APPENDIX H – ENERGY CALCULATIONS

Appendix H - Energy Calculations

Construction-Related Petroleum Fuels

The off-road construction equipment fuel usage was calculated through use of the off-road equipment assumptions utilized in the CalEEMod model run provided in Appendix G: Greenhouse Gas Screening Letter – County of Imperial, March 23, 2021, Ldn Consulting, Inc. and the fuel usage calculations provided in the 2017 Off-road Diesel Emission Factors spreadsheet, prepared by CARB (https://ww3.arb.ca.gov/msei/ordiesel.htm). The Spreadsheet provides the following formula to calculate fuel usage from off-road equipment:

Fuel Used = Load Factor x Horsepower x Total Operational Hours x BSFC / Unit Conversion

Where:

Load Factor - Obtained from CalEEMod default values

Horsepower – Obtained from CalEEMod default values

Total Operational Hours – Calculated by multiplying CalEEMod default daily hours by the estimated number of working days for each phase of construction

BSFC – Brake Specific Fuel Consumption (pounds per horsepower-hour) – If less than 100 Horsepower = 0.408, if greater than 100 Horsepower = 0.367

Unit Conversion – Converts pounds to gallons = 7.109

The Following Table shows the off-road construction equipment fuel calculations based on the above formula, which shows that the off-road equipment utilized during construction of the proposed project would consume 561,273 gallons of fuel.

Off-Road Construction Equipment Modeled in CalEEMod and Fuel Used

Equipment Type	Equipment Quantity	Horse-Power	Load Factor	Operating Hours Per Day	Total Operational Hours[1]	Fuel Used (gallons)
Demolition						
Concrete/Industrial Saws	1	81	0.73	8	80	271
Excavators	3	158	0.38	8	240	744
Rubber Tired Dozers	2	247	0.4	8	160	816
Grading						
Graders	1	187	0.41	8	400	1,583
Off-Highway Trucks	7	402	0.38	8	2,800	22,081
Rollers	1	80	0.38	8	400	698
Rubber Tired Dozers	2	247	0.4	8	800	4,080
Scrapers	4	367	0.48	8	1,600	14,551
Tractors/Loaders/Backhoes	1	97	0.37	8	400	824
Building Construction						
Aerial Lifts	7	63	0.31	8	29,120	32,640
Air Compressor	4	78	0.48	8	16,640	35,755
Cranes	7	231	0.29	7	25,480	88,118
Excavators	2	158	0.38	8	8,320	25,788
Forklifts	7	89	0.2	8	29,120	29,748
Generator Set (small)	1	15	0.74	8	4,160	2,650
Generator Sets (large)	4	84	0.74	8	16,640	59,363
Graders	1	187	0.41	8	4,160	16,466
Off-Highway Trucks	1	402	0.38	8	4,160	32,807
Rubber Tired Dozers	1	247	0.4	8	4,160	21,218
Tractors/Loaders/Backhoes	13	97	0.37	7	47,320	97,470
Welders	1	46	0.45	8	4,160	4,942
Trenching						
Excavators	2	158	0.38	8	2,000	6,199
Off-Highway Trucks	3	402	0.38	8	3,000	23,659
Rollers	1	80	0.38	8	1,000	1,745
Skid Steer Loaders	1	65	0.37	8	1,000	1,380
Tractors/Loaders/Backhoes	3	97	0.37	8	3,000	6,179
Paving						
Graders	2	187	0.41	8	1856	7,346
Pavers	1	130	0.42	8	928	2,616
Rollers	2	80	0.38	8	1856	3,238
Rubber Tired Dozers	2	247	0.4	8	1856	9,467
Tractors/Loaders/Backhoes	3	97	0.37	8	2784	5,734

Equipment Type	Equipment Quantity	Horse-Power	Load Factor	Operating Hours Per Day	Total Operational Hours[1]	Fuel Used (gallons)
Architectural Coatings						
Air Compressor	1	78	0.48	6	510	1,096
Total Off-Road Equipment Fuel used during Construction of the Proposed Project (gallons)						**561,273**

Notes:

[1] Based on 10 days for Grading , 50 days for Grading, 520 days for Building Construction, 125 days for Trenching, 116 days for Paving, and 85 days for Architectural Coatings.

Source: CalEEMod Version 2016.3.2, CARB, 2018.

The on-road construction-related vehicle trips fuel usage was calculated through use of the default construction vehicle trip assumptions from the CalEEMod model run. The fleet average miles per gallon rates have been calculated through use of the EMFAC2017 model (https://www.arb.ca.gov/emfac/2017/) and the EMFAC2017 model printouts are attached. The following Table shows the on-road construction vehicle trips modeled in CalEEMod and the fuel usage calculations, which shows that the on-road construction-related vehicle trips would consume 123,306 gallons of fuel for the proposed Project.

On-Road Construction Vehicle Trips Modeled in CalEEMod and Fuel Used

Vehicle Trip Types	Daily Trips	Trip Length (miles)	Total per Day (miles)	Total per Phase (miles)	Fleet Average Miles per Gallon	Fuel Used (gallons)
Demolition						
Worker Trips	15	10.2	153	1,530	25.1	61
Haul Trips	7	20	136	1,360	7.7	176
Grading						
Worker Trips	40	10.2	408	20,400	25.1	814
Building Construction						
Worker Trips	225	10.2	2,295	1,193,400	25.1	47,603
Vendor Trips	88		1,047	544,544	7.7	70,645
Trenching						
Worker Trips	25	10.2	255	31,875	25.1	1,271
Paving						
Worker Trips	25	10.2	255	29,580	25.1	1,180
Architectural Coatings						
Worker Trips	45	10.2	459	39,015	25.1	1,556
Total On-Road Vehicle Fuel used during Construction of the Proposed Project (gallons)						**123,306**

Notes:

[1] Based on 10 days for Grading , 50 days for Grading, 520 days for Building Construction, 125 days for Trenching, 116 days for Paving, and 85 days for Architectural Coatings.

Source: CalEEMod Version 2016.3.2, CARB, 2018.

Operations-Related Petroleum Fuels

The on-road operations-related vehicle trips fuel usage was calculated through use of the total annual vehicle miles traveled assumptions from the CalEEMod model run provided in Appendix G: Greenhouse Gas Screening Letter – County of Imperial, March 23, 2021, Ldn Consulting, Inc., which found that operation of the proposed project would generate 631,595 vehicle miles traveled per year. The calculated total operational miles were then divided by the Imperial County fleet average rate of 27.5 miles per gallon, which was calculated through use of the EMFAC2017 model for year 2021 for Imperial County. The EMFAC2017 model printouts are attached to this Appendix. Based on the above calculation methodology, the operation of the proposed Project would consume 22,985 gallons per year.

EMFAC2017 (v1.0.2) Emissions Inventory
Region Type: County
Region: IMPERIAL
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, tons/day for Emissions, 1000 gallons/day for Fuel Consumption. Note 'day' in the unit is operation day.

Region	Calendar Y	Vehicle Cat	Model Yea	Speed	Fuel	Population	VMT	Trips	Fuel Consumption
IMPERIAL	2021	HHDT	Aggregate	Aggregate	GAS	2.825263	137.49617	56.52785	0.03343
IMPERIAL	2021	LDA	Aggregate	Aggregate	GAS	145175.9	5643786.6	683437.9	186.6888
IMPERIAL	2021	LDT1	Aggregate	Aggregate	GAS	17276.41	612064.25	77482.43	24.00773
IMPERIAL	2021	LDT2	Aggregate	Aggregate	GAS	52024.47	1908388.1	240462.6	80.63031
IMPERIAL	2021	LHDT1	Aggregate	Aggregate	GAS	4280.077	144693.38	63766.77	13.54718
IMPERIAL	2021	LHDT2	Aggregate	Aggregate	GAS	703.9896	23736.979	10488.4	2.547752
IMPERIAL	2021	MCY	Aggregate	Aggregate	GAS	6622.21	59214.749	13244.42	1.502854
IMPERIAL	2021	MDV	Aggregate	Aggregate	GAS	45128.95	1607774.8	205347.3	82.99022
IMPERIAL	2021	MH	Aggregate	Aggregate	GAS	859.4062	7399.0473	85.975	1.434682
IMPERIAL	2021	MHDT	Aggregate	Aggregate	GAS	505.9482	28400.557	10123.01	5.522487
IMPERIAL	2021	OBUS	Aggregate	Aggregate	GAS	132.3029	6896.0896	2647.116	1.352893
IMPERIAL	2021	SBUS	Aggregate	Aggregate	GAS	30.84301	1760.5474	123.372	0.187748
IMPERIAL	2021	UBUS	Aggregate	Aggregate	GAS	8.282969	947.79829	33.13188	0.241693

vehicle miles per day (All Categories)	10045200	401	1,000 gall per day
		400,688	gallons per day
Fleet Avg Miles per gallon	25.1		

EMFAC2017 (v1.0.2) Emissions Inventory
Region Type: County
Region: IMPERIAL
Calendar Year: 2021
Season: Annual
Vehicle Classification: EMFAC2007 Categories
Units: miles/day for VMT, trips/day for Trips, tons/day for Emissions, 1000 gallons/day for Fuel Consumption. Note 'day' in the unit is operation day.

Region	Calendar Y	Vehicle Cat	Model Yea	Speed	Fuel	Population	VMT	Trips	Fuel Consumption
IMPERIAL	2021	HHDT	Aggregate	Aggregated	DSL	4859.163	727200.53	57864.68	102.13909
IMPERIAL	2021	LDA	Aggregate	Aggregated	DSL	1274.529	50425.669	6002.429	0.9672779
IMPERIAL	2021	LDT1	Aggregate	Aggregated	DSL	13.16284	292.61362	42.55079	0.0113065
IMPERIAL	2021	LDT2	Aggregate	Aggregated	DSL	259.9127	11016.192	1284.794	0.2840536
IMPERIAL	2021	LHDT1	Aggregate	Aggregated	DSL	4178.056	148628.22	52554.68	7.1691825
IMPERIAL	2021	LHDT2	Aggregate	Aggregated	DSL	1332.595	49408.266	16762.37	2.5735426
IMPERIAL	2021	MDV	Aggregate	Aggregated	DSL	896.497	36985.877	4343.927	1.2992358
IMPERIAL	2021	MH	Aggregate	Aggregated	DSL	282.4584	2576.735	28.24584	0.2323685
IMPERIAL	2021	MHDT	Aggregate	Aggregated	DSL	2054.337	118673.4	15348.12	11.096555
IMPERIAL	2021	OBUS	Aggregate	Aggregated	DSL	135.3162	9408.1492	1254.028	1.0144107
IMPERIAL	2021	SBUS	Aggregate	Aggregated	DSL	203.9511	6376.6912	2353.568	0.8660474
IMPERIAL	2021	UBUS	Aggregate	Aggregated	DSL	27.95502	3506.4503	111.8201	0.5197596

Diesel Truck (HHDT, MDV, MHDT) vehicle miles per day	882,860	115	1,000 gall per day
		114,535	gallons per day
Diesel Truck Fleet Avg Miles per gallon	7.7		