Chapter 4
Construction Activities - Air Quality Impacts and Mitigation

4.1 Construction and Air Quality

Construction activities can generate a substantial amount of air pollution. In some cases, the emissions from construction represent the largest air quality impact associated with a project. While construction-related emissions produce only temporary impacts, these short-term impacts can contribute to an exceedance of national and/or state ambient air quality standards. To minimize construction air quality impacts so that a project can be deemed not significant in terms of air quality impacts under CEQA, the emissions from construction should be assessed and if necessary the appropriate mitigation strategy implemented. This chapter provides the recommended methodologies to estimate emissions from common construction activities associated with land development and mitigation strategies to neutralize unnecessary air pollutant emissions.

A project's most common construction activities include site preparation, earthmoving, and general construction. General construction includes adding improvements such as roadway surfaces, structures, and facilities. Earthmoving activities include cut and fill operations, trenching, soil compaction, and grading. Site preparation includes activities such as general land clearing and grubbing. In some cases, a project requires buildings and other obstacles demolished as part of site preparation.

The emissions generated from these common construction activities include the following:

- Combustion emissions (ROG, NOx, CO, SOx, PM_{10}) from mobile heavy-duty diesel- and gasoline-powered equipment, portable auxiliary equipment, and worker commute trips;
- Fugitive dust (PM_{10}) from soil disturbance or demolition; and
- Evaporative emissions (ROG) from asphalt paving and architectural coating applications.

Demolition and earth disturbance may also result in airborne entrainment of asbestos, a toxic air contaminant, particularly where structures built prior to 1980 are being demolished or with regard to soil disturbance in areas of the county where there are naturally occurring surface deposits of ultramafic rock. If there is a possibility that asbestos-containing dust may be generated during the construction phase of a project, the procedures for addressing toxic air contaminants set forth in Chapter 7 should be followed for determining significance and undertaking any required mitigation.

The Air Pollution Control Officer (APCO) may apply significance criteria and/or mitigation measures for evaluating the air quality impacts of construction activities, other than the criteria and mitigation measures set forth in the following sections of this chapter, provided they have been approved for use in another district in the Sacramento federal ozone nonattainment area.

4.2 Project Screening

Either of two approaches may be used for screening construction equipment exhaust emissions for significance: one is based on fuel use, the other on the incorporation of mitigation measures into the project design. If exhaust emissions are determined to be not significant under either approach, then further calculations to determine construction equipment exhaust emissions, as set out in subsequent sections of this chapter, are not necessary. For fugitive dust (PM_{10}) emissions, the screening approach is based on specific dust suppression measures that will prevent visible emissions beyond the boundaries of the project. If those measures are incorporated into the project design, then further calculations to determine PM_{10} fugitive dust emissions are not necessary.

4.2.1 Screening of Construction Equipment Exhaust Emissions Based on Fuel Use. Based on conservative assumptions regarding emissions and fuel use rates for Diesel-powered equipment used for construction, Table 4.1, below, sets forth the average daily fuel use per quarter for all construction equipment at a single site that would ensure that emissions remain below the combined 82 lbs/day significance thresholds for ROG and NOx on a quarterly basis (i.e., total ROG plus NOx emissions remain below 164 lbs/day). The quarterly averaging approach is based on the quarterly calculation of emission offsets used for stationary facilities in the District's New Source Rule 523. If average daily fuel use is kept below the levels shown in Table 4.1 on a quarterly basis, ROG and NOx emissions from construction equipment may be deemed not significant. Where the construction period is shorter than 90 days, fuel use should be determined using average daily fuel use over the full duration of the construction period. If the final construction period of a project scheduled to take more than 90 days is less than one calendar quarter, it may be combined with the previous quarter for averaging purposes. Where construction takes place over two complete quarters or more, the quarter with the highest average daily emissions must be used.

Table 4.1 Construction Equipment Fuel Use Screening Levels

Equipment Age Distribution	Average Daily Fuel Use Per Quarter (Gal. Per Day)
All equipment 1995 model year or earlier	337
All equipment 1996 model year or later	402

Assumptions: 12.5 g/hp-hr ROG+NOx for 1995 and earlier equipment (from EPA Nonroad Model); 10.5 g/hp-hr ROG+NOx for 1996 and later equipment (Based on EPA and CARB Tier 1 standards).
Notes: Determination of fuel use should be documented based on the equipment manufacturer's data. Use linear interpolation between 337 and 402 gal. per day in proportion to distribution of equipment into the two age categories; e.g., 50/50 age distribution yields allowable fuel use of (337+((402-337)/2)), or 370 gal. per day.

The fuel use values in Table 4.1 may be increased based on reasonably documented reductions in ROG or NOx emissions attributed to mitigation measures such as the use of emulsified fuel, alternative fuels, etc. For example, if an emulsified fuel has been certified by CARB (or other testing acceptable to the District) to reduce NOx by 15%, then the values above would be raised to 396 gal. per day (337/(1-0.15)) for 1995 and earlier equipment and 472 gal. per day (402/(1-0.15)) for 1996 and later equipment.

If ROG and NOx emissions are deemed not significant under Table 4.1, then exhaust emissions of CO and PM_{10} from construction equipment, and exhaust emissions of all constituents from worker commute vehicles, may also be deemed not significant. Likewise, the District has determined that keeping total construction phase fuel use under the limits shown in Table 4.2, below, will not result in a health risk from Diesel particulate matter that exceeds the significance criteria for toxic air contaminants (1 in 1 million if T-BACT is not used; 10 in 1 million if T-BACT is used.)

4.2.2 Screening of Construction Equipment Exhaust Emissions Based on Incorporation of Mitigation Measures. Based on its experience with construction activities, and taking into account the temporary and non-continuous nature of construction emissions, ROG and NOx emissions during construction may be assumed to be not significant if:

(a) the project encompasses 12 acres or less of ground that is being worked at one time and at least one of the mitigation measures relating to such pollutants described in Section 4.4.1 of this chapter (or an equivalent measure) is incorporated into the project; or

(b) the project proponent commits to pay mitigation fees in accordance with the provisions of an established mitigation fee program in the District (or such program in another air pollution control district that is acceptable to District).

If ROG and NOx mass emissions are determined to be not significant under the provisions above, then it can be assumed that exhaust emissions of other air pollutants from the operation of equipment and worker commute vehicles are also not significant. In such event, the steps for estimating exhaust emissions of these other pollutants in Section 4.3 need not be undertaken. The potential health risk analysis for Diesel exhaust particulate matter must still be performed, as specified in Chapter 7 of this Guide, unless total Diesel fuel use for construction equipment for the duration of the construction phase is less than shown in Table 4.2, below. The District has determined that fuel use below these levels will not exceed the health risk criteria in Chapter 7.

Table 4.2 Fuel Use Screening Criteria for Acceptable Diesel PM Health Risk

PM Control Technology	Maximum Gallons of Diesel Fuel Consumption During Construction Phase
T-BACT applied	37,000
T-BACT not applied	3,700

Notes: For the purposes of this screening test, T-BACT is defined as the use of 1996 and later model year engines in all Diesel construction equipment. Determination of fuel use should be documented based on the equipment manufacturer's data. Maximum gallons of fuel may be interpolated between 37,000 and 3,700 gallons based on the fraction of T-BACT and non T-BACT engines. Risk calculation to support the above screening values is based on fuel use under the "high risk" Prime Engine Scenario in Table 6, Appendix VII, Risk Characterization Scenarios, from the CARB October 2000 "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles."

The fuel use values in Table 4.2 may be increased based on reasonably documented reductions in PM emissions attributed to such mitigation measures as the use of emulsified Diesel fuel, alternative fuels, etc. For example, if an emulsified Diesel fuel has been certified through testing by CARB or other similar testing to reduce PM by 60%, then the values above would be raised to 92,500 gal. (37,000/(1-0.60)) when T-BACT is applied and 9,250 gal. (3,700/(1-0.60)) when T-BACT is not applied.

4.2.3 Screening of Fugitive Dust PM_{10} Emissions Based on Incorporation of Mitigation Measures. Mass emissions of fugitive dust PM_{10} need not be quantified, and may be assumed to be not significant, if the project includes mitigation measures that will prevent visible dust beyond the project property lines, in compliance with Rule 403 of the South Coast AQMD. See Section C.6 in Appendix C-1, where the mitigation measures in Rule 403 are set forth.

4.2.4 Caveat. The District may determine that any of the screening-level assumptions stated above should not be applicable to a given project due to project-specific considerations, such as especially heavy use of equipment, unique meteorological or soil conditions, or project size. The District recommends that project proponents and Lead Agencies contact the District early in the Initial Study process to confirm whether construction emissions screening may be used for a given project.

4.3 Methodologies for Estimating Construction Emissions

The heart of any CEQA document, especially an EIR, is the analysis of impacts to determine if a proposed project will cause significant adverse environmental effects. For projects that do not qualify for project screening under Section 4.2 above, this chapter discusses three approaches recommended for estimating localized air quality impacts associated with the construction of land development projects: Manual Calculation, URBEMIS, and the Roadway Construction Model. The manual calculation and URBEMIS approaches include shortcomings when used for new road construction, road widening, and bridge and overpass construction projects. Therefore, the Roadway Construction Emissions Model, developed by the Sacramento Metropolitan AQMD, is recommended for estimating emissions from these types of projects. The manual calculation method requires some project-specific information concerning construction activities that usually is available from the project proponent. However, we recognize that detailed project-specific information is sometimes unavailable or unknown at the time the CEQA document is being prepared. In this case, the URBEMIS computer program may be used to calculate emissions from construction activities. This involves using the construction emission module of the program.[1] URBEMIS users are cautioned that the construction module of the URBEMIS uses conservative assumptions as well as generic or dated information that tend to overestimate construction emissions. Therefore, the URBEMIS model should be used only if the Lead Agency or project proponent cannot, with reasonable effort, obtain the necessary specific information that the manual calculation approach requires. URBEMIS users should check with the District to be sure that the most recent version of the model is being used.

[1] If the URBEMIS program is used to calculate construction emissions, run the program separately for the construction emissions and for the operational emissions; the results should not be combined for purposes of comparison to applicable thresholds.

Although the following sections provide methodologies for estimating localized air quality impacts from various activities associated with a project's construction, the Lead Agency is not precluded from using other approaches provided that they are based on proven air quality analytic tools or based on reasonable estimates from past experiences. However, all approaches used to estimate construction emissions should be fully explained and documented in the appropriate section of the CEQA document, with references to this guideline or other supporting documents.

4.3.1 Manual Calculation Method. In this section, we provide in detail a methodology for manually estimating emissions from construction equipment. The manual calculation method includes predictive emission rates for 22 types of equipment, where multiplying the emission rate for a piece of equipment by the number of pieces of equipment would provide a reasonable calculation of daily emissions associated with a land development construction activity. Specific information will need to be supplied by the Lead Agency, such as the number and type of construction equipment and a daily schedule of construction equipment use and activities. As noted above in Section 4.2, these steps need not be undertaken if the screening-level assumptions in Section 4.2 are applicable or if the project proponent or Lead Agency prefers to conduct emissions modeling.

The total daily emissions from construction activities can vary from day-to-day, depending on the size of the project, the number and type of equipment used, and phasing or scheduling of the construction activities. However, because construction emissions are temporary and typically involve a limited number of emission sources, the approach taken in this Guide is to determine average daily construction emissions on a quarterly basis, in the same manner as specified in the screening approach described in Section 4.2. Where construction takes place over two complete quarters or more, the quarter with the highest average daily emissions must be used. Where the construction period is shorter than 90 days, average daily emissions over the full duration of the construction period should be determined. If the final construction period of a project scheduled to take more than 90 days is less than one calendar quarter, it may be combined with the previous quarter for averaging purposes.

As an exception to the average daily emissions approach, where the construction schedule indicates that peak construction activities on consecutive days are considerably greater than the mean level of activity, such that the District considers an averaging approach unrepresentative, the District may require emissions from the peak level of daily activity from one or more categories of activity, or some other representative level of activity, to be used in the calculation.

The following steps generally outline the manual calculation method:

1. Determine the size of the project in acres, square feet, and dwelling units (e.g., houses, apartments, etc).
2. Determine the activities required for constructing the project, such as site preparation, earthmoving, and general construction.
3. Determine the type and number of pieces of construction equipment to be used on each day.
4. Determine the daily hours of operation for each piece of equipment for each specific construction activity.

5. Calculate the average daily engine combustion emissions from construction equipment.
6. Calculate average daily fugitive dust emissions from construction equipment for each specific construction activity; include unpaved travel, paved road travel (if soil trackout will occur), and soil-handling activities.
7. Calculate average daily ROG evaporative emissions from paving activities.
8. Calculate average daily ROG evaporative emissions from architectural coatings activities.
9. Calculate average daily combustion emissions from construction worker trips for each specific construction activity.
10. Sum the average daily construction emissions and compare to the significance criteria.

Further details on how to accomplish these steps are provided in the following sections. Use Table 4.10 in Section 4.3.1.6 to record and sum the calculations described in steps 5 through10.

4.3.1.1 Estimating Engine Combustion Emissions from Heavy-Duty Diesel and Gasoline-Powered Construction Equipment. The combustion of fuel to provide power for equipment used during construction results in the generation of emissions of ROG, NOx, CO, and PM_{10}. The manual calculation procedure involves determining a daily emission rate for each piece of equipment, multiplied by the number of pieces of equipment, for each day of construction activity. The emissions from all equipment categories are then added together and averaged on a quarterly basis. The Lead Agency will therefore need to determine the type of daily construction activities that are likely to occur based on the project's size, duration, and location. The contractor(s) responsible for construction should be able to provide specific information about the number and type of equipment operation during the various phases of project construction. This information would provide for accurate calculation of combustion emissions.

However, in the initial planning phase of a project, the exact type and number of equipment may be unknown or unavailable for the construction activity. In this situation, conservative estimates can be derived using standard construction industry reference materials such as Walker's Building Estimator's Reference Book, 26th Ed.; Richardson Engineering Services' Process Plan Construction Estimating Standards, National Construction Estimator; and Dodge Unit Cost Book. Alternatively, an estimate can be prepared based on Table 4.3, below.

Table 4.3, below, shows the type and number of equipment that construction activities typically may require. Not all of the construction activities listed will be part of a proposed project. For example, the smaller the project the less likely that the large cut and fill activity will occur. The analyst will need to determine the type of construction activities that are likely to occur based on the project's actual size, duration, and location.

Table 4.3 Example Construction Activity Equipment Types and Number Requirements for a 10-Acre Project

Construction Activity	Type of Equipment	Number of Pieces of Equipment
Demolition [1]	Loader Haul Truck	1 1
Land Clearing/Grubbing [1]	Loader Haul Truck	1 1
Backhoe Excavation [1]	Backhoe/Loader Haul Truck	1 1
Bulldozer Excavation [1]	Bulldozer Loader Haul Truck	1 1 1
Small Cut and Fill [2]	Bulldozer Water Truck	1 1
Large Cut and Fill [2]	Scraper Bulldozer Water Truck	1 2 1
Trenching [1]	Trencher and Loader	1 each
Grading [1]	Bulldozer Motor Grader Water Truck	1 1 1
Concrete Slab Pouring [3]	Cement Truck	1
Portable Equipment Operation [4]	Generator Air Compressor	1 1
Paving [1]	Paving Machine Roller	1 1
Architectural Coatings [1]	Air Compressor	1

Sources: [1] Richardson Engineering Services' Process Plan Construction Estimating Standards, 1996; [2] National Construction Estimator, 1998; [3] Dodge Unit Cost Book, 1998; [4] SMAQMD.

Important factors that influence the exact number and type of equipment for the construction activity that should not be overlooked include the project's size, schedule, and location. The number of construction equipment pieces should proportionally increase for every 10 acres of project size. For example, if normally one bulldozer, one motor grader, and one water-truck (3 pieces of equipment) are required to grade 10 acres, then 30 acres require three bulldozers, three motor graders, and three water-trucks (9 pieces of equipment).

Some construction activities may occur simultaneously using the same type of equipment. For example, the same loader used in land clearing activities could be used for stockpiling activities. Therefore, the analyst must take care to account for scheduling on a given day when calculating daily mass emissions to avoid emissions double counting. Conversely, if construction activities occur simultaneously where different pieces of equipment are being used, the analyst will need to account for this so that emissions are not underestimated. In this case, the overlapped daily mass emissions would be higher than if the construction activities occurred separately. Whatever construction equipment configuration is chosen for each construction activity, it should be supported by a schedule of equipment and activities; reasonable grouping of activities over longer periods (e.g., for several weeks) may be used to simplify the presentation of construction schedule information, unless the District determines that such an approach is unrepresentative of how construction will actually be conducted.

To calculate emissions from construction equipment, an emission factor must also be used. Table 4.4, below, shows the predictive emission factors in pounds of pollutant per day recommended for use in estimating exhaust emissions from 22 different types of construction equipment in years 2000 through 2010. The emission factors in this table are derived from several sources including default parameters from the Roadway Construction Emissions Model, rather than the U.S. EPA AP-42 publication, as the former are more current. See Section 4.3.3 for a more detailed explanation about the model.

Table 4.4 Construction Equipment Emission Rates (pounds/day) for Years 2000-2010

Bore/ Drill Rigs	**ROG**	**CO**	**NOx**	**PM_{10}**	**Paving Equipment**	**ROG**	**CO**	**NOx**	**PM_{10}**
2000	2.88	24.45	33.74	1.15	2000	1.03	5.66	10.59	0.55
2001	2.80	23.80	28.33	0.90	2001	1.03	5.95	10.13	0.50
2002	1.65	14.02	14.03	0.40	2002	1.04	6.23	9.68	0.46
2003	2.21	18.75	15.22	0.35	2003	1.04	6.52	9.22	0.42
2004	2.99	25.43	20.64	0.48	2004	1.04	6.81	8.77	0.37
2005	2.22	18.91	15.35	0.36	2005	1.04	7.09	8.31	0.33
2006	2.21	18.75	15.22	0.35	2006	1.04	7.38	7.93	0.30
2007	1.57	13.37	10.85	0.25	2007	1.04	7.66	7.54	0.28
2008	1.88	15.97	12.97	0.30	2008	1.04	7.95	7.16	0.25
2009	2.38	20.21	16.41	0.38	2009	1.04	8.23	6.78	0.22
2010	2.26	19.23	15.61	0.36	2010	1.04	8.52	6.39	0.19
Concrete/ Industrial Saws	**ROG**	**CO**	**NOx**	**PM_{10}**	**Rollers**	**ROG**	**CO**	**NOx**	**PM_{10}**
2000	1.08	5.89	11.01	0.57	2000	0.86	5.91	7.52	0.41
2001	1.08	6.18	10.53	0.52	2001	0.86	6.39	6.76	0.33
2002	1.08	6.48	10.06	0.48	2002	0.86	6.86	6.00	0.26
2003	1.08	6.78	9.59	0.43	2003	0.86	7.34	5.24	0.19
2004	1.08	7.08	9.11	0.39	2004	0.86	7.34	5.13	0.16
2005	1.08	7.37	8.64	0.34	2005	0.86	7.34	5.01	0.14
2006	1.08	7.67	8.24	0.32	2006	0.86	7.34	5.01	0.14
2007	1.08	7.97	7.84	0.29	2007	0.86	7.34	5.01	0.14
2008	1.08	8.26	7.44	0.26	2008	0.86	7.34	5.01	0.14
2009	1.08	8.56	7.04	0.23	2009	0.86	7.34	5.01	0.14
2010	1.08	8.86	6.65	0.20	2010	0.86	7.34	5.01	0.14

Table 4.4 (Cont.) Construction Equipment Emission Rates (pounds/day) for Years 2000-2010

Cranes	ROG	CO	NOx	PM_{10}
2000	1.44	9.44	13.05	0.70
2001	1.44	10.14	11.93	0.59
2002	1.44	10.85	10.80	0.48
2003	1.44	11.56	9.67	0.38
2004	1.44	12.27	8.55	0.27
2005	1.44	12.27	8.37	0.23
2006	1.44	12.27	8.37	0.23
2007	1.44	12.27	8.37	0.23
2008	1.44	12.27	8.37	0.23
2009	1.44	12.27	8.37	0.23
2010	1.44	12.27	8.37	0.23

Rough Terrain Forklifts	ROG	CO	NOx	PM_{10}
2000	0.79	5.40	6.87	0.37
2001	0.79	5.83	6.18	0.30
2002	0.79	6.27	5.48	0.24
2003	0.79	6.70	4.79	0.17
2004	0.79	6.70	4.68	0.15
2005	0.79	6.70	4.57	0.13
2006	0.79	6.70	4.57	0.13
2007	0.79	6.70	4.57	0.13
2008	0.79	6.70	4.57	0.13
2009	0.79	6.70	4.57	0.13
2010	0.79	6.70	4.57	0.13

Crawler Tractors	ROG	CO	NOx	PM_{10}
2000	1.45	7.94	14.85	0.77
2001	1.45	8.34	14.21	0.71
2002	1.45	8.74	13.57	0.65
2003	1.45	9.14	12.93	0.59
2004	1.45	9.54	12.30	0.52
2005	1.45	9.95	11.66	0.46
2006	1.45	10.35	11.12	0.43
2007	1.45	10.75	10.58	0.39
2008	1.45	11.15	10.04	0.35
2009	1.45	11.55	9.50	0.31
2010	1.45	11.95	8.96	0.27

Rubber Tired Dozers	ROG	CO	NOx	PM_{10}
2000	3.66	20.03	37.45	1.93
2001	3.66	21.04	35.84	1.78
2002	3.66	22.05	34.23	1.63
2003	3.66	23.06	32.62	1.48
2004	3.66	24.07	31.01	1.32
2005	3.66	25.09	29.40	1.17
2006	3.66	26.10	28.05	1.07
2007	3.66	27.11	26.69	0.98
2008	3.66	28.12	25.33	0.88
2009	3.66	29.13	23.97	0.78
2010	3.66	30.14	22.61	0.68

Crushing/ Proc. Equipment	ROG	CO	NOx	PM_{10}
2000	2.12	11.60	21.68	1.12
2001	2.12	12.18	20.75	1.03
2002	2.12	12.77	19.82	0.94
2003	2.12	13.35	18.88	0.85
2004	2.12	13.94	17.95	0.77
2005	2.12	14.52	17.02	0.68
2006	2.12	15.11	16.23	0.62
2007	2.12	15.69	15.45	0.57
2008	2.12	16.28	14.66	0.51
2009	2.12	16.86	13.88	0.45
2010	2.12	17.45	13.09	0.40

Rubber Tired Loaders	ROG	CO	NOx	PM_{10}
2000	1.35	9.27	11.80	0.64
2001	1.35	10.02	10.61	0.52
2002	1.35	10.77	9.42	0.41
2003	1.35	11.52	8.23	0.30
2004	1.35	11.52	8.04	0.26
2005	1.35	11.52	7.86	0.22
2006	1.35	11.52	7.86	0.22
2007	1.35	11.52	7.86	0.22
2008	1.35	11.52	7.86	0.22
2009	1.35	11.52	7.86	0.22
2010	1.35	11.52	7.86	0.22

Table 4.4 (Cont.) Construction Equipment Emission Rates (pounds/day) for Years 2000-2010

Excavators	ROG	CO	NOx	PM_{10}	Scrapers	ROG	CO	NOx	PM_{10}
2000	1.84	13.32	15.24	0.83	2000	3.64	21.58	35.39	1.85
2001	1.84	14.48	13.39	0.66	2001	3.64	22.92	33.26	1.65
2002	1.84	15.64	11.54	0.48	2002	3.64	24.26	31.12	1.45
2003	1.84	15.64	11.25	0.42	2003	3.64	25.60	28.99	1.25
2004	1.84	15.64	10.96	0.36	2004	3.64	26.94	26.86	1.04
2005	1.84	15.64	10.67	0.29	2005	3.64	28.28	24.72	0.84
2006	1.84	15.64	10.67	0.29	2006	3.64	29.62	22.92	0.71
2007	1.84	15.64	10.67	0.29	2007	3.64	30.96	21.12	0.58
2008	1.84	15.64	10.67	0.29	2008	3.64	30.96	21.12	0.58
2009	1.84	15.64	10.67	0.29	2009	3.64	30.96	21.12	0.58
2010	1.84	15.64	10.67	0.29	2010	3.64	30.96	21.12	0.58
Graders	**ROG**	**CO**	**NOx**	**PM_{10}**	**Signal Boards**	**ROG**	**CO**	**NOx**	**PM_{10}**
2000	1.76	11.09	16.42	0.87	2000	1.72	9.39	17.55	0.91
2001	1.76	11.87	15.18	0.75	2001	1.72	9.86	16.80	0.83
2002	1.76	12.65	13.94	0.63	2002	1.72	10.33	16.04	0.76
2003	1.76	13.43	12.70	0.52	2003	1.72	10.81	15.29	0.69
2004	1.76	14.21	11.46	0.40	2004	1.72	11.28	14.53	0.62
2005	1.76	14.98	10.22	0.28	2005	1.72	11.75	13.78	0.55
2006	1.76	14.98	10.22	0.28	2006	1.72	12.23	13.14	0.50
2007	1.76	14.98	10.22	0.28	2007	1.72	12.70	12.50	0.46
2008	1.76	14.98	10.22	0.28	2008	1.72	13.18	11.87	0.41
2009	1.76	14.98	10.22	0.28	2009	1.72	13.65	11.23	0.37
2010	1.76	14.98	10.22	0.28	2010	1.72	14.12	10.60	0.32
Off-Highway Tractros/ Compactors	**ROG**	**CO**	**NOx**	**PM_{10}**	**Skid Steer Loaders**	**ROG**	**CO**	**NOx**	**PM_{10}**
2000	1.84	10.07	18.83	0.97	2000	0.56	4.78	3.88	0.23
2001	1.84	10.58	18.02	0.90	2001	0.56	4.78	3.76	0.20
2002	1.84	11.09	17.21	0.82	2002	0.56	4.78	3.63	0.17
2003	1.84	11.60	16.40	0.74	2003	0.56	4.78	3.51	0.14
2004	1.84	12.11	15.60	0.67	2004	0.56	4.78	3.39	0.12
2005	1.84	12.61	14.79	0.59	2005	0.56	4.78	3.26	0.09
2006	1.84	13.12	14.10	0.54	2006	0.56	4.78	3.26	0.09
2007	1.84	13.63	13.42	0.49	2007	0.56	4.78	3.26	0.09
2008	1.84	14.14	12.74	0.44	2008	0.56	4.78	3.26	0.09
2009	1.84	14.65	12.05	0.39	2009	0.56	4.78	3.26	0.09
2010	1.84	15.16	11.37	0.34	2010	0.56	4.78	3.26	0.09

Table 4.4 (Cont.) Construction Equipment Emission Rates (pounds/day) for Years 2000-2010

Off-Highway Trucks/ Water Trucks	ROG	CO	NOx	PM_{10}
2000	3.60	22.67	33.55	1.78
2001	3.60	24.26	31.02	1.54
2002	3.60	25.85	28.49	1.30
2003	3.60	27.44	25.96	1.06
2004	3.60	29.03	23.42	0.82
2005	3.60	30.62	20.89	0.58
2006	3.60	30.62	20.89	0.58
2007	3.60	30.62	20.89	0.58
2008	3.60	30.62	20.89	0.58
2009	3.60	30.62	20.89	0.58
2010	3.60	30.62	20.89	0.58

Surfacing Equipment	ROG	CO	NOx	PM_{10}
2000	3.77	20.62	38.56	1.99
2001	3.77	21.66	36.90	1.83
2002	3.77	22.70	35.24	1.68
2003	3.77	23.75	33.59	1.52
2004	3.77	24.79	31.93	1.36
2005	3.77	25.83	30.27	1.21
2006	3.77	26.87	28.87	1.11
2007	3.77	27.91	27.48	1.01
2008	3.77	28.95	26.08	0.90
2009	3.77	29.99	24.68	0.80
2010	3.77	31.03	23.28	0.70

Other Construction Equipment	ROG	CO	NOx	PM_{10}
2000	2.08	11.37	21.26	1.10
2001	2.08	11.95	20.35	1.01
2002	2.08	12.52	19.44	0.92
2003	2.08	13.09	18.52	0.84
2004	2.08	13.67	17.61	0.75
2005	2.08	14.24	16.69	0.67
2006	2.08	14.82	15.92	0.61
2007	2.08	15.39	15.15	0.55
2008	2.08	15.96	14.38	0.50
2009	2.08	16.54	13.61	0.44
2010	2.08	17.11	12.84	0.39

Tractors/ Loaders/ Backhoes	ROG	CO	NOx	PM_{10}
2000	0.65	3.56	6.66	0.34
2001	0.65	3.74	6.37	0.32
2002	0.65	3.92	6.08	0.29
2003	0.65	4.10	5.80	0.26
2004	0.65	4.28	5.51	0.24
2005	0.65	4.46	5.23	0.21
2006	0.65	4.64	4.98	0.19
2007	0.65	4.82	4.74	0.17
2008	0.65	5.00	4.50	0.16
2009	0.65	5.18	4.26	0.14
2010	0.65	5.36	4.02	0.12

Pavers	ROG	CO	NOx	PM_{10}
2000	1.37	9.36	11.91	0.64
2001	1.37	10.12	10.71	0.53
2002	1.37	10.87	9.51	0.41
2003	1.37	11.62	8.31	0.30
2004	1.37	11.62	8.12	0.26
2005	1.37	11.62	7.93	0.22
2006	1.37	11.62	7.93	0.22
2007	1.37	11.62	7.93	0.22
2008	1.37	11.62	7.93	0.22
2009	1.37	11.62	7.93	0.22
2010	1.37	11.62	7.93	0.22

Trenchers	ROG	CO	NOx	PM_{10}
2000	1.00	7.26	8.31	0.45
2001	1.00	7.90	7.30	0.36
2002	1.00	8.53	6.29	0.26
2003	1.00	8.53	6.14	0.23
2004	1.00	8.53	5.98	0.19
2005	1.00	8.53	5.82	0.16
2006	1.00	8.53	5.82	0.16
2007	1.00	8.53	5.82	0.16
2008	1.00	8.53	5.82	0.16
2009	1.00	8.53	5.82	0.16
2010	1.00	8.53	5.82	0.16

Using the emission factors in Table 4.4, emission estimates can be calculated from the number and type of pieces of construction equipment used for each construction activity by multiplying the equipment's specific emission rate by the number of pieces of equipment. For example, if an activity of land clearing on a particular day includes a maximum area disturbed per day of 5 acres, and requires a dozer, two scrapers, and a water truck to complete the activity during the year 2002, then total NOx emissions for that day would equal 125 pounds (see computation below).

Emissions per day are calculated by the following equation:

$$Em = ER \times Eq$$

Where: Em = amount of pollutant in pounds per day
ER = emission rate in pounds per day for pollutant by target year (see Table 4.2)
Eq = number of pieces of equipment

For the given example then:

$$Em_{(NOx)} = [(ER_{(Dozer\ Yr\ '02\ NOx)} \times Eq) + (ER_{(Scraper\ Yr\ '02\ NOx)} \times Eq) + (ER_{(H2O\ Truck\ Yr\ '02\ NOx)} \times Eq)]$$
$$Em_{(NOx)} = [(34.23 \times 1) + (31.12 \times 2) + (28.49 \times 1)]$$
$$Em_{(NOx)} = 125$$

The emission factors in Table 4.4 assume equipment is operated continuously for 8 hours each day. Results should be adjusted proportionately if it is known that equipment will in fact be used for more or less than 8 hours per day.

To obtain average daily ROG and NOx exhaust emissions from construction activities, ROG and NOx emissions from all equipment operated on each day of construction should be totaled over the life of the construction project and then divided by the total number of construction days. The result should then be entered in line one of Table 4.10.

4.3.1.2 Estimating Fugitive Dust Emissions from Construction. Demolition, clearing, grading, excavating, use of heavy equipment or trucks on unpaved surfaces, and loading/unloading of trucks create large quantities of fugitive dust, including PM_{10}. Fugitive dust emissions may have a significant impact on local air quality.

As explained in Section 4.4.3 below, construction fugitive dust emissions will be considered not significant and estimation of fugitive dust emissions is not required if complete mitigation is undertaken as part of the project (or made a mandatory condition of the project) in compliance with the requirements of Rule 403 of the South Coast AQMD, such that there will be no visible dust beyond the boundaries of the project. If screening is not applied under Section 4.2.3, fugitive dust emissions may be quantified and inserted in Table 4.10 using the generalized emission factors set forth below in Table 4.5 and the equation following that table.

Table 4.5 Fugitive Dust (PM_{10}) Emissions from Construction

Activity	Units of Measure	Emission Factor (EF)
Demolition	Cu. Ft. of Building Demolished Per Day	0.00004 lbs/day
Dirt/Debris Pushing/Grading	No. of Pieces of Equipment Operating During One Hour	21.8 lbs/hr.
Exposed Graded Surfaces	Acres of Exposed Surface Per Day	26.4 lbs/day
Exposed Storage Piles	Acres Per Day	85.6 lbs./day
Truck Dumping	Tons of Material Dumped Per Day	0.009 lbs/day
Truck Travel/Dirt Hauling	Miles Traveled On-Site Per Day	10.0 lbs/mile
Truck Travel on Unpaved Roads	Miles Traveled On-Site Per Day	23.0 lbs/mile
Source: SCAQMD, CEQA Air Quality Handbook, April 1993.		

Completing the equation below with the predictive emission factors from Table 4.5 yields uncontrolled construction-related PM_{10} emissions.

$$Em = AM \times EF$$

Where: Em = Fugitive Dust (PM_{10}) Emissions, lbs
AM = Amount per Unit of Measure for the Activity
EF = Emission Factor

To obtain average daily fugitive dust emissions from construction activities, PM_{10} emissions on each day of construction should be totaled over the life of the construction project and then divided by the total number of construction days. The result should be entered in line 2 of Table 4.10.

Based on project-specific facts, such as the number of pieces of equipment to be used, the size of the project, or the existence of special or unique soil characteristics or meteorology, the District may recommend that a project's potential to affect ambient particulate concentrations be analyzed with an appropriate air pollutant dispersion model, such as ISCST3. The purpose of such an analysis is to help determine if the amount of dust that will be generated by project-related activities will cause an exceedance of an ambient particulate air quality standard. If the analysis indicates that construction fugitive dust emissions will contribute more than five percent to a violation of a particulate ambient air quality standard, a finding of significant impact should be made and appropriate mitigating measures identified. The District will recommend that particulate modeling be conducted if project-related activities and operations may generate airborne PM_{10} in such quantities as to cause an effect in an area where sensitive receptors live or work, including residential areas, schools, day care centers, office complexes, and hospitals. Examples of projects that may require supplemental modeling include mining and quarrying operations, landfills, and excavation and grading operations for large development projects. When the District recommends a particulate modeling analysis, it will provide guidance as to appropriate models and modeling protocols.

4.3.1.3 Estimating Evaporative Emissions from Asphalt Paving. In addition to the emissions generated from combustion of fuel associated with the operation of paving equipment used to apply asphalt (see §4.3.1.1above), ROG emissions are released from the evaporation of solvents contained in asphalt paving materials. The following equation estimates evaporative emissions.

Em = EF x Ac

Where: Em = Emissions
EF = Emission Factor, (lbs/acre/day)
Ac = Acres paved per day

The emission factor in Table 4.6, below, may be used in the equation.

Table 4.6 Asphalt Paving ROG Emissions (lbs/acre/day)

Pollutant	ROG
Emission Factor (EF)	2.62
Source: URBEMIS7G.	

To obtain average daily ROG emissions from asphalt paving, the emissions on each day when asphalt paving is scheduled to be done should be totaled over the life of the construction project and then divided by the total number of construction days. The result should be entered in line 3 of Table 4.10.

4.3.1.4 Estimating Evaporative Emissions from Architectural Coating Application. Architectural coatings release ROG emissions from the evaporation of solvents contained in the paints, primers, lacquers, varnishes, and other surface coatings applied to structures. In the context of a land development project, the vast majority of architectural coatings applied are flat paints for interior walls, ceilings, and exterior walls. The methodology provided below calculates ROG emissions, based on coatings compliant with District Rule 215, from the application of architectural coatings at a project site. Separate procedures are used to estimate evaporative emissions from application of residential and nonresidential architectural coatings. (Assumptions: single family unit = 1,800 sq ft; multi-family units = 850 sq ft; one coat of paint, spray-applied on wood, plasterboard, or metal; no more than 10 units to be painted at one time. Proportional adjustments should be made for larger or smaller units or for more or fewer units.)

For residential (single and multi-family units):

$$Em = (EF \times DU) / (T_d + 3)$$

Where: Em = ROG Emission, $\frac{lbs}{day}$

4.7

EF = Emission Factor, $\frac{lbs}{du}$ (from Table 4.5 below)

DU = Number of dwelling units

T_d = Number of painting days, otherwise use 17 days.

For non-residential:

$$Em = (EF \times \sqrt{Bsize}) \times (T_d + 3)$$

Where: Em = ROG emissions, $\frac{lbs}{day}$

EF = Emission Factor, $\frac{lbs}{sq\ ft}$ (from Table 4.7, below)

$Bsize$ = Building size, sq ft

T_d = Number of painting days, if known; otherwise use 17 days.

Table 4.7 Architectural Coatings Emissions (lbs/day)

Land Use	Applicable Units	ROG Emissions Factor[3] (EF)
Single Family[1]	dwelling units	65.6 lbs/du
Multi-Family[1]	dwelling units	49.2 lbs/du
Non-Residential[2]	square feet (sq ft)	1.63 lbs/sq ft

Source: SMAQMD.

Notes:

[1] Not to exceed 10 units, which assumes no more than 10 units will be painted at one time.

[2] Square root of gross square feet.

[3] Factor based upon coatings compliant with El Dorado Co. APCD Rule 215.

Assumptions: Single Family equal 1,800 sq ft and Multi-Family equal 850 sq ft; 1-coat paint, spray painted on wood, plasterboard, or metal.

To obtain average daily ROG emissions from architectural coating application, the emissions on each day when coating activity is scheduled to be done should be totaled over the life of the construction project and then divided by the total number of construction days. The result should be entered in line 4 of Table 4.10.

4.3.1.5 Estimating Combustion Emissions from Construction Worker Trips. Construction activities also contribute to mobile emissions generated by commute trips to and from the project site and non-work trips associated with lunch or other errands. In some cases, construction vehicle trips are typically difficult to accurately quantify at the time environmental documents are prepared. In all cases, a good-faith effort should be made to quantify these emissions to the degree practical. Rather than manually calculating vehicle emissions associated with construction activities, the analyst may use the vehicle emission factor model, EMFAC2001, to estimate vehicle emissions. The EMFAC2001 model uses CARB's motor vehicle emission factor inventory program to obtain daily emissions from total VMT per day multiplied by the emission factor (grams per mile). However, set forth below is a methodology that the analyst may use to manually calculate worker vehicle emissions, particularly when the analyst does not have project-specific information about the number of daily trips associated with project construction.

The approach to estimating combustion emissions from worker vehicle trips includes estimating worker daily trips by land use type. This approach groups the project into one of four general land use categories: multi- and single-family residential, commercial and/or retail, and office and/or industrial. Then for each category, the number of trips is estimated using the following equation.

$$Tr = TrF \times U$$

Where: Tr = Number of trips per land use type, $\frac{\text{trips}}{\text{day}}$

TrF = Trip Factor, see Table 4.8

U = Number of dwelling units or 1,000 square feet of building.

Table 4.8 Construction Worker Trip Generation (Trips/day)

Land Use	Trip Factor	Unit Type
Multi-Family	0.36/Unit	Dwelling units
Single-Family	0.72/Unit	Dwelling units
Commercial/Retail	0.32/1,000 sq. ft.	1,000 sq. ft.
Office/Employment	0.42/1,000 sq. ft.	1,000 sq. ft.
Source: SCAQMD, CEQA Planners Handbook, 1993.		

Using the total daily construction employee trips, review Table 4.9 below and locate the pollutant values for each pollutant for the amount of emissions generated by the daily trips; if necessary, add the amount of emissions to determine total vehicular emissions. Note: Use the values corresponding with the year of analysis, which should be the build-out year of the project or phase of larger projects.

Table 4.9 Lookup Table for Construction Worker Trip Emissions (Lbs)
Years 2000, 2005, 2010, 2015

	Year 2000				Year 2005			
Trips	ROG	NOx	PM_{10}	CO	ROG	NOx	PM_{10}	CO
1	0.04	0.04	0.001	0.38	0.03	0.02	0.001	0.21
10	0.44	0.35	0.012	3.78	0.26	0.19	0.012	2.10
100	4.38	3.55	0.116	37.79	2.56	1.93	0.117	20.96
1000	43.82	35.47	1.164	377.88	25.62	19.29	1.173	209.56
10000	438.21	354.67	11.640	3778.84	256.23	192.91	11.727	2095.57
	Year 2010				Year 2015			
Trips	ROG	NOx	PM_{10}	CO	ROG	NOx	PM_{10}	CO
1	0.02	0.01	0.001	0.12	0.01	0.01	0.001	0.08
10	0.16	0.11	0.011	1.25	0.10	0.07	0.012	0.75
100	1.59	1.13	0.113	12.46	1.03	0.66	0.119	7.55
1000	15.85	11.25	1.125	124.62	10.31	6.64	1.191	75.49
10000	158.53	112.50	11.250	1246.23	103.07	66.42	11.910	754.92

Source: California Air Resources Board, EMFAC2000, version 2.02.
Runs performed for El Dorado County, Mountain Counties Air Basin, using weighted fleet mix of light-duty autos, light-duty trucks, and medium-duty vehicles, annual average emission rates, and a 10-mile one-way trip. Use linear interpolation or extrapolation if actual number of trips is different from numbers shown. Use linear interpolation for intervening years.

To obtain average daily emissions from construction worker trip emissions, the emissions on each day when workers are scheduled to be present should be totaled over the life of the construction project and then divided by the total number of construction days. The result should be entered in line 5 of Table 4.10 below.

4.3.1.6 Construction Emissions Summary. Using Table 4.10, below, sum the totals of the average daily construction emissions as calculated manually for each category and compare the Total Average Daily Emissions for all categories combined with the significance threshold to determine the project's level of significance. For ROG and NOx, if the Total Average Daily Emissions value in lbs/day is less than the 82 lbs/day significance threshold, then the project does not generate levels of those pollutants that are considered significant. For CO and PM_{10}, Total Average Daily Emissions in lbs/day must be converted to ambient concentrations in line 7 for comparison to the applicable AAQS; use the modeling techniques described in Section 6.3.2 for operation emissions, or an alternative technique acceptable to the District, to make this conversion.

To be sure that the project remains below the significance level during construction, the lead agency should include the following as enforceable conditions of project approval:

1. The number of pieces of equipment operating at the construction site should be limited to the number used in the emissions calculations.
2. The amount of grading on any one day should be limited to the area used in the emission calculations.

If the emission calculations are based on the use of newer, low-emitting equipment, then the project construction must be conducted using only the specified low-emission equipment.

Table 4.10 Average Daily Construction Emissions Summary

Emission Source	ROG (lbs/day)	NO_x (lbs/day)	PM_{10} (lbs/day)	CO (lbs/day)
Construction Equipment Exhaust Emissions				
Fugitive Dust (PM_{10})				
Asphalt Paving ROG				
Architectural Coating ROG				
Construction worker vehicles				
Total Average Daily Emissions (Sum of 5 categories above)				
Modeling Results in ambient concentrations				
Significance Threshold	82	82	AAQS	AAQS
Significance Determination				

Note: "AAQS" refers to the national and state ambient air quality standards for the pollutant indicated. See Appendix B for a listing of the AAQS. Modeling of ROG and NOx impacts is not feasible.

4.3.2 Estimating Construction Emissions Using URBEMIS. URBEMIS is a computer program that can be used to estimate emissions associated with land use development projects in California, such as residential neighborhoods, shopping centers, office buildings, etc. CARB originally created URBEMIS, which stands for "Urban Emissions Model," in the early 1980s. Since that time it has undergone several revisions. The latest version, URBEMIS7G, was developed by Jones and Stokes Associates as consultants for the San Joaquin Valley Unified Air Pollution Control District, in coordination with several other air districts. Previous versions of URBEMIS were designed to estimate only motor vehicle emissions from trips generated by land use development. URBEMIS7G has been enhanced so that the user can estimate construction and area-source emissions. In addition, URBEMIS has been modified to allow the user to estimate motor vehicle trip emissions using EMFAC7G, CARB's motor vehicle emission factor model; hence the name URBEMIS7G. URBEMIS7G also allows the user to select mitigation measures for construction emissions, area sources, and motor vehicle trips.

The URBEMIS7G model and user's manual can be downloaded from CARB's web site at http://www.arb.ca.gov. URBEMIS7G only allows the user to print results (output) from program runs. Currently, the input data cannot be printed from the program. Therefore, to allow the public and other responsible agencies to corroborate the results from URBEMIS7G program runs, the user should provide input data tables indicating the input parameters selected and the assumptions made in running the URBEMIS7G program.

As noted above, users are cautioned that URBEMIS can produce very conservative results; users should also contact the District to be sure that they have the most recent version.

4.3.3 Estimating New Road Construction Emissions Using the Roadway Construction Emission Model. The District recommends use of the roadway construction emissions model, developed by the Sacramento Metropolitan AQMD, for estimating emissions from construction of roads. The model can be used to estimate vehicle exhaust and fugitive dust (PM_{10}) emissions from one of three types of road projects: 1) new road construction, 2) road widening, and 3) bridge construction. For each of these project types, the model estimates emissions for four activities of road construction: 1) grubbing/land clearing, 2) grading/excavation, 3) drainage/utilities/sub-grade, and 4) paving. These four activities are based on published construction information and conversations with individuals working for firms involved in road construction and with individuals at the California Department of Transportation.

The model estimates emissions for load hauling (on-road heavy-duty vehicle trips), worker commute trips, construction site fugitive PM_{10} dust, and off-road construction vehicles. Although exhaust emissions are estimated for each activity, fugitive dust estimates are currently limited to grubbing/land clearing, and grading/excavation.

The road construction model is a public domain spreadsheet model formatted as a series of individual worksheets. The model enables users to estimate emissions using a minimum amount of project-specific information. The user is required to enter information on project type (new road construction, road widening, or bridge/overpass construction), project length (miles), project duration (years), soil type, emission factors, total project area, and maximum area disturbed per day. The model uses this information to calculate emissions. The data on which these default parameters have been developed are based on several sources of information, including discussions with several individuals involved in road construction. Future updates to the model will be used to broaden the data on which the default information is based. If detailed construction information is available, that information can be entered into the model to provide more refined emission estimates.

Off-road construction emissions are estimated for each construction activity. The program generates estimates of the number of each type of construction equipment based on information provided by the user and on information incorporated into the program. The program includes up to 25 different types of construction equipment (see Table 4.11 below).

Table 4.11 Construction Equipment Types Included in the Road Construction Model

Backhoes	Off-Highway Trucks
Bore/Drill Rigs	Other Construction Equipment
Concrete/Industrial Saws	Pavers
Compactors	Paving Equipment
Cranes	Rollers
Crawler Tractors	Scrapers
Crushing/Processing Equipment	Signal Boards
Dozers	Skid/Steer Loaders
Excavators	Surfacing Equipment
Forklifts, Rough Terrain	Tractors
Graders	Trenchers
Loaders, Rubber Tired	Water Trucks

For example, the program will select different numbers and types of vehicles depending on the project type selected, the length of the project, and maximum acreage disturbed per day. The user can override the number and type of construction vehicles selected by the program. Emissions for each piece of construction equipment are estimated by multiplying that equipment's emission factor (grams per horsepower hour) by that equipment's vehicle horsepower rating, the equipment's load factor, and by the number of hours per day. The worksheet's default horsepower rating, load factor, and hours per day values can be overridden by the user.

4.3.3.1 Off-Road Construction Emission Rates. Off-road construction emission rates (grams per horsepower hour) and associated emissions (pounds per day) are estimated separately for each type of equipment. Several steps are involved in estimating off-road vehicle emissions. Emissions are based on the Appendix D worksheet, which is taken directly from the California Air Resources Board's off-road emissions model documentation, Appendix D. Appendix D lists average emissions per engine horsepower category and year. Average emission rates are calculated for pre-1996 engines. Post-1996 emission rates are based on emission standards for heavy-duty off-road engines.

The next step involves estimating replacement rates for each type of construction vehicle. Those replacement rates are based on Appendix B of the California Air Resources Board's off-road emissions model documentation. The replacement rates are used to estimate the percentage of vehicles in each of three classes: pre-1996, 1996-2000, 2001 or later. The percentage of vehicles in each of three categories is then used to estimate average emissions (grams per horsepower-hour) for each year. For each year, the percentage of vehicles in each of the three age classes is multiplied by the emissions for that age class and the three resulting values are summed. Then, pounds per day emissions are estimated by multiplying the grams per hp-hour value by horsepower, load factor, and hours operating per day.

The off-road construction emissions calculation is based on using Appendix D and Appendix B. The on-road emissions are calculated based on either EMFAC7F or EMFAC7G (selected by the user) at 30 miles per hour (mph). EMFAC7F and EMFAC7G represent two versions of the California Air Resources Board's motor vehicle emission factor inventory program. EMFAC7F was superseded by EMFAC7G in the late 1990s. Major improvements made to EMFAC7G include:

- Redefining starts and redistributing starts by vehicle age;
- New start emissions methodology;
- Fuel corrections for diesel;
- High emitter adjustments; and
- Driving cycle adjustments.

The EMFAC2000 and MOBILE5b models are not yet supported. At this time, the District requires the use of EMFAC7G.

4.3.3.2 Load Hauling (On-Road Heavy-Duty Vehicle Trips). Load-hauling emissions are estimated for the grading/excavation construction phase only. Hauling emissions are based on the total miles per day for on-road vehicle trips. The daily vehicle miles traveled (VMT) is estimated by multiplying the vehicle miles per round trip by the number of trips traveled per day. The trips-per-day estimate is derived by dividing the total amount of material imported to and exported from the site per day by the average truck capacity. The amount of material imported and exported is a user input to the model. The average truck capacity is assumed to be 20 cubic yards unless the user overrides that value.

The total VMT per day is then multiplied by the emission factor (grams per mile) to obtain daily emissions. The emission factor is based on the vehicle emission factor model selected by the user, on the project construction start year, and on the project length. The user has the option of selecting the EMFAC7F model or the EMFAC7G model, but as noted above the District requires the use of EMFAC7G. For projects in which the grading/excavation phase spans more than one year, emissions are weighted based on the percentage of time in the year that they occur.

4.3.3.3 Worker Commute Trips. Worker commute trips are estimated for all four activities of construction. Emissions are estimated by multiplying the emission rate (grams per mile) by the total worker commute miles traveled per day. The user has the option of selecting the EMFAC7F model, or the EMFAC7G model; again, EMFAC7G must be selected. EMFAC2000 and MOBILE5b models are not yet supported. Emissions are weighted based on the year in which they occur.

The total worker commute miles traveled per day is calculated by multiplying the average one-way trip distance (default: 20 miles) by the total one-way trips per employee per day (default two trips/employee), which is then multiplied by the total number of employees per construction phase. The total number of employees is assumed to equal 125 percent of the total number of off-road vehicles used for each construction activity. The user has the option of overriding the default values estimated for worker commute trips.

4.3.3.4 Fugitive Dust (PM_{10}). The model uses a simple approach for estimating fugitive PM_{10} dust emissions. Fugitive dust is estimated for two activities of construction: grubbing/land clearing and grading/excavation. Emissions are multiplied by the maximum acreage disturbed per day as entered by the user. That value is multiplied by the California Air Resources Board's emission factor of 220 pounds per day divided by 22 workdays per month. Future improvements to the model will likely focus on providing the user with the option of conducting more detailed estimates of fugitive PM_{10} emissions.

Further information on user instructions for the Roadway Construction Emissions Model is contained in Appendix C-2.

4.4 Reducing Significant Construction Emissions

Public Resources Code §21002 states that " . . . it is a policy of the state that public agencies not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects." This policy may be applied at the design stage of a project so that its emissions and air quality impacts are diminished and thereby deemed not significant in the Initial Study, by incorporating mitigation measures recommended by the District as part of the original project design. Alternatively, mitigation measures may be accepted as project revisions after the project has been submitted for CEQA review, to allow the preparation of a Mitigated Negative Declaration in lieu of an EIR. This section suggests various measures for mitigation that can be used under either approach. If mitigation is not undertaken at this stage, and an EIR is required, mitigation will likely have to be undertaken later.

If the emissions of a proposed project have been estimated using URBEMIS, then we recommend that the mitigation component of the program also be used. The following methodologies include the least complex method of calculating control efficiencies. These mitigation efficiencies are averages based on research; they do not account for the particular variables of a specific project and may over- or underestimate actual emission reductions. URBEMIS allows for a more refined calculation since project-specific data are used. The most refined approach would be to manually calculate control efficiencies based on project-specific data.

The emission reduction that can be expected from implementation of a mitigation measure is identified as that measure's control efficiency and is expressed as a percentage of total emissions. For example, a 25% control efficiency implies that a mitigation measure or series of measures results in emission reductions equal to 25% of uncontrolled values. Efficiencies may differ for each pollutant depending on the mitigation measure, emission source, and specific process affected. Justification must be provided when using control efficiencies other than those provided below.

It must be noted that the control efficiencies listed are general in nature and alternative methods of calculating mitigation efficiencies may be used to prepare an air quality analysis. Any alternative method should be supported by legitimate research, thoroughly documented, and reproducible.

4.4.1 **Mitigating Construction Equipment Exhaust Emissions.** Construction mitigation measures involve emission reductions of NOx, ROG, and PM_{10} which may include reformulated fuels, emulsified fuels, catalyst and filtration technologies, cleaner engine repowers, and new alternative-fueled trucks, among others. Many of the heavy-duty diesel mitigation measures may qualify for state and air district incentive funding programs. Additional construction mitigation measures include emission reductions from controlling visible emissions from diesel-powered equipment and particulate matter emission control measures. The Lead Agency is encouraged to explore and incorporate additional mitigation measures than listed below as technology advances and less emissive products become available. Contact the District either to determine which measures are available or to customize the measures appropriately for the project. The following measures are provided as examples for Lead Agency consideration.

- Require the prime contractor to provide an approved plan demonstrating that heavy-duty (i.e., greater than 50 horsepower) off-road vehicles to be used in the construction project, and operated by either the prime contractor or any subcontractor, will achieve, at a minimum, a fleet-averaged 15 percent NOx reduction compared to the most recent CARB fleet average. Successful implementation of this measure requires the prime contractor to submit a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 horsepower, that will be used an aggregate of 40 or more hours during the construction project. Usually the inventory includes the horsepower rating, engine production year, and hours of use or fuel throughput for each piece of equipment. In addition, the inventory list is updated and submitted monthly throughout the duration of when the construction activity occurs.

- Obligate the prime contractor to use an alternative fuel, other than Diesel, verified by the California Air Resources Board or otherwise documented through emissions testing to have the greatest NOx and PM_{10} reduction benefit available, provided each pollutant is reduced by at least 15%.

- Obligate the prime contractor to use aqueous emulsified fuel verified by the California Air Resources Board or otherwise documented through emissions testing to have the greatest NOx and PM_{10} reduction benefit available, provided each pollutant is reduced by at least 15%.

4.4.2 **Mitigating Asphalt Paving and Architectural Coating Emissions.** Mitigation for asphalt paving requires the use of materials that comply with District Rule 224. The emissions factors used to generate the emissions values in § 4.3.4 above are reflective of the use of compliant materials; therefore no additional mitigation is feasible or available. Likewise, the mitigation for architectural coatings involves the use of materials that comply with District Rule 215. The emissions factors used to generate the emissions values in § 4.3.5 above are reflective of the use of compliant materials, and additional mitigation is generally not considered feasible; however, an investigation may be undertaken to determine if new lower VOC products are available.

4.4.3 Mitigating Fugitive Dust. To qualify for the screening presumption in Section 4.2 that fugitive dust emissions from project construction are not significant, a project must commit to implement fugitive dust control measures sufficient to prevent visible dust beyond the project property lines. This commitment can be satisfied by compliance with all the measures listed in the exemption tables in Rule 403 of the South Coast Air Quality Management District, pertaining to control of fugitive dust emissions. For ease of reference, the exemption tables are contained in Tables C.6 and C.7 of Appendix C-1.

If screening is not used, Table 4.12, below, shows estimated dust emissions reductions for a variety of PM_{10} control measures. These measures are expressed as a percentage of total fugitive dust PM_{10} from project construction. Note that only one mitigation measure may be used for each of the sources. This is because the first mitigation measure for each heading is incorporated in the second measure of each heading. For example, with the source "Soil Piles" you may not claim PM_{10} emissions reduction for watering twice daily and for automatic sprinklers.

Table 4.12 Fugitive Dust Emission Mitigation

Source	Mitigation Measure	Control Efficiency
Soil Piles	Enclose, cover or water twice daily all soil piles	16%
	Automatic sprinkler system installed on all soil piles	39%
Exposed Surface/Grading	Water all exposed soil twice daily	37%
	Water exposed soil with adequate frequency to keep soil moist at all times	75%
Truck Hauling Road	Water all haul roads twice daily	3%
	Pave all haul roads	7%
Truck Hauling Load	Maintain at least two feet of freeboard	1%
	Cover load of all haul/dump trucks securely	2%

Source: SCAQMD, weighted for percentage contribution of PM_{10} emissions.

4.4.4 Mitigating Construction Worker Trips. Currently, no standardized approach to quantify construction employee commute reductions has been approved. Mitigation may exist, and may be quantified by the anticipated reduction in trips from carpooling, use of transit, or other alternative nonpolluting modes of transportation such as walking or biking. To determine the estimated emission reduction, first estimate the number of trips reduced through carpooling or other similar measures and see Appendix D to estimate emissions reduced from trip reduction measures.

4.4.5 Construction Emissions Reduction. Use Table 4.13, below, to estimate emission reductions from mitigation measures proposed for construction.

Table 4.13 Mitigation of Average Daily Construction Emissions

Emission Source	ROG (lbs/day)	NO_x (lbs/day)	PM_{10} (lbs/day)	CO (lbs/day)
Construction Equipment Exhaust Emissions				
Mitigation reduction				
Subtotal				
Fugitive Dust (PM_{10})				
Mitigation reduction				
Subtotal				
Asphalt Paving ROG				
Architectural Coati ng ROG				
Mitigation reduction				
Subtotal				
Construction worker vehicles				
Mitigation reduction				
Subtotal				
Total Average Daily Emissions				
Modeling Results (in ambient concentrations)				
Significance Threshold	82	82	AAQS	AAQS
Significance Determination				

In Table 4.13, sum all Subtotal figures in the line labeled Total Average Daily Emissions, and convert the lbs/day Total Average Daily Emissions values for CO and PM to ambient concentrations in line 8 per the instructions for Table 4.10 in Section 4.4.1. If the Total Average Daily Emissions value for ROG and NOx, and the modeling result for CO and PM_{10}, is less than the applicable significance threshold, then the proposed mitigation will reduce the impact of the project to a less than significant level for that pollutant. If the Total Average Daily Emissions value for ROG or NOx, or the modeling result for CO or PM_{10}, is greater than the significance threshold, then the mitigation measures will not reduce emissions to a less than significant level for that pollutant and, therefore, construction impacts are considered significant.