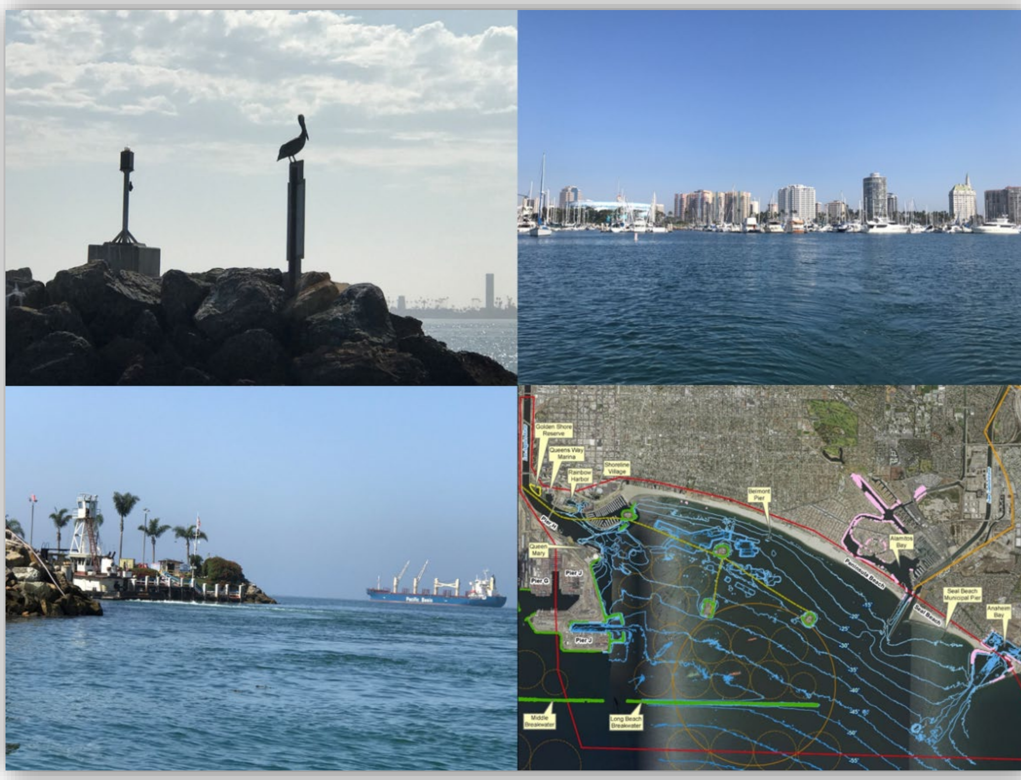
DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT / ENVIRONMENTAL IMPACT REPORT (EIS/EIR)

APPENDIX E: AIR QUALITY AND GREENHOUSE GAS METHODOLOGY AND DATA

EAST SAN PEDRO BAY
ECOSYSTEM RESTORATION STUDY

Long Beach, California

November 2019



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1 AIR QUALITY METHODOLOGY

The air quality area of influence for the project is included in the SCAB, which consists of the urbanized areas of Los Angeles, Riverside, San Bernardino, and Orange counties, and the ocean offshore of the south coast waters.

For the purpose of this analysis, it was assumed that stone material would be imported from either Catalina Quarry and shipped in by barge, or from an inland quarry such as 3M which is located 55 miles away in Corona, California. Given those assumptions, sources of air emissions associated with various project alternatives include:

- Material-hauling emissions
  - Tug boat engine exhaust associated with hauling stone from Catalina Quarry; or
  - Vehicular emissions associations with hauling stone from 3M Quarry
- On-Site Equipment emissions
  - Tug boat and barge generators; and
  - On-deck barge construction equipment such as front-end loaders and cranes/winches

On-site emissions include activities such as stone placement and sand dredging and placement for all alternatives. On-site emissions for Alternative 8 include construction of the sandy island, oyster beds, and the wetlands. Refer to the end of this appendix for full modeling results.

Construction Phasing. Construction would be phased such that the transportation and placement of stones would occur prior to the initiation of sand dredging operations. Emission estimates were sequenced to be consistent with the general construction phasing described.

1.1 MARINE MATERIAL-HAULING EMISSIONS

Marine Hauling. Stone (armor, filter, and core) from Catalina Quarry could be used. Stone would be loaded onto flat-deck barges and tug boats would tow the barges approximately 25 nautical miles to the project area. Engine emission factors associated with harbor craft, dredges and barges were developed from CARB's most recently U.S. EPA-approved off-road emissions model. Emissions estimates were developed using the Harbor Craft, Dredge and Barge Emission Factor Calculator, Version 1.0; a calculation tool developed by the Sacramento Metropolitan Air Quality Management District's (SMAQMD).

Emissions for hauling materials from Catalina Island include emissions outside the three nautical mile limit of the SCAB encompassing the island.

Towing each barge was assumed to take 3.5 hours. The total number of towed barges was estimated based on the volume of stone and capacity of barges. The number of barges towed annually was based on the total number of barges and the duration of construction; a 1-year period was anticipated to include two-thirds of the total barges in the 30 to 53-month construction period (30 months under Alternative 2, 37 months under Alternative 4A, and 53 months under Alternative 8). Similarly, the number of barges towed daily was estimated based on the duration of construction and was rounded up to the nearest whole number.

Table E-1: Modeling Parameters for Project Alternatives

Parameter	Alternative 2	Alternative 4A	Alternative 8
Armor/Cap Stone	137,000 tons	617,000 tons	2,092,000 tons
Filter/Fill Stone	55,000 tons	55,000 tons	87,000 tons
Core/Base Stone	252,000 tons	265,000 tons	303,000 tons
Total Quarry Stone	444,000 tons	937,000 tons	2,482,000 tons
Catalina Quarry Tug Boat Deliveries	1 barge/day 106 barges	1 barge/day 183 barges	3 barge/day 338 barges
3M Quarry Truck Deliveries	44 trips/day**	91 trips/day**	242 trips/day**
Vessels	Flat Barge Derrick Barge	Flat-bed Barge Derrick Barge	Flat-bed Barge Derrick Barge Dredger
On-Deck Equipment	Front-End Loader		
Workday	8 hours/day	8 hours/day	12 hours/day
Sand Dredging			
Volume	100,000 cubic yards	100,000 cubic yards	100,000 cubic yards
Dredging Duration	25 days	25 days	25 days
Dredging Hours	22 hours/day	22 hours/day	22 hours/day
Tug Boat Hours	20 hours/day	20 hours/day	20 hours/day
Total Construction Duration	30 months	37 months	53 months

*Construction-related emissions were estimated using 2019 emission factors. This assumption is conservative; emission factors decrease incrementally over time as newer, cleaner technologies are phased-in.
**Truck trips per day where based on an 18-month construction duration schedule. Truck trips per day for the schedules reported throughout the IFR EIS/EIR would be less.

CARB's Commercial Harbor Craft Regulations were adopted in 2008 and became effective January 1, 2009 (CARB 2017). The Commercial Harbor Craft Regulations apply to all commercial harbor craft such as tugboats, towboats, ferries, barges, dredges, and fishing boats that operate in California regulated waters. The regulations also include compliance schedules for existing vessels. Because vessel engines have been retrofit subsequent to implementation of Commercial Harbor Craft Regulations in 2009 this analysis uses harbor craft emission factors for 2009 model year engines.

Truck Hauling. As an alternative to stone from the Catalina Quarry, stone from 3M Quarry in Corona, California may be used. Obtaining stone from 3M Quarry would require that stone to be loaded into heavy-duty trucks and transported 55 miles to the project staging area (Port of Long Beach Pier T), from the staging area stone would be loaded on barges and towed construction areas within the Bay. Vehicle emissions associated with material hauling were developed from CARB's EMFAC2014, the most recent EPA-approved on-road emissions factor model for use in California. On-road emissions estimates were modeled using SMAQMD's Road Construction Emissions Model Version 8.1.0. Each truck was assumed to carry 22 tons of stone per 55 miles transport to the staging area. The total number of vehicle trips was estimated based on the volume of stone and capacity of trucks. Total trips were divided over the duration of construction to determine the number of annual and daily truck trips.

Marine Vessel Generators. Marine vessels were assumed to require one onboard generator on each barge (one flat-deck barge and one derrick barge). Additionally, material hauling from Catalina Quarry was assumed to require one onboard generator on each tug boat, which was assumed to be active for the 3.5-hour towing duration. Material hauling from 3M Quarry was assumed to require one onboard generator on each tug boat, which was assumed to be active for a 0.5-hour towing duration (within ESPB from the staging site to the construction area). Alternatives that include sand placement (Alternative 8) would require one additional onboard generator on each dredging vessel. As discussed previously, this analysis uses harbor craft emission factors for 2009 model year engines.

Onboard generators for tug boats were assumed to operate at full capacity while tug boats are towing barges. Onboard generators for barges would idle for much of the day while equipment is active and would only operate at full capacity as needed to power winches to reposition the barge. Thus, onboard generators for barges were assumed to operate under full load for approximately one hour per day. Additionally, the derrick barge crane motor would only operate under full load while raising stone, and would be under lesser load during disposition and repositioning. Thus, the derrick barge crane motor was also assumed to operate under full load for one hour per day.

Onboard generator for dredging vessels would be under full load while taking in sand and then would be idle during transport, positioning, and disposition. Thus, onboard generators for dredging vessels were assumed to operate under full load approximately four hours per day.

1.2 ON-SITE EQUIPMENT EMISSIONS

On-Deck Equipment. Equipment emissions from front-end loaders were modeled using CARB's most recent U.S. EPA-approved off-road emissions model. Emission estimates were calculated with SMAQMD's Road Construction Emissions Model Version 8.1.0. Due to the nature of the work, the front-end loader would take frequent breaks while the derrick is active. The front-end loader was assumed to operate under full load approximately for two hours per day.

On-site emissions also include sand dredging emissions under all alternatives. Send dredging operations emissions were estimated using dredges powered by diesel engines using Tier 4 emission standards.

On-site equipment emissions also include emissions associated with construction of the sandy island, oyster beds, and the wetland under Alternative 8. Marine equipment emissions for the construction of these elements were estimated SMAQMD Harbor Craft, Dredge and Barge Emission Factor Calculator, Version 1.0.1.3.

1.3 GENERAL CONFORMITY APPLICABILITY RATES (NEPA)

Annual emissions for the most emission intensive year were totaled and compared to the applicable general conformity rates in the SCAB. The SCAB encompasses two areas with different attainment designation for certain criteria pollutants: Los Angeles County and Riverside County.

Criteria pollutants, except for lead, that are in nonattainment or in maintenance status and their associated General Conformity applicability rates are show in Table E-1.

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Table E-1: General Conformity Applicability Rated in the SCAB

	Los Angeles County		Riverside County	
Pollutant	**Designation Category**	**Emission (tons/year)**	**Designation Category**	**Emission (tons/year)**
Ozone (VOC as precursor)	Nonattainment (Extreme)	10	Nonattainment (Severe)	25
Ozone (NOx as precursor)	Nonattainment (Extreme)	10	Nonattainment (Severe)	25
Carbon Monoxide (CO)	Maintenance	100	Maintenance	100
Nitrogen Dioxide (NO2)	Maintenance	100	Maintenance	100
Particulate Matter (PM10)	Maintenance	100	Unclassifiable	100
Particulate Matter (PM2.5)	Nonattainment (Moderate)	100	Nonattainment (Moderate)	100
Lead (Pb)	Nonattainment	25	Attainment	25
Sources: 40 CFR 93.53(b)(1) and 40 CFR 93.53(b)(2) VOC = Volatile Organic Chemical				

Onsite emissions would be located within the Los Angeles County portion of the SCAB. Emissions associated with transportation of stones from Western Riverside County would be located within the Riverside County portion of the SCAB. However, maximum annual emissions reported are associated with sand dredging operations which are considered part of the on-site emissions. Thus, stone delivery emissions through Riverside County are not shown in a separate table. Given that Riverside County has higher General Conformity applicability rates and that stone delivery emissions would not result in maximum emissions, annual emissions within Riverside County would be below applicable general conformity rates for the area.

Estimates of lead emissions were not calculated. Lead emissions from mobile sources in California have significantly decreased due to the near elimination of lead in fuels. Emission factors developed by the U.S. Environmental Protection Agency, the California Air Resources Board, and the South Coast Air Quality Management District (SCAQMD), including those in CalEEMod, the SCAQMD-approved emission modeling software, do not provide estimated emissions for lead. Little to no quantifiable and foreseeable lead emissions would be generated by the proposed action.

The construction duration for each alternative would span multiple years ranging from approximately 2.5 years for Alternative 2 to approximately 4 years for Alternative 8. Instead of reporting annual emissions for every year of construction for each alternative, only the emissions from the most intensive construction year are reported. Annual emissions for other construction years would be less. Table E-2 shows maximum annual emissions for all alternatives.

Table E-2: Maximum Annual Emissions (tons per year)

Pollutant	Alternative 2		Alternative 4A		Alternative 8	
	Catalina Quarry & On-Site Emissions	3M Quarry & On-Site Emissions	Catalina Quarry & On-Site Emissions	3M Quarry & On-Site Emissions	Catalina Quarry & On-Site Emissions	3M Quarry & On-Site Emissions
Ozone (VOC as precursor)	0.2	0.1	0.2	0.2	0.6	0.5
Ozone (NO_X as precursor)	2.2	2.8	3.1	4.3	7.0	10.3
Carbon Monoxide (CO)	2.0	1.8	2.6	2.2	4.7	3.7
Nitrogen Dioxide (NO2)	2.9	2.4	3.1	4.2	9.1	11.1
Particulate Matter (PM_{10})	0.1	0.1	0.1	0.2	0.2	0.6
Particulate Matter ($PM_{2.5}$)	0.1	0.1	0.1	0.1	0.2	0.3

1.4 SCAQMD DAILY EMISSION THRESHOLDS (CEQA) METHODOLOGY

Maximum daily emissions were totaled and compared to SCAQMD Daily Emission Thresholds as shown in Table E-3.

Table E-3: Significance Thresholds – South Coast Air Quality Management District

Pollutant	Mass Daily Thresholds (pounds per day)		Mass Rate Screening Thresholds (pounds per day)[1]	
	Construction	Operation	Construction	Operation
Ozone (NO_X as precursor)	100	55	179	179
Ozone (VOC as precursor)	75	55	NA	NA
Particulate Matter (PM_{10})	150	150	191	46
Particulate Matter ($PM_{2.5}$)	55	55	120	29
Sulfur Oxides (SO_X)	150	150	NA	NA
Carbon Monoxide (CO)	550	550	10,198	10,198
Lead (Pb)	3	3	NA	NA

Sources: SCAQMD 2008

[1]The source-receptor distance of 500 meters was conservatively selected based on the distance between nearshore rocky reef working areas and the nearest residences. The work area size of 5 acres was selected based on the size of nearshore rocky reef working areas.

For all alternatives, maximum daily emissions would occur in the last year of construction when sand dredging emissions would overlap with stone transport and stone placement emissions. Table E-4 shows maximum daily emissions for all alternatives.

Table E-4: Maximum Daily Emissions (pounds per day)

Pollutant	Alternative 2		Alternative 4A		Alternative 8	
	Catalina Quarry & On-Site Emissions	3M Quarry & On-Site Emissions	Catalina Quarry & On-Site Emissions	3M Quarry & On-Site Emissions	Catalina Quarry & On-Site Emissions	3M Quarry & On-Site Emissions
Ozone (VOC as precursor)	8	8	8	8	8	8
Ozone (NO_X as precursor)*	**90**	**90**	**90**	**90**	**90**	**90**
Carbon Monoxide (CO)	116	116	116	116	116	116
Sulfur Oxides (SO_X)	<1	<1	<1	<1	<1	<1
Particulate Matter (PM_{10})	5	5	5	5	5	5
Particulate Matter ($PM_{2.5}$)	2	2	2	2	2	2

*Construction would be phased such that the transportation and placement of stones would occur prior to the initiation of sand dredging operations. Emission estimates were sequenced to be consistent with the general construction phasing described. The dredging operations phase would result in the highest emissions and used for the maximum daily emission.

1.5 AIR TOXICS AND SENSITIVE RECEPTORS (CEQA)

Toxic air contaminant emissions include diesel particulate matter (DPM) emissions from materials hauling and off-road equipment including marine vessels. Cancer risk from DPM exposure is a function of concentration and duration of exposure.

Hauling emissions would be generated for the duration of the project. Hauling emissions would be distributed, either along the 25 mile nautical waterway between Catalina Island Quarry and the project site or the 55 miles of roadways between 3M Quarry and the project site. As the emissions release for hauling emissions would be distributed over large areas, hauling emissions would not substantially elevate pollutant concentrations at any sensitive receptor.

Thus, toxic air contaminant emissions estimates are limited to maximum on-site daily emissions. Maximum daily emissions would occur in the last year of construction when sand dredging emissions would overlap with stone transport and stone placement emissions. Emissions for all alternatives were compared to mass rate screening thresholds for localized air quality impacts. Table E-5 shows maximum on-site daily emissions for all alternatives.

Table E-5: Maximum On-Site Daily Emissions (pounds per day)

Pollutant	Alternative 2	Alternative 4A	Alternative 8	Significance Threshold (pounds/day)
Carbon Monoxide (CO)	<1	<1	1	10,198
Nitrogen Oxides (NO_X)	5	7	18	179
Particulate Matter (PM_{10})	<1	<1	1	191
Particulate Matter ($PM_{2.5}$)	<1	<1	<1	120

1.6 OBJECTIONABLE ODORS (CEQA) METHODOLOGY.

Impacts associated with objectionable odors were assessed qualitatively. They analysis considered the distance of sensitive receptors to on-site construction activities and the potential for dissipation of pollutants.

1.7 COMPLIANCE WITH APPLICABLE AIR QUALITY PLAN (CEQA)

Impacts associated with the applicable air quality plan were assessed qualitatively. The regional air quality plan, the 2016 Air Quality Management Plan (AQMP), outlines measures to reduce emissions of ozone and $PM_{2.5}$. The growth forecasting for the AQMP is based in part on the land uses established by local general plans. Thus, if an action is consistent with land use as designated in the local general plan, it can normally be considered consistent with the AQMP. Actions that propose a different land use than is identified in the local general plan may also be considered consistent with the AQMP if the proposed land use is less intensive than buildout under the current designation. None of the proposed alternatives would involve a change in land use designation, or would result in regional growth, and would therefore be consistent with the growth assumptions used in development of the AQMP. Thus, none of the proposed actions would obstruct or conflict with implementation of the AQMP.

2 GREENHOUSE GASES METHODOLOGY

Greenhouse gases (GHGs) are considered gases that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). The Greenhouse Gas Effect phenomenon is responsible for maintaining a habitable climate on earth. Anthropogenic emissions of these greenhouse gases in excess of natural ambient concentrations are responsible for the enhancement of the Greenhouse Effect and have led to a trend of unnatural warming of the Earth's natural climate, known as global warming or climate change. Emissions of gases that induce global warming are attributable to human activities associated with industrial/manufacturing, agriculture, utilities, transportation, and residential land uses. According to the CARB website, transportation is responsible for around 41 percent of the State's greenhouse gas emissions, followed by the industrial sector (23%) and electricity generation (10%). Emissions of CO_2 and N_2O are byproducts of fossil fuel combustion. Methane, a potent greenhouse gas, results from off-gassing associated with agricultural practices and landfills. Sinks of CO_2, where CO_2 is stored outside of the atmosphere, include uptake by vegetation and dissolution into the ocean. GHGs have varying global warming potential (GWP). The GWP is the potential of a gas or aerosol to trap heat in the atmosphere; it is the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to the reference gas, CO_2.

Estimates of GHG emissions from all models used above were summed and converted to CO2e, a metric measure used to compare the emissions from various greenhouse gases (CO_2, N_2O, and CH_4) on the basis of their global-warming potential, by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

2.1 10,000 MT OF CO2E PER YEAR (CEQA).

Emissions were amortized over a period of 30 years and compared to the CEQA GHG limit of 10,000 metric tons of CO2E per year. Table E-6 shows total GHG and 30-year amortization quantities for all alternatives.

Table E-6: Total Maximum GHG Emissions (Metric Tons CO_2E)

	Alternative 2		Alternative 4A		Alternative 8	
	Catalina Quarry & On-Site Emissions	**3M Quarry & On-Site Emissions**	**Catalina Quarry & On-Site Emissions**	**3M Quarry & On-Site Emissions**	**Catalina Quarry & On-Site Emissions**	**3M Quarry & On-Site Emissions**
Total GHG Emissions	550	2,175	997	4,066	3,580	11,714
GHG Emissions Amortized Over 30 Years	**18**	**72**	**33**	**136**	**119**	**390**
CEQA GHG 30-year Amortization threshold	10,000	10,000	10,000	10,000	10,000	10,000

GHG emissions from construction of Alternative 2, including dredging activities, were estimated based on the methodology described in Appendix E. Total GHG was estimated for the construction period of 30 months. If stone is imported from the Catalina Quarry, Alternative 2 would result in approximately 550 MT CO2E, which is the 30-year annual equivalent of 18 MT CO2E. If stone is imported from the 3M Quarry in Corona, Alternative 2 would result in approximately 2,175 MT CO2E, which is the 30-year annual equivalent of 72 MT CO2E,therefore, the 30-year annual equivalent of 10,000 MT CO2E would not be exceeded.

GHG emissions from construction of Alternative 4A, including dredging activities, were estimated based on the methodology in Appendix E. Total GHG was estimated for the construction period of 37 months. If stone is imported from the Catalina Quarry, Alternative 4A would result in approximately 997 MT CO_2E, which is the 30-year annual equivalent of 33 MT CO_2E. If stone is imported from the 3M Quarry in Corona, Alternative 4A would result in approximately 4,066 MT CO_2E, which is the 30-year annual equivalent of 136 MT CO_2E, therefore, the 30-year annual equivalent of 10,000 MT CO2E would not be exceeded.

GHG emissions from construction of Alternative 4A, including dredging activities, were estimated based on the methodology in Appendix E. Total GHG was estimated for the construction period of 37 months. If stone is imported from the Catalina Quarry, Alternative 4A would result in approximately 997 MT CO_2E, which is the 30-year annual equivalent of 33 MT CO_2E. If stone is imported from the 3M Quarry in Corona, Alternative 4A would result in approximately 4,066 MT CO_2E, which is the 30-year annual equivalent of 136 MT CO_2E, therefore, the 30-year annual equivalent of 10,000 MT CO2E would not be exceeded.

Table E-7: Modeling Summary – Daily Criteria Pollutant Emissions

Alternative	Source	Description	Emissions (pounds per day)				
			ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Alternative 2 Stone From Catalina Quarry	Material Hauling	Tug Boat (3.5 hrs/day)	1	10	8	0	0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0	4	1	0	0
	On-Deck Equipment	Loader (8 hrs/day)	0	1	0	0	0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	8	89	115	5	2
		Total - Hauling, Vessels, On-Deck Equipment	**1**	**16**	**10**	**0**	**0**
		Total - On-Deck Equipment, Sand Dredging	**8**	**90**	**116**	**5**	**2**
Alternative 2 Stone From 3M Quarry	Material Hauling	Trucks (44 trips/day); (110 miles/trip)	0	8	2	1	0
		Tug Boat (0.5 hrs/day)	0	1	1	0	0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0	4	1	0	0
	On-Deck Equipment	Loader (8 hrs/day)	0	1	0	0	0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	8	89	115	5	2
		Total - Hauling, Vessels, On-Deck Equipment	**1**	**15**	**5**	**1**	**0**
		Total - On-Deck Equipment, Sand Dredging	**8**	**90**	**116**	**5**	**2**
Alternative 4A Stone From Catalina Quarry	Material Hauling	Tug Boats (3.5 hrs/day)	1	10	8	0	0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0	6	1	0	0
	On-Deck Equipment	Loader (8 hrs/day)	0	1	0	0	0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	8	89	115	5	2
		Total - Hauling, Vessels, On-Deck Equipment	**1**	**17**	**10**	**1**	**0**
		Total - On-Deck Equipment, Sand Dredging	**8**	**90**	**116**	**5**	**2**
Alternative 4A Stone From 3M Quarry	Material Hauling	Trucks (91 trips/day); (110 miles/trip)	1	16	4	1	0
		Tug Boat (0.5 hrs/day)	0	1	1	0	0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0	6	1	0	0
	On-Deck Equipment	Loader (8 hrs/day)	0	1	0	0	0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	8	89	115	5	2
		Total - Hauling, Vessels, On-Deck Equipment	**1**	**24**	**7**	**1**	**1**
		Total - On-Deck Equipment, Sand Dredging	**8**	**90**	**116**	**5**	**2**

Alternative	Source	Description	Emissions (pounds per day)				
			ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Alternative 8 Stone From Catalina Quarry	Material Hauling	Tug Boats (3.5 hrs/day) (3/day)	4	31	24	1	1
	Vessel Engines/Generators	Barge (1.5 hr/day) and Dredge (4 hrs/day)	0	17	4	0	0
	On-Deck Equipment	Loader (12 hrs/day)	0	2	1	0	0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	8	89	115	5	2
		Total - Hauling, Vessels, On-Deck Equipment	**4**	**50**	**29**	**1**	**1**
		Total - On-Deck Equipment, Sand Dredging	**8**	**90**	**116**	**5**	**2**
Alternative 8 - Stone From 3M Quarry	Material Hauling	Trucks (242 trips/day); (110 miles/trip)	2	43	11	3	1
		Tug Boat (0.5 hrs/day) (3 per day)	1	4	3	0	0
	Vessel Engines/Generators	Barge (1.5 hr/day) and Dredge (4 hrs/day)	0	17	4	0	0
	On-Deck Equipment	Loader (12 hrs/day)	0	2	1	0	0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	8	89	115	5	2
		Total - Hauling, Vessels, On-Deck Equipment	**3**	**66**	**19**	**4**	**2**
		Total - On-Deck Equipment, Sand Dredging	**8**	**90**	**116**	**5**	**2**

Table E-8: Modeling Summary – Annual Criteria Pollutant Emissions

Scenario	Source	Description	Emissions (tons/year)				
			ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Alternative 2 Stone From Catalina Quarry	Material Hauling	Tug Boats (3.5 hrs/day) (119/year)	0.1	0.6	0.5	0.0	0.0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0.0	0.7	0.2	0.0	0.0
	On-Deck Equipment	Loader (8 hrs/day)	0.0	0.2	0.1	0.0	0.0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	0.1	0.7	1.3	0.0	0.0
		Total	**0.2**	**2.2**	**2.0**	**0.1**	**0.1**
Alternative 2 Stone From 3M Quarry	Material Hauling	Trucks (44 trips/day); (110 miles/trip)	0.1	1.2	0.3	0.1	0.0
		Tug Boats (0.5 hrs/day) (119/year)	0.0	0.1	0.1	0.0	0.0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0.0	0.7	0.2	0.0	0.0
	On-Deck Equipment	Loader (8 hrs/day)	0.0	0.2	0.1	0.0	0.0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	0.1	0.7	1.3	0.0	0.0
		Total	**0.1**	**2.8**	**1.8**	**0.1**	**0.1**
Alternative 4A Stone From Catalina Quarry	Material Hauling	Tug Boats (3.5 hrs/day) (250/year)	0.2	1.3	1.0	0.0	0.0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0.0	0.9	0.2	0.0	0.0
	On-Deck Equipment	Loader (8 hrs/day)	0.0	0.2	0.1	0.0	0.0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	0.1	0.7	1.3	0.0	0.0
		Total	**0.2**	**3.1**	**2.6**	**0.1**	**0.1**
Alternative 4A Stone From 3M Quarry	Material Hauling	Trucks (91 trips/day); (110 miles/trip)	0.1	2.5	0.6	0.2	0.1
		Tug Boats (0.5 hrs/day) (250/year)	0.0	0.2	0.1	0.0	0.0
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	0.0	0.9	0.2	0.0	0.0
	On-Deck Equipment	Loader (8 hrs/day)	0.0	0.2	0.1	0.0	0.0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	0.1	0.7	1.3	0.0	0.0
		Total	**0.2**	**4.3**	**2.2**	**0.2**	**0.1**
	Material Hauling	Tug Boats (3.5 hrs/day) (662/year)	0.4	3.5	2.7	0.1	0.1

Scenario	Source	Description	Emissions (tons/year)				
			ROG	NO_X	CO	PM_{10}	$PM_{2.5}$
Alternative 8 Stone From Catalina Quarry	Vessel Engines/Generators	Barge (1.5 hr/day) and Dredge (4 hrs/day) Generators	0.1	2.6	0.6	0.1	0.1
	On-Deck Equipment	Loader (12 hrs/day)	0.0	0.3	0.1	0.0	0.0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	0.1	0.7	1.3	0.0	0.0
		Total	**0.6**	**7.0**	**4.7**	**0.2**	**0.2**
Alternative 8 Stone From 3M Quarry	Material Hauling	Trucks (242 trips/day); (110 miles/trip)	0.3	6.7	1.7	0.5	0.2
		Tug Boats (0.5 hrs/day) (662/year)	0.1	0.5	0.4	0.0	0.0
	Vessel Engines/Generators	Barge (1.5 hr/day) and Dredge (4 hrs/day) Generators	0.1	2.6	0.6	0.1	0.1
	On-Deck Equipment	Loader (12 hrs/day)	0.0	0.3	0.1	0.0	0.0
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	0.1	0.7	1.3	0.0	0.0
		Total	**0.5**	**10.3**	**3.7**	**0.6**	**0.3**

Table E-9: Modeling Summary – Project Greenhouse Gas Emissions

Scenario	Source	Description	Emissions MT CO_2E
Alternative 2 Stone From Catalina Quarry	Material Hauling	Tug Boats (3.5 hrs/day) (119/year)	106
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	140
	On-Deck Equipment	Loader (8 hrs/day)	29
	Sand Dredging (100,000 cy)	Dredger, Tug, Crew Boat	91
		Total	**366**
Alternative 2 Stone From 3M Quarry	Material Hauling	Trucks (44 trips/day); (110 miles/trip)	1,801
		Tug Boats (0.5 hrs/day) (119/year)	15
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	140
	On-Deck Equipment	Loader (8 hrs/day)	29
			91
		Total	**2,062**
Alternative 4A Stone From Catalina Quarry	Material Hauling	Tug Boats (3.5 hrs/day) (250/year)	222
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	190
	On-Deck Equipment	Loader (8 hrs/day)	29
			91
		Total	**532**
Alternative 4A Stone From 3M Quarry	Material Hauling	Trucks (91 trips/day); (110 miles/trip)	3,725
		Tug Boats (0.5 hrs/day) (250/year)	32
	Vessel Engines/Generators	Barge Crane and Generator (1 hr/day)	190
	On-Deck Equipment	Loader (8 hrs/day)	29
			91
		Total	**4,035**
Alternative 8 Stone From Catalina Quarry	Material Hauling	Tug Boats (3.5 hrs/day) (662/year)	588
	Vessel Engines/Generators	Barge (1.5 hr/day) and Dredge (4 hrs/day) Generators	553
	On-Deck Equipment	Loader (12 hrs/day)	43
			91
		Total	**1,276**
Alternative 8 Stone From 3M Quarry	Material Hauling	Trucks (242 trips/day); (110 miles/trip)	9,866
		Tug Boats (0.5 hrs/day) (662/year)	84
	Vessel Engines/Generators	Barge (1.5 hr/day) and Dredge (4 hrs/day) Generators	553

Scenario	**Source**	**Description**	**Emissions MT CO_2E**
	On-Deck Equipment	Loader (12 hrs/day)	43
			91
		Total	**10,554**

ALTERNATIVE 2 MAIN AND AUXILIARY ENGINE EMISSION CALCULATORS

Alternative 2: Main Engine Emission Factor Calculator

Calendar Year: 2019			**Number of Entries: 3**								
Vessel/Engine Information											
Vessel Name	Vessel Type	Engine Type	Engine Category	Engine Model Year	MdlYr Group	Engine HP	HP Category	FCF HP Category	Engine Load Factor	BSFC (g/hp-hr)	No. of Engines
Flat-Deck Barge	Barge	Main	C1	2009	2009	2,883	10	4	0.45	185.97	1
Derrick Barge	Barge	Main	C1	2009	2009	2,883	10	4	0.45	185.97	1
Tug Boat 1	Tow Boats / Push Boats	Main	A1	2009	2009	331	5	4	0.68	184.16	1

Alternative 2: Main Engine Emission Factor Calculator continued

Calendar Year: 2019				**Number of Entries: 3**									
Activity				Zero-Hour Emission Factors (g/hp-hr)					Deterioration Factors (g/hp-hr)				
Vessel Name	Annual Hours	Age	Useful Life	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	PM_{10}	$PM_{2.5}$	NOx	ROG	CO
Flat-Deck Barge	1,776	10	17										
Derrick Barge	1,776	10	17										
Tug Boat 1	1,250	10	26	0.150	0.138	5.102	0.680	3.730	0.67	0.62	0.21	0.44	0.25

Alternative 2: Emission Rates (lb/hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Flat-Deck Barge	0.351	0.315	13.067	0.376	3.018	0.016	1706.847	0.069	0.014	1712.704
Derrick Barge	0.351	0.315	13.067	0.376	3.018	0.016	1706.847	0.069	0.014	1712.704
Tug Boat 1	0.075	0.068	2.592	0.284	2.028	0.003	293.139	0.012	0.002	294.145

Alternative 2: Emission Rates for a Single Engine (g/bhp-hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Flat-Deck Barge	0.123	0.110	4.569	0.132	1.055	0.006	596.868	0.024	0.005	598.9
Derrick Barge	0.123	0.110	4.569	0.132	1.055	0.006	596.868	0.024	0.005	598.9
Tug Boat 1	0.151	0.137	5.227	0.572	4.089	0.006	591.045	0.024	0.005	593.1

Alternative 2: Emission Factors (g/hr) and Fuel Correction Factors

Vessel Name	Emission Factors (g/hr)									Fuel Correction Factors			
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	NOx	PM	ROG	MY Bin
Tug Boat 1	34.0	30.7	1,175.9	128.8	919.8	1.2	132,965.3	5.4	1.1	0.95	0.80	0.72	1996

Alternative 2: Auxiliary Engine Emission Factor Calculator

Calendar Year: 2019		**Number of Entries: 3**									
Vessel/Engine Information											
Vessel Name	Vessel Type	Engine Type	Engine Category	Engine Model Year	MdlYr Group	Engine HP	HP Category	FCF HP Category	Engine Load Factor	BSFC (g/hp-hr)	No. of Engines
Derrick Barge	Barge/Dredge Generator	Aux	C2	2009	2009	410	7	4	0.75	185.97	1
Derrick Barge	Crane	Aux	C2	2009	2009	349	7	4	0.42	185.97	1
Tug Boat 1	Tow Boats / Push Boats	Aux	A2	2009	2009	79	2	2	0.43	184.16	1

Alternative 2: Emission Rates (lb/hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Derrick Barge	0.077	0.070	2.796	0.070	0.689	0.004	402.559	0.016	0.003	403.941
Derrick Barge	0.048	0.042	1.485	0.041	0.372	0.002	193.136	0.008	0.002	193.799
Tug Boat 1	0.015	0.014	0.398	0.071	0.297	0.000	44.202	0.002	0.000	44.353

Alternative 2: Emission Rates for a Single Engine (g/bhp-hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Derrick Barge	0.11	0.10	4.15	0.10	1.02	0.006	596.87	0.02	0.00	598.9
Derrick Barge	0.15	0.13	4.59	0.13	1.15	0.006	596.87	0.02	0.00	598.9
Tug Boat 1	0.21	0.19	5.33	0.94	3.97	0.006	591.04	0.02	0.00	593.1

Alternative 2 - 3M Quarry Barge On-Deck Equipment

Daily Emission Estimates for -> Project Phases (Pounds)	**ROG lbs/day**	**CO lbs/day**	**NOx lbs/day**	**Total PM10 lbs/day**	**Exhaust PM10 lbs/day**	**Fugitive Dust PM10 lbs/day**	**Total PM2.5 lbs/day**	**Exhaust PM2.5 lbs/day**	**Fugitive Dust PM2.5 lbs/day**	**SOx lbs/day**	**CO2 lbs/day**	**CH4 lbs/day**	**N2O lbs/day**	**CO2e lbs/day**
Grubbing/Land Clearing	0.10	0.41	1.16	0.04	0.04	0.00	0.04	0.04	0.00	0.00	151.57	0.05	0.00	153.18
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	0.10	0.41	1.16	0.04	0.04	0.00	0.04	0.04	0.00	0.00	151.57	0.05	0.00	153.18
Total (tons/construction project)	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	31.86

Notes:
Project Start Year ->2019; Project Length (months) ->30 ; Total Project Area (acres) ->0; Total Project Area (acres) ->0; Maximum Area Disturbed/Day (acres) ->0
Water Truck Used? ->No

Phase	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	0	0	0	0	0	0
Grading/Excavation	0	0	0	0	0	0
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO_2, CH_4 and N_2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 2 - 3M Quarry Barge On-Deck Equipment

Total Emission Estimates by Phase for -> Project Phases (Tons for all except CO2e. Metric tons for CO2e)	ROG tons/phase	CO tons/ phase	NOx tons/ phase	Total PM10 tons/ phase	Exhaust PM10 tons/ phase	Fugitive Dust PM10 tons/ phase	Total PM2.5 tons/ phase	Exhaust PM2.5 tons/ phase	Fugitive Dust PM2.5 tons/ phase	SOx tons/ phase	CO2 tons/ phase	CH4 tons/ phase	N2O tons/ phase	CO2e MT/ phase
Grubbing/Land Clearing	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	28.90
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	28.90
Total (tons/construction project)	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	28.90

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
The CO2e emissions are reported as metric tons per phase.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 2 - 3M Quarry Truck Hauling (via Roadways)

Daily Emission Estimates for -> Project Phases (Pounds)	ROG lbs/day	CO lbs/day	NOx lbs/day	Total PM10 lbs/day	Exhaust PM10 lbs/day	Fugitive Dust PM10 lbs/day	Total PM2.5 lbs/day	Exhaust PM2.5 lbs/day	Fugitive Dust PM2.5 lbs/day	SOx lbs/day	CO2 lbs/day	CH4 lbs/day	N2O lbs/day	CO2e lbs/day
Grubbing/Land Clearing	0.36	1.94	7.85	0.55	0.55	0.00	0.21	0.21	0.00	0.08	8402.7	0.02	0.28	8484.5
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	0.36	1.94	7.85	0.55	0.55	0.00	0.21	0.21	0.00	0.08	8402.7	0.02	0.28	8484.5
Total (tons/construction project)	0.08	0.45	1.84	0.13	0.13	0.00	0.05	0.05	0.00	0.02	1966.2	0.00	0.06	1985.6

Notes:
Project Start Year ->2019; Project Length (months) ->30; Total Project Area (acres) ->0; Total Project Area (acres) ->0; Maximum Area Disturbed/Day (acres) ->0
Water Truck Used? ->No

Phase	Total Material Imported/Exported Volume (yd³/day)		Daily VMT (miles/day)			
	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	44	0	2420	0	0	0
Grading/Excavation	0	0	0	0	0	0
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO_2, CH_4 and N_2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 2 - 3M Quarry Truck Hauling (via Roadways)

Total Emission Estimates by Phase for -> Project Phases (Tons for all except CO2e. Metric tons for CO2e)	ROG tons/phase	CO tons/ phase	NOx tons/ phase	Total PM10 tons/ phase	Exhaust PM10 tons/ phase	Fugitive Dust PM10 tons/ phase	Total PM2.5 tons/ phase	Exhaust PM2.5 tons/ phase	Fugitive Dust PM2.5 tons/ phase	SOx tons/ phase	CO2 tons/ phase	CH4 tons/ phase	N2O tons/ phase	CO2e MT/ phase
Grubbing/Land Clearing	0.08	0.45	1.84	0.13	0. 13	0.00	0.05	0.05	0.00	0.02	1966.2	0.00	0.06	1801.3
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.08	0.45	1.84	0.13	0.13	0.00	0.05	0.05	0.00	0.02	1966.2	0.00	0.06	1801.3
Total (tons/construction project)	0.08	0.45	1.84	0.13	0.13	0.00	0.05	0.05	0.00	0.02	1966.2	0.00	0.06	1801.3

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
The CO2e emissions are reported as metric tons per phase.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 2 – Emission Rates for Sand Dredging Tug Boat, Crew Boat, and Tier 4 Dredger

Equipment	Engine (kW)	Load Factor	Hours per Day	Days per Year	Emission Factor (g/kW-hr)								
					PM_{10}	$PM_{2.5}$	NO_x	SO_x	CO	VOC	CO_2	CH_4	N_2O
Tug Boat Propulsion	223	0.31	20	25	0.54	0.48	17	0.01	11.4	1.37	652	0.03	0.03
Tug Boat Auxiliary	34	0.43	20	25	0.3	0.27	6.27	0.01	5	0.35	652	0.01	0.03
Crew Boat Propulsion	370	0.38	2	25	0.54	0.48	17	0.01	11.4	1.37	652	0.03	0.03
Crew Boat Auxiliary	55	0.20	2	25	0.3	0.27	7.13	0.01	5	0.35	652	0.01	0.03
T4 Dredger	600	0.50	22	25	0.04	0.036	1.8	0.0055	5	0.2	652	0.0038	0.031

ALTERNATIVE 4A MAIN AND AUXILIARY ENGINE EMISSION CALCULATORS

Alternative 4A: Main Engine Emission Factor Calculator

Calendar Year: 2019 **Number of Entries: 3**

Vessel/Engine Information											
Vessel Name	Vessel Type	Engine Type	Engine Category	Engine Model Year	MdlYr Group	Engine HP	HP Category	FCF HP Category	Engine Load Factor	BSFC (g/hp-hr)	No. of Engines
Flat-Deck Barge	Barge	Main	C1	2009	2009	2,883	10	4	0.45	185.97	1
Derrick Barge	Barge	Main	C1	2009	2009	2,883	10	4	0.45	185.97	1
Tug Boat 1	Tow Boats / Push Boats	Main	A1	2009	2009	331	5	4	0.68	184.16	1

Alternative 4A: Main Engine Emission Factor Calculator continued

Calendar Year: 2019				**Number of Entries: 3**									
Activity				Zero-Hour Emission Factors (g/hp-hr)					Deterioration Factors (g/hp-hr)				
Vessel Name	Annual Hours	Age	Useful Life	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	PM_{10}	$PM_{2.5}$	NOx	ROG	CO
Flat-Deck Barge	1,776	10	17	0.110	0.101	4.290	0.145	0.920	0.67	0.62	0.21	0.44	0.25
Derrick Barge	1,776	10	17	0.110	0.101	4.290	0.145	0.920	0.67	0.62	0.21	0.44	0.25
Tug Boat 1	1,250	10	26	0.150	0.138	5.102	0.680	3.730	0.67	0.62	0.21	0.44	0.25

Alternative 4A: Emission Rates (lb/hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Flat-Deck Barge	0.351	0.315	13.067	0.376	3.018	0.016	1706.847	0.069	0.014	1712.704
Derrick Barge	0.351	0.315	13.067	0.376	3.018	0.016	1706.847	0.069	0.014	1712.704
Tug Boat 1	0.075	0.068	2.592	0.284	2.028	0.003	293.139	0.012	0.002	294.145

Alternative 4A: Emission Rates for a Single Engine (g/bhp-hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Flat-Deck Barge	0.123	0.110	4.569	0.132	1.055	0.006	596.868	0.024	0.005	598.9
Derrick Barge	0.123	0.110	4.569	0.132	1.055	0.006	596.868	0.024	0.005	598.9
Tug Boat 1	0.151	0.137	5.227	0.572	4.089	0.006	591.045	0.024	0.005	593.1

Alternative 4A: Emission Factors (g/hr) and Fuel Correction Factors

Vessel Name	Emission Factors (g/hr)									Fuel Correction Factors			
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	NOx	PM	ROG	MY Bin
Flat-Deck Barge	159.1	143.1	5,927.0	170.7	1,368.8	7.2	774,212.0	31.4	6.3	0.95	0.80	0.72	1996
Derrick Barge	159.1	143.1	5,927.0	170.7	1,368.8	7.2	774,212.0	31.4	6.3	0.95	0.80	0.72	1996
Tug Boat 1	34.0	30.7	1,175.9	128.8	919.8	1.2	132,965.3	5.4	1.1	0.95	0.80	0.72	1996

Alternative 4A: Auxiliary Engine Emission Factor Calculator

Calendar Year: 2019			**Number of Entries: 2**								
Vessel/Engine Information											
Vessel Name	Vessel Type	Engine Type	Engine Category	Engine Model Year	MdlYr Group	Engine HP	HP Category	FCF HP Category	Engine Load Factor	BSFC (g/hp-hr)	No. of Engines
Derrick Barge	Barge/Dredge Generator	Aux	C2	2009	2009	410	7	4	0.75	185.97	1
Derrick Barge	Crane	Aux	C2	2009	2009	349	7	4	0.42	185.97	1
Tug Boat 1	Tow Boats / Push Boats	Aux	A2	2009	2009	79	2	2	0.43	184.16	1

Alternative 4A: Emission Rates (lb/hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Derrick Barge	0.077	0.070	2.796	0.070	0.689	0.004	402.559	0.016	0.003	403.941
Derrick Barge	0.077	0.070	2.796	0.070	0.689	0.004	402.559	0.016	0.003	403.941
Tug Boat 1	0.015	0.014	0.398	0.071	0.297	0.000	44.202	0.002	0.000	44.353

Alternative 4A: Emission Rates for a Single Engine (g/bhp-hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Derrick Barge	0.11	0.10	4.15	0.10	1.02	0.006	596.87	0.02	0.00	598.9
Derrick Barge	0.11	0.10	4.15	0.10	1.02	0.006	596.87	0.02	0.00	598.9
Tug Boat 1	0.21	0.19	5.33	0.94	3.97	0.006	591.04	0.02	0.00	593.1

Alternative 4A: 3M Quarry Barge On-Deck Equipment

Daily Emission Estimates for ->				Total	Exhaust	Fugitive Dust	Total	Exhaust	Fugitive Dust					
Project Phases (Pounds)	**ROG lbs/day**	**CO lbs/day**	**NOx lbs/day**	**PM10 lbs/day**	**PM10 lbs/day**	**PM10 lbs/day**	**PM2.5 lbs/day**	**PM2.5 lbs/day**	**PM2.5 lbs/day**	**SOx lbs/day**	**CO2 lbs/day**	**CH4 lbs/day**	**N2O lbs/day**	**CO2e lbs/day**
Grubbing/Land Clearing	0.10	0.41	1.16	0.04	0.04	0.00	0.04	0.04	0.00	0.00	151.57	0.05	0.00	153.18
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	0.10	0.41	1.16	0.04	0.04	0.00	0.04	0.04	0.00	0.00	151.57	0.05	0.00	153.18
Total (tons/construction project)	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	31.86
Notes: Project Start Year ->2019; Project Length (months) ->37; Total Project Area (acres) ->0; Total Project Area (acres) ->0; Maximum Area Disturbed/Day (acres) ->0; Water Truck Used? ->No														

Phase	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	0	0	0	0	0	0
Grading/Excavation	0	0	0	0	0	0
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO_2, CH_4 and N_2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 4A: 3M Quarry Barge On-Deck Equipment

Total Emission Estimates by Phase for -> Project Phases (Tons for all except CO2e. Metric tons for CO2e)	ROG tons/phase	CO tons/ phase	NOx tons/ phase	Total PM10 tons/ phase	Exhaust PM10 tons/ phase	Fugitive Dust PM10 tons/ phase	Total PM2.5 tons/ phase	Exhaust PM2.5 tons/ phase	Fugitive Dust PM2.5 tons/ phase	SOx tons/ phase	CO2 tons/ phase	CH4 tons/ phase	N2O tons/ phase	CO2e MT/ phase
Grubbing/Land Clearing	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	28.90
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	28.90
Total (tons/construction project)	0.02	0.09	0.24	0.01	0.01	0.00	0.01	0.01	0.00	0.00	31.53	0.01	0.00	28.90

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
The CO2e emissions are reported as metric tons per phase.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 4A: 3M Quarry Truck Hauling (via Roadways)

Daily Emission Estimates for -> Project Phases (Pounds)	ROG lbs/day	CO lbs/day	NOx lbs/day	Total PM10 lbs/day	Exhaust PM10 lbs/day	Fugitive Dust PM10 lbs/day	Total PM2.5 lbs/day	Exhaust PM2.5 lbs/day	Fugitive Dust PM2.5 lbs/day	SOx lbs/day	CO2 lbs/day	CH4 lbs/day	N2O lbs/day	CO2e lbs/day
Grubbing/Land Clearing	0.74	4.01	16.24	1.13	1.13	0.00	0.44	0.44	0.00	0.17	17,378.2	0.03	0.57	17,549.5
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	0.74	4.01	16.24	1.13	1.13	0.00	0.44	0.44	0.00	0.17	17,378.2	0.03	0.57	17,549.5
Total (tons/construction project)	0.17	0.94	3.80	0.27	0.27	0.00	0.10	0.10	0.00	0.04	4,066.51	0.01	0.13	4,106.57

Notes:
Project Start Year ->2019
Project Length (months) ->37
Total Project Area (acres) ->0
Total Project Area (acres) ->0
Maximum Area Disturbed/Day (acres) ->0
Water Truck Used? ->No

Phase	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
	Soil	**Asphalt**	**Soil Hauling**	**Asphalt Hauling**	**Worker Commute**	**Water Truck**
Grubbing/Land Clearing	91	0	5005	0	0	0
Grading/Excavation	0	0	0	0	0	0
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1, 25 and 298 for CO_2, CH_4 and N_2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 4A: 3M Quarry Truck Hauling (via Roadways)

Total Emission Estimates by Phase for -> Project Phases (Tons for all except CO2e. Metric tons for CO2e)	ROG tons/phase	CO tons/ phase	NOx tons/ phase	Total PM10 tons/ phase	Exhaust PM10 tons/ phase	Fugitive Dust PM10 tons/ phase	Total PM2.5 tons/ phase	Exhaust PM2.5 tons/ phase	Fugitive Dust PM2.5 tons/ phase	SOx tons/ phase	CO2 tons/ phase	CH4 tons/ phase	N2O tons/ phase	CO2e MT/ phase
Grubbing/Land Clearing	0.17	0.94	3.80	0.27	0.27	0.00	0.10	0.10	0.00	0.04	4,066.51	0.01	0.13	3,725.5
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.17	0.94	3.80	0.27	0.27	0.00	0.10	0.10	0.00	0.04	4066.51	0.01	0.13	3,725.5
Total (tons/construction project)	0.17	0.94	3.80	0.27	0.27	0.00	0.10	0.10	0.00	0.04	4066.51	0.01	0.13	3,725.5

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
The CO2e emissions are reported as metric tons per phase.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 4A – Emission Rates for Sand Dredging Tug Boat, Crew Boat, and Tier 4 Dredger

Equipment	Engine (kW)	Load Factor	Hours per Day	Days per Year	Emission Factor (g/kW-hr)								
					PM_{10}	$PM_{2.5}$	NO_X	SO_X	CO	VOC	CO_2	CH_4	N_2O
Tug Boat Propulsion	223	0.31	20	25	0.54	0.48	17	0.01	11.4	1.37	652	0.03	0.03
Tug Boat Auxiliary	34	0.43	20	25	0.3	0.27	6.27	0.01	5	0.35	652	0.01	0.03
Crew Boat Propulsion	370	0.38	2	25	0.54	0.48	17	0.01	11.4	1.37	652	0.03	0.03
Crew Boat Auxiliary	55	0.20	2	25	0.3	0.27	7.13	0.01	5	0.35	652	0.01	0.03
T4 Dredger	600	0.50	22	25	0.04	0.036	1.8	0.0055	5	0.2	652	0.0038	0.031

ALTERNATIVE 8 MAIN AND AUXILIARY ENGINE EMISSION CALCULATORS

Alternative 8: Main Engine Emission Factor Calculator

Calendar Year: 2019				Number of Entries: 4							
Vessel/Engine Information											
Vessel Name	Vessel Type	Engine Type	Engine Category	Engine Model Year	MdlYr Group	Engine HP	HP Category	FCF HP Category	Engine Load Factor	BSFC (g/hp-hr)	No. of Engines
Flat-Deck Barge	Barge	Main	C1	2009	2009	2,883	10	4	0.45	185.97	1
Derrick Barge	Barge	Main	C1	2009	2009	2,883	10	4	0.45	185.97	1
Dredger	Dredge	Main	C1	2009	2009	2,883	10	4	0.45	185.97	1
Tug Boat 1	Tow Boats / Push Boats	Main	A1	2009	2009	331	5	4	0.68	184.16	1

Alternative 8: Main Engine Emission Factor Calculator continued

Calendar Year: 2019 **Number of Entries: 3**

Activity				Zero-Hour Emission Factors (g/hp-hr)					Deterioration Factors (g/hp-hr)				
Vessel Name	Annual Hours	Age	Useful Life	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	PM_{10}	$PM_{2.5}$	NOx	ROG	CO
Flat-Deck Barge	1,776	10	17	0.110	0.101	4.290	0.145	0.920	0.67	0.62	0.21	0.44	0.25
Derrick Barge	1,776	10	17	0.110	0.101	4.290	0.145	0.920	0.67	0.62	0.21	0.44	0.25
Tug Boat 1	1,250	10	26	0.150	0.138	5.102	0.680	3.730	0.67	0.62	0.21	0.44	0.25

Alternative 8: Emission Rates (lb/hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Flat-Deck Barge	0.351	0.315	13.067	0.376	3.018	0.016	1706.847	0.069	0.014	1712.704
Derrick Barge	0.351	0.315	13.067	0.376	3.018	0.016	1706.847	0.069	0.014	1712.704
Dredge	0.351	0.315	13.067	0.376	3.018	0.016	1706.847	0.069	0.014	1712.704
Tug Boat 1	0.075	0.068	2.592	0.284	2.028	0.003	293.139	0.012	0.002	294.145

Alternative 8: Emission Rates (lb/hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Flat-Deck Barge	0.123	0.110	4.569	0.132	1.055	0.006	596.868	0.024	0.005	598.9
Derrick Barge	0.123	0.110	4.569	0.132	1.055	0.006	596.868	0.024	0.005	598.9
Dredge	0.123	0.110	4.569	0.132	1.055	0.006	596.868	0.024	0.005	598.9
Tug Boat 1	0.151	0.137	5.227	0.572	4.089	0.006	591.045	0.024	0.005	593.1

Alternative 8: Emission Factors (g/hr) and Fuel Correction Factors

Vessel Name	Emission Factors (g/hr)									Fuel Correction Factors			
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	NOx	PM	ROG	MY Bin
Flat-Deck Barge	159.1	143.1	5,927.0	170.7	1,368.8	7.2	774,212.0	31.4	6.3	0.95	0.80	0.72	1996
Derrick Barge	159.1	143.1	5,927.0	170.7	1,368.8	7.2	774,212.0	31.4	6.3	0.95	0.80	0.72	1996
Dredge	159.1	143.1	5,927.0	170.7	1,368.8	7.2	774,212.0	31.4	6.3	0.95	0.80	0.72	1996
Tug Boat 1	34.0	30.7	1,175.9	128.8	919.8	1.2	132,965.3	5.4	1.1	0.95	0.80	0.72	1996

Alternative 8: Auxiliary Engine Emission Factor Calculator

Calendar Year: 2019				**Number of Entries: 4**							
Vessel/Engine Information											
Vessel Name	Vessel Type	Engine Type	Engine Category	Engine Model Year	MdlYr Group	Engine HP	HP Category	FCF HP Category	Engine Load Factor	BSFC (g/hp-hr)	No. of Engines
Derrick Barge	Barge/Dredge Generator	Aux	C2	2009	2009	410	7	4	0.75	185.97	1
Derrick Barge	Crane	Aux	C2	2009	2009	349	7	4	0.42	185.97	1
Dredge	Dredge	Dredge		2009	2009	425			0.51		1
Tug Boat 1	Tow Boats / Push Boats	Aux	A2	2009	2009	79	2	2	0.43	184.16	1

Alternative 8: Emission Rates (lb/hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Derrick Barge	0.077	0.070	2.796	0.070	0.689	0.004	402.559	0.016	0.003	403.941
Derrick Barge	0.077	0.070	2.796	0.070	0.689	0.004	402.559	0.016	0.003	403.941
Dredge	0.060	0.054	2.050	0.053	0.508	0.003	285.215	0.012	0.002	286.193
Tug Boat 1	0.015	0.014	0.398	0.071	0.297	0.000	44.202	0.002	0.000	44.353

Alternative 8: Emission Rates for a Single Engine (g/bhp-hr)

Vessel Name	Emissions									
	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Derrick Barge	0.11	0.10	4.15	0.10	1.02	0.006	596.87	0.02	0.00	598.9
Derrick Barge	0.11	0.10	4.15	0.10	1.02	0.006	596.87	0.02	0.00	598.9
Dredge	0.12	0.11	4.29	0.11	1.06	0.006	596.87	0.02	0.00	598.9
Tug Boat 1	0.21	0.19	5.33	0.94	3.97	0.006	591.04	0.02	0.00	593.1

Alternative 8: 3M Quarry Barge On-Deck Equipment

Daily Emission Estimates for -> Project Phases (Pounds)	ROG lbs/day	CO lbs/day	NOx lbs/day	Total PM10 lbs/day	Exhaust PM10 lbs/day	Fugitive Dust PM10 lbs/day	Total PM2.5 lbs/day	Exhaust PM2.5 lbs/day	Fugitive Dust PM2.5 lbs/day	SOx lbs/day	CO2 lbs/day	CH4 lbs/day	N2O lbs/day	CO2e lbs/day
Grubbing/Land Clearing	0.15	0.62	1.74	0.06	0.06	0.00	0.05	0.05	0.00	0.00	227.35	0.07	0.00	229.77
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	0.15	0.62	1.74	0.06	0.06	0.00	0.05	0.05	0.00	0.00	227.35	0.07	0.00	229.77
Total (tons/construction project)	0.03	0.13	0.36	0.01	0.01	0.00	0.01	0.01	0.00	0.00	47.29	0.02	0.00	47.79

Notes:
Project Start Year ->2019; Project Length (months) ->53; Total Project Area (acres) ->0; Total Project Area (acres) ->0 ; Maximum Area Disturbed/Day (acres) ->0; Water Truck Used? ->No

Phase	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	0	0	0	0	0	0
Grading/Excavation	0	0	0	0	0	0
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO_2, CH_4 and N_2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 8: 3M Quarry Barge On-Deck Equipment

Total Emission Estimates by Phase for -> Project Phases (Tons for all except CO2e. Metric tons for CO2e)	ROG tons/phase	CO tons/ phase	NOx tons/ phase	Total PM10 tons/ phase	Exhaust PM10 tons/ phase	Fugitive Dust PM10 tons/ phase	Total PM2.5 tons/ phase	Exhaust PM2.5 tons/ phase	Fugitive Dust PM2.5 tons/ phase	SOx tons/ phase	CO2 tons/ phase	CH4 tons/ phase	N2O tons/ phase	CO2e MT/ phase
Grubbing/Land Clearing	0.03	0.13	0.36	0.01	0.01	0.00	0.01	0.01	0.00	0.00	47.29	0.02	0.00	43.36
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.03	0.13	0.36	0.01	0.01	0.00	0.01	0.01	0.00	0.00	47.29	0.02	0.00	43.36
Total (tons/construction project)	0.03	0.13	0.36	0.01	0.01	0.00	0.01	0.01	0.00	0.00	47.29	0.02	0.00	43.36

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
The CO2e emissions are reported as metric tons per phase.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 8: 3M Quarry Truck Hauling (via Roadways)

Daily Emission Estimates for -> Project Phases (Pounds)	ROG lbs/day	CO lbs/day	NOx lbs/day	Total PM10 lbs/day	Exhaust PM10 lbs/day	Fugitive Dust PM10 lbs/day	Total PM2.5 lbs/day	Exhaust PM2.5 lbs/day	Fugitive Dust PM2.5 lbs/day	SOx lbs/day	CO2 lbs/day	CH4 lbs/day	N2O lbs/day	CO2e lbs/day
Grubbing/Land Clearing	1.95	10.62	43.01	3.00	3.00	0.00	1.18	1.18	0.00	0.44	46,023.7	0.09	1.51	46,477.1
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	1.95	10.62	43.01	3.00	3.00	0.00	1.18	1.18	0.00	0.44	46,023.7	0.09	1.51	46,477.1
Total (tons/construction project)	0.46	2.49	10.06	0.70	0.70	0.00	0.28	0.28	0.00	0.10	10,769.5	0.02	0.35	10,875.7

Notes:
Project Start Year ->2019; Project Length (months) ->53; Total Project Area (acres) ->0; Total Project Area (acres) ->0; Maximum Area Disturbed/Day (acres) ->0; Water Truck Used? ->No

Phase	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	241	0	13,255	0	0	0
Grading/Excavation	0	0	0	0	0	0
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO_2, CH_4 and N_2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 8: 3M Quarry Truck Hauling (via Roadways)

Total Emission Estimates by Phase for -> Project Phases (Tons for all except CO2e. Metric tons for CO2e)	ROG tons/phase	CO tons/ phase	NOx tons/ phase	Total PM10 tons/ phase	Exhaust PM10 tons/ phase	Fugitive Dust PM10 tons/ phase	Total PM2.5 tons/ phase	Exhaust PM2.5 tons/ phase	Fugitive Dust PM2.5 tons/ phase	SOx tons/ phase	CO2 tons/ phase	CH4 tons/ phase	N2O tons/ phase	CO2e MT/ phase
Grubbing/Land Clearing	0.46	2.49	10.06	0.70	0.70	0.00	0.28	0.28	0.00	0.10	10,769.5	0.02	0.35	9,866.3
Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.46	2.49	10.06	0.70	0.70	0.00	0.28	0.28	0.00	0.10	10,769.5	0.02	0.35	9,866.3
Total (tons/construction project)	0.46	2.49	10.06	0.70	0.70	0.00	0.28	0.28	0.00	0.10	10,769.5	0.02	0.35	9,866.3

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.
Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H.
Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively.
Total CO2e is then estimated by summing CO2e estimates over all GHGs.
The CO2e emissions are reported as metric tons per phase.
Model: Road Construction Emissions Model, Version 8.1.0

Alternative 8 – Emission Rates for Sand Dredging Tug Boat, Crew Boat, and Tier 4 Dredger

Equipment	Engine (kW)	Load Factor	Hours per Day	Days per Year	Emission Factor (g/kW-hr)								
					PM_{10}	$PM_{2.5}$	NO_X	SO_X	CO	VOC	CO_2	CH_4	N_2O
Tug Boat Propulsion	223	0.31	20	25	0.54	0.48	17	0.01	11.4	1.37	652	0.03	0.03
Tug Boat Auxiliary	34	0.43	20	25	0.3	0.27	6.27	0.01	5	0.35	652	0.01	0.03
Crew Boat Propulsion	370	0.38	2	25	0.54	0.48	17	0.01	11.4	1.37	652	0.03	0.03
Crew Boat Auxiliary	55	0.20	2	25	0.3	0.27	7.13	0.01	5	0.35	652	0.01	0.03
T4 Dredger	600	0.50	22	25	0.04	0.036	1.8	0.0055	5	0.2	652	0.0038	0.031

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