

APPENDIX C
AIR EMISSIONS CALCULATIONS AND RECORD OF NON-
APPLICABILITY

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C.1 West Coast Fleet Logistics Center Air Emissions Calculations and RONA

Table C.1-1: Emission Source Data for Construction of the Navy V-22 Action at NAS North Island Alternative 1

<i>Equipment Type</i>	<i>Hp Rating</i>	<i>Ave. Daily Load Factor</i>	<i>Number Active</i>	<i>Hourly Hp-Hrs</i>	<i>Hours/Day</i>	<i>Daily Hp-Hrs</i>	<i>Work Days</i>	<i>Total Hp-Hrs</i>
<i>Demolish All Buildings</i>								
Backhoe	160	0.50	2	160	8	1,280	44.3	56,711
Bulldozer	310	0.50	2	310	8	2,480	44.3	109,877
Crane w/Wrecking Ball	180	0.50	1	90	8	720	44.3	31,900
Loader	215	0.50	3	323	8	2,580	44.3	114,308
Haul Truck (1)	NA	NA	10	NA	20	200	44.3	8,861
Building Demolition (2)	NA	NA	NA	NA	8	NA	44.3	3,948,098
<i>Building Construction</i>								
Air Compressor - 100 CFM	50	0.60	2	60	6	360	442	159,083
Concrete/Industrial Saw	84	0.73	2	123	6	736	442	325,166
Crane	190	0.30	2	114	6	684	442	302,258
Forklift	94	0.48	2	89	6	536	442	236,769
Generator	45	0.60	2	54	8	432	442	190,900
Concrete Trucks (1)	NA	NA	15	NA	14	210	40	8,436
Supply Trucks (1)	NA	NA	20	NA	10	200	67	13,391
Fugitive Dust (3)	NA	NA	2.7	NA	8	NA	214	844
<i>Airfield Demolition</i>								
Asphalt Profiler	950	0.50	2	950	8	7,600	28.1	213,802
Loader - 938G	160	0.50	2	160	4	640	28.1	18,004
Water Truck - 5,000 Gallons	175	0.40	1	70	8	560	28.1	15,754
Haul Truck - 20CY (1)	NA	NA	10	NA	47	468	28.1	13,167
Fugitive Dust (3)	NA	NA	1.0	NA	8	NA	28.1	225

Table C.1-1: Emission Source Data for Construction of the Navy V-22 Action at NAS North Island Alternative 1 (continued)

<i>Equipment Type</i>	<i>Hp Rating</i>	<i>Ave. Daily Load Factor</i>	<i>Number Active</i>	<i>Hourly Hp-Hrs</i>	<i>Hours/Day</i>	<i>Daily Hp-Hrs</i>	<i>Work Days</i>	<i>Total Hp-Hrs</i>
<i>Airfield Paving</i>								
Concrete Paver	25	0.54	2	27	6	162	10	1,658
Concrete Pump Truck, 110' Boom	285	0.41	1	117	5	584	10	5,978
Concrete Trucks (1)	NA	NA	15	NA	95	1,430	10	14,630
Concrete Vibrator	8	0.54	1	4	5	22	10	221
Loader	215	0.50	1	108	2	215	8	1,720
Water Truck - 5,000 Gallons	175	0.40	1	70	4	280	8	2,240
Supply Trucks (1)	NA	NA	10	NA	2	20	6	120
Fugitive Dust (3)	NA	NA	0.5	NA	8	NA	8	4
<i>Vehicle Parking Lot Paving</i>								
Paving Machine	200	0.50	1	100	8	800	5	4,000
Water Truck - 5,000 Gallons	175	0.40	1	70	8	560	8	4,480
Compactive Roller	165	0.50	2	165	8	1,320	5	6,600
Grader	180	0.50	1	90	8	720	3	2,160
Loader	215	0.50	1	108	8	860	6	5,160
Backhoe	160	0.50	1	80	8	640	3	1,920
Bulldozer - D6	165	0.50	1	83	8	660	2	1,320
Haul Truck - Paving (1)	NA	NA	10	NA	27	271	5	1,357
Haul Truck - Base (1)	NA	NA	10	NA	21	206	5	1,028
Semi Truck (1)	NA	NA	10	NA	4	40	4	160
Fugitive Dust (3)	NA	NA	1	NA	8	NA	8	8
<i>Re-Stripe Airfield</i>								
Air Compressor - 100 CFM	50	0.60	1	30	8	240	7	1,725
Concrete/Industrial Saw	84	0.73	1	61	2	123	7	882
Forklift	94	0.48	1	45	2	89	7	642
Supply Trucks (1)	NA	NA	20	NA	2	40	2	80
Fugitive Dust (3)	NA	NA	0.2	NA	8	NA	7	1

Table C.1-1: Emission Source Data for Construction of the Navy V-22 Action at NAS North Island Alternative 1 (continued)

<i>Equipment Type</i>	<i>Hp Rating</i>	<i>Ave. Daily Load Factor</i>	<i>Number Active</i>	<i>Hourly Hp-Hrs</i>	<i>Hours/Day</i>	<i>Daily Hp-Hrs</i>	<i>Work Days</i>	<i>Total Hp-Hrs</i>
<i>Aircraft Wash Rack</i>								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	4.6	831
Concrete/Industrial Saw	84	0.73	1	61	4	245	4.6	1,133
Crane	190	0.30	1	57	2	114	4.6	526
Forklift	94	0.48	1	45	2	89	4.6	412
Generator	45	0.60	1	27	6	162	4.6	748
Concrete Trucks (1)	NA	NA	15	NA	2	30	2.0	60
Supply Trucks (1)	NA	NA	20	NA	2	40	3.0	120
Fugitive Dust (3)	NA	NA	0.10	NA	8	NA	4.6	0.5

CFM = cubic feet per minute; CY = cubic yard; Hp-hrs = horsepower hours; NA = not applicable

Notes: (1) Number Active = miles/roundtrip; Hours/Day = daily truck trips; Daily Hp-Hrs = daily miles; and Total Hp-Hrs = total miles.

(2) Total Hp-Hrs = total cubic feet (cf) of demolished buildings.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table C.1-2: Air Emission Factors for Construction of the Navy V-22 Action at NAS North Island

<i>Source Type</i>	<i>Fuel Type</i>	<i>Emission Factors (Grams/Horsepower-Hour)</i>							<i>References</i>
		<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>	
Off-Road Equipment - 26-50Hp	D	0.88	1.53	4.86	0.01	0.39	0.36	563	(1)
Off-Road Equipment - 51-120Hp	D	0.40	2.37	4.58	0.01	0.33	0.31	523	(1)
Off-Road Equipment - 121-175Hp	D	0.38	0.87	4.80	0.01	0.26	0.24	523	(1)
Off-Road Equipment - 176-250Hp	D	0.30	0.75	4.56	0.01	0.17	0.16	526	(1)
Off-Road Equipment - 250-500Hp	D	0.29	0.84	4.13	0.00	0.16	0.15	518	(1)
Off-Road Equipment - 501-750Hp	D	0.28	1.33	4.01	0.00	0.16	0.14	525	(1)
Off-Road Equipment - 751-1000Hp	D	0.31	0.76	5.70	0.00	0.17	0.15	522	(1)
Off-Road Equipment - 6-25Hp	G	3.17	321.94	1.01	0.22	0.06	0.06	1,053	(2)
HDDV - Idling (Gms/Hr)	D	0.75	2.34	25.20	0.07	0.00	0.00	10,562	(3)
HDDV - 25mph	D	0.38	1.40	8.29	0.02	0.18	0.10	1,951	(3)
HDDV - 55mph	D	0.09	0.37	5.53	0.01	0.17	0.09	1,511	(3)
HDDV - Composite (4)	D	0.24	0.89	6.91	0.02	0.18	0.09	1,731	(4)
Building Demolition (lbs/1000cf)	-	-	-	-	-	0.42	0.04	-	(5)
Disturbed Ground - Fugitive Dust	-	-	-	-	-	9.93	0.99	-	(6)

cf = cubic feet; CO = carbon monoxide; CO₂ = carbon dioxide; Gms/Hr = grams per hour; D = diesel; Hp = horsepower; lbs = pounds; mph = miles per hour; NO_x = nitrogen oxide; SO₂ = sulfur dioxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; VOC = volatile organic compounds

Notes: (1) Data obtained from the AFB OFFROAD2011 Model for San Diego Air Basin Fleet in year 2018 (AFB, 2012). CO factors are from non-road certification data, Table 5 of Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression - Ignition (USEPA, 2010).
(2) Exhaust Emissions Factors for Nonroad Engine Modeling – Spark-Ignition, Table 5 for 4 stroke equipment and Phase 3 standards (2011) (USEPA, 2010).
(3) Estimated with the use of the ARB EMFAC2014 model, version 1.0.7. Based on aggregated model years and annual season high idle emission rates for summer, as presented in the EMFAC2014 Volume III – Technical Documentation Table 3.2-41 (ARB, 2015).
(4) Equal to 50/50% 25/55 mph conditions.
(5) URBEMIS2007 (Jones & Stokes Ass., 2007).
(6) From Table 3-2 for active large-scale earth moving operations (Countess Environmental, 2006). Emissions reduced by 74% from uncontrolled levels to stimulate water application every 2.1 hours and use the best management practices for fugitive dust control (Table 3-7). Converted to units of lbs/acre-day of disturbance assuming 22 work days/month.

**Table C.1-3: Emissions from Construction of the Navy V-22 Action at
NAS North Island – Alternative 1**

Equipment Type	Tons						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Demolish All Buildings							
Backhoe	0.02	0.05	0.30	0.0003	0.02	0.01	32.70
Bulldozer	0.04	0.10	0.50	0.0006	0.02	0.02	62.77
Crane/Wrecking Ball	0.01	0.03	0.17	0.0002	0.01	0.01	18.40
Loader	0.04	0.09	0.57	0.0007	0.02	0.02	66.28
Haul Truck	0.00	0.01	0.07	0.0002	0.00	0.00	17.77
Building Demolition - Dust	-	-	-	-	0.83	0.08	-
Subtotal	0.11	0.28	1.61	0.0020	0.9	0.14	197.92
Building Construction							
Air Compressor - 100 CFM	0.07	0.42	0.80	0.0009	0.06	0.05	91.66
Concrete/Industrial Saw	0.14	0.85	1.64	0.0019	0.12	0.11	187.36
Crane	0.10	0.25	1.52	0.0017	0.06	0.05	175.26
Forklift	0.10	0.62	1.19	0.0013	0.09	0.08	136.43
Generator	0.19	0.32	1.02	0.0012	0.08	0.07	118.56
Concrete Trucks	0.00	0.01	0.07	0.0002	0.00	0.00	16.64
Supply Trucks	0.00	0.01	0.10	0.0003	0.00	0.00	26.20
Fugitive Dust	-	-	-	-	4.19	0.42	-
Subtotal	0.60	2.48	6.34	0.0075	4.60	0.78	752.11
Airfield Demolition							
Asphalt Profiler	0.07	0.18	1.34	0.0012	0.04	0.04	122.99
Loader - 938G	0.01	0.02	0.10	0.0001	0.01	0.00	10.38
Water Truck - 5,000 Gallons	0.01	0.02	0.08	0.0001	0.00	0.00	9.08
Haul Truck - 20 CY - Asphalt	0.00	0.01	0.10	0.0003	0.00	0.00	26.40
Fugitive Dust	-	-	-	-	0.14	0.01	-
Subtotal	0.09	0.23	1.62	0.0017	0.19	0.05	168.85
Airfield Paving							
Concrete Paver	0.01	0.59	0.00	0.0004	0.00	0.0001	1.92
Concrete Pump Truck, 110' Boom	0.00	0.01	0.03	0.0000	0.00	0.0010	3.41
Concrete Trucks	0.00	0.01	0.11	0.0003	0.00	0.0015	28.86
Concrete Vibrator	0.00	0.08	0.00	0.0001	0.00	0.0000	0.26
Loader	0.00	0.00	0.01	0.0000	0.00	0.0003	1.00
Water Truck - 5,000 Gallons	0.00	0.00	0.01	0.0000	0.00	0.0006	1.29
Supply Truck	0.00	0.00	0.00	0.0000	0.00	0.0000	0.24
Fugitive Dust	-	-	-	-	0.02	0.0020	-
Subtotal	0.01	0.69	0.16	0.0008	0.02	0.0055	36.98

**Table C.1-3: Emissions from Construction of the Navy V-22 Action at
NAS North Island – Alternative 1 (continued)**

Equipment Type	Tons						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Vehicle Parking Lot Paving							
Paving Machine	0.0013	0.00	0.02	0.00002	0.00	0.0007	2.32
Water Truck - 5,000 Gallons	0.0019	0.00	0.02	0.00003	0.00	0.0012	2.58
Compactive Roller	0.0028	0.01	0.03	0.00004	0.00	0.0017	3.81
Grader	0.0007	0.00	0.01	0.00001	0.00	0.0004	1.25
Loader	0.0017	0.00	0.03	0.00003	0.00	0.0009	2.99
Backhoe	0.0008	0.00	0.01	0.00001	0.00	0.0005	1.11
Bulldozer - D6	0.0006	0.00	0.01	0.00001	0.00	0.0003	0.76
Haul Truck - Paving	0.0004	0.00	0.01	0.00003	0.00	0.0001	2.72
Haul Truck - Base	0.0003	0.00	0.01	0.00002	0.00	0.0001	2.06
Semi Truck	0.0000	0.00	0.00	0.00000	0.00	0.0000	0.32
Fugitive Dust	-	-	-	-	0.04	0.0040	-
Subtotal	0.0105	0.01	0.15	0.00020	0.04	0.0099	19.92
Re-Stripe Airfield							
Air Compressor - 100 CFM	0.0017	0.0029	0.0092	0.0000	0.0007	0.0007	1.07
Concrete/Industrial Saw	0.0004	0.0023	0.0044	0.0000	0.0003	0.0003	0.51
Forklift	0.0003	0.0017	0.0032	0.0000	0.0002	0.0002	0.37
Supply Trucks	0.0000	0.0001	0.0006	0.0000	0.0000	0.0000	0.16
Fugitive Dust	-	-	-	-	0.0054	0.0005	-
Subtotal	0.0024	0.0070	0.0174	0.0000	0.0066	0.0017	2.11
Aircraft Wash Rack							
Air Compressor - 100 CFM	0.0008	0.0014	0.0045	0.0000	0.0004	0.0003	0.52
Concrete/Industrial Saw	0.0005	0.0030	0.0057	0.0000	0.0004	0.0004	0.65
Crane	0.0002	0.0004	0.0026	0.0000	0.0001	0.0001	0.31
Forklift	0.0002	0.0011	0.0021	0.0000	0.0002	0.0001	0.24
Generator	0.0007	0.0013	0.0040	0.0000	0.0003	0.0003	0.46
Concrete Trucks	0.0000	0.0001	0.0005	0.0000	0.0000	0.0000	0.12
Supply Trucks	0.0000	0.0001	0.0009	0.0000	0.0000	0.0000	0.23
Fugitive Dust	-	-	-	-	0.0023	0.0002	-
Subtotal	0.0024	0.0074	0.0203	0.0000	0.0037	0.0014	2.53
Total Construction Emissions	0.83	3.70	9.92	0.01	5.76	0.99	1,180.42

CFM = cubic feet per minute; CO = carbon monoxide; CO₂ = carbon dioxide; NO_x = nitrogen oxide; SO₂ = sulfur dioxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; VOC = volatile organic compounds

Table C.1-4: Summary of Total Construction Emissions for the Navy V-22 Action at NAS North Island – Alternative 1

Construction Activity	Tons							CO ₂ e (mt)(1)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
Demolish All Buildings	0.11	0.29	1.61	0.00	0.90	0.15	198	180
Building Construction	0.61	2.48	6.35	0.01	4.59	0.79	752	684
Airfield Demolition	0.09	0.22	1.62	0.00	0.19	0.06	169	154
Airfield Paving	0.01	0.69	0.16	0.00	0.02	0.01	37	34
Vehicle Parking Lot Paving	0.01	0.03	0.15	0.00	0.05	0.01	20	18
Re-Stripe Airfield	0.00	0.01	0.02	0.00	0.01	0.00	2	2
Aircraft Wash Rack	0.00	0.01	0.02	0.00	0.00	0.00	3	2
Total Alternative 1	0.83	3.73	9.93	0.01	5.76	1.02	1,181	1,074

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) CO₂ emissions were used to estimate CO₂e emissions.

Table C.1-5: Summary of Total Construction Emissions for the Navy V-22 Action at NAS North Island – Alternative 2

Construction Activity	Tons							CO ₂ e (mt)(2)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
Demolish All Buildings	0.08	0.21	1.18	0.00	0.66	0.11	145	132
Building Construction	0.46	1.87	4.79	0.01	3.47	0.60	568	517
Airfield Demolition	0.07	0.17	1.26	0.00	0.15	0.05	131	119
Airfield Paving	0.01	0.54	0.13	0.00	0.02	0.00	29	26
Vehicle Parking Lot Paving	0.00	0.01	0.06	0.00	0.02	0.00	7	7
Re-Stripe Airfield	0.00	0.01	0.02	0.00	0.01	0.00	2	2
Aircraft Wash Rack	0.00	0.01	0.02	0.00	0.00	0.00	3	2
Total Alternative 2	0.62	2.82	7.46	0.01	4.33	0.76	885	805

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Alternative 2 construction emissions are equal to Alternative 1 construction emissions, minus emissions due to construction of the FRS Hangar and associated components.

(2) CO₂ emissions were used to estimate CO₂e emissions.

**Table C.1-6: Annual Operations for C-2 and CMV-22B Aircraft –
Navy V-22 Alternatives at NAS North Island**

<i>Alternatives/Operation</i>	<i>Annual Number of Operations (1)</i>	
Existing C-2A Operations		
LTO with Straight In Arrival	758	
LTO with Break at Arrival	-	
Touch and Go (T&G)	2,600	
Ground Controlled Approach Box (GCA Box)	330	
In-Frame Engine Testing - Annual # of Aircraft	10	
<i>Transition Complete - CMV-22B Operations</i>	<i>Alternative 1</i>	<i>Alternative 2</i>
Vertical Takeoff (Conversion mode)	582	402
Vertical Landing (Conversion mode)	2,531	1,746
Short Takeoff (Airplane mode)	1,949	1,344
Short Landing (Airplane mode)	-	-
Landing w/Break (Airplane mode)	-	-
T&G	10,003	6,159
GCA Box	899	627
In-Frame Engine Testing - Annual # of Aircraft	23	18

LTO = Landing and Take-off

Notes: (1) Data are from EA Tables 2.3-4 and 2.3-9. However, the data in the EA tables are rounded to the nearest 100, so the number of operations in Table C.1-6 do not exactly match the numbers in the referenced tables.

Table C.1-7: Emissions and Fuel Usage for One C-2A and CMV-22B Aircraft Operation – Navy V-22 Action Alternatives

Operation	Fuel Usage (Pounds)	Emissions (Pounds)								
		THC	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	Source
C-2A										
LTO with Straight In Arrival	1,196	0.53	0.71	3.89	11.21	1.57	1.16	1.16	3,887	(1)
LTO with Break at Arrival	1,320	0.56	0.75	4.08	12.77	1.73	1.23	1.23	4,292	(1)
Touch and Go (T&G)	325	0.10	0.13	0.70	3.55	0.43	0.26	0.26	1,057	(2)
Ground Controlled Approach Box (GCA Box)	490	0.16	0.21	1.09	5.26	0.64	0.41	0.41	1,592	(2)
Annual In-Frame Engine Testing - One C-2A	82,885	37.14	49.54	273.98	746.65	108.58	78.84	78.84	269,075	(1)
CMV-22B										
Vertical Takeoff (Conversion mode)	801	0.03	0.04	2.45	6.79	1.05	1.12	1.12	2,579	(3)
Vertical Landing (Conversion mode)	601	0.04	0.05	2.96	3.87	0.79	0.78	0.78	1,935	(3)
Short Takeoff (Airplane mode)	688	0.03	0.04	2.37	5.38	0.90	0.94	0.94	2,216	(3)
Short Landing (Airplane mode)	601	0.04	0.05	2.96	3.87	0.79	0.78	0.78	1,935	(3)
Landing w/Break (Airplane mode)	776	0.04	0.05	3.07	6.13	1.02	1.05	1.05	2,499	(3)
T&G	280	0.00	0.00	0.19	3.57	0.37	0.44	0.44	899	(4)
GCA Box	400	0.00	0.01	0.26	5.20	0.52	0.63	0.63	1,283	(4)
Annual In-Frame Engine Testing - One CMV-22B	163,640	18.44	24.60	742.12	1,089.72	214.37	111.21	111.21	528,300	(3)

CO = carbon monoxide; CO₂ = carbon dioxide; GCA = ground controlled approach; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; T&G = touch and go; THC = total hydrocarbons; VOC = volatile organic compounds

Notes: (1) Source: Aircraft Emission Estimates: C-2A Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5. Aircraft Environmental Support Office (AESO) – Fleet Readiness Center Southwest Memorandum Report No. 9919 Revision D (AESO, 2015). However SO₂ emission factor of 1.31 pounds/1,000 pounds JP-5 fuel from Sulfur Dioxide Emissions Index, AESO Memorandum Report No. 2012-01E (AESO, 2017). THC to VOC conversion factor obtained from AESO, 2016.

(2) Source: Aircraft Emission Estimates: C-2A Mission Operations Using JP-5. AESO Memorandum Report No. 9936 Revision D (AESO, 2015).

(3) Source: Aircraft Emission Estimates: V-22 Landing and Takeoff Cycle, Cruise Time, and In-Frame Engine Maintenance Testing Using JP-5. AESO Memorandum Report No. 9946 Revision G (AESO, 2016).

(4) Source: Aircraft Emission Estimates: V-22 Mission Operations Using JP-5. AESO Memorandum Report No. 9965 Revision C (AESO, 2015).

**Table C.1-8: Annual Emissions for C-2A and CMV-22B Aircraft Operations at
NAS North Island – Navy V-22 Action Alternative 1**

Operation	Annual Emissions (Tons)						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Existing C-2A Operations							
LTO with Straight In Arrival	0.27	1.47	4.25	0.59	0.44	0.44	1,473
LTO with Break at Arrival	-	-	-	-	-	-	-
T&G	0.17	0.91	4.62	0.55	0.34	0.34	1,374
GCA Box	0.04	0.18	0.87	0.11	0.07	0.07	263
Subtotal - C-2A Flight Operations	0.48	2.56	9.73	1.25	0.85	0.85	3,109
In-Frame Engine Testing	0.25	1.37	3.73	0.54	0.39	0.39	1,345
Total Emissions - Existing C-2A	0.73	3.93	13.46	1.79	1.24	1.24	4,454
Transition Complete - CMV-22B Operations							
Vertical Takeoff (Conversion mode)	0.01	0.71	1.98	0.31	0.33	0.33	751
Vertical Landing (Conversion mode)	0.07	3.75	4.90	1.00	0.99	0.99	2,449
Short Takeoff (Airplane mode)	0.04	2.31	5.24	0.88	0.92	0.92	2,159
T&G	0.02	0.95	17.86	1.83	2.20	2.20	4,496
GCA Box	0.00	0.12	2.34	0.24	0.28	0.28	577
Subtotal - CMV-22B Flight Operations	0.14	7.84	32.31	4.25	4.71	4.71	10,432
In-Frame Engine Testing	0.28	8.53	12.53	2.47	1.28	1.28	6,075
Transition Complete Emissions - CMV-22B	0.42	16.37	44.84	6.72	5.99	5.99	16,507

CO = carbon monoxide; CO₂ = carbon dioxide; GCA = ground controlled approach; LTO = landing and take-offs; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; T&G = touch and go; VOC = volatile organic compounds

Table C.1-9: Annual Emissions for C-2A and CMV-22B Aircraft Operations at NAS North Island – Navy V-22 Action Alternative 2

Operation	Annual Emissions (Tons)						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Existing C-2A Operations							
LTO with Straight In Arrival	0.27	1.47	4.25	0.59	0.44	0.44	1,473
LTO with Break at Arrival	-	-	-	-	-	-	-
T&G	0.17	0.91	4.62	0.55	0.34	0.34	1,374
GCA Box	0.04	0.18	0.87	0.11	0.07	0.07	263
Subtotal - C-2A Flight Operations	0.48	2.56	9.73	1.25	0.85	0.85	3,109
In-Frame Engine Testing	0.25	1.37	3.73	0.54	0.39	0.39	1,345
Total Emissions - Existing C-2A	0.72	3.93	13.46	1.80	1.24	1.24	4,455
Transition Complete - CMV-22B Operations							
Vertical Takeoff (Conversion mode)	0.01	0.49	1.36	0.21	0.22	0.22	518
Vertical Landing (Conversion mode)	0.05	2.58	3.38	0.69	0.68	0.68	1,689
Short Takeoff (Airplane mode)	0.03	1.59	3.62	0.61	0.63	0.63	1,490
T&G	0.01	0.59	10.99	1.13	1.35	1.35	2,768
GCA Box	0.00	0.08	1.63	0.16	0.20	0.20	402
Subtotal - CMV-22B Flight Operations	0.10	5.34	20.98	2.80	3.09	3.09	6,867
In-Frame Engine Testing	0.22	6.68	9.81	1.93	1.00	1.00	4,755
Final Basing Emissions - CMV-22B	0.32	12.01	30.79	4.73	4.09	4.09	11,622

CO = carbon monoxide; CO₂ = carbon dioxide; GCA = ground controlled approach; LTO = landing and take-offs; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; T&G = touch and go; VOC = volatile organic compounds

Table C.1-10: Aerospace Ground Support Equipment Usages for Existing C-2A Aircraft at NAS North Island – Navy V-22 Alternatives

Equipment (1)	Hp (2)	Load Factor (3)	Hours per LTO (4)	Hp-Hrs per LTO	Total Annual Hp-Hrs
Air Compressor - MC-1A	20	0.50	1.00	10	7,580
Air Conditioner - MA-3D	110	0.75	2.00	165	125,070
Generator Set - A/M32A-86D	148	0.82	3.00	364	275,973
Heater - H1	7	0.50	2.00	7	4,927
Hydraulic Test Stand - MJ-2/TTU-228	130	0.50	1.00	65	49,270
Light Cart - NF-2	18	0.50	2.25	20	15,350
Start Cart - A/M32A-95	155	0.90	0.50	70	52,871

LTO = landing and take-offs; Hp = horsepower; Hp-hrs = horsepower hours

Notes: (1) Equipment list equates to those identified as Generic 4 group of aircraft in Table 3-3 of Air Emissions Guide for Air Force Mobile Sources (AFCEC, 2016), except Generic group 1 for the light cart.

(2) From Table 3-4 in AFCEC, 2016.

(3) From Table 3-6 in AFCEC, 2016.

(4) From Table 3-3 in AFCEC, 2014.

Table C.1-11: Nonroad Diesel Emission Factors for Navy V-22 Action Alternatives at NAS North Island

HP Category	Emission Factors (Grams/Horsepower) (1)						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Baseline Year 2016							
Nonroad Equipment - 6-11 Hp	0.62	4.54	4.32	0.004	0.36	0.35	594
Nonroad Equipment - 12-16 Hp	0.50	2.39	4.46	0.004	0.35	0.34	595
Nonroad Equipment - 17-25 Hp	0.50	2.39	4.46	0.004	0.35	0.34	595
Nonroad Equipment - 26-40 Hp	0.21	0.81	3.64	0.003	0.12	0.12	596
Nonroad Equipment - 41-50 Hp	0.21	0.81	3.64	0.003	0.12	0.12	596
Nonroad Equipment - 51-75 Hp	0.26	2.06	3.45	0.004	0.22	0.22	595
Nonroad Equipment - 76-100 Hp	0.26	2.27	2.43	0.003	0.29	0.28	595
Nonroad Equipment - 101-175 Hp	0.22	0.84	2.04	0.003	0.19	0.19	536
Nonroad Equipment - 176-300 Hp	0.20	0.63	1.86	0.003	0.12	0.12	536
Transition Complete Year 2025							
Nonroad Equipment - 7-11 Hp	0.62	4.49	4.32	0.004	0.36	0.35	594
Nonroad Equipment - 12-16 Hp	0.50	2.36	4.46	0.004	0.36	0.35	595
Nonroad Equipment - 17-25 Hp	0.50	2.36	4.46	0.004	0.36	0.35	595
Nonroad Equipment - 26-40 Hp	0.15	0.25	3.01	0.003	0.02	0.02	596
Nonroad Equipment - 41-50 Hp	0.15	0.25	3.01	0.003	0.02	0.02	596
Nonroad Equipment - 51-75 Hp	0.15	0.54	3.03	0.003	0.04	0.04	596
Nonroad Equipment - 76-100 Hp	0.16	0.56	0.47	0.003	0.04	0.03	596
Nonroad Equipment - 101-175 Hp	0.16	0.20	0.44	0.003	0.03	0.03	536
Nonroad Equipment - 176-300 Hp	0.16	0.16	0.42	0.003	0.02	0.02	536

CO = carbon monoxide; CO₂ = carbon dioxide; Hp = horsepower; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Criteria pollutant factors estimated with the use of the EPA NONROAD2008a model for US national average.

Table C.1-12: Annual Air Emissions from Aerospace Ground Support Equipment Usages by Existing C-2A Aircraft at NAS North Island – Navy V-22 Alternatives

Equipment	Annual Emissions (Tons)							
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	CO ₂ e (mt)(1)
Air Compressor - MC-1A	0.00	0.02	0.04	0.0000	0.00	0.00	4.97	4.52
Air Conditioner - MA-3D	0.03	0.12	0.28	0.0004	0.03	0.03	73.92	67.20
Generator Set - A/M32A-86D	0.07	0.26	0.62	0.0010	0.06	0.06	163.12	148.29
Heater - H1	0.00	0.02	0.02	0.0000	0.00	0.00	3.23	2.93
Hydraulic Test Stand - MJ-2/TTU-228	0.01	0.05	0.11	0.0002	0.01	0.01	29.12	26.47
Light Cart - NF-2	0.01	0.04	0.08	0.0001	0.01	0.01	10.06	9.15
Start Cart - A/M32A-95	0.01	0.05	0.12	0.0002	0.01	0.01	31.25	28.41
Total - Year 2016	0.13	0.56	1.27	0.0019	0.12	0.12	315.67	286.97

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; HP = horsepower; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) CO₂ emissions were used to estimate CO₂e emissions.

Table C.1-13: Aerospace Ground Support Equipment Usages for CMV-22 Aircraft – Navy V-22 Alternatives at NAS North Island

Equipment (1)	Hp (2)	Load Factor (3)	Hours per LTO (4)	Hp-Hrs per LTO	Total Annual Hp-Hrs	
					Alternative 1	Alternative 2
Air Compressor - MC-1A	20	0.50	5.25	53	132,878	91,665
Air Conditioner - MA-3D	110	0.75	1.00	83	208,808	144,045
Generator Set - A/M32A-86D	148	0.82	7.50	910	2,303,716	1,589,209
Heater - H1	7	0.50	1.00	3	8,226	5,675
Hydraulic Test Stand - MJ-2A	195	0.50	3.00	293	740,318	510,705
Light Cart - NF-2	18	0.50	6.00	54	136,674	94,284
Start Cart - A/M32A-95	155	0.90	0.25	35	88,269	60,892

Hp = horsepower; Hp-hrs = horsepower hours; LTO = landing and take-offs

Notes: (1) Equipment list equates to those identified as Generic 4 group of aircraft in Table 3-3 of Air Emissions Guide for Air Force Mobile Sources (AFCEC, 2016), except Generic group 1 for the light cart.

(2) From Table 3-4 in AFCEC, 2016.

(3) From Table 3-6 in AFCEC, 2016.

(4) From Table 3-3 in AFCEC, 2014.

Table C.1-14: Annual Air Emissions from Aerospace Ground Support Equipment Usages by CMV-22 Aircraft – Navy V-22 Alternatives at NAS North Island

Equipment	Annual Emissions (Tons)							CO ₂ e (mt)/(1)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
Alternative 1								
Air Compressor - MC-1A	0.07	0.35	0.65	0.0006	0.05	0.05	87	79
Air Conditioner - MA-3D	0.04	0.05	0.10	0.0006	0.01	0.01	123	112
Generator Set - A/M32A-86D	0.40	0.51	1.11	0.0067	0.07	0.07	1,362	1,238
Heater - H1	0.01	0.04	0.04	0.0000	0.00	0.00	5	5
Hydraulic Test Stand - MJ-2A	0.13	0.16	0.36	0.0021	0.02	0.02	438	398
Light Cart - NF-2	0.07	0.36	0.67	0.0006	0.05	0.05	90	81
Start Cart - A/M32A-95	0.02	0.02	0.04	0.0003	0.00	0.00	52	47
Total - Alternative 1	0.74	1.49	2.97	0.0109	0.20	0.20	2,157	1,960
Alternative 2								
Air Compressor - MC-1A	0.05	0.24	0.45	0.0004	0.04	0.03	60	55
Air Conditioner - MA-3D	0.03	0.03	0.07	0.0004	0.00	0.00	85	77
Generator Set - A/M32A-86D	0.28	0.35	0.76	0.0046	0.05	0.05	940	854
Heater - H1	0.00	0.03	0.03	0.0000	0.00	0.00	4	3
Hydraulic Test Stand - MJ-2A	0.09	0.11	0.25	0.0015	0.02	0.02	302	275
Light Cart - NF-2	0.05	0.25	0.46	0.0004	0.04	0.04	62	56
Start Cart - A/M32A-95	0.01	0.01	0.03	0.0002	0.00	0.00	36	33
Total - Alternative 2	0.51	1.02	2.05	0.0075	0.15	0.14	1,489	1,353

AGE = air ground support equipment; CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; Hp = horsepower; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) CO₂ emissions were used to estimate CO₂e emissions.

**Table C.1-15: Annual On-Road Vehicle Mileages for Travel On Base
NAS North Island – Navy V-22 Action Alternatives**

<i>Scenario/Personnel</i>	<i># of Personnel (1)</i>	<i>Vehicle Trips per Day</i>	<i>On Base Miles per Trip</i>	<i>Days per Year (2)</i>	<i>On Base Miles per year</i>
Existing VRC-30 C-2A Detachment					
Total Staff	390	390	1.5	220	128,700
Alternative 1					
Total Staff	731	731	1.5	220	241,230
Alternative 2					
Total Staff	551	551	1.5	220	181,830

Notes: (1) # of Personnel from EA Tables 2.3-3 and 2.3-8.

(2) Source: Helicopter Wings Realignment and MH-60R/S Helicopter Transition Naval Base Coronado, California FEA, Appendix A (Navy, 2011).

**Table C.1-16: On-Road Emissions Factors for Travel On Base
NAS North Island – Navy V-22 Action Alternatives**

<i>Source Type</i>	<i>Emission Factors (Grams/Mile) (1)</i>						
	<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>
Year 2016 - Existing Conditions							
LDA - 25 mph	0.04	1.31	0.12	0.002	0.002	0.002	378
LDT2 - 25 mph	0.04	1.59	0.17	0.003	0.002	0.002	511
Composite (2)	0.04	1.38	0.13	0.003	0.002	0.002	411
Year 2025 - First Year of Transition Complete							
LDA - 25 mph	0.02	0.75	0.07	0.002	0.003	0.002	287
LDT2 - 25 mph	0.02	0.77	0.06	0.003	0.003	0.002	378
Composite (2)	0.02	0.76	0.06	0.003	0.003	0.002	310

CO = carbon monoxide; CO₂ = carbon dioxide; mph = miles per hour; LDA = light-duty auto; LDT2 = light-duty truck2; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Estimated with the use of the ARB EMFAC2014 model and based on default parameters for San Diego County for project years 2016 and 2025 (ARB, 2014).

(2) Equal to 75/25% LDA/LDT2.

**Table C.1-17: Annual Emissions for On-Road Vehicles for Travel On Base
NAS North Island- Navy V-22 Action Alternatives**

<i>Scenario</i>	<i>Tons per Year</i>						
	<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>
Existing C-2A Detachment	0.01	0.20	0.02	0.0004	0.0003	0.0003	58
Alternative 1	0.01	0.20	0.02	0.001	0.001	0.001	82
Alternative 2	0.004	0.15	0.01	0.001	0.001	0.0005	62

CO = carbon monoxide; CO₂ = carbon dioxide; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

**Table C.1-18: Annual On-Road Vehicle Mileages for Travel Off Base
NAS North Island – Navy V-22 Action Alternatives**

Scenario/Personnel	# of Personnel (1)	Vehicle Trips per Day	Off Base Miles per Trip (2)	Days per Year (2)	Off Base Miles per year
Existing VRC-30 C-2A Detachment					
Total Staff	390	390	11.2	220	960,960
Alternative 1					
Total Staff	731	731	11.2	220	1,801,184
Alternative 2					
Total Staff	551	551	11.2	220	1,357,664

Notes: (1) # of Personnel from EA Tables 2.3-3 and 2.3-8.

(2) Source Helicopter Wings Realignment and MH-60R/S Helicopter Transition Naval Base Coronado, California FEA, Appendix A (Navy, 2011).

**Table C.1-19: On-Road Emission Factors for Travel Off Base
NAS North Island – Navy V-22 Action Alternatives**

Source Type	Emission Factors (Grams/Mile) (1)						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Year 2016 - Existing Conditions							
LDA - 25 mph	0.04	1.31	0.12	0.002	0.002	0.002	378
LDA - 55 mph	0.02	0.86	0.10	0.002	0.001	0.001	269
LDT2 - 25 mph	0.04	1.59	0.17	0.003	0.002	0.002	511
LDT2 - 55 mph	0.02	1.04	0.14	0.003	0.001	0.001	363
Composite (2)	0.03	1.05	0.12	0.002	0.001	0.001	335
Year 2025 - First Year of Transition Complete							
LDA - 25 mph	0.02	0.75	0.07	0.002	0.003	0.002	287
LDA - 55 mph	0.01	0.48	0.05	0.002	0.001	0.001	204
LDT2 - 25 mph	0.02	0.77	0.06	0.003	0.003	0.002	378
LDT2 - 55 mph	0.01	0.49	0.05	0.003	0.001	0.001	269
Composite (2)	0.01	0.55	0.05	0.002	0.002	0.001	251

CO = carbon monoxide; CO₂ = carbon dioxide; mph = miles per hour; LDA = light-duty auto; LDT2 = light-duty truck2; mph = miles per hour; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Estimated with the use of the ARB EMFAC2014 model and based on default parameters for San Diego County for project years 2016 and 2025 (ARB, 2014).

(2) Equal to 75/25% LDA/LDT2.

**Table C.1-20: Annual Emissions for On-Road Vehicles for Travel Off Base
NAS North Island – Navy V-22 Action Alternatives**

Scenario	Tons per Year						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Existing C-2A Detachment	0.03	1.11	0.13	0.002	0.002	0.001	355
Alternative 1	0.02	1.10	0.11	0.005	0.003	0.003	499
Alternative 2	0.02	0.83	0.08	0.003	0.002	0.002	376

CO = carbon monoxide; CO₂ = carbon dioxide; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Table C.1-21: Annual Emissions for the Existing VRC-30 C-2A Detachment at NAS North Island – Navy V-22 Action Alternatives

Source Type	Tons per Year							CO ₂ e (mt)(1)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
C-2A Aircraft Operations	0.48	2.56	9.73	1.25	0.85	0.85	3,109	2,827
In-Frame Aircraft Engine Testing - C-2A	0.25	1.37	3.73	0.54	0.39	0.39	1,345	1,223
Aerospace Ground Support Equipment	0.14	0.55	1.27	0.002	0.12	0.11	316	287
Privately-Owned Vehicles - On Base	0.01	0.20	0.02	0.0004	0.0003	0.0003	58	53
Privately-Owned Vehicles - Off Base	0.03	1.11	0.13	0.002	0.002	0.001	355	322
Existing C-2A Emissions	0.91	5.79	14.88	1.80	1.36	1.36	5,183	4,712

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) CO₂ emissions were used to estimate CO₂e emissions.

Table C.1-22: Annual Emissions from the Navy V-22 Alternatives at NAS North Island – Alternative 1

Source Type	Tons per Year							CO ₂ e (mt)(2)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
CMV-22B Aircraft Operations	0.14	7.84	32.31	4.25	4.71	4.71	10,432	9,483
In-Frame Aircraft Engine Testing - CMV-22B	0.28	8.53	12.53	2.47	1.28	1.28	6,075	5,523
Aerospace Ground Support Equipment	0.74	1.49	2.97	0.01	0.20	0.20	2,158	1,960
Privately-Owned Vehicles - On Base	0.01	0.20	0.02	0.001	0.001	0.001	82	75
Privately-Owned Vehicles - Off Base	0.02	1.10	0.11	0.005	0.003	0.003	499	454
Total Annual Emissions - Alternative 1	1.19	19.16	47.94	6.74	6.19	6.19	19,246	17,495
Baseline C-2A Emissions	0.91	5.79	14.88	1.80	1.36	1.36	5,183	4,712
Net Emissions Change - Alternative 1 (1)	0.28	13.37	33.06	4.94	4.83	4.83	14,063	12,783
Conformity Thresholds	100	100	100	NA	NA	NA	NA	NA
PSD Threshold	NA	NA	NA	250	250	250	NA	NA
Exceed Threshold?	No	No	No	No	No	No	NA	NA

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; PSD = Prevention of Significant Deterioration; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Equal to CMV-22B Basing Alternative Emissions minus Existing C-2A Emissions.

(2) CO₂ emissions were used to estimate CO₂e emissions.

**Table C.1-23: Annual Emissions from the Navy V-22 Alternatives at
NAS North Island – Alternative 2**

Source Type	Tons per Year							CO ₂ e (mt)(2)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
CMV-22B Aircraft Operations	0.10	5.34	20.98	2.80	3.09	3.09	6,867	6,243
In-Frame Aircraft Engine Testing - CMV-22B	0.22	6.68	9.81	1.93	1.00	1.00	4,755	4,322
Aerospace Ground Support Equipment	0.51	1.02	2.05	0.01	0.15	0.14	1,489	1,353
Privately-Owned Vehicles - On Base	0.004	0.15	0.01	0.001	0.001	0.0005	62	56
Privately-Owned Vehicles - Off Base	0.02	0.83	0.08	0.003	0.002	0.002	376	342
Total Annual Emissions - Alternative 2	0.85	14.02	32.93	4.74	4.24	4.23	13,549	12,316
Baseline C-2A Emissions	0.91	5.79	14.88	1.80	1.36	1.36	5,183	4,712
Net Emissions Change - Alternative 2 (1)	(0.06)	8.23	18.05	2.94	2.88	2.87	8,366	7,604
Conformity Thresholds	100	100	100	NA	NA	NA	NA	NA
PSD Threshold	NA	NA	NA	250	250	250	NA	NA
Exceed Threshold?	No	No	No	No	No	No	NA	NA

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NA = not applicable; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; PSD = Prevention of Significant Deterioration; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Equal to CMV-22B Basing Alternative Emissions minus Existing C-2A Emissions.

(2) CO₂ emissions were used to estimate CO₂e emissions.

C.1.1

**RECORD OF NON-APPLICABILITY (RONA) FOR
CLEAN AIR ACT CONFORMITY
NAS NORTH ISLAND
TRANSITION FROM C-2A TO NAVY V-22 AIRCRAFT
AT FLEET LOGISTICS CENTERS**

The Proposed Action falls under the Record of Non-Applicability (RONA) category and is documented with this RONA.

Introduction

The U.S. Environmental Protection Agency (EPA) published *Determining Conformity of General Federal Actions to State or Federal Implementation Plans*; Final Rule, in the 30 November 1993 Federal Register (FR) (40 Code of Federal Regulations [CFR] §§ 6, 51, and 93). On 5 April 2010, the EPA finalized revisions to the General Conformity Rule (75 FR 17253–17279). The U.S. Department of the Navy (Navy) published Navy Guidance for Compliance with the Clean Air Act (CAA) General Conformity Rule (30 July 2013), as referenced in Chief of Naval Operations Instruction 5090.1D, Environmental Readiness Program Manual dated 10 January 2014. These publications provide implementing guidance to document CAA Conformity Determination requirements. This RONA is provided to document compliance of the Proposed Action.

Federal regulations state that “no department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity that does not conform to an applicable State Implementation Plan (SIP).” It is the responsibility of the federal agency to determine whether a federal action conforms to the applicable SIP before the action is taken (40 CFR § 51.850[a]).

Federal actions may be exempt from conformity determinations if their emissions do not exceed designated *de minimis* levels for the criteria pollutants of nonattainment or maintenance in the areas of the federal action (40 CFR § 51.853[b]). The applicable *de minimis* levels (in tons/year) for the San Diego Air Basin (SDAB), which encompasses the region affected by the Proposed Action, are listed in Table 1.

Table 1: Applicable *de minimis* Levels of Nonattainment and Maintenance Criteria Pollutants for the SDAB

Criteria Pollutant/Precursor	<i>de minimis</i> levels (tons/year)
Carbon Monoxide (CO)	100 ⁽¹⁾
Ozone (O ₃) - Oxides of Nitrogen (NO _x)	100 ⁽²⁾
Ozone (O ₃)- Volatile Organic Compounds (VOCs)	100 ⁽²⁾

Source: 40 CFR § 93; Navy, 2014.

Notes: (1) Attainment/Maintenance Area for CO.

(2) Moderate nonattainment area for 8-hour ozone precursors: oxides of nitrogen and volatile organic compounds.

Proposed Action

Action Proponent: Commander, U.S. Fleet Forces Command

Location: Naval Air Station (NAS) North Island, California
C-20

Proposed Action Name: Transition from C-2A to CMV-22B Aircraft at Fleet Logistics Centers

Proposed Action and Emissions Summary:

The Proposed Action would replace the current C-2A Greyhound with the new CMV-22B Osprey (herein referred as the Navy V-22) at existing logistics support centers, NAS North Island, California (CA) and Naval Station (NS) Norfolk, Virginia. The region that encompasses the NS Norfolk project attains all National Ambient Air Quality Standards (NAAQS); therefore, Proposed Action activities within this region are not subject to this RONA. At NAS North Island, the Navy would replace 10 legacy C-2A aircraft operated by the existing logistics support squadron with 23 Navy V-22 aircraft operated by fleet logistics support multi-mission squadrons; establish a Navy V-22 training squadron to train pilots and aircrewmembers; establish a maintenance school for maintenance personnel; construct, renovate, and maintain facilities to accommodate Navy V-22 squadron aircraft and personnel; make adjustments to personnel levels (increases or decreases) associated with the Navy V-22 training squadron and maintenance school; and conduct Navy V-22 flight training operations.

The Proposed Action at NAS North Island would be implemented over a 10-year period beginning in 2018 with facility renovations and some personnel actions at NAS North Island. The Navy would begin to transition the C-2A to the Navy V-22 in 2021 as the first aircraft arrive. The C-2A aircraft would gradually be replaced by the Navy V-22 until the transition is complete in 2025. The Navy V-22 would also train at secondary airfields at Naval Auxiliary Field El Centro, CA; Marine Corps Air Station Miramar, CA; Marine Corps Air Station Camp Pendleton, CA; Navy Auxiliary Landing Field San Clemente, CA; Marine Corps Outlying Landing Field Camp Pendleton, CA; and Marine Corps Air Station Yuma, Arizona. Navy V-22 operations would represent small percentage of operations at these airfields. Existing airfield operations, including those of fixed-wing jet and rotary-wing aircraft, at the secondary airfields where most of the Navy V-22 training operations are proposed have been evaluated in previous National Environmental Policy Act (NEPA) documents and RONAs, and therefore are not subject to this RONA.

Activities associated with proposed construction and renovation activities would include (1) demolishing buildings, (2) constructing operational hangars, (3) renovating aircraft parking aprons, (4) re-striping parking apron, and (5) constructing an aircraft wash rack. The analysis of proposed operations is based on the net change in emissions that would occur from replacing existing C-2A activities with the proposed Navy V-22 activities. Sources associated with operation of the existing C-2A and proposed Navy V-22 missions at NAS North Island include (1) C-2A and Navy V-22 aircraft operations and in-frame engine maintenance/testing, (2) aerospace ground support equipment, and (3) on-site and off-site commuting of privately owned vehicles (POVs).

Proposed construction emissions were evaluated using emission factors and calculation methodologies developed by the California Air Resources Board (ARB), including the EMFAC2014 model for on-road vehicles (ARB, 2014) and the ARB OFFROAD2011 emissions model for off-road equipment (ARB, 2011). Construction activity data associated with the Proposed Action were used to estimate project emissions.

Emissions from existing C-2A and proposed Navy V-22 aircraft activities were based on data developed for the project noise analyses and special studies on aircraft operations (Navy Aircraft Environmental Support Office, 2015a, 2015b, 2015c, and 2016).

Emissions from non-aircraft sources generated by proposed activities were estimated by the following methods:

- Emissions for the use of aerospace ground equipment by existing and proposed aircraft were based on usages developed for generic aircraft groups by the U.S. Air Force (AFCEC, 2016) and emission factors obtained from the MOVES2014a emissions model (USEPA, 2015).
- Emissions from POVs were based on the number of personnel for the existing C-2A and proposed Navy V-22 detachments and vehicle trip generation rates developed by the project traffic analysis. On- and off-site miles driven per vehicle trip were obtained from recent NEPA documents for NAS North Island (Navy – U.S. Fleet Forces Command, 2011). The analysis obtained emission factors from the EMFAC2014 emissions model to estimate on-road vehicle emissions (ARB, 2014).

Based on the air quality analysis for the Proposed Action in the project's NEPA document (currently identified as Alternative 1, which has the highest emissions of any project alternative), the maximum estimated emissions of applicable pollutants would be below the conformity *de minimis* levels for the SDAB (Navy, 2017). Therefore, emissions from the Proposed Action would show conformity under the CAA. The estimated annual conformity emissions for construction in 2018 and operations in 2025 and applicable conformity *de minimis* levels for the Proposed Action are shown in Table 2.

Table 2: Estimated Annual Air Pollutant Emissions of the Proposed Action within the SDAB

Calendar year	Air Pollutant Emissions (tons/year)		
	VOCs	CO	NO _x
Maximum Construction 2018	0.83	3.73	9.93
Maximum Operation Net Increase 2025	0.28	13.37	33.06
General Conformity Thresholds	100	100	100
Exceed thresholds each year?	No	No	No

Source: 40 CFR § 93

CO = carbon monoxide; NO_x = nitrogen oxide; VOCs = volatile organic compounds

Affected Air Basin: San Diego Air Basin

Date RONA Prepared: 4 August 2017

RONA Prepared by: Leidos Corporation

Proposed Action Exemption(s)

The Proposed Action is exempt from General Conformity Rule Requirements, based on the determination that emissions associated with the Proposed Action at NAS North Island are below all *de minimis* thresholds.

Attainment Area Status and Emissions Evaluation Conclusion

The Proposed Action would occur within the SDAB, which is the same geographic area as San Diego County. The EPA classifies the SDAB as a moderate nonattainment for the ozone (O₃) NAAQS. The SDAB is also a maintenance area for the carbon monoxide (CO) NAAQS. The SDAB is in attainment of the NAAQS for all other criteria pollutants. Therefore, only project emissions of O₃ (or its precursors, volatile organic compounds [VOCs] and oxides of nitrogen [NO_x]) and CO were analyzed in reference for conformity rule applicability. The annual *de minimis* threshold levels for this region are 100 tons of VOC, CO, and NO_x. The Navy concludes that the conformity *de minimis* levels for applicable criteria pollutants would not be exceeded as a result of implementing the Proposed Action. Therefore, the Proposed

Action is exempt from a formal conformity determination. The Navy concludes that further formal Conformity Determination procedures are not required, resulting in this RONA.

RONA Approval

Signature: 

Name/Rank: Christopher L. Stathos Date: 27 Mar 18

Position: NRSW Deputy REC / Fleet Environmental Coordinator

REFERENCES

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- Navy – U.S. Fleet Forces Command. 2011. Final Environmental Assessment for the Helicopter Wings Realignment and MH-60R/S Helicopter Transition Naval Base Coronado, California.

C.2 East Coast Fleet Logistics Center Air Emissions Calculations

Table C.2-1: Emission Source Data for Construction of the Navy V-22 Action at NS Norfolk – Alternative 1

<i>Equipment Type</i>	<i>Hp Rating</i>	<i>Ave. Daily Load Factor</i>	<i>Number Active</i>	<i>Hourly Hp-Hrs</i>	<i>Hours/Day</i>	<i>Daily Hp-Hrs</i>	<i>Work Days</i>	<i>Total Hp-Hrs</i>
<i>Operational Squadron Hangar</i>								
Air Compressor - 100 CFM	50	0.60	2	60	6	360	219	78,975
Concrete/Industrial Saw	84	0.73	2	123	6	736	219	161,425
Crane	190	0.30	2	114	6	684	219	150,053
Forklift	94	0.48	2	89	6	536	219	117,541
Generator	45	0.60	2	54	8	432	219	94,770
Concrete Trucks (1)	NA	NA	15	NA	14	210	20	4,188
Supply Trucks (1)	NA	NA	20	NA	10	200	33	6,648
Fugitive Dust (3)	NA	NA	1.5	NA	8	NA	106	159
<i>Expand Taxiway</i>								
Concrete Paver	25	0.54	2.0	27	6	162	2	324
Concrete Pump Truck, 110' Boom	285	0.41	1.0	117	5	584	2	1,169
Concrete Trucks (2)	NA	NA	15.0	NA	27	401	2	802
Concrete Vibrator	8	0.54	1.0	4	5	22	2	43
Grader	180	0.50	1.0	90	6	540	1	540
Loader	215	0.50	1.0	108	2	215	3	645
Vibratory Compactor - CB 355D	105	0.75	2.0	158	6	945	1	945
Water Truck - 5,000 Gallons	175	0.40	1.0	70	4	280	3	840
Haul Truck - Debris (2)	NA	NA	10.0	NA	5	50	3	150
Supply Trucks (2)	NA	NA	10.0	NA	2	20	3	60
<i>Treat Parking Aprons</i>								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	3.0	540
Forklift	94	0.48	1	45	2	89	3.0	268
Generator	45	0.60	1	27	6	162	3.0	486
Supply Trucks (2)	NA	NA	20	NA	2	40	3.0	120
Fugitive Dust (3)	NA	NA	0.10	NA	8	NA	3.0	0.3
<i>Re-Stripe Airfield</i>								
Air Compressor - 100 CFM	50	0.60	1	30	8	240	7	1,725
Concrete/Industrial Saw	84	0.73	1	61	2	123	7	882
Forklift	94	0.48	1	45	2	89	7	642
Supply Trucks (2)	NA	NA	20	NA	2	40	2	80
Fugitive Dust (4)	NA	NA	0.2	NA	8	NA	7	1

Table C.2-1: Emission Source Data for Construction of the Navy V-22 Action at NS Norfolk – Alternative 1(continued)

<i>Equipment Type</i>	<i>Hp Rating</i>	<i>Ave. Daily Load Factor</i>	<i>Number Active</i>	<i>Hourly Hp-Hrs</i>	<i>Hours/Day</i>	<i>Daily Hp-Hrs</i>	<i>Work Days</i>	<i>Total Hp-Hrs</i>
Construct CFTD Pad								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	12	2,160
Concrete/Industrial Saw	84	0.73	1	61	4	245	12	2,943
Crane	190	0.30	1	57	2	114	12	1,368
Forklift	94	0.48	1	45	2	89	12	1,072
Generator	45	0.60	1	27	6	162	12	1,944
Concrete Trucks (2)	NA	NA	15	NA	2	30	2	60
Supply Trucks (2)	NA	NA	20	NA	2	40	6	240
Fugitive Dust (3)	NA	NA	0.5	NA	8	NA	12	6

CFM = cubic feet per minute; CFTD = containerize flight training device; Hp-hrs = horsepower hours; NA = not applicable

Notes: (1) Number Active = miles/roundtrip, Hours/Day = daily truck trips, Daily Hp-Hrs = daily miles, and Total Hp-Hrs = total miles.

(2) Total Hp-Hrs = total cubic feet (cf) of demolished buildings.

(3) Number Active is acres disturbed at one time and Total Hp-Hrs is acre-days for the entire activity.

Table C.2-2: Air Emission Factors for Construction of the Navy V-22 Action at NS Norfolk

<i>Source Type</i>	<i>Fuel Type</i>	<i>Emission Factors (Grams/Horsepower-Hour)</i>							<i>References</i>
		<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>	
Nonroad Equipment - 25-39 Hp	D	0.34	1.36	3.73	0.004	0.22	0.21	634	(1)
Nonroad Equipment - 40-49 Hp	D	0.29	1.08	3.62	0.003	0.17	0.16	627	(1)
Nonroad Equipment - 50-74 Hp	D	0.68	3.58	4.34	0.004	0.50	0.49	662	(1)
Nonroad Equipment - 75-99 Hp	D	0.54	3.24	2.81	0.004	0.45	0.44	644	(1)
Nonroad Equipment - 100-174 Hp	D	0.27	0.82	1.73	0.003	0.17	0.17	565	(1)
Nonroad Equipment - 175-299 Hp	D	0.18	0.34	1.13	0.003	0.06	0.06	536	(1)
Nonroad Equipment - 300-599 Hp	D	0.18	0.71	1.84	0.003	0.10	0.10	536	(1)
Nonroad Equipment - 6-25 Hp	G	3.17	321.94	1.01	0.22	0.06	0.06	1,053	(2)
HDDV - Idling (Gms/Hr)	D	0.75	2.34	25.20	0.07	0.003	0.003	10,562	(3)
HDDV - Composite Speeds	D	0.38	1.25	3.13	0.01	0.31	0.15	1,173	(4)
Building Demolition (lbs/1000 cf)	-	-	-	-	-	0.42	0.04	-	(5)
Disturbed Ground - Fugitive Dust	-	-	-	-	-	9.93	0.99	-	(6)

cf = cubic feet; CO = carbon monoxide; CO₂ = carbon dioxide; Gms/Hr = grams per hour; D = diesel; G = gasoline; Hp = horsepower; lbs = pounds; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Data obtained from the AFB OFFROAD2011 Model for San Diego Air Basin Fleet in year 2018 (AFB, 2012). CO factors are from non-road certification data, Table 5 of

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- Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression - Ignition (USEPA, 2010).
- (2) Exhaust Emissions Factors for Nonroad Engine Modeling – Spark-Ignition, Table 5 for 4 stroke equipment and Phase 3 standards (2011) (USEPA, 2010).
 - (3) Estimated with the use of the ARB EMFAC2014 model, version 1.0.7. Based on aggregated model years and annual season high idle emission rates for summer, as presented in the EMFAC2014 Volume III – Technical Documentation Table 3.2-41 (ARB, 2015).
 - (4) Equal to 50/50% 25/55 mph conditions.
 - (5) URBEMIS2007 (Jones & Stokes Ass., 2007)
 - (6) From Table 3-2 for active large-scale earth moving operations (Countess Environmental, 2006). Emissions reduced by 74% from uncontrolled levels to stimulate water application every 2.1 hours and use the best management practices for fugitive dust control (Table 3-7). Converted to units lbs/acre-day of disturbance assuming 22 work days/month.

**Table C.2-3: Total Emissions from Construction of the Navy V-22 Action at
NS Norfolk -Alternative 1**

Equipment Type	Tons						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Operational Squadron Hangar							
Air Compressor - 100 CFM	0.06	0.31	0.38	0.0003	0.04	0.04	57.61
Concrete/Industrial Saw	0.10	0.58	0.50	0.0007	0.08	0.08	114.60
Crane	0.03	0.06	0.19	0.0005	0.01	0.01	88.65
Forklift	0.07	0.42	0.36	0.0005	0.06	0.06	83.45
Generator	0.03	0.11	0.38	0.0004	0.02	0.02	65.55
Concrete Trucks	0.00	0.01	0.02	0.0000	0.00	0.00	5.69
Supply Trucks	0.00	0.01	0.02	0.0001	0.00	0.00	8.92
Fugitive Dust	-	-	-	-	0.79	0.08	-
Subtotal	0.29	1.50	1.85	0.0025	1.00	0.29	424.47
Expand Taxiway							
Concrete Paver	0.0001	0.0005	0.0013	0.00000	0.0001	0.0001	0.23
Concrete Pump Truck, 110' Boom	0.0002	0.0004	0.0015	0.00000	0.0001	0.0001	0.69
Concrete Trucks	0.0003	0.0011	0.0029	0.00001	0.0003	0.0001	1.09
Concrete Vibrator	0.0000	0.0000	0.0001	0.00000	0.0000	0.0000	0.03
Grader	0.0001	0.0002	0.0007	0.00000	0.0000	0.0000	0.32
Loader	0.0001	0.0002	0.0008	0.00000	0.0000	0.0000	0.38
Vibratory Compactor - CB 355D	0.0003	0.0009	0.0018	0.00000	0.0002	0.0002	0.59
Water Truck - 5,000 Gallons	0.0002	0.0003	0.0010	0.00000	0.0001	0.0001	0.50
Haul Truck - Debris	0.0001	0.0002	0.0006	0.00000	0.0001	0.0000	0.21
Supply Trucks	0.0000	0.0001	0.0002	0.00000	0.0000	0.0000	0.08
Fugitive Dust	-	-	-	-	0.0074	0.0007	-
Subtotal	0.0014	0.0039	0.0109	0.00001	0.0083	0.0013	4.12
Treat Parking Aprons							
Air Compressor - 100 CFM	0.0004	0.0021	0.0026	0.000002	0.0003	0.0003	0.39
Forklift	0.0001	0.0002	0.0005	0.000001	0.0001	0.0001	0.17
Generator	0.0002	0.0006	0.0019	0.000002	0.0001	0.0001	0.34
Supply Trucks (2)	0.0001	0.0002	0.0004	0.000001	0.0000	0.0000	0.16
Fugitive Dust (3)	-	-	-	-	0.0015	0.0001	-
Subtotal	0.0008	0.0031	0.0054	0.000006	0.0020	0.0006	1.06

**Table C.2-3: Total Emissions from Construction of the Navy V-22 Action at
NS Norfolk – Alternative 1 (continued)**

Equipment Type	Tons						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Re-Stripe Airfield							
Air Compressor - 100 CFM	0.0013	0.0068	0.0082	0.0000	0.0010	0.0009	1.26
Concrete/Industrial Saw	0.0005	0.0031	0.0027	0.0000	0.0004	0.0004	0.63
Forklift	0.0004	0.0023	0.0020	0.0000	0.0003	0.0003	0.46
Supply Trucks	0.0000	0.0001	0.0003	0.0000	0.0000	0.0000	0.11
Fugitive Dust	-	-	-	-	0.0054	0.0005	-
Subtotal	0.0022	0.0123	0.0132	0.0000	0.0071	0.0021	2.46
Construct CFTD Pad							
Air Compressor - 100 CFM	0.0016	0.0085	0.0103	0.00001	0.0012	0.0012	1.58
Concrete/Industrial Saw	0.0018	0.0105	0.0091	0.00001	0.0015	0.0014	2.09
Crane	0.0003	0.0005	0.0017	0.00000	0.0001	0.0001	0.81
Forklift	0.0006	0.0038	0.0033	0.00000	0.0005	0.0005	0.76
Generator	0.0006	0.0023	0.0078	0.00001	0.0004	0.0003	1.34
Concrete Trucks	0.0000	0.0001	0.0002	0.00000	0.0000	0.0000	0.08
Supply Trucks	0.0001	0.0003	0.0009	0.00000	0.0001	0.0000	0.32
Fugitive Dust	-	-	-	-	0.0298	0.0030	-
Subtotal	0.0050	0.0260	0.0333	0.00003	0.0336	0.0065	6.98
Total Construction Emissions	0.30	1.55	1.93	0.003	1.05	0.30	441.20

CFM = cubic feet per minute; CFTD = containerized flight training device; CO = carbon monoxide; CO₂ = carbon dioxide; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

**Table C.2-4: Summary of Total Construction Emissions for the Navy V-22 Action at
NS Norfolk – Alternative 1**

Construction Activity	Tons							CO ₂ e (mt)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
Operational Squadron Hangar	0.29	1.50	1.85	0.00243	1.00	0.29	424	386
Expand Taxiway	0.00	0.00	0.01	0.00001	0.01	0.00	4	4
Treat Parking Aprons	0.00	0.00	0.01	0.00001	0.00	0.00	1	1
Re-Stripe Airfield	0.00	0.01	0.01	0.00001	0.01	0.00	2	2
Construct CFTD Pad	0.01	0.03	0.03	0.00004	0.03	0.01	7	6
Total Alternative 1	0.30	1.54	1.91	0.00250	1.05	0.30	438	399

CFTD = containerized flight training device; CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Only CO₂ emissions were used to estimate CO₂e emissions.

Table C.2-5: Summary of Total Construction Emissions for the Navy V-22 Action at NS Norfolk – Alternative 2

Construction Activity	Tons							CO ₂ e (mt)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
Squadron Hangars	0.45	2.33	2.88	0.00381	1.57	0.44	664	604
Expand Taxiway	0.00	0.00	0.01	0.00001	0.01	0.00	2	2
Treat Parking Aprons	0.00	0.00	0.01	0.00001	0.00	0.00	1	1
Re-Stripe Airfield	0.00	0.01	0.01	0.00001	0.01	0.00	2	2
Construct CFTD Pad	0.01	0.03	0.03	0.00004	0.03	0.01	7	6
Total Alternative 2	0.46	2.37	2.94	0.00388	1.62	0.45	676	615

CFTD = containerized flight training device; CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Alternative 2 construction emissions equal to Alternative 1 construction emissions, plus emissions due to construction of the LP48 hangar.

(2) Only CO₂ emissions were used to estimate CO₂e emissions.

Table C.2-6: Annual Operations for C-2A and CMV-22B Aircraft – Navy V-22 Action Alternatives at NS Norfolk

Alternatives/Operation	Annual Number of Operations (1)	
Existing C-2A Operations		
LTO with Straight In Arrival	1,179	
LTO with Break at Arrival	-	
Touch and Go (T&G)	4,119	
Ground Controlled Approach Box (GCA Box)	498	
In-Frame Engine Testing - Annual # of Aircraft	17	
Transition Complete - CMV-22B Operations	Alternative 1	Alternative 2
Vertical Takeoff (Conversion mode)	246	414
Vertical Landing (Conversion mode)	1,071	1,802
Short Takeoff (Airplane mode)	825	1,388
Short Landing (Airplane mode)	-	-
Landing w/Break (Airplane mode)	-	-
T&G	4,278	8,121
GCA Box	632	904
In-Frame Engine Testing - Annual # of Aircraft	15	20

LTO = landing and take-offs

Notes: (1) Source: Data are from EA Tables 2.3-4 and 2.3-9. However, the data in the EA tables are rounded to the nearest 100, so the number of operations in Table C.2-6 do not exactly match the numbers in the referenced tables.

Table C.2-7: Emissions and Fuel Usage for One C-2A and CMV-22B Aircraft Operation – Navy V-22 Action Alternatives

Operation	Fuel Usage (Pounds)	Emissions (Pounds)								
		THC	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	Source
C-2A										
LTO with Straight In Arrival	1,196	0.53	0.71	3.89	11.21	1.57	1.16	1.16	3,887	(1)
LTO with Break at Arrival	1,320	0.56	0.75	4.08	12.77	1.73	1.23	1.23	4,292	(1)
Touch and Go (T&G)	325	0.10	0.13	0.70	3.55	0.43	0.26	0.26	1,057	(2)
Ground Controlled Approach Box (GCA Box)	490	0.16	0.21	1.09	5.26	0.64	0.41	0.41	1,592	(2)
Annual In-Frame Engine Testing - One C-2A	82,885	37.14	49.54	273.98	746.65	108.58	78.84	78.84	269,075	(1)
CMV-22B										
Vertical Takeoff (Conversion mode)	801	0.03	0.04	2.45	6.79	1.05	1.12	1.12	2,579	(3)
Vertical Landing (Conversion mode)	601	0.04	0.05	2.96	3.87	0.79	0.78	0.78	1,935	(3)
Short Takeoff (Airplane mode)	688	0.03	0.04	2.37	5.38	0.90	0.94	0.94	2,216	(3)
Short Landing (Airplane mode)	601	0.04	0.05	2.96	3.87	0.79	0.78	0.78	1,935	(3)
Landing w/Break (Airplane mode)	776	0.04	0.05	3.07	6.13	1.02	1.05	1.05	2,499	(3)
T&G	280	0.00	0.00	0.19	3.57	0.37	0.44	0.44	899	(4)
GCA Box	400	0.00	0.01	0.26	5.20	0.52	0.63	0.63	1,283	(4)
Annual In-Frame Engine Testing - One CMV-22B	163,640	18.44	24.60	742.12	1,089.72	214.37	111.21	111.21	528,300	(3)

CO = carbon monoxide; CO₂ = carbon dioxide; GCA = ground controlled approach; LTO = landing and take-offs; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; T&G = touch and go; THC = total hydrocarbons; VOC = volatile organic compounds

- Notes:** (1) Source: Aircraft Emission Estimates: C-2A Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5. Aircraft Environmental Support Office (AESO) – Fleet Readiness Center Southwest Memorandum Report No. 9919 Revision D (AESO, 2015). However, the SO₂ emission factor of 1.31 pounds/1000 pounds JP-5 fuel from Sulfur Dioxide Emissions Index Using JP-5 and JP-8 Fuel. AESO Memorandum Report No. 2012-01E (AESO, 2017). THC to VOC conversion factor obtained from AESO, 2016.
- (2) Source: Aircraft Emission Estimates: C-2A Mission Operations Using JP-5. AESO Memorandum Report No. 9936 Revision D (AESO, 2015).
- (3) Source: Aircraft Emission Estimates: V-22 Landing and Takeoff Cycle, Cruise Time, and In-Frame Engine Maintenance Testing Using JP-5. AESO Memorandum Report No. 9946 Revision G (AESO, 2016).
- (4) Source: Aircraft Emission Estimates: V-22 Mission Operations Using JP-5. AESO Memorandum Report No. 9965 Revision C (AESO, 2015)

**Table C.2-8: Annual Emissions for C-2A and CMV-22B Aircraft Operations at
NS Norfolk – Navy V-22 Action Alternative 1**

Operation	Annual Emissions (Tons)						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Existing C-2A Operations							
LTO with Straight In Arrival	0.42	2.29	6.61	0.92	0.68	0.68	2,291
LTO with Break at Arrival	-	-	-	-	-	-	-
T&G	0.27	1.44	7.31	0.88	0.54	0.54	2,176
GCA Box	0.05	0.27	1.31	0.16	0.10	0.10	396
Subtotal - C-2A Flight Operations	0.74	4.01	15.23	1.96	1.32	1.32	4,864
In-Frame Engine Testing	0.42	2.33	6.35	0.92	0.67	0.67	2,287
Total Emissions - Existing C-2A	1.17	6.34	21.58	2.88	1.99	1.99	7,151
Transition Complete - CMV-22B Operations							
Vertical Takeoff (Conversion mode)	0.00	0.30	0.84	0.13	0.14	0.14	318
Vertical Landing (Conversion mode)	0.03	1.59	2.07	0.42	0.42	0.42	1,036
Short Takeoff (Airplane mode)	0.02	0.98	2.22	0.37	0.39	0.39	914
Short Landing (Airplane mode)	-	-	-	-	-	-	-
Landing w/Break (Airplane mode)	-	-	-	-	-	-	-
T&G	0.01	0.41	7.64	0.78	0.94	0.94	1,923
GCA Box	0.00	0.08	1.64	0.17	0.20	0.20	405
Subtotal - CMV-22B Flight Operations	0.06	3.35	14.41	1.87	2.08	2.08	4,596
In-Frame Engine Testing	0.18	5.57	8.17	1.61	0.83	0.83	3,962
Transition Complete Emissions - CMV-22B	0.24	8.92	22.58	3.48	2.92	2.92	8,558

CO = carbon monoxide; CO₂ = carbon dioxide; GCA = ground controlled approach; LTO = landing and take-offs; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; T&G = touch and go; VOC = volatile organic compounds

Table C.2-9: Annual Emissions for C-2A and CMV-22B Aircraft Operations at NS Norfolk – Navy V-22 Action Alternative 2

Operation	Annual Emissions (Tons)						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Existing C-2A Operations							
LTO with Straight In Arrival	0.42	2.29	6.61	0.92	0.68	0.68	2,291
LTO with Break at Arrival	-	-	-	-	-	-	-
T&G	0.27	1.44	7.31	0.88	0.54	0.54	2,176
GCA Box	0.05	0.27	1.31	0.16	0.10	0.10	396
Subtotal - C-2A Flight Operations	0.74	4.01	15.23	1.96	1.32	1.32	4,864
In-Frame Engine Testing	0.42	2.33	6.35	0.92	0.67	0.67	2,287
Total Emissions - Existing C-2A	1.17	6.34	21.58	2.88	1.99	1.99	7,151
Transition Complete - CMV-22B Operations							
Vertical Takeoff (Conversion mode)	0.01	0.51	1.41	0.22	0.23	0.23	534
Vertical Landing (Conversion mode)	0.05	2.67	3.49	0.71	0.70	0.70	1,743
Short Takeoff (Airplane mode)	0.03	1.64	3.73	0.63	0.65	0.65	1,537
Short Landing (Airplane mode)	-	-	-	-	-	-	-
Landing w/Break (Airplane mode)	-	-	-	-	-	-	-
T&G	0.02	0.77	14.50	1.49	1.79	1.79	3,650
GCA Box	0.00	0.12	2.35	0.24	0.28	0.28	580
Subtotal - CMV-22B Flight Operations	0.11	5.71	25.47	3.28	3.66	3.66	8,046
In-Frame Engine Testing	0.25	7.42	10.90	2.14	1.11	1.11	5,283
Transition Complete Emissions - CMV-22B	0.35	13.13	36.37	5.42	4.77	4.77	13,329

CO = carbon monoxide; CO₂ = carbon dioxide; GCA = ground controlled approach; LTO = landing and take-offs; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; T&G = touch and go; VOC = volatile organic compounds

Table C.2-10: Aerospace Ground Support Equipment Usages for Existing C-2A Aircraft at NS Norfolk – Navy V-22 Action As

Equipment (1)	Hp (2)	Load Factor (3)	Hours per LTO (4)	Hp-Hrs per LTO	Total Annual Hp-Hrs
Air Compressor - MC-1A	20	0.50	1.00	10	11,790
Air Conditioner - MA-3D	110	0.75	2.00	165	194,535
Generator Set - A/M32A-86D	148	0.82	3.00	364	429,250
Heater - H1	7	0.50	2.00	7	7,664
Hydraulic Test Stand - MJ-2/TTU-228	130	0.50	1.00	65	76,635
Light Cart - NF-2	18	0.50	2.25	20	23,875
Start Cart - A/M32A-95	155	0.90	0.50	70	82,235

LTO = landing and take-offs; Hp = horsepower; Hp-hrs = horsepower hours

Notes: (1) Equipment list equates to those identified as Generic 4 group of aircraft in Table 3-3 of Air Emissions Guide for Air Force Mobile Sources (AFCEC, 2016), except Generic group 1 for the light cart.

(2) From Table 3-4 in AFCEC, 2016.

(3) From Table 3-6 in AFCEC, 2016.

(4) From Table 3-3 in AFCEC, 2014.

Table C.2-11: Nonroad Diesel Emission Factors for Navy V-22 Action Alternatives at NS Norfolk

HP Category	Emission Factors (Grams/Horsepower) (1)						
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂
Baseline Year 2016							
Nonroad Equipment - 6-11 Hp	0.62	4.54	4.32	0.004	0.36	0.35	594
Nonroad Equipment - 12-16 Hp	0.50	2.39	4.46	0.004	0.35	0.34	595
Nonroad Equipment - 17-25 Hp	0.50	2.39	4.46	0.004	0.35	0.34	595
Nonroad Equipment - 26-40 Hp	0.21	0.81	3.64	0.003	0.12	0.12	596
Nonroad Equipment - 41-50 Hp	0.21	0.81	3.64	0.003	0.12	0.12	596
Nonroad Equipment - 51-75 Hp	0.26	2.06	3.45	0.004	0.22	0.22	595
Nonroad Equipment - 76-100 Hp	0.26	2.27	2.43	0.003	0.29	0.28	595
Nonroad Equipment - 101-175 Hp	0.22	0.84	2.04	0.003	0.19	0.19	536
Nonroad Equipment - 176-300 Hp	0.20	0.63	1.86	0.003	0.12	0.12	536
Transition Complete Year 2028							
Nonroad Equipment - 7-11 Hp	0.62	4.49	4.32	0.004	0.36	0.35	594
Nonroad Equipment - 12-16 Hp	0.50	2.36	4.46	0.004	0.36	0.35	595
Nonroad Equipment - 17-25 Hp	0.50	2.36	4.46	0.004	0.36	0.35	595
Nonroad Equipment - 26-40 Hp	0.15	0.25	3.01	0.003	0.02	0.02	596
Nonroad Equipment - 41-50 Hp	0.15	0.25	3.01	0.003	0.02	0.02	596
Nonroad Equipment - 51-75 Hp	0.15	0.44	3.02	0.003	0.03	0.03	596
Nonroad Equipment - 76-100 Hp	0.16	0.45	0.35	0.003	0.02	0.02	596
Nonroad Equipment - 101-175 Hp	0.16	0.16	0.34	0.003	0.02	0.02	536
Nonroad Equipment - 176-300 Hp	0.16	0.13	0.33	0.003	0.01	0.01	536

CO = carbon monoxide; CO₂ = carbon dioxide; Hp = horsepower; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Criteria pollutant factors estimated with the use of the EPA NONROAD2008a model for US national average.

Table C.2-12: Annual Air Emissions from Aerospace Ground Support Equipment Usages by Existing C-2A Aircraft at NS Norfolk Navy V-22 Alternatives

Equipment	Annual Emissions (Tons)							
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	CO _{2e} (mt)
Air Compressor - MC-1A	0.01	0.03	0.06	0.0001	0.00	0.00	7.73	7.03
Air Conditioner - MA-3D	0.05	0.18	0.44	0.0007	0.04	0.04	114.98	104.53
Generator Set - A/M32A-86D	0.10	0.40	0.97	0.0015	0.09	0.09	253.71	230.65
Heater - H1	0.01	0.04	0.04	0.0000	0.00	0.00	5.02	4.56
Hydraulic Test Stand - MJ-2/TTU-228	0.02	0.07	0.17	0.0003	0.02	0.02	45.30	41.18
Light Cart - NF-2	0.01	0.06	0.12	0.0001	0.01	0.01	15.65	14.23
Start Cart - A/M32A-95	0.02	0.08	0.19	0.0003	0.02	0.02	48.61	44.19
Total - Year 2016	0.22	0.86	1.97	0.0029	0.18	0.18	491.00	446.37

CO = carbon monoxide; CO₂ = carbon dioxide; CO_{2e} = carbon dioxide equivalent; HP = horsepower; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Only CO₂ emissions were used to estimate CO_{2e} emissions.

Table C.2-13: Aerospace Ground Support Equipment Usages for CMV-22 Aircraft – Navy V-22 Alternatives at NS Norfolk

<i>Equipment (1)</i>	<i>Hp (2)</i>	<i>Load Factor (3)</i>	<i>Hours per LTO (4)</i>	<i>Hp-Hrs per LTO</i>	<i>Total Annual Hp-Hrs</i>	
					<i>Alternative 1</i>	<i>Alternative 2</i>
Air Compressor - MC-1A	20	0.50	5.25	53	56,228	94,605
Air Conditioner - MA-3D	110	0.75	1.00	83	88,358	148,665
Generator Set - A/M32A-86D	148	0.82	7.50	910	974,824	1,640,180
Heater - H1	7	0.50	1.00	3	3,481	5,857
Hydraulic Test Stand - MJ-2A	195	0.50	3.00	293	313,268	527,085
Light Cart - NF-2	18	0.50	6.00	54	57,834	97,308
Start Cart - A/M32A-95	155	0.90	0.25	35	37,351	62,845

Hp = horsepower; Hp-hrs = horsepower hours; LTO = landing and take-offs

Notes: (1) Equipment list equates to those identified as Generic 4 group of aircraft in Table 3-3 of Air Emissions Guide for Air Force Mobile Sources (AFCEC, 2016), except Generic group 1 for the light cart.

(2) From Table 3-4 in AFCEC, 2016.

(3) From Table 3-6 in AFCEC, 2016.

(4) From Table 3-3 in AFCEC, 2014.

**Table C.2-14: Annual Air Emissions from Aerospace Ground Equipment Usages
by CMV-22 – Navy V-22 Alternatives at NS Norfolk**

Equipment	Annual Emissions (Tons)							
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	CO _{2e}
Alternative 1								
Air Compressor - MC-1A	0.03	0.15	0.28	0.0002	0.02	0.02	37	34
Air Conditioner - MA-3D	0.02	0.02	0.03	0.0003	0.00	0.00	52	47
Generator Set - A/M32A-86D	0.17	0.17	0.36	0.0028	0.02	0.02	576	524
Heater - H1	0.00	0.02	0.02	0.0000	0.00	0.00	2	2
Hydraulic Test Stand - MJ-2A	0.05	0.06	0.12	0.0009	0.01	0.01	185	168
Light Cart - NF-2	0.03	0.15	0.28	0.0003	0.02	0.02	38	34
Start Cart - A/M32A-95	0.01	0.01	0.01	0.0001	0.00	0.00	22	20
Total - Alternative 1	0.31	0.58	1.10	0.0046	0.07	0.07	912	829
Alternative 2								
Air Compressor - MC-1A	0.05	0.25	0.47	0.0004	0.04	0.04	62	56
Air Conditioner - MA-3D	0.03	0.03	0.06	0.0004	0.00	0.00	88	80
Generator Set - A/M32A-86D	0.28	0.29	0.61	0.0047	0.03	0.03	970	882
Heater - H1	0.00	0.03	0.03	0.0000	0.00	0.00	4	3
Hydraulic Test Stand - MJ-2A	0.09	0.09	0.20	0.0015	0.01	0.01	312	283
Light Cart - NF-2	0.05	0.25	0.48	0.0004	0.04	0.04	64	58
Start Cart - A/M32A-95	0.01	0.01	0.02	0.0002	0.00	0.00	37	34
Total - Alternative 2	0.51	0.95	1.87	0.0076	0.12	0.12	1,537	1,396

CO = carbon monoxide; CO₂ = carbon dioxide; CO_{2e} = carbon dioxide equivalent; Hp = horsepower; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Only CO₂ emissions were used to estimate CO_{2e} emissions.

**Table C.2-15: Annual On-Road Vehicle Mileages for Travel On Base
NS Norfolk – Navy V-22 Action Alternatives**

<i>Staff Type</i>	<i># of Personnel (1)</i>	<i>Vehicle Round Trips per Day</i>	<i>On Base Miles per Round Trip</i>	<i>Days per Year (2)</i>	<i>On Base Miles per year</i>
Existing VRC-30 C-2A Detachment					
On Base Personnel	581	581	3.0	220	383,460
Alternative 1					
On Base Personnel	455	455	3.0	220	300,300
Alternative 2					
On Base Personnel	635	635	3.0	220	419,100

Notes: (1) # of Personnel from EA Tables 2.3-3 and 2.3-8.

(2) Source: Final EA for Transition of HMM-774 to VMM-774 to VMM-774 (USMC, 2015).

**Table C.2-16: Annual Average On-Road Emission Factors for Travel On Base
NS Norfolk – Navy V-22 Action Alternatives**

<i>Source Type</i>	<i>Emission Factors (Grams/Mile) (1)</i>						
	<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>
Existing VRC-30 C-2A Detachment							
LDA - Composite Speeds	0.04	1.75	0.18	0.005	0.004	0.004	248
LDT2 - Composite Speeds	0.07	2.50	0.28	0.006	0.004	0.004	318
Composite (2)	0.05	1.94	0.20	0.005	0.004	0.004	266
Year 2028 - First Year of Transition Complete							
LDA - Composite Speeds	0.01	0.96	0.03	0.002	0.003	0.003	248
LDT2 - Composite Speeds	0.01	1.34	0.07	0.002	0.004	0.003	328
Composite (2)	0.01	1.05	0.04	0.002	0.003	0.003	268

CO = carbon monoxide; CO₂ = carbon dioxide; mph = miles per hour; LDA = light-duty auto; LDT2 = light-duty truck2; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

**Table C.2-17: Annual Emissions for On-Road Vehicles for Travel On Base
NS Norfolk – Navy V-22 Action Alternatives**

<i>Alternatives</i>	<i>Tons per Year</i>						
	<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>
Existing C-2A Detachment	0.021	0.818	0.085	0.002	0.002	0.002	112
Alternative 1	0.003	0.348	0.013	0.001	0.001	0.001	89
Alternative 2	0.004	0.486	0.019	0.001	0.002	0.001	124

CO = carbon monoxide; CO₂ = carbon dioxide; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

**Table C.2-18: Annual On-Road Vehicle Mileages for Travel Off Base
NS Norfolk – Navy V-22 Action Alternatives**

<i>Staff Type</i>	<i># of Personnel (1)</i>	<i>Vehicle Round Trips per Day</i>	<i>Off Base Miles per Round Trip</i>	<i>Days per Year (2)</i>	<i>Off Base Miles per year</i>
Existing VRC-30 C-2A Detachment					
Off Base Personnel	581	581	40	220	5,112,800
Alternative 1					
Off Base Personnel	455	455	40	220	4,004,000
Alternative 2					
Off Base Personnel	635	635	40	220	5,588,000

Notes: (1) # of Personnel from EA Tables 2.3-3 and 2.3-8.

(2) Source: Final EA for Transition of HMM-774 to VMM-774 to VMM-774 (USMC, 2015).

Table C.2-19: Annual Emissions for On-Road Vehicles for Travel Off Base NS Norfolk – Navy V-22 Action Alternatives

<i>Alternatives</i>	<i>Tons per Year</i>						
	<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>
Existing C-2A Detachment	0.28	10.91	1.14	0.03	0.02	0.02	1,498
Alternative 1 - Net Change	0.03	4.64	0.18	0.01	0.01	0.01	1,184
Alternative 2 - Net Change	0.05	6.48	0.25	0.01	0.02	0.02	1,652

CO = carbon monoxide; CO₂ = carbon dioxide; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Table C.2-20: Annual Emissions for the Existing VRC-30 C-2A Detachment at NS Norfolk – Navy V-22 Action Alternatives

Source Type	Tons per Year							CO ₂ e (mt)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
C-2A Aircraft Operations	0.74	4.01	15.23	1.96	1.32	1.32	4,864	4,422
In-Frame Aircraft Engine Testing - C-2A	0.42	2.33	6.35	0.92	0.67	0.67	2,287	2,079
Aerospace Ground Support Equipment	0.22	0.86	1.97	0.00	0.18	0.18	491	446
Privately-Owned Vehicles - On Base	0.02	0.82	0.09	0.00	0.00	0.00	112	102
Privately-Owned Vehicles - Off Base	0.28	10.91	1.14	0.03	0.02	0.02	1,498	1,362
Existing C-2A Emissions	1.68	18.93	24.78	2.91	2.19	2.19	9,252	8,411

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) These emission reductions equate to the net change in emissions for the Partial and Transition Complete Year alternatives.

(2) Only CO₂ emissions were used to estimate CO₂e emissions.

Table C.2-21: Annual Emissions from the Navy V-22 Alternatives at NS Norfolk – Alternative 1

Source Type	Tons per Year							CO ₂ e (mt)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
CMV-22B Aircraft Operations	0.06	3.35	14.41	1.87	2.08	2.08	4,596	4,178
In-Frame Aircraft Engine Testing - CMV-22B	0.18	5.57	8.17	1.61	0.83	0.83	3,962	3,602
Aerospace Ground Support Equipment	0.31	0.58	1.10	0.00	0.07	0.07	913	829
Privately-Owned Vehicles - On Base	0.00	0.35	0.01	0.00	0.00	0.00	89	81
Privately-Owned Vehicles - Off Base	0.03	4.64	0.18	0.01	0.01	0.01	1,184	1,076
Total Annual Emissions - Alternative 1	0.58	14.49	23.87	3.49	2.99	2.99	10,744	9,766
Baseline C-2A Emissions	1.68	18.93	24.78	2.91	2.19	2.19	9,252	8,411
Net Emissions Change - Alternative 1 (1)	(1.10)	(4.44)	(0.91)	0.58	0.80	0.80	1,492	1,355
PSD Thresholds	250	250	250	250	250	250	NA	NA
Exceed Threshold?	No	No	No	No	No	No	NA	NA

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; PSD = Prevention of Significant Deterioration; SO₂ = sulfur dioxide; VOC = volatile organic compounds.

Notes: (1) Equal to CMV-22B Basing Alternative Emissions minus Existing C-2A Emissions.

(2) Only CO₂ emissions were used to estimate CO₂e emissions.

Table C.2-22: Annual Emissions from the Navy V-22 Alternatives at NS Norfolk – Alternative 2

Source Type	Tons per Year							CO ₂ e (mt)
	VOC	CO	NO _x	SO ₂	PM ₁₀	PM _{2.5}	CO ₂	
CMV-22B Aircraft Operations	0.11	5.71	25.47	3.28	3.66	3.66	8,046	7,314
In-Frame Aircraft Engine Testing - CMV-22B	0.25	7.42	10.90	2.14	1.11	1.11	5,283	4,803
Aerospace Ground Support Equipment	0.52	0.95	1.86	0.01	0.12	0.12	1,536	1,397
Privately-Owned Vehicles - On Base	0.00	0.49	0.02	0.00	0.00	0.00	124	113
Privately-Owned Vehicles - Off Base	0.05	6.48	0.25	0.01	0.02	0.02	1,652	1,502
Total Annual Emissions - Alternative 2	0.93	21.05	38.50	5.44	4.91	4.91	16,641	15,129
Existing C-2A Emissions	1.68	18.93	24.78	2.91	2.19	2.19	9,252	8,411
Net Emissions Change - Alternative 2 (1)	(0.75)	2.12	13.72	2.53	2.72	2.72	7,389	6,718
PSD Thresholds	250	250	250	250	250	250	NA	NA
Exceed Threshold?	No	No	No	No	No	No	NA	NA

CO = carbon monoxide; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalent; mt = metric ton; NA = not applicable; NO_x = nitrogen oxide; PM₁₀ = particulate matter less than or equal to 10 microns in diameter; PM_{2.5} = particulate matter less than or equal to 2.5 microns in diameter; PSD = Prevention of Significant Deterioration; SO₂ = sulfur dioxide; VOC = volatile organic compounds

Notes: (1) Equal to CMV-22B Basing Alternative Emissions minus Existing C-2A Emissions.

(2) Only CO₂ emissions were used to estimate CO₂e emissions.

C.3 Felker Army Airfield Air Emissions Calculations

Table C.3-1. Annual Operations for CMV-22B Aircraft at Felker Army Airfield - Navy V-22 EA Alternative 2.

<i>Mission Operation (3)</i>	<i>Annual Mission Operations (1)</i>	<i>Annual Cruise Mode (Hrs) (2)</i>
Confined Area Landing (CAL)	1,925	
Vertical Replenishment (VERTREP) aka "Rocks and Blocks"	1,925	
<i>Other Flight Modes</i>		
Transitional Cruising (Hours) (2)		481

Notes: (1) Sources: Navy V-22 EA Tables 2.1-3 and 2.3-10. Per EA Table 2.1-3, typical training at FAAF would consist of VERTREP and CAL. For EA Alternative 2 (NS Norfolk FRS), value here in Table 1 conservatively assumes all 7,700 operations (see EA Table 2.3-10) would take place only at FAAF and would not be spread among NALF Fentress and MCAS New River. Assume 7,700 ops/movements divided evenly between VERTREP (3,850 ops/movements) and CAL (3,850 ops/movements). Conservatively assumes that each VERTREP and CAL mission operation consists of two ops or movements (e.g., a landing and a take off). Therefore, conservatively assume that 1,925 each of VERTREP and CAL complete mission operations would take place at FAAF.

(2) Conservatively assumes half of the mission operations at FAAF would also include an additional 15 minutes of cruise mode below 3,000 feet above ground level (AGL) should aircraft transition between mission operations within the FAAF airspace.

(3) "Mission operation" is the terminology used in Aircraft Environmental Support Office (AESO) Memoranda. It describes the overall flight training mission such as CAL or VERTREP, which consists of several components (e.g., an approach, hover, climb out, circle). Each of the components may be counted at an airfield as an operation or movement. Per AESO Memoranda, VERTREP consists of 8 steps conducted over approximately 17 minutes; and CAL consists of 4 steps conducted over approximately 9 minutes.

Table C.3-2. Emissions and Fuel Usage for One CMV-22B Aircraft Mission Operation at Felker Army Airfield - Navy V-22 EA Actions.

Mission Operation	Fuel Usage (Pounds)	Emissions per Mission Operation (Pounds)								
		THC	VOC	CO	NO_x	SO₂	PM₁₀	PM_{2.5}	CO₂	Source
Confined Area Landing (CAL)	592	0.01	0.01	0.29	8.87	0.78	0.94	0.94	1,899	(1)
Rocks and Blocks (Vertical Replenishment [VERTREP])	960	0.01	0.01	0.63	12.25	1.26	1.52	1.52	3,081	(1)
Other Flight Modes										
Cruise (1 Hour)	3,820	0.04	0.05	2.42	53.82	5.00	6.00	6.00	12,259	(2)

Note: (1) Source: V-22 Mission Operations Using JP-5. AESO Memorandum Report No. 9965 Revision C (AESO 2015).

(2) Source: Aircraft Emission Estimates: V-22 Landing and Takeoff Cycle, Cruise Time, and In-Frame Engine Maintenance Testing Using JP-5.

AESO Memorandum Report No. 9946 Revision G (AESO 2016). Represents the highest values for either fixed-wing or helo mode.

Table C.3-3. Annual Emissions for CMV-22B Aircraft Operations at Felker Army Airfield - Navy V-22 EA Alternative 2.

<i>Mission Operation</i>	<i>Annual Emissions - Tons</i>						
	<i>VOC</i>	<i>CO</i>	<i>NO_x</i>	<i>SO₂</i>	<i>PM₁₀</i>	<i>PM_{2.5}</i>	<i>CO₂</i>
Confined Area Landing (CAL)	0.01	0.28	8.54	0.75	0.90	0.90	1,828
Vertical Replenishment (VERTREP)	0.01	0.61	11.79	1.21	1.46	1.46	2,966
<i>Other Flight Modes</i>							
Transitional Cruising	0.01	0.58	12.95	1.20	1.44	1.44	2,950
Total Annual Emissions - Felker Army Airfield	0.04	1.47	33.28	3.16	3.81	3.81	7,743