Appendix G

Air Quality

Appendix G Air Quality

An emissions analysis was conducted to develop emissions inventories pursuant to the National Environmental Policy Act of 1969 (NEPA), and to determine whether emissions associated with the Proposed Action would exceed applicable *de minimis* thresholds as documented in the U.S. Environmental Protection Agency's (EPA's) general conformity regulations.

This appendix documents the methods used to calculate emissions of U.S. EPA criteria pollutants, including carbon monoxide (CO), volatile organic compounds (VOCs), oxides of nitrogen (NO_X), oxides of sulfur (SO_X), particulate matter less than ten microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), from operational and construction-related sources of emissions associated with the Proposed Action Alternative. In addition, the methodologies used to calculate operational and construction-related emissions of greenhouse gases (GHGs)[1] and hazardous air pollutants (HAPs) are presented in this appendix.

Operational emissions inventories were developed for existing conditions (2012) and for two future years (2015 and 2020). Future year emission inventories were developed for the No Action and Proposed Action Alternatives evaluated in this environmental assessment.

Estimates of construction-related emissions were developed for the Proposed Action Alternative using standard industry methodologies and techniques. All construction activities are anticipated to be completed in 2015; hence construction emissions estimates were developed for calendar year 2015.

G.1 Construction Emissions Analysis

This section documents the analysis of estimated emissions generated through construction-related activities associated with constructing the Proposed Action Alternative. Major components of the Proposed Action Alternative included in the construction emissions analysis include pavement rehabilitation of a portion of Runway 24R's keel (or center) section, pavement rehabilitation of Taxiway AA, constructing a cover for a portion of the Argo Drainage Channel located north of the Runway 24R threshold, and demolition and relocation of various service roads.

1 For purposes of this analysis, greenhouse gas emissions are estimated in terms of carbon dioxide equivalent (CO2e).

Construction emissions analyses generally require information such as the type of construction equipment to be used, the amount of time the equipment will operate, estimates of required construction material, areas to be paved, and the number of employees anticipated to be on site. A construction schedule and estimate of various material quantities were provided by URS Corporation. Construction activity estimates, including types, number, and specifications of equipment for various construction activities, were derived from data provided by MARRS Services, Inc., in support of the LAX Runway 7L/25R RSA EA.[2] This data included various types and numbers of construction equipment organized into crews. Crews were assigned to specific construction activities associated with the Proposed Action Alternative by identifying activities that are similar in nature to activities included in the LAX Runway 7L/25R RSA EA. Estimates of construction-related emissions were developed for the Proposed Action Alternative using standard industry methodologies and techniques. Activities associated with construction of the Proposed Action are anticipated to begin in July 2015 and to be completed in December 2015.

Sources of construction emissions estimated in this analysis included construction vehicles and equipment, pavement crushing, asphalt paving and pavement painting activities.[3] Construction equipment emissions are generally estimated using two basic methodologies (nonroad and on-road) depending on the type of construction equipment. Nonroad construction equipment (e.g., bulldozers, backhoes, front end loaders) are generally operated off road and on the construction site. On-road construction equipment (e.g., semi-trucks for material hauling), in contrast, can be operated on public roads. Emissions for on-road construction equipment and nonroad construction equipment were estimated separately, following standard industry practices.

G.1.1 NONROAD CONSTRUCTION EQUIPMENT

Nonroad construction equipment includes dozers, loaders, sweepers, and other heavy-duty construction equipment that operates on the construction site, but is not licensed to travel on public roadways. Nonroad equipment emissions were calculated as shown in **Equation G-1**.

Nonroad equipment types, models, horsepower, and load factor were assigned to each construction task for the Proposed Action Alternative, as previously described. Equipment operating times were derived assuming a 10-hour-per-day, 6-day-per-week workweek. To account for equipment downtime throughout the day, an equipment-specific efficiency factor was calculated from data obtained from the California Air Resources Board (CARB) OFFROAD2007 emission factor model, consistent with the methodology used in the LAX Runway 7L/25R RSA EA.

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2 City of Los Angeles, Los Angeles World Airports, *Final Environmental Assessment for Los Angeles International Airport (LAX) Runway 7L/25R Runway Safety Area (RSA) and Associated Improvements Project*, August 2013.

3 It was assumed that asphalt would be batched offsite at batch plant facilities operating under stationary source permits and therefore, emissions were not estimated separately for batch plants.

Equation G-1 Nonroad Construction Equipment Emissions Calculation Equation

$$E = HP \times L \times H \times e \times EF$$

Where:

E	=	emissions (lb/day)
HP	=	horsepower
L	=	load factor
H	=	total hours per day of equipment operation
e	=	efficiency factor
EF	=	emission factor (lb/hp-hr)

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

Emission factors for nonroad equipment were obtained from several sources. For CO and SO_X, emission factors were obtained from CARB's OFFROAD2007 emission factor model for 2015. For each construction equipment type, the model generates emissions in tons per day for several horsepower ranges/bins. For each equipment type and horsepower bin combination, the emissions in tons per day were multiplied by 2000 (pounds per ton) and divided by activity (hours per day), load factor (from the OFFROAD2007 data file), and average horsepower (from the OFFROAD2007 data file). Using this methodology, an emission factor in pounds per horsepower-hour (lb/hp-hr) was derived for each equipment type by horsepower bin. The emission factor applied to a given piece of equipment was then selected based on the horsepower of the equipment. It should be noted that the OFFROAD2007 model does not include every specific type of equipment assumed for construction of the Proposed Action Alternative. Where necessary, specific equipment types were matched with an equivalent/representative OFFROAD2007 equipment type for purposes of selecting an appropriate emission factor.

Emission factors for VOC, NO_X, and PM_{10} were obtained and used based on construction-related air quality control measures developed for LAX. All off-road diesel-powered construction equipment greater than 50 horsepower was assumed to meet USEPA Tier 4 off-road emission standards for these pollutants (final Tier 4 NO_X standards were assumed for most equipment types, based on assumptions used in the LAX Runway 7L/25R RSA EA). These emissions standards are reflected in emission factors reported in grams per horsepower-hour (g/hp-hr) for various horsepower ranges. The factors were converted to lb/hp-hr for emissions calculation purposes.

CARB's OFFROAD2011 emission factor model was used for deriving emission factors of VOC, NO_X, and PM_{10} for off-road construction equipment less than 50 horsepower. The computation of emission factors from OFFROAD2011 was performed essentially identically to the methodology described previously for deriving emission factors from OFFROAD2007.

$PM_{2.5}$ emission factors were derived using the PM_{10} emission factors and $PM_{2.5}$ size profiles derived from the CARB-approved California Emission Inventory Development and Reporting System (CEIDARS) database. In this case, a factor of 0.92 was applied to PM_{10} emission factors to derive $PM_{2.5}$ emission factors. This factor represents the size fraction of PM_{10} emissions that can be assumed to be $PM_{2.5}$ emissions with respect to diesel vehicle exhaust.

The data used to estimate emissions from nonroad construction equipment in 2015, as well as total emissions by equipment type, are presented in **Table G-1**.

G.1.2 ON-ROAD ON-SITE CONSTRUCTION EQUIPMENT

On-road on-site equipment emissions are generated from on-site pickup trucks, water trucks, haul trucks, cement trucks, flatbed trucks, and other trucks that are licensed to travel on public roadways. **Equation G-2** was used to calculate emissions from on-road on-site equipment.

Equation G-2 On-Road Construction Equipment Emissions Calculation Equation

E = VMT × EF

Where:

E	=	emissions (lb/day)
VMT	=	vehicle miles traveled per day
EF	=	emission factor (lb/mile)

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

Equipment types and specifications by construction activity for on-road on-site equipment were developed in the same way as nonroad equipment. Emissions factors for all criteria pollutants (including $PM_{2.5}$) for on-road on-site equipment were obtained from CARB's EMFAC2011 emission factor model. The EMFAC2011 model was run for 2015 and each seasonal period (annual, summer, winter) in the South Coast Air Basin.

Table G-1 Nonroad Construction Equipment Emissions – 2014

							EMISSION FACTORS (POUNDS PER HORSEPOWER-HOUR)								EMISSIONS (TONS PER YEAR) [1/]					
EQUIPMENT	FUEL	LOAD FACTOR	HORSEPOWER	USAGE FACTOR	HOURS	EMISSION TIER	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	FUGITIVE PM_{10}	FUGITIVE $PM_{2.5}$	CO	VOC	NO_X	SO_X	PM_{10} [2/]	$PM_{2.5}$ [2/]
Asphalt Paver, 130 HP	Diesel	0.42	200	0.39	400	4	0.0036	0.0003	0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0236	0.0020	0.0217	0.0001	0.0002	0.0002
Backhoe Loader, 48 HP	Diesel	0.37	83	0.45	12,220	4	0.0084	0.0003	0.0055	0.0000	0.0009	0.0002	0.0009	0.0001	0.7134	0.0261	0.4665	0.0012	0.0764	0.0137
Compactor, Roller, Vibratory, 25 Ton	Diesel	0.38	315	0.33	260	4	0.0032	0.0003	0.0033	0.0000	0.0075	0.0041	0.0074	0.0041	0.0164	0.0016	0.0170	0.0001	0.0383	0.0211
Concrete Pump	Diesel	0.36	290	0.40	320	4f	0.0035	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0232	0.0020	0.0043	0.0001	0.0002	0.0002
Concrete Saw	Diesel	0.42	10	0.29	2,950		0.0052	0.0024	0.0123	0.0000	0.0011	0.0010	0.0000	0.0000	0.0093	0.0043	0.0221	0.0000	0.0020	0.0018
Dozer, 200 HP	Diesel	0.40	305	0.76	175	4f	0.0059	0.0003	0.0007	0.0000	0.0032	0.0018	0.0032	0.0018	0.0475	0.0025	0.0053	0.0001	0.0260	0.0144
Dozer, 300 HP	Diesel	0.40	305	0.76	1,533	4f	0.0059	0.0003	0.0007	0.0000	0.0032	0.0018	0.0032	0.0018	0.4158	0.0218	0.0467	0.0009	0.2273	0.1258
FE Loader, W.M., 1.5 CY	Diesel	0.37	220	0.45	1,300	4f	0.0026	0.0003	0.0007	0.0000	0.0004	0.0001	0.0003	0.0000	0.0621	0.0074	0.0158	0.0003	0.0086	0.0019
FE Loader, W.M., 4 CY	Diesel	0.37	499	0.45	11,940	4f	0.0026	0.0003	0.0007	0.0000	0.0002	0.0001	0.0001	0.0000	1.2804	0.1534	0.3288	0.0070	0.0883	0.0260
Generator	Diesel	0.42	749	0.06	320	4f	0.0025	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0068	0.0008	0.0018	0.0000	0.0001	0.0001
Grader, 30,000 lbs	Diesel	0.41	275	0.45	555	4f	0.0031	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0436	0.0043	0.0092	0.0002	0.0005	0.0004
Heating Kettle, 115 Gallon	Diesel	0.42	85	0.33	680	4	0.0081	0.0003	0.0055	0.0000	0.0000	0.0000	0.0000	0.0000	0.0321	0.0012	0.0219	0.0001	0.0001	0.0001
Hyd. Crane 25 tons	Diesel	0.29	130	0.60	125	4f	0.0075	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0105	0.0004	0.0009	0.0000	0.0000	0.0000
Hyd. Excavator, 1 C.Y.	Diesel	0.38	222	0.67	280	4f	0.0027	0.0003	0.0007	0.0000	0.0001	0.0000	0.0001	0.0000	0.0216	0.0025	0.0053	0.0001	0.0012	0.0004
Hyd. Hammer (1200 lbs)	Diesel	0.42	222	0.46	11,940	4f	0.0026	0.0003	0.0007	0.0000	0.0032	0.0004	0.0031	0.0004	0.6697	0.0780	0.1672	0.0036	0.8024	0.1032
Paint Thermo. Striper, TM	Diesel	0.30	85	0.24	680	4	0.0082	0.0003	0.0055	0.0000	0.0000	0.0000	0.0000	0.0000	0.0172	0.0007	0.0116	0.0000	0.0001	0.0001
Pavt. Rem. Bucket	Diesel	0.38	222	0.67	11,940	4f	0.0027	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.9202	0.1048	0.2247	0.0048	0.0112	0.0103
Pvmt. Profiler, 750 HP	Diesel	0.36	750	0.40	1,300	4f	0.0035	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.2433	0.0213	0.0456	0.0010	0.0023	0.0021
Roller, Pneum., Whl., 12 Ton	Diesel	0.38	145	0.33	400	4	0.0071	0.0003	0.0055	0.0000	0.0162	0.0089	0.0161	0.0089	0.0260	0.0011	0.0200	0.0001	0.0588	0.0324
S.P. Crane, 4x4, 5 Ton	Diesel	0.29	125	0.60	4,720	4f	0.0075	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.3824	0.0158	0.0338	0.0007	0.0017	0.0016
Scraper, Towed, 10 C.Y.	Diesel	0.48	450	0.53	810	4f	0.0042	0.0003	0.0007	0.0000	0.0048	0.0008	0.0048	0.0007	0.1923	0.0142	0.0305	0.0006	0.2223	0.0348
Tandem Roller, 10 Ton	Diesel	0.38	145	0.33	400	4	0.0071	0.0003	0.0055	0.0000	0.0162	0.0089	0.0161	0.0089	0.0260	0.0011	0.0200	0.0001	0.0588	0.0324
Vibrator	Diesel	0.42	8	0.10	1,280		0.0077	0.0024	0.0123	0.0000	0.0011	0.0010	0.0000	0.0000	0.0016	0.0005	0.0026	0.0000	0.0002	0.0002
Belt Placer	Diesel	0.36	200	0.40	170	4f	0.0035	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0085	0.0007	0.0016	0.0000	0.0001	0.0001
Concrete Paver	Diesel	0.42	335	0.39	170	4f	0.0044	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0203	0.0014	0.0031	0.0001	0.0002	0.0001
Cure/Texture Rig	Diesel	0.36	70	0.40	170	4f	0.0089	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0075	0.0003	0.0006	0.0000	0.0000	0.0000
Total															**5.0027**	**0.4498**	**1.5126**	**0.0208**	**1.6003**	**0.4694**

Notes:

Columns may not add to totals shown because of rounding.

1/ Vehicle emissions are calculated by multiplying the annual hours, load factor, horsepower, emission factor, usage factor, and conversion factor (1 ton/2000 pounds = 0.0005) to create a value of tons per year for each piece of equipment.

2/ PM_{10} and $PM_{2.5}$ emissions include fugitive dust.

Source: Ricondo & Associates, Inc., January 2014, based on information provided by URS Corporation and MARRS Services, Inc.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

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EMFAC2011 contains a comprehensive list of vehicle categories. For this analysis, on-site pickup trucks were assumed to be represented by the LHD2 (gasoline) EMFAC2011 vehicle category, which is defined as light-heavy-duty trucks (10,001-140,000 lbs.). All other on-road on-site equipment was assumed to be represented by the T7 single construction (diesel) EMFAC2011 vehicle category. This category is defined as heavy-heavy duty diesel single unit construction trucks. In accordance with construction-related air quality control measures developed for LAX, emission factors for these vehicles were modeled for model year 2007 vehicles to represent compliance with U.S. EPA 2007 on-road emissions standards.

For diesel vehicles, the EMFAC2011 factors account for running and idling emissions for all pollutants. PM_{10} and $PM_{2.5}$ factors include tire and brake wear. For gasoline vehicles, VOC emission factors include diurnal, hot soak, running, and resting emissions, and the PM_{10} and $PM_{2.5}$ factors include tire and brake wear. EMFAC2011 emission factors are expressed in pounds per mile; therefore, roundtrip distances for on-site travel were determined for each vehicle type to calculate emissions in pounds per day. Travel distances were assumed to be 5 miles roundtrip for water trucks and sweepers, and 2 miles roundtrip for all other vehicles. In addition, on-road on-site vehicles were assumed to travel at a speed of 20 mph. These assumptions are consistent with the LAX Runway 7L/25R RSA EA.

In accordance with construction-related air quality control measures developed for LAX, diesel vehicles (in this case the T7 single construction vehicles) were assumed to be fitted with exhaust retrofit devices providing an 85-percent reduction in PM_{10} and $PM_{2.5}$ emissions.

Table G-2 presents the EMFAC2011 emission factors used to calculate emissions for on-road on-site construction equipment for the Proposed Action Alternative for 2015. The emission factor for fugitive dust accounts for emissions of fugitive dust particulate matter entrained by vehicular travel on paved roads.

Table G-2 On-Road On-Site Construction Equipment Emission Factors

	EMISSION FACTORS (GRAMS/VEHICLE-MILE) 1/						FUGITIVE DUST 2/	
VEHICLE TYPE	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Water Truck	1.3604	0.4435	9.3213	0.0168	0.0422	0.0334	1.9435	0.1390
Flatbed Truck	1.3604	0.4435	9.3213	0.0168	0.0422	0.0334	1.9435	0.1390
Pickup Truck	11.9438	1.1704	1.4329	0.0126	0.0564	0.0284	1.9435	0.1390
Road Sweeper	1.3604	0.4435	9.3213	0.0168	0.0422	0.0334	1.9435	0.1390
Truck Tractor	1.3604	0.4435	9.3213	0.0168	0.0422	0.0334	1.9435	0.1390
Transit Mixer	1.3604	0.4435	9.3213	0.0168	0.0422	0.0334	1.9435	0.1390

Notes:

1/ Assuming an average speed of 20 miles per hour for on-road on-site vehicle trips.

2/ Fugitive dust emission factor measured in grams/vehicle-mile and derived from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors AP-42, Volume I: Stationary Point and Area Sources*, Chapter 13.2.2, "Unpaved Roads," updated November 2006.

SOURCE: Ricondo & Associates, Inc., December 2013, based on output from the California Air Resources Board EMFAC2011 emission factor model.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

Table G-3 presents emissions estimates for on-road on-site construction equipment for the Proposed Action Alternative.

Table G-3 On-Road On-Site Construction Equipment Emissions

				EMISSIONS (TONS PER YEAR)					
VEHICLE TYPE	ROUNDTRIPS PER YEAR	MILES PER TRIP	VMT 1/	CO	VOC	NO_X	SO_X	PM_{10} 2/	$PM_{2.5}$ 2/
Water Truck	5	5	25	0.0000	0.0000	0.0003	0.0000	0.0001	0.0000
Flatbed Truck	551	2	1,101	0.0017	0.0005	0.0113	0.0000	0.0024	0.0002
Pickup Truck	8,805	2	17,610	0.2319	0.0227	0.0278	0.0002	0.0388	0.0032
Road Sweeper	26	5	130	0.0002	0.0001	0.0013	0.0000	0.0003	0.0000
Truck Tractor	54	2	108	0.0002	0.0001	0.0011	0.0000	0.0002	0.0000
Transit Mixer	192	2	384	0.0006	0.0002	0.0039	0.0000	0.0008	0.0001
Total				**0.2345**	**0.0236**	**0.0458**	**0.0003**	**0.0426**	**0.0036**

Notes:

Columns may not add to totals shown because of rounding.

1/ Vehicle miles traveled (VMT) is calculated by multiplying the total number of vehicle trips by the trip distance.

2/ PM_{10} and $PM_{2.5}$ emissions include fugitive dust (entrained road dust).

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

G.1.3 ON-ROAD OFF-SITE CONSTRUCTION EQUIPMENT

On-road off-site trips include personal vehicles used by construction workers to access the construction site, as well as hauling trips for the transport of various materials to and from the site. The emissions calculation is the same as the calculation of on-site on-road vehicles.

Emission factors for on-road off-site vehicles were obtained from EMFAC2011 in the same way as described previously for on-road on-site vehicles, although emission factors were used in units of g/mi and applied to the VMT estimates to calculate total emissions. For all on-road off-site vehicles, emission factors were obtained assuming an aggregated speed. **Table G-4** presents the EMFAC2011 emission factors used to calculate emissions for on-road off-site construction equipment for the Proposed Action Alternative for 2015.

Table G-4 On-Road Off-Site Construction Equipment Emission Factors

	EMISSION FACTORS (GRAMS/VEHICLE-MILE) [1/]						FUGITIVE DUST [2/]	
VEHICLE TYPE	**CO**	**VOC**	**NO_X**	**SO_X**	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Employee Vehicles	6.9347	0.6145	0.5630	0.0087	0.0635	0.0350	0.2998	0.0736
Construction Material Deliveries	1.5909	0.2937	6.6345	0.0171	0.1087	0.0455	2.8998	0.7118
Concrete Deliveries	1.7346	0.3136	6.7336	0.0172	0.1088	0.0456	2.8998	0.7118
Asphalt Treated Base Material Deliveries	1.5909	0.2937	6.6345	0.0171	0.1087	0.0455	2.8998	0.7118
Base Material Deliveries	1.5909	0.2937	6.6345	0.0171	0.1087	0.0455	2.8998	0.7118
Asphalt Deliveries	1.5909	0.2937	6.6345	0.0171	0.1087	0.0455	2.8998	0.7118
Cut/Fill Material Hauling	1.5909	0.2937	6.6345	0.0171	0.1087	0.0455	2.8998	0.7118
Demolished Pavement Material Hauling	3.2673	0.5265	7.7908	0.0191	0.1093	0.0461	2.8998	0.7118

Notes:

1/ Assuming an aggregate speed for on-road on-site vehicle trips.

2/ Fugitive dust emission factor measured in grams/vehicle-mile and derived from U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors AP-42, Volume I: Stationary Point and Area Sources*, Chapter 13.2.1, "Paved Roads," updated January 2011.

SOURCE: Ricondo & Associates, Inc., December 2013, based on output from the California Air Resources Board EMFAC2011 emission factor model.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

Total daily construction workers for a given construction activity was derived from crew data provided by MARRS Services, Inc. for the LAX Runway 7L/25R RSA EA. Total daily workers were converted to daily vehicle trips by assuming a factor of 1.15 workers per vehicle per trip. Daily VMT for construction worker vehicles was then calculated by multiplying the number of daily vehicle trips by an assumed roundtrip distance of 40 miles. To represent a mix of construction worker vehicles, the analysis assumed a mix of 50 percent passenger cars (EMFAC2011 vehicle category LDA), 30 percent light-duty trucks (0-3,750 lbs.) (LDT1) and 20 percent light duty trucks (3,751-5,750 lbs.) (LDT2). This vehicle mix is identified in the South Coast Air Quality Management District (SCAQMD) California Emissions Estimator Model (CalEEMod) as an option for modeling emissions from construction worker vehicles and represents a reasonable vehicle mix for such trips.

Off-site hauling trips include the delivery of construction materials, concrete, asphalt, and base material to the construction site, and hauling of excess cut/fill material and demolished pavement from the construction site. The calculation of VMT for on-road on-site hauling trips was based on quantities provided by URS Corporation. Haul trucks were assumed to have a capacity of 20 cubic yards, while transit cement mixers were assumed to have a capacity of 10 cubic yards. Based on information from Connico, Inc., haul trucks were assumed to travel a roundtrip distance of 40 miles for all hauling trips, except for concrete deliveries (25 miles) and hauling of demolished pavement (5 miles). For off-site hauling trips, the T-7 single construction EMFAC2011 vehicle category was assumed for all vehicles.

Table G-5 presents emissions estimates for on-road off-site construction equipment for the Proposed Action Alternative.

Table G-5 On-Road Off-Site Construction Equipment Emissions

				EMISSIONS (TONS PER YEAR)					
VEHICLE TYPE	**ROUNDTRIPS PER YEAR**	**MILES PER TRIP**	**VMT 1/**	**CO**	**VOC**	**NO_X**	**SO_X**	**PM_{10} 2/**	**$PM_{2.5}$ 2/**
Employee Vehicles	14,834	40	593,348	4.5357	0.4019	0.3682	0.0057	0.2377	0.0229
Construction Material Deliveries	500	40	20,000	0.0351	0.0065	0.1463	0.0004	0.0663	0.0167
Concrete Deliveries	4,339	25	108,480	0.2074	0.0375	0.8052	0.0021	0.3598	0.0906
Asphalt Treated Base Material Deliveries	389	40	15,571	0.0273	0.0050	0.1139	0.0003	0.0516	0.0130
Base Material Deliveries	305	40	12,186	0.0214	0.0039	0.0891	0.0002	0.0404	0.0102
Asphalt Deliveries	116	40	4,629	0.0081	0.0015	0.0339	0.0001	0.0154	0.0039
Cut/Fill Material Hauling	600	40	24,016	0.0421	0.0078	0.1756	0.0005	0.0796	0.0200
Demolished Pavement Material Hauling	2,023	5	10,115	0.0364	0.0059	0.0869	0.0002	0.0336	0.0085
Total				**4.9135**	**0.4700**	**1.8190**	**0.0094**	**0.8843**	**0.1857**

Notes:

Columns may not add to totals shown because of rounding.

1/ Vehicle miles traveled (VMT) is calculated by multiplying the total number of vehicle trips by the trip distance.

2/ PM_{10} and $PM_{2.5}$ emissions include fugitive dust (entrained road dust).

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

G.1.4 PAVEMENT CRUSHING

Various elements of the Proposed Action Alternative involve the demolition of existing concrete or asphalt pavement. It was assumed that the demolished pavement would be hauled to an on-site crusher and crushed. The crushing process generates exhaust emissions from the running crusher, as well as fugitive dust. **Table G-6** presents the methodology and results of estimating emissions associated with utilization of the crusher equipment.

Table G-6 Pavement Crushing Emissions

Runway material to be crushed:	Cubic Feet	Pavement	Tons
Reinforced PCC Keel Replacement	847,703	Concrete	61,458
Taxiway AA Pavement Rehab & Hold Bar Rotation	182,400	Concrete	13,224
Infield VSR	30,011	Asphalt	2,176
North Perimeter Vehicle Service Road (VSR)	32,354	Asphalt	2,346

Asphalt density (lbs/cf):	145
Concrete density (lbs/cf):	145

Sources: National Asphalt Association and Portland Cement Association

Average throughput for crusher:	
Crushing of concrete:	175 tons/hour
Crushing of asphalt:	300 tons/hour

Source: HNTB Corporation, based on conversations with crushing contractors

Crusher Operating Hours (per Year)	
Reinforced PCC Keel Replacement	351
Taxiway AA Pavement Rehab & Hold Bar Rotat	76
Infield VSR	7
North Perimeter Vehicle Service Road (VSR)	8

Crusher Operating Emissions	
Ref. Model	CAT 325L
Fuel	Diesel
Horsepower	168
Load Factor	0.415
Usage Factor	0.459
Emissions Tier	Tier 4

Emission Factors (lb/hp-hr)	
CO	0.00716
VOC	0.00031
Nox	0.00551
Sox	0.00001
PM10	0.00003
PM2.5	0.00003

Fugitive Dust Emission Factors (lb/ton):

Source	PM10/PM2.5
Tertiary Crushing (controlled)	0.00054
Fines Crushing (controlled)	0.0012
Screening (controlled)	0.00074
Fines Screening (controlled)	0.0022
Conveyer Transfer Point (controlled)	0.000046
Total	0.004726 lb/ton

Source: AP-42 Table 11.19.2-2 Emission Factors For Crushed Stone Processing Operations

Emissions (tons/year)	CO	VOC	NOx	SOx	PM10 1/	PM2.5 1/
Reinforced PCC Keel Replacement	0.0403	0.0017	0.0310	0.0001	0.1454	0.1454
Taxiway AA Pavement Rehab & Hold Bar Rotation	0.0087	0.0004	0.0067	0.0000	0.0313	0.0313
Infield VSR	0.0008	0.0000	0.0006	0.0000	0.0051	0.0051
North Perimeter Vehicle Service Road (VSR)	0.0009	0.0000	0.0007	0.0000	0.0055	0.0055
	0.0507	**0.0022**	**0.0390**	**0.0001**	**0.1874**	**0.1874**

Notes:

Columns may not add to totals shown because of rounding.

1/ PM_{10} and $PM_{2.5}$ emissions include fugitive dust.

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

G.1.5 FUGITIVE DUST

Additional sources of PM_{10} and $PM_{2.5}$ emissions associated with construction activities are related to fugitive dust. Fugitive dust includes re-suspended road dust from both off- and on-road vehicles, as well as dust from grading, loading, unloading, and other activities. Additional sources of fugitive dust quantified in the analysis included building demolition, crushing of demolished pavement, and concrete batching.

Fugitive dust emissions (PM_{10} and $PM_{2.5}$) were calculated using the guidance from the USEPA's AP-42, the SCAQMD's CEQA Air Quality Handbook, and documentation associated with CalEEMod. Fugitive dust emissions were calculated for the following construction activities and incorporated into the nonroad, on-road, and pavement crushing emissions analyses, as appropriate:

- Vehicles traveling on paved roads. All off-site on-road vehicles are assumed to travel on paved roads.
- Vehicles traveling on unpaved roads. All on-road on-site vehicles are assumed to travel on unpaved roads.
- On-site construction activities (grading, crushing, loading, hauling and storage)
- An on-site rock crusher. An overall emission factor was derived by summing emission factors for crushing activities including tertiary crushing, fine crushing, and screening.

Water, as required under LAWA construction contracts and also being one of the main dust suppression measures recognized in SCAQMD Rule 402, was assumed to reduce fugitive dust emissions by 61 percent.

G.1.6 FUGITIVE VOCS

The primary source of construction-related fugitive VOC emissions is hot-mix asphalt paving. VOC emissions from asphalt paving operations result from evaporation of the petroleum distillate solvent, or diluent, used to liquefy asphalt cement. Based on the CARB default data contained within CalEEMod, an emission factor of 2.62 pounds of VOC (from asphalt curing) per acre of asphalt material was used to determine VOC emissions from asphalt paving. VOCs resulting from the application of runway/taxiway striping were also estimated. **Table G-7** presents the VOC emissions associated with asphalt paving and pavement striping/painting.

Table G-7 Asphalt Paving and Pavement Striping Emissions

ASPHALT PAVING EMISSIONS

Asphalt Paving Emission Factor (lbs/acre)	2.62

	AREA (SF)	ACRES	VOC (LB)
Infield VSR	74,043	1.70	4.4535
North VSR	87,957	2.02	5.2904
Total (tons)			**0.0049**

PAVEMENT PAINTING EMISSIONS

Emission Factor (lb/ft2)	0.002316

	PAINT AREA (SF)	VOC (LB)
Runway Rehab	25,000	57.8959
Taxiway AA Rehab	2,500	5.7896
Infield VSR	616	1.4266
North VSR	616	1.4266
Total (tons)		**0.0333**

Notes:

Columns may not add to totals shown because of rounding.

SOURCE: Ricondo & Associates, Inc., January 2014, based on information provided by URS Corporation and methodologies in Appendix A of the CalEEMod User's Guide, February 2011.

PREPARED BY: Ricondo & Associates, Inc., February 2014.

G.1.7 AIRCRAFT OPERATIONS DURING CONSTRUCTION

Runway 6L-24R would be closed for approximately 4 months during the runway rehabilitation construction period; operations from this runway must be accommodated through the use of other runways at LAX during this time. Additionally, operations of ADG IV or greater aircraft would need to shift to other runways during the 2 months of reduced runway length on Runway 6L-24R. In order to determine air quality impacts during this period, airport simulation models (SIMMOD) were developed for the 2015 No Action Alternative and the 2015 runway closure period. Information on the number and types of aircraft operations considered at LAX for 2015 were developed specifically for the Project. These data were used to develop SIMMOD of aircraft operations in order to determine Project-specific taxi/idle times. The SIMMOD used information about facilities and operations to predict specific timing, volume, and location (e.g., runway used) for aircraft operations.

The incremental differences in SIMMOD taxi/idle times were used for the analysis of aircraft emissions associated with the shift in aircraft operations during the runway closure; taxi/idle times during this period will be slightly greater than normal operations during 2015. In addition, to allow for completion of construction work on a portion of the Argo Ditch, Runway 6L-24R must operate at a reduced length of 7,000 feet for a period of 60 days (2 months). Taxi times for this period were calculated using the increased taxiing distance and a taxiway speed of 15 knots. A detailed discussion describing the methodology to the taxi times is found in Section G.2.2, *Aircraft Time in Mode*. A summary of the taxi times are shown in **Table G-8**.

Table G-8 Comparison of Taxi Times during Runway Closure

	2015 NO ACTION	2015 RUNWAY CLOSURE	2015 SHORTENED RUNWAY PERIOD
Arrivals	9.21	9.26	9.39
Departures	12.05	12.62	12.05

SOURCE: Ricondo & Associates, Inc., March 2014.
PREPARED BY: Ricondo & Associates, Inc., March 2014.

Operational aircraft emissions for the No Action Alternative and Proposed Action were calculated using the taxi times in Table G-8 and FAA's Emissions and Dispersion Modeling System (EDMS), Version 5.1.4.1. EDMS is a U.S. EPA approved air quality model that estimates emissions from airport sources based on information input into the model. Aircraft emissions occur during approach, taxi-in (from runway to apron including landing roll), engine startup at the apron, taxi-out (from apron to runway), takeoff, and climb-out; emissions for each of these operational modes were calculated for the 2015 No Action Alternative and the 2015 runway closure period. The taxi/idle times were derived from the SIMMOD results. However, as none of the other operational phases would be affected by the runway closure or reduced runway length, the EDMS default times-in-mode were the basis for climbout, approach, and takeoff times; however, climbout and approach times were adjusted according to the average mixing height adjustment parameters contained in EDMS. For LAX, a mixing height of 1,806 feet above mean sea level was used in the emissions modeling.

The aircraft fleet mix and operational levels for the 2015 No Action Alternative and the 2015 runway closure period were assumed equal to the Proposed Action Alternative, as further discussed in section G.2.

Annual emissions outputs from EDMS for the runway closure and reduced runway length periods, and normal operations, were then normalized based on the 4-month runway closure and 2-month reduced runway period.

Hazardous air pollutant (HAPs) and greenhouse gas (GHG) emissions were calculated in a consistent manner with the methodology for operational impacts, as discussed in sections G.2.3 and G.2.4, respectively.

G.1.8 SUMMARY OF CONSTRUCTION EMISSIONS ANALSYIS

A summary of total construction-related emissions for the Proposed Action Alternative in 2015 is presented in **Table G-9**.

Table G-9 2015 Construction Emissions Summary (Criteria Pollutants)

	EMISSIONS (TONS/YEAR)					
SOURCE	**CO**	**VOC**	**NO_X**	**SO_X**	**PM_{10}**	**$PM_{2.5}$**
Nonroad Equipment	5.003	0.450	1.513	0.021	1.600	0.469
On-Road On-Site Equipment	0.234	0.024	0.046	0.000	0.043	0.004
On-Road Off-Site Equipment	4.914	0.470	1.819	0.009	0.884	0.186
Pavement Crushing	0.051	0.002	0.039	0.000	0.187	0.187
Asphalt Paving		0.005				
Pavement Striping		0.033				
Incremental Aircraft Operations	36.503	4.640	6.502	-	0.275	0.275
Total	**46.704**	**5.627**	**9.918**	**0.031**	**2.990**	**1.121**

Notes:

Columns may not add to totals shown because of rounding.

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

G.1.9 HAZARDOUS AIR POLLUTANTS

Hazardous air pollutants (HAPs) are pollutants that do not have established NAAQS, but present potential adverse human health risks from short-term (acute) or long-term (chronic) exposures. Although the analysis of HAPs is not an FAA requirement, the HAPs inventory presented in the EA is for disclosure purposes. HAPs of concern that were included in this analysis were included based on emissions estimates and human toxicity information, as well as results of the *LAX Master Plan Final Environmental Impact Statement/Environmental Impact Report* Human Health Risk Assessment.[4]

Both organic and particulate-bound HAPs were calculated for this EA. HAPs exist in air as either reactive organic gases or particulate matter. For purposes of this EA, organic emissions are represented by volatile organic compounds (VOC). Emission inventories of organic HAPs were developed from VOC emission inventories for the same construction sources as previously outlined. HAPs associated with small particles, or those particles less than 10 microns in diameter (PM_{10}), are the focus for particulate emissions, because this size fraction can deposit in the lung and are therefore primarily responsible for inhalation exposure. Speciation profiles were applied to annual emissions inventories for VOC and PM_{10} from individual source types.

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[4] City of Los Angeles, Los Angeles World Airports, *Los Angeles International Airport Master Plan Final Environmental Impact Statement/Environmental Impact Report*, January 2005.

Emissions of DPM (assumed to be equal to the engine exhaust component of particulates less than 10 microns in diameter) are expected to contribute the majority to total incremental cancer risks for construction sources. Based on previous evaluations of construction impacts at LAX, other HAPs have minimal contributions. However, HAPs emissions inventories evaluated the release of DPM as well as other associated HAPs from construction equipment.

HAPs inventories for construction equipment VOC emissions were developed from Organic Profile No. 818 for diesel-fueled equipment, and Organic Profile No. 2110 for gasoline vehicles. TAC emission inventories for construction equipment PM emissions were developed from Profile No. 425 for diesel-fueled equipment, and Profile No. 420 for construction dust.

G.1.10 GREENHOUSE GASES EMISSIONS INVENTORY

In addition to criteria pollutant emissions, construction equipment is a source of greenhouse gas (GHG) emissions. The project-related construction sources for which GHG emissions were calculated are the same as those calculated for criteria pollutant emissions and include the following:

- Off-Road On-Site Equipment
- On-Road On-Site Equipment
- On-Road Off-Site Equipment

Data such as the project schedule, quantity data, construction equipment usage and construction activity, are used in the same way for developing the GHG emissions inventory as for the criteria pollutant inventory. Differences in methodology as to how applicable GHG emission factors are derived are described in this section.

Off-Road On-Site Equipment

In addition to criteria pollutants, OFFROAD2007 provides data for calculating emission factors for GHGs, including CO_2 and CH_4. For off-road on-site equipment, these emission factors were derived and applied using the same methodology described in Section G.1.1 for CO and SO_X. For each equipment type, the appropriate emission factor for CH_4 was multiplied by its global warming potential (21) and added to the appropriate emission factor for CO_2 (with a global warming potential of 1) to calculate an emission factor of CO_{2e} in lb/hp-hr. This emission factor was then multiplied by equipment horsepower, load factor, an efficiency factor, and total operating hours, resulting in GHG emissions for the 2015 construction year.

On-Road On-Site Equipment

EMFAC2011 was used to obtain emission factors of CO_2. These emission factors were obtained and applied using the same methodology described in Section G.1.2 for criteria pollutants. CO_2 emission factors obtained from EMFAC2011 and used in this analysis assume Pavley-I and Low Carbon Fuel Standard (LCFS) benefits.

In accordance with CARB guidance, for heavy-duty vehicles (assumed to be all on-road on-site vehicles except on-site pickup trucks) emission factors for CH_4 were calculated by multiplying the TOG emission factor by

0.0408. N_2O emission factors for all on-road on-site diesel vehicles were calculated by applying a factor of 0.3316 grams/gallon of fuel consumed by the vehicles. EMFAC2011 was used to derive the gallons of fuel consumed per VMT for T7 single construction vehicles by year. The resulting fuel consumption was multiplied by the grams/gallon factor above to derive an emission factor of N_2O in g/mi. This emission factor was then multiplied by an assumed on-site speed of 20 mph, resulting in an emission factor in g/hr.

For on-road on-site gasoline vehicles (i.e., on-site pickup trucks), EMFAC2011-LDV was used to calculate CH4 emission factors in g/mi and multiplied by an assumed speed of 20 mph to derive emission factors in g/hr. Per CARB guidance, N_2O emission factors for gasoline vehicles were derived by multiplying the appropriate NO_X emission factor (in g/hr) by 4.16 percent.

Once appropriate emission factors for CO_2, CH_4, and N_2O were calculated for each vehicle, a combined emission factor of CO_{2e} was derived by taking the sum of the emission factor of CO_2 (multiplied by a global warming potential of 1), the emission factor for CH_4 (multiplied by a global warming potential of 21) and the emission factor for N_2O (multiplied by a global warming potential of 310). The resulting emission factor of CO_{2e} in g/hr was converted to lb/hr, which was applied to the monthly operating hours for each equipment type to estimate monthly emissions.

On-Road Off-Site Equipment

GHG emission factors and resulting emissions for on-road off-site vehicles were obtained and applied using the same methodology described in Section G.1.3 for criteria pollutants. Emission factors of CO_{2e} for on-road off-site equipment were calculated using the same methodology described previously for on-road on-site equipment, except that emission factors were derived in lb/mi and multiplied by the annual operating hours for each equipment type to estimate monthly emissions.

Greenhouse Gases Emissions Summary

Table G-10 summarizes the total emissions of CO_{2e} generated by the Proposed Action Alternative by each construction sector. Results are shown in metric tons of CO_2e.

Table G-10 2015 Construction Emissions Summary (Greenhouse Gases)

SOURCE	MTCO$_2$e PER YEAR
Nonroad Equipment	1,825.64
On-Road On-Site Equipment	1,310.61
On-Road Off-Site Equipment	1,252.04
Pavement Crushing	8.06
Incremental Aircraft Operations	4,448.69
Total	**8,845.04**

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., February 2014.

G.2 Operational Emissions Analysis

Operational emissions associated with the Proposed Action were calculated using the FAA's Emissions and Dispersion Modeling System (EDMS) Version 5.1.4.1. EDMS is a combined emissions and dispersion model developed by the FAA. EDMS is the FAA's and EPA's preferred guideline model for air quality analyses at airports. The primary applications of the model are to generate an inventory of emissions caused by sources on and around an airport and to calculate pollutant concentrations in the surrounding environment. EDMS data tables include emission factors for civilian and military aircraft, ground support equipment, and motor vehicles. EDMS criteria pollutant emissions inventories include CO, VOC, NO_X, SO_X, PM_{10}, and $PM_{2.5}$. While the EDMS emissions inventory module incorporates EPA-approved methodologies for calculating aircraft emissions, on- and off-road vehicle emissions, and stationary source emissions, only aircraft emissions were calculated in this EA. The Proposed Action Alternative does not alter aircraft takeoff or landing points, auxiliary power units (APUs), ground support equipment (GSE), or on-road mobile sources.

Annual aircraft emissions are a function of the number of annual operations, the aircraft fleet mix (types of aircraft/engines used), the length of time aircraft spend in various modes (taxi/idle, takeoff, climbout, approach, and landing roll), and the emission rates of the engine. The EDMS database contains an expansive list of aircraft types (airframes) and engine types for use in air quality analyses.

G.2.1 ANNUAL OPERATIONS AND FLEET MIX

Annual landing and takeoff (LTO) cycles data were assembled to determine existing and projected pollutant emissions from aircraft operations. LTO cycles are one-half the number of total aircraft operations, because one aircraft operation represents one takeoff or landing. Annual 2012 operations are shown in **Table G-11**. Aircraft engines representing the actual in-use fleet at LAX were applied in EDMS using LAWA's Aircraft Noise and Operations Monitoring System (ANOMS) data, and cross-referenced with proprietary fleet data for air carrier and business jet operations, on the basis of reported aircraft tail number. In segments of the fleet where such matches were not possible, EDMS default engine selections were retained.

Table G-11 LAX 2012 Annual Operations and Fleet Mix (1 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2012 OPERATIONS
A300B4-200	CF6-50C2	1,330
A300F4-600	CF6-80C2A5F	1,330
A319-100	V2527M-A5	20,942
A320-200	V2527-A5	61,829
A321-200	V2533-A5	10,637
A330-200	Trent 772	3,324
A340-200	CFM56-5C4	665
A340-300	CFM56-5C4	1,994

Table G-11 LAX 2012 Annual Operations and Fleet Mix (2 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2012 OPERATIONS
A340-500	Trent 553-61	665
A340-600	Trent 556-61	1,994
A380-800	GP7270	3,324
B737-300	CFM56-3-B1	29,917
B737-400	CFM56-3C-1	4,321
B737-500	CFM56-3-B1	2,659
B737-700	CFM56-7B22	55,846
B737-800	CFM56-7B26	50,860
B737-900	CFM56-7B27	10,970
B747-200	JT9D-7F	665
B747-400	CF6-80C2B1F	12,632
B757-200	PW2037	54,849
B757-300	RB211-535E4B	14,294
B767-200	CF6-80A2	7,313
B767-300	CF6-80C2B7F	12,299
B777-200	PW4090	19,945
B777-200-LR	GE90-110B1	1,330
B777-300	GE90-115B	5,319
B787-800	GEnx-1B64	665
Beechjet 400	JT15D-5, -5A, -5B	1,547
Bombardier Challenger 300	AE3007A1	797
Bombardier Challenger 600	ALF 502L-2	2,872
Bombardier CRJ-100	CF34-3A1	21,757
Bombardier CRJ700	CF34-8C1	47,203
Bombardier CRJ-900	CF34-8C5	10,637
Bombardier Q400	PW150A	6,648
CITATION V	JT15D-5, -5A, -5B	2,345
Convair CV-580	501D22A	375
DC10-10	CF6-6D	1,994
Embraer EMB120 Brasilia	PW118B	41,264
Embraer ERJ 135/140	AE3007A1/3	32,308
Embraer ERJ-145LR	AE3007A1	1,500
Embraer ERJ190	CF34-10E5A1	4,986
Falcon 2000EX	PW308C	797

Table G-11 LAX 2012 Annual Operations and Fleet Mix (3 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2012 OPERATIONS
Gulfstream III	F113-RR-100	797
Gulfstream IV	TAY Mk611-8	4,783
Hawker HS 125-700	TFE731-3	1,459
King Air 200	PT6A-42	1,547
L-100 HERCULES	501D22A	662
Learjet 35/36	TFE731-2-2B	3,189
MD-11	CF6-80C2D1F	2,659
MD-80	JT8D-219	15,291
Raytheon Beech 1900-D	PT6A-67D	6,143
		605,480

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

Annual aircraft operations were developed based on the No Action Alternative and Proposed Action aircraft operations forecasts for 2015, as depicted in **Table G-12**. As the number and types of airport operations do not change under the Proposed Action Alternative, the fleet mix is the same as the No Action Alternative.

Table G-12 2015 Annual Operations and Fleet Mix (1 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2015 OPERATIONS
A300B4-200	CF6-50C2	1,353
A300F4-600	CF6-80C2A5F	1,353
A310-200	CF6-80A3	676
A319-100	V2527M-A5	29,108
A320-200	V2527-A5	59,565
A321-200	V2533-A5	10,153
A330-200	Trent 772	3,384
A340-300	CFM56-5C4	2,707
A340-500	Trent 553-61	676
A340-600	Trent 556-61	2,706
A380-800	GP7270	4,737
B737-300	CFM56-3-B1	17,600
B737-400	CFM56-3C-1	6,769
B737-700	CFM56-7B22	58,894

Table G-12 2015 Annual Operations and Fleet Mix (2 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2015 OPERATIONS
B737-800	CFM56-7B26	72,433
B737-900	CFM56-7B27	18,277
B747-200	JT9D-7F	676
B747-400	CF6-80C2B1F	12,184
B747-800	GEnx-2B67	2,368
B757-200	PW2037	48,739
B757-300	RB211-535E4B	21,660
B767-200	CF6-80A2	7,445
B767-300	CF6-80C2B7F	17,600
B777-200	PW4090	13,200
B777-300	GE90-115B	12,861
B787-800	GEnx-1B64	1,690
Beechjet 400	JT15D-5, -5A, -5B	1,482
Bombardier Challenger 300	AE3007A1	803
Bombardier Challenger 600	ALF 502L-2	3,309
Bombardier CRJ-100	CF34-3A1	42,125
Bombardier CRJ700	CF34-8C1	50,093
Bombardier CRJ-900	CF34-8C5	11,507
Bombardier Q400	PW150A	6,769
CITATION V	JT15D-5, -5A, -5B	2,285
Convair CV-580	501D22A	339
DC10-10	CF6-6D	2,030
DC-8-7	CFM56-2C	676
Embraer EMB120 Brasilia	PW118B	33,292
Embraer ERJ 135/140	AE3007A1/3	803
Embraer ERJ-145LR	AE3007A1	678
Embraer ERJ190	CF34-10E5A1	3,384
Falcon 2000EX	PW308C	803
Gulfstream III	F113-RR-100	803
Gulfstream IV	TAY Mk611-8	4,823
Hawker HS 125-700	TFE731-3	1,702
King Air 200	PT6A-42	1,080
L-100 HERCULES	501D22A	850
Learjet 35/36	TFE731-2-2B	3,214

Table G-12 2015 Annual Operations and Fleet Mix (3 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2015 OPERATIONS
MD-11	CF6-80C2D1F	2,707
MD-80	JT8D-219	8,121
Raytheon Beech 1900-D	PT6A-67D	6,488
		618.978

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

As operations are the same for the No Action and Proposed Action Alternatives, published data was used for the 2020 emissions inventory. The 2020 annual operations and fleet mix are shown in **Table G-13**.

Table G-13 2020 Annual Operations and Fleet Mix (1 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2020 OPERATIONS
A300B4-2	CF6-50C2	1,512
A300F4-6	CF6-80C2A5F	2,388
A310-3	PW4152	108
A319-1	V2522-A5	38,220
A320-2	CFM56-5B4/P	61,430
A321-2	CFM56-5B3/P	10,954
A330-3	PW4168A	5,896
A330-3	PW4168A	284
A340-2	CFM56-5B1/2P	3,122
A340-6	Trent 556-61	4,360
A380-8	TRENT97X	1,740
B707-3	TIO-540-J2B2	10
B727-1	CFM56-2B	46
B727-2	JT8D-9	146
B727-2	JT8D-15	10
B737-1	JT8D-15	18
B737-3	JT8D-17	30,920
B737-4	CFM56-3-B1	7,246
B737-5	CFM56-3C-1	5,792
B737-7	CFM56-3-B1	77,388
B737-8	CFM56-7B22	63,762

Table G-13 2020 Annual Operations and Fleet Mix (2 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2020 OPERATIONS
B747-1	JT9D-7A	224
B747-2	JT9D-7A (MOD V)	642
B747-4	JT9D-7R4G2	22,088
B757-2	PW4056	68,552
B757-3	PW2037	7,928
B767-2	PW2040	10,588
B767-3	CF6-80A	19,594
B767-4	PW4060	100
B777-2	PW4077	14,098
B777-3	PW4077	15,432
DC10-3	PW4056	3,232
Bombardier Challenger 600	ALF 502L-2	2
Bombardier Challenger 601	CF34-3A	4
Bombardier CRJ-705-LR	CF34-8C5 LEC	700
Bombardier CRJ-900-ER	CF34-8C5 LEC	14
Bombardier Learjet 25	CJ610-6	16
Bombardier Learjet 35	TFE 731-2-2B	4
Cessna 150 Series	O-200	4,546
Cessna 172 Skyhawk	O-320	14
Cessna 182	IO-360-B	5,798
Cessna 206	IO-360-B	8,382
Cessna 208 Caravan	#N/A	72
Cessna 441 Conquest II	TPE331-8	16
Cessna 500 Citation I	JT15D-1	13,870
Cessna 500 Citation I	JT15D-1	36,526
Cessna 550 Citation II	JT15D-4 (B,C,D)	3,448
Cessna 650 Citation III	TFE731-3	36,954
Cessna 680 Citation Sovereign	PW306B	92
Cessna 750 Citation X	AE3007C1 (Type 1)	3,170
CNA150	CF6-50C2	14
CNA172	JT9D-59A	26
CNA182	R-1820	18
CNA206	CFM56-2B	168
CNA208	PT6A-114A	250

Table G-13 2020 Annual Operations and Fleet Mix (3 of 3)

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2020 OPERATIONS
CNA441	JT8D-15	626
CNA500	JT8D-17	786
DeHavilland DHC-6-200 Twin Otter	PT6A-20	486
DeHavilland DHC-8-100	PW120A	2,324
DeHavilland DHC-8-300	PW123	142
Dornier 228-200 Series	PT6A-28	528
Embraer EMB120 Brasilia	PW118B	1,738
Embraer ERJ145	AE3007A1E	46
Embraer ERJ170-LR	AE3007A1E	43,988
Gulfstream G200	PW306A	39,056
Gulfstream G400	TAY Mk611-8	1,142
Gulfstream G500	BR700-710A1-10 GulfV	174
Gulfstream II-B	SPEY MK511	3,272
Israel IAI-1125 Astra	TFE731-2/2A	2,282
GULF2-B	CF6-80C2D1F	366
IAI1125	JT8D-217A	266
MU300	JT8D-217C	624
PA28	JT8D-219	24
PA30	V2528-D5	2
Mitsubishi MU-300 Diamond	JT15D-4 (B,C,D)	34
Piper PA-28 Cherokee Series	O-320	5,588
Piper PA-30 Twin Comanche	IO-320-D1AD	226
Piper PA-31 Navajo	TIO-540-J2B2	618
Raytheon Beech 1900-D	PT6A-67D	190
Raytheon Beech Baron 58	TIO-540-J2B2	8,816
Shorts 330	PT6A-45R	2
		705,280

SOURCE: URS Corporation, 2013.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

G.2.2 AIRCRAFT TIME IN MODE

To model aircraft emissions, it is necessary to determine the time for each of the five operating modes that make up an LTO cycle – approach, taxi-in, taxi-out, takeoff, and climbout. To derive times spent in the approach, takeoff, and climbout modes, EDMS uses a dynamic flight performance modeling module that accounts for aircraft weight and meteorological conditions. Mixing heights at LAX are adjusted to 1,806 feet. To obtain taxi-in and taxi-out times, SIMMOD was used, as discussed in Section G.1.7, *Aircraft Operations during Construction*. SIMMOD of aircraft operations for the 2015 No Action and Proposed Action Alternatives were developed in order to determine Project-specific taxi/idle times. Aircraft emissions were then calculated using EDMS and the taxi/idle times derived from the SIMMOD results.

Taxi times for the 2015 No Action and Proposed Action Alternatives were calculated based on the difference of the averages of the following runway operating conditions from SIMMOD:

- Visual flight rules (VFR) with visual approaches – West Flow (69.2%); and
- VFR with simultaneous instrument landing system (ILS) approaches – West Flow (24.6%)

These configurations make up nearly 94 percent of the runway operating configurations at LAX, as shown in **Table G-14**.

Table G-14 LAX Primary Runway Operating Configurations

CONFIGURATION	ANNUAL USE
VFR Visual - West Flow	69.2%
VFR ILS – West Flow	24.6%
VFR ILS – East Flow	2.1%
IFR – West Flow	4.1%

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

Table G-15 depicts the total aircraft operations utilized in the emissions inventories for the 2015 and 2020 calendar years. These operational levels do not differ between the No Action Alternative and the Proposed Action for a given year, and are based upon total operations reported in the FAA Terminal Area Forecast (TAF) and extrapolated annual operations based on the Specific Plan Amendment Study (SPAS) Passenger Forecast. Table G-15 also presents the SIMMOD derived taxi times utilized in the operational emissions analysis by year and alternative. There would be no difference in taxi times between the No Action Alternative and the Proposed Action for either 2015 or 2020. As mentioned above, these are average taxi times based on two of the primary runway operating configurations; they include unimpeded taxi time and ground delay.

Table G-15 Total Aircraft Operations and Taxi Times, by Calendar Year

		TAXI-IN TIME (MINUTES)		TAXI-OUT TIME (MINUTES)	
YEAR	OPERATIONS	NO ACTION	PROPOSED ACTION	NO ACTION	PROPOSED ACTION
2015	618,978 [1/]	9.21	9.21	12.05	12.05
2020	705,281 [2/]	10.90	10.90	13.82	13.82

NOTES:

1/ The 2015 annual operations were extrapolated based on the numbers of forecasted passengers identified in the SPAS Passenger Forecast, a peak month-to-year ratio for July 2012 and the resulting numbers of peak month average day operations for each year between 2009 and 2025.

2/ The 2020 annual operations were obtained from the 2012 Federal Aviation Administration Terminal Area Forecast for 2020.

SOURCE: Ricondo & Associates, Inc., January 2014.
PREPARED BY: Ricondo & Associates, Inc., January 2014.

Annual emissions were calculated in EDMS using the above fleet mixes and times in mode.

G.2.3 HAZARDOUS AIR POLLUTANTS

In addition to criteria pollutants, EDMS also provides HAP emissions for certain pollutants associated with aircraft operations, mainly from formaldehyde, acetaldehyde, acrolein and propylene. Inputs into EDMS were the same as those outlined in Sections G.2.1 and G.2.2 for criteria pollutants.

G.2.4 GREENHOUSE GAS EMISSIONS

Parts of the earth's atmosphere act as an insulating blanket, trapping sufficient solar energy to keep the global average temperature in a suitable range. The blanket is a collection of atmospheric gases called GHGs. These gases – primarily water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone, chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) – all act as effective global insulators, reflecting back to earth visible light and infrared radiation.

The global warming potential (GWP) is the potential of a gas or aerosol to trap heat in the atmosphere; it is the "cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas." Individual GHG species have varying GWP and atmospheric lifetimes. The carbon dioxide equivalent (CO_2e) -- the mass emissions of an individual GHG multiplied by its GWP is a consistent methodology for comparing GHG emissions because it normalizes various GHG emissions to a consistent metric. The three GHGs focused on in this Environmental Assessment are CO_2, CH_4, and N_2O. The reference gas for GWP is CO_2; CO_2 has a GWP of 1. Compared to CH_4's GWP of 21, CH_4 has a greater global warming effect than CO_2 on a molecule-per-molecule basis. N_2O has a GWP of 310.

In addition to criteria pollutants and HAPs emissions, EDMS also provides aircraft CO_2 emissions. Inputs into EDMS were the same as those outlined in Sections G.2.1 and G.2.2 for criteria pollutants. CH_4 and N_2O emissions are not directly estimated by EDMS; therefore, it was necessary to estimate emissions using other methods. Emissions were calculated using fuel burn (converted from lbs to gallons) from EDMS and emission factors (in g/gal of fuel) from the U.S. Energy Information Administration. Emission factors for CH_4 and N_2O are shown in **Table G-16**. Once appropriate emissions for CH_4 and N_2O were calculated, $MTCO_2e$ was calculated by taking the sum of CO_2 emissions (multiplied by a global warming potential of 1), the CH_4 emissions (multiplied by a global warming potential of 21) and the N_2O emissions (multiplied by a global warming potential of 310).

Table G-16 Jet Fuel GHG Emission Factors

FUEL TYPE	CH4 (G/GAL FUEL)	N2O (G/GAL FUEL)
Jet Fuel	0.27	0.31

SOURCE: U.S. Energy Information Administration, "Voluntary Reporting of Greenhouse Gases Program Fuel Emission Coefficients," January 31, 2011, available: www.eia.gov/oiaf/1605/coefficients.html#tbl7.

PREPARED BY: Ricondo & Associates, Inc., January 2014.

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