12 Appendix C – Technical Memoranda

12.10 Appendix to Air Quality Analysis – Construction Related Data

12.10 Appendix to Air Quality Analysis – Construction Related Data

Construction-related emissions are primarily associated the exhaust from heavy equipment (i.e., backhoes, bulldozers, graders, etc.), delivery trucks (i.e., cement trucks, dump trucks, etc.) and construction worker vehicles getting to and from the site; dust from site preparation, land clearing, material handling, equipment movement on unpaved areas, blasting, and demolition activities; and fugitive emissions from the storage/transfer of raw materials. These emissions are temporary in nature and generally confined to the construction site and the access/egress roadways.

Emissions from construction activities were estimated based on the projected construction activity schedule, the number of vehicles/pieces of equipment, the types of equipment/type of fuel used, vehicle/equipment utilization rates, and the year construction occurs. This information was derived directly from the *Estimated Schedule, Manpower and Equipment Utilization during Construction of the Eagle Mountain Pumped-Storage Project* developed by GEI Consultants, which is provided in Section 12.7.

Data regarding the number of pieces and types of construction equipment to be used on the project, the deployment schedule of equipment (monthly and annually), and the approximate daily operating time (including activity level or usage factor)[1] were estimated for each individual construction project based on the previously referenced schedule of construction activity. A construction workday of ten hours was used. However, construction equipment is assumed to operate between two and ten hours per day, based on available usage factors. Construction is expected to occur between 2012 and 2015.

Table 12.10-1 provides a list of construction equipment, along with their horsepower, load factor[2], fuel type, Source Classification Code (SCC) designation and usage factor expected to be used. Load factor and usage factor are presented in greater detail further in this appendix.

The emission inventories for off-road (non-highway) equipment were calculated using emission factors obtained from the California Air Resources Board (CARB)'s OFFROAD emissions model (Version 2007)[3]. Emission factors for on-road (highway) pickup, dump trucks, concrete trucks, employee vehicles, and other on-road regulated vehicles were obtained from the CARB EMFAC[4] motor vehicle emission model. Refer to Tables 12.10-2 through 12.10-6 for a summary of the emission factors developed for this analysis.

[1] Activity level (or usage factor) are defined as the hours of operation for a piece of equipment over a given time.
[2] Load factor (or throttle setting) are the engine performance demands, as a percent of maximum power.
[3] CARB EMFAC2007 Emissions Model, http://www.arb.ca.gov/msei/onroad/latest_version.htm
[4] CARB OFFROAD2007 Emissions Model http://www.arb.ca.gov/msei/offroad/offroad.htm

Emission factors for each equipment type were applied to the anticipated equipment work output (horsepower-hours of expected equipment use). Operating times for the equipment were based on a five-day workweek and a ten-hour workday during which the equipment may be operating.

A usage factor accounting for the percentage of daily operation and a load factor accounting for the average throttle setting relative to capacity were used. That is, a usage factor of 0.75 equates to six hours of operation and a load factor of 0.62 equates to 62 percent of throttle capacity during operation. For the off-road equipment sulfur dioxide and particulate matter emission factors, a diesel sulfur content of 15 parts per million (ultra low sulfur diesel fuel) was assumed, based on EPA mandated regulations effective June 2010.

Table 12.10-1
Construction Equipment

Equipment	Size (hp)	Load Factor	SCC	Usage Factor	Fuel Type
AIR COMPRESSOR	5	0.56	2265006015	0.41	4-Stroke Gasoline
BACKHOE / FRONT END LOADER	87	0.54	2270002060	0.26	Diesel
BACKHOE, TRACKED	75	0.55	2270002066	0.26	Diesel
CHIPPER, WOOD	18	0.78	2265004065	0.00	4-Stroke Gasoline
COMPACTOR	84	0.56	2270002015	0.40	Diesel
COMPACTOR	84	0.56	2270002015	0.55	Diesel
CONCRETE / GROUT PUMP	8	0.69	2265006010	0.42	4-Stroke Gasoline
CRANE, 40 TON	149	0.43	2270002045	0.72	Diesel
CRANE, 70 TON	208	0.43	2270002045	0.47	Diesel
DOZER, D5	175	0.59	2270002063	0.61	Diesel
DOZER, D6	248	0.59	2270002063	0.26	Diesel
DOZER, D8	358	0.59	2270002063	0.38	Diesel
DOZER, D10	539	0.59	2270002063	0.00	Diesel
DRILL, TRACKED	18	0.79	2265002033	0.38	4-Stroke Gasoline
DUMP TRUCK, 15 TON	233	0.57	2270002051	0.47	Diesel
DUMP TRUCK, 34 TON	381	0.57	2270002051	0.48	Diesel
DUMP TRUCK, SEMI TRAILER	618	0.57	2270002051	0.00	Diesel
EXCAVATOR	157	0.57	2270002036	0.41	Diesel
FORKLIFT, ROUGH TERRAIN	83	0.6	2270002057	0.52	Diesel
FRONT END LOADER, TRACKED	37	0.55	2270002072	0.00	Diesel

FRONT END LOADER, WHEELED	87	0.54	2270002060	0.44	Diesel
FUEL / SUPPORT TRUCK	381	0.57	2270002051	0.44	Diesel
GENERATOR, DIESEL	84	0.74	2270006005	0.42	Diesel
HYDROSEED SPRAYER, TRUCK MOUNTED	4	0.5	2265005035	0.00	4-Stroke Gasoline
MOTOR GRADER	1662	0.61	2270002048	0.32	Diesel
PILE DRIVER	85	0.78	2270002054	0.00	Diesel
PUMP TRUCK – CONCRETE	381	0.57	2270002051	0.39	Diesel
POWDER TRUCK	381	0.57	2270002051	0.00	Diesel
SCRAPER, 21 CY, SELF-PROPELLED	356	0.72	2270002018	0.00	Diesel
TRUCK, FLATBED	381	0.57	2270002051	0.36	Diesel
TUNNEL RIG	18	0.79	2265002033	0.49	4-Stroke Gasoline
WATER PUMP, DIESEL	84	0.74	2270006010	0.50	Diesel
WATER TRUCK	381	0.57	2270002051	0.41	Diesel
WELDER AND GENERATOR SET	84	0.74	2270006005	0.54	Diesel
EMPLOYEE VEHICLES				--	
CONCRETE MIXER TRUCK – 8CY		ON-ROAD VEHICLES		0.40	Composite
SEMI TRAILER TRUCK				0.44	

Source: CARB OFFROAD2007

Table 12.10-2
Construction Equipment Emissions Factors (g/hp-hr) for 2012

		Exhaust								Evaporative
Equipment	hp	ROG	CO	NOX	CO2	SO2	PM10	N2O	CH4	ROG
AIR COMPRESSOR	5	11.373	134.347	5.163	429.438	0.015	0.140	0.635	0.649	0.942
BACKHOE / FRONT END	87	1.009	4.040	6.180	568.297	0.007	0.556	0.000	0.091	--
BACKHOE, TRACKED	75	0.837	3.909	5.398	568.297	0.007	0.475	0.000	0.075	--
CHIPPER, WOOD	18	6.628	288.600	3.151	429.438	0.011	3.262	0.230	0.381	6.495
COMPACTOR	84	1.017	3.949	6.379	568.297	0.007	0.554	0.000	0.092	--
CONCRETE / GROUT PUMP	8	6.972	253.287	4.942	429.438	0.012	3.600	0.451	0.399	1.638
CRANE, 40 TON	149	0.771	3.422	5.845	568.297	0.006	0.339	0.000	0.070	--
CRANE, 70 TON	208	0.559	1.571	5.430	568.297	0.006	0.197	0.000	0.050	--
DOZER, D5	175	0.970	3.743	7.158	568.297	0.006	0.415	0.000	0.088	--
DOZER, D6	248	0.788	2.204	6.810	568.297	0.006	0.292	0.000	0.071	--
DOZER, D8	358	0.717	3.261	6.182	568.297	0.006	0.259	0.000	0.065	--
DOZER, D10	539	0.718	3.246	6.286	568.297	0.006	0.261	0.000	0.065	--
DRILL, TRACKED	18	6.854	266.795	4.297	429.438	0.011	3.600	0.269	0.393	1.109
DUMP TRUCK, 15 TON	233	0.501	1.346	4.614	568.297	0.006	0.157	0.000	0.045	--
DUMP TRUCK, 34 TON	381	0.472	1.390	4.063	568.297	0.006	0.147	0.000	0.043	--
DUMP TRUCK, SEMI TRAILER	618	0.475	1.388	4.199	568.297	0.006	0.150	0.000	0.043	--
EXCAVATOR	157	0.653	3.382	4.872	568.297	0.006	0.288	0.000	0.059	--
FORKLIFT, ROUGH TERRAIN	83	0.946	3.972	5.849	568.297	0.007	0.533	0.000	0.085	--
FRONT END LOADER, TRACKED	37	1.330	5.196	5.350	568.296	0.007	0.402	0.000	0.120	--
GENERATOR, DIESEL	84	0.856	3.596	5.808	568.297	0.007	0.457	0.000	0.077	--
HYDROSEED SPRAYER, TRUCK	4	10.108	165.825	4.627	429.438	0.015	0.140	0.698	0.580	--
MOTOR GRADER	162	0.713	3.377	5.476	568.297	0.006	0.316	0.000	0.064	--
PILE DRIVER	85	1.043	3.985	6.272	568.297	0.007	0.583	0.000	0.094	--
SCRAPER, 21 CY, SELF-	356	0.589	2.296	5.332	568.297	0.006	0.210	0.000	0.053	--
WATER PUMP, DIESEL	84	0.887	3.653	5.897	568.297	0.007	0.477	0.000	0.080	--

Source: CARB OFFROAD2007

Table 12.10-3
Construction Equipment Emissions Factors (g/hp-hr) for 2013

		Exhaust								Evaporative
Equipment	hp	ROG	CO	NOX	CO2	SO2	PM10	N2O	CH4	ROG
AIR COMPRESSOR	5	11.375	134.370	5.162	429.438	0.015	0.140	0.635	0.649	0.942
BACKHOE / FRONT END	87	0.937	4.006	5.806	568.297	0.007	0.507	0.000	0.085	--
BACKHOE, TRACKED	75	0.764	3.877	5.018	568.297	0.007	0.421	0.000	0.069	--
CHIPPER, WOOD	18	6.470	285.217	3.177	429.438	0.011	3.332	0.231	0.371	6.256
COMPACTOR	84	0.951	3.915	6.027	568.297	0.007	0.515	0.000	0.086	--
CONCRETE / GROUT PUMP	8	6.838	251.813	4.974	429.437	0.012	3.600	0.453	0.391	1.406
CRANE, 40 TON	149	0.730	3.410	5.498	568.297	0.006	0.315	0.000	0.066	--
CRANE, 70 TON	208	0.527	1.493	5.043	568.297	0.006	0.178	0.000	0.048	--
DOZER, D5	175	0.931	3.712	6.832	568.297	0.006	0.392	0.000	0.084	--
DOZER, D6	248	0.754	2.115	6.449	568.297	0.006	0.273	0.000	0.068	--
DOZER, D8	358	0.689	3.049	5.857	568.297	0.006	0.243	0.000	0.062	--
DOZER, D10	539	0.690	3.035	5.958	568.297	0.006	0.244	0.000	0.062	--
DRILL, TRACKED	18	6.756	265.782	4.332	429.438	0.011	3.600	0.270	0.388	0.976
DUMP TRUCK, 15 TON	233	0.478	1.309	4.226	568.297	0.006	0.141	0.000	0.043	--
DUMP TRUCK, 34 TON	381	0.453	1.327	3.730	568.297	0.006	0.132	0.000	0.041	--
DUMP TRUCK, SEMI TRAILER	618	0.456	1.326	3.855	568.297	0.006	0.135	0.000	0.041	--
EXCAVATOR	157	0.612	3.377	4.527	568.297	0.006	0.260	0.000	0.055	--
FORKLIFT, ROUGH TERRAIN	83	0.870	3.938	5.459	568.297	0.007	0.482	0.000	0.079	--
FRONT END LOADER, TRACKED	37	1.153	5.041	5.075	568.297	0.007	0.350	0.000	0.104	--
GENERATOR, DIESEL	84	0.782	3.559	5.430	568.297	0.007	0.419	0.000	0.071	--
HYDROSEED SPRAYER, TRUCK	4	10.110	165.786	4.628	429.438	0.015	0.140	0.698	0.580	--
MOTOR GRADER	162	0.674	3.369	5.138	568.297	0.006	0.290	0.000	0.061	--
PILE DRIVER	85	0.960	3.941	5.848	568.297	0.007	0.533	0.000	0.087	--
SCRAPER, 21 CY, SELF-	356	0.563	2.140	5.002	568.297	0.006	0.194	0.000	0.051	--
WATER PUMP, DIESEL	84	0.812	3.614	5.513	568.297	0.007	0.438	0.000	0.073	--

Source: CARB OFFROAD2007

Table 12.10-4
Construction Equipment Emissions Factors (g/hp-hr) for 2014

		Exhaust								Evaporative
Equipment	hp	ROG	CO	NOX	CO2	SO2	PM10	N2O	CH4	ROG
AIR COMPRESSOR	5	11.376	134.392	5.162	429.438	0.015	0.140	0.635	0.649	0.941
BACKHOE / FRONT END	87	0.871	3.974	5.458	568.297	0.007	0.460	0.000	0.079	--
BACKHOE, TRACKED	75	0.698	3.849	4.675	568.297	0.007	0.370	0.000	0.063	--
CHIPPER, WOOD	18	6.329	282.286	3.213	429.437	0.011	3.377	0.232	0.363	6.021
COMPACTOR	84	0.888	3.883	5.693	568.297	0.007	0.476	0.000	0.080	--
CONCRETE / GROUT PUMP	8	6.748	250.861	4.993	429.438	0.012	3.600	0.454	0.386	1.228
CRANE, 40 TON	149	0.692	3.400	5.171	568.297	0.006	0.291	0.000	0.062	--
CRANE, 70 TON	208	0.496	1.427	4.608	568.297	0.006	0.161	0.000	0.045	--
DOZER, D5	175	0.893	3.683	6.522	568.297	0.006	0.369	0.000	0.081	--
DOZER, D6	248	0.719	2.030	6.047	568.297	0.006	0.254	0.000	0.065	--
DOZER, D8	358	0.659	2.852	5.490	568.297	0.006	0.227	0.000	0.059	--
DOZER, D10	539	0.660	2.840	5.589	568.297	0.006	0.228	0.000	0.060	--
DRILL, TRACKED	18	6.696	265.135	4.356	429.438	0.011	3.600	0.271	0.384	0.875
DUMP TRUCK, 15 TON	233	0.452	1.283	3.774	568.297	0.006	0.126	0.000	0.041	--
DUMP TRUCK, 34 TON	381	0.431	1.280	3.329	568.297	0.006	0.118	0.000	0.039	--
DUMP TRUCK, SEMI TRAILER	618	0.434	1.279	3.445	568.297	0.006	0.121	0.000	0.039	--
EXCAVATOR	157	0.575	3.373	4.219	568.297	0.006	0.232	0.000	0.052	--
FORKLIFT, ROUGH TERRAIN	83	0.799	3.906	5.110	568.297	0.007	0.432	0.000	0.072	--
FRONT END LOADER, TRACKED	37	0.987	4.890	4.811	568.297	0.007	0.299	0.000	0.089	--
GENERATOR, DIESEL	84	0.710	3.523	5.094	568.297	0.007	0.379	0.000	0.064	--
HYDROSEED SPRAYER, TRUCK	4	10.107	165.875	4.626	429.437	0.015	0.140	0.698	0.580	--
MOTOR GRADER	162	0.636	3.362	4.825	568.297	0.006	0.265	0.000	0.057	--
PILE DRIVER	85	0.879	3.899	5.471	568.297	0.007	0.482	0.000	0.079	--
SCRAPER, 21 CY, SELF-	356	0.536	2.006	4.622	568.297	0.006	0.179	0.000	0.048	--
WATER PUMP, DIESEL	84	0.739	3.578	5.172	568.297	0.007	0.397	0.000	0.067	--

Source: CARB OFFROAD2007

Table 12.10-5
Construction Equipment Emissions Factors (g/hp-hr) for 2015

		Exhaust								Evaporative
Equipment	**hp**	**ROG**	**CO**	**NOX**	**CO2**	**SO2**	**PM10**	**N2O**	**CH4**	**ROG**
AIR COMPRESSOR	5	11.378	134.414	5.162	429.438	0.015	0.140	0.635	0.649	0.941
BACKHOE / FRONT END	87	0.807	3.946	5.045	568.297	0.007	0.416	0.000	0.073	--
BACKHOE, TRACKED	75	0.635	3.824	4.255	568.297	0.007	0.323	0.000	0.057	--
CHIPPER, WOOD	18	6.188	279.367	3.251	429.438	0.011	3.416	0.234	0.355	5.781
COMPACTOR	84	0.827	3.854	5.299	568.297	0.007	0.438	0.000	0.075	--
CONCRETE / GROUT PUMP	8	6.700	250.375	5.002	429.438	0.012	3.600	0.455	0.383	1.093
CRANE, 40 TON	149	0.651	3.391	4.732	568.297	0.006	0.268	0.000	0.059	--
CRANE, 70 TON	208	0.469	1.374	4.201	568.297	0.006	0.145	0.000	0.042	--
DOZER, D5	175	0.853	3.657	6.124	568.297	0.006	0.347	0.000	0.077	--
DOZER, D6	248	0.684	1.951	5.662	568.297	0.006	0.236	0.000	0.062	--
DOZER, D8	358	0.629	2.670	5.139	568.297	0.006	0.211	0.000	0.057	--
DOZER, D10	539	0.630	2.660	5.234	568.297	0.006	0.213	0.000	0.057	--
DRILL, TRACKED	18	6.664	264.808	4.369	429.438	0.011	3.600	0.272	0.382	0.800
DUMP TRUCK, 15 TON	233	0.427	1.263	3.354	568.297	0.006	0.112	0.000	0.039	--
DUMP TRUCK, 34 TON	381	0.409	1.241	2.958	568.297	0.006	0.105	0.000	0.037	--
DUMP TRUCK, SEMI TRAILER	618	0.411	1.241	3.063	568.297	0.006	0.107	0.000	0.037	--
EXCAVATOR	157	0.533	3.369	3.755	568.297	0.006	0.205	0.000	0.048	--
FORKLIFT, ROUGH TERRAIN	83	0.730	3.877	4.702	568.297	0.007	0.383	0.000	0.066	--
FRONT END LOADER, TRACKED	37	0.842	4.761	4.569	568.297	0.007	0.252	0.000	0.076	--
GENERATOR, DIESEL	84	0.639	3.490	4.710	568.297	0.007	0.341	0.000	0.058	--
HYDROSEED SPRAYER, TRUCK	4	10.110	165.787	4.628	429.438	0.015	0.140	0.698	0.580	--
MOTOR GRADER	162	0.596	3.357	4.377	568.297	0.006	0.241	0.000	0.054	--
PILE DRIVER	85	0.799	3.860	5.044	568.297	0.007	0.431	0.000	0.072	--
SCRAPER, 21 CY, SELF-	356	0.510	1.888	4.263	568.297	0.006	0.164	0.000	0.046	--
WATER PUMP, DIESEL	84	0.667	3.544	4.781	568.297	0.007	0.357	0.000	0.060	--

Source: CARB OFFROAD2007

Table 12.10-6
Motor Vehicle Emissions Factors (g/mile)

Light Duty Auto -- Emission Factor									
Year	**ROG**	**CO**	**NOX**	**CO2**	**SO2**	**PM10**	**PM2.5**	**N2O**	**CH4**
2012	0.073	2.400	0.218	310.221	0.003	0.032	0.017	0.005	0.022
2013	0.062	2.138	0.193	309.667	0.003	0.032	0.017	0.005	0.020
2014	0.052	1.910	0.159	309.214	0.003	0.032	0.017	0.005	0.018
2015	0.044	1.718	0.152	308.851	0.003	0.032	0.017	0.005	0.016
Heavy Heavy Duty Vehicle -- Emission Factor									
Year	**ROG**	**CO**	**NOX**	**CO2**	**SO2**	**PM10**	**PM2.5**	**N2O**	**CH4**
2012	1.050	5.161	11.967	2027.333	0.019	0.540	0.459		0.050
2013	0.948	4.601	10.574	2026.682	0.019	0.472	0.397		0.045
2014	0.850	4.078	9.047	2026.088	0.019	0.411	0.340		0.041
2015	0.761	3.615	8.101	2025.597	0.019	0.358	0.291		0.036

Source: CARB EMFAC 2007

For on-road employee vehicles, the anticipated vehicle miles traveled were estimated to determine annual emissions. Assumptions included a one-way trip distance of 65 miles and two trips per day (one-way to/from Indio and Palm Desert) for employee trips. For on-road haul trucks, the anticipated vehicle miles traveled were estimated to determine annual emissions. Assumptions included a one-way trip distance of 5 miles and two trips per day for onsite concrete and dump trucks and a one-way trip distance of 150 miles and two trips per day for offsite hauling (one-way to/from from Ontario). The number of haul trucks was based on the *Schedule, Manpower and Equipment Utilization during Construction of the Eagle Mountain Pumped-Storage Project* developed by GEI Consultants and applied to a grams-mile emissions factor. The following equations were used to obtain annual emission rates for off-road equipment and on-road vehicles:

*Emission Rate (tons/year) = OFFROAD Emission Factor (g/hp-hr) * size (hp) * 8 hours per day * days/year * Load Factor * Usage Factor * (453.59/2000 tons/g)*

*Emission Rate (tons/year) = EMFAC Emission Factor (g/mile) * trips per day * miles per trip * days/year * (453.59/2000 tons/g)*

*Emission Rate (tons/year) = EMFAC Emission Factor (g/hour) * total hours in use * Usage Factor * (453.59/2000 tons/g)*

Additionally, the construction emissions inventories for fugitive dust sources were calculated using emission factors within EPA's AP-42 and SCAQMD *CEQA Air Quality Handbook* and other publications. Fugitive dust emissions result from the following activities: grading, moving soil, and digging, loading/unloading of trucks, movement of trucks on unpaved surfaces, and wind erosion of stockpiles. A particulate matter less than 10 micrometers (PM_{10}) fugitive dust emission factor of 26.4 pounds per day per acre disturbed was used. Particulate matter less than 2.5 micrometers ($PM_{2.5}$)was assumed to be 20.8 percent and 92 percent of PM_{10} for the purposes of this analysis for fugitive dust and offroad equipment, respectively, based on SCAQMD's $PM_{2.5}$ fractions within the *CEQA Air Quality Handbook*.

Erosion control measures and water programs are typically taken to minimize these fugitive dust and particulate emissions. A dust control efficiency of 75 percent due to daily watering and other measures was estimated. Application of water reduces fugitive dust emissions by a factor of approximately 34 to 68 percent (per SCAQMD *CEQA Air Quality Handbook*). It is assumed that one water application per day reduces fugitive dust by 34 percent, two water applications per day reduces fugitive dust by 50 percent, and three water applications per day reduces fugitive dust by 68 percent. Additional measures would allow for a total control efficiency of 75 percent and compliance with SCAQMD Rule 403.

Additionally, construction activities (i.e. tunnel excavation) that involved blasting employed the following emissions factor[5]:

*Blasting Emissions Factor (lbs PM_{10} per day) = 0.2 * 961 * Blast Area (sq.ft)$^{0.8}$ / [Blast Depth (ft)$^{1.8}$ * Moisture Content (%)$^{1.9}$]*

Square footage of the blast area for each associated task was derived from the *Schedule, Manpower and Equipment Utilization during Construction of the Eagle Mountain Pumped-Storage Project* developed by GEI Consultants, and if a blast depth was not provided, 30 feet was assumed. Additionally, one percent moisture content was applied.

[5] Source: *Sonoma County Aggregate Resources Management Plan and Environmental Impact Report (Sonoma County, 1994)*

Concrete Batch Plant

Concrete is composed essentially of water, cement, sand (fine aggregate), and coarse aggregate, consisting of crushed stone. Sand, aggregate, cement, and water are all gravity fed from a weigh hopper into the mixer trucks. The cement is transferred to elevated storage silos. The sand and coarse aggregate are transferred to elevated bins. From these elevated bins, the constituents are fed by gravity or screw conveyor to weigh hoppers, which combine the proper amounts of each material.

Air emissions were determined for the operation of the concrete batching plants. The air emission calculations accounted for the proposed production level, the number, types, and size of equipment. The emission factors can be calculated using the methodology found in EPA *Compilation of Air Pollutant Emission Factors* (AP-42) Section 11.12. The cement unloading and truck loading points have air emission controls applied to them.

Construction Activities

The construction requirements for the Proposed Project will involve a variety of air emissions sources including on- and off-road construction vehicles, machinery and equipment. These emission sources are associated with the following activities:

- Site preparation and earth-moving;
- Transport and placement of fill;
- Leveling and grading of project footprint;
- Drilling, blasting and excavation of tunnel sites;
- Storage and movement of raw and construction materials; and
- Other miscellaneous construction operations (e.g., installation of roadways and underground utilities.).

This section outlines the procedures, data sources, and other analytical parameters to be used in developing the air emissions estimates for constructing the Proposed Project.

Construction Equipment Types

For the purposes of this analysis, the construction equipment types will be subdivided into two categories: off-road equipment and on-road vehicles. Off-road equipment is used to move and grade fill materials, install utilities, pave surfaces, construct necessary structures and install other miscellaneous support features. These include a wide array of scrapers, loaders, dozers, cranes and off-road haul trucks. On-road vehicles include transport trucks for the delivery of raw materials, supplies and equipment, as well as the personal vehicles used by the construction workers. Typical on-road vehicles include automobiles, vans and trucks of various sizes and functions.

Activity Levels and Load Factors

Activity levels are defined as the hours of operation for a piece of equipment over a given time, and load factors are the engine performance demands, as a percent of maximum power. Equipment activity levels are based on the construction requirements and schedule for each project component. GEI Consultants have reviewed the work cycles for each type of equipment to estimate an average activity level for each project and type of equipment. These estimated activity levels for the construction equipment vary depending on the individual project elements and phase.

The peak work force is estimated to be 209 laborers. The total work force is estimated to be 4,674 person months over the duration of construction. The peak monthly on-site equipment items are estimated to be 150 items. The peak daily concrete trucks (on-site) are estimated to be 210 trucks. This estimate assumes the trucks are traveling to and from an on-site batch plant. The peak daily heavy trucks (on-site) are estimated to be 258 trucks. This estimate assumes the trucks are hauling materials to and from locations on-site. The peak monthly off-site truck volume is estimated to be 79 trucks. The total off-site truck volume is estimated to be 925 trucks for the duration of construction. This estimate assumes the off-site trucks are importing the necessary construction materials to the site such as steel linings, steel reinforcement, electrical components, etc.

The average crew size for each major feature of the project construction, the associated average duration in months, and the total number of person months for each item and for the complete project were provided. The type and total number of equipment required for each major feature of the project construction were also provided. Equipment and crew size calculation spreadsheets for each major feature of the project construction were also provided.

Equipment & Vehicle Emissions Factors

The construction-related emission inventories were calculated using emission factors obtained from the CARB OFFROAD 2007 model and EMFAC2007 model, as well as U.S. EPA's *Compilation of Air Pollutant Emission Factors* (AP-42), SCAQMD's *CEQA Air Quality Handbook*, and other accepted guidance.

Fugitive Dust

Fugitive dust emissions during construction are estimated based on the surface area disturbed, expected duration of activity in a given area, and an emissions factors and an emissions reduction based on expected control measures (under CEQA). This emissions factor accounts for fugitive dust emissions from land clearing, ground excavation, cut and fill operations, blasting and excavation operations vehicle travel over construction areas, and wind erosion of exposed areas.

Based on expected exposed area, the construction schedule and acceptable emission factors, the PM_{10} and $PM_{2.5}$ annual emissions from fugitive dust are expected to be 11.0 and 2.53 tons per year, respectively. The PM_{10} and $PM_{2.5}$ daily emissions from fugitive dust are expected to be 84.6 and 19.5 pounds per day, respectively.

Detailed Results

Construction-related annual and daily emissions associated with the Proposed Project are presented, segregated by project year, pollutant type, and equipment/vehicle category, in Tables 12.10-7 through 12.10-10. Off-road equipment amounts to a greater percentage of the emissions for all pollutants except PM_{10} and $PM_{2.5}$, which is dominated by fugitive dust sources.

Off-road equipment contributes approximately 80, 90, 90, 18, 45, and 75 percent of the total CO, VOC, NO_x, PM_{10}, $PM_{2.5}$, and SO_2 emissions, respectively. On-road equipment contributes approximately 20, 10, 10, 2, 5, and 25 percent of the total CO, VOC, NO_x, PM_{10}, $PM_{2.5}$, and SO_2 emissions, respectively. Fugitive dust contributes approximately 80 and 50 percent of the total PM_{10} and $PM_{2.5}$ emissions

The daily emissions are less than the SCAQMD CEQA thresholds for all pollutants except NO_x where the threshold is 100 pounds per day. Without mitigation, the NO_x impact would be significant.

Table 12.10-7
Offroad Equipment Annual Construction Emissions (tons)

Year	CO	VOC	NO_X	PM_{10}	$PM_{2.5}$	SO_2	CO_2	N_2O	CH_4
2012	48.7	6.86	49.6	2.54	2.33	0.06	6,236	0.03	0.58
2013	46.3	7.01	49.1	2.52	2.32	0.07	6,486	0.03	0.60
2014	48.7	7.13	47.3	2.49	2.29	0.07	7,012	0.04	0.61
2015	13.3	1.58	9.20	0.56	0.51	0.02	1,445	0.02	0.13

Source: KB Environmental Sciences, Inc., 2009.

Table 12.10-8
Onroad Vehicles Annual Construction Emissions (tons)

Year	CO	VOC	NO_X	PM_{10}	$PM_{2.5}$	SO_2	CO_2	N_2O	CH_4
2012	10.3	0.60	4.60	0.29	0.21	0.02	1,762	0.02	0.10
2013	11.5	0.85	7.54	0.43	0.32	0.02	2,535	0.02	0.11
2014	11.5	0.54	3.65	0.30	0.20	0.02	2,285	0.03	0.11
2015	2.52	0.08	0.41	0.05	0.03	0.005	486	0.01	0.02

Source: KB Environmental Sciences, Inc., 2009.

Table 12.10-9
Offroad Equipment Daily Construction Emissions (pounds)

Year	CO	VOC	NO_X	PM_{10}	$PM_{2.5}$	SO_2
2012	375	52.8	382	19.5	18.0	0.49
2013	356	53.9	378	19.4	17.8	0.52
2014	375	54.8	364	19.1	17.6	0.56
2015	102	12.2	70.8	4.29	3.95	0.12
CEQA Threshold	550	75	100	150	55	150

Source: KB Environmental Sciences, Inc., 2009.

Table 12.10-10
Onroad Vehicles Daily Construction Emissions (pounds)

Year	CO	VOC	NO_X	PM_{10}	$PM_{2.5}$	SO_2
2012	79.0	4.59	35.4	2.21	1.60	0.13
2013	88.4	6.58	58.0	3.31	2.48	0.19
2014	88.5	4.17	28.1	2.30	1.51	0.17
2015	19.4	0.62	3.17	0.41	0.24	0.04
CEQA Threshold	550	75	100	150	55	150

Source: KB Environmental Sciences, Inc., 2009.