

APPENDIX C
AIR QUALITY CALCULATIONS

Summary Summarizes total emissions for each project by calendar year

Combustion Estimates emissions from non-road equipment exhaust as well as painting

Fugitive Estimates fine particulate emissions from earthmoving, vehicle traffic, and windblown dust

Grading Estimates the number of days of site preparation, to be used for estimating heavy equipment exhaust and earthmoving dust emissions

Cochise County Emissions Data Summarizes total emissions for Cochise County, AZ for 2009, to be used to compare project to county emissions.
Source: Scorecard -The Pollution Information Site- (http://www.scorecard.goodeguide.com/env-release/cap/county/tcf?rps_county_code=040003). Site visited on 8 August 2013.

Current or future year emissions inventories are not readily available. Therefore, available 2009 air emissions inventories (given in tons per year (tpy)) for Cochise county were used as an approximation of the regional inventory. Because the Proposed Action is several orders of magnitude below regional significance, the determination would be the same, regardless of whether future year budget data set were used.

Cochise County Emissions - Determination Significance for Proposed Activities (Significance Threshold = 10%)

Mobile, Point and Area Sources Combined					
NO _x (tpy)	VOC (tpy)	CO (tpy)	SO ₂ (tpy)	PM ₁₀ (tpy)	PM _{2.5} (tpy)
18,074	7,817	57,607	7,074	13,644	4,369
1,807	782	5,761	707	1,364	437

10% of Cochise County Emissions

Air Quality Emissions from Proposed Alternative Action (PA)						
Construction Emissions from the Proposed Action		NO _x (tpy)	VOC (tpy)	CO (tpy)	SO _x (tpy)	PM _{2.5} (tpy)
Proposed Alternative #1		2.50	0.32	1.09	0.18	0.68
Air Quality Emissions - Total Proposed Action		2.50	0.32	1.09	0.18	0.68
10% of Cochise County Emissions		1,807	782	5,761	707	1,364
Proposed Action %		0.138%	0.041%	0.019%	0.026%	0.156%
Regionally Significant?		no	no	no	no	no

Air Quality Emissions from the No Action Alternative to the Proposed Action						
Construction Emissions from Alternative to PA		NO _x (tpy)	VOC (tpy)	CO (tpy)	SO _x (tpy)	PM _{2.5} (tpy)
No Action Alternative #2 -existing Facility		1,611	0.096	0.637	0.032	0.137
Air Quality Emissions - Total Alternative to PA		1.61	0.10	0.64	0.032	0.14
10% of Cochise County Emissions		1,807	782	5,761	707	1,364
Proposed Action %		0.089%	0.012%	0.011%	0.005%	0.031%
Regionally Significant?		no	no	no	no	no

Proposed Alternative #1 Construction Project Summary

Includes:

1 Proposed Alternative #1 Construction

304,920 ft²

7 acres of Impacted Construction Site

Assumptions:

All land disturbance/grading area includes building construction, utility installation, landscaping, and paving operations.

Total Building Construction Area:

59,200 ft²

40,000 sq/ft of hangar, 14,000sq/ft admin, 5200 sq/ft of utilities

Total Demolished Area:

0 ft²

If project includes any demolition, include here

Total Paved Area:

112,500 ft²

44250 apron, 20000 paved parking, 5000 storage parking, 43250 of hardstand

Total Disturbed Area:

304,920 ft²

Spill Gate #1 Projects could disturb more than the project area. If so, cell "C14" should be changed t

Construction Duration:

0.50 year(s)

If construction duration is less than a year, change the value.

Paving Duration:

4.00 months

Annual Construction Activity:

115.0 days/yr

Project Proposed for CY 2014

	NO _x	VOC	CO	SO ₂	PM ₁₀	PM _{2.5}
Combustion Emissions (tpy)	2.50	0.32	1.09	0.18	0.18	0.17
Fugitive Dust Emissions (tpy)	0.00	0.00	0.00	0.00	4.26	0.51
Total Project Emissions (tpy)	2.498	0.322	1.093	0.184	4.438	0.682
Cochise County Emissions (tpy)	18,074	7,817	57,607	7,074	13,644	4,369
Project Percentage (%)	0.0138%	0.00411%	0.00190%	0.002599%	0.0325%	0.0156%
Regionally Significant? (more than 10%)	no	no	no	no	no	no

Combustion Emissions

Emission Factors Used for Construction Equipment

References: Guide to Air Quality Assessment, SMAQMD, 2004; and U.S. EPA NONROAD Emissions Model, Version 2005.0.0

Emission factors are taken from the NONROAD model.

Factors provided are for the weighted average US fleet for CY2007.

Assumptions regarding the type and number of equipment are from SMAQMD Table 3-1 unless otherwise noted.

Grading		No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Equipment								
Bulldozer		1	13.60	0.96	5.50	1.02	0.89	0.87
Motor Grader		1	9.69	0.73	3.20	0.80	0.66	0.64
Water Truck		1	18.36	0.89	7.00	1.64	1.00	0.97
Total per 10 acres of activity		3	41.64	2.58	15.71	0.83	2.55	2.47

Paving		No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Equipment								
Paver		1	3.83	0.37	2.06	0.28	0.35	0.34
Roller		1	4.82	0.44	2.51	0.37	0.43	0.42
Truck		2	36.71	1.79	14.01	3.27	1.99	1.93
Total per 10 acres of activity		4	45.37	2.61	18.58	0.91	2.78	2.69

Demolition		No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Equipment								
Loader		1	13.45	0.99	5.58	0.95	0.93	0.90
Haul Truck		1	18.36	0.89	7.00	1.64	1.00	0.97
Total per 10 acres of activity		2	31.81	1.89	12.58	0.64	1.92	1.87

Building Construction		No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Equipment ^d								
Stationary								
Generator Set		1	2.38	0.32	1.18	0.15	0.23	0.22
Industrial Saw		1	2.62	0.32	1.97	0.20	0.32	0.31
Welder		1	1.12	0.38	1.50	0.08	0.23	0.22
Mobile (non-road)								
Truck		1	18.36	0.89	7.00	1.64	1.00	0.97
Forklift		1	5.34	0.56	3.33	0.40	0.55	0.54
Crane		1	9.57	0.66	2.39	0.65	0.50	0.49
Total per 10 acres of activity		6	39.40	3.13	17.38	3.12	2.83	2.74

Note: Footnotes for tables are on following page

Architectural Coatings

Equipment	No. Req. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Air Compressor	1	3.57	0.37	1.57	0.25	0.31	0.30
Total per 10 acres of activity	1	3.57	0.37	1.57	0.07	0.31	0.30

- The SMAQMD 2004 guidance suggests a default equipment fleet for each activity, assuming 10 acres of that activity, (e.g., 10 acres of grading, 10 acres of paving, etc.). The default equipment fleet is increased for each 10 acre increment in the size of the construction project. That is, a 26 acre project would round to 30 acres and the fleet size would be three times the default fleet for a 10 acre project.
- The SMAQMD 2004 reference lists emission factors for reactive organic gas (ROG). For the purposes of this worksheet ROG = VOC.
- The NONROAD model contains emissions factors for total HC and for VOC. The factors used here are the VOC factors. The NONROAD emission factors assume that the average fuel burned in nonroad trucks is 1100 ppm sulfur. Trucks that would be used for the Proposed Actions will all be fueled by highway grade diesel fuel which cannot exceed 500 ppm sulfur. These estimates therefore over-estimate SO₂ emissions by more than a factor of two.
- Typical equipment fleet for building construction was not itemized in SMAQMD 2004 guidance. The equipment list above was assumed based on SMAQMD 1994 guidance.

PROJECT-SPECIFIC EMISSION FACTOR SUMMARY

Source	Equipment Multiplier*	Project-Specific Emission Factors (lb/day)					
		NO _x	VOC	CO	SO ₂ **	PM ₁₀	PM _{2.5}
Grading Equipment	1	41.641	2.577	15.710	0.833	2.546	2.469
Paving Equipment	1	45.367	2.606	18.578	0.907	2.776	2.693
Demolition Equipment	1	31.808	1.886	12.584	0.636	1.923	1.865
Building Construction	1	39.396	3.130	17.382	3.116	2.829	2.744
Air Compressor for Architectural Coating	1	3.574	0.373	1.565	0.071	0.309	0.300
Architectural Coating**			12.626				

*The equipment multiplier is an integer that represents units of 10 acres for purposes of estimating the number of equipment required for the project.

**Emission factor is from the evaporation of solvents during painting, per 'Air Quality Thresholds of Significance', SMAQMD, 1994

Example: SMAQMD Emission Factor for Grading Equipment NO_x = (Total Grading NO_x per 10 acre)*(Equipment Multiplier)

Summary of Input Parameters

	Total Area (ft ²)	Total Area (acres)	Total Days
Grading:	304,920	7.00	4
Paving:	43,560	1.00	5
Demolition:	0	0.00	0
Building Construction:	24,000	0.55	115
Architectural Coating	24,000	0.55	20

(from "GRADING" below)

(per SMAQMD "Air Quality of Thresholds of Significance", 1994)

NOTE: The 'Total Days' estimate for paving is calculated by dividing the total number of acres by 0.21 acres/day, which is a factor derived from the 2005 MEANS Heavy Construction Cost Data, 19th Edition, for 'Asphaltic Concrete Pavement, Lots and Driveways - 6" stone base', which provides an estimate of square feet paved per day. There is also an estimate for 'Plain Cement Concrete Pavement', however the estimate for asphalt is used because it is more conservative. The 'Total Days' estimate for demolition is calculated by dividing the total number of acres by 0.02 acres/day, which is a factor also derived from the 2005 MEANS reference. This is calculated by averaging the demolition estimates from 'Building Demolition - Small Buildings, Concrete', assuming a height of 30 feet for a two-story building; from 'Building Footings and Foundations Demolition - 6" Thick, Plain Concrete'; and from 'Demolish, Remove Pavement and Curb - Concrete to 6" thick, rod reinforced'. Paving is double-weighted since projects typically involve more paving demolition. The 'Total Days' estimate for building construction is assumed to be 230 days, unless project-specific data is known.

Total Project Emissions by Activity (lbs)

	NO _x	VOC	CO	SO ₂	PM ₁₀	PM _{2.5}
Grading Equipment	166.56	10.31	62.84	3.33	10.18	9.88
Paving	226.84	13.03	92.89	4.54	13.88	13.46
Demolition	-	-	-	-	-	-
Building Construction	4,530.58	359.93	1,998.97	358.38	325.34	315.58
Architectural Coatings	71.48	259.98	31.31	1.43	6.19	6.00
Total Emissions (lbs):	4,995.46	643.25	2,186.01	367.68	355.59	344.92

Results: Total Project Annual Emission Rates

	NO _x	VOC	CO	SO ₂	PM ₁₀	PM _{2.5}
Total Project Combustion Emissions (lbs)	4,995.46	643.25	2,186.01	367.68	355.59	344.92
Total Project Combustion Emissions (tons)	2.4977	0.3216	1.0930	0.1838	0.1778	0.1725

Construction Fugitive Dust Emissions

Construction Fugitive Dust Emission Factors

General Construction Activities	Emission Factor	Units	Source
New Road Construction	0.19 ton PM ₁₀ /acre-month		MRI 1996; EPA 2001; EPA 2006
	0.42 ton PM ₁₀ /acre-month		MRI 1996; EPA 2001; EPA 2006

PM_{2.5} Emissions

PM_{2.5} Multiplier (10% of PM₁₀ emissions assumed to be PM_{2.5})

EPA 2001; EPA 2006

Control Efficiency

(assume 50% control efficiency for PM₁₀ and PM_{2.5} emissions)

EPA 2001; EPA 2006

Project Assumptions

New Roadway Construction (0.42 ton PM₁₀/acre-month)

Duration of Construction Project

4 months

Area

1.0 acres

General Construction Activities (0.19 ton PM₁₀/acre-month)

Duration of Construction Project

6 months

Area

6.0 acres

	Project Emissions (tons/year)			
	PM ₁₀		PM _{2.5}	
	uncontrolled	controlled	uncontrolled	controlled
New Roadway Construction	1.68	0.84	0.17	0.08
General Construction Activities	6.84	3.42	0.34	0.17
Total	8.52	4.26	0.51	0.26

Construction Fugitive Dust Emission Factors

General Construction Activities Emission Factor

0.19 ton PM₁₀/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The area-based emission factor for construction activities is based on a study completed by the Midwest Research Institute (MRI) Improvement of Specific Emission Factors (BACM Project No. 1), March 29, 1996. The MRI study evaluated seven construction projects in Nevada and California (Las Vegas, Coachella Valley, South Coast Air Basin, and the San Joaquin Valley). The study determined an average emission factor of 0.11 ton PM₁₀/acre-month for sites without large-scale cut/fill operations. A worst-case emission factor of 0.42 ton PM₁₀/acre-month was calculated for sites with active large-scale earth moving operations. The monthly emission factors are based on 168 work-hours per month (MRI 1996). A subsequent MRI Report in 1999, Estimating Particulate Matter Emissions From Construction Operations, calculated the 0.19 ton PM₁₀/acre-month emission factor by applying 25% of the large-scale earthmoving emission factor (0.42 ton PM₁₀/acre-month) and 75% of the average emission factor (0.11 ton PM₁₀/acre-month). The 0.19 ton PM₁₀/acre-month emission factor is referenced by the EPA for non-residential construction activities in recent procedures documents for the National Emission Inventory (EPA 2001; EPA 2006). The 0.19 ton PM₁₀/acre-month emission factor represents a refinement of EPA's original AP-42 area-based total suspended particulate (TSP) emission factor in Section 13.2.3 Heavy Construction Operations. In addition to the EPA, this methodology is also supported by the South Coast Air Quality Management District as well as the Western Regional Air Partnership (WRAP) which is funded by the EPA and is administered jointly by the Western Governor's Association and the National Tribal Environmental Council. The emission factor is assumed to encompass a variety of non-residential construction activities including building construction (commercial, industrial, institutional, governmental), public works, and travel on unpaved roads. The EPA National Emission Inventory documentation assumes that the emission factors are uncontrolled and recommends a control efficiency of 50% for PM₁₀ and PM_{2.5} in PM nonattainment areas.

New Road Construction Emission Factor

0.42 ton PM₁₀/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The emission factor for new road construction is based on the worst-case conditions emission factor from the MRI 1996 study described above (0.42 tons PM₁₀/acre-month). It is assumed that road construction involves extensive earthmoving and heavy construction vehicle travel resulting in emissions that are higher than other general construction projects. The 0.42 ton PM₁₀/acre-month emission factor for road construction is referenced in recent procedures documents for the EPA National Emission Inventory (EPA 2001; EPA 2006).

PM_{2.5} Multiplier

0.10

PM_{2.5} emissions are estimated by applying a particle size multiplier of 0.10 to PM₁₀ emissions. This methodology is consistent with the procedures documents for the National Emission Inventory (EPA 2006).

Control Efficiency for PM₁₀ and PM_{2.5}

0.50

The EPA National Emission Inventory documentation recommends a control efficiency of 50% for PM₁₀ and PM_{2.5} in PM nonattainment areas (EPA 2006). Wetting controls will be applied during project construction.

References:

EPA 2001. *Procedures Document for National Emissions Inventory, Criteria Air Pollutants, 1985-1999*. EPA-454/R-01-006. Office of Air Quality Planning and Standards, United States Environmental Protection Agency. March 2001.
EPA 2006. *Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants*. Prepared for: Emissions Inventory and Analysis Group (C339-02) Air Quality Assessment Division Office of Air Quality Planning and Standards, United States Environmental Protection Agency. July 2006.
MRI 1996. *Improvement of Specific Emission Factors (BACM Project No. 1)*. Midwest Research Institute (MRI). Prepared for the California South Coast Air Quality Management District, March 29, 1996.

Construction (Grading) Schedule

Estimate of time required to grade a specified area.

Input Parameters
Construction area:

Qty Equipment: 7.00 acres/yr (from "COMBUSTION" above)
3.00 (calculated based on 3 pieces of equipment for every 10 acres)

Assumptions.

Terrain is mostly flat.
An average of 6" soil is excavated from one half of the site and backfilled to the other half of the site; no soil is hauled off-site or borrowed.
200 hp bulldozers are used for site clearing.
300 hp bulldozers are used for stripping, excavation, and backfill.
Vibratory drum rollers are used for compacting.
Stripping, Excavation, Backfill and Compaction require an average of two passes each.
Excavation and Backfill are assumed to involve only half of the site.

Calculation of days required for one piece of equipment to grade the specified area.

Reference: Means Heavy Construction Cost Data, 19th Ed., R. S. Means, 2005.

Means Line No.	Operation	Description	Output	Units	Acres per equip-day)	equip-days per acre	Acres/yr (project-specific)	Equip-days per year
2230 200 0550	Site Clearing	Dozer & rake, medium brush	8	acre/day	8	0.13	7.00	0.88
2230 500 0300	Stripping	Topsoil & stockpiling, adverse s	1,650	cu. yd/day	2.05	0.49	7.00	3.42
2315 432 5220	Excavation	Bulk, open site, common earth,	800	cu. yd/day	0.99	1.01	3.50	3.53
2315 120 5220	Backfill	Structural, common earth, 150'	1,950	cu. yd/day	2.42	0.41	3.50	1.45
2315 310 5020	Compaction	Vibrating roller, 6 " lifts, 3 passe	2,300	cu. yd/day	2.85	0.35	7.00	2.46
TOTAL								11.73

Calculation of days required for the indicated pieces of equipment to grade the designated acreage.

(Equip)(day)/yr: 11.73
Qty Equipment: 3.00
Grading days/yr: 3.91

Spill Gate #2 Construction Project Summary

Includes:

1 No Action Alternative #2 -existing Facility

43,560 ft²

1 acre

Assumptions:

All land disturbance/grading area includes building construction, utility installation, landscaping, and paving operations.

Total Building Construction Area:

0 ft²

Total Demolished Area:

87,120 ft²

Total Paved Area:

0 ft²

Total Disturbed Area:

65,340 ft²

Construction Duration:

0.25 year(s)

Paving Duration:

0.0 months

Annual Construction Activity:

57.5 days/yr

If project includes any demolition, include here-removal of temporary trailers and hangars= 2 acres

Alternative #2 Projects has disturbed more than the project area. If so, cell "C14" should be changed

If construction duration is less than a year, change the value.

Project for CY 2008

	NO _x	VOC	CO	SO ₂	PM ₁₀	PM _{2.5}
Combustion Emissions (tpy)	1.61	0.10	0.64	0.03	0.10	0.09
Fugitive Dust Emissions (tpy)	0.00	0.00	0.00	0.00	0.43	0.04
Total Project Emissions (tpy)	1.61	0.10	0.64	0.032	0.52	0.14
Cochise County Emissions (tpy)	18,074	7,817	57,607	7,074	13,644	4,369
Project Percentage (%)	0.0089%	0.00122%	0.00111%	0.000456%	0.0038%	0.0031%
Regionally Significant? (more than 10%)	no	no	no	no	no	no

Combustion Emissions

Emission Factors Used for Construction Equipment

References: Guide to Air Quality Assessment, SMAQMD, 2004; and U.S. EPA NONROAD Emissions Model, Version 2005.0.0

Emission factors are taken from the NONROAD model.

Factors provided are for the weighted average US fleet for CY2007.

Assumptions regarding the type and number of equipment are from SMAQMD Table 3-1 unless otherwise noted.

Grading

Equipment	No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Bulldozer	1	13.60	0.96	5.50	1.02	0.89	0.87
Motor Grader	1	9.69	0.73	3.20	0.80	0.66	0.64
Water Truck	1	18.36	0.89	7.00	1.64	1.00	0.97
Total per 10 acres of activity	3	41.64	2.58	15.71	0.83	2.55	2.47

Paving

Equipment	No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Paver	1	3.83	0.37	2.06	0.28	0.35	0.34
Roller	1	4.82	0.44	2.51	0.37	0.43	0.42
Truck	2	36.71	1.79	14.01	3.27	1.99	1.93
Total per 10 acres of activity	4	45.37	2.61	18.58	0.91	2.78	2.69

Demolition

Equipment	No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Loader	1	13.45	0.99	5.58	0.95	0.93	0.90
Haul Truck	1	18.36	0.89	7.00	1.64	1.00	0.97
Total per 10 acres of activity	2	31.81	1.89	12.58	0.64	1.92	1.87

Building Construction

Equipment ^d	No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c (lb/day)	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Stationary							
Generator Set	1	2.38	0.32	1.18	0.15	0.23	0.22
Industrial Saw	1	2.62	0.32	1.97	0.20	0.32	0.31
Welder	1	1.12	0.38	1.50	0.08	0.23	0.22
Mobile (non-road)							
Truck	1	18.36	0.89	7.00	1.64	1.00	0.97
Forklift	1	5.34	0.56	3.33	0.40	0.55	0.54
Crane	1	9.57	0.66	2.39	0.65	0.50	0.49
Total per 10 acres of activity	6	39.40	3.13	17.38	3.12	2.83	2.74

Note: Footnotes for tables are on following page

Architectural Coatings

Equipment	No. Req'd. ^a per 10 acres	NO _x (lb/day)	VOC ^b (lb/day)	CO (lb/day)	SO ₂ ^c	PM ₁₀ (lb/day)	PM _{2.5} (lb/day)
Air Compressor	1	3.57	0.37	1.57	0.25	0.31	0.30
Total per 10 acres of activity	1	3.57	0.37	1.57	0.07	0.31	0.30

- The SMAQMD 2004 guidance suggests a default equipment fleet for each activity, assuming 10 acres of that activity, (e.g., 10 acres of grading, 10 acres of paving, etc.). The default equipment fleet is increased for each 10 acre increment in the size of the construction project. That is, a 26 acre project would round to 30 acres and the fleet size would be three times the default fleet for a 10 acre project.
- The SMAQMD 2004 reference lists emission factors for reactive organic gas (ROG). For the purposes of this worksheet ROG = VOC.
- The NONROAD model contains emissions factors for total HC and for VOC. The factors used here are the VOC factors. The NONROAD emission factors assume that the average fuel burned in nonroad trucks is 1100 ppm sulfur. Trucks that would be used for the Proposed Actions will all be fueled by highway grade diesel fuel which cannot exceed 500 ppm sulfur. These estimates therefore over-estimate SO₂ emissions by more than a factor of two.
- Typical equipment fleet for building construction was not itemized in SMAQMD 2004 guidance. The equipment list above was assumed based on SMAQMD 1994 guidance.

PROJECT-SPECIFIC EMISSION FACTOR SUMMARY

Source	Equipment Multiplier [*]	NO _x	VOC	CO	SO ₂ ^{**}	PM ₁₀	PM _{2.5}
Grading Equipment	1	41.641	2.577	15.710	0.833	2.546	2.469
Paving Equipment	1	45.367	2.606	18.578	0.907	2.776	2.693
Demolition Equipment	1	31.808	1.886	12.584	0.636	1.923	1.865
Building Construction	1	39.396	3.130	17.382	3.116	2.829	2.744
Air Compressor for Architectural Coating	1	3.574	0.373	1.565	0.071	0.309	0.300
Architectural Coating ^{**}			0.000				

^{*}The equipment multiplier is an integer that represents units of 10 acres for purposes of estimating the number of equipment required for the project.

^{**}Emission factor is from the evaporation of solvents during painting, per 'Air Quality Thresholds of Significance', SMAQMD, 1994

Example: SMAQMD Emission Factor for Grading Equipment NO_x = (Total Grading NO_x per 10 acre)*(Equipment Multiplier)

Summary of Input Parameters

	Total Area (ft ²)	Total Area (acres)	Total Days
Grading:	65,340	1.50	1
Paving:	0	0.00	0
Demolition:	87,120	2.00	100
Building Construction:	0	0.00	0
Architectural Coating	0	0.00	0

(from "GRADING" below)

(per SMAQMD "Air Quality of Thresholds of Significance", 1994)

NOTE: The 'Total Days' estimate for paving is calculated by dividing the total number of acres by 0.21 acres/day, which is a factor derived from the 2005 MEANS Heavy Construction Cost Data, 19th Edition, for 'Asphaltic Concrete Pavement, Lots and Driveways - 6" stone base', which provides an estimate of square feet paved per day. There is also an estimate for 'Plain Cement Concrete Pavement', however the estimate for asphalt is used because it is more conservative. The 'Total Days' estimate for demolition is calculated by dividing the total number of acres by 0.02 acres/day, which is a factor also derived from the 2005 MEANS reference. This is calculated by averaging the demolition estimates from 'Building Demolition - Small Buildings, Concrete', assuming a height of 30 feet for a two-story building; from 'Building Footings and Foundations Demolition - 6" Thick, Plain Concrete'; and from 'Demolish, Remove Pavement and Curb - Concrete to 6" thick, rod reinforced'. Paving is double-weighted since projects typically involve more paving demolition. The 'Total Days' estimate for building construction is assumed to be 230 days, unless project-specific data is known.

Total Project Emissions by Activity (lbs)

	NO _x	VOC	CO	SO ₂	PM ₁₀	PM _{2.5}
Grading Equipment	41.64	2.58	15.71	0.83	2.55	2.47
Paving	-	-	-	-	-	-
Demolition	3,180.76	188.55	1,258.38	63.62	192.32	186.55
Building Construction	-	-	-	-	-	-
Architectural Coatings	-	-	-	-	-	-
Total Emissions (lbs):	3,222.40	191.13	1,274.09	64.45	194.86	189.02

Results: Total Project Annual Emission Rates

	NO _x	VOC	CO	SO ₂	PM ₁₀	PM _{2.5}
Total Project Combustion Emissions (lbs)	3,222.40	191.13	1,274.09	64.45	194.86	189.02
Total Project Combustion Emissions (tons)	1.6112	0.0956	0.6370	0.0322	0.0974	0.0945

Construction Fugitive Dust Emissions

Construction Fugitive Dust Emission Factors

General Construction Activities	Emission Factor	Units	Source
New Road Construction	0.19	ton PM_{10} /acre-month	MRI 1996; EPA 2001; EPA 2006
	0.42	ton PM_{10} /acre-month	MRI 1996; EPA 2001; EPA 2006

$PM_{2.5}$ Emissions

$PM_{2.5}$ Multiplier (10% of PM_{10} emissions assumed to be $PM_{2.5}$)

EPA 2001; EPA 2006

Control Efficiency

(assume 50% control efficiency for PM_{10} and $PM_{2.5}$ emissions)

EPA 2001; EPA 2006

Project Assumptions

New Roadway Construction (0.42 ton PM_{10} /acre-month)

Duration of Construction Project

- months

Area

- acres

3 months

1.5 acres

General Construction Activities (0.19 ton PM_{10} /acre-month)

Duration of Construction Project

Area

	Project Emissions (tons/year)			
	PM_{10}		$PM_{2.5}$	
	uncontrolled	controlled	uncontrolled	controlled
New Roadway Construction	0.00	0.00	0.00	0.00
General Construction Activities	0.86	0.43	0.04	0.02
Total	0.86	0.43	0.04	0.02

Construction Fugitive Dust Emission Factors

General Construction Activities Emission Factor

0.19 ton PM₁₀/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The area-based emission factor for construction activities is based on a study completed by the Midwest Research Institute (MRI) Improvement of Specific Emission Factors (BACM Project No. 1), March 29, 1996. The MRI study evaluated seven construction projects in Nevada and California (Las Vegas, Coachella Valley, South Coast Air Basin, and the San Joaquin Valley). The study determined an average emission factor of 0.11 ton PM₁₀/acre-month for sites without large-scale cutoff operations. A worst-case emission factor of 0.42 ton PM₁₀/acre-month was calculated for sites with active large-scale earth moving operations. The monthly emission factors are based on 168 work-hours per month (MRI 1996). A subsequent MRI Report in 1999, Estimating Particulate Matter Emissions From Construction Operations, calculated the 0.19 ton PM₁₀/acre-month emission factor by applying 25% of the large-scale earthmoving emission factor (0.42 ton PM₁₀/acre-month) and 75% of the average emission factor (0.11 ton PM₁₀/acre-month). The 0.19 ton PM₁₀/acre-month emission factor is referenced by the EPA for non-residential construction activities in recent procedures documents for the National Emission Inventory (EPA 2001; EPA 2006). The 0.19 ton PM₁₀/acre-month emission factor represents a refinement of EPA's original AP-42 area-based total suspended particulate (TSP) emission factor in Section 13.2.3 Heavy Construction Operations. In addition to the EPA, this methodology is also supported by the South Coast Air Quality Management District as well as the Western Regional Air Partnership (WRAP) which is funded by the EPA and is administered jointly by the Western Governor's Association and the National Tribal Environmental Council. The emission factor is assumed to encompass a variety of non-residential construction activities including building construction (commercial, industrial, institutional, governmental), public works, and travel on unpaved roads. The EPA National Emission Inventory documentation assumes that the emission factors are uncontrolled and recommends a control efficiency of 50% for PM₁₀ and PM_{2.5} in PM nonattainment areas.

New Road Construction Emission Factor

0.42 ton PM₁₀/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The emission factor for new road construction is based on the worst-case conditions emission factor from the MRI 1996 study described above (0.42 tons PM₁₀/acre-month). It is assumed that road construction involves extensive earthmoving and heavy construction vehicle travel resulting in emissions that are higher than other general construction projects. The 0.42 ton PM₁₀/acre-month emission factor for road construction is referenced in recent procedures documents for the EPA National Emission Inventory (EPA 2001; EPA 2006).

PM_{2.5} Multiplier

0.10

PM_{2.5} emissions are estimated by applying a particle size multiplier of 0.10 to PM₁₀ emissions. This methodology is consistent with the procedures documents for the National Emission Inventory (EPA 2006).

Control Efficiency for PM₁₀ and PM_{2.5}

0.50

The EPA National Emission Inventory documentation recommends a control efficiency of 50% for PM₁₀ and PM_{2.5} in PM nonattainment areas (EPA 2006). Wetting controls will be applied during project construction.

References:

EPA 2001. *Procedures Document for National Emissions Inventory, Criteria Air Pollutants, 1985-1999*. EPA-454/R-01-006. Office of Air Quality Planning and Standards, United States Environmental Protection Agency. March 2001.

EPA 2006. *Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants*. Prepared for: Emissions Inventory and Analysis Group (C339-02) Air Quality Assessment Division Office of Air Quality Planning and Standards, United States Environmental Protection Agency. July 2006.

MRI 1996. *Improvement of Specific Emission Factors (BACM Project No. 1)*. Midwest Research Institute (MRI). Prepared for the California South Coast Air Quality Management District, March 29, 1996.

Construction (Grading) Schedule

Estimate of time required to grade a specified area.

Input Parameters
Construction area:

Qty Equipment: 1.50 acres/yr (from "COMBUSTION" above)
3.00 (calculated based on 3 pieces of equipment for every 10 acres)

Assumptions.

Terrain is mostly flat.
An average of 6" soil is excavated from one half of the site and backfilled to the other half of the site; no soil is hauled off-site or borrowed.
200 hp bulldozers are used for site clearing.
300 hp bulldozers are used for stripping, excavation, and backfill.
Vibratory drum rollers are used for compacting.
Stripping, Excavation, Backfill and Compaction require an average of two passes each.
Excavation and Backfill are assumed to involve only half of the site.

Calculation of days required for one piece of equipment to grade the specified area.

Reference: Means Heavy Construction Cost Data, 19th Ed., R. S. Means, 2005.

Means Line No.	Operation	Description	Output	Units	Acres per equip-day	equip-days per acre	Acres/yr (project-specific)	Equip-days per year
2230 200 0550	Site Clearing	Dozer & rake, medium brush	8	acre/day		0.13	1.50	0.19
2230 500 0300	Stripping	Topsoil & stockpiling, adverse s	1,650	cu. yd/day	2.05	0.49	1.50	0.73
2315 432 5220	Excavation	Bulk, open site, common earth,	800	cu. yd/day	0.99	1.01	0.75	0.76
2315 120 5220	Backfill	Structural, common earth, 150'	1,950	cu. yd/day	2.42	0.41	0.75	0.31
2315 310 5020	Compaction	Vibrating roller, 6" lifts, 3 passe	2,300	cu. yd/day	2.85	0.35	1.50	0.53
TOTAL								
								2.51

Calculation of days required for the indicated pieces of equipment to grade the designated acreage.

(Equip)(day)/yr: 2.51
Qty Equipment: 3.00
Grading days/yr: 0.84

Expressed in tons of pollutant emitted)

	<u>Carbon monoxide</u>	<u>Nitrogen oxides</u>	<u>PM-2.5</u>	<u>PM-10</u>	<u>Sulfur dioxide</u>	<u>Volatile organic compounds</u>
<u>Mobile Sources</u>	<u>39,955</u>	<u>8,446</u>	<u>1,448</u>	<u>6,919</u>	<u>415</u>	<u>4,625</u>
<u>Area Sources</u>	<u>13,960</u>	<u>1,285</u>	<u>1,914</u>	<u>4,452</u>	<u>62</u>	<u>3,135</u>
<u>Point Sources</u>	<u>3,692</u>	<u>8,343</u>	<u>1,007</u>	<u>2,273</u>	<u>6,598</u>	<u>58</u>
All sources	57,607	18,074	4,369	13,644	7,074	7,817
	<u>[top]</u>					

Source: Scorecard -The Pollution Information Site- (http://www.scorecard.goodeguide.com/env-release/cap/county.tcl?fips_county_code=04003).
 Site visited on 8 August 2013.