Appendix F
Air Quality

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ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Engineering and the Environment
EPA	U.S. Environmental Protection Agency
GHG	greenhouse gas
lb/hr	pounds per hour
IPCC	Intergovernmental Panel on Climate Change
MOA	Military Operations Area
UAV	unmanned aerial vehicle

APPENDIX F
AIR QUALITY

F.1 FOX 3 MOA EXPANSION AND NEW PAXON MOA

Table F-1 shows the average sortie duration and altitude distribution for aircraft operating in the affected area of the Fox 3 Military Operations Area (MOA) expansion and new Paxon MOA action alternatives.

Table F-1. Altitude Distribution for Aircraft Operating in Affected Area of the Fox 3 MOA Expansion and New Paxon MOA Action

Aircraft Type	Altitude Distribution [1,2] (Typical Percentage of Sortie Duration Time – total 100%)						
	500–1,000 ft AGL	1,000–3,000 ft AGL	3,000–5,000 ft AGL	5,000–10,000 ft AGL	10,000 ft AGL–FL180	FL180 and above	Total Percentage of Time Below 3,000 ft
A-10	33	17	16	24	10	0	50
AV-8	4	2	3	5	26	60	6
B-1B	2	5	5	3	20	65	7
B-2	0	0	0	0	3	97	0
B-52	0	1	1	3	5	90	1
CH-47	20	27	28	25	0	0	47
C-130	28	15	15	22	20	–	43
C-17	10	12	13	30	23	12	22
E-3	0	0	0	0	0	100	0
E-767	0	0	0	0	0	100	0
F-15C	0	2	3	10	25	60	2
F-15E	5	1	0	10	25	50	6
F-15J	5	1	0	10	25	50	6
F-16	4	2	3	5	26	60	6
F-16CJ	4	2	3	5	26	60	6
F-22	5	2	3	5	10	75	7
GR1	5	2	3	12	28	50	7
HC-130	28	15	15	22	20	–	43
F-18	5	2	3	12	28	50	7
HH-60	20	27	28	25	0	0	47
KC-10	0	0	0	0	0	100	0
KC-130	0	0	0	0	0	100	0
KC-135R	0	0	0	0	0	100	0
KC-767	0	0	0	0	0	100	0
OH-58	20	27	28	25	0	0	47
UH-60	20	27	28	25	0	0	47

Key: AGL = above ground level; ft = feet

1. Shaded cells indicate that operations occurring at these altitudes do not impact ground-level concentrations and air quality.
2. Typical sortie duration in MOAs = 0.7 hours.

Table F-2 shows the emissions factors used to calculate emissions from aircraft operations below 3,000 feet associated with the Fox 3 MOA expansion and new Paxon MOA action alternatives.

Table F-2. Emission Factors and Operational Information for Aircraft that Operate Below 3,000 Feet in the Expanded Fox 3 and New Paxon MOAs

Aircraft	Engine Type	Number of Engines	Fuel Flow/ Engine (lb/hr)	Pounds/1000 Pounds Fuel								
				VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
A-10	TF34-GE-100/100A	2	1,776	0.40	4.08	5.96	1.80	0.27	0.24	3,130.43	0.10	0.09
AV-8	F402-RR-406A	1	8,094	0.43	6.93	10.78	1.80	0.32	0.29	3,130.43	0.10	0.09
B-1B	F101-GE-102	4	7,904	0.11	0.84	12.80	1.80	0.17	0.15	3,130.43	0.10	0.09
B-2	F118-GE-100	4	10,992	0.00	0.74	33.05	1.80	0.11	0.10	3,130.43	0.10	0.09
B-52	JT3D-3B	8	9,720	0.98	1.05	12.05	1.80	0.39	0.35	3,130.43	0.10	0.09
CH-47	T55-L-7C	2	1,736	0.16	2.56	7.43	1.80	0.16	0.14	3,130.43	0.10	0.09
C-130	T56-A-9	4	2,088	0.41	2.47	1.17	1.80	0.31	0.28	3,130.43	0.10	0.09
C-17	F117-PW-100	4	14,111	0.11	0.38	34.23	1.80	0.12	0.11	3,130.43	0.10	0.09
E-3	JT3D-3B	4	9,720	0.98	1.05	12.05	1.80	0.39	0.35	3,130.43	0.10	0.09
E-767	JT9D-70	2	16,182	N/A	N/A	N/A	N/A	N/A	N/A	3,130.43	0.10	0.09
F-15C	F100-PW-220	2	9,776	2.30	0.86	29.26	1.80	1.01	0.91	3,130.43	0.10	0.09
F-15E	F100-PW-229	2	11,601	0.40	0.40	57.52	1.80	0.38	0.34	3,130.43	0.10	0.09
F-15J	F100-PW-229	2	11,601	0.40	0.40	57.52	1.80	0.38	0.34	3,130.43	0.10	0.09
F-16	F100-PW-200	1	8,801	4.02	0.67	39.04	1.80	1.86	1.67	3,130.43	0.10	0.09
F-16CJ	F100-PW-200	1	8,801	4.02	0.67	39.04	1.80	1.86	1.67	3,130.43	0.10	0.09
F-22	F119-PW-1003	2	18,612	0.00	0.80	19.80	1.80	1.12	1.01	3,130.43	0.10	0.09
GR1	RB199-34R Mk 103	2	28,672	0.24	12.14	9.20	1.80	0.17	0.15	3,130.43	0.10	0.09
HC-130	T56-A-9	4	2,088	0.41	2.47	1.17	1.80	0.31	0.28	3,130.43	0.10	0.09
F-18	F404-GE-400	2	28,672	0.24	12.14	9.20	1.80	0.17	0.15	3,130.43	0.10	0.09
HH-60	T700-GE-401/401C	1	443	0.53	10.11	5.60	1.80	0.46	0.41	3,130.43	0.10	0.09
KC-10	F103-GE-100/101	3	19,929	0.62	0.50	36.46	1.80	0.41	0.37	3,130.43	0.10	0.09
KC-130	T56-A-9	4	2,088	N/A	N/A	N/A	N/A	N/A	N/A	3,130.43	0.10	0.09
KC-135R	F108-CF-100	4	6,521	N/A	N/A	N/A	N/A	N/A	N/A	3,130.43	0.10	0.09
KC-767	JT9D-70	2	16,182	N/A	N/A	N/A	N/A	N/A	N/A	3,130.43	0.10	0.09
OH-58	T700-GE-401/401C	1	443	0.53	10.11	5.60	1.80	0.46	0.41	3,130.43	0.10	0.09
UH-60	T700-GE-401/401C	1	443	0.53	10.11	5.60	1.80	0.46	0.41	3,130.43	0.10	0.09

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; lb/hr = pounds per hour; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. All engines are assumed to run at military power setting.

Table F-3 shows the baseline and proposed sortie data for Alternatives A and E of the Fox 3 MOA expansion and new Paxon MOA action.

Table F-3. Sortie Data for Alternatives A and E of the Fox 3 MOA Expansion and New Paxon MOA Action

Baseline Number of Sorties

Aircraft	Stony MOA	Fox 3 MOA[1]
A-1q0	0	645
AV-8	0	253
B-1B	0	1
B-2	0	54
B-52	0	113
CH-47	0	0
C-130	0	133
C-17	4	53
E-3	0	99
E-767	0	29
F-15C	539	688
F-15E	0	284
F-15J	0	219
F-16	0	3,599
F-16CJ	0	265
F-22	1,942	2,717
GR1	0	275
HC-130	0	0
F-18	11	106
HH-60	0	0
KC-10	0	1
KC-130	0	16
KC-135R	6	413
KC-767	0	24
OH-58	0	0
UH-60	0	0
Total	**2,502**	**9,987**

1. Fox 3 baseline sorties all occur over 3,000 feet.

Alternatives A and E Number of Sorties

Aircraft	Stony MOA	Fox 3 MOA	Paxon MOA[1]
A-10	0	645	573
AV-8	0	253	220
B-1B	0	1	0
B-2	0	54	0
B-52	0	113	0
CH-47	0	0	0
C-130	0	133	111
C-17	2	55	35
E-3	0	99	0
E-767	0	29	0
F-15C	270	958	214
F-15E	0	284	215
F-15J	0	219	180
F-16	0	3,599	2,523
F-16CJ	0	265	235
F-22	971	3,688	465
GR1	0	275	231
HC-130	0	0	0
F-18	6	112	0
HH-60	0	0	0
KC-10	0	1	15
KC-130	0	16	393
KC-135R	3	416	20
KC-767	0	24	0
OH-58	0	0	0
UH-60	0	0	0
Total	**1,251**	**11,238**	**5,430**

1. Paxon MOA sorties are estimated to be the same as the 2011 Delta MOA sorties.

Alternatives A and E Change in Number of Sorties with Portions Under 3,000 ft

Aircraft	Stony MOA	Fox 3 MOA[1]	Paxon MOA
A-10	0	645	573
AV-8	0	253	220
B-1B	0	1	0
B-2	0	54	0
B-52	0	113	0
CH-47	0	0	0
C-130	0	133	111
C-17	-2	55	35
E-3	0	99	0
E-767	0	29	0
F-15C	-270	958	214
F-15E	0	284	215
F-15J	0	219	180
F-16	0	3,599	2,523
F-16CJ	0	265	235
F-22	-971	3,688	465
GR1	0	275	231
HC-130	0	0	0
F-18	-6	112	0
HH-60	0	0	0
KC-10	0	1	15
KC-130	0	16	393
KC-135R	-3	416	20
KC-767	0	24	0
OH-58	0	0	0
UH-60	0	0	0
Total	**-1,251**	**11,238**	**5,430**

1. Portion of the Fox 3 proposed sorties will occur below 3,000 feet as shown in Table F-2.

Table F-4 shows the change in emissions at the Stony MOA due to changes in operations associated with Alternatives A and E of the Fox 3 addition and new Paxon MOA action.

Table F-4. Change in Emissions at Stony MOA under Alternatives A and E of the Fox 3 MOA Expansion and New Paxon MOA Action

Aircraft	Change in Annual Criteria Pollutant Emissions (Tons/Year)						Change in Annual Green House Gas (GHG) Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e[1]
C-17	0.00	0.00	-0.28	-0.01	0.00	0.00	-107	0.00	0.00	-108
F-15C	-0.08	-0.03	-1.03	-0.06	-0.04	-0.03	-4,988	-0.16	-0.14	-5,035
F-22	0.00	-0.67	-16.70	-1.52	-0.94	-0.85	-34,215	-1.12	-0.98	-34,534
F-18	0.00	-0.09	-0.07	-0.01	0.00	0.00	-299	-0.01	-0.01	-301
KC-135	0.00	0.00	0.00	0.00	0.00	0.00	-74	0.00	0.00	-75
Total	**-0.08**	**-0.80**	**-18.08**	**-1.61**	**-0.98**	**-0.89**	**-39,683**	**-1.30**	**-1.13**	**-40,053**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. Intergovernmental Panel on Climate Change (IPCC), *Fourth Assessment Report and Global Warming Potentials*, 2007.

Table F-5 shows the change in emissions at the Fox 3 MOA due to changes in operations associated with Alternatives A and E of the Fox 3 MOA addition and new Paxon MOA action.

Table F-5. Change in Emissions at Fox 3 MOA under Alternatives A and E of the Fox 3 MOA Expansion and New Paxon MOA Action

Aircraft	Change in Annual Criteria Pollutant Emissions (Tons/Year)						Change in Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e[2]
A-10	0.15	1.56	2.28	0.69	0.10	0.09	2,168	0.07	0.06	2,189
AV-8	0.02	0.28	0.44	0.07	0.01	0.01	1,938	0.06	0.06	1,956
B-1B[1]	0.00	0.00	0.01	0.00	0.00	0.00	30	0.00	0.00	30
B-2	0.00	0.00	0.00	0.00	0.00	0.00	2,248	0.07	0.06	2,268
B-52	0.03	0.03	0.35	0.05	0.01	0.01	8,318	0.27	0.24	8,396
C-130	0.07	0.39	0.19	0.29	0.05	0.04	1,052	0.03	0.03	1,061
C-17	0.03	0.09	7.79	0.41	0.03	0.03	2,939	0.10	0.08	2,966
E-3[1]	0.00	0.00	0.00	0.00	0.00	0.00	3,644	0.12	0.10	3,678
E-767[1]	0.00	0.00	0.00	0.00	0.00	0.00	888	0.03	0.03	897
F-15C	0.29	0.11	3.65	0.22	0.13	0.11	17,723	0.58	0.51	17,888
F-15E	0.05	0.05	7.58	0.24	0.05	0.04	6,238	0.20	0.18	6,296
F-15J	0.04	0.04	5.85	0.18	0.04	0.03	4,810	0.16	0.14	4,855
F-16	2.55	0.42	24.73	1.14	1.18	1.06	29,985	0.98	0.85	30,264
F-16CJ	0.19	0.03	1.82	0.08	0.09	0.08	2,208	0.07	0.06	2,228
F-22	0.00	2.56	63.42	5.77	3.59	3.24	129,955	4.25	3.70	131,166
GR1	0.09	4.47	3.39	0.66	0.06	0.06	14,928	0.49	0.43	15,067
F-18	0.04	1.81	1.37	0.27	0.03	0.02	6,053	0.20	0.17	6,109
KC-10[1]	0.00	0.00	0.00	0.00	0.00	0.00	57	0.00	0.00	57
KC-130[1]	0.00	0.00	0.00	0.00	0.00	0.00	127	0.00	0.00	128
KC-135R[1]	0.00	0.00	0.00	0.00	0.00	0.00	10,271	0.34	0.29	10,367
KC-767[1]	0.00	0.00	0.00	0.00	0.00	0.00	735	0.02	0.02	742
Total	**3.53**	**11.85**	**122.87**	**10.08**	**5.36**	**4.83**	**246,313**	**8.06**	**7.02**	**248,607**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. All aircraft activities occur in the MOA above 3,000 feet. Only changes in GHG emissions are assessed.
2. IPCC, Fourth Assessment Report and Global Warming Potentials, 2007.

Table F-6 shows the change in emissions at the New Paxon MOA due to changes in operations associated with Alternatives A and E of the Fox 3 MOA addition and New Paxon MOA action.

Table F-6. Change in Emissions at New Paxon MOA Under Alternatives A and E of the Fox 3 MOA Expansion and New Paxon MOA Action

Aircraft	Change in Criteria Pollutant Emissions (Tons/Year)						Change in Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^2
A-10	0.14	1.38	2.02	0.61	0.09	0.08	1,926	0.06	0.05	1,944
AV-8	0.02	0.25	0.38	0.06	0.01	0.01	1,686	0.06	0.05	1,701
C-130	0.05	0.33	0.16	0.24	0.04	0.04	878	0.03	0.03	886
C-17	0.02	0.06	4.96	0.26	0.02	0.02	1,870	0.06	0.05	1,887
F-15C	0.06	0.02	0.82	0.05	0.03	0.03	3,961	0.13	0.11	3,998
F-15E	0.04	0.04	5.74	0.18	0.04	0.03	4,722	0.15	0.13	4,766
F-15J	0.03	0.03	4.80	0.15	0.03	0.03	3,953	0.13	0.11	3,990
F-16	1.79	0.30	17.34	0.80	0.83	0.74	21,020	0.69	0.60	21,216
F-16CJ	0.17	0.03	1.61	0.07	0.08	0.07	1,958	0.06	0.06	1,976
F-22	0.00	0.32	8.00	0.73	0.45	0.41	16,385	0.54	0.47	16,538
GR1	0.07	3.75	2.84	0.56	0.05	0.05	12,539	0.41	0.36	12,656
KC-10[1]	0.00	0.00	0.00	0.00	0.00	0.00	849	0.03	0.02	857
KC-130[1]	0.00	0.00	0.00	0.00	0.00	0.00	3,108	0.10	0.09	3,137
KC-135[1]	0.00	0.00	0.00	0.00	0.00	0.00	494	0.02	0.01	498
Total	**2.38**	**6.51**	**48.67**	**3.71**	**1.67**	**1.50**	**75,349**	**2.47**	**2.15**	**76,051**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. All aircraft activities occur in the MOA above 3,000 feet. Only changes in GHG emissions are assessed.
2. IPCC, Fourth Assessment Report and Global Warming Potentials, 2007.

Table F-7 shows the total change in emissions due to Alternatives A and E of the Fox 3 MOA addition and New Paxon action.

Table F-7. Total Change in Emissions for Alternatives A and E of the Fox 3 MOA Expansion and New Paxon MOA Action

Area	Change in Criteria Pollutant Emissions (Tons/Year)						Change in Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^1
Stony MOA	-0.08	-0.80	-18.08	-1.61	-0.98	-0.89	-39,683	-1.30	-1.13	-40,053
Fox 3 MOA	3.53	11.85	122.87	10.08	5.36	4.83	246,313	8.06	7.02	248,607
Paxon MOA	2.38	6.51	48.67	3.71	1.67	1.50	75,349	2.47	2.15	76,051
Total	**5.83**	**17.56**	**153.47**	**12.18**	**6.04**	**5.44**	**281,979**	**9.23**	**8.04**	**284,606**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, Fourth Assessment Report and Global Warming Potentials, 2007

F.2 REALISTIC LIVE ORDNANCE DELIVERY (RLOD)

Table F-8 shows the operational data for RLOD action alternatives.

Table F-8. Change in Munitions Usage for RLOD Action Alternatives A and B

Change in Munitions Usage for Alternative A

Impact Area	GBU 32
R-2202	200

Change in Munitions Usage for Alternative B

Impact Area	GBU 32
R-2202	100
R-2211	100

Explosive Weight for GBU-32: 165.5 lb per item

Table F-9 shows the emission factors used to calculate emissions from changes in munitions use from the RLOD action alternatives.

Table F-9. Munitions Emission Factors

Munitions Type	Pounds/Ton of Explosive[1]					
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
GBU-32	7.01	554.89	0.00	--	0.71	0.04

Key: CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1, Criteria pollutant emission factors obtained from "AP-42 Section 15," U.S. Environmental Protection Agency (EPA), 2008.

Table F-10 shows the change in emissions due to the operations associated with RLOD Alternative A.

Table F-10. Change in Emissions for RLOD Alternative A

Impact Area	Annual Criteria Pollutant Emissions (Tons/Year)					
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
R-2202	0.06	4.59	0.00	--	0.01	0.00
Total	**0.06**	**4.59**	**0.00**	**0.00**	**0.01**	**0.00**

Key: CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

Table F-11 shows the change in emissions due to the operations associated with RLOD Alternative B.

Table F-11. Change in Emissions for RLOD Alternative B

Impact Area	Annual Criteria Pollutant Emissions (Tons/Year)					
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$
R-2202	0.03	2.30	0.00	--	0.00	0.00
R-22011	0.03	2.30	0.00	--	0.00	0.00
Total	**0.06**	**4.59**	**0.00**	**0.00**	**0.01**	**0.00**

Key: CO = carbon monoxide; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

F.3 UNMANNED AERIAL VEHICLE

Table F-12 shows the sortie information for the unmanned aerial vehicle (UAV) corridor action.

Table F-12. UAV Sortie and Operational Information

UAV	Number of Daily Trips	Number of Days per Year	Airspeed (Knots/Hr)[1]	Airspeed (Miles/Hour)[1]	Weight (lbs)
MQ-1 (Predator)	1.6	242	70	80.57	2,250
RQ-4 (Global Hawk)	1.6	242	310	356.81	32,250
MQ-5B (Hunter)	1.6	242	106	122.006	1,600
MQ-9 (Reaper)	1.6	242	200	230.2	10,050
RQ-8B (Fire Scout)	1.6	242	110	126.61	3,150
RQ-7B (Shadow)[3]	1.6	242	90	103.59	375
MQ-1C (Gray Eagle)	1.6	242	70	80.57	2,250
BAT-MAV WASP III[2]	1.6	242	100	115.1	14

1. Airspeed and weight data obtained from AF or Navy official websites.
2. The BAT-MAV WASP III is electric powered, thus it produces no significant emissions.
3. RQ-7B airspeed and weight information estimated from internet sources.

Table F-13 shows the corridor information for the UAV corridor action.

Table F-13. UAV Corridor Information

Corridor	Distance Per Trip (miles)
Eielson Air Force Base to R-2211	30
Eielson Air Force Base to R-2205	20
Allen Army Airfield and R-2202	10
R-2202 to R-2211	30
R-2205 to R-2202	35
Fort Wainwright and R-2211	35
Fort Wainwright and R-2205	15

Table F-14 shows the Small UAV operational information and criteria pollutant emissions factors for the UAV corridor action.

Table F-14. Small UAV Operational Information and Criteria Pollutant Emissions Factors

UAV	Fuel Flow Rate (lb/hr)[1]	Pounds/Hour[2]					
		VOCs	CO	NO_x	SO_2[3]	PM_{10}	$PM_{2.5}$
MQ-1 (Predator)	114.40	1.59	0.48	2.80	0.21	0.40	0.40
MQ-5B (Hunter)	81.35	1.59	0.48	2.80	0.15	0.40	0.40
MQ-9 (Reaper)	511.01	1.59	0.48	2.80	0.92	0.40	0.40
RQ-7B (Shadow)	19.07	1.59	0.48	2.80	0.03	0.40	0.40
MQ-1C (Gray Eagle)	114.40	1.59	0.48	2.80	0.21	0.40	0.40

Key: lb/hr = pounds per hour; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. Fuel flow rates for small UAVs estimated using the RQ-4 intermediate flow rate multiplied by the weight ratio of the UAV and the RQ-4.
2. Tetra Tech, *Environmental Assessment for Routine and Recurring Unmanned Aerial Vehicle Flight Operations at Edwards Air Force Base, California*,.2006.
3. SO_2 emission factors (lb SO_2/1,000 lb fuel) were calculated as: 20 x weight percent sulfur content of the fuel, per geographic region (specifically 0.09 the Pacific region.) The factors shown were converted into pounds per hour using the fuel flow rates.

Table F-15 shows the Large UAV operational information and criteria pollutant emissions factors for the UAV corridor action.

Table F-15. Large UAV Operational Information and Emissions Factors

UAV	Fuel Flow Rate (lb/hr)[1]	Pounds/1,000 Pound Fuel[1]					
		VOCs	CO	NO_x	SO_2[2]	PM_{10}	$PM_{2.5}$
MQ-4 (Global Hawk)	1639.80	0.01	0.45	15.06	1.80	1.58	1.58

Key: lb/hr = pounds per hour; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. Tetra Tech. *Environmental Assessment for Routine and Recurring Unmanned Aerial Vehicle Flight Operations at Edwards Air Force Base, California*. 2006.
2. SO_2 emission factors (lb SO_2/1,000 lb fuel) were calculated as follows: 20 × weight percent sulfur content of the fuel, per geographic region (specifically 0.09 the Pacific region.)

Table F-16 shows the Rotary Powered UAV operational information and criteria pollutant emissions factors for the UAV corridor action.

Table F-16. Rotary Powered UAV Operational Information and Emissions Factors

UAV	Fuel Flow Rate (lb/hr)[1]	Pounds/1,000 Pound Fuel[1]					
		VOCs	CO	NO_x	SO_2[2]	PM_{10}	$PM_{2.5}$
RQ-8B (Fire Scout)	592.39	1.07	17.24	4.46	1.80	0.51	0.46

Key: lb/hr = pounds per hour; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. Air Force Center for Engineering and the Environment (AFCEE). *Air Emissions Factor Guide to Air Force Mobile Sources.* 2009.
2. SO2 emission factors (lb SO2/1,000 lb fuel) were calculated as follows: 20 × weight percent sulfur content of the fuel, per geographic region (specifically 0.09 the Pacific region.)

Table F-17 shows the greenhouse gas emission factors for aviation fuel.

Table F-17. Green House Gas Emission Factors for Aviation Fuel

Pounds/1,000 Pound Fuel[1]		
CO_2	CH_4	N_2O
3,096.18	0.10	0.09

Key: CH_4 = methane; CO_2 = carbon dioxide; GHG = greenhouse gas; N_2O = nitrous oxide

1. GHG emission factors obtained from General Reporting Protocol, Tables C.3 and C.6 jet fuel (California Climate Action Registry 2009).

Table F-18 shows the annual emissions by UAV type from operations in the proposed corridor between Eielson Air Force Base and R-2211.

Table F-18. Estimated Annual Emissions from UAV Operations in the Proposed Corridor Between Eielson Air Force Base and R-2211

UAV	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^1
MQ-1 (Predator)	0.11	0.03	0.20	0.01	0.03	0.03	24.81	0.00	0.00	25.04
MQ-4 (Global Hawk)	0.00	0.01	0.40	0.05	0.04	0.04	80.29	0.00	0.00	81.03
MQ-5B (Hunter)	0.07	0.02	0.13	0.01	0.02	0.02	11.65	0.00	0.00	11.76
MQ-9 (Reaper)	0.04	0.01	0.07	0.02	0.01	0.01	38.78	0.00	0.00	39.14
RQ-8B (Fire Scout)	0.03	0.46	0.12	0.05	0.01	0.01	81.74	0.00	0.00	82.50
RQ-7B (Shadow)	0.09	0.03	0.15	0.00	0.02	0.02	3.22	0.00	0.00	3.25
MQ-1C (Gray Eagle)	0.11	0.03	0.20	0.01	0.03	0.03	24.81	0.00	0.00	25.04
Total	**0.46**	**0.60**	**1.27**	**0.16**	**0.16**	**0.16**	**265.29**	**0.01**	**0.01**	**267.74**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, Fourth Assessment Report and Global Warming Potentials, 2007.

Table F-19 shows the annual emissions by UAV type from operations in the proposed corridor between Eielson Air Force Base and R-2205.

Table F-19. Estimated Emissions from UAV Operations in the Proposed Corridor Between Eielson Air Force Base and R-2205

UAV	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^1
MQ-1 (Predator)	0.08	0.02	0.13	0.01	0.02	0.02	16.54	0.00	0.00	16.69
MQ-4 (Global Hawk)	0.00	0.01	0.26	0.03	0.03	0.03	53.53	0.00	0.00	54.02
MQ-5B (Hunter)	0.05	0.01	0.09	0.00	0.01	0.01	7.77	0.00	0.00	7.84
MQ-9 (Reaper)	0.03	0.01	0.05	0.02	0.01	0.01	25.85	0.00	0.00	26.09
RQ-8B (Fire Scout)	0.02	0.31	0.08	0.03	0.01	0.01	54.49	0.00	0.00	55.00
RQ-7B (Shadow)	0.06	0.02	0.10	0.00	0.01	0.01	2.14	0.00	0.00	2.16
MQ-1C (Gray Eagle)	0.08	0.02	0.13	0.01	0.02	0.02	16.54	0.00	0.00	16.69
Total	0.30	0.40	0.84	0.10	0.11	0.11	176.86	0.01	0.01	178.49

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, Fourth Assessment Report and Global Warming Potentials, 2007.

Table F-20 shows the annual emissions by UAV type from operations in the proposed corridor between Allan Army Airfield and R-2202.

Table F-20. Estimated Emissions from UAV Operations in the Proposed Corridor Between Allen Army Airfield and R-2202

UAV	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^1
MQ-1 (Predator)	0.04	0.01	0.07	0.00	0.01	0.01	8.27	0.00	0.00	8.35
MQ-4 (Global Hawk)	0.00	0.00	0.13	0.02	0.01	0.01	26.76	0.00	0.00	27.01
MQ-5B (Hunter)	0.02	0.01	0.04	0.00	0.01	0.01	3.88	0.00	0.00	3.92
MQ-9 (Reaper)	0.01	0.00	0.02	0.01	0.00	0.00	12.93	0.00	0.00	13.05
RQ-8B (Fire Scout)	0.01	0.15	0.04	0.02	0.00	0.00	27.25	0.00	0.00	27.50
RQ-7B (Shadow)	0.03	0.01	0.05	0.00	0.01	0.01	1.07	0.00	0.00	1.08
MQ-1C (Gray Eagle)	0.04	0.01	0.07	0.00	0.01	0.01	8.27	0.00	0.00	8.35
Total	**0.15**	**0.20**	**0.42**	**0.05**	**0.05**	**0.05**	**88.43**	**0.00**	**0.00**	**89.25**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, Fourth Assessment Report and Global Warming Potentials, 2007.

Table F-21 shows the annual emissions by UAV type from operations in the proposed corridor between R-2202 and R-2211.

Table F-21. Estimated Emissions from UAV Operations in the Proposed Corridor Between R-2202 and R-2211

UAV	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^1
MQ-1 (Predator)	0.11	0.03	0.20	0.01	0.03	0.03	24.81	0.00	0.00	25.04
MQ-4 (Global Hawk)	0.00	0.01	0.40	0.05	0.04	0.04	80.29	0.00	0.00	81.03
MQ-5B (Hunter)	0.07	0.02	0.13	0.01	0.02	0.02	11.65	0.00	0.00	11.76
MQ-9 (Reaper)	0.04	0.01	0.07	0.02	0.01	0.01	38.78	0.00	0.00	39.14
RQ-8B (Fire Scout)	0.03	0.46	0.12	0.05	0.01	0.01	81.74	0.00	0.00	82.50
RQ-7B (Shadow)	0.09	0.03	0.15	0.00	0.02	0.02	3.22	0.00	0.00	3.25
MQ-1C (Gray Eagle)	0.11	0.03	0.20	0.01	0.03	0.03	24.81	0.00	0.00	25.04
Total	**0.46**	**0.60**	**1.27**	**0.16**	**0.16**	**0.16**	**265.29**	**0.01**	**0.01**	**267.74**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, *Fourth Assessment Report and Global Warming Potentials*, 2007.

Table F-22 shows the annual emissions by UAV type from operations in the proposed corridor between R-2205 and R-2202.

Table F-22. Estimated Emissions from UAV Operations in the Proposed Corridor Between R-2205 and R-2202

UAV	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^1
MQ-1 (Predator)	0.13	0.04	0.23	0.02	0.03	0.03	28.94	0.00	0.00	29.21
MQ-4 (Global Hawk)	0.00	0.01	0.46	0.06	0.05	0.05	93.67	0.00	0.00	94.54
MQ-5B (Hunter)	0.09	0.03	0.15	0.01	0.02	0.02	13.59	0.00	0.00	13.72
MQ-9 (Reaper)	0.05	0.01	0.08	0.03	0.01	0.01	45.24	0.00	0.00	45.66
RQ-8B (Fire Scout)	0.03	0.54	0.14	0.06	0.02	0.01	95.36	0.00	0.00	96.25
RQ-7B (Shadow)	0.10	0.03	0.18	0.00	0.03	0.03	3.75	0.00	0.00	3.79
MQ-1C (Gray Eagle)	0.13	0.04	0.23	0.02	0.03	0.03	28.94	0.00	0.00	29.21
Total	**0.53**	**0.70**	**1.48**	**0.18**	**0.19**	**0.19**	**309.50**	**0.01**	**0.01**	**312.36**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, *Fourth Assessment Report and Global Warming Potentials*, 2007.

Table F-23 shows the annual emissions by UAV type from operations in the proposed corridor between Fort Wainwright and R-2211.

Table F-23. Estimated Emissions from UAV Operations in the Proposed Corridor Between Fort Wainwright and R-2211

UAV	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e^1
MQ-1 (Predator)	0.13	0.04	0.23	0.02	0.03	0.03	28.94	0.00	0.00	29.21
MQ-4 (Global Hawk)	0.00	0.01	0.46	0.06	0.05	0.05	93.67	0.00	0.00	94.54
MQ-5B (Hunter)	0.09	0.03	0.15	0.01	0.02	0.02	13.59	0.00	0.00	13.72
MQ-9 (Reaper)	0.05	0.01	0.08	0.03	0.01	0.01	45.24	0.00	0.00	45.66
RQ-8B (Fire Scout)	0.03	0.54	0.14	0.06	0.02	0.01	95.36	0.00	0.00	96.25
RQ-7B (Shadow)	0.10	0.03	0.18	0.00	0.03	0.03	3.75	0.00	0.00	3.79
MQ-1C (Gray Eagle)	0.13	0.04	0.23	0.02	0.03	0.03	28.94	0.00	0.00	29.21
Total	**0.53**	**0.70**	**1.48**	**0.18**	**0.19**	**0.19**	**309.50**	**0.01**	**0.01**	**312.36**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, *Fourth Assessment Report and Global Warming Potentials*, 2007

Table F-24 shows the annual emissions by UAV type from operations in the proposed corridor between Fort Wainwright and R-2205.

Table F-24. Estimated Emissions from UAV Operations in the Proposed Corridor Between Fort Wainwright and R-2205

UAV	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e[1]
MQ-1 (Predator)	0.06	0.02	0.10	0.01	0.01	0.01	12.40	0.00	0.00	12.52
MQ-4 (Global Hawk)	0.00	0.01	0.20	0.02	0.02	0.02	40.14	0.00	0.00	40.52
MQ-5B (Hunter)	0.04	0.01	0.07	0.00	0.01	0.01	5.82	0.00	0.00	5.88
MQ-9 (Reaper)	0.02	0.01	0.03	0.01	0.00	0.00	19.39	0.00	0.00	19.57
RQ-8B (Fire Scout)	0.01	0.23	0.06	0.02	0.01	0.01	40.87	0.00	0.00	41.25
RQ-7B (Shadow)	0.04	0.01	0.08	0.00	0.01	0.01	1.61	0.00	0.00	1.62
MQ-1C (Gray Eagle)	0.06	0.02	0.10	0.01	0.01	0.01	12.40	0.00	0.00	12.52
Total	**0.23**	**0.30**	**0.63**	**0.08**	**0.08**	**0.08**	**132.64**	**0.00**	**0.00**	**133.87**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, *Fourth Assessment Report and Global Warming Potentials*, 2007.

Table F-25 shows the annual emissions from operations in all UAV corridors.

Table F-25. Total Estimated Emissions from UAV Operations in Proposed Corridors

Corridor	Criteria Pollutant Emissions (Tons/Year)						Annual GHG Emissions (Metric Tons/Year)			
	VOCs	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e[1]
Eielson Air Force Base to R-2211	0.46	0.60	1.27	0.16	0.16	0.16	265.29	0.01	0.01	267.74
Eielson Air Force Base to R-2205	0.30	0.40	0.84	0.10	0.11	0.11	176.86	0.01	0.01	178.49
Allen Army Airfield and R-2202	0.15	0.20	0.42	0.05	0.05	0.05	88.43	0.00	0.00	89.25
R-2202 to R-2211	0.46	0.60	1.27	0.16	0.16	0.16	265.29	0.01	0.01	267.74
R-2205 to R-2202	0.53	0.70	1.48	0.18	0.19	0.19	309.50	0.01	0.01	312.36
Fort Wainwright and R-2211	0.53	0.70	1.48	0.18	0.19	0.19	309.50	0.01	0.01	312.36
Fort Wainwright and R-2205	0.23	0.30	0.63	0.08	0.08	0.08	132.64	0.00	0.00	133.87
Total	**2.66**	**3.51**	**7.39**	**0.91**	**0.95**	**0.94**	**1,547.52**	**0.05**	**0.04**	**1,561.81**

Key: CH_4 = methane; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; NO_x = nitrogen oxides; N_2O = nitrous oxide; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than10 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound

1. IPCC, *Fourth Assessment Report and Global Warming Potentials*, 2007.