Appendix A
Air Quality Methodology and Calculations

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A.1 General Conformity Rule - Record of Non-Applicability (RONA) for Clean Air Act Conformity

Environmental Assessment for Proposed Home Basing of the MQ-25A Stingray Carrier-Based Unmanned Air System at Naval Station Norfolk, Virginia

Designation:	Environmental Assessment
Title of Proposed Action:	Home Basing of the MQ-25A Stingray Carrier-Based Unmanned Air System
Project Location:	Naval Station Norfolk, Virginia
Lead Agency for the EA:	Department of the Navy
Cooperating Agency:	None
Affected Region:	Hampton Roads Metropolitan Area, Virginia
Action Proponent:	United States Fleet Forces Command, Department of the Navy
Point of Contact:	Dara Suich, Code EV21 Naval Facilities Engineering Systems Command, Atlantic Division 6506 Hampton Boulevard Norfolk, Virginia 23508 Email address: dara.m.suich.civ@us.navy.mil

Proposed Action and Emissions Summary:

The Clean Air Act requires federal actions in air pollutant nonattainment or maintenance areas to conform to the applicable State Implementation Plan. The State Implementation Plan is designed to achieve or maintain an attainment designation of air pollutants as defined by the National Ambient Air Quality Standards (NAAQS). The regulations governing this requirement are found in 40 Code of Federal Regulations part 93, also known as the "General Conformity Rule," which applies to federal actions occurring in regions designated as nonattainment or areas subject to maintenance plans. Emission (*de minimis*) thresholds have been established for actions with the potential to have significant air quality impacts. A project/action in an area designated as nonattainment/maintenance and exceeding the *de minimis* thresholds must have a general conformity determination prepared to address significant impacts.

Naval Station Norfolk is located in Norfolk City, Virginia, which is within the Hampton Roads Intrastate Air Quality Control Region (40 Code of Federal Regulations section 81.93). This area is designated as being in attainment for all criteria pollutant NAAQS and an "orphan" maintenance area for the 1997 ozone standard. Thus, the *de minimis* thresholds for ozone precursors (nitrogen oxides, volatile organic compounds) apply to the conformity applicability analysis.

Air Emissions Summary

Based on the maximum annual project emissions estimates identified in Table 1 below, a general conformity determination is not required, because the maximum annual direct and indirect emissions for the Environmental Assessment Proposed Action are well below the *de minimis* thresholds.

Supporting documentation and emissions estimates can be found in the Environmental Assessment in Section 3.4, *Air Quality*.

Table 1 Summary of Maximum Annual Air Pollutant Emissions Compared to the Applicable Conformity *de minimis* Thresholds – Proposed Action

Project Scenario	*Annual Emissions (tons/year)*	
	NO_x	*VOCs*
Net Change	39.34	3.07
Conformity *de minimis* Thresholds	100	100

Notes: NO_x = nitrogen oxides; VOC = volatile organic compound

Date RONA Prepared: November 01, 2024

RONA Prepared by: Allison Williams - Leidos

RONA Approval:

11/01/2024

Signature Date

A.2 Air Quality Example Calculations

This section presents an export of results directly from the air quality modeling software, retaining the organizational headings, text, and table formatting produced by the software.

A.2.1 Aircraft Activities Emissions

Aircraft activities of concern for criteria pollutants are those that occur from ground level up to 3,000 feet above ground level (AGL). The 3,000 feet AGL ceiling is the default atmospheric mixing height above which any pollutant generated would not contribute to increased pollutant concentrations at ground level. An exception to this is greenhouse gases (GHGs), which are relevant across the entire flight profile. Therefore, aircraft emissions were also calculated for operations across the entire flight profile. All criteria pollutant emissions from aircraft generated at greater than 3,000 feet AGL are excluded from this analysis. The pollutant emission rate is a function of the engine's operating mode, the fuel flow rate, and the engine's overall efficiency. Emissions for one complete flight for a particular aircraft are calculated using the specific engine pollutant emission factors for each mode of operation.

For this Environmental Assessment, emission factors for aircraft engines were obtained from the United States (U.S.) Department of the Navy's (the Navy) Aircraft Environmental Support Office (AESO) memoranda.

Using these data, criteria pollutant emissions for each aircraft and activity were calculated by applying the equation below.

Emissions = TIM/MINxLTO-EF

Where:

Emissions = Aircraft Emissions (pounds per activity)

TIM = Time-in-mode below 3,000 feet AGL

MIN = Minutes per landing and takeoff (LTO) cycle

EF = Emission factor for one specific airframe LTO cycle, including emissions from ground operations associated with the LTO cycle

As the equation indicates, emissions were determined by estimating the total number of landings and takeoffs (LTOs) per airframe and then applying the appropriate AESO LTO/touch-and-go emissions factors for the specified airframe. Aircraft operational emissions are provided in Table A-1.

A.2.2 Aircraft In-Frame Maintenance (Ground Operations)

Emissions are generated by aircraft conducting routine in-frame maintenance runs. During tests, pilots operate engines at a range of operating modes while on the ground. Emissions associated with aircraft in-frame maintenance were estimated based on emission factors in AESO Memorandum Report Number 2019-17A Aircraft Emissions Estimates: MQ-25 Landing and Takeoff Cycle and In-Frame Maintenance Testing (AESO, 2020a). In-frame maintenance operations were calculated only for MQ-25A operations. E-2D in-frame maintenance is already ongoing, so this activity is not part of the Proposed Action.

Emissions were then calculated as follows, based on the total annual in-frame maintenance hours for each representative airframe.

Emissions = OPSxEF

Where:

Emissions = Aircraft in-frame maintenance emissions

OPS = Total annual in-frame maintenance hours

EF = Averaged emission factor for specific airframe in-frame maintenance (lbs/hr)

Aircraft in-frame maintenance emissions are provided in Table A-1.

A.2.3 Ground Support Equipment Emissions

Ground support equipment (GSE) includes various gasoline or diesel equipment to support aircraft operations. Test stands, tow tractors, generators, loaders, and trucks are examples of equipment used regularly. Because the Proposed Action would increase E-2D operations, E-2D GSE emissions were included. Emissions from the use of ground support equipment for the E-2D aircraft were estimated using the Air Conformity Applicability Model (ACAM). Emissions from the use of GSE for the MQ-25A aircraft were calculated with the use of activity data provided by the MQ-25A fleet integration team. E-2 GSE emissions are provided in Table A-2. MQ-25A GSE emissions are provided in Table A-3.

Table A-1 Aircraft Operations and In-Frame Maintenance Emissions

Operation	Number of LTOs/TGOs	Fuel Used (lbs)	Emission Factors (lbs per LTO/TGO cycle)[1]						Annual Emissions (tons/year)					
			CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	THC	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC^2
Single MQ-25A LTO	480	613	12.44	5.36	0.03	0.03	0.55783	0.84	2.99	1.29	0.01	0.01	0.13	0.23
Single E-2D LTO	480	1,161	2.92	10.78	0.63	0.63	0.3744	0.45	0.7	2.59	0.15	0.15	0.09	0.12
Single E-2D TGO	960	339	0.42	3.89	0.18	0.18	0.7488	0.09	0.2	1.87	0.09	0.09	0.36	0.05
Maintenance Emissions from MQ-25A	20	72,702	202.34	717.04	3.39	3.39	66.15888	0.07	2.02	7.17	0.03	0.03	0.66	0.001
								TOTAL	***5.91***	***12.91***	***0.28***	***0.28***	***1.24***	***0.40***

Sources:

MQ-25A: (AESO, 2020a; AESO, 2020b)
E-2D: (AESO, 2015a; AESO, 2015b)
SO_2: (AESO, 2020c)

Notes: AESO = Aircraft Environmental Support Office; CO = carbon monoxide; lbs = pounds; LTO = landing and takeoff; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = particulate matter less than or equal to 10 microns in diameter; SO_2 = sulfur dioxide; TGO = touch-and-go (only E-2D); THC = total hydrocarbons; VOCs = volatile organic compounds

[1] Maintenance emission factors are provided in pounds per aircraft per year.

[2] VOC = THC x 1.15 per AESO Memo Number 2019-17A

Table A-2 E-2 Ground Support Equipment Emissions

AGE Type	Total Number of AGE	Operational Hours for Each LTO	Fuel Flow (gal/hr)	AGE Emission Factor (lbs/hr)								Total Emissions from Annual Equipment Use (tons/year)						
				Number of LTOs	NO_x	CO	SO_x	PM_{10}	VOC	$PM_{2.5}$	CO_2e	NO_x	CO	SO_x	PM_{10}	VOC	$PM_{2.5}$	CO_2e
Air Compressor MC-1A - 18.4hp	1	10	1.1	480	0.42	0.27	0.01	0.07	0.27	0.07	24.60	1.01	0.64	0.02	0.17	0.64	0.16	59
Air Compressor MA-3D - 120hp	1	1	7.1	480	4.17	0.32	0.05	0.11	0.05	0.11	160.80	1.00	0.08	0.01	0.03	0.01	0.03	39
Generator Set A/M32A-86D	1	11	6.5	480	6.10	0.46	0.05	0.09	0.29	0.09	146.10	16.11	1.21	0.12	0.24	0.78	0.23	386
Heater H1	1	1	0.4	480	0.16	0.18	0.01	0.01	0.10	0.01	8.80	0.04	0.04	0.00	0.00	0.02	0.00	2
Hydraulic Test Stand MJ-2A	1	3	0	480	3.85	2.46	0.24	0.08	0.19	0.08	185.30	2.77	1.77	0.17	0.06	0.14	0.05	133
Light Cart NF-2	1	10	0	480	0.11	0.08	0.04	0.01	0.01	0.01	23.80	0.26	0.19	0.10	0.02	0.02	0.02	57

Table A-2 E-2 Ground Support Equipment Emissions

AGE Type	*Total Number of AGE*	*Operational Hours for Each LTO*	*Fuel Flow (gal/hr)*	*AGE Emission Factor (lbs/hr)*								*Total Emissions from Annual Equipment Use (tons/year)*						
				Number of LTOs	*NO_x*	*CO*	*SO_x*	*PM_{10}*	*VOC*	*$PM_{2.5}$*	*CO_2e*	*NO_x*	*CO*	*SO_x*	*PM_{10}*	*VOC*	*$PM_{2.5}$*	*CO_2e*
Start Cart A/M32A-60A	1	0.25	0	480	1.82	5.48	0.31	0.21	0.27	0.21	238.20	0.11	0.33	0.02	0.01	0.02	0.01	14
											Total	***21.30***	***4.26***	***0.45***	***0.53***	***1.63***	***0.52***	***690***

Notes: AGE = Aerospace Ground Equipment; CO = carbon monoxide; CO_2e = carbon dioxide equivalent; hr = hour; lbs = pounds; LTO = landing and takeoff; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = particulate matter less than or equal to 10 microns in diameter; SO_x = sulfur oxides; VOCs = volatile organic compounds

Emissions were estimated using ACAM 5.0.23 (Solutio Environmental, Inc., 2022).

Table A-3 MQ-25A Ground Support Equipment Emissions

Equipment Type	*Tier*	*Fuel*	*kW*	*Typical In-Use Load*	*Cumulative Annual Use Estimate (total hours)*	*Emission Rate (grams per kilowatt-hour)*						*Total Emissions from Annual Equipment Use (tons/year)*					
						CO	*VOC*	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*SO_2 (lbs/hp-hr)[1]*	*CO*	*VOC*	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*SO_2*
Test stand, hydraulic portable, diesel	2	Diesel	83	34	480	5	0.33	6.27	0.3	0.3	1.21E-05	0.07	0.00	0.09	0.00	0.00	0.00
Cart, corrosion control	2	Diesel	7	34	2,160	8	0.375	7.125	0.8	0.8	1.21E-05	0.05	0.00	0.04	0.00	0.00	0.00
Tow tractor (land based)	2	Diesel	66	54	1,440	5	0.375	7.125	0.4	0.4	1.21E-05	0.28	0.02	0.40	0.02	0.02	0.00
Air conditioner, diesel	3	Diesel	262	34	4,320	3.5	0.2	3.8	0.2	0.2	1.21E-05	1.49	0.08	1.61	0.08	0.08	0.00
Air conditioner-trailer mounted, ground support	3	Diesel	193	34	4,320	3.5	0.2	3.8	0.2	0.2	1.21E-05	1.09	0.06	1.19	0.06	0.06	0.00

Table A-3 MQ-25A Ground Support Equipment Emissions

Equipment Type	*Tier*	*Fuel*	*kW*	*Typical In-Use Load*	*Cumulative Annual Use Estimate (total hours)*	*Emission Rate (grams per kilowatt-hour)*						*Total Emissions from Annual Equipment Use (tons/year)*					
						CO	*VOC*	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*SO_2 (lbs/ hp-hr)[1]*	*CO*	*VOC*	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*SO_2*
Mobile electric power plant, 120 kVA	3	Diesel	164	34	4,320	3.5	0.2	3.8	0.2	0.2	1.21E-05	0.93	0.05	1.01	0.05	0.05	0.00
											TOTAL	***3.91***	***0.23***	***4.35***	***0.23***	***0.23***	***0.00***

Source: MQ-25A Fleet Integration Team provided a list of MQ-25A GSE and estimates of GSE run time.

Note: CO = carbon monoxide; GSE = ground support equipment; HP = horsepower; hp-hr = horsepower-hour; kVA = kilovolt-ampere; kW = kilowatt; lbs = pounds; NO_x = nitrogen oxide; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = particulate matter less than or equal to 10 microns in diameter; SO_2 = sulfur dioxide

[1] SO_2 was estimated based on U.S. Environmental Protection Agency factors for uncontrolled SO_2 emissions (used Small Gasoline and Diesel Engine worksheet to calculate emissions factor based on 1,000 hours operation and sulfur content of fuel): https://www.mecknc.gov/LUESA/AirQuality/PermittingRegulations/Pages/emissioncalcspsheet.aspx

A.2.4 GHG Emissions

To account for global warming potentials, GHG emissions are reported as a carbon dioxide equivalent (CO_2e) and commonly expressed in units of metric tons. CO_2e is calculated by multiplying the emissions of each GHG by its global warming potential and adding the results together to produce a single, combined emission rate representing all GHGs. For example, the global warming potential of methane is 265, therefore one metric ton of methane is equal to 265 metric tons of $C0_2e$ (USEPA, 2025).

Aircraft GHG emissions were calculated based on the "per operation" factors in the respective AESO reports discussed previously. Because GHG emissions are relevant across the entire flight profile, aircraft emissions were also calculated for operations occurring above 3,000 feet AGL. Table A-4 presents the GHG emissions generated below 3,000 feet AGL associated with LTOs, touch-and-go, and maintenance, and Table A-5 provides the times in mode, emission factors, and calculated annual emissions of GHGs for the estimated portion of aircraft operations that would take place above the mixing layer for both MQ-25A and E-2D aircraft. Table A-6 presents annual emissions of GHGs for MQ-25A ground support equipment.

Table A-4 Aircraft GHG Emissions Below 3,000 Feet AGL

Operation	*Number of LTOs/TGOs*	*Emission Factors (lbs per LTO/TGO cycle)*		*Annual Emissions*	
		Fuel Used (lbs)	*CO_2e*	*CO_2e (tons/year)*	*CO_2e (t/year)*
Single MQ-25A LTO	480	613	1936	465	422
Single E-2D LTO	480	1,161	3,774.69	906	822
Single E-2D TGO	960	339	1,102.52	529	480
Maintenance emissions from MQ-25A annually	20	72,702	229,810	2,298	2,085
			TOTAL	***4,198***	***3,808***

Notes: AGL = above ground level; CO_2e = carbon dioxide equivalent; lbs = pounds; LTO = landing and takeoff; t = metric tons; TGO = touch-and-go

Table A-5 Aircraft GHG Emissions Above 3,000 Feet AGL

Aircraft	*Mode*	*Annual TIM >3k' (min)*	*Fuel Flow Rate (lbs/hour)*	*Emission Factors (lbs/1,000 lbs fuel)*	*Annual Emissions*	
				CO_2e	*CO_2e (tons/year)*	*CO_2e (t/year)*
MQ-25A	Approach	5,184	1,222	3,161	167	151
	Climbout	10,368	4,035	3,161	1,102	1,000
	Circle	157,248	1,700	3,161	7,042	6,388
				MQ-25A TOTAL	***8,311***	***7,539***
E-2D	Approach	15,552	1,133	3,251.78	477	433
	Climbout	31,104	2,042	3,251.78	1,721	1,561
	Circle	471,744	1,133	3,251.78	14,484	13,139
				E-2D TOTAL	***16,682***	***15,134***
				GRAND TOTAL	***24,993***	***22,673***

Notes: >3k' = greater than 3,000 feet; AGL = above ground level; CO_2e = carbon dioxide equivalent; lbs = pounds; LTO = landing and takeoff; min = minutes; t = metric tons; TIM = time in mode

Table A-6 MQ-25A Ground Support Equipment GHG Emissions

Equipment Type	*Fuel*	*Tier*	*Engine HP*	*Annual Operating Hours*	*CO_2e*	*CO_2e (t/year)*
Test Stand, Hydraulic Portable, Diesel	Diesel	2	111	480	11	10
Cart, Corrosion Control	Diesel	2	9.8	2,160	4	4
Tow Tractor (Land Based)	Diesel	2	88	1,440	40	36
Air Conditioner, Diesel	Diesel	3	352	4,320	300	273
Air Conditioner - Trailer Mounted, Ground Support	Diesel	3	259	4,320	221	201
Mobile Electric Power Plant, 120 kVA	Diesel	3	220	4,320	188	170
				TOTAL	***764***	***693***

Notes: CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; HP = horsepower; kVA = kilovolt-ampere; t = metric tons

A.2.5 Construction and Personnel Commuter Emissions

The following sections provide outputs from ACAM Version 5.0.23a. ACAM, developed for the Air Force Civil Engineer Center and Solutio Environmental (Solutio Environmental, Inc., 2022), was used to calculate emissions generated by several project elements, including facility construction (grading, site preparation, trenching, paving, renovation, construction and architectural coating), along with emissions from construction worker commutes. These activities are anticipated to produce emissions from construction equipment operation, land disturbance, material transport, fuel combustion, and dust generation. Beyond construction-related emissions, ACAM was also used to calculated emissions associated with the anticipated increase in military personnel, E-2D Ground Support Equipment (AGE) and the diesel-powered generators associated with the Proposed Action.

Activity data specific to this project were integrated as inputs to ACAM. Project assumptions, including operational timelines and phasing, equipment mix and usage rates, personnel commuting patterns, and support requirements, were based on information provided by the applicant, relevant experience with similar projects when Proposed Action specifics were not known, and ACAM defaults. For the purpose of this analysis, construction activities associated with the Proposed Action are projected to commence in January 2026, with completion anticipated by February 2028. Emergency generators are expected to be installed near the end of construction period, by January 2028. The increase in personnel is projected to occur in phases, beginning in 2031 and culminating in 2034, and E-2D AGE activity is expected to commence around fiscal year 2031, coinciding with the arrival of personnel.

ACAM is an air emissions estimating model that performs an analysis to assess the potential air quality impacts associated with an action (e.g., Military Construction) in accordance with the Clean Air Act section 176(c) and the General Conformity Rule (Title 40 Code of Federal Regulations part 93 subpart B). Table A-7 presents a summary of construction, emergency generator, and personnel commute emissions as estimated by ACAM.

Table A-7 Summary ACAM Estimated Annual Air Pollutant Emissions from Construction Activities and Personnel Commutes

Year	Air Pollutant Emissions[1] (tons/year)						
	CO	NO_x[2]	PM_{10}	$PM_{2.5}$	SO_x	VOC[2]	CO_2e (t/year)
2026	1.824	1.482	6.826	0.057	0.003	0.172	297
2027	1.717	1.311	0.044	0.041	0.003	0.530	300
2028	0.535	0.819	0.031	0.030	0.006	0.425	90
2029	0.154	0.544	0.021	0.021	0.005	0.020	27
2030	0.154	0.544	0.021	0.021	0.005	0.020	27
2031	2.655	0.607	0.026	0.025	0.007	0.217	301
2032	5.061	0.667	0.030	0.029	0.008	0.410	579
2033	7.350	0.723	0.034	0.032	0.010	0.601	843
2034	9.639	0.778	0.038	0.036	0.011	0.791	1,113
2035 SS	9.639	0.778	0.038	0.036	0.011	0.791	1,113

Notes: ACAM = Air Conformity Applicability Model; CO = carbon monoxide; CO_2e = carbon dioxide equivalent; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; PM_{10} = particulate matter less than or equal to 10 microns in diameter; SO_x = sulfur oxides; SS = steady state; t = metric tons; VOCs = volatile organic compounds

[1] Emissions were estimated using ACAM version 5.0.23a (Solutio Environmental, Inc., 2022).

[2] VOCs and NO_x are precursors to the formation of ozone.

A.3 References

AESO. (2015a). *Aircraft Emission Estimates of E-2C/D Landing and Takeoff Cycle, and In-Frame Maintenance Testing Using JP-5. AESO Memorandum Report No. 9920 Revision E.* San Diego, CA: Aircraft Environmental Support Office. September.

AESO. (2015b). *Aircraft Emission Estimates of E-2C and E-2D Mission Operations Using JP-5. AESO Memorandum Report No. 9943 Revision E.* San Diego, CA: Aircraft Environmental Support Office. September.

AESO. (2020a). *Aircraft Emissions Estimates: MQ-25 Landing and Takeoff Cycle and In-Frame Maintenance Testing. AESO Memorandum Report No. 2019-17A.* San Diego, CA: Aircraft Environmental Support Office, Fleet Readiness Center Southwest. September.

AESO. (2020b). *Aircraft Emissions Estimates: MQ-25 Mission Operations. AESO Memorandum Report No. 2019-18A.* San Diego, CA: Aircraft Environmental Support Office. September.

AESO. (2020c). *Sulfur Dioxide Emission Index Using JP-5, JP-8 and F-24 Fuel. AESO Memorandum Report No. 2012-01 Revision H.* San Diego, CA: Aircraft Environmental Support Office. March.

Solutio Environmental, Inc. (2022). *USAF Air Conformity Applicability Model (ACAM). Version 5.0.23a.* Retrieved from https://aqhelp.com/acam.html.

USEPA. (2025). *Greenhouse Gas Equivalencies Calculator*. Retrieved from U.S. Environmental Protection Agency: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results.

A.4 Detail Air Conformity Applicability Model Report

This section presents an export of results directly from the air quality modeling software (ACAM), retaining the organizational headings, text, and table formatting produced by the software. This ACAM report section details the calculations performed to estimate emissions associated with construction, personnel, emergency generators, and E-2D ground support equipment.

To assess air quality impacts associated with construction activities occurring between 2026 and 2028, ACAM calculates the total number of days and hours each type of equipment would be used, based on industry standards. A conservative 20-mile on-installation commute is assumed for construction vehicles and workers, although the actual commute distance may be shorter. This assumption accounts for potential multiple daily trips for supplies and meal breaks.

For personnel, the report assumes the phased arrival of approximately 600 MQ-25A personnel beginning in 2031, with full staffing anticipated by 2034. A conservative, 20-mile commute is used for estimating travel distances, based on two trips per day, a five-day work week, and an assumption of no zero-emission privately owned vehicles.

ACAM was also used to estimate emissions associated with the installation and operation of the three diesel-powered generators included in the Proposed Action. These include two 500-kilowatt diesel-powered emergency generators located at buildings LP48 and LP48A and one 100-kilowatt diesel generator installed to support the Ground-Based Sense and Avoid LSTAR Tower. Emissions estimates were based on standard operational assumptions and project-specific details, applying an expected 30 hours of annual operation per generator to account for routine testing, maintenance, and potential emergency scenarios.

Finally, The ACAM "Aircraft and Engine" module was utilized to estimate emissions associated with the E-2D Ground Support Equipment (AGE), which include air compressors, air conditioners, generator sets, heaters, hydraulic test stands, light carts, and start carts. To estimate emissions associated with E-2D Ground Support Equipment, the E-2D LTO operations were simulated to determine corresponding AGE activity levels. It should be noted that this analysis is focused solely on emissions generated from ground support equipment and not the E-2D aircraft itself. Based on the proposed action timeline, AGE and aircraft activity is expected to commence around fiscal year 2031, coinciding with the arrival of personnel.

1. General Information

- Action Location
Base: GENERIC BASE
State: Virginia
County(s): Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Action Title: Home Basing of the MQ-25A Stingray Carrier-Based Unmanned Air System

- Project Number/s (if applicable): N/A

- Projected Action Start Date: 1 / 2026

- Action Purpose and Need:

The purpose of the Proposed Action is to base a new East Coast squadron designed to enhance aircraft carrier capability and versatility for the Joint Forces commander through the integration of a persistent, sea-based, multi-mission aerial refueling and intelligence, surveillance, and reconnaissance UAS into the carrier air wing .

The need for the Proposed Action is primarily to extend the range and reach of the carrier air wing on the East Coast to meet and pace current and future threats, with secondary recovery refueling and intelligence, surveillance, and reconnaissance capabilities in support of national defense objectives and policies. In this regard, the Proposed Action furthers the Navy's execution of its congressionally mandated roles and responsibilities under 10 U.S.C. section 8062.

- Action Description:

The Navy proposes to establish facilities and functions at Naval Station (NAVSTA) Norfolk, Virginia to support East Coast home basing and operations of the MQ-25A Stingray Carrier-based Unmanned Air Systems (Stingray CBUAS). Under the Proposed Action, the Navy would home base up to 20 Stingray CBUAS, renovate an existing hangar, construct supporting infrastructure; perform air vehicle (AV) maintenance; provide training for air vehicle pilots (AVPs) and maintainers; conduct approximately 960 Stingray CBUAS annual flight operations; and station approximately 600 personnel, plus their family members at Naval Station Norfolk, Virginia. The Proposed Action would involve facility construction and renovation between approximately fiscal year (FY) 2025 and FY 2029 followed by a phased move in of the facilities by aircraft and personnel between FY 2031 and FY 2035.

Under the Proposed Action, the East Coast home basing of the Stingray CBUAS would require new facilities and infrastructure. In particular, the Stingray CBUAS would require construction of a two story support facility, renovation of an existing hangar, installation of a Ground Based Detect and Avoid (GBDAA) system and Lightweight Surveillance and Target Acquisition Radar (LSTAR) tower; repairs to the existing run up testing pad, and modifications to the west aircraft wash rack

The Proposed Action requires military, civilian, and contractor personnel to perform Stingray CBUAS functions. Approximately 600 Stingray CBUAS military and civilian personnel would be stationed at NAVSTA Norfolk. Personnel would be added in phases over three to five years.

- Point of Contact

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Report generated with ACAM version: 5.0.23a

- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	Construction and Site Preparation for MILCON P-222
3.	Emergency Generator	Emergency Generator Installation for Building LP48 and LP48A
4.	Emergency Generator	Emergency Generator Installation for GBDAA/LSTAR Tower
5.	Personnel	Personnel FY 2031
6.	Personnel	Personnel FY 2032
7.	Personnel	Personnel FY 2033
8.	Personnel	Personnel FY 2034
9.	Aircraft	E-2D Ground Support Equipment

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: Construction and Site Preparation for MILCON P-222

- Activity Description:
The Proposed Action involves the renovation of hangar LP48, including two building additions, and the construction of a new LP48A support facility to the north. The project also includes paint restriping of the entire apron and west wash rack, replacement of two mounts at the run-up testing pads, and installation of a new Ground-Based Sense and Avoid (GBDAA) system and LSTAR tower. Site preparation activities include utility relocation, excavation, cut and fill, and grading, with anticipated elevation changes of 1-3 feet to achieve finished grades.

Site grading is a critical part of the preparation for new construction, covering the expansion of hangar LP48, the building of the new LP48A support facility, and the installation of the GBDAA/LSTAR tower. Grading will also support utility relocation and accommodate the expected 1 to 3-foot elevation changes. The total area assumed for site grading is 110,000 square feet, reflecting the extent of land preparation required for these facility and infrastructure improvements. Site grading is expected to begin in January 2026 and take approximately 6 months to complete. The amount of material to be hauled on-site is 6,700 cubic yards, and 900 cubic yards will be hauled off-site.

Trenching will be necessary for the relocation of utilities, as well as for the installation of new infrastructure. This includes electrical and fiber optic connections for the GBDAA/LSTAR tower and other essential systems tied to both hangar LP48 and LP48A. These trenching activities are a key component of the overall site preparation, ensuring the establishment of underground connections needed to support the Stingray CBUAS mission. The trenching area is estimated at 10,000 square feet, with 700 cubic yards of material to be hauled on-site and an additional 800 cubic yards to be hauled off-site. Trenching is expected to begin in July of 2026, and take approximately 2 months to complete. These estimates are based on a trench approximately two feet wide, four feet deep and 5,000 feet in distance.

The construction phase includes renovations to hangar LP48 and its two building additions, as well as the construction of the new LP48A support building. The renovated hangar will provide space for AV maintenance, flight planning, and support areas, while LP48A will house additional maintenance shops, operational training spaces, and personnel support areas. The total area for construction is estimated at 94,088 square feet, covering both renovation and new construction efforts. Construction is anticipated to begin in September 2026 and take approximately 18 months to complete, with the buildings' heights assumed to be 35 feet.

Architectural coating activities will cover both internal and external surfaces of hangar LP48 and the new LP48A support facility. Additionally, it includes restriping the apron and west wash rack to accommodate Stingray CBUAS parking and operations. The total area assumed for architectural coating is 63,900 square feet, encompassing all surfaces that will require painting or finishing, including the renovated structures and exterior markings. The architectural coating phase is expected to begin in December 2027 and take approximately 2 months to complete.

Paving activities will focus on key areas such as the run-up test pad and aircraft wash rack. The total area for paving is estimated at 25,000 square feet, covering both asphalt and concrete work to ensure the upgrades meet the

operational needs for Stingray CBUAS. Paving is expected to begin in February of 2028 and take approximately 1 month to complete.

- Activity Start Date
Start Month: 1
Start Month: 2026

- Activity End Date
Indefinite: False
End Month: 2
End Month: 2028

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.106715
SO_x	0.006552
NO_x	3.068231
CO	3.922606

Pollutant	Total Emissions (TONs)
PM 10	6.879790
PM 2.5	0.105941
Pb	0.000000
NH_3	0.009734

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.027622
N_2O	0.016719

Pollutant	Total Emissions (TONs)
CO_2	722.061477
CO_2e	727.733564

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.027619
N_2O	0.016717

Pollutant	Total Emissions (TONs)
CO_2	721.983844
CO_2e	727.655482

2.1 Site Grading Phase

2.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 1
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 6
Number of Days: 0

2.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 110000
Amount of Material to be Hauled On-Site (yd^3): 6700

Amount of Material to be Hauled Off-Site (yd^3): 900

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Graders Composite	1	8
Other Construction Equipment Composite	1	8
Rubber Tired Dozers Composite	1	8
Tractors/Loaders/Backhoes Composite	2	7

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Graders Composite [HP: 148] [LF: 0.41]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.31292	0.00490	2.52757	3.39734	0.14041	0.12918
Other Construction Equipment Composite [HP: 82] [LF: 0.42]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.28160	0.00487	2.73375	3.50416	0.15811	0.14546
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.35280	0.00491	3.22260	2.72624	0.14205	0.13069
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.18406	0.00489	1.88476	3.48102	0.06347	0.05839

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Graders Composite [HP: 148] [LF: 0.41]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02153	0.00431	530.81500	532.63663
Other Construction Equipment Composite [HP: 82] [LF: 0.42]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02140	0.00428	527.54121	529.35159
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02160	0.00432	532.54993	534.37751
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.70686	531.52468

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**NH_3**
LDGV	0.24693	0.00166	0.12605	3.79468	0.00443	0.00392	0.04942
LDGT	0.20609	0.00206	0.15718	3.28057	0.00506	0.00447	0.04174
HDGV	0.73588	0.00470	0.59291	10.11613	0.01994	0.01764	0.09079
LDDV	0.10663	0.00124	0.14984	5.40767	0.00364	0.00334	0.01643
LDDT	0.16311	0.00141	0.42108	4.71893	0.00569	0.00523	0.01698
HDDV	0.11141	0.00422	2.31293	1.45606	0.04257	0.03916	0.06665
MC	2.58645	0.00200	0.66857	12.24584	0.02234	0.01976	0.05452

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	**N_2O**	**CO_2**	**CO_2e**
LDGV	0.01491	0.00490	320.12657	321.95651
LDGT	0.01412	0.00680	396.22932	398.60697
HDGV	0.05128	0.02600	904.79960	913.82064
LDDV	0.05404	0.00067	367.38031	368.93032
LDDT	0.04024	0.00098	415.42062	416.71812
HDDV	0.02667	0.16412	1256.68964	1306.26349
MC	0.11083	0.00291	394.98905	398.62781

2.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD}$ = (20 * ACRE * WD) / 2000

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)

ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)

2000: Conversion Factor pounds to tons

2.2 Trenching/Excavating Phase

2.2.1 Trenching / Excavating Phase Timeline Assumptions

- Phase Start Date
Start Month: 7
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 2
Number of Days: 0

2.2.2 Trenching / Excavating Phase Assumptions

- General Trenching/Excavating Information
Area of Site to be Trenched/Excavated (ft^2): 10000
Amount of Material to be Hauled On-Site (yd^3): 700
Amount of Material to be Hauled Off-Site (yd^3): 800

- Trenching Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	2	8
Other General Industrial Equipment Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.2.3 Trenching / Excavating Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Excavators Composite [HP: 36] [LF: 0.38]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.39317	0.00542	3.40690	4.22083	0.09860	0.09071
Other General Industrial Equipment Composite [HP: 35] [LF: 0.34]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.45335	0.00542	3.58824	4.59368	0.11309	0.10404
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.18406	0.00489	1.88476	3.48102	0.06347	0.05839

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Excavators Composite [HP: 36] [LF: 0.38]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02381	0.00476	587.02896	589.04350
Other General Industrial Equipment Composite [HP: 35] [LF: 0.34]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02385	0.00477	587.87714	589.89459
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.70686	531.52468

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**NH_3**
LDGV	0.24693	0.00166	0.12605	3.79468	0.00443	0.00392	0.04942
LDGT	0.20609	0.00206	0.15718	3.28057	0.00506	0.00447	0.04174
HDGV	0.73588	0.00470	0.59291	10.11613	0.01994	0.01764	0.09079
LDDV	0.10663	0.00124	0.14984	5.40767	0.00364	0.00334	0.01643
LDDT	0.16311	0.00141	0.42108	4.71893	0.00569	0.00523	0.01698
HDDV	0.11141	0.00422	2.31293	1.45606	0.04257	0.03916	0.06665
MC	2.58645	0.00200	0.66857	12.24584	0.02234	0.01976	0.05452

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	**N_2O**	**CO_2**	**CO_2e**
LDGV	0.01491	0.00490	320.12657	321.95651
LDGT	0.01412	0.00680	396.22932	398.60697
HDGV	0.05128	0.02600	904.79960	913.82064
LDDV	0.05404	0.00067	367.38031	368.93032

LDDT	0.04024	0.00098	415.42062	416.71812
HDDV	0.02667	0.16412	1256.68964	1306.26349
MC	0.11083	0.00291	394.98905	398.62781

2.2.4 Trenching / Excavating Phase Formula(s)

- Fugitive Dust Emissions per Phase
$PM10_{FD} = (20 * ACRE * WD) / 2000$
$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)

WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.3 Building Construction Phase

2.3.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 9
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 18
Number of Days: 0

2.3.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 94088
Height of Building (ft): 35
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	6
Forklifts Composite	2	6
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8
Welders Composite	3	8

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips
Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.3.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19758	0.00487	1.83652	1.63713	0.07527	0.06925
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.24594	0.00487	2.34179	3.57902	0.11182	0.10287
Generator Sets Composite [HP: 14] [LF: 0.74]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.53947	0.00793	4.32399	2.85973	0.17412	0.16019
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.18406	0.00489	1.88476	3.48102	0.06347	0.05839
Welders Composite [HP: 46] [LF: 0.45]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.46472	0.00735	3.57020	4.49314	0.09550	0.08786

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02140	0.00428	527.46069	529.27080
Forklifts Composite [HP: 82] [LF: 0.2]				

	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02138	0.00428	527.09717	528.90603
Generator Sets Composite [HP: 14] [LF: 0.74]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02305	0.00461	568.32694	570.27730
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.70686	531.52468
Welders Composite [HP: 46] [LF: 0.45]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02305	0.00461	568.29068	570.24091

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.24693	0.00166	0.12605	3.79468	0.00443	0.00392	0.04942
LDGT	0.20609	0.00206	0.15718	3.28057	0.00506	0.00447	0.04174
HDGV	0.73588	0.00470	0.59291	10.11613	0.01994	0.01764	0.09079
LDDV	0.10663	0.00124	0.14984	5.40767	0.00364	0.00334	0.01643
LDDT	0.16311	0.00141	0.42108	4.71893	0.00569	0.00523	0.01698
HDDV	0.11141	0.00422	2.31293	1.45606	0.04257	0.03916	0.06665
MC	2.58645	0.00200	0.66857	12.24584	0.02234	0.01976	0.05452

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01491	0.00490	320.12657	321.95651
LDGT	0.01412	0.00680	396.22932	398.60697
HDGV	0.05128	0.02600	904.79960	913.82064
LDDV	0.05404	0.00067	367.38031	368.93032
LDDT	0.04024	0.00098	415.42062	416.71812
HDDV	0.02667	0.16412	1256.68964	1306.26349
MC	0.11083	0.00291	394.98905	398.62781

2.3.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower

LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase
$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.4 Architectural Coatings Phase

2.4.1 Architectural Coatings Phase Timeline Assumptions

- Phase Start Date
Start Month: 12
Start Quarter: 1
Start Year: 2027

- Phase Duration
Number of Month: 2
Number of Days: 0

2.4.2 Architectural Coatings Phase Assumptions

- General Architectural Coatings Information
Building Category: Non-Residential
Total Square Footage (ft^2): 63900
Number of Units: N/A

- Architectural Coatings Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.4.3 Architectural Coatings Phase Emission Factor(s)

- Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.24693	0.00166	0.12605	3.79468	0.00443	0.00392	0.04942
LDGT	0.20609	0.00206	0.15718	3.28057	0.00506	0.00447	0.04174
HDGV	0.73588	0.00470	0.59291	10.11613	0.01994	0.01764	0.09079
LDDV	0.10663	0.00124	0.14984	5.40767	0.00364	0.00334	0.01643
LDDT	0.16311	0.00141	0.42108	4.71893	0.00569	0.00523	0.01698

HDDV	0.11141	0.00422	2.31293	1.45606	0.04257	0.03916	0.06665
MC	2.58645	0.00200	0.66857	12.24584	0.02234	0.01976	0.05452

- Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01491	0.00490	320.12657	321.95651
LDGT	0.01412	0.00680	396.22932	398.60697
HDGV	0.05128	0.02600	904.79960	913.82064
LDDV	0.05404	0.00067	367.38031	368.93032
LDDT	0.04024	0.00098	415.42062	416.71812
HDDV	0.02667	0.16412	1256.68964	1306.26349
MC	0.11083	0.00291	394.98905	398.62781

2.4.4 Architectural Coatings Phase Formula(s)

- Worker Trips Emissions per Phase
$VMT_{WT} = (1 * WT * PA) / 800$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
1: Conversion Factor man days to trips (1 trip / 1 man * day)
WT: Average Worker Round Trip Commute (mile)
PA: Paint Area (ft^2)
800: Conversion Factor square feet to man days (1 ft^2 / 1 man * day)

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_{AC} = (AB * 2.0 * 0.0116) / 2000.0$

VOC_{AC}: Architectural Coating VOC Emissions (TONs)
BA: Area of Building (ft^2)
2.0: Conversion Factor total area to coated area (2.0 ft^2 coated area / total area)
0.0116: Emission Factor (lb/ft^2)
2000: Conversion Factor pounds to tons

2.5 Paving Phase

2.5.1 Paving Phase Timeline Assumptions

- Phase Start Date

Start Month: 2
Start Quarter: 1
Start Year: 2028

- Phase Duration
Number of Month: 1
Number of Days: 0

2.5.2 Paving Phase Assumptions

- General Paving Information
Paving Area (ft^2): 25000

- Paving Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cement and Mortar Mixers Composite	4	6
Pavers Composite	1	7
Paving Equipment Composite	1	8
Rollers Composite	1	7
Tractors/Loaders/Backhoes Composite	1	7

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.5.3 Paving Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.55275	0.00855	4.19697	3.25556	0.16292	0.14989
Pavers Composite [HP: 81] [LF: 0.42]						

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.21588	0.00486	2.33827	3.43520	0.10542	0.09699
Paving Equipment Composite [HP: 89] [LF: 0.36]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.16337	0.00488	1.88314	3.37709	0.05778	0.05316
Rollers Composite [HP: 36] [LF: 0.38]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.50057	0.00542	3.50905	4.08429	0.13206	0.12150
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.17299	0.00489	1.74942	3.49553	0.04787	0.04404

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02314	0.00463	570.33256	572.28980
Pavers Composite [HP: 81] [LF: 0.42]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02133	0.00427	525.89644	527.70118
Paving Equipment Composite [HP: 89] [LF: 0.36]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02141	0.00428	527.90982	529.72147
Rollers Composite [HP: 36] [LF: 0.38]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02382	0.00476	587.11688	589.13172
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02148	0.00430	529.56544	531.38277

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.24693	0.00166	0.12605	3.79468	0.00443	0.00392	0.04942
LDGT	0.20609	0.00206	0.15718	3.28057	0.00506	0.00447	0.04174
HDGV	0.73588	0.00470	0.59291	10.11613	0.01994	0.01764	0.09079
LDDV	0.10663	0.00124	0.14984	5.40767	0.00364	0.00334	0.01643
LDDT	0.16311	0.00141	0.42108	4.71893	0.00569	0.00523	0.01698
HDDV	0.11141	0.00422	2.31293	1.45606	0.04257	0.03916	0.06665
MC	2.58645	0.00200	0.66857	12.24584	0.02234	0.01976	0.05452

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01491	0.00490	320.12657	321.95651
LDGT	0.01412	0.00680	396.22932	398.60697
HDGV	0.05128	0.02600	904.79960	913.82064
LDDV	0.05404	0.00067	367.38031	368.93032
LDDT	0.04024	0.00098	415.42062	416.71812
HDDV	0.02667	0.16412	1256.68964	1306.26349
MC	0.11083	0.00291	394.98905	398.62781

2.5.4 Paving Phase Formula(s)

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = PA * 0.25 * (1 / 27) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
PA: Paving Area (ft^2)
0.25: Thickness of Paving Area (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

VMT_{WT} = WD * WT * 1.25 * NE

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
VOC_P = (2.62 * PA) / 43560 / 2000

VOC_P: Paving VOC Emissions (TONs)
2.62: Emission Factor (lb/acre)
PA: Paving Area (ft^2)
43560: Conversion Factor square feet to acre (43560 ft2 / acre)^2 / acre)
2000: Conversion Factor square pounds to TONs (2000 lb / TON)

3. Emergency Generator

3.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: Emergency Generator Installation for Building LP48 and LP48A

- Activity Description:
The proposed action includes the installation of two parallel diesel emergency generators to support operations at buildings LP48 and LP48A. Each generator is anticipated to have a capacity of 500 kilowatts (670 HP) and will be equipped with a 24-hour base fuel tank to ensure continuous power supply during outages and other emergencies. These generators are critical for maintaining operational readiness and supporting essential functions within the facility, such as aircraft maintenance, communication systems, and other mission-essential activities, ensuring that operations can continue uninterrupted in the event of a power failure.
Given the timeline, the generators are expected to be installed and operational by the end of the facility construction phase, ahead of the phased move-in of personnel and aircraft. For the purposes of this analysis, It is assumed that these generators will arrive onsite in January 2028. Additionally, it is assumed that each generator will

operate for 30 hours per year, based on standard industry practices for testing, maintenance and occasional use during power outages.

- Activity Start Date
Start Month: 1
Start Year: 2028

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.014392
SO_x	0.000251
NO_x	0.520590
CO	0.138288

Pollutant	Emissions Per Year (TONs)
PM 10	0.016261
PM 2.5	0.016261
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000931
N_2O	0.000186

Pollutant	Emissions Per Year (TONs)
CO_2	23.115000
CO_2e	26.733000

3.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 2

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 670
Average Operating Hours Per Year (hours): 30

3.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

3.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

4. Emergency Generator

4.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: Emergency Generator Installation for GBDAA/LSTAR Tower

- Activity Description:
The proposed action includes the installation of an emergency diesel generator, estimated at 100 kilowatts (135 HP), to support operations at the GBDAA/LSTAR tower, which will provide airspace awareness for UAS pilots and ensure the safe operation of unmanned systems. This generator will be connected to the existing installation infrastructure via electrical and fiber optic tie-ins to the Air Traffic Control (ATC) tower. The GBDAA/LSTAR tower itself is anticipated to reach a maximum height of 155 feet. The generator is essential for maintaining continuous power supply during outages or other emergencies, ensuring UAS pilots can maintain critical airspace awareness and safety. For the purposed of this analysis, it is assumed that the generator will arrive on site and be installed by January 28 to coincide with the facilities readiness for operational testing and integration. It is expected to operate for 30 hours per year, following standard industry practices for testing, maintenance and use during outages.

- Activity Start Date
Start Month: 1
Start Year: 2028

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.005650
SO_x	0.004759
NO_x	0.023288

Pollutant	Emissions Per Year (TONs)
PM 10	0.005083
PM 2.5	0.005083
Pb	0.000000

CO	0.015552

NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000094
N_2O	0.000019

Pollutant	Emissions Per Year (TONs)
CO_2	2.328750
CO_2e	2.693250

4.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: Yes

- Emergency Generators Consumption
Emergency Generator's Horsepower: 135 (default)
Average Operating Hours Per Year (hours): 30 (default)

4.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

4.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
$AE_{POL} = (NGEN * HP * OT * EF_{POL}) / 2000$

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

5. Personnel

5.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: Personnel FY 2031

- Activity Description:
The Proposed Action requires military, civilian, and contractor personnel to perform Stingray CBUAS functions. Approximately 600 Stingray CBUAS military and civilian personnel would be stationed at NAVSTA Norfolk. Personnel would be added in phases over three to five years between FY 2031 and FY 2035. It is assumed that 150 personnel will arrive each year over the course of four years, with approximately 105 active duty military personnel and 45 civilian personnel arriving annually.
Personnel associated with the Proposed Action would each be accompanied by an estimated 1.1 family members including spouses, children, and adult dependents.

- Activity Start Date
Start Month: 1
Start Year: 2031

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.196503
SO_x	0.001559
NO_x	0.062996
CO	2.501471

Pollutant	Emissions Per Year (TONs)
PM 10	0.004159
PM 2.5	0.003678
Pb	0.000000
NH_3	0.034165

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.011106
N_2O	0.004183

Pollutant	Emissions Per Year (TONs)
CO_2	300.622113
CO_2e	302.145717

5.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 105
Civilian Personnel: 45
Support Contractor Personnel: 0
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule

Active Duty Personnel:	5 Days Per Week (default)
Civilian Personnel:	5 Days Per Week (default)
Support Contractor Personnel:	5 Days Per Week (default)
Air National Guard (ANG) Personnel:	4 Days Per Week (default)
Reserve Personnel:	4 Days Per Month (default)

5.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

5.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.21005	0.00157	0.05725	2.98761	0.00424	0.00375	0.04443
LDGT	0.17080	0.00196	0.06466	2.58279	0.00466	0.00412	0.03637
HDGV	0.54340	0.00472	0.33041	7.38410	0.01716	0.01518	0.08640
LDDV	0.09965	0.00121	0.13573	6.22389	0.00486	0.00447	0.01635
LDDT	0.06539	0.00127	0.08080	3.09724	0.00391	0.00360	0.01739
HDDV	0.07181	0.00391	1.46849	1.28512	0.01820	0.01675	0.06860
MC	2.44444	0.00200	0.66065	11.63199	0.02233	0.01975	0.05617

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01140	0.00411	302.11653	303.62543
LDGT	0.01086	0.00541	377.58786	379.47112
HDGV	0.03864	0.01993	908.35236	915.24937
LDDV	0.05135	0.00066	360.19971	361.68016
LDDT	0.04040	0.00097	378.47749	379.77732
HDDV	0.02588	0.16829	1169.01574	1219.81314
MC	0.10459	0.00290	395.27114	398.75101

5.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_{C} + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_{C}: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

6. Personnel

6.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: Personnel FY 2032

- Activity Description:
The Proposed Action requires military, civilian, and contractor personnel to perform Stingray CBUAS functions. Approximately 600 Stingray CBUAS military and civilian personnel would be stationed at NAVSTA Norfolk. Personnel would be added in phases over three to five years between FY 2031 and FY 2035. It is assumed that 150 personnel will arrive each year over the course of four years, with approximately 105 active duty military personnel and 45 civilian personnel arriving annually.
Personnel associated with the Proposed Action would each be accompanied by an estimated 1.1 family members including spouses, children, and adult dependents.

- Activity Start Date
Start Month: 1
Start Year: 2032

- Activity End Date
Indefinite: Yes
End Month: N/A

End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.193818
SO_x	0.001550
NO_x	0.060060
CO	2.405449

Pollutant	Emissions Per Year (TONs)
PM 10	0.004131
PM 2.5	0.003659
Pb	0.000000
NH_3	0.033133

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.010843
N_2O	0.004168

Pollutant	Emissions Per Year (TONs)
CO_2	299.064546
CO_2e	300.576014

6.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 105
Civilian Personnel: 45
Support Contractor Personnel: 0
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

6.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

6.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.20750	0.00156	0.05411	2.83371	0.00417	0.00369	0.04254

LDGT	0.16791	0.00195	0.06101	2.49689	0.00465	0.00412	0.03555
HDGV	0.51958	0.00473	0.29872	7.02259	0.01651	0.01460	0.08566
LDDV	0.10013	0.00122	0.14146	6.29134	0.00506	0.00465	0.01609
LDDT	0.06400	0.00126	0.07635	3.01541	0.00390	0.00359	0.01717
HDDV	0.06594	0.00387	1.34036	1.25587	0.01557	0.01432	0.06888
MC	2.42238	0.00200	0.65930	11.53134	0.02233	0.01975	0.05643

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01097	0.00408	299.89560	301.38527
LDGT	0.01066	0.00540	375.97333	377.84614
HDGV	0.03724	0.01961	910.48157	917.24711
LDDV	0.04984	0.00066	360.30221	361.74453
LDDT	0.03966	0.00097	376.79723	378.07870
HDDV	0.02571	0.16889	1156.61816	1207.58987
MC	0.10346	0.00290	395.26820	398.71961

6.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

7. Personnel

7.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: Personnel FY 2033

- Activity Description:
The Proposed Action requires military, civilian, and contractor personnel to perform Stingray CBUAS functions. Approximately 600 Stingray CBUAS military and civilian personnel would be stationed at NAVSTA Norfolk. Personnel would be added in phases over three to five years between FY 2031 and FY 2035. It is assumed that 150 personnel will arrive each year over the course of four years, with approximately 105 active duty military personnel and 45 civilian personnel arriving annually.
Personnel associated with the Proposed Action would each be accompanied by an estimated 1.1 family members including spouses, children, and adult dependents.

- Activity Start Date
Start Month: 1
Start Year: 2033

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.190432
SO_x	0.001534
NO_x	0.055709
CO	2.289360

Pollutant	Emissions Per Year (TONs)
PM 10	0.004113
PM 2.5	0.003637
Pb	0.000000
NH_3	0.032163

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.010510
N_2O	0.004143

Pollutant	Emissions Per Year (TONs)
CO_2	295.729644
CO_2e	297.225717

7.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 105
Civilian Personnel: 45

Support Contractor Personnel: 0
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

7.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

7.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.20313	0.00154	0.04974	2.66346	0.00421	0.00372	0.04081
LDGT	0.16495	0.00193	0.05540	2.38252	0.00459	0.00406	0.03475
HDGV	0.50075	0.00472	0.28244	6.70903	0.01637	0.01448	0.08531
LDDV	0.09712	0.00121	0.13455	6.34503	0.00550	0.00506	0.01607
LDDT	0.06333	0.00125	0.07359	2.94670	0.00392	0.00361	0.01690
HDDV	0.05835	0.00383	1.22567	1.22399	0.01313	0.01208	0.06904
MC	2.39560	0.00200	0.65789	11.42837	0.02233	0.01975	0.05669

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01050	0.00405	296.14341	297.61159
LDGT	0.01035	0.00537	371.88859	373.74612
HDGV	0.03626	0.01942	909.26543	915.95149
LDDV	0.04925	0.00066	358.71533	360.14256
LDDT	0.03867	0.00097	374.52569	375.78236
HDDV	0.02559	0.16919	1144.62359	1195.68146
MC	0.10231	0.00290	395.26100	398.68287

7.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$
VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

8. Personnel

8.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: Personnel FY 2034

- Activity Description:
The Proposed Action requires military, civilian, and contractor personnel to perform Stingray CBUAS functions. Approximately 600 Stingray CBUAS military and civilian personnel would be stationed at NAVSTA Norfolk. Personnel would be added in phases over three to five years between FY 2031 and FY 2035. It is assumed that 150 personnel will arrive each year over the course of four years, with approximately 105 active duty military personnel and 45 civilian personnel arriving annually.
Personnel associated with the Proposed Action would each be accompanied by an estimated 1.1 family members including spouses, children, and adult dependents.

- Activity Start Date
Start Month: 1
Start Year: 2034

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.190432
SO_x	0.001534
NO_x	0.055709
CO	2.289360

Pollutant	Emissions Per Year (TONs)
PM 10	0.004113
PM 2.5	0.003637
Pb	0.000000
NH_3	0.032163

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.010510
N_2O	0.004143

Pollutant	Emissions Per Year (TONs)
CO_2	295.729644
CO_2e	297.225717

8.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 105
Civilian Personnel: 45
Support Contractor Personnel: 0
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

8.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

8.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.20313	0.00154	0.04974	2.66346	0.00421	0.00372	0.04081
LDGT	0.16495	0.00193	0.05540	2.38252	0.00459	0.00406	0.03475
HDGV	0.50075	0.00472	0.28244	6.70903	0.01637	0.01448	0.08531
LDDV	0.09712	0.00121	0.13455	6.34503	0.00550	0.00506	0.01607
LDDT	0.06333	0.00125	0.07359	2.94670	0.00392	0.00361	0.01690
HDDV	0.05835	0.00383	1.22567	1.22399	0.01313	0.01208	0.06904
MC	2.39560	0.00200	0.65789	11.42837	0.02233	0.01975	0.05669

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01050	0.00405	296.14341	297.61159
LDGT	0.01035	0.00537	371.88859	373.74612
HDGV	0.03626	0.01942	909.26543	915.95149
LDDV	0.04925	0.00066	358.71533	360.14256
LDDT	0.03867	0.00097	374.52569	375.78236
HDDV	0.02559	0.16919	1144.62359	1195.68146
MC	0.10231	0.00290	395.26100	398.68287

8.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

9. Aircraft

9.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Norfolk City
Regulatory Area(s): Norfolk-Virginia Beach-Newport News (Hampton Roads), VA

- Activity Title: E-2D Ground Support Equipment

- Activity Description:
The proposed action involves the operation of E-2D aircraft as part of Stingray CBUAS support, including ground support provided by various types of Aerospace Ground Equipment (AGE). AGE is essential for maintaining aircraft readiness, facilitating air vehicle operations, and ensuring the safe take-off and landing of the E-2D aircraft used as chase aircraft during Stingray CBUAS missions. The E-2D Ground Support Equipment includes equipment such as air compressors, air conditioners, generator sets, heaters, hydraulic test stands, light carts, and start carts, all of which contribute to the operational readiness of the aircraft. For the purposes of this analysis, the proposed E-2D landing and takeoff (LTO) cycles were simulated to estimate the corresponding AGE usages and emissions. It should be noted that this section does not include emissions from the E-2D aircraft itself but instead presents solely emissions from the ground support equipment required for operations. These emissions are the only ones presented and included in this analysis below. Based on the proposed action timeline, AGE and aircraft activity is expected to commence around FY 2031, coinciding with the arrival of personnel.

- Activity Start Date
Start Month: 1
Start Year: 2031

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	6.510474
SO_x	0.841299
NO_x	23.404788
CO	11.347001

Pollutant	Emissions Per Year (TONs)
PM 10	0.823104
PM 2.5	0.772876
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.077461
N_2O	0.015245

Pollutant	Emissions Per Year (TONs)
CO_2	1866.601605
CO_2e	1873.082366

- Activity Emissions of Criteria Pollutants [LTO Flight Operations (includes Trim Test & APU) part]:

Pollutant	Emissions Per Year (TONs)
VOC	4.880720
SO_x	0.393693
NO_x	2.107486
CO	7.088857

Pollutant	Emissions Per Year (TONs)
PM 10	0.287493
PM 2.5	0.258750
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses [LTO Flight Operations (includes Trim Test & APU) part]:

Pollutant	Emissions Per Year (TONs)
CH_4	0.049561
N_2O	0.009669

Pollutant	Emissions Per Year (TONs)
CO_2	1178.666025
CO_2e	1182.786926

- Activity Emissions of Criteria Pollutants [Aerospace Ground Equipment (AGE) part]:

Pollutant	Emissions Per Year (TONs)
VOC	1.629754
SO_x	0.447606
NO_x	21.297302
CO	4.258145

Pollutant	Emissions Per Year (TONs)
PM 10	0.535611
PM 2.5	0.514127
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses [Aerospace Ground Equipment (AGE) part]:

Pollutant	Emissions Per Year (TONs)
CH_4	0.027899
N_2O	0.005576

Pollutant	Emissions Per Year (TONs)
CO_2	687.935580
CO_2e	690.295440

9.2 Aircraft & Engines

9.2.1 Aircraft & Engines Assumptions

- Aircraft & Engine
Aircraft Designation: E-2D
Engine Model: T56-A-427
Primary Function: Transport - Bomber
Aircraft has After burn: No
Number of Engines: 2

- Aircraft & Engine Surrogate
Is Aircraft & Engine a Surrogate? No
Original Aircraft Name:

Original Engine Name:

9.2.2 Aircraft & Engines Emission Factor(s)

- Aircraft & Engine Criteria Pollutant Emission Factors (lb/1000lb fuel)

	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Idle	794.00	24.15	1.07	3.90	32.00	0.83	0.75
Approach	1423.00	14.26	1.07	4.40	22.20	0.97	0.87
Intermediate	1825.00	0.58	1.07	9.20	2.40	0.51	0.46
Military	2302.00	0.46	1.07	9.30	2.10	0.50	0.45
After Burn	0.00	0.00	0.00	0.00	0.00	0.00	0.00

- Aircraft & Engine Greenhouse Gasses Pollutant Emission Factors (lb/1000lb fuel)

	Fuel Flow	CH_4	N_2O	CO_2	CO_2e
Idle	794.00	0.13	0.03	3203.44	3214.64
Approach	1423.00	0.13	0.03	3203.44	3214.64
Intermediate	1825.00	0.13	0.03	3203.44	3214.64
Military	2302.00	0.13	0.03	3203.44	3214.64
After Burn	0.00	0.13	0.03	3203.44	3214.64

9.3 Flight Operations

9.3.1 Flight Operations Assumptions

- Flight Operations
Number of Aircraft: 10
Flight Operation Cycle Type: LTO (Landing and Takeoff)
Number of Annual Flight Operation Cycles for all Aircraft: 480
Number of Annual Trim Test(s) per Aircraft: 12

- Default Settings Used: Yes

- Flight Operations TIMs (Time In Mode)
Taxi [Idle] (mins): 15.9 (default)
Approach [Approach] (mins): 5.1 (default)
Climb Out [Intermediate] (mins): 1.2 (default)
Takeoff [Military] (mins): 0.4 (default)
Takeoff [After Burn] (mins): 0 (default)

Per the Air Emissions Guide for Air Force Mobile Sources, the defaults values for military aircraft equipped with after burner for takeoff is 50% military power and 50% afterburner. (Exception made for F-35 where KARNES 3.2 flight profile was used)

- Trim Test
Idle (mins): 12 (default)

Approach (mins): 27 (default)
Intermediate (mins): 9 (default)
Military (mins): 12 (default)
AfterBurn (mins): 0 (default)

9.3.2 Flight Operations Formula(s)

- Aircraft Emissions per Mode for Flight Operation Cycles per Year
AEM_{POL} = (TIM / 60) * (FC / 1000) * EF * NE * FOC / 2000

AEM_{POL}: Aircraft Emissions per Pollutant & Mode (TONs)
TIM: Time in Mode (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)
NE: Number of Engines
FOC: Number of Flight Operation Cycles (for all aircraft)
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for Flight Operation Cycles per Year
$AE_{FOC} = AEM_{IDLE\_IN} + AEM_{IDLE\_OUT} + AEM_{APPROACH} + AEM_{CLIMBOUT} + AEM_{TAKEOFF}$

AE_{FOC}: Aircraft Emissions (TONs)
AEM_{IDLE_IN}: Aircraft Emissions for Idle-In Mode (TONs)
AEM_{IDLE_OUT}: Aircraft Emissions for Idle-Out Mode (TONs)
$AEM_{APPROACH}$: Aircraft Emissions for Approach Mode (TONs)
$AEM_{CLIMBOUT}$: Aircraft Emissions for Climb-Out Mode (TONs)
$AEM_{TAKEOFF}$: Aircraft Emissions for Take-Off Mode (TONs)

- Aircraft Emissions per Mode for Trim per Year
$AEPS_{POL}$ = (TD / 60) * (FC / 1000) * EF * NE * NA * NTT / 2000

$AEPS_{POL}$: Aircraft Emissions per Pollutant & Power Setting (TONs)
TD: Test Duration (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)
NE: Number of Engines
NA: Number of Aircraft
NTT: Number of Trim Test
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for Trim per Year
$AE_{TRIM} = AEPS_{IDLE} + AEPS_{APPROACH} + AEPS_{INTERMEDIATE} + AEPS_{MILITARY} + AEPS_{AFTERBURN}$

AE_{TRIM}: Aircraft Emissions (TONs)
$AEPS_{IDLE}$: Aircraft Emissions for Idle Power Setting (TONs)
$AEPS_{APPROACH}$: Aircraft Emissions for Approach Power Setting (TONs)
$AEPS_{INTERMEDIATE}$: Aircraft Emissions for Intermediate Power Setting (TONs)
$AEPS_{MILITARY}$: Aircraft Emissions for Military Power Setting (TONs)

$AEPS_{AFTERBURN}$: Aircraft Emissions for After Burner Power Setting (TONs)

9.4 Auxiliary Power Unit (APU)

9.4.1 Auxiliary Power Unit (APU) Assumptions

- Default Settings Used: Yes

- Auxiliary Power Unit (APU) (default)

Number of APU per Aircraft	Operation Hours for Each LTO	Exempt Source?	Designation	Manufacturer

9.4.2 Auxiliary Power Unit (APU) Emission Factor(s)

- Auxiliary Power Unit (APU) Criteria Pollutant Emission Factors (lb/hr)

Designation	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5

- Auxiliary Power Unit (APU) Greenhouse Gasses Emission Factors (lb/hr)

Designation	Fuel Flow	CH_4	N_2O	CO_2	CO_2e

9.4.3 Auxiliary Power Unit (APU) Formula(s)

- Auxiliary Power Unit (APU) Emissions per Year
$APU_{POL} = APU * OH * LTO * EF_{POL} / 2000$

APU_{POL}: Auxiliary Power Unit (APU) Emissions per Pollutant (TONs)
APU: Number of Auxiliary Power Units
OH: Operation Hours for Each LTO (hour)
LTO: Number of LTOs
EF_{POL}: Emission Factor for Pollutant (lb/hr)
2000: Conversion Factor pounds to tons

9.5 Aerospace Ground Equipment (AGE)

9.5.1 Aerospace Ground Equipment (AGE) Assumptions

- Default Settings Used: Yes

- AGE Usage
Number of Annual LTO (Landing and Take-off) cycles for AGE: 480

- Aerospace Ground Equipment (AGE) (default)

Total Number of AGE	Operation Hours for Each LTO	Exempt Source?	AGE Type	Designation
1	10	No	Air Compressor	MC-1A - 18.4hp

1	1	No	Air Conditioner	MA-3D - 120hp
1	11	No	Generator Set	A/M32A-86D
1	1	No	Heater	H1
1	3	No	Hydraulic Test Stand	MJ-2A
1	10	No	Light Cart	NF-2
1	0.25	No	Start Cart	A/M32A-60A

9.5.2 Aerospace Ground Equipment (AGE) Emission Factor(s)

- Aerospace Ground Equipment (AGE) Emission Factor (lb/hr)

Designation	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
MC-1A - 18.4hp	1.1	0.267	0.008	0.419	0.267	0.071	0.068
MA-3D - 120hp	7.1	0.053	0.050	4.167	0.317	0.109	0.105
A/M32A-86D	6.5	0.294	0.046	6.102	0.457	0.091	0.089
H1	0.4	0.100	0.011	0.160	0.180	0.006	0.006
MJ-2A	0.0	0.190	0.238	3.850	2.460	0.083	0.076
NF-2	0.0	0.010	0.043	0.110	0.080	0.010	0.010
A/M32A-60A	0.0	0.270	0.306	1.820	5.480	0.211	0.205

- Aerospace Ground Equipment (AGE) Greenhouse Gasses Emission Factors (lb/hr)

Designation	Fuel Flow	CH_4	N_2O	CO_2	CO_2e
MC-1A - 18.4hp	1.1	0.0	0.0	24.5	24.6
MA-3D - 120hp	7.1	0.0	0.0	160.2	160.8
A/M32A-86D	6.5	0.0	0.0	145.6	146.1
H1	0.4	0.0	0.0	8.8	8.8
MJ-2A	0.0	0.0	0.0	184.7	185.3
NF-2	0.0	0.0	0.0	23.7	23.8
A/M32A-60A	0.0	0.0	0.0	237.4	238.2

9.5.3 Aerospace Ground Equipment (AGE) Formula(s)

- Aerospace Ground Equipment (AGE) Emissions per Year

$AGE_{POL} = AGE * OH * LTO * EF_{POL} / 2000$

AGE_{POL}: Aerospace Ground Equipment (AGE) Emissions per Pollutant (TONs)
AGE: Total Number of Aerospace Ground Equipment
OH: Operation Hours for Each LTO (hour)
LTO: Number of LTOs
EF_{POL}: Emission Factor for Pollutant (lb/hr)
2000: Conversion Factor pounds to tons

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