Decker Island Restoration Project Air Quality Calculation

Construction of the Decker Island Project is scheduled to be carried out from August to September 2017. Air pollutants will be generated during this short-term construction period, and after project construction is completed, operation of the proposed project will not generate air pollutants. Therefore, only emissions during the less-than-two-month construction phase will be calculated to evaluate the project's impacts to air quality.

The air pollutants of most concern from project construction are Particulate Matter (PM_{10} and $PM_{2.5}$) and ozone precursors Reactive Organic Gases (ROG) and Nitrogen Oxides (NOx). Project construction will also generate Sulphur Dioxide (SO_2), Carbon monoxide (CO), as well as greenhouse gases such as Carbon Dioxide (CO_2) and Methane (CH_4). The Air pollutants are primarily consists of exhaustion emissions of the construction equipment and vehicles, which includes (a) off-road construction equipment such as dozers, excavators, cranes, for activities such as clearing and grubbing, soil excavation and re-spreading, (b) on-road vehicles such as cars or trucks for worker commute, water trucks, service trucks, and (c) barges for mobilization and demobilization of construction equipment and boats for worker commute). The list of equipment, including of equipment type s and their quantity and work schedule prepared by the design engineers, are shown in **Table 1**. In addition, fugitive dust from soil disturbance activities such as clearing and grubbing, soil excavation and re-spreading and movement of off-road vehicles on unpaved ground is also a major cause of Particular Matter (PM_{10} and $PM_{2.5}$).

Table 1 List of Equipment for each Construction Phase for Decker Island Project

	Equipment				
Construction Phase	Type	Horse Power	Max Daily # Pieces	Max Daily Work Hours	Total Work Hours
1. MOBILIZATION					
	Barge	1000	1	8	8
	Boat	250	1	2	2
	Boat (Worker Commute)	250	1	2	2
2. SITE PREPARATION					
	Loader/Backhoe	175	2	16	304
	Dumper/Tender	25	2	16	112
	Excavator	250	2	16	240
	Crane	120	1	8	24
	Sheep foot roller	250	2	16	208
	Utility Truck	350	2	16	48
	Other Equipment	50	2	16	64
	Misc Portable Equipment	120	2	16	48
	Boat (Worker	250	1	2	2

	Commute)				
3. CONSTRUCTION					
	Loader/Backhoe	175	2	16	272
	Dumper/Tender	25	2	16	272
	Excavator	250	2	16	272
	Crane	120	1	8	24
	Sheep foot roller	250	0	0	0
	Utility Truck	350	2	16	48
	Other Equipment	50	2	16	80
	Misc Portable Equipment	120	2	16	48
	Boat (Worker Commute)	250	1	2	2
4. DEMOBILIZATION					
	Barge	1000	1	8	8
	Boat	250	1	2	2
	Boat (Worker Commute)	250	1	2	2

This Appendix uses the Road Construction Emissions Model Version 8.1.0 (Roadway Model), although indirectly, to calculate air pollutant emissions during project construction. The Roadway Model was developed by the Sacramento Metropolitan Air Quality Management District to perform quantitative air quality analysis for roadway projects, which also uses off-road construction equipment and on-road vehicles for work commute and material hauling. The Roadway Model quantifies project construction emissions from the following sources: worker commute, material hauling, water truck, and fugitive dust and off-road equipment. The Roadway Model contains a pre-defined set of commonly-used off-road construction vehicles with their emission rates calculated based on the construction year and the corresponding emission factors, default horsepower values and load factors from the California Air Resources Board's (CARB) OFFROAD2007 emission model. The off-road equipment emission factors and default average horsepower by equipment type were updated to be consistent with CalEEMod (version 2013.2.2). The Roadway Model also embeds the emission rates for On-Road vehicles from CARB's EMFAC2014 emission model. Because the Road Construction Emissions Model estimates emissions for ROG, CO, NO_x, PM_{10} and PM $_{2.5}$, SO_x, CH_4, N_2O and CO_2e, so this Appendix also estimated the emissions for these pollutants . **Table 2** contains the daily emissions for each piece of construction equipment calculated by using the Roadway Model with the following data entry: on the "Data Entry" sheet, set the Construction Start Year field to 2017. In the Equipment Section, override the horsepower fields by the values provided by Design Engineers, override the Number of Construction Vehicle with 1 and keep the Hours per Day field to 8. In the section for a construction phase, for example the "" phase, for each

equipment type in **Table 1**, set its quantity to 1, and the daily emissions for one piece of that equipment type can be obtained.

Table 2 List of Equipment for each Construction Phase for Decker Island Project

Construction Phase	Equipment	Emissions for One Piece of Construction Equipment in Pounds per Day									
		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
1. MOBILIZATION											
	Barge	1.78	9.86	64.45	1.97	1.91	8.55	4537.48	0.59	0.13	4591.47
	Boat	0.44	2.47	16.11	0.49	0.48	2.14	1134.37	0.15	0.03	1147.87
	Boat (Worker Commute)	0.44	2.47	16.11	0.49	0.48	2.14	1134.37	0.15	0.03	1147.87
2. SITE PREPARATION											
	Loader/Backhoe	0.58	3.91	5.77	0.32	0.30	0.01	552.62	0.17	0.00	558.27
	Dumper/Tender	0.28	1.17	0.98	0.10	0.09	0.00	97.50	0.03	0.00	98.49
	Excavator	0.41	2.09	5.56	0.18	0.16	0.01	835.14	0.26	0.01	843.67
	Crane	0.67	2.89	5.62	0.42	0.38	0.00	304.28	0.09	0.00	307.39
	Sheep foot roller	0.46	2.36	6.57	0.22	0.20	0.01	837.26	0.26	0.01	845.81
	Utility Truck	0.02	0.07	0.58	0.01	0.01	0.00	148.51	0.00	0.01	150.03
	Other Equipment	0.46	2.09	2.01	0.18	0.16	0.00	206.67	0.06	0.00	208.78
	Misc Portable Equipment	0.44	2.64	3.77	0.31	0.29	0.00	327.25	0.10	0.00	330.59
	Boat (Worker Commute)	0.44	2.47	16.11	0.49	0.48	2.14	1134.37	0.15	0.03	1147.87
3. CONSTRUCTION											
	Loader/Backhoe	0.58	3.91	5.77	0.32	0.30	0.01	552.62	0.17	0.00	558.27
	Dumper/Tender	0.28	1.17	0.98	0.10	0.09	0.00	97.50	0.03	0.00	98.49
	Excavator	0.41	2.09	5.56	0.18	0.16	0.01	835.14	0.26	0.01	843.67
	Crane	0.67	2.89	5.62	0.42	0.38	0.00	304.28	0.09	0.00	307.39
	Sheep foot roller	0.46	2.36	6.57	0.22	0.20	0.01	837.26	0.26	0.01	845.81
	Utility Truck	0.02	0.07	0.58	0.01	0.01	0.00	148.51	0.00	0.01	150.03
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	Misc Portable Equipment	0.44	2.64	3.77	0.31	0.29	0.00	327.25	0.10	0.00	330.59
	Boat (Worker Commute)	0.44	2.47	16.11	0.49	0.48	2.14	1134.37	0.15	0.03	1147.87
4. DEMOBILIZATION											
	Barge	1.78	9.86	64.45	1.97	1.91	8.55	4537.48	0.59	0.13	4591.47
	Boat	0.44	2.47	16.11	0.49	0.48	2.14	1134.37	0.15	0.03	1147.87
	Boat (Worker Commute)	0.44	2.47	16.11	0.49	0.48	2.14	1134.37	0.15	0.03	1147.87

The total emissions were calculated using the following formula:

Total Emissions (masses per day) for an Equipment Type in a construction phase

= Daily Emissions (masses per 8-hour day) x Total Hours for the Equipment in the Phase/ 8.0 (hours per day)

Total Emissions (masses per day) for All Equipment Type in a construction phase

= Sum of Total Emissions (masses per 8-hour day) for all Equipment Types in the Phase

Total Emissions (masses per day) for the Project

= Sum of Total emissions for all construction phases

The air pollutant emissions for each construction phase and for the whole project are shown in **Table 3**

Table 3: Air Pollutant Emissions Summary (in pounds)

Construction Phase	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
1. MOBILIZATION	0.55	3.08	20.14	0.62	0.60	2.67	1417.96	0.18	0.04	1434.83
2. SITE PREPARATION	58.89	331.31	633.80	130.98	47.42	1.27	74891.89	22.63	0.67	75657.37
3. CONSTRUCTION	52.90	290.28	485.82	137.41	45.89	1.09	56616.53	17.03	0.51	57195.46
4. DEMOBILIZATION	0.55	3.08	20.14	0.62	0.60	2.67	1417.96	0.18	0.04	1434.83
Project Total (pounds)	112.90	627.76	1159.89	269.63	94.51	7.70	134344.35	40.03	1.27	135722.50
Project Total (tons)	0.06	0.31	0.58	0.13	0.05	0.00	67.17	0.02	0.00	67.86

The maximum daily emissions were calculated using the following formula:

Maximum Daily Emissions (masses per day) for each Equipment Type

= Daily Emissions (masses per 8-hour day) x Maximum Hours on one Day in the Phase/ 8.0 (hours per day)

Maximum Daily Emissions (masses per day) in a construction phase =

= Sum of Maximum Daily Emissions (masses per day) for All Equipment Type in that construction phase

Maximum Daily Emissions (masses per day) for the Project =

= Maximum of Maximum Daily Emissions (masses per day) for all construction phases

The maximum daily air pollutant emissions for each construction phase and for the whole project are shown in **Table 4**

Table 4: Maximum Daily Air Pollutant Emissions (in pounds per day)

Construction Phase	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
1. MOBILIZATION	0.55	3.08	20.14	0.62	0.60	2.67	1417.96	0.18	0.04	1434.83
2. SITE PREPARATION	6.09	32.16	60.13	14.97	5.29	0.60	6597.77	1.88	0.07	6665.64
3. CONSTRUCTION	5.17	27.45	47.00	23.97	6.80	0.58	4923.25	1.37	0.06	4974.03
4. DEMOBILIZATION	0.55	3.08	20.14	0.62	0.60	2.67	1417.96	0.18	0.04	1434.83