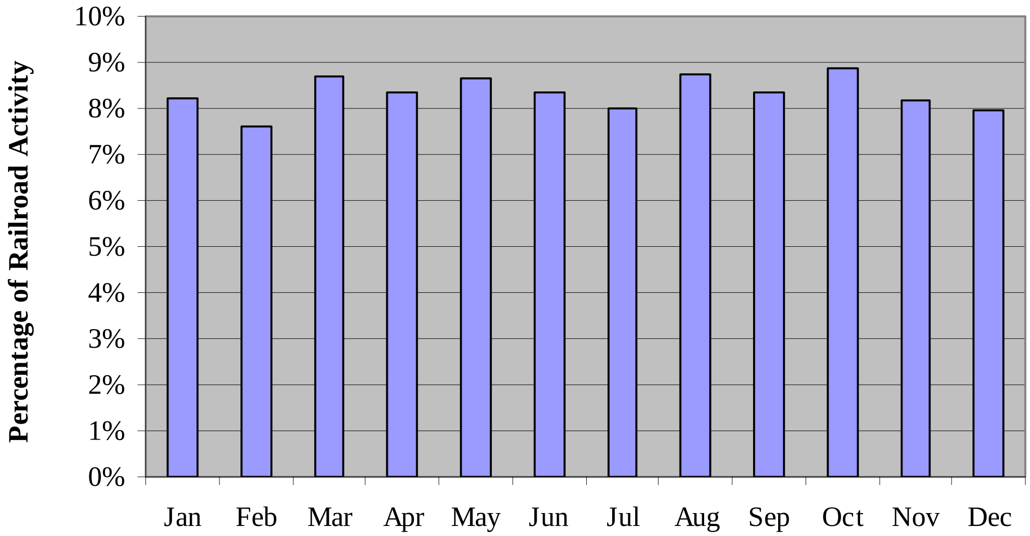


Figure 2-9. Monthly variability in locomotive activity.

2.2.2 Assessment of Emissions from Locomotives

Most of the effort of emission inventory development for locomotives was directed toward Class I railroads, which, though small in number, typically account for over 90% of the annual fuel consumption by railroads in the United States (U.S. Environmental Protection Agency, 1998a). Fuel consumption and traffic density data for 2002 were obtained for all eight Class I railroads operating in the CENRAP states, and this information was used to generate county-level emission estimates. Although less effort was expended on smaller railroads, representative bottom-up data sets were collected, including 2002 fuel consumption data for six of the 14 Class II railroads, and either fuel consumption data or yard locomotive fleet sizes for 35 of the 113 Class III and switching railroads that operate in the CENRAP region. Overall, of 1.48 billion gallons of fuel consumed by railroads in the CENRAP region for 2002, 1.44 billion gallons (or 97%) were directly reported by individual railroads, while the remainder were extrapolated from activity patterns. Therefore, the vast majority of the emission inventory for locomotives is based on directly reported, bottom-up activity data.

Figure 2-10 compares the CENRAP's inventory with the 2002 preliminary NEI inventory. CENRAP's emission estimates for most pollutants are about 50% higher than those in the NEI with the exception of NO_x, for which the CENRAP and NEI emission estimates are roughly equal. "Uncontrolled" emission factors were applied across the board for the 2002 NEI, which offset a corresponding underestimate of locomotive activity levels in the CENRAP area. CENRAP's NO_x inventory for locomotives reflects existing federal emission standards for locomotives. These emission standards, which took effect with the 1973 model year, predominately affect NO_x emissions. Therefore, although activity levels estimated for the CENRAP inventory were higher than those estimated for the NEI, the resultant NO_x emissions are about the same.

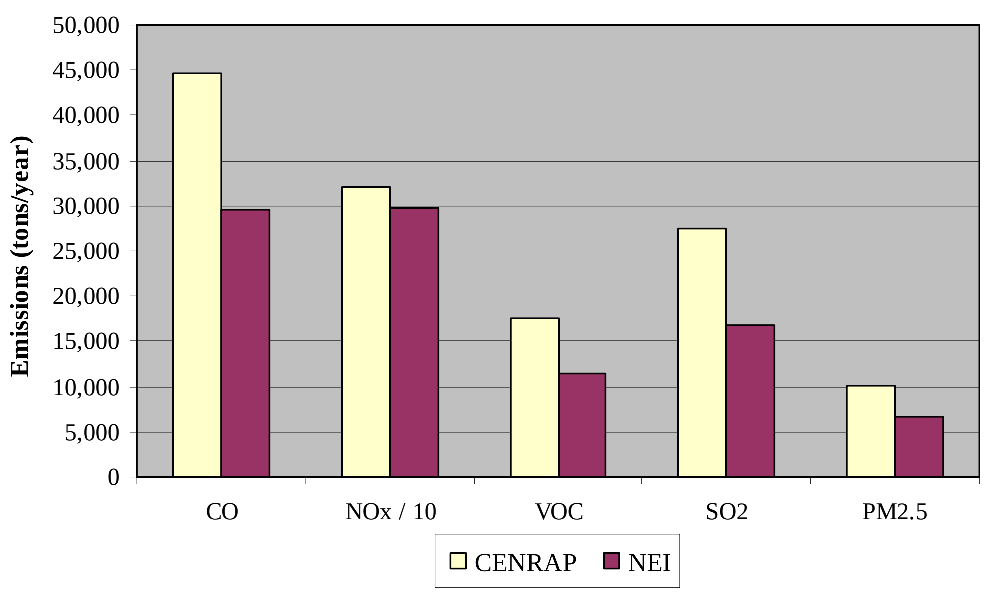


Figure 2-10. Comparison of locomotive emissions estimates with results from the 2002 preliminary NEI (note: NO_x emissions have been divided by 10 for scaling purposes).

Use of 2002 railroad-specific fuel consumption estimates and emission factors reflective of existing emissions standards greatly improved the degree of certainty in the CENRAP region-wide emission inventory above that associated with the preliminary 2002 NEI. Additional survey work could improve the accuracy of the inventory, but this improvement would likely be significant only at county or metropolitan scales where railroad activities are dominated by Class II or III railroads. In addition, local data would likely be more representative of variances in local activity patterns than the national-level data that were used to create a monthly temporal profile.

2.2.3 Summary of Emissions from Commercial Marine Vessels

Emission estimates were generated for commercial marine vessels operating in commercially active waterways in the CENRAP region, including inland river systems, Lake Superior, and the Gulf Intracoastal Waterway (GIWW). County-level emissions were designated as either “in-port” or “underway”, as shown in **Table 2-3** and **Figure 2-11**. **Figure 2-12** illustrates the geographic distribution of commercial marine emissions for a selected date, and **Figure 2-13** shows the monthly variability in commercial marine activity by state, with profiles based on monthly summaries of freight movements through selected locks and ports for 2002.

Table 2-3. 2002 commercial marine vessel emissions (tons) in CENRAP states.

State	Type	CO	NOx	VOC	SO2	PM2.5	NH_3
Arkansas	Port	13	68	1	6	1	0
	Underway	1,783	9,274	193	889	197	4
Iowa	Port	55	286	6	27	6	0
	Underway	534	2,776	58	266	59	1
Kansas	Port	2	9	0	1	0	0
	Underway	4	22	0	2	0	0
Louisiana	Port	2,719	20,772	739	5,369	693	6
	Underway	6,912	48,574	999	7,082	1,221	7
Minnesota	Port	211	1,533	57	230	37	1
	Underway	492	2,822	65	484	79	1
Missouri	Port	585	4,281	170	443	84	2
	Underway	1,472	7,656	159	734	163	3
Nebraska	Port	1	3	0	0	0	0
	Underway	5	27	1	3	1	0
Oklahoma	Port	1	5	0	0	0	0
	Underway	97	505	10	48	11	0
Texas	Port	1,613	12,300	423	4,315	526	3
	Underway	1,882	13,009	300	5,778	686	3
Total		18,381	123,922	3,182	25,677	3,764	32

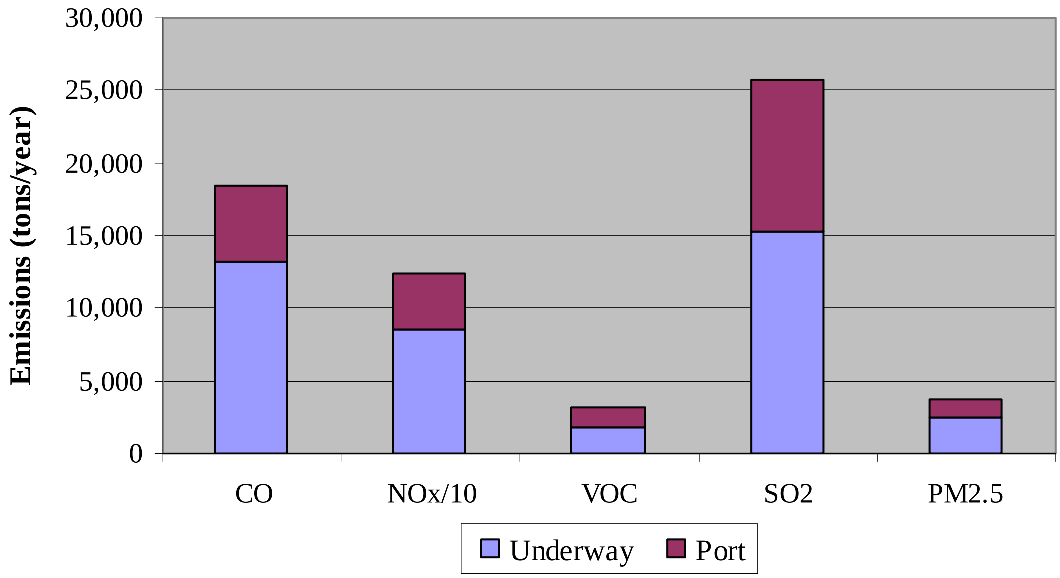


Figure 2-11. Annual commercial marine vessel emissions by pollutant and source type for the CENRAP region (note: NO_x emissions have been divided by 10 for scaling purposes).

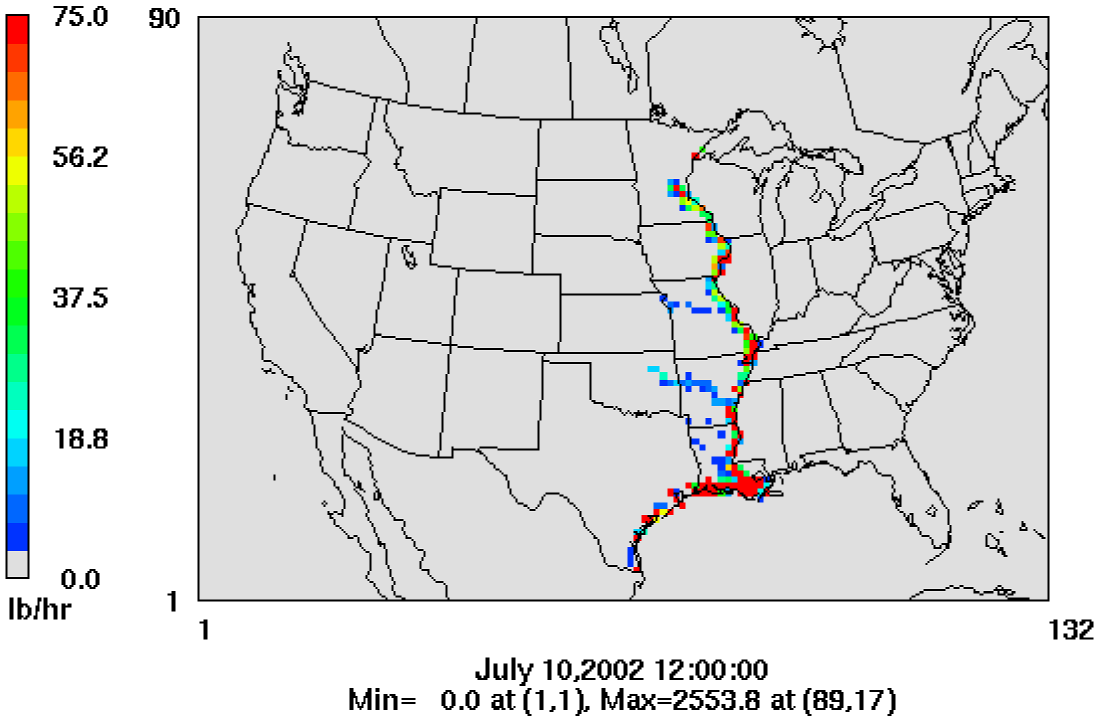


Figure 2-12. Geographic distribution of commercial marine emissions of NO_x in the CENRAP states on July 10, 2002.

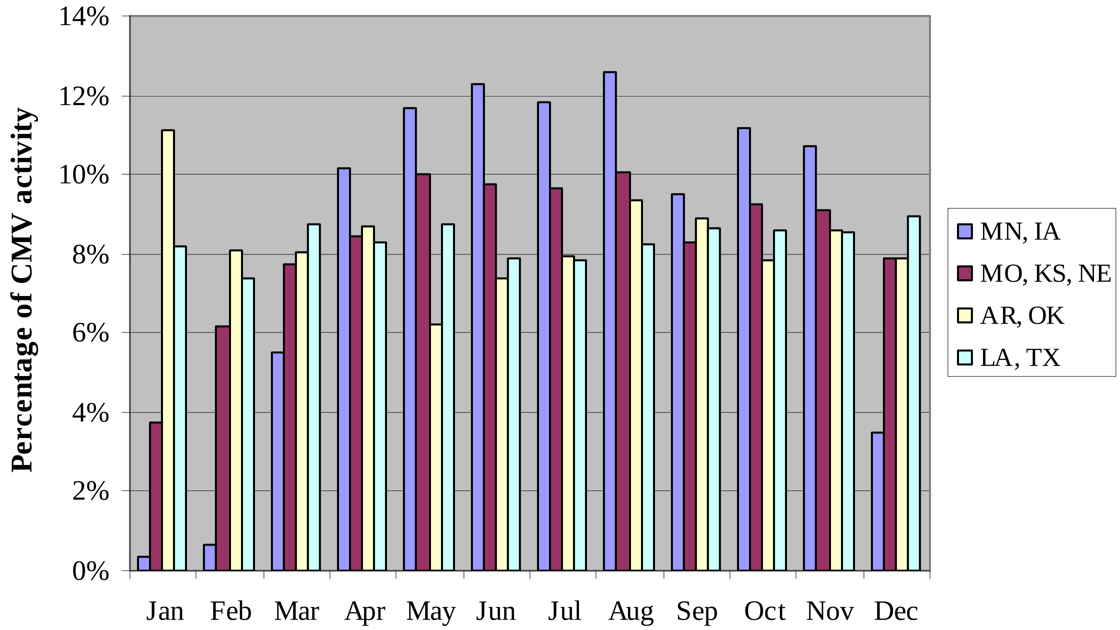


Figure 2-13. Monthly variability in commercial marine vessel activity.

2.2.4 Assessment of Emissions from Commercial Marine Vessels

Emission estimates for this inventory differ significantly from those found in the preliminary 2002 NEI. CENRAP's emissions are lower by approximately a factor of 3 for all pollutants (see **Figure 2-14**). Emissions in Louisiana and Texas account for most of the emissions and much of the overall difference, as seen in **Figure 2-15**.

For inland river systems in the CENRAP region, emission estimates were based on bottom-up fuel consumption data derived from the Tennessee Valley Authority (TVA) Barge Costing Model. This model was developed to estimate fuel usage by inland river segment for fuel tax purposes, and annual model results have varied from actual tax receipts by an average of only 1.5% since 1996. The results indicate that the activity data used to estimate emissions for most of the CENRAP region (including all of Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma) have a high degree of certainty.

However, the TVA model does not cover fuel consumption by "deep-draft" (oceangoing) vessels, harbor tugs, and other vessels that operate around ports in the Great Lakes or the Gulf Inland Waterway of Louisiana and Texas. In these cases, emission estimates were prepared using work-based (rather than fuel-based) emission factors and a complex array of activity data, including the number of vessel calls at specific ports, vessel speeds, and vessel characteristics (such as engine horsepower, load factors, etc.). Although detailed information was available for several important ports in the CENRAP region, including St. Louis, Baton Rouge, New Orleans, South Louisiana, and Corpus Christi, a complete survey of ports in Louisiana, Texas, and Minnesota was not possible within the scope of this project. Therefore, data from "known" ports were extrapolated to "unknown" ports using techniques outlined in a two-volume report produced by ARCADIS on behalf of the EPA (U.S. Environmental Protection Agency, 1999a).

Improvements to the inventory could be made at local scales by gathering more detailed data on individual ports within a county or region.

The difference between the CENRAP inventory and the preliminary 2002 NEI is most likely due to the use of top-down methods to develop the 2002 NEI, for which national-level emissions were calculated from estimated annual hours of operation and fuel consumption for the U.S. commercial marine fleet, then disaggregated to port and underway emissions based on the simplifying assumption that 75% of distillate fuel and 25% of residual fuel is consumed "in-port". National-scale, in-port emissions were then assigned to the largest 150 ports in the country based on the amount of freight handled by each, and the remaining "underway" emissions were assigned to active shipping lanes based on traffic density patterns (U.S. Environmental Protection Agency, 1999b). These methods seem to have resulted in significantly overestimated emissions at large ports, as seen in **Table 2-4**, which compares "in-port" emissions from the 2002 NEI for the counties containing the Port of Baton Rouge and the Houston-Galveston Port with other estimates of emissions for these same ports. CENRAP's emission inventories for these ports are more closely aligned with previous estimates prepared by Booz Allen Hamilton (1991) and Eastern Research Group & Starcrest (2003), both of whom also applied bottom-up activity data to prepare their inventories.

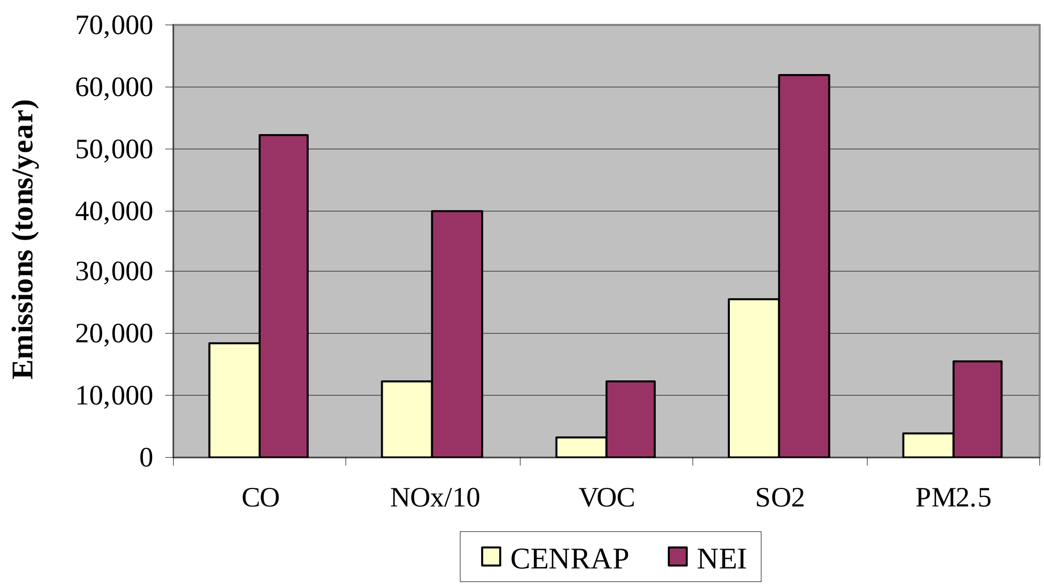


Figure 2-14. Comparison of commercial marine emissions estimates with results from the 2002 preliminary NEI (note: NO_x emissions have been divided by 10 for scaling purposes).

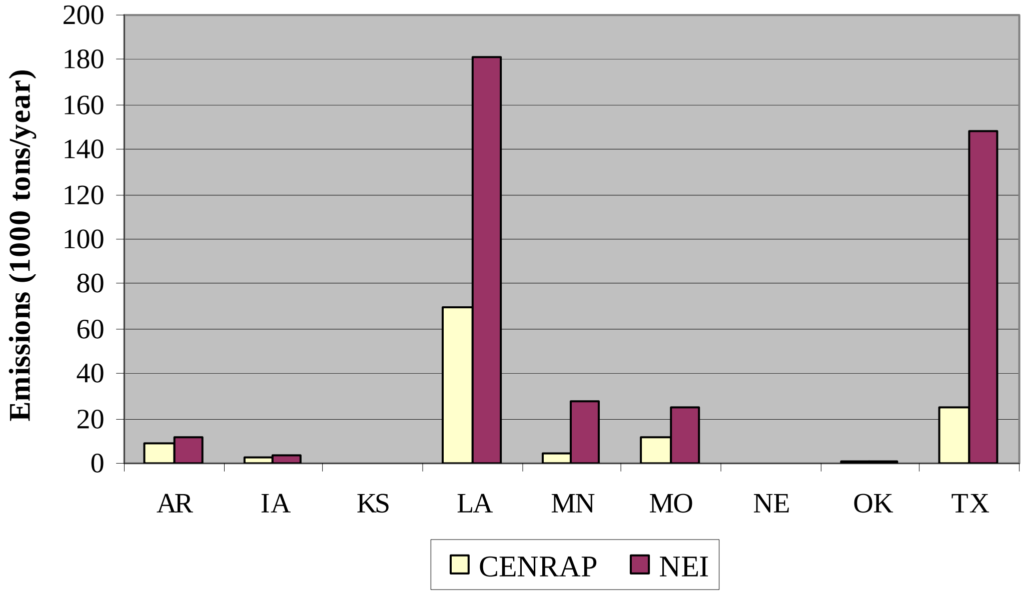


Figure 2-15. State-by-state comparison of commercial marine NOx emissions.

Table 2-4. Comparison of inventories for selected ports in the CENRAP region (emissions in tons/year).

Port	Inventory	$PM_{2.5}$	NO_x	CO	VOC	SO_2
Baton Rouge	1991 Booz-Allen Hamilton	129	2,187	449	203	928
	2002 CENRAP	196	5,355	737	170	1,562
	2002 NEI	1,407	36,088	4,756	1,128	5,291
Houston-Galveston	1991 Booz-Allen Hamilton	887	14,977	2,131	1,391	6,554
	2000 Starcrest	-----	7,336	1,022	219	-----
	2002 CENRAP	318	7,232	943	245	2,610
	2002 NEI	2,955	75,787	9,989	2,370	11,111

2.2.5 Summary of Emissions from Recreational Boats

Emissions from recreational boats were calculated with the latest version of the EPA's NONROAD model (NONROAD 2004). NONROAD produces county-level emission estimates for several categories of recreational boats using national equipment populations, which are disaggregated to the county level on the basis of the total water surface area in a given county. NONROAD also relies on broad assumptions related to boating activity (such as annual hours of operation, engine load factors, and temporal variations in activity). These assumptions vary by equipment type but not geographic area. The activity data files used by the NONROAD model were updated for the CENRAP inventory with information gathered through a bottom-up survey of representative groups of recreational boat owners. The survey was designed to gather data on vessel characteristics, hours of use, fuel consumption, engine loads, and temporal and geographic usage patterns in each of the CENRAP states. Data assembled through this survey were then incorporated into the NONROAD model, along with state-specific data on temperatures and fuels characteristics.[5] The more significant survey results showed that boating activities varied substantially by state in most respects, including types of boats used, diurnal patterns of boating, seasonal patterns of boating, and hours of boat use.

One of the challenges associated with conducting the recreational boating survey and analyzing results was the tendency of survey respondents to generally over-report their use of recreational boats. This phenomenon, called "reporting bias", often occurs when survey respondents have non-neutral attitudes about the behaviors they report. Under-reporting of illicit behaviors (such as use of illegal drugs or driving above posted speed limits) and over-reporting of positive behaviors (such as exercising regularly or volunteering for charity) are commonly observed, unless surveys are designed to control or eliminate these biases. The CENRAP recreational boating survey was designed to control for reporting bias. Respondents were asked about their "typical" usage pattern, but they were also asked about their specific usage pattern for the preceding week—information that is much more likely to be reported accurately. The average usage pattern for the preceding week was used to adjust reported "typical" usage patterns, which greatly reduced the effects of over-reporting by factors of 1.5 to 2.0. In addition, respondents were asked about the quantities of fuel purchased for their recreational boats—information that could be used as a second check of reporting bias. On the basis of reported fuel consumptions, recreational boating usage was further reduced for over-reporting bias by a factor of 0.3 (with a range of uncertainty from 0.0 to 0.5). The resulting database of activity levels in the CENRAP region indicates greater usage of recreational boats than the NONROAD 2004 defaults by a factor of approximately 2. In spite of this large difference, the uncertainty in the overall survey results is judged to be approximately only ±25%. Notably, geographic areas in which subsistence fishing is prevalent exhibited the least evidence of over-reporting bias, while owners of personal watercraft over-reported usage to a greater extent than owners of other types of watercraft. This is consistent with the theory that recreational activities tend to be over-reported more often than non-recreational activities.

Emission estimates for recreational boating vary widely from state to state, as shown in **Table 2-5** and **Figures 2-16 and 2-17**. Louisiana, Minnesota, Missouri, and Texas account for almost 80% of the annual NO_x emissions from recreational boating in the CENRAP region, while Nebraska and Kansas combined contribute less than 4% of the total NO_x emissions. Emissions also vary widely across the months of the year, days of the week, and hours of the day, as shown in **Figures 2-18 through 2-20**. Recreational boating activity peaks during the summer months for each state, and this peak is more pronounced for the four northern states of Minnesota, Nebraska, Kansas, and Iowa. Activity peaks also occur on the weekends and during morning to midday hours.

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[5] See Section 2.1.1 for a discussion of sources of information on fuels characteristics.

Table 2-5. Recreational boating emissions (tons) by state and boat type.

Page 1 of 2

State	Category	PM2.5	NOx	VOC	SO2	CO	NH3
Arkansas	2-Stroke Outboards	1,662	803	25,604	63	69,155	6
	2-Stroke Personal Watercraft	204	115	4,253	10	11,469	1
	4-Stroke Inboards	8	785	1,430	21	19,809	1
	Diesel Inboards	10	570	21	10	90	0
	Diesel Outboards	0	2	0	0	1	0
	Total	1,884	2,274	31,309	103	100,524	8
Iowa	2-Stroke Outboards	1,418	682	21,346	54	58,835	5
	2-Stroke Personal Watercraft	192	108	3,944	9	10,777	1
	4-Stroke Inboards	7	738	1,000	20	18,380	1
	Diesel Inboards	9	536	20	9	85	0
	Diesel Outboards	0	2	0	0	1	0
	Total	1,626	2,066	26,310	92	88,079	7
Kansas	2-Stroke Outboards	266	123	4,581	10	10,940	1
	2-Stroke Personal Watercraft	72	41	1,495	3	4,069	0
	4-Stroke Inboards	3	293	431	7	6,919	0
	Diesel Inboards	3	202	8	3	32	0
	Diesel Outboards	0	1	0	0	0	0
	Total	345	660	6,515	24	21,962	2
Louisiana	2-Stroke Outboards	4,341	2,107	66,542	165	180,909	15
	2-Stroke Personal Watercraft	509	286	10,608	24	28,589	2
	4-Stroke Inboards	20	1,928	3,598	52	49,469	3
	Diesel Inboards	25	1,420	53	26	225	1
	Diesel Outboards	0	5	1	0	3	0
	Total	4,895	5,746	80,803	267	259,196	21
Minnesota	2-Stroke Outboards	5,113	2,462	77,086	69	211,905	17
	2-Stroke Personal Watercraft	710	402	14,580	12	39,829	3
	4-Stroke Inboards	27	2,807	3,666	26	67,462	4
	Diesel Inboards	34	1,982	74	34	314	1
	Diesel Outboards	1	6	2	0	5	0
	Total	5,886	7,659	95,409	142	319,514	26
Missouri	2-Stroke Outboards	5,397	2,671	79,005	207	226,163	18
	2-Stroke Personal Watercraft	502	283	10,360	23	28,213	2
	4-Stroke Inboards	19	1,892	2,899	51	48,478	3
	Diesel Inboards	25	1,401	52	26	222	1
	Diesel Outboards	0	4	1	0	3	0
	Total	5,943	6,251	92,318	308	303,079	24

Table 2-5. Recreational boating emissions (tons) by state and boat type.

Page 2 of 2

State	Category	PM2.5	NOx	VOC	SO2	CO	NH3
Nebraska	2-Stroke Outboards	414	198	6,366	16	17,146	1
	2-Stroke Personal Watercraft	60	34	1,243	3	3,382	0
	4-Stroke Inboards	2	247	355	6	5,727	0
	Diesel Inboards	3	168	6	3	27	0
	Diesel Outboards	0	1	0	0	0	0
	Total	479	648	7,971	28	26,282	2
Oklahoma	2-Stroke Outboards	1,462	695	23,269	55	60,589	5
	2-Stroke Personal Watercraft	226	127	4,709	11	12,702	1
	4-Stroke Inboards	9	874	1,588	23	21,922	1
	Diesel Inboards	11	631	24	11	100	0
	Diesel Outboards	0	2	0	0	1	0
	Total	1,708	2,330	29,590	100	95,314	7
Texas	2-Stroke Outboards	5,095	2,422	81,866	192	211,147	17
	2-Stroke Personal Watercraft	795	447	16,620	37	44,684	3
	4-Stroke Inboards	31	2,947	5,890	81	78,276	5
	Diesel Inboards	39	2,219	83	39	352	1
	Diesel Outboards	1	7	2	0	5	0
	Total	5,960	8,043	104,461	350	334,464	26
All States	2-Stroke Outboards	25,167	12,166	385,666	832	1,046,790	84
	2-Stroke Personal Watercraft	3,270	1,843	67,812	131	183,714	14
	4-Stroke Inboards	126	12,511	20,858	288	316,441	19
	Diesel Inboards	159	9,128	342	162	1,447	6
	Diesel Outboards	3	29	7	0	21	0
	Total	28,725	35,676	474,685	1,413	1,548,413	122

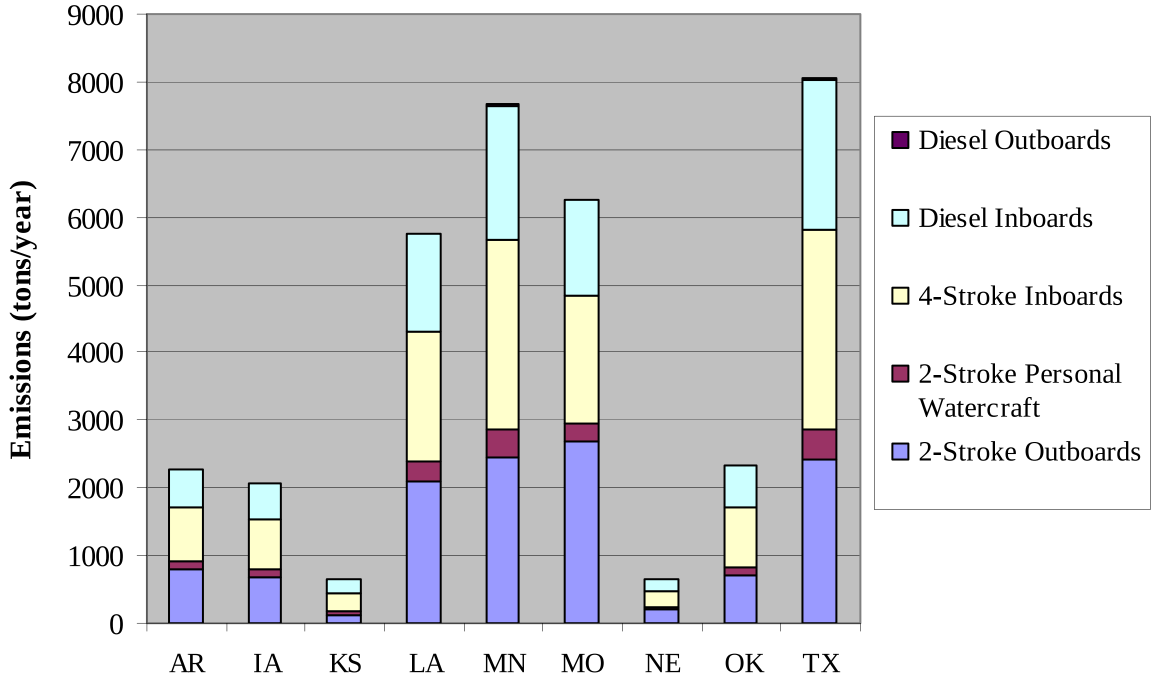

Figure 2-16. Annual NO_x emissions from recreational boating activities by state and boat type.

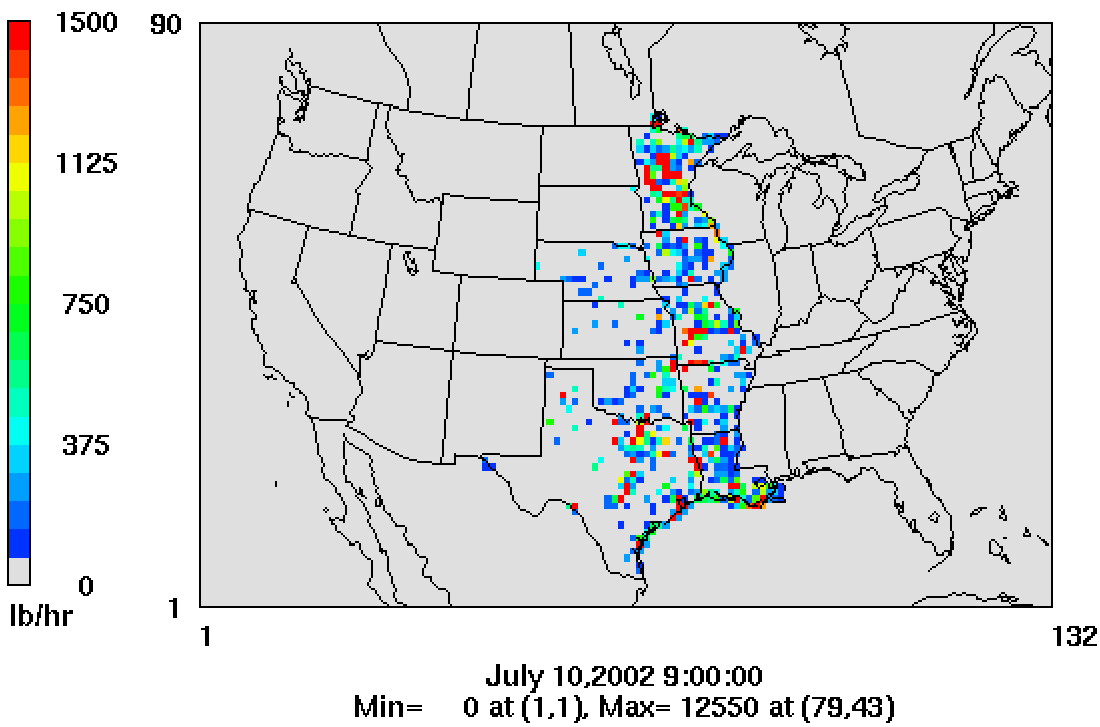

Figure 2-17. Geographic distribution of recreational boating emissions of NO_x in the CENRAP states on July 10, 2002.

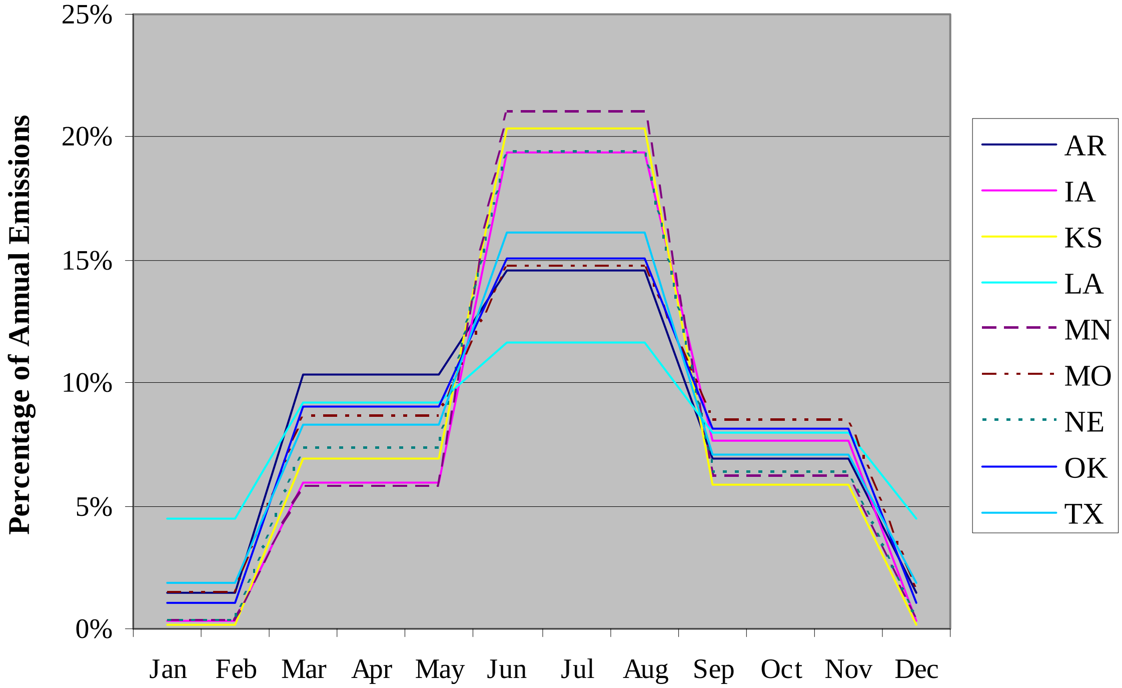

Figure 2-18. Monthly variability in recreational boating emissions by state.

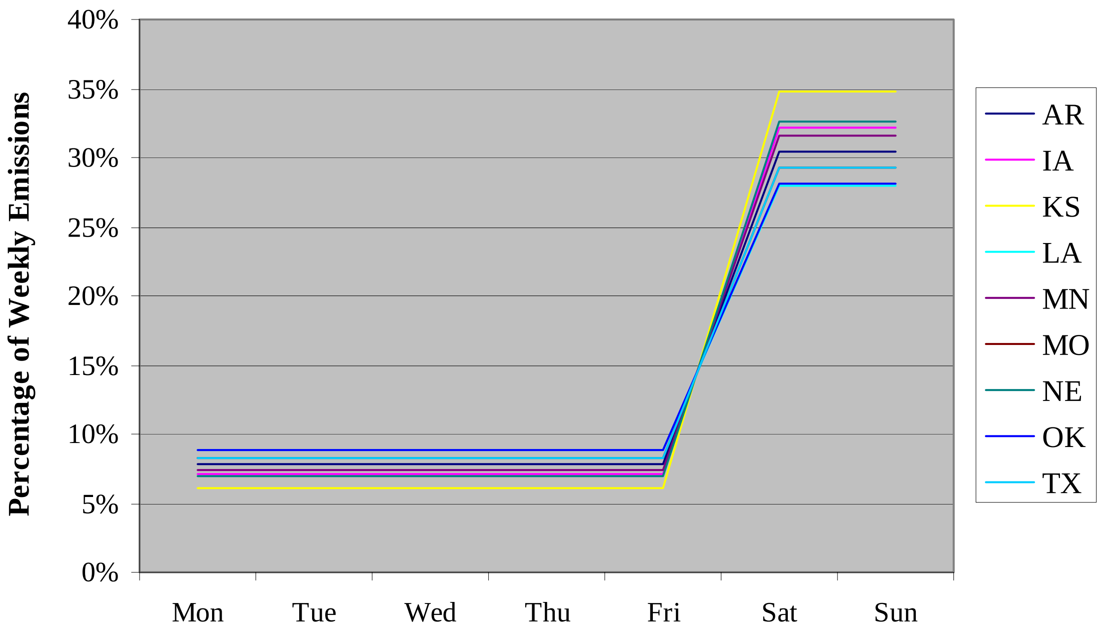

Figure 2-19. Day-of-week variability in recreational boating emissions by state.

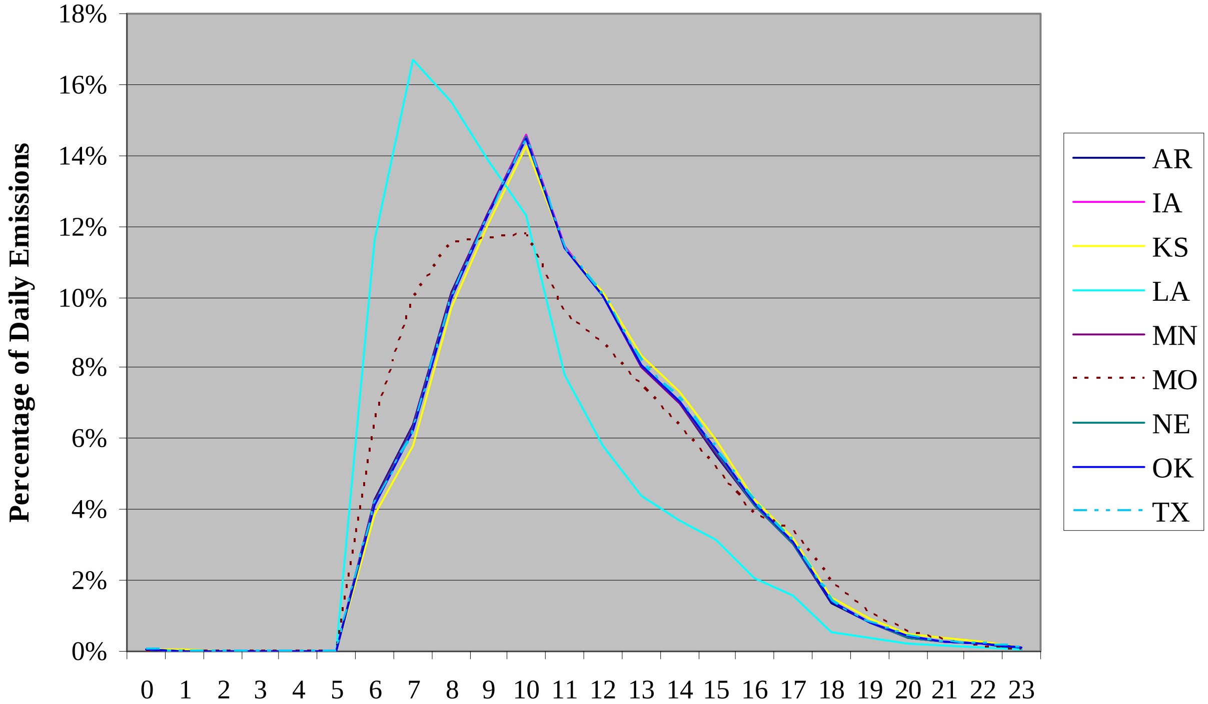

Figure 2-20. Diurnal variability in recreational boating emissions by state.

2.2.6 Assessment of Emissions from Recreational Boats

The CENRAP's emission inventory for recreational boating represents a significant improvement over existing inventories and NONROAD default activity data. Surveys of representative groups of boat owners in each of the CENRAP states made possible the replacement of NONROAD default data with state-specific information that more accurately represents recreational boating activity in the CENRAP region. The improved activity data resulted in emission estimates 2 to 4 times greater than estimates from the preliminary 2002 NEI (see **Figure 2-21**). The scale of the differences may seem surprising; however, we believe that they are reasonably accurate and reliable because care was taken to control over-reporting bias (as discussed in Section 2.2.5) and to ensure the representativeness of the survey results.

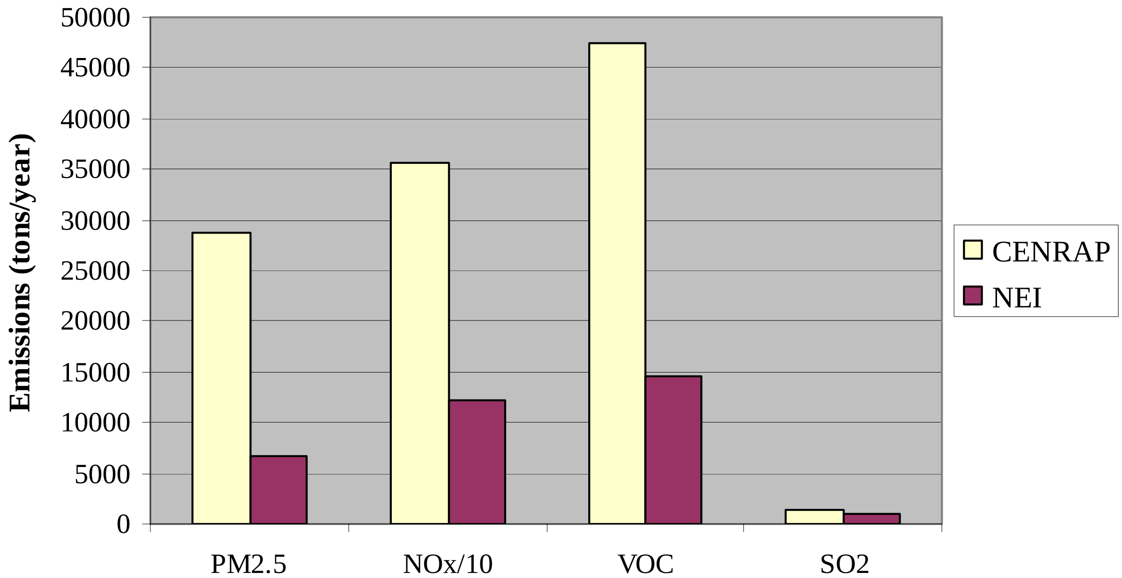

Figure 2-21. Comparison of recreational boating emissions estimates with results from the 2002 preliminary NEI (note: NO_x emissions have been divided by 10 for scaling purposes).

Figure 2-22 illustrates a county-by-county comparison of the CENRAP emission inventory with an inventory produced by running NONROAD 2004 with default inputs. The inventories differ significantly throughout the CENRAP region with respect to quantities of pollutants emitted and spatial distributions of emissions. The differences are due to the improved activity data, which were more representative of the scale and geographic distribution of recreational boating activities than NONROAD 2004 defaults. **Figure 2-23** provides a side-by-side comparison of the spatial distributions that resulted from NONROAD 2004 defaults and from the CENRAP recreational boating survey results. The CENRAP spatial allocation represents the usage patterns reported by survey respondents and is, therefore, highly representative of real-world behavior. The NONROAD spatial allocation was achieved by allocating statewide emissions proportionally to each county's water surface area. This technique overallocates emissions to areas that are unpopular with recreational boaters due to boating restrictions, remoteness from population centers, or other reasons.

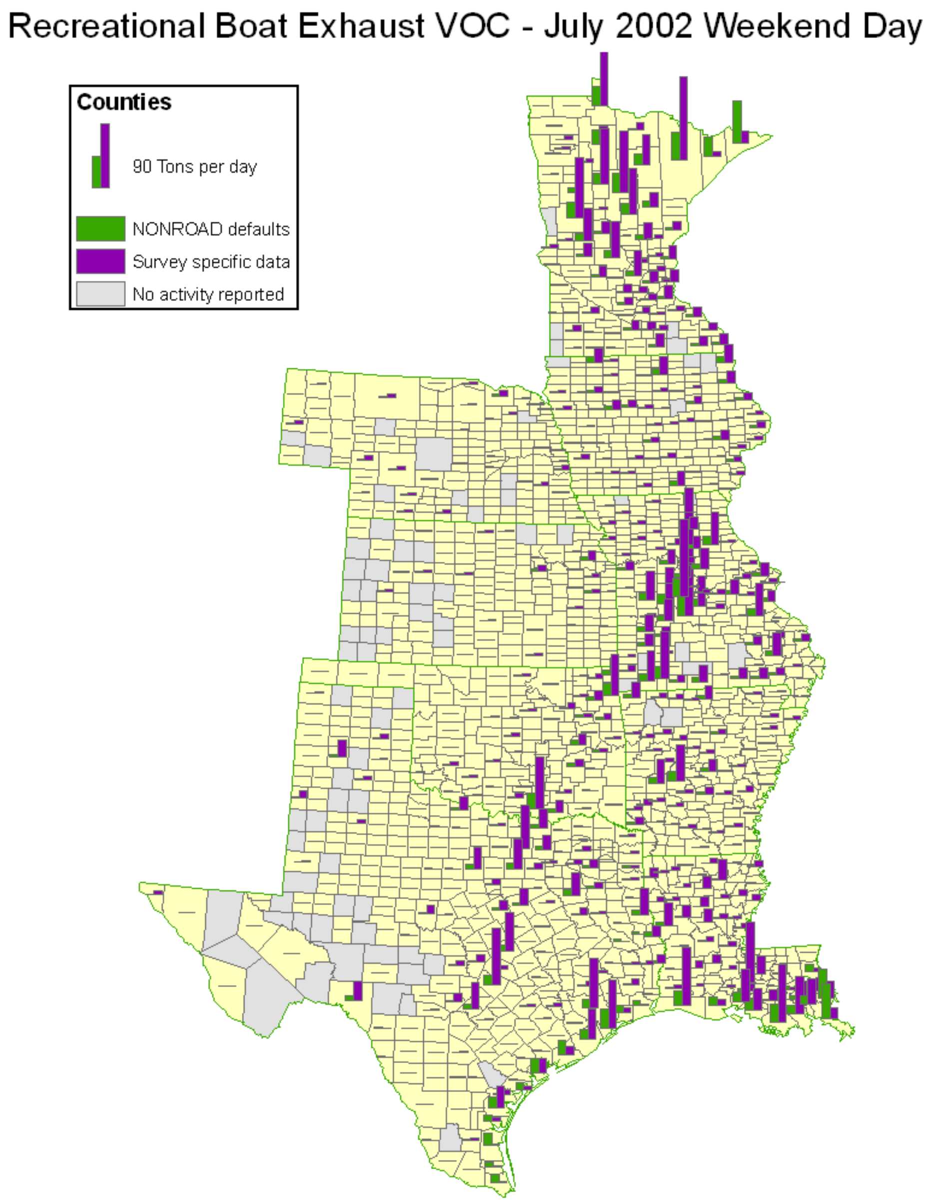

Figure 2-22. Comparison of county-level exhaust VOC emissions estimates with results obtained using NONROAD model defaults.

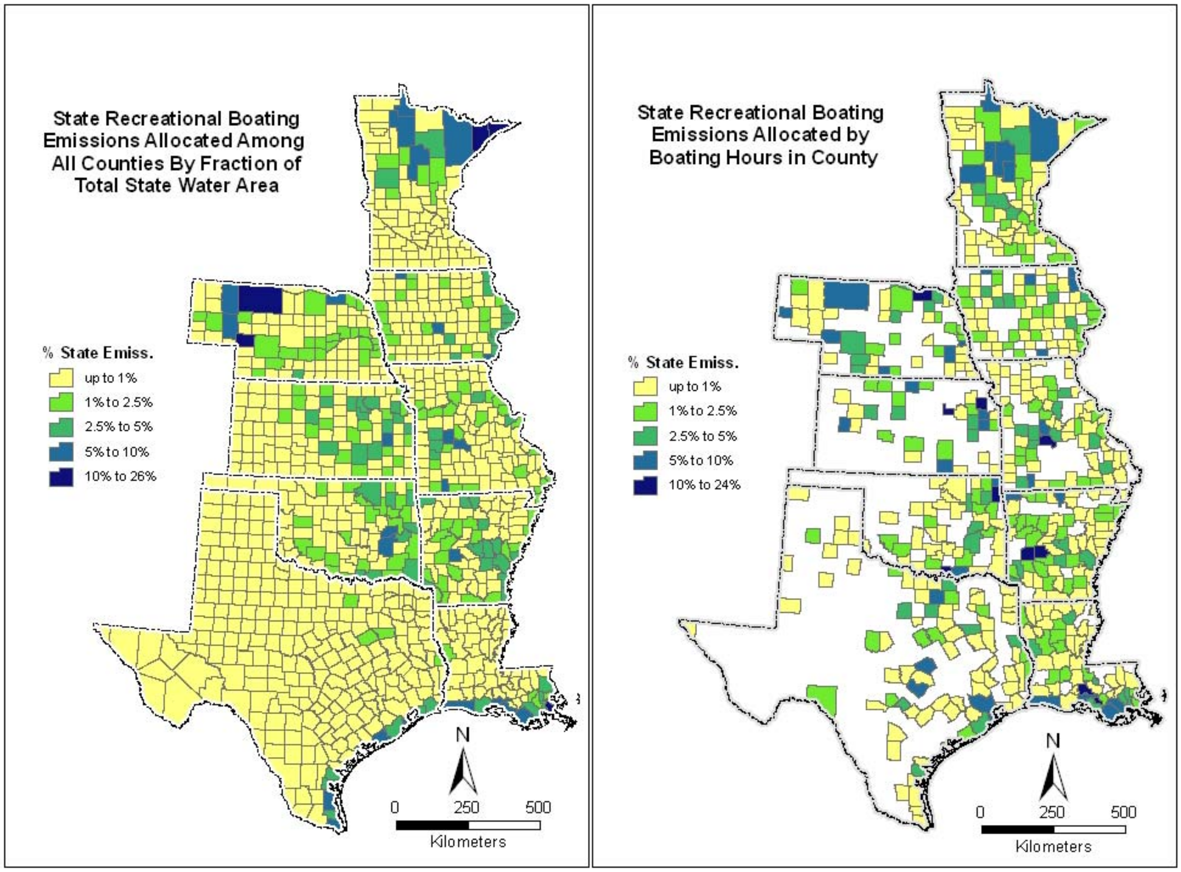

Figure 2-23. Comparison of county-level spatial allocation factors with NONROAD model defaults.

2.2.7 Summary of Emissions from Other Non-Road Mobile Sources

An initial prioritization of efforts related to non-road mobile sources indicated that commercial marine vessels, locomotives, and recreational boats represent at least two-thirds of the non-road primary and precursor emissions in counties containing or adjacent to Class I areas in the CENRAP region.[6] Therefore, these source categories were selected for bottom-up treatment, and emissions from remaining non-road mobile sources were estimated with the best available top-down methods. The EPA's NONROAD model is the approved method for estimating emissions from these sources, and the latest version of the model was run with default activity data, but with region-specific fuels characteristics and temperatures as appropriate.

Table 2-6 lists emissions for non-road mobile source categories not previously treated in earlier sections of this report—i.e., excluding emissions from locomotives, commercial marine vessels, recreational boats, and aircraft. The table lists the five largest $PM_{2.5}$ sources in each state. Agricultural equipment and construction and mining equipment, which are largely fueled

[6] The final CENRAP inventory indicates that these sources are even more substantial contributors to emissions in these areas than the initial prioritization first indicated.

by diesel fuel, tend to be the largest sources of NO_x, SO_2, and $PM_{2.5}$ for the CENRAP states, whereas recreational and lawn and garden equipment (predominantly gasoline-powered) are the largest sources of VOC. A geographic distribution of emissions for a selected date can be seen in **Figure 2-24**.

Table 2-6. "Other" non-road mobile source emissions (tons) by state and equipment type (not including emissions for locomotives, commercial marine vessels, recreational boats, and aircraft).

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State	Category	$PM_{2.5}$	NO_x	VOC	SO_2	CO	NH_3
Arkansas	Agricultural Equipment	1,127	10,344	1,480	166	12,372	6
	Construction & Mining	677	8,285	1,508	152	12,639	5
	Recreational Equipment	253	177	8,041	15	26,894	1
	Industrial Equipment	132	4,954	1,222	33	19,657	1
	Lawn & Garden	92	426	3,713	18	57,637	1
	Other	135	1,666	1,866	34	41,660	9
	Total	2,415	25,852	17,830	418	170,860	22
Iowa	Agricultural Equipment	4,961	45,544	6,428	731	53,863	26
	Construction & Mining	808	9,893	1,789	181	15,007	5
	Recreational Equipment	322	227	13,516	36	51,872	3
	Lawn & Garden	229	1,088	8,190	42	127,060	2
	Commercial Equipment	142	1,775	2,314	36	58,916	1
	Other	145	5,198	1,270	35	20,234	1
	Total	6,607	63,725	33,506	1,062	326,950	38
Kansas	Agricultural Equipment	3,337	30,673	4,346	452	36,410	17
	Construction & Mining	785	9,622	1,744	161	14,608	5
	Lawn & Garden	206	909	7,155	35	106,296	2
	Commercial Equipment	124	1,535	2,033	30	52,119	1
	Industrial Equipment	112	4,024	977	26	15,550	1
	Other	101	618	3,125	13	19,689	72
	Total	4,665	47,382	19,381	716	244,673	98
Louisiana	Construction & Mining	1,095	13,383	2,436	260	20,482	8
	Agricultural Equipment	589	5,402	773	91	6,469	3
	Recreational Equipment	261	170	8,285	15	26,223	1
	Lawn & Garden	158	713	6,177	31	95,753	2
	Commercial Equipment	156	1,854	2,564	40	66,691	2
	Other	320	8,128	5,939	98	59,742	508
	Total	2,579	29,650	26,173	536	275,361	525
Minnesota	Agricultural Equipment	3,954	36,320	5,125	577	42,761	21
	Recreational Equipment	2,024	924	91,180	87	262,747	21
	Construction & Mining	1,161	14,209	2,571	259	21,446	8
	Lawn & Garden	329	1,613	11,938	26	184,758	4
	Industrial Equipment	236	8,807	2,152	55	34,390	2
	Other	275	3,492	3,880	49	94,248	4
	Total	7,979	65,365	116,847	1,052	640,351	59

Table 2-6. "Other" non-road mobile source emissions (tons) by state and equipment type (not including emissions for locomotives, commercial marine vessels, recreational boats, and aircraft).

State	Category	$PM_{2.5}$	NO_x	VOC	SO_2	CO	NH_3
Missouri	Agricultural Equipment	2,643	24,252	3,435	421	28,831	14
	Construction & Mining	1,045	12,766	2,314	254	19,485	7
	Lawn & Garden	439	2,031	15,731	83	244,136	5
	Recreational Equipment	256	259	8,067	18	39,236	1
	Industrial Equipment	242	8,701	2,120	64	33,917	2
	Other	270	3,319	3,997	69	101,239	4
	Total	4,895	51,328	35,664	909	466,845	33
Nebraska	Agricultural Equipment	2,870	26,356	3,733	423	31,201	15
	Construction & Mining	417	5,107	924	93	7,728	2
	Lawn & Garden	120	533	4,219	20	62,304	1
	Recreational Equipment	83	99	2,824	8	17,152	0
	Commercial Equipment	82	1,020	1,342	20	34,191	1
	Other	73	2,441	607	18	9,401	3
	Total	3,644	35,556	13,650	582	161,977	23
Oklahoma	Agricultural Equipment	1,277	11,731	1,679	188	14,025	6
	Construction & Mining	655	8,016	1,459	147	12,213	4
	Lawn & Garden	172	776	6,348	32	97,477	2
	Recreational Equipment	129	124	4,106	9	18,720	1
	Commercial Equipment	126	1,532	2,097	31	53,592	1
	Other	184	5,383	3,157	53	34,267	250
	Total	2,543	27,563	18,846	460	230,294	265
Texas	Construction & Mining	4,610	56,355	10,274	1,049	86,597	36
	Agricultural Equipment	2,791	25,621	3,676	414	30,877	14
	Lawn & Garden	1,393	5,908	46,403	240	708,712	16
	Commercial Equipment	794	9,459	13,202	199	340,914	10
	Industrial Equipment	671	21,938	5,264	167	82,994	5
	Other	983	11,728	28,062	201	190,438	1,362
	Total	11,241	131,009	106,881	2,271	1,440,533	1,444
Total – All States and Sources		46,568	477,429	388,778	8,006	3,957,843	2,507

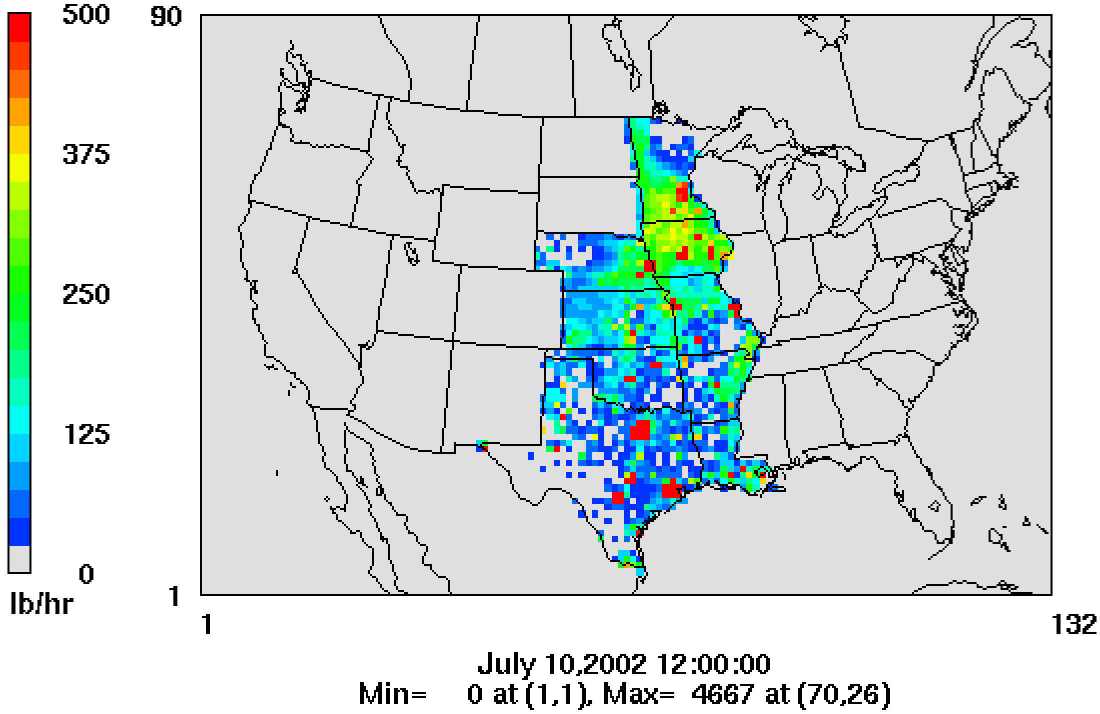

Figure 2-24. Geographic distribution of "other" non-road mobile source emissions of NO_x in CENRAP states on July 10, 2002.

2.2.8 Assessment of Emissions from Non-Road Mobile Sources

Emissions estimates for non-road mobile sources represent an improvement over existing inventories due to the use of region-specific fuels characteristics. **Figure 2-25** shows a comparison of the CENRAP inventory and the preliminary 2002 NEI. A significant difference in SO_2 emissions and a modest difference in VOC emissions are apparent. These differences are due to the use of state-specific diesel sulfur contents and gasoline volatilities for the CENRAP inventory. However, further improvements could be made by gathering bottom-up activity data (as was done for recreational boating). Based on a review of the emissions totals, the priority categories for further study are agricultural equipment and construction and mining equipment, which account for 75% of the total NO_x, $PM_{2.5}$, and SO_2 emissions from "other" non-road mobile sources and/or recreational or lawn and garden equipment, which dominate VOC emissions.

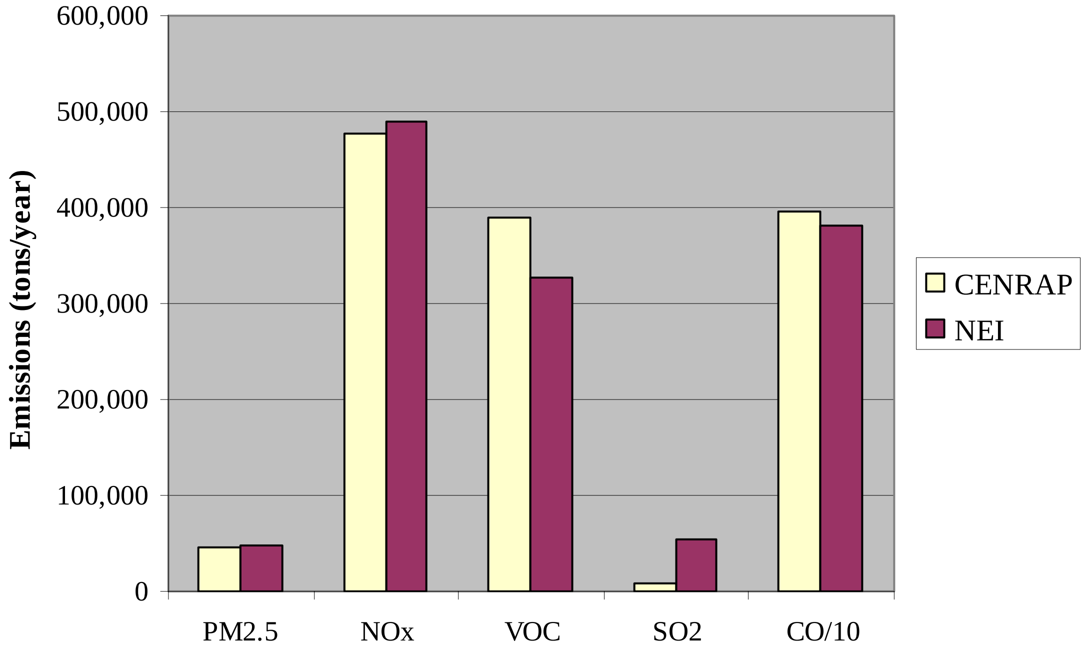

Figure 2-25. Comparison of non-road mobile source emissions with results from the preliminary 2002 NEI (note: CO emissions have been divided by 10 for scaling purposes).

2.3 EMISSIONS FROM SOURCES OF AGRICULTURAL DUST

2.3.1 Summary of Emissions from Agricultural Tilling Operations

Particulate matter (PM) emissions from agricultural tilling operations in the CENRAP region were estimated combining a constant emission factor with county-level activity data, including the silt content of surface soils, the number of tillings performed in a year for each crop type, the acres of each crop type, and information about conservational tillage practices. (Conservational tilling practices, such as no-till, mulch-till, and ridge-till, reduce the number of tilling passes performed in a year.) Total PM_{10} emissions from agricultural tilling operations in the CENRAP region were estimated to be over 1.3 million tons per year, with $PM_{2.5}$ emissions contributing about 270,000 tons to this total (see **Table 2-7** and **Figure 2-26**). A geographic distribution of county-level $PM_{2.5}$ emissions appears in **Figure 2-27**. Temporal variations in $PM_{2.5}$ emissions by month, day-of-week, and hour-of-day appear in **Figures 2-28 through 2-30**.

Table 2-7. Particulate matter emissions (tons) from agricultural tilling operations by state.

State	PM_{10}	$PM_{2.5}$
Arkansas	87,895	17,579
Iowa	236,520	47,304
Kansas	253,850	50,769
Louisiana	42,443	8,489
Minnesota	215,070	43,013
Missouri	104,530	20,905
Nebraska	138,850	27,770
Oklahoma	100,160	20,033
Texas	167,420	33,484
Total	1,346,738	269,346

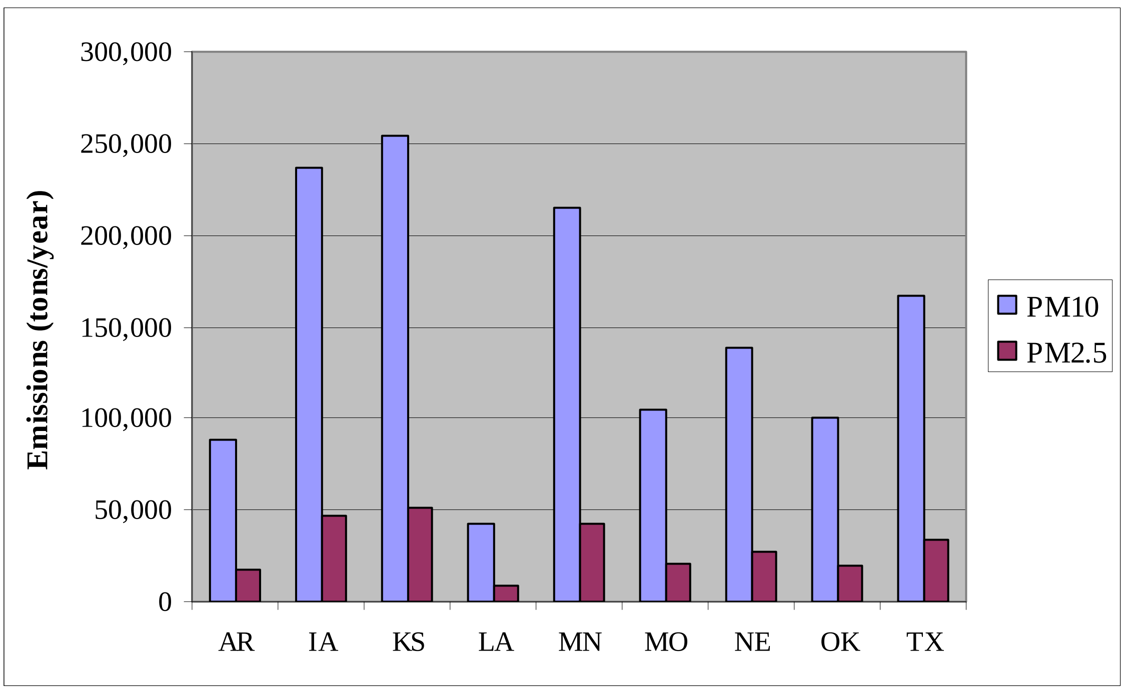

Figure 2-26. Particulate matter emissions from agricultural tilling operations by state.

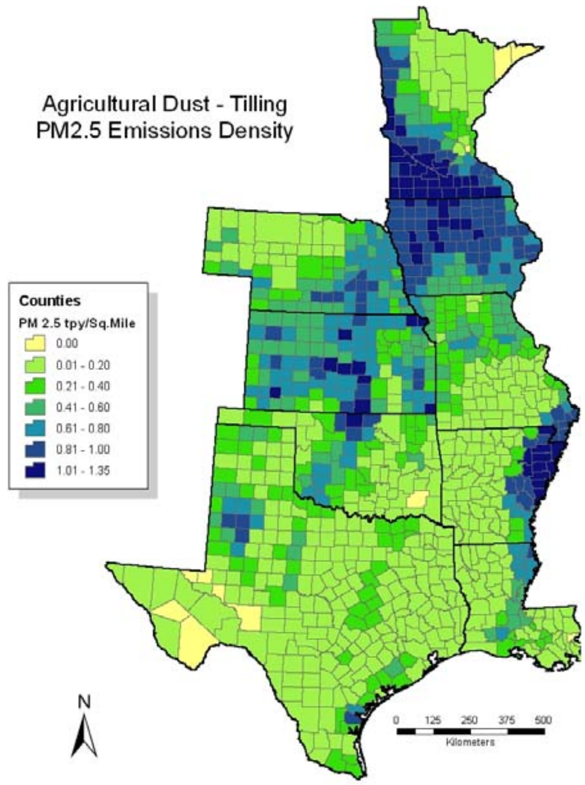

Figure 2-27. County-level $PM_{2.5}$ emission estimates for agricultural tilling operations.

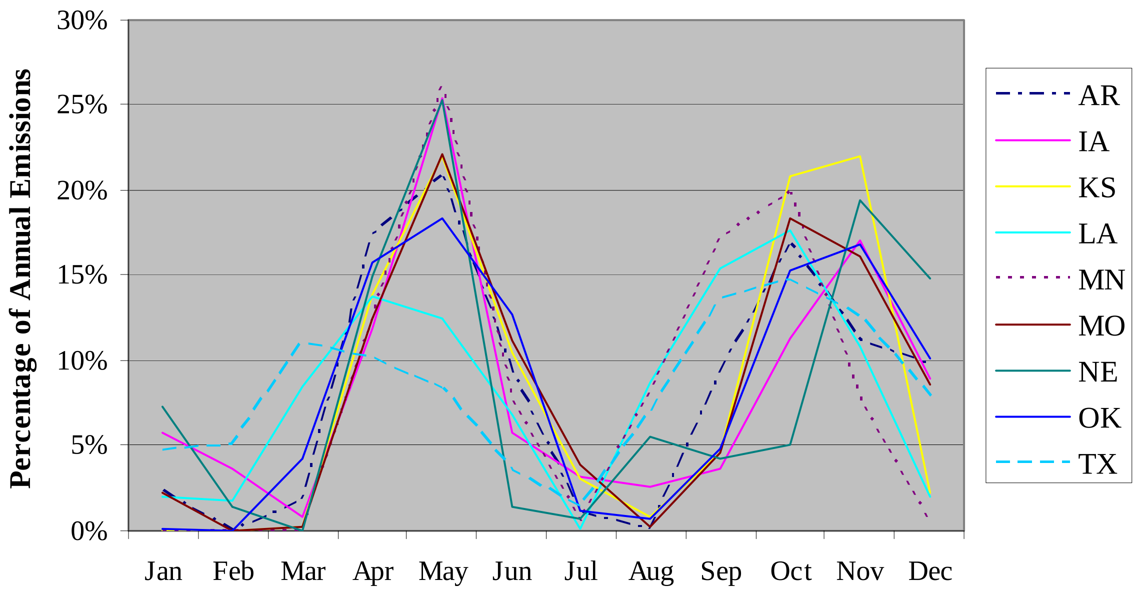

Figure 2-28. Monthly variability in agricultural tilling emissions by state.

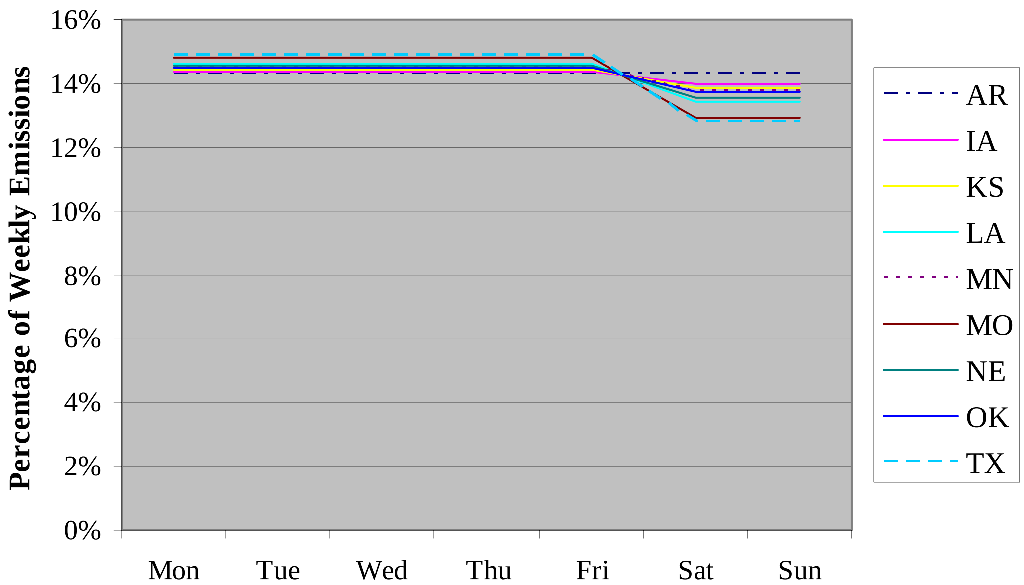

Figure 2-29. Day-of-week variability in agricultural tilling emissions by state.

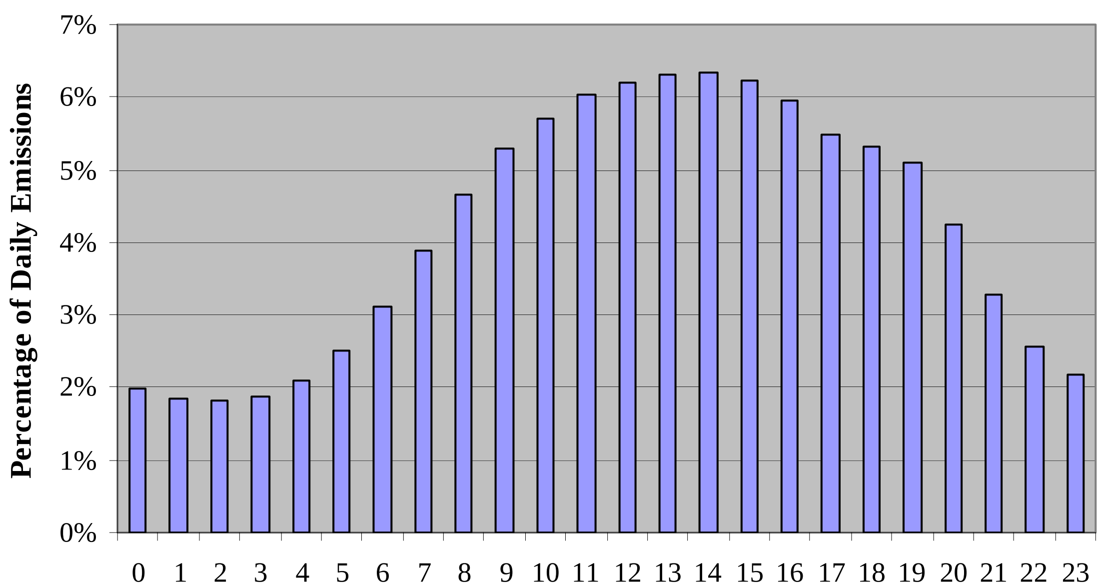

Figure 2-30. Diurnal variability in agricultural tilling emissions (same for all states).

2.3.2 Assessment of Emissions from Agricultural Tilling Operations

The use of locally representative activity information in the development of emission inventories for agricultural tilling operations permitted a significant improvement over the inventory compiled for the preliminary 2002 NEI. The most significant improvements included county-level soil silt contents and locally reported tilling practices (reported as the number of tilling passes completed for each crop type), which were found to correlate with the actual prevalence of conservational tilling practices. Emission estimates from this inventory are generally about 25% to 30% lower than corresponding estimates from the preliminary 2002 NEI, although the comparison varies from state-to-state (see **Figure 2-31**). These reductions seem primarily due to the incorporation of local information on tilling practices because the reported number of tilling passes for each crop type was often less than indicated by EPA guidance. A likely explanation is that conservational tilling practices have become more prevalent in recent years, particularly in Texas, where the most dramatic differences between the preliminary 2002 NEI and the CENRAP inventory are apparent.

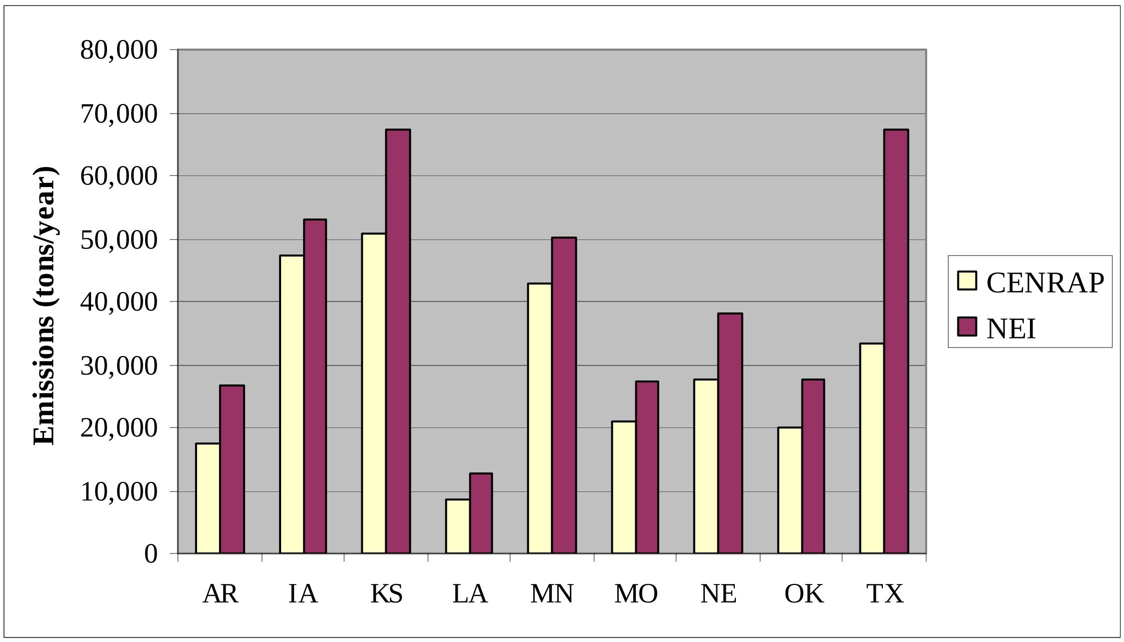

Figure 2-31. State-by-state comparison of $PM_{2.5}$ emissions from agricultural tilling operations.

2.3.3 Summary of Emissions from Livestock Operations

PM emissions from livestock operations in the CENRAP region were estimated using a PM_{10} emission factor and a $PM_{2.5}$ size fraction selected after a literature review. These factors were applied to facility-specific annual populations for beef cattle feedlots and dairies. Because facility locations were also acquired, emissions from livestock operations were treated as point sources and assigned to the specific location coordinates of each facility. Total PM_{10} emissions from livestock operations in the CENRAP region were estimated to be 51,000 tons per year, with $PM_{2.5}$ emissions contributing about 7,700 tons to this total (see **Table 2-8** and **Figure 2-32**). A geographic distribution of county-level PM_{10} emissions appears in **Figure 2-33**.

Table 2-8. Particulate matter emissions (tons) from livestock operations by state.

State	Facility Type	PM_{10}	$PM_{2.5}$
Arkansas	Beef Cattle Feedlot	0.0	0.0
	Dairy	3.9	0.6
Iowa	Beef Cattle Feedlot	4,314.0	647.1
	Dairy	40.8	6.1
Kansas	Beef Cattle Feedlot	18,378.5	2,756.8
	Dairy	142.7	21.4
Louisiana	Beef Cattle Feedlot	15.9	2.4
	Dairy	0.0	0.0
Minnesota	Beef Cattle Feedlot	252.6	37.9
	Dairy	35.6	5.3
Missouri	Beef Cattle Feedlot	109.3	16.4
	Dairy	9.7	1.5
Nebraska	Beef Cattle Feedlot	8,732.9	1,309.9
	Dairy	15.4	2.3
Oklahoma	Beef Cattle Feedlot	3,390.4	508.6
	Dairy	22.5	3.4
Texas	Beef Cattle Feedlot	15,673.8	2,351.1
	Dairy	152.2	22.8
Total		51,290.2	7,693.6

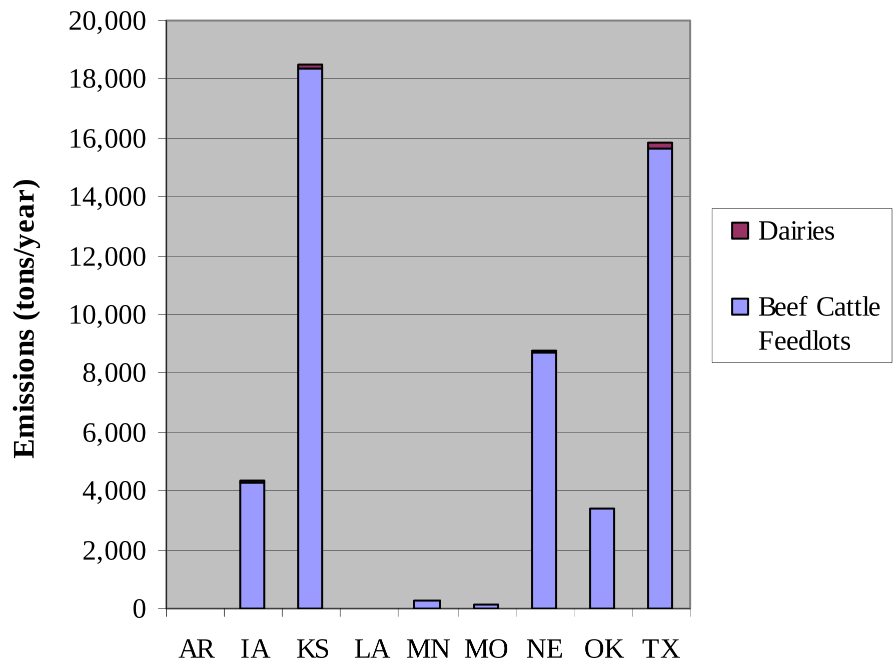

Figure 2-32. PM_{10} emissions from livestock operations by state and facility type.

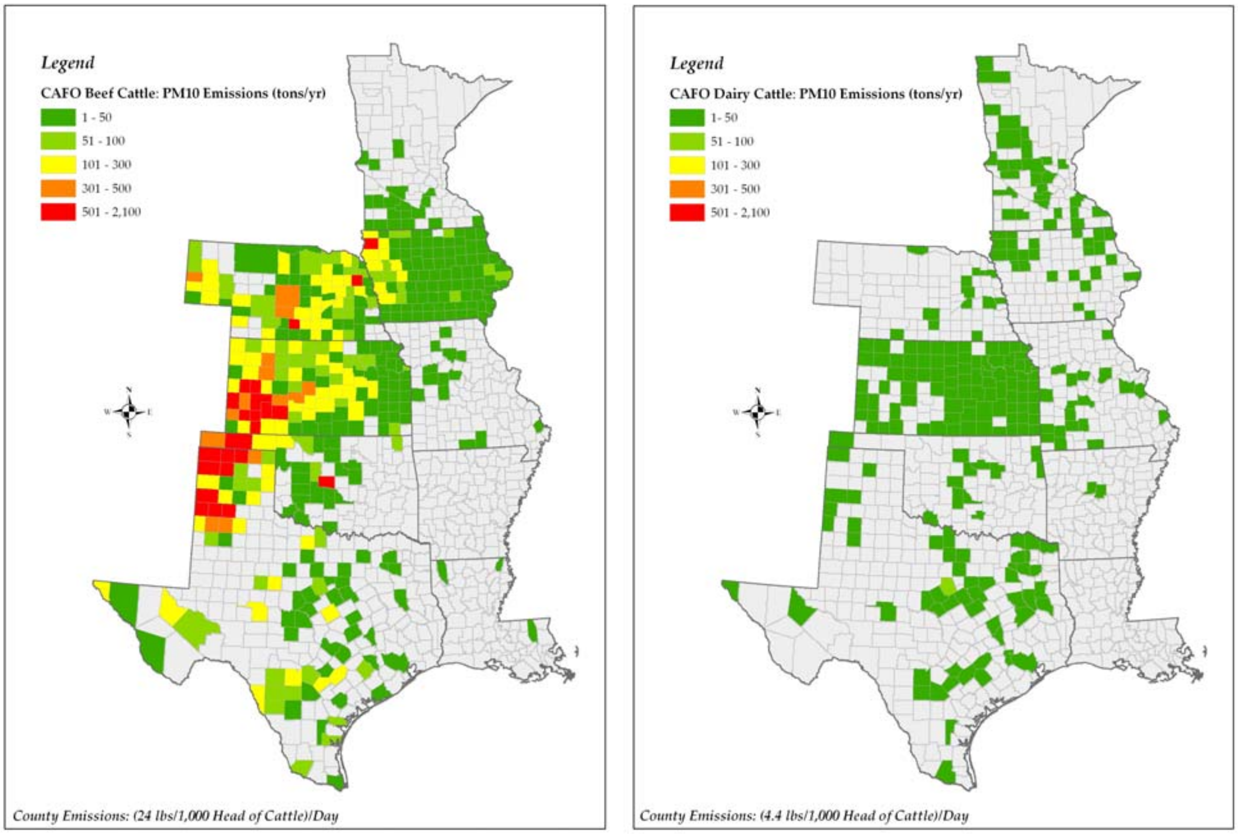

Figure 2-33. County-level PM_{10} emission estimates for beef cattle feedlots (left) and dairies (right).

2.3.4 Assessment of Emissions from Livestock Operations

The methods used to develop emission inventories for livestock operations represent a significant improvement over existing inventories, both in terms of the total annual emissions calculated and the geographic distribution of those emissions. The 1999 NEI[7] included an estimated 270,000 tons per year of PM_{10} emissions from CAFOs in the CENRAP region—a figure more than five times higher than that estimated for the CENRAP inventory. A literature search indicated that the emission factor of 17 tons per 1000 animals per year, which was used during development of the 1999 NEI, was too high for this source category. Ultimately, an emission factor of 4.4 tons per 1000 animals per year was selected for beef cattle and an emission factor of 0.8 tons per 1000 animals per year was used for dairy cows.

In addition, the use of facility coordinates greatly enhanced the spatial distribution of emissions. For the 1999 NEI, a simplifying assumption was used that the number of cattle housed at CAFOs is approximately 10% of the total number of beef cattle in each county, regardless of feedlot locations or local animal husbandry practices. As a result, emissions were assigned to many counties in which no feedlots operate, as illustrated by **Figure 2-34**, which

[7] Particulate emissions from animal feedlots are not yet included in the 2002 version of the NEI.

contrasts the geographic distribution of emissions in the 1999 NEI with known feedlot locations and animal populations. Side-by-side comparison of these figures shows that the 1999 NEI registers high emissions densities in eastern Texas, Oklahoma, western Missouri, and northwestern Nebraska—areas where very few CAFOs exist. In reality, most CAFOs in the CENRAP region accumulate in a band that reaches from the Texas panhandle, across Kansas and southeastern Nebraska, and across the state of Iowa.

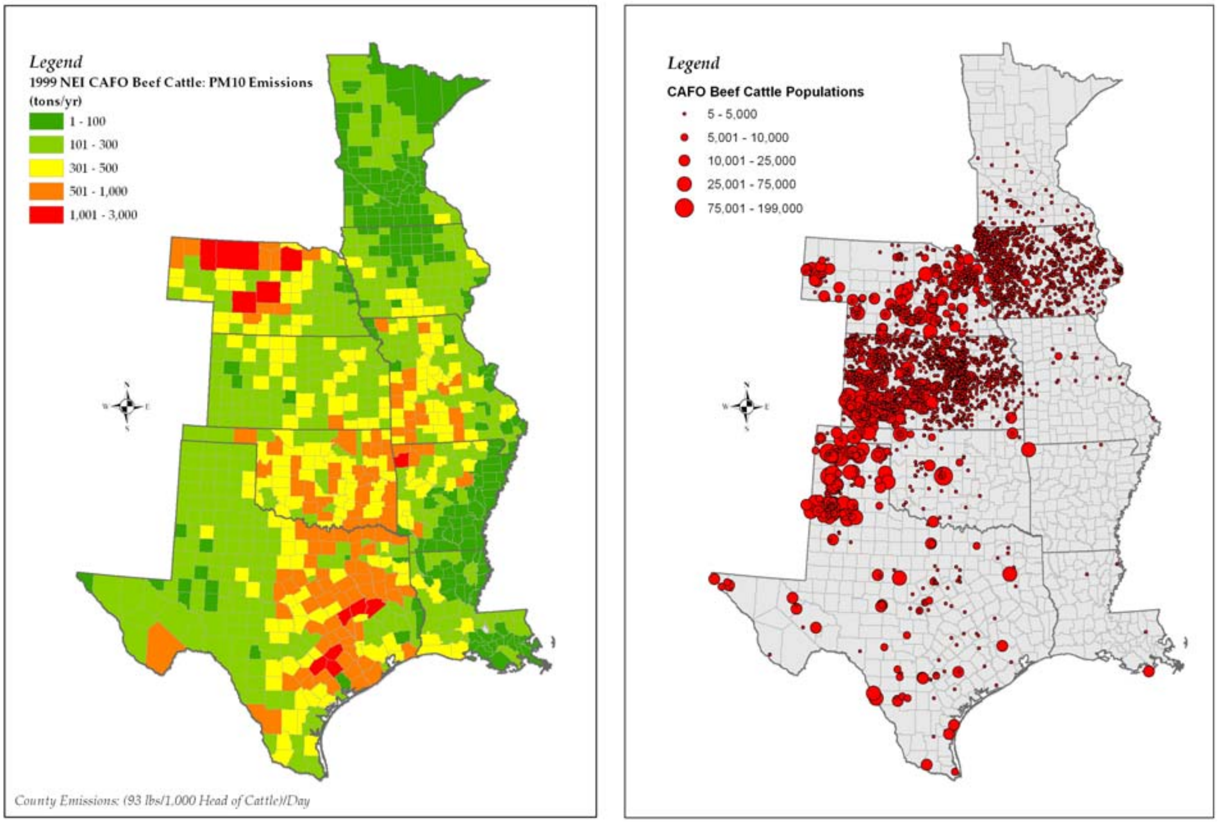

Figure 2-34. NEI county-level PM_{10} emissions for beef cattle feedlots vs. actual beef cattle feedlot locations and populations.

3. RECOMMENDATIONS FOR FURTHER RESEARCH

This study resulted in significant improvements to the 2002 emission inventories for on-road and off-road mobile sources and for sources of agricultural fugitive dust in the CENRAP region. Emission inventories were prepared on highly region-specific or even county-specific bases and adhered closely to EPA's recommended guidance for inventory development. Additional refinements and improvements should be incorporated as the products of ongoing research into emission factors and updates to activity data sets become available. Additionally, we identified the following potential sources of uncertainty in the inventories (roughly in order of importance):

1. Unusual vehicle age distributions and duplicate VIN records were observed in DMV databases of vehicle registrations.
2. The inventories of non-road mobile sources could benefit from additional bottom-up data collection efforts.
3. Existing VMT distributions could be refined to better represent the increasing popularity of SUVs and light trucks.
4. Fuels testing programs could be deployed or improved to better represent fuels characteristics.
5. VIN decoding yielded too few records corresponding to alternative-fueled vehicles to allow improvements to this component of the inventory (though this affects future-year projections more than the 2002 inventory).
6. Day-specific inventories (e.g., Monday, Tuesday, etc.) may be superior to assuming all weekdays are the same and both weekend days are the same for photochemical modeling purposes.
7. The inventories of agricultural fugitive dust sources could benefit from additional bottom-up data collection efforts.

This section briefly discusses recommendations for addressing these issues.

3.1 RECOMMENDATIONS FOR IMPROVING INVENTORIES OF ON-ROAD MOBILE SOURCES

3.1.1 Incorporate New Data and Information as They Become Available

Emission inventories operate best as dynamic databases—subject to continuous refinements, additions, and improvements as research develops and activity data are updated. The electronic file systems of the activity data and emission inventories developed for the CENRAP, which were delivered as products of this project, are likely to be revised and improved as new information becomes available. Examples of recently developed or soon-to-be-available data sets that could be incorporated to further improve the CENRAP's inventories include (1) locally generated VMT estimates for Kansas City, Minneapolis-St. Paul, and Little

Rock; (2) results of the fuels testing program of the Texas Department of Agriculture; and (3) reports of fuels sulfur contents that refiners will be submitting to EPA beginning in February 2005 for diesel and February 2007 for gasoline. In addition, we recommend encouraging fuel testing programs in states where they are not yet planned—Louisiana, Arkansas, Iowa, and Nebraska—and encouraging the Oklahoma Department of Agriculture to archive and maintain records of their existing fuels testing program.

3.1.2 Investigate Databases of Vehicle Registrations

Unusual features in several states' databases of vehicle registrations were noted, including (roughly in order of importance) unexpected numbers of duplicate VINs, unusually large proportions of old light-duty vehicles, and unexpectedly small numbers of light-duty vehicles less than 2-3 years in age. High frequencies of duplicate VINs are sources of error in fleet distributions in and of themselves—particularly in Iowa, where the frequency of duplicates could only be reduced to 6%. However, high frequencies of duplicate records may only be one symptom of general database maintenance problems—such as retention of outdated records, mis-assignment of records, etc.—that cannot be easily recognized and remedied without in-depth review and diagnosis. The possibility that unidentified errors in the vehicle registration databases are related to unusual vehicle age distributions in some states is a cause for concern. MOBILE6 models older vehicles with higher emission rates due to their levels of deterioration and outdated emissions control technologies. Therefore, errors in this component of the vehicle population distributions exert significant impacts on the emission inventories of on-road mobile sources. In addition, errors across all age ranges can significantly impact projections of emission inventories to future years.

3.1.3 Use Fleet Distributions to Refine VMT Distributions

Patterns of SUVs and light-duty-truck use have been shifting rapidly in recent years. However, for this study, VMT distributions by vehicle type for many areas of the CENRAP were based on EPA defaults, which are based on predictions and data from a number of years ago. Errors in the VMT distributions by vehicle type can be significant because emissions standards vary across the classes of light-duty vehicles, and emissions from gasoline-fueled vehicles differ considerably from those of diesel-fueled vehicles. VMT distributions could be refined or adjusted by using vehicle registration data. This approach is based on an assumption, which we believe is well-founded, that due to recent trends in vehicle ownership and driver behavior, many light-duty trucks (e.g., SUVs) are now driven very similarly like passenger vehicles. Thus, the proportions of VMT that should be assigned to each vehicle type and fuel type are approximately equal to the proportions of vehicles registered in each vehicle- and fuel-type category. (Note that this assumption has already been applied in EPA Region I.) Alternatively, the VMT mix could be calculated from registration data using the vehicle type-specific assumptions about annual mileage accumulation rates that are part of the MOBILE6 model.

3.1.4 Prepare Inventories Specific to the Days of the Week

Driving activities for on-road motor vehicles appear to vary with each day of the week. Therefore, a day-specific approach may be preferable to a simple weekday-weekend approach for some photochemical modeling applications. In general, urban VMT declines on Sundays below average weekday levels to an even greater extent than on Saturdays. Friday evening VMT is somewhat higher than on other weekday evenings, and daily total VMT on Mondays is usually somewhat below average for weekdays in urban areas. Day-specific patterns are also likely to occur in rural areas. The 2002 CENRAP inventories reflect the most significant weekday-weekend patterns supported by research results from other areas of the United States. However, further improvements could be made by investing in research projects that investigate region-specific, day-of-week patterns for both rural and urban areas.

3.1.5 Improve Inventories for Alternative-Fueled Vehicles

VIN decoding yielded too little information to support improvements to the inventory of alternative-fueled vehicles. In addition, fuels characteristics of alternative fuels are rarely tested, and no region-specific data were identified. While these uncertainties have little effect on the 2002 inventory, they may become more important when future-year emission inventories are projected to 2018 and beyond. Alternative-fueled vehicles may compose significantly larger proportions of vehicle fleets in the future and trace levels of sulfur in alternative fuels may become more important as sulfur levels in diesel and gasoline fuels continue to decline as a result of existing regulations.

3.2 RECOMMENDATIONS FOR IMPROVING INVENTORIES OF NON-ROAD MOBILE SOURCES

A survey of representative groups of recreational boat owners in the CENRAP region produced dramatic revisions to the emission inventories for this source category. Emissions estimates were revised by factors of 3 or more, on average. Further improvements in the non-road component of the inventory could be made by gathering bottom-up activity data for the next-largest non-road mobile source categories, including agricultural equipment and construction and mining equipment (which are significant sources of NO_x, $PM_{2.5}$, and SO_2 emissions) and/or recreational or lawn and garden equipment (which are important sources of VOC emissions).

3.3 RECOMMENDATIONS FOR IMPROVING INVENTORIES OF SOURCES OF AGRICULTURAL DUST

3.3.1 Research and Develop Process-Based Emissions Estimation Methods

The limited body of research into emission factors and emission processes represents the most significant weakness in the emission inventories of sources agricultural fugitive dust. Investment in the development of emissions measurement programs and process-based approaches that account for soil moisture, meteorological conditions, and agricultural practices would produce substantial improvements to the accuracy and certainty of this component of the inventory.

3.3.2 Prepare Bottom-Up Inventories for Additional Source Categories

A survey of agricultural extension offices and the use of bottom-up animal population data produced significantly altered spatial allocations and emissions estimates for sources of agricultural fugitive dust. State-level emissions estimates were revised by 25% to 50%, and CAFO emissions were displaced to entirely different geographic areas of the CENRAP. Further modest improvements could be made by gathering bottom-up activity data for the next-largest sources of agricultural fugitive dust, including cotton ginning operations and/or crop transport. However, emissions from these types of sources are likely to be dwarfed by emissions from agricultural tilling dust and are likely to be of significance in only a few areas of the CENRAP where cotton ginning occurs.

4. REFERENCES

Booz Allen Hamilton Inc. (1991) Commercial marine vessel contributions to emission inventories. Final report prepared for U.S. Environmental Protection Agency, Office of Mobile Sources, Ann Arbor, MI by Booz Allen Hamilton Inc. Transportation Consulting Division, Los Angeles, CA, PB93-173961 (316129818), October.

Chinkin L.R., Coe D.L., Funk T.H., Hafner H.R., Roberts P.T., Ryan P.A., and Lawson D.R. (2003) Weekday versus weekend activity patterns for ozone precursor emissions in California's South Coast Air Basin. *J. Air & Waste Manag. Assoc.* **53**, 829-843 (STI-999679-2225).

Coe D.L. and Reid S.B. (2003) Research and development of ammonia emission inventories for the Central States Regional Air Planning Association. Final report prepared for The Central States Air Resource Agencies and The Central Regional Air Planning Association, Oklahoma City, OK. Prepared by Sonoma Technology, Inc., Petaluma, CA, STI-902501-2241-FR, October.

Coe D.L., Reid S.B., Stiefer P.S., Penfold B.M., Funk T.H., and Chinkin L.R. (2004) Collection and analysis of weekend/weekday emissions activity data in the South Coast Air Basin. Final report prepared for the California Air Resources Board, Sacramento, CA, by Sonoma Technology, Inc., Petaluma, CA, STI-901140/901150-2477-FR; ARB Contract Nos. 00-305 and 00-313, May.

Croes B.E., Dolislager L.J., Larsen L.C., and Pitts J.N. (2003) The O_3 "weekend effect" and NO_x control strategies: scientific and public health findings and their regulatory implications. *EM* **July**, 27-35.

Eastern Research Group & Starcrest Consulting Group LLC (2003) Improvements to the commercial marine vessel emission inventory in the vicinity of Houston, Texas. Prepared for the Houston Advanced Research Center, July.

Energy Information Administration (2003) Petroleum marketing annual 2002. Report prepared by the Energy Information Administration Office of Oil and Gas, U.S. Department of Energy, Washington, DC, DOE/EIA-0487(2002), August.

Flocchini R.G. and James T.A., et al., (2001) Sources and sinks on PM_{10} in the San Joaquin Valley, Interim Report. Prepared by the Air Quality Group, Crocker Nuclear Laboratory, University of California, Davis, CA, August.

Goodrich L.B., Parnell C.B., Mukhtar S., Lacey R.E., and Shaw B.W. (2002) Preliminary PM_{10} emission factor for freestall dairies. Paper number 022148 presented to the *2002 ASAE Annual International Meeting, July,* by the Department of Biological and Agricultural Engineering, Texas A&M University.

Lawson D.R. (2003) The weekend ozone effect--the weekly ambient emissions control experiment. *EM* **July**, 17-25.

Pacific Environmental Services (2001) Assessment of emission inventory needs for regional haze plans. Prepared for the Ozone Transport Commission and the Southeast States Air Resources Managers by Pacific Environmental Services under contract to the Mid-Atlantic Regional Air Management Association, March.

Reid S.B., Brown S.G., Sullivan D.C., Arkinson H.L., Funk T.H., and Stiefer P.S. (2004a) Research and development of planned burning emission inventories for the Central States Regional Air Planning Association. Final report prepared for The Central States Air Resource Agencies and The Central Regional Air Planning Association, Oklahoma City, OK, by Sonoma Technology, Inc., Petaluma, CA, STI-902514-2516-FR, July.

Reid S.B., Sullivan D.C., Funk T.H., Tamura T.M., Stiefer P.S., Penfold B.M., and Raffuse S.M. (2004b) Emission estimation methods for mobile sources and agricultural dust sources in the Central States. Methods Document Prepared for The Central States Air Resource Agencies and The Central Regional Air Planning Association, Oklahoma City, OK by Sonoma Technology, Inc., Petaluma, CA, STI-903574-2610-MD, September.

Sullivan D.C. (2004) Mobile source and agricultural dust emission inventory for the central states. Final work plan/quality assurance project plan prepared for The Central States Air Resource Agencies and The Central Regional Air Planning Association, Oklahoma City, OK, by Sonoma Technology, Inc., Petaluma, CA, STI-903571-2460-FWP/QAPP, February 27.

U.S. Environmental Protection Agency (1992) Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources. EPA420-R-92-009, December.

U.S. Environmental Protection Agency (1997) Emission factors for locomotives, technical highlights. EPA420-F-97-051, December.

U.S. Environmental Protection Agency (1998a) Locomotive emission standards: regulatory support document. Prepared by the U.S. Environmental Protection Agency Office of Mobile Sources, April.

U.S. Environmental Protection Agency (1998b) Compilation of air pollutant emission factors, AP-42. Section 1.3: Fuel oil combustion. Volume 1, 5th ed., September. Available on the Internet at <http://www.epa.gov/ttn/chief/ap42/ch01/> ; last accessed September 17, 2004.

U.S. Environmental Protection Agency (1999a) Commercial marine activity for the Great Lake and inland river ports of the United States. EPA420-R-99-019, September.

U.S. Environmental Protection Agency (1999b) 1999 National Emission Inventory documentation and data. Available on the Internet at <http://www.epa.gov/ttn/chief/net/1999inventory.html>; last accessed August 2004.

U.S. Environmental Protection Agency (1999c) Final regulatory impact analysis: control of emissions from marine diesel engines. Prepared by the Office of Mobile Sources, Ann Arbor, MI, EPA 420-R-99-026, November.

U.S. Environmental Protection Agency (2000) Analysis of commercial marine vessels emissions and fuel consumption data. Prepared by the Office of Mobile Sources, Ann Arbor, MI, EPA420-R-00-002, February.

U.S. Environmental Protection Agency (2003a) National Emission Inventory (NEI) Air Pollutant Emission Trends, Criteria Pollutant Data, Current Emission Trends Summaries, Average Annual Emissions, All Criteria Pollutants, Years Including 1980, 1985, 1989-2001. Available on the Internet at <http://www.epa.gov/ttn/chief/trends/index.html>; last accessed May 2003.

U.S. Environmental Protection Agency (2003b) Documentation for aircraft, commercial marine vessel, locomotive, and other nonroad components of the National Emissions Inventory. Prepared by the Emission Factor and Inventory Group, Research Triangle Park, NC, October.

U.S. Environmental Protection Agency (2004a) National emission inventory—Ammonia emissions from animal husbandry operations. Available on the Internet at <http://www.epa.gov/ttn/chief/net/2002inventory.html>; last accessed April 22, 2004. January 30.

U.S. Environmental Protection Agency (2004b) Emission Inventory Improvement Program - EIIP document series - Volume IX - Particulate emissions - Fugitive dust from agricultural tilling. Web site of the Technology Transfer Network Clearinghouse for Inventories & Emission Factors. Available on the Internet at <http://www.epa.gov/ttn/chief/eiip/techreport/volume09/index.html>; last accessed September 20, 2004.

APPENDIX A

EMISSION ESTIMATION METHODS FOR MOBILE SOURCES AND AGRICULTURAL DUST SOURCES IN THE CENTRAL STATES (STI-903574-2610-MD)

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EMISSION ESTIMATION METHODS FOR MOBILE SOURCES AND AGRICULTURAL DUST SOURCES IN THE CENTRAL STATES

METHODS DOCUMENT
STI-903574-2610-MD

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September 22, 2003

QUALITY ASSURANCE STATEMENT

This report was reviewed and approved by the project Quality Assurance (QA) Officer or his delegated representatives, as provided in the project QA Plan (Sullivan, 2004).

Lyle R. Chinkin
Project QA Officer

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1. INTRODUCTION

The Central States Regional Air Planning Association (CENRAP) is developing a regional haze plan in response to the U.S. Environmental Protection Agency's (EPA) mandate to protect visibility in Class I areas. To develop an effective regional haze plan, the CENRAP ultimately must develop a conceptual model of the phenomena that lead to episodes of low visibility in the CENRAP region. Thus, the CENRAP is researching visibility-related issues for its region, which includes the states of Texas, Oklahoma, Louisiana, Arkansas, Kansas, Missouri, Nebraska, Iowa, and Minnesota. Both primary particulate matter (which is emitted directly to the atmosphere in particulate form) and the formation of secondary particulate matter (which is generated from chemical transformations in the atmosphere of gaseous precursor species such as ammonia, nitrogen oxides, sulfur oxides, and volatile organic compounds [VOCs]) contribute to episodes of regional haze and low visibility in the CENRAP region. Mobile sources and sources of agricultural fugitive dust are thought to be significant sources of these pollutants (as illustrated in **Figure 1-1**). In recognition of these issues, the CENRAP sponsored the development of improved emission inventories for mobile sources and sources of agricultural dust. The project objectives were to improve or develop activity data for off- and on-road mobile sources and sources of agricultural dust throughout the nine CENRAP states; to prepare the activity data in formats compatible for reprocessing and use with MOBILE6, NONROAD, and SMOKE 1.5 (which runs MOBILE6 internally); and/or to prepare the emission inventories in the latest version of the National Emission Inventory Input Format (NIF).

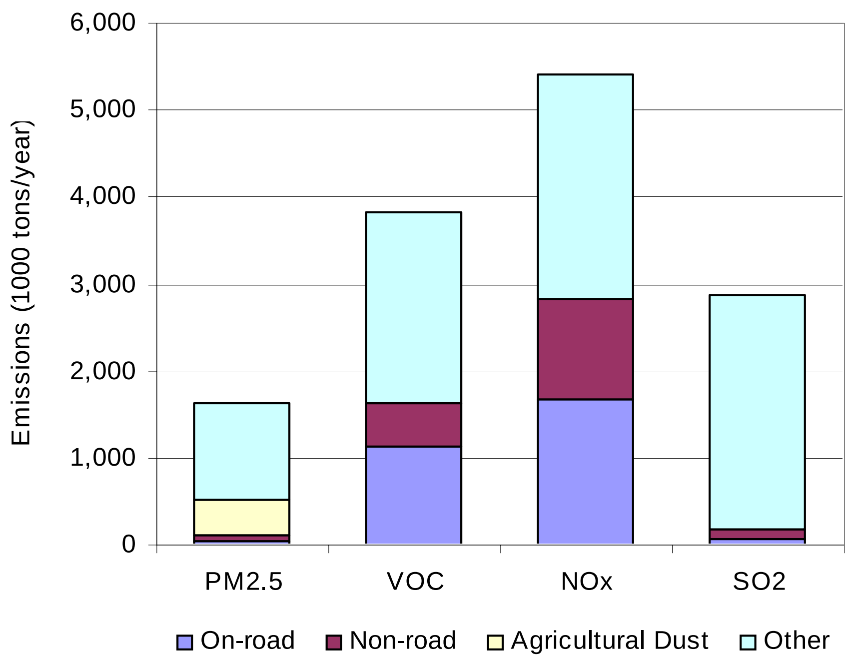

Figure 1-1. Estimated emissions for the CENRAP region. Source: 1999 NEI (U.S. Environmental Protection Agency, 1999c).

1.1 BRIEF OVERVIEWS OF EMISSIONS MODELING METHODS

1.1.1 Overview of Methods to Prepare Emission Inventories of On-Road Mobile Sources

The EPA's MOBILE6 model—an emission factor model that estimates emission factors for on-road mobile sources—and SMOKE were used to generate and prepare emission inventories of on-road mobile sources for photochemical modeling. SMOKE processes and prepares on-road mobile source emission inventories for photochemical air quality modeling by applying temporal profiles, speciation profiles, and gridding surrogates to county-level emissions estimates. In addition, SMOKE self-contains MOBILE6. Thus, SMOKE has the added capability of generating county-level emission inventories for on-road mobile sources by estimating MOBILE6 emission factors and matching these to county-level activity data. MOBILE6 requires a variety of inputs, including temperatures, fleet distributions, vehicle speeds, regulatory controls settings, and fuels characteristics. **Figure 1-2** illustrates the general processes of using MOBILE6 within SMOKE to generate on-road mobile source emission inventories. Figure 1-2 also illustrates the MOBILE6/SMOKE activity data, input files, and outputs that were prepared as products of this project. The products of these inventory development efforts are highly region-specific, or even county-specific, emission inventories that adhere to EPA's recommended guidance for the development of emission inventories for on-road mobile sources.

1.1.2 Overview of Methods to Prepare Emission Inventories of Non-Road Mobile Sources

The EPA's NONROAD model was used to estimate emissions for most non-road mobile sources. The NONROAD model applies equipment populations, activity data (e.g., hours of operation, load factors, etc.), emission factors, and growth factors to estimate emissions for non-road mobile sources. Default input files accompany the model, which are sufficient to estimate emissions for the entire United States at the county level. However, many of the default values are based on national defaults or general assumptions and can be improved with region-specific data, if available. Improved activity data were collected throughout the CENRAP region for recreational boating, which is considered to be one of the most important non-road mobile source categories in the region. These efforts resulted in emission inventories that are much improved over those generated by using the national default values. The most significant improvements included the hours of operation, load factors, spatial distributions, and temporal patterns of recreational boating.

Emissions from locomotives and commercial marine vessels, which are excluded from the NONROAD model, were estimated according to EPA guidance documents and using bottom-up activity data to the extent available. Aircraft emissions, which are also excluded from the NONROAD project, were considered to be a lower priority and were not included in the scope of this project.

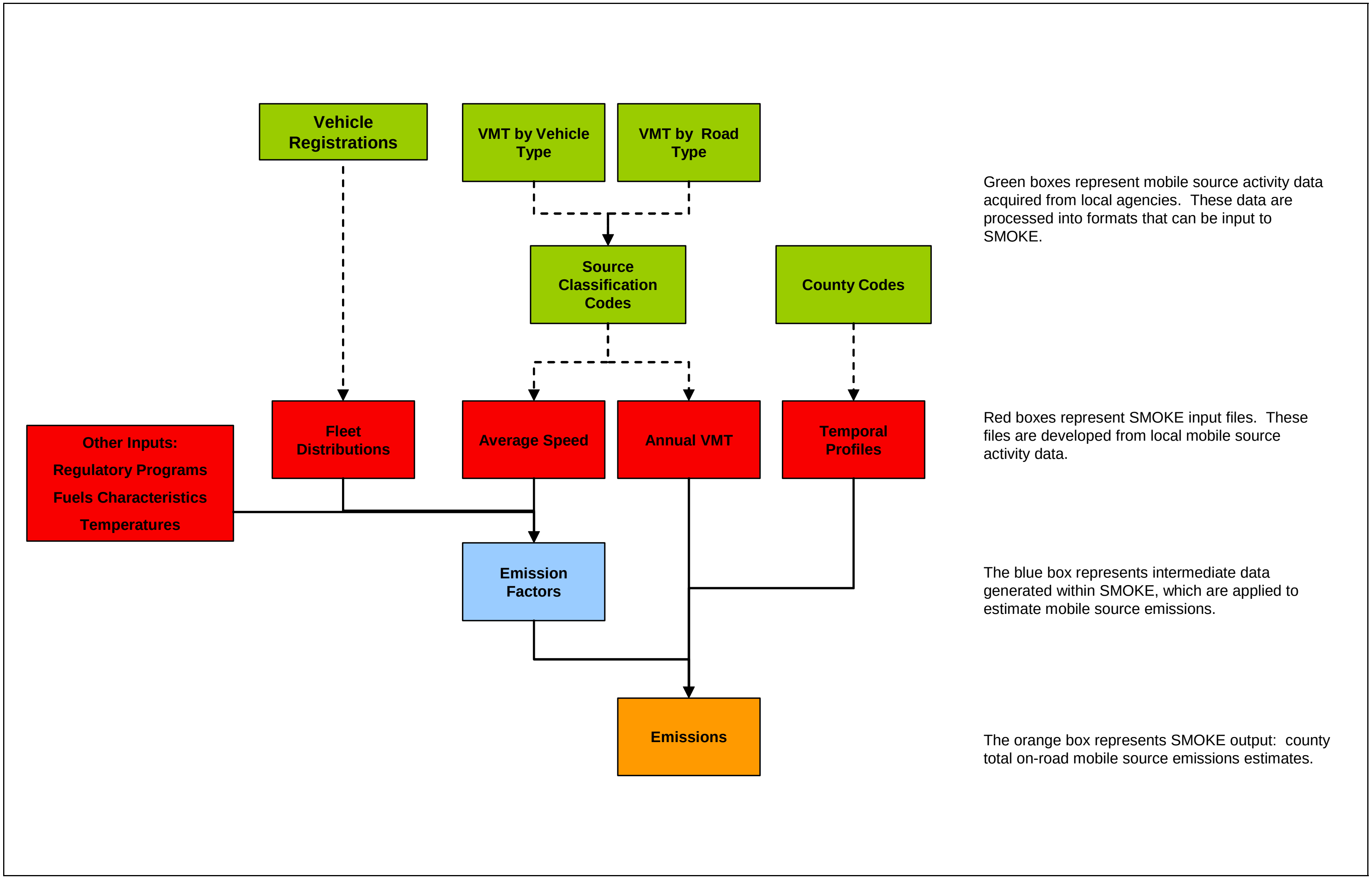

Figure 1-2. General illustration of the overall process and files used by SMOKE to generate on-road mobile source emissions output files.

1.1.3 Overview of Methods to Prepare Emission Inventories for Sources of Agricultural Dust

Emissions from agricultural fugitive dust sources were estimated according to EPA guidance documents or published literature. Bottom-up activity data were used to the extent available, including facility-specific animal populations for confined animal feeding operations (CAFOs) and activity data to describe agricultural tilling operations. Up-to-date GIS databases of soil characteristics and crop types were also used to improve the inventories. These activity data represent a significant improvement over inventories developed by applying national default assumptions. The most significant improvements include the CAFO animal populations, the geographic distributions of CAFO populations, the estimates of the number of tilling passes completed for each crop type, the representative soil silt content for each county, and the temporal patterns of agricultural tilling activities.

1.2 IMPORTANT ASSUMPTIONS

The methods employed to estimate emissions relied on several fundamental assumptions:

- Monthly fuel consumption data from the Federal Highway Administration (FHWA) and Energy Information Administration are representative of monthly patterns of on-road motor vehicle activity.
- Day-of-week and diurnal patterns of on-road motor vehicle activities observed in rural and urban geographic areas of the United States (such as Texas, California, or the national average) are reasonably representative of urban and rural areas of the CENRAP region.
- Rail link-specific traffic density data (ton-miles of cargo moved) is a reasonable surrogate for allocating locomotive fuel usage to the county level.
- The characteristics and speeds of marine vessels at key ports in the CENRAP region can be extrapolated to other ports for which detailed vessel data are not available.

Surveys were conducted to collect bottom-up information for recreational boating and agricultural dust source categories. In those cases, it was assumed that

- Recreational boat owners were capable of providing survey responses that could be interpreted to reasonably represent recreational boating activities across the CENRAP region. Techniques to eliminate or minimize the effects of over-reporting biases were sufficient.
- County agricultural extension service agents were capable of providing survey responses that reasonably represent agricultural tilling activities in the CENRAP region.
- In some cases, incomplete data were recovered. Thus, extrapolation or aggregation of bottom-up observations was assumed to produce reasonably representative results when data were missing, incomplete, or uncertain. A few examples of affected data sets include age distributions for vehicle types that appear with very low frequencies in the vehicle population, reported numbers of tilling passes for rarely grown crop types,

reported hours of use for recreational boats with inboard motors, and others as discussed in the main body of the Final Report.

- Lastly, we relied on state motor vehicle departments' databases of vehicle registrations to represent the 2002 vehicle populations in each county. In some cases, unusual features in vehicle distributions appeared (e.g., larger than expected populations of old vehicles), but no reasons to discount these phenomena could be determined.

2. METHODS TO PREPARE ACTIVITY DATA FOR ON-ROAD MOBILE SOURCES

This section describes the information sources used and the data processing steps followed to prepare activity data for on-road mobile sources, including vehicle miles traveled (VMT), speed distributions, and temporal distributions. VMT, speed distributions of VMT, and temporal distributions of VMT are critical input variables for emission inventories of on-road mobile sources and photochemical air quality models. VMT is a measure of on-road vehicle activity, which is often used as the foundation of emission inventories of on-road mobile sources, including those prepared with MOBILE6. Speed distributions of VMT significantly affect emission rates, while the timing of vehicle activities by season, day, or hour also significantly influences emissions (which vary with temperature).

The SMOKE emissions processor uses VMT, distributions of VMT by speed bin, and temporal distributions of VMT to estimate on-road motor vehicle emissions and to prepare emission inventories for use with photochemical air quality models. The objective of this task was to develop the SMOKE inputs for the CENRAP domain, including county-level VMT, speed distributions, and temporal profiles, which were used to model and prepare emission inventories of on-road mobile sources for the year 2002 (as discussed in Section 8).

2.1 BACKGROUND AND TECHNICAL ISSUES

The FHWA maintains the Highway Performance Monitoring System (HPMS) database, which contains estimates of VMT for all U.S. states and counties. The HPMS database is updated periodically with VMT data submitted by states. However, VMT data developed at the local or state level are preferable because they generally better represent regional or local conditions, are often more current than the data in the HPMS database, and, therefore, result in better quality emissions inventories. Therefore, locally or regionally developed mobile source activity data were given preference, were acquired whenever available from state and local transportation or air quality management agencies, and were used preferentially over the national default VMT estimates.

The availability of local- or state-level data varied geographically within the CENRAP domain and depended on the area's attainment status and level of urbanization. **Figure 2-1** depicts non-attainment areas, urban attainment areas, Class I areas, and tribal lands in the CENRAP region. Areas for which data existed at the local level included five non-attainment areas, which had previously performed emissions modeling with MOBILE6 or MOBILE5, as well as some urban attainment areas. Although none of the urban attainment areas had prepared VMT for emissions modeling, most had VMT data for transportation planning purposes. Thus, for all non-attainment and most urban attainment areas, locally developed VMT, speed distributions, and temporal distributions were acquired. For all other areas (i.e., rural attainment areas and some urban attainment areas), data that had been developed at the state level were acquired.

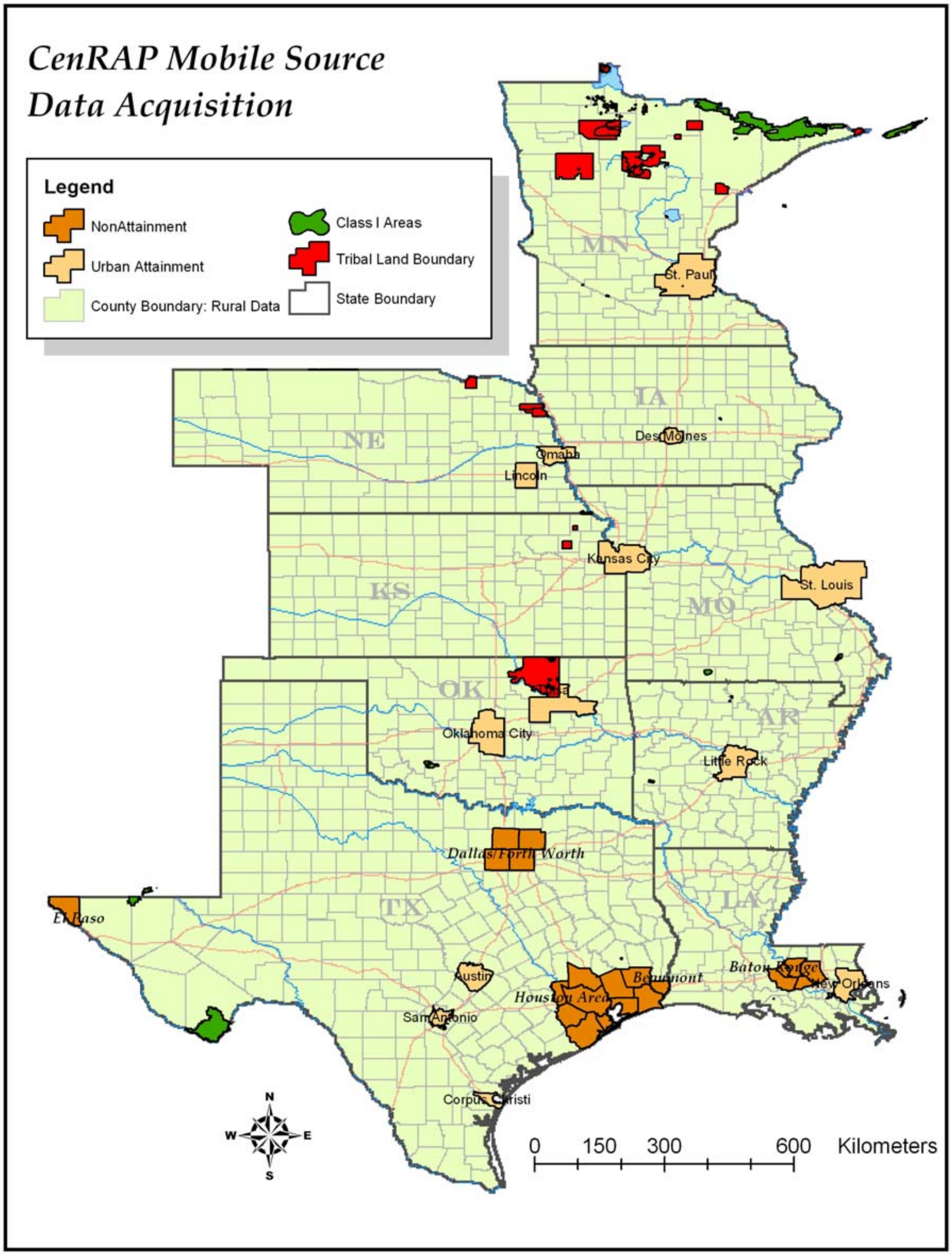

Figure 2-1. Non-attainment areas, urban attainment areas, Class I areas, and tribal lands in the CENRAP region.

To ensure effective use of project resources, we identified areas to be given highest priority according to the following criteria:

1. Magnitude of each region's VMT, population, and proximity to Class I areas.
2. Availability of MOBILE input data.
3. Availability of state or local mobile source activity data to represent the year 2002.

2.2 DATA ACQUISITION

Urban areas often maintain state-generated or locally generated VMT and speed or temporal distributions for the purposes of emissions assessments, air quality modeling, or transportation planning. In addition, the FHWA maintains the national Highway Performance Monitoring System (HPMS) database of VMT on major U.S. roadways. The HPMS data are reported at the county or sub-county level by road type (i.e., freeway, highway, major arterial).

Sonoma Technology, Inc. (STI) requested locally developed on-road mobile source activity data for all non-attainment areas in the CENRAP region and for urban attainment areas located near Class I areas. When locally developed mobile source activity data were not available, Metropolitan Planning Organizations (MPOs) and state departments of transportation (DOTs) were contacted with requests for data. For all other areas, state DOTs were contacted for the most up-to-date HPMS data. **Table 2-1** summarizes the mobile source activity data acquired for each area of the CENRAP domain.

Table 2-1. Summary of the on-road mobile source activity data acquired for each area of the CENRAP domain.

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Area	Data Acquired	Year	Source of Data
Non-Attainment Areas			
Houston/Galveston, Beaumont/Port Arthur, and El Paso, Texas	MOBILE6 input files, VMT by vehicle/road type, temporal/speed distributions	2002	Texas Transportation Institute (TTI)
Dallas/Forth Worth, Texas	VMT by vehicle/road type, temporal/speed distributions	1999	Texas Commission on Environmental Quality (TCEQ)
Baton Rouge, Louisiana	MOBILE6 input files, VMT by road type	2002	Louisiana Department of Environmental Quality (LDEQ)

Table 2-1. Summary of the on-road mobile source activity data acquired for each area of the CENRAP domain.

Urban Attainment Areas – Within 500 km of a Class I Area			
Attainment counties, Dallas/Ft. Worth, Texas	VMT by vehicle/road type, temporal/speed distributions	1999	TCEQ
New Orleans, Louisiana	MOBILE6 input files, VMT by road type	2002	LDEQ
St. Louis, Missouri	VMT by vehicle/road type, temporal distributions	2004	East-West Gateway Coordinating Council
Kansas City, Missouri -Kansas	VMT by road type	2002	Kansas Highway Department (KHD) and Missouri Department of Transportation (MoDOT)
Topeka and Wichita, Kansas	VMT by road type	2002	KHD
Little Rock, Arkansas	VMT by road type	2002	Arkansas Highways and Transportation Department (AHTD)
Minneapolis/St. Paul, Duluth, and St. Cloud, Minnesota	VMT by road type	2002	Minnesota Department of Transportation (MnDOT)
Lincoln, Nebraska	VMT by road/vehicle type and speed	2002	Lincoln-Lancaster Metropolitan Planning Organization
Oklahoma City and Tulsa, Oklahoma	VMT by road type	2002	Oklahoma State Highway Department (OSHD)

Table 2-1. Summary of the on-road mobile source activity data acquired for each area of the CENRAP domain.

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All Other Areas			
Texas	MOBILE6 input files, VMT by vehicle/road type, temporal/speed distributions	2002	TTI
Louisiana	MOBILE6 input files, VMT by road type	2002	LDEQ
Arkansas	VMT by road type	2002	AHTD
Iowa	VMT by road type	2002	Iowa Department of Transportation
Kansas	VMT by road type	2002	KHD
Minnesota	VMT by road type	2002	MnDOT
Missouri	VMT by road type	2002	MoDOT
Nebraska	VMT by road type	2002	Nebraska Department of Transportation
Oklahoma	VMT by road type	2002	OSHD

2.2.1 Details of Data Acquisition for Non-attainment Areas

The CENRAP region currently has five non-attainment areas: four in Texas and one in Louisiana. The El Paso, Texas, non-attainment area (designated as serious) consists of El Paso County and is within about 150 km of the Guadalupe Mountains and Carlsbad Caverns National Parks and within about 400 km of Big Bend National Park. The Dallas-Ft. Worth and Baton Rouge non-attainment areas are located within about 300 kilometers of Class I areas. Houston-Galveston and Beaumont-Port Arthur are at least 500 km distant from any Class I area.

For the non-attainment areas in Texas, MOBILE6-compatible files were acquired from the TTI and the TCEQ. TTI provided hourly and annual VMT and average speed distributions for 2002 by road type and vehicle type. The TCEQ provided MOBILE6-compatible files for 1999, which were grown to 2002 based on additional information provided by the TCEQ. For Baton Rouge, the LDEQ supplied 2002 MOBILE6 input files, as well as 2002 VMT data from the Louisiana Department of Transportation Development (LDOTD).

2.2.2 Details of Data Acquisition for Urban Attainment Areas within 500 km of Class I Areas

Several urban attainment areas in the CENRAP domain are within 500 km of Class I areas (identified in Table 2-1). Of these, three provided locally developed activity data for mobile sources: (1) New Orleans, Louisiana; (2) St. Louis, Missouri; and (3) Lincoln, Nebraska. Other urban areas were unable to provide locally developed activity data within the time available for data acquisition; therefore, VMT data were acquired for these areas from state DOTs. Activity data for a few urban attainment areas have become available very recently or will become available soon (e.g., Kansas City, Missouri-Kansas; Minneapolis-St. Paul, Minnesota). These locally developed data are recommended for use during future inventory development projects.

2.2.3 Details of Data Acquisition for All Other Areas

Texas and Louisiana provided MOBILE6 inputs and activity data for all counties or parishes within those states. Mobile source activity data for 2002 were acquired from the state DOTs in Arkansas, Missouri, Iowa, Minnesota, Oklahoma, Nebraska, and Kansas. In all cases, the data acquired from the state DOTs contain the same type of information as the national HPMS database. However, in some cases, the data supplied by states were more up to date than the latest version of the national HPMS database.

2.3 DATA PREPARATION

A broad array of data types and formats were acquired for this task, which necessitated a strategic data processing scheme to assemble, process, and format the data for use with SMOKE/MOBILE6. The processing scheme was carried out for the following data types:

1. Data acquired for non-attainment areas (MOBILE-compatible inputs)
2. Data acquired for urban attainment areas (MOBILE-compatible inputs or transportation model data)
3. Data acquired for all other areas (HPMS)

Two standardized data processing algorithms were developed to process (1) MOBILE-compatible inputs and transportation demand model data or (2) national HPMS data. **Figure 2-2** illustrates the processing scheme applied to the MOBILE-compatible input data and transportation model data. **Figure 2-3** illustrates the processing scheme applied to the HPMS data. These algorithms included functions to process VMT data into the formats required by SMOKE and to process and calculate average speed distributions and temporal profiles. The outputs of the data processing schemes were SMOKE-ready input files suitable for use with MOBILE6 running within the SMOKE emissions processor.

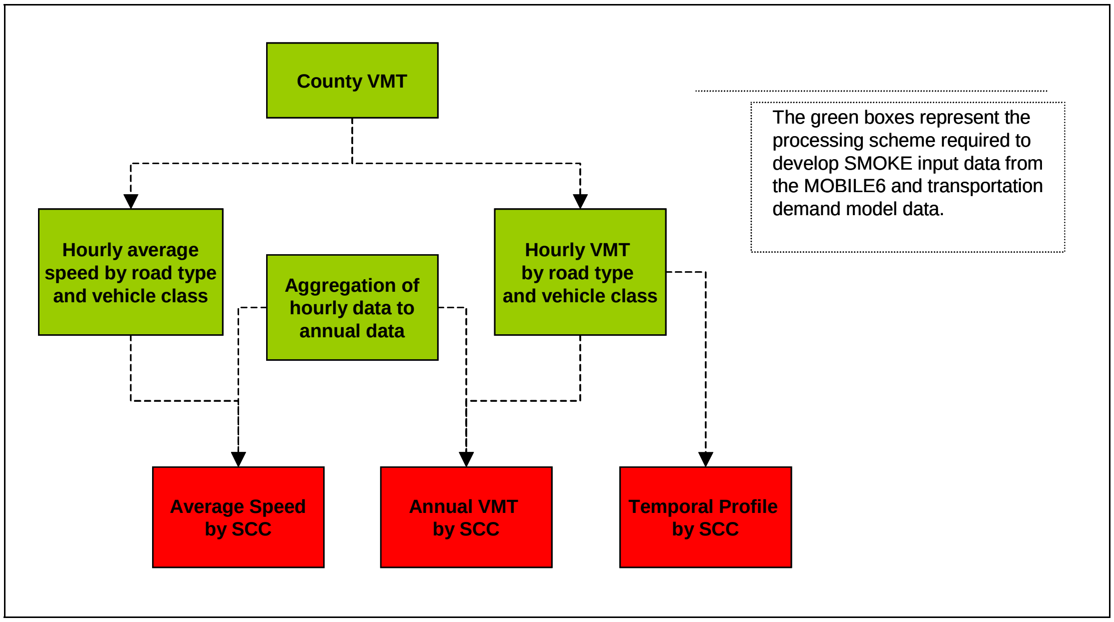

Figure 2-2. Illustration of the processing scheme applied to the MOBILE-compatible input data and transportation model data to develop SMOKE input files.

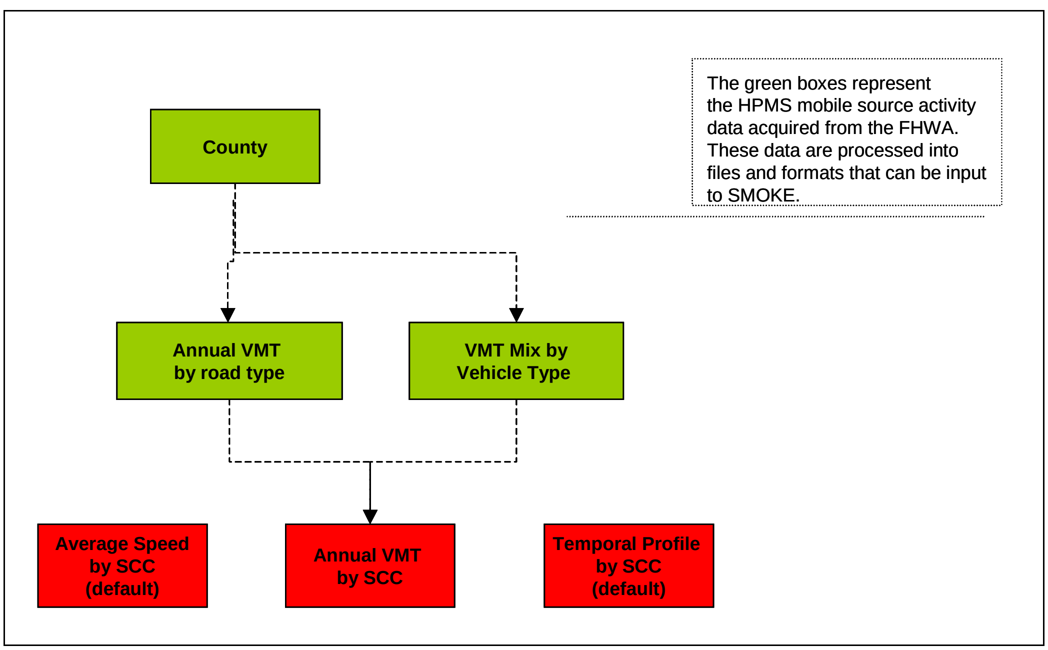

Figure 2-3. Illustration of the processing scheme applied to the national HPMS data.

2.3.1 Details of Data Preparation for Mobile Source Activity Data

SMOKE requires VMT data distributed by 96 standard source classification codes (SCC). Each SCC denotes a vehicle type and a road type combination of those listed in **Table 2-2**. For each state in the CENRAP domain, STI compiled SMOKE inputs for the 96 SCCs using the data sets discussed in Section 2-2.

Table 2-2. Definitions of the 8 vehicle types and 12 road types used by SMOKE.

Vehicle Types	Road Types
LDGV - Light Duty Gasoline Vehicles	Rural Interstate
LDGT1 - Light Duty Gasoline Trucks 1	Rural Principal Arterial
LDGT2 - Light Duty Gasoline Trucks 2	Rural Minor Arterial
HDGV - Heavy Duty Gasoline Vehicles	Rural Major Collector
LDDV - Light Duty Diesel Vehicles	Rural Minor Collector
LDDT - Light Duty Diesel Trucks	Rural Local
HDDV - Heavy Duty Diesel Vehicles	Urban Interstate
MC - Motorcycles	Urban Freeway
	Urban Principal Arterial
	Urban Minor Arterial
	Urban Collector
	Urban Local

2.3.2 Details of Data Preparation for Temporal Profiles

SMOKE uses a default library (data file) of monthly, weekly, and diurnal temporal profiles for all emissions source categories. STI reviewed and revised the default SMOKE/EPA profiles to better represent the temporal patterns of on-road mobile emissions in the CENRAP domain. For Texas and parts of Missouri, where locally developed temporal data were available, local temporal profiles were added to the SMOKE profile library. For other areas, representative temporal profiles were selected. Day-of-week temporal profiles were adopted from a recent study of traffic activity patterns (Coe et al., 2004). Monthly temporal profiles were based on the 1995 National Personal Transportation Survey (Federal Highway Administration, 1995). Diurnal profiles were based on the SMOKE/EPA default profiles for counties inside metropolitan statistical areas (MSAs) and other relatively urbanized counties. For other counties, where population densities or urban populations fell below established thresholds, diurnal profiles were based on Texas' profiles for groups of counties sharing similar population characteristics. (Population demographics were acquired from the U.S. Census Bureau.)

2.4 QUALITY ASSURANCE

On completion of the development of the VMT data, speed distribution data, and temporal profiles, the following quality assurance/quality control (QA/QC) reviews were conducted, and graphical illustrations were included as an appendix to the Final Report. In addition, the procedures outlined in the project Quality Assurance Project Plan (QAPP) were followed (Sullivan, 2004).

- Examine county-level total VMT estimates and their relative magnitudes and distributions throughout the domain.
- Examine VMT fractions by road type and vehicle type.
- Examine maps, plots, and graphs of VMT by county, road type, and vehicle type.
- Examine graphs of speed distributions by road type and region.
- Examine graphs of temporal profiles for each region.

3. METHODS TO PREPARE FLEET CHARACTERISTICS FOR ON-ROAD MOBILE SOURCES

Emission factors for on-road mobile sources vary with the following fleet characteristics, which are derived from state transportation departments' vehicle registration records.

- *The vehicle age distribution* determines (1) the estimated proportion of the fleet that has been designed to meet certain emissions standards, and (2) the estimated average deterioration level of on-board emissions control devices. Vehicle design standard and deterioration level, in turn, are variables that govern the choice of emission factor.
- The *fractions of the vehicle fleet that are powered by different fuels* (e.g., gasoline or diesel) affect the choice of appropriate emission factors.

Registration distributions vary widely across regions, and Giannelli et al. (2002) indicated that registration distributions exert a major influence (i.e., potentially more than a 20% change) on MOBILE6-modeled emission factors. Therefore, the application of county-specific registration distributions is essential to the development of accurate emission inventories for on-road mobile sources. This section describes the information sources used and the data processing steps followed to prepare fleet characteristics, including vehicle age distributions and vehicle fuel fractions.

3.1 DATA ACQUISITION

Seven state DOTs in the CENRAP region provided extracts of their vehicle registration databases, which were decoded and processed to prepare MOBILE6-ready fleet-age distributions and fuel fractions for light-duty vehicles. The DOTs provided vehicle identification numbers (VIN) and county codes for every vehicle registered in their states on a specified date. The VIN records were decoded to yield vehicle ages and fuel types, which were used to calculate county-specific fleet characteristics. **Table 3-1** provides details about each of the acquired vehicle registration databases.

Texas provided ready-made MOBILE6 inputs, including fleet characteristics, for use in this project. Arkansas was excluded from development of fleet characteristics because the state is currently developing an on-road mobile source inventory, which is expected to be available in 2004. Instead, MOBILE6 default fleet characteristics were used for the state of Arkansas. Fleet characteristics were developed for light-duty vehicles only because heavy-duty vehicles are often used for interstate travel; therefore, national average fleet distributions (i.e., MOBILE6 defaults) are reasonably representative.

Table 3-1. Descriptions of acquired vehicle registration databases and related information.

State	Vehicle Registration Database Characteristics		Contact Information	Comments
	Number of Records	Date Represented		
Texas	n/a	n/a	Mary McGarry-Barber and Chris Kite, Texas Commission on Environmental Quality	Texas provided ready-made fleet characteristics.
Louisiana	2,941,066	July 1, 2002	Cecile Bush and Ray Thomas, Louisiana Department of Public Service	
Arkansas	n/a	n/a	Mary Pettyjohn, Arkansas Department of Environmental Quality and Charles Beaver, Arkansas Department of Revenue	Arkansas is currently funding a separate project to process VINs and estimate emissions from on-road mobile sources. Results will be made available to CENRAP in 2004.
Oklahoma	5,703,980	January 9, 2004	Ray Bishop, Oklahoma Department of Environmental Quality and Chuck Dusenbery, Oklahoma Tax Commission	Oklahoma's database included registrations of non-road vehicles, such as recreational boats, which were eliminated after the automated VIN decoding process.
Kansas	2,568,781	January 21, 2004	Donnita Thomas and Leonard Corkill, Kansas Department of Revenue	
Missouri	5,069,888	February 1, 2004	John Rustige and Fonda Thomas, Missouri Department of Natural Resources and	
Iowa	2,880,936	October 31, 2003	Chad Daniel and Priyanka Painuly, Iowa Department of Natural Resources	
Nebraska	1,850,509	December 11, 2003	David Brown, Nebraska Department of Environmental Quality and Deric Bloom, Nebraska Department of Motor Vehicles	Nebraska uses a state-specific system of county identification codes.
Minnesota	4,606,640	February 1, 2004	Innocent Eyoh and Chun-Yi Wu, Minnesota Pollution Control Agency and Judith Franklin, Minnesota Department of Public Safety	

3.2 DATA PREPARATION, QUALITY ASSURANCE, AND QUALITY CONTROL

The following steps were carried out to prepare, error-check, and correct the vehicle registration databases as needed before carrying out the process of VIN decoding.

- Load records into a unified database for processing.
- Translate county codes if necessary.
- Eliminate null VIN and county federal information processing standard (FIPS) codes.
- Identify and eliminate duplicate VINs.
- Independently verify the number of records.
- Export files for VIN decoding.

Load records into a unified database for processing. All vehicle registration records, including VINs and county FIPs codes, were unified into a structured query language (SQL) database. The unified SQL database supported more efficient preliminary data processing, quality assurance, and quality control procedures and permitted a running record of any changes made to the data sets. Copies of the original data sets from the states were archived before loading them into the unified database.

Translate county codes. Each state provided county information for registration records. Iowa's and Louisiana's databases included FIPS county codes. Kansas', Minnesota's, Missouri's, Nebraska's, and Oklahoma's databases contained county names or county codes that were translated to conform to the standard 5-digit FIPS format, "SSCCC", where SS are 2 integers that identify the state and CCC are 3 integers that identify the county or parish. VIN records without valid county names or codes were eliminated. For example, some of the VIN records were classified as state vehicles and were not assigned to any county. Less than one percent of the VIN records received from each state were eliminated due to unavailable county codes.

Eliminate null VIN and FIPS records. Null VIN and FIPS entries were identified, and records that contained null entries were eliminated. Less than one percent of the records from each state contained null entries. An additional 6% of the Kansas records were eliminated because they were flagged as representing trailers or mobile homes rather than on-road vehicles.

Identify and eliminate duplicate VINs. Each state's database was examined for duplicate VINs. Theoretically, no duplicates should exist because each VIN uniquely identifies a single vehicle. However, duplicate VINs may appear in a vehicle registration database for a variety of administrative reasons, such as failure to update vehicle information associated with changes of owner address or transfers of vehicle ownership. Each state DOT was contacted to discuss any duplicates in their registration databases. Duplicates that occurred within the same county were simply deleted, but cross-county duplicates were retained in most cases. The State of Missouri identified the most recent database entry associated with each duplicate VIN. Therefore, cross-county duplicates were eliminated from Missouri's database by retaining only the most recent duplicate record. The frequencies of duplicate records in the final databases were small for most of the states (i.e., less than one in ten thousand for the Kansas, Louisiana, Minnesota, Nebraska, and Oklahoma data sets). Thus, the potential errors in the vehicle age and fuel type distributions are expected to be small or negligible. However, a significant number of duplicate records could not be eliminated from Iowa's databases and may represent a source of error in the fleet characteristics for that state. **Table 3-2** summarizes the numbers of duplicate records existing in the vehicle registration databases for each state.

Table 3-2. Summary of null and duplicate VIN record identification and elimination.

State	Original Database (as received)		Final Database	
	Total No. Records	% Duplicates	Total No. Records	% Duplicates
Texas	n/a	n/a	n/a	n/a
Louisiana	2,941,090	0.004	2,941,066	0.004
Arkansas	n/a	n/a	n/a	n/a
Oklahoma	5,704,139	0.000	5,703,980	0.000
Kansas	2,782,208	0.002	2,568,781	0.002
Missouri	5,230,782	2.960	5,069,888	3.053
Iowa	3,111,046	19.016	2,880,936	5.939
Nebraska	1,863,340	0.002	1,850,509	0.002
Minnesota	4,611,407	0.005	4,606,640	0.005

Verify the number of records. The final number of records in each state's database was compared to the number of registered vehicles reported by the FHWA (Federal Highway Administration, 2004) and the state's population as reported for the 2000 Census (U.S. Census Bureau, 2004). The population comparison was performed at a county level to ensure that the most populated counties in each state had the highest numbers of registered vehicles. When large discrepancies were observed, the appropriate state agencies were contacted to resolve the differences. For example, Oklahoma's vehicle registration database includes off-road vehicles. VINs for off-road vehicles were eliminated following VIN decoding, at which time the numbers of records compared better with the figures reported by the FHWA and the 2000 Census. Louisiana's vehicle registration database contained a relatively low number of vehicles (given the state's population and FHWA's reported number of registered vehicles); however, the Louisiana Department of Public Safety confirmed that the number of records in their database was correct.

Export files for VIN decoding. The final VIN data sets for each state were exported into separate ASCII text files and formatted for VIN decoding.

3.3 VIN DECODING

Eastern Research Group (ERG) developed and maintains VIN decoding software that returns model year, series, gross vehicle weight rating, fuel type, and other vehicle specifications for all domestic and foreign light duty vehicles sold in the United States from 1972 to 2002.[1] Version 2000.01 of the ERG VIN Decoder was used to decode the VINs received from state registration databases. Before proceeding with VIN decoding, the accuracy of the VIN decoder software was validated by decoding several known VINs and verifying the results and by comparing results to the outputs of other VIN decoders.

After the VINs from each state were decoded, the age of each decoded vehicle was determined by subtracting the model year from the current year, where the current year was defined for each state as the year represented by its VIN data set (see Table 3-1). For each county and each vehicle type, the fractions of vehicles aged <1 through 24 years were calculated. Vehicles of ages greater than 24 years were assigned to age 24. The products of these calculations were county-specific fractional age distributions for light-duty vehicle classes.

In addition, the ERG VIN Decoder returned the type of fuel utilized by each decoded vehicle. The fractions of diesel-fueled vehicles in each county, vehicle class, and age group, from age <1 through 24 or greater were calculated. In some cases, vehicle populations were very small and required extrapolation or aggregation across geographic areas or vehicle classes to calculate representative diesel fractions. The results of these calculations are diesel fractions for each county, light-duty vehicle type, and age group. Too few natural-gas powered vehicles were identified to produce meaningful distributions; therefore, MOBILE6 defaults were used for this fuel type (unless locally developed MOBILE6 inputs were provided).

3.4 FINAL QUALITY ASSURANCE, QUALITY CONTROL, AND DATA PREPARATION

On completion of VIN decoding, the following QA/QC reviews and processing steps were conducted to prepare the MOBILE6-ready inputs, and graphical illustrations were included in an appendix to the Final Report. In addition, the procedures outlined in the project QAPP were followed (Sullivan, 2004):

- Verify the number of decoded VIN records.
- Examine the vehicle age fractions and fuel type fractions for reasonableness.
- Independently calculate and verify a vehicle age fraction and a fuel type fraction.
- Parse the vehicle age distributions and fuel type fractions into MOBILE6-ready inputs.
- Verify correct parsing and formatting of the final deliverables.
- Test the use of these files with the SMOKE emissions processor.

Verify the number of decoded VIN records. The ERG VIN Decoder appended several fields containing vehicle information and error codes to the original data records containing the VINs and FIPS codes. The number of records contained within each decoded file was verified to be equal to the number of records originally submitted for decoding. The decoded VIN files were loaded into the unified SQL database for the final QA/QC procedures. VINs that were not

[1] A listing of the vehicle manufacturers treated by the software and more information is available online at http://www.ergweb2.com/vindecoder/index.cfm.

decoded by the software remained in the output files and were flagged with error codes for explanation.

Examine the vehicle age fractions and fuel type fractions for reasonableness. Two separate files, one containing the age distributions for all vehicle classes and counties and another containing the diesel fractions for all vehicle classes and counties, were loaded into the SQL database in order to examine the calculated fractions. The 25 vehicle fractions for each vehicle class and each county were verified to sum to one. The minimum, maximum, mean, and median fractions for each age class from all the age distributions were examined in order to identify any outlier values and assess their effects. Similarly, the minimum, maximum, mean, and median diesel fractions for each age class from all the vehicle classes and counties were examined. Pivot tables and corresponding pivot charts were also created for the default and calculated age distributions and diesel fractions in order to facilitate quick visual examinations.

Parse the vehicle age distributions and fuel type fractions into MOBILE6-ready inputs. The calculated age distributions for each vehicle class and county were contained within a single table in the SQL database that had variable character fields of character length 50 for the FIPS codes and the vehicle classes and 25 numeric fields of precision 0.0001 for the calculated age fractions. The calculated diesel fractions for each vehicle class and county were contained in a similar table in the SQL database. A separate ASCII text file containing 25 age fractions for each of the 5 decoded vehicle classes was exported from the SQL database. The space-delimited text files contained the header REG DIST on the first line followed by rows of 26 fields containing the vehicle class code and the age fractions from zero to age 24. The diesel fractions were exported into similar ASCII text files for each county. The files contained sets of 25 diesel fractions for 14 of the 16 combined MOBILE6 vehicle classes, for a total of 350 fractions. For the remaining 2 vehicle classes, MOBILE6 assumes that all motorcycles (MC) are gasoline-fueled and all urban/transit buses (HDBT) are diesel-fueled. The age distribution files were prepared as external inputs for the MOBILE6 runs, while the diesel fractions were incorporated into the MOBILE6 input files.

Verify correct parsing and formatting of the final deliverables. A random sample of registration distribution files and diesel fraction files were examined to ensure that the files were properly exported from the SQL database. The selected registration distribution files were verified to contain the appropriate heading and 25 age fractions for each of the 5 vehicle classes. The selected diesel fraction files were verified to contain 5 sets of 25 fractions with 10 fractions in the first row of each set, 10 fractions in the second row of each set, and 5 fractions in the third row of each set.

Test the use of these files with the SMOKE emissions processor. The selected registration distribution files were run through the SMOKE emissions processor using a test MOBILE6 input file with default values to ensure that the files ran properly within the framework of MOBILE6 operating within SMOKE. Similarly, the selected diesel fractions were verified with a test MOBILE6 input file. The diesel fractions were incorporated into the test input file, each in turn, and the files were run through SMOKE to ensure that the diesel fractions were formatted properly to run within the framework of SMOKE.

4. METHODS TO PREPARE FUELS CHARACTERISTICS AND IMPACTS OF REGULATORY CONTROLS FOR ON-ROAD AND OFF-ROAD MOBILE SOURCES

Fuel parameters and regulatory controls can significantly impact emission factors predicted by the MOBILE6 model (for on-road sources) and the NONROAD model (for off-road sources). This section describes the information sources used and the data processing steps followed to prepare fuels characteristics and regulatory control settings for use in MOBILE6. When appropriate, fuels characteristics were also prepared for the NONROAD model.

4.1 FUELS CHARACTERISTICS

Three characteristics of fuels significantly affect criteria pollutant emission predictions from the MOBILE6 and NONROAD models:

1. Sulfur content
2. Fuel volatility
3. Oxygenate content

Fuel sulfur content directly affects emissions of sulfates (particulate matter) and SO_2 from combustion of all fuels. In addition, sulfur's adverse effects on catalytic converters indirectly affect emissions of VOCs, CO, and NO_x from gasoline-fueled vehicles. Fuel volatility and oxygenate content are only necessary for gasoline-fueled vehicles.

EPA found that gasoline volatility can have a major effect on MOBILE6 estimates of VOC and CO emissions (Giannelli et al., 2002), although the influence diminishes at lower temperatures and has no effect at temperatures below 45^{o}F (Tang et al., 2003). Oxygenates for gasoline fall into two classes: alcohols and ethers (see **Table 4-1)**. All are assumed to reduce emissions of CO, but ethanol can also increase the gasoline volatility.

Table 4-1. Common types of oxygenates (listed in approximate order of decreasing prevalence).

Alcohols	Ethers
Ethanol	Methyl tert-butyl ether (MTBE)
Methanol	Tert-amyl methyl ether (TAME)
Butanol	Ethyl tert-butyl ether (ETBE)
	Diisopropyl ether (DIPE)

Both MOBILE6 and NONROAD accept sulfur content information on a weight basis. MOBILE6 requires that sulfur content be specified in parts per million by weight (ppmw or sometimes just ppm), and NONROAD requires that sulfur content be expressed as a percentage by weight (wt. %). Gasoline volatility is expressed in terms of Reid Vapor Pressure (RVP), or pounds per square inch (psi). The extent to which oxygenates are present can be defined either as the percentage of a specific oxygenate blended by volume (% vol.), or the total weight percentage (% wt.) of oxygen atoms in the blended fuel.

4.1.1 Data Acquisition

For gasoline and diesel fuel, a number of information sources exist, including EPA, commercial data sources, state departments of agriculture, and fuel associations. In addition, the American Society for Testing and Materials (ASTM) standards can be used as guidelines for areas where information is missing or incomplete. Each of these sources of information is discussed in greater detail below.

For compressed natural gas (CNG) and liquefied petroleum gas (LPG), only the NONROAD model requires fuels characteristics, and the only information required is the sulfur content. NONROAD only allows entry of a single sulfur content to describe both fuels, although CNG and LPG sulfur contents sometimes differ. However, for both fuels, the sulfur content is very low (often well below specifications), is rarely tested, and currently has a negligible impact on the overall inventory (although it may become more important in the future as sulfur levels in gasoline and diesel fuel drop). Therefore, for NONROAD, a CNG/LPG sulfur content of approximately 0.0007 wt. % was used, which is consistent with the CNG sulfur content assumed by EPA's AP-42 publication for stationary sources (U.S. Environmental Protection Agency, 1998a).[2]

U.S. Environmental Protection Agency

EPA maintains a database of reformulated gasoline (RFG) data for those areas that utilize RFG. Also, MOBILE6 allows RFG to be modeled explicitly (i.e., the model chooses appropriate values for sulfur content, volatility, and oxygen content). For future inventories, information for fuels sold in other areas may be available from EPA. Specifically, federal regulations (40 CFR 80.370 and 40 CFR 80.593) will require refiners to submit annual reports of sulfur content to EPA by February 2005 and February 2007 for gasoline and diesel fuel, respectively.

Commercially available data

Information about gasoline and diesel fuel compositions is available for purchase from Northrop Grumman and the American Association of Automobile Manufacturers (AAM). These data are the basis for fuel data estimated in EPA's National Emission Inventory (NEI) (E.H. Pechan and Associates, 2004). However, each of these data sets consists of a relatively small number of samples from relatively few areas (e.g., 1-6 cities per state, 1-20 samples per city, and 1-3 locations per city). Data are collected by these entities for winter and summer months only.

AAM can identify specific laboratories and analytical methodologies used, whereas Northrup Grumman's data are reported by a number of private companies and laboratory information cannot be readily tracked down. However, the AAM data are less extensive than the

[2] A sulfur content of 0.0007% (wt.) corresponds to 2000 gr/MMscf = 0.2 gr/100 scf. This factor includes sulfur that is added for safety purposes (odorant).

Northrop Grumman data, and costs are significantly higher. Therefore, Northrup Grumman's data were used rather than AAM's data.

State departments of agriculture

Some weights and measures divisions of state departments of agriculture test gasoline and/or diesel fuel on a regular basis and are able to provide these data electronically. These data are often far more extensive (e.g., hundreds or thousands of samples taken, throughout the entire year and the entire state) than the data available from commercial surveys. Thus, they represent a significant improvement over the commercially available data when available.

For 2002, data were available from three of the CENRAP states (Kansas, Minnesota, and Missouri), and it is likely that Texas will have data for future calendar years. Oklahoma conducts tests but currently does not maintain a database of results.[3] Other CENRAP states do not currently test for fuel parameters relevant to mobile source emissions modeling.

Oxygenated fuel and octane grade data

In several CENRAP states, blending ethanol into fuel is prevalent, even though no regulatory requirements are in effect. The U.S. Department of Energy's Energy Information Administration (EIA) tracks sales volumes of gasoline and oxygenated gasoline by state; however, these data are tracked at the refinery, whereas blending of ethanol is more likely to occur downstream of the refineries at bulk terminals (due to difficulties associated with sending ethanol-blended fuel through pipelines). For states known to blend significant amounts of ethanol, oxygenated fuel associations were contacted to determine the extent of blending.

EIA data were also collected for the purposes of obtaining information about relative sales of regular and premium gasoline. This information was used to estimate the weighted average sulfur content because sulfur contents are significantly higher for regular gasoline than premium gasoline.

Standards and existing assumptions

ASTM standards provide volatility guidelines for every part of the country and every month. ASTM standards, regulations, and assumptions made by state and local agencies/MPOs were collected for the purposes of filling in gaps in fuel sampling data, quality assurance, and consistency with current inventories. However, it should be noted that average values are often below regulatory limits to allow a margin of compliance. In addition, ASTM standards are not regulatory limits, and EPA has found that RVP values can often exceed the ASTM standards (U.S. Environmental Protection Agency, 1992, pp. 25-26).

[3] Oklahoma's Department of Agriculture deferred to the Oklahoma Corporation Commission, which is the lead agency for fuel testing in that state.

4.1.2 Data Processing and Quality Assurance

In general, fuels characteristics were defined for various geographic subregions of the CENRAP region, various fuel types, and for on-road or non-road sources. Fuels characteristics were then organized and prepared for use with MOBILE6 and NONROAD. The discussions below provide the relevant factors that were considered when calculating or preparing the fuels characteristics for diesel fuel and gasoline.

Diesel fuel

As stated previously, sulfur content is the only parameter of interest for diesel fuel. In 2002, transportation-grade diesel fuel was required to have a sulfur content of no more than 500 ppmw = 0.05 wt. %, and for the 2002 NEI, EPA assumed that sulfur content was approximately 500 ppm for all areas of the United States from 1994 through 2002 (E.H. Pechan and Associates, 2004). However, average sulfur content is likely to be lower than the regulatory standard. Furthermore, EPA regulations require sulfur content to be less than 15 ppmw = 0.0015 wt. % by September 1, 2006. Thus, refineries are likely to be lowering the sulfur content of their diesel fuel already. Therefore, available diesel fuel sulfur content information for 2002 was inspected for statistically significant seasonal or regional differences, and for differences between on-road and off-road fuels.

Reformulated Gasoline (RFG)

For areas utilizing RFG (covered areas), little data processing was required because RFG can be modeled explicitly by MOBILE6 with command “FUEL PROGRAM : 2”. The only areas of the CENRAP currently utilizing RFG are listed in **Table 4-2**. When RFG is modeled explicitly, user inputs for sulfur content and RVP are overridden by the program. User-supplied oxygenate levels are also overridden, with the exception of user-specified wintertime oxygen contents greater than 2.1 wt. % (U.S. Environmental Protection Agency, 2003a, 2002d). Therefore, in each covered area, the extents to which wintertime oxygen contents are above this level were examined.

Table 4-2. Listing of CENRAP areas utilizing RFG.

Metropolitan Area	Specific Counties
St. Louis, Missouri	Franklin, Jefferson, St. Charles, St. Louis
Dallas/Fort Worth, Texas	Collin, Dallas, Denton, Tarrant
Houston/Galveston, Texas	Brazoria, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller, Chambers

Source: 40 CFR 80.70.

When the “FUEL PROGRAM : 2” command is used, the user must also specify whether the RFG is being used in a southern or northern area. These are referred to as “VOC-Control Region 1” and “VOC-Control Region 2”, respectively, by federal regulations (40 CFR 80.71); both Missouri and Texas are in VOC-Control Region 1, which corresponds to a MOBILE6 input of “S” (for southern).

Areas not using RFG – spatial variability and local requirements

Historically, regional differences in gasoline were modeled by dividing the country into districts on the bases of pipelines and other distribution channels. Northrop Grumman still organizes its gasoline data by these districts. Although the continued appropriateness of these divisions has not been verified (and does not account for RFG usage, localized regulations in metropolitan areas, and regional ethanol blending), the district divisions were utilized to investigate spatial differences among areas that do not have localized requirements. The five districts for various metropolitan areas within CENRAP are identified in **Table 4-3**.

Table 4-3. Gasoline distribution districts identified by Northrop Grumman.

District	CENRAP Metropolitan Areas
3 (Southeast)	Little Rock, Arkansas New Orleans, Louisiana
5 (North Central)	Minneapolis-St. Paul, Minnesota
7 (Central and Upper Plains)	Kansas City (Kansas/Missouri) Davenport, Iowa Des Moines, Iowa St. Louis, Missouri Omaha, Nebraska
8 (Oklahoma and East Texas)	Tulsa, Oklahoma Dallas-Ft. Worth, Texas Houston, Texas San Antonio, Texas
11 (New Mexico and West Texas)	Amarillo, Texas El Paso, Texas

Localized regulations restrict summertime fuel volatility, and include requirements and restrictions for oxygenate usage; but currently, there are no localized controls on gasoline sulfur content in the CENRAP region.

Sulfur content of gasoline (non-RFG)

MOBILE6 incorporates two elements of gasoline sulfur content data: (1) information about the average sulfur content existing during the calendar year of interest (for purposes of determining SO_2 and PM emissions), and (2) information about the maximum sulfur content ever experienced by vehicles in a given model year (for purposes of determining deterioration of catalysts). Available fuel data can only be utilized to modify sulfur contents for the calendar year of interest, not the lifetime maxima of fuel contents ever experienced. Data for regular and premium gasolines were averaged separately, and weighted average sulfur contents were determined based upon relative sales volumes of different grades of gasoline. Given the limited availability of data, the calculated weighted average sulfur contents were only added to MOBILE6 input files if they differed significantly from the MOBILE6 default values.

Default sulfur content data can be different for "western" areas due to a geographic phase-in of gasoline sulfur regulations. However, this only affects Nebraska (of the CENRAP states) and calendar year 2003 and later. A full listing of MOBILE6 default sulfur contents is shown in **Table 4-4**.

Table 4-4. MOBILE6 default sulfur content data for conventional gasoline (i.e., non-RFG).

Calendar Year	Average Fuel Sulfur Content (ppmw)		Vehicle Model Year	Maximum Fuel Sulfur Content Experienced (ppmw)	
	Eastern Areas[a]	Western Areas[b]		Eastern Areas[a]	Western Areas[b]
2000	300	300	2000[c]	1000	1000
2001	299	299	2001	1000	1000
2002	279	279	2002	1000	1000
2003	259	263	2003	1000	1000
2004	121	160	2004	303	325
2005	92	160	2005	303	325
2006	33	160	2006	87	325
2007	33	60	2007	87	142
2008+	30	30	2008+	80	80

[a] Within CENRAP, this includes all counties except those specifically identified as western areas.
[b] Within CENRAP, this only includes the following counties, all of which are located in western Nebraska: Banner, Box Butte, Cheyenne, Dawes, Deuel, Garden, Keith, Kimball, Morrill, Scotts Bluff, Sheridan, and Sioux (Source: 40 CFR 80.215(a)(2)(i)).
[c] Within MOBILE6, maximum sulfur content does not affect emissions from vehicles of model year 1999 and older.

RVP and oxygenate content of gasoline (non-RFG) – agriculture department data

For RVP and oxygenate, the data obtained from state departments of agriculture were analyzed. For regions where data were available, temporal variations in volatilities over the course of the year were compared with the variations in the corresponding ASTM standards for those regions. Within each state, areas known to have local regulatory requirements were examined separately from areas without such requirements, and gasoline blended with ethanol was examined separately from other gasoline. (Methodology documentation for the 2002 NEI indicates that, aside from areas with local requirements, RVP was assumed to be uniform across each state [E.H. Pechan and Associates, 2004].) The limited data obtained from Northrop Grumman were compared to the agriculture departments' data for purposes of gauging the extent to which the Northrop Grumman data are representative.

EPA and local regulations restrict the maximum RVP of some summertime gasolines. For purposes of quality assurance, summertime RVP data were compared to these requirements. However, it should be noted that EPA and many local governments grant a waiver of 1.0 psi to ethanol blends (i.e., the blends are allowed to have RVP values that are 1.0 psi higher than regulatory limits[4]), and in such cases MOBILE6 assumes that the RVP of the ethanol-blended gasoline is 1.0 psi higher than the RVP specified in the model input file. Available data from

[4] EPA's waiver (40 CFR 80.27(d)) only applies if a sufficient quantity of ethanol is used (9-10% vol.)

state agricultural departments were utilized to investigate the extent to which the RVP of ethanol blends is higher than the RVP of conventional gasoline. If differences were found to be considerably smaller than 1.0 psi, the area was modeled as one without a waiver (even if a waiver exists) to prevent MOBILE6 from increasing the RVP of the ethanol blends.

The extent to which a fuel is characterized as an "ethanol blend" depends on how this term is defined. In some cases, the blend is mandated. For example, the State of Minnesota requires that ethanol be blended into all gasoline sold in the state, year-round, to reach a level of 2.7-3.5 wt. % oxygen in the blend.[5] However, in other areas, a variety of levels of oxygenate are in use, and oxygenate analyses show a variety of oxygenate concentrations, which in some cases contain both alcohols and ethers in the same sample. Because MOBILE6 only models one oxygenate type or the other and assumes a single average oxygenate concentration, frequency plots were generated to determine the extent to which different oxygenate concentrations were present, and analytical data were screened to eliminate low data (e.g., near detection limits). It is worth noting that volatility increases due to ethanol tend to be somewhat independent of concentration above approximately 3%. This is important in areas modeled with RVP waivers, for which MOBILE6 will increase RVP by 1.0 psi for all ethanol blends, regardless of the ethanol concentration.

RVP and oxygenate content of gasoline (non-RFG) – other data

For states in which agriculture department data were not available, RVP estimates were based primarily on data obtained from Northrop Grumman in the summer and winter. These data were interpolated to different months using ASTM standards—similar to the procedure applied for the 2002 NEI (E.H. Pechan and Associates, 2004). Spatial and temporal variations were also compared to publicly available RVP data from the 1999 NEI (which was generated based upon data from Northrop Grumman and AAM). Areas with specific RVP or oxygenate restrictions were modeled to reflect those restrictions, even if no sampling data were available for those areas.

Although gasoline volatilities are highest in the winter, the extent of wintertime data analysis was tempered by two factors: (1) the effects of volatility are lessened at colder temperatures, and (2) MOBILE6 models any RVP higher than 11.7 psi as equal to 11.7 psi (U.S. Environmental Protection Agency, 2003a, 2002d).

General quality assurance

Given the recent court cases involving environmental laboratory fraud (Bureau of National Affairs, 2002a, b), particularly with respect to testing vehicle fuels (McCarthy, 2001; Bureau of National Affairs, 2002c; U.S. Department of Justice, 2002), an effort was made to determine the source of the data collected. Data from fuel testing sources known to have been indicted and/or convicted of laboratory fraud were discarded when appropriate. The methodologies utilized were also examined. For example, it is known that RVP measurements using Grabner equipment are adjusted using a variety of formulas (sometimes season-

[5] The 2.7% minimum oxygen content is identified by Section 239.791 of the Minnesota Statutes, and ethers are specifically excluded from meeting that requirement; Section 239.761 bans the use of ethers (above approximately 0.33%) and limits the maximum ethanol content to 10% vol., which corresponds to approximately 3.5 wt. % oxygen.

dependent), and gas chromatography (GC) results for oxygenates can differ from Fourier-transform infrared (FTIR) results. In addition, the procedures outlined in the project QAPP were followed (Sullivan, 2004).

4.1.3 Data Preparation

Fuels characteristics were prepared as a summary data table listing gasoline volatilities as a function of county and month, and the extent to which oxygenated fuel information and fuel sulfur contents differ from MOBILE6 defaults. The tables, which are included in an appendix to the Final Report, show the appropriate MOBILE6 inputs with respect to the commands shown in **Table 4-5**. These command lines were inserted into the SMOKE input files for the complete set of geographic areas within the CENRAP and time periods within calendar year 2002.

Table 4-5. MOBILE6 input commands relevant to fuel composition.

Command	Meaning	Data
FUEL PROGRAM[a]	Identifies gasoline sulfur content, and whether RFG is being used	1 = eastern default sulfur values, 2 = RFG, 3 = western default sulfur values, 4 = user-supplied sulfur data
DIESEL SULFUR	Diesel sulfur content	Average diesel sulfur content, in ppmw
OXYGENATED FUELS[b]	Extent of oxygenate usage	% of gasoline sold that is blended with alcohols, and that is blended with ethers; average oxygen wt. % in each of those blends
FUEL RVP	Gasoline RVP (prior to ethanol addition, if any)	Average RVP, in psi
SEASON	For RFG, an identifier of which season's requirements are in effect	1 = summertime RFG, 2 = wintertime RFG

[a]Optional command; MOBILE6 default is FUEL PROGRAM = 1.
[b]Optional command; MOBILE6 default is no oxygenate.

4.2 REGULATORY CONTROLS

Regulatory controls that affect engine emissions and are modeled by MOBILE6 and/or NONROAD include the following:

- Anti-Tampering Programs (ATPs)
- Inspection & Maintenance (I/M) Programs
- Stage II Refueling Controls

Stage II refueling emissions are typically excluded from mobile source emission inventories developed using MOBILE6 because they are considered to be stationary area source emissions. Thus, refueling emissions were excluded from the CENRAP emission inventory of on-road mobile sources, and associated MOBILE6 settings were not prepared. However, the appropriate MOBILE6 commands were prepared as a table and included in an appendix to the Final Report.

4.2.1 Data Acquisition

Environmental regulatory agencies in each of the CENRAP states were contacted for information regarding ATPs, I/M programs, and Stage II controls. These agencies provided the relevant information in the form of MOBILE6 input files.

4.2.2 Data Processing and Quality Assurance

Data processing consisted primarily of quality assurance, based in part on EPA technical guidance. Information provided by regulatory agencies was reviewed for consistency with EPA guidance and for reasonableness, and was investigated further if warranted. For example, I/M program compliance rates are often assumed to be 96% prior to implementation (U.S. Environmental Protection Agency, 2002d) but should be based on operating program data after they have been implemented. In addition, if a customized I/M program effectiveness is identified (using the I/M EFFECTIVENESS command), EPA requires that the state or local agency consult with the EPA first (U.S. Environmental Protection Agency, 2002d). For Stage II vapor recovery systems, a working system is assumed to be 95% effective. However, a 95% in-use effectiveness should not be input into MOBILE6 because this does not reflect rule penetration or rule effectiveness (U.S. Environmental Protection Agency, 1991b). Appropriate values for program compliance rates and in-use effectivenesses were selected and reported in a summary data table included in an appendix to the Final Report. In addition, the procedures outlined in the project QAPP were followed (Sullivan, 2004).

4.2.3 Data Preparation

Regulatory controls were prepared as a summary data table listing the counties that have ATPs, I/M programs, and/or Stage II vapor recovery, and as an electronic file with the associated MOBILE6 command lines. The tables, which are included in an appendix to the Final Report, show the appropriate MOBILE6 inputs with respect to the commands shown in **Table 4-6**. Command lines were inserted into the SMOKE input files for the geographic areas within the entire CENRAP region. (Note that the I/M commands are provided in external files that will be referenced by MOBILE6 through the “I/M DESC FILE” command.)

Table 4-6. MOBILE6 input commands relevant to non-fuel-related regulatory programs. (Command lines are needed only if programs are in place; some input files may require information for multiple ATPs and I/M programs.)

Command	Data
ANTI-TAMP PROG	Calendar years applied, vehicle model years affected, vehicle types affected, inspection frequency, compliance rate, types of components inspected
I/M PROGRAM I/M MODEL YEARS I/M VEHICLES I/M STRINGENCY[a] I/M COMPLIANCE[b] I/M WAIVER RATES[b] I/M CUTPOINTS[c] I/M EXEMPTION AGE[d] I/M GRACE PERIOD[d] NO I/M TTC CREDITS[e] I/M EFFECTIVENESS[f]	Calendar years applied, test frequency, program type, inspection test type, model years affected, vehicle types affected, failure rate, percentage of vehicles that get inspected and either comply or are waived, extent to which inspected vehicles are waived rather than being modified to comply, exempted vehicle ages, number of years that new vehicles are exempted, extent of technician training, customized program effectiveness values (pollutant-specific)
STAGE II REFUELING	Calendar year that Stage II program begins to be phased in, number of years of phase-in, in-use efficiency for light-duty vehicles, in-use efficiency for heavy-duty vehicles

[a] This command is only used for (and required for) exhaust I/M programs.
[b] This command is required for exhaust I/M programs and highly recommended for evaporative I/M programs.
[c] This command is only used (and is required) if I/M PROGRAM is IM240.
[d] This command is optional for exhaust I/M programs and highly recommended for evaporative I/M programs.
[e] This command is optional for exhaust I/M programs and is not used for evaporative I/M programs.
[f] This command is optional.

5. ADDITIONAL PARAMETERS FOR ON-ROAD MOBILE SOURCES

Additional optional inputs to MOBILE6 were prepared when readily available. These parameters are of lesser significance than VMT, fleet characteristics, fuels characteristics, or regulatory controls. However, they do have some effects and should be prepared when resources permit. In addition, consistency between the states' and the CENRAP's MOBILE6 inputs is desirable.

Examples included customized annual mileage accumulation rates, relative humidities, and/or natural gas vehicle (NGV) fractions that were provided by environmental regulatory agencies within the CENRAP region in response to other data requests. These data generally were provided in the form of MOBILE5 or MOBILE6 input files. Other inputs were relatively easy to determine. Altitude, which has been identified as having an "intermediate" (5-20%) effect upon VOC and NO_x emissions by EPA (Giannelli et al., 2002, p. iii), is easily determined from regulatory guidance and readily available geographic information systems (GIS) tools.

5.1 DATA ACQUISITION

MOBILE input files were requested from environmental regulatory agencies and/or MPOs in each of the CENRAP states, and optional input commands were reviewed and used if appropriate. Topographical GIS databases were used to determine altitudes.

5.2 DATA PROCESSING AND QUALITY ASSURANCE

Relatively little data processing was necessary, because data were in MOBILE5 or MOBILE6 format. However, consistency with applicable EPA guidance was checked.

In the case of altitude, MOBILE6 only allows the selection of "high" or "low" altitude. ("Low" is the default setting.) High altitude model outputs are based on conditions representative of approximately 5,500 feet above mean sea level (msl), and low altitude model outputs are based on conditions representative of approximately 500 feet msl (U.S. Environmental Protection Agency, 2003a, 2002d). EPA refers users to 40 CFR 86.091-30(a)(5)(ii) and (iv) for guidance. However, Section (a)(5)(ii) lists no CENRAP areas as "designated high-altitude locations" and Section (a)(5)(iv) names four counties in Nebraska (Banner, Cheyenne, Kimball, and Sioux) as specifically not "designated low-altitude locations." STI utilized GIS tools to determine that substantial portions of these counties are above 4,000 feet msl (see **Figure 5-1**) and that, therefore, they should be modeled as "high" altitude.

5.3 DATA PREPARATION

A summary data table listing the additional MOBILE6 input commands was included with an appendix to the Final Report. Command lines were inserted into the MOBILE6/SMOKE input files.

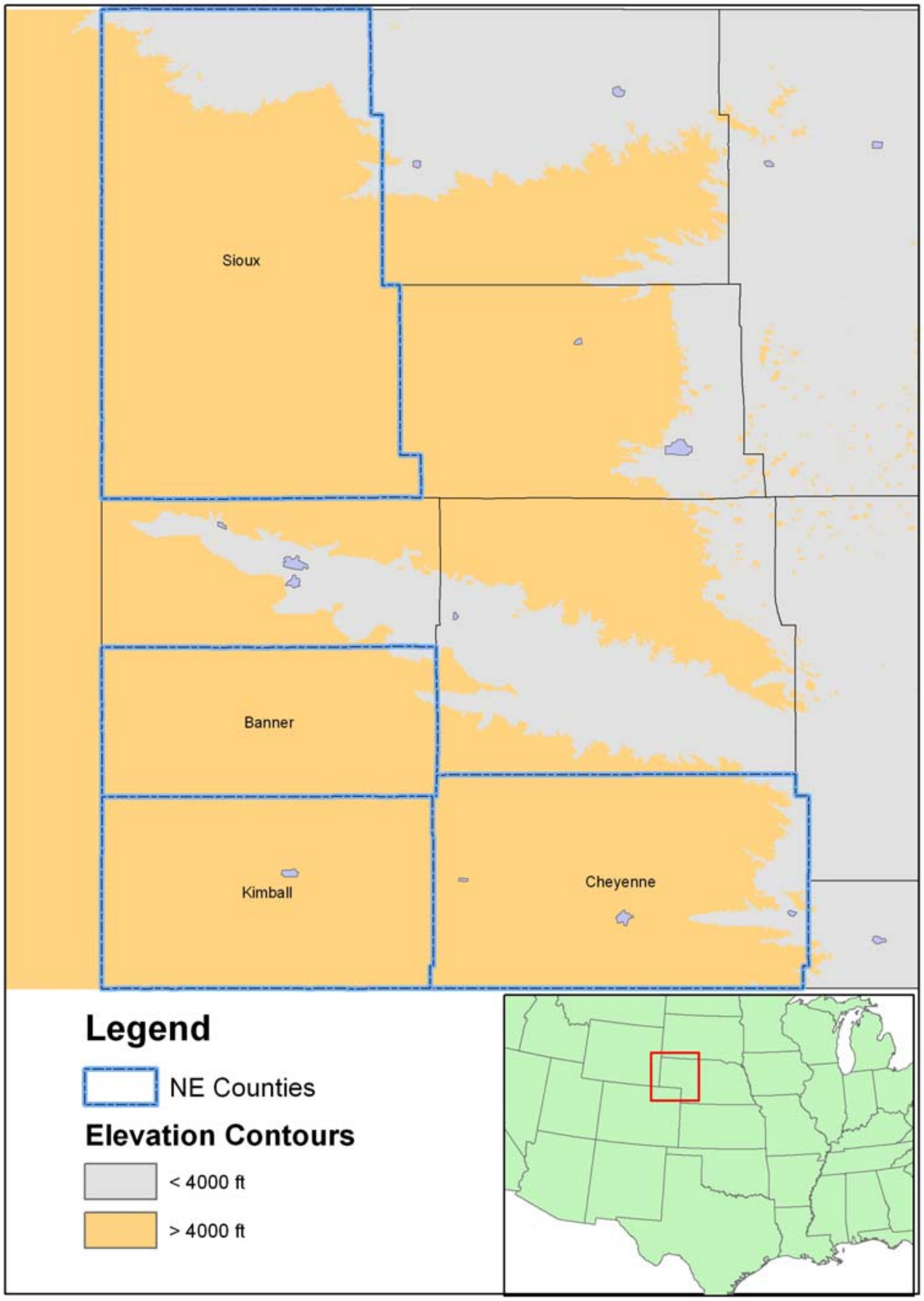

Figure 5-1. Extent to which western Nebraska counties are “high altitude” (above 4000 ft msl).

6. METHODS TO ESTIMATE EMISSIONS FOR NON-ROAD MOBILE SOURCES

Non-road mobile sources include equipment and vehicles that have internal combustion engines and are used off-road. Examples include ships, locomotives, aircraft, industrial equipment, recreational boats, and many others. This section describes information sources and methods used to prioritize efforts, gather activity data, and estimate emissions for non-road mobile sources.

6.1 PRIORITIZATION

STI reviewed the EPA's 1999 NEI (U.S. Environmental Protection Agency, 1999c) to assess the likely importance of various non-road sources to visibility in Class I areas. **Table 6-1** shows the top five non-road emitters of primary particulates and particulate precursors for counties in the CENRAP region containing or adjoining a Class I area. This review illustrated the likelihood that commercial marine vessels and railroad equipment impact visibility in the CENRAP's Class I areas more than most other non-road mobile sources. However, it also indicated that pleasure craft (recreational boats) are a much more significant source of particulates and particulate precursors than other types of recreational vehicles. It also demonstrated the importance of agricultural equipment, especially in Oklahoma and Missouri. Based on this analysis, an assessment of available resources, and consultation with the CENRAP's Emission Inventory Work Group, a decision was made to give bottom-up treatment to commercial marine vessels, locomotives, and recreational boats. These categories represent at least two-thirds of the non-road primary and precursor emissions in counties containing or adjacent to Class I areas in the CENRAP region.

Table 6-1. 1999 non-road emissions (tons/year) by state and source category for counties in the CENRAP region containing or adjoining a Class I area (U.S. Environmental Protection Agency, 2004b).

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Poll.	Source Category	AR	LA	MN	MO	OK	TX	Total
$PM_{2.5}$	Pleasure Craft	52.3	403.5	700.3	150.4	31.1	3.2	1,340.8
	Commercial Marine Vessels	0.0	151.6	771.6	151.3	0.0	0.0	1,074.5
	Agricultural Equipment	71.4	1.0	27.3	404.5	280.2	8.8	793.2
	Construction & Mining Eq.	49.3	45.0	56.5	73.1	58.1	16.6	298.6
	Railroad Equipment	24.4	0.5	5.1	57.2	9.3	127.2	223.7
	Other Sources	52.2	9.0	144.9	56.0	32.0	2.9	297.0
	Total – All Sources	249.6	610.6	1,705.7	892.5	410.7	158.7	4,027.8
VOC	Pleasure Craft	1,197.9	9,434.0	15,418.6	3,338.8	707.9	74.7	30,171.9
	Recreational Equipment	1,102.7	250.7	5,448.3	1,603.8	154.5	94.4	8,654.4
	Lawn & Garden Equipment	319.8	91.5	463.5	660.3	341.9	48.1	1,925.1
	Agricultural Equipment	89.9	1.2	34.4	507.5	352.3	11.1	996.4
	Commercial Marine Vessels	0.0	114.5	615.9	114.2	0.0	0.0	844.6
	Other Sources	440.0	161.8	405.4	592.9	309.9	264.7	2,174.7
	Total – All Sources	3,150.3	10,053.7	22,386.1	6,817.5	1,866.5	493.0	44,767.1

Table 6-1. 1999 non-road emissions (tons/year) by state and source category for counties in the CENRAP region containing or adjoining a Class I area (U.S. Environmental Protection Agency, 2004b).

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NO_x	Commercial Marine Vessels	0.0	3,665.1	19,700.1	3,657.6	0.0	0.0	27,022.8
	Railroad Equipment	1,074.9	14.0	212.5	2,533.2	399.1	5,694.0	9,927.7
	Agricultural Equipment	557.7	7.5	213.8	3,160.6	2,188.3	69.1	6,197.0
	Construction & Mining Eq.	531.5	483.4	607.9	786.6	625.1	179.0	3,213.5
	Pleasure Craft	79.4	634.9	1,119.2	229.0	47.6	4.0	2,114.1
	Other Sources	885.5	135.5	610.9	850.9	341.6	25.4	2,849.8
	Total – All Sources	3,129.0	4,940.4	22,464.4	11,217.9	3,601.7	5,971.5	51,324.9
SO_2	Commercial Marine Vessels	0.0	714.6	2,978.5	713.1	0.0	0.0	4,406.2
	Agricultural Equipment	62.5	0.8	23.9	353.8	245.4	7.7	694.1
	Construction & Mining Eq.	71.1	64.9	80.7	104.5	83.8	24.0	429.0
	Railroad Equipment	32.1	0.5	6.5	75.2	12.1	168.6	295.0
	Pleasure Craft	7.5	61.0	103.1	21.7	4.5	0.4	198.2
	Other Sources	66.9	10.5	70.5	59.8	25.7	2.7	236.1
	Total – All Sources	240.1	852.3	3,263.2	1,328.1	371.5	203.4	6,258.6

6.2 RECREATIONAL BOATS

6.2.1 Emissions Modeling with NONROAD

Emissions from recreational boats were modeled with the latest version of the EPA's NONROAD model. NONROAD categorizes equipment types by SCC code, and the codes pertaining to recreational boats are listed in **Table 6-2**.

Table 6-2. NONROAD source categories related to recreational boats.

SCC code[a]	Equipment Description
22-82-yyy-005	Pleasure Craft: Inboard Engine
22-82-yyy-010	Pleasure Craft: Outboard Engine
22-82-yyy-015	Pleasure Craft: Personal Watercraft
22-82-yyy-025	Pleasure Craft: Sailboat Auxiliary Engine

[a] In each code, the letters "yyy" refer to fuel type: 2-stroke gasoline (005), 4-stroke gasoline (010), or diesel (020).

For each of these source categories, the NONROAD model provides exhaust emission factors in units of grams of emissions per horsepower-hour (g/hp-hr) that are a function of engine types and sizes. Activity data include size-dependent engine populations, the load on the engines (hp) while they are in use, and the number of hours that the engines are in use per year. (These data are in turn utilized to calculate fuel consumption, which is needed for the calculation of evaporative emissions.) Sources of these model inputs are primarily activity data collected by Power Systems Research, Inc. (PSR) and methodological information from a previous EPA non-road engine and vehicle study (U.S. Environmental Protection Agency, 1991a).

NONROAD includes the following default databases of recreational boating activity. Each may be updated with bottom-up or region-specific activity data, if available.

- NONROAD's default engine populations are based on 1998 PSR national surveys of engine manufacturer sales. The national population estimate was disaggregated to the state level by using a fuel consumption distribution developed by the Oak Ridge National Laboratory (ORNL). State-level populations were further disaggregated to the county level by using the total water surface area contained in each county (U.S. Environmental Protection Agency, 2002a).
- Default temporal profiles are based on two sources of information. Monthly allocation factors are derived from a boat usage survey done for the National Marine Manufacturers Association (NMMA) (U.S. Environmental Protection Agency, 2002c). Weekday-weekend allocation factors were derived from a survey of recreational marine use conducted in California during 1993 and 1994. These weekday-weekend factors are specific to equipment type only and do not vary geographically (U.S. Environmental Protection Agency, 1999b).
- Annual equipment usages (hours of use) are based on a 1998 PSR equipment activity database. The application-specific estimates in this database were based on several yearly surveys of equipment owners conducted by PSR (U.S. Environmental Protection Agency, 2002b).
- Default engine load factors were based on a simplifying assumption that the EPA's recreational marine engine test cycle is representative of load factors for engines in use. Although PSR survey results for load factors exist, they are not represented in the NONROAD model because the EPA considered them to be insufficiently documented (U.S. Environmental Protection Agency, 2002b).

Because NONROAD relies primarily on national-level activity data, some regional and/or local equipment population and usage characteristics are likely not properly represented in the model. Moreover, the use of water surface area as a geographic allocation surrogate does not account for the navigability of a given body of water or its popularity. Improving the various types of activity data utilized by NONROAD required gathering additional information about the ownership and use of recreational boats within the CENRAP region.

6.2.2 Acquisition of Activity Data

The activity data needed to update the NONROAD inputs for recreational boats were gathered through a bottom-up survey of representative groups of recreational boat owners. The survey was designed to gather data on vessel characteristics, hours of use, fuel consumptions, engine loads, and temporal and geographic usage patterns in each CENRAP state. A representative pool of nearly 1,400 registered boat owners was recruited by telephone to participate in the study. A survey questionnaire and an incentive for participation was mailed to each participant, followed one week later by a reminder postcard. For the purposes of study design, a 50% return rate was anticipated for the mail survey; however, a significantly better response rate—more than 70%—was actually achieved. Geographic coverage and representativeness of the survey results were considered to be excellent for all states of the CENRAP region. Survey results were analyzed and used to estimate annual hours of use and engine load factors for each state and each type of boat. Survey questionnaires, results, and raw data files are included as an appendix to the Final Report.

6.2.3 Spatial Allocation

In order to spatially allocate emissions, the counties where recreational boats are used should be determined (i.e., the county where the boat is registered is not a good spatial surrogate). The survey questionnaire included one or more maps detailing the navigable waterways in the respondents' region, which allowed respondents to easily identify the counties in which they typically operate their boats. (Participants indicated their regions during telephone recruitment.) These responses were converted and used to calculate county-level activity for recreational boats.

6.2.4 Temporal Allocation

The survey questionnaire also queried how recreational boat activity is distributed across the months of the year, the days of the week, and the hours of the day. Large variances in climate and boating habits throughout the CENRAP region meant that these temporal patterns were likely to vary greatly from state to state. Responses to these questions were analyzed and used to calculate seasonal, day-of-week, and diurnal temporal profiles for each state and type of boat.

6.2.5 Data Preparation

Deliverables for this source category included the updated input files used to run the NONROAD model, as well as county-level emission estimates derived from outputs of the latest version of NONROAD (NONROAD 2004). These emission estimates were provided in both NIF 3.0 format and the IDA format used by the SMOKE emissions model. The temporal allocation profiles and cross-reference files used by SMOKE were also provided.

6.3 MARINE VESSELS

Emissions estimates were prepared for commercial marine vessels operating in commercially active waterways in the CENRAP region. This inventory included river barges and other commercial vessels operating in inland waterways, as well as ocean-going ships, harbor tugboats, and other commercial vessels operating in the Gulf Intracoastal Waterway (GIWW). These waterways can be seen in **Figure 6-1** (U.S. Army Corps of Engineers, 1997).

Figure 6-1. Map of commercially active inland and intracoastal waterways in the United States.

6.3.1 Emission Factors

In 1999, the EPA released a Regulatory Impact Analysis (RIA) on commercial marine vessel emissions (U.S. Environmental Protection Agency, 1999e). This report estimated emissions for the three categories of marine engines shown in **Table 6-3**:

Table 6-3. EPA marine engine categories.

Category	Displacement per Cylinder	Description
1	disp. < 5 liters power ≥ 37 kW	Similar to land-based non-road engines. Used in smaller tugboats, ferries, fishing vessels, and dredges. Fueled by marine diesel oil.
2	5 ≤ disp. < 30 liters	Similar to engines used in locomotives. Used in smaller ocean-going vessels, as well as large tugboats, towboats, ferries, and fishing vessels. Fueled by marine diesel oil.
3	disp. ≥ 30 liters	Used primarily for propulsion in large, ocean-going vessels. Usually fueled by residual oil, which has a higher sulfur content than diesel oil.

In addition to the uses cited in Table 6-3, all three categories of engines can be used for "auxiliary" purposes (such as electrical generation) on larger vessels, though Category 2 engines are used in this way more often than the other types. The EPA RIA estimated emission factors for Category 1 marine engines and cited emission factors for Category 2 and 3 marine engines from a previous EPA report (U.S. Environmental Protection Agency, 1998c). **Tables 6-4 and 6-5** show the emission factors for marine engines in each category.

Table 6-4. Emission factors for Category 1 marine engines.

Power Range (kW)	HC (g/kW-hr)	NO_x (g/kW-hr)	CO (g/kW-hr)	PM (g/kW-hr)
37 – 75	0.27	11	2.0	0.9
75 – 130	0.27	10	1.7	0.4
130 – 225	0.27	10	1.5	0.4
225 – 450	0.27	10	1.5	0.3
450 – 560	0.27	10	1.5	0.3
560 – 1000	0.27	10	1.5	0.3
1000+	0.27	13	2.5	0.3

Table 6-5. Emission factors for Category 2 and 3 marine engines.

Engine Speed[1]	HC (g/kW-hr)[2]	NO_x (g/kW-hr)	CO (g/kW-hr)	PM (g/kW-hr)
Medium[2]	0.5	12	1.6	0.25
Slow[2]	0.5	17	1.4	1.48

[1] Category 2 and smaller Category 3 engines are medium speed (2-stroke). Larger Category 3 engines are slow speed (4-stroke).
[2] Emission factors converted from kilograms per ton of fuel consumed to gram per kilowatt-hour using fuel consumption estimates of 195 g/kW-hr for slow speed engines and 210 g/kW-hr for medium speed engines (Pollack et al., 2004).

Emission factors for SO_2 were calculated using Equation 6-1, an algorithm that is based on fuel sulfur content (U.S. Environmental Protection Agency, 2000). **Table 6-6** lists the assumed fuel sulfur content (U.S. Environmental Protection Agency, 2003b) for marine diesel oil and residual oil, as well as the SO_2 emission factors calculated for each engine type.

Emission rate (g/kW-hr) =
2.3735* [Fuel Consumption (in g/kW-hr) * Fractional Fuel Sulfur content] **(6-1)**

Table 6-6. SO_2 emission factors for marine engines.

Engine Type	Fuel Sulfur Content	SO^2 (g/kW-hr)
Category 1		
<1000 hp	0.25%	1.29
>1000 hp	0.25%	1.25
Category 2 and 3		
Medium speed	0.25%/2.70%[a]	1.25/13.46[a]
Slow speed	2.70%	12.5

[a] The first value is for marine diesel oil, which is used in Category 2 engines, and the second value is for residual oil, which is used in Category 3 engines.

These emission factors can also be converted to fuel-based factors by dividing them by the fuel consumption rate for a given engine type. For example, the SO_2 emission factor for slow-speed Category 3 engines can be converted to a fuel basis as follows:

Fuel-based emission rate = (12.5 g/kW-hr / 195 g/kW-hr) * 1000 g/kg = 64.1 g/kg of fuel **(6-2)**

6.3.2 Acquisition of Activity Data

Emissions estimates were based primarily on bottom-up fuel usage data for inland river systems in the CENRAP region derived from the Tennessee Valley Authority (TVA) Barge Costing Model. This model was developed to estimate fuel usage by inland river segment for fuel tax purposes.[6] Inputs to the model include engine horsepower and trip characteristics for each vessel that travels on a given waterway segment in a given year. These data are used to estimate fuel consumption for each significant inland waterway segment in the United States.[7] The model uses these data to estimate total fuel consumption, total cargo transported, and average vessel horsepower by waterway segment. Each year, fuel consumption estimates are compared to actual tax receipts, and model errors have averaged only 1.5% per year since 1996.

For the GIWW, however, the TVA model does not provide a complete picture of fuel consumption, as “deep-draft” (oceangoing), harbor tugs, and other vessels not bound for an inland river system are not considered. For these vessels, emission estimates were prepared with work-based emission factors and the following types of activity data (U.S. Environmental Protection Agency, 1999a):

- The number of total trips to and from each port
- The total number of trips passing (but not stopping at) each port

[6] Some “segments” consist of an entire river, such as the Atchafalaya River in Louisiana. Longer rivers, such as the Mississippi, are broken up into multiple segments.
[7] The small rivers and tributaries not considered by the model account for only 1-3% of the total tonnage moved over inland waterways each year (Dager, 2004).

- Vessel characteristics for tugboats and transport ships operating in and through each port
- Speed and time-in-mode data for four operational modes: cruise, slow cruise, maneuvering, and hoteling (or docking)
- Engine load factors for each of the four operational modes listed above

Much of the necessary data on vessel trips can be obtained from the U.S. Army Corps of Engineers (USACE) Waterborne Commerce Statistics Center, which tracks vessel movements and characteristics, as well as barge trips and tonnage. The Maritime Administration of the Department of Transportation also maintains a U.S. waterway database that includes vessel names and ports/waterways visited.

Vessel characteristics, speeds, times-in-mode, and engine load data have been modeled for deep sea, river, and Great Lake ports in the United States in a two-volume report produced by ARCADIS on behalf of the EPA (U.S. Environmental Protection Agency, 1999a, d). These documents provide a detailed analysis of selected ports, as well as a method for extrapolating activity data from these "known" ports to other ports with similar characteristics. Several of the ports chosen for detailed analysis are located within the CENRAP region, including St. Louis, Baton Rouge, New Orleans, Plaquemines, South Louisiana, and Corpus Christi. The techniques described in these reports were used to produce a profile of vessel characteristics and operations for all ports in the CENRAP states. Also, some bottom-up surveys of selected port authorities and/or vessel operators were done to verify the assumptions made in creating these profiles.

6.3.3 Spatial Allocation

Emissions occurring in and around a deep sea or Great Lake port area were assigned to the county in which the port is located. If a port spanned multiple counties, the number of port terminals in each county was used to allocate maneuvering and hoteling emissions, and the length of the port area in each county was used to allocate emissions from cruise mode. Data on port terminals and their waterway locations are available from the USACE (2003a).

However, for inland river systems, fuel consumption must first be disaggregated into "in-port" and "underway" components. To accomplish this, fuel consumption at river ports in the CENRAP states was estimated with fuel-based emission factors described in Section 6.3.1 and port-specific data on vessel trips; and characteristics (as outlined in Section 6.3.2) were obtained from USACE data, EPA guidance documents, and surveys of port authorities. Once in-port fuel consumption was estimated, the values were subtracted from Barge Costing Model fuel consumption estimates for the river segment in question. The remaining fuel consumption was considered "underway" and allocated to counties based on the fraction of a river segment's length passing through each county. These county-level river segment fractions were derived from the GIS-based National Waterway Network database produced by the Bureau of Transportation Statistics (BTS).

6.3.4 Temporal Allocation

Monthly variations in vessel activity and fuel usage are significant (Dager, 2004). These seasonal variations are influenced by climate (the upper Mississippi is closed during winter) and by the types of commodity being moved (grain shipments, for example, primarily occur in April/May and September/October).

Fuel usage estimates produced by the Barge Costing Model are not currently available on a monthly basis. Therefore, monthly activity patterns were determined from the Lock Performance Monitoring System (LPMS) maintained by the USACE. This database provides USACE operators, planners, and managers with information on the use, performance, and characteristics of the USACE's national system of locks. The LPMS consists of data collected at most USACE-owned and/or -operated locks, including the number of vessels and barges locked, dates of lockages, and the type and tonnage of commodity carried (U.S. Army Corps of Engineers, 2003b). Statistics are published monthly for selected key locks, and these monthly data were used to generate a monthly activity profile for each inland river system, as well as the GIWW.

6.3.5 Data Preparation

Deliverables for this source category include the county-level emission estimates in both NIF 3.0 format and the IDA format used by the SMOKE emissions model. The temporal allocation profiles and cross-reference files used by SMOKE were also provided.

6.4 LOCOMOTIVES

Railroads can be separated into three class sizes. Class I railroads operate over a large geographic area, serve many states, and maintain fleets of locomotives that number from several hundred to several thousand. These railroads, while few in number, are responsible for about 93% of the annual fuel consumption of all railroads nationwide (U.S. Environmental Protection Agency, 1998d). Class II (or regional) railroads serve only a few states and typically operate about 30 to 200 locomotives. Class III (or local) railroads usually serve only one state and operate only a handful of locomotives. Locomotives in each of these classifications can be used for two types of operation: line haul and yard (or switching) activities. Line haul locomotives generally travel long distances, whereas yard locomotives only move railcars within a local railway yard. Some local railroads do not operate any line haul locomotives, but only provide switching services to other railroads. These "Switching and Terminal" railroads were treated as a fourth classification for emission estimation purposes.

Table 6-7 shows the total number of railroads operating in the entire CENRAP region by class (Association of American Railroads, 2004). Using the emission factors and activity data described in the following sections, emissions were estimated for all line haul and yard locomotives operated by one of these railroads.

Table 6-7. Railroads operating in the CENRAP region by class.

Railroad Class	Number of Railroads	Railroad Names
Class I	8	Amtrak Burlington Northern & Sante Fe Kansas City Southern Union Pacific Norfolk Southern CSX Transportation Canadian National Canadian Pacific/Soo Line
Class II	14	Chicago, Central & Pacific Dakota, Minnesota & Eastern Duluth, Missabe & Iron Range I & M Rail Link Iowa Interstate Kansas City & Oklahoma Kyle Missouri & Northern Arkansas Nebraska, Kansas & Colorado Northern Plains Red River Valley & Western South Kansas & Oklahoma Texas Mexican Texas Pacifico
Class III	80	Numerous
Switching & Terminal	33	Numerous

6.4.1 Emission Factors

Emissions from locomotives are calculated based on fuel consumption. The EPA has estimated average emissions rates for locomotives as grams of pollutant emitted per gallon of fuel consumed (g/gal) (U.S. Environmental Protection Agency, 1997). These emission factors vary by the age of the locomotive, as three separate sets of emissions standards have been adopted by the EPA (see **Table 6-8**).

Table 6-8. Locomotive emission factors by model year.

Locomotive Type	Model Year	Controls	Emission factors (g/gal)			
			HC	CO	NO^x	PM
Line haul	<1973	Uncontrolled	10	26.6	270	6.7
	1973-2001	Tier 0	10	26.6	178	6.7
	2002-2004	Tier 1	9.8	26.6	139	6.7
	>2004	Tier 2	5.4	26.6	103	3.6
Switch	<1973	Uncontrolled	21	38.1	362	9.2
	1973-2001	Tier 0	21	38.1	262	9.2
	2002-2004	Tier 1	21	38.1	202	9.2
	>2004	Tier 2	11	38.1	152	4.3

For Class I railroads, weighted emission factors were calculated based on locomotive fleet age distribution data available from the Bureau of Transportation Statistics (Bureau of Transportation Statistics, 2003a). The latest BTS locomotive fleet information indicates that 14% of Class I locomotives were built prior to 1973 and 86% were built from 1973 to 2001 (and are, therefore, subject to Tier 1 controls). At the time of data acquisition, no information was available on the number of locomotives built in 2002 that have entered the fleet; so for purposes of the 2002 inventory, it was assumed that the impact of Tier 1 controls is negligible. The weighted emission factors shown in **Table 6-9** were calculated based on the BTS fractions listed above.[8]

Table 6-9. Weighted emission factors for Class I locomotives.

Locomotive Type	Emission factors (g/gal)			
	HC	CO	NO_x	PM
Line haul	10	26.6	191	6.7
Switch	21	38.1	273	9.2

For Class II, Class III, and switching railroads, no specific information on fleet age distributions is readily available, and since these railroads use only about 5% of the fuel consumed by all railroads nationwide (U.S. Environmental Protection Agency, 1998d), a simple, conservative approach was applied. Because it is known that these smaller railroads tend to have an older fleet mix than Class I railroads (U.S. Environmental Protection Agency, 1992), uncontrolled emission factors were applied to all Class I, Class II, and switching railroads.

[8] For purposes of this calculation, it was assumed that fuel usage per locomotive does not vary with age, either due to fuel economy changes or the reduced usage of older locomotives.

6.4.2 Acquisition of Activity Data

Class I Railroads

Class I line haul locomotives, which operate over large geographic regions, do not burn all their fuel in the same area where the fuel was pumped. Therefore, total annual fuel consumption for each Class I railroad must be estimated at the state (or county) level in order to determine the amount of fuel consumed within the inventory area. Such estimates were made by calculating a system-wide fuel consumption index (expressed in gross ton-miles[9] per gallon or GTM/gal) for each railroad and applying that index to state-level traffic density data (U.S. Environmental Protection Agency, 1992). As a quality assurance check, Class I railroads were contacted individually to see if they track state or county-level fuel consumption data that could be compared to the estimated values.

The data needed to calculate a fuel consumption index can be obtained from the "R-1" reports all Class I railroads are required to file with the Surface Transportation Board (STB) each year. Schedule 755 of this report lists the annual traffic density in gross ton-miles for a given railroad, and Schedule 750 lists the total fuel consumption for line haul operations and switching operations. Copies of these schedules for all Class I railroads were obtained from the STB, and **Table 6-10** lists the 2002 traffic density and fuel consumption data for each Class I railroad operating in the CENRAP region.

Table 6-10. 2002 system-wide activity data for Class I railroads.

Railroad Name	Traffic Density (1000 ton-miles)	Fuel Consumption (gal)	
		Line Haul	Switching
Amtrak[a]	N/A	75,000,000	N/A
Burlington Northern and Sante Fe	958,862,994	1,091,248,247	57,434,118
Kansas City Southern	37,563,933	51,256,604	4,057,180
Union Pacific	1,085,700,525	1,176,963,998	137,902,327
Norfolk Southern	373,281,203	433,678,710	38,810,939
CSX Transportation	469,392,729	514,107,567	56,172,596
Canadian National	104,578,305	108,013,647	15,135,382
Canadian Pacific/Soo Line	45,426,616	42,198,000	3,060,000

[a] Amtrak does not file reports with the STB, so fuel consumption data for that railroad was obtained from the BTS (2003b).

Using these data, a fuel consumption index for each railroad was calculated by dividing the system-wide traffic density by the system-wide fuel usage. For example, the fuel consumption index for the Burlington Northern & Sante Fe (BNSF) railroad was calculated as follows:

$$FCI_{BNSF} = 958{,}862{,}994 \times 10^3 \text{ ton-miles} / 1{,}091{,}248{,}247 \text{ gal} = 878.7 \text{ ton-miles/gal} \qquad \textbf{(6-3)}$$

[9] Gross ton-miles include the weight of locomotives, freight cars, etc. rather than the weight of freight only.

State-level traffic density data were obtained from the Federal Railroad Administration (FRA), as Class I railroads are only required to report their traffic density to the STB on an aggregate (or national) basis. The FRA has a rail network model which is used to estimate traffic flows on specific rail lines, and the agency provided state-level traffic density data for all Class I railroads (Kedar, 2004). These data can be used in conjunction with the fuel consumption index calculations described above to estimate fuel usage by state for each Class I railroad. For example, FRA data show that the 2002 gross traffic density for the BNSF Railroad in Arkansas was 8090.66 million ton-miles. Fuel usage for this railroad in Arkansas can then be calculated as follows:

$$\text{Fuel Consumption} = 8090.66 \times 10^6 \text{ ton-miles} / 878.7 \text{ ton-miles/gal} = 9{,}207{,}696 \text{ gal} \qquad \textbf{(6-4)}$$

Class I switching emissions were also calculated based on fuel usage data gathered from Class I railroads or taken from R-1 reports. These data were disaggregated to the state level using procedures similar to those outlined above, with a fuel consumption index generated for each railroad by dividing the railroad's system-wide traffic density by the system-wide fuel usage for switching operations.

Class II and Class III Railroads

Emissions from Class II and III locomotives were calculated based on the amount of fuel consumed in the inventory area. However, these smaller railroad companies are not required to file R-1 reports with the STB, so the only source of fuel consumption information is the railroads themselves. Because there are only 14 Class II (regional) railroads operating in the CENRAP states, each one was surveyed to determine fuel usage by state. In cases where Class II railroads are unable or unwilling to provide data, an average fuel consumption index was calculated for railroads that did supply information and extrapolated to railroads with missing data. This fuel consumption index was based on the total miles of track operated by a railroad and the total carloads of freight transported each year—information gathered through annual surveys conducted by the Association of American Railroads (AAR).

A similar approach was used for Class III railroads. Surveying each of the 80 local railroads in the CENRAP states individually was not feasible within the scope of this project, so a sample of such railroads was contacted in each state. Again, a fuel consumption index was calculated from available data and used to estimate fuel usage for railroads that were not surveyed.

Switching and Terminal Railroads

For yard (or switching) locomotives, the EPA recommends an emission estimation method based on the number of yard locomotives operating within an inventory area. The EPA estimates that the average yard locomotive operates 24 hours per day, 365 days per year, and consumes 228 gallons of diesel fuel per day (U.S. Environmental Protection Agency, 1992). Yard locomotive emissions can be derived by multiplying the number of yard locomotives within the inventory area by this fuel usage factor and applying the switch locomotive emission factors previously cited. However, these assumptions indicate that the typical yard locomotive consumes over 80,000 gallons of fuel per year, and, while this figure may be appropriate for busy Class I yard locomotives, it is almost certainly too high for local switching operations.[10] Therefore, fuel usage for switching railroads was calculated in a manner similar to that carried out for other Class III railroads. A sample of switching railroads was contacted to obtain annual fuel usage data, and a fuel consumption index was derived and applied to other railroads. This fuel consumption index was based on the number of yard locomotives and total miles of track operated, as well as the number of carloads of freight handled each year—information available from the AAR.

6.4.3 Spatial Allocation

For Class I railroads, emissions were apportioned to the county level by using the GIS-based National Rail Network produced by BTS. This network contains traffic density data[11] by railway segment and railroad classification, and the network can be overlaid with county boundaries to estimate the fraction of a given state's Class I rail traffic that passes through each county in that state. These fractions were used to disaggregate emissions from the state to the county level. Similarly, state-level emissions from switching operations were assigned to individual counties based on the number of railroad terminals[12] in a given county.

For Class II and III railroads, emission factors for line haul locomotives[13] were applied to statewide fuel usage estimates for Class II and III railroads, and emissions were apportioned to the county level using the Class II and III traffic density data contained in the National Rail Network. For Class III switching operations, emission factors for switching locomotives were applied to fuel usage estimates, and the emissions were apportioned to the county in which each railroad's yard is located.

6.4.4 Temporal Allocation

Movements of freight by rail occur 24 hours per day, 7 days per week, though there are slight variations across the months of the year (Kedar, 2004). The AAR produces an annual report that summarizes weekly carloads of freight shipped in the United States, and these weekly data were used to model monthly variations in locomotive activity (American Association of Railroads, 2003).

[10] Preliminary data collected for Iowa show that two local switching railroads consume less than 10,000 gallons of diesel fuel per year each.
[11] Each rail segment is assigned to one of seven density groupings (for example, Group 2 represents densities ranging from 5.0 to 9.9 million GTM/mile). The average of each range will be used when apportioning traffic density to the county level.
[12] The BTS National Rail Network contains data on the locations of railroad terminals and junctions in each state.
[13] Class II and III railroads are not as likely as Class I railroads to operate their own switching engines or to track fuel by locomotive type. This assumption was also made by the EPA in a regulatory support document (U.S. Environmental Protection Agency, 1998d).

6.4.5 Quality Assurance

For Class I railroads, fuel consumption estimates by state from the FRA rail network model were cross-checked with other readily available estimates of railroad activity as a quality assurance check. For example, the state-level data published by the AAR list the total tons of freight transported through each state annually (Association of American Railroads, 2004). These data show that freight traffic in Nebraska is significantly higher in than any of the other CENRAP states, which corroborates initial fuel estimates performed for Class I railroads from available STB data.

For Class II and III railroads, survey data gathered in 2001 by the American Shortline and Regional Railroad Association (ASRRA) were used as a quality assurance check. This survey included questions related to fuel consumption; and while confidentiality concerns prevent the release of the actual database, a researcher with ASRRA provided an aggregate estimate of fuel consumed by all Class II and III railroads headquartered in CENRAP states for 2001 (Benson, 2004). This estimate of 50,000,000 gallons matches up very well with the results of the CENRAP inventory.

In addition, the procedures outlined in the project QAPP were followed (Sullivan, 2004).

6.4.6 Data Preparation

Deliverables for this source category include the county-level emission estimates in both NIF 3.0 format and the IDA format used by the SMOKE emissions model. The temporal allocation profiles and cross-reference files used by SMOKE were also provided.

7. METHODS TO ESTIMATE EMISSIONS FOR SOURCES OF AGRICULTURAL FUGITIVE DUST

Agricultural operations, such as crop tilling, crop harvesting, or confined animal feeding operations (CAFOs), release emissions of geologic fugitive dust. This section describes the information sources and methods used to calculate county-level emissions of agricultural fugitive dust for the CENRAP region for calendar year 2002.

7.1 PRIORITIZATION

Emissions estimation methodologies and existing emission inventories for the CENRAP region and for other regions of the country were reviewed. The EPA's 1999 NEI includes particulate matter (PM) emissions for the CENRAP region for the following agricultural source categories, as illustrated in **Figure 7-1**: tilling, beef cattle feedlots, cotton ginning, and agricultural crop burning (U.S. Environmental Protection Agency, 2004b). The Western Regional Air Partnership (WRAP) projected emissions from the 1999 NEI to estimate 2002 agricultural PM emissions for the WRAP region (E.H. Pechan and Associates, 2004). The WRAP region's inventories indicated that agricultural tilling and beef cattle feedlots were the largest contributors to agricultural fugitive dust, followed by crop transport and cotton ginning, as illustrated in **Figure 7-2**. Other sources of agricultural PM emissions in the WRAP region included harvesting, crop burning, and other combustion sources.

In the NEI and WRAP inventories, agricultural tilling and CAFOs encompass more than 90% of the PM emissions from agricultural sources. Therefore, agricultural tilling and CAFOs were selected for bottom-up treatment. Emissions of PM_{10} and $PM_{2.5}$[14] for these source categories were estimated by acquiring bottom-up activity data and applying emission factors from EPA guidance or other literature. Activity data for agricultural tilling operations were gathered through a survey of county agricultural extension offices (Reid et al., 2004). Facility-specific population estimates for beef cattle feedlots and dairies were prepared previously (Coe and Reid, 2003).

[14] PM_{10} is PM of less than or equal to 10 microns (µm) aerodynamic matter. $PM_{2.5}$ is PM of less than or equal to 2.5 microns (µm) aerodynamic matter

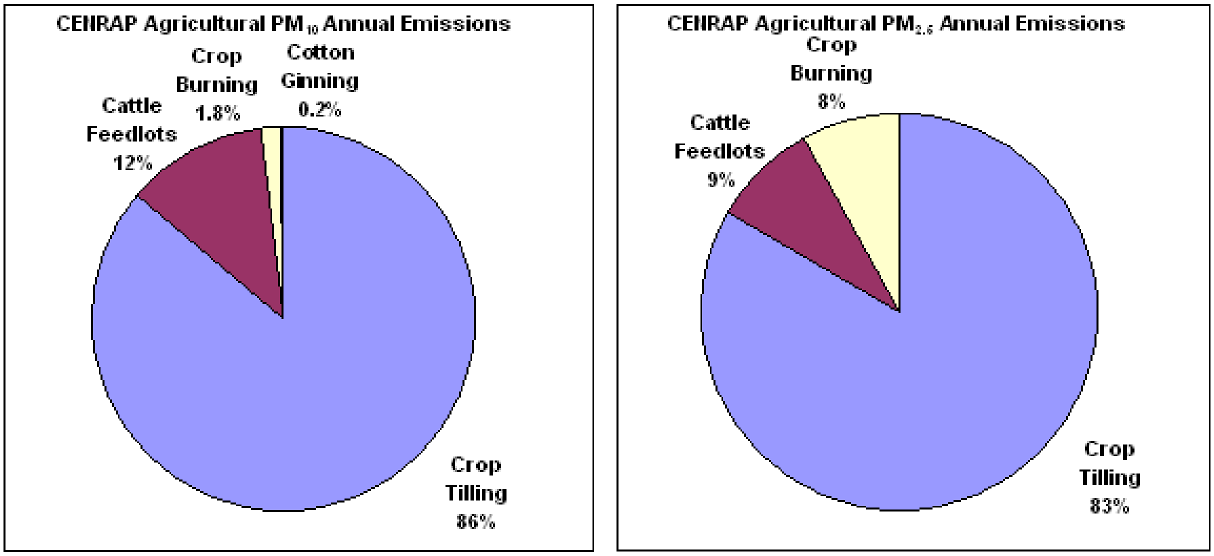

Figure 7-1. 1999 agricultural PM emissions for the CENRAP region.

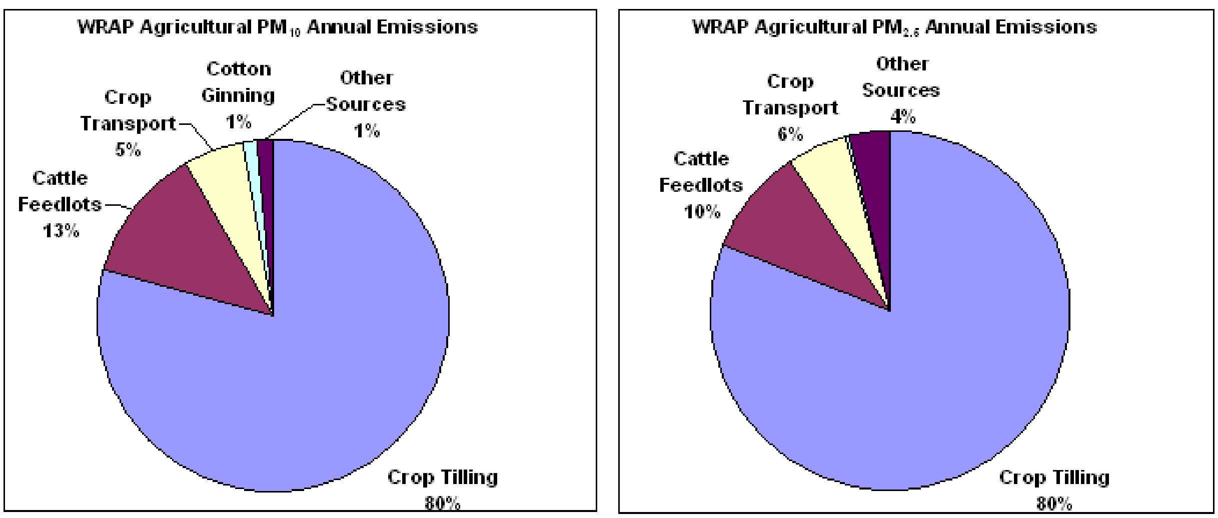

Figure 7-2. Projected 2002 agricultural PM emissions for the WRAP region.

7.2 AGRICULTURAL CROP TILLING

EPA's guidance for estimating PM emissions from agricultural crop tilling involves combining a constant emission factor with county-level activity data, including the silt content of surface soils, the number of tillings performed in a year for each crop type, and the acres of each crop type (U.S. Environmental Protection Agency, 2001, 2004c). For conservational tillage practices, such as no till, mulch till, and ridge till, the number of tillings performed in a year is reduced proportionally according to information provided by the Conservation Information

Technology Center (CTIC) (U.S. Environmental Protection Agency, 2004c; Conservation Technology Information Center, 2004). Emissions from agricultural crop tilling are calculated according to Equation 6-1.

$$E = c \times k \times s^{0.6} \times p \times a \qquad \textbf{(6-1)}$$

E represents the PM emissions in units of pounds per year, and *c* equals the constant emission factor of 4.8 lbs/acre-tilling. A dimensionless particle size multiplier, *k*, is applied to calculate either PM_{10} (k=0.21) or $PM_{2.5}$ (k=0.042). The silt content of the soil, *s*, is defined as the mass fraction of particles smaller than 0.75 µm diameter found in soil to a depth of 10 cm, expressed as a percent. The other activity data include *p*, which represents the number of tillings or passes that are performed in a year for each crop type, and *a*, which represents the acres of land tilled for each crop type. In summary, the methodology requires the following information, at county level, as activity data:

- The number of tillings per year by crop.
- The conservational tilling practices.
- The silt content of soils.
- The acres of land planted by crop type .

The EPA's Emissions Inventory Improvement Program suggests that local data for the number of tillings per year for each crop type and the temporal distribution of tilling activities are desirable (U.S. Environmental Protection Agency, 2004c). A survey of tilling practices was conducted by contacting county agricultural extension offices throughout the CENRAP region (Reid et al., 2004). Questionnaires were designed to elicit information about the types of crops in each respondent's county and the tilling practices for each crop type. The survey results were analyzed and extrapolated for each of the CENRAP states to estimate the number of tillings per year by crop type, the temporal distributions of temporal tilling activities, and the prevalences of conservational tilling practices.

The EPA National Air Pollutant Emission Trends Procedures Document provides a cross-reference table with silt contents for various soil types (U.S. Environmental Protection Agency, 1998b). The State Soil Survey Geographic Database (STATSGO) produced by the Natural Resources Conservation Service of the United States Department of Agriculture was used to determine soil types at the county level (National Resources Conservation Service, 1994). County-level silt contents were determined by using the EPA Procedures Document to cross-reference silt contents with STATSGO soil types.

County-level acreages of grown crops were prepared previously (Reid et al., 2004). These acreages were based on 2002 National Agricultural Statistics Service (NASS) data.

7.3 CATTLE FEEDLOTS AND DAIRIES

The open surfaces of the pens and/or the manure pack are sources of fugitive dust at cattle feedlots and dairies. The major difference between cattle feedlots and dairies is the proportion of time that herds are in contact with the manure pack, which tends to limit fugitive dust emissions at dairies to levels much lower than those of beef cattle feedlots (Goodrich et al., 2002).

EPA guidance specifies an emission factor equal to 17 tons of PM_{10} per thousand head of feeding cattle per year (or 93 lbs PM_{10} per thousand head per day), and an assumption that 15% of PM_{10} is emitted as $PM_{2.5}$ (U.S. Environmental Protection Agency, 2004a). However, a literature review indicated that the EPA's guidance results in greatly overestimated emission inventories (Flocchini and James, 2001; Goodrich et al., 2002). Two recent studies performed by the University of California at Davis and Texas A&M University yielded emission factors of 28.9 lbs PM_{10} per thousand head per day (Flocchini and James, 2001) and 19 lbs PM_{10} per thousand head per day (Goodrich et al., 2002) for beef cattle at feedlots. The midpoint—24 lbs PM_{10} per thousand head per day—was selected and used to estimate emissions of PM_{10} for beef cattle feedlots in the CENRAP region. In addition, an emission factor of 4.4 lbs PM_{10} per thousand head per day was selected for use in estimating emissions for dairies. This emission factor is based on sampling conducted at a single central Texas dairy in the summer of 2002 (Goodrich et al., 2002), and is therefore highly uncertain. However, it is the best and most reasonable emission rate that could be identified at this time.

Facility-specific population estimates for beef cattle feedlots and dairies were prepared previously (Coe and Reid, 2003). These population estimates were based primarily on facility-specific animal populations and species available from National Pollutant Discharge Elimination System (NPDES).

No information was identified that could be used to develop temporal patterns for this source category. However, emissions are likely to vary because climate conditions and animal husbandry practices vary seasonally and diurnally.

7.4 DATA PREPARATION

Deliverables for this source category include the county-level emission estimates in both NIF 3.0 format and the IDA format used by the SMOKE emissions model. The temporal allocation profiles and cross-reference files used by SMOKE were also provided.

8. PREPARATION OF INVENTORIES AND DATA FILE SYSTEMS FOR DELIVERY

8.1 ON-ROAD MOBILE SOURCES

Activity data, MOBILE6-ready input files, temporal profiles and cross-references used by SMOKE, and MOBILE6 command files were prepared to allow an independent third party to run MOBILE6 within SMOKE. These deliverables permitted CENRAP to prepare hourly meteorological inputs, estimate emissions, and prepare gridded emission inventories for any 2002 time period. In addition, STI ran MOBILE6 within SMOKE, estimated annual emissions for on-road mobile sources, and prepared NIF 3.0 emission inventories for the entire CENRAP region.

To estimate annual emissions, CENRAP's MM5 meteorological inputs for the months of January and July 2002 were used. Annual emissions were estimated from the average of the emission inventories for January and July 2002.[15] In addition, although SMOKE/MOBILE6 can be used to calculate emissions from refueling, these emissions are better allocated spatially and temporally if they are calculated separately from MOBILE6 runs. Therefore, refueling emissions were not included in the CENRAP emission inventory.

8.2 NON-ROAD MOBILE SOURCES

Revised activity data files and fuels characteristics, formatted for use with NONROAD, were prepared to allow an independent third party to run NONROAD and estimate emissions. In addition, STI ran the latest version of NONROAD (NONROAD 2004), estimated annual emissions for non-road mobile sources, and prepared NIF 3.0 and IDA-formatted emission inventories for the entire CENRAP region. The temporal allocation profiles and cross-reference files used by SMOKE were also provided. Emissions for locomotives and commercial marine vessels were estimated externally to the NONROAD model, which does not treat these sources, and were prepared in NIF 3.0 and IDA formats.

8.3 SOURCES OF AGRICULTURAL FUGITIVE DUST

STI estimated annual emissions for sources of agricultural fugitive dust, and prepared NIF 3.0 and IDA-formatted emission inventories for the entire CENRAP region. For agricultural tilling dust, the temporal allocation profiles and cross-reference files used by SMOKE were also provided.

[15] Test runs were also completed using representative temperatures for April and October to determine the potential effects on the annual average; however, the effects of including four months in the annual average were negligible.

9. REFERENCES

American Association of Railroads (2003) Weekly railroad traffic. Available on the Internet at <http://www.aar.org/pubstores/listitems.aspx>; last accessed September 21, 2004.

Association of American Railroads (2004) RR Industry Info – Railroads and States. Web page. Available on the Internet at <http://www.aar.org/AboutTheIndustry/StateInformation.asp>; last accessed September 16, 2004.

Benson D. (2004) Personal communication with the professor at North Dakota State University who conducted the ASRRA survey. February 26.

Bureau of National Affairs (2002a) Testing company to pay $8.7 million for false claims from Texas laboratory. *BNA Environment Reporter* **33** (13), 702.

Bureau of National Affairs (2002b) Michigan lab owner sentenced to year in prison. *BNA Environment Reporter* **33** (21), 1164.

Bureau of National Affairs (2002c) Former testing lab chief guilty of ignoring reporting requirement for reformulated gas. *BNA Environment Reporter* **33** (25), 1383.

Bureau of Transportation Statistics (2003a) National transportation statistics 2003, Table 1-29 - Class I railroad locomotive fleet by year built. Available on the Internet at <http://www.bts.gov/publications/national_transportation_statistics/2003/index.html>; last accessed September 20, 2004.

Bureau of Transportation Statistics (2003b) National transportation statistics 2003, Table 4-5 - Fuel consumption by mode of transportation. Available on the Internet at <http://www.bts.gov/publications/national_transportation_statistics/2003/index.html>; last accessed September 20, 2004.

Coe D.L. and Reid S.B. (2003) Research and development of ammonia emission inventories for the Central States Regional Air Planning Association. Final report prepared for The Central States Air Resource Agencies and The Central Regional Air Planning Association, Oklahoma City, OK. Prepared by Sonoma Technology, Inc., Petaluma, CA, STI-902501-2241-FR, October.

Coe D.L., Reid S.B., Stiefer P.S., Penfold B.M., Funk T.H., and Chinkin L.R. (2004) Collection and analysis of weekend/weekday emissions activity data in the South Coast Air Basin. Final report prepared for the California Air Resources Board, Sacramento, CA, by Sonoma Technology, Inc., Petaluma, CA, STI-901140/901150-2477-FR; ARB Contract Nos. 00-305 and 00-313, May.

Conservation Technology Information Center (2004) 2002 National Crop Residue Management Survey Data. Available on the Internet at <http://www.ctic.purdue.edu/Core4/CT/CT.html>; last accessed September 20, 2004.

Dager C. (2004) Personal communication with personnel at the Tennessee Valley Authority. January 7.

E.H. Pechan and Associates (2004) Documentation for the onroad National Emissions Inventory (NEI) for base years 1970-2002. Report prepared for the Office of Air Quality Planning and Standards, Emission Factor and Inventory Group, U.S. Environmental Protection Agency, Research Triangle Park, NC, by E.H. Pechan & Associates, Springfield, VA, January.

Federal Highway Administration (1995) National personal transportation survey. Available on the Internet at <http://npts.ornl.gov/npts/1995/doc/users_guide.shtml>; last accessed March 18, 2004.

Federal Highway Administration (2004) Highway statistics 2002. Available on the Internet at <http://www.fhwa.dot.gov/policy/ohim/hs02/index.htm>; last accessed September 20, 2004.

Flocchini R.G. and James T.A., et al., (2001) Sources and sinks on PM_{10} in the San Joaquin Valley, Interim Report. Prepared by the Air Quality Group, Crocker Nuclear Laboratory, University of California, Davis, CA, August.

Giannelli R.A., Gilmore J.H., Landman L., Srivastava S., Beardsley M., Brzezinski D., Dolce G., Koupal J., Pedelty J., and Shyu G. (2002) Sensitivity analysis of MOBILE6.0. Report prepared by Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA420-R-02-035, December.

Goodrich L.B., Parnell C.B., Mukhtar S., Lacey R.E., and Shaw B.W. (2002) Preliminary PM_{10} emission factor for freestall dairies. Paper number 022148 presented to the *2002 ASAE Annual International Meeting, July,* by the Department of Biological and Agricultural Engineering, Texas A&M University.

Kedar R. (2004) Personal communicatin with personnel at the Federal Railroad Administration. January 7.

McCarthy L. (2001) Court fines New Jersey lab $1 million for false statements in gas testing case. *BNA Environment Reporter* **32** (16), 751.

National Resources Conservation Service (1994) State Soil Geographic (STATSGO) database. Available on the Internet at <http://www.ftw.nrcs.usda.gov/stat_data.html>.

Pollack A., Chi R., Lindhjem C., Tran C., and Chandraker P. (2004) Development of WRAP mobile source emission inventories. Prepared by Environ International Corporation, February.

Reid S.B., Brown S.G., Sullivan D.C., Arkinson H.L., Funk T.H., and Stiefer P.S. (2004) Research and development of planned burning emission inventories for the Central States Regional Air Planning Association. Final report prepared for The Central States Air Resource Agencies and The Central Regional Air Planning Association, Oklahoma City, OK, by Sonoma Technology, Inc., Petaluma, CA, STI-902514-2516-FR, July.

Sullivan D.C. (2004) Mobile source and agricultural dust emission inventory for the central states. Final work plan/quality assurance project plan prepared for The Central States Air Resource Agencies and The Central Regional Air Planning Association, Oklahoma City, OK, by Sonoma Technology, Inc., Petaluma, CA, STI-903571-2460-FWP/QAPP, February 27.

Tang T., Roberts M., and Ho C. (2003) Sensitivity analysis of MOBILE6 Motor Vehicle Emission Factor Model. Report edited and produced by Federal Highway Administration Resource Center, Atlanta, GA, FHWA-RC-Atlanta-03-0007.

U.S. Army Corps of Engineers (1997) Inland waterway navigation--value to the nation. Available on the Internet at <http://www.mvr.usace.army.mil/PA_brochure20558/PA20558_01.htm>.

U.S. Army Corps of Engineers (2003a) Ports facility database. Available on the Internet at <http://www.iwr.usace.army.mil/ndc/ports/ports.htm>; last accessed September 16, 2004.

U.S. Army Corps of Engineers (2003b) Lock performance monitoring system. Available on the Internet at <http://www.iwr.usace.army.mil/ndc/lpms/lpms.htm>; last accessed September 16, 2004.

U.S. Census Bureau (2004) Entire data set - County population datasets - County population and estimated components of population change, all counties: April 1, 2000 to July 1, 2003. Available on the Internet at < http://www.census.gov/popest/datasets.html>; last accessed September 20, 2004.

U.S. Department of Justice (2002) Former company vice president indicted for conspiring to falsify data on millions of gallons of reformulated gasoline. Available on the Internet at <http://www.usdoj.gov/opa/pr/2002/April/02_enrd_233.htm>. Press release 02-233, April 17.

U.S. Environmental Protection Agency (1991a) Nonroad engine and vehicle emission study-report. EPA 460/3-91-02, November.

U.S. Environmental Protection Agency (1991b) Technical guidance – Stage II vapor recovery systems for control of vehicle refueling emissions at gasoline dispensing facilities, vol. I – chapters. Report prepared by the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Divisions (MD-13), Research Triangle Park, NC, EPA-450/3-91-022a, November.

U.S. Environmental Protection Agency (1992) Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources. EPA420-R-92-009, December.

U.S. Environmental Protection Agency (1997) Emission factors for locomotives, technical highlights. EPA420-F-97-051, December.

U.S. Environmental Protection Agency (1998a) Compilation of air pollutant emission factors, AP-42. Vol. 1: stationary point and area sources. Section 1.4, 5th ed. Natural gas combustion. July.

U.S. Environmental Protection Agency (1998b) National air pollutant emission trends, procedures document, 1900-1996. Report prepared by the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-454/R-98-008, May.

U.S. Environmental Protection Agency (1998c) Compilation of air pollutant emission factors, AP-42. Section 1.3: Fuel oil combustion. Volume 1, 5th ed., September. Available on the Internet at <http://www.epa.gov/ttn/chief/ap42/ch01/> ; last accessed September 17, 2004.

U.S. Environmental Protection Agency (1998d) Regulatory support document for locomotive emission standards. Prepared by the Office of Mobile Sources, Ann Arbor, MI, April.

U.S. Environmental Protection Agency (1999a) Commercial marine activity for the Great Lake and inland river ports of the United States. EPA420-R-99-019, September.

U.S. Environmental Protection Agency (1999b) Weekday and weekend day temporal allocation of activity in the nonroad model. EPA420-P-99-033. Report No. NR-015, March.

U.S. Environmental Protection Agency (1999c) 1999 National Emission Inventory documentation and data. Available on the Internet at <http://www.epa.gov/ttn/chief/net/1999inventory.html>; last accessed August 2004.

U.S. Environmental Protection Agency (1999d) Commercial marine activity for deep sea ports in the United States. Prepared by the Office of Mobile Sources, Ann Arbor, MI, EPA420-R-99-020, September.

U.S. Environmental Protection Agency (1999e) Final regulatory impact analysis: control of emissions from marine diesel engines. Prepared by the Office of Mobile Sources, Ann Arbor, MI, EPA 420-R-99-026, November.

U.S. Environmental Protection Agency (2000) Analysis of commercial marine vessels emissions and fuel consumption data. Prepared by the Office of Mobile Sources, Ann Arbor, MI, EPA420-R-00-002, February.

U.S. Environmental Protection Agency (2001) Procedures document for National Emission Inventory, criteria air pollutants, 1985-1999. Prepared by the Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-454/R-01-006, March.

U.S. Environmental Protection Agency (2002a) Geographic allocation of state level nonroad engine population data to the county level. EPA420-P-02-009. Report No. NR-014b, July.

U.S. Environmental Protection Agency (2002b) Median life, annual activity, and load factor values for nonroad engine emissions modeling. EPA420-P-02-014. Report No. NR-005b, December.

U.S. Environmental Protection Agency (2002c) Seasonal and monthly activity allocation fractions for nonroad engine emissions modeling. EPA420-P-02-010, Report No. NR-004a, July.

U.S. Environmental Protection Agency (2002d) Technical guidance on the use of MOBILE6 for emission inventory preparation. Report prepared by the U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Transportation and Air Quality, January.

U.S. Environmental Protection Agency (2003a) User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model. Report prepared by the Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA420-R-03-010, August.

U.S. Environmental Protection Agency (2003b) Documentation for aircraft, commercial marine vessel, locomotive, and other nonroad components of the National Emissions Inventory. Prepared by the Emission Factor and Inventory Group, Research Triangle Park, NC, October.

U.S. Environmental Protection Agency (2004a) Emission Inventory Improvement Program - Particulate emissions - Animal husbandry - Cattle. Web site of the Technology Transfer Network Clearinghouse for Inventories & Emission Factors. Available on the Internet at <http://www.epa.gov/ttn/chief/eiip/techreport/volume09/index.html>; last accessed September 16, 2004.

U.S. Environmental Protection Agency (2004b) 1999 National Emission Inventory documentation and data - final version 3.0. Web site of the Technology Transfer Network Clearinghouse for Inventories & Emission Factors. Available on the Internet at <http://www.epa.gov/ttn/chief/net/1999inventory.html>; last accessed September 20, 2004.

U.S. Environmental Protection Agency (2004c) Emission Inventory Improvement Program - EIIP document series - Volume IX - Particulate emissions - Fugitive dust from agricultural tilling. Web site of the Technology Transfer Network Clearinghouse for Inventories & Emission Factors. Available on the Internet at <http://www.epa.gov/ttn/chief/eiip/techreport/volume09/index.html>; last accessed September 20, 2004.

APPENDIX A

CENTRAL STATES REGIONAL AIR PLANNING ASSOCIATION (CENRAP) PLEASURE CRAFT STUDY

Central States Regional
Air Planning Association (CENRAP)
Pleasure Craft Study

Final Report

Prepared for

Sonoma Technology, Inc.

Project 1031

July 2004

Prepared by

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Final Report

Overview

Population Research Systems (PRS), LLC, a subsidiary of Freeman, Sullivan & Co., conducted the Pleasure Craft Survey for the Central States Regional Air Planning Association (CENRAP) Study in July 2004 on behalf of Sonoma Technologies, Inc. The project, which was sponsored by CENRAP, was designed to quantify air pollutant emissions from pleasure craft activities in the states of Nebraska, Kansas, Oklahoma, Arkansas, Texas, Iowa, Minnesota, Missouri and Louisiana.

Sonoma Technology, Inc. and PRS collaborated closely on the development of the mail survey instrument (Appendix B) used for this project. PRS was responsible for printing and mailing of the mail survey, the personalized cover letter (Appendix C), four-color state waterway maps as well as for programming of the telephone recruitment screener used by the PRS computer-assisted telephone interviewing (CATI) laboratory.

All project files and an electronic copy of this report can be found on the enclosed CD-Rom in Appendix D.

Methods

A. Sample

PRS purchased commercially available sample of registered boat owners in the target states from Dunhill International. Altogether 17,454 records of boat owners were loaded into the CATI system, 2,000 randomly drawn records per state. The only exception was Oklahoma, were the total number of available and loaded sample points was 1,454 records. Out of all records, 16,878 records were attempted, and 577 were not attempted, since some state quota cells were filled without calling all available records. Table 1. shows the number of sample points available per state.

Table 1. Number of loaded sample points per CENRAP state

STATE	Frequency
AR	2,000
IA	2,000
KS	2,000
LA	2,000
MN	2,000
MO	2,000
NE	2,000
OK	1,454
TX	2,000
Total	17,454

B. Telephone Recruit and Survey Package Mailing

Potential participants for the Pleasure Craft Study were recruited over the phone in a brief 10 minute interview (Appendix A).

Respondents were recruited from May 20, 2004 through June 10, 2004. All recruits were conducted by trained PRS CATI laboratory interviewers on weekdays between 5:00 PM and 9:00 PM Central Standard Time. At a respondent's request, PRS also scheduled callback appointments outside of these interviewing hours.

A maximum of four call attempts were made to each sample point and no refusal conversions were used to convince eligible respondents to participate in the study.

Once a respondent agreed to participate, a survey package containing a personalized letter, a pen-and-paper survey, waterway map(s) for the state respondent is using motorized watercraft, a business reply envelope and a safety whistle on a floating lanyard as incentive were mailed.

About two weeks after the initial survey mailing, a reminder postcard was sent to respondents who had not yet returned their surveys.

C. Results

PRS recruited 1,387 respondents for the mail survey, and 979 completed surveys were returned. Table 2 shows the distribution of recruits and returned surveys per state, as well as the respective percentage of response rate per state. The response rate varied between 67.4% and 77.1% and averaged at a return rate of 70.6%.

Table 2. Number of recruits and completed interviews per state

STATE	recruited	returned	%
AR	158	111	70.3%
IA	153	118	77.1%
KS	160	107	66.9%
LA	153	105	68.6%
MN	160	115	71.9%
MO	157	113	72.0%
NE	152	110	72.4%
OK	135	91	67.4%
TX	159	109	68.6%
Totals	**1387**	**979**	**70.6%**

APPENDIX A

TELEPHONE RECRUIT SCREENER

CENRAP Boating Study, Project 1031
Telephone Recruitment Script

INTRO1
Hello, my name is <interviewer>, may I speak with <insert fname, lname>?

1. On the phone (skpto INTRO3)
2. No, respondent is coming to the phone (skpto INTRO2)
3. No, respondent is not at home (schedule callback)
4. No such person (skpto TERM1)

INTRO2
Hello, my name is <interviewer> and I'm calling on behalf of CENRAP, the Central States Regional Air Planning Association. CENRAP is an organization of states, tribes, federal agencies, and other interested parties that studies and addresses air pollution, regional haze and visibility issues. Your state is participating in CENRAP and as such, you have been randomly selected to participate in an important air quality study. (Skpto INTRO4)

INTRO3
Hi, I'm calling on behalf of CENRAP, the Central States Regional Air Planning Association. CENRAP is an organization of states, tribes, federal agencies, and other interested parties that studies and addresses air pollution, regional haze and visibility issues. Your state is participating in CENRAP and as such, you have been randomly selected to participate in this important air quality study.

INTRO4
This telephone interview will take only a few minutes and I can assure you that I am not selling anything. We are conducting a study about recreational boating activities and are interested in learning more about how people use their watercrafts. All of your answers will be confidential and not used for any purpose other than this research.

Q1
Do you own a motorized sailboat, a personal watercraft such as a Jet-Ski or Waverunner or a power boat?

1. Yes
2. No (skpto TERM1)
8. Don't know/Refused (skpto TERM1)

Q2
Do you own more than one watercraft?

1. Yes
2. No (skpto Q5)
8. Don't know/Refused

Q3
What types of watercrafts do you own? Do you own… *(multiple choice, click all that apply)*

1. Powerboats
2. Motorized sail boats
3. Personal watercrafts
8. Don't know/Refused

Q4
Which of your watercrafts do you use the most?
1. Powerboat
2. Motorized sail boat
3. Personal watercraft
8. Don't know/Refused

Q5
Did you use your (primary) watercraft in the past year?
1. Yes
2. No
8. Don't know/Refused (IF answers = 2 skpto TERM1)

Q6
In which states did you use your <Insert Answer from Q4 here> in the past year?
(multiple choice, click all that apply)
1. Arkansas
2. Iowa
3. Kansas
4. Louisiana
5. Minnesota
6. Missouri
7. Nebraska
8. Oklahoma
9. Texas
10. Don't know/Refused

Q7

We would like to invite you to fill out a short paper survey regarding your boating activities with your watercraft you have used most in the past year, the <Insert Answer from Q5 here>. We would mail you the survey with a business reply envelope, and as a Thank-you gift you will also receive a Kwik Tex Safety whistle with floating Lanyard for your watercraft keys. May I have your address to send you the brief mail survey?
1. Yes
2. No, not interested (skpto TERM1)
3. Not sure (call back)

Q8

What is your mailing address?
Name:
Address:
City: / State: / Zip:

END1

Thank you very much for your participation in this important air quality study. You will receive the survey together with a business reply envelope and the boating key chain in the next 1-2 weeks in the mail. Please use the provided return envelope to send us back the filled out survey. You do not have to pay for postage. Do you have any other questions about this?

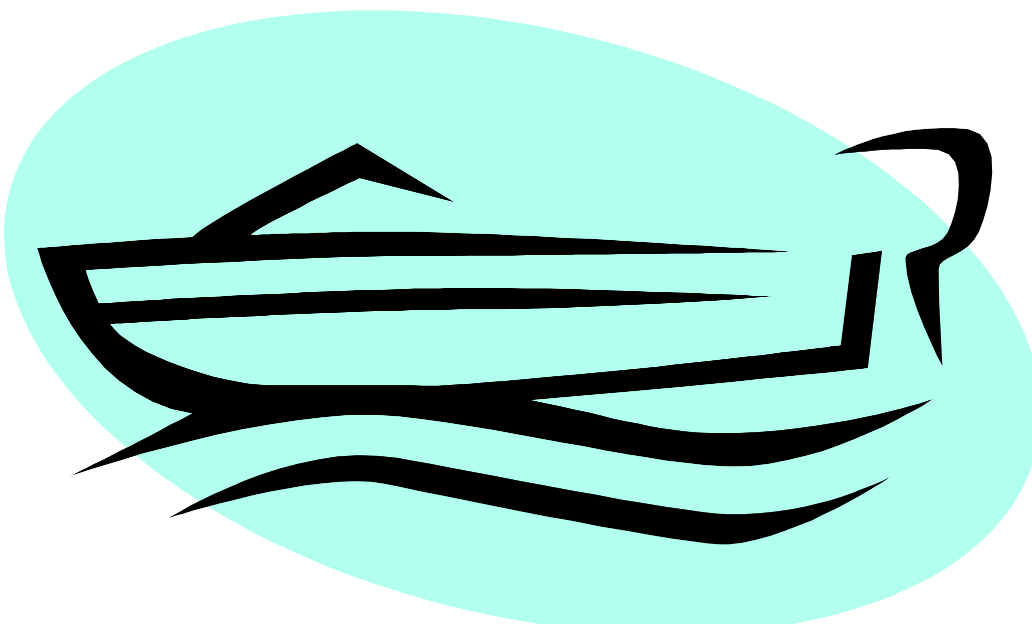
TERM1
Then these are all the questions I have for you. Thank you for your time. Good bye.

APPENDIX B

MAIL SURVEY INSTRUMENT

put sticker w/ boat type here
fscid

PLEASURE CRAFT SURVEY



1. **Check the one category, which best describes your registered boat.**

- ❑1 Sailboat with engine
- ❑2 Personal Water Craft (Jetski, Waverunner, etc.)
- ❑3 Power boat (bassboat, speedboat, houseboat, etc.)

2. **Which category below describes your primary propulsion engine?**

(*Do not describe any secondary propulsion used for low speed trolling and fishing.)*

- ❑1 Two-Stroke Gasoline Engine (requires gasoline and oil fuel mixture)
- ❑2 Four-Stroke Gasoline Engine (has an oil sump and dipstick)
- ❑3 Diesel (either 2 or 4 Stroke; requires diesel fuel)

3. **Which one of the following is the primary propulsion type for your boat?**
(Include auxiliary motors for sailboats, but do not include secondary motors for low speed trolling or fishing.)

- ❑1 Outboard
- ❑2 Inboard
- ❑3 Personal Water Craft Jet (Jetski engine, Waverunner engine, etc.)
- ❑4 Other (please specify): ____

4. **What is the horsepower for this boat's primary engine?**
(If unsure, you might want to check the specifications in the owner's manual. Otherwise, give your best estimate.)

_______________ hp

5. **What year was your engine manufactured?**
(If unsure, you might want to find the model year in the owner's manual.)

_______________A (enter year)

- ❑1 Not sure, but probably before 1997
- ❑2 Not sure, but probably 1997 or later
- ❑3 Don't know

6a. Typically, how often do you use your boat during the following seasons?
(Please choose the answer that best matches your boat usage.)

Winter (Dec - Feb):

- ❑ 1` Practically never
- ❑ 2 1 time per week or less
- ❑ 3 2-3 times per week
- ❑ 4 4-5 times per week
- ❑ 5 6 times per week
- ❑ 6 Practically every day

Spring (Mar – May):

- ❑ 7 Practically never
- ❑ 8 1 time per week or less
- ❑ 9 2-3 times per week
- ❑ 10 4-5 times per week
- ❑ 11 6 times per week
- ❑ 12 Practically every day

6b. Summer (Jun - Aug):

- ❑ 1` Practically never
- ❑ 2 1 time per week or less
- ❑ 3 2-3 times per week
- ❑ 4 4-5 times per week
- ❑ 5 6 times per week
- ❑ 6 Practically every day

Fall (Sep – Nov):

- ❑ 7 Practically never
- ❑ 8 1 time per week or less
- ❑ 9 2-3 times per week
- ❑ 10 4-5 times per week
- ❑ 11 6 times per week
- ❑ 12 Practically every day

7. How often did you use your boat <u>during the past week</u>?

- ❑ 1` Never
- ❑ 2 1 time
- ❑ 3 2 times
- ❑ 4 3 times
- ❑ 5 4 or more times

8a. **During each of the following seasons, what percentage of your boat trips occur on weekdays vs. weekends?**
(Please choose the answer that best matches your boat usage.)

Winter (Dec - Feb):

	Weekday	Weekend
❑ 1	0%	100%
❑ 2	25%	75%
❑ 3	50%	50%
❑ 4	75%	25%
❑ 5	100%	0%

Spring (Mar – May):

	Weekday	Weekend
❑ 6	0%	100%
❑ 7	25%	75%
❑ 8	50%	50%
❑ 9	75%	25%
❑ 10	100%	0%

8b. **Summer (Jun - Aug):**

	Weekday	Weekend
❑ 1	0%	100%
❑ 2	25%	75%
❑ 3	50%	50%
❑ 4	75%	25%
❑ 5	100%	0%

Fall (Sep – Nov):

	Weekday	Weekend
❑ 6	0%	100%
❑ 7	25%	75%
❑ 8	50%	50%
❑ 9	75%	25%
❑ 10	100%	0%

9a. **Typically, how many hours is the engine operating <u>per trip</u> when you use your boat during the following seasons?**
(Please choose the answer that best matches your boat usage.)

Winter (Dec - Feb):

❑ 1` More than 8 hours
❑ 2 6 – 8 hours
❑ 3 4 – 6 hours
❑ 4 2 – 4 hours
❑ 5 0 – 2 hours

Spring (Mar – May):

❑ 6 More than 8 hours
❑ 7 6 – 8 hours
❑ 8 4 – 6 hours
❑ 9 2 – 4 hours
❑ 10 0 – 2 hours

9b. **Summer (Jun - Aug):**

❑ 1` More than 8 hours
❑ 2 6 – 8 hours
❑ 3 4 – 6 hours
❑ 4 2 – 4 hours
❑ 5 0 – 2 hours

Fall (Sep – Nov):

❑ 6 More than 8 hours
❑ 7 6 – 8 hours
❑ 8 4 – 6 hours
❑ 9 2 – 4 hours
❑ 10 0 – 2 hours

10a. At what time do you typically launch your boat during the following seasons?

Winter (Dec - Feb):

- ❑ 1 Before 8:00 AM
- ❑ 2 8:00 AM – 11:00 AM
- ❑ 3 11:00 AM – 1:00 PM
- ❑ 4 1:00 PM – 4:00 PM
- ❑ 5 After 4:00 PM

Spring (Mar – May):

- ❑ 6 Before 8:00 AM
- ❑ 7 8:00 AM – 11:00 AM
- ❑ 8 11:00 AM – 1:00 PM
- ❑ 9 1:00 PM – 4:00 PM
- ❑ 10 After 4:00 PM

10b. Summer (Jun - Aug):

- ❑ 1 Before 8:00 AM
- ❑ 2 8:00 AM – 11:00 AM
- ❑ 3 11:00 AM – 1:00 PM
- ❑ 4 1:00 PM – 4:00 PM
- ❑ 5 After 4:00 PM

Fall (Sep – Nov):

- ❑ 6 Before 8:00 AM
- ❑ 7 8:00 AM – 11:00 AM
- ❑ 8 11:00 AM – 1:00 PM
- ❑ 9 1:00 PM – 4:00 PM
- ❑ 10 After 4:00 PM

11. When your boat engine is in operation, what percentage of time is typically spent at the following power settings? (Please circle an answer for each setting; answers should sum to 100%).

Example: 30
\+ 60
\+ 10 = **100%**

Near Idle/Low Throttle →	0	10	20	30	40	50	60	70	80	90	100 %
Mid-throttle →	0	10	20	30	40	50	60	70	80	90	100 %
Full throttle →	0	10	20	30	40	50	60	70	80	90	100 %

Total: **100%** (of time when engine is in operation)

12. Please estimate the amount of fuel you use in your boat each year.

Number of gallons purchased:

- ❑ 1 More than 300 gallons
- ❑ 2 200 – 300 gallons
- ❑ 3 100 – 200 gallons
- ❑ 4 50 – 100 gallons
- ❑ 5 Less than 50 gallons

13. In which counties do you typically operate your boat? (Use the county codes printed on the enclosed Waterways Map and choose up to three counties.)

County Code 1: ____________

County Code 2: ____________

County Code 3: ____________

Thank you for your cooperation.
Please use the provided business reply envelope to mail back the survey to

Population Research Systems
100 Spear St., 17th Floor
San Francisco, CA 94105

No postage necessary!

APPENDIX C

PERSONALIZED COVER LETTER

Population Research Systems

A Member of the FSC Group

May 2004

«fscid»:

Dear «q8»,

Thank you for agreeing to participate in the Central States Regional Air Planning Association (CENRAP) Pleasure Craft Study. CENRAP is an organization of states, tribes, federal agencies, and other interested parties that studies and addresses air pollution, regional haze and visibility issues. Through your participation, you will help CENRAP learn about factors that affect air quality in your state.

Please complete the enclosed questionnaire about your boat and your boating activities. We have provided a pre-paid business reply envelope to make it simple for you to send back the completed questionnaire. It should only take a few minutes of your time. In appreciation, we are including a safety whistle with floating lanyard for your watercraft keys.

The Central States Regional Air Planning Association has contracted with Population Research Systems (PRS), a research company, to collect this information. Please be assured that your responses and personal information will be kept confidential and will not be used for any purpose other than this study. PRS will combine your responses with hundreds of others and will report only group results, and only to the study sponsors.

If you have any questions about the study, please call Dr. Katrin Ewald of PRS, toll-free at (800) 777-0737. If you are interested in learning more about CENRAP, please visit their website at http://www.cenrap.org.

Thank you once again for participating in this important research.

Sincerely,

Katrin Ewald, Ph.D.
Director

Enclosures:
Waterways Maps

APPENDIX D

WATERWAY MAPS

Nebraska Waterways

Nebraska Counties

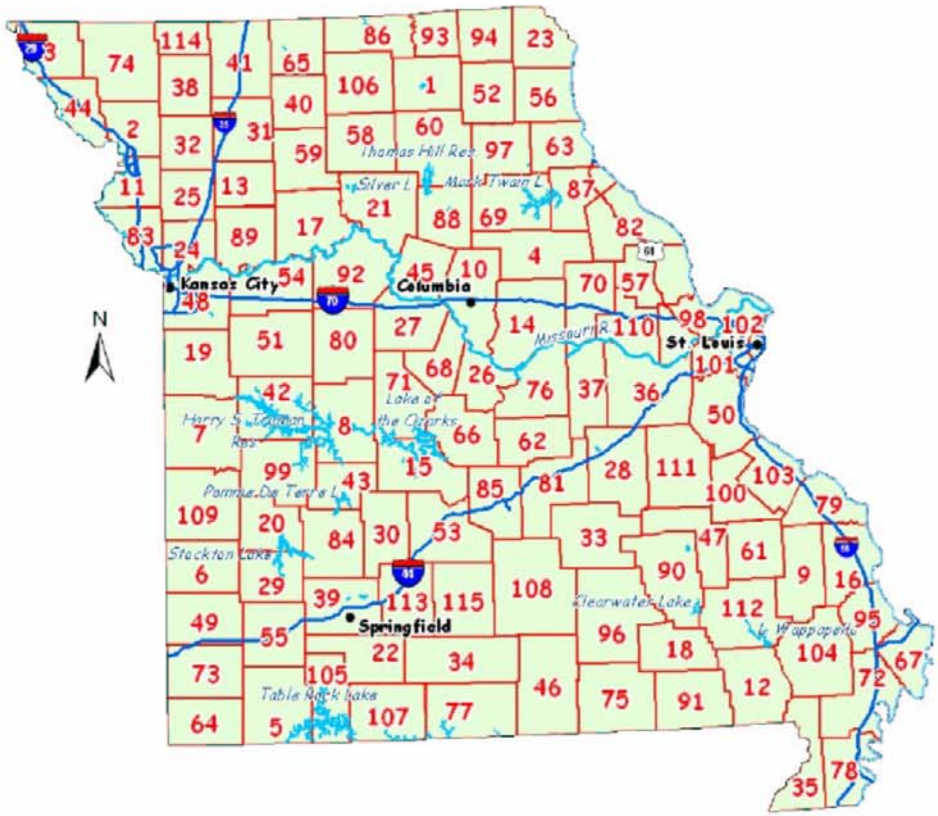
Number	County Name	Number	County Name	Number	County Name
1	Adams	32	Frontier	63	Nance
2	Antelope	33	Furnas	64	Nemaha
3	Arthur	34	Gage	65	Nuckolls
4	Banner	35	Garden	66	Otoe
5	Blaine	36	Garfield	67	Pawnee
6	Boone	37	Gosper	68	Perkins
7	Box Butte	38	Grant	69	Phelps
8	Boyd	39	Greeley	70	Pierce
9	Brown	40	Hall	71	Platte
10	Buffalo	41	Hamilton	72	Polk
11	Burt	42	Harlan	73	Red Willow
12	Butler	43	Hayes	74	Richardson
13	Cass	44	Hitchcock	75	Rock
14	Cedar	45	Holt	76	Saline
15	Chase	46	Hooker	77	Sarpy
16	Cherry	47	Howard	78	Saunders
17	Cheyenne	48	Jefferson	79	Scotts Bluff
18	Clay	49	Johnson	80	Seward
19	Colfax	50	Kearney	81	Sheridan
20	Cuming	51	Keith	82	Sherman
21	Custer	52	Keya Paha	83	Sioux
22	Dakota	53	Kimball	84	Stanton
23	Dawes	54	Knox	85	Thayer
24	Dawson	55	Lancaster	86	Thomas
25	Deuel	56	Lincoln	87	Thurston
26	Dixon	57	Logan	88	Valley
27	Dodge	58	Loup	89	Washington
28	Douglas	59	Madison	90	Wayne
29	Dundy	60	McPherson	91	Webster
30	Fillmore	61	Merrick	92	Wheeler
31	Franklin	62	Morrill	93	York

Oklahoma Waterways

Oklahoma Counties

Number	County Name	Number	County Name	Number	County Name
1	Adair	27	Grant	53	Nowata
2	Alfalfa	28	Greer	54	Okfuskee
3	Atoka	29	Harmon	55	Oklahoma
4	Beaver	30	Harper	56	Okmulgee
5	Beckham	31	Haskell	57	Osage
6	Blaine	32	Hughes	58	Ottawa
7	Bryan	33	Jackson	59	Pawnee
8	Caddo	34	Jefferson	60	Payne
9	Canadian	35	Johnston	61	Pittsburg
10	Carter	36	Kay	62	Pontotoc
11	Cherokee	37	Kingfisher	63	Pottawatomie
12	Choctaw	38	Kiowa	64	Pushmataha
13	Cimarron	39	Latimer	65	Roger Mills
14	Cleveland	40	Le Flore	66	Rogers
15	Coal	41	Lincoln	67	Seminole
16	Comanche	42	Logan	68	Sequoyah
17	Cotton	43	Love	69	Stephens
18	Craig	44	Major	70	Texas
19	Creek	45	Marshall	71	Tillman
20	Custer	46	Mayes	72	Tulsa
21	Delaware	47	McClain	73	Wagoner
22	Dewey	48	McCurtain	74	Washington
23	Ellis	49	McIntosh	75	Washita
24	Garfield	50	Murray	76	Woods
25	Garvin	51	Muskogee	77	Woodward
26	Grady	52	Noble		

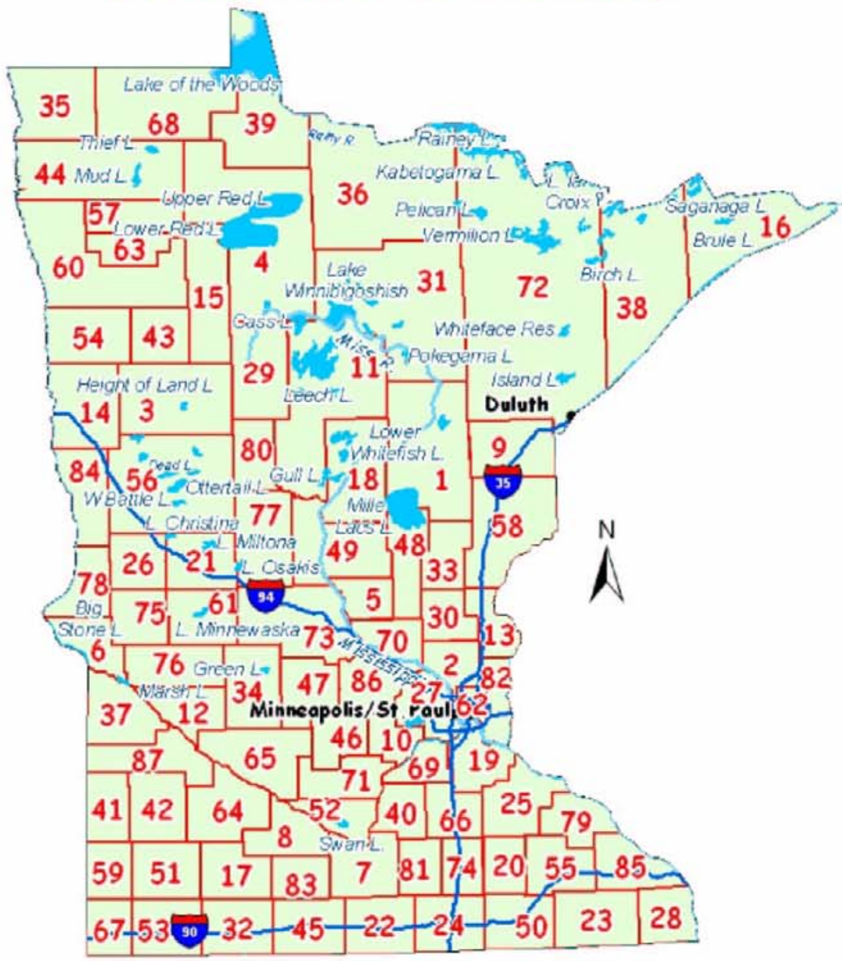
Missouri Waterways



Missouri Counties

Number	County Name	Number	County Name	Number	County Name	Number	County Name
1	Adair	30	Dallas	59	Livingston	88	Randolph
2	Andrew	31	Daviess	60	Macon	89	Ray
3	Atchison	32	DeKalb	61	Madison	90	Reynolds
4	Audrain	33	Dent	62	Maries	91	Ripley
5	Barry	34	Douglas	63	Marion	92	Saline
6	Barton	35	Dunklin	64	McDonald	93	Schuyler
7	Bates	36	Franklin	65	Mercer	94	Scotland
8	Benton	37	Gasconade	66	Miller	95	Scott
9	Bollinger	38	Gentry	67	Mississippi	96	Shannon
10	Boone	39	Greene	68	Moniteau	97	Shelby
11	Buchanan	40	Grundy	69	Monroe	98	St. Charles
12	Butler	41	Harrison	70	Montgomery	99	St. Clair
13	Caldwell	42	Henry	71	Morgan	100	St. Francois
14	Callaway	43	Hickory	72	New Madrid	101	St. Louis
15	Camden	44	Holt	73	Newton	102	St. Louis City
16	Cape Girardeau	45	Howard	74	Nodaway	103	Ste. Genevieve
17	Carroll	46	Howell	75	Oregon	104	Stoddard
18	Carter	47	Iron	76	Osage	105	Stone
19	Cass	48	Jackson	77	Ozark	106	Sullivan
20	Cedar	49	Jasper	78	Pemiscot	107	Taney
21	Chariton	50	Jefferson	79	Perry	108	Texas
22	Christian	51	Johnson	80	Pettis	109	Vernon
23	Clark	52	Knox	81	Phelps	110	Warren
24	Clay	53	Laclede	82	Pike	111	Washington
25	Clinton	54	Lafayette	83	Platte	112	Wayne
26	Cole	55	Lawrence	84	Polk	113	Webster
27	Cooper	56	Lewis	85	Pulaski	114	Worth
28	Crawford	57	Lincoln	86	Putnam	115	Wright
29	Dade	58	Linn	87	Ralls		

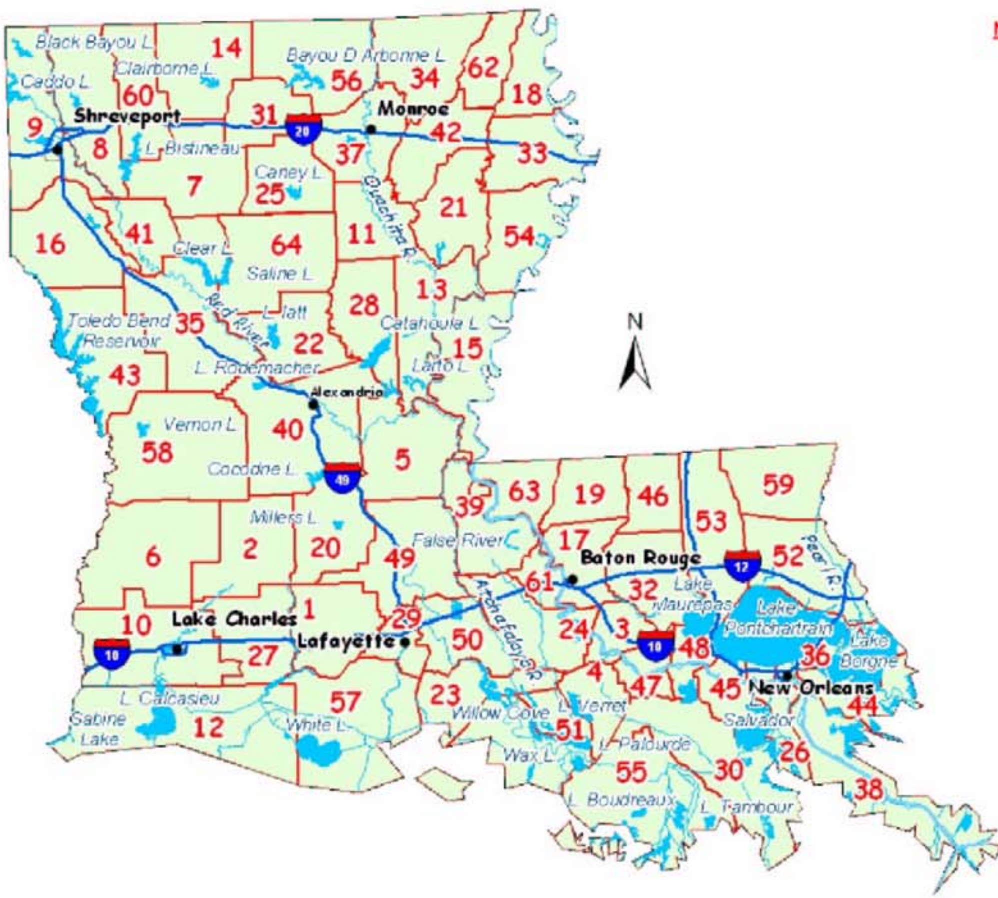
Minnesota Waterways



Minnesota Counties

Number	County Name	Number	County Name	Number	County Name
1	Aitkin	30	Isanti	59	Pipestone
2	Anoka	31	Itasca	60	Polk
3	Becker	32	Jackson	61	Pope
4	Beltrami	33	Kanabec	62	Ramsey
5	Benton	34	Kandiyohi	63	Red Lake
6	Big Stone	35	Kittson	64	Redwood
7	Blue Earth	36	Koochiching	65	Renville
8	Brown	37	Lac Qui Parle	66	Rice
9	Carlton	38	Lake	67	Rock
10	Carver	39	Lake of the Woods	68	Roseau
11	Cass	40	Le Sueur	69	Scott
12	Chippewa	41	Lincoln	70	Sherburne
13	Chisago	42	Lyon	71	Sibley
14	Clay	43	Mahnomen	72	St. Louis
15	Clearwater	44	Marshall	73	Stearns
16	Cook	45	Martin	74	Steele
17	Cottonwood	46	McLeod	75	Stevens
18	Crow Wing	47	Meeker	76	Swift
19	Dakota	48	Mille Lacs	77	Todd
20	Dodge	49	Morrison	78	Traverse
21	Douglas	50	Mower	79	Wabasha
22	Faribault	51	Murray	80	Wadena
23	Fillmore	52	Nicollet	81	Waseca
24	Freeborn	53	Nobles	82	Washington
25	Goodhue	54	Norman	83	Watonwan
26	Grant	55	Olmsted	84	Wilkin
27	Hennepin	56	Otter Tail	85	Winona
28	Houston	57	Pennington	86	Wright
29	Hubbard	58	Pine	87	Yellow Medicine

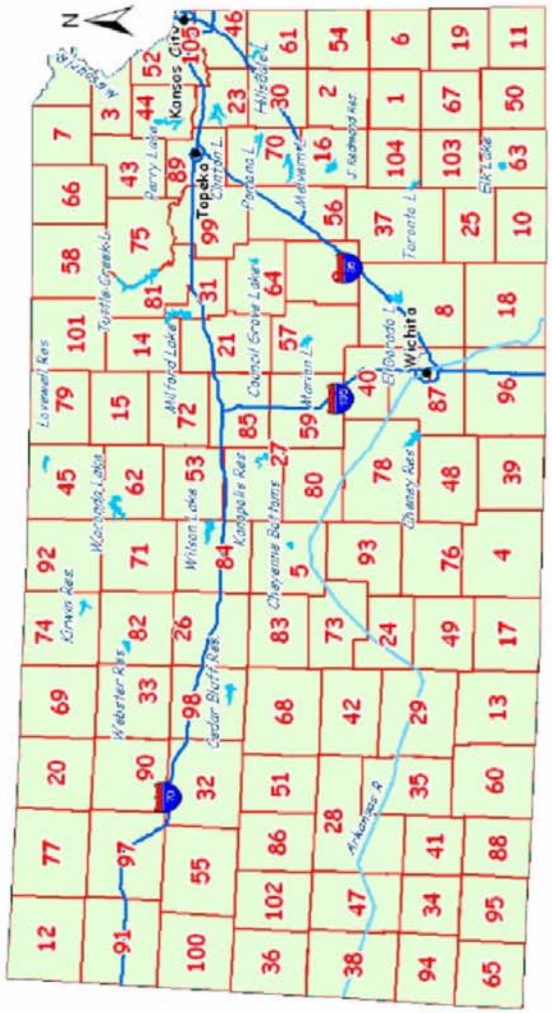
Louisiana Waterways



Louisiana Parishes

Number	County Name	Number	County Name	Number	County Name
1	Acadia	22	Grant	43	Sabine
2	Allen	23	Iberia	44	St. Bernard
3	Ascension	24	Iberville	45	St. Charles
4	Assumption	25	Jackson	46	St. Helena
5	Avoyelles	26	Jefferson	47	St. James
6	Beauregard	27	Jefferson Davis	48	St. John the Baptist
7	Bienville	28	La Salle	49	St. Landry
8	Bossier	29	Lafayette	50	St. Martin
9	Caddo	30	LaFourche	51	St. Mary
10	Calcasieu	31	Lincoln	52	St. Tammany
11	Caldwell	32	Livingston	53	Tangipahoa
12	Cameron	33	Madison	54	Tensas
13	Catahoula	34	Morehouse	55	Terrebonne
14	Claiborne	35	Natchitoches	56	Union
15	Concordia	36	Orleans	57	Vermilion
16	De Soto	37	Ouachita	58	Vernon
17	East Baton Rouge	38	Plaquemines	59	Washington
18	East Carroll	39	Pointe Coupee	60	Webster
19	East Feliciana	40	Rapides	61	West Baton Rouge
20	Evangeline	41	Red River	62	West Carroll
21	Franklin	42	Richland	63	West Feliciana
				64	Winn

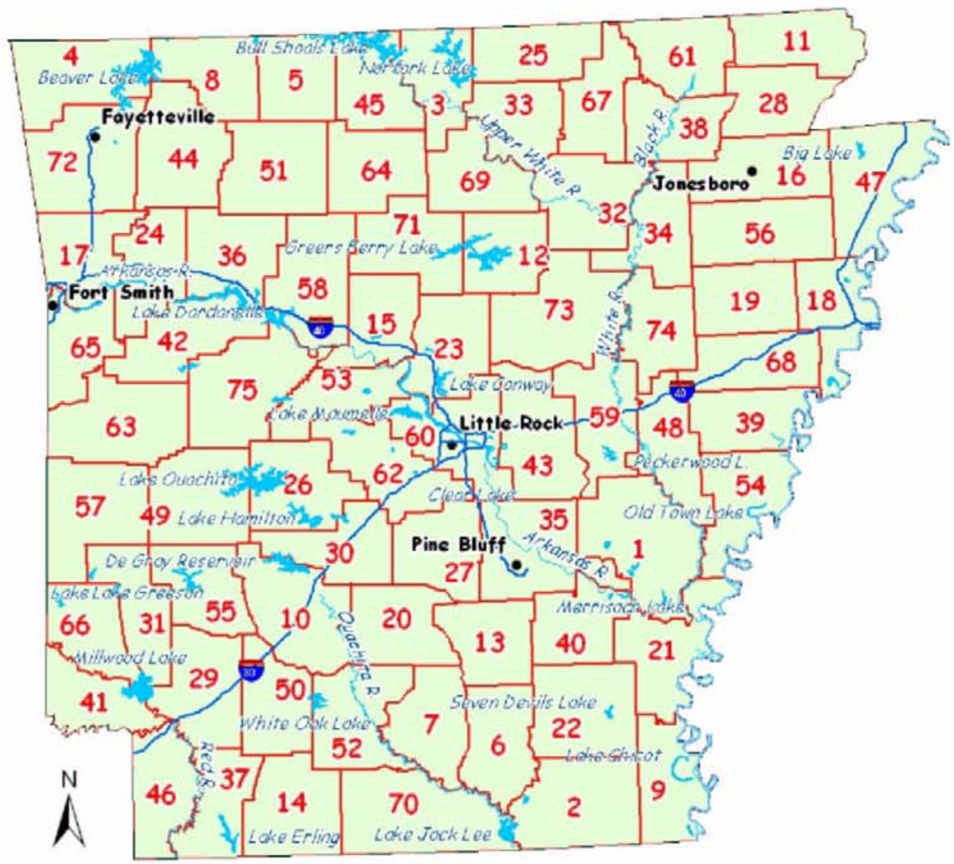
Kansas Waterways



Kansas Counties

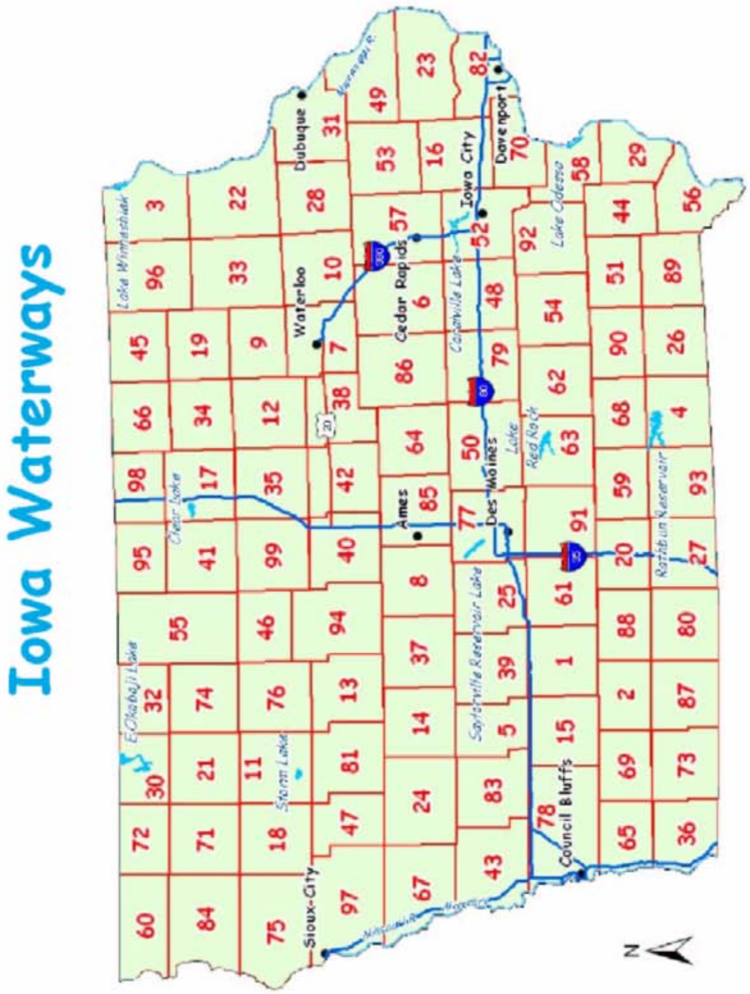
Number	County Name	Number	County Name	Number	County Name	Number	County Name
1	Allen	27	Ellsworth	53	Lincoln	79	Republic
2	Anderson	28	Finney	54	Linn	80	Rice
3	Atchison	29	Ford	55	Logan	81	Riley
4	Barber	30	Franklin	56	Lyon	82	Rooks
5	Barton	31	Geary	57	Marion	83	Rush
6	Bourbon	32	Gove	58	Marshall	84	Russell
7	Brown	33	Graham	59	McPherson	85	Saline
8	Butler	34	Grant	60	Meade	86	Scott
9	Chase	35	Gray	61	Miami	87	Sedgwick
10	Chautauqua	36	Greeley	62	Mitchell	88	Seward
11	Cherokee	37	Greenwood	63	Montgomery	89	Shawnee
12	Cheyenne	38	Hamilton	64	Morris	90	Sheridan
13	Clark	39	Harper	65	Morton	91	Sherman
14	Clay	40	Harvey	66	Nemaha	92	Smith
15	Cloud	41	Haskell	67	Neosho	93	Stafford
16	Coffey	42	Hodgeman	68	Ness	94	Stanton
17	Comanche	43	Jackson	69	Norton	95	Stevens
18	Cowley	44	Jefferson	70	Osage	96	Sumner
19	Crawford	45	Jewell	71	Osborne	97	Thomas
20	Decatur	46	Johnson	72	Ottawa	98	Trego
21	Dickinson	47	Kearny	73	Pawnee	99	Wabaunsee
22	Doniphan	48	Kingman	74	Phillips	100	Wallace
23	Douglas	49	Kiowa	75	Pottawatomie	101	Washington
24	Edwards	50	Labette	76	Pratt	102	Wichita
25	Elk	51	Lane	77	Rawlins	103	Wilson
26	Ellis	52	Leavenworth	78	Reno	104	Woodson
						105	Wyandotte

Arkansas Waterways



Arkansas Counties

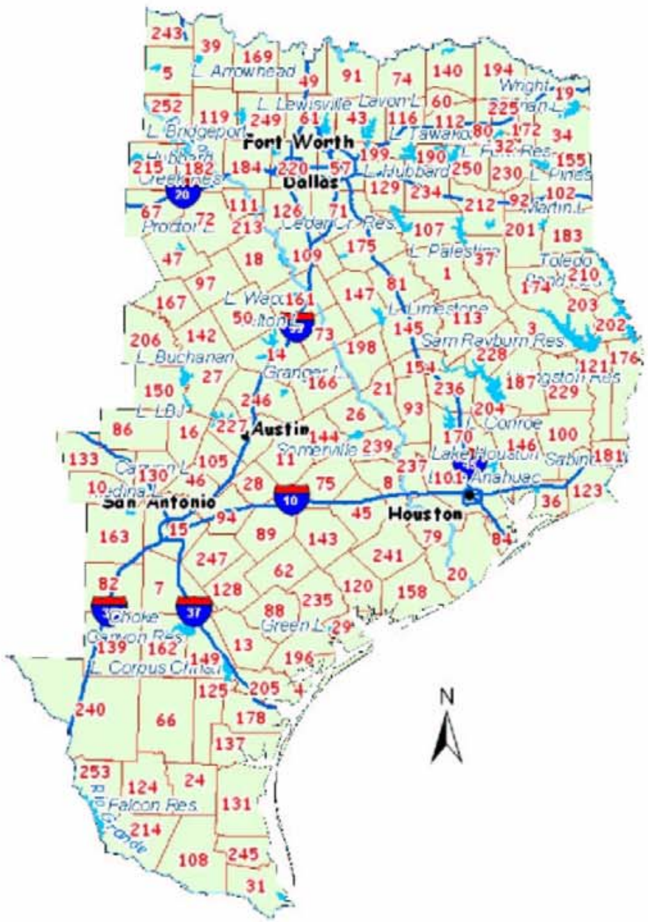
Number	County Name	Number	County Name	Number	County Name
1	Arkansas	26	Garland	51	Newton
2	Ashley	27	Grant	52	Ouachita
3	Baxter	28	Greene	53	Perry
4	Benton	29	Hempstead	54	Phillips
5	Boone	30	Hot Spring	55	Pike
6	Bradley	31	Howard	56	Poinsett
7	Calhoun	32	Independence	57	Polk
8	Carroll	33	Izard	58	Pope
9	Chicot	34	Jackson	59	Prairie
10	Clark	35	Jefferson	60	Pulaski
11	Clay	36	Johnson	61	Randolph
12	Cleburne	37	Lafayette	62	Saline
13	Cleveland	38	Lawrence	63	Scott
14	Columbia	39	Lee	64	Searcy
15	Conway	40	Lincoln	65	Sebastian
16	Craighead	41	Little River	66	Sevier
17	Crawford	42	Logan	67	Sharp
18	Crittenden	43	Lonoke	68	St. Francis
19	Cross	44	Madison	69	Stone
20	Dallas	45	Marion	70	Union
21	Desha	46	Miller	71	Van Buren
22	Drew	47	Mississippi	72	Washington
23	Faulkner	48	Monroe	73	White
24	Franklin	49	Montgomery	74	Woodruff
25	Fulton	50	Nevada	75	Yell



Iowa Counties

Number	County Name	Number	County Name	Number	County Name	Number	County Name
1	Adair	26	Davis	51	Jefferson	76	Pocahontas
2	Adams	27	Decatur	52	Johnson	77	Polk
3	Allamakee	28	Delaware	53	Jones	78	Pottawattamie
4	Appanoose	29	Des Moines	54	Keokuk	79	Poweshiek
5	Audubon	30	Dickinson	55	Kossuth	80	Ringgold
6	Benton	31	Dubuque	56	Lee	81	Sac
7	Black Hawk	32	Emmet	57	Linn	82	Scott
8	Boone	33	Fayette	58	Louisa	83	Shelby
9	Bremer	34	Floyd	59	Lucas	84	Sioux
10	Buchanan	35	Franklin	60	Lyon	85	Story
11	Buena Vista	36	Fremont	61	Madison	86	Tama
12	Butler	37	Greene	62	Mahaska	87	Taylor
13	Calhoun	38	Grundy	63	Marion	88	Union
14	Carroll	39	Guthrie	64	Marshall	89	Van Buren
15	Cass	40	Hamilton	65	Mills	90	Wapello
16	Cedar	41	Hancock	66	Mitchell	91	Warren
17	Cerro Gordo	42	Hardin	67	Monona	92	Washington
18	Cherokee	43	Harrison	68	Monroe	93	Wayne
19	Chickasaw	44	Henry	69	Montgomery	94	Webster
20	Clarke	45	Howard	70	Muscatine	95	Winnebago
21	Clay	46	Humboldt	71	O'Brien	96	Winneshiek
22	Clayton	47	Ida	72	Osceola	97	Woodbury
23	Clinton	48	Iowa	73	Page	98	Worth
24	Crawford	49	Jackson	74	Palo Alto	99	Wright
25	Dallas	50	Jasper	75	Plymouth		

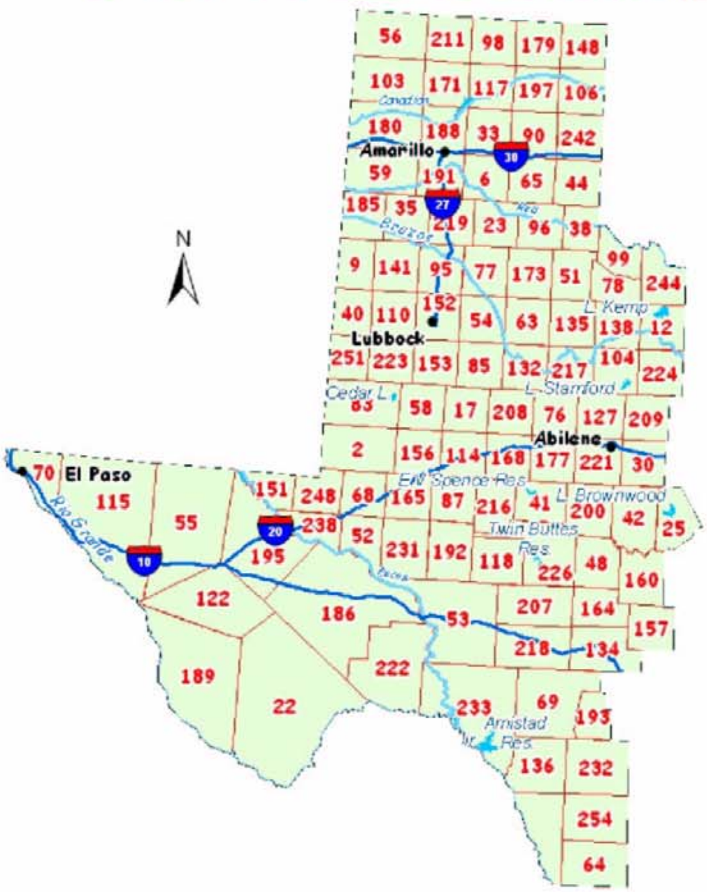
East Texas Waterways



East Texas Counties

Number	County Name	Number	County Name	Number	County Name	Number	County Name	Number	County Name
1	Anderson	47	Comanche	105	Hays	150	Llano	205	San Patricio
3	Angelina	49	Cooke	107	Henderson	154	Madison	206	San Saba
4	Aransas	50	Coryell	108	Hidalgo	155	Marion	210	Shelby
5	Archer	57	Dallas	109	Hill	158	Matagorda	212	Smith
7	Atascosa	60	Delta	111	Hood	161	McLennan	213	Somervell
8	Austin	61	Denton	112	Hopkins	162	McMullen	214	Starr
10	Bandera	62	DeWitt	113	Houston	163	Medina	215	Stephens
11	Bastrop	66	Duval	116	Hunt	166	Milam	220	Tarrant
13	Bee	67	Eastland	119	Jack	167	Mills	225	Titus
14	Bell	71	Ellis	120	Jackson	169	Montague	227	Travis
15	Bexar	72	Erath	121	Jasper	170	Montgomery	228	Trinity
16	Blanco	73	Falls	123	Jefferson	172	Morris	229	Tyler
18	Bosque	74	Fannin	124	Jim Hogg	174	Nacogdoches	230	Upshur
19	Bowie	75	Fayette	125	Jim Wells	175	Navarro	234	Van Zandt
20	Brazoria	79	Fort Bend	126	Johnson	176	Newton	235	Victoria
21	Brazos	80	Franklin	128	Karnes	178	Nueces	236	Walker
24	Brooks	81	Freestone	129	Kaufman	181	Orange	237	Waller
26	Burleson	82	Frio	130	Kendall	182	Palo Pinto	239	Washington
27	Burnet	84	Galveston	131	Kenedy	183	Panola	240	Webb
28	Caldwell	86	Gillespie	133	Kerr	184	Parker	241	Wharton
29	Calhoun	88	Goliad	137	Kleberg	187	Polk	243	Wichita
31	Cameron	89	Gonzales	139	La Salle	190	Rains	245	Willacy
32	Camp	91	Grayson	140	Lamar	194	Red River	246	Williamson
34	Cass	92	Gregg	142	Lampasas	196	Refugio	247	Wilson
36	Chambers	93	Grimes	143	Lavaca	198	Robertson	249	Wise
37	Cherokee	94	Guadalupe	144	Lee	199	Rockwall	250	Wood
39	Clay	97	Hamilton	145	Leon	201	Rusk	252	Young
43	Collin	100	Hardin	146	Liberty	202	Sabine	253	Zapata
45	Colorado	101	Harris	147	Limestone	203	San Augustine		
46	Comal	102	Harrison	149	Live Oak	204	San Jacinto		

West Texas Waterways



West Texas Counties

Number	County Name	Number	County Name	Number	County Name	Number	County Name
2	Andrews	65	Donley	135	King	195	Reeves
6	Armstrong	68	Ector	136	Kinney	197	Roberts
9	Bailey	69	Edwards	138	Knox	200	Runnels
12	Baylor	70	El Paso	141	Lamb	207	Schleicher
17	Borden	76	Fisher	148	Lipscomb	208	Scurry
22	Brewster	77	Floyd	151	Loving	209	Shackelford
23	Briscoe	78	Foard	152	Lubbock	211	Sherman
25	Brown	83	Gaines	153	Lynn	216	Sterling
30	Callahan	85	Garza	156	Martin	217	Stonewall
33	Carson	87	Glasscock	157	Mason	218	Sutton
35	Castro	90	Gray	159	Maverick	219	Swisher
38	Childress	95	Hale	160	McCulloch	221	Taylor
40	Cochran	96	Hall	164	Menard	222	Terrell
41	Coke	98	Hansford	165	Midland	223	Terry
42	Coleman	99	Hardeman	168	Mitchell	224	Throckmorton
44	Collingsworth	103	Hartley	171	Moore	226	Tom Green
48	Concho	104	Haskell	173	Motley	231	Upton
51	Cottle	106	Hemphill	177	Nolan	232	Uvalde
52	Crane	110	Hockley	179	Ochiltree	233	Val Verde
53	Crockett	114	Howard	180	Oldham	238	Ward
54	Crosby	115	Hudspeth	185	Parmer	242	Wheeler
55	Culberson	117	Hutchinson	186	Pecos	244	Wilbarger
56	Dallam	118	Irion	188	Potter	248	Winkler
58	Dawson	122	Jeff Davis	189	Presidio	251	Yoakum
59	Deaf Smith	127	Jones	191	Randall	254	Zavala
63	Dickens	132	Kent	192	Reagan		
64	Dimmit	134	Kimble	193	Real		

APPENDIX E

DATA FILES (CD-ROM)

APPENDIX B

ANNUAL EMISSIONS BY STATE AND SOURCE CATEGORY FOR THE CENRAP REGION

B-1. Annual emissions (tons) by state and source category for the CENRAP region.

State	Source Category	$PM_{2.5}$	CO	NO_x	SO_2	VOC	NH_3
Arkansas	On-road Mobile						
	Light-Duty	*235*	*502,991*	*27,137*	*1,383*	*29,752*	*1,971*
	Heavy-Duty	*2,076*	*102,247*	*90,833*	*2,163*	*9,786*	*313*
	Total On-road	2,311	605,238	117,970	3,545	39,537	2,284
	Non-road Mobile						
	Locomotives	*624*	*2,759*	*19,831*	*1,690*	*1,099*	*7*
	Commercial Marine	*198*	*1,796*	*9,341*	*895*	*194*	*4*
	Recreational Boats	*1,884*	*100,524*	*2,274*	*103*	*31,309*	*8*
	Other Non-road	*2,415*	*170,860*	*25,852*	*418*	*17,830*	*22*
	Total Non-road	5,121	275,939	57,298	3,107	50,432	41
	Agricultural Dust						
	Animal Feedlots	*1*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*17,579*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	17,580	0	0	0	0	0
	Arkansas Total	25,012	881,177	175,267	6,652	89,969	2,326
Iowa	On-road Mobile						
	Light-Duty	*381*	*973,854*	*53,702*	*2,113*	*67,501*	*2,755*
	Heavy-Duty	*931*	*30,853*	*44,607*	*884*	*2,993*	*107*
	Total On-road	1,312	1,004,707	98,308	2,997	70,494	2,863
	Non-road Mobile						
	Locomotives	*905*	*3,992*	*28,705*	*2,447*	*1,575*	*11*
	Commercial Marine	65	589	3,062	294	64	1
	Recreational Boats	*1,626*	*88,079*	*2,066*	*92*	*26,310*	*7*
	Other Non-road	*6,607*	*326,950*	*63,725*	*1,062*	*33,506*	*38*
	Total Non-road	9,203	419,610	97,558	3,895	61,455	57
	Agricultural Dust						
	Animal Feedlots	*653*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*47,304*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	47,957	0	0	0	0	0
	Iowa Total	58,472	1,424,317	195,866	6,891	131,949	2,920

B-1. Annual emissions (tons) by state and source category for the CENRAP region.

State	Source Category	$PM_{2.5}$	CO	NO_x	SO_2	VOC	NH_3
Kansas	On-road Mobile						
	Light-Duty	*345*	*930,039*	*47,210*	*1,938*	*61,867*	*2,528*
	Heavy-Duty	*855*	*29,686*	*35,520*	*758*	*2,979*	*98*
	Total On-road	1,200	959,725	82,730	2,696	64,846	2,626
	Non-road Mobile						
	Locomotives	*1,164*	*5,147*	*37,022*	*3,157*	*2,035*	*15*
	Commercial Marine	*1*	*6*	*32*	*3*	*1*	*0*
	Recreational Boats	*345*	*21,962*	*660*	*24*	*6,515*	*2*
	Other Non-road	*4,665*	*244,673*	*47,382*	*716*	*19,381*	*98*
	Total Non-road	6,175	271,788	85,096	3,900	27,931	115
	Agricultural Dust						
	Animal Feedlots	*2,778*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*50,769*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	53,547	0	0	0	0	0
	Kansas Total	60,923	1,231,513	167,825	6,595	92,777	2,740
Louisiana	On-road Mobile						
	Light-Duty	*416*	*824,585*	*45,929*	*2,396*	*57,283*	*3,485*
	Heavy-Duty	*2,272*	*74,770*	*105,449*	*2,257*	*7,361*	*263*
	Total On-road	2,689	899,355	151,378	4,653	64,643	3,748
	Non-road Mobile						
	Locomotives	*370*	*1,638*	*11,787*	*1,003*	*658*	*4*
	Commercial Marine	*1,914*	*9,631*	*69,345*	*12,450*	*1,739*	*14*
	Recreational Boats	*4,895*	*259,196*	*5,746*	*267*	*80,803*	*21*
	Other Non-road	*2,579*	*275,361*	*29,650*	*536*	*26,173*	*525*
	Total Non-road	9,757	545,825	116,528	14,256	109,373	563
	Agricultural Dust						
	Animal Feedlots	*2*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*8,489*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	8,491	0	0	0	0	0
	Louisiana Total	20,936	1,445,180	267,906	18,908	174,016	4,311

B-1. Annual emissions (tons) by state and source category for the CENRAP region.

State	Source Category	$PM_{2.5}$	CO	NO_x	SO_2	VOC	NH_3
Minnesota	On-road Mobile						
	Light-Duty	*595*	*1,285,076*	*73,656*	*1,274*	*75,663*	*4,771*
	Heavy-Duty	*1,577*	*43,160*	*65,290*	*1,314*	*5,255*	*182*
	Total On-road	2,172	1,328,236	138,946	2,588	80,918	4,954
	Non-road Mobile						
	Locomotives	*693*	*3,053*	*21,947*	*1,873*	*1,179*	*9*
	Commercial Marine	*116*	*703*	*4,355*	*714*	*122*	*2*
	Recreational Boats	*5,886*	*319,514*	*7,659*	*142*	*95,409*	*26*
	Other Non-road	*7,979*	*640,351*	*65,365*	*1,052*	*116,847*	*59*
	Total Non-road	14,673	963,621	99,327	3,781	213,557	96
	Agricultural Dust						
	Animal Feedlots	*43*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*43,013*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	43,056	0	0	0	0	0
	Minnesota Total	59,901	2,291,857	238,272	6,369	294,474	5,049
Missouri	On-road Mobile						
	Light-Duty	*680*	*1,375,126*	*77,916*	*3,120*	*76,004*	*5,356*
	Heavy-Duty	*1,841*	*52,065*	*79,607*	*1,787*	*5,491*	*209*
	Total On-road	2,521	1,427,190	157,523	4,907	81,495	5,565
	Non-road Mobile						
	Locomotives	*953*	*4,215*	*30,308*	*2,582*	*1,658*	*12*
	Commercial Marine	*247*	*2,057*	*11,937*	*1,177*	*329*	*5*
	Recreational Boats	*5,943*	*303,079*	*6,251*	*308*	*92,318*	*24*
	Other Non-road	*4,895*	*466,845*	*51,328*	*909*	*35,664*	*33*
	Total Non-road	12,038	776,195	99,823	4,976	129,969	74
	Agricultural Dust						
	Animal Feedlots	*18*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*20,905*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	20,923	0	0	0	0	0
	Missouri Total	35,481	2,203,386	257,347	9,883	211,464	5,639

B-1. Annual emissions (tons) by state and source category for the CENRAP region.

State	Source Category	$PM_{2.5}$	CO	NO_x	SO_2	VOC	NH_3
Nebraska	On-road Mobile						
	Light-Duty	*246*	*581,402*	*30,649*	*1,229*	*38,788*	*1,581*
	Heavy-Duty	*624*	*18,626*	*25,037*	*589*	*2,115*	*71*
	Total On-road	870	600,028	55,685	1,819	40,902	1,652
	Non-road Mobile						
	Locomotives	*2,617*	*11,559*	*83,121*	*7,085*	*4,543*	*34*
	Commercial Marine	*1*	*6*	*31*	*3*	*1*	*0*
	Recreational Boats	*479*	*26,282*	*648*	*28*	*7,971*	*2*
	Other Non-road	*3,644*	*161,977*	*35,556*	*582*	*13,650*	*23*
	Total Non-road	6,740	199,824	119,355	7,697	26,165	59
	Agricultural Dust						
	Animal Feedlots	*1,312*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*27,770*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	29,082	0	0	0	0	0
	Nebraska Total	36,692	799,852	175,041	9,516	67,067	1,711
Oklahoma	On-road Mobile						
	Light-Duty	*509*	*1,194,649*	*64,504*	*2,989*	*81,676*	*3,968*
	Heavy-Duty	*1,331*	*48,382*	*54,812*	*1,265*	*5,062*	*154*
	Total On-road	1,840	1,243,032	119,317	4,253	86,738	4,122
	Non-road Mobile						
	Locomotives	*645*	*2,853*	*20,505*	*1,750*	*1,116*	*8*
	Commercial Marine	*11*	*98*	*509*	*49*	*11*	*0*
	Recreational Boats	*1,708*	*95,314*	*2,330*	*100*	*29,590*	*7*
	Other Non-road	*2,543*	*230,294*	*27,563*	*460*	*18,846*	*265*
	Total Non-road	4,907	328,559	50,906	2,359	49,562	280
	Agricultural Dust						
	Animal Feedlots	*512*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*20,033*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	20,545	0	0	0	0	0
	Oklahoma Total	27,292	1,571,590	170,223	6,612	136,300	4,402

B-1. Annual emissions (tons) by state and source category for the CENRAP region.

State	Source Category	$PM_{2.5}$	CO	NO_x	SO_2	VOC	NH_3
Texas	On-road Mobile						
	Light-Duty	*2,339*	*3,653,523*	*220,819*	*10,555*	*248,680*	*19,365*
	Heavy-Duty	*6,276*	*113,949*	*340,992*	*6,667*	*14,057*	*692*
	Total On-road	8,615	3,767,472	561,811	17,222	262,737	20,057
	Non-road Mobile						
	Locomotives	*2,148*	*9,488*	*68,236*	*5,816*	*3,753*	*26*
	Commercial Marine	*1,212*	*3,495*	*25,310*	*10,092*	*723*	*6*
	Recreational Boats	*5,960*	*334,464*	*8,043*	*350*	*104,461*	*26*
	Other Non-road	*11,241*	*1,440,533*	*131,009*	*2,271*	*106,881*	*1,444*
	Total Non-road	20,561	1,787,980	232,597	18,529	215,819	1,502
	Agricultural Dust						
	Animal Feedlots	*2,374*	*0*	*0*	*0*	*0*	*0*
	Tilling Operations	*33,484*	*0*	*0*	*0*	*0*	*0*
	Total Ag Dust	35,858	0	0	0	0	0
	Texas Total	65,034	5,555,452	794,408	35,750	478,555	21,559
All States	All Sources	389,744	17,404,324	2,442,155	107,177	1,676,572	50,657

APPENDIX C

SUMMARIES OF ACTIVITY DATA AND EMISSIONS MODELING INPUTS PREPARED FOR ON-ROAD EMISISON INVENTORIES:

VEHICLE-MILES OF TRAVEL, FLEET DISTRIBUTIONS, FUELS CHARACTERISTICS, AND REGULATORY CONTROLS

Pages C-3 through C-14 (12 pages) illustrate vehicle-miles of travel (VMT) compiled for each CENRAP state. One- to two-page data summary sheets were prepared for each state. Each data summary sheet includes the following elements of information. (The page position of each element is indicated relative to landscape orientation.)

<u>Element of Information (Page Position)</u>

- Sources of information—i.e., specific state agencies or "default", which indicates EPA guidance defaults (page header)
- CENRAP overview map identifying location of the state of interest (upper left)
- State overview map with interstate freeways (upper center)
- County-specific total annual VMT for 2002 (upper right)
- Distribution of total annual VMT by road type (lower left)
- Distribution of total annual VMT by vehicle type (lower center)
- Average speed by road type (most states: center right; Texas and Louisiana: lower right)
- Weekday diurnal pattern of VMT (most states: lower right; Texas, Louisiana, and St. Louis, Missouri, area: second page of data summary sheet for each state)

Box whisker plots were prepared as follows. The box centerline indicates the median, and the box extents represent the 25^{th} and 75^{th} percentiles with "outliers" plotted above the whiskers.

The whiskers have a maximum length equal to 1.5 times the length of the box (interquartile range). If there are data outside this range, the points are shown on the plot and the whisker ends on the highest or lowest data point within the range of the whisker. The outliers are further identified with asterisks representing the points that fall within 3 times the interquartile range from the end of the box and with squares representing points beyond this range.

Pages C-15 through C-18 (4 pages) illustrate the inputs that were compiled for MOBILE6 and NONROAD 2004 to describe fuel characteristics (such as sulfur content) for areas throughout the CENRAP.

Pages C-19 through C-21 (3 pages) illustrate the inputs that were compiled for MOBILE6 to describe regulatory programs (such as inspection and maintenance, or I/M) for areas throughout the CENRAP.

Pages C-22 through C-24 (3 pages) illustrate the inputs that were compiled for MOBILE6 to describe the IM 240 program of St. Louis, Missouri.

Pages C-25 through C-32 (8 pages) illustrate the MOBILE6 default age distribution of the vehicle fleet (for comparison purposes) and the weighted-average age distribution of the vehicle fleets for each of the CENRAP states. The weighted averages were calculated as the averages of county-level age distributions, weighted by the number of vehicles in each county. Thus, counties with more registered vehicles were weighted proportionally more heavily.

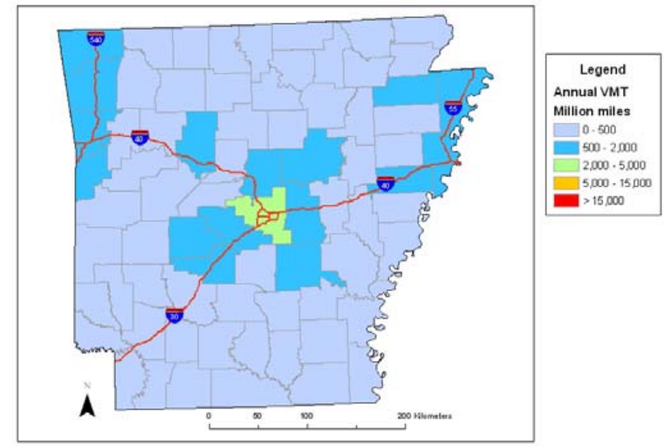
Pages C-33 through C-35 (3 pages) illustrate the fractions of the light-duty vehicle and light-duty truck fleets that are diesel-powered.

Data Summary Sheet: Arkansas

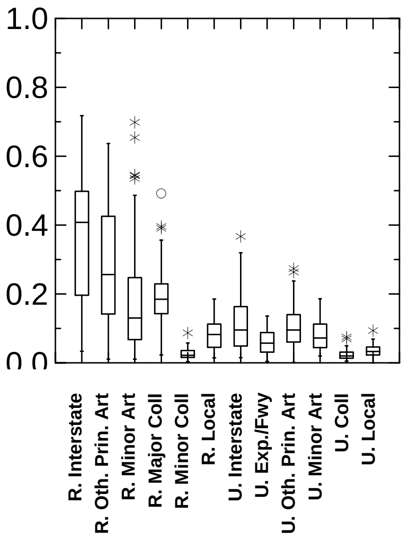
Data Source: [1] Arkansas Dept. of Transportation & Highways

[2] Default Data

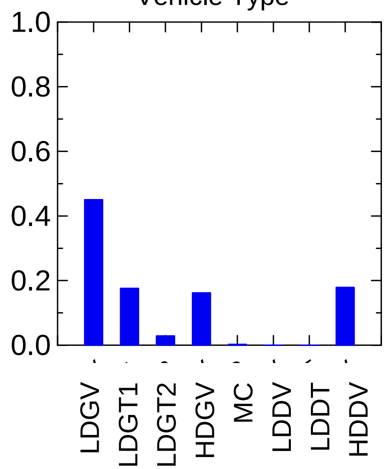
2002 Countywide VMT [1]



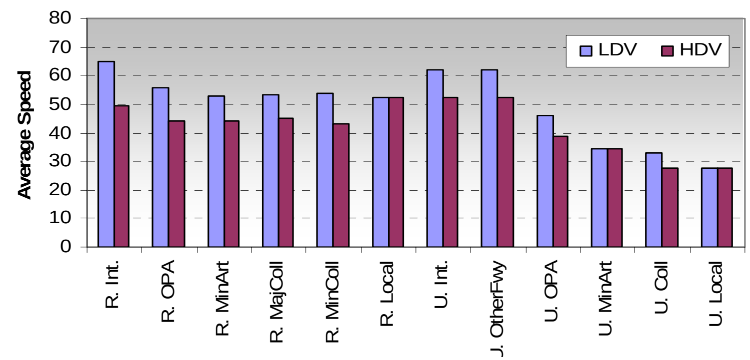
VMT Distribution by Road Type [1]



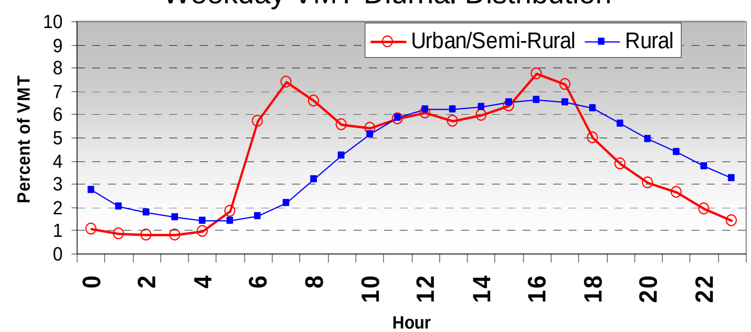
VMT Distribution by Vehicle Type [1]



Average Speed by Road Type [2]



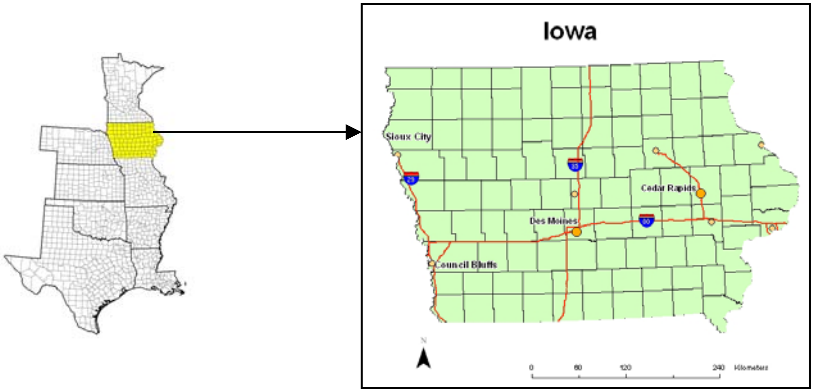
Weekday VMT Diurnal Distribution [2]



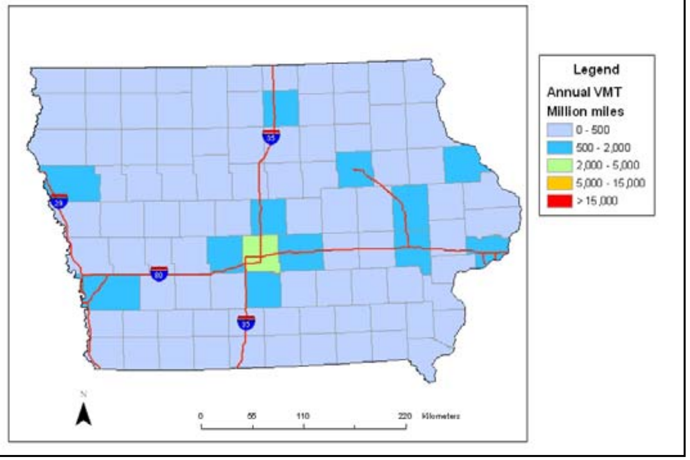
Data Summary Sheet: Iowa

Data Source: [1] **Iowa Dept. of Transportation**

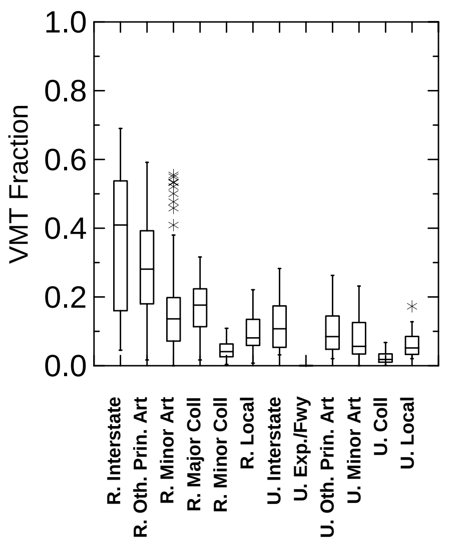
[2] **Default Data**



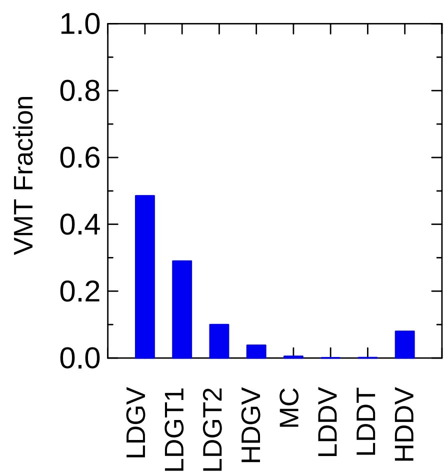
2002 Countywide VMT [1]



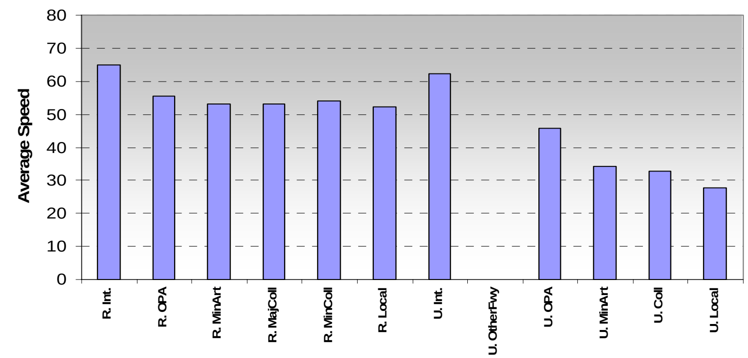
VMT Distribution by Road Type [1]



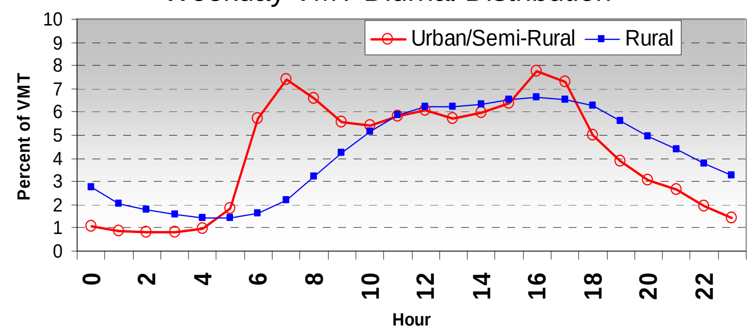
VMT Distribution by Vehicle Type [2]



Average Speed by Road Type [1]



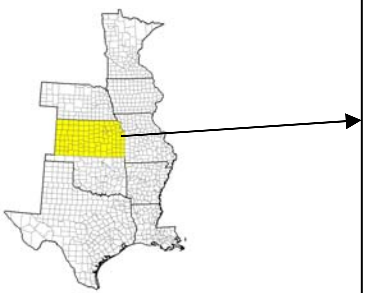
Weekday VMT Diurnal Distribution [2]



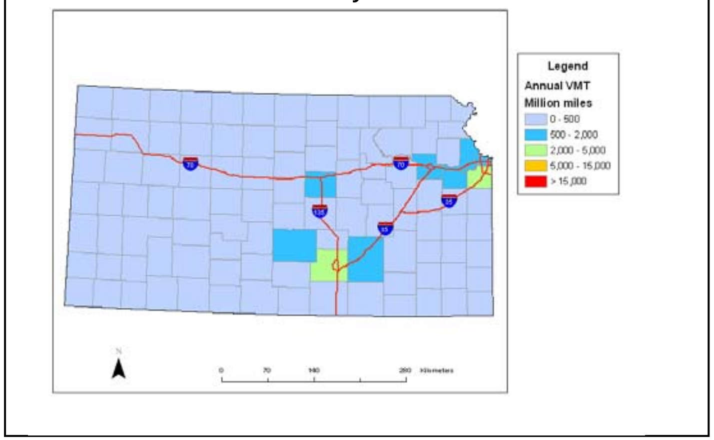
Data Summary Sheet: Kansas

Data Source: [1] **Kansas Highway Dept.**

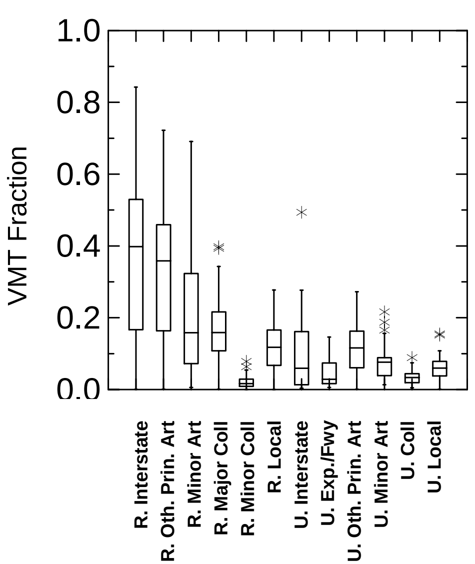
[2] **Default Data**



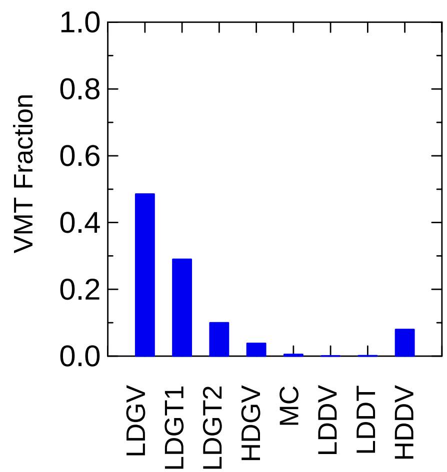
2002 Countywide VMT [1]



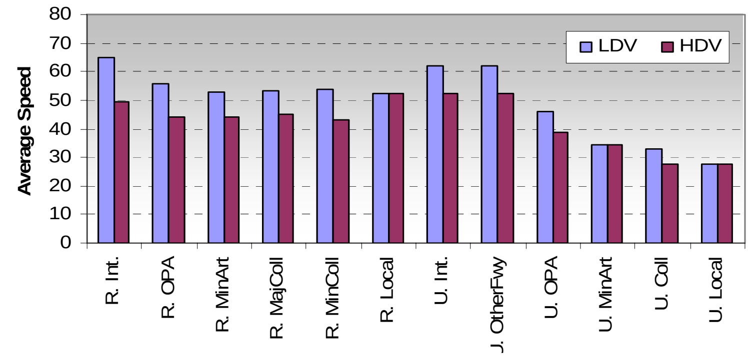
VMT Distribution by Road Type [1]



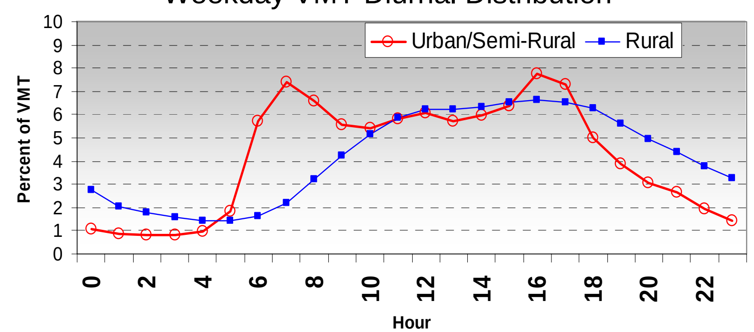
VMT Distribution by Vehicle Type [2]



Average Speed by Road Type [2]



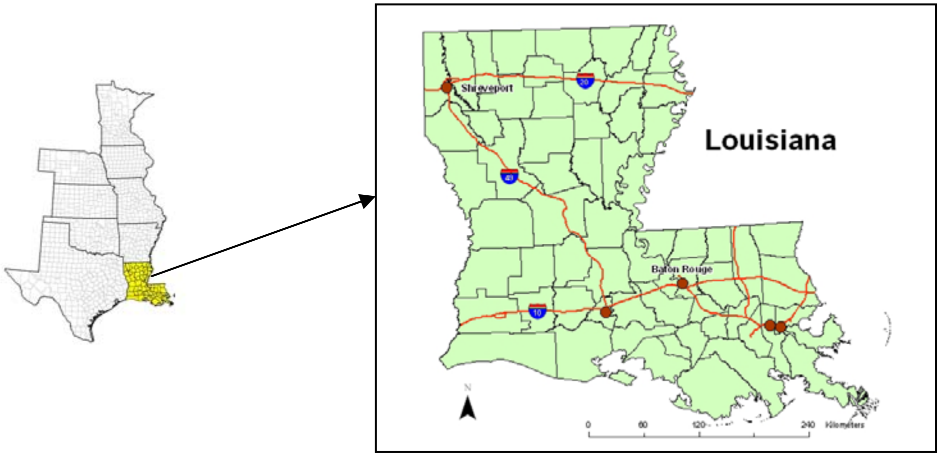
Weekday VMT Diurnal Distribution [2]



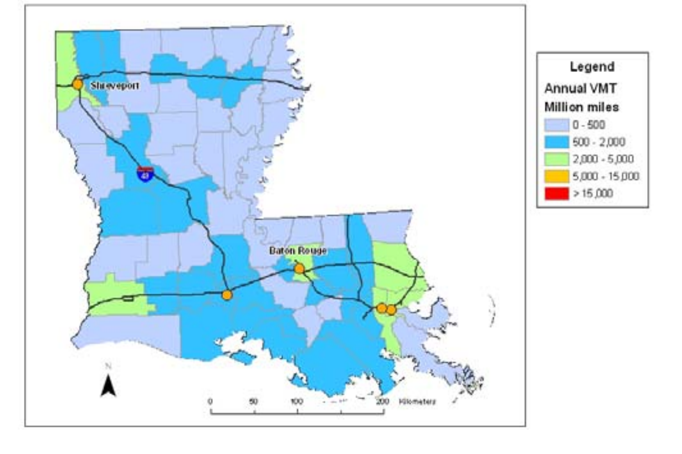
Data Summary Sheet: Louisiana

Data Source: [1] Louisiana Dept. of Environmental Quality

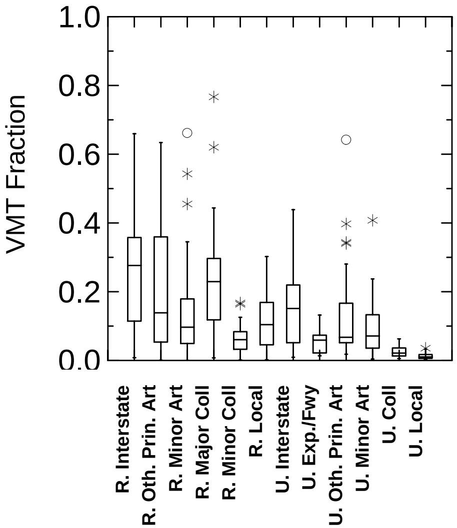
[2] Default Data



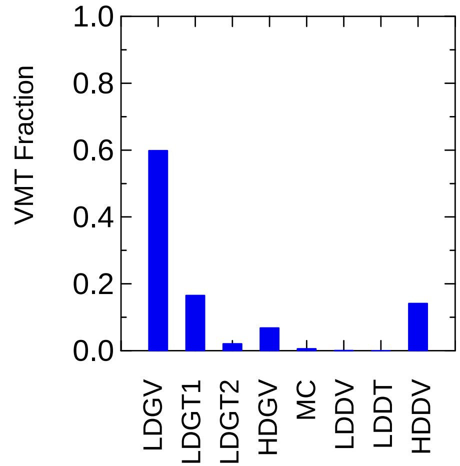
2002 Countywide VMT [1]



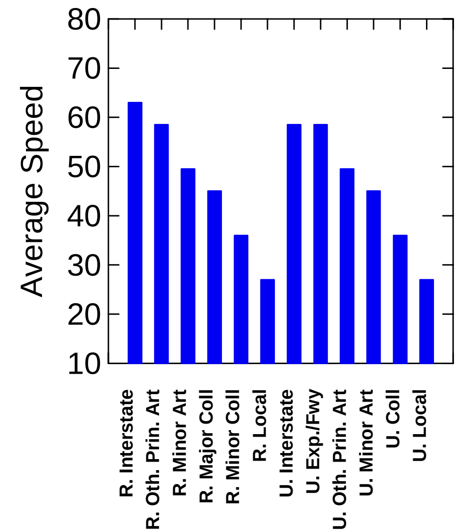
VMT Distribution by Road Type [1]



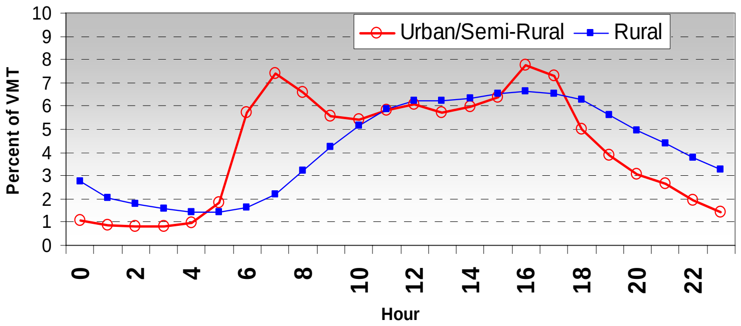
VMT Distribution by Vehicle Type [1]



Average Speed by Road Type [1]



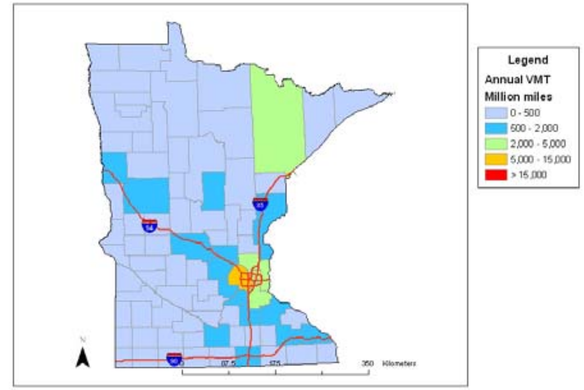
Weekday VMT Diurnal Distribution [2]



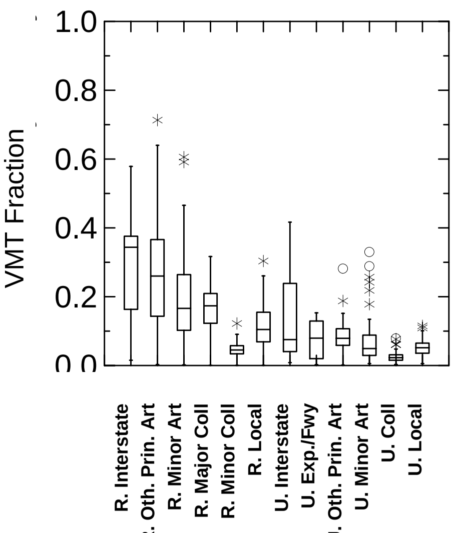
Data Summary Sheet: Minnesota

Data Source: [1] **Minnesota Dept. of Transportation**
[2] **Default Data**

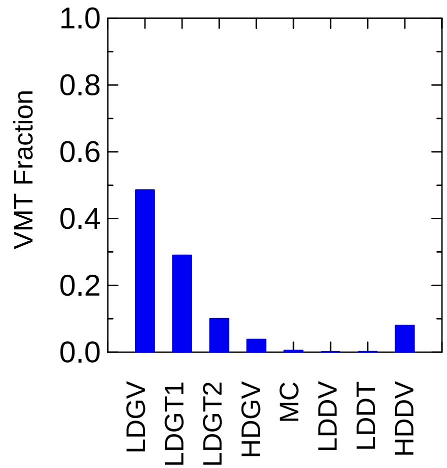
2002 Countywide VMT [1]



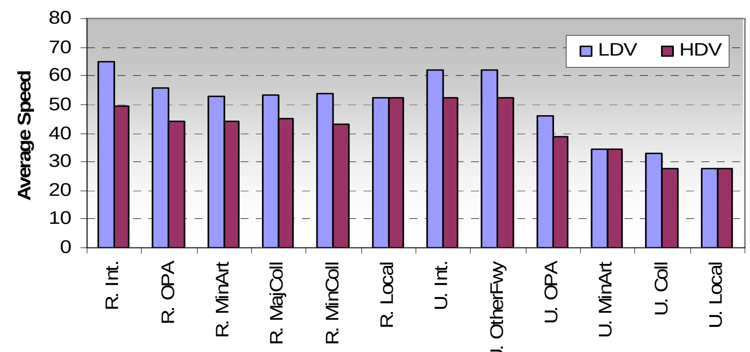
VMT Distribution by Road Type [1]



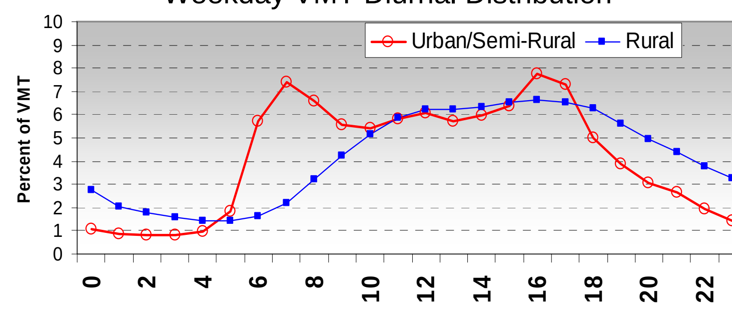
VMT Distribution by Vehicle Type [2]



Average Speed by Road Type [2]

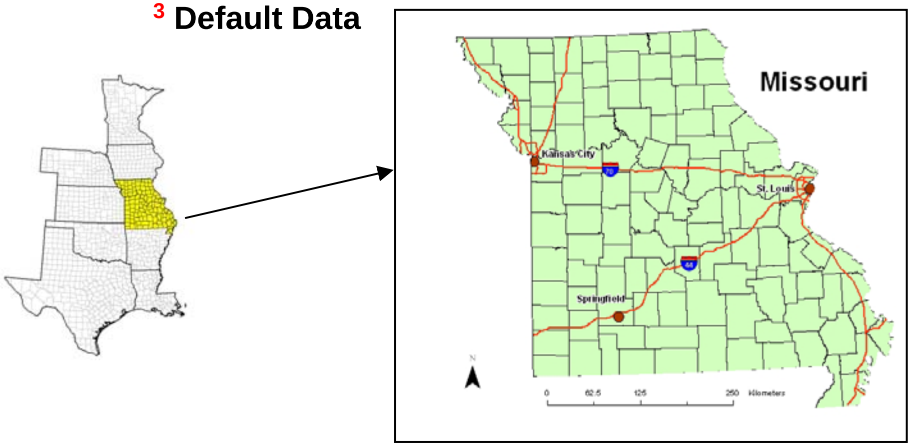


Weekday VMT Diurnal Distribution [2]

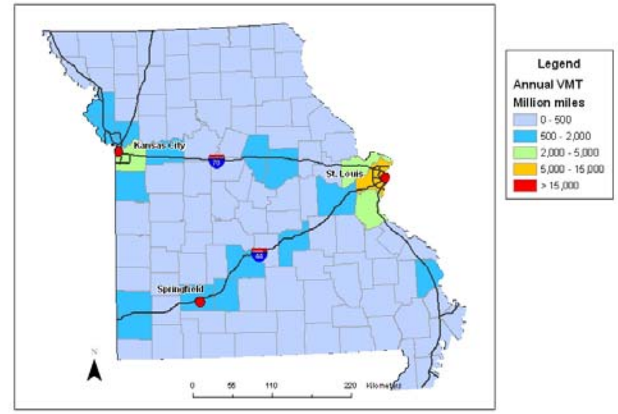


Data Summary Sheet: Missouri

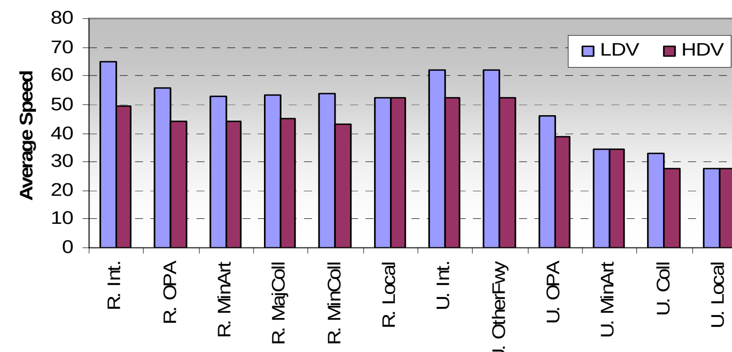
Data Source: [1] **Missouri Dept. of Transportation &**
[2] **East-West Gateway Coordinating Council**
[3] **Default Data**



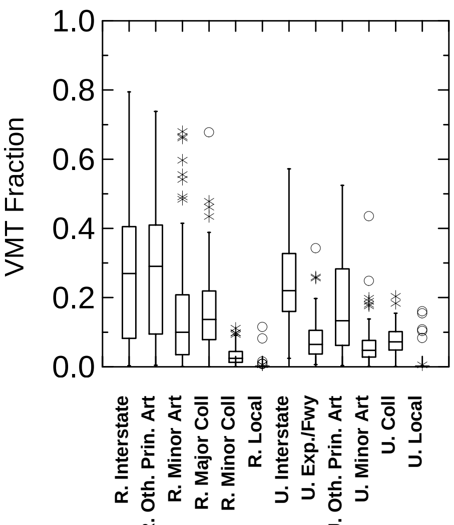
2002 Countywide VMT [1,2]



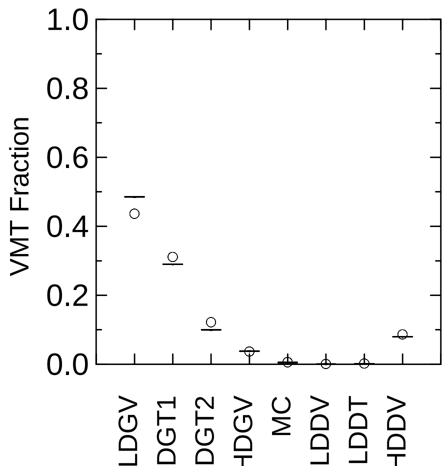
Average Speed by Road Type [3]



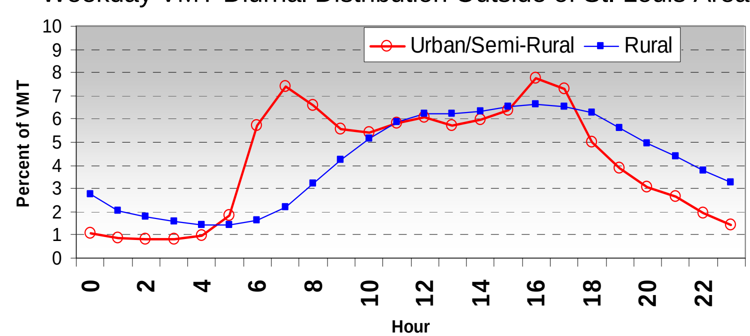
VMT Distribution by Road Type
MoDOT [1] & EWGCC Data [2]



VMT Distribution by Vehicle Type
EWGCC Data [2] & Default Data [3]

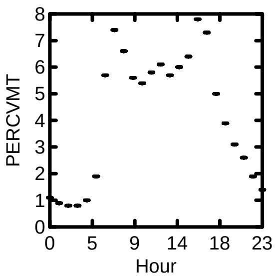


Weekday VMT Diurnal Distribution Outside of St. Louis Area [3]

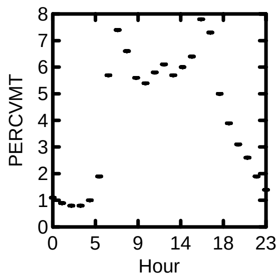


Average of hourly VMT distributions by road type, St. Louis Area**

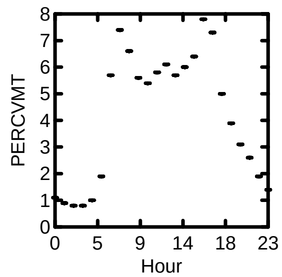
R. Intst



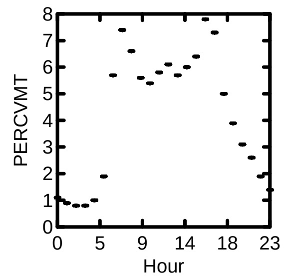
R. OPrArt



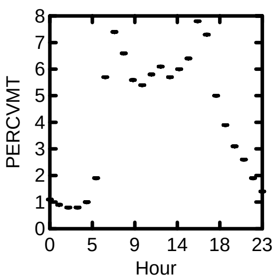
R. MinArt



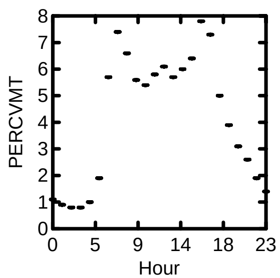
R. MajCol



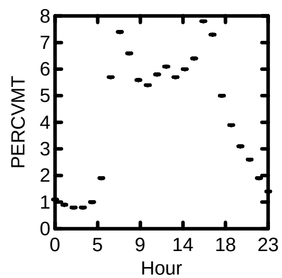
R. MinCol



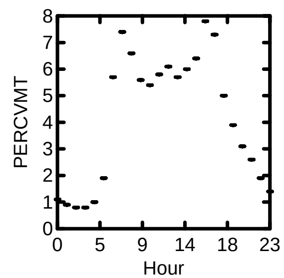
R. Local



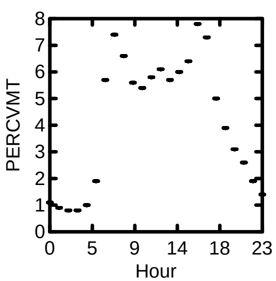
U. Intst



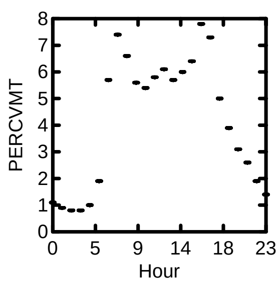
U. ExpFwy



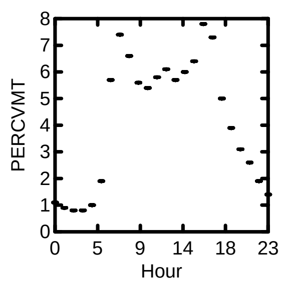
U. OPrArt



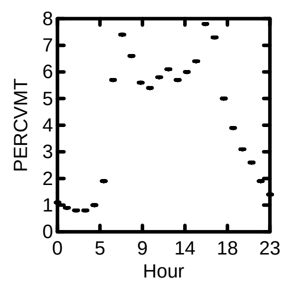
U. MinArt



U. Coll



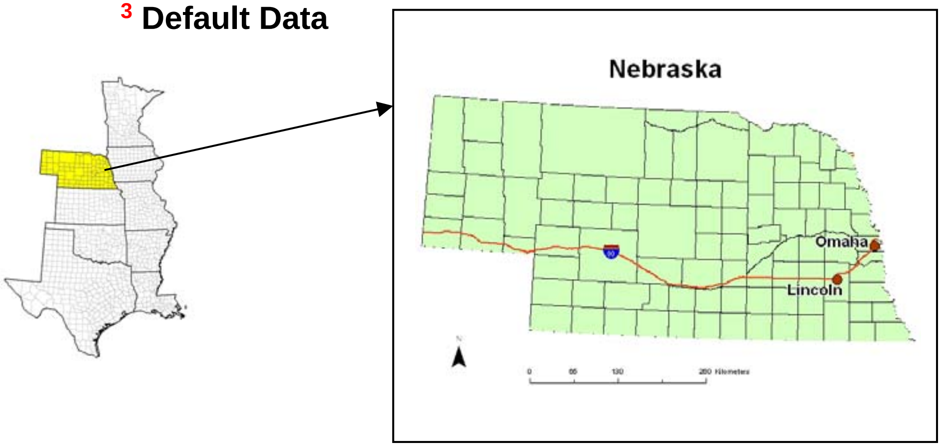
U. Local



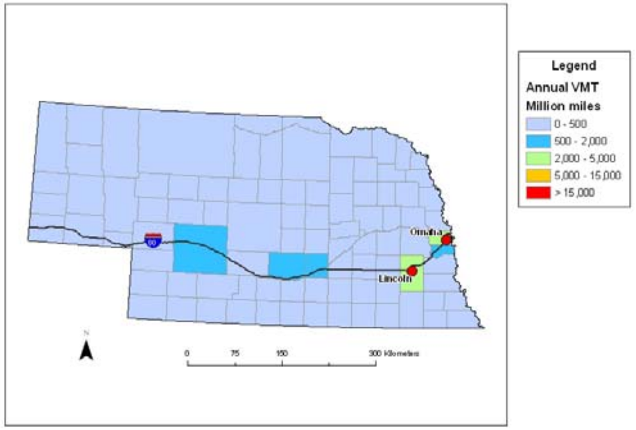
Note that box-whisker plots appear as points because only a small number of counties with negligible variability are plotted.

Data Summary Sheet: Nebraska

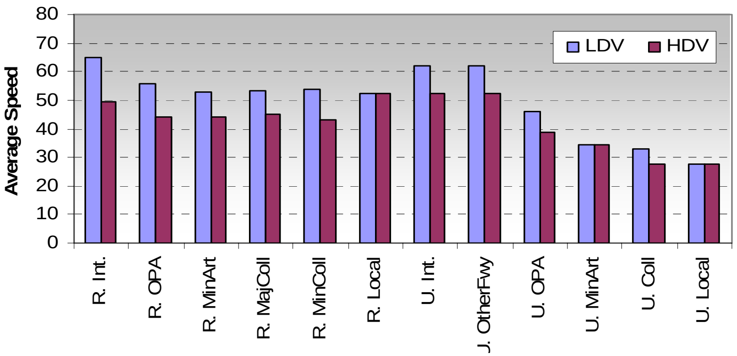
Data Source: [1] Nebraska Dept. of Transportation &
[2] Lincoln-Lancaster MPO
[3] Default Data



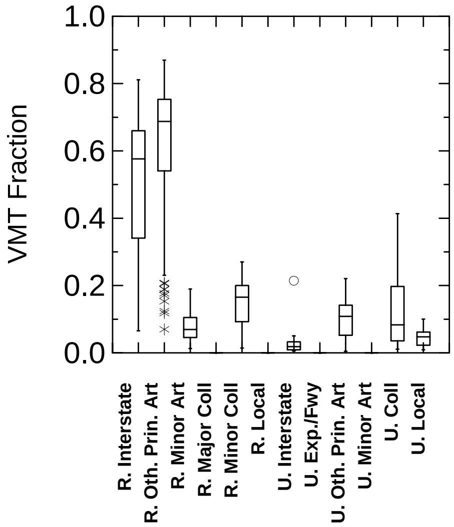
2002 Countywide VMT [1]



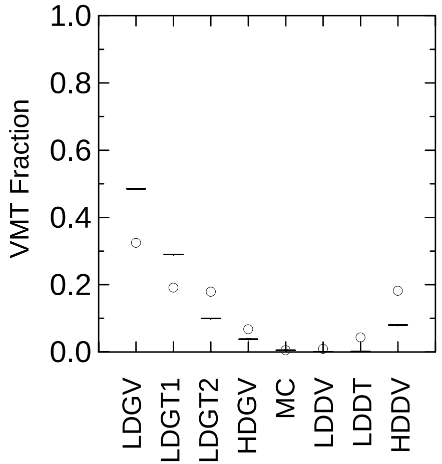
Average Speed by Road Type [3]



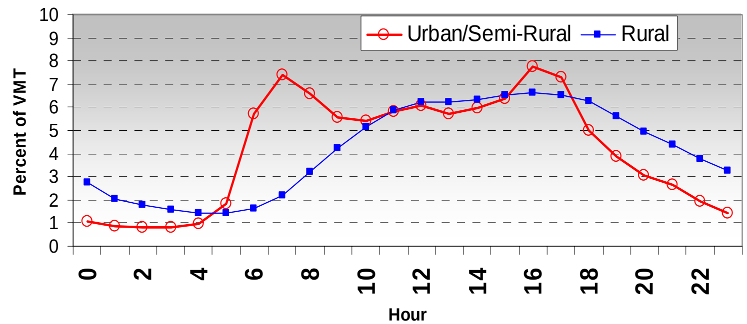
VMT Distribution by Road Type
NeDOT [1] & LLMPO Data [2]



VMT Distribution by Vehicle Type
LLMPO Data [2] & Default Data [3]



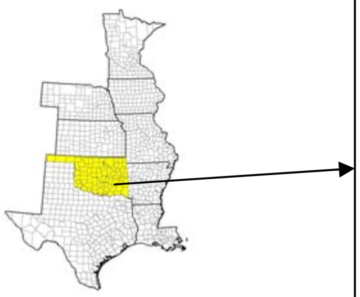
Weekday VMT Diurnal Distribution [3]

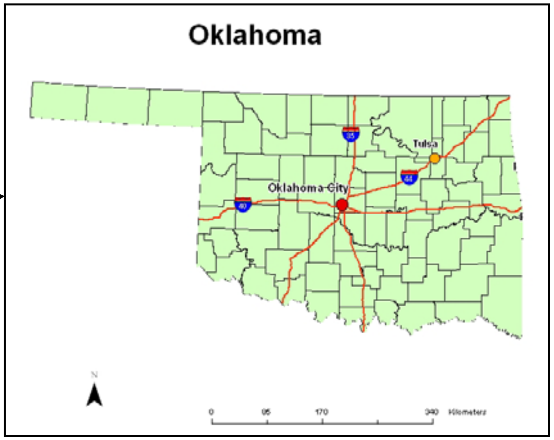


Data Summary Sheet: Oklahoma

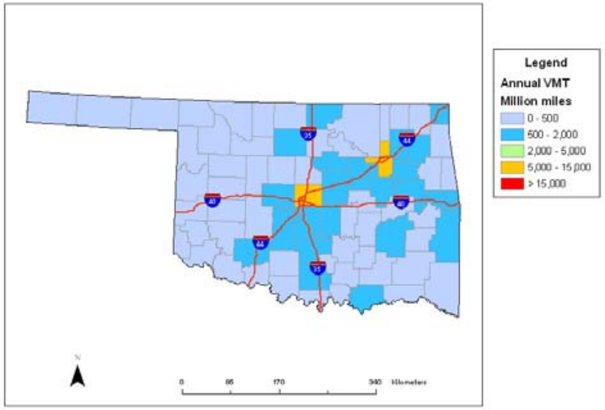
Data Source: [1] **Oklahoma State Highway Dept.**

[2] **Default Data**

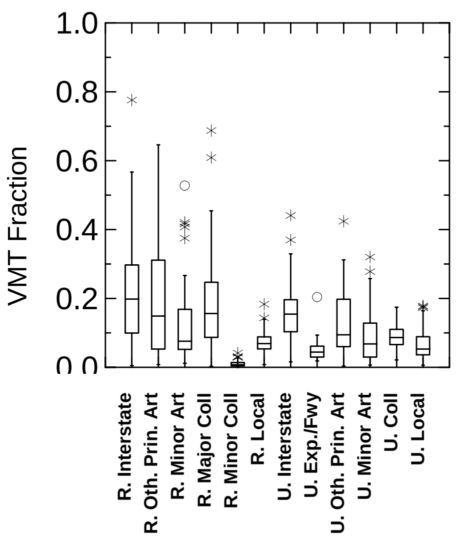




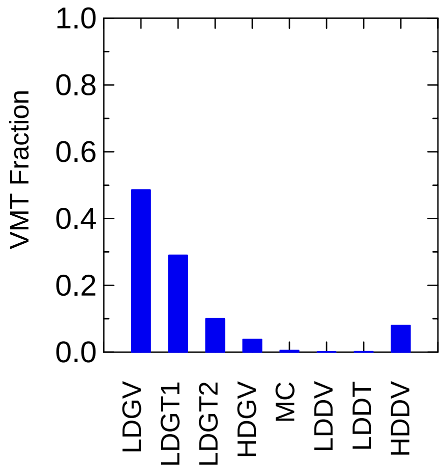
2002 Countywide VMT [1]



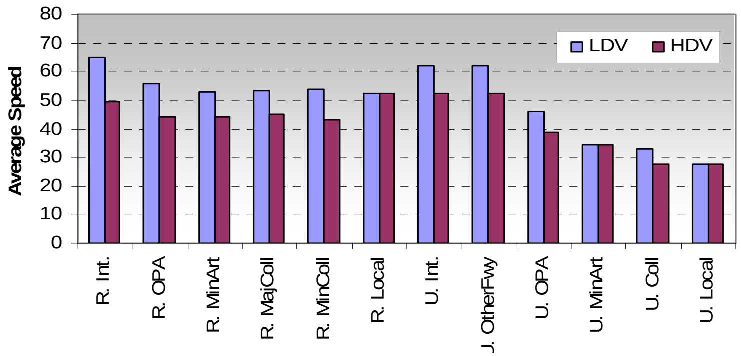
VMT Distribution by Road Type [1]



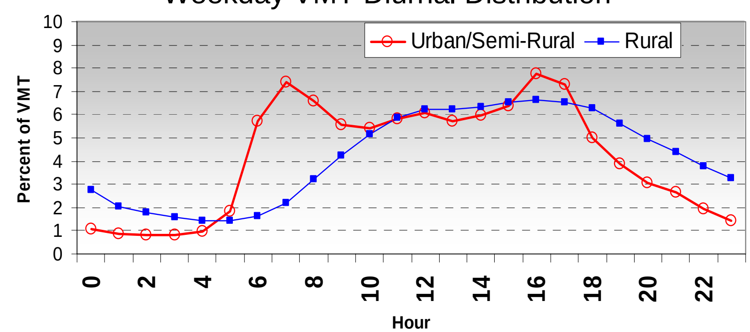
VMT Distribution by Vehicle Type [2]



Average Speed by Road Type [2]

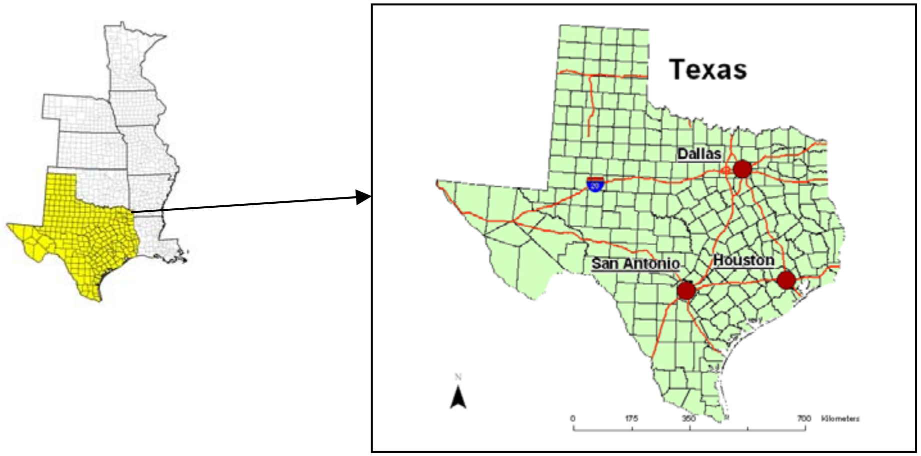


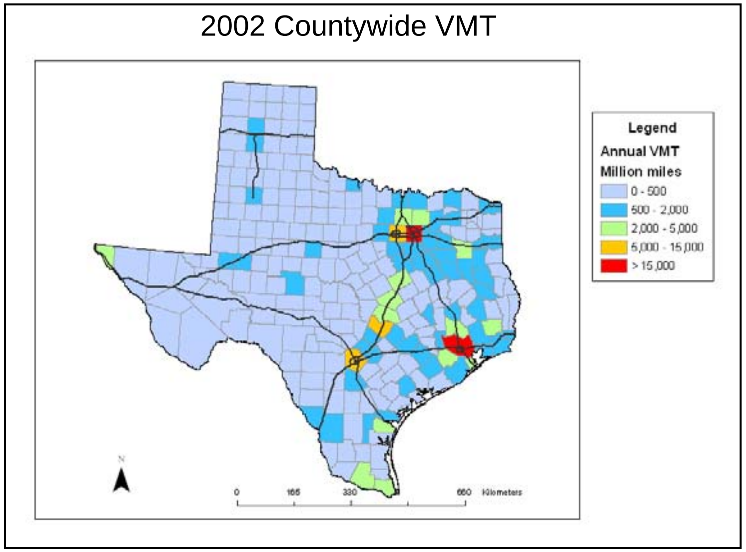
Weekday VMT Diurnal Distribution [2]

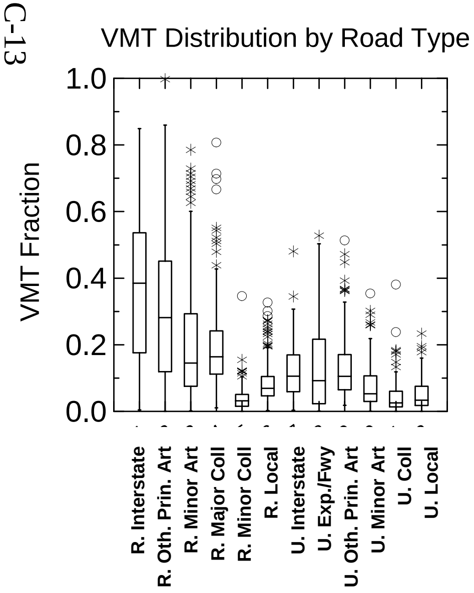


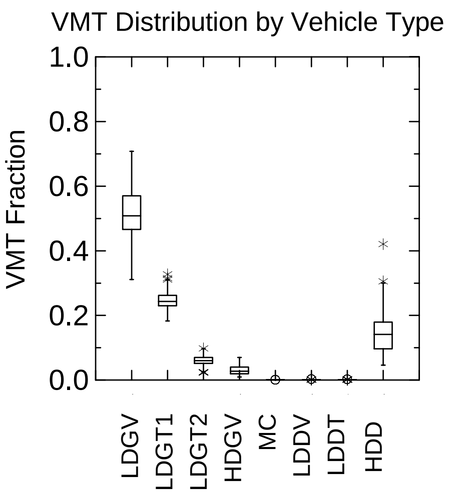
Data Summary Sheet: Texas

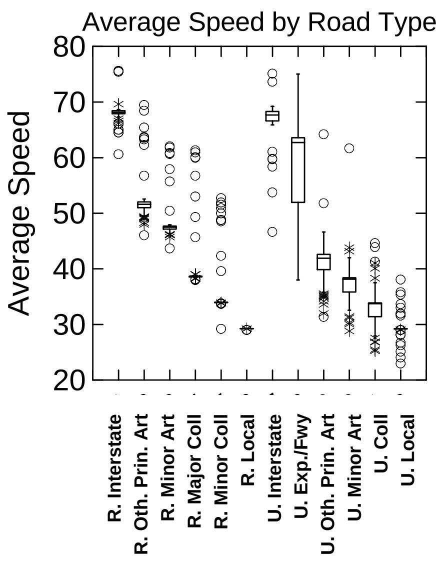
Data Source: Texas Transportation Institute & TCEQ.

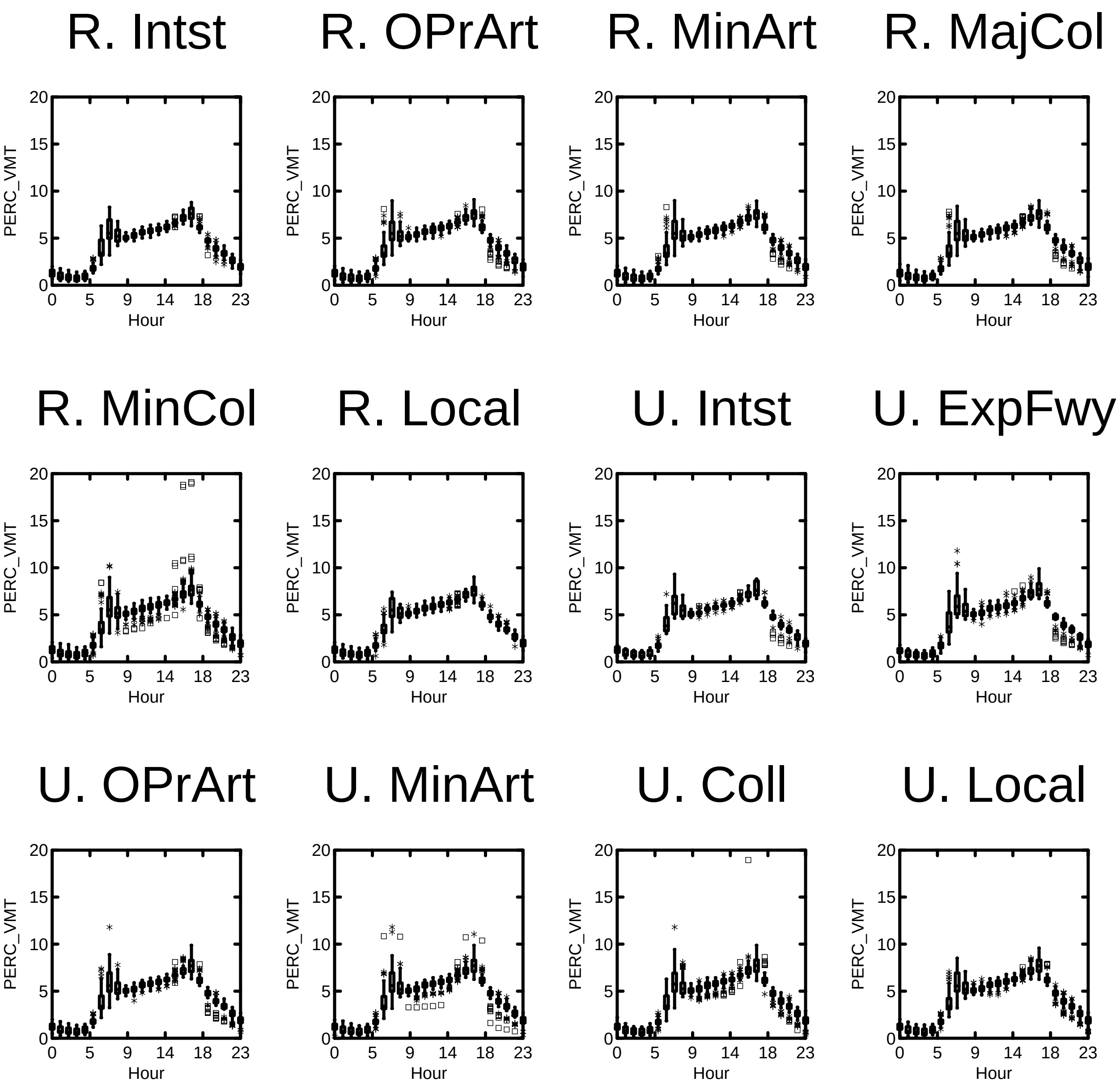












Average of hourly VMT distributions by road type.

(range limited to 20%, 1 outlier was excluded)

Summary of MOBILE6 Inputs for Fuels Characteristics

State	County	FUEL PROGRAM command[a]
AR	All counties	FUEL PROGRAM : 1
IA	All counties	FUEL PROGRAM : 1
KS	All counties	FUEL PROGRAM : 1
LA	All counties	FUEL PROGRAM : 1
MN	All counties	FUEL PROGRAM : 4 300.0 299.0 100.0 100.0 100.0 92.0 33.0 33.0 30.0 30.0 30.0 30.0 30.0 30.0 30.0 30.0 1000.0 1000.0 1000.0 1000.0 303.0 303.0 87.0 87.0 80.0 80.0 80.0 80.0 80.0 80.0 80.0 80.0
MO	St. Louis area[b.c]	FUEL PROGRAM : 2 S
NE	Western counties[d]	FUEL PROGRAM : 3
	All other counties	FUEL PROGRAM : 1
OK	All counties	FUEL PROGRAM : 1
TX	Dallas/Fort Worth counties[c,e]	FUEL PROGRAM : 2 S
	Houston/Galveston counties[c,f]	FUEL PROGRAM : 2 S
	All other counties	FUEL PROGRAM : 1

[a] If not specified, MOBILE6 assumes FUEL PROGRAM : 1, which corresponds to "Conventional Gasoline East": i.e., an average 2002 fuel sulfur content of 279 ppm and a maximum 2002 fuel sulfur content of 1000 ppm. For areas using Federal Reformulated Gasoline (RFG), the designation "S" or "N" is based upon the classification of regions in 40 CFR 80.71.

[b] Includes Franklin, Jefferson, St. Charles, and St. Louis Counties, and St. Louis City.

[c] All FUEL PROGRAM : 2 S areas should also use the SEASON command. SEASON : 1 applies May 1 through September 15; SEASON : 2 applies for the rest of the calendar year.

[d] Includes the following counties: Banner, Box Butte, Cheyenne, Dawes, Deuel, Garden, Keith, Kimball, Morrill, Scotts Bluff, Sheridan, and Sioux (40 CFR 80.215(a)(2)(i). Although this is the program recommended by EPA for these counties, use of this fuel program command in 2002 is optional, since the 2002 sulfur contents for FUEL PROGRAM : 3 are the same as those for FUEL PROGRAM : 1.

[e] Includes the following counties: Collin, Dallas, Denton, Tarrant.

[f] Includes the following counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller.

Summary of MOBILE6 Inputs for Sulfur Contents of Diesel Fuels

State	DIESEL SULFUR command[a]
AR	DIESEL SULFUR : 360.0
IA	DIESEL SULFUR : 360.0
KS	DIESEL SULFUR : 330.0
LA	DIESEL SULFUR : 380.0
MN	DIESEL SULFUR : 360.0
MO	DIESEL SULFUR : 390.0
NE	DIESEL SULFUR : 360.0
OK	DIESEL SULFUR : 360.0
TX	DIESEL SULFUR : 364.0

[a] Value is sulfur content in units of parts per million by weight (ppmw); regulatory limit is 500 ppmw in 2002.

Summary of MOBILE6 Inputs for Oxygenated Fuels Specifications

State	Area	Period	Command	Ethers market share (fraction)	Alcohols market share (fraction)	Avg. wt. frac. Oxygen in Ether Blends	Avg. wt. frac. Oxygen in Alcohol Blends	RVP Waiver for Alcohol Blends
AR	All areas	All Months	OXYGENATED FUELS :	0.500	0.000	0.006	0.000	2
IA	All areas	All Months	OXYGENATED FUELS :	0.000	0.555	0.000	0.035	2
KS	All areas	All Months	OXYGENATED FUELS :	0.000	0.040	0.000	0.035	2
LA	All areas	All Months	OXYGENATED FUELS :	0.300	0.000	0.009	0.000	2
MN	All areas	All Months	OXYGENATED FUELS :	0.000	0.977	0.000	0.034	2
MO	St. Louis area[a]	All Months	(N/A)[b]					
	All other areas	All Months	OXYGENATED FUELS :	0.000	0.095	0.000	0.033	2
NE	All areas	All Months	OXYGENATED FUELS :	0.000	0.420	0.000	0.035	2
OK	All areas	All Months	OXYGENATED FUELS :	0.000	0.000	0.000	0.000	2
TX	Dallas/Fort Worth area[c]	All Months	(N/A)[b]					
	Houston/Galveston area[d]	All Months	(N/A)[b]					
		All Months	(N/A)[b]					
	El Paso County	Oct to Mar	OXYGENATED FUELS :	0.000	1.000	0.000	0.027	2
		Apr to Sep	OXYGENATED FUELS :	0.000	0.000	0.000	0.000	2
	All other areas	All Months	OXYGENATED FUELS :	0.000	0.000	0.000	0.000	2

[a] Includes Franklin, Jefferson, St. Charles, and St. Louis Counties, and St. Louis City.
[b] The OXYGENATED FUELS command is not specified for these areas (overridden by FUEL PROGRAM : 2 S command).
[c] Includes the following counties: Collin, Dallas, Denton, Tarrant.
[d] Includes the following counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller.

Summary of MOBILE6 Inputs for Fuel Volatilities

State	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 1-15	Sep 16-30	Oct	Nov	Dec
AR	All areas	13.0	13.0	12.0	10.0	9.0	9.0	9.0	9.0	9.0	9.0	9.5	11.0	12.0
IA	All areas	13.2	12.8	11.8	10.3	9.0	8.7	8.3	8.4	8.4	8.3	9.4	11.2	12.0
KS	Kansas City area[a]	13.2	12.4	11.3	10.3	7.3	7.0	7.0	7.0	7.0	8.4	9.4	11.2	12.0
	All other areas	13.2	12.8	11.8	10.4	9.1	8.9	8.2	8.5	8.4	8.4	9.1	11.0	11.5
LA	Baton Rouge area[b]	13.0	13.0	12.0	10.0	9.0	7.8	7.8	7.8	7.8	9.0	9.5	11.0	12.0
	Beauregard, Calcasieu, Grant, Lafayette, Lafourche, Pointe Coupee, St. James, and St. Mary Parishes	13.0	13.0	12.0	10.0	9.0	7.8	7.8	7.8	7.8	9.0	9.5	11.0	12.0
	New Orleans area[c]	13.0	13.0	12.0	10.0	9.0	7.8	7.8	7.8	7.8	9.0	9.5	11.0	12.0
	All other areas	13.0	13.0	12.0	10.0	9.0	9.0	9.0	9.0	9.0	9.0	9.5	11.0	12.0
MN	All areas	13.4	13.6	12.8	10.4	9.2	8.8	8.7	8.6	8.5	8.5	9.6	10.1	12.4
MO	Kansas City[a]	13.1	12.4	11.3	10.3	7.3	7.0	7.0	7.0	7.0	8.4	9.4	11.2	12.0
	St. Louis[d,e]	13.1	12.8	11.0	7.4	6.0	6.7	6.7	6.7	6.7	6.8	9.1	10.3	12.6
	All other areas	13.2	12.8	11.8	10.1	8.8	8.5	8.4	8.4	8.4	8.2	9.7	11.5	12.4
NE	All areas	13.2	12.8	11.8	10.3	9.0	8.7	8.3	8.4	8.4	8.3	9.4	11.2	12.0
OK	Tulsa area[f]	13.0	13.0	12.0	10.0	9.0	7.8	7.8	7.8	7.8	9.0	9.5	11.0	12.0
	All other areas	13.0	13.0	12.0	10.0	9.0	9.0	9.0	9.0	9.0	9.0	9.5	11.0	12.0
TX	Beaumont/Port Arthur area[g]	13.0	13.0	12.0	10.0	9.0	7.5	7.5	7.5	7.5	9.0	9.5	11.0	12.0
	Dallas/Fort Worth area[e,h]	13.1	12.8	11.0	7.4	6.0	6.7	6.7	6.7	6.7	6.8	9.1	10.3	12.6
	Houston/Galveston area[e,i]	13.1	12.8	11.0	7.4	6.0	6.7	6.7	6.7	6.7	6.8	9.1	10.3	12.6
	Other East Texas counties[j]	13.0	13.0	12.0	10.0	7.8	7.5	7.5	7.5	7.5	9.0	9.5	11.0	12.0
	El Paso County	12.3	13.0	12.0	10.0	9.0	6.8	6.8	6.8	6.8	9.0	9.5	11.0	12.0
	All other areas	13.0	13.0	12.0	10.0	9.0	9.0	9.0	9.0	9.0	9.0	9.5	11.0	12.0

[a] Includes the following counties: Johnson (KS), Wyandotte (KS), Clay (MO), Jackson (MO), Platte (MO).
[b] Includes the following parishes: Ascension, East Baton Rouge, Iberville, Livingston, West Baton Rouge.
[c] Includes the following parishes: Jefferson, Orleans, St. Bernard, St. Charles.
[d] Includes Franklin, Jefferson, St. Charles, and St. Louis counties, and St. Louis City.
[e] Although the FUEL RVP command must be used, input data will be overridden by the FUEL PROGRAM : 2 S command during May 1 through September 15.
[f] Includes the following counties: Creek, Osage, Rogers, Tulsa, Wagoner.
[g] Includes the following counties: Jefferson, Hardin, Orange.
[h] Includes the following counties: Collin, Dallas, Denton, Tarrant.
[I] Includes the following counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller.
[j] Includes the following counties: Anderson, Angelina, Aransas, Atascosa, Austin, Bastrop, Bee, Bell, Bexar, Bosque, Bowie, Brazos, Burleson, Caldwell, Calhoun, Camp, Cass, Cherokee, Colorado, Comal, Cooke, Coryell, De Witt, Delta, Ellis, Falls, Fannin, Fayeete, Franklin, Freestone, Goliad, Gonzales, Grayson, Gregg, Grimes, Guadalupe, Harrison, Hays, Henderson, Hill, Hood, Hopkins, Houston, Hunt, Jackson, Jasper, Johnson, Karnes, Kaufman, Lamar, Lavaca, Lee, Leon, Limestone, Live Oak, Madison, Marion, Matagorda, McLennan, Milam, Morris, Nacogdoches, Navarro, Newton, Nueces, Panola, Parker, Polk, Rains, Red River, Refugio, Robertson, Rockwall, Rusk, Sabine, San Jacinto, San Patricio, San Augustine, Shelby, Smith, Somervell, Titus, Travis, Trinity, Tyler, Upshur, VanZandt, Victoria, Walker, Washington, Wharton, Williamson, Wilson, Wise, Wood.

Summary of MOBILE6 Inputs for Anti-tampering Programs

State	County					Vehicles types covered (1 = exempt, 2 = covered)														Inspection Frequency (11 = annual, 12 = biennial)	Program Compliance Rate (%)	Inspections (1 = no, 2 = yes)							
			Start Year	Earliest MY	Final MY	LDGV	LDGT1	LDGT2	LDGT3	LDGT4	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGVB	GAS BUS			Air pump	Catalyst	Inlet	Lead deposit	EGR system	Evap system	PCV system	Gas cap
Louisiana	All		00	80	50	2	2	2	2	2	2	1	1	1	1	1	1	1	1	11	072.	2	2	2	2	2	2	2	2
Texas	Harris	Program A	84	78	83	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	1	1	1	2	2	2	2
		Program B	84	84	00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	2	1	1	2	2	2	2
		As modeled	84	78	00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	2	1	1	2	2	2	2
Texas	El Paso	Program A	86	81	83	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	1	1	1	2	2	2	2
		Program B	86	84	00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	2	1	1	2	2	2	2
		As modeled	86	81	00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	2	1	1	2	2	2	2
Texas	Dallas, Tarrant	Program A	86	76	83	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	1	1	1	2	2	2	2
		Program B	86	84	00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	2	1	1	2	2	2	2
		As modeled	86	76	00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	11	096.	2	2	1	1	2	2	2	2

Summary of MOBILE6 Inputs for Inspection and Maintenance Programs

							Vehicle Model Years, Types, and Ages Covered																		Compliance Rate	Waiver Rate		Exhaust I/M Parameters				
							Model Years (MY)		Vehicles types covered (1 = exempt, 2 = covered)																					TR Effectiveness		
State	Counties	Start Year	End Year	Inspection Frequency (1 = annual, 2 = biennial)	Inspection Facility Type[a]	Inspection Test Type[b]	Earliest	Final	LDGV	LDGT1	LDGT2	LDGT3	LDGT4	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B	GAS BUS	EXEMPTION AG	GRACE PERIOD		MY 1980 and older	MY 1981 and newer	Stringency (Failure Rate for MY 1980 and older)	Tech. Training?	HC	CO	NOx
Louisiana	Ascension, East Baton Rouge, Iberville, Livingston, West Baton Rouge	2000	(current)	1	TRC	GC	1980	(current)	2	2	2	2	2	2	1	1	1	1	1	1	1	1	(N/A)	1	96.0%	0%	0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
Missouri	Jefferson, St. Charles, St. Louis, St. Louis City	1990	(current)	2	T/O	IDLE	1971	1980	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	25.3%	(N/A)	18.0%	Yes	(N/A)	(N/A)	(N/A)
		2000	(current)	2	T/O	IM240	1981	(current)	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	(N/A)	25.3%	(N/A)	Yes	(N/A)	(N/A)	(N/A)
		2000	(current)	2	T/O	GC	1981	(current)	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	(N/A)	0.0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
	Franklin	2000	(current)	1	T/O	IDLE	1971	(current)	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	10.9%	9.9%	15.2%	Yes	(N/A)	(N/A)	(N/A)
		2000	(current)	1	T/O	GC	1981	(current)	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	(N/A)	0.0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
Texas	Harris	1997	Apr. 2002	1	TRC	2500/IDLE	1978	2000	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.0%	0.0%	10.0%	Yes	(N/A)	(N/A)	(N/A)
		May 2002	(current)	1	TRC	2500/IDLE	1978	2000	1	1	1	1	1	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	2.1%	4.4%	14.2%	Yes	100%	100%	100%
		May 2002	(current)	1	TRC	ASM 2525/5015 PHASE-IN	1978	1995	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	1.1%	0.7%	27.4%	Yes	100%	100%	100%
		May 2002	(current)	1	TRC	OBD I/M	1996	2000	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	(N/A)	0.2%	(N/A)	Yes	100%	100%	100%
		1997	(current)	1	TRC	GC	1978	2000	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.0%	0.0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
Texas	Brazoria, Chambers, Fort Bend, Galveston, Liberty, Montgomery, Waller	2000	(current)	1	TRC	GC	1978	2000	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.0%	0.0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
Texas	Dallas, Tarrant	1990	Apr. 2002	1	TRC	2500/IDLE	1975	2000	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.3%	0.0%	10.0%	Yes	100%	100%	100%
Texas	Collin, Denton, Dallas, Tarrant	May 2002	(current)	1	TRC	2500/IDLE	1978	2000	1	1	1	1	1	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.8%	1.5%	15.3%	Yes	100%	100%	100%
		May 2002	(current)	1	TRC	ASM 2525/5015 PHASE-IN	1978	1995	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	2.7%	1.9%	28.7%	Yes	100%	100%	100%
		May 2002	(current)	1	TRC	OBD I/M	1996	2000	2	2	2	2	2	1	1	1	1	1	1	1	1	1	(N/A)	2	96.0%	(N/A)	0.3%	(N/A)	Yes	100%	100%	100%
Texas	Collin, Denton	May 2002	(current)	1	TRC	GC	1975	2000	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.0%	0.0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
Texas	Dallas, Tarrant	1996	(current)	1	TRC	GC	1975	2000	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.0%	0.0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)
Texas	El Paso	1987	(current)	1	TRC	2500/IDLE	1950	(current)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.0%	0.0%	10.0%	Yes	(N/A)	(N/A)	(N/A)
		1997	(current)	1	TRC	GC	1950	(current)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	(N/A)	2	96.0%	0.0%	0.0%	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)

[a] TRC = Test and Repair program, computerized; T/O = Test Only program

[b] GC = gas cap check (evaporative emissions); IDLE = idling only test; 2500/IDLE = idling and 2500 rpm test; ASM 2525/5015 PHASE-IN = testing at 25 mph/25% load and 15 mph/50% load, phased-in cutpoints; OBD I/M = check of malfunction indicator lights; IM240 = transient 240-second test

[c] Default Waiver Rate is 5.0% for evaporative programs, except where an exhaust I/M program is also applicable, in which case the waiver rate for the evaporative program is the same as that for the exhaust program.

Summary of MOBILE6 Inputs for Stage II Vapor Recovery Programs

State	MSA/CMSA	County	Start Year	Phase In Period (Years)	In-use control efficiency (%)	
					LDGV/ LDGT	HDGV
Louisiana	Baton Rouge	Ascension	93	2	77.	77.
Louisiana	Baton Rouge	East Baton Rouge	93	2	77.	77.
Louisiana	Baton Rouge	Iberville	93	2	77.	77.
Louisiana	Baton Rouge	Livingston	93	2	77.	77.
Louisiana	Baton Rouge	West Baton Rouge	93	2	77.	77.
Louisiana	Pointe Coupee	Pointe Coupee	93	2	77.	77.
Missouri	St. Louis	St. Louis City	87	2	89.	89.
Missouri	St. Louis	Jefferson County	87	2	89.	89.
Missouri	St. Louis	St. Charles County	87	2	89.	89.
Missouri	St. Louis	Franklin County	87	2	89.	89.
Missouri	St. Louis	St. Louis County	87	2	89.	89.
Texas	Beaumont-Port Arthur	Hardin	92	2	84.	84.
Texas	Beaumont-Port Arthur	Jefferson	92	2	84.	84.
Texas	Beaumont-Port Arthur	Orange	92	2	84.	84.
Texas	Dallas-Ft. Worth	Collin	92	2	84.	84.
Texas	Dallas-Ft. Worth	Dallas	92	2	84.	84.
Texas	Dallas-Ft. Worth	Denton	92	2	84.	84.
Texas	Dallas-Ft. Worth	Tarrant	92	2	84.	84.
Texas	El Paso	El Paso	92	2	84.	84.
Texas	Houston-Galveston	Brazoria	92	2	84.	84.
Texas	Houston-Galveston	Chambers	92	2	84.	84.
Texas	Houston-Galveston	Fort Bend	92	2	84.	84.
Texas	Houston-Galveston	Galveston	92	2	84.	84.
Texas	Houston-Galveston	Harris	92	2	84.	84.
Texas	Houston-Galveston	Liberty	92	2	84.	84.
Texas	Houston-Galveston	Montgomery	92	2	84.	84.
Texas	Houston-Galveston	Waller	92	2	84.	84.

Summary of MOBILE6 Inputs for the IM240 Program in St. Louis, Missouri (Page 1 of 3)

Approx. VMT Mix				
LDGV	LDGT1	LDGT2	LDGT3	LDGT4
0.46	0.071	0.24	0.073	0.033

Calendar Year
2002

% Final
25%

HC Cutpoints

	LDGV		LDGT1 & LDGT2		LDGT3 & LDGT4	
Model Year	Phase-In	Final	Phase-In	Final	Phase-In	Final
1981	2.0	0.8	7.5	3.4	7.5	3.4
1982	2.0	0.8	7.5	3.4	7.5	3.4
1983	2.0	0.8	7.5	3.4	7.5	3.4
1984	2.0	0.8	3.2	1.6	3.2	1.6
1985	2.0	0.8	3.2	1.6	3.2	1.6
1986	2.0	0.8	3.2	1.6	3.2	1.6
1987	2.0	0.8	3.2	1.6	3.2	1.6
1988	2.0	0.8	3.2	1.6	3.2	1.6
1989	2.0	0.8	3.2	1.6	3.2	1.6
1990	2.0	0.8	3.2	1.6	3.2	1.6
1991	1.2	0.8	2.4	1.6	2.4	1.6
1992	1.2	0.8	2.4	1.6	2.4	1.6
1993	1.2	0.8	2.4	1.6	2.4	1.6
1994	1.2	0.8	2.4	1.6	2.4	1.6
1995	1.2	0.8	2.4	1.6	2.4	1.6
1996	0.8	0.6	1.0	0.8	2.4	0.8
1997+	same as 1996		same as 1996		same as 1996	

Allowable range in model

Min	Max
0.80	5.0

MOBILE6 ages

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24					

Model year standards applicable to each MOBILE6 age

1996	1996	1996	1996	1996	1996	1996	1995	1994	1993
1992	1991	1990	1989	1988	1987	1986	1985	1984	1983
1982	1981	1981	1981	1981					

MOBILE6 Block 1 (LDGV & LDGT1)

0.800	0.800	0.800	0.800	0.800	0.800	0.800	1.247	1.247	1.247
1.247	1.247	1.847	1.847	1.847	1.847	1.847	1.847	1.847	2.338
2.338	2.338	2.338	2.338	2.338					

MOBILE6 Block 2 (LDGT2 & LDGT3)

1.195	1.195	1.195	1.195	1.195	1.195	1.195	2.200	2.200	2.200
2.200	2.200	2.800	2.800	2.800	2.800	2.800	2.800	2.800	5.000
5.000	5.000	5.000	5.000	5.000					

MOBILE6 Block 3 (LDGT4)

2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.200	2.200	2.200
2.200	2.200	2.800	2.800	2.800	2.800	2.800	2.800	2.800	5.000
5.000	5.000	5.000	5.000	5.000					

Approx. VMT Mix				
LDGV	LDGT1	LDGT2	LDGT3	LDGT4
0.46	0.071	0.24	0.073	0.033

Calendar Year
2002

% Final
25%

CO Cutpoints

	LDGV		LDGT1 & LDGT2		LDGT3 & LDGT4	
Model Year	Phase-In	Final	Phase-In	Final	Phase-In	Final
1981	60.0	30.0	100.0	70.0	100.0	70.0
1982	60.0	30.0	100.0	70.0	100.0	70.0
1983	30.0	15.0	100.0	70.0	100.0	70.0
1984	30.0	15.0	80.0	40.0	80.0	40.0
1985	30.0	15.0	80.0	40.0	80.0	40.0
1986	30.0	15.0	80.0	40.0	80.0	40.0
1987	30.0	15.0	80.0	40.0	80.0	40.0
1988	30.0	15.0	80.0	40.0	80.0	40.0
1989	30.0	15.0	80.0	40.0	80.0	40.0
1990	30.0	15.0	80.0	40.0	80.0	40.0
1991	20.0	15.0	60.0	40.0	60.0	40.0
1992	20.0	15.0	60.0	40.0	60.0	40.0
1993	20.0	15.0	60.0	40.0	60.0	40.0
1994	20.0	15.0	60.0	40.0	60.0	40.0
1995	20.0	15.0	60.0	40.0	60.0	40.0
1996	15.0	10.0	20.0	13.0	60.0	15.0
1997+	same as 1996		same as 1996		same as 1996	

Allowable range in model

Min	Max
15.00	100.0

MOBILE6 ages

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24					

Model year standards applicable to each MOBILE6 age

1996	1996	1996	1996	1996	1996	1996	1995	1994	1993
1992	1991	1990	1989	1988	1987	1986	1985	1984	1983
1982	1981	1981	1981	1981					

MOBILE6 Block 1 (LDGV & LDGT1)

15.000	15.000	15.000	15.000	15.000	15.000	15.000	23.597	23.597	23.597
23.597	23.597	32.100	32.100	32.100	32.100	32.100	32.100	32.100	35.108
57.848	57.848	57.848	57.848	57.848					

MOBILE6 Block 2 (LDGT2 & LDGT3)

25.363	25.363	25.363	25.363	25.363	25.363	25.363	55.000	55.000	55.000
55.000	55.000	70.000	70.000	70.000	70.000	70.000	70.000	70.000	92.500
92.500	92.500	92.500	92.500	92.500					

MOBILE6 Block 3 (LDGT4)

48.750	48.750	48.750	48.750	48.750	48.750	48.750	55.000	55.000	55.000
55.000	55.000	70.000	70.000	70.000	70.000	70.000	70.000	70.000	92.500
92.500	92.500	92.500	92.500	92.500					

Approx. VMT Mix				
LDGV	LDGT1	LDGT2	LDGT3	LDGT4
0.46	0.071	0.24	0.073	0.033

Calendar Year
2002

% Final
25%

NO_x Cutpoints

Model Year	LDGV		LDGT1 & LDGT2		LDGT3 & LDGT4	
	Phase-In	Final	Phase-In	Final	Phase-In	Final
1981	3.0	2.0	7.0	4.5	7.0	4.5
1982	3.0	2.0	7.0	4.5	7.0	4.5
1983	3.0	2.0	7.0	4.5	7.0	4.5
1984	3.0	2.0	7.0	4.5	7.0	4.5
1985	3.0	2.0	7.0	4.5	7.0	4.5
1986	3.0	2.0	7.0	4.5	7.0	4.5
1987	3.0	2.0	7.0	4.5	7.0	4.5
1988	3.0	2.0	3.5	2.5	5.0	3.5
1989	3.0	2.0	3.5	2.5	5.0	3.5
1990	3.0	2.0	3.5	2.5	5.0	3.5
1991	2.5	2.0	3.0	2.5	4.5	3.5
1992	2.5	2.0	3.0	2.5	4.5	3.5
1993	2.5	2.0	3.0	2.5	4.5	3.5
1994	2.5	2.0	3.0	2.5	4.5	3.5
1995	2.5	2.0	3.0	2.5	4.5	3.5
1996	2.0	1.5	2.5	1.8	4.0	2.0
1997+	same as 1996		same as 1996		same as 1996	

Allowable range in model	
Min	Max
2.00	4.5

MOBILE6 ages

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24					

Model year standards applicable to each MOBILE6 age

1996	1996	1996	1996	1996	1996	1996	1995	1994	1993
1992	1991	1990	1989	1988	1987	1986	1985	1984	1983
1982	1981	1981	1981	1981					

MOBILE6 Block 1 (LDGV & LDGT1)

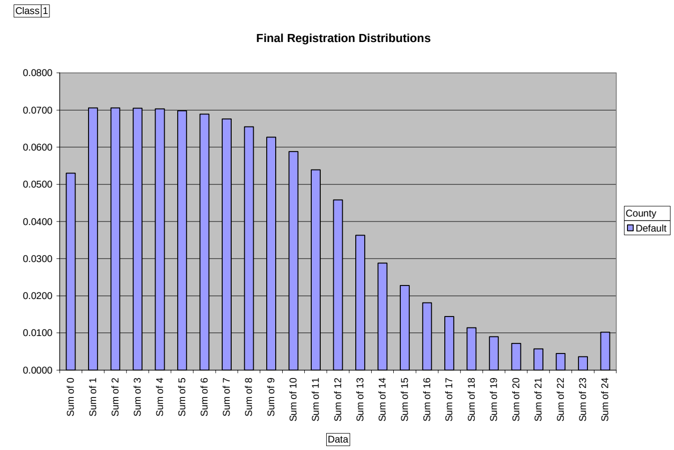
2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.442	2.442	2.442
2.442	2.442	2.817	2.817	2.817	3.235	3.235	3.235	3.235	3.235
3.235	3.235	3.235	3.235	3.235					

MOBILE6 Block 2 (LDGT2 & LDGT3)

2.599	2.599	2.599	2.599	2.599	2.599	2.599	3.196	3.196	3.196
3.196	3.196	3.571	3.571	3.571	4.500	4.500	4.500	4.500	4.500
4.500	4.500	4.500	4.500	4.500					

MOBILE6 Block 3 (LDGT4)

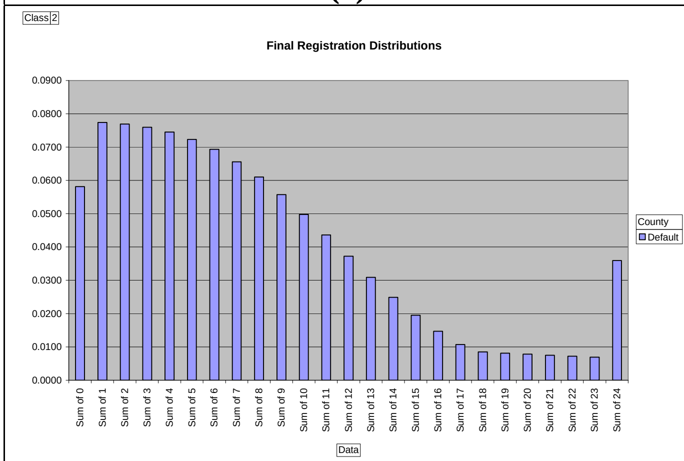
3.500	3.500	3.500	3.500	3.500	3.500	3.500	4.250	4.250	4.250
4.250	4.250	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500
4.500	4.500	4.500	4.500	4.500					



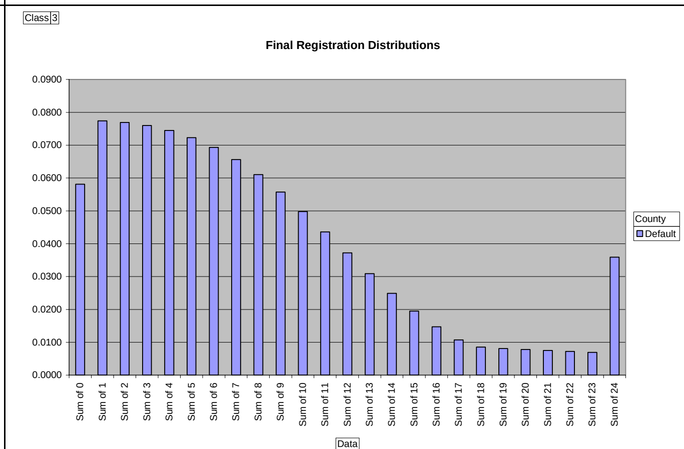
(a)

<u>Key to Figures</u>
Y-axis: Fraction of total fleet in the indicated age bin
X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload.
Adjusted loaded vehicle weight (ALVW) is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR).
Loaded vehicle weight (LVW) is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



(b)



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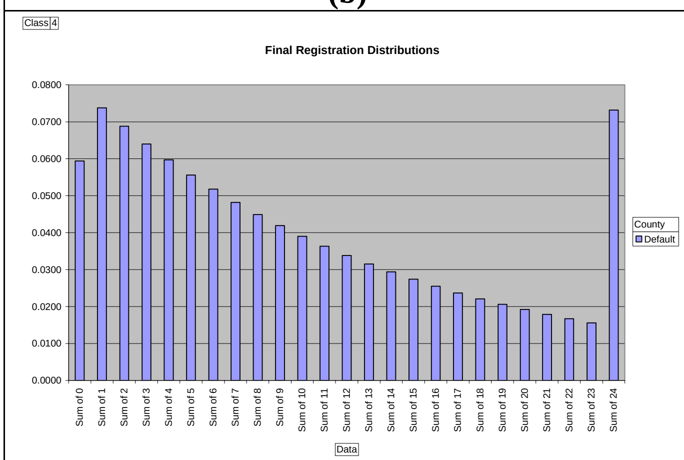

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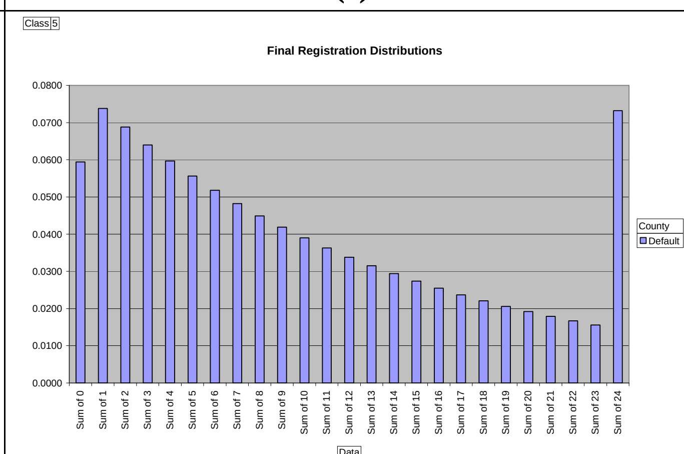
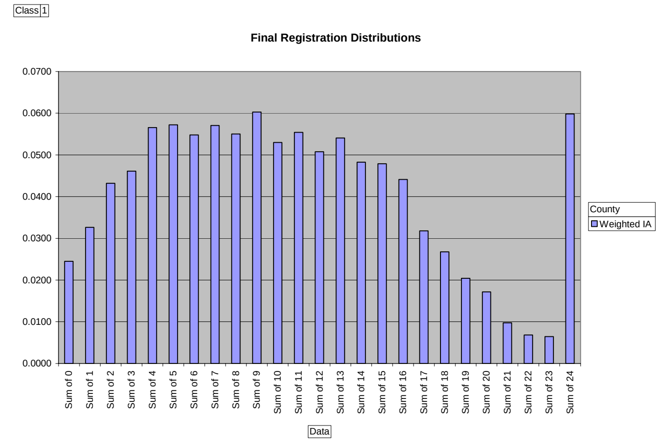


(e)

Age distributions of vehicle fleets corresponding to the **<u>MOBILE6 defaults</u>** for:

(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)

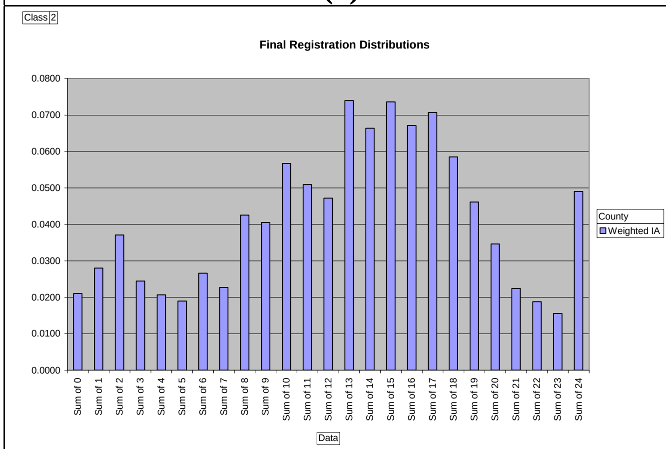


(a)

Key to Figures

Y-axis: Fraction of total fleet in the indicated age bin
X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload.
Adjusted loaded vehicle weight (ALVW) is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR).
Loaded vehicle weight (LVW) is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



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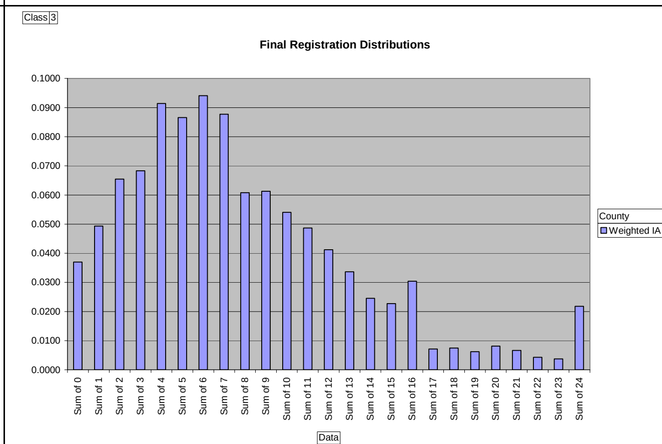

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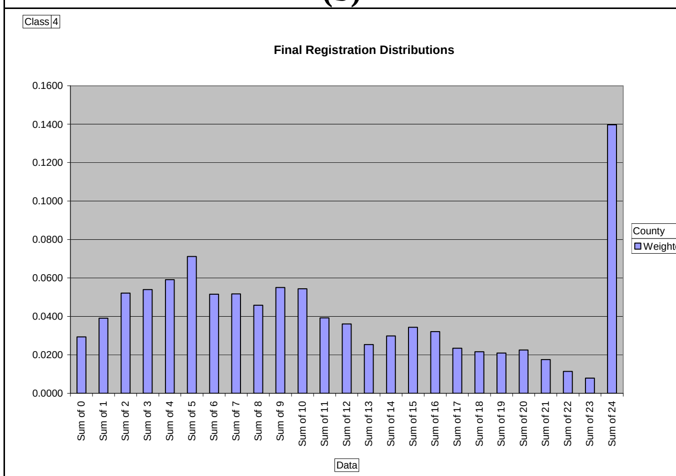

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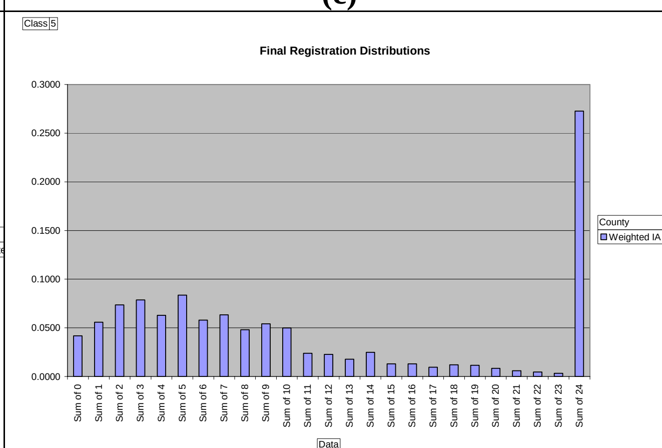

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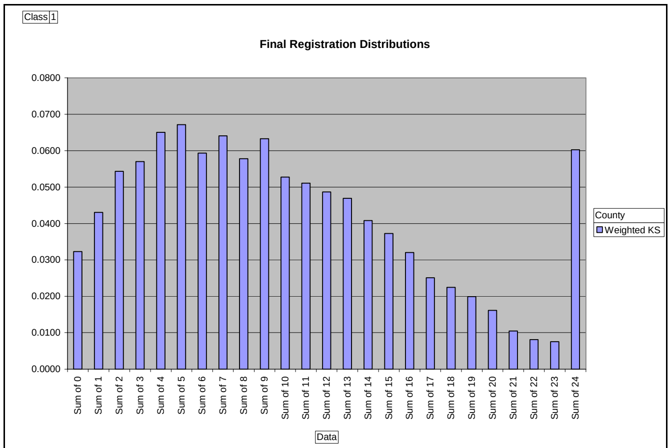
Weighted-average age distributions of vehicle fleets for **Iowa** and for the following vehicle classes:

(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)



(a)

<u>Key to Figures</u>

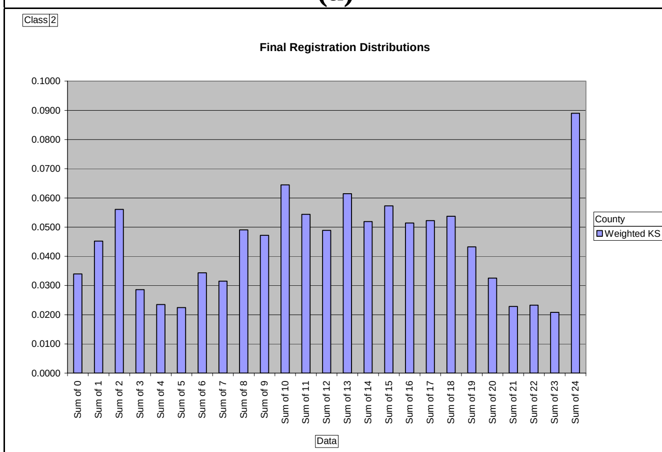
Y-axis: Fraction of total fleet in the indicated age bin

X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload.

Adjusted loaded vehicle weight (ALVW) is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR).

Loaded vehicle weight (LVW) is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



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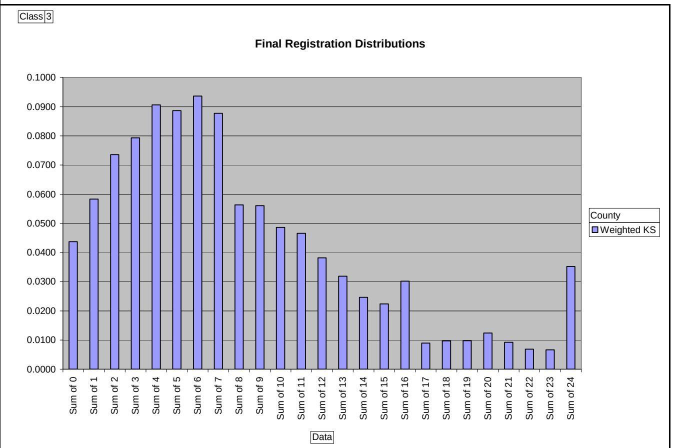

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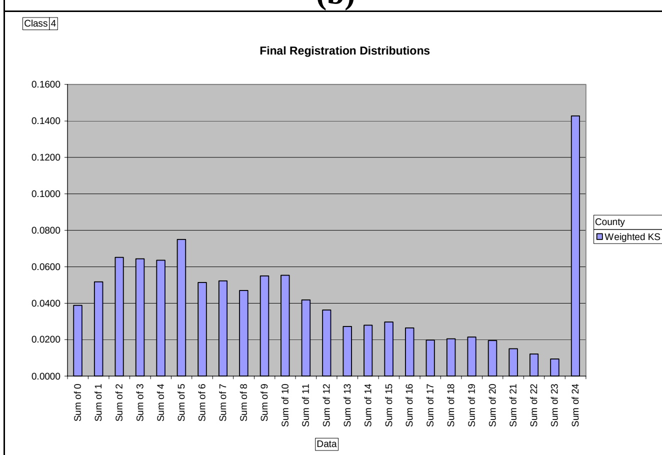

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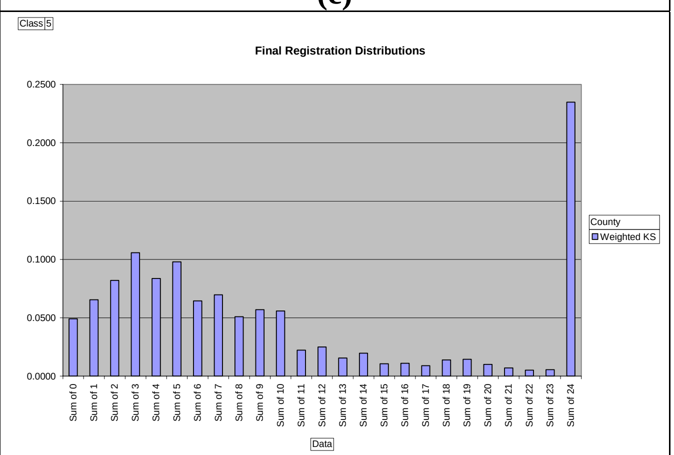

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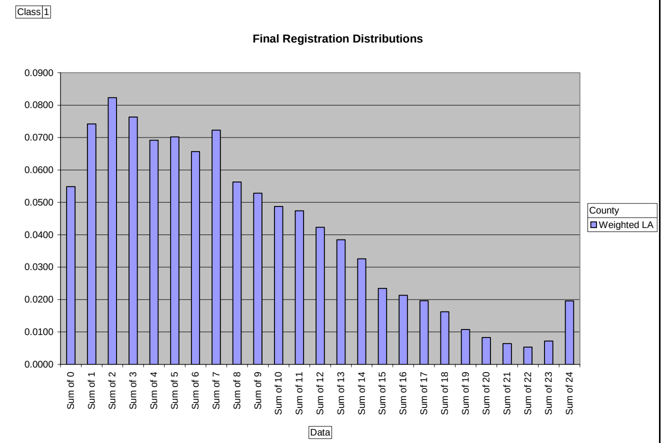
Weighted-average age distributions of vehicle fleets for **<u>Kansas</u>** and for the following vehicle classes:

(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)

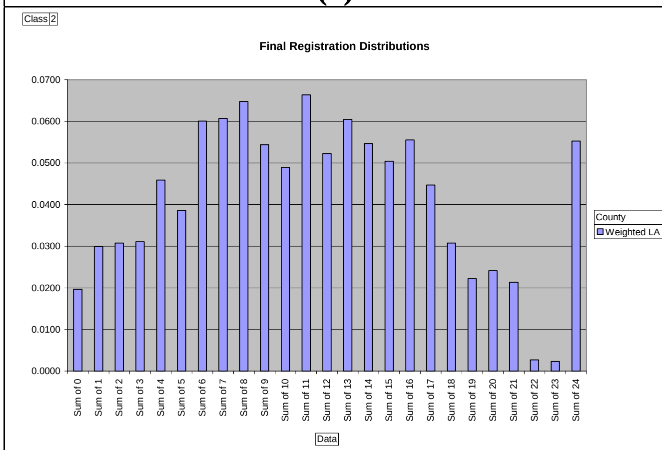


(a)

Key to Figures

Y-axis: Fraction of total fleet in the indicated age bin
X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload. **Adjusted loaded vehicle weight (ALVW)** is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR). **Loaded vehicle weight (LVW)** is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



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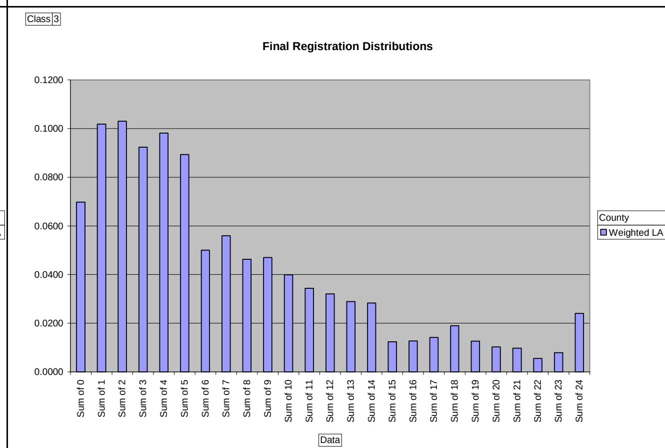

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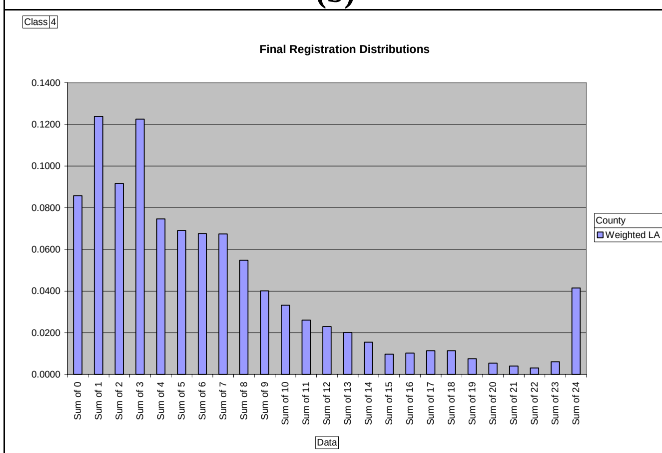

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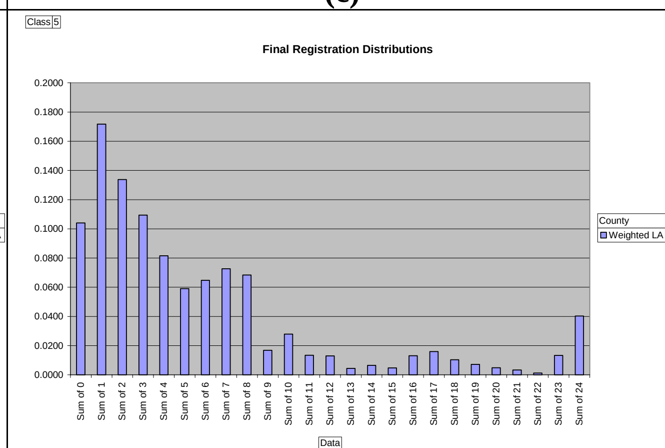

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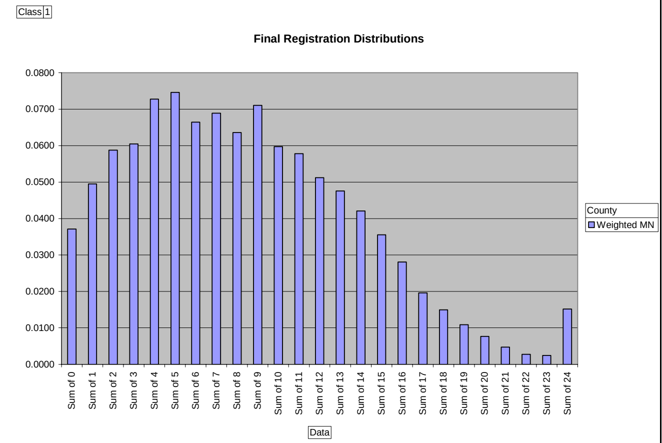
Weighted-average age distributions of vehicle fleets for **Louisiana** and for the following vehicle classes:

(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)

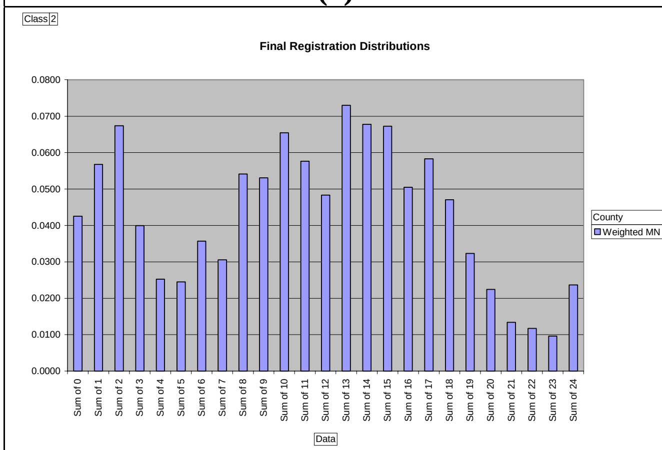


(a)

Key to Figures

Y-axis: Fraction of total fleet in the indicated age bin
X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload. **Adjusted loaded vehicle weight (ALVW)** is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR). **Loaded vehicle weight (LVW)** is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



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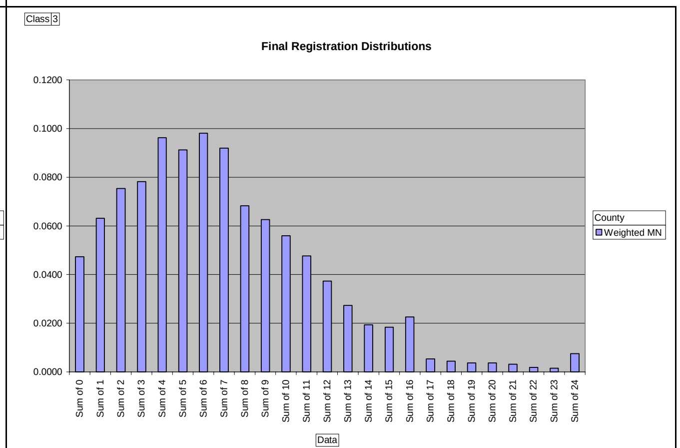

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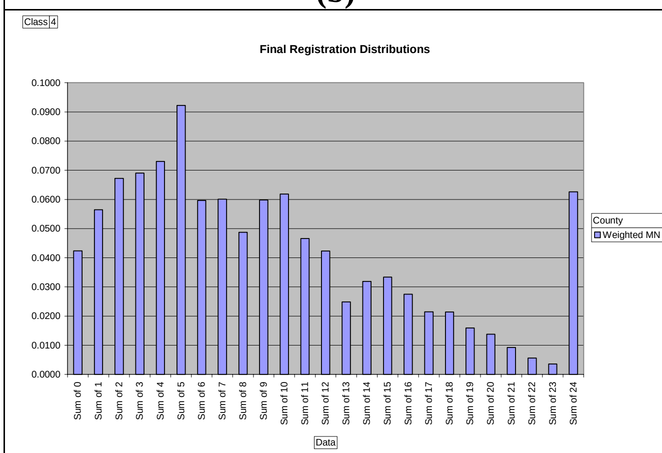

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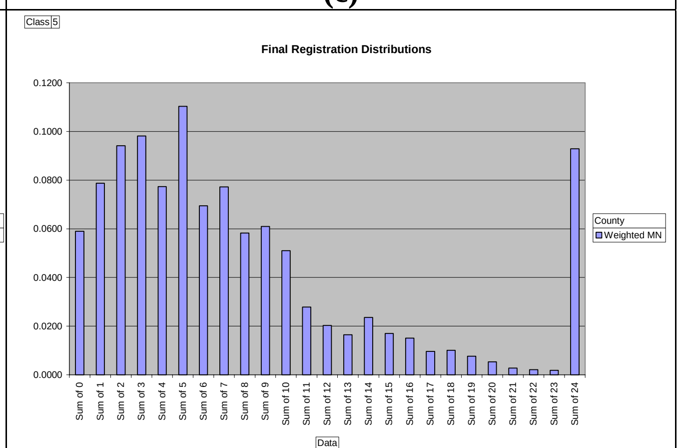

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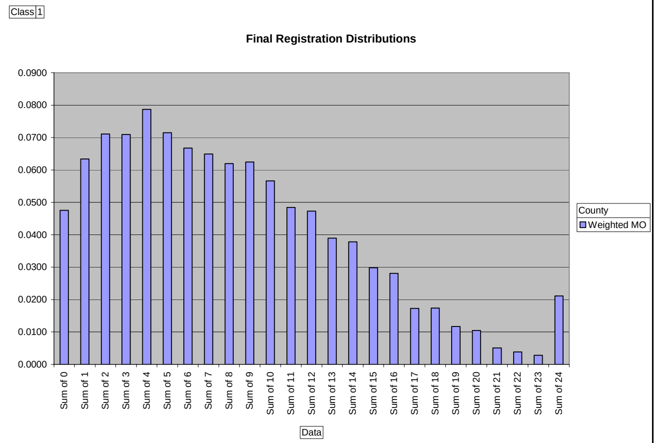
Weighted-average age distributions of vehicle fleets for **Minnesota** and for the following vehicle classes:

(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)

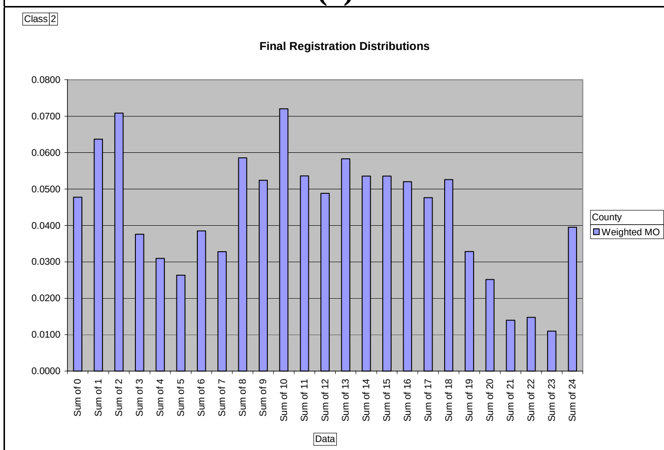


(a)

Key to Figures

Y-axis: Fraction of total fleet in the indicated age bin
X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload. **Adjusted loaded vehicle weight (ALVW)** is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR). **Loaded vehicle weight (LVW)** is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



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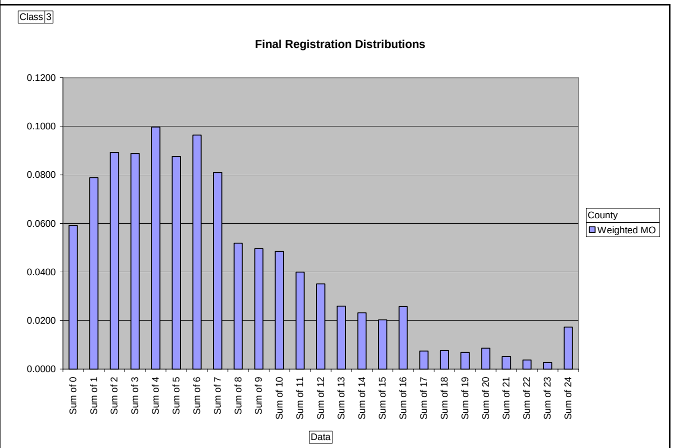

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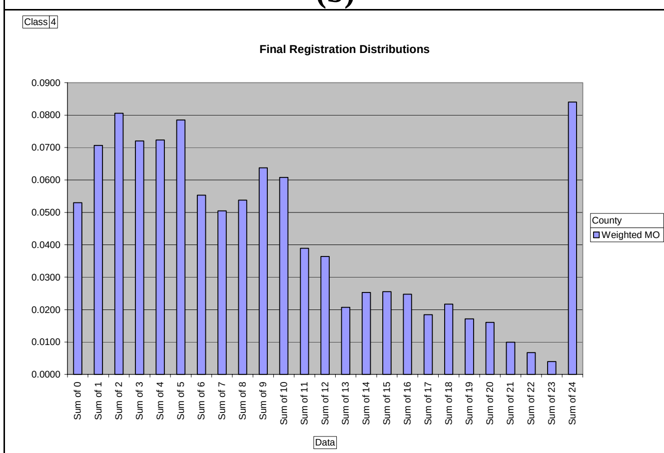

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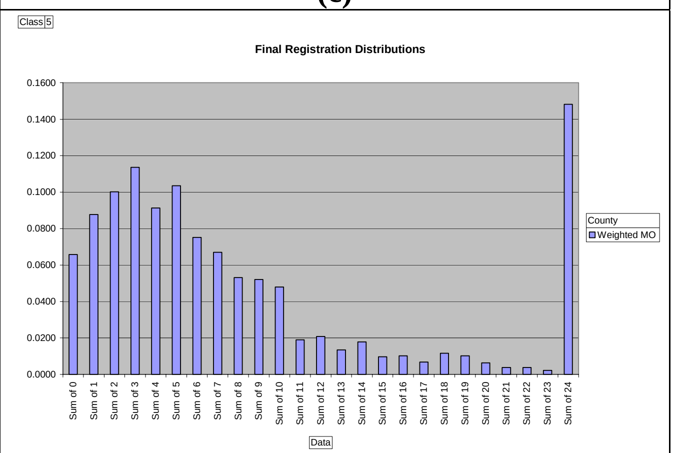

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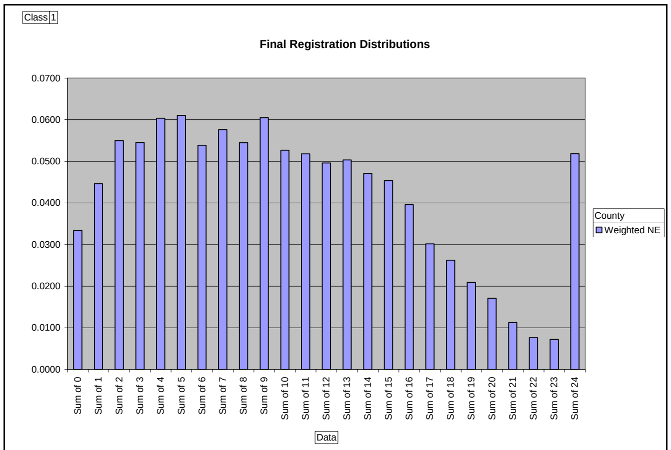
Weighted-average age distributions of vehicle fleets for **Missouri** and for the following vehicle classes:

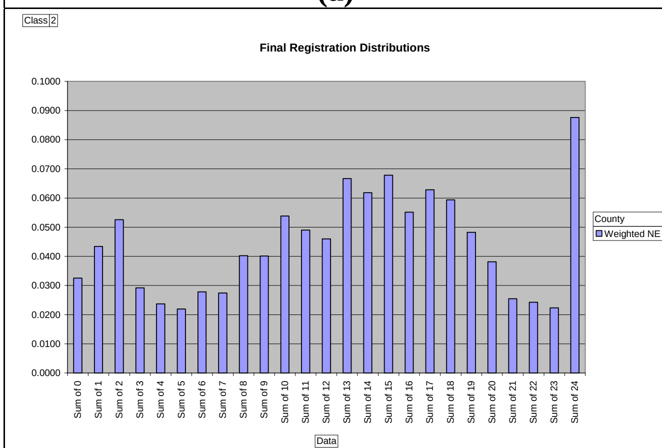
(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)



(a)

<u>Key to Figures</u>
Y-axis: Fraction of total fleet in the indicated age bin
X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload.
Adjusted loaded vehicle weight (ALVW) is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR).
Loaded vehicle weight (LVW) is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



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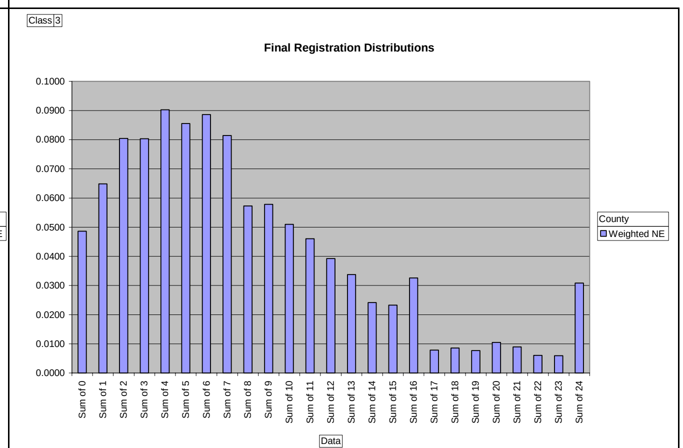

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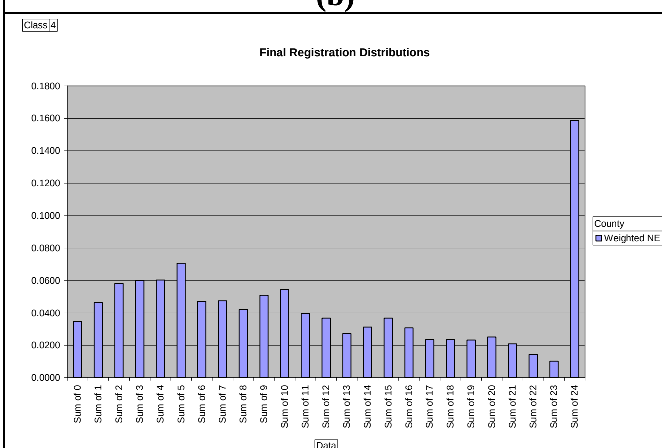

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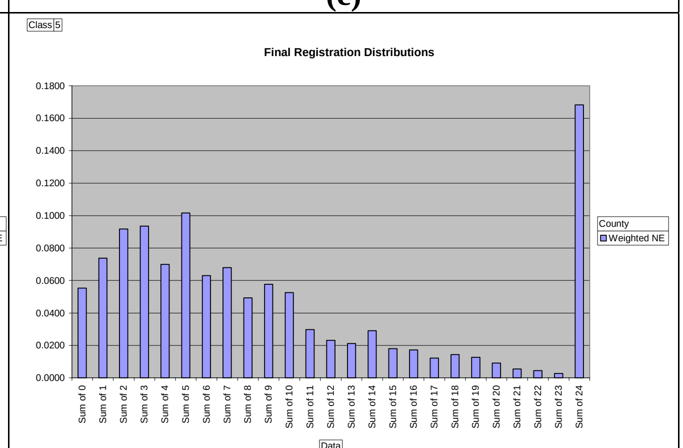

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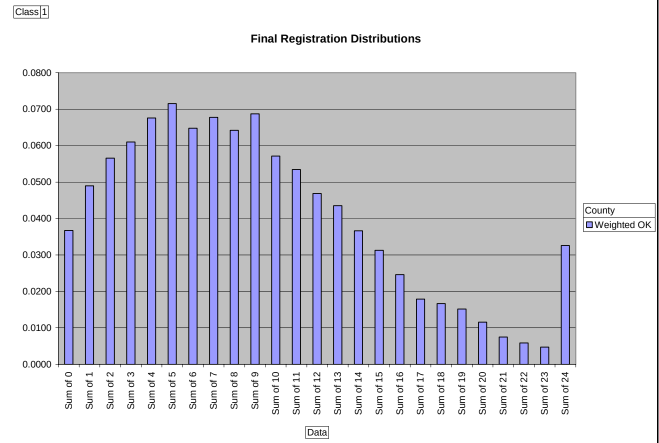
Weighted-average age distributions of vehicle fleets for **<u>Nebraska</u>** and for the following vehicle classes:
(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)

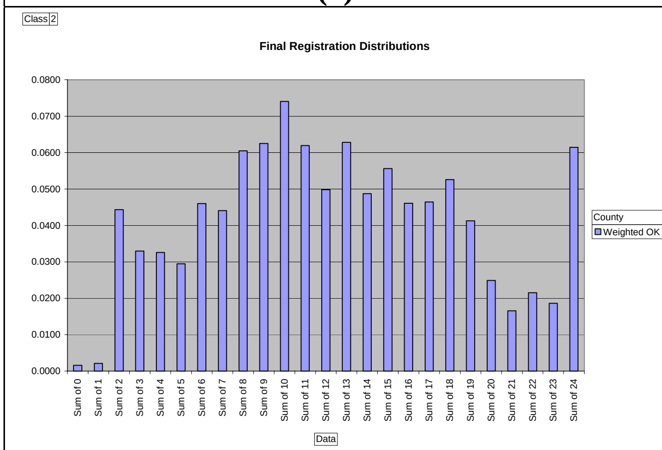


(a)

Key to Figures

Y-axis: Fraction of total fleet in the indicated age bin
X-axis: Vehicle age from <1 year to ≥ 24 years

Gross vehicle weight rating (GVWR) equals the total weight of the vehicle including its curb (empty) weight, fluids, driver and the maximum recommended payload. **Adjusted loaded vehicle weight (ALVW)** is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR). **Loaded vehicle weight (LVW)** is the curb weight of the vehicle plus 300 lbs., which is intended to correspond to the weight of a driver plus incidental payload.



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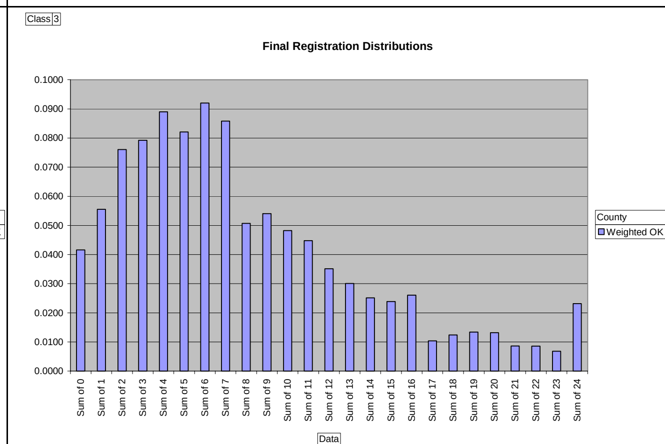

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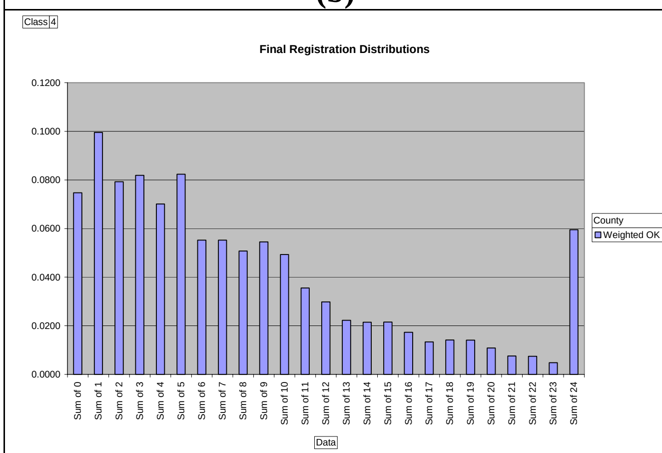

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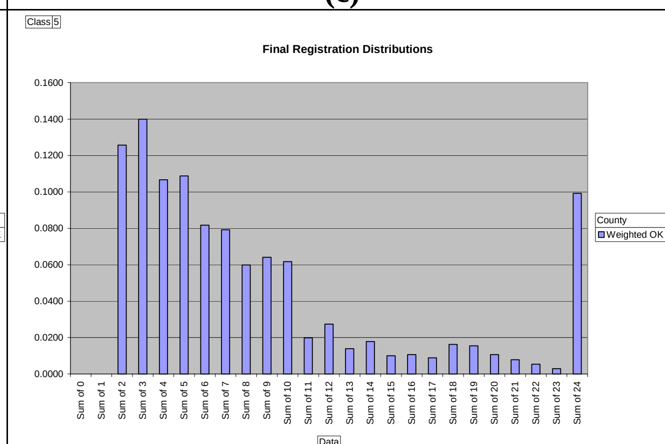
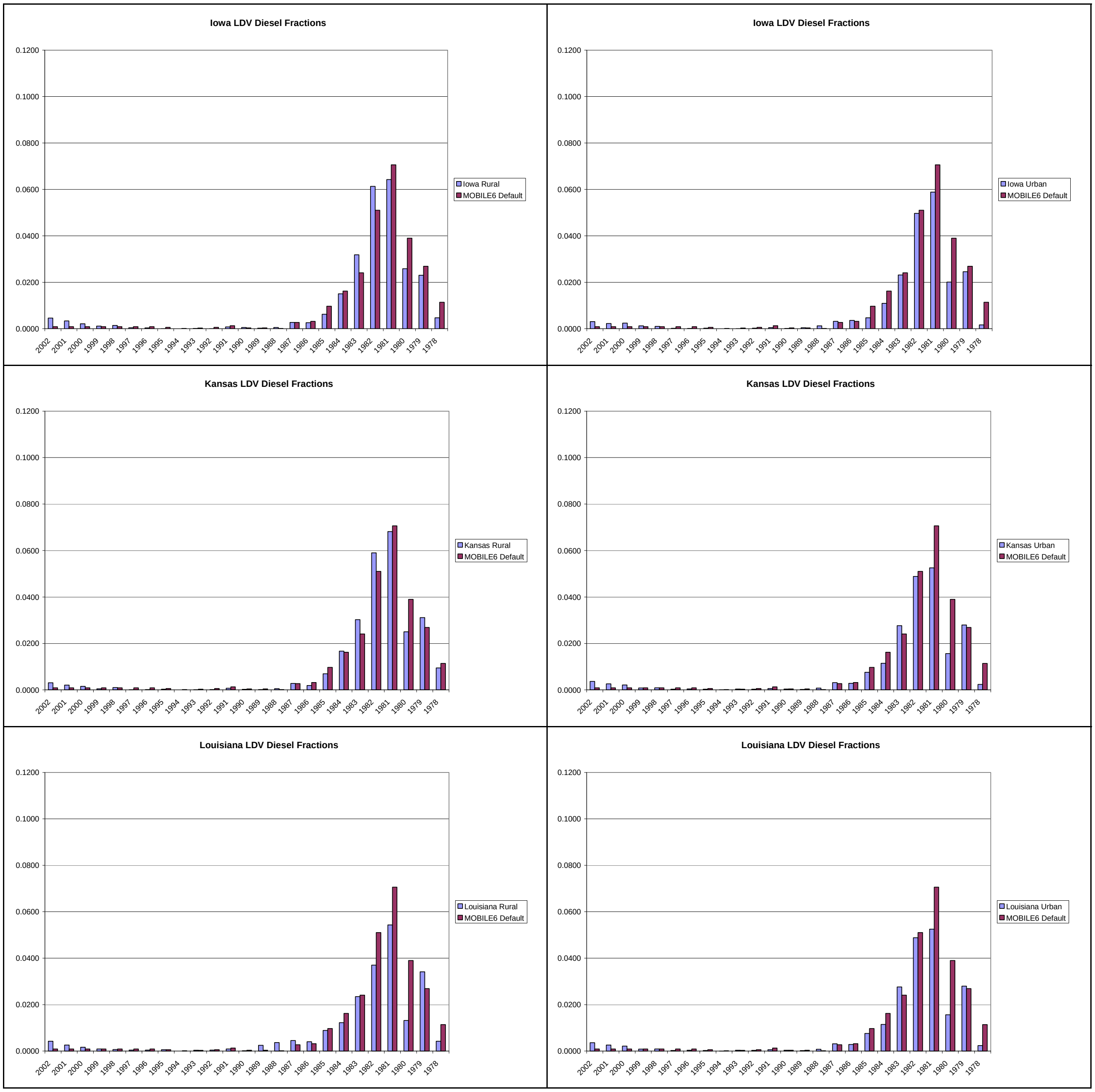


(e)

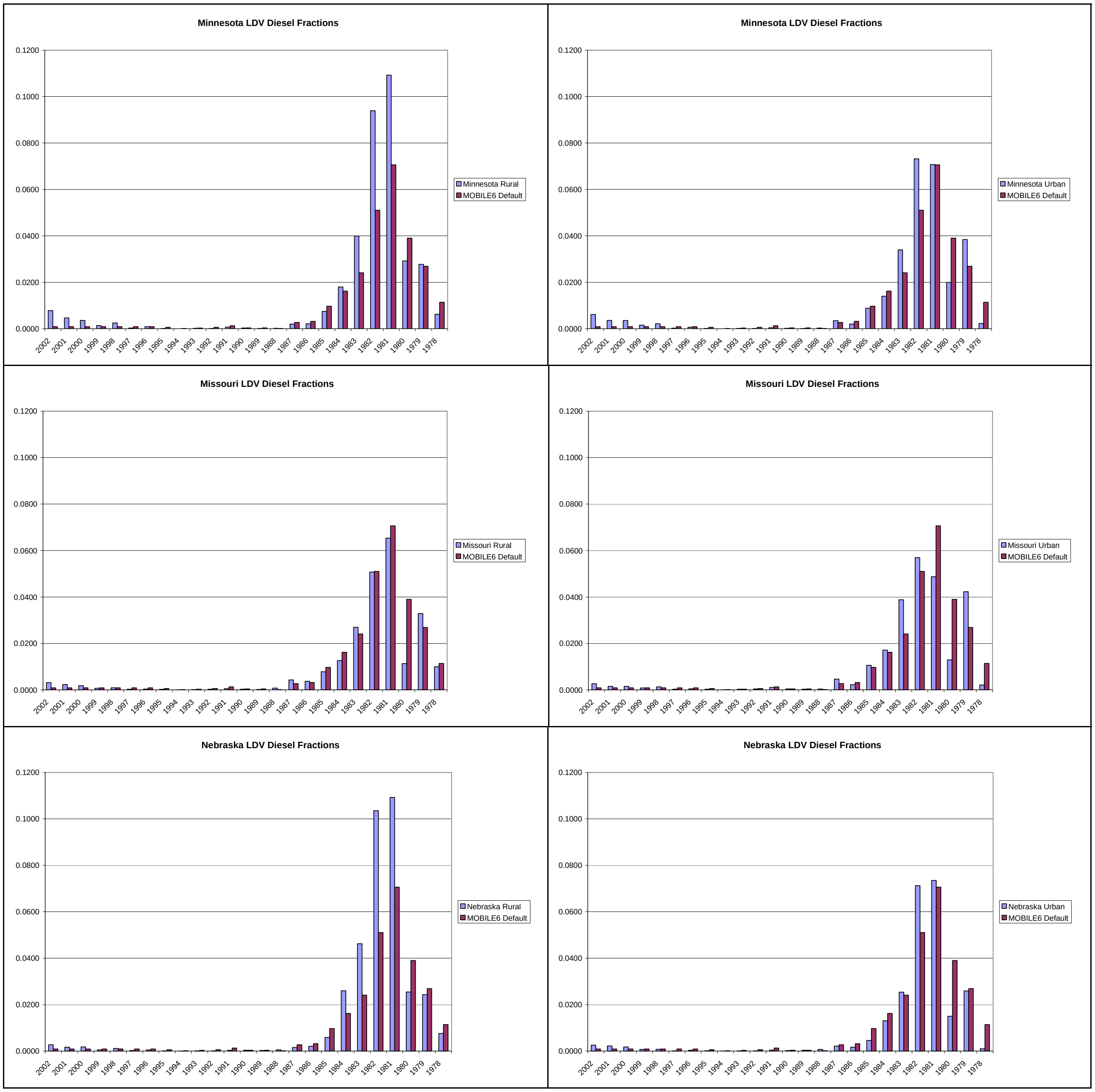
Weighted-average age distributions of vehicle fleets for **Oklahoma** and for the following vehicle classes:

(a) Light-Duty Vehicles (Passenger Cars)
(b) Light-Duty Trucks, Class 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
(c) Light Duty Trucks, Class 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
(d) Light Duty Trucks, Class 3 (6,001-8500 lbs. GVWR, 0-5750 lbs. ALVW)
(e) Light Duty Trucks, Class 4 (6,001-8500 lbs. GVWR, >5750 lbs. ALVW)



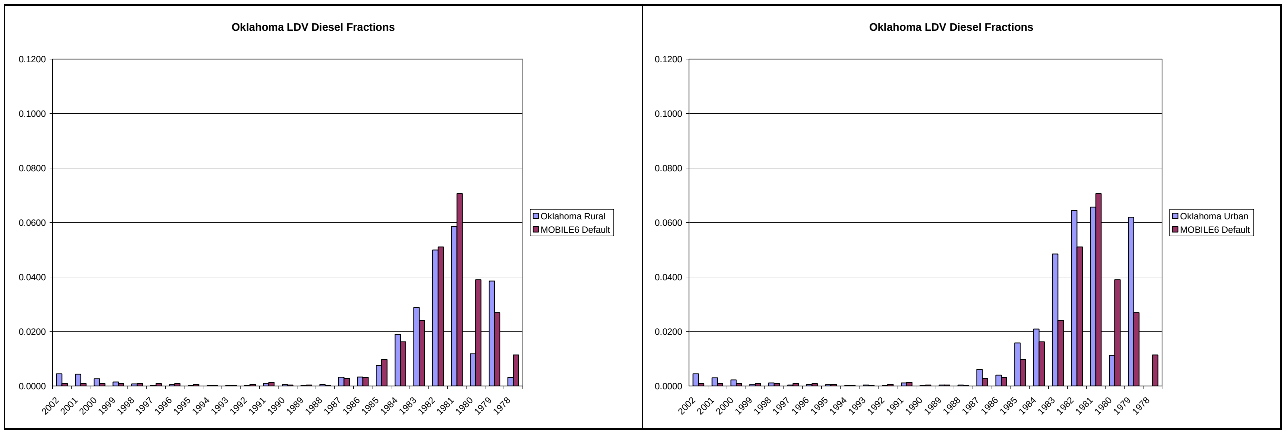
Fractions of the light-duty vehicle fleet that are diesel-powered vehicles for the rural (left) and urban (right) areas of the states of Iowa, Kansas, and Louisiana. The diesel fractions corresponding to MOBILE6 defaults are plotted for comparison on each chart.

Key to Figures:
Y-axis: Fraction of the total fleet that is comprised of diesel-powered vehicles
X-axis: Vehicle age from <1 to ≥24 years

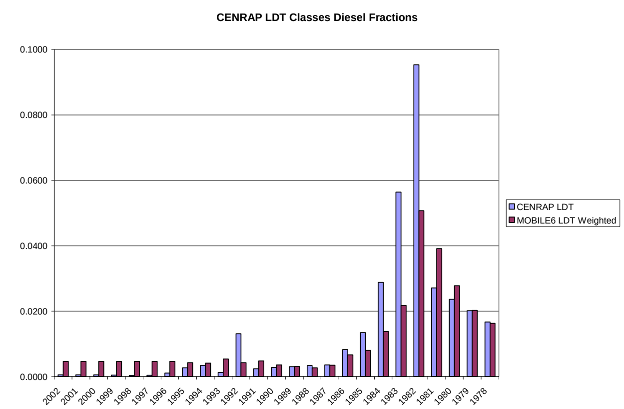


Fractions of the light-duty vehicle fleet that are diesel-powered vehicles for the rural (left) and urban (right) areas of the states of Minnesota, Missouri, and Nebraska. The diesel fractions corresponding to MOBILE6 defaults are plotted for comparison on each chart.

<u>Key to Figures:</u>
Y-axis: Fraction of the total fleet that is comprised of diesel-powered vehicles
X-axis: Vehicle age from <1 to ≥24 years



Fractions of the light-duty vehicle fleet that are diesel-powered vehicles for the rural (left) and urban (right) areas of the state of Oklahoma. The diesel fractions corresponding to MOBILE6 defaults are plotted for comparison on each chart.



Fractions of the light-duty truck fleet that are diesel powered in the CENRAP region. The diesel fractions corresponding to MOBILE6 defaults are plotted for comparison.

<u>Key to Figures:</u>
Y-axis: Fraction of the total fleet that is comprised of diesel-powered vehicles
X-axis: Vehicle age from <1 to ≥24 years

APPENDIX
7.2-E

Development of Growth and Control Inputs for CENRAP 2018 Emissions Draft Technical Support Document

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Prepared by:

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5528-B Hempstead Way
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May 2005

Contract No. 04-0628-RPO-018
Pechan Report No. 05.05.003/9500.002

CONTENTS

TABLES AND FIGURES

Page

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ACRONYMS AND ABBREVIATIONS

AEO	*Annual Energy Outlook*
AIM	architectural and industrial maintenance
BPA	Beaumont/Port Arthur
CENRAP	Central Regional Air Planning Association
CO	carbon monoxide
CTG	control techniques guideline
DFW	Dallas/Ft. Worth
DOE	U.S. Department of Energy
EGAS	Economic Growth Analysis System
EGUs	electricity generating units
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
HAPs	hazardous air pollutants
HGA	Houston/Galveston Area
IPM	Integrated Planning Model
MERR	mobile equipment repair and refinishing
NAAQS	National Ambient Air Quality Standards
NH_3	ammonia
NO_x	oxides of nitrogen
NSPS	New Source Performance Standards
O_2	oxygen
OSD	ozone season daily
Pechan	E.H. Pechan & Associates, Inc.
PM	particulate matter
PM_{10}	particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers
$PM_{2.5}$	particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
REMI	Regional Economic Models, Inc.
RIA	Regulatory Impact Analysis
RPOs	Regional Planning Organizations
RVP	Reid vapor pressure
SCCs	source classification codes
SIP	State Implementation Plan
SO_x	sulfur oxides
STI	Sonoma Technology, Inc.
TCEQ	Texas Commission on Environmental Quality
TSD	Technical Support Document
USDA	U.S. Department of Agriculture
VMT	vehicle miles traveled
VOC	volatile organic compound

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CHAPTER I. INTRODUCTION

The purpose of this project was to prepare emission growth and control factors that can be applied to the Central Regional Air Planning Association (CENRAP) 2002 base year emission inventory to obtain a 2018 emissions inventory for the CENRAP region. The CENRAP region includes the States and Tribal areas of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. In addition to the CENRAP States, additional factors were compiled under this project to include the entire CENRAP modeling domain. This includes projected emissions data or projection year growth and control factor data from the other Regional Planning Organizations (RPOs), Canada, and Mexico. All data products were prepared in SMOKE-compatible format.

These projection year growth and control factor data will be used to support air quality modeling and State Implementation Plan (SIP) development and implementation activities for the regional haze rule and fine particulate matter (PM) and ozone National Ambient Air Quality Standards (NAAQS). The data are applicable to all source categories and pollutants included in the CENRAP 2002 emission inventory. This includes the following pollutants: sulfur oxides (SO_x), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), ammonia (NH_3), and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$).

This Technical Support Document (TSD) explains the data sources that E.H. Pechan & Associates, Inc. (Pechan) used and the procedures Pechan followed in developing the necessary growth and control data for this project. Appendix A of this document contains the Methods Document that was prepared under this project. The purpose of this TSD is not to duplicate the information contained in that document, but to supplement it with the actual data obtained under this project and to note areas where the methods were modified from those included in the Methods Document. Chapter II of this document presents information on the control factors and growth factors that Pechan developed for the CENRAP States. The methods are presented separately for each of the major source categories. Chapter III of this document presents the data sources and methods that Pechan used to compile the data for areas outside of the CENRAP States, including other RPOs and Canada and Mexico. Issues of concern are discussed in Chapter IV and references are included in Chapter V. Appendix A contains the Methods document prepared for this project and Appendix B contains the Quality Assurance Project Plan for this work.

This TSD is accompanied by a set of SMOKE-formatted modeling files, as well as a set of State-level Excel spreadsheets. The State spreadsheets are included for area source controls, point source controls, VMT growth, area and point source growth factors, and nonroad emissions. These spreadsheets summarize data contained in the modeling files, in a more readable format. The control files also contain 2002 emissions, in most cases, so that the effects of the controls can be estimated, using the 2002 emissions as a base (e.g., without the growth factors applied). These spreadsheets can be used by the States to review the inputs to the SMOKE modeling in more detail and can be used to help in quality assuring the emissions calculated by the SMOKE model.

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CHAPTER II. DEVELOPMENT OF GROWTH AND CONTROL FACTORS FOR THE CENRAP STATES

A. DEVELOPMENT OF GROWTH FACTORS FOR NON-EGU POINT AND AREA SOURCES

This chapter identifies the data sources and methods that Pechan used to develop point and area source emission activity growth factors to support 2018 emission projections for CENRAP. Table II-1 identifies the Regions and States for which Pechan developed emission activity growth factors. It is important to note that this section describes the development of growth factors for all point and area sources in the CENRAP base year inventory. For the EGU sector, CENRAP will be using emission data projected by the Integrated Planning Model (IPM). These IPM projections are not expected to be completed until late in the summer of 2005. Because these data were not available at the time Pechan prepared the point source growth factors, the growth factors Pechan prepared included growth factors for all EGU source classification codes (SCCs) that were included in the base year inventory as described in this section. When the IPM model runs are completed, the IPM-based emissions should overwrite EGU emissions projected with these growth factors. As such, these EGU growth factors should be considered as temporary placeholders.

Table II-1. Regions and States Included in Emission Activity Growth Factor Files

Region	States	Region	States	Region	States
CENRAP	Arkansas	MANE_VU	Connecticut	Midwest RPO	Indiana
	Iowa		District of Columbia		Illinois
	Kansas		Delaware		Michigan
	Louisiana		Massachusetts		Ohio
	Minnesota		Maryland		Wisconsin
	Missouri		Maine		
	Nebraska		New Hampshire		
	Oklahoma		New Jersey		
	Texas		New York		
			Pennsylvania		
			Rhode Island		
			Vermont		

NOTE: growth factors are also included for offshore emission source categories located in the Gulf of Mexico.

In addition to all point and area source categories, it was necessary to develop growth factors for the following nonroad source categories because they are not included in EPA's NONROAD model: railroads, commercial marine vessels, and aircraft.

To identify the State/County/SCC combinations for which growth factors are required, Pechan summarized the CENRAP 2002 base year inventory (Pechan and CEP, 2005) and the base year inventories for MANE-VU and Midwest RPO available from CENRAP's visibility modeling website (CENRAP, 2005).[1] A zip file containing all of the data files titled "NonCENRAP States Inventory SMOKE Input Files" was available at CENRAP's website (see Table II-2 for list of files contained in the zip file). Because some of these files provide information for States outside of the geographic area of interest, the State/County/SCC summary did not include all of the States reported in these non-CENRAP State files.

Table II-2. Base Year Inventory Files for Non-CENRAP States

File Name	Contents
arinv_nei02_032404_MW_MVU_NOnh3.ida.txt	Midwest RPO and MANE-VU area sources excluding agriculture-related ammonia SCCs and fugitive dust emissions
ar_dust_phaseii_22mar04_USnoCENRAP.ida	U.S. fugitive dust inventory (excluding road dust)
nr_2002_23mar04_MW_MVU.ida	CENRAP, Midwest RPO, and MANE-VU 2002 nonroad mobile inventory
rdinv.pvd_US_${season}02_ida.txt	U.S. annual 2002 paved road dust inventory
rdinv.unp_US_${season}02_ida.txt	U.S. seasonal 2002 unpaved road dust inventory
ptinv_2002NEI_041504_MW_MVU.ida.txt	CENRAP, Midwest RPO, & MANE-VU point source inventory

In addition to the CENRAP web-site files noted above, Pechan was supplied with a separate file that listed SCCs used to report agriculture-related ammonia emissions in the non-CENRAP States (Omary, 2005). Because this file did not contain any geographic identifiers, Pechan developed a comprehensive list of MANE-VU and Midwest RPO State/SCC combinations that may exist in each region's base year inventory.[2]

The following sections describe the data and methods that were used to prepare emission activity growth factors for the State/County/SCC combinations of interest.

1. Overview

For most source categories, Pechan developed default emission activity growth factors utilizing data and methods that are expected to be incorporated into the final Economic Growth Analysis System (EGAS) Version 5.0. CENRAP selected EGAS 5.0-based growth factors over the growth factors available from EGAS 4.0 because the EGAS 5.0 growth factors will be based on the latest set of economic/demographic projections developed by Regional Economic Models, Inc. (REMI) and the latest energy forecasts prepared by the U.S. Department of Energy (DOE) (Houyoux, 2004; DOE, 2004). In addition, the crosswalk between SCCs and emission activity

[1] Note that projections/growth factors for the following regions were not developed because they were available from other studies: Visibility Improvement State and Tribal Association of the Southeast (VISTAS) and Western Regional Air Partnership (WRAP).

[2] Except for oil and gas production, Pechan did not have access to offshore-specific projections data. Therefore, Pechan assumed that Texas area growth factors could be used to represent growth in all offshore non-oil and gas production SCCs.

growth indicators and the regression equations relating socioeconomic indicators to emission activity levels will both be refined in EGAS 5.0. Furthermore, the REMI economic models in EGAS 5.0 allocate national economic activity based on relative production costs at the 53-sector level rather than the 14-sector level used in EGAS 4.0. Local relative factor costs may be substantially different for a given detailed industry within one of the 14-sectors included in the REMI models in EGAS Version 4.0. However, the 14-sector models cannot model this distinction, since they are constrained by data specified at this level of detail. More accurate regional forecasts result from the more detailed representation of relative cost competitiveness that is available from the EGAS 5.0 REMI models.

Because EGAS represents a default set of growth factors, Pechan investigated alternatives to the EGAS default indicators for the highest-emitting point, nonpoint, and nonroad SCCs in the base year inventory for the CENRAP States.[3] Based on this review, Pechan identified a number of alternatives that were deemed preferable to the EGAS defaults, including:

- Use of regression equations developed for EGAS 5.0, but not incorporated into the beta version (for architectural coating and commercial pesticide application SCCs);[4]
- Replacement of suspect beta EGAS 5.0 growth factors with values deemed to be more reasonable;[5]
- Use of county-level population projections available from each State in the CENRAP region;
- Use of *Annual Energy Outlook* (AEO) projections (for oil and gas production SCCs);
- Use of average historical values (for prescribed burning SCCs);
- Extrapolation of historical trend (for unpaved road SCCs);
- Use of United States Department of Agriculture (USDA) projections of planted acreage for major crops (for crop tilling SCCs);
- Use of onroad vehicle miles traveled projections (for paved road SCCs); and
- Use of USDA livestock projections (for swine, cattle and calves, and poultry SCCs).

[3]Note that this discussion only applies to nonroad SCCs that are not included in the NONROAD model. A separate Pechan memorandum addressed refinements to the NONROAD model default growth information.

[4]The current EGAS 5.0 design does not support incorporation of some of the emission activity forecasting equations that Pechan developed for use in EGAS 5.0.

[5]The beta version of EGAS 5.0 has not yet undergone beta testing to identify/fix suspect values.

Further details on these emission activity growth surrogates are provided in the following section.

2. Alternative Forecast

There are a number of problems and shortcomings of the beta version of EGAS 5.0 that was available during this project's period of performance. Although some of these limitations were known at the time the beta version was released in November 2004 (see http://www.epa.gov/ttn/ecas/EGAS5limitations.pdf), a number of additional problems have since been identified. Therefore, except as noted below, point and non-point source emission projections rely on the methods and data that are expected to be incorporated into the final version of EGAS 5.0 rather than the information in the beta version. The following subsections summarize differences between the information developed for this effort and the EGAS 5.0 beta version.

a. Use of Regression Equations Not Yet Incorporated into EGAS

For certain sectors, Pechan utilized regression equations developed for EGAS 5.0, but not incorporated into the beta version. For the SCCs displayed in Table II-3, Pechan replaced the beta EGAS 5.0 growth factors based on REMI socioeconomic data with growth factors derived from the emission estimation approaches developed for EGAS 5.0 that have yet to be incorporated. The following sections identify the emission activity forecasting methods that were applied to these SCCs.[6]

Table II-3. Additional Source Categories Utilizing Regression Equation Approach

SCC	SCC Description
2401001000	Solvent Utilization; Surface Coating; Architectural Coatings; Total: All Solvent Types
2461800000	Solvent Utilization; Miscellaneous Non-industrial: Commercial; Pesticide Application: All Processes; Total: All Solvent Types
2810030000	Miscellaneous Area Sources; Other Combustion; Structure Fires; Total

i. Architectural Coating

To estimate growth factors representing the future year to base year change in volume of architectural coatings consumed, Pechan developed the following equation by regressing national coating shipments over the period 1981-2001 against data for a number of potential explanatory variables:

$$y = b_0 + b_1 * x + b_2 * LAG(y) \quad \text{(Eq. 1)}$$

[6] Note that there may be other SCCs for which the final version of EGAS 5.0 will incorporate additional regression equations. Pechan will update the growth factor files to reflect the latest available information as to the list of SCCs for which the final EGAS 5.0 will utilize the approaches identified in this section.

where:

y	=	ratio of current year architectural coating shipments to base year shipments
b_0	=	-0.017
b_1	=	0.614
b_2	=	0.437
x	=	current year housing expenditures
$LAG(y)$	=	ratio of previous year's architectural coating shipments to base year shipments.

This equation is not incorporated into the beta EGAS 5.0 because the program currently does not support equations with lagged variables. In addition to the total volume of coatings used, it is important to reflect any projected change in the solvent content of these coatings because the emission activity for these SCCs is the amount of solvent emitted from these coatings. Therefore, Pechan recommended that EPA incorporate factors into EGAS 5.0 that reflect the projected future year architectural coating solvent content relative to base year solvent content (Pechan, 2004). Although these factors are not incorporated into the beta EGAS 5.0, they are expected to be included in the final EGAS 5.0. Therefore, Pechan obtained data representing the proportion of forecast year total and 2002 total architectural paints shipments that are solvent-based from the Freedonia Group, Inc. (Freedonia, 2002). Based on the available forecast information, Pechan applied a factor of 0.729 to the 2018 growth factor developed from the output of equation 1 for each State. The Freedonia data were reported for 1992 and each fifth year over the period 1996 to 2011. Pechan interpolated between the 2001 and 2006 values to obtain a 2002 value and used the 2011 value for 2018 in lieu of any forecast information beyond 2011.

ii. Commercial Pesticide Application

To estimate the amount of commercial pesticides applied, Pechan computed the following equation by regressing the national volume of active pesticide ingredients applied over the period 1980-1999 against data for a number of potential explanatory variables:

$$LOG(y) = b_0 + b_1 * LAG\,(LOG(y)) + b_2 * LOG(x) \quad \text{(Eq. 2)}$$

where:

$LOG(y)$	=	ratio of current year log of volume of active pesticide ingredients to base year log of volume of ingredients
b_0	=	-0.003
b_1	=	0.480
b_2	=	0.334
x	=	current year Agricultural Chemicals sector (SIC code 287) employment
$LAG(LOG(y))$	=	ratio of previous year's log of volume of active pesticide ingredients to base year's log of volume of ingredients.

This equation is not incorporated into the beta EGAS 5.0 because the program currently does not support equations with lagged variables. It is important to reflect any projected change in the solvent content of the pesticides. Therefore, Pechan recommended that EPA incorporate factors into EGAS 5.0 that reflect the ratio of future year volume of solvents per dollar of Agricultural Chemical sector shipments to base year volume of solvents for these shipments (Pechan, 2004). Although these factors are not incorporated into the beta EGAS 5.0, they are expected to be included in the final EGAS 5.0. Therefore, Pechan obtained data representing the proportion of forecast year and 2002 volume of solvents per dollar of Agricultural Chemicals sector shipments from the Freedonia Group, Inc. (Freedonia, 2003). Based on the available forecast information, Pechan applied a factor of 1.048 to the 2018 growth factor developed from the output of equation 2 for each State. Freedonia's solvent content data were reported for each fifth year over the period 1992 to 2012, including 2002. In lieu of any forecast information beyond 2012, Pechan used the 2012 value to represent 2018.

iii. Structure Fires

EPA acknowledges that the structure fires forecast methodology/data were not properly incorporated into the beta version of EGAS 5.0. Therefore, Pechan replaced the beta EGAS 5.0 structure fire growth factors to follow the two-step approach that Pechan developed for use in EGAS 5.0, and, which is expected to be incorporated into the final EGAS 5.0 (Pechan, 2004). This approach relies on an equation that relates the number of housing units to housing expenditures and factors representing the projected change in the number of structure fires per 10,000 housing units. For this study, Pechan applied a factor of 0.905 to the housing unit projections that represents the change in structure fires per 10,000 housing units between 2002 and 2018.

b. Revisions To Beta EGAS 5.0 Regression-Based Growth Factors

Because the EGAS 5.0 emission activity projection equations were developed using national historical data, it is unclear if the EGAS 5.0 equation growth rates will appear reasonable when incorporating State-level values into each equation. Therefore, Pechan reviewed the output for each State to identify potentially anomalous growth factors. Pechan selected growth factors of 2 and 0.2 to represent thresholds in determining suspect values. In cases where State-level values were deemed to be questionable, Pechan implemented one of two types of refinements, depending on the number of States for which the equation-based approach resulted in suspect growth rates. The following summarizes the two types of refinements that were applied.

The first refinement, which was used when the equation output appeared questionable for many States, was to use a combination of national and State REMI data. This approach first projects national growth factors up through 2009 by inputting <u>national</u> values of the independent variable in the emission activity equation. The 2009-2018 national growth rates were estimated using methods that were unique for each source category.[7] Pechan developed State-level growth factors by multiplying the national equation-based factors by ratios representing each State's

[7]Post-2009 growth factors were not projected using the equation-based approach because of concerns that the estimated national post-2009 growth rates appear to be unsustainable.

growth relative to National growth for the REMI indicator used in the regression equation. Section a below provides further details on this projection approach.

The second refinement, which was applied to a few specific States when the State-level equation output appeared reasonable in most cases, was to use the State-level output of the equation only up through either 2007 or 2009. The 2018 growth factors were estimated for these States by extrapolating each State's projected growth over the 2002 to 2007/9 timeframe using an exponential curve fitted to the data for this period. Further details on this refinement are provided in Section ii below.

i. National Equation-Based Growth Factors

For three source categories – Consumer/Commercial Solvents: All Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Related Products; Surface Coating: Miscellaneous Manufacturing; and Consumer/Commercial Solvents: All Coatings and Related Products, the use of State-level REMI forecasts in the nationally-derived emission activity estimation equations results in numerous anomalous growth rates. For these source categories, Pechan first utilized national REMI projections in the emission activity equations. Because of the dramatically higher growth/decline predicted after 2009, Pechan used the regression equation to directly develop national growth factors only through 2009.

Consumer/Commercial Solvents: All FIFRA Products

The 2009 national growth factor was held constant through 2018 for this category because the emission activity equation first predicted a continuation of the historical decline in activity for this category through 2009, then forecasted an increase in activity that was uncharacteristically large by 2018. Because of the uncertainty of the predicted post-2009 trend, Pechan held the 2018 national growth factor constant at 2009 levels. Pechan developed State-level growth factors for this category by multiplying the national growth factors by State/National growth factor ratios. These ratios were determined using State/National projections for the REMI indicator (population) that was included in the emission activity equation.

Surface Coating: Miscellaneous Manufacturing and Consumer/Commercial Solvents: All Coatings

To estimate national 2018 growth factors for each of these two categories, Pechan reduced each national post-2009 annual growth rate, as estimated by each emission estimation equation, by one-half. This adjustment factor was used because it resulted in post-2009 growth rates that approximated those predicted over the 2002-2009 period. Pechan developed State-level growth factors by multiplying the national growth factors by State/National growth factor ratios. These ratios were determined using State/National projections for the REMI indicators that were included in each regression equation (value added in Miscellaneous Manufacturing Industries sector and value added in Chemicals and Allied Products sector).

ii. State Equation-Based Growth Factor Changes

Sulfite Pulping

The use of State-level REMI forecasts in the nationally-derived Sulfite Pulping emission activity equation resulted in uncharacteristically large post-2009 growth rate changes in the District of Columbia. For DC, Pechan used the output of the regression equations up through 2009; 2018 growth factors were developed by extrapolation using an exponential curve fitted to the 2002-2009 growth factor projections.

Electronic and Other Electrical Surface Coating

For Iowa, the use of State-level REMI forecasts in the nationally-derived Electronic and Other Electrical emission activity equation resulted in unusually large post-2007 growth rate changes. For this State, Pechan utilized the State-level equation output to develop growth factors through 2007. The 2018 growth factor was developed for Iowa via extrapolation using an exponential curve fitted to the projected 2002-2007 Iowa growth factors.

c. Non-EGAS Data Sources

Because EGAS provides a *default* set of emission activity growth indicators, Pechan reviewed the availability of better projections sources where time and resources permitted. The following two sections describe specific areas where EGAS default information was replaced with projections from alternative data sources.

i. Population

EGAS is geographically defined by State, and so differences in growth within a State are not reflected in the EGAS default growth factors. Therefore, to account for differences in population projections within a State, Pechan obtained county-level population projections from each State in the CENRAP region and replaced the State-level EGAS population projections with these county-level population projections (Kansas, 2004; LPDC, 2003; MNPLAN, 2002; MO, 1999; ODOC, 2002; SLI, 2004; TXCDS, 2004; UALR, 2003; and UNE, 2002). Appendix Table C-1 presents the population projections complied for this effort.

ii. Other Data

Because of resource constraints, Pechan's research into potential alternative data sources focused on the EGAS growth surrogates that are applied to the highest-emitting point, nonpoint, and nonroad SCCs in the base year inventory for the CENRAP States.[8] Tables III-1 through III-5 in an earlier Pechan report present the top 10 SCCs responsible for the highest 2002 emissions in the CENRAP States for each of the following pollutants: NO_x, PM25-PRI, NH_3, SO_2, and VOC (Pechan, 2005). Based on this review, Pechan was able to identify alternative data sources that

[8]Note that this discussion only applies to nonroad SCCs that not included in the NONROAD model. Refinements to the NONROAD model default growth information are addressed in Section D.1.

were deemed to provide better emission activity surrogates for many of these SCCs. These surrogates are summarized in Table II-4. The following sections describe the rationale for the use of these non-EGAS growth surrogates for projecting emissions in the CENRAP States.

Oil and Gas Production Forecasts

Pechan used DOE's *Annual Energy Outlook* 2004 regional forecasts of onshore and offshore oil and gasoline production (DOE, 2004). From maps of the regions, the production values were allocated to the lower 48 continental States. New Mexico and Texas were the only States to belong to multiple onshore production regions. For these States, Pechan calculated the total production from all regions associated with each State. For SCC 2310000000, on and offshore drilling, the offshore area of the Pacific was added the onshore West Coast region and the offshore area of the Gulf was added to the on-shore region the Gulf Coast to develop growth factors for the States within the overlapping regions.

Historical Average Acres Prescribed Burned

Historical prescribed burning acreage data indicate that 2002 represented a year with uncharacteristically high levels of burning activity. Therefore, Pechan computed the average acreage burned in each State from data available over the period 1996 through 2003 (EPA, 2005). The 2018 growth factors were then developed for each State by computing the ratio of 2002 acreage to the average acreage over the 1996 to 2003 period.

Planted Crop Acreage Forecasts

Pechan obtained 2002 through 2013 national planted acreage projections for major crops from the USDA (ERS, 2004). Pechan then developed an estimated national 2018 planted acreage value via linear extrapolation of the 2002 through 2013 trend.

USDA Livestock Projections

Pechan obtained national livestock projections from USDA's "February 2004 Agricultural Baseline, Projection Tables to 2013" for beef cows, cattle, young chickens and turkeys (ERS, 2004). The USDA's 2002 to 2013 estimates were projected to 2018 using linear extrapolation. The USDA data for young chickens and turkey data were combined for use in projecting poultry SCC emissions activity.

Table II-4. Summary of Non-EGAS Growth Indicators Used For Highest-Emitting SCCs in CENRAP Region

SCC	SCC Description	Growth Indicator	
		EGAS5	This Study
2294000000	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives	Population	Onroad VMT
2296000000	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives	Population	Extrapolation of regional historical trend
2310000000	Industrial Processes; Oil and Gas Production: SIC 13; All Processes; Total: All Processes	SIC 13 constant $ output	AEO regional production forecast
2310001000	Industrial Processes; Oil and Gas Production: SIC 13; All Processes; On-shore; Total: All Processes	SIC 13 constant $ output	AEO regional production forecast
2310002000	Industrial Processes; Oil and Gas Production: SIC 13; All Processes; Off-shore; Total: All Processes	SIC 13 constant $ output	AEO regional production forecast
2801000003	Miscellaneous Area Sources; Agriculture Production - Crops; Agriculture - Crops; Tilling	Farm sector constant $ value added	USDA national crop projections
2810015000	Miscellaneous Area Sources; Other Combustion; Prescribed Burning for Forest Management; Total	No growth	Historical average (2002 levels were greater than average)
2805020002	Miscellaneous Area Sources; Agriculture Production - Livestock; Cattle and Calves Waste Emissions; Beef Cows	Farm sector constant $ value added	USDA national beef cow inventory projection
2805020004	Miscellaneous Area Sources; Agriculture Production - Livestock; Cattle and Calves Waste Emissions; Steers, Steer Calves, Bulls, and Bull Calves	Farm sector constant $ value added	USDA national cattle inventory projection
2805025000	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production composite; Not Elsewhere Classified (see also 28-05-039, -047, -053)	Farm sector constant $ value added	USDA national hog inventory projection
2805030000	Miscellaneous Area Sources; Agriculture Production - Livestock; Poultry Waste Emissions; Not Elsewhere Classified (see also 28-05-007, -008, -009)	Farm sector constant $ value added	USDA national turkey plus young chicken inventory projection
2805047100	Miscellaneous Area Sources; Agriculture Production - Livestock; Swine production - deep-pit house operations (unspecified animal age); Confinement	Farm sector constant $ value added	USDA national hog inventory projection
30202001	Industrial Processes; Food and Agriculture; Beef Cattle Feedlots; Feedlots: General	Farm sector constant $ value added	USDA national beef cow inventory projection

Onroad Vehicle Miles Traveled Projections

Pechan used onroad VMT projections to forecast paved road fugitive dust emissions activity. The VMT projections are discussed in Section E.1 of this report.

Extrapolation of Historical Unpaved Road VMT Trend

Unpaved road VMT for 1990 to 2002 were compiled for each of the CENRAP States, based on data used in EPA's National Emission Inventory. A review of the data indicated a disconnect between the 1995 and 1996 values and questionable State-level unpaved road VMT trends. In addition, data for Arkansas and Minnesota appeared questionable for multiple years. Therefore, Pechan concluded that the most reasonable approach would be to develop a single regional growth factor based on post-1995 unpaved road VMT data excluding data for Arkansas and Minnesota. First, Pechan summed the VMT estimates for each year across CENRAP States (excluding Arkansas, and Minnesota). Next, Pechan identified a best fit linear function from the 1996 to 2002 regional data and used that function to estimate 2018 unpaved road VMT in the CENRAP region. The 2002 to 2018 regional growth factor (0.813) was then applied to all of the CENRAP States.

Point Source NOx Cap in Texas Ozone Nonattainment Areas

To account for a point source NO_x emissions cap in certain Texas ozone nonattainment area counties, Pechan applied a no growth assumption (growth factor of 1.0) to all NO_x point sources in the following Texas counties: Brazoria, Chambers, Collin, Dallas, Denton, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Montgomery, Orange, Tarrant, and Waller.

Integrated Planning Model

Pechan compiled a comprehensive set of growth factors for all base year EGU SCC records using EGAS 5.0. The EGAS 5.0 defaults are based on DOE's *Annual Energy Outlook* electric generation sector energy forecasts (DOE, 2004). For the final CENRAP modeling, it is anticipated that some, but not all, base year EGU SCC records will be projected using forecast information from IPM runs.

B. DEVELOPMENT OF CONTROL FACTORS FOR NON-EGU POINT SOURCES

This section describes control factor development for non-EGU point sources. This analysis focused on Federal, State, and local rules and regulations that are expected to reduce emissions or emission rates for criteria pollutants in the CENRAP States post-2002. After the control factor development is described, some examples of resulting emissions are provided as a point of reference.

1. State Controls

a. Texas

For developing control factors (expected emission reductions) for the non-EGU point source categories in Texas, it was recommended by Texas Commission on Environmental Quality (TCEQ) staff that the most recent Houston/Galveston Area (HGA) ozone episode modeling files be reviewed. Appropriate data are those listed in Chapter 3: Photochemical Modeling 2007 Future Base Case Summary of Controls Applied found on the TCEQ website (TCEQ, 2004). Separate files are posted according to the geographic area covered, and the applicable control programs. The non-EGU portion of this table is summarized below:

Geographic Area	Base Inventory	Controls Applied	File Name
Beaumont/Port Arthur	NEGU	Ch. 117 controls via Emission Factor Survey; assuming no VOC controls	control.2007.BPA.NEGU
Houston/Galveston	NEGU HRVOC Cap	2007 NO_x Cap Revised Speciation and Cap Cutoff Levels	control.HG_07NO$_x$Cap_NEGU control.new_hga_hrvoc_cap.to2n2_negu and then apply control.new_hga_hrvoc_cap.less20inharris
Dallas/Ft. Worth	NEGU	Ch. 117 controls via Emission Factor Survey; assuming no VOC controls	control.2007.dfw.negu
East Texas	Cement Kiln NO_x	Permit modifications	Already applied permit modifications to afs.MidloKilns._v5 via ellis_kilns.TIPI.00-07
	Agreed Orders and Consent Decree for East Texas	Specific reductions at ALCOA and Eastman	AgreedOrdersControlFactors00to07
West Texas	NEGU	None	None

i. Beaumont/Port Arthur (BPA)

The Beaumont/Port Arthur ozone nonattainment area includes Hardin, Jefferson, and Orange counties. TCEQ (2000a) expects that Tier 1 reductions in NO_x emissions from these three counties will be enough for Beaumont/Port Arthur to attain the 1-hour ozone standard.

The BPA.NEGU file lists the point sources in the Beaumont-Port Arthur ozone nonattainment area that have control factors applied for NO_x. Control factors were developed by facility and unit by the TCEQ by comparing survey results that established base year NO_x emission factors with Chapter 117 NO_x emission limits (which are by source category). The survey included all BPA NO_x sources with 25 tons per year or more of NO_x. Source-specific NO_x control factors range from 0.16 to 1.00 for affected sources.

ii. Houston/Galveston (HGA)

The Houston/Galveston ozone nonattainment area includes Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. On December 6, 2000, the TCEQ adopted a program for the trading of NO_x allowances in the HGA nonattainment area. The trading of these allowances takes place under an area-wide cap. The program requires incremental reductions beginning in 2003 and continuing through 2007, when the full reductions of the program are to be achieved. The trading program is expected to provide as much flexibility in meeting these limits as possible.

The most recent HGA SIP revision is based on analysis to date showing that limiting emissions of ethylene, propylene, 1,3-butadiene, and butanes in conjunction with an 80 percent reduction in NO_x is equivalent in terms of air quality benefit to that resulting from a 90 percent point source NO_x reduction requirement.

The Control.HG_NOxCap_NEGU files for 2007 and 2010, when applied to estimate a control factor for 2018, yield a control factor of 0.45 (a 55 percent reduction). The control factor affects all non-EGU point source NO_x emissions in this nonattainment area.

There are also requirements for additional fugitive VOC emission reductions in Houston-Galveston. These include new rules to reduce emissions of highly reactive VOCs from four key industrial sources: fugitives, flares, process vents, and cooling towers. The highly reactive VOC rules are performance-based, emphasizing monitoring, record keeping, reporting, and enforcement, rather than establishing individual unit emission rates. After evaluation of how these rules were applied in the Houston SIP analysis, which involved adding highly reactive VOCs to the 2000 emission inventory and removing those HRVOC emissions in the future case, it was decided to not apply any VOC control factors to the 2002 VOC emissions in the 2018 emission projections.

iii. Dallas/Fort Worth

Appendix F of the Dallas/Fort Worth ozone nonattainment demonstration (TNRCC, 1999a) identifies NO_x control factors proposed for specific industrial boilers and engines and EGUs in that area. These unit-specific reductions will be applied to estimate 2018 NO_x emissions.

30 TAC 117, Subchapter 13 limits NO_x emissions from cement kilns in the Dallas/Fort Worth area. This rule establishes emission limits on the basis of pounds of NO_x per ton of clinker produced. These limits are based on the NO_x emissions averaged over each 30 consecutive day period (later changed to a 365 day period), and vary depending on the type of cement kiln. These NO_x emission limits by kiln type are as follows:

1. For each long wet kiln:
    a. In Bexar, Comal, Hays, and McLennan Counties, 6.0 lbs/ton of clinker produced
    b. In Ellis County, 4.0 lbs/ton
2. For each long dry kiln, 5.1 lbs/ton
3. For each preheater kiln, 3.8 lbs/ton
4. For each preheater-precalciner or precalciner kiln, 2.8 lbs/ton

These emission limits are expected to achieve a 30 percent reduction in cement kiln NO_x emissions.

Appendix F of the Dallas/Fort Worth ozone nonattainment demonstration (TNRCC, 1999a) identifies eleven cement kilns modeled as part of the proposed Dallas/Fort Worth NO_x emission reduction strategy. The level of NO_x controls required by TNRCC ranged by unit from 6 percent to 66 percent. These controls were applied on a unit-by-unit basis.

The DFW.NEGU file lists the point sources in the Dallas-Ft. Worth area that have control factors applied for NO_x. Control factors were developed by facility and unit by the TCEQ using the same emission factor survey and comparison with NO_x emission limit technique that was described above for Beaumont-Port Arthur. The survey included all DFW NO_x sources that reported 2 tons per year or more of NO_x. Source-specific control factors range from 0.13 to 1.00 for affected sources.

Agreed order control factors from the TCEQ were applied to simulate the effects of such orders on two facilities. A control factor of zero is applied to the Eastman plant (482030019), simulating the shutdown of this facility. NO_x control factors are applied to three boilers at the Alcoa (483310001) aluminum production facility.

Another TCEQ control factor file contains information about the future year criteria pollutant emissions for the cement kilns in Ellis County. These emission estimates were used to estimate appropriate growth and control factors for the 2018 emission forecasts for this area/source category.

b. Missouri

The fine grid counties in eastern Missouri are affected by EPA NO_x SIP Call requirements. The State of Missouri supplied information about unit-specific NO_x emission reductions for affected facilities. For non-EGUs, this included an 8 ton per ozone season NO_x emission limit applied to Anheuser Busch-Unit 6, a 9 ton per ozone season limit applied to Trigen-Unit 5, and a 36 ton per ozone season limit applied to Trigen-Unit 6.

c. Kansas

Rule 28-19-717 requires control of VOC emissions from commercial bakery ovens in Johnson and Wyandotte counties. This rule applies to bakery ovens with a potential to emit VOCs equal to or greater than 100 tons per year. Each commercial bakery oven subject to this regulation shall install and operate VOC emissions control devices for each bakery oven to achieve at least an 80 percent total removal efficiency on the combined VOC emissions of all baking ovens, calculated as the capture efficiency times the control device efficiency. Each bakery oven (Keebler Company) in these two counties with more than 100 tons per year of VOC emissions in 2002 had an 80 percent VOC control efficiency applied in the 2018 projections.

d. Louisiana

Point sources in the Baton Rouge nonattainment area and the nearby region of influence are affected by Chapter 22 NO_x control provisions. The provisions of this chapter apply to any affected facility in the Baton Rouge nonattainment area (the entire parishes of Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge) and the Region of Influence (affected facilities in the attainment parishes of East Feliciana, Pointe Coupee, St. Helena, and West Feliciana). The provisions of this chapter apply during the ozone season (May 1 to September 30) of each year. Compliance is expected to occur as expeditiously as possible, but no later than May 1, 2005.

The effects of this NO_x regulation were included in the analysis by applying a 34 percent NO_x emission reduction to the 2002 non-EGU point source emissions in the greater Baton Rouge area. This control factor application is consistent with what was included in the most recent Houston-Galveston area modeling domain assessments by the TCEQ.

2. Federal Maximum Achievable Control Technology (MACT) Standards

Numerous MACT standards have been promulgated pursuant to Section 112 of Title I of the Clean Air Act, and are controlling emissions of hazardous air pollutants (HAPs) from stationary sources of air pollution. Many of the MACT standards are expected to produce associated VOC reductions, since many HAPs are also VOCs, so the emission projections need to capture the expected effects of post-2002 MACT standards.

Pechan performed the following steps to determine the MACT standards expected to have the greatest impact of VOC, NO_x, and PM emissions for the forecast year:

1. Identified the source categories and associated SCCs for each MACT standard having a post-2002 compliance date for existing sources.
2. Eliminated MACT categories that do not achieve significant VOC emission reductions.
3. VOC emission reduction estimates for the reciprocating internal combustion engine MACT category are based on information from EPA's Clean Air Interstate Rule technical support document (Alpine, 2004).
4. VOC emission reduction estimates for all other MACT categories are based on information found in the preamble to the final rule of each MACT Subpart as published in the *Federal Register*. Table II-5 lists those MACT categories for which VOC, NO_x, and/or PM emission reduction percentages could be estimated based on emission reduction information found in the preamble to each respective final rule.

3. Non-EGU Point Source Analysis Results

a. Houston Galveston Area (HGA)

Pechan's modeling of the NO_x emissions cap in the 8-county HGA applies a 55 percent NO_x emission reduction to the 2002 NO_x point source emissions. NO_x emissions in the HGA are expressed in annual tons. These annual tons and the equivalent ozone season daily (OSD) tons are listed below. Then, the right-most column below shows the comparable values from the TCEQ analysis for HGA.

Table II-5. Post-2002 MACT Standards and Expected VOC, NO_x, and PM Reductions

MACT Standard - Source Category	Code of Federal Regulations Subpart	Compliance Date (existing sources)	VOC (% Reduction)	NO_x (% Reduction)	Total PM (% Reduction)	Affected SCCs
Asphalt		5/1/2006	85			305001XX, 305002XX, 305050XX, 306011XX
Auto and Light Duty Trucks	IIII	4/26/2007	40			40201601 to 40201632; 40201699
Coke Ovens: Pushing, Quenching and Battery Stacks	CCCCC	4/14/2006	43			30300304; 30300303
Fabric Printing, Coating & Dyeing	OOOO	5/29/2006	60			40201101 to 40201199; 40201201; 40201210
Friction Products Manufacturing	QQQQQ	10/18/2005	44			30111103; 30111199; 31401001; 31401002
Integrated Iron and Steel	FFFFF	5/20/2006	20		20	30301501 to 30301596
Large Appliances	NNNN	7/23/2005	45			40201401 to 40201499
Leather Finishing Operations	TTTT	2/27/2005	51			32099997; 32099998; 32099999
Lime Manufacturing	AAAAA	1/5/2007			23	305016XX
Manufacturing Nutritional Yeast	CCCC	5/21/2004	10			30203404 to 30203424; 30203504 to 30203540
Metal Can	KKKK	6/10/2005	70			40201702; 40201703 to 40201799
Metal Coil	SSSS	6/10/2005	53			402018XX
Metal Furniture	RRRR	5/23/2006	73			402020XX
Misc. Coating Manufacturing	HHHHH	12/11/2006	64			402026XX
Misc. Metal Parts and Products	MMMM	1/2/2007	48			402025XX
Misc. Organic Chemical Production and Processes (MON)	FFFF	11/10/2006	66			645200XX; 30113001 to 30113007; 684300XX; 30101005 to 30101099; 68445001; 68445010; 68445013; 68445020; 68445022; 68445101; 68445201; 30110002 to 30110099; 64820001; 64820010; 64821001; 64821010; 64822001; 64822010; 64823001; 64823010; 64823001; 64823010; 64880001; 64882001; 64882002; 64882599; 30105001; 30105101 to 30105130; 30801001; 31604001; 31604002; 31600403; 68510001; 68510010; 68510011; 68580001; 68582001; 68582002; 68582599; 30101837; 64610301 to 64610350; 64610001 to 64610050; 64610101 to 64610150; 64610201 to 64610250; 64615001 to 64615030; 64620001 to 64620038; 64630001 to 64630083; 64631001 to 64631083; 64632001 to 64632083; 64680001; 64682001; 64682002; 64682501; 64682502; 64682599; 64130001 to 64130025; 64130101 to 64130125; 64130201 to 64130225; 64131010 to 64131030; 64132001 to 64132030; 64133001 to 64133030; 64180001; 64182001; 64182002; 64182599; 64615001; 64620001; 65135001

Table II-5 (continued)

MACT Standard - Source Category	Code of Federal Regulations Subpart	Compliance Date (existing sources)	VOC (% Reduction)	NO_x (% Reduction)	Total PM (% Reduction)	Affected SCCs
Paper and Other Web	JJJJ	12/4/2005	80			30701199; 402013XX
Pesticide Active Ingredient Production	MMM	12//23/2003	65			30103301
Petroleum Refineries	UUU	4/11/2005	55			Catalytic cracking: 30600201; 30600202; 30600301 Catalytic reforming: 30601601; 30601602; 30601603; 30601604
Plastic Parts	PPPP	4/19/2007	80			402022XX
Plywood and Composite Wood Products	DDDD	9/28/2007	54			307007XX; 30700921 to 30700971; 30701001 to 30701057; 30700602 to 30700661
Polymers and Resins III	OOO	1/20/2003	51			Phenolic resins: 30101805; “polyamide” resins: 30101827
Reciprocating Internal Combustion Engines (RICE)	ZZZZ	6/15/2007	13	17		20100102; 20100202; 20100702; 20100802; 20100902; 20200102; 20200104; 20200202; 20200204; 20200301; 20201001; 20201002; 20201012, 20201014; 20201602; 20201702, 20200501; 20200702; 20200706; 20200902; 20300101; 20300201; 20300301
Rubber Tire Manufacturing	XXXX	7/11/2005	52			308001XX
Secondary Aluminum Production	RRR	3/24/2003			61	30400101 to 30400199
Site Remediation	GGGGG	10/8/2006	50			504001XX; 50400201, 50400202; 504002XX; 504100XX; 504101XX; 504102XX; 504103XX; 504102XX; 504103XX; 504104XX; 504105XX; 504106XX; 504107XX; 50480001; 50482001; 50482002; 50482599; 50480004
Solvent Extraction for Vegetable Oil Production	GGGG	4/12/2004	25			302019XX
Stationary Combustion Turbines	YYYY	3/5/2007	90			20100101, 20100201, 20200101, 20200103, 20200201, 20200203, 20200901, 20300102, 20300202, 20300203
Taconite Iron Ore Processing	RRRRR	10/30/2006			62	32302371 to 32302399
Wet Formed Fiberglass Mat Production	HHHH	4/11/2005	74			30501201 to 30501299
Wood Building Products	QQQQ	5/28/2006	63			40202101 to 40202199

NOTE: **Based on organic HAP emission reductions

	HGA Non-EGU NO_x Emissions		
	Annual Tons	**Daily Tons**	**TCEQ Analysis OSD Tons**
2002 Point Source NO_x	113,109	309.9	283
Post-cap NO_x	50,899	139.4	135

The TCEQ analysis OSD NO_x cap summary values above are for non-EGU 2000 NO_x and 2007 modeled NO_x (see Table 3.5-16 in their report). The above comparison indicates that the CENRAP NO_x modeling for HGA will be consistent with prior analyses by TCEQ for this area.

b. Beaumont-Port Arthur (BPA)

Pechan's modeling of the NO_x emissions cap in the 3-county BPA area applies NO_x control efficiencies based on an emission factor survey for the area. These results are summarized below.

	BPA Area Non-EGU NO_x Emissions		
	Annual Tons	**Daily Tons**	**TCEQ Analysis Daily Tons**
2002 Point Source NO_x	35,441	97.0	96.6
Post-cap NO_x	28,254	77.4	81.9

The TCEQ analysis OSD NO_x cap summary values above are for non-EGU 2000 NO_x OSD and 2007 modeled NO_x with growth and controls. The CENRAP non-EGU NO_x emissions in the 2002 point source file are about the same as the 2000 estimates on an OSD basis. However, the expected emission benefit of the non-EGU NO_x controls is greater than that modeled by TCEQ on both a percentage and an absolute tonnage basis.

c. Dallas Fort Worth (DFW)

Pechan's modeling of the NO_x emissions cap in the 4-county DFW area applies NO_x control efficiencies to certain sources based on an emission factor survey for the area. These results are summarized below.

	DFW Area Non-EGU NO_x Emissions		
	Annual Tons	**Daily Tons**	**TCEQ Analysis Daily Tons**
2002 Point Source NO_x	846	2.3	6.9
Post-cap NO_x	647	1.8	13.1

The TCEQ analysis OSD NO_x ton values listed above are for non-EGU 2000 NO_x OSD and 2007 modeled NO_x with growth and controls. The 2002 and post-cap NO_x tons listed for the DFW area only include sources affected by the NO_x control program, so these values are much lower than the TCEQ emissions, which include all non-EGU point source emissions in the area.

d. Baton Rouge

Pechan's modeling of the NO_x emissions cap in the greater Baton Rouge area applies a 34 percent NO_x emissions reduction to the 2002 NO_x point source emissions. These results are summarized below.

	Baton Rouge 9-Parish Area Non-EGU NO_x Emissions		
	Annual Tons	Daily Tons	TCEQ Analysis Daily Tons
2002 Point Source NO_x	74,847	205	630.9
Post-cap NO_x	49,399	135	586.2

The TCEQ analysis daily tons summary values above are for the entire State of Louisiana, and are for non-EGU 2000 NO_x and 2007 NO_x with growth and LDEQ SIP controls. Because the TCEQ summaries are for the entire State, the values are necessarily higher than those for the 9-parish area. Pechan estimates a 70 tpd NO_x reduction for the 9-parish NO_x control program. TCEQ estimates that the Statewide emission benefit of the LDEQ SIP controls is a 45 tpd reduction from 2000 levels, or a 61 tpd reduction from what the 2007 NO_x emissions would be expected to be without the Baton Rouge SIP controls.

C. DEVELOPMENT OF CONTROL FACTORS FOR AREA SOURCES

1. State Controls

Table II-6 summarizes regulations in the CENRAP States for which more stringent State requirements relative to Federal rules are in place for the mobile equipment repair and refinishing (MERR), architectural and industrial maintenance (AIM) coatings, consumer products and solvent cleaning area source VOC emission categories. For categories where more stringent rules for these categories are not found in the State regulations, "National Rule" is stated to refer to the applicable Federal requirements. The sections below describe how the information from these rules were used to develop control efficiencies. Table II-7 summarizes the final control efficiencies that were used to model these rules, and the counties and SCCs where these rules were applied.

Stage II, or at-the-pump, refueling control programs are in place in three States in the CENRAP region—Louisiana, Missouri, and Texas. Although these programs may have been in place prior to 2002, these controls are included here because the phase-in of the onboard vapor recovery systems controls changes the overall refueling control efficiency of Stage II programs.

Table II-6. VOC Solvent Rule Summary

SCCs	2465000000	2401001000	2415360000, 2415300000, 2415230000, 2415200000	2401005000	
State	**Consumer Products**	**AIM Coating**	**Solvent Cleaning Operations**	**Mobile Equipment Repair and Refinishing**	**State Contact, e-mail**
Arkansas	National Rule	National Rule	National Rule	National Rule	
Iowa	National Rule	National Rule	National Rule	National Rule	Marnie Stein Marnie.stein@dnr.state.ia.us
Kansas	National Rule	National Rule	28-19-714 The provisions of this regulation apply to cold cleaning, open-top vapor degreasing, and conveyorized degreasing operations located in Johnson and Wyandotte counties, and to the sale of cold cleaner solvents for use within either county. These requirements apply after August 31, 2002. Only cold cleaning solvents with a vapor pressure less than 1.0 mm Hg at 68F shall be used. Only cold cleaning solvents with a vapor pressure less than 5.0 mm Hg at 68F shall be used for each cold cleaning operation that is used for cleaning carburetors. Each cold solvent cleaner shall be equipped with a cover. Open-top vapor degreasers shall be equipped with a cover. Conveyorized degreasers shall have a processing system with an overall VOC control efficiency of 65 percent or greater.	National Rule	
Louisiana	National Rule	National Rule	Title 33, Part III Subchapter C, Section 2125 (Vapor Degreasers) These requirements were last amended April 2004. Open-top vapor degreasers shall achieve an overall VOC control efficiency of 85 percent or greater.	National Rule	
Minnesota	National Rule	National Rule	National Rule	National Rule	Paul Kim Paul.kim@state.mn.us
Missouri - Statewide (metro and outstate areas)	National Rule	National Rule	National Rule	National Rule	
Missouri - St. Louis metro area only (city of St. Louis, and St. Louis, St. Charles, Jefferson & Franklin counties)	National Rule	National Rule	- 10 CSR 10-5.300 (degreasing operations) - 10 CSR 10-5.455 (solvent cleanup operations not subject to degreasing operations) - Effective 2001 - Rule covers entire areas of counties specified - Cold cleaners, open-top vapor degreasers and conveyorized cleaner requirements modeled after 1977 CTG - Restrictions on cold cleaning more stringent than CTG in some cases - EPA NESHAP Subpart T requirements override some solvent cleaning requirements - Degreasers meeting certain size/solvent criteria required to meet minimum 65% VOC reduction efficiency	National Rule	

Table II-6 (continued)

SCCs	2465000000	2401001000	2415360000, 2415300000, 2415230000, 2415200000	2401005000	
State	**Consumer Products**	**AIM Coating**	**Solvent Cleaning Operations**	**Mobile Equipment Repair and Refinishing**	**State Contact, e-mail**
Missouri - Kansas City metro area only (Clay, Jackson, Platte counties)	National Rule	National Rule	- 10 CSR 10-2.210 (degreasing operations) - 10 CSR 10-2.215 (solvent cleanup operations not subject to degreasing operations) - Effective 2001 - Rule covers entire areas of counties specified - Cold cleaners, open-top vapor degreasers and conveyorized cleaner requirements modeled after 1977 CTG - Restrictions on cold cleaning more stringent than CTG in some cases - EPA NESHAP Subpart T requirements override some solvent cleaning requirements - Degreasers meeting certain size/solvent criteria required to meet minimum 65% VOC reduction efficiency	National Rule	
Nebraska	National Rule	National Rule	National Rule	National Rule	David Brown David.brown@ndeq.state.ne.us
Oklahoma	National Rule	National Rule	National Rule	National Rule	Ray Bishop Ray.bishop@deq.state.ok.us
Texas	Chapter 115.612 establishes control requirements effective in February 2004 for automotive windshield washer fluid. No person shall sell, supply, offer for sale, distribute, or manufacture for use in Texas any automotive windshield washer fluid containing VOCs in excess of 23.5% by weight.	Rule 115.420 applies to surface coating processes.	Degreasing processes in the Beaumont/Port Arthur, Dallas/Ft. Worth, and Houston/Galveston areas and in Gregg, Nueces, Victoria, Bexar, Comal, Guadalupe, Wilson, Bastrop, Caldwell, Hays, Travis, and Williamson counties have VOC control requirements via Chapter 115.412 for cold solvent cleaning and open-top vapor or conveyorized degreasers. The cold solvent cleaner requirement is equivalent to a VOC reduction efficiency of 65 percent or greater. The open-top vapor or conveyorized degreaser requirement is equivalent to a VOC reduction efficiency of 85 percent or greater.	Rule 115.422 control requirements apply in Beaumont/Port Arthur, Dallas/Fort Worth, El Paso, and Houston/Galveston. Vehicle refinishing operations shall minimize VOC emissions during equipment cleanup via enclosed containers for washing, rinsing, and draining, keeping wash solvents in an enclosed reservoir, and waste solvents and other cleaning materials in closed containers. Coating application equipment shall have a transfer efficiency of at least 65 percent.	

Table II-7. VOC Solvent Controls As Modeled

Counties	Pollutant	Control Efficiency* (%)	SCC	Description
KS: Johnson, Wyandotte	VOC	66	2415000000	Solvent Utilization: Degreasing: All Processes/All Industries
TX: Dallas, El Paso, Galveston, Hardin, Harris, Jefferson, Tarrant	VOC	35	2401005000	Auto Refinishing: SIC 7532
TX: Bastrop, Bexar, Caldwell, Comal, Gregg, Guadalupe, Hays, Nueces, Travis, Victoria, Williamson, Wilson	VOC	83	2415105000	Furniture and Fixtures (SIC 25): Open Top Degreasing
			2415110000	Primary Metal Industries (SIC 33): Open Top Degreasing
			2415120000	Fabricated Metal Products (SIC 34): Open Top Degreasing
			2415125000	Industrial Machinery and Equipment (SIC 35): Open Top Degreasing
			2415130000	Electronic and Other Elec. (SIC 36): Open Top Degreasing
			2415135000	Transportation Equipment (SIC 37): Open Top Degreasing
			2415140000	Instruments and Related Products (SIC 38): Open Top Degreasing
			2415145000	Miscellaneous Manufacturing (SIC 39): Open Top Degreasing
TX: Statewide	VOC	17	2460400000	Solvent Utilization: Miscellaneous Non-industrial: Consumer and Commercial: All Automotive Aftermarket Products

*These control efficiencies are all applied with a rule penetration of 100 percent and a rule effectiveness of 100 percent.

a. Kansas

i. Solvent Cleaning Operations

Kansas Rule 28-19-714 contains a 1.0 mm Hg maximum vapor pressure requirement for solvent cleaning operations, effective September 2002. Based on an evaluation of the Ozone Transport Commission (OTC) model rule for this source category, a 1.0 mm Hg at 68°F maximum VOC vapor pressure requirement leads to an estimated 66 percent reduction in VOC emissions relative to the national rule for cold cleaners and vapor degreasers (Pechan, 2001). The Kansas rule also includes a higher (5.0 mm Hg at 68°F) maximum vapor pressure requirement for the cleaning of carburetors, but this difference may not be significant relative to the OTC rule. Conveyorized degreasers are required to achieve an overall VOC control efficiency of 65 percent or greater; however, the Kansas rule does not appear to include any additional requirements relative to the national rule (other than the maximum vapor pressure requirements). Therefore, a 66 percent post-2002 VOC control efficiency was applied in Johnson and Wyandotte Counties, based on data from the OTC model rule.

b. Missouri

i. Solvent Cleaning Operations

Based on Pechan's review of Missouri's regulations, solvent cleaning regulations applicable to the Kansas City and St. Louis metropolitan areas appear to be more stringent than the national rule; however, these rules became effective before 2002. Therefore, no additional solvent controls were applied in Missouri.

ii. Stage II Refueling Controls

Stage II controls are required in the city of St. Louis and the following St. Louis area counties: Franklin County, Jefferson County, St. Charles County, and St. Louis County. This is required under 10 CSR 10-5.220 "Control of Petroleum Liquid Storage, Loading and Transfer." This regulation requires that gasoline stations with a minimum monthly throughput of 10,000 gallons of gasoline are required to maintain a 95 percent efficiency of total capture and emission reduction. These gasoline station owners are required to comply with the Missouri Performance Evaluation Test Procedures beginning in 1998.

c. Louisiana

i. Solvent Cleaning Operations

Title 33, Part III, Section 2125 specifies additional operational requirements for open top vapor degreasers not found in EPA's 1977 control techniques guideline (CTG). One requirement of the Louisiana Code specifies a minimum 85 percent VOC reduction efficiency for open top vapor degreasers not found in the CTG. Section 2125 was last amended in April 2004.

ii. Stage II Refueling Controls

A Stage II control program is in place in the following parishes in Louisiana: Ascension, East Baton Rouge, Iberville, Livingston, Pointe Coupee, and West Baton Rouge. The Stage II controls are required to attain a minimum of 95 percent gasoline vapor control efficiency at stations with a minimum throughput of 10,000 gallons of gasoline per month. This rule is under Title 33, Part III, Section 2132 "Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities." Compliance with these regulations was first required in 1993.

d. Texas

i. Cold Cleaners

The 1977 CTG for cold solvent cleaners is estimated to achieve VOC emission reductions of between 55 and 69 percent relative to 1977 baseline (uncontrolled) levels (Pechan, 2002). Texas rule 115.412 is equivalent to VOC emission reductions of at least 65 percent relative to uncontrolled levels. There do not appear to be any significant differences between the Texas rule and the CTG, and therefore no additional VOC reductions were applied to the 2002 Texas inventory for cold cleaners.

ii. Open-top Vapor or Conveyorized Degreasers

The national rule for vapor degreasing is estimated to achieve VOC emission reductions of between 10 and 15 percent (Pechan, 2002). The Texas rule 115.412 requires VOC emission reductions of at least 85 percent from these sources for the following counties: Bastrop, Bexar, Caldwell, Comal, Gregg, Guadalupe, Hays, Nueces, Travis, Victoria, Williamson, and Wilson. Assuming that the baseline 2002 vapor degreasing emissions include a 10 percent reduction from the national rule and that a total control of 85 percent would be applied to comply with the Texas rule, the incremental reduction from the Texas rule, relative to the 2002 emissions, would be 83 percent. This rule became effective in December 2004.

iii. Mobile Equipment Repair and Refinishing

Texas rule 115.422 requires that coating application equipment shall have a transfer efficiency of at least 65 percent and requires the use of high volume low pressure (HVLP) spray guns. This rule applies in the following counties: Dallas, El Paso, Galveston, Hardin, Harris, Jefferson, and Tarrant. Based on an evaluation of the OTC model rule for this source category, the use of “high transfer efficiency” HVLP guns is estimated to achieve a 35 percent VOC emission reduction relative to the national rule (Pechan, 2001). Spray gun controls are estimated to contribute an additional 3 percent VOC emission reduction. However, the Texas rule contains a less stringent requirement for the enclosure of spray guns and related parts. Therefore, a 35 percent post-2002 VOC control efficiency incremental to the national rule was applied in the counties listed above to account for this rule. This rule became effective in May 2002.

iv. Consumer Products

The national rule limits the VOC content of windshield wiper fluid to 35 percent by weight (effective December 1998). The Texas rule 115.612 limits the VOC content to 23.5 percent by weight. This represents a 33 percent reduction in the VOC content (and as a result, emissions) from the 2002 baseline. A single SCC includes all “auto aftermarket products”. Therefore, an assumption must be made as to what fraction of emissions from auto aftermarket products can be attributed to auto wiper fluid. An engineering estimate of 50 percent was applied, based on the assumption that the other major VOC-emitting auto aftermarket products (waxes, polishes and cleaning products) are likely consumed in lesser quantities by volume than windshield wiper fluid. Thus, the reduction applied to VOC emissions from the SCC representing auto aftermarket products was 17 percent. This rule became effective in February 2004.

v. Portable Fuel Containers

Texas has a portable fuel container rule (Statewide). In TCEQ analyses, this has been modeled as a reduction in evaporative VOC emissions using lawn and garden equipment SCCs within EPA’s NONROAD model. See the Nonroad section of this chapter for information about how the rule effects were incorporated in the analysis.

vi. Stage II Refueling Controls

Stage II refueling controls are required in the following Texas counties: Brazoria, Chambers, Collin, Dallas, Denton, El Paso, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Montgomery, Orange, Tarrant, and Waller. This is regulated by the TCEQ Chapter 115, Sections 240 through 249 "Control of Vehicle Refueling Emissions (Stage II) at Motor Vehicle Fuel Dispensing Facilities." This regulation requires that gasoline stations with a minimum monthly throughput of 10,000 gallons of gasoline are required to have installed an approved Stage II vapor recovery system which is certified to reduce VOC emissions to the atmosphere by at least 95 percent. Annual inspections are required and the program began in 1992.

vii. Gas-fired Water Heaters, Small Boilers, and Process Heaters

A Statewide rule, adopted as part of the April 2000 Dallas/Forth Worth SIP revision, reduces NO_x emissions from new natural gas-fired water heaters, small boilers, and process heaters sold and installed in Texas beginning in 2002. The rule applies to each new water heater, boiler, or process heater with a maximum rated capacity of up to 2.0 million British thermal units per hour. This is Rule 117.461. It should be noted that this control on natural gas-fired water heaters may be overturned by the SB 473 prohibition on regulating water heater emissions.

To simulate the effects of this rule in 2018, the following factors were applied Statewide in Texas.

SCC	NO_x Control Efficiency	Rule Penetration	Rule Effectiveness
2103006000	75%	80%	100%
2104006000	75%	80%	100%

2. Federal Controls

a. Residential Wood Combustion

For this analysis, a 20 year estimated lifetime for woodstoves and fireplace inserts was used along with the SCC-specific growth factors, and emission factor ratios by SCC, to account for the replacement of retired woodstoves that emit at pre-new source performance standard (NSPS) levels, with new catalyst-equipped wood burning equipment. This was done using an equation to estimate equipment turnover for a situation with a 4 percent per year retirement rate, and the SCC-specific growth factors. Emission factor ratios are pollutant-specific. The growth and retirement equation was used to estimate the relationship between base year (2002) emissions and 2018 emissions by SCC and pollutant.

Then, this relationship was used to estimate the control efficiency that would have to be applied along with the growth factor to yield the appropriate future year emission value. SCCs for controlled woodstoves and fireplace inserts have no control efficiency applied. Their 2018 emissions will change in proportion to the growth rate. Table II-8 displays the various residential woodstove and fireplace area source SCCs that are used in the CENRAP State emission inventories and the associated 2018 control factors used in this analysis.

Table II-8. Residential Wood Combustion Control Factors for CENRAP States

SCC	Description	Growth Factor 2002 to 2018	Pollutant	CF*	2018 Ratio of Controlled/ Uncontrolled Emissions	2018 Control Factor (Emission Reduc. %)
States: AR, LA, OK, TX						
2104008000	Total Woodstoves and Fireplaces	1.034	VOC	0.28	0.664	35.8
		1.034	CO	0.45	0.751	27.3
		1.034	NOx	0.71	0.885	14.4
		1.034	PM	0.67	0.864	16.4
2104008002	Fireplace inserts	1.034	VOC	0.28	0.664	35.8
		1.034	CO	0.45	0.751	27.3
		1.034	NOx	0.71	0.885	14.4
		1.034	PM	0.67	0.864	16.4
2104008010	Woodstoves-general	1.034	VOC	0.28	0.654	34.6
		1.034	CO	0.45	0.736	26.4
		1.034	NOx	0.71	0.861	13.9
		1.034	PM	0.67	0.842	15.8
2104008001	Fireplaces	1.034			1.034	0
2104008003	Fireplace inserts-certified-non-catalytic	1.034			1.034	0
2104008004	Fireplace inserts-certified-catalytic	1.034			1.034	0
2104008030	Woodstoves-certified-catalytic	1.034			1.034	0
2104008050	Woodstoves-certified-non-catalytic	1.034			1.034	0
States: IA, KS, NE, MO, MN						
2104008000	Total Woodstoves and Fireplaces	0.986	VOC	0.28	0.65	34
		0.986	CO	0.45	0.73	26
		0.986	NOx	0.71	0.851	13.7
		0.986	PM	0.67	0.832	15.6
2104008002	Fireplace inserts	0.986	VOC	0.28	0.65	34
		0.986	CO	0.45	0.73	26
		0.986	NOx	0.71	0.851	13.7
		0.986	PM	0.67	0.832	15.6
2104008010	Woodstoves-general	0.986	VOC	0.28	0.654	34.6
		0.986	CO	0.45	0.736	26.4
		0.986	NOx	0.71	0.861	13.9
		0.986	PM	0.67	0.842	15.8
2104008001	Fireplaces	0.986			0.986	0
2104008003	Fireplace inserts-certified-non-catalytic	0.986			0.986	0
2104008004	Fireplace inserts-certified-catalytic	0.986			0.986	0
2104008030	Woodstoves-certified-catalytic	0.986			0.986	0
2104008050	Woodstoves-certified-non-catalytic	0.986			0.986	0

NOTE: *The ratio between the emission factor for a certified-catalyst equipped woodstove/fireplace insert and for an uncontrolled unit.

b. Onboard Vapor Recovery Systems

The control efficiency from refueling onroad vehicles will be greater in 2018 than in 2002 due to vehicle turnover and the Federal requirement for onboard vapor recovery systems in onroad vehicles. Percentage reductions in VOC emissions from this control measure in 2018, relative to 2002, were calculated using a sampling of MOBILE6 runs, including the effect of Stage II programs where they are in place. These resulting reduction factors were included in the area source sector control files.

D. DEVELOPMENT OF NONROAD 2018 EMISSION INVENTORY

Pechan estimated NONROAD model mass emissions for 2018 for all CENRAP States using EPA's NONROAD2004 model (EPA, 2004a). Pechan developed nonroad option files to reflect season-specific inputs that applied to an entire State or group of counties. These runs also incorporated revised activity, seasonal allocation, and county allocation files developed by Sonoma Technology, Inc. (STI) to improve the recreational marine component of the 2002 base year NONROAD inventory (STI, 2004).

Pechan ran NONROAD for four scenarios: 1) typical January weekday (JanWD); 2) typical January weekend day (JanWE); 3) typical July weekday (JulWD); and 4) typical July weekend day (JulWE). The January runs represented average daily emissions for the time period October 1 through April 30, and the July runs represented average daily emissions for the time period May 1 through September 30. Annual emissions were estimated using these daily results as input to the formula below:

(JanWD x 152 days) + (JanWE x 60 days) + (JulWD x 109 days) + (JulWE x 44 days) = Annual Average Emissions

In Table II-9, the default Statewide temperatures and Reid vapor pressure (RVP) values used are listed for each model scenario. Pechan also accounted for local fuel-related programs that would affect NONROAD model engine emissions. A listing of the areas with county-specific fuel programs are presented in Tables II-10 through II-13. In addition, the characteristics or input values needed to model these programs in NONROAD are presented. Table II-10 provides a list of those areas that have year-round Stage II programs in place. Tables II-11 and II-12 show the summer season RVP values assumed for areas with reformulated gasoline and low RVP programs, as well as year-round oxygenated fuel programs that are part of RFG programs. Table II-13 presents the weight percent oxygen (O_2) levels used for the 2018 runs. Iowa, Minnesota, and El Paso County, Texas are the only areas with official oxygenated fuel programs. For the remaining areas, it was established that some blending of ethanol into their fuel is occurring, even though no regulatory requirement is in effect (STI, 2004). The 2018 diesel fuel sulfur values reflect the requirements of the Clean Air Diesel Rule that all nonroad diesel fuel meet 15 parts per million sulfur content by the year 2015. Per the requirements of the Tier 2 and gasoline sulfur rulemaking, the gasoline sulfur levels were also revised to 30 parts per million.

Table II-9. Statewide Temperature and RVP Inputs for 2018 NONROAD Model Runs

State FIPS	State	Typical Day	Minimum Temperature, ºF	Maximum Temperature, ºF	Average Temperature, ºF	RVP, psi
5	Arkansas	July	72	93	82	9
		January	31	50	40	13
19	Iowa	July	66	86	76	8.3
		January	12	29	20	13.2
20	Kansas	July	68	89	78	8.2
		January	17	37	27	13.2
22	Louisiana	July	73	91	82	9
		January	40	60	50	13
27	Minnesota	July	63	83	73	8.7
		January	4	22	13	13.4
29	Missouri	July	67	90	78	8.4
		January	22	42	32	13.2
31	Nebraska	July	66	88	77	8.3
		January	13	33	23	13.2
40	Oklahoma	July	71	93	82	9
		January	26	47	36	13
48	Texas	July	77	96	86	9
		January	36	55	45	13

Table II-10. CENRAP Stage II Refueling Programs

FIPS State Code	State Name	FIPS County Code	County Name	Effectiveness
22	LOUISIANA	5	Ascension Parish	95
22	LOUISIANA	33	East Baton Rouge Parish	95
22	LOUISIANA	47	Iberville Parish	95
22	LOUISIANA	63	Livingston Parish	95
22	LOUISIANA	77	Pointe Coupee Parish	95
22	LOUISIANA	121	West Baton Rouge Parish	95
29	MISSOURI	71	Franklin County	95
29	MISSOURI	99	Jefferson County	95
29	MISSOURI	183	St. Charles County	95
29	MISSOURI	189	St. Louis County	95
29	MISSOURI	510	St. Louis city	95
48	TEXAS	39	Brazoria County	95
48	TEXAS	71	Chambers County	95
48	TEXAS	85	Collin County	95
48	TEXAS	113	Dallas County	95
48	TEXAS	121	Denton County	95
48	TEXAS	141	El Paso County	95
48	TEXAS	157	Fort Bend County	95
48	TEXAS	167	Galveston County	95
48	TEXAS	199	Hardin County	95
48	TEXAS	201	Harris County	95
48	TEXAS	245	Jefferson County	95
48	TEXAS	291	Liberty County	95
48	TEXAS	339	Montgomery County	95
48	TEXAS	361	Orange County	95
48	TEXAS	439	Tarrant County	95
48	TEXAS	473	Waller County	95

Table II-11. CENRAP Reformulated Gasoline Programs

FIPS State Code	State Name	FIPS County Code	County Name	RVP	O2, wt %
29	MISSOURI	71	Franklin County	6.8	2.1
29	MISSOURI	99	Jefferson County	6.8	2.1
29	MISSOURI	183	St. Charles County	6.8	2.1
29	MISSOURI	189	St. Louis County	6.8	2.1
29	MISSOURI	510	St. Louis city	6.8	2.1
48	TEXAS	39	Brazoria County	6.7	2.1
48	TEXAS	71	Chambers County	6.7	2.1
48	TEXAS	85	Collin County	6.7	2.1
48	TEXAS	113	Dallas County	6.7	2.1
48	TEXAS	121	Denton County	6.7	2.1
48	TEXAS	157	Fort Bend County	6.7	2.1
48	TEXAS	167	Galveston County	6.7	2.1
48	TEXAS	201	Harris County	6.7	2.1
48	TEXAS	291	Liberty County	6.7	2.1
48	TEXAS	339	Montgomery County	6.7	2.1
48	TEXAS	439	Tarrant County	6.7	2.1
48	TEXAS	473	Waller County	6.7	2.1

Table II-12. CENRAP Low RVP Programs

FIPS State Code	State Name	FIPS County Code	County Name	RVP
20	KANSAS	091	JOHNSON	7.0
20	KANSAS	209	WYANDOTTE	7.0
22	LOUISIANA	005	ASCENSION PARISH	7.8
22	LOUISIANA	033	EAST BATON ROUGE PARISH	7.8
22	LOUISIANA	047	IBERVILLE PARISH	7.8
22	LOUISIANA	063	LIVINGSTON PARISH	7.8
22	LOUISIANA	077	POINTE COUPEE PARISH	7.8
22	LOUISIANA	121	WEST BATON ROUGE PARISH	7.8
29	MISSOURI	047	CLAY	7.0
29	MISSOURI	095	JACKSON	7.0
29	MISSOURI	165	PLATTE	7.0
48	TEXAS	001	ANDERSON	7.5
48	TEXAS	005	ANGELINA	7.5
48	TEXAS	007	ARANSAS	7.5
48	TEXAS	013	ATASCOSA	7.5
48	TEXAS	015	AUSTIN	7.5
48	TEXAS	021	BASTROP	7.5
48	TEXAS	025	BEE	7.5
48	TEXAS	027	BELL	7.5
48	TEXAS	029	BEXAR	7.5
48	TEXAS	035	BOSQUE	7.5
48	TEXAS	037	BOWIE	7.5
48	TEXAS	041	BRAZOS	7.5
48	TEXAS	051	BURLESON	7.5
48	TEXAS	055	CALDWELL	7.5
48	TEXAS	057	CALHOUN	7.5
48	TEXAS	063	CAMP	7.5
48	TEXAS	067	CASS	7.5
48	TEXAS	073	CHEROKEE	7.5
48	TEXAS	089	COLORADO	7.5
48	TEXAS	091	COMAL	7.5
48	TEXAS	097	COOKE	7.5
48	TEXAS	099	CORYELL	7.5
48	TEXAS	119	DELTA	7.5
48	TEXAS	123	DEWITT	7.5
48	TEXAS	139	ELLIS	7.5
48	TEXAS	141	EL PASO	7.0
48	TEXAS	145	FALLS	7.5
48	TEXAS	147	FANNIN	7.5
48	TEXAS	149	FAYETTE	7.5
48	TEXAS	159	FRANKLIN	7.5
48	TEXAS	161	FREESTONE	7.5

Table II-12 (continued)

FIPS State Code	State Name	FIPS County Code	County Name	RVP
48	TEXAS	175	GOLIAD	7.5
48	TEXAS	177	GONZALES	7.5
48	TEXAS	181	GRAYSON	7.5
48	TEXAS	183	GREGG	7.5
48	TEXAS	185	GRIMES	7.5
48	TEXAS	187	GUADALUPE	7.5
48	TEXAS	199	HARDIN	7.5
48	TEXAS	203	HARRISON	7.5
48	TEXAS	209	HAYS	7.5
48	TEXAS	213	HENDERSON	7.5
48	TEXAS	217	HILL	7.5
48	TEXAS	221	HOOD	7.5
48	TEXAS	223	HOPKINS	7.5
48	TEXAS	225	HOUSTON	7.5
48	TEXAS	231	HUNT	7.5
48	TEXAS	239	JACKSON	7.5
48	TEXAS	241	JASPER	7.5
48	TEXAS	245	JEFFERSON	7.5
48	TEXAS	251	JOHNSON	7.5
48	TEXAS	255	KARNES	7.5
48	TEXAS	257	KAUFMAN	7.5
48	TEXAS	277	LAMAR	7.5
48	TEXAS	285	LAVACA	7.5
48	TEXAS	287	LEE	7.5
48	TEXAS	289	LEON	7.5
48	TEXAS	293	LIMESTONE	7.5
48	TEXAS	297	LIVE OAK	7.5
48	TEXAS	309	MCLENNAN	7.5
48	TEXAS	313	MADISON	7.5
48	TEXAS	315	MARION	7.5
48	TEXAS	321	MATAGORDA	7.5
48	TEXAS	331	MILAM	7.5
48	TEXAS	343	MORRIS	7.5
48	TEXAS	347	NACOGDOCHES	7.5
48	TEXAS	349	NAVARRO	7.5
48	TEXAS	351	NEWTON	7.5
48	TEXAS	355	NUECES	7.5
48	TEXAS	361	ORANGE	7.5
48	TEXAS	365	PANOLA	7.5
48	TEXAS	367	PARKER	7.5
48	TEXAS	373	POLK	7.5
48	TEXAS	379	RAINS	7.5

Table II-12 (continued)

FIPS State Code	State Name	FIPS County Code	County Name	RVP
48	TEXAS	387	RED RIVER	7.5
48	TEXAS	391	REFUGIO	7.5
48	TEXAS	395	ROBERTSON	7.5
48	TEXAS	397	ROCKWALL	7.5
48	TEXAS	401	RUSK	7.5
48	TEXAS	403	SABINE	7.5
48	TEXAS	405	SAN AUGUSTINE	7.5
48	TEXAS	407	SAN JACINTO	7.5
48	TEXAS	409	SAN PATRICIO	7.5
48	TEXAS	419	SHELBY	7.5
48	TEXAS	423	SMITH	7.5
48	TEXAS	425	SOMERVELL	7.5
48	TEXAS	449	TITUS	7.5
48	TEXAS	453	TRAVIS	7.5
48	TEXAS	455	TRINITY	7.5
48	TEXAS	457	TYLER	7.5
48	TEXAS	459	UPSHUR	7.5
48	TEXAS	467	VAN ZANDT	7.5
48	TEXAS	469	VICTORIA	7.5
48	TEXAS	471	WALKER	7.5
48	TEXAS	477	WASHINGTON	7.5
48	TEXAS	481	WHARTON	7.5
48	TEXAS	491	WILLIAMSON	7.5
48	TEXAS	493	WILSON	7.5
48	TEXAS	497	WISE	7.5
48	TEXAS	499	WOOD	7.5

Table II-13. CENRAP Oxygenated Fuel Inputs

FIPS State Code	State Name	Area/County	O2, wt %
05	ARKANSAS	Statewide	0.30
19	IOWA	Statewide	1.94
20	KANSAS	Statewide	0.14
22	LOUISIANA	Statewide	0.27
27	MINNESOTA	Statewide	3.32
29	MISSOURI	Statewide	0.32
31	NEBRASKA	Statewide	1.47
40	OKLAHOMA	Statewide	0.0
48	TEXAS	El Paso County	2.7

1. Growth

Growth factors in NONROAD2004 are based on national, historical changes in fuel-specific equipment populations. Pechan has concerns about using growth rates that vary significantly from the model growth rates without fully evaluating the impact the revised growth rates may have on other related activity variables such as median life and scrappage rates. Pechan did, however, reflect State differences in growth rates by adjusting the NONROAD model growth rates for several significant nonroad categories, as identified in CENRAP's 2002 base year NONROAD model inventory (STI, 2004). These adjustments were made using State-level growth rates based on surrogate socioeconomic indicators believed to correlate with activity for each category. These data are available from the REMI model, and are incorporated into EGAS (Houyoux, 2004). The proposed methodology for making these adjustments was first documented in a technical memorandum prepared for CENRAP (Pechan, 2005). The NONROAD priority categories, along with the socioeconomic indicator used to adjust the national growth rate for each category, are listed in Table II-14. Note that employment and value added data are available from REMI for the Agricultural Production sector (SIC 01, 02). This is expected to be a suitable surrogate for the growth in farm equipment, but growth rates for these variables were not calculated separately in REMI for each State, and are reported as the same value for all States. As such, Pechan used *Output in Agricultural Services* (SIC 07) as a surrogate indicator for farm equipment growth.

Table II-15 lists the NONROAD national growth factor value for 2018 (relative to 2002 base year) for each of the priority categories. Unlike other nonroad categories, separate growth rates are included in NONROAD for some of the specific recreational equipment applications, such as ATVs and Off-Highway Motorcycles. Table II-16 lists the 2018 growth factors for each chosen REMI surrogate indicator. Values are presented for each CENRAP State, as well as the nation. The general equation used to make this adjustment is shown below, along with an example of this calculation for gasoline lawn and garden equipment:

$$NRDGR_{ST} = NRDGR_{NAT} \; x \; (REMIGR_{ST}/REMIGR_{NAT})$$

Table II-14. NONROAD Model Priority Growth Categories and REMI Data for Adjusting National NONROAD Growth Rates

SCC	SCC Description	NONROAD Model Growth Indicator Code	REMI Code	REMI Code Description
2270002000	Diesel Construction	21	604	Construction Employment - SIC 15, 16, 17
2270005000	Diesel Farm	31	165	Agricultural Services Output - SIC 07
2260004000 2265004000	2-Stroke Gasoline Lawn and Garden 4-Stroke Gasoline Lawn and Garden	52	901	Population (Thousands)
2282005000 2282010000	2-Stroke Gasoline Recreational Marine 4-Stroke Gasoline Recreational Marine	92	903	Real Disposable Personal Income
2260001030 2265001030	2-Stroke Gasoline ATVs 4-Stroke Gasoline ATVs	95 96	903	Real Disposable Personal Income
2260001010 2265001010	2-Stroke Gasoline Off-Highway Motorcycles 4-Stroke Gasoline Off-Highway Motorcycles	97	903	Real Disposable Personal Income
2260001020	2-Stroke Gasoline Snowmobiles	98	903	Real Disposable Personal Income
2282005015	2-Stroke Gasoline Recreational Marine - Personal Watercraft	99	903	Real Disposable Personal Income

Table II-15. NONROAD Model Category Growth Factors for 2018

Category	Indicator Code	Growth Factor[1]
Diesel Construction	21	1.432
Diesel Farm	31	1.389
2 and 4-stroke Gasoline Lawn and Garden	52	1.337
2 and 4-stroke Gasoline Recreational Marine	92	1.146
2-stroke Gasoline ATVs	95	2.756
4-stroke Gasoline ATVs	96	2.105
2 and 4-stroke Gasoline Off-Highway Motorcycles	97	1.925
2-Stroke Gasoline Snowmobiles	98	1.705
2-Stroke Gasoline Recreational Marine - Personal Watercraft	99	1.146

NOTE: [1]Growth factor values calculated relative to base year 2002.

Table II-16. REMI State and National Growth Factors for 2018

REMI CODE	CODEDESC	STFIPS	Geographic Area	Growth Factor[1]
604	Construction - SIC 15, 16, 17	05	Arkansas	1.035
604	Construction - SIC 15, 16, 17	19	Iowa	1.049
604	Construction - SIC 15, 16, 17	20	Kansas	1.016
604	Construction - SIC 15, 16, 17	22	Louisiana	1.120
604	Construction - SIC 15, 16, 17	27	Minnesota	1.005
604	Construction - SIC 15, 16, 17	29	Missouri	1.023
604	Construction - SIC 15, 16, 17	31	Nebraska	1.011
604	Construction - SIC 15, 16, 17	40	Oklahoma	1.098
604	Construction - SIC 15, 16, 17	48	Texas	1.011
604	Construction - SIC 15, 16, 17	NA	National	1.025
165	Agricultural Services	05	Arkansas	1.117
165	Agricultural Services	19	Iowa	1.301
165	Agricultural Services	20	Kansas	1.329
165	Agricultural Services	22	Louisiana	1.330
165	Agricultural Services	27	Minnesota	1.334
165	Agricultural Services	29	Missouri	1.391
165	Agricultural Services	31	Nebraska	1.281
165	Agricultural Services	40	Oklahoma	1.358
165	Agricultural Services	48	Texas	1.400
165	Agricultural Services	NA	National	1.376
901	Population (Thousands)	05	Arkansas	1.173
901	Population (Thousands)	19	Iowa	1.126
901	Population (Thousands)	20	Kansas	1.160
901	Population (Thousands)	22	Louisiana	1.138
901	Population (Thousands)	27	Minnesota	1.171
901	Population (Thousands)	29	Missouri	1.150
901	Population (Thousands)	31	Nebraska	1.144
901	Population (Thousands)	40	Oklahoma	1.253
901	Population (Thousands)	48	Texas	1.299
901	Population (Thousands)	NA	National	1.218
903	Real Disposable Personal Income	05	Arkansas	1.561
903	Real Disposable Personal Income	19	Iowa	1.519
903	Real Disposable Personal Income	20	Kansas	1.550
903	Real Disposable Personal Income	22	Louisiana	1.588
903	Real Disposable Personal Income	27	Minnesota	1.576
903	Real Disposable Personal Income	29	Missouri	1.540
903	Real Disposable Personal Income	31	Nebraska	1.530
903	Real Disposable Personal Income	40	Oklahoma	1.621
903	Real Disposable Personal Income	48	Texas	1.665
903	Real Disposable Personal Income	NA	National	1.596

NOTE: [1]Growth factor values calculated relative to base year 2002.

where:

$NRDGR_{ST}$	=	Revised NONROAD State-level Growth Rate
$NRDGR_{NAT}$	=	Base NONROAD National Growth Rate
$REMIGR_{ST}$	=	State REMI Growth Rate
$REMIGR_{NAT}$	=	National REMI Growth Rate

The revised growth rate for gasoline lawn and garden equipment in Oklahoma is calculated as follows:

$$NRDGR_{ST} = 1.337 \times (1.253 \div 1.218) = 1.374$$

Table II-17 shows the adjusted 2018 growth factors calculated for all CENRAP States for all priority equipment categories, and compares these values to the NONROAD model default growth factor values.

Pechan prepared a revised NATION.GRW file for use in the NONROAD model. Once 2002-based growth rates were calculated, Pechan normalized these rates to reflect the 2002 year value in the NATION.GRW file. Since this year was not reported for most category codes, these 2002 data were calculated using linear interpolation of values reported for the most recent prior year and closest future year. Pechan then incorporated 2018 data for each of the appropriate indicator codes for all CENRAP States. State-specific records for historic years prior to 2002 were also added (since base year population values for most equipment types are for 1996 or 1998) using the same values as the national-level indicators.

2. Controls

EPA's NONROAD2004 model incorporates the effects of most final Federal standards, including the Tier 4 diesel engine standards and the exhaust emission standards for large spark-ignition (S-I) engines, diesel marine, and land-based recreational engines. The only remaining federal standards not modeled by NONROAD2004 include permeation and evaporative emission standards for gasoline recreational and large S-I engines, respectively. The evaporative standards for recreational equipment only affect permeation emissions, which are not currently included in NONROAD2004. These standards do not affect any other evaporative emission components in the model (i.e., diurnal or refueling). Therefore, Pechan did not model the recreational equipment permeation emission standards. Pechan developed an estimate of the emission reductions due to the large S-I standard to apply to the affected SCCs as a post-processing adjustment, which is discussed below.

For the large S-I evaporative standards, Pechan obtained overall emission reduction information from the Large S-I Regulatory Support Document (EPA, 2002). Using large S-I evaporative base and control case future year inventories, emission reductions were estimated for 2018. These emission reductions vary by evaporative component, but for this analysis Pechan summed the emissions across all components to estimate emission reductions for all evaporative

Table II-17. Adjusted 2018 Growth Factors for Nonroad Priority Equipment Categories

State FIPS	State Name	NONROAD Growth Factor[1]	Adjusted Growth Factor[1]	Percent Difference
2 and 4-stroke Gasoline Lawn and Garden - Indicator Code 52				
5	Arkansas	1.337	1.287	-3.9
19	Iowa	1.337	1.235	-8.3
20	Kansas	1.337	1.273	-5
22	Louisiana	1.337	1.249	-7
27	Minnesota	1.337	1.284	-4.1
29	Missouri	1.337	1.261	-6
31	Nebraska	1.337	1.255	-6.5
40	Oklahoma	1.337	1.374	2.7
48	Texas	1.337	1.424	6.1
Diesel Construction - Indicator Code 21				
5	Arkansas	1.432	1.446	1
19	Iowa	1.432	1.466	2.3
20	Kansas	1.432	1.419	-0.9
22	Louisiana	1.432	1.565	8.5
27	Minnesota	1.432	1.404	-2
29	Missouri	1.432	1.429	-0.2
31	Nebraska	1.432	1.412	-1.4
40	Oklahoma	1.432	1.534	6.6
48	Texas	1.432	1.412	-1.4
Diesel Farm - Indicator Code 31				
5	Arkansas	1.389	1.127	-23.2
19	Iowa	1.389	1.314	-5.7
20	Kansas	1.389	1.342	-3.5
22	Louisiana	1.389	1.343	-3.4
27	Minnesota	1.389	1.346	-3.2
29	Missouri	1.389	1.404	1.1
31	Nebraska	1.389	1.293	-7.4
40	Oklahoma	1.389	1.37	-1.4
48	Texas	1.389	1.413	1.7
2 and 4-stroke Gasoline Recreational Marine - Indicator Code 92				
5	Arkansas	1.146	1.121	-2.2
19	Iowa	1.146	1.091	-5
20	Kansas	1.146	1.113	-3
22	Louisiana	1.146	1.141	-0.4
27	Minnesota	1.146	1.132	-1.2
29	Missouri	1.146	1.106	-3.6
31	Nebraska	1.146	1.099	-4.3
40	Oklahoma	1.146	1.165	1.6
48	Texas	1.146	1.196	4.2
2-stroke Gasoline ATVs - Indicator Code 95				
5	Arkansas	2.756	2.696	-2.2
19	Iowa	2.756	2.623	-5.1
20	Kansas	2.756	2.677	-3
22	Louisiana	2.756	2.742	-0.5

Table II-17 (continued)

State FIPS	State Name	NONROAD Growth Factor[1]	Adjusted Growth Factor[1]	Percent Difference
27	Minnesota	2.756	2.721	-1.3
29	Missouri	2.756	2.659	-3.6
31	Nebraska	2.756	2.642	-4.3
40	Oklahoma	2.756	2.8	1.6
48	Texas	2.756	2.875	4.1
4-stroke Gasoline ATVs - Indicator Code 96				
5	Arkansas	2.105	2.059	-2.2
19	Iowa	2.105	2.003	-5.1
20	Kansas	2.105	2.045	-2.9
22	Louisiana	2.105	2.095	-0.5
27	Minnesota	2.105	2.078	-1.3
29	Missouri	2.105	2.031	-3.6
31	Nebraska	2.105	2.018	-4.3
40	Oklahoma	2.105	2.139	1.6
48	Texas	2.105	2.196	4.1
2 and 4-stroke Gasoline Off-Highway Motorcycles - Indicator Code 97				
5	Arkansas	1.925	1.884	-2.2
19	Iowa	1.925	1.832	-5.1
20	Kansas	1.925	1.87	-2.9
22	Louisiana	1.925	1.916	-0.5
27	Minnesota	1.925	1.901	-1.3
29	Missouri	1.925	1.858	-3.6
31	Nebraska	1.925	1.846	-4.3
40	Oklahoma	1.925	1.956	1.6
48	Texas	1.925	2.009	4.2
2-Stroke Gasoline Snowmobiles - Indicator Code 98				
5	Arkansas	1.705	1.669	-2.2
19	Iowa	1.705	1.623	-5.1
20	Kansas	1.705	1.657	-2.9
22	Louisiana	1.705	1.697	-0.5
27	Minnesota	1.705	1.684	-1.2
29	Missouri	1.705	1.646	-3.6
31	Nebraska	1.705	1.635	-4.3
40	Oklahoma	1.705	1.733	1.6
48	Texas	1.705	1.779	4.2
2-Stroke Gasoline Recreational Marine - Personal Watercraft - Indicator Code 99				
5	Arkansas	1.146	1.121	-2.2
19	Iowa	1.146	1.091	-5
20	Kansas	1.146	1.113	-3
22	Louisiana	1.146	1.141	-0.4
27	Minnesota	1.146	1.132	-1.2
29	Missouri	1.146	1.106	-3.6
31	Nebraska	1.146	1.099	-4.3
40	Oklahoma	1.146	1.165	1.6
48	Texas	1.146	1.196	4.2

NOTE: [1]Growth factor values calculated relative to base year 2002.

emissions combined, as well as crankcase emissions. Large S-I evaporative emission reductions for 2018 were estimated to be 78.1 percent.

Pechan calculated two rule penetration adjustments to account for the fraction of the SCC-level emissions that are affected by the rule. Since the rule only affects large S-I engines greater than 25 horsepower, the first adjustment was developed to reflect that fraction of the activity associated with these larger engines. This was estimated using 2002 national gasoline consumption results by horsepower and equipment category from NONROAD2004. As a simplifying assumption, we used the 2002 rule penetration value for 2018 and for all applications within a category, though this is likely to vary by year and application. Table II-18 provides a summary of the horsepower-related rule penetration values by equipment category. A second rule penetration adjustment by SCC was also developed to account for that fraction of the SCC-level emissions associated with evaporative VOC relative to the total VOC emissions (i.e., exhaust plus evaporative). Final emission reductions by SCC are presented in Table II-19. These emission reductions were applied directly to the SCC-level output from the NONROAD model as a post-processing step.

The following equation shows an example of how overall adjusted emission reductions were estimated for 4-stroke industrial forklifts in 2018:

$$ER_{ADJ} = RP_{hp} \ x \ RP_{evap} \ x \ ER$$

Table II-18. Horsepower-Related Rule Penetration Values by Category for Large S-I Evaporative Standards

Fuel Type	Classification	Rule Penetration
Gasoline	Agricultural Equipment	0.40
Gasoline	Airport Equipment	0.74
Gasoline	Commercial Equipment	0.05
Gasoline	Construction and Mining Equipment	0.14
Gasoline	Industrial Equipment	0.59
Gasoline	Commercial Lawn and Garden Equipment	0.07
Gasoline	Railroad Equipment	0.04
Gasoline	Recreational Equipment[1]	0.43
CNG	All Classifications	1.0
LPG	All Classifications	1.0

NOTE: [1]Applies to specialty vehicle carts only; other recreational equipment covered by recreational standards.

Table II-19. Control Effectiveness Values by SCC for Large S-I Evaporative Standards in 2018

SCC	Percent Control Effectiveness
2260001060	11.2
2260002006	0.3
2260002009	0.6
2260002021	0.6
2260002027	0.3
2260002039	0.1
2260002054	0.3
2260003030	3.8
2260003040	2.7
2260004016	0.9
2260004021	1
2260004026	1.1
2260004031	0.4
2260004036	0.2
2260004071	0.2
2260005035	3.7
2260005050	1.6
2260006005	0.4
2260006010	0.3
2260006015	0.2
2265001060	7.3
2265002003	1.4
2265002006	1.5
2265002009	1.1
2265002015	1.2
2265002021	1.7
2265002024	1.1
2265002027	1
2265002030	1.2
2265002033	2
2265002039	1
2265002042	2.8
2265002045	4.1
2265002054	1.3
2265002057	5.7
2265002060	6.5
2265002066	1
2265002072	2.7
2265002078	2.9
2265002081	5
2265003010	14.5
2265003020	24.4
2265003030	9
2265003040	5
2265003050	13.1
2265003060	5
2265003070	25.8

Table II-19 (continued)

SCC	Percent Control Effectiveness
2265004011	1.5
2265004016	1.9
2265004026	2.6
2265004031	1.8
2265004036	1.8
2265004041	0.9
2265004046	1.2
2265004051	1.9
2265004056	0.8
2265004066	0.9
2265004071	0.6
2265004076	1.9
2265005010	3.4
2265005015	8.3
2265005020	18.4
2265005025	20.4
2265005030	4.7
2265005035	9.5
2265005040	7.2
2265005045	18.3
2265005050	3.6
2265005055	11.6
2265005060	14.5
2265006005	1
2265006010	0.8
2265006015	0.6
2265006025	0.7
2265006030	0.8
2265008005	11.5
2265010010	3
2267001060	17.5
2267002003	6.6
2267002021	12.6
2267002024	6.1
2267002030	6.3
2267002033	17
2267002045	10.9
2267002054	10.4
2267002057	7.7
2267002060	1
2267002072	11.7
2267002081	13.1
2267003010	13.7
2267003020	0.8
2267003030	0.1
2267003050	9.6
2267005050	8
2267005055	17.6

Table II-19 (continued)

SCC	Percent Control Effectiveness
2267006005	17.2
2267006010	13.8
2267006015	4.7
2267006025	4.3
2267006030	11.5
2268002081	12.9
2268003020	0.9
2268003030	0.3
2268003060	2.7
2268006005	17.6
2268006010	15.3
2268006015	5.8
2285004015	0.6
2285006015	9.8

where:

ER_{ADJ}	=	adjusted emission reduction accounting for rule penetration
RP_{hp}	=	rule penetration for affected horsepower fraction
RP_{evap}	=	rule penetration for evaporative fraction of total VOC emissions
ER	=	evaporative emission reduction for affected engines

$$ER_{ADJ} = 0.590 \times 0.529 \times 0.781$$
$$= 0.244$$
$$= 24.4 \text{ percent}$$

a. State Controls

In addition to Federal controls, Pechan accounted for regulations in Texas that control nonroad refueling spillage emissions from use of portable fuel containers. Similar to the large S-I evaporative standard modeling discussed above, Pechan calculated two rule penetration adjustments accounting for the appropriate fraction of the SCC-level emissions affected by the rule. The first adjustment was developed to reflect that fraction of the SCC emissions associated with equipment fueled with a portable fuel container. Nonroad equipment refueled by a portable container are generally smaller horsepower engines than those refueled at service stations. A second rule penetration adjustment by SCC was also developed to account for that fraction of the SCC-level emissions associated with evaporative spillage VOC relative to the total VOC emissions (i.e., exhaust plus evaporative). These adjustments were both estimated using 2002 national evaporative VOC emissions data by horsepower, equipment category, and evaporative component, from NONROAD2004. Control efficiency was assumed to be 100 percent, and full equipment turnover of gas cans should be achieved by 2018.

The final emission reductions by SCC are presented in Table II-20. These emission reductions were applied directly to the appropriate SCCs as a post-processing step for all counties in Texas.

3. Non-NONROAD Model

Pechan compiled control information for commercial marine vessels and locomotives. Standards affecting these categories are Federal standards that affect all areas of the nation. No additional local controls were modeled in the CENRAP region for these categories.

In 2003, EPA proposed aircraft engine NO_x emission standards that will bring U.S. aircraft standards into alignment with standards developed by the International Civil Aviation Organization. EPA did not prepare emission reduction estimates for these standards because any such reductions would be modest (e.g., 94 percent of aircraft engines are currently meeting or exceeding these standards). Therefore, Pechan did not account for emission reductions from these standards for this analysis.

Table II-20. 2018 VOC Emission Reductions by SCC for Texas Portable Container Rule

SCC	Percent VOC Reduction
2260001010	0.8%
2260001030	2.7%
2260003030	6.6%
2260003040	4.2%
2260004015	14.3%
2260004016	15.7%
2260004020	39.1%
2260004021	17.7%
2260004025	19.9%
2260004026	19.7%
2260004030	5.5%
2260004031	5.4%
2260004035	3.2%
2260004071	2.1%
2260006005	6.1%
2260006010	5.4%
2260006015	4.0%
2260007005	9.1%
2265001010	5.5%
2265001030	7.0%
2265001060	0.1%
2265003010	0.3%
2265003030	2.3%
2265003040	4.3%
2265003050	0.0%
2265004010	23.5%
2265004011	25.7%
2265004015	29.9%
2265004016	33.0%
2265004025	39.4%
2265004026	46.7%
2265004030	13.0%
2265004031	28.7%
2265004035	15.6%
2265004040	6.3%
2265004041	9.1%
2265004046	8.8%
2265004051	31.8%
2265004055	7.0%
2265004056	8.7%
2265004066	3.1%
2265004071	4.2%
2265004075	3.8%
2265004076	3.8%
2265006005	4.6%
2265006010	9.7%
2265006015	6.4%
2265006025	10.2%
2265006030	9.6%
2265007010	52.4%

a. Locomotives

Emission reduction impacts of the Federal locomotive engine standards are available in an EPA Regulatory Support Document (EPA, 1998). This document contains emission reduction information specific to Class I Operations, Class II/III Operations, Passenger Trains (Amtrak and Commuter Lines), and Switch (Yard) Locomotives. Year-specific percentage reduction estimates for select pollutants are available for each locomotive sector for each year over the 1999-2040 period. These emission reductions reflect the control technology efficiencies, as well as the expected rule penetration for the years of interest. Rule effectiveness was assumed to be 100 percent.

In addition, overall SO_2, PM_{10}, and $PM_{2.5}$ emission reductions associated with decreases in the diesel fuel sulfur content were also included. These were estimated from future base case and control case locomotive emission inventories prepared for EPA's regulatory impact analysis (RIA) for the Clean Air Diesel Rule (EPA, 2004). In the case of PM, since exhaust PM standards already apply to locomotives, a combined emission reduction was calculated for each future year that accounted for both the exhaust standards and reductions in PM sulfate due to the fuel sulfur limits. Table II-21 presents the 2018 emission reductions that apply to locomotive SCC emissions.

b. Commercial Marine Vessels

EPA has promulgated two sets of commercial marine vessel regulations: a regulation setting Category 1 and 2 marine diesel engine standards and a regulation setting Category 3 marine diesel engine standards. Category 1 marine diesel engines are defined as engines of greater than 37 kilowatts but with a per-cylinder displacement of 5 liters/cylinder or less. Category 2 marine diesel engines cover engines of 5 to 30 liters/cylinder, and Category 3 marine diesel engines include the remaining, very large, engines. For this analysis, overall emission reductions were estimated for each projection year of interest using information from the regulatory support documents prepared for these rulemakings (EPA, 1999; EPA, 2003). In addition to the EPA standards, beginning in 2000, marine diesel engines greater than or equal to 130 kilowatts are subject to an international NO_x emissions treaty (MARPOL) developed by the International Maritime Organization. The emission reductions reflect both the MARPOL and EPA standards.

Because the reductions vary by category of vessel, assumptions were made concerning the characterization of engines associated with diesel commercial marine vessel SCCs included in the base year inventory. For SCC 2280002100 (Marine Vessels, Commercial Diesel Port emissions), Category 2 engines were assumed. For SCC 2280002200 (Marine Vessels, Commercial Diesel Underway emissions), Category 3 engines were assumed.

Table II-21. 2018 Emission Reductions and Control Information for Federal Rail Standards[1]

SCC	SCC Description	Pollutant	2018 Emission Reduction, %	2018 Control Efficiency	2018 Rule Effectiveness	2018 Rule Penetration
2285000000	Railroad Equipment All Fuels Total	NOX	47.7	62	100	76.9
2285002000	Railroad Equipment Diesel Total	NOX	47.7	62	100	76.9
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	NOX	52	62	100	83.9
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	NOX	13	62	100	21
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	NOX	51	62	100	82.3
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	NOX	51	62	100	82.3
2285002010	Railroad Equipment Diesel Yard Locomotives	NOX	31	58	100	53.4
2285000000	Railroad Equipment All Fuels Total	PM10-PRI	42.31			
2285002000	Railroad Equipment Diesel Total	PM10-PRI	42.31			
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	PM10-PRI	44.8			
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	PM10-PRI	22.25	22.3	100	99.8
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	PM10-PRI	43.24			
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	PM10-PRI	43.24			
2285002010	Railroad Equipment Diesel Yard Locomotives	PM10-PRI	30.8			
2285000000	Railroad Equipment All Fuels Total	PM25-PRI	42.31			
2285002000	Railroad Equipment Diesel Total	PM25-PRI	42.31			
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	PM25-PRI	44.8			
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	PM25-PRI	22.25	22.3	100	99.8
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	PM25-PRI	43.24			
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	PM25-PRI	43.24			
2285002010	Railroad Equipment Diesel Yard Locomotives	PM25-PRI	30.8			

Table II-21 (continued)

SCC	SCC Description	Pollutant	2018 Emission Reduction, %	2018 Control Efficiency	2018 Rule Effectiveness	2018 Rule Penetration
2285000000	Railroad Equipment All Fuels Total	SO2	97.58	97.6	100	100
2285002000	Railroad Equipment Diesel Total	SO2	97.58	97.6	100	100
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	SO2	97.58	97.6	100	100
2285002007	Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	SO2	97.58	97.6	100	100
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	SO2	97.58	97.6	100	100
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	SO2	97.58	97.6	100	100
2285002010	Railroad Equipment Diesel Yard Locomotives	SO2	97.58	97.6	100	100
2285000000	Railroad Equipment All Fuels Total	VOC	23.6	47	100	50.2
2285002000	Railroad Equipment Diesel Total	VOC	23.6	47	100	50.2
2285002006	Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	VOC	27	47	100	57.4
2285002008	Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	VOC	26	47	100	55.3
2285002009	Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	VOC	26	47	100	55.3
2285002010	Railroad Equipment Diesel Yard Locomotives	VOC	10	50	100	20

NOTE: [1]Values for CE, RE, and RP for PM10 and PM25 were not estimated since these values account for PM reductions due to both exhaust and fuel sulfur standards.

Similar to locomotives, overall SO_2, PM_{10} and $PM_{2.5}$ emission reductions associated with decreases in the diesel fuel sulfur content were also included based on information in EPA's RIA for the Clean Air Diesel Rule (EPA, 2004b). See Table II-22 for the 2018 emission reductions that apply to commercial marine vessel SCC emissions.

E. DEVELOPMENT OF ONROAD DATA

For the onroad projections in the CENRAP air quality modeling, Pechan provided a set of VMT growth factors in SMOKE format, along with SMOKE-formatted MOBILE6 input files. The MOBILE6 input files incorporate any Federal, State, or local control program information. Thus, control factors or emission reduction percentages are not explicitly provided for this sector, but rather are incorporated in the MOBILE6 modeling. The development of the VMT growth factors and the MOBILE6 input files are discussed below. Once VMT growth factors were calculated for all of the CENRAP States, the growth factors were multiplied by the CENRAP base year 2002 VMT data to calculate 2018 VMT. The projected 2018 VMT by county and SCC (vehicle type and roadway type) were then provided in a SMOKE-formatted file, along with the corresponding average vehicle speed for that county/SCC combination. These speed inputs are the same as those used in the 2002 CENRAP base case—no updates were made to the modeled speeds.

1. VMT Growth

a. Default VMT Growth Methodology

As indicated in the Methods Document, Pechan's proposed default VMT growth methodology was to use EGAS VMT growth factors when more specific data were not supplied by the State or local agencies. However, when attempting to prepare the EGAS VMT growth factors using the beta version of EGAS 5, Pechan encountered a bug in the EGAS code that prevented data from being output for the onroad mobile SCCs. As an alternative (but similar) methodology, Pechan developed a set of 2002 to 2018 VMT growth factors using the same methodology used by EPA in their CAIR rule analysis that had originally been developed for EPA's draft Section 812 second prospective analysis (Mullen and Neumann, 2004).

The VMT projections account for vehicle class-specific growth factors and population growth factors. The data used for the vehicle class-specific growth factors are vehicle category-specific 2002 VMT and VMT projections to 2018, both at the national level, for the following three vehicle classes: 1) Light-duty vehicles (under 8,500 lbs); 2) Commercial light trucks (between 8,500 and 10,000 lbs); and 3) Freight trucks (greater than 10,000 lbs). These national VMT projections were obtained from the 2005 Annual Energy Outlook (DOE, 2005).

The national 2002 VMT and the 2018 VMT projections were allocated to the MOBILE6 vehicle categories using the default MOBILE6 VMT fractions by vehicle type in 2002 and 2018. Overall vehicle-specific growth factors were then calculated by multiplying the ratio of the 2018 to 2002 VMT at the MOBILE6 vehicle type level.

Table II-22. 2018 Emission Reductions and Control Information for Federal Diesel Commercial Marine Standards

SCC	SCC Description	Pollutant	2018 Emission Reduction, %	2018 Control Efficiency	2018 Rule Effectiveness	2018 Rule Penetration
2280002100	Marine Vessels, Commercial Diesel Port emissions	PM25-PRI	12.14	12.1	100	100
2280002100	Marine Vessels, Commercial Diesel Port emissions	PM10-PRI	12.14	12.1	100	100
2280002100	Marine Vessels, Commercial Diesel Port emissions	SO2	97.58	97.6	100	100
2280002100	Marine Vessels, Commercial Diesel Port emissions	NOX	20.46	43.7	100	46.8
2280002200	Marine Vessels, Commercial Diesel Underway emissions	PM25-PRI	12.14	12.1	100	100
2280002200	Marine Vessels, Commercial Diesel Underway emissions	PM10-PRI	12.14	12.1	100	100
2280002200	Marine Vessels, Commercial Diesel Underway emissions	SO2	97.58	97.6	100	100
2280002200	Marine Vessels, Commercial Diesel Underway emissions	NOX	14.88	43.2	100	34.4

Different levels of population growth throughout the CENRAP States were accounted for by calculating the ratio of county level population growth to national population growth. The population estimates used in these calculations were the EGAS population projections derived from Census population estimates and the REMI demographic/migration module which forecasts regional population change (REMI, 1997).

These resulting growth factors were then multiplied by the CENRAP 2002 VMT data at the county/roadway type/vehicle type level of detail to obtain projected 2018 VMT data. This is illustrated in the following equation:

$$VMT18_{C,V,R} = VMT02_{,C,V,R} * (VMT_{EIA18,V} / VMT_{EIA02,V}) * [(POP_{18,C}/POP02_{,C})/(POP_{18,US}/POP_{02,US})]$$

where:

$VMT18_{C,V,R}$	=	2018 projected VMT for county *C*, vehicle type *V*, road type *R* (million miles)
$VMT02_{C,V,R}$	=	2002 CENRAP VMT for county *C*, vehicle type *V*, road type *R* (million miles)
$VMT_{EIA20,\ \ V}$	=	2020 EIA-based VMT projection for vehicle type *V* (billion miles)
$VMT_{EIA99,V}$	=	1999 EIA-based VMT for vehicle type *V* (billion miles)
$POP_{20,C}$	=	2020 EGAS 4.0 population of county *C*
$POP_{99,C}$	=	1999 EGAS 4.0 population of county *C*
$POP_{20,US}$	=	2020 EGAS 4.0 population of *US*
$POP_{99,US}$	=	1999 EGAS 4.0 population of *US*

It should be noted that this equation does not specifically account for varying growth rates by functional roadway class. Our research in 2003 did not reveal a consistent national basis on which to make roadway-class-specific projections.

b. State or Local VMT Growth Methodology

Several State and local agencies within the CENRAP States provided data to be used in projecting VMT growth for that State or local area. Early in this project, Pechan asked the CENRAP emission inventory contacts for information on appropriate contacts from their State Departments of Transportation and from the major metropolitan planning organizations in their State. Pechan then inquired of these contacts whether they had developed their own VMT growth projections, and if so, the VMT growth data and will request any available documentation on the development of these growth factors and the growth factors themselves so that these growth factors would be applied correctly in the CENRAP projections. Responses to this request were provided by Arkansas, Iowa, Minnesota, Missouri, Nebraksa, and Oklahoma. However, the VMT projection data provided by Arkansas and Missouri were for 2003 only, and the VMT projection data provided by Nebraska were to 2009 only. Neither of these projections were considered sufficient for use in projecting VMT to 2018, so these data were discarded. Within the resources available, Pechan also attempted to locate publicly available projected VMT data for major cities within the CENRAP States that were not included in the State-provided VMT projection data and was able to obtain projected VMT information for several cities in Texas. The non-default VMT projection data used are described below.

i. Iowa

The Des Moines Area Metropolitan Planning Organization (MPO) provided projected VMT data for four counties in the Des Moines area: Dallas, Madison, Polk, and Warren. For each of these counties, daily link-level VMT data were provided for the years 2000, 2005, 2010, 2020, and 2030. For each of these years, Pechan summed the total VMT for each county and then performed a linear interpolation between the 2000 and 2005 county-level VMT totals to estimate county-level 2002 VMT. Similarly, Pechan linearly interpolated the county-level VMT totals from 2010 and 2020 to obtain an estimate of the 2018 county-level VMT totals. Finally, for each of these four counties, Pechan divided the interpolated 2018 county-level VMT by the interpolated 2002 county-level VMT to calculate a 2002 to 2018 VMT growth factor. These county-level VMT growth factors were then applied to all road types and vehicle types within the corresponding county. These growth factors are as follows: 2.09 for Dallas County, 1.64 for Madison County, 1.48 for Polk County, and 1.64 for Warren County. Default VMT growth factors were used in all other Iowa counties.

ii. Minnesota

The Minnesota Department of Transportation (MnDOT) provided a series of historical annual VMT data from 1983 to 2003. From these data, Pechan conducted a set of regression analyses with the Minnesota historical VMT as the dependent variable, and historical Minnesota values (from REMI model incorporated into EGAS 5) for the following potential independent variables: year, driving age population, gasoline and oil expenditures, real disposable per capita income, and total output. Although population came in a close second, the variable with the best statistical fit was year. Pechan solved the resulting equation with values for year of 2002 and 2018 and computed the ratio of the 2018 equation value to the 2002 equation value. This resulted in 2002 to 2018 VMT growth factor of 1.37 that was applied Statewide to all road types and vehicle types.

iii. Oklahoma

The Oklahoma DEQ provided a spreadsheet containing State total VMT from 1983 through 2020. The VMT from 1983 through 2003 were daily Highway Performance Modeling System (HPMS) actual VMT totals. The 2004 through 2020 daily VMT totals were estimated by Oklahoma DEQ using linear regression based on the actual VMT data. From these data, Pechan estimated a 2002 to 2018 State-level VMT growth factor by dividing the projected 2018 daily VMT value by the 2002 Oklahoma HPMS daily VMT value. This resulted in a growth factor of 1.2754 and was applied Statewide to all road types and vehicle types.

iv. Texas

Pechan estimated VMT growth factors for the counties in the Austin and Dallas areas, based on publicly available data.

Pechan obtained VMT for the Austin area from August 2003 TCEQ-sponsored on-road mobile source emission inventories for the Austin/San Marcos Metropolitan Statistical Area. The following counties were included in these inventories: Bastrop, Caldwell, Hays, Travis, and Caldwell. For each of these counties, daily September VMT were provided for 1995, 1999, 2002, 2005, 2007, and 2012, with separate values for Monday through Thursday, Friday, Saturday, and Sunday. Pechan summed the VMT by county in each year to obtain total VMT for a week in September. Using the 2007 and 2012 weekly September VMT data, Pechan performed a linear extrapolation to estimate 2018 weekly September VMT. County-level VMT growth factors from 2002 to 2018 were then calculated by dividing the 2018 weekly September VMT by the 2002 weekly September VMT.

Pechan obtained VMT projection data for the Dallas area from the 2004 update to the Metropolitan Transportation Plan, prepared by the North Central Texas Council of Governments. This document included 1999 and 2025 VMT data for five individual counties (Dallas, Tarrant, Denton, Collin, and Rockwall) plus two additional area groups including two counties each (Ellis and Kaufman in one group and Johnson and Parker in another group). Pechan used linear interpolation to estimate 2002 and 2018 VMT data for each of these counties or county groups and then calculated the 2002 to 2018 VMT growth factors by dividing the estimated 2018 VMT by the estimated 2002 VMT.

Table II-23 summarizes the non-default VMT growth factors applied in the CENRAP States. All of these non-default growth factors were applied to all road types and vehicle types in that county.

Table II-23. 2002 to 2018 Non-Default VMT Growth Factors Applied in CENRAP States

State	County	2002 to 2018 VMT Growth Factor
Iowa	Dallas	2.09
	Madison	1.64
	Polk	1.48
	Warren	1.64
Minnesota	All	1.37
Oklahoma	All	1.28
Texas	Bastrop	1.62
	Caldwell	1.43
	Collin	1.85
	Dallas	1.32
	Denton	1.99
	Ellis	1.79
	Hays	1.44
	Johnson	1.75
	Kaufman	1.79
	Parker	1.75
	Rockwall	1.70
	Tarrant	1.47
	Travis	1.75
	Williamson	2.18

2. SMOKE MOBILE6 Inputs

Each SMOKE-formatted MOBILE6 input file represents a single representative MOBILE6 scenario for a specific county or group of counties. For each county or group of counties modeled, two SMOKE-formatted MOBILE6 files were prepared: one representing July conditions and one representing January conditions. Within SMOKE, the July input files will be used to model the ozone season months (i.e., May through September) and the January input files will be used to represent all other months. For counties with no State or local control programs and no locally-provided inputs, these MOBILE6 inputs primarily contain the calendar year being modeled (2018) and fuel input parameters for the season being modeled. Temperature data are also provided, but these are overridden in SMOKE by temperatures specific to the month being modeled. A simple SMOKE-formatted MOBILE6 input file for a county with no local inputs is shown below:

```
SCENARIO RECORD     : ARKANSAS COUNTY, AR - WINTER
CALENDAR YEAR       : 2018
EVALUATION MONTH    : 1
ALTITUDE            : 1
MIN/MAX TEMPERATURE: 50.0 70.0
FUEL RVP            : 13.0
FUEL PROGRAM        : 1
DIESEL SULFUR       : 15.0
OXYGENATED FUELS    : 0.500  0.001  0.006  0.001  1
PARTICULATE EF      : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
```

Note that no speed information is included in this input file. The speed information is provided in the projected VMT files at the county/roadway type level of detail. In all cases, CALENDAR YEAR was set to 2018, ALTITUDE was set to "1" (i.e., low altitude), MIN/MAX TEMPERATURE was set as shown above (as dummy temperature values), DIESEL SULFUR was set to 15.0 (i.e., 15 ppm sulfur in the diesel fuel), and the PARTICULATE EF command was set using the files listed in the example above. The EVALUATION MONTH command was set to "1" for the January input files and to "2" for the July input files. The remaining commands listed in the example above (FUEL RVP, FUEL PROGRAM, ands OXYGENATED FUELS), as well as any additional commands needed, were set according to the specifics of the county or counties being modeled.

Note that the diesel sulfur input of 15 ppm sulfur in the diesel fuel represents the expected national diesel sulfur content in 2018. This reflects the requirements of the Federal heavy-duty vehicle/low sulfur diesel rulemaking. Other Federal control programs are included in the MOBILE6 defaults, with no additional inputs needed. This includes the emission standards associated with the heavy-duty vehicle rulemaking, the Tier 2 emission standards for light-duty vehicles and trucks, as well as all prior emission standards.

Optional local inputs that were included in the MOBILE6 files that are not related to control programs are the registration distributions and diesel sales fractions. The registration distributions (a distribution of registered vehicles by age for 16 vehicle types) used in the CENRAP 2002 base year modeling were used without change in the 2018 modeling. All CENRAP States except Arkansas has included registration distributions in the 2002 modeling.

The diesel sales fractions (the fraction of vehicles sales by model year that are diesel-fueled for 14 weight categories of vehicles) from 2002 were projected forward to 2018. To do this, the vehicles sales fractions listed for the 2002 model year were carried forward to all model years from 2003 to 2018. The diesel sales fractions values from the 1994 through 2002 model years, as listed in the 2002 diesel sales fractions files, were not changed. The diesel sales fractions from model years 1978 were removed from the files, as these model years are not needed in the 2018 calendar year modeling. Diesel sales fractions were provided in the 2002 CENRAP base year modeling for all CENRAP States except Arkansas and Texas.

A set of January and July SMOKE MOBILE6 input files were created for each group of counties with a unique combination of local inputs, fuels, and control programs. Thus, since Arkansas had supplied no local inputs, and there are no county-specific control programs in the State, a single set of MOBILE6 input files is used to model the entire State of Arkansas. In most of the other States, a single set of input files models a single county since most States provided county-specific registration distributions or diesel sales fraction data.

Area-specific control programs modeled in each State are described below.

a. Inspection and Maintenance and Anti-tampering Programs

Onroad vehicle inspection and maintenance (I/M) programs and/or anti-tampering programs (ATPs) are required in specific counties in Louisiana, Missouri, and Texas. Changes to these programs have occurred or will occur such that the versions needed for the 2002 modeling were updated to best reflect the programs expected to be in place in 2018.

i. Louisiana

The Louisiana I/M program applies to the 5-parish Baton Rouge ozone nonattainment area (Ascension Parish, East Baton Rouge Parish, Iberville Parish, Livingston Parish, and West Baton Rouge Parish). The specifics of this program, in MOBILE6 format, are shown in Figure II-1.

ii. Missouri

Missouri includes a basic I/M program in Franklin County, per State regulation 11 CSR 50-2.400 "Emission Test Procedures" and an enhanced I/M program in the remainder of the St. Louis area (St. Louis City, Jefferson County, St. Charles County, and St. Louis County), per State regulation 10 CSR10-5.380 "Motor Vehicle Emissions Inspection." The specifics of the Franklin County program, in MOBILE6 format, are shown in Figure II-2. The St. Louis enhanced program is shown in Figure II-3.

Figure II-1. Baton Rouge I/M Program and ATP Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M PROGRAM        : 1 2002 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 21111111 1
I/M STRINGENCY     : 1 20.0
I/M EFFECTIVENESS  : 0.75 0.75 0.75
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 0.0 0.0

I/M PROGRAM        : 2 2000 2001 1 TRC GC
I/M MODEL YEARS    : 2 1980 2001
I/M VEHICLES       : 2 22222 21111111 1
I/M COMPLIANCE     : 2 96.0

I/M PROGRAM        : 3 2002 2006 1 TRC GC
I/M MODEL YEARS    : 3 1980 2006
I/M VEHICLES       : 3 11111 21111111 1
I/M COMPLIANCE     : 3 96.0

I/M PROGRAM        : 4 2002 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 21111111 1
I/M STRINGENCY     : 4 20.0
I/M COMPLIANCE     : 4 96.0

I/M PROGRAM        : 5 2007 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 5 2007 2050
I/M VEHICLES       : 5 11111 21111111 1
I/M STRINGENCY     : 5 20.0
I/M COMPLIANCE     : 5 96.0

ANTI-TAMP PROG     :
00 80 50 22222 21111111 1 11 072. 22212222
```

Figure II-2. Franklin County I/M Program and ATP Characteristics

```
I/M PROGRAM        : 1 2000 2050 2 T/O IDLE
I/M MODEL YEARS    : 1 1971 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 15.2
I/M COMPLIANCE     : 1 96.0
I/M WAIVER RATES   : 1 10.9 9.9
I/M GRACE PERIOD   : 1 2

I/M PROGRAM        : 2 2000 2050 2 T/O GC
I/M MODEL YEARS    : 2 1981 2050
I/M VEHICLES       : 2 22222 11111111 1
I/M COMPLIANCE     : 2 96.0
I/M GRACE PERIOD   : 2 2

ANTI-TAMP PROG     :
00 71 50 22222 11111111 1 12 096. 12212122
```

Figure II-3. St. Louis Enhanced I/M Program Characteristics

```
I/M PROGRAM        : 1 2003 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20.0
I/M COMPLIANCE     : 1 96.0
I/M WAIVER RATES   : 1 3.0 3.0
I/M GRACE PERIOD   : 1 2

I/M PROGRAM        : 2 1990 2002 2 T/O IDLE
I/M MODEL YEARS    : 2 1971 1980
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 18.0
I/M COMPLIANCE     : 2 96.0
I/M WAIVER RATES   : 2 25.3 25.3
I/M GRACE PERIOD   : 2 2

I/M PROGRAM        : 3 1990 2002 2 T/O IM240
I/M MODEL YEARS    : 3 1981 2050
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 18.0
I/M COMPLIANCE     : 3 96.0
I/M WAIVER RATES   : 3 25.3 25.3
I/M CUTPOINTS      : 3 MO_IM240.cut
I/M GRACE PERIOD   : 3 2

I/M PROGRAM        : 4 2003 2050 2 T/O OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96.0
I/M GRACE PERIOD   : 4 2

I/M PROGRAM        : 5 2000 2002 2 T/O GC
I/M MODEL YEARS    : 5 1981 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M COMPLIANCE     : 5 96.0
I/M GRACE PERIOD   : 5 2
```

iii. Texas

The Texas I/M program and ATP differ by the start date of the program in various county groups. In addition, the El Paso program is different from that in the other parts of the State. The Texas I/M program is defined in State regulation section 114.50 “Vehicle Emissions Inspection Requirements. The specifics of the Texas program, in MOBILE6 format, are shown in Figure II-4 for Harris, Dallas, and Tarrant Counties. The El Paso program is shown in Figure II-5. I/M inspections began in Collin and Denton Counties in 2002. This program is shown in Figure II-6. Testing began in 2003 for Brazoria, Ellis, Fort Bend, Galveston, Johnson, Kaufman, Montgomery, Parker, and Rockwall Counties. This program is shown in Figure II-7. Finally, testing is scheduled to begin in 2005 for the Austin area counties of Travis and Williamson. The characteristics of this program are shown in Figure II-8.

Figure II-4. Harris, Dallas, and Tarrant Counties I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 1996 2001 1 TRC 2500/IDLE
I/M MODEL YEARS    : 1 1978 2050
I/M VEHICLES       : 1 22222 22222222 2
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2002 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 2 1996 2050
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 3 1978 1995
I/M VEHICLES       : 3 22222 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 4 96
I/M WAIVER RATES   : 4 3.0 3.0

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2002 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 6 2
I/M EXEMPTION AGE  : 625
I/M PROGRAM        : 6 2002 2050 1 TRC GC
I/M MODEL YEARS    : 6 1978 1995
I/M VEHICLES       : 6 22222 22222222 2
I/M COMPLIANCE     : 6 96
```

Figure II-4 (continued)

```
I/M GRACE PERIOD   : 7 2
I/M EXEMPTION AGE  : 7 25
I/M PROGRAM        : 7 2002 2050 1 TRC GC
I/M MODEL YEARS    : 7 1996 2050
I/M VEHICLES       : 7 11111 22222222 2
I/M COMPLIANCE     : 7 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-5. El Paso County I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 1996 2050 1 TRC 2500/IDLE
I/M MODEL YEARS    : 1 1978 2050
I/M VEHICLES       : 1 22222 22222222 2
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 1996 2050 1 TRC GC
I/M MODEL YEARS    : 2 1978 2050
I/M VEHICLES       : 2 22222 22222222 2
I/M COMPLIANCE     : 2 96

ANTI-TAMP PROG     :
86 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-6. Collin and Denton Counties I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 2002 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 2 1978 1995
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2002 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 3 1996 2050
I/M VEHICLES       : 3 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2002 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2002 2050 1 TRC GC
I/M MODEL YEARS    : 5 1978 1995
I/M VEHICLES       : 5 22222 22222222 2
I/M COMPLIANCE     : 5 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2002 2050 1 TRC GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 11111 22222222 2
I/M COMPLIANCE     : 5 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-7. 9-County Texas, 2003 Start Year, I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 2003 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2003 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 2 1978 1995
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2003 2050 1 TRC ASM 2525/5015 FINAL
I/M MODEL YEARS    : 3 1996 2050
I/M VEHICLES       : 3 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2003 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2003 2050 1 TRC GC
I/M MODEL YEARS    : 5 1978 1995
I/M VEHICLES       : 5 22222 22222222 2
I/M COMPLIANCE     : 5 96

I/M GRACE PERIOD   : 6 2
I/M EXEMPTION AGE  : 6 25
I/M PROGRAM        : 6 2003 2050 1 TRC GC
I/M MODEL YEARS    : 6 1996 2050
I/M VEHICLES       : 6 11111 22222222 2
I/M COMPLIANCE     : 6 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

Figure II-8. Austin Area I/M Program Characteristics

```
I/M GRACE PERIOD   : 1 2
I/M EXEMPTION AGE  : 1 25
I/M PROGRAM        : 1 2005 2050 1 TRC OBD I/M
I/M MODEL YEARS    : 1 1996 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M COMPLIANCE     : 1 96
I/M WAIVER RATES   : 1 3.0 3.0

I/M GRACE PERIOD   : 2 2
I/M EXEMPTION AGE  : 2 25
I/M PROGRAM        : 2 2005 2050 1 TRC 2500/IDLE
I/M MODEL YEARS    : 2 1978 1995
I/M VEHICLES       : 2 22222 22222222 2
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 2 96
I/M WAIVER RATES   : 2 3.0 3.0

I/M GRACE PERIOD   : 3 2
I/M EXEMPTION AGE  : 3 25
I/M PROGRAM        : 3 2005 2050 1 TRC 2500/IDLE
I/M MODEL YEARS    : 3 1996 2050
I/M VEHICLES       : 3 11111 22222222 2
I/M STRINGENCY     : 3 20
I/M COMPLIANCE     : 3 96
I/M WAIVER RATES   : 3 3.0 3.0

I/M GRACE PERIOD   : 4 2
I/M EXEMPTION AGE  : 4 25
I/M PROGRAM        : 4 2005 2050 1 TRC EVAP OBD & GC
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M COMPLIANCE     : 4 96

I/M GRACE PERIOD   : 5 2
I/M EXEMPTION AGE  : 5 25
I/M PROGRAM        : 5 2005 2050 1 TRC GC
I/M MODEL YEARS    : 5 1978 1995
I/M VEHICLES       : 5 22222 22222222 2
I/M COMPLIANCE     : 5 96

I/M GRACE PERIOD   : 6 2
I/M EXEMPTION AGE  : 6 25
I/M PROGRAM        : 6 2005 2050 1 TRC GC
I/M MODEL YEARS    : 6 1996 2050
I/M VEHICLES       : 6 11111 22222222 2
I/M COMPLIANCE     : 6 96

ANTI-TAMP PROG     :
84 78 16 22222 22222222 2 11 096. 22112222
```

b. Gasoline Programs

The control programs modeled in the SMOKE MOBILE6 input files included the effects of several gasoline programs. Reformulated gasoline was modeled in the St. Louis, Missouri; Houston, Texas; and Dallas, Texas ozone nonattainment areas. The specific counties modeled with Federal reformulated gasoline are the same as those modeled with this program in the NONROAD model runs, as shown in Table II-11. No changes were expected in oxygenated fuel programs or inputs. Therefore, the MOBILE6 oxygenated fuel input parameters did not change from the 2002 base year modeling.

State-run low RVP gasoline control programs are in place in three of the CENRAP States: Kansas, Missouri, and Texas. These low RVP programs are not statewide, but are in specific counties. The Kansas and Missouri programs are in 1-hour ozone maintenance areas. The Texas program covers a broader area of the State. In addition to these State low RVP programs, the six-parish Baton Rouge ozone nonattainment area is subject to a 7.8 psi RVP maximum during the ozone season months, as regulated by the Federal RVP program for southern ozone nonattainment areas. Descriptions of the individual State low RVP programs are given below. Note that these RVP limits were applied to the nonroad gasoline engines covered in the NONROAD model, as well as onroad vehicles, for the counties and months discussed below, and this information was summarized in Table II-12.

i. Kansas

The Kansas low RVP program is specified under Section 28-19-719 "Fuel Volatility" of the Kansas Air Quality Regulations and applies in Johnson and Wyandotte Counties. These two counties are part of the Kansas City ozone maintenance area. This regulation specifies that gasoline dispensed for use in motor vehicles in Johnson and Wyandotte Counties not exceed an RVP of 7.0 pounds per square inch (psi). Gasoline containing between 9 and 10 percent ethanol by volume is limited to an RVP of 8.0 psi. These regulations are in effect from June 1 through September 15 of each year, starting in 2001. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

ii. Missouri

The Missouri low RVP program is specified under Section 10-2.330 "Control of Gasoline Reid Vapor Pressure" of the Missouri Code of State Regulations for the Air Conservation Commission and applies in Clay, Platte, and Jackson Counties. These counties are part of the Kansas City ozone maintenance area. This regulation specifies that gasoline dispensed for use in motor vehicles in Clay, Platte, and Jackson Counties not exceed an RVP of 7.0 psi. Gasoline containing between 9 and 10 percent ethanol by volume is limited to an RVP of 8.0 psi. These regulations are in effect from June 1 through September 15 of each year, starting in 2001. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

iii. Texas

The Texas low RVP program is specified under Section 114.301 through 114.309 "Low Emission Fuels, Division 1: Gasoline Volatility" of the Texas Natural Resource Conservation Commission regulations and applies in a 95-county area of eastern Texas. This area excludes the eastern Texas counties in the Dallas and Houston area that are included in the Federal reformulated gasoline program. This regulation specifies that gasoline dispensed for use in the 95 affected counties not exceed an RVP of 7.8 psi. These regulations are in effect at gasoline dispensing facilities from June 1 through October 1 of each year, beginning in 2001. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

A separate low RVP program is in place in El Paso County. Under this program, gasoline dispensed in El Paso County is limited to an RVP of 7.0 psi from June 1 through September 16. This program began in 1996. To account for the time needed for individual gasoline stations to comply with these limits, the low RVP program is modeled from May through September in the MOBILE6 SMOKE input files.

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CHAPTER III. DEVELOPMENT OF DATA FOR AREAS OUTSIDE OF THE CENRAP STATES

A. WRAP

The Western Regional Air Partnership (WRAP) includes all of the States west of the CENRAP region. WRAP's current schedule for preparing new emission projections for its States did not include any new information by March 2005, so the previous WRAP 2018 emission forecasts will be used as the basis for CENRAP's projection year emissions modeling. The existing WRAP 2018 emission forecasts are made from a 1996 base year. The CENRAP emission modelers already have access to these WRAP emission inventory projection files, so Pechan did not expend any further effort in preparing or modifying the WRAP emission projection data.

B. VISTAS

The Visibility Improvement State and Tribal Association of the Southeast (VISTAS) includes the States of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia. VISTAS had recently completed 2018 emission projections for its States in March 2005. VISTAS agreed that CENRAP may use the 2018 SMOKE-ready emission modeling files that VISTAS developed for its States once all QA has been completed on these files. Because the CENRAP emission modelers are the same as those performing the emission modeling for VISTAS, Pechan did not expend any further effort in preparing or modifying the VISTAS emission inventory.

For the EGU sector, CENRAP determined that it would be best to use a consistent IPM data set for all of the non-WRAP States. Therefore, for the EGU sector, the VISTAS EGU data will be replaced by the EGU data from the summer 2005 IPM projections.

C. MRPO

The Midwest Regional Planning Organization (MRPO) includes the States of Illinois, Indiana, Michigan, Ohio, and Wisconsin. Pechan developed growth factors for the point and area source emissions for the MRPO States as discussed in section II.A of this document. Pechan obtained the mobile source inputs for the MRPO States from 2018 modeling prepared by VISTAS, with the permission of both VISTAS and MRPO. These are the inputs that were used in VISTAS 2018 modeling for these States, with inputs provided by MRPO States. Pechan prepared point and area source control factors, based on projection year modeling we had prepared earlier for MRPO. The emission inventory file for 2018 for the NONROAD model categories was based on interpolating the 2015 and 2020 nonroad emission inventories prepared by EPA in support of the Clean Air Interstate Rule in 2004 (EPA, 2004c). Emissions from the MRPO States for the EGU sector will be obtained by CENRAP from the summer 2005 IPM runs.

D. MANE-VU

The Mid-Atlantic/Northeast Visibility Union (MANE-VU) MRPO includes the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont, and the District of Columbia. For the MANE-VU States, Pechan used the point and area source growth factors developed for the MRPO States as discussed in section II.A of this document. Pechan obtained the mobile source inputs for the MANE-VU States from the 2018 modeling prepared by VISTAS, as discussed above for MRPO. These are the inputs that were used in VISTAS 2018 modeling for the MANE-VU States. Pechan prepared point and area source control factors, based on projection year modeling we had prepared earlier for MRPO that include the MANE-VU States. The emission inventory file for 2018 for the NONROAD model categories was based on interpolating the 2015 and 2020 nonroad emission inventories prepared by EPA in support of the Clean Air Interstate Rule in 2004 (EPA, 2004c). Emissions from the MRPO States for the EGU sector will be obtained by CENRAP from the summer 2005 IPM runs.

E. CANADA

Available emission data sets for Canada are currently limited to historical emission years--1995 and 2000. EPA and LADCO/MRPO are using these inventories to estimate current and future year emissions for these provinces. It is our understanding that LADCO is using/planning to use 1995 point source emission estimates and 2000 onroad/off-road/area source emission estimates to estimate Canadian emissions for their modeling domain. (The 2000 point source emissions data are not being used because of confidentiality limitations.) The 2000 Canadian emission data sets for the three nonproprietary sectors (non-point/area, nonroad mobile, and onroad mobile) are available at: http://www.epa.gov/ttn/chief/net/canada.html#data. This file contains information in both dBaseIV and SMOKE IDA format.

While we know that Environment Canada compiles emission projections on a regular basis to support the development of Federal and provincial emission control strategies, it is not expected that Environment Canada would be able to provide growth and control factors on a timely basis for this CENRAP project. Pechan recommended that CENRAP use the base year 1995 and 2000 Canadian emissions data without adjustments for all future year model simulations. The CENRAP emission modelers already have access to these Canadian emission inventory files, so Pechan did not expend any further effort in preparing or modifying the Canadian emission inventory.

F. MEXICO

The emissions inventory base year for Mexico is for 1999, from the BRAVO study. Inventories for the years 2002 and 2012 were also estimated in order to understand how growth and existing control strategies may impact future emissions. Currently, the 1999 emission inventory is available, but the emission databases for the other years are not. Moreover, the point source database will most likely be proprietary, and could require signing a non-disclosure agreement for access. Pechan has recommended, and CENRAP has agreed, that the 1999 Mexican emission database be used as is for the CENRAP 2018 modeling, due to the uncertainty inherent in applying growth and control factors to this inventory. The CENRAP emission modelers already have access to these Mexican emission inventory files, so Pechan did not expend any further effort in preparing or modifying the 1999 Mexican emission inventory.

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CHAPTER IV. ISSUES OF CONCERN

Due to the timing of the growth and control factor development under this project, some adjustments may need to be made in the future to the factors developed under this project. As the CENRAP 2002 emission inventory continues to be revised, as well as the base year inventories for the other RPOs, issues may arise related to matching the growth and control factors to a revised base year inventory. In cases where SCCs are changed, added to, or deleted from the base year inventory, the growth and control factors may no longer match correctly to the base year inventory. In these cases, the projection year inventories will be incorrect.

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CHAPTER V. REFERENCES

Alpine, 2004: Alpine Geophysics, "Technical Memorandum: Control Packet Development and Data Sources, Burnsville, NC, prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, (www.epa.gov/interstateairquality), July 14, 2004.

CENRAP, 2005: CENRAP Visibility Modeling, Interim 2002 Emissions QA (scen02a_36), "NonCENRAP States Inventory SMOKE Input Files," Riverside, CA; weblink: http://pah.cert.ucr.edu/aqm/cenrap/scen02a_36.shtml. last updated February 15, 2005.

DOE, 2004: U.S. Department of Energy, *Annual Energy Outlook 2004, with Projections through 2025*, DOE/EIA-0383(2004), Energy Information Administration, Office of Integrated Analysis and Forecasting, Washington, DC, January 2004.

DOE, 2005: Department of Energy, Energy Information Administration, *Annual Energy Outlook 2005 With Projections to 2025*, DOE/EIA-0383(2005), February 2005.

EPA, 1998: U.S. Environmental Protection Agency, "Locomotive Emission Standards, Regulatory Support Document," Office of Mobile Sources, Ann Arbor, MI, April 1998.

EPA, 1999: U.S. Environmental Protection Agency, "Final Regulatory Impact Analysis: Control of Emissions from Marine Diesel Engines," EPA420-R-99-026, Office of Mobile Sources, Ann Arbor, MI, November 1999.

EPA, 2002: U.S. Environmental Protection Agency, "Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines," EPA420-R-02-022, Office of Mobile Sources, Ann Arbor, MI, September 2002.

EPA, 2003: U.S. Environmental Protection Agency, "Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder," EPA420-R-03-004, Office of Mobile Sources, Ann Arbor, MI, January 2003.

EPA, 2004a: U.S. Environmental Protection Agency, Draft NONROAD2004, [Computer software], Office of Transportation and Air Quality, Ann Arbor, MI, available May 21, 2004 at: http://www.epa.gov/otaq/nonroadmdl.htm

EPA, 2004b: U.S. Environmental Protection Agency, "Final Regulatory Analysis: Control of Emissions from Nonroad Diesel Engines," EPA420-R-04-007, Office of Mobile Sources, Ann Arbor, MI, May 2004.

EPA, 2004c: U.S. Environmental Protection Agency, "Clean Air Interstate Rule Emissions Inventory Technical Support Document," available from http://www.epa.gov/CAIR/pdfs/finaltech01.pdf, March 4, 2005.

EPA, 2005: U.S. Environmental Protection Agency, data compiled in support of 2002 and previous versions of the National Emissions Inventory (NEI), 2002 NEI documentation available from http://www.epa.gov/ttn/chief/net/2002inventory.html, web page last updated March 4, 2005.

ERS, 2004: Economic Research Service, "February 2004, USDA Agricultural Baseline, Projection Tables to 2013," WAOB-2004-1, TAB06.WK1, TAB21-27.WK1, Washington, D.C., February 2004.

Freedonia, 2002: The Freedonia Group, Inc., "Paints & Coatings to 2006," Cleveland, OH, September 2002.

Freedonia, 2003: The Freedonia Group, Inc., "Solvents: Green & Conventional to 2007," April 2003.

Houyoux, 2004: Houyoux, M., U.S. Environmental Protection Agency, *REMI ver 5.5 baseline.zip* [Electronic File], Emission Factor and Inventory Group, Emissions, Monitoring, and Analysis Division, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 2, 2004.

Kansas, 2004: State of Kansas, Division of the Budget, "Kansas Population Projections," Topeka, Kansas, accessed December, 2004 from http://da.state.ks.us/budget/files/FY2006/Kansas_Population_Projections_through_2027.xls.

LPDC, 2003: Louisiana Population Data Center, "LA Population Projections to 2020," Baton Rouge, Louisiana, available for download from http://www.lapop.lsu.edu/products.html, web page last updated October, 2003.

MNPLAN, 2002: Minnesota Planning (Agency), Minnesota State Demographic Center, "Minnesota Population Projections: 2000-2030," St. Paul, Minnesota, available from http://server.admin.state.mn.us/resource.html?Id=3124#viewer, October, 2002.

MO, 1999: State of Missouri, Office of Administration, "Projections of the Population by Age and Sex: 1990 to 2025," Jefferson City, MO, available from http://www.oa.mo.gov/bp/tables02.htm, May 1999.

Mullen and Neumann, 2004: "Documentation of 2003 VMT Projection Methodology, EPA Contract No. 68-W-02-048, WA B-41," technical memorandum from Maureen Mullen, E.H. Pechan & Associates, Inc. and Jim Neumann, Industrial Economics, Incorporated to Jim DeMocker, U.S. Environmental Protection Agency, OAR/OPAR, March 4, 2004.

ODOC, 2002: Oklahoma Department of Commerce, "Population Projections for the State, Metropolitan Areas, and Counties: 2000-2030," Oklahoma City, Oklahoma, available from http://www.okcommerce.gov/index.php?option=com_docman&task=view_category&Itemid=99&subcat=45&catid=64&limitstart=0&limit=20, November, 2002.

Omary, 2005: Mohammed Omary, University of California Riverside, “scc_nh_expanded1.txt,” [Electronic file], transmitted to Lee Warden, Oklahoma Department of Environmental Quality, February 23, 2005.

Pechan, 2001. E.H. Pechan & Associates, Inc., “Control Measure Development Support – Analysis of Ozone Transport Commission Model Rules,” Final Report prepared for Ozone Transport Commission, March 31, 2001.

Pechan, 2002. E.H. Pechan & Associates, Inc., “Evaluation of U.S. Measures to Reduce Emissions of Volatile Organic Compounds from the Solvent Sector,” Final Report prepared for Environment Canada, May 31, 2002.

Pechan, 2004. E.H. Pechan & Associates, Inc., “EGAS 5.0 Regression Analyses, Final Technical Memorandum,” available from http://www.epa.gov/ttn/ecas/models/EGAS_regression_memo.pdf, August 6, 2004.

Pechan, 2005a. E.H. Pechan & Associates, Inc., “Background Information on Versions 4.0 and 5.0 of the Economic Growth Analysis System (EGAS), Technical Memorandum,” prepared for Central Regional Air Planning Association, January 3, 2005.

Pechan, 2005b: E.H. Pechan & Associates, Inc., “NONROAD Model Growth Rates for CENRAP,” Draft Technical Memorandum prepared by Pechan for Central Regional Air Planning Association, February 1, 2005.

Pechan and CEP, 2005: E.H. Pechan & Associates, Inc. and Carolina Environmental Program, “Consolidation of Emissions Inventories (Schedule 9; Work Item 3) Draft,” prepared for Central Regional Air Planning Association, January 4, 2005.

REMI, 1997: Regional Economic Models, Inc., “Model Documentation for the REMI EDFS-14 Forecasing Simulation Model,” REMI Reference Set, Volume 1, March 1997.

STI, 2004: Sonoma Technology, Inc., “Emission Inventory Development for Mobile Sources and Agricultural Dust Sources for the Central States, Draft Final Report,” Prepared by STI for Central States Air Resource Agencies and Central Regional Air Planning Association, September 22, 2004.

SLI, 2004: State Library of Iowa, State Data Center of Iowa (projections prepared by Woods and Poole Economics, Inc.), "Projections of Total Population for U.S., Iowa, and its Counties: 2005-2030," accessed December, 2004 from http://www.silo.lib.ia.us/specialized-services/datacenter/datatables/CountyAll/co2004populationprojections20002030.xls.

TCEQ, 2004: Texas Commission on Environmental Quality, “Revisions to the State Implementation Plan (SIP) for the Control of Ozone Pollution –

Houston/Galveston/Brazoria Ozone Nonattainment Area," Chapter 3, Part 1, Austin, Texas, Adopted December 1, 2004 (http://www.tnrcc.state.tx.us/oprd/sips/june2004hgb.

TXSDC, 2004: Texas State Data Center and Office of the State Demographer, Institute for Demographic and Socioeconomic Research,"2004 Population Projections- Texas Counties (use of migration scenario 0.5 projections)," College of Business, University of Texas at San Antonio, available from http://txsdc.utsa.edu/tpepp/2004projections/, June 2004.

UALR, 2003: University of Arkansas at Little Rock, Institute for Economic Advancement, "Arkansas 2003-2027 County and State Population Projections," Little Rock, Arkansas, available from http://www.aiea.ualr.edu/research/demographic/population/proj2027.xls, July 8, 2003.

UNE, 2002: University of Nebraska, Bureau of Business Research, "Nebraska County Population Projection," Lincoln, Nebraska, http://info.neded.org/stathand/bsect12.htm, web page last updated June, 2002.

APPENDIX A
METHODS FOR DEVELOPMENT OF GROWTH AND CONTROL INPUTS FOR 2018 EMISSIONS (SCHEDULES 3 AND 9)

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CHAPTER I. INTRODUCTION

The purpose of this project is to prepare emission growth and control factors that can be applied to the Central Regional Air Planning Association (CENRAP) 2002 base year emission inventory to obtain a 2018 emissions inventory for the CENRAP region. The CENRAP region includes the States and Tribal areas of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. In addition to the CENRAP States, additional factors will be compiled under this project to include the entire CENRAP modeling domain. This will include projected emissions data or projection year growth and control factor data from the other Regional Planning Organizations (RPOs), Canada, and Mexico. All data products will be prepared in SMOKE-compatible format.

These projection year growth and control factor data will be used to support air quality modeling and State Implementation Plan (SIP) development and implementation activities for the regional haze rule and fine particulate matter (PM) and ozone National Ambient Air Quality Standards (NAAQS). The data will be applicable to all source categories and pollutants included in the CENRAP 2002 emission inventory. This includes the following pollutants: sulfur oxides (SO_x), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), ammonia (NH_3), and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$).

This Methods Document explains the data sources that E.H. Pechan & Associates, Inc. (Pechan) plans to use and the procedures Pechan will follow in developing the necessary growth and control data for this project. Chapter II of this document presents Pechan's planned methods for developing control factors and growth factors for the CENRAP States. The methods are presented separately for each of the major source categories. Chapter III of this document presents the data sources and methods that Pechan will use for developing the data for areas outside of the CENRAP States, including other RPOs and Canada and Mexico. References are included in Chapter IV.

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CHAPTER II. METHODS FOR THE CENRAP REGION

A. CONTROL FACTOR DEVELOPMENT METHODS AND DATA SOURCES

1. Non-EGU Point Sources

a. Federal Controls

For non-electricity generating unit (EGU) point sources, the analysis of Federal controls will focus on maximum achievable control technology (MACT) standards. Numerous MACT emission standards have been promulgated since 1990, and are designed to control emissions of hazardous air pollutants (HAPs) from stationary sources. Many of the MACT standards are expected to produce associated VOC emission reductions, so the 2018 control factors need to capture the expected effects of post-2002 MACT standards.

Pechan prepared criteria pollutant-specific emission control factors for various projection years (including 2018) for the Lake Michigan Air Directors Consortium (LADCO) during late 2004. The procedure for developing the MACT standard-associated control factors included identifying source categories and associated Source Classification Codes (SCCs) for each MACT standard having a post-2002 compliance date for existing sources. The control factors for most MACT categories are based on information found in the preamble to the final rule of each MACT subpart as published in the *Federal Register*. Pechan plans to circulate this table of control factors to the CENRAP States for review before using this table to develop non-EGU point source control factors for the CENRAP States.

b. State/Local Controls

CENRAP States will be surveyed to gather information on control programs for the 2018 inventory. The general approach is to use State contacts and information for 1-hour ozone and PM_{10} SIPs to determine where post-2002 emission reductions are expected. Two States where we expect there to be post-2002 non-EGU point source emission reductions include Texas and Missouri. For Texas, it is expected that control factors will be based on the control factor file developed by Pechan during 2001 for the prior Western Regional Air Partnership (WRAP) emission forecast to 2018, with updates to a 2002 base year and to reflect recent SIP updates (Houston-Galveston area). Another possible way to approach this is to obtain the most recent Texas control factor file from the Texas Commission on Environmental Quality (CEQ) and incorporate it into the CENRAP State control factor database. Key issues in determining whether using any new Texas CEQ control factor files in this analysis is advisable include whether this file is for a 2002 base year inventory, and how the reductions in highly reactive VOCs that are required in the Houston-Galveston area SIP are treated in 2002 and any forecast years.

The portion of eastern Missouri that is within the fine grid is affected by the NO_x SIP Call, so controls would be expected to be added in those counties to reduce point source NO_x emissions between 2002 and 2018. It appears to us that the associated Missouri rule affects NO_x emissions from EGUs but not some of the non-EGU source categories like industrial boilers/turbines, stationary internal combustion engines, and cement kilns that are regulated in other NO_x SIP Call affected States. Rules that potentially affect the non-EGU source categories appear to be under development. Pechan plans to inquire with the Missouri Department of Natural Resources to determine whether control factors for these non-EGU categories should be included in the 2018 control factor file. The number of affected sources appears to be small enough that source-specific control factors can be developed.

We can also survey the other CENRAP States (besides Texas and Missouri) to determine whether these are State/local regulations that would be expected to provide post-2002 emissions reductions. If there are, pollutant-specific control factors will be developed for those geographic areas by SCC.

2. Area Sources

For the CENRAP States, Pechan will contact each State to obtain information for any on-the-books controls affecting non-EGU point and area sources from 2002 to 2018. Pechan will also compile information for national controls affecting these sources from EPA regulatory support documents. Based on the analyses performed by Pechan for other RPOs, the Federal controls for which area source control factors are expected to be developed is limited to residential wood combustion. For this analysis, a 20-year estimated lifetime for woodstoves and fireplace inserts will be used along with the SCC-specific growth factors, and emission factor ratios by SCC, to account for the replacement of retired woodstoves that emit at pre-new source performance standard levels, with new wood burning equipment, that would be catalyst-equipped. Emission factor ratios will be pollutant-specific.

Federal rules affecting VOC solvent emissions such as those from consumer products and architectural and industrial maintenance coatings are expected to be incorporated in the 2002 emission databases, so no post-2002 emission rate reductions are expected for these categories.

3. EGU Point Sources

Data sources to be used for developing EGU control factors include CENRAP's 2002 nine State point source National Emissions Inventory (NEI) input format (NIF) data files (prepared by Pechan and Carolina Environmental Program and delivered on December 10, 2004), the Workgroup-selected growth factors, and the U.S. Environmental Protection Agency's (EPA's) 2020 Integrated Planning Model (IPM) Base and Clean Air Interstate Rule (CAIR) Control post-processed scenario data files (developed by Pechan for EPA from IPM parsed output files). Because 2018 IPM data from two RPOs are unavailable, 2020 data will be used as a surrogate (with CENRAP's agreement). This should pose no significant problem since no known pollutant regulations are in effect in 2020 and not 2018. The 2020 Base and Control (CAIR) post-processed IPM scenario data files include annual emission values for seven pollutants – sulfur dioxide (SO_2), NO_x, CO, VOC, NH_3, primary PM_{10}, and primary $PM_{2.5}$ – as well as annual heat input; only SO_2, NO_x, and heat input are provided in the initial IPM files; the other emissions, along with throughput, were developed during the post-processing phase. Because EPA required that Pechan use an older emission factor file from 2003, and new NH_3 emissions factors for EGUs were developed in Spring 2004, the post-processed files delivered to EPA included ammonia emissions developed using the old emission factors; as agreed to in a January 10th conference call, Pechan will recalculate these emissions using the new NH_3 emissions factors.

For EGUs in the CENRAP States and in the 2020 IPM Base Case and CAIR post-processed data files, Pechan will provide growth and control factors in SMOKE format. The control factors will be provided in SMOKE CONTROL (Table 8.66 in the SMOKE v2.1 User's Manual) formatted files.

Each EGU record in both the 2020 Base and Control Cases will be ORISPL-BLRID matched into the EGU extract of the CENRAP NIF files (if at all possible) to obtain the FIPS State and county, plant ID, and point ID (where a point is generally equivalent to a boiler) as needed. Since the IPM scenarios only have one SCC per boiler, the emissions for all SCCs at a given point in CENRAP will be assigned to the SCC with the largest emissions.

The control factor (cf) for each 2020 Base and Control Case EGU unit will be calculated as follows for each of the seven pollutant emissions:

2020 EGU pollutant's emissions cf = (2020 pollutant's emissions) / (2002 EGU's State-SCC gf ∗ 2002 CENRAP pollutant's emissions summed to the point-level and assigned to the SCC with the largest emissions).

The IPM units that operate in 2020 but either are not in the 2002 CENRAP data (i.e., generic or committed/planned units) or could not be matched, will not be included in the SMOKE CONTROL formatted files because no control factors can be calculated. Yet, they have emissions that need to be accounted for. Based on a conversation with EPA's Marc Houyoux, a principal developer of SMOKE, it would be best for Pechan to provide the projected emissions for those units in either an Excel file or a SMOKE IDA (Table 8.45 in the SMOKE v2.1 User's Manual) point source formatted file.

4. Nonroad Sources

Pechan will contact CENRAP States to determine whether each State has specific nonroad equipment regulations beyond the Federal engine standards that are expected to be in place by 2018. In cases where State regulations do exist, Pechan will determine the affected SCCs and pollutants, and will compile or develop estimates of the percent emission reduction of the rule in 2018. To date, Pechan has determined that the States of Iowa, Kansas, Minnesota, Nebraska, and Oklahoma do not have additional air requirements for nonroad sources.

Pechan has compiled estimates of control effectiveness for 2018 for Federal regulations affecting diesel locomotives and commercial marine engines. This information is available from the relevant Regulatory Support Documents prepared by EPA (EPA, 1998; EPA, 1999; EPA, 2003). These regulations include engine exhaust standards, as well as diesel fuel sulfur limits that will reduce SO_2 and PM emissions. For their 2003 aircraft engine NO_x emission standards, EPA did not prepare emission reduction estimates because any such reductions were believed to be modest (e.g., 94 percent of aircraft engines are currently meeting or exceeding these standards). Therefore, Pechan does not propose to account for aircraft emission reductions from these standards for this analysis.

In running the NONROAD2004 model, all Federal engine standards are accounted for, with the exception of evaporative emission standards for large spark-ignition and land-based recreational gasoline equipment. The evaporative standards for recreational equipment only affect permeation emissions, which are not currently included in NONROAD2004. As such, baseline emissions and reductions will not be modeled. The large spark ignition standards affect a subset of evaporative emissions for engines of a specified horsepower (EPA, 2002). Under contract to LADCO, Pechan has developed estimates of SCC-specific emission reductions for this standard, which can be applied to the NONROAD model output as a post-processing step.

5. Onroad Sources

For the onroad sources, control measures are defined in terms of inputs to the SMOKE MOBILE6 files rather than a control factors file. These input files will incorporate all promulgated Federal control programs, including the heavy-duty diesel (2007) engine standard and low sulfur diesel fuel as well as the Tier 2 emission standards and low sulfur gasoline program. Federal control programs are generally modeled through the MOBILE6 defaults, with no specific user input commands necessary. Reformulated gasoline will be modeled in the following nonattainment areas: St. Louis (4 Missouri counties plus St. Louis City), Dallas-Fort Worth (4 counties), and Houston-Galveston (8 counties).

Pechan will contact each of the CENRAP State contacts to determine whether any changes in fuel programs or inspection and maintenance (I/M) programs, from those modeled in the CENRAP 2002 emission inventory, are expected to take place by 2018. Pechan will also determine from these contacts whether any other area-specific control programs are planned. If any programs are planned that cannot be modeled with MOBILE6 (e.g., transportation control measures), Pechan either will develop control factors that can be applied by the emission modelers to the resulting onroad emissions or will adjust the vehicle miles traveled (VMT) growth factors to account for the control measure, depending upon which approach is appropriate for the specific measure.

B. GROWTH FACTOR DEVELOPMENT METHODS AND DATA SOURCES

1. Non-EGU Point Sources and Area Sources (EGAS)

Pechan will develop emission activity growth data for the CENRAP States using a combination of approaches/data sources. For the most part, Pechan will rely on growth factors that are produced by EPA's Economic Growth Analysis System (EGAS). Under Task 5, Pechan prepared a Technical Memorandum comparing EGAS Versions 4.0 and 5.0 (Pechan, 2005).

In preparing the Task 5 memorandum, Pechan reviewed the indicators selected as default emission activity growth surrogates in EGAS 4.0 and 5.0 for the highest-emitting point and nonpoint SCCs in the CENRAP base year inventory. Pechan then reviewed alternative data sources for the availability of better growth surrogates. Based on this review, Pechan identified alternative growth indicator recommendations for a number of important CENRAP source categories (e.g., use of *Annual Energy Outlook* projections for oil and gas production SCCs). In addition, Pechan identified alternatives to the State-level population projections from EGAS (i.e., county-level population projections prepared by government agencies/universities in each CENRAP State).

Chapter III of the Task 5 memorandum details Pechan's recommendations for the methods and data sources to use in developing stationary point and nonpoint (area) source growth factors for the CENRAP States. Pechan will prepare emission activity growth data for the stationary source emission sources in the CENRAP States that reflects CENRAP feedback on the recommended methods and data sources that are outlined in this chapter.

2. EGU Point Sources

a. Data Sources/Quality Assurance Issues

Data sources to be used to calculate EGU growth factors include EPA’s 2020 IPM Base post-processed scenario data file (developed by Pechan for EPA from IPM parsed output files), EPA’s 2002 EGU inventory, and EGAS 5 EGU 2020 growth factors. Reasons for these choices are explained below.

Pechan will compare the CENRAP nine State-SCC level (2002 to 2020) EGAS 5 growth factors with growth factors calculated as throughput (fuel consumption) ratios derived from EPA’s 2020 Base Case Scenario and the 2002 EGU inventory developed for EPA (and based on the Department of Energy’s Energy Information Administration (EIA) Form EIA-767 and EPA’s Clean Air Markets Division (CAMD)’s Emission Tracking System/ Continuous Emissions Monitoring (ETS/CEM) reported data).

For the IPM-based growth factor development, Pechan originally planned to use the EGUs extracted from the CENRAP data files for the 2002 throughput, but found that several States did not report throughput. We tried to fill in missing values by back calculating throughput using CENRAP reported CO emissions (which would be uncontrolled, unlike SO_2 and NO_x; and larger in magnitude than VOC) and its emissions factor (or the SCC-based EPA-approved uncontrolled emission factor for CO if no emission factor was included in the CENRAP files). However, from a check of some CENRAP records with both throughput and CO reported, it was found that the back-calculated throughput was frequently different from the reported throughput (i.e., had a greater than ten percent difference).

An additional issue with using the CENRAP data files is that we first broadly defined EGUs as those records with a positive ORISPL or SIC=4911, 4932, or 4939, and SCCs beginning with 101 or 201. However, we found several plants “missing” from the CENRAP EGU data that were in either the EIA-767 or ETS/CEM data files; these plants may be in the CENRAP data files, but not in our EGU extract. Also, some sets of records with ORISPLs and SCCs beginning with 101 or 201 did not have any boiler IDs included in the data files and/or some had some boiler IDs identified and some not (and some seemingly duplicated). Additionally, we found some discrepant ORISPLs.

Pechan also compared total SO_2, NO_x, and CO emissions for each of the nine CENRAP States from the 2002 Inventory and the all inclusive CENRAP EGU extract. In most cases, the 2002 EGU inventory emission totals were greater. All three pollutant emissions are within a 10 percent difference for three States (Kansas, Missouri, and Nebraska); NO_x is within a 10 percent difference for five more States (Iowa, Louisiana, Minnesota, Oklahoma, and Texas); and SO_2 is within an 11 percent difference for three more States (Minnesota, Oklahoma, and Texas); Arkansas' emissions for all three pollutants were not close, perhaps because some plant data in the CENRAP files were missing, some emissions may be reversed, etc.

Pechan had not anticipated nor allotted hours for performing quality assurance (QA) on the CENRAP data, but found it necessary to do so to some extent to determine whether the data could be used for throughput. To avoid further expenditure of hours, we determined that it would be best to use the 2002 EPA EGU Inventory for the 2002 throughput data, rather than the CENRAP data files. Please note that we are not stating that all nine of the CENRAP States have all or any of the issues addressed above, but that enough of them did that we were not able to either use the reported throughput or calculated throughput at the State-SCC level with a high degree of confidence.

b. Growth Factor Calculation

The growth factor (gf) for each State-SCC will be calculated as follows:

gf = (2020 IPM Base Case throughput aggregate) / (2002 EGU inventory throughput aggregate),

where:

the 2020 IPM Base Case throughput is derived from the given heat input and a default fuel heat content; and

the 2002 EGU inventory throughput is reported data if the boiler is included in the EIA-767, and is derived from the given heat input and a default fuel heat content if it is not in the EIA-767 but is in the ETS/CEM data file.

Pechan will provide an Excel data file which will include the nine State-SCC level records and their EGAS 5 and IPM-based growth factors for 2020 as well as a Technical Memorandum that includes a recommendation and rationale for the proposed growth factor methodology.

A summary report of the changes in 2018 IPM inputs requested by the Visibility Improvement – State and Tribal Association of the Southeast (VISTAS) and the Midwest Regional Planning Organization (MRPO) was provided to Pechan, along with a response to a follow-up question. If VISTAS and MRPO approve the release of this information, with CENRAP's agreement, it will be included in the final report and will serve as the part of the deliverable Technical Memorandum that presents a summary of the changes made to IPM inputs by the other RPOs.

The growth factors (whose methodology will be determined by the CENRAP Workgroup) from Task 6 will be provided in SMOKE PROJECTION format (Table 8.70 in the SMOKE v2.1 User's Manual).

3. Nonroad Sources

For the aircraft, commercial marine vessel and locomotive categories, Pechan will develop emission activity growth data for the CENRAP States using EGAS. Pechan's recommendations for developing growth factors for these categories were outlined in a Task 5 Technical Memorandum, and the final methods will reflect any additional feedback from CENRAP.

Also as part of Task 5, Pechan will prepare a separate Technical Memorandum to describe the proposed adjustments to the NONROAD model national growth rates to reflect State data for significant categories. The data to regionalize the NONROAD model growth factors will be obtained from REMI, as incorporated into EGAS (Houyoux, 2004).

4. VMT for Onroad Sources

To estimate growth in onroad VMT, Pechan will first ask CENRAP for appropriate contacts from their State Departments of Transportation and from the major metropolitan planning organizations (MPOs) in their State. Pechan will then inquire of these contacts whether they have developed their own growth projections, and if so, will request any available documentation on the development of these growth factors and the growth factors themselves. The documentation will be important in understanding the geographic area covered by the growth factors, the base and projection years of the growth factors, and the sources of data driving the projections. The documentation should also provide information on the level of detail at which the growth factors were developed (e.g., do the factors vary by interstates vs. arterials, by rural area vs. urban area, by vehicle type, etc.). Any growth factor data will need to be provided electronically in database (Access, DBF, or MySQL), spreadsheet (Excel), or text file format for processing under this project. When VMT growth factors are provided for a different base and projection year, Pechan will consult with the agency supplying the data to determine the best method for converting the growth factors to a 2002 to 2018 projection. For areas with no local VMT growth factor information available, or those for which growth factors cannot be appropriately calculated within the time and resources available under this contract, Pechan will use EGAS VMT growth factors.

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CHAPTER III. METHODS FOR AREAS OUTSIDE OF THE CENRAP REGION

A. CANADIAN EMISSION ESTIMATES

Pechan expects to provide emission estimates for Canada to CENRAP using data and methods that are consistent with those being used by LADCO/MRPO and EPA to estimate current and future year emissions for these provinces. These data sets are currently limited to historical emission years (1995 and 2000). It is our understanding that LADCO is using/planning to use 1995 point source emission estimates and 2000 onroad/off-road/area source emission estimates to estimate Canadian emissions for their modeling domain. (The 2000 point source emissions data is not being used because of confidentiality limitations.) The 2000 Canadian emission data sets for the three sectors (non-point/area, nonroad mobile, and onroad mobile) are available at: http://www.epa.gov/ttn/chief/net/canada.html#data. This file contains information in both dBaseIV and SMOKE IDA format.

While we know that Environment Canada compiles emission projections on a regular basis to support the development of Federal and provincial emission control strategies, it is not clear whether Environment Canada would be able to provide growth and control factors on a timely basis for this CENRAP project. Pechan will contact Marc Deslauriers of Environment Canada on this issue. In short, though, Pechan expects that its recommendation will be that CENRAP use the base year Canadian emissions data without adjustments for all future year model simulations. If we want to pursue the course of developing our own growth and control factors to apply to Canadian base year emissions to estimate 2018 emissions, some information on the forecasting methods that Environment Canada uses is available from a draft NARSTO report. However, the description in the NARSTO report is less detailed than is needed to develop source category-specific growth and control factors. This alternative is probably best pursued by our contacting Marc Deslauriers to determine that organization's willingness/ability to provide us with either the data or the methods that they have developed to prepare emission forecasts to a year close to 2018.

B. MEXICAN EMISSION ESTIMATES

The baseline emissions inventory base year for Mexico is for 1999. Inventories for the years 2002 and 2012 were also estimated in order to understand how growth and existing control strategies may impact future emissions. Currently, the 1999 emission inventory is available, but the emission databases for the other years are not. Moreover, the point source database will most likely be proprietary, and could require signing a non-disclosure agreement for access. Therefore, the three alternatives for estimating 2018 emissions for Mexico for this CENRAP project appear to be:

1. Use the available 1999 emission databases as is.
2. Pursue obtaining the 2012 Mexican emissions database via Leonora Rojas to see if it might be available on a timely basis.

3. Develop growth and control factors to apply to the 1999 emissions data to better estimate 2018 emissions. We have a summary description of how Mexico performs its own projections to use as a guide for doing this. In general, growth factors are applied to all sectors, but control factors are only applied for onroad vehicles.

C. WRAP EMISSION ESTIMATES

WRAP's current schedule for preparing any new emission projections for its States will not provide any new information by March 2005, so Pechan expects to use the previous WRAP 2018 emission forecasts as the basis for what it provides to CENRAP. The existing WRAP 2018 emission forecasts are made from a 1996 base year. One potential update to the previous non-EGU point and area source forecasts is adapting the previous projections (which were prepared by Pechan) to incorporate updated growth factors, and to use the 2002 emissions data set as the new base year. However, these updates may be difficult to accomplish within the project constraints.

D. VISTAS EMISSION ESTIMATES

Pechan has contacted the VISTAS Technical Coordinator, Pat Brewer, to determine the availability of emission projection data for this project. VISTAS has recently completed 2018 emission projections for its States. These projection data are now being reviewed by the States. VISTAS will need to get permission from the States in order to release the data to CENRAP. It is expected that this would occur during February. SMOKE-ready modeling files for VISTAS are expected to be completed in January. Pechan will have further conversations with VISTAS to determine whether the mass emissions files or SMOKE files are more appropriate for CENRAP's purposes. It may be preferable to obtain the annual mass emission files, as the SMOKE modeling files were set up to model specific episodes that may not be consistent with the modeling that CENRAP will do. If CENRAP determines that it is preferable to use the emissions, Pechan will format the emissions in SMOKE/IDA format.

E. MRPO PROJECTIONS

For these five States, Pechan has developed 2018 (and other year) growth and control factors for LADCO for all man-made emission sectors, except on-road vehicles. Therefore, we expect that these same growth and control factors will be delivered to CENRAP. Because LADCO is performing the emissions processing of these files, Pechan plans to check with Mark Janssen to determine whether LADCO made any revisions to these files during its processing steps. If so, the revised files will be obtained from LADCO. We will also check with LADCO about the status and availability of their on-road vehicle emission files.

CHAPTER IV. REFERENCES

EPA, 1998: U.S. Environmental Protection Agency, "Locomotive Emission Standards, Regulatory Support Document," Office of Mobile Sources, Ann Arbor, MI, April 1998.

EPA, 1999: U.S. Environmental Protection Agency, "Final Regulatory Impact Analysis: Control of Emissions from Marine Diesel Engines," EPA420-R-99-026, Office of Mobile Sources, Ann Arbor, MI, November 1999.

EPA, 2002: U.S. Environmental Protection Agency, "Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines," EPA420-R-02-022, Office of Mobile Sources, Ann Arbor, MI, September 2002.

EPA, 2003: U.S. Environmental Protection Agency, "Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder," EPA420-R-03-004, Office of Mobile Sources, Ann Arbor, MI, January 2003.

Houyoux, 2004: Houyoux, M., U.S. Environmental Protection Agency, REMI ver 5.5 baseline.zip [Electronic File], Emission Factor and Inventory Group, Emissions, Monitoring, and Analysis Division, Office of Air Quality Planning and Standards. Research Triangle Park, NC. March 2, 2004.

NARSTO, 2005: "Improving Emission Inventories for Effective Air Quality Management Across North America: A NARSTO Assessment," January 2005.

Pechan, 2005: E.H. Pechan & Associates, Inc. "Background Information on Versions 4.0 and 5.0 of The Economic Growth Analysis System (EGAS), Technical Memorandum," prepared for Central Regional Air Planning Association (CENRAP), January 3, 2005.

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APPENDIX B
QUALITY ASSURANCE PROJECT PLAN FOR DEVELOPMENT OF GROWTH AND CONTROL INPUTS FOR 2018 EMISSIONS MODELING
(SCHEDULES 3 AND 9)

DRAFT

Prepared by
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5528 Hempstead Way
Springfield, VA 22151

January 6, 2005

for the
Central Regional Air Planning Association (CENRAP)
10005 S. Pennsylvania, Suite C
Oklahoma City, OK 73159

____ Date ____________________
Ms. Kathy Pendleton, CENRAP Project Manager

____ Date ____________________
Ms. Lisa Brenneman, CENRAP Project Manager

____ Date ____________________
Ms. Annette Sharp, CENRAP Quality Assurance Officer

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INTRODUCTION

The purpose of this project is to prepare emission growth and control factors that can be applied to the Central Regional Air Planning Association (CENRAP) 2002 base year emission inventory to obtain a 2018 emission inventory for the CENRAP region. The CENRAP region includes the States and Tribal areas of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. In addition to the CENRAP States, additional factors will be compiled under this project to include the entire CENRAP modeling domain. This will include projected emissions data or projection year growth and control factor data from the other Regional Planning Organizations (RPOs), Canada, and Mexico. All data products will be prepared in SMOKE-compatible format.

These projection year growth and control factor data will be used to support air quality modeling and State Implementation Plan (SIP) development and implementation activities for the regional haze rule and fine PM and ozone National Ambient Air Quality Standards (NAAQS). The data will be applicable to all source categories and pollutants included in the CENRAP 2002 emission inventory. This includes the following pollutants: sulfur oxides (SO_x), oxides of nitrogen (NO_x), volatile organic compounds (VOC), carbon monoxide (CO), ammonia (NH_3), and particles with an aerodynamic diameter less than or equal to a nominal 10 and 2.5 micrometers (i.e., primary PM_{10} and $PM_{2.5}$).

This Quality Assurance Project Plan (QAPP) specifies how data quality objectives of accuracy, completeness, and representativeness will be met in compiling the growth and control factor data to be used as inputs to 2018 projection year regional emissions modeling for the CENRAP region for air quality modeling purposes.

A series of checklists will be prepared to implement the quality assurance (QA) steps. The QA checklists will include information on the specific QA item, the date that the QA check was performed, and the person who performed the QA check.

II. QA PLAN FOR CONSOLIDATION OF EMISSIONS INVENTORIES

A. Project Management

Specific project management elements are discussed below.

1. Distribution List

Ms. Kathy Pendleton, CENRAP Project Manager
Ms. Lisa Brenneman, CENRAP Project Manager
Ms. Annette Sharp, CENRAP Technical Director and Quality Assurance Officer
Mr. James H. Wilson, E.H. Pechan & Associates, Inc. (Pechan) Corporate QA/QC Coordinator
Ms. Maureen Mullen, Pechan Project Manager

Mr. Steve Roe, Pechan QA Reviewer

2. Project / Task Organization

Ms. Kathy Pendleton of CENRAP will be the primary technical contact and Project Manager. She will be assisted by Ms. Lisa Brenneman. Ms. Annette Sharp, will be the Technical Director and Quality Assurance Manager (QAM). Ms. Sharp will be involved in all quality assurance/quality control (QA/QC) activities.

Pechan's QA/QC policy requires that all work be documented, defensible, of known and acceptable quality, and consistent with all contract requirements. This policy is implemented through an integrated three-tiered approach that includes corporate, department, and program elements. At the corporate level, Pechan management provides oversight of the QA/QC program and approves and enforces the overall program. To assist in implementing these functions, Pechan maintains a corporate QA/QC unit that monitors the program, prepares guidelines, and conducts independent program audits.

The Pechan Corporate QA/QC Program is implemented through the Corporate QA/QC Plan and corporate guidelines. The Corporate Plan is an internal document that states the corporate policy and the requirements for department and project plans. The plan is supplemented by guidelines that are used to develop or update department plans and standard operating procedures (SOPs). Department management ensures the technical and fiscal quality of work through management oversight of projects assigned to the department and work performed by department staff; establishes and enforces department plans; approves project plans, budgets and schedules; and ensures a thorough technical and department management review of work.

The Pechan Corporate QA/QC Coordinator, Mr. James H. Wilson, is responsible for QA/QC functions throughout the firm, and has the necessary authority and independence to identify, report, and correct any existing quality problems. The Pechan QA reviewer for this project will be Mr. Steve Roe. Mr. Roe will conduct QA review on each of the SMOKE files developed under this project, on the data and methods used to develop growth and control factors in the SMOKE files, and on the final documentation.

Pechan's Project Manager, Ms. Maureen Mullen, will direct all work to be completed for this project. Ms. Mullen will ensure that all support staff are familiar with and understand the data quality objectives, and the procedures to be followed for meeting the objectives, as well as the requirements of the QA plan (e.g., completion of QA/QC forms).

3. Problem Definition / Background

SIPs for regional haze mitigation must contain emission inventories. Related emission inventories are needed for air quality modeling of regional haze. Inventories prepared for the SIP submittal and for use in modeling are prepared in different formats, but both should be derived from the same or comparable input data. Furthermore, regional modeling will encompass States outside the CENRAP region, so inventory methods should be coordinated with other regions to the extent possible. The eastern RPOs (including CENRAP) have selected 2002 as the baseline year for regional haze modeling. Also, in order to demonstrate progress in improving visibility, it will be necessary to forecast emissions for future years. This project will result in a set of growth and control factors that can be used in SMOKE emissions modeling to project the CENRAP 2002 base year emission inventory to 2018.

4. Project / Task Description

The description of this project by task can be found in Pechan's response (dated November 18, 2004) to the Request for Quotes (RFQ) for "Schedules 3 and 9 - Development of Growth and Control Inputs for 2018 Emissions Modeling" and the "Award of Work and Notice to Proceed" that CENRAP issued to Pechan (Contract Number 04-0628-RPO-018) on December 1, 2004.

5. Data Quality Objectives

The main data quality objectives that Pechan will work to fulfill include:

- Accuracy – Pechan's QA Reviewer will ensure that 100 percent of the procedures/calculations that a Pechan staff member develops and applies to develop growth or control factors will be checked for accuracy and completeness. The procedures/calculations will first be tested on a data sample and the results will be reviewed to ensure that the procedures/calculations are applied as intended and that the results make sense. Adjustments to the procedures/calculations will be made if the results indicate flaws in the initial procedures/calculations. The procedures/calculations will be applied to the entire data set after the procedures/calculations have been tested for accuracy. Sample calculations will be documented covering all procedures.

- Completeness – As part of the quality control (QC) process, review by Pechan, as well as State/local/Tribal (S/L/T) agencies, may indicate missing growth or control factors for certain sources and/or pollutants for a particular county or jurisdiction. Pechan will compare the growth and control factor files to the CENRAP 2002 base year emission inventory to identify source category/county combinations that may be missing growth factors and source category/county/pollutant combinations that should be controlled but that have no control factors in the control factor database.

- Representativeness –Representative growth and control factors will be compiled that can be used by CENRAP to develop a representative 2018 emission inventory. The QA checks on data content discussed in section D of this QAP will be used to identify missing data or data that exceed typical ranges for review with CENRAP and the S/L/T agencies. These factors will be corrected or revised as approved by CENRAP.

- Comparability – The CENRAP 2018 growth and control factors will be compared to those used by the U.S. Environmental Protection Agency (EPA) in its Clean Air Interstate Rule (CAIR) modeling as well as those used by other RPOs for similar projection year emission inventories. Significant differences between these growth and control factor data will be evaluated and any necessary corrections to the data will be made.

6. Documents and Records

Pechan maintains a records management system to ensure that completed work meets EPA documentation requirements. Pechan also maintains a record-keeping plan to identify and file information. The company assigns unique control numbers to all documents and records prepared for and delivered to all clients. These numbers link the materials to the correct contract and work assignment and are used to store the materials in hard copy and electronically in chronological order. The records management coordinator at each Pechan office location assigns the control numbers and maintains these files. Pechan's Contracts Administrator also stores hard copy or electronic versions of all documents and records submitted as contract deliverables as part of the company's contract files.

The Pechan Project Manager will be responsible for the following document and records management activities:

- Determining all deliverables under a project, including work plans, progress reports, and all technical products;
- Determining the time lines for various stages of the document (that is, outline, draft, and final);
- Determining the appropriate review cycle (internal versus external review);
- Determining the appropriate reviewers; and
- Ensuring that all documents and records are incorporated into Pechan's filing system and are distributed to the appropriate recipients.

B. Data Generation and Acquisition

The following explains how data will be acquired or generated for each task of the project:

Task 1. Develop a Quality Assurance Project Plan (QAPP) and Work Plan

This QAPP is being prepared under this task. The following discussion explains the data sources that will be acquired and data that will be generated during preparation of the draft and final deliverables for Tasks 2 through 10. Section D of this QAPP explains the data review and validation procedures that will be applied during preparation of the draft and final deliverables for Tasks 2 through 10.

Pechan has also prepared a draft work plan for the project. The work plan includes the tasks, budgets, and schedules specified in Pechan's response (dated November 18, 2004) to the RFQ for "Schedules 3 and 9 - Development of Growth and Control Inputs for 2018 Emissions Modeling" and the "Award of Work and Notice to Proceed" that CENRAP issued to Pechan (Contract Number 04-0628-RPO-018) on December 1, 2004.

Task 2. Develop a Methods Document

In the Methods Document, Pechan will explain the data sources to be used and the procedures to be followed for developing the necessary growth and control data for this project. Through this task, Pechan will determine the appropriate contacts and data sources to be used to obtain and develop the growth and control data for the CENRAP States, control data sources for Federal control measures, and vehicle miles traveled (VMT) projection data and sources. Pechan will also determine the available sources for obtaining projection year inventory data for other RPOs, Canada, and Mexico. The methods document will also explain the procedures to be followed when data are not available for a specific source category or geographic area.

Task 3. Identify State Controls

Pechan will query the CENRAP State contacts on State control programs expected to be in place in 2018. In addition, Pechan will use information from 1-hour ozone and PM_{10} SIPs to determine where post-2002 emission reductions are expected. For Texas, Pechan will base the control factors on the control factor file developed by Pechan during 2001 for the prior Western Regional Air Partnership (WRAP) emission forecast to 2018, and update this information to a 2002 base year and to reflect recent SIP updates (Houston-Galveston area). Pechan will account for NO_x emission changes for Missouri counties affected by the NO_x SIP Call. This may include using future year NO_x allowances by unit to estimate unit-specific control factors. Where necessary, Pechan will convert the emission reductions to the control efficiency, rule effectiveness, and rule penetration rates needed for the SMOKE modeling. All rule citations will be fully documented.

For the onroad sources, Pechan will start with the 2002 SMOKE-formatted MOBILE6 files developed for the 2002 CENRAP emission inventory. Pechan will query the State contacts provided by CENRAP for expected changes in emission control programs, such as inspection and maintenance programs, and fuel properties or programs between 2002 and 2018. Local data on fleet information, such as vehicle age distributions, will be kept the same as in 2002. Federal control programs, such as the Tier 2 emission standards, will be accounted for by using the MOBILE6 defaults for such programs.

Task 4. Identify Federal Controls

Pechan will compile information on Federal control measures that will be in place in 2018. Pechan's initial source of information will be the work conducted by Pechan to develop

2018 emission inventory control factors for the Midwest RPO (MRPO). Pechan will review documentation from other RPOs (e.g., VISTAS) and the analysis performed by EPA for the CAIR (this had a 2001 base year), as well as any new information on Federal rules. Pechan will focus its primary efforts for this task on maximum achievable control technology (MACT) standards with post-2002 effects. Where necessary, Pechan will convert the emission reductions from the identified Federal control measures to the control efficiency, rule effectiveness, and rule penetration rates needed for the SMOKE modeling. All rule citations will be fully documented.

Task 5. Compare and Provide a Written Summary of Differences Between the Economic Growth Analysis System (EGAS) 4 and EGAS 5 Models

Pechan will use EPA's EGAS 4 and EGAS 5 data and models to compile 2002 to 2018 State- Standard Industrial Classification (SIC) growth factors for the CENRAP States. These data are available in internal Pechan databases which house the Regional Economic Models, Inc. (REMI) data used in EGAS 4 and EGAS 5. Within each State, the comparisons will be developed at the 3-digit SIC code level with a crosswalk between REMI sectors and SCCs.

For the NONROAD model source categories, Pechan will compile data to develop regional growth factors to reflect relative growth rates in the CENRAP States. These will be used to regionalize the default growth factors in NONROAD that use national historic trends by fuel type to project equipment populations and emissions nationwide.

Task 6. Isolate and Examine Emission Growth Factors for CENRAP Electricity Generating Units (EGUs) using the Integrated Planning Model (IPM) and the EGAS 5 Model

Pechan will obtain the EGU EGAS growth factors from the Task 5 output. Pechan has obtained the IPM 2018 Base Case and IPM 2018 CAIR Case outputs from VISTAS/MRPO. Pechan has also obtained generalized information about the changes made by VISTAS/MRPO to the IPM inputs for this data set. However, MRPO has requested that Pechan not use any of these data until they have been reviewed and approved by the MRPO/VISTAS States. If approval of these files does not come in the timeframe needed for completion of this task, Pechan will use the Base Case and CAIR Case outputs from IPM prepared for EPA during August through November 2004. Pechan has these data in-house for projection years of 2010, 2015, and 2020. Pechan developed the final CENRAP 2002 base year emissions inventory for CENRAP that will be used in this task. Pechan will generate State-SCC growth factors for the EGU sector in the CENRAP States from the heat input or throughput data in the 2002 CENRAP emissions inventory and the IPM outputs.

Task 7. Develop Onroad Growth Factors and Nonroad Emissions Inventory for the Future Case CENRAP Emissions Inventory

To prepare the 2018 NONROAD2004 model inputs, Pechan will first acquire from CENRAP the activity inputs that were used to develop the 2002 base year nonroad emissions inventory. Pechan will adjust the growth rates and fuel program inputs with data obtained or generated under Task 5. These data will then be input to EPA's NONROAD2004 model to generate a 2018 nonroad emission inventory for the CENRAP States, for all nonroad categories except locomotives, aircraft, and commercial marine vessels. Growth and control factors for these three nonroad categories will be developed under Tasks 3, 4, and 5 with other area sources.

To develop VMT growth rates, Pechan will first develop a list of contacts in the following priority order: (1) major Metropolitan Planning Organizations, (2) State Departments of Transportation, and (3) State air agencies. Pechan will then contact these agencies to obtain available data for projecting VMT from 2002 to 2018. If the data from these agencies are for a different base or projection year, Pechan will inquire as to whether the average annual growth rate over the period projected by that agency can be applied to the period from 2002 to 2018. If it cannot, Pechan will not use that data source (in these instances, data from the next contact based on the above priority will be used). For QA and tracking purposes, Pechan will log the contact information, data file names and date, geographic coverage of data, level of detail of data (e.g., by vehicle type or road type), and base and projection years of data. Pechan will provide this information to the CENRAP QAM before proceeding to incorporate VMT projection data. For counties or States with no VMT projection data available, Pechan will use EGAS VMT growth factors as the defaults.

Task 8. Develop Future Case Inventory of Areas Outside the CENRAP Region

This task will involve gathering and consolidating projection year emissions data or growth and control data for areas outside the CENRAP region. The sources of data include emissions inventories compiled by the other RPOs, the EPA, and the most currently available Mexican and Canadian emissions inventories.

Pechan will generate a list of organizations (e.g., EPA, RPOs, Environment Canada) and contact information for each organization that potentially has data that can be used to develop a 2018 emissions inventory for CENRAP air quality applications. This list will then be provided to the Workgroup for any feedback.

Once the data acquisition contact list has been finalized, Pechan will contact each organization to identify the projection year emissions data or growth and control data available, determine the quality and format of each available data set, and help facilitate the best mode of data transfer of the desired data sets for use in this task.

Modeling inventory databases or growth and control files acquired during this task will be summarized in tabular form so that CENRAP will know the date acquired, the sources used to assemble the data, the contractor(s) and/or organizations that assembled the data, possible deficiencies of the data, time period of the data (e.g., base year and projection year), and other necessary information needed to enable CENRAP to best understand the databases that are available.

Task 9. Prepare Future Case Growth and Control Summary

Pechan will develop the EGU growth factors at the point level of detail based on either IPM or EGAS model outputs, as determined by the Workgroups in Task 6. This will involve matching the EGU identifiers from the CENRAP 2002 emission inventory to the IPM data. IPM uses unique plant codes (ORISPL) and boiler IDs while the CENRAP inventory uses Federal Information Processing Standard State and county identifiers, plant IDs, and point IDs. From the matched data set, Pechan will develop EGU-specific control factors for all relevant pollutants, based on 2018 IPM emissions data and the 2002 CENRAP EGU data.

For all source sectors covered by this contract, Pechan will develop Excel summary workbooks for each CENRAP State and Tribal area at the SCC level for all relevant source categories and pollutants. The data used in these summaries will be obtained from data generated in Tasks 3 through 7.

Task 10. Prepare a Technical Support Document (TSD)

The Task 2 Methods Document will be used as the starting point for the TSD. Information from the technical memoranda developed under Tasks 5, 6, and 8 and the State and Federal control measure lists from Tasks 3 and 4 will also be included in the TSD. The TSD will document the methods and data sources used in preparing the SMOKE-ready growth and control factors, the nonroad emissions inventory, and the MOBILE6 SMOKE inputs. The Excel workbooks summarizing the growth and control factors for the CENRAP States will be either included in or referenced in the TSD.

C. Assessment and Oversight

Pechan uses assessments to evaluate and improve the quality of environmental data operations. The assessments are an independent process of evaluating the project to ensure that specified requirements of the project are being fulfilled. Pechan will perform periodic audits of data quality and will coordinate with CENRAP's QAM to allow for ongoing oversight of project quality. For this project, QA Summary Reports will be prepared in Excel spreadsheets under Task 9, along with the growth and control factor summaries, to document any QA issues in the growth and control factors. The reports will be sent to each S/L/T agency to review. Each agency will be asked to provide corrections for the QA issues in the spreadsheets, or provide Pechan and CENRAP with directions in supplemental files or by e-mail. Each agency will then return the QA Summary Reports to Pechan. Pechan will then use directions provided in the reports to revise the appropriate growth and control factor files, and will update the reports to log directions that S/L/T agencies provide via e-mail and data provided in supplemental files. A Pechan staff member will then note the date on which revisions are made to the growth and control factor files as specified in the QA reports. Mr. Steve Roe will manage the audit function, which will involve comparing the directions provided in the QA reports to the revised growth and control factor files to ensure that the directions are interpreted correctly, and the files are revised correctly. The auditor will then note in the QA report when corrections have been completed. If corrections are not implemented correctly, the auditor will note this in the QA Summary Report file and will provide follow-up to ensure that the Pechan staff member corrects the issue. Thus, each QA Summary Report file will be used as a chain-of-custody form to document QA issues, S/L/T agency approval for resolution of the issues, and corrections to growth and control factor files.

D. Data Review and Validation

Task 1. Develop a QAPP and Work Plan

Pechan will prepare a draft QAPP and work plan that will undergo review by Pechan internally, and then be submitted to the CENRAP's Workgroups for review and comment. Pechan will revise the QAPP and work plan to address comments provided by the Workgroups. The final QAPP and work plan will be submitted to CENRAP for final approval and signature. The draft and final QAPP and work plan will be submitted in Microsoft Word format.

Task 2. Develop a Methods Document

Pechan will prepare a draft Methods Document that will undergo review by Pechan internally, and then will be submitted to the CENRAP's Workgroups for review and comment. Pechan will revise the Methods Document to address comments provided by CENRAP. The final Methods Document will be submitted to CENRAP for final approval. The draft and final Methods Document will be submitted in Microsoft Word format.

Task 3. Identify State Controls

Pechan will conduct a QA review of the SMOKE control factor files. Range checks will be performed on all values including control efficiency, rule effectiveness, and rule penetration to make sure that all values are valid and reasonable. Comparisons of the control efficiencies will be made with the 2002 CENRAP emissions inventory files to ensure that controls included in the 2002 emission inventory are not double-counted for the projection year. Any point-specific control information will be matched to the 2002 CENRAP emissions inventory to ensure that the correct point identifiers have been used. A QA summary will be developed listing State/SCC combinations in the 2002 CENRAP base year emissions inventory with no control efficiency listed in the State controls file to ensure that all source categories that should have controls applied contain the necessary information in the SMOKE control factor file. Pechan will ensure that the format of the control factor databases are correct based on the SMOKE2.1 User's Guide documentation.

Pechan has developed programs to review MOBILE6 input files. These programs will be modified to perform QA on the SMOKE-formatted MOBILE6 input files to insure that all appropriate control measure commands and input data are included in the appropriate MOBILE6 input files.

Each database in text or database format, as well as each set of MOBILE6 input files, developed during this task will be assigned a version control ID, so that any future modifications of these data sets can be tracked. The version control ID will contain the date that the file was revised, as well as a version number, if more than one revision occurred on the same date (e.g. mobilexxx 2-15-05v2).

Task 4. Identify Federal Controls

Pechan will conduct a QA review of the SMOKE control factor files for the Federal controls as listed above for the State controls. Range checks will be performed on all values including control efficiency, rule effectiveness, and rule penetration to make sure that all values are valid and reasonable. Comparisons of the control efficiencies will be made with the 2002 CENRAP emission inventory files to ensure that controls included in the 2002 emission inventory are not double-counted for the projection year. In addition, checks will be made to verify that source categories with both State and Federal control measures have been given the appropriate controls and that sources are not inappropriately over-controlled. Any point-specific control information will be matched to the 2002 CENRAP emission inventory to ensure that the correct point identifiers have been used. A QA summary will be developed listing State/SCC combinations in the 2002 CENRAP base year emission inventory with no control efficiency listed in either the State controls file or the Federal controls file to ensure that all source categories that should have controls applied contain the necessary information in the SMOKE control factor file. Pechan will ensure that the format of the control factor databases are correct based on documentation in the SMOKE2.1 User's Guide. Each database developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 5. Compare and Provide a Written Summary of Differences Between the Economic Growth Analysis System (EGAS) 4 and EGAS 5 Models

Pechan will conduct a QA review of the SMOKE growth factor files prepared under this task. This will include range checks on all growth factors. Any growth factors above or below the expected range of growth factors will be reviewed for reasonableness. Significant variations in growth factors for the same source categories across States will also be reviewed for reasonableness. The growth factor data will be cross-checked with the CENRAP 2002 emissions inventory to ensure that all State/SCC combinations present in the 2002 inventory have corresponding growth factors (with the exception of onroad and NONROAD model source categories which will be handled in Task 7). Pechan will ensure that the format of the growth factor databases are correct based on the SMOKE2.1 User's Guide. Each database developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 6. Isolate and Examine Emission Growth Factors for CENRAP Electricity Generating Units (EGUs) using the Integrated Planning Model (IPM) and the EGAS 5 Model

The EGAS EGU growth factors to be used in this task will have undergone QA review under Task 5. In developing the IPM EGU growth factors, Pechan will review State/SCC combinations that are present either in the base year or projection year data, but not both. These cases, and Pechan's proposed approach for dealing with these cases for the development of growth factors, will be documented in the Technical Memorandum to be prepared under this task for CENRAP's review. In addition, cases with insufficient data in the CENRAP base year inventory to calculate growth factors will be documented for CENRAP review. The remaining

IPM EGU growth factors by State/SCC will be carefully reviewed. Growth factors that are outside of the expected range of factors will be reviewed for reasonableness and accuracy. If all calculations have been performed correctly, but the data seem unreasonable, these factors will be documented for CENRAP to review and provide corrections or comments on.

Task 7. Develop Onroad Growth Factors and Nonroad Emissions Inventory for the Future Case CENRAP Emissions Inventory

Pechan will use EPA's NIF Format and Content Check QA tool to perform initial QA on the NONROAD2004 NIF output file. Any errors flagged by this tool will be reviewed and corrected as necessary. After the nonroad inventory data are converted into SMOKE format, QA checks will be performed to ensure that the SMOKE-formatted emissions are the same as the emissions in the NIF files. Cross-checks will be performed to ensure that all State/SCC combinations included in the 2002 emission inventory for the source categories included in the NONROAD2004 model are also included in the SMOKE emission files.

Pechan will QA the VMT growth factors prepared in SMOKE format. Range checks will be performed on all VMT growth factors to make sure that all values are valid and reasonable. Any growth factors above or below the expected range of growth factors will be reviewed for reasonableness. Significant variations in growth factors for the same source categories across States will also be reviewed for reasonableness. The growth factor data will be cross-checked with the CENRAP 2002 onroad VMT data to ensure that all onroad State/SCC combinations present in the 2002 inventory have corresponding VMT growth factors. Pechan will ensure that the format of the VMT growth factor databases are correct based on the SMOKE2.1 User's Guide.

Each database developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 8. Develop Future Case Inventory of Areas Outside the CENRAP Region

Each projection year emission inventory or set of growth and control factors for the areas outside the CENRAP region will be assigned a version control ID as described under Task 4 and tracked accordingly. Pechan will ensure the data acquired are formatted correctly for use in SMOKE modeling based on the SMOKE2.1 User's Guide and will document any deficiencies for each inventory database. Pechan will prepare draft summaries for each database indicating the source of the data, base and projection years of the original data, and any data conversions needed from the original base and projection years to the CENRAP base and projection years of 2002 and 2018 for review by CENRAP. Final revisions to the data will be made based on the feedback received.

Task 9. Prepare Future Case Growth and Control Summary

Growth and control factors developed in tasks 3 through 7, as well as the EGU control factors to be developed under this task, will be summarized in Excel spreadsheets by State or Tribal area and SCC. These reports will provide the States and Tribal agencies with an opportunity to review the growth and control data developed under this project and to provide corrections or comments where the data do not correspond with the agencies' expectations. As discussed in Section C, above, Pechan will also provide QA Summary Reports that show concerns that Pechan or the States might have with some of the growth or control factors that should be given additional review by the agency. These QA Summary Reports will be used to track revisions that need to be made to the draft SMOKE growth and control factor files.

Once the State and Tribal agencies have documented the need for any revisions to the growth and control factors, Pechan will prepare final growth and control factor files in SMOKE format. These files will undergo the same QA checks described in the tasks above, along with the final QA audit ensuring that the requested revisions to the growth and control factors have been appropriately implemented in the final SMOKE-formatted files. Each database revised or developed during this task will be assigned a version control ID as described under Task 4, so that any future modifications of these data sets can be tracked.

Task 10. Prepare a TSD

The TSD will undergo QA review to ensure that all methods and data sources are accurately documented and data are reported correctly. Pechan will revise the TSD to incorporate comments provided by the CENRAP Workgroups.

APPENDIX C
CENRAP STATE POPULATION PROJECTIONS

Table C-1. CENRAP State Population Projections

FIPS Code	County	2002	2018	2018GF
ARKANSAS				
05001	Arkansas	20,355	17,110	0.841
05003	Ashley	23,875	22,294	0.934
05005	Baxter	38,672	42,580	1.101
05007	Benton	165,500	257,479	1.556
05009	Boone	34,713	39,145	1.128
05011	Bradley	12,531	12,357	0.986
05013	Calhoun	5,681	5,430	0.956
05015	Carroll	26,166	32,181	1.23
05017	Chicot	13,623	10,529	0.773
05019	Clark	23,535	23,535	1
05021	Clay	17,127	14,968	0.874
05023	Cleburne	24,570	28,788	1.172
05025	Cleveland	8,541	8,541	1
05027	Columbia	25,343	25,343	1
05029	Conway	20,411	20,411	1
05031	Craighead	84,074	97,527	1.16
05033	Crawford	54,973	67,511	1.228
05035	Crittenden	51,291	51,291	1
05037	Cross	19,343	17,697	0.915
05039	Dallas	8,785	5,322	0.606
05041	Desha	14,805	10,730	0.725
05043	Drew	18,639	18,639	1
05045	Faulkner	89,590	110,979	1.239
05047	Franklin	17,868	18,213	1.019
05049	Fulton	11,527	10,893	0.945
05051	Garland	90,059	104,079	1.156
05053	Grant	16,848	19,377	1.15
05055	Greene	38,038	41,968	1.103
05057	Hempstead	23,492	23,492	1
05059	Hot Spring	30,558	31,999	1.047
05061	Howard	14,251	14,251	1
05063	Independence	34,431	37,350	1.085
05065	Izard	13,192	12,567	0.953
05067	Jackson	17,802	15,475	0.869
05069	Jefferson	83,374	78,668	0.944
05071	Johnson	23,148	26,711	1.154
05073	Lafayette	8,382	6,755	0.806
05075	Lawrence	17,587	17,597	1.001
05077	Lee	12,217	9,790	0.801
05079	Lincoln	14,247	14,247	1
05081	Little River	13,474	13,472	1
05083	Logan	22,394	23,965	1.07
05085	Lonoke	55,302	73,873	1.336

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
05087	Madison	14,345	15,785	1.1
05089	Marion	16,259	16,202	0.996
05091	Miller	41,133	43,426	1.056
05093	Mississippi	50,380	44,719	0.888
05095	Monroe	9,689	5,310	0.548
05097	Montgomery	9,243	9,699	1.049
05099	Nevada	9,742	8,052	0.827
05101	Newton	8,506	8,506	1
05103	Ouachita	27,868	22,234	0.798
05105	Perry	10,436	12,221	1.171
05107	Phillips	25,001	14,105	0.564
05109	Pike	11,137	10,278	0.923
05111	Poinsett	25,401	24,555	0.967
05113	Polk	20,200	20,785	1.029
05115	Pope	55,223	66,020	1.196
05117	Prairie	9,440	8,499	0.9
05119	Pulaski	364,381	379,945	1.043
05121	Randolph	18,102	17,701	0.978
05123	St. Francis	28,773	26,036	0.905
05125	Saline	86,290	107,280	1.243
05127	Scott	11,004	11,787	1.071
05129	Searcy	8,039	5,953	0.741
05131	Sebastian	117,220	136,374	1.163
05133	Sevier	15,811	16,804	1.063
05135	Sharp	17,270	18,451	1.068
05137	Stone	11,518	12,558	1.09
05139	Union	45,279	43,122	0.952
05141	Van Buren	16,314	16,865	1.034
05143	Washington	166,511	219,999	1.321
05145	White	69,354	83,925	1.21
05147	Woodruff	8,466	6,644	0.785
05149	Yell	21,410	24,162	1.129
IOWA				
19001	Adair	8	8	0.962
19003	Adams	4	4	0.919
19005	Allamakee	15	15	1.046
19007	Appanoose	14	13	0.969
19009	Audubon	7	6	0.943
19011	Benton	26	30	1.153
19013	Black Hawk	128	131	1.022
19015	Boone	26	27	1.013
19017	Bremer	23	24	1.021
19019	Buchanan	21	21	1.005
19021	Buena Vista	20	21	1.031
19023	Butler	15	15	0.975
19025	Calhoun	11	10	0.927
19027	Carroll	21	21	0.983
19029	Cass	14	14	0.958

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
19031	Cedar	18	19	1.048
19033	Cerro Gordo	46	45	0.977
19035	Cherokee	13	12	0.962
19037	Chickasaw	13	13	0.972
19039	Clarke	9	10	1.085
19041	Clay	17	17	0.981
19043	Clayton	18	18	0.978
19045	Clinton	50	49	0.979
19047	Crawford	17	17	0.981
19049	Dallas	43	56	1.291
19051	Davis	9	9	1.029
19053	Decatur	9	9	1.007
19055	Delaware	18	19	1.053
19057	Des Moines	42	41	0.968
19059	Dickinson	17	18	1.097
19061	Dubuque	90	95	1.055
19063	Emmet	11	10	0.937
19065	Fayette	22	22	0.992
19067	Floyd	17	16	0.966
19069	Franklin	11	10	0.963
19071	Fremont	8	7	0.944
19073	Greene	10	10	0.987
19075	Grundy	12	13	1.016
19077	Guthrie	11	12	1.05
19079	Hamilton	16	16	0.99
19081	Hancock	12	12	0.978
19083	Hardin	19	18	0.955
19085	Harrison	16	16	1.038
19087	Henry	20	22	1.061
19089	Howard	10	10	0.975
19091	Humboldt	10	10	0.95
19093	Ida	8	8	0.987
19095	Iowa	16	17	1.058
19097	Jackson	20	21	1.041
19099	Jasper	37	39	1.047
19101	Jefferson	16	16	1.011
19103	Johnson	115	143	1.248
19105	Jones	20	21	1.011
19107	Keokuk	11	11	0.958
19109	Kossuth	17	16	0.922
19111	Lee	37	36	0.959
19113	Linn	196	229	1.17
19115	Louisa	12	13	1.066
19117	Lucas	9	10	1.045
19119	Lyon	12	11	0.966
19121	Madison	14	16	1.112
19123	Mahaska	22	23	1.012
19125	Marion	33	35	1.086

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
19127	Marshall	39	40	1.022
19129	Mills	15	16	1.115
19131	Mitchell	11	10	0.95
19133	Monona	10	10	0.98
19135	Monroe	8	8	0.959
19137	Montgomery	12	11	0.961
19139	Muscatine	42	45	1.062
19141	O'Brien	15	15	0.989
19143	Osceola	7	6	0.931
19145	Page	17	17	0.992
19147	Palo Alto	10	9	0.929
19149	Plymouth	25	26	1.038
19151	Pocahontas	8	8	0.899
19153	Polk	384	443	1.154
19155	Pottawattamie	88	92	1.04
19157	Poweshiek	19	19	1.016
19159	Ringgold	5	5	0.942
19161	Sac	11	10	0.916
19163	Scott	160	172	1.078
19165	Shelby	13	12	0.962
19167	Sioux	32	34	1.073
19169	Story	81	89	1.105
19171	Tama	18	18	1.023
19173	Taylor	7	7	0.942
19175	Union	12	12	0.974
19177	Van Buren	8	8	1.031
19179	Wapello	36	36	1.006
19181	Warren	42	49	1.183
19183	Washington	21	23	1.087
19185	Wayne	7	6	0.946
19187	Webster	40	38	0.961
19189	Winnebago	12	11	0.971
19191	Winneshiek	21	22	1.024
19193	Woodbury	104	108	1.038
19195	Worth	8	8	0.969
19197	Wright	14	13	0.946
KANSAS				
20001	Allen	14,229	13,001	0.914
20003	Anderson	8,142	8,071	0.991
20005	Atchison	16,679	15,072	0.904
20007	Barber	5,084	4,563	0.898
20009	Barton	27,736	24,532	0.884
20011	Bourbon	15,167	15,043	0.992
20013	Brown	10,499	11,492	1.095
20015	Butler	60,536	82,104	1.356
20017	Chase	2,929	2,751	0.939
20019	Chautauqua	4,210	3,994	0.949

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
20021	Cherokee	21,947	20,693	0.943
20023	Cheyenne	3,122	3,084	0.988
20025	Clark	2,382	2,480	1.041
20027	Clay	8,702	7,681	0.883
20029	Cloud	9,931	8,625	0.868
20031	Coffey	8,899	8,832	0.992
20033	Comanche	1,984	1,711	0.862
20035	Cowley	36,416	34,277	0.941
20037	Crawford	38,041	38,870	1.022
20039	Decatur	3,406	2,952	0.867
20041	Dickinson	19,139	21,077	1.101
20043	Doniphan	8,211	7,982	0.972
20045	Douglas	102,290	112,566	1.1
20047	Edwards	3,339	2,406	0.721
20049	Elk	3,137	3,041	0.969
20051	Ellis	27,266	26,864	0.985
20053	Ellsworth	6,417	5,784	0.901
20055	Finney	39,720	42,589	1.072
20057	Ford	32,652	33,945	1.04
20059	Franklin	25,314	24,041	0.95
20061	Geary	26,403	25,905	0.981
20063	Gove	2,991	2,807	0.938
20065	Graham	2,845	2,479	0.871
20067	Grant	7,892	7,078	0.897
20069	Gray	6,044	7,510	1.243
20071	Greeley	1,472	1,338	0.909
20073	Greenwood	7,651	7,681	1.004
20075	Hamilton	2,656	2,423	0.912
20077	Harper	6,274	5,471	0.872
20079	Harvey	33,423	35,899	1.074
20081	Haskell	4,292	4,624	1.077
20083	Hodgeman	2,148	2,467	1.149
20085	Jackson	12,738	20,837	1.636
20087	Jefferson	18,659	17,896	0.959
20089	Jewell	3,495	3,125	0.894
20091	Johnson	476,642	604,251	1.268
20093	Kearny	4,543	4,367	0.961
20095	Kingman	8,424	8,187	0.972
20097	Kiowa	3,106	3,146	1.013
20099	Labette	22,273	21,940	0.985
20101	Lane	2,000	1,907	0.954
20103	Leavenworth	70,805	78,196	1.104
20105	Lincoln	3,542	3,458	0.976
20107	Linn	9,672	9,204	0.952
20109	Logan	2,997	2,918	0.974
20111	Lyon	35,893	34,835	0.971
20113	McPherson	29,404	29,217	0.994

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
20115	Marion	13,244	12,953	0.978
20117	Marshall	10,580	11,483	1.085
20119	Meade	4,619	4,423	0.958
20121	Miami	28,910	35,458	1.226
20123	Mitchell	6,691	6,096	0.911
20125	Montgomery	35,296	31,308	0.887
20127	Morris	6,082	6,213	1.022
20129	Morton	3,359	3,151	0.938
20131	Nemaha	10,459	10,064	0.962
20133	Neosho	16,634	15,009	0.902
20135	Ness	3,316	3,011	0.908
20137	Norton	5,877	5,860	0.997
20139	Osage	16,924	21,237	1.255
20141	Osborne	4,237	3,731	0.881
20143	Ottawa	6,287	6,183	0.983
20145	Pawnee	6,944	6,715	0.967
20147	Phillips	5,869	6,096	1.039
20149	Pottawatomie	18,485	19,005	1.028
20151	Pratt	9,540	8,741	0.916
20153	Rawlins	2,887	2,885	0.999
20155	Reno	63,771	55,264	0.867
20157	Republic	5,468	4,928	0.901
20159	Rice	10,500	10,053	0.957
20161	Riley	61,463	62,795	1.022
20163	Rooks	5,489	5,602	1.021
20165	Rush	3,492	3,252	0.931
20167	Russell	7,053	6,436	0.913
20169	Saline	53,897	54,778	1.016
20171	Scott	4,921	4,772	0.97
20173	Sedgwick	461,943	508,467	1.101
20175	Seward	23,065	22,499	0.975
20177	Shawnee	170,703	170,471	0.999
20179	Sheridan	2,641	2,405	0.911
20181	Sherman	6,396	7,428	1.161
20183	Smith	4,363	3,942	0.904
20185	Stafford	4,662	4,474	0.96
20187	Stanton	2,409	2,396	0.995
20189	Stevens	5,331	5,062	0.95
20191	Sumner	25,526	24,678	0.967
20193	Thomas	8,090	8,008	0.99
20195	Trego	3,141	2,940	0.936
20197	Wabaunsee	6,713	7,171	1.068
20199	Wallace	1,691	1,583	0.936
20201	Washington	6,268	5,917	0.944
20203	Wichita	2,502	2,743	1.096
20205	Wilson	10,141	10,612	1.046
20207	Woodson	3,668	3,261	0.889
20209	Wyandotte	158,366	153,806	0.971

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
LOUISIANA				
22001	Acadia	59,246	64,410	1.087
22003	Allen	26,248	31,234	1.19
22005	Ascension	71,326	83,180	1.166
22007	Assumption	22,740	24,412	1.074
22009	Avoyelles	40,928	45,028	1.1
22011	Beauregard	33,124	36,678	1.107
22013	Bienville	16,368	18,256	1.115
22015	Bossier	93,962	103,806	1.105
22017	Caddo	247,834	268,132	1.082
22019	Calcasieu	180,196	197,882	1.098
22021	Caldwell	11,058	12,550	1.135
22023	Cameron	8,506	8,580	1.009
22025	Catahoula	11,572	12,702	1.098
22027	Claiborne	17,600	19,458	1.106
22029	Concordia	20,996	22,658	1.079
22031	De Soto	24,966	26,984	1.081
22033	East Baton Rouge	419,394	471,404	1.124
22035	East Carroll	9,340	10,110	1.082
22037	East Feliciana	22,278	25,978	1.166
22039	Evangeline	34,952	38,332	1.097
22041	Franklin	22,580	24,498	1.085
22043	Grant	18,108	19,564	1.08
22045	Iberia	74,270	82,838	1.115
22047	Iberville	31,382	34,130	1.088
22049	Jackson	15,740	17,088	1.086
22051	Jefferson	468,032	505,370	1.08
22053	Jefferson Davis	32,264	35,156	1.09
22055	Lafayette	191,976	219,210	1.142
22057	Lafourche	88,170	94,076	1.067
22059	La Salle	13,978	15,048	1.077
22061	Lincoln	45,514	51,604	1.134
22063	Livingston	86,918	100,042	1.151
22065	Madison	12,642	13,980	1.106
22067	Morehouse	32,456	35,486	1.093
22069	Natchitoches	38,372	42,554	1.109
22071	Orleans	478,430	517,570	1.082
22073	Ouachita	152,474	168,980	1.108
22075	Plaquemines	25,464	26,914	1.057
22077	Pointe Coupee	23,848	26,562	1.114
22079	Rapides	121,182	124,696	1.029
22081	Red River	9,354	10,186	1.089
22083	Richland	20,694	22,542	1.089
22085	Sabine	24,762	27,930	1.128
22087	St. Bernard	67,156	70,540	1.05
22089	St. Charles	50,146	57,400	1.145
22091	St. Helena	9,978	10,912	1.094

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
22093	St. James	21,418	23,470	1.096
22095	St. John the Baptist	44,126	49,278	1.117
22097	St. Landry	85,284	94,860	1.112
22099	St. Martin	48,066	53,584	1.115
22101	St. Mary	56,430	59,374	1.052
22103	St. Tammany	198,430	242,360	1.221
22105	Tangipahoa	98,780	113,228	1.146
22107	Tensas	6,784	7,332	1.081
22109	Terrebonne	104,530	114,252	1.093
22111	Union	22,490	25,262	1.123
22113	Vermilion	51,776	55,980	1.081
22115	Vernon	51,726	50,504	0.976
22117	Washington	42,826	45,868	1.071
22119	Webster	42,862	46,920	1.095
22121	West Baton Rouge	21,034	23,428	1.114
22123	West Carroll	11,920	12,612	1.058
22125	West Feliciana	13,792	15,426	1.118
22127	Winn	18,032	20,514	1.138
	MINNESOTA			
27001	Aitkin	15,937	21,444	1.346
27003	Anoka	308,230	372,816	1.21
27005	Becker	30,520	34,878	1.143
27007	Beltrami	40,790	48,980	1.201
27009	Benton	35,228	41,944	1.191
27011	Big Stone	5,752	5,484	0.953
27013	Blue Earth	56,601	59,804	1.057
27015	Brown	26,939	28,232	1.048
27017	Carlton	32,291	37,004	1.146
27019	Carver	74,807	108,532	1.451
27021	Cass	28,450	38,826	1.365
27023	Chippewa	13,041	13,250	1.016
27025	Chisago	43,321	59,310	1.369
27027	Clay	51,629	52,780	1.022
27029	Clearwater	8,494	9,130	1.075
27031	Cook	5,385	7,134	1.325
27033	Cottonwood	12,092	12,026	0.995
27035	Crow Wing	57,491	77,012	1.34
27037	Dakota	370,438	461,880	1.247
27039	Dodge	18,155	21,778	1.2
27041	Douglas	33,629	40,776	1.213
27043	Faribault	16,037	15,834	0.987
27045	Fillmore	21,241	22,692	1.068
27047	Freeborn	32,806	34,524	1.052
27049	Goodhue	44,692	49,786	1.114
27051	Grant	6,293	6,620	1.052
27053	Hennepin	1,133,884	1,249,232	1.102
27055	Houston	19,923	21,808	1.095

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
27057	Hubbard	19,090	24,854	1.302
27059	Isanti	32,264	38,986	1.208
27061	Itasca	44,703	50,370	1.127
27063	Jackson	11,213	11,300	1.008
27065	Kanabec	15,786	19,388	1.228
27067	Kandiyohi	41,706	45,540	1.092
27069	Kittson	5,231	5,154	0.985
27071	Koochiching	14,177	13,244	0.934
27073	Lac qui Parle	7,924	7,324	0.924
27075	Lake	11,199	12,450	1.112
27077	Lake of the Woods	4,589	5,100	1.111
27079	Le Sueur	25,820	28,608	1.108
27081	Lincoln	6,385	6,392	1.001
27083	Lyon	25,503	26,226	1.028
27085	McLeod	35,447	39,344	1.11
27087	Mahnomen	5,222	5,472	1.048
27089	Marshall	10,001	9,258	0.926
27091	Martin	21,617	21,104	0.976
27093	Meeker	22,994	26,098	1.135
27095	Mille Lacs	23,102	29,500	1.277
27097	Morrison	32,067	35,198	1.098
27099	Mower	38,834	41,278	1.063
27101	Murray	9,051	8,638	0.954
27103	Nicollet	30,199	32,966	1.092
27105	Nobles	20,887	21,702	1.039
27107	Norman	7,377	7,140	0.968
27109	Olmsted	127,654	153,218	1.2
27111	Otter Tail	58,307	69,350	1.189
27113	Pennington	13,670	14,260	1.043
27115	Pine	27,302	33,588	1.23
27117	Pipestone	9,789	9,290	0.949
27119	Polk	31,177	31,122	0.998
27121	Pope	11,282	12,000	1.064
27123	Ramsey	516,633	552,076	1.069
27125	Red Lake	4,295	4,396	1.023
27127	Redwood	16,733	16,946	1.013
27129	Renville	17,104	17,220	1.007
27131	Rice	58,271	70,890	1.217
27133	Rock	9,689	9,826	1.014
27135	Roseau	16,543	18,200	1.1
27137	St. Louis	201,457	211,366	1.049
27139	Scott	96,259	147,138	1.529
27141	Sherburne	69,006	101,934	1.477
27143	Sibley	15,566	17,390	1.117
27145	Stearns	136,352	160,364	1.176
27147	Steele	34,256	38,210	1.115
27149	Stevens	10,060	10,112	1.005

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
27151	Swift	11,994	12,784	1.066
27153	Todd	24,620	26,798	1.088
27155	Traverse	4,052	3,744	0.924
27157	Wabasha	21,938	24,614	1.122
27159	Wadena	13,872	15,082	1.087
27161	Waseca	19,716	21,184	1.074
27163	Washington	211,906	286,342	1.351
27165	Watonwan	11,906	12,250	1.029
27167	Wilkin	7,083	6,986	0.986
27169	Winona	50,491	54,190	1.073
27171	Wright	94,096	123,258	1.31
27173	Yellow Medicine	11,000	10,826	0.984
	MISSOURI			
29001	Adair	23,945	22,652	0.946
29003	Andrew	15,808	17,000	1.075
29005	Atchison	6,733	5,873	0.872
29007	Audrain	24,287	24,807	1.021
29009	Barry	36,132	46,461	1.286
29011	Barton	12,300	13,717	1.115
29013	Bates	16,176	17,637	1.09
29015	Benton	17,773	21,214	1.194
29017	Bollinger	12,027	13,823	1.149
29019	Boone	137,011	168,775	1.232
29021	Buchanan	82,652	80,828	0.978
29023	Butler	41,397	43,463	1.05
29025	Caldwell	8,817	9,554	1.084
29027	Callaway	39,168	45,700	1.167
29029	Camden	36,567	45,152	1.235
29031	Cape Girardeau	68,404	75,037	1.097
29033	Carroll	9,858	8,889	0.902
29035	Carter	6,753	8,226	1.218
29037	Cass	86,299	112,085	1.299
29039	Cedar	13,700	15,350	1.12
29041	Chariton	8,477	7,884	0.93
29043	Christian	56,199	86,229	1.534
29045	Clark	7,480	7,549	1.009
29047	Clay	183,989	216,063	1.174
29049	Clinton	19,590	23,030	1.176
29051	Cole	70,819	76,706	1.083
29053	Cooper	16,849	18,354	1.089
29055	Crawford	23,944	29,357	1.226
29057	Dade	8,365	9,348	1.117
29059	Dallas	16,983	22,566	1.329
29061	Daviess	7,940	8,189	1.031
29063	DeKalb	13,482	14,488	1.075
29065	Dent	14,332	14,662	1.023
29067	Douglas	12,541	13,246	1.056

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
29069	Dunklin	32,627	31,891	0.977
29071	Franklin	96,978	116,194	1.198
29073	Gasconade	15,267	17,259	1.13
29075	Gentry	6,884	7,200	1.046
29077	Greene	237,440	260,399	1.097
29079	Grundy	10,141	9,592	0.946
29081	Harrison	8,181	7,931	0.969
29083	Henry	21,840	23,383	1.071
29085	Hickory	9,360	10,807	1.155
29087	Holt	5,398	4,903	0.908
29089	Howard	9,725	9,906	1.019
29091	Howell	38,114	45,840	1.203
29093	Iron	11,154	11,721	1.051
29095	Jackson	653,141	668,410	1.023
29097	Jasper	103,291	118,819	1.15
29099	Jefferson	205,743	247,773	1.204
29101	Johnson	50,194	59,158	1.179
29103	Knox	4,271	4,074	0.954
29105	Laclede	32,042	38,311	1.196
29107	Lafayette	33,443	36,866	1.102
29109	Lawrence	34,399	40,134	1.167
29111	Lewis	10,023	9,700	0.968
29113	Lincoln	38,970	53,491	1.373
29115	Linn	14,060	14,681	1.044
29117	Livingston	14,385	14,000	0.973
29119	McDonald	21,109	26,954	1.277
29121	Macon	15,088	14,876	0.986
29123	Madison	11,734	12,819	1.092
29125	Maries	8,496	9,169	1.079
29127	Marion	28,015	28,953	1.033
29129	Mercer	4,325	4,859	1.123
29131	Miller	23,815	28,155	1.182
29133	Mississippi	12,979	11,247	0.867
29135	Moniteau	14,560	16,349	1.123
29137	Monroe	8,847	8,904	1.006
29139	Montgomery	12,067	13,007	1.078
29141	Morgan	19,328	23,273	1.204
29143	New Madrid	20,428	19,695	0.964
29145	Newton	50,569	58,237	1.152
29147	Nodaway	20,521	18,673	0.91
29149	Oregon	10,506	11,236	1.069
29151	Osage	12,751	13,503	1.059
29153	Ozark	10,322	11,596	1.123
29155	Pemiscot	21,471	21,369	0.995
29157	Perry	18,005	19,443	1.08
29159	Pettis	38,000	40,961	1.078
29161	Phelps	39,610	42,920	1.084

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
29163	Pike	16,780	16,719	0.996
29165	Platte	75,949	95,760	1.261
29167	Polk	27,597	34,199	1.239
29169	Pulaski	41,942	37,494	0.894
29171	Putnam	4,934	4,625	0.937
29173	Ralls	9,112	9,811	1.077
29175	Randolph	23,863	23,397	0.98
29177	Ray	23,519	26,189	1.114
29179	Reynolds	6,722	6,536	0.972
29181	Ripley	14,997	18,480	1.232
29183	St. Charles	295,337	399,603	1.353
29185	St. Clair	9,375	10,254	1.094
29186	Ste. Genevieve	17,581	19,427	1.105
29187	St. Francois	57,936	66,648	1.15
29189	St. Louis	1,000,468	972,728	0.972
29195	Saline	22,426	21,654	0.966
29197	Schuyler	4,517	4,845	1.073
29199	Scotland	4,795	4,756	0.992
29201	Scott	40,920	42,065	1.028
29203	Shannon	8,500	9,450	1.112
29205	Shelby	6,747	6,682	0.99
29207	Stoddard	29,132	28,107	0.965
29209	Stone	31,887	44,919	1.409
29211	Sullivan	6,770	7,288	1.077
29213	Taney	39,389	53,373	1.355
29215	Texas	24,647	26,637	1.081
29217	Vernon	19,555	20,427	1.045
29219	Warren	26,349	35,226	1.337
29221	Washington	23,758	27,109	1.141
29223	Wayne	13,715	15,786	1.151
29225	Webster	31,186	40,596	1.302
29227	Worth	2,277	2,102	0.923
29229	Wright	21,191	26,671	1.259
29510	St. Louis City	308,084	203,291	0.66
NEBRASKA				
31001	Adams	31,573	35,093	1.111
31003	Antelope	7,325	6,432	0.878
31005	Arthur	438	390	0.891
31007	Banner	810	743	0.918
31009	Blaine	561	410	0.731
31011	Boone	6,135	5,419	0.883
31013	Box Butte	11,998	10,816	0.901
31015	Boyd	2,352	1,760	0.748
31017	Brown	3,475	3,135	0.902
31019	Buffalo	43,358	52,767	1.217
31021	Burt	7,786	7,703	0.989
31023	Butler	8,807	9,355	1.062

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
31025	Cass	24,932	30,776	1.234
31027	Cedar	9,453	8,445	0.893
31029	Chase	3,996	3,496	0.875
31031	Cherry	6,086	5,570	0.915
31033	Cheyenne	9,915	10,650	1.074
31035	Clay	7,015	6,887	0.982
31037	Colfax	10,650	12,812	1.203
31039	Cuming	10,186	10,564	1.037
31041	Custer	11,637	10,555	0.907
31043	Dakota	21,004	28,123	1.339
31045	Dawes	9,103	9,356	1.028
31047	Dawson	25,038	31,659	1.264
31049	Deuel	2,069	1,900	0.918
31051	Dixon	6,354	6,581	1.036
31053	Dodge	36,719	42,744	1.164
31055	Douglas	475,053	575,897	1.212
31057	Dundy	2,236	1,815	0.812
31059	Fillmore	6,547	6,018	0.919
31061	Franklin	3,513	3,113	0.886
31063	Frontier	3,098	3,105	1.002
31065	Furnas	5,275	4,970	0.942
31067	Gage	23,078	24,509	1.062
31069	Garden	2,259	2,034	0.9
31071	Garfield	1,848	1,487	0.804
31073	Gosper	2,143	2,160	1.008
31075	Grant	732	625	0.854
31077	Greeley	2,639	2,097	0.795
31079	Hall	54,710	66,217	1.21
31081	Hamilton	9,510	10,598	1.114
31083	Harlan	3,755	3,627	0.966
31085	Hayes	1,032	767	0.743
31087	Hitchcock	3,002	2,232	0.743
31089	Holt	11,289	9,473	0.839
31091	Hooker	769	740	0.962
31093	Howard	6,640	7,321	1.102
31095	Jefferson	8,233	7,519	0.913
31097	Johnson	4,484	4,561	1.017
31099	Kearney	6,933	7,415	1.07
31101	Keith	8,947	9,453	1.056
31103	Keya Paha	960	778	0.811
31105	Kimball	4,078	4,021	0.986
31107	Knox	9,293	8,699	0.936
31109	Lancaster	259,022	339,780	1.312
31111	Lincoln	35,207	40,975	1.164
31113	Logan	754	619	0.821
31115	Loup	703	651	0.926
31117	McPherson	526	499	0.948

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
31119	Madison	35,797	41,896	1.17
31121	Merrick	8,221	8,511	1.035
31123	Morrill	5,464	5,720	1.047
31125	Nance	3,984	3,608	0.906
31127	Nemaha	7,518	7,029	0.935
31129	Nuckolls	4,923	3,939	0.8
31131	Otoe	15,678	18,653	1.19
31133	Pawnee	3,036	2,760	0.909
31135	Perkins	3,163	2,934	0.928
31137	Phelps	9,734	9,705	0.997
31139	Pierce	7,868	7,975	1.014
31141	Platte	32,052	36,498	1.139
31143	Polk	5,621	5,569	0.991
31145	Red Willow	11,389	11,002	0.966
31147	Richardson	9,450	8,973	0.95
31149	Rock	1,700	1,292	0.76
31151	Saline	14,109	16,745	1.187
31153	Sarpy	127,219	167,476	1.316
31155	Saunders	20,130	23,249	1.155
31157	Scotts Bluff	37,472	43,116	1.151
31159	Seward	16,635	18,095	1.088
31161	Sheridan	6,104	5,437	0.891
31163	Sherman	3,233	2,620	0.81
31165	Sioux	1,455	1,247	0.857
31167	Stanton	6,481	6,728	1.038
31169	Thayer	5,928	5,042	0.85
31171	Thomas	704	527	0.749
31173	Thurston	7,271	8,147	1.12
31175	Valley	4,545	3,835	0.844
31177	Washington	19,312	24,628	1.275
31179	Wayne	9,973	11,028	1.106
31181	Webster	4,007	3,726	0.93
31183	Wheeler	861	703	0.817
31185	York	14,660	15,532	1.06
	OKLAHOMA			
40001	Adair	21,743	27,960	1.286
40003	Alfalfa	6,063	5,900	0.973
40005	Atoka	14,167	17,040	1.203
40007	Beaver	5,834	5,960	1.022
40009	Beckham	20,039	22,800	1.138
40011	Blaine	12,066	13,500	1.119
40013	Bryan	37,360	44,060	1.179
40015	Caddo	30,210	31,820	1.053
40017	Canadian	89,538	104,960	1.172
40019	Carter	45,893	49,600	1.081
40021	Cherokee	44,073	56,420	1.28
40023	Choctaw	15,365	15,920	1.036

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
40025	Cimarron	3,169	3,360	1.06
40027	Cleveland	212,930	245,480	1.153
40029	Coal	6,139	7,400	1.205
40031	Comanche	116,758	130,360	1.117
40033	Cotton	6,568	6,660	1.014
40035	Craig	15,250	17,940	1.176
40037	Creek	68,220	76,040	1.115
40039	Custer	26,445	28,800	1.089
40041	Delaware	38,326	48,620	1.269
40043	Dewey	4,686	4,500	0.96
40045	Ellis	4,005	3,740	0.934
40047	Garfield	58,048	60,640	1.045
40049	Garvin	27,246	28,080	1.031
40051	Grady	46,110	51,620	1.12
40053	Grant	5,126	5,160	1.007
40055	Greer	5,997	5,900	0.984
40057	Harmon	3,250	3,300	1.015
40059	Harper	3,537	3,400	0.961
40061	Haskell	12,115	14,940	1.233
40063	Hughes	14,412	17,100	1.186
40065	Jackson	28,743	31,540	1.097
40067	Jefferson	6,731	6,660	0.989
40069	Johnston	10,708	12,720	1.188
40071	Kay	48,248	50,480	1.046
40073	Kingfisher	14,156	16,740	1.183
40075	Kiowa	10,136	9,900	0.977
40077	Latimer	10,735	11,380	1.06
40079	Le Flore	48,505	54,700	1.128
40081	Lincoln	32,568	37,200	1.142
40083	Logan	34,874	42,540	1.22
40085	Love	9,139	11,940	1.307
40087	McClain	28,764	37,320	1.297
40089	McCurtain	34,601	36,880	1.066
40091	McIntosh	19,874	23,780	1.197
40093	Major	7,527	7,500	0.996
40095	Marshall	13,910	20,040	1.441
40097	Mayes	39,061	45,460	1.164
40099	Murray	12,854	14,760	1.148
40101	Muskogee	69,671	72,820	1.045
40103	Noble	11,527	12,480	1.083
40105	Nowata	10,821	13,340	1.233
40107	Okfuskee	11,808	12,120	1.026
40109	Oklahoma	668,989	728,840	1.089
40111	Okmulgee	40,091	44,560	1.111
40113	Osage	45,022	50,260	1.116
40115	Ottawa	33,516	36,820	1.099
40117	Pawnee	16,887	19,800	1.172

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
40119	Payne	70,194	82,360	1.173
40121	Pittsburg	44,172	46,960	1.063
40123	Pontotoc	35,326	37,420	1.059
40125	Pottawatomie	66,393	73,880	1.113
40127	Pushmataha	11,920	14,380	1.206
40129	Roger Mills	3,422	3,400	0.994
40131	Rogers	72,465	88,040	1.215
40133	Seminole	24,896	25,840	1.038
40135	Sequoyah	39,863	47,280	1.186
40137	Stephens	43,069	43,280	1.005
40139	Texas	21,344	31,420	1.472
40141	Tillman	9,252	9,360	1.012
40143	Tulsa	570,659	625,040	1.095
40145	Wagoner	59,285	71,220	1.201
40147	Washington	49,118	50,600	1.03
40149	Washita	11,585	12,220	1.055
40151	Woods	9,093	9,200	1.012
40153	Woodward	18,612	19,840	1.066
		TEXAS		
48001	Anderson	55,825	62,092	1.112
48003	Andrews	13,238	15,107	1.141
48005	Angelina	81,575	94,579	1.159
48007	Aransas	22,934	26,209	1.143
48009	Archer	9,024	10,468	1.16
48011	Armstrong	2,158	2,290	1.061
48013	Atascosa	40,167	53,775	1.339
48015	Austin	24,077	28,473	1.183
48017	Bailey	6,735	8,082	1.2
48019	Bandera	18,390	25,243	1.373
48021	Bastrop	61,069	94,372	1.545
48023	Baylor	4,055	3,877	0.956
48025	Bee	32,849	36,562	1.113
48027	Bell	246,823	314,037	1.272
48029	Bexar	1,427,012	1,671,927	1.172
48031	Blanco	8,718	11,557	1.326
48033	Borden	733	781	1.065
48035	Bosque	17,437	20,107	1.153
48037	Bowie	89,580	91,580	1.022
48039	Brazoria	250,581	326,663	1.304
48041	Brazos	156,104	186,034	1.192
48043	Brewster	8,926	10,029	1.124
48045	Briscoe	1,804	1,932	1.071
48047	Brooks	8,144	9,519	1.169
48049	Brown	38,032	41,331	1.087
48051	Burleson	16,885	20,825	1.233
48053	Burnet	35,695	50,786	1.423
48055	Caldwell	33,656	48,066	1.428

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48057	Calhoun	21,104	24,148	1.144
48059	Callahan	13,015	14,012	1.077
48061	Cameron	350,379	483,238	1.379
48063	Camp	11,822	14,014	1.185
48065	Carson	6,549	6,818	1.041
48067	Cass	30,445	30,639	1.006
48069	Castro	8,485	10,065	1.186
48071	Chambers	27,049	36,395	1.346
48073	Cherokee	47,518	55,687	1.172
48075	Childress	7,756	8,283	1.068
48077	Clay	11,083	11,653	1.051
48079	Cochran	3,801	4,447	1.17
48081	Coke	3,842	3,837	0.999
48083	Coleman	9,219	9,345	1.014
48085	Collin	526,153	822,200	1.563
48087	Collingsworth	3,184	3,160	0.992
48089	Colorado	20,586	22,907	1.113
48091	Comal	81,730	116,670	1.428
48093	Comanche	14,078	14,909	1.059
48095	Concho	4,005	4,113	1.027
48097	Cooke	36,899	42,123	1.142
48099	Coryell	77,652	101,132	1.302
48101	Cottle	1,892	1,928	1.019
48103	Crane	4,076	4,674	1.147
48105	Crockett	4,171	4,720	1.132
48107	Crosby	7,195	8,188	1.138
48109	Culberson	3,050	3,524	1.155
48111	Dallam	6,367	7,305	1.147
48113	Dallas	2,284,143	2,865,380	1.254
48115	Dawson	15,188	16,641	1.096
48117	Deaf Smith	19,054	22,958	1.205
48119	Delta	5,331	5,362	1.006
48121	Denton	465,947	753,768	1.618
48123	DeWitt	20,169	21,436	1.063
48125	Dickens	2,749	2,689	0.978
48127	Dimmit	10,495	12,165	1.159
48129	Donley	3,826	3,776	0.987
48131	Duval	13,353	14,883	1.115
48133	Eastland	18,293	18,668	1.02
48135	Ector	123,150	142,079	1.154
48137	Edwards	2,185	2,331	1.067
48139	Ellis	115,879	159,805	1.379
48141	El Paso	703,516	904,018	1.285
48143	Erath	34,293	41,401	1.207
48145	Falls	18,747	20,606	1.099
48147	Fannin	31,641	35,727	1.129
48149	Fayette	22,019	25,273	1.148

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48151	Fisher	4,308	4,070	0.945
48153	Floyd	7,874	8,875	1.127
48155	Foard	1,618	1,618	1
48157	Fort Bend	373,357	540,789	1.448
48159	Franklin	9,552	10,277	1.076
48161	Freestone	18,062	20,161	1.116
48163	Frio	16,725	20,219	1.209
48165	Gaines	14,799	17,918	1.211
48167	Galveston	253,900	283,666	1.117
48169	Garza	4,942	5,472	1.107
48171	Gillespie	21,030	23,313	1.109
48173	Glasscock	1,425	1,654	1.161
48175	Goliad	7,036	7,739	1.1
48177	Gonzales	18,950	21,801	1.15
48179	Gray	22,624	22,406	0.99
48181	Grayson	111,888	123,924	1.108
48183	Gregg	112,696	125,782	1.116
48185	Grimes	24,203	30,486	1.26
48187	Guadalupe	92,465	123,890	1.34
48189	Hale	37,285	42,886	1.15
48191	Hall	3,799	3,951	1.04
48193	Hamilton	8,252	8,873	1.075
48195	Hansford	5,440	6,269	1.152
48197	Hardeman	4,720	4,746	1.006
48199	Hardin	48,944	55,591	1.136
48201	Harris	3,503,977	4,416,624	1.26
48203	Harrison	63,224	73,646	1.165
48205	Hartley	5,629	6,275	1.115
48207	Haskell	6,056	6,000	0.991
48209	Hays	106,152	174,701	1.646
48211	Hemphill	3,384	3,668	1.084
48213	Henderson	75,340	94,009	1.248
48215	Hidalgo	603,081	911,390	1.511
48217	Hill	33,057	40,340	1.22
48219	Hockley	23,092	25,645	1.111
48221	Hood	42,466	55,163	1.299
48223	Hopkins	32,358	36,114	1.116
48225	Houston	23,266	24,481	1.052
48227	Howard	33,901	36,108	1.065
48229	Hudspeth	3,417	3,945	1.155
48231	Hunt	80,012	105,234	1.315
48233	Hutchinson	23,974	25,212	1.052
48235	Irion	1,783	1,810	1.015
48237	Jack	8,840	9,508	1.076
48239	Jackson	14,622	16,558	1.132
48241	Jasper	36,303	42,026	1.158
48243	Jeff Davis	2,229	2,312	1.037

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48245	Jefferson	254,598	273,841	1.076
48247	Jim Hogg	5,377	6,197	1.153
48249	Jim Wells	40,067	45,874	1.145
48251	Johnson	131,417	175,962	1.339
48253	Jones	20,871	22,002	1.054
48255	Karnes	15,785	18,764	1.189
48257	Kaufman	74,604	107,395	1.44
48259	Kendall	24,885	35,870	1.441
48261	Kenedy	424	499	1.177
48263	Kent	848	823	0.971
48265	Kerr	44,086	48,298	1.096
48267	Kimble	4,487	4,585	1.022
48269	King	359	401	1.117
48271	Kinney	3,403	3,513	1.032
48273	Kleberg	33,117	41,183	1.244
48275	Knox	4,238	4,340	1.024
48277	Lamar	48,834	51,485	1.054
48279	Lamb	14,911	16,850	1.13
48281	Lampasas	18,234	22,529	1.236
48283	La Salle	6,050	7,479	1.236
48285	Lavaca	19,194	19,632	1.023
48287	Lee	16,086	20,471	1.273
48289	Leon	15,593	17,889	1.147
48291	Liberty	72,445	93,467	1.29
48293	Limestone	22,368	25,486	1.139
48295	Lipscomb	3,065	3,215	1.049
48297	Live Oak	12,488	13,788	1.104
48299	Llano	16,945	16,260	0.96
48301	Loving	67	63	0.94
48303	Lubbock	249,130	278,019	1.116
48305	Lynn	6,648	7,364	1.108
48307	McCulloch	8,244	8,680	1.053
48309	McLennan	216,167	247,741	1.146
48311	McMullen	852	877	1.029
48313	Madison	13,176	15,081	1.145
48315	Marion	11,091	12,025	1.084
48317	Martin	4,847	5,700	1.176
48319	Mason	3,725	3,609	0.969
48321	Matagorda	38,580	44,184	1.145
48323	Maverick	49,212	65,897	1.339
48325	Medina	40,817	54,778	1.342
48327	Menard	2,363	2,442	1.033
48329	Midland	117,378	132,227	1.127
48331	Milam	24,569	27,688	1.127
48333	Mills	5,170	5,589	1.081
48335	Mitchell	9,723	9,930	1.021
48337	Montague	19,275	20,913	1.085

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48339	Montgomery	309,930	461,971	1.491
48341	Moore	20,762	26,367	1.27
48343	Morris	13,099	13,530	1.033
48345	Motley	1,425	1,367	0.959
48347	Nacogdoches	59,776	67,457	1.128
48349	Navarro	46,048	55,397	1.203
48351	Newton	15,325	17,183	1.121
48353	Nolan	15,989	17,389	1.088
48355	Nueces	321,277	384,672	1.197
48357	Ochiltree	9,198	10,968	1.192
48359	Oldham	2,214	2,423	1.094
48361	Orange	85,840	91,950	1.071
48363	Palo Pinto	27,446	31,612	1.152
48365	Panola	22,978	24,587	1.07
48367	Parker	91,640	119,974	1.309
48369	Parmer	10,208	12,008	1.176
48371	Pecos	17,083	19,202	1.124
48373	Polk	42,165	51,096	1.212
48375	Potter	116,392	142,151	1.221
48377	Presidio	7,584	9,955	1.313
48379	Rains	9,402	11,529	1.226
48381	Randall	106,619	125,769	1.18
48383	Reagan	3,405	4,101	1.204
48385	Real	3,051	3,040	0.996
48387	Red River	14,351	14,641	1.02
48389	Reeves	13,369	14,786	1.106
48391	Refugio	7,943	8,652	1.089
48393	Roberts	897	998	1.113
48395	Robertson	16,287	19,279	1.184
48397	Rockwall	45,533	67,942	1.492
48399	Runnels	11,577	12,475	1.078
48401	Rusk	47,780	51,956	1.087
48403	Sabine	10,523	10,716	1.018
48405	San Augustine	9,069	9,770	1.077
48407	San Jacinto	22,977	29,104	1.267
48409	San Patricio	69,800	93,570	1.341
48411	San Saba	6,222	6,843	1.1
48413	Schleicher	2,970	3,342	1.125
48415	Scurry	16,476	17,562	1.066
48417	Shackelford	3,337	3,574	1.071
48419	Shelby	25,639	29,603	1.155
48421	Sherman	3,237	3,594	1.11
48423	Smith	177,083	201,037	1.135
48425	Somervell	6,979	8,490	1.217
48427	Starr	56,216	79,415	1.413
48429	Stephens	9,731	10,457	1.075
48431	Sterling	1,402	1,543	1.101

Table C-1 (continued)

FIPS Code	County	2002	2018	2018GF
48433	Stonewall	1,694	1,695	1.001
48435	Sutton	4,181	4,814	1.151
48437	Swisher	8,496	9,523	1.121
48439	Tarrant	1,489,319	1,847,868	1.241
48441	Taylor	128,262	141,533	1.103
48443	Terrell	1,081	1,095	1.013
48445	Terry	12,997	14,910	1.147
48447	Throckmorton	1,860	1,866	1.003
48449	Titus	28,786	34,989	1.215
48451	Tom Green	105,294	116,825	1.11
48453	Travis	845,053	1,080,424	1.279
48455	Trinity	13,942	15,034	1.078
48457	Tyler	21,250	24,626	1.159
48459	Upshur	35,908	41,645	1.16
48461	Upton	3,461	3,902	1.127
48463	Uvalde	26,616	32,217	1.21
48465	Val Verde	46,318	57,703	1.246
48467	Van Zandt	49,269	59,968	1.217
48469	Victoria	86,205	102,198	1.186
48471	Walker	63,272	72,115	1.14
48473	Waller	34,583	49,277	1.425
48475	Ward	11,060	12,051	1.09
48477	Washington	30,752	35,292	1.148
48479	Webb	206,306	325,594	1.578
48481	Wharton	41,738	46,881	1.123
48483	Wheeler	5,231	4,997	0.955
48485	Wichita	133,000	143,299	1.077
48487	Wilbarger	14,793	16,126	1.09
48489	Willacy	20,651	25,372	1.229
48491	Williamson	267,736	434,237	1.622
48493	Wilson	33,943	48,616	1.432
48495	Winkler	7,273	7,999	1.1
48497	Wise	50,769	68,763	1.354
48499	Wood	37,500	43,929	1.171
48501	Yoakum	7,488	8,997	1.202
48503	Young	17,982	18,841	1.048
48505	Zapata	12,587	16,344	1.298
48507	Zavala	11,887	14,101	1.186

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