APPENDIX B

Air Quality and Greenhouse Gas Analysis Methodology and Results

APPENDIX B AIR QUALITY AND GREENHOUSE GAS ANALYSIS METHODOLOGY AND RESULTS

This appendix discusses the approach and methodology used to assess construction emissions associated with the proposed Project. The analysis evaluates daily and yearly emissions generated by terrestrial equipment and vehicles, and by marine activities within 24 nautical miles (nm) of the shore. Emissions analyzed include criteria pollutants of ozone precursors (reactive organic gases [ROGs] 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,* in the Initial Study/Mitigated Negative Declaration (MND), the criteria pollutant impact analysis is limited to emissions generated with 3 nm from the U.S. coastline. This is consistent with the regulatory authority of the California State Lands Commission (CSLC) under the California Environmental Quality Act (CEQA).

As discussed in Section 3.9, *Greenhouse Gases,* in the MND, 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 CLSC has conservatively elected to analyze emissions up 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 directional boring, fiber optic cable (cable) pulling, and construction of landing vaults. These activities would generate criteria pollutant and GHG emissions from off-road equipment (e.g., backhoes) and vehicles used for employee commuting and hauling. Fugitive dust and ROGs also would be generated by earthmoving (e.g., minor grading of the cable landing site) activities. Marine activities include laying and burying the cables. Vessels used to support these activities include a main lay vessel, dive support vessels, and a workboat.

The following sections summarize the methods used to assess each of the terrestrial and marine emission sources. An overview of the construction schedule also is 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 July 2021. Even if the work schedule changes beyond July 2021, it would not change the number of working days (Tables 1 and 2). Table 1 summarizes the construction equipment and vehicle working durations 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 Nautical Miles from the U.S. Coastline

Phase and Description		Working Days
Phase 1 (2021)		
1-1	Terrestrial conduit installation	5
1-2	Landing Pipes – marine	28
1-3	Installation of ocean ground bed and landing vaults	14
1-6	Pre-lay grapnel run	1
1-7	Marine cable landing	1
1-8	Marine cable lay	1
1-9	Marine cable burial (diver-assisted)	2
1-10	Marine cable burial (ROV-assisted)	2
1-11	Worker/delivery	54
Phase 2 (2022)		
2-1	Ocean ground bed installation	5
2-4	Pre-lay grapnel run	1
2-5	Marine cable landing	1
2-6	Marine cable lay	1
2-7	Marine cable burial (diver-assisted)	2
2-8	Marine cable burial (ROV-assisted)	2
2-9	Worker/delivery	12
Phase 3 (2023)		
3-1	Ocean ground bed installation	5
3-4	Pre-lay grapnel run	1
3-5	Marine cable landing	1
3-6	Marine cable lay	1
3-7	Marine cable burial (diver-assisted)	2
3-8	Marine cable burial (ROV-assisted)	2
3-9	Worker/delivery	12

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

Phase and Description		Working Days
Phase 4 (2024)		
4-1	Ocean ground bed installation	5
4-4	Pre-lay grapnel run	1
4-5	Marine cable landing	1
4-6	Marine cable lay	1
4-7	Marine cable burial (diver-assisted)	2
4-8	Marine cable burial (ROV-assisted)	2
4-9	Worker/delivery	12

Source: Brungardt pers. comm.

Term:

ROV = remotely operated vehicle

Note:

The phase descriptions and durations may differ slight from what is presented in Table 2-1 in the Chapter 2, *Project Description* in the main document. The phase names are specific to the air quality modeling assumptions. Likewise, the durations are reflective of expected equipment and vessel working days, as opposed to the overall phase length, which is presented in Table 2-1.

Table 2. Schedule for Marine Construction between 3 and 24 Nautical Miles

Phase and Description		Working Days
Phase 1 (2021)		
1-6	Pre-lay grapnel run	2
1-8	Marine cable lay	6
1-10	Marine cable burial (ROV-assisted)	4
Phase 2 (2022)		
2-4	Pre-lay grapnel run	2
2-6	Marine cable lay	6
2-8	Marine cable burial (ROV-assisted)	4
Phase 3 (2023)		
3-4	Pre-lay grapnel run	2
3-6	Marine cable lay	6
3-8	Marine cable burial (ROV-assisted)	4
Phase 4 (2024)		
4-4	Pre-lay grapnel run	2
4-6	Marine cable lay	6
4-8	Marine cable burial (ROV-assisted)	4

Source: Brungardt pers. comm.

Term:

ROV = remotely operated vehicle

Note:

The phase descriptions and durations may differ slight from what is presented in Table 2-1 in the Chapter 2, *Project Description* in the main document. The phase names are specific to the air quality modeling assumptions. Likewise, the durations are reflective of expected vessel working days, as opposed to the overall phase length, which is presented in Table 2-1.

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, and fugitive dust (PM10 and PM2.5) 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 (https://arb.ca.gov/emfac/) and marine vessel guidance; and the U.S. Environmental Protection Agency's (EPA) (2006, 2011) *AP-42 Compilation of Air Pollutant Emission Factors* (AP-42) based on Project-specific construction data (e.g., schedule, equipment, and 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, and 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 the 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

[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 (2019).

Table 3. Off-Road Equipment Inventory for Terrestrial Construction

Phase	Equipment	#/Day	Hours/Day	Horsepower
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
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. CARB's SAFE Vehicles Rule adjustment factors (CARB 2019, 2020) were applied to the emission factors for gasoline-powered vehicles. Emission factors for delivery and tractor trailer trucks were based on aggregated-speed emission rates for EMFAC's T7 Single and T7 Tractor vehicle categories, respectively. Emission factors for employee commute vehicles were based on a weighted average for all vehicle speeds for EMFAC's LDA/LDT vehicle categories. One-way employee commute trip lengths were conservatively assumed to be 50 miles. 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 emission rates. On-site 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. On-site 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 (EPA 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	Miles/Day
1-1	Pick-up truck	1	2	10
1-1	Dump truck	1	2	20
1-1	Asphalt truck	1	2	10
1-2	Pick-up truck	1	2	15
1-2	Tractor trailer	1	2	20
1-3	One-ton truck	1	2	10
1-3	Pick-up truck	1	2	15
1-3	Delivery truck	1	2	10
1-3	Dump truck	1	2	10
2-1	One-ton truck	1	2	10
2-1	Pick-up truck	1	2	15
2-1	Delivery truck	1	2	10
2-1	Dump truck	1	2	10
3-1	One-ton truck	1	2	10
3-1	Pick-up truck	1	2	15
3-1	Delivery truck	1	2	10
3-1	Dump truck	1	2	10
4-1	One-ton truck	1	2	10
4-1	Pick-up truck	1	2	15
4-1	Delivery truck	1	2	10
4-1	Dump truck	1	2	10
1-11	Tractor trailer	2	5	500
2-9	Tractor trailer	2	5	500
3-9	Tractor trailer	2	5	500
4-9	Tractor trailer	2	5	500
1-11	Fuel and misc delivery	1	1	100
2-9	Fuel and misc delivery	1	1	100
3-9	Fuel and misc delivery	1	1	100
4-9	Fuel and misc delivery	1	1	100

Table 4. On-Road Vehicle Inventory for Terrestrial Construction

Phase	Vehicle	Vehicles/Day	Trips/Day	Miles/Day
1-7	Pick-up truck	1	2	15
2-5	Pick-up truck	1	2	15
3-5	Pick-up truck	1	2	15
4-5	Pick-up truck	1	2	15
1-11	Employee vehicle	10	10	1,000
2-9	Employee vehicle	10	10	1,000
3-9	Employee vehicle	10	10	1,000
4-9	Employee vehicle	10	10	1,000

Source: Brungardt pers. comm.

B.1.2.3 Earthmoving

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.).

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

Table 5. Earthmoving Quantities for Terrestrial Construction

Phase	Grading (acres/day)	Cut/Fill (cubic yards/day)
1-1	0.07	44
1-2	0.09	0
1-3	0	14
2-1	0	14
3-1	0	14
4-1	0	14

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 Nautical Miles (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

Table 6. Marine Vessel Inventory

Phase	Vessel	Hours per Day
3 to 24 Nautical Miles (greenhouse gas 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 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 landing pipe (about 3,600 feet offshore), feed the marine cable into the landing pipe, and then 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 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 2019). 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, the 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 2018 emissions inventory (Starcrest Consulting Group 2019). 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 emissions inventory,[2] assuming that all engines were Category 3 medium-speed engines running on 0.1% sulfur marine gasoil/marine diesel oil, 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; CARB 2011a). The main lay emission factors are presented in Table 7.

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

Engine Type	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
Propulsion/Auxiliary	0.47	9.10	0.82	0.19	0.18	0.32	484	0.02	0.01
Boiler	0.09	1.49	0.15	0.10	0.10	0.45	688	0.06	0.001

Term:
g/hp-hr = grams per horsepower-hour
Note:
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 ocean-going vessels, per CARB guidance, the emission factors are held constant for all analysis years.

[2] Emission factors for ocean-going vessels have not changed since the 2014 emissions inventory and therefore are not repeated in subsequent inventories, including the latest 2018 emissions inventory.

Support Vessel

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

Under CARB's Harbor Craft regulations, the support vessel is in 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 emissions 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 also would 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 Type	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	0.023	0.013
Auxiliary	0.81	5.10	3.73	0.22	0.21	0.13	486	0.023	0.016

Term:
g/hp-hr = grams per horsepower-hour

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

Engine Type	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,

[3] Emission factors for crew and supply boats have not changed since the 2013 emissions inventory and therefore are not repeated in subsequent inventories, including the latest 2018 emissions inventory.

PM, ROG 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 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 equal 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 Type	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 Type	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
2021	Propulsion	0.54	5.05	3.93	0.15	0.14	0.01	486	0.02	0.01
	Auxiliary	0.61	4.96	3.84	0.20	0.20	0.01	486	0.02	0.01
2022+[a]	Propulsion	0.54	5.08	3.95	0.15	0.14	0.01	486	0.02	0.01
	Auxiliary	0.61	4.96	3.84	0.20	0.20	0.01	486	0.02	0.01

Term:
g/hp-hr = grams per horsepower-hour

[a] The support vessel will reach the 12,000-hour deterioration cap in 2022. After this time, it is assumed that 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 landing pipe.
- As a dive platform for divers to jet bury the cable in the shallow water areas.
- As a taxi to take divers to/from the dive platform.

Under CARB Harbor Craft regulations, the *Danny C* is in the category of work boat. It was repowered in 2015 under the CARB Harbor Craft Rule. It currently is 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 Type	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	0.02	0.01
Auxiliary	0.81	5.10	3.73	0.22	0.21	0.13	486	0.02	0.02

Term:
g/hp-hr = grams per horsepower-hour

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

Engine Type	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

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

Year	Engine Type	ROG	NOx	CO	PM10	PM2.5	SO_2	CO_2	N_2O	CH_4
2021	Propulsion	0.57	5.19	4.06	0.16	0.15	0.01	486	0.02	0.01
	Auxiliary	1.75	5.12	4.13	0.20	0.20	0.01	486	0.02	0.03
2022	Propulsion	0.58	5.25	4.11	0.16	0.16	0.01	486	0.02	0.01
	Auxiliary	1.78	5.14	4.20	0.21	0.20	0.01	486	0.02	0.03
2023	Propulsion	0.59	5.31	4.17	0.17	0.16	0.01	486	0.01	0.02
	Auxiliary	1.82	5.15	4.26	0.21	0.20	0.01	486	0.03	0.02
2024	Propulsion	0.60	5.37	4.22	0.17	0.17	0.01	486	0.02	0.01
	Auxiliary	1.85	5.16	4.33	0.21	0.20	0.01	486	0.02	0.03

Term:
g/hp-hr = grams per horsepower-hour

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

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 rarely are required because the cable ships usually have dynamic thrusters so they can hold station, but tug boats have been added in the emission calculations in the event they are needed.

Under the CARB Harbor Craft Rule, the patrol boat is in the category of a crew and supply boat, and the tug boat is in 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 2018 emissions inventory to define the characteristics of the patrol boat, and average towboat characteristics were used to define the tug boats for analysis purposes (Starcrest Consulting Group 2019). 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 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.

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

Engine Type	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	0.02	0.01
Auxiliary	1.18	5.32	3.73	0.30	0.29	0.13	486	0.02	0.02
Tug Boat									
Propulsion	0.68	5.53	3.73	0.20	0.19	0.13	486	0.02	0.01
Auxiliary	1.18	5.32	3.73	0.22	0.21	0.13	486	0.02	0.02

Term:
g/hp-hr = grams per horsepower-hour

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

Engine Type	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 Type	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

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

Engine Type	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	0.02	0.01
Auxiliary	0.89	5.18	3.84	0.26	0.25	0.01	486	0.02	0.01
Tug Boat									
Propulsion	0.54	5.50	3.95	0.18	0.18	0.01	486	0.02	0.01
Auxiliary	0.89	5.16	3.83	0.19	0.18	0.01	486	0.02	0.02

Term:
g/hp-hr = grams per horsepower-hour

Note:
The patrol and tug boats will reach the 12,000-hour deterioration cap before 2019. After this time, it is assumed that 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 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 Nautical Miles

Phase	Source	Tons per Year					
		ROG	NOx	CO	PM10	PM2.5	SO_2
Phase 1	Terrestrial	<1	<1	<1	<1	<1	<1
	Marine (0 to 3 nautical miles [nm])	<1	4	2	<1	<1	<1
	Marine (3 to 24 nm)	<1	7	1	<1	<1	<1
	Total	1	12	3	1	<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
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
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

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