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.

Estimates of construction-related emissions were developed for the Proposed Action Alternative using standard industry methodologies and techniques. All construction activities are assumed to be completed in 2016; hence construction emissions estimates were developed for calendar year 2016.

Future year emission inventories for 2016 and 2021 were developed for the No Action Alternative, Proposed Action Alternative, Refinement #1 Alternative, and Refinement #7 Alternative evaluated in this environmental assessment.

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 construction of new runway, taxiway, and blast pad pavement, demolition of existing taxiway pavement, demolition and grading of vehicle parking areas, and relocation of a service road and perimeter fence.

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1 For purposes of this analysis, greenhouse gas emissions are estimated in terms of carbon dioxide equivalent (CO_2e).

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 was provided by RS&H and an estimate of various material quantities was provided by Connico, Inc., as published in the Project Definition Booklet (PDB).[2] 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.[3] 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. The construction schedule published in the PDB assumes mobilization commencement beginning in September 2015, with all construction completed in April 2017. For purposes of this analysis, all activities associated with construction of the Proposed Action Alternative are conservatively assumed to take place in 2016.

Sources of construction emissions estimated in this analysis included construction vehicles and equipment, pavement crushing, asphalt paving and pavement painting activities.[4] 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 8-hour-per-day, 5-day-per-week workweek, as stated in the PDB. 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 Los Angeles World Airports, *Runway 6R-24L Safety Area (RSA) Improvements Project Definition Booklet*, June 19, 2014.

3 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.

4 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., July 2014.
PREPARED BY: Ricondo & Associates, Inc., November 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 2016. 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 Project 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 400 horsepower was assumed to meet USEPA Tier 3 off-road emission standards for these pollutants. Off-road diesel-powered construction equipment less than 400 horsepower, but 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 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 2016, 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

$$\mathbf{E = VMT \times EF}$$

Where:

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

SOURCE: Ricondo & Associates, Inc., July 2014.
PREPARED BY: Ricondo & Associates, Inc., November 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 2016 and each seasonal period (annual, summer, winter) in the South Coast Air Basin.

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.

Table G-1: Nonroad Construction Equipment Emissions – 2016

							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	224	4	0.00346	0.00031	0.00331	0.0000	0.0000	0.0000	0.0000	0.0000	0.0127	0.0011	0.0121	0.0001	0.0001	0.0001
Backhoe Loader, 48 HP	Diesel	0.37	83	0.45	2,920	4	0.00838	0.00031	0.00551	0.0000	0.0000	0.0000	0.0009	0.0001	0.1695	0.0062	0.1115	0.0003	0.0182	0.0033
Belt Placer	Diesel	0.36	200	0.40	1,608	4f	0.00338	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0770	0.0070	0.0151	0.0003	0.0008	0.0007
Compactor, Roller,Vibratory, 25 Ton	Diesel	0.38	315	0.33	160	4	0.00304	0.00031	0.00331	0.0000	0.0000	0.0000	0.0074	0.0041	0.0096	0.0010	0.0104	0.0000	0.0236	0.0130
Concrete Paver	Diesel	0.42	335	0.39	1,608	4f	0.00411	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.1814	0.0136	0.0292	0.0005	0.0015	0.0013
Concrete Pump	Diesel	0.36	290	0.40	272	4f	0.00338	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0189	0.0017	0.0037	0.0001	0.0002	0.0002
Concrete Saw	Diesel	0.42	10	0.29	3,048		0.00516	0.00237	0.01218	0.0000	0.0011	0.0010	0.0000	0.0000	0.0096	0.0044	0.0226	0.0000	0.0020	0.0019
Crawler Loader, 3 CY	Diesel	0.37	499	0.45	80	3	0.00253	0.00033	0.00628	0.0000	0.0003	0.0003	0.0001	0.0000	0.0084	0.0011	0.0209	0.0000	0.0016	0.0011
Cure/Texture Rig	Diesel	0.36	70	0.40	1,608	4f	0.00888	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0707	0.0025	0.0053	0.0001	0.0003	0.0002
Dozer, 200 HP	Diesel	0.40	305	0.76	96	4f	0.00552	0.00031	0.00066	0.0000	0.0000	0.0000	0.0032	0.0018	0.0244	0.0014	0.0029	0.0001	0.0142	0.0079
Dozer, 300 HP	Diesel	0.40	305	0.76	1,690	4f	0.00552	0.00031	0.00066	0.0000	0.0000	0.0000	0.0032	0.0018	0.4299	0.0240	0.0515	0.0010	0.2506	0.1387
FE Loader, W.M., 4 CY	Diesel	0.37	499	0.45	2,800	3	0.00253	0.00033	0.00628	0.0000	0.0003	0.0003	0.0001	0.0000	0.2950	0.0386	0.7325	0.0016	0.0554	0.0380
Generator	Diesel	0.42	749	0.06	272	3	0.00238	0.00033	0.00628	0.0000	0.0003	0.0003	0.0000	0.0000	0.0056	0.0008	0.0147	0.0000	0.0008	0.0007
Grader, 30,000 lbs	Diesel	0.41	275	0.45	1,248	4f	0.00302	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0945	0.0097	0.0207	0.0004	0.0010	0.0010
Heating Kettle, 115 Gallon	Diesel	0.42	85	0.33	216	4	0.00801	0.00031	0.00551	0.0000	0.0000	0.0000	0.0000	0.0000	0.0101	0.0004	0.0070	0.0000	0.0000	0.0000
Hyd. Crane 25 tons	Diesel	0.29	130	0.60	112	4f	0.00746	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0094	0.0004	0.0008	0.0000	0.0000	0.0000
Hyd. Excavator, 1 C.Y.	Diesel	0.38	222	0.67	800	4f	0.00268	0.00031	0.00066	0.0000	0.0000	0.0000	0.0001	0.0000	0.0609	0.0070	0.0151	0.0003	0.0033	0.0011
Hyd. Hammer (1200 lbs)	Diesel	0.42	222	0.46	2,800	4f	0.0026	0.00031	0.00066	0.0000	0.0000	0.0000	0.0031	0.0004	0.1540	0.0183	0.0392	0.0008	0.1882	0.0242
Paint Thermo. Striper, TM	Diesel	0.30	85	0.24	216	4	0.0081	0.00031	0.00551	0.0000	0.0000	0.0000	0.0000	0.0000	0.0054	0.0002	0.0037	0.0000	0.0000	0.0000
Pavt. Rem. Bucket	Diesel	0.38	222	0.67	2,800	4f	0.00268	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.2132	0.0246	0.0527	0.0011	0.0026	0.0024
Roller, Pneum., Whl., 12 Ton	Diesel	0.38	145	0.33	128	4	0.00713	0.00031	0.00551	0.0000	0.0000	0.0000	0.0161	0.0089	0.0083	0.0004	0.0064	0.0000	0.0188	0.0104
S.P. Crane, 4x4, 5 Ton	Diesel	0.29	125	0.60	920	4f	0.00746	0.00031	0.00066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0744	0.0031	0.0066	0.0001	0.0003	0.0003
Scraper, Towed, 10 C.Y.	Diesel	0.48	450	0.53	1,048	3	0.00394	0.00033	0.00628	0.0000	0.0003	0.0003	0.0048	0.0007	0.2353	0.0197	0.3752	0.0007	0.3054	0.0614
Tandem Roller, 10 Ton	Diesel	0.38	145	0.33	224	4	0.00713	0.00031	0.00551	0.0000	0.0000	0.0000	0.0161	0.0089	0.0145	0.0006	0.0112	0.0000	0.0329	0.0181
Vibrator	Diesel	0.42	8	0.10	1,088		0.00765	0.00237	0.01218	0.0000	0.0011	0.0010	0.0000	0.0000	0.0014	0.0004	0.0022	0.0000	0.0002	0.0002
Total															**2.1940**	**0.1882**	**1.5733**	**0.0078**	**0.9222**	**0.3263**

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., February 2015, based on information provided by URS Corporation and MARRS Services, Inc.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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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 2016. 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	1.4110	0.4600	9.4360	0.0168	0.0425	0.0338	1.9435	0.1390
Dump Truck	1.4110	0.4600	9.4360	0.0168	0.0425	0.0338	1.9435	0.1390
Flatbed Truck	1.4110	0.4600	9.4360	0.0168	0.0425	0.0338	1.9435	0.1390
Pickup Truck	10.3011	1.0363	1.3425	0.0126	0.0550	0.0272	1.9435	0.1390
Truck Tractor	1.4110	0.4600	9.4360	0.0168	0.0425	0.0338	1.9435	0.1390
Transit Mixer	1.4110	0.4600	9.4360	0.0168	0.0425	0.0338	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., July 2014, based on output from the California Air Resources Board EMFAC2011 emission factor model.
PREPARED BY: Ricondo & Associates, Inc., November 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 – 2016

				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	8	5	40	0.0001	0.0000	0.0004	0.0000	0.0001	0.0000
Flatbed Truck	20	2	40	0.0001	0.0000	0.0004	0.0000	0.0001	0.0000
Flatbed Truck	320	2	640	0.0010	0.0003	0.0067	0.0000	0.0014	0.0001
Pickup Truck	440	2	881	0.0100	0.0010	0.0013	0.0000	0.0019	0.0002
Truck Tractor	128	2	256	0.0004	0.0001	0.0027	0.0000	0.0006	0.0000
Transit Mixer	204	2	408	0.0006	0.0002	0.0042	0.0000	0.0009	0.0001
Total				**0.0122**	**0.0017**	**0.0157**	**0.0000**	**0.0050**	**0.0004**

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., February 2015.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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 2016.

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.

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	6.2398	0.5514	0.5119	0.0086	0.0627	0.0343	0.2998	0.0736
Construction Material Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
Demolished Pavement Material Hauling	3.3175	0.5362	7.8704	0.0191	0.1097	0.0464	2.8998	0.7118
Cut/Fill Material Hauling	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
Econocrete Deliveries	1.7848	0.3233	6.8132	0.0172	0.1091	0.0460	2.8998	0.7118
Concrete Deliveries	1.7848	0.3233	6.8132	0.0172	0.1091	0.0460	2.8998	0.7118
Processed Misc. Base Course Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
Crushed Aggregate Base Course Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
Asphalt Concrete Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
Sod Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
Top Soil Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
Asphalt Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	2.8998	0.7118
EMAS Material Deliveries	1.6411	0.3033	6.7141	0.0171	0.1091	0.0459	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., February 2015, based on output from the California Air Resources Board EMFAC2011 emission factor model.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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 – 2016

				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	6,665	40	686,774	1.8336	0.1620	0.1504	0.0025	0.1065	0.0317
Construction Material Deliveries	400	40	16,000	0.0289	0.0053	0.1184	0.0003	0.0531	0.0134
Demolished Pavement Material Hauling	1,362	5	15,122	0.0249	0.0040	0.0591	0.0001	0.0226	0.0057
Cut/Fill Material Hauling	1,450	40	100,649	0.1049	0.0194	0.4293	0.0011	0.1924	0.0484
Concrete Deliveries	2,530	25	91,805	0.1244	0.0225	0.4750	0.0012	0.2098	0.0528
Processed Misc. Base Course Deliveries	1,287	40	23,338	0.0931	0.0172	0.3810	0.0010	0.1707	0.0430
Crushed Aggregate Base Course Deliveries	84	40	9,826	0.0061	0.0011	0.0248	0.0001	0.0111	0.0028
Asphalt Concrete Deliveries	753	40	5,263	0.0545	0.0101	0.2229	0.0006	0.0999	0.0252
Total				**2.2705**	**0.2417**	**1.8609**	**0.0069**	**0.8661**	**0.2230**

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., February 2015.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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 – 2016

Runway material to be crushed:	Cubic Feet	Pavement	Tons
Runway 24L Component - PCC Pavement	27,500	Concrete	1,994
Runway 24L Component - Parking in RSA	661	Asphalt	48
Runway 6R Component - PCC Pavement	19,015	Concrete	1,379

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)	
Runway 24L Component - PCC Pavement	11
Runway 24L Component - Parking in RSA	0
Runway 6R Component - PCC Pavement	8

Crusher Operating Emissions		**Emission Factors (lb/hp-hr)**	
Ref. Model	CAT 325L	CO	0.00715
Fuel	Diesel	VOC	0.00031
Horsepower	168	Nox	0.00551
Load Factor	0.415	Sox	0.00001
Usage Factor	0.459	PM10	0.00003
Emissions Tier	Tier 4	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/
Runway 24L Component - PCC Pavement	0.0013	0.0001	0.0010	0.0000	0.0047	0.0047
Runway 24L Component - Parking in RSA	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
Runway 6R Component - PCC Pavement	0.0009	0.0000	0.0007	0.0000	0.0033	0.0033
	0.0022	**0.0001**	**0.0017**	**0.0000**	**0.0081**	**0.0081**
Emissions (lb/day)						
Runway 24L Component	0.0661	0.0029	0.0510	0.0001	0.2415	0.2415
Runway 6R Component	0.0902	0.0039	0.0695	0.0002	0.3262	0.3261

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., February 2015.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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 – 2016

ASPHALT PAVING EMISSIONS

Asphalt Paving Emission Factor (lbs/acre)			2.62
	AREA (SF)	**ACRES**	**VOC (LB)**
Taxiway Shoulders and Base Material	1,219,600	28.00	73.3558
Service Roads	27,244	0.63	1.6387
Total (tons)			**0.0375**

PAVEMENT PAINTING EMISSIONS

Emission Factor (lb/ft2)		0.002316
	AREA (SF)	**VOC (LB)**
Pavement Painting, Reflective	175,000	405.2710
Border Painting, Non-Reflective	40,000	92.6334
Total (tons)		**0.2490**

NOTE: Columns may not add to totals shown because of rounding.

SOURCE: Ricondo & Associates, Inc., February 2015, 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 2015.

G.1.7 AIRCRAFT OPERATIONS DURING CONSTRUCTION

Construction of the Proposed Action Alternative would require construction activities within the Runway 6R-24L RSA on both ends of the runway, which would be conducted in two distinct phases, estimated at 6 months each, for the entire 2016 calendar year. The first phase of construction would focus on the RSA improvements to the Runway 24L end; once those improvements are completed, construction of the RSA improvements to the Runway 6R end would be conducted. While an extended closure of the runway is not expected, the Proposed Action Alternative would require connecting taxiways to be intermittently closed during construction. As Runway 6R-24L is the primary departures runway on the north airfield, normal aircraft operations on this runway would need to be adjusted during construction. Operations during each phase of construction are discussed in more detail below.

During the first phase of construction, the eastern 225 feet of the Runway would be closed, also requiring closures of Taxiways V, D7, and E7. A runway length analysis was conducted to determine the number and types of aircraft that would still be able to depart on the reduced departure length of 9,000 feet. Aircraft under this threshold would perform intersection departures from Taxiway E8. Aircraft operations unable to depart from 24L were shifted to Runways 25R and 25L. Additionally, with the closure of Taxiway E7, aircraft would not be able to depart from Runway 24R. Although departures on Runway 24R are infrequent, these operations would be shifted to Runway 24L for aircraft capable of departures on 9,000 feet, and to Runways 25R and 25L for all other aircraft. These assumptions are for analysis purposes only: FAA coordination on the actual number and frequency of flights shifted to other runways will be required to minimize disruption to aircraft operations and changes in approach and departure procedures.

The second phase of construction would focus on RSA improvements to the Runway 6R end; the western 900 feet of the runway would be closed. However, 9,200 feet would be maintained for aircraft departures on Runway 24L during this period. A runway length analysis was also conducted for the second phase of construction. Aircraft capable of departures on 9,200 feet of runway would still takeoff on Runway 24L; aircraft that require a longer distance were shifted to Runways 24R, 25R, and 25L, depending on required takeoff distance. Also during the second phase of construction, nighttime over-ocean operations arriving on Runway 6R would be prohibited; a shift in these arrivals to Runway 6L would need to be coordinated and confirmed with FAA Air Traffic Control. Assumptions for the shift in aircraft operations during construction are discussed in more detail in Appendix E.

In order to determine air quality impacts during the two phases of construction, taxi times were calculated using the increased or decreased taxiing distance from shifting operations to other runways, 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

	2016 NO ACTION TAXI TIME (MINUTES)	2016 PROPOSED ACTION CONSTRUCTION (PHASE 1) TAXI TIME (MINUTES)	2016 PROPOSED ACTION CONSTRUCTION (PHASE 2) TAXI TIME (MINUTES)
Arrivals	10.32	10.32	10.33
Departures	13.16	13.18	13.34

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

Operational aircraft emissions for the No Action Alternative and Proposed Action Alternative 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 2016 No Action Alternative and both phases of the 2016 construction period. The taxi/idle times were derived from previously conducted 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 2016 No Action Alternative and the 2016 construction period were assumed equal to the Proposed Action Alternative, as further discussed in Section F.2. Annual emissions outputs from EDMS for the construction year (2016) were normalized based on the first phase of construction occurring for 6 months and second phase of construction occurring for 6 months.

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 ANALYSIS

A summary of total construction-related emissions for the Proposed Action Alternative in 2016 is presented in **Table G-9**.

Table G-9: 2016 Construction Emissions Summary (Criteria Pollutants)

	EMISSIONS (TONS/YEAR)					
SOURCE	**CO**	**VOC**	**NO_X**	**SO_X**	**PM_{10}**	**$PM_{2.5}$**
Nonroad Equipment	2.194	0.188	1.573	0.008	0.926	0.327
On-Road On-Site Equipment	0.012	0.002	0.016	0.000	0.005	0.000
On-Road Off-Site Equipment	2.270	0.242	1.861	0.007	0.866	0.223
Pavement Crushing	0.002	0.000	0.002	0.000	0.008	0.008
Asphalt Paving		0.037				
Pavement Painting		0.249				
Incremental Aircraft Operations	15.230	1.962	2.626	0.803	0.111	0.111
Total	**19.709**	**2.680**	**6.078**	**0.818**	**1.917**	**0.670**

NOTE: Columns may not add to totals shown because of rounding.

SOURCE: Ricondo & Associates, Inc., February 2015.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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.[5]

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.

[5] 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 criteria pollutants. 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 2016 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 F.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 F.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. Results are shown by emissions source in tons and metric tons.

Table G-10: 2016 Construction Emissions Summary (Greenhouse Gases)

SOURCE	MTCO_2e PER YEAR
Nonroad Equipment	663.820
On-Road On-Site Equipment	6.479
On-Road Off-Site Equipment	794.101
Pavement Crushing	0.354
Incremental Aircraft Operations	1,797.649
Total	**3,262.404**

NOTE: Columns may not add to totals shown because of rounding.

SOURCE: Ricondo & Associates, Inc., February 2015.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

G.2 Operational Emissions Analysis

Operational emissions associated with the No Action Alternative, Proposed Action Alternative, Refinement #1 Alternative, and Refinement #7 Alternative 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.

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 aircraft operations were developed based on the No Action Alternative, Proposed Action Alternative, Refinement #1 Alternative, and Refinement #7 Alternative aircraft operations forecasts for 2016, as shown in **Table G-11**. As the number and types of airport operations do not change under any of the action alternatives, the fleet mix is the same as the No Action Alternative.

[DRAFT]

Table G-11 (1 of 2): 2016 Annual Operations and Fleet Mix

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2016 OPERATIONS
A300B4-2	CF6-50C2	1,055
A300F4-6	CF6-80C2A5F	1,671
A310-2	CF6-80A3	682
A319-1	V2527M-A5	29,308
A320-2	V2527-A5	63,728
A321-2	CFM56-5B3/P	10,224
A330-3	CF6-80E1A3	3,408
A340-2	CFM56-5C2	3,119
A340-6	Trent 556-61	3,016
A380-8	GP7270	4,771
B737-3	CFM56-3-B1	19,088
B737-4	CFM56-3C-1	5,359
B737-5	CFM56-3C-1	51
B737-7	CFM56-7B22	63,838
B737-8	CFM56-7B26	92,285
B747-2	JT9D-7F	742
B747-4	CF6-80C2B1F	12,570
B747-8I	GEnx-2B67	2,766
B757-2	PW2037	61,750
B757-3	RB211-535E4B	11,861
B767-2	CF6-80A2	7,673
B767-3	CF6-80C2B7F	17,379
B767-4	CF6-80C2B8F	166
B777-2	PW4090	9,173
B777-3	GE90-115B	17,068
B787-8	GEnx-1B64	1,704
BEECH1900-D	PT6A-67D	4,107
BEECH200	PT6A-42	74

[Draft]

Table G-11 (2 of 2): 2016 Annual Operations and Fleet Mix

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2016 OPERATIONS
BEECH400	JT15D-5, -5A, -5B	1,072
BEECH58	TIO-540-J2B2	201
CL600	ALF 502L-2	2,868
CNA182	IO-360-B	548
CNA441	TPE331-8	759
CNA500	JT15D-1 series	1,755
CNA560	JT15D-5, -5A, -5B	1,099
CNA650	TFE731-3	97
CNA680	PW308C	1,953
CRJ1	CF34-3A1	48,257
CRJ9	CF34-8C5	64,751
DC10-1	CF6-6D	2,386
DC8-7	CFM56-2C	1,646
DHC8-3	PW123	6,845
ECLIPSE500	PW610F	31
EMB120	PW118B	36,386
ERJ140	AE3007A1/3	151
ERJ145-LR	AE3007A1	1,110
ERJ170	CF34-8E5	2,576
ERJ190	CF34-10E5A1	2,018
GULF2	SPEY MK511-8	489
GULF4-SP	TAY Mk611-8	5,174
HS125-7	TFE731-3	65
IAI1125	TFE731-3	210
LEAR35	TFE731-2-2B	2,457
MD11	CF6-80C2D1F	3,067
MD83	JT8D-219	8,179
MIL-C130	T56-A-15	520
PA28	O-320	42
		645,346

NOTE: Columns may not add to totals shown because of rounding.

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

As the fleet mix and annual operations are the same for the No Action Alternative, Proposed Action Alternative, Refinement #1 Alternative, and Refinement #7 Alternative, published data was used for the 2021 emissions inventory. The 2021 annual operations and fleet mix are shown in **Table G-12**.

Table G-12 (1 of 2): 2021 Annual Operations and Fleet Mix

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2021 OPERATIONS
A300B4-2	CF6-50C2	1,193
A300F4-6	CF6-80C2A5F	1,889
A310-2	CF6-80A3	771
A319-1	V2527M-A5	33,133
A320-2	V2527-A5	72,045
A321-2	CFM56-5B3/P	11,558
A330-3	CF6-80E1A3	3,853
A340-2	CFM56-5C2	3,526
A340-6	Trent 556-61	3,409
A380-8	GP7270	5,394
B737-3	CFM56-3-B1	21,579
B737-4	CFM56-3C-1	6,059
B737-5	CFM56-3C-1	58
B737-7	CFM56-7B22	72,168
B737-8	CFM56-7B26	104,328
B747-2	JT9D-7F	728
B747-4	CF6-80C2B1F	14,210
B747-8I	GEnx-2B67	3,127
B757-2	PW2037	69,808
B757-3	RB211-535E4B	13,409
B767-2	CF6-80A2	8,675
B767-3	CF6-80C2B7F	19,647
B767-4	CF6-80C2B8F	188
B777-2	PW4090	10,370
B777-3	GE90-115B	19,295
B787-8	GEnx-1B64	1,926
BEECH1900-D	PT6A-67D	4,249
BEECH200	PT6A-42	73

Table G-12 (2 of 2): 2021 Annual Operations and Fleet Mix

EDMS AIRCRAFT	EDMS ENGINE	ANNUAL 2021 OPERATIONS
BEECH400	JT15D-5, -5A, -5B	1,110
BEECH58	TIO-540-J2B2	210
CL600	ALF 502L-2	2,995
CNA182	IO-360-B	572
CNA441	TPE331-8	781
CNA500	JT15D-1 series	1,833
CNA560	JT15D-5, -5A, -5B	1,148
CNA650	TFE731-3	101
CNA680	PW308C	2,040
CRJ1	CF34-3A1	49,930
CRJ9	CF34-8C5	73,200
DC10-1	CF6-6D	2,697
DC8-7	CFM56-2C	1,716
DHC8-3	PW123	7,082
ECLIPSE500	PW610F	33
EMB120	PW118B	37,648
ERJ140	AE3007A1/3	156
ERJ145-LR	AE3007A1	1,148
ERJ170	CF34-8E5	2,839
ERJ190	CF34-10E5A1	2,281
GULF2	SPEY MK511-8	511
GULF4-SP	TAY Mk611-8	5,404
HS125-7	TFE731-3	67
IAI1125	TFE731-3	219
LEAR35	TFE731-2-2B	2,567
MD11	CF6-80C2D1F	3,467
MD83	JT8D-219	9,246
MIL-C130	T56-A-15	509
PA28	O-320	44
		718,222

SOURCE: Ricondo & Associates, Inc., February 2015.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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. The taxi/idle times were derived from previous SIMMOD results prepared as part of various LAWA environmental documents. The SIMMOD used information about facilities and operations to predict specific timing, volume, and location (e.g., runway used) for aircraft operations. Aircraft emissions were then calculated using EDMS and the taxi/idle times derived from the SIMMOD results.

Taxi times for the 2016 No Action Alternative, Proposed Action Alternative, Refinement #1 Alternative, and Refinement #7 Alternative were calculated based on the difference of the averages of all runway operating conditions from SIMMOD, as shown in **Table G-13,** along with the change in taxiing distance for each alternative.

Table G-13: 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., August 2014.
PREPARED BY: Ricondo & Associates, Inc., August 2014.

Table G-14 depicts the total aircraft operations utilized in the emissions inventories for the 2016 and 2021 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). Table G-14 also presents the SIMMOD derived taxi times utilized in the operational emissions analysis by year and alternative. There would be a slight difference in taxi times between the No Action Alternative and the action alternatives for both 2016 and 2021, as a result of a slight taxi route modification for departures.

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

[Draft]

Table G-14: Total Aircraft Operations and Taxi Times, by Calendar Year

YEAR	OPERATIONS[1/]	TAXI-IN TIME (MINUTES) NO ACTION	TAXI-IN TIME (MINUTES) PROPOSED ACTION AND REFINEMENT #1 ALTERNATIVE	TAXI-IN TIME (MINUTES) REFINEMENT #7 ALTERNATIVE	TAXI-OUT TIME (MINUTES) NO ACTION	TAXI-OUT TIME (MINUTES) PROPOSED ACTION AND REFINEMENT #1 ALTERNATIVE	TAXI-OUT TIME (MINUTES) REFINEMENT #7 ALTERNATIVE
2016	645,346	10.32	10.32	10.32	13.16	13.18	13.17
2021	718,222	12.06	12.06	12.06	15.20	15.22	15.21

NOTE:

1/ Terminal Area Forecast, Federal Aviation Administration, February 2014.

SOURCE: Ricondo & Associates, Inc., February 2015.
PREPARED BY: Ricondo & Associates, Inc., February 2015.

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-15**. 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-15: Jet Fuel GHG Emission Factors

FUEL TYPE	CH_4 (g/gal FUEL)	N_2O (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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