Air Quality and Health Risk Assessment

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October 14, 2014~~July 18, 2014~~

Air Quality Emissions

Air quality calculations were made for combustion sources such as on-road vehicles from employees and haul trucks as well as onsite combustion equipment such as loaders and excavators. Fugitive dust from grading, loading/unloading, vehicle movement on unpaved surfaces, and processing such as hoppers and conveyors was also calculated.

A.1 On-Road Vehicles

Vehicular emissions were computed using the CARB's emission factor model, EMFAC2011, to estimate on-road emissions. Employee trips were modeled using the light-duty auto classification. Paved road dust, break wear, and tire wear particulate emissions were also accounted for and included in the analysis using EMFAC2011 factors and methodologies from CARB and the USEPA. The Proposed Project would include approximately five to six employees, each traveling a round trip distance of 15 miles; assuming 306 working days a year (six-day work week, with six holidays). Additionally, emissions due to employee commutes to and from the work site were calculated, assuming an average commute distance of 7.5 miles (15 miles round trip). Employee trips are a composite of gasoline and diesel vehicles. Vehicles speeds are assumed to be 30 miles per hour.

Vehicular emissions were computed using the CARB's emission factor model, EMFAC2011, to estimate on-road emissions. Haul trucks were modeled using the T7 classification, which is a heavy-heavy duty truck emission factor for public vehicles. Paved road dust, break wear, and tire wear particulate emissions were also accounted for and included in the analysis using EMFAC2011 factors and methodologies from CARB and the USEPA. Assuming 306 working days a year (6-day work week, with 6 holidays), this will result in 262 one-way truck trips a day or 131 round trips. Haul trucks will only be at the loading area during operating hours when picking up a load. Haul trucks are diesel powered and assume a travel distance of 3.8 miles (7.2 miles round trip) to pit No 2 (located at 1245 East Arrow Highway in Irwindale). The trucks will enter Pit No 2 from Arrow Highway and then leave Pit No 2 via Avenida Barbosa. Vehicles speeds are assumed to be 30 miles per hour. Transportation to the processing plant will be conducted during the hours of 7 am to 5 pm - six days a week (or 306 days per year). Transport trucks will be parked overnight at the existing United Rock processing plant.

Trucks would idle during unloading and during load weighing/financial transaction at the scale house. Idling emissions were calculated using idling emission factors from the EMFAC2011 model and idle limits of five minutes.

Criteria pollutant emissions associated with on-road vehicles were calculated by combining the activity information with emissions factors, in grams per mile and grams

per idle hour, derived using the CARB EMFAC2011 emissions model.[1] Emissions calculations were based on **Equation 1**. The EMFAC2011 emissions factors are summarized on **Tables AQ-1 through AQ-3** for employee vehicles, haul trucks, and truck idling. EMFAC2011 estimates emission factors through 2035. Project activities beyond 2035 assumed the same emission factors as 2035. Significant decreases in emissions occur from 2015 through 2035 due to regulatory requirements.

Equation 1

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

*Emission Rate (tons/year) = EMFAC Emission Factor (gram/hour) * total idle hours * (453.59/2000 tons/gram)*

Table AQ-1 – Emissions Factors (g/mile) for Employee Vehicles, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.035	1.32	0.11	359	0.0021	0.0019
2016	0.030	1.19	0.10	359	0.0020	0.0018
2017	0.025	1.07	0.090	360	0.0019	0.0018
2018	0.020	0.98	0.083	360	0.0019	0.0018
2019	0.017	0.90	0.077	360	0.0019	0.0018
2020	0.016	0.85	0.072	360	0.0020	0.0018
2021	0.015	0.82	0.070	360	0.0020	0.0018
2022	0.014	0.79	0.067	360	0.0020	0.0019
2023	0.013	0.76	0.065	360	0.0021	0.0019
2024	0.013	0.74	0.063	360	0.0021	0.0019
2025	0.012	0.72	0.062	360	0.0021	0.0020
2026	0.012	0.71	0.061	360	0.0022	0.0020
2027	0.012	0.70	0.060	360	0.0022	0.0021
2028	0.012	0.69	0.060	360	0.0023	0.0021
2029	0.011	0.68	0.059	360	0.0023	0.0021
2030	0.011	0.67	0.058	360	0.0023	0.0021
2031	0.011	0.67	0.058	361	0.0023	0.0022
2032	0.011	0.67	0.057	361	0.0023	0.0022
2033	0.011	0.66	0.056	361	0.0023	0.0022
2034	0.010	0.66	0.056	361	0.0023	0.0022
2035	0.010	0.65	0.056	361	0.0023	0.0022

Source: CARB EMFAC2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

[1] CARB EMFAC20~~07~~11 Emissions Model, http://www.arb.ca.gov/msei/modeling.htm

Table AQ-2 – Emissions Factors (g/mile) for Haul Trucks, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.103	0.523	13.9	1,924	0.0676	0.0622
2016	0.105	0.522	13.2	1,921	0.0655	0.0603
2017	0.108	0.518	12.4	1,918	0.0632	0.0581
2018	0.112	0.519	11.7	1,915	0.0609	0.0560
2019	0.117	0.523	10.9	1,912	0.0587	0.0540
2020	0.121	0.531	10.1	1,908	0.0564	0.0519
2021	0.128	0.544	9.28	1,903	0.0543	0.0499
2022	0.135	0.561	8.49	1,899	0.0521	0.0479
2023	0.140	0.574	7.75	1,894	0.0499	0.0459
2024	0.145	0.585	7.03	1,889	0.0477	0.0439
2025	0.149	0.593	6.39	1,884	0.0457	0.0421
2026	0.153	0.602	5.80	1,880	0.0440	0.0405
2027	0.155	0.608	5.26	1,876	0.0425	0.0391
2028	0.157	0.610	4.82	1,873	0.0412	0.0379
2029	0.158	0.610	4.43	1,870	0.0402	0.0369
2030	0.159	0.609	4.08	1,868	0.0391	0.0360
2031	0.160	0.610	3.82	1,866	0.0387	0.0356
2032	0.161	0.610	3.59	1,865	0.0383	0.0352
2033	0.162	0.610	3.35	1,864	0.0377	0.0347
2034	0.163	0.610	3.10	1,863	0.0370	0.0340
2035	0.164	0.606	2.87	1,862	0.0356	0.0328

Source: CARB EMFAC2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

~~http://www.arb.ca.gov/msei/onroad/latest_version.htm~~.

Table AQ-3 – Idle Emissions Factors (g/hour) for Haul Trucks, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	6.34	34.5	64.0	7,032	0.268	0.247
2016	6.02	33.7	58.4	7,046	0.147	0.136
2017	6.16	34.6	54.8	7,046	0.125	0.115
2018	6.37	35.8	52.0	7,044	0.123	0.113
2019	6.52	36.7	50.0	7,043	0.120	0.111
2020	6.74	37.9	47.2	7,043	0.117	0.107
2021	7.02	39.5	43.5	7,039	0.114	0.105
2022	7.29	41.0	39.9	7,034	0.112	0.103
2023	7.29	41.1	39.7	7,034	0.110	0.101
2024	7.30	41.2	39.6	7,034	0.110	0.101
2025	7.31	41.2	39.5	7,035	0.110	0.101
2026	7.32	41.3	39.4	7,035	0.109	0.101
2027	7.33	41.3	39.3	7,035	0.109	0.100
2028	7.33	41.4	39.2	7,035	0.109	0.100
2029	7.34	41.4	39.1	7,035	0.109	0.100
2030	7.34	41.4	39.1	7,035	0.109	0.100
2031	7.35	41.5	39.0	7,035	0.108	0.100
2032	7.35	41.5	39.0	7,035	0.108	0.100
2033	7.36	41.5	38.9	7,035	0.108	0.100
2034	7.36	41.5	38.8	7,036	0.108	0.099
2035	7.37	41.6	38.8	7,036	0.108	0.099

Source: CARB EMFAC2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

A.2 Off-Road Equipment

Operation of the Proposed Project would require the use of heavy-duty equipment, such as excavators, loaders, forklifts, off-road haul trucks. This equipment would be used to load and unload material and otherwise sort and handle material. Emissions from this equipment were estimated using the same approach as construction emissions. Emission factors from the OFFROAD2011 model, as included in CalEEMod were used. Equipment load factors were adjusted using the latest information in the OFFROAD2011 model. All equipment will work during business hours except the grader, which will work 25 percent of the time. Hours of operation (business hours) are 6 am to 6 pm - six days a week (or 306 days per year). Off-road mining equipment will remain onsite and at the bottom of the pit at all times.

Parameters for off-road equipment, including equipment and fuel type, estimated horsepower and estimated annual hours of operation, were developed. Annual hours of

off-road equipment operation were based on normal business hours of 12 hours per day, six days per week.

This information was applied to criteria pollutant emissions factors, in grams per horsepower-hour, primarily derived using the CARB OFFROAD2011 emissions model (i.e., the Offroad Emissions Inventory [OEI] Database).[2]. **Equation 2** outlines how off-road construction equipment emissions were computed, and the emissions factors used in this assessment are summarized, by equipment type and construction year, on **Tables AQ-4** through **AQ-10**. **Exhibit 1** provides the emission factors for Tier 1 through 4 off-road equipment (as part of mitigation measures). OFFROAD2011 estimates emission factors through 2040. Project activities beyond 2040 assumed the same emission factors as 2040. Significant decreases in emissions occur from 2015 through 2040 due to regulatory requirements.

Equation 2

*Emission Rate (tons/year) = OFFROAD Emission Factor (gram/hp-hour) * size (hp) * hours of operation * Load Factor * (453.59/2000 tons/gram)*

Table AQ-4 – Emissions Factors (g/hp-hour) for Excavator, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.232	1.32	3.21	510	0.104	0.096
2016	0.213	1.23	2.81	504	0.091	0.083
2017	0.200	1.20	2.51	497	0.081	0.075
2018	0.175	1.14	2.05	489	0.066	0.061
2019	0.162	1.11	1.78	481	0.058	0.053
2020	0.153	1.10	1.57	470	0.052	0.048
2021	0.143	1.09	1.33	470	0.045	0.041
2022	0.128	1.06	1.04	470	0.035	0.032
2023	0.122	1.05	0.89	470	0.030	0.028
2024	0.121	1.05	0.83	470	0.029	0.026
2025	0.115	1.05	0.73	470	0.026	0.024
2030	0.202	1.09	0.43	568	0.016	0.016
2035	0.195	1.09	0.34	568	0.013	0.013
2040	0.192	1.09	0.30	568	0.011	0.011

Source: CARB OFFROAD2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

[2] CARB OFFROAD2011 Emissions Model, http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

Table AQ-5 – Emissions Factors (g/hp-hour) for Water Trucks, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.473	1.90	5.24	508	0.227	0.209
2016	0.446	1.82	4.83	502	0.208	0.191
2017	0.417	1.75	4.37	495	0.189	0.174
2018	0.341	1.54	3.45	488	0.141	0.130
2019	0.307	1.46	2.98	480	0.119	0.110
2020	0.275	1.39	2.51	470	0.098	0.090
2021	0.249	1.35	2.11	470	0.082	0.076
2022	0.215	1.28	1.62	470	0.064	0.059
2023	0.207	1.27	1.46	469	0.059	0.054
2024	0.202	1.26	1.36	469	0.054	0.050
2025	0.185	1.21	1.13	469	0.043	0.040
2030	0.217	1.17	0.48	568	0.017	0.017
2035	0.208	1.17	0.35	568	0.013	0.013
2040	0.204	1.17	0.31	568	0.012	0.012

Source: CARB OFFROAD2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

Table AQ-6 – Emissions Factors (g/hp-hour) for Rock Trucks, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.385	2.04	4.53	516	0.173	0.159
2016	0.351	1.89	4.05	510	0.153	0.141
2017	0.325	1.75	3.67	501	0.136	0.125
2018	0.287	1.56	3.09	494	0.113	0.104
2019	0.264	1.48	2.67	485	0.097	0.089
2020	0.246	1.41	2.35	475	0.086	0.079
2021	0.225	1.34	1.95	475	0.072	0.066
2022	0.196	1.25	1.49	475	0.054	0.050
2023	0.187	1.22	1.32	475	0.048	0.044
2024	0.185	1.21	1.24	475	0.045	0.041
2025	0.177	1.18	1.06	475	0.038	0.035
2030	0.216	1.10	0.458	568	0.017	0.017
2035	0.208	1.11	0.348	568	0.013	0.013
2040	0.204	1.11	0.305	568	0.012	0.012

Source: CARB OFFROAD2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

Table AQ-7 – Emissions Factors (g/hp-hour) for Graders, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.326	1.79	3.72	512	0.144	0.133
2016	0.334	1.77	3.69	507	0.144	0.133
2017	0.334	1.71	3.56	499	0.139	0.128
2018	0.324	1.56	3.34	491	0.130	0.119
2019	0.323	1.53	3.22	483	0.124	0.115
2020	0.322	1.53	3.11	472	0.121	0.111
2021	0.322	1.46	3.01	472	0.117	0.108
2022	0.311	1.39	2.80	472	0.108	0.100
2023	0.309	1.38	2.70	471	0.105	0.097
2024	0.293	1.36	2.43	470	0.095	0.088
2025	0.280	1.31	2.26	471	0.088	0.081
2030	0.214	1.10	0.647	568	0.023	0.023
2035	0.195	1.08	0.434	568	0.016	0.016
2040	0.188	1.08	0.351	568	0.013	0.013

Source: CARB OFFROAD2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

Table AQ-8 – Emissions Factors (g/hp-hour) for Loader, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.308	1.82	4.18	506	0.152	0.140
2016	0.300	1.67	4.02	501	0.144	0.133
2017	0.296	1.65	3.86	493	0.139	0.128
2018	0.271	1.60	3.40	485	0.124	0.114
2019	0.262	1.60	3.12	479	0.117	0.107
2020	0.268	1.61	3.12	469	0.117	0.108
2021	0.247	1.43	2.75	466	0.104	0.096
2022	0.232	1.35	2.45	467	0.094	0.087
2023	0.234	1.36	2.42	467	0.095	0.087
2024	0.221	1.31	2.22	467	0.085	0.079
2025	0.187	1.26	1.65	466	0.067	0.062
2030	0.182	1.07	0.407	568	0.014	0.014
2035	0.177	1.07	0.327	568	0.012	0.012
2040	0.174	1.07	0.297	568	0.011	0.011

Source: CARB OFFROAD2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

Table AQ-9 – Emissions Factors (g/hp-hour) for Sweeper, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.833	4.10	6.89	514	0.610	0.561
2016	0.783	4.06	6.45	508	0.571	0.525
2017	0.721	4.01	6.02	500	0.520	0.479
2018	0.600	3.88	5.14	493	0.428	0.394
2019	0.550	3.85	4.77	485	0.387	0.356
2020	0.520	3.83	4.48	474	0.360	0.331
2021	0.440	3.76	3.96	474	0.291	0.268
2022	0.372	3.69	3.47	474	0.232	0.214
2023	0.351	3.69	3.29	474	0.210	0.193
2024	0.332	3.69	3.10	474	0.189	0.173
2025	0.303	3.66	2.82	474	0.160	0.147
2030	0.261	3.70	1.57	568	0.023	0.023
2035	0.253	3.70	1.49	568	0.016	0.016
2040	0.251	3.70	1.47	568	0.015	0.015

Source: CARB OFFROAD2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

Table AQ-10 – Emissions Factors (g/hp-hour) for Dragline, by Year

Year	ROG	CO	NOx	CO2	PM10	PM2.5
2015	0.324	2.41	4.42	515	0.163	0.150
2016	0.308	2.28	4.09	510	0.151	0.139
2017	0.290	2.12	3.78	501	0.138	0.127
2018	0.251	1.81	3.17	493	0.115	0.105
2019	0.234	1.67	2.86	485	0.103	0.094
2020	0.224	1.63	2.64	475	0.096	0.088
2021	0.215	1.60	2.43	475	0.090	0.083
2022	0.188	1.44	1.98	476	0.074	0.068
2023	0.180	1.40	1.81	476	0.069	0.063
2024	0.175	1.38	1.68	476	0.064	0.059
2025	0.168	1.36	1.55	476	0.059	0.055
2030	0.154	1.03	0.391	568	0.014	0.014
2035	0.147	1.03	0.311	568	0.011	0.011
2040	0.145	1.03	0.282	568	0.010	0.010

Source: CARB OFFROAD2011.

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; CO_2 = carbon dioxide

Exhibit 1 – Emissions Factors (g/hp-hr) for Tiered Off-road Equipment

Emission Factors (NOx) for Off-Road Diesel Engines by Model Year and Horsepower Group (g/bhp-hr)								
Engine Model Year	Horsepower Group							
	25-49	50-74	75-99	100-174	175-299	300-599	600-750	Over 750
1900 – 1969	7.2	14.8	14.8	15.9	15.9	15.2	15.2	15.2
1970 – 1971	7.2	14.8	14.8	14.8	14.8	14.1	14.1	14.1
1972 – 1979	7.2	14.8	14.8	13.6	13.6	13.0	13.0	13.0
1980 – 1987	7.2	14.8	14.8	12.5	12.5	11.9	11.9	11.9
1988	7.1	9.9	9.9	9.3	9.3	8.9	8.9	8.9
1989 – 1995	7.1	9.9	9.9	9.3	9.3	8.9	8.9	8.9
1996	7.1	9.9	9.9	9.3	6.9	6.9	6.9	8.9
1997	7.1	9.9	9.9	6.9	6.9	6.9	6.9	8.9
1998	7.1	6.9	6.9	6.9	6.9	6.9	6.9	8.9
1999	6.2	6.9	6.9	6.9	6.9	6.9	6.9	8.9
2000	6.2	6.9	6.9	6.9	6.9	6.9	6.9	6.9
2001	6.2	6.9	6.9	6.9	6.9	4.2	6.9	6.9
2002	6.2	6.9	6.9	6.9	6.9	4.2	4.2	6.9
2003	6.2	6.9	6.9	4.3	4.3	4.2	4.2	6.9
2004	4.9	4.9	4.9	4.3	4.3	4.2	4.2	6.9
2005	4.9	4.9	4.9	4.3	4.3	4.2	4.2	6.9
2006	4.9	4.9	4.9	4.3	2.6	2.6	2.6	4.2
2007	4.9	4.9	4.9	2.6	2.6	2.6	2.6	4.2
2008	4.9	3.0	3.0	2.6	2.6	2.6	2.6	4.2
2009	4.9	3.0	3.0	2.6	2.6	2.6	2.6	4.2
2010	4.9	3.0	3.0	2.6	2.6	2.6	2.6	4.2
2011	4.9	3.0	3.0	2.6	1.5	1.5	1.5	2.6
2012	4.9	3.0	2.5	2.5	1.5	1.5	1.5	2.6
2013	3.0	3.0	2.5	2.5	1.5	1.5	1.5	2.6
2014	3.0	3.0	2.5	2.5	0.3	0.3	0.3	2.6
2015 and later	3.0	3.0	0.3	0.3	0.3	0.3	0.3	2.6

Tier 0 Engine*	
Tier 1 Engine	
Tier 2 Engine	

Tier 3 Engine	
Interim Tier 4	
Tier 4 Engine	

Source: CARB In-Use Off-Road Diesel Vehicle Regulation,
http://www.arb.ca.gov/msprog/ordiesel/documents/emissionfactorsfaq.pdf

A.3 Fugitive Dust Sources

Aggregate Processing

Generally, rock and crushed stone products are loosened and extracted, loaded by front-end loader into large haul trucks that transport the material to the screening/hoppers. Typically, quarried stone is dumped into hopper feeders, usually a vibrating grizzly type, or onto screens. The feeder or screens separate large stones from finer rocks that do not require primary crushing, thus, reducing the load to the primary crusher.

Air emissions were determined for the operation of the processing units. The air emission calculations accounted for the number and type of equipment, process rates, number of transfer points, daily operations, and the type of material processed and emission controls, if any. The emission factors were determined using the methodology found in Section 11.19 of EPA's Compilation of Air Pollutant Emission Factors (AP-42).[3] **Table AQ-11** presents the PM_{10} emission factors for the processing operations. $PM_{2.5}$ emissions were assumed to represent 15 percent of PM_{10} emissions. A substantial portion of the air emissions from processing consists of heavy particles that may settle out within the plant area. For this analysis, it was assumed that the material excavated is transported to the loading area by conveyor or off-road haul trucks and subsequently placed in overhead hoppers (a total of six) and loaded onto haul trucks. SCAQMD's fugitive dust mitigation measures[4] were applied to determine the applicable emission rates. Emissions are based on a material process rate of 200 tons per hour, 3,268 tons per day, and one million tons per year.

Fugitive sources include the transfer of sand and aggregate, truck loading, mixer loading, vehicle traffic, and wind erosion from aggregate storage piles. The amount of fugitive emissions generated during the transfer of aggregate depends primarily on the surface moisture content of these materials. A material moisture content of 0.7 percent was assumed for this analysis. A silica content of 78 percent was assumed for this analysis.[5]

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[3] Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 11.19.2 *Crushed Stone Processing and Pulverized Mineral Processing* (http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s1902.pdf), August 2004.

[4] Air Quality Management District (AQMD), Fugitive Dust Mitigation Measures, Tables XI-A through XI-E.

[5] Rhyolite silica content (SiO2) approximately 70 to 78 percent http://www.flashcardmachine.com/civil220-igneous-rocks.html

Table AQ-11 – Aggregate Processing PM10 Emission Factors

Emission Point	Number of Transfer Points	Uncontrolled Emission Factor (lbs/ton of material)	Controlled Emission Factor (lbs/ton of material)
Screens/Hoppers	6	0.0087	0.00074
Conveyors	6	0.0011	~~0.00084~~0.000046
Truck Unloading/Loading	6	0.0001	-
Source: USEPA, AP-42, Section 11.19.2 - *Crushed Stone Processing and Pulverized Mineral Processing*, August 2004; and AQMD, Table XI-B - *Mitigation Measures Examples: Fugitive Dust From Material Handling*.			

Handling and Storage

Fugitive particulate matter emissions are expected from the handling and storage of raw materials from quarry processing. The methodology for the calculation of particulate emissions from the handling and storage of raw materials is described in Section 13.2.4 of EPA's AP-42[6] for aggregate handling and storage piles. The quantity of dust emissions from aggregate handling and storage operations varies with the volume of aggregate passing through the storage cycle. The emission factor for the quantity of emissions per quantity of material is estimated using the following equation:

$$EF = k(0.0032)\frac{\left[\frac{U}{5}\right]^{1.3}}{\left[\frac{M}{2}\right]^{1.4}}$$

where:

EF	=	emission factor (lb emissions/ton material)
k	=	particulate size multiplier (PM_{10} = 0.35, $PM_{2.5}$ = 0.053)
U	=	mean wind speed (4.3 mph)
M	=	material moisture content (0.7 percent)

Based on available data, the emission factors for handling and storage activities are 0.004 and 0.0006 pounds per ton of material processed (uncontrolled) of PM_{10} and $PM_{2.5}$, respectively; and 0.0010 and 0.0002 pounds per ton of material processed (controlled) of PM_{10} and $PM_{2.5}$, respectively. Weather data (wind speed) was acquired from the Western Regional Climate Center and was based on the Ontario International Airport weather station[7] (nearest to the City of Irwindale) and SCAQMD data from Azusa. To account for

[6] Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 13.2.4 *Aggregate Handling and Storage Piles* (http://www.epa.gov/ttnchie1/ap42/ch13/final/c13s0204.pdf), November 2006.

[7] Western Regional Climate Center, http://www.wrcc.dri.edu/summary/ont.ca.html.

emission controls, a control efficiency of 75 percent was applied. A silica content of 78 percent was assumed for this analysis.[8]

Unpaved Roads

When a vehicle travels over an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The emission factors were calculated using the methodology found in Section 13.2, of the EPA's AP-42[9]. The equation for developing the emission factor is:

$$EF = k\,(S/12)^{a}(W/3)^{b}\,[(365-p)/365]\,(1-CE)$$

where:

EF	=	size-specific emission factor (lb/VMT)
k	=	empirical constant (PM_{10} = 1.5, $PM_{2.5}$ = 0.15)
S	=	Silt content of 8.3 percent (use whole number value)
W	=	Mean vehicle weight (65 tons, the average of empty and full)
p	=	Number of days with measurable precipitation (35 days)
a	=	0.9 (empirical constant)
b	=	0.45 (empirical constant)
CE	=	Control efficiency rate of 84 percent

Based on available data, the emission factor for unpaved roads is 4.1 and 0.41 pounds of PM_{10} and $PM_{2.5}$ per vehicle mile traveled (uncontrolled), respectively; and 0.6 and 0.06 pounds of PM_{10} and $PM_{2.5}$ per vehicle mile traveled (controlled), respectively. To account for emission controls, a control efficiency of 84 percent was applied.[10] The number of days with measurable precipitation in Irwindale, California, were acquired from the Western Regional Climate Center.[11] The project condition provides for 58 daily and 17,241 annual vehicle trips; each vehicle is presumed to be traveling a distance of 0.4

[8] Rhyolite silica content (SiO2) approximately 70 to 78 percent http://www.flashcardmachine.com/civil220-igneous-rocks.html

[9] Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 13.2.2 *Unpaved Roads* (http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf), November 2006.

[10] South Coast Air Quality Management District, Table XI-B - *Mitigation Measures Examples: Fugitive Dust From Material Handling* and *WRAP Fugitive Dust Handbook*, September 7, 2006 (http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf

[11] Western Regional Climate Center, http://www.wrcc.dri.edu/summary/ont.ca.html

miles one-way from the pit to the hopper on an unpaved circulation area. A silica content of 78 percent was assumed for this analysis.[12]

Access on-to the site will be relocated from Olive Street to the southern portion of the property along Los Angeles Street. The new access road will be constructed with a combination of on-site materials and inert fill materials from off-site sources. The access road will ascend from the bottom of the pit along the southern edge of the property to the southeastern corner of the site where it will exit at Los Angeles Street. The new access road will be constructed with a 45-foot wide road bed at a maximum grade of eight percent. Beginning at Los Angeles Street, the first 200 feet of the access road will be paved. The remaining length of the road will be treated with dust palliatives and watered for dust control and soil stabilization.

Grading Activity

Fugitive dust emissions from grading equipment passes were determined using the methodology found in Section 11.9 of EPA's AP-42.[13] PM_{10} emission factor estimated applying a scaling factor to that of PM_{15}. Similarly, the emission factor of $PM_{2.5}$ was scaled from that of total suspended particulates (TSP). The equations used to calculate the emission factors for PM_{15} and TSP and the scaling factors for those of PM_{10} and $PM_{2.5}$ are presented:

$$EF_{PM15} = 0.051(S)^{2.0}, \text{ and } EF_{PM10} = EF_{PM15} \times F_{PM10}$$

$$EF_{TSP} = 0.04(S)^{2.5}, \text{ and } EF_{PM2.5} = EF_{TSP} \times F_{PM2.5}$$

where:

EF	=	emission factor (lb/VMT)
S	=	mean vehicle speed (mph). The AP-42 default value is 7.1 mph
F_{PM10}	=	PM_{10} scaling factor. The AP-42 default value is 0.6
$F_{PM2.5}$	=	$PM_{2.5}$ scaling factor. The AP-42 default value is 0.031

The grading dust emissions are estimated by multiplying the emission factors with the total vehicle miles traveled (VMT) for the grading equipment. The VMT are estimated based on the dimensions of the grading area and the blade width of the grading

[12] Rhyolite silica content (SiO2) approximately 70 to 78 percent http://www.flashcardmachine.com/civil220-igneous-rocks.html

[13] Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, 11.9 *Western Surface Coal Mining* (http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf), November 2006.

equipment. It was assumed that 0.5 acres are being graded per day. In addition, a default blade width of 12 feet was assumed based on Caterpillar's 140 Motor Grader.[14]

$$E = EF \times VMT, \text{ and}$$

$$VMT = (A_s/W_b)(43{,}560\ ft^2/acre)/(5{,}280\ ft/mile)$$

where:

E	=	emissions (lb)
EF	=	emission factor (lb/VMT)
VMT	=	vehicle miles traveled (mile)
A_s	=	acreage of the grading site (0.5 acres per day)
W_b	=	Blade width of the grading equipment (12 feet)

Based on available data, the emission factor for grading equipment activities is 194 and 21 pounds (uncontrolled) of PM_{10} and $PM_{2.5}$, respectively; and 184 and 20 pounds (controlled) of PM_{10} and $PM_{2.5}$, respectively. To account for emission controls, a control efficiency of 5 percent was applied. A silica content of 78 percent was assumed for this analysis.[15]

Health Risk Assessment

A health risk assessment (HRA) is accomplished in four steps; hazards identification, exposure assessment, toxicity assessment, and risk characterization. These steps cover the estimation of air emissions, the estimation of the air concentrations resulting from a dispersion analysis, the incorporation of the toxicity of the pollutants emitted, and the characterization of the risk based on exposure parameters such as breathing rate, age adjustment factors, and exposure duration; each depending on receptor type.

The HRA was conducted in accordance with technical guidelines developed by federal, state, and regional agencies, including US Environmental Protection Agency (USEPA), California Environmental Protection Agency (CalEPA), California Office of Environmental Health Hazard Assessment (OEHHA) *Air Toxics Hot Spots Program Guidance*, and the South Coast Air Quality Management District (SCAQMD) *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act.*

According to CalEPA, a HRA should not be interpreted as the expected rates of cancer or other potential human health effects, but rather as estimates of potential risk or likelihood

[14] Caterpillar, http://www.cat.com/en_US/products.html?x=7.
[15] Rhyolite silica content (SiO2) approximately 70 to 78 percent http://www.flashcardmachine.com/civil220-igneous-rocks.html

of adverse effects based on current knowledge, under a number of highly conservative assumptions and the best assessment tools currently available.

Terms and Definitions

As the practice of conducting a HRA is particularly complex and involves concepts that are not altogether familiar to most people, several terms and definitions are provided that are considered essential to the understanding of the approach, methodology and results:

Acute effect – a health effect (non-cancer) produced within a short period of time (few minutes to several days) following an exposure to toxic air contaminants (TAC).

Cancer risk – the probability of an individual contracting cancer from a lifetime (i.e., 70 year) exposure to TAC in the ambient air.

Chronic effect – a health effect (non-cancer) produced from a continuous exposure occurring over an extended period of time (weeks, months, years).

Hazard Index (HI) – the unitless ratio of an exposure level over the acceptable reference dose (RfC). The HI can be applied to multiple compounds in an additive manner.

Hazard Quotient (HQ) – the unitless ratio of an exposure level over the acceptable reference dose (RfC). The HQ is applied to individual compounds.

Toxic air contaminants (TAC) – any air pollutant that is capable of causing short-term (acute) and/or long-term (chronic or carcinogenic, i.e., cancer causing) adverse human health effects (i.e., injury or illness). The current California list of TAC lists approximately 200 compounds, including particulate emissions from diesel-fueled engines.

Human Health Effects - comprise disorders such as eye watering, respiratory or heart ailments, and other (i.e., non-cancer) related diseases.

Health Risk Assessment (HRA) – an analysis designed to predict the generation and dispersion of TAC in the outdoor environment, evaluate the potential for exposure of human populations, and to assess and quantify both the individual and population-wide health risks associated with those levels of exposure.

Incremental – under CEQA, the net difference (or change) in conditions or impacts when comparing the baseline to future year project conditions.

Maximum exposed individual (MEI) – an individual assumed to be located at the point where the highest concentrations of TAC, and therefore, health risks are predicted to occur.

Non-cancer risks – health risks such as eye watering, respiratory or heart ailments, and other non-cancer related diseases.

Receptors – the locations where potential health impacts or risks are predicted (schools, residences and work-sites).

Limitations and Uncertainties

There are a number of important limitations and uncertainties commonly associated with a HRA due to the wide variability of human exposures to TACs, the extended timeframes over which the exposures are evaluated and the inability to verify the results. Among these challenges are the following:

- The HRA exposure estimates do not take into account that people do not usually reside at the same location for 70 years and that other exposures (i.e., school children) are also of much shorter durations than was assumed in this analysis. Therefore, the results of the HRA are highly overstated for those cases.

- Other limitations and uncertainties associated with HRA and identified by the CalEPA include: (a.) lack of reliable monitoring data; (b.) extrapolation of toxicity data in animals to humans; (c.) estimation errors in calculating TACs emissions; (d.) concentration prediction errors with dispersion models; and (e.) the variability in lifestyles, fitness and other confounding factors of the human population.

Significance Threshold

The operation of any project with the potential to expose sensitive receptors to substantial levels of TACs (such as DPM) would be deemed to have a potentially significant impact. TACs are airborne substances that are capable of causing short-term (acute) and/or long-term (chronic or carcinogenic, i.e., cancer causing) adverse human health effects (i.e., injury or illness). The California list of TACs includes approximately 200 compounds, including particulate emissions from diesel-fueled engines. More specifically, proposed projects that have the potential to expose the public to TACs in excess of the following thresholds would be considered to have a significant air quality impact:

- Probability of contracting cancer for the Maximally Exposed Individual exceeds 10 in one million people for 70 year exposure.

- Ground-level concentrations of non-carcinogenic TACs exceed the acceptable health based concentrations.

These standards are typically applied to the results of a HRA based on an air dispersion modeling effort. These criteria apply only to the direct impacts of a project and not to cumulative impacts.

Hazards Identification

Emissions of DPM associated with the Proposed Project would occur from the following project activities:

- Truck traffic on local streets, arterials, and freeways in transit to or from the facilities,
- Truck idling and movement on-site,
- Equipment operating on-site, and
- Fugitive dust from unpaved surfaces and material handling.

DPM emissions would be generated by facility trucks along haul routes (and idling at the facility) and on-site equipment such as loaders, excavators, and processing equipment such as hoppers during the lifetime of the project.

Diesel Particulate Matter (DPM)

Diesel exhaust is a complex mixture of thousands of individual gaseous and particulate compounds emitted from diesel-fueled combustion engines. DPM is formed primarily through the incomplete combustion of diesel fuel. Particulate matter in diesel exhaust can be emitted from on- and off-road vehicles, stationary area sources, and stationary point sources. DPM is removed from the atmosphere through physical processes including atmospheric fall-out and washout by rain. Humans can be exposed to airborne DPM or via deposition on water, soil, and vegetation. Acute inhalation exposure to elevated DPM has shown increased symptoms of irritation, cough, phlegm, chronic bronchitis, and inhibited pulmonary function. The USEPA has concluded that DPM is likely to be carcinogenic to humans by inhalation.

Diesel particulates, as defined by most emission standards, are sampled from diluted and cooled exhaust gases. This definition includes both solids and liquid material that condenses during the dilution process. The basic fractions of DPM are elemental carbon; heavy hydrocarbons derived from the fuel and lubricating oil and hydrated sulfuric acid derived from the fuel sulfur. DPM contains a large portion of the polycyclic aromatic hydrocarbons (PAH) found in diesel exhaust. Diesel particulates include small nuclei particles of diameters below 0.04 micrometer (μm) and their agglomerates of diameters up to 1 μm. Ambient exposures to diesel particulates in California are significant fractions of total TAC levels in the State.

In August 1998, the California Air Resource Board (CARB) identified diesel PM as a TAC. The CARB developed *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel- Fueled Engines and Vehicles and Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines* and approved these documents on September 28, 2000. The documents represent proposals to reduce DPM emissions, with the goal of reducing emissions and the associated health risk by 75 percent in 2010 and by 85 percent in 2020. The program aims to require the use of state-of-the-art catalyzed DPM filters and ultra-low-sulfur diesel fuel.

In December 2000, the USEPA promulgated regulations requiring that the sulfur content in motor vehicle diesel fuel be reduced to less than 15 ppm by June 1, 2006. Control of DPM emissions focuses on two strategies, reducing the amount of sulfur in diesel fuel and developing filters for operating diesel engines to reduce the amount of particulate matter that is emitted. The USEPA has also finalized a comprehensive national emissions control program which regulates highway heavy-duty vehicles and diesel fuel as a single system. The USEPA established new emission standards that would significantly reduce PM and NO_x from highway heavy-duty vehicles.

In 2001, CARB assessed the state-wide health risks from exposure to diesel exhaust and to other toxic air contaminants. It is difficult to distinguish the health risks of diesel emissions from those of other air toxics because diesel exhaust contains approximately 40 different TACs. The CARB study detected diesel exhaust by using ambient air carbon soot measurements as a surrogate for diesel emissions. The study reported that in 2000, the state-wide cancer risk from exposure to diesel exhaust was about 540 per million population as compared to a total risk for exposure to all ambient air toxics of 760 per million. This estimate, which accounts for about 70 percent of the total risk from TACs, included both urban and rural areas in the state. It can be considered as an average worst-case for the state, since it assumes constant exposure to outdoor concentrations of diesel exhaust and does not account for expected lower concentrations indoors, where most of time is spent.

The CARB's Findings of the Scientific Review Panel on The Report on Diesel Exhaust (http://www.arb.ca.gov/toxics/dieseltac/de-fnds.htm) states that approximately 94 percent of the mass of these particles are less than 2.5 microns in diameter ($PM_{2.5}$). Thus, the $PM_{2.5}$ exhaust emissions were represented as DPM.

Exposure Assessment

Dispersion is the process by which atmospheric pollutants disseminate due to wind and vertical stability. The results of a dispersion analysis are used to assess pollutant concentrations at or near an emission source. This section presents the methodology used

for the dispersion modeling analysis and addresses all of the fundamental components of an air dispersion modeling analysis including:

- Model selection and options
- Receptor locations
- Meteorological data
- Source release characteristics

Based on CAPCOA's *Air Toxics "Hot Spots" Program Gasoline Service Station Industry-wide Risk Assessment Guidelines* the loading and breathing emissions were treated as a volume source while refueling and spillage emissions were treated as a point source (modeling release parameters contained in Appendix D of CAPCOA's *Guidelines*).

Model Selection and Options

The AERMOD dispersion model (Version 13350) was used for the modeling analysis. AERMOD is the USEPA preferred dispersion model for general industrial purposes. The AERMOD model is the appropriate model for this analysis based on the coverage of simple, intermediate, and complex terrain. It also predicts both short-term (one to 24 hours) and long-term (annual) average concentrations. The model was executed using the regulatory default options (stack-tip downwash, buoyancy-induced dispersion, final plume rise), default wind speed profile categories, default potential temperature gradients, and no pollutant decay.

The selection of the appropriate dispersion coefficients depends on the land use within three kilometers (km) of the project site. The land use typing was based on the classification method defined by Auer (1978); using pertinent United States Geological Survey (USGS) 1:24,000 scale (7.5 minute) topographic maps of the area. If the Auer land use types of heavy industrial, light-to-moderate industrial, commercial, and compact residential account for 50 percent or more of the total area, the *Guideline on Air Quality Models* recommends using urban dispersion coefficients; otherwise, the appropriate rural coefficients were used. Using GIS, the following criteria apply:

- If land use (i.e., industrial, commercial, and dense residential) types I1, I2, C1, R2, and R3 account for 50 percent or more of the area, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients.

- If average population density is greater than 750 people/km^2, use urban dispersion coefficients; otherwise use appropriate rural dispersion coefficients.

Based on observation of the area surrounding the project site, urban dispersion coefficients were applied in the analysis. The general effect of an urban area is to create enough additional turbulence, due to the buildings and urban "heat island" effects, which enhance plume dispersion. **Exhibits 2 and 3** display the land use and population density.

Exhibit 2 – Land Use

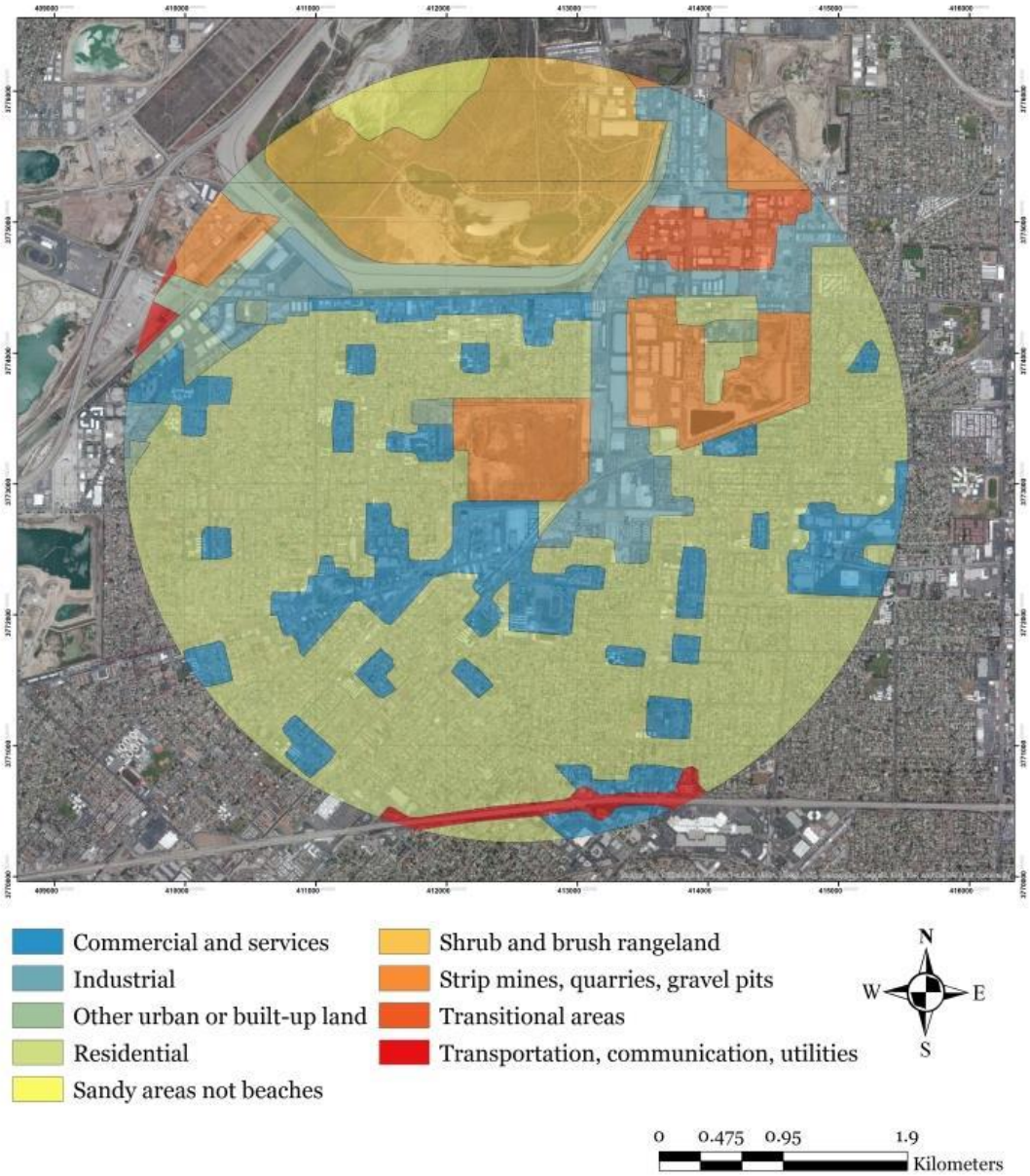
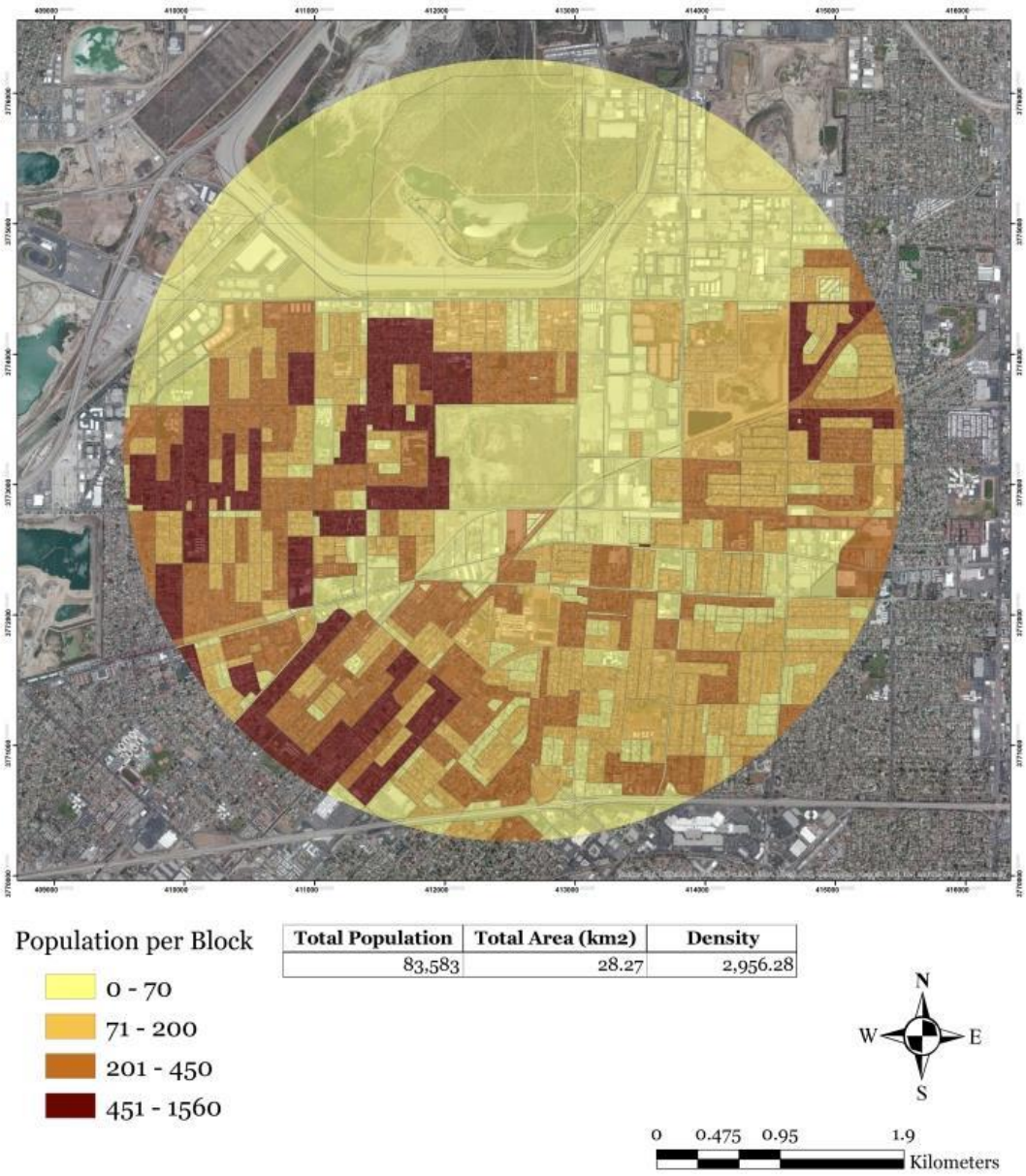


Exhibit 3 – Population Density



Total Population	Total Area (km2)	Density
83,583	28.27	2,956.28

Receptor Locations

Exhibit 4 shows receptors that include residential areas, commercial/industrial areas and sensitive receptors such schools and outdoor recreational areas near the Proposed Project. Sensitive receptors within a quarter-mile of the project site (threshold sited within CARB *Air Quality and Land Use Handbook* as distance of concern) are as follows:

- Single- and multi-family residences to the west and north of the Proposed Project and approximately 100 feet from the Project. Residence are also located within a mobile home park to the south of the Proposed Project along Los Angeles Street.
- Off-site workers within industrial and commercial areas surrounding the project site and along Los Angeles Street and Azusa Canyon Road.
- Ernest Geddes Elementary (240 feet), North Park High School (500 feet), Pleasant View Elementary (690 feet), Jerry Holland Junior High (2,660 feet), and Santa Fe Elementary (2,760 feet) as well as additional single- and multi-family residences and industrial and commercial areas.

A total of 940 receptors were analyzed which includes a grid of receptors spaced 25 meters apart. Receptors were placed at a height of 1.8 meters (typical breathing height). Terrain elevations for receptor locations were used (i.e., complex terrain) based on available USGS information for the area.

Criteria pollutant impacts were evaluated at receptors where a person can be situated for an hour or longer at a time. The following receptors (see **Exhibit 5**) are included in the AERMOD model were a fine grid 25 meters by 25 meters located up to 500 meters from the fence line.

Exhibit 4 – Health Risk Assessment Receptors

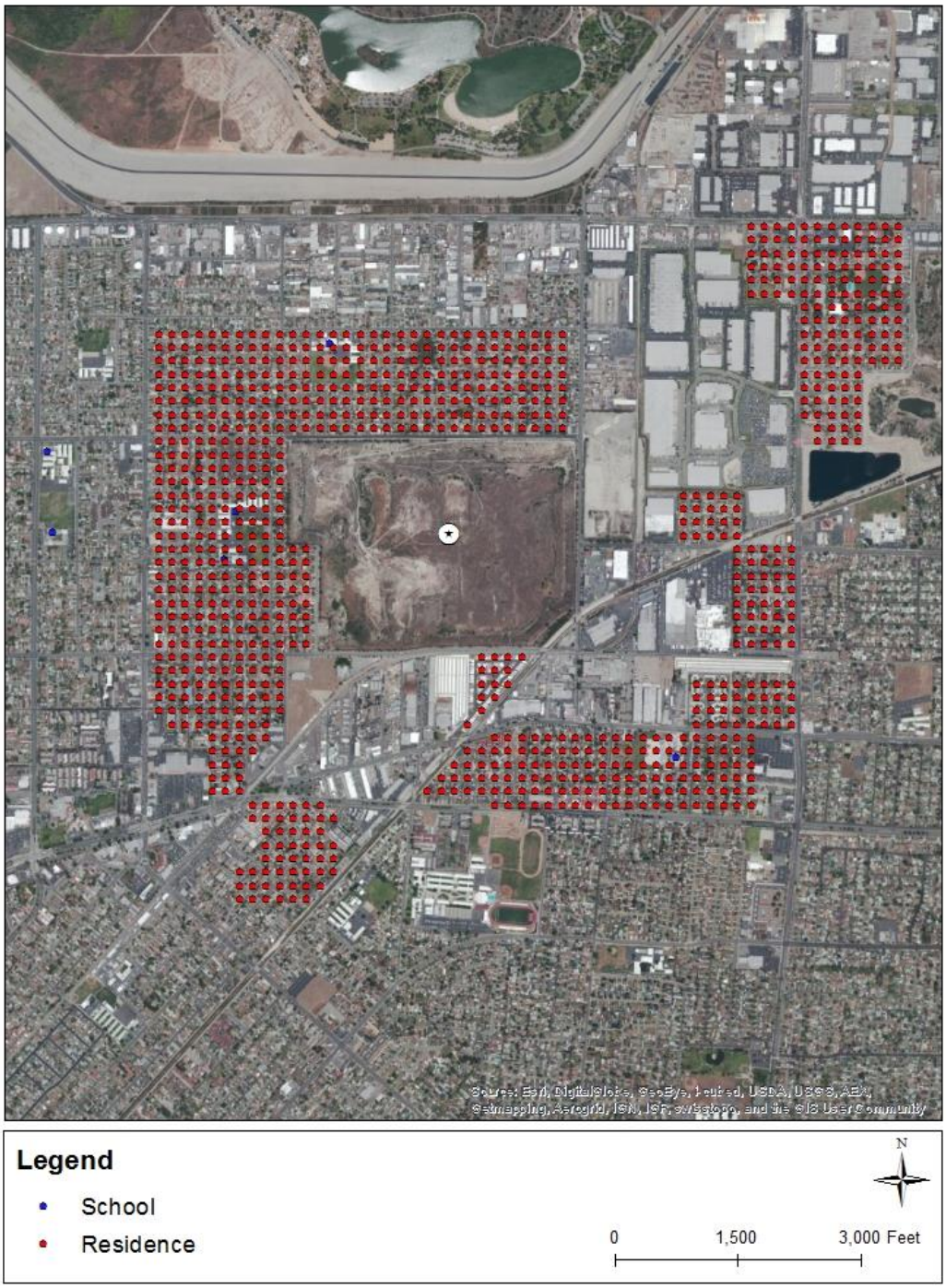


Exhibit 5 – Ambient Air Quality Receptors

Meteorological Data

The rate at which emissions are dispersed in the atmosphere depends upon the intensity of the ambient turbulence, the wind velocity, the position relative to obstacles in the flow field, and any dilutions attributable to the source itself.

Surface meteorological data and upper air meteorological (mixing heights) data from Azusa and Los Angeles, California, respectively, were used for the modeling analysis. Meteorological data were obtained from SCAQMD for the period 2008 through 2012. The windrose (**Exhibit 6**) indicates winds are predominantly from the west-southwest and north-northeast with an average wind speed of 2.00 meters per second (4.5 miles per hour).

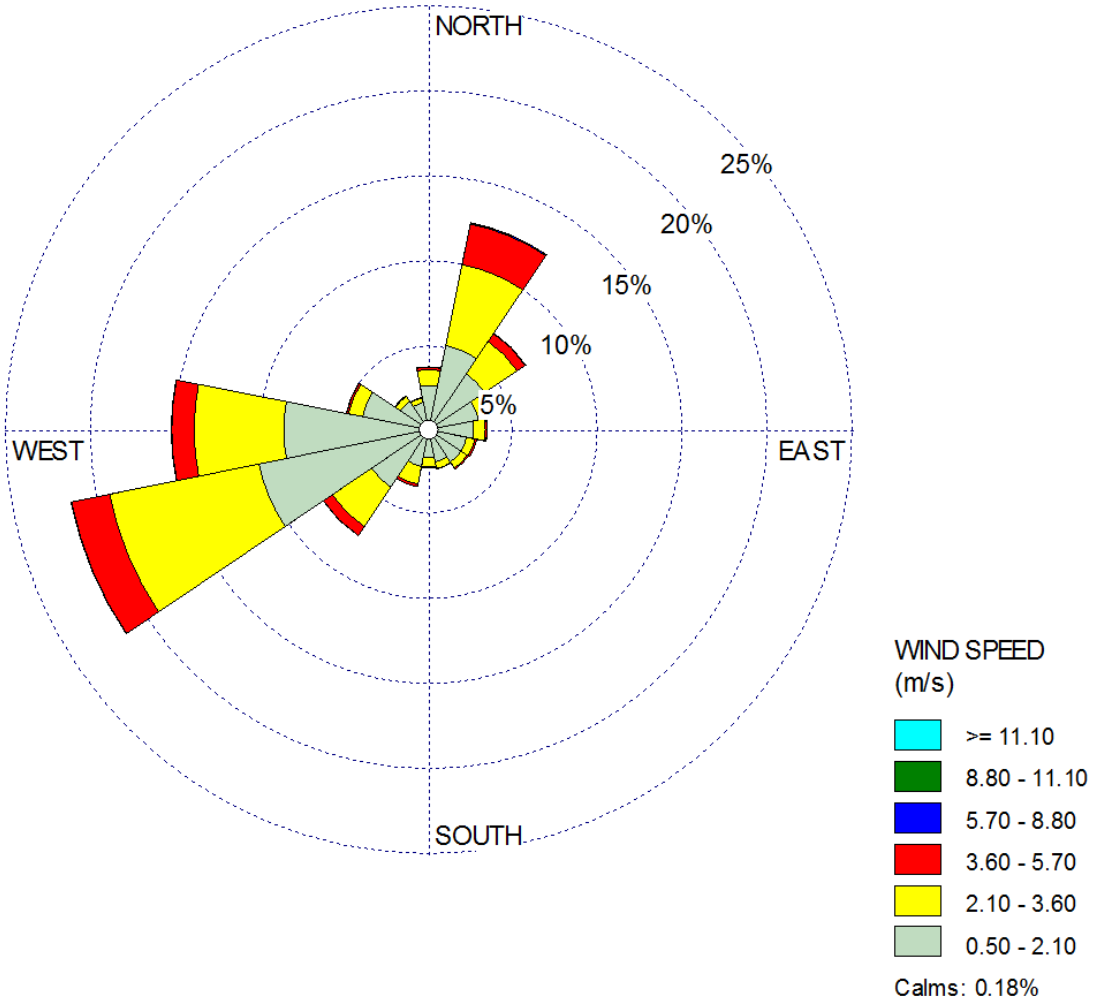


Exhibit 6 Azusa Windrose

Source Release Characteristics

Facility trucks idling at the facility and on-site equipment were treated as an area source with a release height of 3.1 meters. The facility trucks along roadways were treated as line sources along the haul routes to the United Rock Products (URP) processing plant located at 1245 E Arrow Highway in Irwindale. These sources were modeled with a release height of 3.1 meters and a plume height of 4.2 meters which accounts for the turbulence of vehicle movement and a width of 10 meters. Onsite equipment were treated as an area source with a release height of 3.1 meters and a vertical dimension of 4.2 meters. The unpaved route from the pit to the processing pad will be treated as a line source with a vehicle height of ~~12.2~~ 10 meters and a vehicle width of ~~24~~ 10 meters. Terrain elevations for emission source locations and receptors were based on available USGS information for the area.

NOx to NO2 Conversion

Dispersion modeling predicts NO_x concentrations, while NAAQS are associated with NO_2 concentrations. The combustion process typically forms several types of NO_x. For modeling purposes, the NO_x emissions are typically assumed to be nitric oxide (NO) and NO_2. However, after the flue gas exits the stack, additional NO is created as the exhaust mixes with the surrounding air.

Oxidation by O_3 is typically the main reaction for NO_2 formation, especially in rural areas. While the reaction rate is essentially instantaneous, the total amount of NO_2 conversion is limited by how quickly the plume entrains surrounding air. Therefore, the amount of NO_2 within the NO_x plume increases as the plume travels and disperses downwind of the stack. The final plume NO_x-to-NO_2 ratio will equal the existing ambient NO_x-to-NO_2 ratio. Therefore, once the ambient NO_x-to-NO_2 ratio is established, the predicted NO_2 impact can be determined by multiplying the modeled NO_x concentration by the NO_x-to-NO_2 ambient ratio.

While AERMOD is generally considered a non-chemistry model, it offers three methods for modeling NO_2 formation from NO_x emissions: (i) the Ambient Ratio Method (ARM), (ii) the Ozone Limiting Method (OLM), and (iii) the Plume Volume Molar Ratio Method (PVMRM). Moreover, USEPA's *Guideline on Air Quality Models*[16], recommends a three-tiered screening approach to estimate ambient concentrations of NO_2:

- *Tier 1* – Assumes complete (100 percent) conversion of all emitted NO_x to NO_2 based on application of an appropriate refined modeling technique under *Section 4.2.2 of Appendix W* to estimate ambient NO_x concentrations.

[16] Appendix W to Part 51 – Guideline on Air Quality Models, http://www.ecfr.gov/cgi-bin/text-idx?SID=e6a5b817b94abf58460f48c032d9a39c&node=40:2.0.1.1.2.23.11.5.37&rgn=div9.

- *Tier 2* – Ambient Ratio Method (ARM), where model predicted NO_x concentrations are multiplied by a NO_2/NO_x ambient ratio, derived from ambient monitoring data.

  The ARM multiplies Tier 1 results by empirically-derived ambient NO_2/NO_x ratio, with 0.75 as the default ratio for annual impacts and 0.80 as the default ratio for 1-hour impacts, also known as the ARM. Site-specific ambient NO_2/NO_x ratios derived from appropriate ambient monitoring data may also be considered as detailed screening methods on a case-by-case basis, with proper justification.

- *Tier 3* – Performs a detailed analysis on a case-by-case basis by employing the OLM or PVMRM. These methods require the most detailed level of analysis and produce the least conservative, and presumably the most representative results. Tier 3 requires information such as in stack NO_2/NO_x ratio and ambient ozone concentrations.

The Tier 2 ARM was applied for this analysis.

Toxicity Assessment

The toxicity values for DPM used in this analysis were based on OEHHA guidance. These toxicity values are for carcinogenic effects and chronic health impacts. The primary pathway for exposures was assumed to be inhalation and carcinogenic and non-carcinogenic effects were evaluated separately. The Cancer Potency Factor for DPM was established by the OEHHA as 1.1 mg/kg-day for 70 years. ~~The HARP incorporates OEHHA cancer potency factors for additional air toxics included in the analysis.~~Cancer potency factors were based on California Office of Environmental Health Hazards Assessment Toxicity Criteria Database, 2013, http://www.oehha.ca.gov/tcdb/."

The HRA was conducted following methodologies in SCAQMD *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act* and in the California OEHHA *Air Toxics Hot Spots Program Guidance.* This was accomplished by applying the highest estimated concentrations at the receptors analyzed to the established cancer risk estimates and acceptable reference concentrations (RfC) for non-cancer health effects.

The toxicity values used in this analysis were based on OEHHA guidance. These toxicity values are for carcinogenic effects and acute/chronic health impacts. The primary pathway for exposures was assumed to be inhalation and carcinogenic and non-carcinogenic effects were evaluated separately. The incremental risks were determined for each emission source of TAC and summed to obtain an estimated total incremental carcinogenic health risk.

Cancer risk estimates also incorporate age sensitivity factors (ASFs). This approach provides updated calculation procedures that factor in the increased susceptibility of infants and children to carcinogens as compared to adults. OEHHA recommends that cancer risks be weighted by a factor of 10 for exposures that occur from the third trimester of pregnancy to 2 years of age, and by a factor of 3 for exposures from 2 years through 15 years of age. For estimating cancer risks for residential receptors over a 70 year lifetime, the incorporation of the ASFs results in a cancer risk adjustment factor (CRAF) of 1.7.

Per OEHHA guidance for cancer risk analysis, a continuous exposure of 24 hours per day, 350 days per year for a 70-year lifetime is assumed for residents. This is a highly conservative assumption, since most people do not remain at home all day and on average residents change residences every 11 to 12 years. In addition, this analysis assumes that residents are experiencing outdoor concentrations for the entire exposure period. For children at school sites, exposure is assumed to occur 10 hours per day for 180 days (or 36 weeks) per year.

For occupational receptors, SCAQMD guidance suggests that the exposure be based on 8 hours per day, 5 days per week, 245 working days per year, and a 40-year working lifetime. This is a conservative assumption, since most people do not remain at the same job for 40 years.

The SCAQMD also suggests specific daily breathing rates and exposure value factors for estimating cancer risks. The 80th percentile adult breathing rate of 302 liters per kilogram per day (L/kg-day) was used to determine cancer risks to residents from exposure to TAC. The residential exposure frequency and duration was assumed to be 350 days per year and 70 years. For children, OEHHA recommends assuming a breathing rate of 581 L/kg-day to assess potential risk via the inhalation exposure pathway. This value represents the upper 95th percentile of daily breathing rates for children. The modeled TAC concentrations were used to represent the exposure concentrations in the air. The inhalation absorption factor was assumed to be 1. Cancer risk to residential receptors based on a 70-year lifetime exposure. Cancer risk estimates for children at school sites are calculated based on 9 year exposure duration. **Table AQ-12** provides a summary of the risk assessment exposure parameters used in the analysis.

Table AQ-12 – Health Risk Assessment Exposure Parameters

Receptor	Breathing Rate (DBR)	Cancer Risk Adjustment Factor (CRAF)	Daily Exposure	Annual Exposure	Exposure Duration (ED)
Worker	149	1.7	12 hours	245 days	40 year
Adult	302	1.7	24 hours	350 days	70 years
Child	581	10	24 hours	350 days	3 years
School	581	3	10 hours	180 days	9 years

Source: Office of Environmental Health Hazard Assessment (OEHHA), 2003. *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*, http://www.oehha.org/air/hot_spots/pdf/HRAguidefinal.pdf and South Coast Air Quality Management District, Risk Assessment Procedures for Rules 1401 and 212 http://www.aqmd.gov/prdas/risk%20assessment/riskassessment.html

Risk Characterization

Cancer risk is defined as the lifetime probability of developing cancer from exposure to carcinogenic substances. Cancer risks are expressed as the chance in one million of getting cancer (i.e., number of cancer cases among one million people exposed). The cancer risks are assumed to occur exclusively through the inhalation pathway. The cancer risk can be estimated by using the cancer potency factor (milligrams per kilogram of body weight per day [mg/kg-day]), the 70-year annual average concentration (microgram per cubic meter [$\mu g/m^3$]), and the lifetime exposure adjustment.

Following guidelines established by OEHHA, the incremental cancer risks attributable to the Project were calculated by applying exposure parameters to modeled TAC concentrations in order to determine the inhalation dose (mg/kg-day) or the amount of pollutants inhaled per body weight mass per day. The cancer risks occur exclusively through the inhalation pathway; therefore, the cancer risks can be estimated from the following equation:

$$\text{Dose-inh} = \frac{C_{air} * \{DBR\} * A * CRAF * EF * ED * 10^{-6}}{AT}$$

Where:

Dose-inh	= Dose of the toxic substance through inhalation in mg/kg-day
10^{-6}	= Micrograms to milligrams conversion, Liters to cubic meters conversion
C_{air}	= Concentration in air in microgram (µg)/cubic meter (m^3)
{DBR}	= Daily breathing rate in liter (L)/kg body weight – day
A	= Inhalation absorption factor
CRAF	= Cancer Risk Adjustment Factor, Age Sensitivity Factor
EF	= Exposure frequency (days/year)
ED	= Exposure duration (years)
AT	= Averaging time period over which exposure is averaged in days (25,550 days for a 70 year cancer risk)

To determine incremental cancer risk, the estimated inhalation dose attributed to the Project was multiplied by the cancer potency slope factor (cancer risk per mg/kg-day). The cancer potency slope factor is the upper bound on the increased cancer risk from a lifetime exposure to a pollutant. These slope factors are based on epidemiological studies and are different values for different pollutants. This allows the estimated inhalation dose to be equated to a cancer risk.

Non-cancer adverse health impacts, acute (short-term) and chronic (long-term), are measured against a hazard index (HI), which is defined as the ratio of the predicted incremental exposure concentration from the Project to a published reference exposure level (REL) that could cause adverse health effects as established by OEHHA. The ratio (referred to as the Hazard Quotient [HQ]) of each non-carcinogenic substance that affects a certain organ system is added to produce an overall HI for that organ system. The overall HI is calculated for each organ system. If the overall HI for the highest-impacted organ system is greater than one, then the impact is considered to be significant.

The HI is an expression used for the potential for non-cancer health effects. The relationship for the non-cancer health effects is given by the annual concentration (in $\mu g/m^3$) and the REL (in $\mu g/m^3$). The acute hazard index was determined using the "simple" concurrent maximum approach, which tends to be conservative (i.e., overpredicts).

The relationship for the non-cancer health effects is given by the following equation:

$$HI = C/REL$$

Where:

HI	= Hazard index; an expression of the potential for non-cancer health effects.
C	= Annual average concentration ($\mu g/m^3$) during the 70 year exposure period.
REL	= Concentration at which no adverse health effects are anticipated.

The chronic REL for DPM was established by the California OEHHA[17] as 5 $\mu g/m^3$. There is no acute REL for DPM. However, diesel exhaust does contain acrolein and other compounds, which do have an acute REL. BAAQMD's DPM speciation table (based on profile 4674 within the USEPA Speciate 4.2)[18] was used to assess the acute impacts. Acrolein emissions are approximately 1.3 percent of the total diesel emissions. The acute

[17] California Office of Environmental Health Hazards Assessment Toxicity Criteria Database, 2010, http://www.oehha.ca.gov//.

[18] Provides for a speciation faction of 1.3 percent of acrolein per DPM emission rate, http://www.epa.gov////.html.

REL for acrolein was established by the California OEHHA[19] as 2.5 μg/m^3. The chronic reference exposure level for crystalline silica was established by the OEHHA as 3 μg/m^3.

[19] California Office of Environmental Health Hazards Assessment Toxicity Criteria Database, 2010, http://www.oehha.ca.gov//.

Supporting Air Quality and Health Risk Assessment Files

Ambient Monitoring Data

Construction and Operational Emissions

CALEEMOD

AERMOD with Meteorological/Terrain/Ozone Data

Fugitive Dust Analysis

EMFAC Emission Factors

OFFROAD Emission Factors

Health Risk Assessment

Local Significance Threshold Analysis