APPENDIX B

Air Quality Analysis Methodology and Results

APPENDIX B AIR QUALITY ANALYSIS METHODOLOGY AND RESULTS

This appendix discusses the approach and methodology used to assess construction and operational emissions associated with the proposed project. The analysis evaluates average daily and yearly emissions generated by terrestrial equipment and vehicles and marine activities within 3 nautical miles (nm) of the shore. Emissions analyzed include criteria pollutants of ozone precursors (reactive organic gases [ROG] and nitrogen oxides [NOx]), carbon monoxide (CO), particulate matter (PM10 and PM2.5), and sulfur dioxide (SO_2) and greenhouse gases (GHG) of carbon dioxide (CO_2), methane (CH_4), and nitrous oxides (N_2O).

As discussed in Section 3.3., *Air Quality*, the criteria pollutant impact analysis is limited to emissions generated with 3 nautical miles (nm) from the U.S. Coastline. This is consistent with the regulatory authority of the Commission under CEQA and the jurisdiction of the Mendocino County Air Quality Management District (MCAQMD) (Rule 1-105).

As discussed in Section 3.8, *Greenhouse Gases*, the GHG impact analysis extends to 24 nm from the U.S. Coastline. While this distance goes beyond the area typically analyzed in CEQA documents (3 nm), the Commission has conservatively elected to analyze emissions to 24 nm for consistency with the State's GHG emissions inventory and reduction planning goals.

Data and assumptions for the two analyses (3 nm and 24 nm) are included in the following sections and labeled as such, where applicable. Criteria pollutant emissions within 24 nm from the U.S. Coastline are included for informational purposes at the end of this appendix.

B.1 CONSTRUCTION

Construction of the proposed project requires both terrestrial (i.e., on land) and marine activities. Terrestrial activities include conduit installation, directional boring, cable pulling, and construction of the CLS facility. These activities would generate criteria pollutant and GHG emissions from offroad equipment (e.g., backhoes) and vehicles used for employee commuting and hauling. Fugitive dust and ROG would also be generated by earthmoving (e.g., grading) and paving, respectively. Marine activities include laying and burying the cables. Vessels used to support these activities include main lay vessels, support vessels, workboats, patrol boats, and tugboats.

The following sections summarize the methods used to assess each of the terrestrial and marine emission sources. An overview of the construction schedule is also provided.

B.1.1 Schedule

Each of the cables would be installed in four separate phases. Construction on the first cable is expected to begin in April 2019. The CLS facility would be constructed during this first phase, extending the duration of Phase 1 to 165 working days. Installation of the remaining three cables would require no more than 34 working days per year. Table 1 summarizes the construction schedule assumed in the emissions modeling for terrestrial and marine construction within 3 nm from the U.S. Coastline. Table 2 summarizes the construction schedule for marine activities between 3 and 24 nm from the U.S. Coastline.

Table 1. Schedule for Terrestrial and Marine Construction within 3 NM from the U.S. Coastline

Phase and Description		Start Date	End Date	Working Days[a]
Phase 1				
1-1	Terrestrial conduit installation	5/1/2019	7/24/2019	84
1-2	Directional bores – marine	4/1/2019	4/29/2019	28
1-3	OGB and LMH	4/29/2019	5/13/2019	14
1-4	Terrestrial cable pulling	7/24/2019	7/29/2019	5
1-5	CLS facility (construction and testing)	5/1/2019	8/29/2019	120
1-6	Pre-lay grapnel run	8/30/2019	8/31/2019	1
1-7	Marine cable landing	9/4/2019	9/5/2019	1
1-8	Marine cable lay	9/6/2019	9/7/2019	1
1-9	Marine cable burial (diver-assisted)	9/8/2019	9/10/2019	2
1-10	Marine cable burial (ROV-assisted)	9/11/2019	9/13/2019	2
1-11	Worker/Delivery	4/1/2019	9/13/2019	165
Phase 2				
2-1	OGB installation	8/1/2021	8/6/2021	5
2-2	Terrestrial cable pulling	8/7/2021	8/14/2021	7
2-3	CLS facility (construction and testing)	8/15/2021	8/20/2021	5
2-4	Pre-lay grapnel run	8/21/2021	8/22/2021	1
2-5	Marine cable landing	8/26/2021	8/27/2021	1
2-6	Marine cable lay	8/28/2021	8/29/2021	1
2-7	Marine cable burial (diver-assisted)	8/30/2021	9/1/2021	2
2-8	Marine cable burial (ROV-assisted)	9/2/2021	9/4/2021	2
2-9	Worker/Delivery	8/1/2021	9/4/2021	34
Phase 3				
3-1	OGB installation	9/1/2023	9/6/2023	5
3-2	Terrestrial cable pulling	9/7/2023	9/14/2023	7
3-3	CLS facility (construction and testing)	9/15/2023	9/20/2023	5
3-4	Pre-lay grapnel run	9/21/2023	9/22/2023	1
3-5	Marine cable landing	9/26/2023	9/27/2023	1
3-6	Marine cable lay	9/28/2023	9/29/2023	1
3-7	Marine cable burial (diver-assisted)	9/30/2023	10/2/2023	2
3-8	Marine cable burial (ROV-assisted)	10/3/2023	10/5/2023	2
3-9	Worker/Delivery	9/1/2023	10/5/2023	34

Phase and Description		Start Date	End Date	Working Days[a]
Phase 4				
4-1	OGB installation	10/1/2025	10/6/2025	5
4-2	Terrestrial cable pulling	10/7/2025	10/14/2025	7
4-3	CLS facility (construction and testing)	10/15/2025	10/20/2025	5
4-4	Pre-lay grapnel run	10/21/2025	10/22/2025	1
4-5	Marine cable landing	10/26/2025	10/27/2025	1
4-6	Marine cable lay	10/28/2025	10/29/2025	1
4-7	Marine cable burial (diver-assisted)	10/30/2025	11/1/2025	2
4-8	Marine cable burial (ROV-assisted)	11/2/2025	11/4/2025	2
4-9	Worker/Delivery	10/1/2025	11/4/2025	34

Source: Brungardt pers. comm.

[a] Table 2-1 in the Chapter 2, *Project Description*, shows slightly longer phase durations. This is because the phase durations in Table 2-1 include non-working/activity days, whereas the durations shown above only reflect the days in which activity would occur and emissions would be generated.

Table 2. Schedule for Marine Construction between 3 NM and the NAECA

Phase and Description		Start Date	End Date	Working Days[a]
Phase 1				
1-6	Pre-lay grapnel run	9/1/2019	9/3/2019	2
1-8	Marine cable lay	9/8/2019	9/16/2019	6
1-10	Marine cable burial (ROV-assisted)	9/14/2019	9/19/2019	4
Phase 2				
2-4	Pre-lay grapnel run	8/23/2021	8/25/2021	2
2-6	Marine cable lay	8/30/2021	9/7/2021	6
2-8	Marine cable burial (ROV-assisted)	9/5/2021	9/10/2021	4
Phase 3				
3-4	Pre-lay grapnel run	9/23/2023	9/25/2023	2
3-6	Marine cable lay	9/30/2023	10/8/2023	6
3-8	Marine cable burial (ROV-assisted)	10/6/2023	10/11/2023	4
Phase 4				
4-4	Pre-lay grapnel run	10/23/2025	10/25/2025	2
4-6	Marine cable lay	10/30/2025	11/7/2025	6
4-8	Marine cable burial (ROV-assisted)	11/5/2025	11/10/2025	4

Source: Brungardt pers. comm.

[a] Table 2-1 in the Chapter 2, *Project Description*, shows slightly longer phase durations. This is because the phase durations in Table 2-1 include non-working/activity days, whereas the durations shown above only reflect the days in which activity would occur and emissions would be generated.

B.1.2 Models and Methods for Emissions Quantification

Criteria pollutant and GHG emissions generated by construction of the proposed project were assessed using standard and accepted models and tools. Combustion exhaust, fugitive dust (PM10 and PM2.5), and fugitive off-gassing (ROG) were estimated using a combination of emission factors and methodologies from CalEEMod, version 2016.3.2; the California Air Resources Board's (CARB) EMFAC2017 model and marine vessel guidance; and the United States Environmental Protection Agency's (EPA) *AP-42 Compilation of Air Pollutant Emission Factors* (AP-42) based on project-specific construction data (e.g., schedule, equipment, truck volumes). The following sections describe the quantification approach for each of the primary emission sources.

B.1.2.1 Off-Road Equipment

Emission factors for off-road construction equipment (e.g., loaders, graders, bulldozers) were obtained from the CalEEMod (version 2016.3.2) User's Guide appendix, which provides values per unit of activity (in grams per horsepower-hour) (Trinity Consultants 2017).[1] Pollutants were estimated by multiplying the CalEEMod emission factors by the equipment inventory shown in Table 3. Model defaults were assumed for equipment horsepower and load factors, except for drill rig used during terrestrial boring. This equipment was assumed to use a 600-horsepower engine. All off-road equipment would be used for terrestrial construction (i.e., on land).

Table 3. Off-road Equipment Inventory for Terrestrial Construction

Phase	Equipment	#/Day	Hours/Day	Horsepower
1-1	Concrete/Industrial Saws	1	2	81
1-1	Tractors/Loaders/Backhoes	1	8	97
1-1	Rollers	1	2	80
1-1	Plate Compactors	1	1	8
1-2	Bore/Drill Rigs	1	10	600
1-2	Excavators	1	2	158
1-2	Welders	1	8	46
1-2	Generator Sets	1	10	84
1-3	Tractors/Loaders/Backhoes	1	8	97
1-3	Bore/Drill Rigs	1	4	221
1-3	Plate Compactors	1	1	8
2-1	Tractors/Loaders/Backhoes	1	8	97
2-1	Bore/Drill Rigs	1	4	221
2-1	Plate Compactors	1	1	8
3-1	Tractors/Loaders/Backhoes	1	8	97
3-1	Bore/Drill Rigs	1	4	221
3-1	Plate Compactors	1	1	8
4-1	Tractors/Loaders/Backhoes	1	8	97

[1] CalEEMod does not include emission factors for N_2O. Emissions of N_2O were determined by scaling CO_2 emissions by the ratio of N_2O/CO_2 (0.000025) emissions expected per gallon of diesel fuel according to the Climate Registry (2018).

Phase	Equipment	#/Day	Hours/Day	Horsepower
4-1	Bore/Drill Rigs	1	4	221
4-1	Plate Compactors	1	1	8
1-7	Tractors/Loaders/Backhoes	1	4	97
1-7	Other General Industrial Equipment	1	8	88
1-7	Cranes	1	2	231
1-7	Generator Sets	1	4	84
2-5	Tractors/Loaders/Backhoes	1	4	97
2-5	Other General Industrial Equipment	1	8	88
2-5	Cranes	1	2	231
2-5	Generator Sets	1	4	84
3-5	Tractors/Loaders/Backhoes	1	4	97
3-5	Other General Industrial Equipment	1	8	88
3-5	Cranes	1	2	231
3-5	Generator Sets	1	4	84
4-5	Tractors/Loaders/Backhoes	1	4	97
4-5	Other General Industrial Equipment	1	8	88
4-5	Cranes	1	2	231
4-5	Generator Sets	1	4	84

Source: Brungardt pers. comm.

B.1.2.2 On-Road Vehicles

On-road vehicles include vehicles used for material and equipment hauling, employee commuting, and onsite crew and material movement. Exhaust emissions from on-road vehicles were estimated using the EMFAC2017 emissions model. Emission factors for delivery and tractor trailer trucks are based on aggregated-speed emission rates for EMFAC's T7 Single and T7 Tractor vehicle categories, respectively. Emission factors for employee commute vehicles are based on a weighted average for all vehicle speeds for EMFAC's LDA/LDT vehicle categories. One-way employee commute trip lengths were based on CalEEMod defaults for Mendocino County. Offsite pick-up trucks required for crew movement and fuel delivery trucks were modeled using EMFAC's LDT and T6 Instate Heavy vehicle categories, respectively.

Emission factors for on-site trucks were based on 5 miles per hour (mph) emission rates. Onsite dump trucks were modeled using EMFAC's T7 Single vehicle category, whereas onsite asphalt and equipment trucks were modeled using EMFAC's T6 Instate Heavy vehicle category. Onsite cable pulling trucks were modeled using EMFAC's T6 Utility vehicle category.

Fugitive re-entrained road dust emissions for all vehicle types were estimated using the EPA's AP-42, Sections 13.2.1 and 13.2.2 (U.S. Environmental Protection Agency 2006, 2011).

Table 4 summarizes the on-road vehicle inventory assumed in the emissions modeling. All on-road vehicles would be used for terrestrial construction (i.e., on land).

Table 4. On-Road Vehicle Inventory for Terrestrial Construction

Phase	Vehicle	Vehicles/Day	Trips/Day	Hours/Veh/Day	Miles/Day
1-1	Pickup Truck	1	2	2	10
1-1	Dump Truck	1	2	4	20
1-1	Asphalt Truck	1	2	2	10
1-2	Pickup Truck	1	2	3	15
1-2	Tractor Trailer	1	2	4	20
1-3	One Ton Truck	1	2	2	10
1-3	Pickup Truck	1	2	3	15
1-3	Delivery Truck	1	2	2	10
1-3	Dump Truck	1	2	2	10
2-1	One Ton Truck	1	2	2	10
2-1	Pickup Truck	1	2	3	15
2-1	Delivery Truck	1	2	2	10
2-1	Dump Truck	1	2	2	10
3-1	One Ton Truck	1	2	2	10
3-1	Pickup Truck	1	2	3	15
3-1	Delivery Truck	1	2	2	10
3-1	Dump Truck	1	2	2	10
4-1	One Ton Truck	1	2	2	10
4-1	Pickup Truck	1	2	3	15
4-1	Delivery Truck	1	2	2	10
4-1	Dump Truck	1	2	2	10
1-4	Cable-Pulling Truck	1	2	8	40
1-4	Pickup Truck with Reel	1	2	4	20
1-4	Equipment Truck	1	2	3	15
2-2	Cable-Pulling Truck	1	2	8	40
2-2	Pickup Truck with Reel	1	2	4	20
2-2	Equipment Truck	1	2	3	15
3-2	Cable-Pulling Truck	1	2	8	40
3-2	Pickup Truck with Reel	1	2	4	20
3-2	Equipment Truck	1	2	3	15
4-2	Cable-Pulling Truck	1	2	8	40
4-2	Pickup Truck with Reel	1	2	4	20
4-2	Equipment Truck	1	2	3	15
1-11	Tractor Trailer	2	5	9	500
2-9	Tractor Trailer	2	5	9	500
3-9	Tractor Trailer	2	5	9	500
4-9	Tractor Trailer	2	5	9	500

Phase	Vehicle	Vehicles/Day	Trips/Day	Hours/Veh/Day	Miles/Day
1-11	Fuel and Misc Delivery	1	1	1.8	100
2-9	Fuel and Misc Delivery	1	1	1.8	100
3-9	Fuel and Misc Delivery	1	1	1.8	100
4-9	Fuel and Misc Delivery	1	1	1.8	100
1-5	Equipment Truck	1	2	3	15
1-7	Pickup Truck	1	2	3	15
2-5	Pickup Truck	1	2	3	15
3-5	Pickup Truck	1	2	3	15
4-5	Pickup Truck	1	2	3	15

Source: Brungardt pers. comm.

B.1.2.3 Earthmoving and Paving

Fugitive dust emissions from earth movement (i.e., site grading, excavation, and truck loading) were quantified using emission factors from the CalEEMod User’s Guide (Trinity Consultants 2017). Grading acres and cut and fill quantities were provided by the project applicant (Brungardt pers. comm.).

Fugitive ROG emissions associated with paving were calculated using activity data (e.g., square feet paved) provided by the project applicant and the CalEEMod default emission factor of 2.62 pounds of ROG per acre paved (Brungardt pers. comm.; Trinity Consultants 2017).

Table 5 summarizes the earthmoving and paving quantities assumed in the emissions modeling. All earthmoving and paving would occur during terrestrial construction (i.e., on land).

Table 5. Earthmoving and Paving Quantities for Terrestrial Construction

Phase	Grading (acres/day)	Cut/Fill (cy/day)	Paving (sf/day)
1-1	0.07	44	0.003
1-2	0.09	0	0
1-3	0	14	0
2-1	0	14	0
3-1	0	14	0
4-1	0	14	0

Source: Brungardt pers. comm.

B.1.2.4 Marine Vessels

Marine vessels used during construction include main lay vessels, support vessels, workboats, patrol boats, and tugboats. Criteria pollutant emissions from marine vessels were quantified using CARB’s (2010a) *Updates on the Emissions Inventory for*

Commercial Harbor Craft Operating in California (Harbor Craft Methodology) and several other sources. Emissions per vessel were determined using the equation below.

$$E = P \times LF \times A \times EF$$

Where E = *Emissions (grams)*
P = *Maximum Continuous Rating Power (horsepower)*
LF = *Load Factor (percent of vessel's total power)*
A = *Activity (hours)*
EF = *Emission Factor (grams per horsepower-hour [g/hp-hr])*

Emissions were calculated separately for propulsion and auxiliary engines for each vessel. The following section describes the vessels, engine horsepower assumptions, load factors, and emission factors used in the calculations. Activity hours were provided by the project applicant and are summarized in Table 6 (Brungardt pers. comm.).

Table 6. Marine Vessel Inventory

Phase	Vessel	Hours per Day
U.S. Coastline to 3 NM (air quality impact analysis)		
1-2	Work Boat	6
1-2	Tug Boat	5
1-2	Patrol Boat	6
1-6	Main Lay Vessel (laying)	24
1-7	Main Lay Vessel (transit)	10
1-8	Main Lay Vessel (laying)	24
1-9	Support Vessel	24
1-10	Main Lay Vessel (laying)	24
2-4	Main Lay Vessel (laying)	24
2-5	Main Lay Vessel (transit)	10
2-6	Main Lay Vessel (laying)	24
2-7	Support Vessel	24
2-8	Main Lay Vessel (laying)	24
3-4	Main Lay Vessel (laying)	24
3-5	Main Lay Vessel (transit)	10
3-6	Main Lay Vessel (laying)	24
3-7	Support Vessel	24
3-8	Main Lay Vessel (laying)	24
4-4	Main Lay Vessel (laying)	24
4-5	Main Lay Vessel (transit)	10
4-6	Main Lay Vessel (laying)	24
4-7	Support Vessel	24
4-8	Main Lay Vessel (laying)	24

Phase	Vessel	Hours per Day
3 to 24 NM (GHG impact analysis)		
1-6	Main Lay Vessel (laying)	20
1-6	Main Lay Vessel (transit)	4
1-6	Support Vessel	12
1-8	Main Lay Vessel (laying)	20
1-8	Main Lay Vessel (transit)	4
1-10	Main Lay Vessel (laying)	20
1-10	Main Lay Vessel (transit)	4
2-4	Main Lay Vessel (laying)	20
2-4	Main Lay Vessel (transit)	4
2-4	Support Vessel	12
2-6	Main Lay Vessel (laying)	20
2-6	Main Lay Vessel (transit)	4
2-8	Main Lay Vessel (laying)	20
2-8	Main Lay Vessel (transit)	4
3-4	Main Lay Vessel (laying)	20
3-4	Main Lay Vessel (transit)	4
3-4	Support Vessel	12
3-6	Main Lay Vessel (laying)	20
3-6	Main Lay Vessel (transit)	4
3-8	Main Lay Vessel (laying)	20
3-8	Main Lay Vessel (transit)	4
4-4	Main Lay Vessel (laying)	20
4-4	Main Lay Vessel (transit)	4
4-4	Support Vessel	12
4-6	Main Lay Vessel (laying)	20
4-6	Main Lay Vessel (transit)	4
4-8	Main Lay Vessel (laying)	20
4-8	Main Lay Vessel (transit)	4

Source: Brungardt pers. comm.

Main Lay Vessel

The main lay vessel is modelled after the Ile de Batz (IMO # 9247041). It is a DPS-2 classed cable lay and multi-purpose offshore support vessel and used by Alcatel-Lucent for cable laying (CBS n.d.). This vessel will be laying the cable on the ocean. It will pull the cable plow that will be installing the cable to a depth of 1 meter below the ocean floor. It will come to the end of the bore pipe (about 2,000 feet offshore) and feed the marine cable into the bore pipe, then will continue offshore with the cable and across the ocean.

The main lay vessel is a diesel-electric vessel powered by four 5,873 horsepower Mak 9M32 Category 3 diesel engines (IHS Markit n.d.). All four engines are connected to generators. Propulsion is driven by two 5,368 horsepower electric motors. Under CARB harbor craft guidance, the main lay vessel is considered an ocean going vessel (OGV) because it is longer than 400 feet. The vessel was built in 2001.

The main lay vessel will operate in two modes during construction. The first is “transit” back and forth to the construction site. Transit occurs at 12 knots. The second is during “cable laying” when the vessel is travelling at 8 knots and laying cable.

Propulsion load factors for the two modes were calculated using the propeller law equation below (Starcrest Consulting Group 2017). This load factor is applied to the two electric motors used for propulsion.

$$\textit{Propulsion Load Factor} = (\textit{actual speed}/\textit{maximum speed})^3$$

As the vessel has a maximum speed of 16.4 knots, transit propulsion load factor is 0.39 and the cable laying propulsion load factor is 0.12. Auxiliary engine loads and auxiliary boiler loads for the two modes were obtained from the Port of Los Angeles 2016 emission inventory (Starcrest Consulting Group 2017). The calculations for the transit mode assumed an auxiliary load of 643 kilowatts (kW), while the cable laying mode assumed an auxiliary load of 597 kW. Boiler loads were 33 kW during transit and 65 kW during cable laying.

Emission factors for the main lay vessel were obtained from the Port of Los Angeles 2014 emission inventory[2] assuming all engines were Category 3 medium speed engines running on 0.1% sulfur marine gasoil/marine diesel oil (MGO/MDO), which has been required within California waters since 2014 and within the North American Emission Control Area (up to 200 nm from the U.S. Coastline) since 2015 (Starcrest Consulting Group 2015; California Air Resources Board 2011a). The main lay emission factors are presented in Table 7.

Table 7. Main Lay Vessel Emission Factors (g/hp-hr)[a]

Engine	ROG	NOx	CO	PM10	PM2.5	SO2	CO2	N2O	CH4
Prop/Aux	0.5	9.1	0.8	0.19	0.18	0.3	484	0.022	0.007
Boiler	0.1	1.5	0.1	0.10	0.10	0.5	688	0.056	0.001

[a] The emission factors from the 2014 emissions inventory have been corrected for use of 0.1% sulfur distillate fuel. Accordingly, application of a fuel correction factor is not required. Because deterioration factors are not applied to OGV, per CARB guidance, the emission factors are held constant for all analysis years.

[2] Emission factors for OGV have not changed since the 2014 emissions inventory and are therefore not repeated in subsequent inventories, including the latest 2016 emissions inventory.

Support Vessel

The support vessel is modelled after the DSV Clean Ocean (Aqueos n.d.). It is a 155-foot-long anchor, offshore supply, dive and remotely operated undersea vehicle (ROV) support. The support vessel will be used for the prelay grapnel run (where it will pull a grapnel along the cable alignment to ensure it is free of debris), and to support the main cable lay through control of remotely operated vehicles. It will also be used during cable burial.

Under CARB's Harbor craft regulations, the support vessel falls under the category of crew and supply boat. It was repowered in 2015 under the CARB (2011b) harbor craft rule. It is currently powered by two 750 horsepower Cummins QSK-19 Tier 3 engines and has two 133 horsepower auxiliary Tier 3 engines.

Load factors for this type of vessel were obtained from CARB's (2010a) Harbor Craft Methodology and were assumed to be 0.38 for the propulsion engines and 0.32 for the auxiliary engines. Uncorrected zero hour emission rates for NOx, PM10, ROG and CO were derived from CARB's Harbor Craft Methodology. GHG and SO_2 emission factors were obtained from the Port of Los Angeles 2013 emission inventory (Starcrest Consulting Group 2014)[3]. All harbor craft must use ultra-low sulfur diesel (ULSD) within California Regulated Waters (CARB 2005). Since these vessels are small and generally only have one fuel tank, it was assumed that they would also use ULSD out to 24 NM.

Uncorrected zero hour emission rates are shown in Table 8. Fuel correction factors for ULSD are shown in Table 9 (these also apply to the work boat described in the next section).

Table 8. Support Vessel Uncorrected Zero Hour Emission Rates (g/hp-hr)

Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
Propulsion	0.68	5.10	3.73	0.15	0.15	0.13	486.2	0.023	0.013
Auxiliary	0.81	5.10	3.73	0.22	0.21	0.13	486.2	0.023	0.016

Table 9. Fuel Correction Factors for the Support Vessel and Work Boat

Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
All	0.720	0.948	1.000	0.852	0.852	0.043	1.000	0.948	0.720

Deterioration factors were applied to compensate for engine wear. CARB's Harbor Craft Methodology recommends that a tug or barge at the end of its useful life could have NOx, PM, HC, and CO emission factors that are 21%, 67%, 44% and 25%, respectively, higher than the zero-hour values. Since the Harbor Craft Methodology was released, CARB has

[3] Emission factors for crew and supply boats have not changed since the 2013 emissions inventory and are therefore not repeated in subsequent inventories, including the latest 2016 emissions inventory.

revised its methodology to limit deterioration at 12,000 hours of operation. This is because CARB found, in discussions with stakeholders and the industry, that diesel engines are typically rebuilt after 12,000 hours of use (Dolney pers. comm.). Based on this new guidance, once an engine's cumulative hours equals 12,000 hours, the deteriorated emission factor is assumed to remain constant (CARB 2010b).

Annual hours of operation, useful life and the deterioration factors for the propulsion and auxiliary engines are shown in Table 10. Final emission factors are shown in Table 11.

Table 10. Hours of Operation, Useful Life and Deterioration Factors for Support Vessel

Engine	Annual Hours	Useful Life	Deterioration Factor			
			NOx	PM	ROG	CO
Propulsion	1,796	28	0.21	0.67	0.44	0.25
Auxiliary	2,265	28	0.14	0.44	0.28	0.16

Table 11 Support Vessel Emission Factors (g/hp-hr)

Year	Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
2019	Propulsion	0.52	4.98	3.86	0.14	0.14	0.01	486.2	0.022	0.010
	Auxiliary	0.61	4.93	3.82	0.20	0.19	0.01	486.2	0.022	0.012
2020	Propulsion	0.53	5.02	3.90	0.14	0.14	0.01	486.2	0.022	0.010
	Auxiliary	0.61	4.96	3.84	0.20	0.20	0.01	486.2	0.022	0.012
2021	Propulsion	0.54	5.05	3.93	0.15	0.14	0.01	486.2	0.022	0.010
	Auxiliary	0.61	4.96	3.84	0.20	0.20	0.01	486.2	0.022	0.012
2022+[a]	Propulsion	0.54	5.08	3.95	0.15	0.14	0.01	486.2	0.022	0.010
	Auxiliary	0.61	4.96	3.84	0.20	0.20	0.01	486.2	0.022	0.012

[a] The support vessel will reach the 12,000 hour deterioration cap in 2022. After this time, it is assumed the engine will be rebuilt, per CARB guidance. However, this analysis conservatively holds the final deteriorated emission factor constant for all future analysis years.

Work Boat

The work boat is modelled after the Danny C vessel, which is a 77-foot utility boat used in dive support, ROV support, anchor support, and equipment transport. The work boat will be used during construction to perform the following activities.

- As a dive platform for divers to support the marine side of the directional bores.
- As a dive platform for divers to support the cable landing where the main cable vessel feeds the marine cable into the bore pipe.
- As a dive platform for divers to jet bury the cable in the shallow water areas (out to a water depth of approximately 30 meters).
- As a taxi to take divers to/from the dive platform.

Under CARB harbor craft regulations, the Danny C falls under the category of work boat. It was repowered in 2015 under the CARB harbor craft rule. It is currently powered by two 405 horsepower Cummins QSM11 Tier 3 engines and has two 32 horsepower auxiliary Tier 3 engines.

Load factors[4], zero hour emission rates, annual hours of operation, useful life assumptions, and deterioration factors were derived using the same methods and sources as described above for the support vessel. Uncorrected zero hour emission rates are shown in Table 12. Annual hours of operation, useful life, and the deterioration factors for the propulsion and auxiliary engines are shown in Table 13. Final emission factors are shown in Table 14. Refer to Table 9 above for the ULSD fuel correction factors.

Table 12. Work Boat Uncorrected Zero Hour Emission Rates (g/hp-hr)

Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
Propulsion	0.68	5.10	3.73	0.15	0.15	0.13	486.2	0.023	0.013
Auxiliary	0.81	5.10	3.73	0.22	0.21	0.13	486.2	0.023	0.016

Table 13. Hours of Operation, Useful Life and Deterioration Factors for Work Boat

Engine	Annual Hours	Useful Life	Deterioration Factor			
			NOx	PM	ROG	CO
Propulsion	675	17	0.21	0.67	0.44	0.25
Auxiliary	750	23	0.06	0.31	0.51	0.41

[4] Load factors for the work boat were assumed to be 0.45 for the propulsion engines and 0.43 for the auxiliary engines.

Table 14. Work Boat Emission Factors (g/hp-hr)

Year	Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
2019	Propulsion	0.54	5.08	3.95	0.15	0.14	0.01	486.2	0.022	0.010
	Auxiliary	1.68	5.10	4.00	0.20	0.19	0.01	486.2	0.022	0.031
2020	Propulsion	0.55	5.13	4.00	0.15	0.15	0.01	486.2	0.022	0.010
	Auxiliary	1.71	5.11	4.06	0.20	0.19	0.01	486.2	0.022	0.031
2021	Propulsion	0.57	5.19	4.06	0.16	0.15	0.01	486.2	0.022	0.010
	Auxiliary	1.75	5.12	4.13	0.20	0.20	0.01	486.2	0.022	0.031
2022	Propulsion	0.58	5.25	4.11	0.16	0.16	0.01	486.2	0.022	0.010
	Auxiliary	1.78	5.14	4.20	0.21	0.20	0.01	486.2	0.022	0.031
2023	Propulsion	0.59	5.31	4.17	0.17	0.16	0.01	486.2	0.022	0.010
	Auxiliary	1.82	5.15	4.26	0.21	0.20	0.01	486.2	0.022	0.031
2024	Propulsion	0.60	5.37	4.22	0.17	0.17	0.01	486.2	0.022	0.010
	Auxiliary	1.85	5.16	4.33	0.21	0.20	0.01	486.2	0.022	0.031
2025	Propulsion	0.62	5.43	4.28	0.18	0.17	0.01	486.2	0.022	0.010
	Auxiliary	1.88	5.17	4.39	0.21	0.21	0.01	486.2	0.022	0.031
2026	Propulsion	0.63	5.49	4.33	0.18	0.18	0.01	486.2	0.022	0.010
	Auxiliary	1.92	5.19	4.46	0.22	0.21	0.01	486.2	0.022	0.031

Patrol Boat and Tug Boat

The patrol boat would be used to shuttle divers to and from the dive platform or to take observers (inspectors or monitors) to the site during the directional bore activities or during the cable landing. The tug boat may be needed to anchor the main lay vessel. Tug boats are rarely required because the cable ships usually have dynamic thrusters so they can hold station but have been added in the emission calculations in the event they are needed.

Under the CARB harbor craft rule, the patrol boat falls under the category of a crew and supply boat and the tug boat falls under the category of a tow boat. Both ships are a "ship of opportunity" meaning that any available crew and supply boat can be used. Average crew boat characteristics were obtained from the Port of Los Angeles 2016 emission inventory to define the characteristics of the patrol and average towboat characteristics were used to define the tug boats for analysis purposes (Starcrest Consulting Group 2017). The assumptions are listed in Table 15.

Table 15. Patrol Boat and Tug Boat Characteristics

Engine Type	Patrol Boat			Tug Boat		
	Model Year	Engines		Model Year	Engines	
		HP	Number		HP	Number
Propulsion	2009	572	2	2010	777	2
Auxiliary	2008	55	1	2009	64	2

Load factors[5], zero hour emission rates, annual hours of operation, useful life assumptions, and deterioration factors were derived using the same methods and sources as described above for the support vessel. Uncorrected zero hour emission rates are shown in Table 16. Annual hours of operation, useful life, and the deterioration factors for the propulsion and auxiliary engines are shown in Table 17. Table 18 summarizes the ULSD fuel correction factors, which are applicable to engines older than model year 2011. Final emission factors are shown in Table 19.

Table 16. Patrol Boat and Tug Boat Uncorrected Zero Hour Emission Rates (g/hp-hr)

Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
Patrol Boat									
Propulsion	0.68	5.10	3.73	0.15	0.15	0.13	486.2	0.023	0.013
Auxiliary	1.18	5.32	3.73	0.30	0.29	0.13	486.2	0.023	0.016
Tug Boat									
Propulsion	0.68	5.53	3.73	0.20	0.19	0.13	486.2	0.023	0.013
Auxiliary	1.18	5.32	3.73	0.22	0.21	0.13	486.2	0.023	0.024

Table 17. Useful Life and Deterioration Factors for Patrol Boat and Tug Boat

Engine	Annual Hours	Useful Life	Deterioration Factor			
			NOx	PM	ROG	CO
Patrol Boat						
Propulsion	1,796	28	0.21	0.67	0.44	0.25
Auxiliary	2,265	28	0.14	0.44	0.28	0.16
Tug Boat						
Propulsion	1,993	26	0.21	0.67	0.44	0.25
Auxiliary	2,965	25	0.14	0.44	0.28	0.16

Table 18. Fuel Correction Factors for the Patrol Boat and Tug Boat

Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
All	0.720	0.948	1.000	0.800	0.800	0.043	1.000	0.948	0.720

[5] Load factors for the patrol boat were assumed to be 0.38 for the propulsion engines and 0.32 for the auxiliary engines. Load factors for the tug boat were assumed to be 0.68 for the propulsion engines and 0.43 for the auxiliary engines.

Table 19. Patrol Boat and Tug Boat Emission Factors (g/hp-hr)[a]

Engine	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
Patrol Boat									
Propulsion	0.54	5.08	3.95	0.14	0.14	0.01	486.19	0.022	0.010
Auxiliary	0.89	5.18	3.84	0.26	0.25	0.01	486.19	0.022	0.012
Tug Boat									
Propulsion	0.54	5.50	3.95	0.18	0.18	0.01	486.2	0.022	0.010
Auxiliary	0.89	5.16	3.83	0.19	0.18	0.01	486.2	0.022	0.017

[a] The patrol and tug boats will reach the 12,000 hour deterioration cap before 2019. After this time, it is assumed the engines will be rebuilt, per CARB guidance. However, this analysis conservatively holds the final deteriorated emission factor constant for all future analysis years.

B.2 OPERATION

The Project's normal operation consists of monthly inspections, requiring a vehicle trip, and testing of a standby diesel-fueled emergency generator. Electricity would also be consumed at the CLS facilities. Emissions from the generator engine were quantified using the methods described above for off-road equipment. The generator was assumed to run for 1 hour during testing. Emissions from employee commuting were quantifying using the methods described above for on-road vehicles. The employee was conservatively assumed to travel 100 miles to the Project site. Indirect GHG emissions from electricity consumption were quantified using emission factors from Pacific Gas and Electric (2015) and the EPA (2018). The project was assumed to use 292 megawatt-hours of electricity each year. Emissions were quantified using 2026 emission rates, which is the first year of full operation.

B.3 INFORMATIONAL CRITERIA POLLUTANT ANALYSIS

Criteria pollutants generated by construction activities out to 24 nm are presented in Table 20. As previously noted, these emissions are presented for informational purposes only.

Table 20. Informational Criteria Pollutant Emissions Generated by Terrestrial and Marine Activities Out to 24 NM

Phase	Source	Tons per Year (unless otherwise stated)					
		ROG	NOx	CO	PM10	PM2.5	SO_2
Phase 1	Terrestrial	<1	2	1	<1	<1	<1
	Marine (0 to 3 NM)	<1	4	2	<1	<1	<1
	Marine (3 to 24 NM)	<1	7	1	<1	<1	<1
	Total	1	13	3	1	<1	<1
	Average (pounds per day)	5	74	18	4	1	1
Phase 2	Terrestrial	<1	<1	<1	<1	<1	<1
	Marine (0 to 3 NM)	<1	3	<1	<1	<1	<1
	Marine (3 to 24 NM)	<1	7	1	<1	<1	<1
	Total	1	10	1	<1	<1	<1
	Average (pounds per day)	3	57	7	2	<1	1
Phase 3	Terrestrial	<1	<1	<1	<1	<1	<1
	Marine (0 to 3 NM)	<1	3	<1	<1	<1	<1
	Marine (3 to 24 NM)	<1	7	1	<1	<1	<1
	Total	1	10	1	<1	<1	<1
	Average (pounds per day)	3	56	6	2	0	1
Phase 4	Terrestrial	<1	<1	<1	<1	<1	<1
	Marine (0 to 3 NM)	<1	3	<1	<1	<1	<1
	Marine (3 to 24 NM)	<1	7	1	<1	<1	<1
	Total	1	10	1	<1	<1	<1
	Average (pounds per day)	3	56	6	2	<1	1

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B.4.2 Personal Communications

Chris Brungardt. RTI Solutions, Inc. San Francisco, CA. July 30, 2018—conversation with Laura Yoon of ICF.

Nicole Dolney. California Air Resource Board. Sacramento, CA. March 25, 2013—conversation with Lou Browning of ICF.