

# **Mining and Quarrying Equipment Emission Inventory for CAPCOG counties and Milam County**

**Technical Report**

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**Prepared by:**

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<b>Abstract:</b> Refinements were made to the 2006 and 2008 quarry and mining non-road equipment emissions inventories published by TCEQ for the area covered by the CAPCOG counties as well as Milam County. Population counts from aerial imagery of the CAPCOG region and Milam County, and data from the 2011 quarry survey in the San Antonio region were used to update emissions estimates. VOC, NO <sub>x</sub> , and CO emission factors, and load factors used in the calculations are based on data in the TexN Model 1.6. Daily ozone season emissions from quarry and mining equipment in 2006 were estimated to be 0.25 tons of VOC, 4.03 tons of NO <sub>x</sub> , and 1.63 tons of CO in CAPCOG and Milam County. In 2008, estimated emissions from quarry and mining equipment were 0.23 tons of VOC, 3.51 tons of NO <sub>x</sub> , and 1.56 tons of CO in CAPCOG and Milam County. Non-road equipment emissions from mining and quarrying operations are dominated by rock trucks and loaders, while rock processing equipment, dozers, and excavators are also significant emission sources. As expected, Williamson and Travis Counties had the highest quarry and mining non-road equipment emissions followed by Burnet, Fayette, and Hays Counties. Emissions were allocated to the 4km photochemical model grid system, converted to the Emissions Processing System version 3 (EPS3), and formatted to EPA's NIF format.		
<b>Related Reports:</b> Alamo Area Council of Governments, July 1 <sup>st</sup> , 2012. "Non-Road Emission Inventory Improvements."	<b>Distribution Statement:</b> Alamo Area Council of Governments, Natural Resources/Transportation Department	<b>Permanent File:</b> Alamo Area Council of Governments, Natural Resources/Transportation Department

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## 1. INTRODUCTION

The Clean Air Act is the comprehensive federal law that regulates airborne emissions across the United States.<sup>1</sup> This law authorizes the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. Of the many air pollutants commonly found throughout the country, EPA has recognized six “criteria” pollutants that can injure health, harm the environment, and/or cause property damage. One of these criteria pollutants, ozone, is produced when volatile organic compounds (VOC) and nitrogen compounds (NO<sub>x</sub>) react in the presence of sunlight.<sup>2</sup>

According to the EPA, “the health effects associated with ozone exposure include respiratory health problems ranging from decreased lung function and aggravated asthma to increased emergency department visits, hospital admissions and premature death. The environmental effects associated with seasonal exposure to ground-level ozone include adverse effects on sensitive vegetation, forests, and ecosystems.”<sup>3</sup> Currently, the ozone primary standard, which is designed to protect human health, is set at 75 parts per billion (ppb). The secondary standard, which is designed to protect the environment, is the same as the primary standard.

Local and state agencies rely on such tools as emissions inventories (EI) that temporally and geographically describe chemical emission rates by source to support air quality planning activities in a region. The more accurate the EI, the more useful it is for modeling and planning purposes. Quarry and mining non-road equipment emissions in the CAPCOG region and Milam County were identified as EI categories that could be further refined through additional research and analysis. Not only will this benefit the planning process, but the refinements can improve understanding of how these sources create ozone precursor pollutants, allowing planners, political leaders, and industries to work together to protect health and the environment.

As a subsequent step in the process, the refined CAPCOG area and Milam County quarry and mining equipment emissions were formatted for input into the regional photochemical model and National Emissions Inventory (NEI) Input Format (NIF).

## 2. Inventory Pollutants

Ozone is a secondary pollutant because it forms as the result of chemical reactions between other pollutants, namely:

- NO<sub>x</sub>
- VOC
- Carbon monoxide (CO)

Emission inventory data is one category of inputs used in photochemical modeling. These models help determine a regions ability to comply with the NAAQS, and their usefulness depends, in part, on accurately identifying and quantifying emission rates from these pollutants.

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<sup>1</sup> US Congress, 1990. “Clean Air Act”. Available online: <http://www.epa.gov/air/caa/>. Accessed 07/19/2010.

<sup>2</sup> EPA, Sept. 23, 2011, “Ground-level Ozone”. Available online: <http://www.epa.gov/air/ozonepollution/>. Accessed 10/31/2011.

<sup>3</sup> EPA, September 16, 2009. “Fact Sheet: EPA to Reconsider Ozone Pollution Standards”, p. 1. Available online: [http://www.epa.gov/air/ozonepollution/pdfs/O3\\_Reconsideration\\_FACT%20SHEET\\_091609.pdf](http://www.epa.gov/air/ozonepollution/pdfs/O3_Reconsideration_FACT%20SHEET_091609.pdf). Accessed 06/28/2010.

### **3. Geographic Area**

Updates to the 2006 and 2008 non-road emission inventories were calculated for quarry and mining operations in the CAPCOG region, consisting of ten counties. These counties include: Bastrop, Blanco, Burnet, Caldwell, Fayette, Hays, Lee, Llano, Travis, and Williamson. In addition, quarry and mining activities Milam County were included in the emission inventory calculations (Figure 4-1).

### **4. Modeling Domain Parameters**

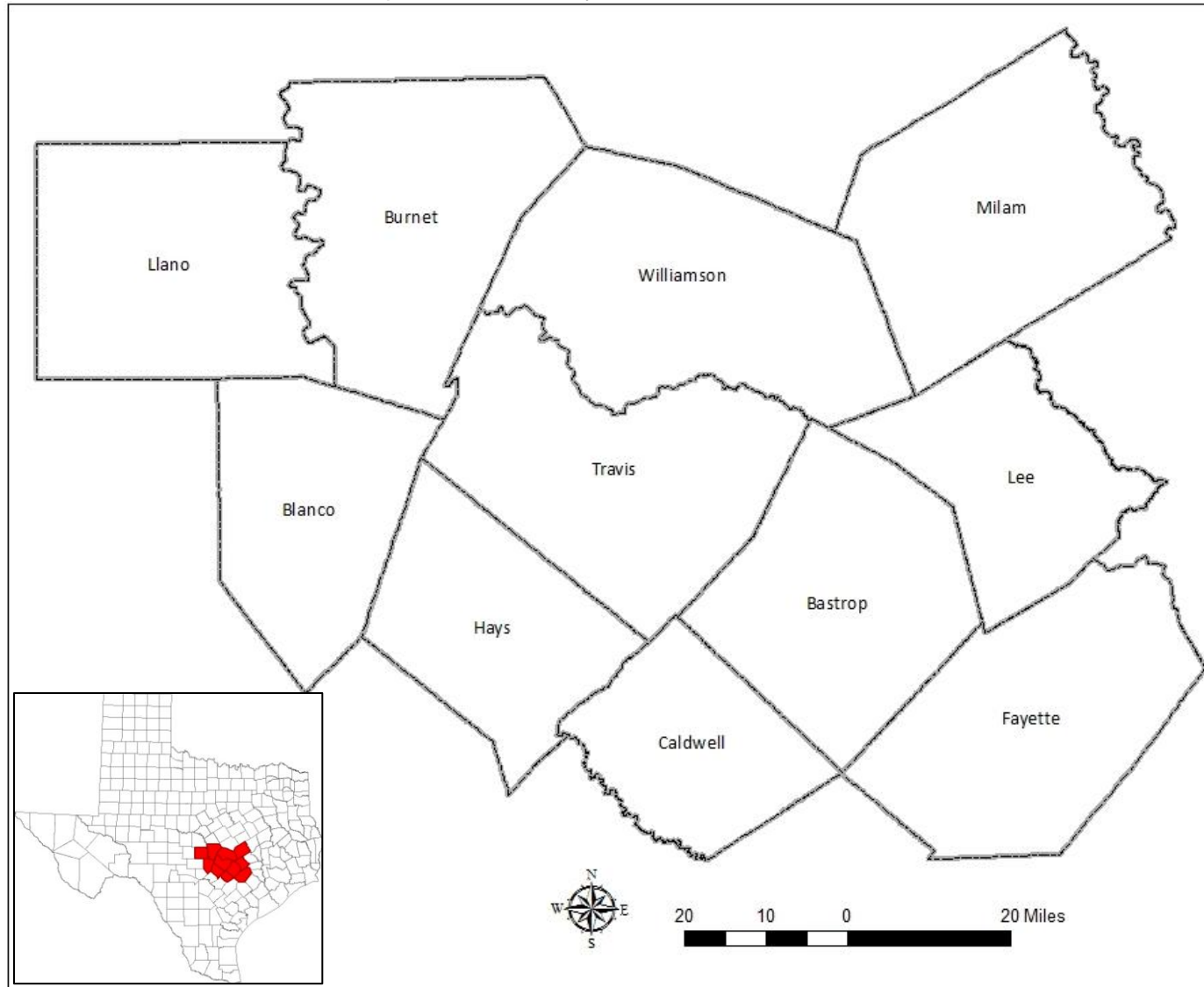
The development of input files for photochemical model emissions processing is based on a grid system consistent with EPA's Regional Planning Organizations (RPO) Lambert Conformal Conic map projection with the following parameters:

- First True Latitude (Alpha): 33°N
- Second True Latitude (Beta): 45°N
- Central Longitude (Gamma): 97°W
- Projection Origin: (97°W, 40°N)
- Spheroid: Perfect Sphere, Radius = 6,370 km

All future TCEQ photochemical model emissions processing work will be based on this grid system.



Figure 4-1: Location of CAPCOG counties plus Milam County



Plot Date: Dec. 19, 2012  
Map Compilation: Dec. 19, 2012

## 5. Methodology

Due to the abundance of limestone, aggregate, granite, sand, gravel, and coal deposits, there are numerous quarries and mines in the CAPCOG region and Milam County. Large diesel non-road equipment is used to extract and haul deposits from these sites. Emissions were calculated for the following diesel quarry equipment:

- Rollers
- Scrapers
- Bore/Drill Rigs
- Excavators
- Cranes
- Graders
- Rock Trucks
- Water Trucks
- Vacuum Trucks
- Rock Processing Equipment
- Loaders
- Backhoes
- Dozers
- Aerial Lifts
- Tractors
- Other Construction Equipment

Equipment population counts from aerial imagery and data from the 2011 quarry survey in the San Antonio region<sup>4</sup> were used to calculate emissions from quarry and mining non-road equipment. The following steps were used to calculate emissions:

1. Identify and count equipment using available aerial imagery of quarries and mines
2. Determine equipment population for quarry sites without aerial imagery.
3. Apply horsepower and activity rates results from the San Antonio survey to quarry and mining non-road equipment in CAPCOG and Milam County.
4. Calculate ozone precursor emissions using TexN 1.6 Model load and emission factors.
5. Calculate weekly adjustment factor for diesel quarry equipment based on AACOG's 2011 survey.
6. Allocate diesel quarry equipment emissions to the 4km photochemical model grid system.
7. Format 2008 emission inventory results in EPA's NIF format
8. Provide updated data to TCEQ in electronic format that can be readily included in the TexN Model by Diesel Construction Equipment (DCE) subsector.

There are 66 operating quarries and mines in the CAPCOG and Milam counties that are large enough to use heavy construction equipment on a regular basis.

- Bastrop 6 Quarries
- Blanco 0 Quarries
- Burnet 9 Quarries
- Caldwell 0 Quarries
- Fayette 10 Quarries
- Hays 4 Quarries
- Lee 0 Quarries
- Llano 3 Quarries
- Travis 10 Quarries
- Williamson 20 Quarries
- Milam 4 Quarries

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<sup>4</sup> Alamo Area Council of Governments, July 1<sup>st</sup>, 2012. "Non-Road Emission Inventory Improvements". San Antonio, Texas. Available online: <http://www.aacog.com/DocumentCenter/View/6546>. Accessed 12/27/2012.

### 5.1. Analysis of Aerial Photography

Aerial photographs were studied to provide equipment population counts for quarries and mines in the region. Equipment for each location was identified, marked, and counted on the aerial photographs. For example, the aerial photography of one of the quarries in Travis County shows there were 3 excavators, 1 crane, 3 off-highway rock trucks, and 8 rubber tire loaders in operation. Figure 3-1 shows an example of an aerial photo for a quarry that was used to identify specific equipment. In this aerial photograph, 2 rock trucks, 2 rubber-tire loaders, one backhoe, one tractor, and one rock crusher were identified.

When the counts of non-road equipment were completed, results for quarry and mining equipment were similar for both AACOG and CAPCOG regions (Table 5-1). On average, there were 3.14 pieces of equipment per 10,000 hours of operation in the AACOG region and 3.15 pieces of equipment per 10,000 hours of operation in the CAPCOG region. CAPCOG quarries and mines had more excavators and tractors, while quarries in the AACOG region had more drill rigs and cranes.

Table 5-1: Quarry Equipment Ratio per 10,000 Hours of Operation

Equipment Type	SCC	AACOG Counties	CAPCOG + Milam Counties	Combined
Rollers	2270002015	0.01	0.02	0.02
Scrapers	2270002018	0.05	0.07	0.06
Bore/Drill Rigs	2270002033	0.12	0.04	0.07
Excavators	2270002036	0.25	0.34	0.30
Cranes	2270002045	0.14	0.08	0.11
Graders	2270002048	0.10	0.14	0.13
Off-Road Trucks	2270002051	0.85	0.81	0.82
Water Trucks	2270002051	0.08	0.09	0.09
Rock Crushers/Separators	2270002054	N/A		
Loaders	2270002060	1.10	0.94	1.01
Backhoes	2270002066	0.10	0.11	0.11
Dozers/Tractors	2270002069	0.23	0.21	0.22
Tractors	2270002075	0.00	0.14	0.08
Other Construction Eq.	2270002081	0.00	0.05	0.03
Aerial Lifts	2270003010	0.09	0.11	0.10

N/A – Ratios for Rock Crushers/Separators were not calculated because population counts were only based on data in TCEQ’s permit database

Figure 5-1: Aerial Photography of Quarry Equipment



## 5.2. Determining Equipment Population for Quarry Sites without Local Data

Equipment populations for quarries that did not have aerial imagery were estimated based on the number of hours worked by strip, quarry, and open pit workers reported to the Mine Safety and Health Administration<sup>5</sup>. Aerial imagery was not available for 15 quarries in the CAPCOG region; however they only account for 19% of quarry operating hours (Table 5-2). Most of the quarries without local aerial imagery were small quarries operating in Fayette County.

Table 5-2: Availability of Aerial Imagery for Quarries in CAPCOG and Milam Counties

Data Availability	Number		Operating Hours, 2006	
	n	Percent	n	Percent
Quarries with Aerial Imagery	51	77%	1,790,435	81%
Quarries with no Aerial Imagery	15	23%	413,462	19%
Total	68	100%	2,203,897	100%

A quarry operating hours to equipment ratio was calculated by dividing the total pieces of equipment counted in each category by the operation hours at these quarries for those quarries and mines for which the data was available from surveys and/or aerial photography. The ratio was then used to calculate estimated equipment populations for the remaining quarry sites without aerial imagery. The margin of error per 10,000 operating hours was marginal for those equipment types operating at most quarries: rock trucks and loaders (Table 5-3). Other equipment types have a significant margin of error because they are not located at all quarries: rollers, scrapers, aerial lifts, and drill rigs.

<sup>5</sup> Mine Safety and Health Administration, Dec. 14, 2012. "Mine Data Retrieval System". United States Department of Labor. Available online: <http://www.msha.gov/drs/drshome.htm>. Accessed 12/18/2012.

Table 5-3: Quarry Equipment Ratio Statistics (AACOG, CAPCOG, and Milam counties combined)\*

Equipment Type	SCC	n	Standard Deviation	Low	Mean	High	Margin of Error	
Rollers	2270002015	6	0.15	-0.10	0.02	0.14	0.12	
Scrapers	2270002018	19	0.16	-0.01	0.06	0.14	0.07	
Bore/Drill Rigs	2270002033	22	0.18	0.00	0.07	0.15	0.07	
Excavators	2270002036	88	0.49	0.19	0.30	0.40	0.10	
Cranes	2270002045	33	0.31	0.01	0.11	0.21	0.10	
Graders	2270002048	38	0.35	0.02	0.13	0.24	0.11	
Off-Road Trucks	2270002051	248	1.17	0.69	0.83	0.98	0.15	
Water Trucks	2270002051	27	0.24	0.00	0.09	0.18	0.09	
Rock Crushers/Separators	2270002054	30	N/A					
Loaders	2270002060	298	1.14	0.87	1.00	1.13	0.13	
Backhoes	2270002066	32	0.27	0.01	0.11	0.20	0.09	
Dozers/Tractors	2270002069	65	0.35	0.13	0.22	0.30	0.09	
Tractors	2270002075	22	0.12	0.02	0.07	0.12	0.05	
Other Construction Eq.	2270002081	7	0.08	-0.03	0.02	0.08	0.06	
Aerial Lifts	2270003010	30	0.32	-0.01	0.10	0.22	0.12	

\*Only for Quarries with more than 10,000 quarry hours

N/A - Rock Crushers and separators population counts came only from TCEQ permit database

Equation 5-1 documents the formula used to determine the equipment ratio per 10,000 work hours, while Equation 5-2 was used to calculate equipment counts at quarries without aerial imagery. Although there is a large margin of error for some of the equipment that is not used by all quarries, the calculated ratios are only used for the 15 quarries that did not have aerial imagery.

Equation 5-1, Equipment to hours ratio for quarries without local data

$$HRATIO_A = EP_A / \text{Hours} \times 10,000 \text{ hours}$$

Where,

- HRATIO<sub>A</sub> = Equipment to hours operated ratio for equipment type A
- EP<sub>A</sub> = Equipment population for equipment type A (from survey data in the AACOG region and aerial imagery in both CAPCOG and AACOG regions)
- Hours = Number of hours worked by strip, quarry, and open pit workers in AACOG, CAPCOG, and Milam County for sites with aerial imagery or survey data in 2011<sup>6</sup>, 3,032,600 (from Mine Safety and Health Administration)

Sample Equation – Equipment to hours operated ratio for loaders

$$\begin{aligned} HRATIO_A &= 307 \text{ loaders} / 3,032,600 \text{ hours} \times 10,000 \text{ hours} \\ &= 1.01 \text{ loaders per } 10,000 \text{ hours of operation} \end{aligned}$$

Equation 5-2, Equipment population at each quarry without local data

$$POP_{AB} = EMP_A \times HRATIO_A / 10,000 \text{ hours}$$

Where,

- POP<sub>AB</sub> = Estimated population of equipment for equipment type A at quarry B
- EMP<sub>B</sub> = Number of hours worked by strip, quarry, and open pit workers at quarry B in 2006 or 2008 (from Mine Safety and Health Administration)
- HRATIO<sub>A</sub> = Equipment to hours operated ratio for equipment type A (from equation 3-2 provided in Table 5-1)

Sample Equation – Number of loaders operating at quarry B

$$\begin{aligned} POP_{AB} &= 36,741 \text{ hours operated by quarry B} \times 1.01 \text{ Rubber Tire Loaders} / 10,000 \text{ hours} \\ &= 4 \text{ loaders at quarry B} \end{aligned}$$

Quarry and mining equipment counts for the CAPCOG plus Milam County region and a comparison to the TexN Model 1.6 default data is provided in Table 5-4. Aerial imagery indicates that population counts for several equipment types were lower, than the default equipment settings in the TexN Model. Specifically, there were fewer excavators, graders, loaders, and dozers operating at quarries and mines in the CAPCOG and Milam County regions than listed in the model. Some of the less common equipment types, bore drill rigs, cranes, aerial lifts, tractors, and rock processing equipment, are not reported in the mining and quarry DCE subsector of the model and some of the default equipment populations are set at zero.

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<sup>6</sup> Note: 2011 employment data was used because 2011 aerial imagery was used to count equipment population

Table 5-4: Quarry Equipment Counts for the CAPCOG counties plus Milam County

Equipment Type	SCC	TexN Model DCE #23 Mining & Quarry (2006)	CAPCOG 2006	CAPCOG 2008
Rollers	2270002015	*	5	5
Scrapers	2270002018	33	15	16
Bore/Drill Rigs	2270002033	*	9	9
Excavators	2270002036	120	78	79
Cranes	2270002045	*	19	19
Draglines	0000000000	*	2	2
Graders	2270002048	51	32	32
Rock Trucks	2270002051	200	178	181
Water Trucks	2270002051		20	21
Rock Proc. Eq.	2270002054	0	13	13
Loaders	2270002060	359	224	228
Backhoes	2270002066	18	23	23
Dozers	2270002069	133	49	50
Aerial Lifts	2270003010	*	24	24
Tractors	2270002075	*	29	29
Other Construction Eq.	2270002081	*	9	9

\*Not included in the DCE #23 Mining & Quarry subsector and the TexN Model does not break down bore/drill rigs and cranes into individual DCE subsectors

As shown in Table 5-5 and Table 5-6, Williamson County had the largest population of quarry equipment followed by Travis and Burnet Counties. Significant numbers of quarry and mining equipment also operate in Hays, Fayette, and Milam counties, while there was no quarry or mining equipment operating in Blanco and Caldwell counties. Overall there were 730 pieces of quarry and mining equipment operating in 2006, and 741 pieces of quarry and mining equipment operating in 2008.



Table 5-5: Quarry and Mining Equipment Counts by County, 2006

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0	0	0	0	0	3	0	0	0	0	1	5
Scrapers	2270002018	0	0	0	0	1	2	6	0	1	4	1	15
Bore/Drill Rigs	2270002033	0	0	1	0	1	3	0	0	1	2	0	9
Excavators	2270002036	8	0	11	0	5	4	0	0	29	19	2	78
Cranes	2270002045	1	0	6	0	2	3	0	0	3	2	2	19
Draglines	0000000000	1	0	0	0	0	0	1	0	0	0	0	2
Graders	2270002048	1	0	4	0	2	4	2	0	10	7	1	32
Rock Trucks	2270002051	9	0	34	0	14	13	7	0	41	47	13	178
Water Trucks	2270002051	0	0	2	0	2	2	4	0	2	6	2	20
Rock Proc. Eq.	2270002054	1	0	2	0	0	2	0	0	4	1	3	13
Loaders	2270002060	10	0	40	0	18	20	4	3	54	65	11	224
Backhoes	2270002066	0	0	2	0	2	6	0	0	4	6	3	23
Dozers	2270002069	5	0	5	0	4	1	9	0	11	11	4	49
Aerial Lifts	2270003010	0	0	2	0	2	2	1	1	3	9	4	24
Tractors	2270002075	11	0	0	0	1	2	2	0	10	1	1	29
Other Construction Eq.	2270002081	2	0	1	0	0	2	2	0	1	0	0	9
<b>Total</b>		<b>36</b>	<b>0</b>	<b>109</b>	<b>0</b>	<b>52</b>	<b>63</b>	<b>33</b>	<b>3</b>	<b>160</b>	<b>170</b>	<b>43</b>	<b>730</b>

Table 5-6: Quarry and Mining Equipment Counts by County, 2008

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0	0	0	0	0	3	0	0	0	0	1	5
Scrapers	2270002018	0	0	0	0	1	2	6	0	1	4	1	16
Bore/Drill Rigs	2270002033	0	0	1	0	1	3	0	0	1	2	0	9
Excavators	2270002036	8	0	11	0	6	4	0	0	29	19	2	79
Cranes	2270002045	1	0	6	0	2	3	0	0	3	2	2	19
Draglines	0000000000	1	0	0	0	0	0	1	0	0	0	0	2
Graders	2270002048	1	0	4	0	3	4	2	0	10	7	1	32
Rock Trucks	2270002051	9	0	34	0	16	13	7	0	41	48	13	181
Water Trucks	2270002051	0	0	2	0	2	2	4	0	2	7	2	21
Rock Proc. Eq.	2270002054	1	0	2	0	0	2	0	0	4	1	3	13
Loaders	2270002060	10	0	39	0	20	20	4	3	54	66	11	228
Backhoes	2270002066	0	0	2	0	2	6	0	0	4	6	3	23
Dozers	2270002069	5	0	5	0	4	1	9	0	11	11	4	50
Aerial Lifts	2270003010	0	0	2	0	2	2	1	1	3	9	4	24
Tractors	2270002075	11	0	0	0	2	2	2	0	10	1	1	29
Other Construction Eq.	2270002081	2	0	1	0	1	2	2	0	1	0	0	9
<b>Total</b>		<b>36</b>	<b>0</b>	<b>107</b>	<b>0</b>	<b>59</b>	<b>63</b>	<b>33</b>	<b>4</b>	<b>160</b>	<b>174</b>	<b>43</b>	<b>741</b>

### 5.3. Determine Activity Rates and Horsepower for Quarry and Mining Equipment in the CAPCOG region

Quarry and mining equipment activity rates and horsepower are based on a 2011 survey conducted in the AACOG region. Fifteen cement/limestone quarries, seven sand/gravel, and 1 gypsum quarry responded to the survey in the AACOG region. CAPCOG had more Dimension stone compared to the AACOG region (Table 5-7).

Table 5-7: Employment by Mined Material for AACOG and CAPCOG regions, 2011

Mined Material	AACOG Region			CAPCOG & Milam County		
	Number	Hours	Percent	Number	Hours	Percent
Cement/Limestone/Lime	35	1,319,703	54%	22	545,861	25%
Sand/Gravel	19	566,485	23%	23	688,779	31%
Dimension Stone	9	66,225	3%	15	523,981	24%
Coal	1	480,243	20%	1	425,503	19%
Clay	1	5,477	0%	5	19,776	1%
Gypsum	1	19,529	1%	0	0	0%
<b>Total</b>	<b>66</b>	<b>2,457,663</b>	<b>100%</b>	<b>66</b>	<b>2,203,900</b>	<b>100%</b>

Table 5-8 shows that most quarry and mining equipment, such as scrapers, bore/drill rigs, graders, rock trucks, and loaders, operate longer hours at regional quarries than what is reported in the TexN Model. Several equipment types operating at Austin area quarries are not included in DCE subsector #23 for mining and quarries including rollers, rock processing equipment, aerial lifts, and tractors. Data on tractors and other construction equipment operating at quarries and mines in the Austin region were not available from the AACOG survey. Consequently, activity rates and horsepower from the TexN model were used to calculate emissions for tractors and other construction equipment.

Table 5-9 lists the reported horsepower for quarry equipment from AACOG's 2011 survey and previous emission inventories. Horsepower ratings for bore/drill rigs, rock trucks and dozers were found to be higher than results from previous studies and existing data in the TexN Model, while horsepower ratings for graders were lower. Horsepower data for excavator were significantly lower than previous studies, except for results documented by ERG in their 2009 equipment analysis for Texas.<sup>7</sup>

<sup>7</sup> Eastern Research Group Inc., July 31, 2009. "Update of Diesel Construction Equipment Emission Estimates for the State of Texas – Phase I and II". Austin, Texas. Prepared for: The Texas Commission on Environmental Quality. p. 3-7. Available online: [http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/20090731-ergi-DCE\\_EI\\_Update.pdf](http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/20090731-ergi-DCE_EI_Update.pdf). Accessed 11/02/2011.

Table 5-8: Estimated Hours of Operation by Equipment Type for Quarries and Mines from Previous Studies

Equipment Type	SCC	NONROAD 2008a Model	TexN Model (#23 Mining & Quarry when available)	ERG's 2005 Dallas Study <sup>8</sup>	ERG's 2009 Texas Study	AACOG 2005 <sup>9</sup>	<b>AACOG 2011</b>
Rollers	2270002015	760	-	-	20	-	<b>2,088</b>
Scrapers	2270002018	914	957	-	957	2,208	<b>1,813</b>
Bore/Drill Rigs	2270002033	466	466	-	-	466	<b>1,715</b>
Excavators	2270002036	1,092	1,593	1,600	1,593	1,092	<b>1,626</b>
Cranes	2270002045	990	990	-	-	990	<b>1,017</b>
Graders	2270002048	962	422	500	422	1,135	<b>762</b>
Rock Trucks	2270002051	1,641	1,551	2,333	1,551	2,051	<b>2,288</b>
Water Trucks	2270002051	1,641	-	-	-	-	<b>1,780</b>
Rock Proc. Eq.	2270002054	955	-	-	1,102	-	1,193
Loaders	2270002060	761	1,974	3,314	1,974	1,665	<b>2,377</b>
Backhoes	2270002066	1,135	1,566	500	1,566	1,172	<b>814</b>
Bulldozers	2270002069	936	1,897	3,314	1,897	1,467	<b>1,713</b>
Aerial Lifts	2270003010	384	-	-	-	-	<b>1,364</b>
Tractors	2270002075	855	<b>855</b>	-	-	-	-
Other Construction Eq.	2270002081	606	<b>606</b>	-	-	-	-

**Bolded** values indicate the results used for CAPCOG and Milam County

<sup>8</sup> Eastern Research Group Inc., August 31, 2005. "Ozone Science and Air Modeling Research Project H43T163: Diesel Construction Equipment Activity and Emissions Estimates for the Dallas/Ft. Worth Region". Austin, Texas. Prepared for: The Houston Advanced Research Center. p. 5-38. Available online: <http://files.harc.edu/Projects/AirQuality/Projects/H043.T163/H43.T163FinalReport.pdf>. Accessed 11/02/2011.

<sup>9</sup> Note: A previous survey was also performed in the AACOG region in 2005.

Table 5-9: Estimated Average HP by Equipment Type for Quarries from Previous Studies

Equipment Type	SCC	NONROAD 2008a Model	TexN Model (#23 Mining & Quarry when available)	ERG's 2001 Austin Study <sup>10</sup>	ERG's 2005 Dallas Study <sup>11</sup>	ERG's 2009 Texas Study <sup>12</sup>	AACOG 2005	AACOG 2011
Rollers	2270002015	92	-	-	-	150	-	<b>110</b>
Scrapers	2270002018	409	426	250	-	363	250	<b>315</b>
Bore/Drill Rigs	2270002033	176	176	-	-	-	176	<b>269</b>
Excavators	2270002036	171	500	500	300-600	246	500*	<b>231</b>
Cranes	2270002045	231	230	-	-	-	231	<b>200</b>
Graders	2270002048	204	200	200	100-175	160	200*	<b>142</b>
Rock Trucks	2270002051	783	411	400	454	353	408	<b>529</b>
Water Trucks	2270002051	783	-	-	-	-	-	<b>304</b>
Rock Proc. Eq.	2270002054	153	-	-	-	319	-	369
Loaders	2270002060	243	395	500	575	280	394	<b>382</b>
Backhoes	2270002066	93	80	80	50-75	73	80*	<b>97</b>
Dozers	2270002069	260	250	250	-	241	400	<b>483</b>
Aerial Lifts	2270003010	49	-	-	-	-	-	<b>59</b>
Tractors	2270002075	725	<b>725</b>	-	-	-	-	-
Other Construction Eq.	2270002081	328	<b>218</b>	-	-	-	-	-

\*Based on ERG's 2001 Austin Study

**Bolded** values indicate the results used for CAPCOG and Milam County

<sup>10</sup> Eastern Research Group Inc., November 30, 2001. "Diesel Construction Equipment Emissions in the Austin Region, Draft 1.4". Texas. p.15.

<sup>11</sup> Eastern Research Group Inc., August 31, 2005. "Ozone Science and Air Modeling Research Project H43T163: Diesel Construction Equipment Activity and Emissions Estimates for the Dallas/Ft. Worth Region". Austin, Texas. Prepared for: The Houston Advanced Research Center. p. 5-38. Available online: <http://files.harc.edu/Projects/AirQuality/Projects/H043.T163/H43.T163FinalReport.pdf>. Accessed 11/02/2011.

<sup>12</sup> Eastern Research Group Inc., July 31, 2009. "Update of Diesel Construction Equipment Emission Estimates for the State of Texas – Phase I and II". Austin, Texas. Prepared for: The Texas Commission on Environmental Quality. p. 3-7. Available online: [http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/20090731-ergi-DCE\\_EI\\_Update.pdf](http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/20090731-ergi-DCE_EI_Update.pdf). Accessed 11/02/2011.

The most common equipment types at quarries are front end loaders and rock trucks, followed by excavators and dozers. To determine the error bounds of quarry equipment survey results, an analysis of activity and horsepower responses was conducted. A 95% level of confidence ( $p = 0.05$ ) was used for equipment types with 5 or more observations in Table 5-10. The results assume that the means are normally distributed. The most common equipment types reported had the lowest percent margin of error for activity rates and horsepower. Loaders and rock trucks had the lowest percent margin of error because they are used by most quarries: less than 9% for both activity and horsepower. Other common equipment types, dozers and excavator also had a low percent margin of error. Equipment that had a high margin of error for activity rates, bore drill rigs, cranes, graders, and aerial lifts, are only operated at a few quarries. Equipment horsepower can vary greatly even at the same quarry depending on the need and what equipment is available at the time.

Table 5-10: Confidence Interval at 95% for Quarry Equipment from AACOG's 2011 Survey

Equipment Type	SCC	Parameter	n	Mean	+ / -	Percent of Mean
Bore/Drill Rigs	2270002033	Hours/Year	7	1,715	620	36.2%
		Horsepower	7	269	12	4.4%
Excavators	2270002036	Hours/Year	17	1,626	323	19.9%
		Horsepower	16	231	40	17.2%
Cranes	2270002045	Hours/Year	8	1,017	359	35.3%
		Horsepower	8	200	44	21.8%
Graders	2270002048	Hours/Year	11	762	431	56.5%
		Horsepower	10	142	17	12.2%
Rock trucks	2270002051	Hours/Year	71	2,288	171	7.5%
		Horsepower	63	529	46	8.8%
Water Trucks	2270002051	Hours/Year	10	1,780	474	26.6%
		Horsepower	10	304	76	24.8%
Loaders	2270002060	Hours/Year	90	2,377	191	8.0%
		Horsepower	77	382	28	7.2%
Backhoes	2270002066	Hours/Year	18	814	161	19.7%
		Horsepower	12	97	28	29.5%
Dozers	2270002069	Hours/Year	26	1,713	310	18.1%
		Horsepower	23	483	81	16.8%
Aerial Lifts	2270003010	Hours/Year	7	1,364	765	56.0%
		Horsepower	7	59	16	27.6%

Survey responses for annual hours (Table 5-11) and horsepower (Table 5-12) were compared between Cement/Limestone and Sand/Gravel quarries. Annual hours were similar for excavators, graders, and backhoes between the two types of quarries. However, annual hours were higher for rock trucks, loaders, and dozers for cement/limestone quarries. Similarly, rock trucks, loaders, and dozer operating at cement/limestone quarries have higher horsepower than at sand/gravel quarries. While the CAPCOG region has a significant number of dimension stone quarries, no dimensional stone quarries responded to the 2011 survey in the AACOG region.

Table 5-11: Annual Hours Confidence Interval at 95% from AACOG's 2011 Survey for Cement and Sand Quarries

Equipment Type	SCC	Type	Percentage of Quarries with Equipment Type <sup>13</sup>	n	Mean	+ / -	Percent of Mean
Bore/Drill Rigs	2270002033	Cement/Limestone	54%	6	1,827	686	37.6%
		Sand/Gravel	N/A	1	1,044	N/A	N/A
Excavators	2270002036	Cement/Limestone	79%	12	1,653	373	22.6%
		Sand/Gravel	42%	3	1,474	N/A	N/A
Cranes	2270002045	Cement/Limestone	40%	7	1,088	383	35.2%
		Sand/Gravel	N/A	1	522	N/A	N/A
Graders	2270002048	Cement/Limestone	62%	6	805	600	74.5%
		Sand/Gravel	54%	4	822	N/A	N/A
Rock trucks	2270002051	Cement/Limestone	96%	55	2,443	142	5.8%
		Sand/Gravel	90%	14	1,668	567	34.0%
Water Trucks	2270002051	Cement/Limestone	57%	8	1,918	369	19.2%
		Sand/Gravel	N/A	1	104	N/A	N/A
Loaders	2270002060	Cement/Limestone	100%	70	2,570	173	6.8%
		Sand/Gravel	100%	18	1,748	549	31.4%
Backhoes	2270002066	Cement/Limestone	83%	13	755	175	23.2%
		Sand/Gravel	35%	5	969	351	36.2%
Dozers	2270002069	Cement/Limestone	90%	19	1,944	325	16.7%
		Sand/Gravel	85%	6	1,052	623	59.2%
Aerial Lifts	2270003010	Cement/Limestone	38%	7	1,364	765	56.0%
		Sand/Gravel	0%	0	-	N/A	N/A

N/A = Not Applicable for results with less than 5 responses

<sup>13</sup> Based on the number of hours worked by strip, quarry, and open pit workers for the quarries that responded to AACOG's survey

Table 5-12: Horsepower Confidence Interval at 95% from AACOG's 2011 Survey for Cement and Sand Quarries

Equipment Type	SCC	Type	Percentage of Quarries with Equipment Type	n	Mean	+ / -	Percent of Mean
Bore/Drill Rigs	2270002033	Cement/Limestone	54%	6	274	8	3.0%
		Sand/Gravel	N/A	1	240	N/A	N/A
Excavators	2270002036	Cement/Limestone	79%	12	228	39	17.0%
		Sand/Gravel	42%	2	213	N/A	N/A
Cranes	2270002045	Cement/Limestone	40%	7	185	38	20.8%
		Sand/Gravel	N/A	1	300	N/A	N/A
Graders	2270002048	Cement/Limestone	62%	5	158	23	14.6%
		Sand/Gravel	54%	4	133	N/A	N/A
Rock trucks	2270002051	Cement/Limestone	96%	52	566	48	8.5%
		Sand/Gravel	90%	9	317	74	23.3%
Water Trucks	2270002051	Cement/Limestone	57%	8	327	88	26.9%
		Sand/Gravel	N/A	1	225	N/A	N/A
Loaders	2270002060	Cement/Limestone	100%	67	400	28	7.1%
		Sand/Gravel	100%	8	235	49	20.6%
Backhoes	2270002066	Cement/Limestone	83%	10	100	34	34.1%
		Sand/Gravel	35%	2	80	N/A	N/A
Dozers	2270002069	Cement/Limestone	90%	18	546	76	13.9%
		Sand/Gravel	85%	4	220	N/A	N/A
Aerial Lifts	2270003010	Cement/Limestone	38%	7	59	16	27.6%
		Sand/Gravel	0%	0	-	N/A	N/A

N/A = Not Applicable for results with less than 5 responses



Several quarries have a rock crusher and/or a rock separator located on site, but most rock processing equipment are electric. However, there are several diesel powered rock crushers and separators operating at quarries in rural areas. TCEQ's permit database identified 13 diesel powered rock processors at quarries in the CACPOG region and Milam County. The point source emission inventory was also checked to make sure emissions from rock processing equipment was not double counted.

There are 2 draglines operating at the Three Oaks Mine in Milam County. Dragline 79 and Dragline 80 have 102 and 115 cubic yard capacity. Both draglines are electric<sup>14</sup> and are not included in the emission inventory because they do not emit ozone precursor emissions from combustion engines.

#### 5.4. Calculate Ozone Precursor Emissions

The methodology used to estimate quarry and mining non-road equipment emissions incorporated information on horsepower and activity data extracted from the 2011 survey in the AACOG region and equipment population counts from aerial imagery. Existing data in the TexN Model 1.6 was updated with AACOG survey responses (Table 5-13) to estimate load and emission factors. The TexN Model run specifications were:

- Analysis Year = 2006 and 2008
- Max Tech. Year = 2006 and 2008
- Met Year = Typical Year
- Period = Ozone Season Day (OSD)
- Summation Type = Typical Day, Weekday
- Post Processing Adjustments = All
- Rules Enabled = All
- Regions = Travis County
- Sources = Diesel construction equipment

All current federal and state regulations are taken into account when calculating emissions. Horsepower and activity rates in the TexN model were updated with survey data from the AACOG region. A detailed list of the updates to TexN model horsepower bins are provided in Appendix C. VOC, NO<sub>x</sub>, and CO emissions for 2006 and 2008 were calculated using the formula provided below.

Equation 5-3, Emissions from quarry or mining diesel equipment

$$QDE_A = (EP_A \times HRS_A \times HP_A \times LF_A \times EF_A) / 907,184.74 \text{ grams/ton} / 365 \text{ days/year}$$

Where:

- QDE<sub>A</sub> = Emissions for equipment type A, tons of NO<sub>x</sub>, VOC, or CO per ozone season day
- EP<sub>A</sub> = Equipment population for equipment type A (from aerial imagery or Equation 5-2)
- HRS<sub>A</sub> = Annual hours of operation for equipment type A (from AACOG's 2011 survey)
- HP<sub>A</sub> = Average rated horsepower for equipment type A (from AACOG's 2011 survey)
- LF<sub>A</sub> = Typical load factor for equipment type A (from TexN Model, Table 5-13)

<sup>14</sup> US Army Corps of Engineers, Fort Worth District, May 2003. "Three Oaks Mine, Final Impact Statement Volume I". Fort Worth Texas. p. 2-32. Available online: <http://media.swf.usace.army.mil/pubdata/notices/3oakpdf/Voll-sec1-beginning-pg3-22.pdf>. Accessed 12/27/2012.

$EF_A$  = NO<sub>x</sub>, VOC, or CO emission factor for equipment type A (from TexN Model, Table 5-13)

Sample equation – ozone season day 2006 NO<sub>x</sub> emissions for front end loaders operating at a quarry in Hays County

$$\begin{aligned} QDE_A &= (3 \text{ loaders} \times 2,377 \text{ hours for each loader} \times 382 \text{ hp} \times 0.59 \times 3.829 \text{ grams of NO}_x \\ &\text{per hour}) / 907,184.74 \text{ grams/ton} / 365 \text{ days/year} \\ &= 0.01861 \text{ tons of NO}_x \text{ per ozone season day} \end{aligned}$$

Figure 5-2 and Figure 5-3 provide emission results by equipment type for 2006 and 2008, while Figure 5-4 and Figure 5-5 show emission totals by county. Ozone season day 2006 emissions from quarry and mining equipment were 0.252 tons of VOC, 4.028 tons of NO<sub>x</sub>, and 1.626 tons of CO in the CAPCOG and Milam County region. In 2008, there were 0.233 tons of VOC, 3.505 tons of NO<sub>x</sub>, and 1.564 tons of CO in the CAPCOG and Milam County region from quarry and mining non-road equipment.

Emissions are dominated by rock trucks and loaders, while rock processing equipment, dozers, and excavators are also significant emission sources. As expected, Williamson and Travis Counties had the highest quarry and mining non-road equipment emissions followed by Burnet, Hays, and Fayette Counties. Detailed lists of emissions by county and equipment type are provided in Appendix A for 2006 and Appendix B for 2008.

Future work on quarry and mining equipment can include using a two part survey similar to the one used in the AACOG region to update equipment populations, horsepower, and activity rates in the CAPCOG and Milam county region. A survey will also provide an improved estimation of emissions from rock processing equipment. The current methodology uses data from the TCEQ permit database and emissions may be over estimated.

### 5.1. Temporal Allocation

A weekday versus weekend adjustment factor was calculated based on the total hours of equipment operation for each time period from AACOG's 2011 survey. Weekend average activity hours are 29.6 percent of weekday average activity hours. The Emissions Preprocessor System (EPS3) TMPRL inputs used for the photochemical model were updated accordingly.

### 5.2. Spatial Allocation of Emissions

Emissions were spatially allocated to the 4-km photochemical grid system used in the June 2006 photochemical model. Emissions were geo-coded to the location of quarries identified through TCEQ Permits<sup>15</sup>, Mineral Locations Database<sup>16</sup>, Find the Best directory<sup>17</sup>, and aerial photographs. All 2006 and 2008 emissions were converted to AFS formatting used by EPS3, and 2008 emissions were also converted to EPA's NIF formatting.

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<sup>15</sup> TCEQ. Permit Database". Austin Texas. Available online: <https://webmail.tceq.state.tx.us/gw/webpub>. Accessed 12/20/2012.

<sup>16</sup> MineralMundi. "Mineral Locations Database". United States Geological Survey Mineral Resources Program. Available online: <http://www.mineralmundi.com/texas.htm>. Accessed 12/20/2012.

<sup>17</sup> Find the Best, 2011. "Texas Active Mines". Available online: <http://active-mines.findthebest.com/directory/d/Texas>. Accessed 12/20/2012.

Table 5-13: CAPCOG counties plus Milam County 2006 and 2008 Emission Factors for Construction Equipment from the TexN Model (g/hp-hr)

Equipment Type	SCC	Load Factor	2006			2008		
			VOC	NO <sub>x</sub>	CO	VOC	NO <sub>x</sub>	CO
Rollers	2270002015	0.59	0.378	3.679	1.419	0.304	3.045	1.431
Scrapers	2270002018	0.59	0.210	3.795	1.608	0.195	3.178	1.473
Bore/Drill Rigs	2270002033	0.43	0.318	3.997	0.817	0.278	3.337	0.801
Excavators	2270002036	0.59	0.283	3.748	1.451	0.247	3.134	1.381
Cranes	2270002045	0.43	0.382	4.638	1.106	0.334	4.071	0.984
Graders	2270002048	0.59	0.415	4.455	1.777	0.358	3.908	1.557
Rock Trucks	2270002051	0.59	0.226	3.958	1.622	0.210	3.390	1.551
Water Trucks	2270002051	0.59	0.239	3.740	1.515	0.214	3.126	1.413
Rock Proc. Eq.	2270002054	0.43	0.276	4.420	1.174	0.243	3.782	1.053
Loaders	2270002060	0.59	0.239	3.829	1.534	0.218	3.203	1.475
Backhoes	2270002066	0.21	1.799	6.670	7.686	1.659	6.257	7.391
Dozers	2270002069	0.59	0.250	4.070	1.561	0.223	3.492	1.426
Tractors	2270002075	0.59	0.462	5.289	2.988	0.383	4.762	2.562
Other Construction Eq.	2270002081	0.59	0.729	8.010	4.728	0.558	6.383	3.667
Aerial Lifts	2270003010	0.21	1.750	7.336	7.754	1.598	6.749	7.405

Figure 5-2: Diesel Quarry and Mining Equipment Emissions by Equipment Type, Tons per Ozone Season Day, 2006

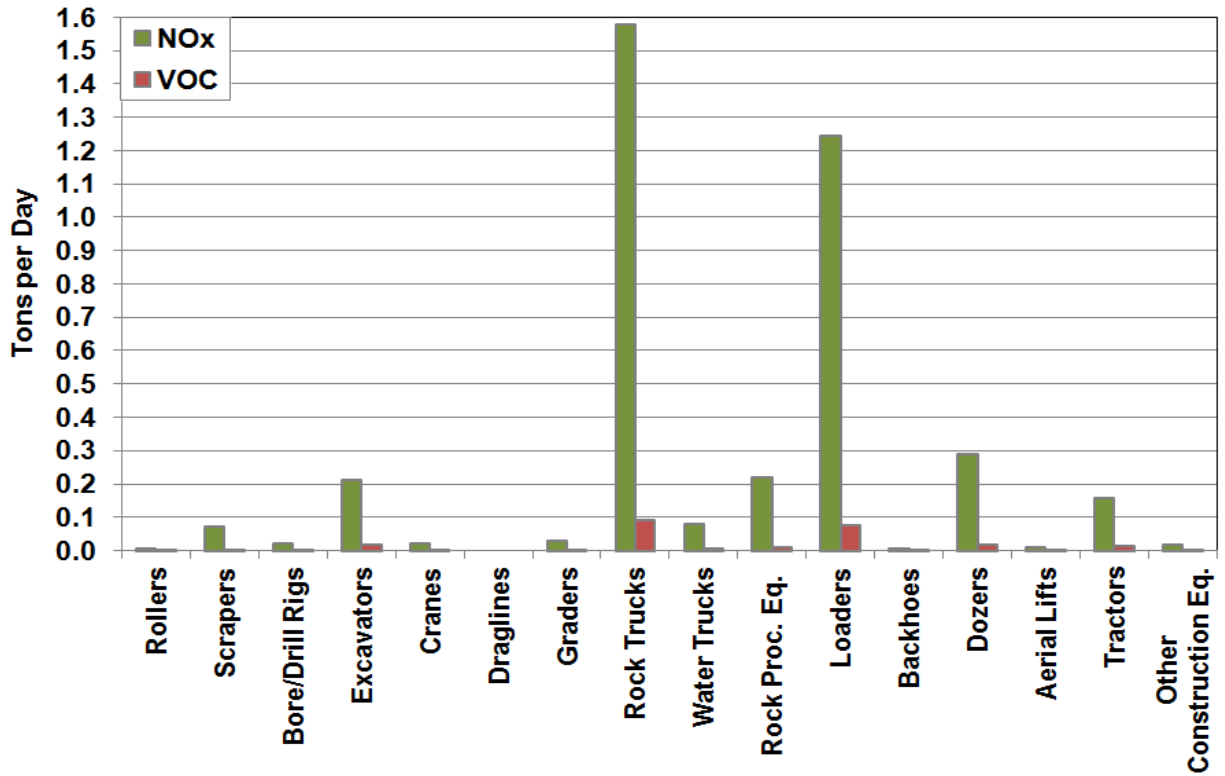


Figure 5-3: Diesel Quarry and Mining Equipment Emissions by Equipment Type, Tons per Ozone Season Day, 2008

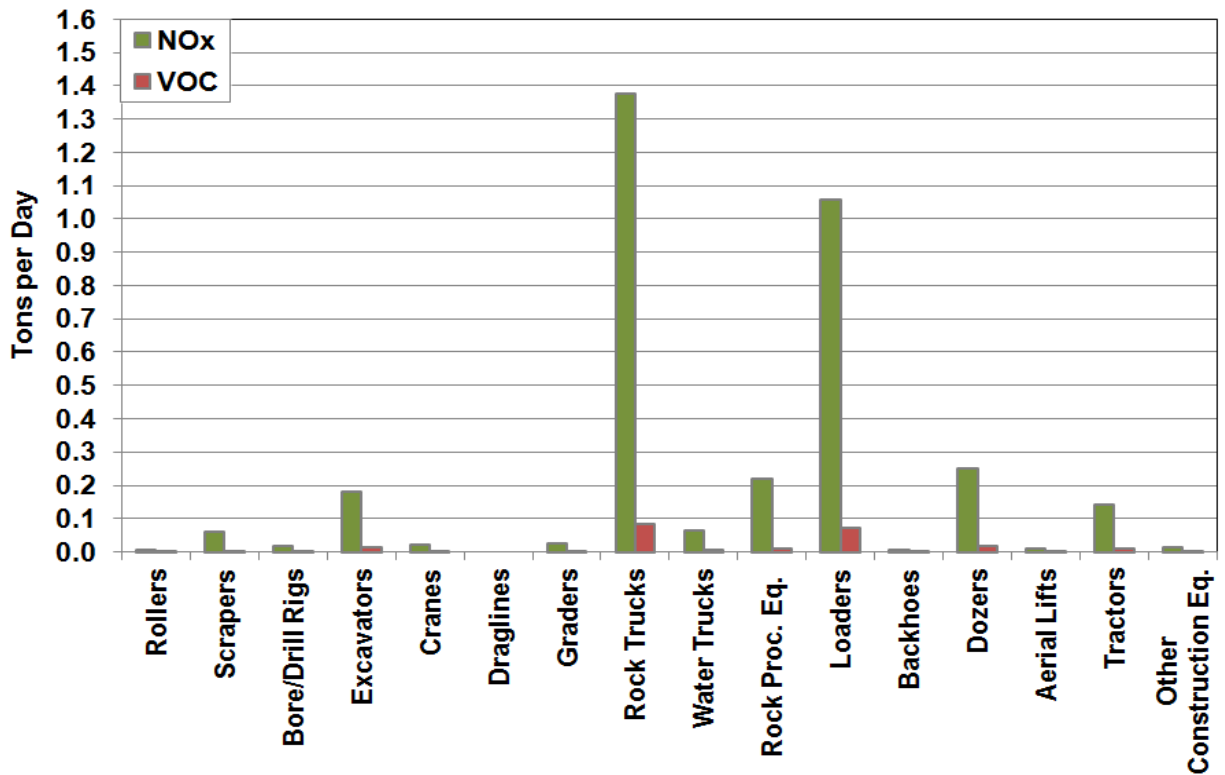


Figure 5-4: Diesel Quarry and Mining Equipment Emissions by County, Tons per Ozone Season Day, 2006

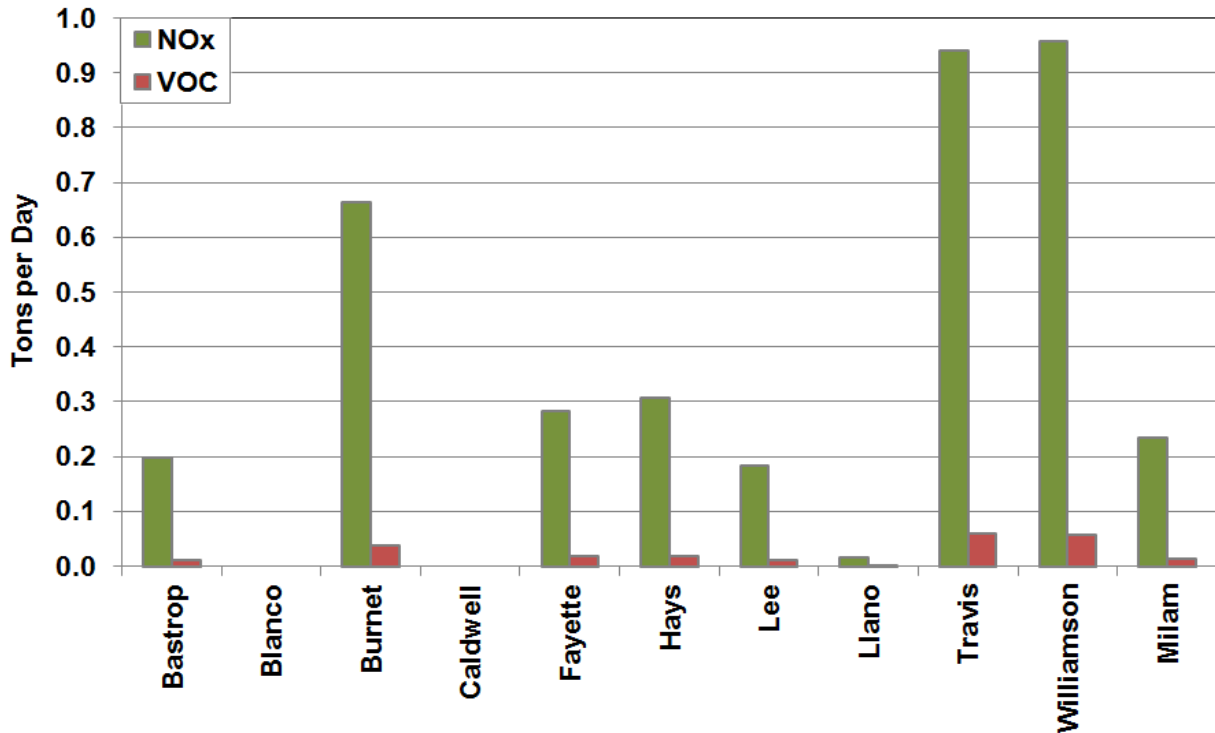
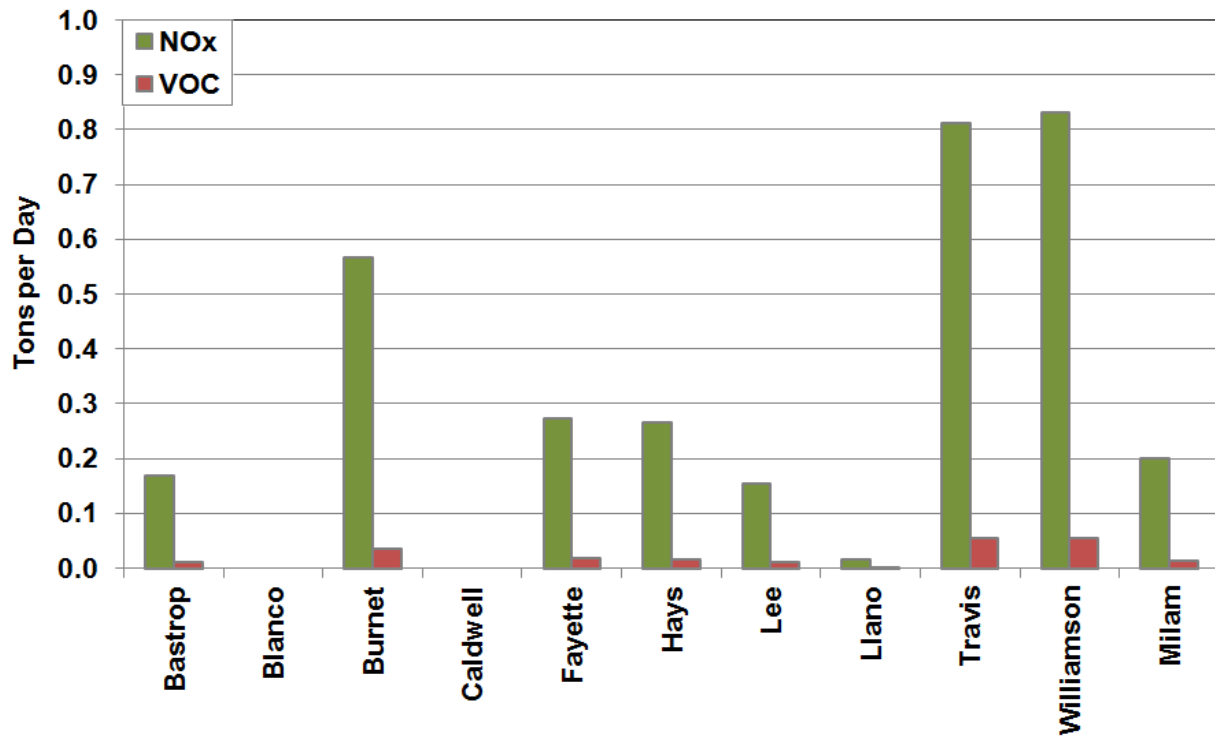


Figure 5-5: Diesel Quarry and Mining Equipment Emissions by County, Tons per Ozone Season Day, 2008



## A. Appendix A: Quarry and Mining Equipment Emissions by County, 2006

Table A-1: Annual Quarry and Mining Equipment VOC Emissions by County, 2006 (Tons/Year)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.00	0.00	0.00	0.00	0.02	0.17	0.00	0.00	0.00	0.02	0.06	0.27
Scrapers	2270002018	0.00	0.00	0.02	0.00	0.09	0.16	0.47	0.00	0.08	0.31	0.08	1.20
Bore/Drill Rigs	2270002033	0.00	0.00	0.09	0.00	0.09	0.21	0.00	0.00	0.07	0.15	0.00	0.61
Excavators	2270002036	0.55	0.00	0.77	0.00	0.36	0.28	0.00	0.00	2.00	1.31	0.14	5.41
Cranes	2270002045	0.04	0.00	0.24	0.00	0.07	0.11	0.00	0.00	0.11	0.07	0.07	0.70
Draglines	0000000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Graders	2270002048	0.03	0.00	0.13	0.00	0.06	0.12	0.06	0.00	0.29	0.21	0.03	0.92
Rock Trucks	2270002051	1.60	0.00	6.06	0.00	2.58	2.31	1.25	0.00	7.30	8.30	2.31	31.71
Water Trucks	2270002051	0.00	0.00	0.20	0.00	0.13	0.17	0.34	0.00	0.17	0.54	0.17	1.71
Rock Proc. Eq.	2270002054	0.01	0.00	0.42	0.00	0.00	0.16	0.00	0.00	3.18	0.09	0.16	4.03
Loaders	2270002060	1.41	0.00	5.61	0.00	2.51	2.83	0.57	0.42	7.63	9.14	1.55	31.69
Backhoes	2270002066	0.00	0.00	0.08	0.00	0.06	0.20	0.00	0.00	0.13	0.19	0.10	0.75
Dozers	2270002069	0.67	0.00	0.64	0.00	0.51	0.13	1.21	0.00	1.48	1.42	0.54	6.61
Aerial Lifts	2270003010	0.00	0.00	0.08	0.00	0.06	0.07	0.03	0.03	0.10	0.29	0.13	0.78
Tractors	2270002075	2.05	0.00	0.02	0.00	0.11	0.37	0.37	0.00	1.86	0.10	0.19	5.07
Other Construction Eq.	2270002081	0.13	0.00	0.07	0.00	0.02	0.13	0.13	0.00	0.06	0.02	0.00	0.54
<b>Total</b>		<b>4.31</b>	<b>0.00</b>	<b>14.26</b>	<b>0.00</b>	<b>6.50</b>	<b>6.84</b>	<b>3.88</b>	<b>0.42</b>	<b>22.44</b>	<b>21.75</b>	<b>5.21</b>	<b>92.00</b>

Table A-2: Annual Quarry and Mining Equipment NO<sub>x</sub> Emissions by County, 2006 (Tons/Year)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.00	0.00	0.04	0.00	0.19	1.65	0.00	0.00	0.00	0.18	0.55	2.61
Scrapers	2270002018	0.00	0.00	0.32	0.00	1.55	2.82	8.46	0.00	1.41	5.69	1.41	21.65
Bore/Drill Rigs	2270002033	0.00	0.00	1.11	0.00	1.12	2.62	0.00	0.00	0.87	1.92	0.00	7.65
Excavators	2270002036	7.31	0.00	10.15	0.00	4.82	3.66	0.00	0.00	26.51	17.33	1.83	71.61
Cranes	2270002045	0.45	0.00	2.86	0.00	0.85	1.34	0.00	0.00	1.34	0.80	0.89	8.53
Draglines	0000000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Graders	2270002048	0.31	0.00	1.40	0.00	0.69	1.25	0.63	0.00	3.13	2.21	0.31	9.93
Rock Trucks	2270002051	28.03	0.00	105.97	0.00	45.12	40.48	21.80	0.00	127.68	145.14	40.48	554.71
Water Trucks	2270002051	0.00	0.00	3.06	0.00	2.06	2.63	5.26	0.00	2.63	8.51	2.63	26.79
Rock Proc. Eq.	2270002054	3.63	0.00	21.48	0.00	0.05	9.75	0.00	0.00	37.90	4.25	4.19	81.26
Loaders	2270002060	22.64	0.00	89.94	0.00	40.29	45.29	9.06	6.79	122.28	146.53	24.91	507.72
Backhoes	2270002066	0.00	0.00	0.29	0.00	0.23	0.73	0.00	0.00	0.49	0.70	0.36	2.79
Dozers	2270002069	10.95	0.00	10.51	0.00	8.38	2.19	19.71	0.00	24.09	23.20	8.76	107.78
Aerial Lifts	2270003010	0.00	0.00	0.33	0.00	0.25	0.28	0.14	0.14	0.41	1.20	0.55	3.29
Tractors	2270002075	23.45	0.00	0.25	0.00	1.21	4.26	4.26	0.00	21.32	1.14	2.13	58.04
Other Construction Eq.	2270002081	1.38	0.00	0.73	0.00	0.19	1.38	1.38	0.00	0.69	0.18	0.00	5.93
<b>Total</b>		<b>73.32</b>	<b>0.00</b>	<b>247.12</b>	<b>0.00</b>	<b>105.34</b>	<b>114.41</b>	<b>64.91</b>	<b>6.79</b>	<b>348.33</b>	<b>356.46</b>	<b>86.33</b>	<b>1,470.28</b>

Table A-3: Annual Quarry and Mining Equipment CO Emissions by County, 2006 (Tons/Year)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.00	0.00	0.02	0.00	0.07	0.64	0.00	0.00	0.00	0.07	0.21	1.01
Scrapers	2270002018	0.00	0.00	0.14	0.00	0.66	1.19	3.58	0.00	0.60	2.41	0.60	9.18
Bore/Drill Rigs	2270002033	0.00	0.00	0.23	0.00	0.23	0.54	0.00	0.00	0.18	0.39	0.00	1.56
Excavators	2270002036	2.83	0.00	3.93	0.00	1.87	1.42	0.00	0.00	10.26	6.71	0.71	27.72
Cranes	2270002045	0.11	0.00	0.68	0.00	0.20	0.32	0.00	0.00	0.32	0.19	0.21	2.03
Draglines	0000000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Graders	2270002048	0.12	0.00	0.56	0.00	0.27	0.50	0.25	0.00	1.25	0.88	0.12	3.96
Rock Trucks	2270002051	11.49	0.00	43.43	0.00	18.49	16.59	8.93	0.00	52.33	59.48	16.59	227.33
Water Trucks	2270002051	0.00	0.00	1.24	0.00	0.83	1.07	2.13	0.00	1.07	3.45	1.07	10.85
Rock Proc. Eq.	2270002054	6.12	0.00	8.87	0.00	0.01	1.17	0.00	0.00	4.40	0.61	0.86	22.04
Loaders	2270002060	9.07	0.00	36.04	0.00	16.14	18.15	3.63	2.72	49.00	58.72	9.98	203.45
Backhoes	2270002066	0.00	0.00	0.33	0.00	0.26	0.84	0.00	0.00	0.56	0.80	0.42	3.22
Dozers	2270002069	4.20	0.00	4.03	0.00	3.21	0.84	7.56	0.00	9.24	8.89	3.36	41.32
Aerial Lifts	2270003010	0.00	0.00	0.35	0.00	0.26	0.29	0.15	0.15	0.44	1.26	0.58	3.47
Tractors	2270002075	13.25	0.00	0.14	0.00	0.69	2.41	2.41	0.00	12.05	0.64	1.20	32.79
Other Construction Eq.	2270002081	0.81	0.00	0.43	0.00	0.11	0.81	0.81	0.00	0.41	0.11	0.00	3.50
<b>Total</b>		<b>33.94</b>	<b>0.00</b>	<b>99.48</b>	<b>0.00</b>	<b>42.26</b>	<b>43.25</b>	<b>26.08</b>	<b>2.72</b>	<b>129.19</b>	<b>142.61</b>	<b>34.14</b>	<b>593.45</b>



Table A-4: Ozone Season Daily Quarry and Mining Equipment VOC Emissions by County, 2006 (Tons/Day)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Scrapers	2270002018	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.003
Bore/Drill Rigs	2270002033	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.002
Excavators	2270002036	0.002	0.000	0.002	0.000	0.001	0.001	0.000	0.000	0.005	0.004	0.000	0.015
Cranes	2270002045	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Draglines	0000000000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Graders	2270002048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.003
Rock Trucks	2270002051	0.004	0.000	0.017	0.000	0.007	0.006	0.003	0.000	0.020	0.023	0.006	0.087
Water Trucks	2270002051	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.005
Rock Proc. Eq.	2270002054	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.011
Loaders	2270002060	0.004	0.000	0.015	0.000	0.007	0.008	0.002	0.001	0.021	0.025	0.004	0.087
Backhoes	2270002066	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.002
Dozers	2270002069	0.002	0.000	0.002	0.000	0.001	0.000	0.003	0.000	0.004	0.004	0.001	0.018
Aerial Lifts	2270003010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002
Tractors	2270002075	0.006	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.005	0.000	0.001	0.014
Other Construction Eq.	2270002081	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
<b>Total</b>		<b>0.012</b>	<b>0.000</b>	<b>0.039</b>	<b>0.000</b>	<b>0.018</b>	<b>0.019</b>	<b>0.011</b>	<b>0.001</b>	<b>0.061</b>	<b>0.060</b>	<b>0.014</b>	<b>0.252</b>

Table A-5: Ozone Season Daily Diesel Quarry and Mining Equipment NO<sub>x</sub> Emissions by County, 2006 (Tons/Day)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.000	0.000	0.000	0.000	0.001	0.005	0.000	0.000	0.000	0.000	0.002	0.007
Scrapers	2270002018	0.000	0.000	0.001	0.000	0.004	0.008	0.023	0.000	0.004	0.016	0.004	0.059
Bore/Drill Rigs	2270002033	0.000	0.000	0.003	0.000	0.003	0.007	0.000	0.000	0.002	0.005	0.000	0.021
Excavators	2270002036	0.020	0.000	0.028	0.000	0.013	0.010	0.000	0.000	0.073	0.047	0.005	0.196
Cranes	2270002045	0.001	0.000	0.008	0.000	0.002	0.004	0.000	0.000	0.004	0.002	0.002	0.023
Draglines	0000000000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Graders	2270002048	0.001	0.000	0.004	0.000	0.002	0.003	0.002	0.000	0.009	0.006	0.001	0.027
Rock Trucks	2270002051	0.077	0.000	0.290	0.000	0.124	0.111	0.060	0.000	0.350	0.398	0.111	1.520
Water Trucks	2270002051	0.000	0.000	0.008	0.000	0.006	0.007	0.014	0.000	0.007	0.023	0.007	0.073
Rock Proc. Eq.	2270002054	0.010	0.000	0.059	0.000	0.000	0.027	0.000	0.000	0.104	0.012	0.011	0.223
Loaders	2270002060	0.062	0.000	0.246	0.000	0.110	0.124	0.025	0.019	0.335	0.401	0.068	1.391
Backhoes	2270002066	0.000	0.000	0.001	0.000	0.001	0.002	0.000	0.000	0.001	0.002	0.001	0.008
Dozers	2270002069	0.030	0.000	0.029	0.000	0.023	0.006	0.054	0.000	0.066	0.064	0.024	0.295
Aerial Lifts	2270003010	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.003	0.002	0.009
Tractors	2270002075	0.064	0.000	0.001	0.000	0.003	0.012	0.012	0.000	0.058	0.003	0.006	0.159
Other Construction Eq.	2270002081	0.004	0.000	0.002	0.000	0.001	0.004	0.004	0.000	0.002	0.000	0.000	0.016
Total		0.201	0.000	0.677	0.000	0.289	0.313	0.178	0.019	0.954	0.977	0.237	4.028

Table A-6: Ozone Season Daily Diesel Quarry Equipment CO Emissions by County, 2006 (Tons/Day)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.003
Scrapers	2270002018	0.000	0.000	0.000	0.000	0.002	0.003	0.010	0.000	0.002	0.007	0.002	0.025
Bore/Drill Rigs	2270002033	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.004
Excavators	2270002036	0.008	0.000	0.011	0.000	0.005	0.004	0.000	0.000	0.028	0.018	0.002	0.076
Cranes	2270002045	0.000	0.000	0.002	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.006
Draglines	0000000000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Graders	2270002048	0.000	0.000	0.002	0.000	0.001	0.001	0.001	0.000	0.003	0.002	0.000	0.011
Rock Trucks	2270002051	0.031	0.000	0.119	0.000	0.051	0.045	0.024	0.000	0.143	0.163	0.045	0.623
Water Trucks	2270002051	0.000	0.000	0.003	0.000	0.002	0.003	0.006	0.000	0.003	0.009	0.003	0.030
Rock Proc. Eq.	2270002054	0.017	0.000	0.024	0.000	0.000	0.003	0.000	0.000	0.012	0.002	0.002	0.060
Loaders	2270002060	0.025	0.000	0.099	0.000	0.044	0.050	0.010	0.007	0.134	0.161	0.027	0.557
Backhoes	2270002066	0.000	0.000	0.001	0.000	0.001	0.002	0.000	0.000	0.002	0.002	0.001	0.009
Dozers	2270002069	0.012	0.000	0.011	0.000	0.009	0.002	0.021	0.000	0.025	0.024	0.009	0.113
Aerial Lifts	2270003010	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.003	0.002	0.010
Tractors	2270002075	0.036	0.000	0.000	0.000	0.002	0.007	0.007	0.000	0.033	0.002	0.003	0.090
Other Construction Eq.	2270002081	0.002	0.000	0.001	0.000	0.000	0.002	0.002	0.000	0.001	0.000	0.000	0.010
Total		0.093	0.000	0.273	0.000	0.116	0.119	0.071	0.007	0.354	0.391	0.094	1.626

## B. Appendix B: Quarry and Mining Equipment Emissions by County, 2008

Table B-1: Annual Quarry and Mining Equipment VOC Emissions by County, 2008 (Tons/Year)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.00	0.00	0.00	0.00	0.02	0.14	0.00	0.00	0.00	0.02	0.05	0.22
Scrapers	2270002018	0.00	0.00	0.01	0.00	0.09	0.14	0.43	0.00	0.07	0.30	0.07	1.13
Bore/Drill Rigs	2270002033	0.00	0.00	0.08	0.00	0.09	0.18	0.00	0.00	0.06	0.14	0.00	0.55
Excavators	2270002036	0.48	0.00	0.66	0.00	0.36	0.24	0.00	0.00	1.75	1.17	0.12	4.78
Cranes	2270002045	0.03	0.00	0.20	0.00	0.07	0.10	0.00	0.00	0.10	0.06	0.06	0.63
Draglines	0000000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Graders	2270002048	0.03	0.00	0.11	0.00	0.06	0.10	0.05	0.00	0.25	0.18	0.03	0.81
Rock Trucks	2270002051	1.49	0.00	5.55	0.00	2.72	2.15	1.16	0.03	6.77	7.88	2.15	29.88
Water Trucks	2270002051	0.00	0.00	0.17	0.00	0.13	0.15	0.30	0.00	0.15	0.50	0.15	1.56
Rock Proc. Eq.	2270002054	0.01	0.00	0.42	0.00	0.00	0.14	0.00	0.00	3.18	0.08	0.15	3.98
Loaders	2270002060	1.29	0.00	5.06	0.00	2.61	2.58	0.52	0.42	6.97	8.53	1.42	29.39
Backhoes	2270002066	0.00	0.00	0.07	0.00	0.06	0.18	0.00	0.00	0.12	0.18	0.09	0.71
Dozers	2270002069	0.60	0.00	0.56	0.00	0.52	0.12	1.08	0.01	1.32	1.31	0.48	6.00
Aerial Lifts	2270003010	0.00	0.00	0.07	0.00	0.06	0.06	0.03	0.03	0.09	0.26	0.12	0.73
Tractors	2270002075	1.70	0.00	0.02	0.00	0.10	0.31	0.31	0.00	1.54	0.09	0.15	4.22
Other Construction Eq.	2270002081	0.10	0.00	0.05	0.00	0.02	0.10	0.10	0.00	0.05	0.01	0.00	0.42
<b>Total</b>		<b>3.92</b>	<b>0.00</b>	<b>12.91</b>	<b>0.00</b>	<b>6.75</b>	<b>6.22</b>	<b>3.54</b>	<b>0.46</b>	<b>20.73</b>	<b>20.34</b>	<b>4.76</b>	<b>84.99</b>

Table B-2: Annual Quarry and Mining Equipment NO<sub>x</sub> Emissions by County, 2008 (Tons/Year)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.00	0.00	0.03	0.00	0.18	1.36	0.00	0.00	0.00	0.16	0.45	2.19
Scrapers	2270002018	0.00	0.00	0.24	0.00	1.48	2.36	7.08	0.02	1.18	4.86	1.18	18.40
Bore/Drill Rigs	2270002033	0.00	0.00	0.90	0.00	1.06	2.19	0.00	0.01	0.73	1.68	0.00	6.57
Excavators	2270002036	6.12	0.00	8.38	0.00	4.59	3.06	0.00	0.05	22.17	14.81	1.53	60.70
Cranes	2270002045	0.39	0.00	2.49	0.00	0.85	1.18	0.00	0.01	1.18	0.76	0.78	7.64
Draglines	0000000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Graders	2270002048	0.27	0.00	1.21	0.00	0.69	1.10	0.55	0.01	2.75	1.99	0.27	8.83
Rock Trucks	2270002051	24.01	0.00	89.78	0.00	43.97	34.68	18.67	0.48	109.37	127.42	34.68	483.06
Water Trucks	2270002051	0.00	0.00	2.52	0.00	1.96	2.20	4.40	0.02	2.20	7.25	2.20	22.74
Rock Proc. Eq.	2270002054	3.63	0.00	21.38	0.00	0.05	9.75	0.00	0.00	37.90	4.25	3.91	80.87
Loaders	2270002060	18.94	0.00	74.36	0.00	38.34	37.88	7.58	6.10	102.27	125.25	20.83	431.55
Backhoes	2270002066	0.00	0.00	0.27	0.00	0.24	0.68	0.00	0.00	0.46	0.67	0.34	2.66
Dozers	2270002069	9.39	0.00	8.83	0.00	8.18	1.88	16.91	0.09	20.67	20.48	7.52	93.95
Aerial Lifts	2270003010	0.00	0.00	0.30	0.00	0.26	0.25	0.13	0.13	0.38	1.12	0.51	3.07
Tractors	2270002075	21.12	0.00	0.20	0.00	1.24	3.84	3.84	0.01	19.20	1.11	1.92	52.48
Other Construction Eq.	2270002081	1.10	0.00	0.58	0.00	0.17	1.10	1.10	0.00	0.55	0.16	0.00	4.76
<b>Total</b>		<b>62.75</b>	<b>0.00</b>	<b>210.38</b>	<b>0.00</b>	<b>101.59</b>	<b>98.32</b>	<b>55.19</b>	<b>6.78</b>	<b>300.87</b>	<b>309.58</b>	<b>73.70</b>	<b>1,279.47</b>

Table B-3: Annual Quarry and Mining Equipment CO Emissions by County, 2008 (Tons/Year)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.00	0.00	0.01	0.00	0.08	0.64	0.00	0.00	0.00	0.08	0.21	1.03
Scrapers	2270002018	0.00	0.00	0.11	0.00	0.69	1.09	3.28	0.01	0.55	2.25	0.55	8.53
Bore/Drill Rigs	2270002033	0.00	0.00	0.22	0.00	0.25	0.53	0.00	0.00	0.18	0.40	0.00	1.58
Excavators	2270002036	2.69	0.00	3.69	0.00	2.02	1.35	0.00	0.02	9.77	6.52	0.67	26.74
Cranes	2270002045	0.09	0.00	0.60	0.00	0.21	0.28	0.00	0.00	0.28	0.18	0.19	1.85
Draglines	0000000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Graders	2270002048	0.11	0.00	0.48	0.00	0.27	0.44	0.22	0.00	1.09	0.79	0.11	3.52
Rock Trucks	2270002051	10.98	0.00	41.07	0.00	20.11	15.86	8.54	0.22	50.03	58.28	15.86	220.96
Water Trucks	2270002051	0.00	0.00	1.14	0.00	0.88	0.99	1.99	0.01	0.99	3.28	0.99	10.28
Rock Proc. Eq.	2270002054	6.12	0.00	8.85	0.00	0.01	1.17	0.00	0.00	4.40	0.61	0.81	21.97
Loaders	2270002060	8.72	0.00	34.24	0.00	17.65	17.44	3.49	2.81	47.09	57.67	9.59	198.72
Backhoes	2270002066	0.00	0.00	0.31	0.00	0.28	0.81	0.00	0.00	0.54	0.79	0.40	3.14
Dozers	2270002069	3.83	0.00	3.61	0.00	3.34	0.77	6.90	0.04	8.44	8.36	3.07	38.35
Aerial Lifts	2270003010	0.00	0.00	0.32	0.00	0.28	0.28	0.14	0.14	0.42	1.23	0.56	3.37
Tractors	2270002075	11.36	0.00	0.11	0.00	0.67	2.07	2.07	0.01	10.33	0.60	1.03	28.23
Other Construction Eq.	2270002081	0.63	0.00	0.33	0.00	0.10	0.63	0.63	0.00	0.32	0.09	0.00	2.73
<b>Total</b>		<b>32.56</b>	<b>0.00</b>	<b>94.33</b>	<b>0.00</b>	<b>45.82</b>	<b>41.37</b>	<b>24.42</b>	<b>3.11</b>	<b>123.35</b>	<b>139.23</b>	<b>32.46</b>	<b>570.99</b>

Table B-4: Ozone Season Daily Quarry and Mining Equipment VOC Emissions by County, 2008 (Tons/Day)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Scrapers	2270002018	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.003
Bore/Drill Rigs	2270002033	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.002
Excavators	2270002036	0.001	0.000	0.002	0.000	0.001	0.001	0.000	0.000	0.005	0.003	0.000	0.013
Cranes	2270002045	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Draglines	0000000000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Graders	2270002048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.002
Rock Trucks	2270002051	0.004	0.000	0.015	0.000	0.007	0.006	0.003	0.000	0.019	0.022	0.006	0.082
Water Trucks	2270002051	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.004
Rock Proc. Eq.	2270002054	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.011
Loaders	2270002060	0.004	0.000	0.014	0.000	0.007	0.007	0.001	0.001	0.019	0.023	0.004	0.081
Backhoes	2270002066	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Dozers	2270002069	0.002	0.000	0.002	0.000	0.001	0.000	0.003	0.000	0.004	0.004	0.001	0.016
Aerial Lifts	2270003010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002
Tractors	2270002075	0.005	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.004	0.000	0.000	0.012
Other Construction Eq.	2270002081	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
<b>Total</b>		<b>0.011</b>	<b>0.000</b>	<b>0.035</b>	<b>0.000</b>	<b>0.018</b>	<b>0.017</b>	<b>0.010</b>	<b>0.001</b>	<b>0.057</b>	<b>0.056</b>	<b>0.013</b>	<b>0.233</b>

Table B-5: Ozone Season Daily Diesel Quarry and Mining Equipment NO<sub>x</sub> Emissions by County, 2008 (Tons/Day)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.001	0.006
Scrapers	2270002018	0.000	0.000	0.001	0.000	0.004	0.006	0.019	0.000	0.003	0.013	0.003	0.050
Bore/Drill Rigs	2270002033	0.000	0.000	0.002	0.000	0.003	0.006	0.000	0.000	0.002	0.005	0.000	0.018
Excavators	2270002036	0.017	0.000	0.023	0.000	0.013	0.008	0.000	0.000	0.061	0.041	0.004	0.166
Cranes	2270002045	0.001	0.000	0.007	0.000	0.002	0.003	0.000	0.000	0.003	0.002	0.002	0.021
Draglines	0000000000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Graders	2270002048	0.001	0.000	0.003	0.000	0.002	0.003	0.002	0.000	0.008	0.005	0.001	0.024
Rock Trucks	2270002051	0.066	0.000	0.246	0.000	0.120	0.095	0.051	0.001	0.300	0.349	0.095	1.323
Water Trucks	2270002051	0.000	0.000	0.007	0.000	0.005	0.006	0.012	0.000	0.006	0.020	0.006	0.062
Rock Proc. Eq.	2270002054	0.010	0.000	0.059	0.000	0.000	0.027	0.000	0.000	0.104	0.012	0.011	0.222
Loaders	2270002060	0.052	0.000	0.204	0.000	0.105	0.104	0.021	0.017	0.280	0.343	0.057	1.182
Backhoes	2270002066	0.000	0.000	0.001	0.000	0.001	0.002	0.000	0.000	0.001	0.002	0.001	0.007
Dozers	2270002069	0.026	0.000	0.024	0.000	0.022	0.005	0.046	0.000	0.057	0.056	0.021	0.257
Aerial Lifts	2270003010	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.003	0.001	0.008
Tractors	2270002075	0.058	0.000	0.001	0.000	0.003	0.011	0.011	0.000	0.053	0.003	0.005	0.144
Other Construction Eq.	2270002081	0.003	0.000	0.002	0.000	0.000	0.003	0.003	0.000	0.002	0.000	0.000	0.013
Total		0.172	0.000	0.576	0.000	0.278	0.269	0.151	0.019	0.824	0.848	0.202	3.505



Table B-6: Ozone Season Daily Diesel Quarry Equipment CO Emissions by County, 2008 (Tons/Day)

Equipment Type	SCC	Bastrop	Blanco	Burnet	Caldwell	Fayette	Hays	Lee	Llano	Travis	Williamson	Milam	Total
		48021	48031	48053	48055	48149	48209	48287	48299	48453	48491	48331	
Rollers	2270002015	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.003
Scrapers	2270002018	0.000	0.000	0.000	0.000	0.002	0.003	0.009	0.000	0.001	0.006	0.001	0.023
Bore/Drill Rigs	2270002033	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.004
Excavators	2270002036	0.007	0.000	0.010	0.000	0.006	0.004	0.000	0.000	0.027	0.018	0.002	0.073
Cranes	2270002045	0.000	0.000	0.002	0.000	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.005
Draglines	0000000000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Graders	2270002048	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.000	0.003	0.002	0.000	0.010
Rock Trucks	2270002051	0.030	0.000	0.113	0.000	0.055	0.043	0.023	0.001	0.137	0.160	0.043	0.605
Water Trucks	2270002051	0.000	0.000	0.003	0.000	0.002	0.003	0.005	0.000	0.003	0.009	0.003	0.028
Rock Proc. Eq.	2270002054	0.017	0.000	0.024	0.000	0.000	0.003	0.000	0.000	0.012	0.002	0.002	0.060
Loaders	2270002060	0.024	0.000	0.094	0.000	0.048	0.048	0.010	0.008	0.129	0.158	0.026	0.544
Backhoes	2270002066	0.000	0.000	0.001	0.000	0.001	0.002	0.000	0.000	0.001	0.002	0.001	0.009
Dozers	2270002069	0.011	0.000	0.010	0.000	0.009	0.002	0.019	0.000	0.023	0.023	0.008	0.105
Aerial Lifts	2270003010	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.003	0.002	0.009
Tractors	2270002075	0.031	0.000	0.000	0.000	0.002	0.006	0.006	0.000	0.028	0.002	0.003	0.077
Other Construction Eq.	2270002081	0.002	0.000	0.001	0.000	0.000	0.002	0.002	0.000	0.001	0.000	0.000	0.007
Total		0.089	0.000	0.258	0.000	0.126	0.113	0.067	0.009	0.338	0.381	0.089	1.564

### C. Appendix C: Updated TexN Inputs

SCC	SCC Description	HP Range	Avg. HP	Population Estimate <sup>18</sup>
2270002015	Diesel Rollers	50-75	0	0.0
2270002015	Diesel Rollers	75-100	0	0.0
2270002015	Diesel Rollers	100-175	110	100.0
2270002015	Diesel Rollers	175-300	0	0.0
2270002015	Diesel Rollers	300-600	0	0.0
2270002015	Diesel Rollers	600-750	0	0.0
2270002015	Diesel Rollers	750-1000	0	0.0
2270002018	Diesel Scrapers	50-75	0	0.0
2270002018	Diesel Scrapers	75-100	0	0.0
2270002018	Diesel Scrapers	100-175	0	0.0
2270002018	Diesel Scrapers	175-300	230	10.8
2270002018	Diesel Scrapers	300-600	405	89.2
2270002018	Diesel Scrapers	600-750	0	0.0
2270002018	Diesel Scrapers	750-1000	0	0.0
2270002033	Diesel Bore/Drill Rigs	50-75	0	0.0
2270002033	Diesel Bore/Drill Rigs	75-100	0	0.0
2270002033	Diesel Bore/Drill Rigs	100-175	0	0.0
2270002033	Diesel Bore/Drill Rigs	175-300	269	100.0
2270002033	Diesel Bore/Drill Rigs	300-600	0	0.0
2270002033	Diesel Bore/Drill Rigs	600-750	0	0.0
2270002033	Diesel Bore/Drill Rigs	750-1000	0	0.0
2270002036	Diesel Excavators	50-75	0	0.0
2270002036	Diesel Excavators	75-100	75	3.8
2270002036	Diesel Excavators	100-175	143	10.4
2270002036	Diesel Excavators	175-300	240	56.3
2270002036	Diesel Excavators	300-600	331	29.6
2270002036	Diesel Excavators	600-750	0	0.0
2270002036	Diesel Excavators	750-1000	0	0.0
2270002045	Diesel Cranes	50-75	0	0.0
2270002045	Diesel Cranes	75-100	0	0.0
2270002045	Diesel Cranes	100-175	129	17.9
2270002045	Diesel Cranes	175-300	208	75.6
2270002045	Diesel Cranes	300-600	300	6.4
2270002045	Diesel Cranes	600-750	0	0.0
2270002045	Diesel Cranes	750-1000	0	0.0
2270002048	Diesel Graders	50-75	0	0.0
2270002048	Diesel Graders	75-100	0	0.0
2270002048	Diesel Graders	100-175	132	72.0
2270002048	Diesel Graders	175-300	188	28.0
2270002048	Diesel Graders	300-600	0	0.0
2270002048	Diesel Graders	600-750	0	0.0
2270002048	Diesel Graders	750-1000	0	0.0
2270002051	Diesel Off-highway Trucks (Rock)	50-75	0	0.0
2270002051	Diesel Off-highway Trucks (Rock)	75-100	0	0.0

<sup>18</sup> Note: All equipment was based on a total population of 100 to calculate emission factors

SCC	SCC Description	HP Range	Avg. HP	Population Estimate
2270002051	Diesel Off-highway Trucks (Rock)	100-175	150	0.2
2270002051	Diesel Off-highway Trucks (Rock)	175-300	217	2.3
2270002051	Diesel Off-highway Trucks (Rock)	300-600	444	65.0
2270002051	Diesel Off-highway Trucks (Rock)	600-750	725	15.1
2270002051	Diesel Off-highway Trucks (Rock)	750-1000	840	17.5
2270002051	Diesel Off-highway Trucks (Water)	50-75	0	0.0
2270002051	Diesel Off-highway Trucks (Water)	75-100	0	0.0
2270002051	Diesel Off-highway Trucks (Water)	100-175	0	0.0
2270002051	Diesel Off-highway Trucks (Water)	175-300	218	50.7
2270002051	Diesel Off-highway Trucks (Water)	300-600	433	49.3
2270002051	Diesel Off-highway Trucks (Water)	600-750	0	0.0
2270002051	Diesel Off-highway Trucks (Water)	750-1000	0	0.0
2270002054	Diesel Crushing/Proc. Equipment	50-75	0	0.0
2270002054	Diesel Crushing/Proc. Equipment	75-100	0	0.0
2270002054	Diesel Crushing/Proc. Equipment	100-175	0	0.0
2270002054	Diesel Crushing/Proc. Equipment	175-300	205	48.2
2270002054	Diesel Crushing/Proc. Equipment	300-600	400	51.8
2270002054	Diesel Crushing/Proc. Equipment	600-750	0	0.0
2270002054	Diesel Crushing/Proc. Equipment	750-1000	0	0.0
2270002060	Diesel Rubber Tire Loaders	50-75	0	0.0
2270002060	Diesel Rubber Tire Loaders	75-100	0	0.0
2270002060	Diesel Rubber Tire Loaders	100-175	124	8.0
2270002060	Diesel Rubber Tire Loaders	175-300	269	22.5
2270002060	Diesel Rubber Tire Loaders	300-600	396	66.1
2270002060	Diesel Rubber Tire Loaders	600-750	0	0.0
2270002060	Diesel Rubber Tire Loaders	750-1000	800	3.5
2270002066	Diesel Tractors/Loaders/Backhoes	50-75	67	3.6
2270002066	Diesel Tractors/Loaders/Backhoes	75-100	80	86.8
2270002066	Diesel Tractors/Loaders/Backhoes	100-175	125	2.5
2270002066	Diesel Tractors/Loaders/Backhoes	175-300	250	7.1
2270002066	Diesel Tractors/Loaders/Backhoes	300-600	0	0.0
2270002066	Diesel Tractors/Loaders/Backhoes	600-750	0	0.0
2270002066	Diesel Tractors/Loaders/Backhoes	750-1000	0	0.0
2270002069	Diesel Crawler Tractor/Dozers	50-75	0	0.0
2270002069	Diesel Crawler Tractor/Dozers	75-100	0	0.0
2270002069	Diesel Crawler Tractor/Dozers	100-175	110	2.3
2270002069	Diesel Crawler Tractor/Dozers	175-300	250	18.0
2270002069	Diesel Crawler Tractor/Dozers	300-600	463	65.6
2270002069	Diesel Crawler Tractor/Dozers	600-750	0	0.0
2270002069	Diesel Crawler Tractor/Dozers	750-1000	850	14.1
2270002069	Aerial Lifts	6-11	0	0.0
2270002069	Aerial Lifts	11-16	0	0.0
2270002069	Aerial Lifts	16-25	0	0.0
2270002069	Aerial Lifts	25-40	0	0.0
2270002069	Aerial Lifts	40-50	0	0.0
2270002069	Aerial Lifts	50-75	59	100.0

SCC	SCC Description	HP Range	Avg. HP	Population Estimate
2270002069	Aerial Lifts	75-100	0	0.0
2270002069	Aerial Lifts	100-175	0	0.0