WEST COAST BASING OF THE MV-22

Final
Environmental Impact Statement

Volume III
Appendices B through H

October 2009

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Air Quality Emission Calculations and Clean Air Act Conformity Analyses

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Table B1-1. Existing and Proposed Annual CH-46 Operations - Air Stations

	Calendar Year/Annual Operations							
Location/Flight Activity	*09*	*10*	*11*	*12*	*13*	*14*	*15*	
MCAS Miramar								
CH-46 Operations - % of Year 2000 Activity (1)	100	50	50	-	-	-	-	-
MCAS Camp Pendleton								
CH-46 Operations - % of Year 2000 Activity (1)	100	100	100	100	100	67	-	-
Other Air Stations/Ranges								
CH-46 Operations - % of Year 2000 Activity (1)(2)	100	71	71	43	43	29	-	-
MCAS Yuma								
Departure	1,431	1,022	1,022	613	613	409	-	-
Arrival (Straight In)	1,381	986	986	592	592	395	-	-
29 Palms EAF								
Departure	365	261	261	156	156	104	-	-
Arrival (Straight In)	373	266	266	160	160	107	-	-
Touch and Go	13	9	9	6	6	4	-	-

Notes: (1) Equates to percentage of annual CH-46 aircraft operations relative to year 2000 baseline conditions. These data were applied to emissions from current CH-46 operations in Tables B1-4 and B1-5 to estimate emissions due to future CH-46 activities at MCAS Miramar and Camp Pendleton, respectively.

(2) Based upon the replacement of 7 existing CH-46 squadrons according to the following schedule: (1) -2 from MCAS Miramar in 2010, (2) -2 in 2012 from MCAS Miramar, (3) -1 in 2014 from MCAS Camp Pendleton, and (4) -2 in 2015 from MCAS Camp Pendleton.

Table B1-2. Emission Factors for CH-46 Aircraft Operations.

FLIGHT ACTIVITY	NUMBER OF ENGINES IN USE	ENGINE POWER (% NG RPM)	TIME IN MODE PER ENGINE (MINUTES)	FUEL FLOW RATE PER ENGINE (LBS/HR)	Emission Factors (Pounds/Operation) (1)(4)								
					ROG/HC	CO	NOx	SO2	PM10	PM2.5	*CO2*	*CH4*	*N2O*
Departure Total (2)					2.41	7.81	0.53	0.06	0.51	0.51	496	0.07	0.00
Arrival Total (2)					4.40	13.57	0.54	0.08	0.85	0.85	634	0.09	0.01
Cruise (Lb/1,000 Lb of Fuel) (2)	2	91		560	3.43	19.74	3.94	0.40	1.78	1.78	3,176	0.44	0.03
Touch and Go Total (3)					0.22	1.38	0.33	0.03	0.15	0.15	255	0.04	0.00
GCA Box Pattern Total (3)					0.38	2.41	0.58	0.06	0.26	0.26	446	0.06	0.00
FCLP Total (3)					0.22	1.38	0.33	0.03	0.15	0.15	255	0.04	0.00
Single Pad Landing Total (3)					0.35	1.87	0.39	0.04	0.19	0.19	302	0.04	0.00

Notes: (1) Units in pounds of emissions per operation, except for cruise mode, units in pounds per 1,000 pounds of fuel comsumed.

(2) AESO Memorandum Report No. 9816, Revision F, Aircraft Emissions Estimates: H-46 Takeoff and Landing Cycle and In-Frame, Maintenance Testing Using JP-5, January 2001 (Reference 1).

(3) AESO Memorandum Report No. 9959, Revision B, Aircraft Emissions Estimates: H-46 Mission Operations Using JP-5, January 2001 (Reference 2).

(4) PM2.5 factor based upon AESO report No. 2001-30 (AESO 2001). Emission factors for CH4 and N2O obtained from the California Climate Action Registry General Reporting Protocol, Version 3.0, source type commercial/institutional kerosene combustion (CCAR 2008).

Table B1-3. BRAC Total Annual Emissions at MCAS Miramar - Calendar Year 2000.

	Emissions (Tons per Year)					
Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Aircraft	736.00	1,973.00	413.00	20.65	41.30	41.30
Personal-Owned Vehicles	69.00	526.00	50.00	0.30	1.80	1.76
Government-Owned Vehicles	7.00	47.00	17.00	0.10	0.61	0.60
Ground/Tactical Support Equipment	45.00	277.00	299.00	1.50	32.89	32.23
Construction	1.00	10.00	4.00	0.02	0.44	0.43
Other Sources	5.00	24.00	5.00	0.33	2.80	0.78
Total Emissions Year 2000	863.00	2,857.00	788.00	22.90	79.84	76.70

Notes: The above data represent year 2000 emissions for MCAS Miramar that were developed for a conformity analysis and they do not include emissions from sources that require SDCAPCD air permits, such as certain stationary sources (URS 2004).
These data were used to obtain non-aircraft emissions for existing CH-46 activities at MCAS Miramar, as presented in Table B1-4 below.

Table B1-4. Annual Emissions from Current CH-46E Operations at MCAS Miramar - Calendar Year 2000.

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
CH-46E Aircraft (1)	41.00	161.00	19.00	2.66	24.13	24.13	8,512.07	1.19	0.08	8,564
Personal-Owned Vehicles	8.42	64.17	6.10	0.04	0.22	0.22	8,199	0.15	0.01	8,206
Government-Owned Vehicles	0.85	5.73	2.07	0.01	0.07	0.07	733	0.01	0.00	733
Ground/Tactical Support Equipment	8.20	80.78	7.02	0.04	0.77	0.76	10,321	0.19	0.01	10,330
Construction	0.12	1.22	0.49	0.00	0.05	0.05	156	0.00	0.00	156
Other Sources	0.61	2.93	0.61	0.04	0.34	0.10	374	0.01	0.00	374
Stationary Sources (3)	3.00	2.50	9.20	0.42	10.49	6.71	319	0.01	0.00	320
Total Emissions - Year 2000	62.20	318.33	44.50	3.21	36.08	32.04	28,614	1.56	0.11	28,683

Notes: (1) Equates to emissions from operations and engine maintenance and testing activities.

(2) Data for POVs, GOVs, construction, and other sources calculated by multiplying the total emissions for each of these source category for MCAS Miramar in Table B1-3 by 0.122, which is equal to the personnel population associated with the CH-46Es at MCAS Miramar (1,269) / total personnel at MCAS Miramar identified in the conformity analysis (10,377). Emissions for G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Camp Pendleton (Table B1-5) by the ratio of existing CH-46 aircraft numbers at MCAS Miramar / MCAS Pendleton (48/41).

(3) Data estimated by multiplying stationary source emissions in Table 4.2-3, FEIS for Realignment of MCAS Miramar (DoN 1996) by the MCAS Miramar population associated with the current CH-46E basing (1,269) / total MCAS Miramar population generating the emissions in Table 4.2-3 (12,600).

Table B1-5. Annual Emissions from Current CH-46E Operations at MCAS Camp Pendleton - Calendar Year 2000.

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
CH-46E Aircraft (1)	44.00	171.00	20.00	2.80	25.40	25.40	9,041	1.27	0.09	9,096
Personal-Owned Vehicles	5.00	37.00	4.00	0.02	0.14	0.14	4,727	0.09	0.01	4,731
Government-Owned Vehicles	1.00	4.00	1.00	0.01	0.04	0.04	511	0.01	0.00	511
Ground/Tactical Support Equipment	7.00	69.00	6.00	0.03	0.66	0.65	8,816	0.16	0.01	8,823
Construction	1.00	3.00	5.00	0.03	0.55	0.54	383	0.01	0.00	384
Other Sources	-	-	1.00	0.07	0.56	0.16	-	-	-	-
Stationary Sources (2)	0.70	3.90	4.90	0.23	5.59	3.58	498	0.01	0.00	499
Total Emissions - Year 2000	58.70	287.90	41.90	3.18	32.94	30.49	23,977	1.54	0.11	24,045

Notes: The above data represent year 2000 emissions for existing CH-46 activities at MCAS Camp Pendleton that were developed for a conformity analysis and they do not include emissions from sources that require SDCAPCD air permits, such as certain stationary sources (URS 2004).

(1) Equates to emissions from operations and engine maintenance and testing activities.

(2) Data estimated by multiplying stationary source emissions in Table 4.2-3, FEIS for Realignment of MCAS Miramar (DoN 1996) by the MCAS Camp Pendleton population associated with the current CH-46E basing (908) / total MCAS Camp Pendleton population generating the emissions in Table 4.2-3 (3983).

Table B1-6. Annual Existing Emissions at MCAS Yuma

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Abrasive Blasting	---	---	---	---	---	---	---	---	---	---
Boilers and Chillers	0.25	3.65	4.58	0.03	0.34	0.33	466.35	0.01	0.00	466.74
Degreasers	0.16	---	---	---	---	---	---	---	---	---
Fuel Storage Tanks	6.69	---	---	---	---	---	---	---	---	---
Gasoline Dispensing	3.48	---	---	---	---	---	---	---	---	---
Internal Combustion Engines	0.22	3.12	1.63	0.11	0.12		398.63	0.01	0.00	398.97
Jet Engine Test Cells	0.20	2.61	5.45	0.21	1.58		333.47	0.01	0.00	333.75
Material Usage	4.42	---	---	---	---	---	---	---	---	---
Open Pit Burning	0.54	0.34	0.01	0.04	0.26		43.44	0.00	0.00	43.48
Painting	0.08	---	---	---	---	---	---	---	---	---
Remediation Systems	---	---	---	---	---	---	---	---	---	---
Welding	---	---	---	---	0.01	0.00	---	---	---	---
Total Stn. Source Emissions Year 2002	16.04	9.72	11.67	0.39	2.31	0.34	1,241.89	0.02	0.00	1,242.93
CH-46E Aircraft Ops - Year 2000 (1)	4.76	14.96	0.75	0.10	0.95	0.94	793.02	0.11	0.01	797.87
Total Baseline Emissions	20.80	24.68	12.42	0.49	3.26	1.28	2,034.91	0.13	0.01	2,040.81

Notes: (1) Excludes emissions associated with CH-46 aircraft operations at the AUX-2 field, which are in the BMG Range.

Table B1-6a. Factors to Convert 2000 MCAS Miramar/Camp Pendleton POV/GOV Emissions to 2010+ Emissions.

	Daily	*San Diego County Vehicle Emissions (Tons per Day)*					
Year	*VMT*	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
2000	74,567	96.20	1,007.06	145.52	0.91	5.21	4.79
2012	88,384	39.82	397.43	77.25	0.45	5.44	5.00
Factor applied to 2000 emissions (1)		0.35	0.33	0.45	0.42	0.88	0.88

Notes: (1) Equates to (year 2012/2000 emissions) * (year 2000/2012 VMT).

Table B1-7. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2009

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*	*CO2*	*CH4*	*N2O*	CO_2e
MCAS Miramar										
2009	62.20	318.33	44.50	3.21	36.08	32.04	28,614.17	1.56	0.11	28,683.15
MCAS Camp Pendleton										
2009	58.70	287.90	41.90	3.18	32.94	30.49	23,976.69	1.54	0.11	24,044.57
MCAS Yuma										
Departure	1.72	5.59	0.38	0.04	0.36	0.36	355.10	0.05	0.00	357.28
Arrival (Straight In)	3.04	9.37	0.37	0.06	0.59	0.59	437.92	0.06	0.00	440.60
AUX-2	0.02	0.14	0.03	0.00	0.02	0.02	26.05	0.00	0.00	26.21
Subtotal	4.79	15.10	0.79	0.10	0.97	0.97	819.06	0.11	0.01	824.08
29 Palms EAF										
Departure	0.44	1.43	0.10	0.01	0.09	0.09	90.57	0.01	0.00	91.13
Arrival (Straight In)	0.82	2.53	0.10	0.01	0.16	0.16	118.28	0.02	0.00	119.00
Touch and Go	0.00	0.01	0.00	0.00	0.00	0.00	1.66	0.00	0.00	1.67
Subtotal	1.26	3.97	0.20	0.03	0.25	0.25	210.51	0.03	0.00	211.80

Table B1-8. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2010

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
MCAS Miramar										
2010	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09	0.78	0.06	14,341.57
MCAS Camp Pendleton										
2010	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35	0.77	0.05	12,022.28
MCAS Yuma										
Departure	1.23	3.99	0.27	0.03	0.26	0.26	253.64	0.04	0.00	255.20
Arrival (Straight In)	2.17	6.69	0.27	0.04	0.42	0.42	312.80	0.04	0.00	314.71
AUX-2	0.02	0.14	0.03	0.00	0.02	0.02	26.05	0.00	0.00	26.21
Subtotal	3.42	10.83	0.57	0.07	0.70	0.69	592.49	0.08	0.01	596.11
29 Palms EAF										
Departure	0.31	1.02	0.07	0.01	0.07	0.07	64.70	0.01	0.00	65.09
Arrival (Straight In)	0.59	1.81	0.07	0.01	0.11	0.11	84.48	0.01	0.00	85.00
Touch and Go	0.00	0.01	0.00	0.00	0.00	0.00	1.18	0.00	0.00	1.19
Subtotal	0.90	2.83	0.14	0.02	0.18	0.18	150.36	0.02	0.00	151.29

Table B1-9. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2011

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2011	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09	0.78	0.06	14,341.57
MCAS Camp Pendleton										
2011	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35	0.77	0.05	12,022.28
MCAS Yuma										
Departure	1.23	3.99	0.27	0.03	0.26	0.26	253.64	0.04	0.00	255.20
Arrival (Straight In)	2.17	6.69	0.27	0.04	0.42	0.42	312.80	0.04	0.00	314.71
AUX-2	0.02	0.14	0.03	0.00	0.02	0.02	26.05	0.00	0.00	26.21
Subtotal	3.42	10.83	0.57	0.07	0.70	0.69	592.49	0.08	0.01	596.11
29 Palms EAF										
Departure	0.31	1.02	0.07	0.01	0.07	0.07	64.70	0.01	0.00	65.09
Arrival (Straight In)	0.59	1.81	0.07	0.01	0.11	0.11	84.48	0.01	0.00	85.00
Touch and Go	0.00	0.01	0.00	0.00	0.00	0.00	1.18	0.00	0.00	1.19
Subtotal	0.90	2.83	0.14	0.02	0.18	0.18	150.36	0.02	0.00	151.29

Table B1-10. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2012

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2012	-	-	-	-	-	-	-	-	-	-
MCAS Camp Pendleton										
2012	58.70	287.90	41.90	3.18	32.94	30.24	-	-	-	-
MCAS Yuma										
Departure	0.74	2.39	0.16	0.02	0.16	0.15	152.19	0.02	0.00	153.12
Arrival (Straight In)	1.30	4.02	0.16	0.02	0.25	0.25	187.68	0.03	0.00	188.83
AUX-2	0.01	0.08	0.02	0.00	0.01	0.01	15.63	0.00	0.00	15.72
Subtotal	2.05	6.50	0.34	0.04	0.42	0.41	355.49	0.05	0.00	357.67
29 Palms EAF										
Departure	0.19	0.61	0.04	0.00	0.04	0.04	38.82	0.01	0.00	39.06
Arrival (Straight In)	0.35	1.08	0.04	0.01	0.07	0.07	50.69	0.01	0.00	51.00
Touch and Go	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.71
Subtotal	0.54	1.70	0.09	0.01	0.11	0.11	90.22	0.01	0.00	90.77

Table B1-11. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2013

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2013	-	-	-	-	-	-	-	-	-	-
MCAS Camp Pendleton										
2013	58.70	287.90	41.90	3.18	32.94	30.24	-	-	-	-
MCAS Yuma										
Departure	0.74	2.39	0.16	0.02	0.16	0.15	152.19	0.02	0.00	153.12
Arrival (Straight In)	1.30	4.02	0.16	0.02	0.25	0.25	187.68	0.03	0.00	188.83
AUX-2	0.01	0.08	0.02	0.00	0.01	0.01	15.63	0.00	0.00	15.72
Subtotal	2.05	6.50	0.34	0.04	0.42	0.41	355.49	0.05	0.00	357.67
29 Palms EAF										
Departure	0.19	0.61	0.04	0.00	0.04	0.04	38.82	0.01	0.00	39.06
Arrival (Straight In)	0.35	1.08	0.04	0.01	0.07	0.07	50.69	0.01	0.00	51.00
Touch and Go	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.71
Subtotal	0.54	1.70	0.09	0.01	0.11	0.11	90.22	0.01	0.00	90.77

Table B1-12. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2014

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2014	-	-	-	-	-	-	-	-	-	-
MCAS Camp Pendleton										
2014	39.33	192.89	28.07	2.13	22.07	20.26	-	-	-	-
MCAS Yuma										
Departure	0.49	1.60	0.11	0.01	0.10	0.10	101.46	0.01	0.00	102.08
Arrival (Straight In)	0.87	2.68	0.11	0.02	0.17	0.17	125.12	0.02	0.00	125.88
AUX-2	0.01	0.06	0.01	0.00	0.01	0.01	10.42	0.00	0.00	10.48
Subtotal	1.37	4.33	0.23	0.03	0.28	0.28	237.00	0.03	0.00	238.45
29 Palms EAF										
Departure	0.13	0.41	0.03	0.00	0.03	0.03	25.88	0.00	0.00	26.04
Arrival (Straight In)	0.23	0.72	0.03	0.00	0.05	0.04	33.79	0.00	0.00	34.00
Touch and Go	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.48
Subtotal	0.36	1.13	0.06	0.01	0.07	0.07	60.15	0.01	0.00	60.51

Table B1-13. Existing and Proposed Annual CH-46 Operations - MCB Pendleton Range

	Fiscal Year/Annual Operations								Cruise
Flight Activity/Flight Details	*09*	*10*	*11*	*12*	*13*	*14*	*15*		*Duration (Hrs)*
CAL									
Pad Landing + Cruise	933	666	666	400	400	267	-	-	0.25
Cruise Only	502	359	359	215	215	144	-	-	0.33
Subtotal Ops	1,435	1,025	1,025	615	615	410	-	-	
Drop Zone									
GCA Box + Cruise	1,397	998	998	599	599	399	-	-	0.38
Cruise Only	155	111	111	67	67	44	-	-	0.50
Subtotal Ops	1,552	1,109	1,109	665	665	443	-	-	
IP									
Cruise Only	493	352	352	211	211	141	-	-	0.08
Subtotal Ops	493	352	352	211	211	141	-	-	
Landing Zone									
Pad Landing + Cruise	714	510	510	306	306	204	-	-	0.25
Cruise Only	384	275	275	165	165	110	-	-	0.33
Subtotal Ops	1,098	784	784	471	471	314	-	-	
PAD, etc.									
Pad Landing + Cruise	1,426	1,018	1,018	611	611	407	-	-	0.25
Cruise Only	768	548	548	329	329	219	-	-	0.33
Subtotal Ops	2,193	1,567	1,567	940	940	627	-	-	
TERF									
Cruise Only	181	129	129	78	78	52	-	-	1.67
Subtotal Ops	181	129	129	78	78	52	-	-	
Impact Areas									
Pad Landing + Cruise	75	54	54	32	32	21	-	-	0.83
Cruise Only	75	54	54	32	32	21	-	-	0.92
Subtotal Ops	150	107	107	64	64	43	-	-	
RWR-1									
Cruise	1,990	1,421	1,421	853	853	569	-	-	0.23
Subtotal Ops	1,990	1,421	1,421	853	853	569	-	-	
RWR-2									
Cruise	1,990	1,421	1,421	853	853	569	-	-	0.16
Subtotal Ops	1,990	1,421	1,421	853	853	569	-	-	
RWR-3									
Cruise	1,990	1,421	1,421	853	853	569	-	-	0.18
Subtotal Ops	1,990	1,421	1,421	853	853	569	-	-	
RWR-4									
Cruise	50	36	36	21	21	14	-	-	0.19
Subtotal Ops	50	36	36	21	21	14	-	-	
RWR-5									
Cruise	50	36	36	21	21	14	-	-	0.19
Subtotal Ops	50	36	36	21	21	14	-	-	
Total Ops	13,173	9,409	9,409	5,645	5,645	3,764	-	-	

Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.2.8 - Modeled Airspace MCBCP Flight Profiles Data Base.

Table B1-14. Existing and Proposed Annual CH-46 Operations - BMG Range

Flight Activity/Flight Details	*Fiscal Year/Annual Operations*								*Cruise Duration (Hrs)*
	09	*10*	*11*	*12*	*13*	*14*	*15*		
AUX-2									
FCLP	286	204	204	123	123	82	-	-	
Subtotal Ops	286	204	204	123	123	82	-	-	
Air to Air/Gnd									
Cruise Only	258	184	184	111	111	74	-	-	1.00
Subtotal Ops	258	184	184	111	111	74	-	-	
Transient									
Cruise Only	133	95	95	57	57	38	-	-	0.33
Subtotal Ops	133	95	95	57	57	38	-	-	
Flight Work									
Cruise Only	4,916	3,511	3,511	2,107	2,107	1,404	-	-	0.42
Subtotal Ops	4,916	3,511	3,511	2,107	2,107	1,404	-	-	
Total Ops	5,307	3,791	3,791	2,274	2,274	1,516	-	-	

Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.3.8 - Modeled Airspace BMGRW Flight Profiles Data Base.

Table B1-15. Existing and Proposed Annual CH-46 Operations - Chocolate Mt. Range

Flight Activity/Flight Details	*Fiscal Year/Annual Operations*								*Cruise Duration (Hrs)*
	09	*10*	*11*	*12*	*13*	*14*	*15*		
CAS - Areas									
Pad Landing + Cruise	243	173	173	104	104	69	-	-	2.42
Subtotal Ops	243	173	173	104	104	69	-	-	
CAS - Routes									
Cruise Only	935	668	668	401	401	267	-	-	0.05
Subtotal Ops	935	668	668	401	401	267	-	-	
Total Ops	1,178	841	841	505	505	337	-	-	

Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.3.11 - Modeled Airspace CMAGR Flight Profiles Data Base.

Table B1-16. Existing and Proposed Annual CH-46 Operations - El Centro Range

Flight Activity/Flight Details	*Fiscal Year/Annual Operations*								*Cruise Duration (Hrs)*
	09	*10*	*11*	*12*	*13*	*14*	*15*		
CAS - Areas									
Pad Landing + Cruise	11	8	8	5	5	3	-	-	0.75
Subtotal Ops	11	8	8	5	5	3	-	-	
Total Ops	11	8	8	5	5	3	-	-	

Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.3.14 - Modeled Airspace NAFECRC Flight Profiles Data Base.

Table B1-17. Existing and Proposed Annual CH-46 Operations - 29 Palms Range

Flight Activity/Flight Details	*Fiscal Year/Annual Operations*								*Cruise Duration (Hrs)*
	09	*10*	*11*	*12*	*13*	*14*	*15*		
R-2501									
Pad Landing + Cruise	4,522	3,230	3,230	1,938	1,938	1,292	-	-	0.16
Subtotal Ops	4,522	3,230	3,230	1,938	1,938	1,292	-	-	
Bristol/Sundance									
Cruise Only	336	240	240	144	144	96	-	-	0.36
Subtotal Ops	336	240	240	144	144	96	-	-	
Total Ops	4,858	3,470	3,470	2,082	2,082	1,388	-	-	

Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.4.8 - Modeled Airspace MCAGCCTP Flight Profiles Data Base.

Table B1-18. MCB Pendleton Range CH-46 Aircraft Emissions - Fiscal Year 2009

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.16	0.87	0.18	0.02	0.09	0.09	140.86	0.02	0.00	141.73
Cruise (from Pad Landing)	0.45	-	0.00	0.00	0.00	0.00	1.32	0.00	0.02	8.15
Cruise Only	0.32	1.85	0.37	0.04	0.17	0.17	297.80	0.04	0.00	299.62
Subtotal Ops	0.93	2.72	0.55	0.06	0.26	0.26	439.99	0.06	0.03	449.50
Drop Zone										
GCA Box	0.27	1.68	0.41	0.04	0.18	0.18	311.48	0.04	0.00	313.38
Cruise (from GCA Box)	1.03	5.92	1.18	0.12	0.53	0.53	952.29	0.13	0.01	958.12
Cruise Only	0.15	0.86	0.17	0.02	0.08	0.08	138.01	0.02	0.00	138.86
Subtotal Ops	1.44	8.46	1.76	0.18	0.79	0.79	1,401.78	0.20	0.01	1,410.36
IP										
Cruise Only	0.08	0.45	0.09	0.01	0.04	0.04	73.08	0.01	0.00	73.53
Subtotal Ops	0.08	0.45	0.09	0.01	0.04	0.04	73.08	0.01	0.00	73.53
Landing Zone										
Pad Landing	0.12	0.67	0.14	0.01	0.07	0.07	107.78	0.02	0.00	108.44
Cruise (from Pad Landing)	0.34	1.97	0.39	0.04	0.18	0.18	317.37	0.04	0.00	319.32
Cruise Only	0.25	1.42	0.28	0.03	0.13	0.13	227.86	0.03	0.00	229.25
Subtotal Ops	0.71	4.06	0.82	0.08	0.37	0.37	653.01	0.09	0.01	657.01
PAD, etc.										
Pad Landing	0.25	1.33	0.28	0.03	0.14	0.14	215.28	0.03	0.00	216.60
Cruise (from Pad Landing)	0.68	3.94	0.79	0.08	0.36	0.36	633.92	0.09	0.01	637.80
Cruise Only	0.49	2.83	0.56	0.06	0.26	0.26	455.12	0.06	0.00	457.90
Subtotal Ops	1.43	8.10	1.63	0.17	0.75	0.75	1,304.31	0.18	0.01	1,312.30
TERF										
Cruise Only	0.58	3.34	0.67	0.07	0.30	0.30	536.77	0.08	0.01	540.05
Subtotal Ops	0.58	3.34	0.67	0.07	0.30	0.30	536.77	0.08	0.01	540.05
Impact Areas										
Pad Landing	0.01	0.07	0.01	0.00	0.01	0.01	11.33	0.00	0.00	11.39
Cruise (from Pad Landing)	0.12	0.69	0.14	0.01	0.06	0.06	111.16	0.02	0.00	111.84
Cruise Only	0.13	0.76	0.15	0.02	0.07	0.07	122.28	0.02	0.00	123.02
Subtotal Ops	0.27	1.52	0.30	0.03	0.14	0.14	244.76	0.03	0.00	246.26
RWR-1										
Cruise	0.89	5.11	1.02	0.10	0.46	0.46	822.57	0.12	0.01	827.61
Subtotal Ops	0.89	5.11	1.02	0.10	0.46	0.46	822.57	0.12	0.01	827.61
RWR-2										
Cruise	0.61	3.50	0.70	0.07	0.32	0.32	563.20	0.08	0.01	566.65
Subtotal Ops	0.61	3.50	0.70	0.07	0.32	0.32	563.20	0.08	0.01	566.65
RWR-3										
Cruise	0.70	4.01	0.80	0.08	0.36	0.36	644.72	0.09	0.01	648.67
Subtotal Ops	0.70	4.01	0.80	0.08	0.36	0.36	644.72	0.09	0.01	648.67
RWR-4										
Cruise	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
Subtotal Ops	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
RWR-5										
Cruise	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
Subtotal Ops	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
Total Emissions	7.67	41.48	8.38	0.85	3.81	3.80	6,718.24	0.94	0.09	6,766.18

Table B1-19. MCB Pendleton Range CH-46 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.12	0.62	0.13	0.01	0.06	0.06	100.62	0.01	0.00	101.23
Cruise (from Pad Landing)	0.32	1.84	0.37	0.04	0.17	0.17	296.28	0.04	0.00	298.10
Cruise Only	0.23	1.32	0.26	0.03	0.12	0.12	212.72	0.03	0.00	214.02
Subtotal Ops	0.67	3.79	0.76	0.08	0.35	0.35	609.62	0.09	0.01	613.35
Drop Zone										
GCA Box	0.19	1.20	0.29	0.03	0.13	0.13	222.48	0.03	0.00	223.85
Cruise (from GCA Box)	0.73	4.23	0.84	0.09	0.38	0.38	680.21	0.10	0.01	684.37
Cruise Only	0.11	0.61	0.12	0.01	0.06	0.06	98.58	0.01	0.00	99.18
Subtotal Ops	1.03	6.04	1.26	0.13	0.57	0.57	1,001.27	0.14	0.01	1,007.40
IP										
Cruise Only	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Subtotal Ops	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Landing Zone										
Pad Landing	0.09	0.48	0.10	0.01	0.05	0.05	76.99	0.01	0.00	77.46
Cruise (from Pad Landing)	0.24	1.41	0.28	0.03	0.13	0.13	226.70	0.03	0.00	228.08
Cruise Only	0.18	1.01	0.20	0.02	0.09	0.09	162.76	0.02	0.00	163.75
Subtotal Ops	0.51	2.90	0.58	0.06	0.27	0.27	466.44	0.07	0.00	469.29
PAD, etc.										
Pad Landing	0.18	0.95	0.20	0.02	0.10	0.10	153.77	0.02	0.00	154.71
Cruise (from Pad Landing)	0.49	2.81	0.56	0.06	0.25	0.25	452.80	0.06	0.00	455.57
Cruise Only	0.35	2.02	0.40	0.04	0.18	0.18	325.09	0.05	0.00	327.07
Subtotal Ops	1.02	5.79	1.16	0.12	0.53	0.53	931.65	0.13	0.01	937.36
TERF										
Cruise Only	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Subtotal Ops	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Impact Areas										
Pad Landing	0.01	0.05	0.01	0.00	0.01	0.01	8.09	0.00	0.00	8.14
Cruise (from Pad Landing)	0.09	0.49	0.10	0.01	0.04	0.04	79.40	0.01	0.00	79.89
Cruise Only	0.09	0.54	0.11	0.01	0.05	0.05	87.34	0.01	0.00	87.87
Subtotal Ops	0.19	1.09	0.22	0.02	0.10	0.10	174.83	0.02	0.00	175.90
RWR-1										
Cruise	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
Subtotal Ops	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
RWR-2										
Cruise	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
Subtotal Ops	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
RWR-3										
Cruise	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
Subtotal Ops	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
RWR-4										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
RWR-5										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Total Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08	0.71	0.05	5,125.26

Table B1-20. MCB Pendleton Range CH-46 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.12	0.62	0.13	0.01	0.06	0.06	100.62	0.01	0.00	101.23
Cruise (from Pad Landing)	0.32	1.84	0.37	0.04	0.17	0.17	296.28	0.04	0.00	298.10
Cruise Only	0.23	1.32	0.26	0.03	0.12	0.12	212.72	0.03	0.00	214.02
Subtotal Ops	0.67	3.79	0.76	0.08	0.35	0.35	609.62	0.09	0.01	613.35
Drop Zone										
GCA Box	0.19	1.20	0.29	0.03	0.13	0.13	222.48	0.03	0.00	223.85
Cruise (from GCA Box)	0.73	4.23	0.84	0.09	0.38	0.38	680.21	0.10	0.01	684.37
Cruise Only	0.11	0.61	0.12	0.01	0.06	0.06	98.58	0.01	0.00	99.18
Subtotal Ops	1.03	6.04	1.26	0.13	0.57	0.57	1,001.27	0.14	0.01	1,007.40
IP										
Cruise Only	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Subtotal Ops	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Landing Zone										
Pad Landing	0.09	0.48	0.10	0.01	0.05	0.05	76.99	0.01	0.00	77.46
Cruise (from Pad Landing)	0.24	1.41	0.28	0.03	0.13	0.13	226.70	0.03	0.00	228.08
Cruise Only	0.18	1.01	0.20	0.02	0.09	0.09	162.76	0.02	0.00	163.75
Subtotal Ops	0.51	2.90	0.58	0.06	0.27	0.27	466.44	0.07	0.00	469.29
PAD, etc.										
Pad Landing	0.18	0.95	0.20	0.02	0.10	0.10	153.77	0.02	0.00	154.71
Cruise (from Pad Landing)	0.49	2.81	0.56	0.06	0.25	0.25	452.80	0.06	0.00	455.57
Cruise Only	0.35	2.02	0.40	0.04	0.18	0.18	325.09	0.05	0.00	327.07
Subtotal Ops	1.02	5.79	1.16	0.12	0.53	0.53	931.65	0.13	0.01	937.36
TERF										
Cruise Only	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Subtotal Ops	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Impact Areas										
Pad Landing	0.01	0.05	0.01	0.00	0.01	0.01	8.09	0.00	0.00	8.14
Cruise (from Pad Landing)	0.09	0.49	0.10	0.01	0.04	0.04	79.40	0.01	0.00	79.89
Cruise Only	0.09	0.54	0.11	0.01	0.05	0.05	87.34	0.01	0.00	87.87
Subtotal Ops	0.19	1.09	0.22	0.02	0.10	0.10	174.83	0.02	0.00	175.90
RWR-1										
Cruise	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
Subtotal Ops	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
RWR-2										
Cruise	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
Subtotal Ops	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
RWR-3										
Cruise	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
Subtotal Ops	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
RWR-4										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
RWR-5										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Total Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08	0.71	0.05	5,125.26

Table B1-21. MCB Pendleton Range CH-46 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.07	0.37	0.08	0.01	0.04	0.04	60.37	0.01	0.00	60.74
Cruise (from Pad Landing)	0.19	1.10	0.22	0.02	0.10	0.10	177.77	0.02	0.00	178.86
Cruise Only	0.14	0.79	0.16	0.02	0.07	0.07	127.63	0.02	0.00	128.41
Subtotal Ops	0.40	2.27	0.46	0.05	0.21	0.21	365.77	0.05	0.00	368.01
Drop Zone										
GCA Box	0.11	0.72	0.17	0.02	0.08	0.08	133.49	0.02	0.00	134.31
Cruise (from GCA Box)	0.44	2.54	0.51	0.05	0.23	0.23	408.12	0.06	0.00	410.62
Cruise Only	0.06	0.37	0.07	0.01	0.03	0.03	59.15	0.01	0.00	59.51
Subtotal Ops	0.62	3.63	0.75	0.08	0.34	0.34	600.76	0.08	0.01	604.44
IP										
Cruise Only	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Subtotal Ops	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Landing Zone										
Pad Landing	0.05	0.29	0.06	0.01	0.03	0.03	46.19	0.01	0.00	46.47
Cruise (from Pad Landing)	0.15	0.85	0.17	0.02	0.08	0.08	136.02	0.02	0.00	136.85
Cruise Only	0.11	0.61	0.12	0.01	0.05	0.05	97.65	0.01	0.00	98.25
Subtotal Ops	0.31	1.74	0.35	0.04	0.16	0.16	279.86	0.04	0.00	281.58
PAD, etc.										
Pad Landing	0.11	0.57	0.12	0.01	0.06	0.06	92.26	0.01	0.00	92.83
Cruise (from Pad Landing)	0.29	1.69	0.34	0.03	0.15	0.15	271.68	0.04	0.00	273.34
Cruise Only	0.21	1.21	0.24	0.02	0.11	0.11	195.05	0.03	0.00	196.24
Subtotal Ops	0.61	3.47	0.70	0.07	0.32	0.32	558.99	0.08	0.01	562.41
TERF										
Cruise Only	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Subtotal Ops	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Impact Areas										
Pad Landing	0.01	0.03	0.01	0.00	0.00	0.00	4.85	0.00	0.00	4.88
Cruise (from Pad Landing)	0.05	0.30	0.06	0.01	0.03	0.03	47.64	0.01	0.00	47.93
Cruise Only	0.06	0.33	0.07	0.01	0.03	0.03	52.40	0.01	0.00	52.72
Subtotal Ops	0.11	0.65	0.13	0.01	0.06	0.06	104.90	0.01	0.00	105.54
RWR-1										
Cruise	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
Subtotal Ops	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
RWR-2										
Cruise	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
Subtotal Ops	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
RWR-3										
Cruise	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
Subtotal Ops	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
RWR-4										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
RWR-5										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Total Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45	0.43	0.03	3,075.16

Table B1-22. MCB Pendleton Range CH-46 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.07	0.37	0.08	0.01	0.04	0.04	60.37	0.01	0.00	60.74
Cruise (from Pad Landing)	0.19	1.10	0.22	0.02	0.10	0.10	177.77	0.02	0.00	178.86
Cruise Only	0.14	0.79	0.16	0.02	0.07	0.07	127.63	0.02	0.00	128.41
Subtotal Ops	0.40	2.27	0.46	0.05	0.21	0.21	365.77	0.05	0.00	368.01
Drop Zone										
GCA Box	0.11	0.72	0.17	0.02	0.08	0.08	133.49	0.02	0.00	134.31
Cruise (from GCA Box)	0.44	2.54	0.51	0.05	0.23	0.23	408.12	0.06	0.00	410.62
Cruise Only	0.06	0.37	0.07	0.01	0.03	0.03	59.15	0.01	0.00	59.51
Subtotal Ops	0.62	3.63	0.75	0.08	0.34	0.34	600.76	0.08	0.01	604.44
IP										
Cruise Only	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Subtotal Ops	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Landing Zone										
Pad Landing	0.05	0.29	0.06	0.01	0.03	0.03	46.19	0.01	0.00	46.47
Cruise (from Pad Landing)	0.15	0.85	0.17	0.02	0.08	0.08	136.02	0.02	0.00	136.85
Cruise Only	0.11	0.61	0.12	0.01	0.05	0.05	97.65	0.01	0.00	98.25
Subtotal Ops	0.31	1.74	0.35	0.04	0.16	0.16	279.86	0.04	0.00	281.58
PAD, etc.										
Pad Landing	0.11	0.57	0.12	0.01	0.06	0.06	92.26	0.01	0.00	92.83
Cruise (from Pad Landing)	0.29	1.69	0.34	0.03	0.15	0.15	271.68	0.04	0.00	273.34
Cruise Only	0.21	1.21	0.24	0.02	0.11	0.11	195.05	0.03	0.00	196.24
Subtotal Ops	0.61	3.47	0.70	0.07	0.32	0.32	558.99	0.08	0.01	562.41
TERF										
Cruise Only	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Subtotal Ops	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Impact Areas										
Pad Landing	0.01	0.03	0.01	0.00	0.00	0.00	4.85	0.00	0.00	4.88
Cruise (from Pad Landing)	0.05	0.30	0.06	0.01	0.03	0.03	47.64	0.01	0.00	47.93
Cruise Only	0.06	0.33	0.07	0.01	0.03	0.03	52.40	0.01	0.00	52.72
Subtotal Ops	0.11	0.65	0.13	0.01	0.06	0.06	104.90	0.01	0.00	105.54
RWR-1										
Cruise	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
Subtotal Ops	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
RWR-2										
Cruise	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
Subtotal Ops	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
RWR-3										
Cruise	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
Subtotal Ops	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
RWR-4										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
RWR-5										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Total Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45	0.43	0.03	3,075.16

Table B1-23. MCB Pendleton Range CH-46 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.05	0.25	0.05	0.01	0.03	0.03	40.25	0.01	0.00	40.49
Cruise (from Pad Landing)	0.13	0.74	0.15	0.01	0.07	0.07	118.51	0.02	0.00	119.24
Cruise Only	0.09	0.53	0.11	0.01	0.05	0.05	85.09	0.01	0.00	85.61
Subtotal Ops	0.27	1.51	0.30	0.03	0.14	0.14	243.85	0.03	0.00	245.34
Drop Zone										
GCA Box	0.08	0.48	0.12	0.01	0.05	0.05	88.99	0.01	0.00	89.54
Cruise (from GCA Box)	0.29	1.69	0.34	0.03	0.15	0.15	272.08	0.04	0.00	273.75
Cruise Only	0.04	0.25	0.05	0.00	0.02	0.02	39.43	0.01	0.00	39.67
Subtotal Ops	0.41	2.42	0.50	0.05	0.23	0.23	400.51	0.06	0.00	402.96
IP										
Cruise Only	0.02	0.13	0.03	0.00	0.01	0.01	20.88	0.00	0.00	21.01
Subtotal Ops	0.02	0.13	0.03	0.00	0.01	0.01	20.88	0.00	0.00	21.01
Landing Zone										
Pad Landing	0.04	0.19	0.04	0.00	0.02	0.02	30.79	0.00	0.00	30.98
Cruise (from Pad Landing)	0.10	0.56	0.11	0.01	0.05	0.05	90.68	0.01	0.00	91.23
Cruise Only	0.07	0.40	0.08	0.01	0.04	0.04	65.10	0.01	0.00	65.50
Subtotal Ops	0.20	1.16	0.23	0.02	0.11	0.11	186.58	0.03	0.00	187.72
PAD, etc.										
Pad Landing	0.07	0.38	0.08	0.01	0.04	0.04	61.51	0.01	0.00	61.88
Cruise (from Pad Landing)	0.20	1.13	0.22	0.02	0.10	0.10	181.12	0.03	0.00	182.23
Cruise Only	0.14	0.81	0.16	0.02	0.07	0.07	130.03	0.02	0.00	130.83
Subtotal Ops	0.41	2.31	0.47	0.05	0.21	0.21	372.66	0.05	0.00	374.94
TERF										
Cruise Only	0.17	0.95	0.19	0.02	0.09	0.09	153.36	0.02	0.00	154.30
Subtotal Ops	0.17	0.95	0.19	0.02	0.09	0.09	153.36	0.02	0.00	154.30
Impact Areas										
Pad Landing	0.00	0.02	0.00	0.00	0.00	0.00	3.24	0.00	0.00	3.26
Cruise (from Pad Landing)	0.03	0.20	0.04	0.00	0.02	0.02	31.76	0.00	0.00	31.95
Cruise Only	0.04	0.22	0.04	0.00	0.02	0.02	34.94	0.00	0.00	35.15
Subtotal Ops	0.08	0.43	0.09	0.01	0.04	0.04	69.93	0.01	0.00	70.36
RWR-1										
Cruise	0.25	1.46	0.29	0.03	0.13	0.13	235.02	0.03	0.00	236.46
Subtotal Ops	0.25	1.46	0.29	0.03	0.13	0.13	235.02	0.03	0.00	236.46
RWR-2										
Cruise	0.17	1.00	0.20	0.02	0.09	0.09	160.92	0.02	0.00	161.90
Subtotal Ops	0.17	1.00	0.20	0.02	0.09	0.09	160.92	0.02	0.00	161.90
RWR-3										
Cruise	0.20	1.14	0.23	0.02	0.10	0.10	184.21	0.03	0.00	185.33
Subtotal Ops	0.20	1.14	0.23	0.02	0.10	0.10	184.21	0.03	0.00	185.33
RWR-4										
Cruise	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
Subtotal Ops	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
RWR-5										
Cruise	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
Subtotal Ops	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
Total Emissions	2.19	12.59	2.54	0.26	1.15	1.15	2,037.63	0.29	0.02	2,050.11

Table B1-24. BMG Range CH-46 Aircraft Emissions - Fiscal Year 2009

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2										
FCLP	0.03	0.20	0.05	0.00	0.02	0.02	36.47	0.01	0.00	36.69
Subtotal Ops	0.03	0.20	0.05	0.00	0.02	0.02	36.47	0.01	0.00	36.69
Air to Air/Gnd										
Cruise Only	0.50	2.85	0.57	0.06	0.26	0.26	459.08	0.06	0.00	461.89
Subtotal Ops	0.50	2.85	0.57	0.06	0.26	0.26	459.08	0.06	0.00	461.89
Transient										
Cruise Only	0.09	0.49	0.10	0.01	0.04	0.04	79.11	0.01	0.00	79.59
Subtotal Ops	0.09	0.49	0.10	0.01	0.04	0.04	79.11	0.01	0.00	79.59
Flight Work										
Cruise Only	3.97	22.87	4.57	0.46	2.06	2.06	3,679.97	0.52	0.04	3,702.50
Subtotal Ops	3.97	22.87	4.57	0.46	2.06	2.06	3,679.97	0.52	0.04	3,702.50
Total Ops	4.59	26.41	5.28	0.54	2.39	2.39	4,254.63	0.60	0.04	4,280.67
Total without AUX-2	4.56	26.22	5.23	0.53	2.36	2.36	4,218.17	0.59	0.04	4,243.98

Table B1-25. BMG Range CH-46 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2										
FCLP	0.02	0.14	0.03	0.00	0.02	0.02	26.05	0.00	0.00	26.21
Subtotal Ops	0.02	0.14	0.03	0.00	0.02	0.02	26.05	0.00	0.00	26.21
Air to Air/Gnd										
Cruise Only	0.35	2.04	0.41	0.04	0.18	0.18	327.92	0.05	0.00	329.92
Subtotal Ops	0.35	2.04	0.41	0.04	0.18	0.18	327.92	0.05	0.00	329.92
Transient										
Cruise Only	0.06	0.35	0.07	0.01	0.03	0.03	56.51	0.01	0.00	56.85
Subtotal Ops	0.06	0.35	0.07	0.01	0.03	0.03	56.51	0.01	0.00	56.85
Flight Work										
Cruise Only	2.84	16.34	3.26	0.33	1.47	1.47	2,628.55	0.37	0.03	2,644.64
Subtotal Ops	2.84	16.34	3.26	0.33	1.47	1.47	2,628.55	0.37	0.03	2,644.64
Total Ops	3.28	18.87	3.77	0.38	1.70	1.70	3,039.02	0.43	0.03	3,057.62
Total without AUX-2	3.25	18.73	3.74	0.38	1.69	1.69	3,012.98	0.42	0.03	3,031.42

Table B1-26. BMG Range CH-46 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2										
FCLP	0.02	0.14	0.03	0.00	0.02	0.02	26.05	0.00	0.00	26.21
Subtotal Ops	0.02	0.14	0.03	0.00	0.02	0.02	26.05	0.00	0.00	26.21
Air to Air/Gnd										
Cruise Only	0.35	2.04	0.41	0.04	0.18	0.18	327.92	0.05	0.00	329.92
Subtotal Ops	0.35	2.04	0.41	0.04	0.18	0.18	327.92	0.05	0.00	329.92
Transient										
Cruise Only	0.06	0.35	0.07	0.01	0.03	0.03	56.51	0.01	0.00	56.85
Subtotal Ops	0.06	0.35	0.07	0.01	0.03	0.03	56.51	0.01	0.00	56.85
Flight Work										
Cruise Only	2.84	16.34	3.26	0.33	1.47	1.47	2,628.55	0.37	0.03	2,644.64
Subtotal Ops	2.84	16.34	3.26	0.33	1.47	1.47	2,628.55	0.37	0.03	2,644.64
Total Ops	3.28	18.87	3.77	0.38	1.70	1.70	3,039.02	0.43	0.03	3,057.62
Total without AUX-2	3.25	18.73	3.74	0.38	1.69	1.69	3,012.98	0.42	0.03	3,031.42

Table B1-27. BMG Range CH-46 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2										
FCLP	0.01	0.08	0.02	0.00	0.01	0.01	15.63	0.00	0.00	15.72
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	15.63	0.00	0.00	15.72
Air to Air/Gnd										
Cruise Only	0.21	1.22	0.24	0.02	0.11	0.11	196.75	0.03	0.00	197.95
Subtotal Ops	0.21	1.22	0.24	0.02	0.11	0.11	196.75	0.03	0.00	197.95
Transient										
Cruise Only	0.04	0.21	0.04	0.00	0.02	0.02	33.90	0.00	0.00	34.11
Subtotal Ops	0.04	0.21	0.04	0.00	0.02	0.02	33.90	0.00	0.00	34.11
Flight Work										
Cruise Only	1.70	9.80	1.96	0.20	0.88	0.88	1,577.13	0.22	0.02	1,586.78
Subtotal Ops	1.70	9.80	1.96	0.20	0.88	0.88	1,577.13	0.22	0.02	1,586.78
Total Ops	1.97	11.32	2.26	0.23	1.02	1.02	1,823.41	0.26	0.02	1,834.57
Total without AUX-2	1.95	11.24	2.24	0.23	1.01	1.01	1,807.79	0.25	0.02	1,818.85

Table B1-28. BMG Range CH-46 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2										
FCLP	0.01	0.08	0.02	0.00	0.01	0.01	15.63	0.00	0.00	15.72
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	15.63	0.00	0.00	15.72
Air to Air/Gnd										
Cruise Only	0.21	1.22	0.24	0.02	0.11	0.11	196.75	0.03	0.00	197.95
Subtotal Ops	0.21	1.22	0.24	0.02	0.11	0.11	196.75	0.03	0.00	197.95
Transient										
Cruise Only	0.04	0.21	0.04	0.00	0.02	0.02	33.90	0.00	0.00	34.11
Subtotal Ops	0.04	0.21	0.04	0.00	0.02	0.02	33.90	0.00	0.00	34.11
Flight Work										
Cruise Only	1.70	9.80	1.96	0.20	0.88	0.88	1,577.13	0.22	0.02	1,586.78
Subtotal Ops	1.70	9.80	1.96	0.20	0.88	0.88	1,577.13	0.22	0.02	1,586.78
Total Ops	1.97	11.32	2.26	0.23	1.02	1.02	1,823.41	0.26	0.02	1,834.57
Total without AUX-2	1.95	11.24	2.24	0.23	1.01	1.01	1,807.79	0.25	0.02	1,818.85

Table B1-29. BMG Range CH-46 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2										
FCLP	0.01	0.06	0.01	0.00	0.01	0.01	10.42	0.00	0.00	10.48
Subtotal Ops	0.01	0.06	0.01	0.00	0.01	0.01	10.42	0.00	0.00	10.48
Air to Air/Gnd										
Cruise Only	0.14	0.82	0.16	0.02	0.07	0.07	131.17	0.02	0.00	131.97
Subtotal Ops	0.14	0.82	0.16	0.02	0.07	0.07	131.17	0.02	0.00	131.97
Transient										
Cruise Only	0.02	0.14	0.03	0.00	0.01	0.01	22.60	0.00	0.00	22.74
Subtotal Ops	0.02	0.14	0.03	0.00	0.01	0.01	22.60	0.00	0.00	22.74
Flight Work										
Cruise Only	1.14	6.53	1.30	0.13	0.59	0.59	1,051.42	0.15	0.01	1,057.86
Subtotal Ops	1.14	6.53	1.30	0.13	0.59	0.59	1,051.42	0.15	0.01	1,057.86
Total Ops	1.31	7.55	1.51	0.15	0.68	0.68	1,215.61	0.17	0.01	1,223.05
Total without AUX-2	1.30	7.49	1.50	0.15	0.68	0.68	1,205.19	0.17	0.01	1,212.57

Table B1-30. Chocolate Mt. Range CH-46 Aircraft Emissions - Fiscal Year 2009

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.04	0.23	0.05	0.00	0.02	0.02	36.67	0.01	0.00	36.90
Cruise (from Pad Landing)	1.13	6.49	1.30	0.13	0.59	0.59	1,043.94	0.15	0.01	1,050.33
Subtotal Ops	1.17	6.72	1.34	0.14	0.61	0.61	1,080.62	0.15	0.01	1,087.23
CAS - Routes										
Cruise Only	0.09	0.53	0.11	0.01	0.05	0.05	84.82	0.01	0.00	85.34
Subtotal Ops	0.09	0.53	0.11	0.01	0.05	0.05	84.82	0.01	0.00	85.34
Total Ops	1.26	7.24	1.45	0.15	0.66	0.66	1,165.44	0.16	0.01	1,172.57

Table B1-31. Chocolate Mt. Range CH-46 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.03	0.16	0.03	0.00	0.02	0.02	26.20	0.00	0.00	26.36
Cruise (from Pad Landing)	0.81	4.63	0.93	0.09	0.42	0.42	745.67	0.10	0.01	750.24
Subtotal Ops	0.84	4.80	0.96	0.10	0.43	0.43	771.87	0.11	0.01	776.59
CAS - Routes										
Cruise Only	0.07	0.38	0.08	0.01	0.03	0.03	60.58	0.01	0.00	60.96
Subtotal Ops	0.07	0.38	0.08	0.01	0.03	0.03	60.58	0.01	0.00	60.96
Total Ops	0.90	5.17	1.03	0.11	0.47	0.47	832.45	0.12	0.01	837.55

Table B1-32. Chocolate Mt. Range CH-46 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.03	0.16	0.03	0.00	0.02	0.02	26.20	0.00	0.00	26.36
Cruise (from Pad Landing)	0.81	4.63	0.93	0.09	0.42	0.42	745.67	0.10	0.01	750.24
Subtotal Ops	0.84	4.80	0.96	0.10	0.43	0.43	771.87	0.11	0.01	776.59
CAS - Routes										
Cruise Only	0.07	0.38	0.08	0.01	0.03	0.03	60.58	0.01	0.00	60.96
Subtotal Ops	0.07	0.38	0.08	0.01	0.03	0.03	60.58	0.01	0.00	60.96
Total Ops	0.90	5.17	1.03	0.11	0.47	0.47	832.45	0.12	0.01	837.55

Table B1-33. Chocolate Mt. Range CH-46 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.02	0.10	0.02	0.00	0.01	0.01	15.72	0.00	0.00	15.81
Cruise (from Pad Landing)	0.48	2.78	0.56	0.06	0.25	0.25	447.40	0.06	0.00	450.14
Subtotal Ops	0.50	2.88	0.58	0.06	0.26	0.26	463.12	0.06	0.00	465.96
CAS - Routes										
Cruise Only	0.04	0.23	0.05	0.00	0.02	0.02	36.35	0.01	0.00	36.57
Subtotal Ops	0.04	0.23	0.05	0.00	0.02	0.02	36.35	0.01	0.00	36.57
Total Ops	0.54	3.10	0.62	0.06	0.28	0.28	499.47	0.07	0.00	502.53

Table B1-34. Chocolate Mt. Range CH-46 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.02	0.10	0.02	0.00	0.01	0.01	15.72	0.00	0.00	15.81
Cruise (from Pad Landing)	0.48	2.78	0.56	0.06	0.25	0.25	447.40	0.06	0.00	450.14
Subtotal Ops	0.50	2.88	0.58	0.06	0.26	0.26	463.12	0.06	0.00	465.96
CAS - Routes										
Cruise Only	0.04	0.23	0.05	0.00	0.02	0.02	36.35	0.01	0.00	36.57
Subtotal Ops	0.04	0.23	0.05	0.00	0.02	0.02	36.35	0.01	0.00	36.57
Total Ops	0.54	3.10	0.62	0.06	0.28	0.28	499.47	0.07	0.00	502.53

Table B1-35. Chocolate Mt. Range CH-46 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.01	0.06	0.01	0.00	0.01	0.01	10.48	0.00	0.00	10.54
Cruise (from Pad Landing)	0.32	1.85	0.37	0.04	0.17	0.17	298.27	0.04	0.00	300.10
Subtotal Ops	0.33	1.92	0.38	0.04	0.17	0.17	308.75	0.04	0.00	310.64
CAS - Routes										
Cruise Only	0.03	0.15	0.03	0.00	0.01	0.01	24.23	0.00	0.00	24.38
Subtotal Ops	0.03	0.15	0.03	0.00	0.01	0.01	24.23	0.00	0.00	24.38
Total Ops	0.36	2.07	0.41	0.04	0.19	0.19	332.98	0.05	0.00	335.02

Table B1-36. El Centro Range CH-46 Aircraft Emissions - Fiscal Year 2009

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.00	0.01	0.00	0.00	0.00	0.00	1.67	0.00	0.00	1.68
Cruise (from Pad Landing)	0.02	0.09	0.02	0.00	0.01	0.01	14.73	0.00	0.00	14.82
Total Ops	0.02	0.10	0.02	0.00	0.01	0.01	16.39	0.00	0.00	16.49

Table B1-37. El Centro Range CH-46 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.00	0.01	0.00	0.00	0.00	0.00	1.19	0.00	0.00	1.20
Cruise (from Pad Landing)	0.01	0.07	0.01	0.00	0.01	0.01	10.52	0.00	0.00	10.58
Total Ops	0.01	0.07	0.01	0.00	0.01	0.01	11.71	0.00	0.00	11.78

Table B1-38. El Centro Range CH-46 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.00	0.01	0.00	0.00	0.00	0.00	1.19	0.00	0.00	1.20
Cruise (from Pad Landing)	0.01	0.07	0.01	0.00	0.01	0.01	10.52	0.00	0.00	10.58
Total Ops	0.01	0.07	0.01	0.00	0.01	0.01	11.71	0.00	0.00	11.78

Table B1-39. El Centro Range CH-46 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.72
Cruise (from Pad Landing)	0.01	0.04	0.01	0.00	0.00	0.00	6.31	0.00	0.00	6.35
Total Ops	0.01	0.04	0.01	0.00	0.00	0.00	7.03	0.00	0.00	7.07

Table B1-40. El Centro Range CH-46 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.72
Cruise (from Pad Landing)	0.01	0.04	0.01	0.00	0.00	0.00	6.31	0.00	0.00	6.35
Total Ops	0.01	0.04	0.01	0.00	0.00	0.00	7.03	0.00	0.00	7.07

Table B1-41. El Centro Range CH-46 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAS - Areas										
Pad Landing	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.48
Cruise (from Pad Landing)	0.00	0.03	0.01	0.00	0.00	0.00	4.21	0.00	0.00	4.23
Total Ops	0.01	0.03	0.01	0.00	0.00	0.00	4.68	0.00	0.00	4.71

Table B1-42. 29 Palms Range CH-46 Aircraft Emissions - Fiscal Year 2009

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
R-2501										
Pad Landing	0.79	4.23	0.88	0.09	0.43	0.43	682.87	0.10	0.01	687.05
Cruise (from Pad Landing)	1.35	7.80	1.56	0.16	0.70	0.70	1,254.63	0.18	0.01	1,262.31
Subtotal Ops	2.15	12.03	2.44	0.25	1.13	1.13	1,937.50	0.27	0.02	1,949.36
Bristol/Sundance										
Cruise Only	0.23	1.34	0.27	0.03	0.12	0.12	215.04	0.03	0.00	216.36
Subtotal Ops	0.23	1.34	0.27	0.03	0.12	0.12	215.04	0.03	0.00	216.36
Total Ops	2.38	13.36	2.71	0.28	1.25	1.25	2,152.54	0.30	0.02	2,165.72

Table B1-43. 29 Palms Range CH-46 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_3*	*PM_{11}*	*$PM_{2.6}$*	*CO_3*	*CH_5*	*N_2O*	CO_2e
R-2502										
Pad Landing	0.57	3.02	0.63	0.06	0.31	0.31	487.76	0.07	0.00	490.75
Cruise (from Pad Landing)	0.97	5.57	1.11	0.11	0.50	0.50	896.17	0.13	0.01	901.65
Subtotal Ops	1.53	8.59	1.74	0.18	0.81	0.81	1,383.93	0.19	0.01	1,392.40
Bristol/Sundance										
Cruise Only	0.17	0.95	0.19	0.02	0.09	0.09	153.60	0.02	0.00	154.54
Subtotal Ops	0.17	0.95	0.19	0.02	0.09	0.09	153.60	0.02	0.00	154.54
Total Ops	1.70	9.54	1.93	0.20	0.90	0.90	1,537.53	0.22	0.02	1,546.94

Table B1-44. 29 Palms Range CH-46 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_4*	*PM_{12}*	*$PM_{2.7}$*	*CO_4*	*CH_6*	*N_2O*	CO_2e
R-2503										
Pad Landing	0.57	3.02	0.63	0.06	0.31	0.31	487.76	0.07	0.00	490.75
Cruise (from Pad Landing)	0.97	5.57	1.11	0.11	0.50	0.50	896.17	0.13	0.01	901.65
Subtotal Ops	1.53	8.59	1.74	0.18	0.81	0.81	1,383.93	0.19	0.01	1,392.40
Bristol/Sundance										
Cruise Only	0.17	0.95	0.19	0.02	0.09	0.09	153.60	0.02	0.00	154.54
Subtotal Ops	0.17	0.95	0.19	0.02	0.09	0.09	153.60	0.02	0.00	154.54
Total Ops	1.70	9.54	1.93	0.20	0.90	0.90	1,537.53	0.22	0.02	1,546.94

Table B1-45. 29 Palms Range CH-46 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_5*	*PM_{13}*	*$PM_{2.8}$*	*CO_5*	*CH_7*	*N_2O*	CO_2e
R-2504										
Pad Landing	0.34	1.81	0.38	0.04	0.18	0.18	292.66	0.04	0.00	294.45
Cruise (from Pad Landing)	0.58	3.34	0.67	0.07	0.30	0.30	537.70	0.08	0.01	540.99
Subtotal Ops	0.92	5.15	1.04	0.11	0.49	0.49	830.36	0.12	0.01	835.44
Bristol/Sundance										
Cruise Only	0.10	0.57	0.11	0.01	0.05	0.05	92.16	0.01	0.00	92.73
Subtotal Ops	0.10	0.57	0.11	0.01	0.05	0.05	92.16	0.01	0.00	92.73
Total Ops	1.02	5.73	1.16	0.12	0.54	0.54	922.52	0.13	0.01	928.17

Table B1-46. 29 Palms Range CH-46 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO* [6]	*PM* [14]	*PM* [2.9]	*CO* [6]	*CH* [8]	*N* [2] *O*	CO_2e
R-2505										
Pad Landing	0.34	1.81	0.38	0.04	0.18	0.18	292.66	0.04	0.00	294.45
Cruise (from Pad Landing)	0.58	3.34	0.67	0.07	0.30	0.30	537.70	0.08	0.01	540.99
Subtotal Ops	0.92	5.15	1.04	0.11	0.49	0.49	830.36	0.12	0.01	835.44
Bristol/Sundance										
Cruise Only	0.10	0.57	0.11	0.01	0.05	0.05	92.16	0.01	0.00	92.73
Subtotal Ops	0.10	0.57	0.11	0.01	0.05	0.05	92.16	0.01	0.00	92.73
Total Ops	1.02	5.73	1.16	0.12	0.54	0.54	922.52	0.13	0.01	928.17

Table B1-47. 29 Palms Range CH-46 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO* [7]	*PM* [15]	*PM* [2.10]	*CO* [7]	*CH* [9]	*N* [2] *O*	CO_2e
R-2506										
Pad Landing	0.23	1.21	0.25	0.03	0.12	0.12	195.11	0.03	0.00	196.30
Cruise (from Pad Landing)	0.39	2.23	0.44	0.05	0.20	0.20	358.47	0.05	0.00	360.66
Subtotal Ops	0.61	3.44	0.70	0.07	0.32	0.32	553.57	0.08	0.01	556.96
Bristol/Sundance										
Cruise Only	0.07	0.38	0.08	0.01	0.03	0.03	61.44	0.01	0.00	61.82
Subtotal Ops	0.07	0.38	0.08	0.01	0.03	0.03	61.44	0.01	0.00	61.82
Total Ops	0.68	3.82	0.77	0.08	0.36	0.36	615.01	0.09	0.01	618.78

Table B1-48. Annual MV-22 Operational Fielding Rates

Flight Activity/Annual Rate	*Calendar Year/Annual Operations*							
	10	*11*	*12*	*13*	*14*	*15*	*16*	*17*
MV-22 Annual Fielding Rate								
MV-22 Operations - % of Year 2017 Activity (1)	24	47	59	47	59	82	82	100

Notes: (1) Equates to percentage of annual MV-22 aircraft operations relative to full build-out year 2017 operations.

Table B1-48a. Annual Number of MV-22 Squadrons Proposed for San Diego County

Fiscal Year	Fleet Squadrons (1)		Reserve Squadrons (1)	Total On-Station (A - B + C)	Equivalent Fleet On-Station (2)	% of Peak Operations
	On-Station	Deployed				
2010	2	0	0	2	2	24%
2011	4	0	0	4	4	47%
2012	6	1	0	5	5	59%
2013	5	1	0	4	4	47%
2014	6	1	0	5	5	59%
2015	8	1	0	7	7	82%
2016	8	1	0	7	7	82%
2017	8	1	2	9	8.5	100%

Notes: 1) Source: Headquarters Marine Corps. 2008. FY2009 Marine Aviation Plan, MV-22 Transition Timeline, page 5-

URL http://hqinet001.hqmc.usmc.mil/AVN/FY2009%20AVPLAN.pdf.

(2) One reserve squadron activity level equal to 75% of a fleet squadron.

Table B1-49. Annual MV-22 Aircraft Operations - Air Bases - 10 Squadrons

	Fiscal Year/Annual Operations								
Activity/Mode	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Reserves*
Flight Operations									
Vertical Departure	1,256	2,512	3,140	2,512	3,140	4,396	4,396	5,338	942
Short Departure	3,768	7,536	9,420	7,536	9,420	13,187	13,187	16,013	2,826
Short Arrival	251	502	628	502	628	879	879	1,068	188
Vertical Arrival	251	502	628	502	628	879	879	1,068	188
Arrival (with Break)	4,522	9,045	11,306	9,045	11,306	15,829	15,829	19,220	3,392
Touch and Go	464	928	1,160	928	1,160	1,624	1,624	1,972	348
GCA Box Pattern	580	1,160	1,449	1,160	1,449	2,029	2,029	2,464	435
Hover (1)	4.5	9.1	11.3	9.1	11.3	15.9	15.9	19.3	3
Engine Maintenance&Testing									
APU Check	24	48	60	48	60	84	84	102	18
Water Wash	24	48	60	48	60	84	84	102	18
Low Power - One Engine	24	48	60	48	60	84	84	102	18
Low Power - Two Engines	24	48	60	48	60	84	84	102	18
High Power	24	48	60	48	60	84	84	102	18
Prop Balance	24	48	60	48	60	84	84	102	18

Notes: (1) Hours of low work per year, based upon 7 minutes of operation per sortie.

Table B1-50. MV-22 Aircraft Emissions for Air Base Operations - 10 Squadrons at MCAS Miramar (2 Pages)

AIRCRAFT TYPE:	**V-22**	REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**120**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**47,225**	SCENARIO: 10 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**21,351**	TOTAL OPS:	**21,356**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS[b] (TONS/YR) **NOx**	**SO2**	**CO**	**PM10**	**ROG**
5,338	4	APU USE	1	1	ON	1	5338	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.64	0.11	1.62	0.06	0.05
VERTICAL DEPARTURE		START/WARM UP	2	1	G IDLE	1	5338	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.65	0.06	1.43	0.25	0.02
		WARM UP	2	1	F IDLE	1	5338	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		3.53	0.23	1.96	0.93	0.01
		TAXI OUT	2	1	F IDLE	1	5338	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.77	0.12	0.98	0.46	0.01
		ENGINE RUN-UP	2	1			5338	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.39	0.02	0.07	0.07	0.00
		TAKEOFF TO HOVER	2	1			5338	4	1.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01		2.39	0.07	0.09	0.27	0.00
		HOVER	2	1			5338	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		1.80	0.06	0.10	0.23	0.00
		HELO CLIMBOUT	2	1			5338	4	2.00	1	1,770	1	13.19	0.40	0.60	1.58	0.01		4.15	0.13	0.19	0.50	0.00
		FW CLIMBOUT	2	1			5338	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		1.80	0.06	0.10	0.23	0.00
DEPARTURE TOTALS																			**18.13**	**0.86**	**6.53**	**3.00**	**0.09**
16,013	4	APU USE	1	1	ON	1	16,013	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		4.92	0.33	4.87	0.18	0.16
SHORT DEPARTURE		START/WARM UP	2	1	G IDLE	1	16013	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.96	0.19	4.28	0.76	0.05
		WARM UP	2	1	F IDLE	1	16013	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		10.60	0.70	5.87	2.78	0.04
		TAXI OUT	2	1	F IDLE	1	16013	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		5.30	0.35	2.93	1.39	0.02
		ENGINE RUN-UP	2	1			16013	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		1.16	0.05	0.22	0.22	0.00
		TAKEOFF	2	1			16013	4	1.00	1	2,060	1	15.06	0.40	0.45	1.58	0.01		8.28	0.22	0.25	0.87	0.01
		FW CLIMBOUT	2	1			16013	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		10.81	0.35	0.60	1.38	0.01
DEPARTURE TOTALS																			**43.04**	**2.20**	**19.01**	**7.58**	**0.27**
1,069	4	FW (0°) APPROACH	2	1			1,069	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.62	0.03	0.08	0.10	0.00
SHORT ARRIVAL		TRANSITION (16°) LANDING	2	1			1068.5	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.24	0.01	0.02	0.04	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	1068.5	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.21	0.01	0.12	0.06	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	1068.5	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.34	0.03	0.74	0.13	0.01
		HOT REFUEL (APU)	1	1	ON	1	1068.5	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.28	0.02	0.28	0.01	0.01
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	1068.5	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.21	0.01	0.12	0.06	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	1068.5	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.05	0.01	0.11	0.02	0.00
		APU USE	1	1	ON	1	1068.5	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.11	0.01	0.11	0.00	0.00
ARRIVAL TOTALS																			**2.07**	**0.13**	**1.58**	**0.42**	**0.03**
1,069	4	FW (0°) APPROACH	2	1			1069	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.62	0.03	0.08	0.10	0.00
VERTICAL ARRIVAL		TRANSITION (90°) LANDING	2	1			1069	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.24	0.01	0.02	0.04	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	1069	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.21	0.01	0.12	0.06	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	1069	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.34	0.03	0.74	0.13	0.01
		HOT REFUEL (APU)	1	1	ON	1	1069	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.28	0.02	0.28	0.01	0.01
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	1069	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.21	0.01	0.12	0.06	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	1069	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.05	0.01	0.11	0.02	0.00
		APU USE	1	1	ON	1	1069	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.11	0.01	0.11	0.00	0.00
ARRIVAL TOTALS																			**2.07**	**0.13**	**1.58**	**0.42**	**0.03**
19,219	4	FW APPROACH TO BREAK	2	1			19219	4	2.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		11.41	0.39	0.77	1.55	0.01
ARRIVAL (WITH BREAK)		BREAK	2	1			19219	4	1.00	1	1,030	1	8.41	0.40	1.58	1.58	0.02		2.77	0.13	0.52	0.52	0.01
		CIRCLE	2	1			19219	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		12.98	0.42	0.72	1.66	0.01
		FW APPROACH	2	1			19219	4	1.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		5.70	0.20	0.39	0.77	0.00
		TRANSITION (16°) LANDING	2	1			19219	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		4.29	0.17	0.44	0.66	0.01
		TAXI TO HOT REFUEL	2	1	F IDLE	1	19219	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		3.82	0.25	2.11	1.00	0.01
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	19219	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		6.13	0.60	13.34	2.37	0.15
		HOT REFUEL (APU)	1	1	ON	1	19219	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		5.12	0.34	5.06	0.19	0.16
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	19219	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		3.82	0.25	2.11	1.00	0.01
		COOL/SHUT DOWN	2	1	G IDLE	1	19219	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.94	0.09	2.05	0.36	0.02
		APU USE	1	1	ON	1	19219	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.97	0.13	1.95	0.07	0.06
ARRIVAL TOTALS																			**58.95**	**2.98**	**29.48**	**10.17**	**0.46**

Table B1-50. MV-22 Aircraft Emissions for Air Base Operations - 10 Squadrons at MCAS Miramar (2 Pages)

		REF
AIRCRAFT TYPE:	**V-22**	
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**120**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE:	**T406-AD-400**	1/b

TOTAL OPERATIONS:	**47,225**	SCENARIO: 10 SQUADRONS					
DEPARTURES		ARRIVALS				CRUISE	
TOTAL OPS:	**21,351**	TOTAL OPS:	**21,356**			TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK		FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]		**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
0	4							4															
FW (0°) CRUISE (<3,000 FEET MSL)		CRUISE	2	1			0	4	60.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01		0.00	0.00	0.00	0.00	0.00
								4															
CRUISE TOTALS																			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	4							4															
HELO (16°) CRUISE (<3,000 FEET MSL)		CRUISE	2	1			0	4	60.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		0.00	0.00	0.00	0.00	0.00
								4															
CRUISE TOTALS																			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1,972	4	APPROACH	2	3			1972	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01		1.17	0.04	0.08	0.16	0.00
T & G		CLIMBOUT	2	3			1972	4	1.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01		1.02	0.03	0.03	0.11	0.00
		CIRCLE	2	3			1972	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01		1.33	0.04	0.07	0.17	0.00
TOUCH AND GO TOTALS																			**3.52**	**0.11**	**0.18**	**0.44**	**0.00**
2,464	4	APPROACH	2	3			2464	4	3.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01		2.19	0.08	0.15	0.30	0.00
GCA BOX PATTERN		CLIMBOUT	2	3			2464	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01		2.55	0.07	0.08	0.27	0.00
		CIRCLE	2	3			2464	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01		1.66	0.05	0.09	0.21	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS																			**6.41**	**0.20**	**0.32**	**0.78**	**0.00**
	4	APPROACH	2	3			0	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01		0.00	0.00	0.00	0.00	0.00
FCLP		CLIMBOUT	2	3			0	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01		0.00	0.00	0.00	0.00	0.00
		CIRCLE	2	3			0	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01		0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS																			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
83	4																						
LOW WORK		HOVER	2	1			83	4	7.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.19	0.01	0.01	0.02	0.00
LOW WORK TOTALS																			**0.19**	**0.01**	**0.01**	**0.02**	**0.00**
OVERALL V-22 LTO CYCLE AND MISSION OPERATIONS AIR EMISSIONS TOTALS (TONS)																			**134.38**	**6.61**	**58.70**	**22.83**	**0.89**
																			NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table B1-51. MV-22 Aircraft Emissions for Air Base Operations - 8 Squadrons at MCAS Miramar (2 Pages)

AIRCRAFT TYPE:	**V-22**	REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**96**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE:	**T406-AD-400**	1/b

TOTAL OPERATIONS:	**36,113**	SCENARIO: 8 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**16,327**	TOTAL OPS:	**16,331**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY	ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE	ENGINE POWER (% Q_{TRANS})	ANNUAL NUMBER OF OPERATIONS	TIME IN MODE PER ENGINE (MINUTES)	FUEL FLOW RATE PER ENGINE (LBS/HR)	EMISSION FACTORS (LB/1,000 LB OF FUEL)					EMISSIONS[b] (TONS/YR)				
							NOx	SO2	CO	PM10	ROG	NOx	SO2	CO	PM10	ROG
4,082 [4]	APU USE	1 [1]	ON [1]	4082 [4]	15.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	1.25	0.08	1.24	0.05	0.04
VERTICAL DEPARTURE	START/WARM UP	2 [1]	G IDLE [1]	4082 [4]	5.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.50	0.05	1.09	0.19	0.01
	WARM UP	2 [1]	F IDLE [1]	4082 [4]	10.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	2.70	0.18	1.50	0.71	0.01
	TAXI OUT	2 [1]	F IDLE [1]	4082 [4]	5.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	1.35	0.09	0.75	0.35	0.00
	ENGINE RUN-UP	2 [1]		4082 [4]	0.50 [1]	1,030 [1]	8.41	0.40	1.58	1.58	0.02	0.29	0.01	0.06	0.06	0.00
	TAKEOFF TO HOVER	2 [1]		4082 [4]	1.00 [1]	1,910 [1]	14.09	0.40	0.52	1.58	0.01	1.83	0.05	0.07	0.21	0.00
	HOVER	2 [1]		4082 [4]	1.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	1.38	0.04	0.08	0.18	0.00
	HELO CLIMBOUT	2 [1]		4082 [4]	2.00 [1]	1,770 [1]	13.19	0.40	0.60	1.58	0.01	3.18	0.10	0.14	0.38	0.00
	FW CLIMBOUT	2 [1]		4082 [4]	1.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	1.38	0.04	0.08	0.18	0.00
DEPARTURE TOTALS												**13.87**	**0.65**	**5.00**	**2.30**	**0.07**
12,245 [4]	APU USE	1 [1]	ON [1]	12,245 [4]	15.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	3.76	0.25	3.72	0.14	0.12
SHORT DEPARTURE	START/WARM UP	2 [1]	G IDLE [1]	12245 [4]	5.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	1.50	0.15	3.27	0.58	0.04
	WARM UP	2 [1]	F IDLE [1]	12245 [4]	10.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	8.11	0.54	4.49	2.13	0.03
	TAXI OUT	2 [1]	F IDLE [1]	12245 [4]	5.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	4.05	0.27	2.24	1.06	0.01
	ENGINE RUN-UP	2 [1]		12245 [4]	0.50 [1]	1,030 [1]	8.41	0.40	1.58	1.58	0.02	0.88	0.04	0.17	0.17	0.00
	TAKEOFF	2 [1]		12245 [4]	1.00 [1]	2,060 [1]	15.06	0.40	0.45	1.58	0.01	6.33	0.17	0.19	0.66	0.00
	FW CLIMBOUT	2 [1]		12245 [4]	2.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	8.27	0.27	0.46	1.06	0.01
DEPARTURE TOTALS												**32.91**	**1.69**	**14.54**	**5.80**	**0.21**
817.5 [4]	FW (0°) APPROACH	2 [1]		818 [4]	3.00 [1]	1,210 [1]	9.57	0.40	1.20	1.58	0.02	0.47	0.02	0.06	0.08	0.00
SHORT ARRIVAL	TRANSITION (16°) LANDING	2 [1]		817.5 [4]	1.00 [1]	1,310 [1]	10.22	0.40	1.04	1.58	0.02	0.18	0.01	0.02	0.03	0.00
	TAXI TO HOT REFUEL	2 [1]	F IDLE [1]	817.5 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	HOT REFUEL (MAIN ENGS)	2 [1]	G IDLE [1]	817.5 [4]	13.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.26	0.03	0.57	0.10	0.01
	HOT REFUEL (APU)	1 [1]	ON [1]	817.5 [4]	13.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.22	0.01	0.22	0.01	0.01
	TAXI TO SQUAD. APRON	2 [1]	F IDLE [1]	817.5 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	COOL/SHUT DOWN	2 [1]	G IDLE [1]	817.5 [4]	2.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.04	0.00	0.09	0.02	0.00
	APU USE	1 [1]	ON [1]	817.5 [4]	5.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.08	0.01	0.08	0.00	0.00
ARRIVAL TOTALS												**1.58**	**0.10**	**1.21**	**0.32**	**0.02**
817.5 [4]	FW (0°) APPROACH	2 [1]		818 [4]	3.00 [1]	1,210 [1]	9.57	0.40	1.20	1.58	0.02	0.47	0.02	0.06	0.08	0.00
VERTICAL ARRIVAL	TRANSITION (90°) LANDING	2 [1]		818 [4]	1.00 [1]	1,310 [1]	10.22	0.40	1.04	1.58	0.02	0.18	0.01	0.02	0.03	0.00
	TAXI TO HOT REFUEL	2 [1]	F IDLE [1]	818 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	HOT REFUEL (MAIN ENGS)	2 [1]	G IDLE [1]	818 [4]	13.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.26	0.03	0.57	0.10	0.01
	HOT REFUEL (APU)	1 [1]	ON [1]	818 [4]	13.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.22	0.01	0.22	0.01	0.01
	TAXI TO SQUAD. APRON	2 [1]	F IDLE [1]	818 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	COOL/SHUT DOWN	2 [1]	G IDLE [1]	818 [4]	2.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.04	0.00	0.09	0.02	0.00
	APU USE	1 [1]	ON [1]	818 [4]	5.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.08	0.01	0.08	0.00	0.00
ARRIVAL TOTALS												**1.58**	**0.10**	**1.21**	**0.32**	**0.02**
14696 [4]	FW APPROACH TO BREAK	2 [1]		14696 [4]	2.00 [1]	1,530 [1]	11.64	0.40	0.79	1.58	0.01	8.72	0.30	0.59	1.18	0.01
ARRIVAL (WITH BREAK)	BREAK	2 [1]		14696 [4]	1.00 [1]	1,030 [1]	8.41	0.40	1.58	1.58	0.02	2.12	0.10	0.40	0.40	0.01
	CIRCLE	2 [1]		14696 [4]	2.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	9.92	0.32	0.55	1.27	0.01
	FW APPROACH	2 [1]		14696 [4]	1.00 [1]	1,530 [1]	11.64	0.40	0.79	1.58	0.01	4.36	0.15	0.30	0.59	0.00
	TRANSITION (16°) LANDING	2 [1]		14696 [4]	1.00 [1]	1,310 [1]	10.22	0.40	1.04	1.58	0.02	3.28	0.13	0.33	0.51	0.01
	TAXI TO HOT REFUEL	2 [1]	F IDLE [1]	14696 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	2.92	0.19	1.61	0.77	0.01
	HOT REFUEL (MAIN ENGS)	2 [1]	G IDLE [1]	14696 [4]	13.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	4.69	0.46	10.20	1.81	0.11
	HOT REFUEL (APU)	1 [1]	ON [1]	14696 [4]	13.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	3.91	0.26	3.87	0.14	0.12
	TAXI TO SQUAD. APRON	2 [1]	F IDLE [1]	14696 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	2.92	0.19	1.61	0.77	0.01
	COOL/SHUT DOWN	2 [1]	G IDLE [1]	14696 [4]	2.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.72	0.07	1.57	0.28	0.02
	APU USE	1 [1]	ON [1]	14696 [4]	5.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	1.50	0.10	1.49	0.06	0.05
ARRIVAL TOTALS												**45.07**	**2.28**	**22.54**	**7.77**	**0.36**

Table B1-51. MV-22 Aircraft Emissions for Air Base Operations - 8 Squadrons at MCAS Miramar (2 Pages)

		REF
AIRCRAFT TYPE:	**V-22**	
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**96**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE:	**T406-AD-400**	1/b

TOTAL OPERATIONS:	**36,113**	SCENARIO: 8 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**16,327**	TOTAL OPS:	**16,331**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY	ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE	ENGINE POWER (% Q_{TRANS})	ANNUAL NUMBER OF OPERATIONS	TIME IN MODE PER ENGINE (MINUTES)	FUEL FLOW RATE PER ENGINE (LBS/HR)	EMISSION FACTORS (LB/1,000 LB OF FUEL)					EMISSIONS[b] (TONS/YR)				
							NOx	SO2	CO	PM10	ROG	NOx	SO2	CO	PM10	ROG
0 [4]																
FW (0°) CRUISE (<3,000 FEET MSL)	CRUISE	2 [1]		0 [4] [4]	60.00 [1]	1,910 [1]	14.09	0.40	0.52	1.58	0.01	0.00	0.00	0.00	0.00	0.00
CRUISE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0 [4]																
HELO (16°) CRUISE (<3,000 FEET MSL)	CRUISE	2 [1]		0 [4] [4]	60.00 [1]	1,530 [1]	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
CRUISE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1,508 [4]	APPROACH	2 [3]		1508 [4]	2.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.89	0.03	0.06	0.12	0.00
T & G	CLIMBOUT	2 [3]		1508 [4]	1.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.78	0.02	0.02	0.08	0.00
	CIRCLE	2 [3]		1508 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	1.02	0.03	0.06	0.13	0.00
TOUCH AND GO TOTALS												**2.69**	**0.08**	**0.14**	**0.33**	**0.00**
1,885 [4]	APPROACH	2 [3]		1885 [4]	3.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	1.68	0.06	0.11	0.23	0.00
GCA BOX PATTERN	CLIMBOUT	2 [3]		1885 [4]	2.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	1.95	0.05	0.06	0.20	0.00
	CIRCLE	2 [3]		1885 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	1.27	0.04	0.07	0.16	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS												**4.90**	**0.15**	**0.24**	**0.60**	**0.00**
[4]	APPROACH	2 [3]		0 [4]	2.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FCLP	CLIMBOUT	2 [3]		0 [4]	2.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.00	0.00	0.00	0.00	0.00
	CIRCLE	2 [3]		0 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
63 [4]																
LOW WORK	HOVER	2 [1]		63 [4]	7.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	0.15	0.00	0.01	0.02	0.00
LOW WORK TOTALS												**0.15**	**0.00**	**0.01**	**0.02**	**0.00**
TOTAL AIR EMISSIONS (TONS)												**102.76**	**5.06**	**44.89**	**17.46**	**0.68**
												NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table B1-52. MV-22 Aircraft Emissions for Air Base Operations - 8 Squadrons at MCAS Yuma (2 Pages)

		REF
AIRCRAFT TYPE:	**V-22**	
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**96**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE:	**T406-AD-400**	1/b

TOTAL OPERATIONS:	**38,891**	SCENARIO: 8 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**17,584**	TOTAL OPS:	**17,586**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
4,396	4	APU USE	1	1	ON	1	4396	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.35	0.09	1.34	0.05	0.04
VERTICAL DEPARTURE		START/WARM UP	2	1	G IDLE	1	4396	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.54	0.05	1.17	0.21	0.01
		WARM UP	2	1	F IDLE	1	4396	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		2.91	0.19	1.61	0.76	0.01
		TAXI OUT	2	1	F IDLE	1	4396	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.46	0.10	0.81	0.38	0.00
		ENGINE RUN-UP	2	1			4396	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.32	0.02	0.06	0.06	0.00
		TAKEOFF TO HOVER	2	1			4396	4	1.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01		1.97	0.06	0.07	0.22	0.00
		HOVER	2	1			4396	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		1.48	0.05	0.08	0.19	0.00
		HELO CLIMBOUT	2	1			4396	4	2.00	1	1,770	1	13.19	0.40	0.60	1.58	0.01		3.42	0.10	0.16	0.41	0.00
		FW CLIMBOUT	2	1			4396	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		1.48	0.05	0.08	0.19	0.00
DEPARTURE TOTALS																			**14.93**	**0.70**	**5.38**	**2.47**	**0.08**
13,188	4	APU USE	1	1	ON	1	13,188	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		4.05	0.27	4.01	0.15	0.13
SHORT DEPARTURE		START/WARM UP	2	1	G IDLE	1	13188	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.62	0.16	3.52	0.63	0.04
		WARM UP	2	1	F IDLE	1	13188	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		8.73	0.58	4.83	2.29	0.03
		TAXI OUT	2	1	F IDLE	1	13188	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		4.37	0.29	2.42	1.15	0.01
		ENGINE RUN-UP	2	1			13188	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.95	0.05	0.18	0.18	0.00
		TAKEOFF	2	1			13188	4	1.00	1	2,060	1	15.06	0.40	0.45	1.58	0.01		6.82	0.18	0.20	0.72	0.00
		FW CLIMBOUT	2	1			13188	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		8.90	0.29	0.50	1.14	0.01
DEPARTURE TOTALS																			**35.44**	**1.82**	**15.66**	**6.25**	**0.23**
879.5	4	FW (0°) APPROACH	2	1			880	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.51	0.02	0.06	0.08	0.00
SHORT ARRIVAL		TRANSITION (16°) LANDING	2	1			879.5	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.20	0.01	0.02	0.03	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	879.5	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.17	0.01	0.10	0.05	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	879.5	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.28	0.03	0.61	0.11	0.01
		HOT REFUEL (APU)	1	1	ON	1	879.5	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.23	0.02	0.23	0.01	0.01
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	879.5	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.17	0.01	0.10	0.05	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	879.5	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.04	0.00	0.09	0.02	0.00
		APU USE	1	1	ON	1	879.5	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.09	0.01	0.09	0.00	0.00
ARRIVAL TOTALS																			**1.70**	**0.11**	**1.30**	**0.34**	**0.02**
879.5	4	FW (0°) APPROACH	2	1			880	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.51	0.02	0.06	0.08	0.00
VERTICAL ARRIVAL		TRANSITION (90°) LANDING	2	1			880	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.20	0.01	0.02	0.03	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	880	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.17	0.01	0.10	0.05	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	880	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.28	0.03	0.61	0.11	0.01
		HOT REFUEL (APU)	1	1	ON	1	880	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.23	0.02	0.23	0.01	0.01
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	880	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.17	0.01	0.10	0.05	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	880	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.04	0.00	0.09	0.02	0.00
		APU USE	1	1	ON	1	880	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.09	0.01	0.09	0.00	0.00
ARRIVAL TOTALS																			**1.70**	**0.11**	**1.30**	**0.34**	**0.02**
15827	4	FW APPROACH TO BREAK	2	1			15827	4	2.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		9.40	0.32	0.64	1.28	0.01
ARRIVAL (WITH BREAK)		BREAK	2	1			15827	4	1.00	1	1,030	1	8.41	0.40	1.58	1.58	0.02		2.28	0.11	0.43	0.43	0.01
		CIRCLE	2	1			15827	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		10.69	0.35	0.60	1.37	0.01
		FW APPROACH	2	1			15827	4	1.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		4.70	0.16	0.32	0.64	0.00
		TRANSITION (16°) LANDING	2	1			15827	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		3.53	0.14	0.36	0.55	0.01
		TAXI TO HOT REFUEL	2	1	F IDLE	1	15827	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		3.14	0.21	1.74	0.83	0.01
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	15827	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		5.05	0.49	10.99	1.95	0.12
		HOT REFUEL (APU)	1	1	ON	1	15827	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		4.21	0.28	4.17	0.16	0.13
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	15827	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		3.14	0.21	1.74	0.83	0.01
		COOL/SHUT DOWN	2	1	G IDLE	1	15827	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.78	0.08	1.69	0.30	0.02
		APU USE	1	1	ON	1	15827	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.62	0.11	1.60	0.06	0.05
ARRIVAL TOTALS																			**48.54**	**2.46**	**24.27**	**8.37**	**0.38**

Table B1-52. MV-22 Aircraft Emissions for Air Base Operations - 8 Squadrons at MCAS Yuma (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**96**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**38,891**	SCENARIO: 8 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**17,584**	TOTAL OPS:	**17,586**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG	EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
0	4							4														
FW (0°) CRUISE		CRUISE	2	1			0	4	60.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01	0.00	0.00	0.00	0.00	0.00
(<3,000 FEET MSL)								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	4							4														
HELO (16°) CRUISE		CRUISE	2	1			0	4	60.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
(<3,000 FEET MSL)								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1,624	4	APPROACH	2	3			1624	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.96	0.03	0.07	0.13	0.00
T & G		CLIMBOUT	2	3			1624	4	1.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.84	0.02	0.03	0.09	0.00
		CIRCLE	2	3			1624	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	1.10	0.04	0.06	0.14	0.00
TOUCH AND GO TOTALS																		**2.90**	**0.09**	**0.15**	**0.36**	**0.00**
2,029	4	APPROACH	2	3			2029	4	3.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	1.81	0.06	0.12	0.25	0.00
GCA BOX PATTERN		CLIMBOUT	2	3			2029	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	2.10	0.06	0.06	0.22	0.00
		CIRCLE	2	3			2029	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	1.37	0.04	0.08	0.18	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS																		**5.27**	**0.16**	**0.26**	**0.64**	**0.00**
	4	APPROACH	2	3			0	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FCLP		CLIMBOUT	2	3			0	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.00	0.00	0.00	0.00	0.00
		CIRCLE	2	3			0	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
68	4																					
LOW WORK		HOVER	2	1			68	4	7.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01	0.16	0.01	0.01	0.02	0.00
LOW WORK TOTALS																		**0.16**	**0.01**	**0.01**	**0.02**	**0.00**
TOTAL AIR EMISSIONS (TONS)																		**110.66**	**5.45**	**48.34**	**18.80**	**0.74**
																		NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table B1-53. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Miramar (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**8,335**	SCENARIO: 2 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**3,767**	TOTAL OPS:	**3,770**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
942	4	APU USE	1	1	ON	1	942	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.29	0.02	0.29	0.01	0.01
VERTICAL DEPARTURE		START/WARM UP	2	1	G IDLE	1	942	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.12	0.01	0.25	0.04	0.00
		WARM UP	2	1	F IDLE	1	942	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.62	0.04	0.35	0.16	0.00
		TAXI OUT	2	1	F IDLE	1	942	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.31	0.02	0.17	0.08	0.00
		ENGINE RUN-UP	2	1			942	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.07	0.00	0.01	0.01	0.00
		TAKEOFF TO HOVER	2	1			942	4	1.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01		0.42	0.01	0.02	0.05	0.00
		HOVER	2	1			942	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.32	0.01	0.02	0.04	0.00
		HELO CLIMBOUT	2	1			942	4	2.00	1	1,770	1	13.19	0.40	0.60	1.58	0.01		0.73	0.02	0.03	0.09	0.00
		FW CLIMBOUT	2	1			942	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.32	0.01	0.02	0.04	0.00
DEPARTURE TOTALS																			**3.20**	**0.15**	**1.15**	**0.53**	**0.02**
2,825	4	APU USE	1	1	ON	1	2,825	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.87	0.06	0.86	0.03	0.03
SHORT DEPARTURE		START/WARM UP	2	1	G IDLE	1	2825	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.35	0.03	0.75	0.13	0.01
		WARM UP	2	1	F IDLE	1	2825	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.87	0.12	1.03	0.49	0.01
		TAXI OUT	2	1	F IDLE	1	2825	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.94	0.06	0.52	0.25	0.00
		ENGINE RUN-UP	2	1			2825	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.20	0.01	0.04	0.04	0.00
		TAKEOFF	2	1			2825	4	1.00	1	2,060	1	15.06	0.40	0.45	1.58	0.01		1.46	0.04	0.04	0.15	0.00
		FW CLIMBOUT	2	1			2825	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		1.91	0.06	0.11	0.24	0.00
DEPARTURE TOTALS																			**7.59**	**0.39**	**3.35**	**1.34**	**0.05**
189	4	FW (0°) APPROACH	2	1			189	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.11	0.00	0.01	0.02	0.00
SHORT ARRIVAL		TRANSITION (16°) LANDING	2	1			189	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.04	0.00	0.00	0.01	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	189	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.06	0.01	0.13	0.02	0.00
		HOT REFUEL (APU)	1	1	ON	1	189	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.05	0.00	0.05	0.00	0.00
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	189	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.01	0.00	0.02	0.00	0.00
		APU USE	1	1	ON	1	189	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.02	0.00	0.02	0.00	0.00
ARRIVAL TOTALS																			**0.37**	**0.02**	**0.28**	**0.07**	**0.00**
189	4	FW (0°) APPROACH	2	1			189	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.11	0.00	0.01	0.02	0.00
VERTICAL ARRIVAL		TRANSITION (90°) LANDING	2	1			189	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.04	0.00	0.00	0.01	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	189	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.06	0.01	0.13	0.02	0.00
		HOT REFUEL (APU)	1	1	ON	1	189	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.05	0.00	0.05	0.00	0.00
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	189	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.01	0.00	0.02	0.00	0.00
		APU USE	1	1	ON	1	189	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.02	0.00	0.02	0.00	0.00
ARRIVAL TOTALS																			**0.37**	**0.02**	**0.28**	**0.07**	**0.00**
3392	4	FW APPROACH TO BREAK	2	1			3392	4	2.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		2.01	0.07	0.14	0.27	0.00
ARRIVAL (WITH BREAK)		BREAK	2	1			3392	4	1.00	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.49	0.02	0.09	0.09	0.00
		CIRCLE	2	1			3392	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		2.29	0.07	0.13	0.29	0.00
		FW APPROACH	2	1			3392	4	1.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		1.01	0.03	0.07	0.14	0.00
		TRANSITION (16°) LANDING	2	1			3392	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.76	0.03	0.08	0.12	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	3392	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.67	0.04	0.37	0.18	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	3392	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.08	0.11	2.35	0.42	0.03
		HOT REFUEL (APU)	1	1	ON	1	3392	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.90	0.06	0.89	0.03	0.03
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	3392	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.67	0.04	0.37	0.18	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	3392	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.17	0.02	0.36	0.06	0.00
		APU USE	1	1	ON	1	3392	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.35	0.02	0.34	0.01	0.01
ARRIVAL TOTALS																			**10.40**	**0.53**	**5.20**	**1.79**	**0.08**

Table B1-53. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Miramar (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:				**8,335**	SCENARIO: 2 SQUADRONS									
DEPARTURES					ARRIVALS						CRUISE			
TOTAL OPS:	**3,767**				TOTAL OPS:	**3,770**					TOTAL HRS:	**0**		
VERTICAL		SHORT			SHORT		VERTICAL		BREAK		FW MODE		HELO MODE	
25.0%	d	**75.0%**	d		**5.0%**	d	**5.0%**	d	**90.0%**	d	**85.0%**	d	**15.0%**	d

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG	EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
0	4							4														
FW (0°) CRUISE (<3,000 FEET MSL)		CRUISE	2	1			0	4	60.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01	0.00	0.00	0.00	0.00	0.00
								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	4							4														
HELO (16°) CRUISE (<3,000 FEET MSL)		CRUISE	2	1			0	4	60.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
348	4	APPROACH	2	3			348	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.21	0.01	0.01	0.03	0.00
T & G		CLIMBOUT	2	3			348	4	1.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.18	0.00	0.01	0.02	0.00
		CIRCLE	2	3			348	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.23	0.01	0.01	0.03	0.00
TOUCH AND GO TOTALS																		**0.62**	**0.02**	**0.03**	**0.08**	**0.00**
435	4	APPROACH	2	3			435	4	3.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.39	0.01	0.03	0.05	0.00
GCA BOX PATTERN		CLIMBOUT	2	3			435	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.45	0.01	0.01	0.05	0.00
		CIRCLE	2	3			435	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.29	0.01	0.02	0.04	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS																		**1.13**	**0.03**	**0.06**	**0.14**	**0.00**
	4	APPROACH	2	3			0	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FCLP		CLIMBOUT	2	3			0	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.00	0.00	0.00	0.00	0.00
		CIRCLE	2	3			0	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
15	4																					
LOW WORK		HOVER	2	1			15	4	7.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01	0.03	0.00	0.00	0.00	0.00
LOW WORK TOTALS																		**0.03**	**0.00**	**0.00**	**0.00**	**0.00**
OVERALL V-22 LTO CYCLE AND MISSION OPERATIONS AIR EMISSIONS TOTALS (TONS)																		**23.71**	**1.17**	**10.36**	**4.03**	**0.16**
																		NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table B1-54. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Camp Pendleton (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**11,069**	SCENARIO: 2 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**5,005**	TOTAL OPS:	**5,005**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**50.0%** [d]	**50.0%** [d]	**0.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
1,252	4	APU USE	1	1	ON	1	1252	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.38	0.03	0.38	0.01	0.01
VERTICAL DEPARTURE		START/WARM UP	2	1	G IDLE	1	1252	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.15	0.02	0.33	0.06	0.00
		WARM UP	2	1	F IDLE	1	1252	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.83	0.06	0.46	0.22	0.00
		TAXI OUT	2	1	F IDLE	1	1252	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.41	0.03	0.23	0.11	0.00
		ENGINE RUN-UP	2	1			1252	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.09	0.00	0.02	0.02	0.00
		TAKEOFF TO HOVER	2	1			1252	4	1.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01		0.56	0.02	0.02	0.06	0.00
		HOVER	2	1			1252	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.42	0.01	0.02	0.05	0.00
		HELO CLIMBOUT	2	1			1252	4	2.00	1	1,770	1	13.19	0.40	0.60	1.58	0.01		0.97	0.03	0.04	0.12	0.00
		FW CLIMBOUT	2	1			1252	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.42	0.01	0.02	0.05	0.00
DEPARTURE TOTALS																			**4.25**	**0.20**	**1.53**	**0.70**	**0.02**
3,754	4	APU USE	1	1	ON	1	3,754	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.15	0.08	1.14	0.04	0.04
SHORT DEPARTURE		START/WARM UP	2	1	G IDLE	1	3754	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.46	0.05	1.00	0.18	0.01
		WARM UP	2	1	F IDLE	1	3754	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		2.49	0.17	1.38	0.65	0.01
		TAXI OUT	2	1	F IDLE	1	3754	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.24	0.08	0.69	0.33	0.00
		ENGINE RUN-UP	2	1			3754	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.27	0.01	0.05	0.05	0.00
		TAKEOFF	2	1			3754	4	1.00	1	2,060	1	15.06	0.40	0.45	1.58	0.01		1.94	0.05	0.06	0.20	0.00
		FW CLIMBOUT	2	1			3754	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		2.53	0.08	0.14	0.32	0.00
DEPARTURE TOTALS																			**10.09**	**0.52**	**4.46**	**1.78**	**0.06**
2,503	4	FW (0°) APPROACH	2	1			2,503	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		1.45	0.06	0.18	0.24	0.00
SHORT ARRIVAL		TRANSITION (16°) LANDING	2	1			2503	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.56	0.02	0.06	0.09	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	2503	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.28	0.13	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	2503	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.80	0.08	1.74	0.31	0.02
		HOT REFUEL (APU)	1	1	ON	1	2503	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.67	0.04	0.66	0.02	0.02
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	2503	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.28	0.13	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	2503	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.12	0.01	0.27	0.05	0.00
		APU USE	1	1	ON	1	2503	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.26	0.02	0.25	0.01	0.01
ARRIVAL TOTALS																			**4.85**	**0.30**	**3.71**	**0.98**	**0.06**
2502	4	FW (0°) APPROACH	2	1			2502	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		1.45	0.06	0.18	0.24	0.00
VERTICAL ARRIVAL		TRANSITION (90°) LANDING	2	1			2502	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.56	0.02	0.06	0.09	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	2502	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.27	0.13	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	2502	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.80	0.08	1.74	0.31	0.02
		HOT REFUEL (APU)	1	1	ON	1	2502	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.67	0.04	0.66	0.02	0.02
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	2502	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.27	0.13	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	2502	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.12	0.01	0.27	0.05	0.00
		APU USE	1	1	ON	1	2502	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.26	0.02	0.25	0.01	0.01
ARRIVAL TOTALS																			**4.84**	**0.30**	**3.71**	**0.98**	**0.06**
0	4	FW APPROACH TO BREAK	2	1			0	4	2.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		0.00	0.00	0.00	0.00	0.00
ARRIVAL (WITH BREAK)		BREAK	2	1			0	4	1.00	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		CIRCLE	2	1			0	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.00	0.00	0.00	0.00	0.00
		FW APPROACH	2	1			0	4	1.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		0.00	0.00	0.00	0.00	0.00
		TRANSITION (16°) LANDING	2	1			0	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	0	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	0	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.00	0.00	0.00	0.00	0.00
		HOT REFUEL (APU)	1	1	ON	1	0	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.00	0.00	0.00	0.00	0.00
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	0	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	0	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.00	0.00	0.00	0.00	0.00
		APU USE	1	1	ON	1	0	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.00	0.00	0.00	0.00	0.00
ARRIVAL TOTALS																			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Table B1-54. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Camp Pendleton (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**11,069**	SCENARIO: 2 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**5,005**	TOTAL OPS:	**5,005**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**50.0%** [d]	**50.0%** [d]	**0.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG	EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
0	4							4														
FW (0°) CRUISE (<3,000 FEET MSL)		CRUISE	2	1			0	4	60.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01	0.00	0.00	0.00	0.00	0.00
								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	4							4														
HELO (16°) CRUISE (<3,000 FEET MSL)		CRUISE	2	1			0	4	60.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
464	4	APPROACH	2	3			464	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.28	0.01	0.02	0.04	0.00
T & G		CLIMBOUT	2	3			464	4	1.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.24	0.01	0.01	0.03	0.00
		CIRCLE	2	3			464	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.31	0.01	0.02	0.04	0.00
TOUCH AND GO TOTALS																		**0.83**	**0.03**	**0.04**	**0.10**	**0.00**
580	4	APPROACH	2	3			580	4	3.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.52	0.02	0.04	0.07	0.00
GCA BOX PATTERN		CLIMBOUT	2	3			580	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.60	0.02	0.02	0.06	0.00
		CIRCLE	2	3			580	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.39	0.01	0.02	0.05	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS																		**1.51**	**0.05**	**0.07**	**0.18**	**0.00**
	4	APPROACH	2	3			0	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FCLP		CLIMBOUT	2	3			0	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.00	0.00	0.00	0.00	0.00
		CIRCLE	2	3			0	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
15	4																					
LOW WORK		HOVER	2	1			15	4	7.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01	0.03	0.00	0.00	0.00	0.00
LOW WORK TOTALS																		**0.03**	**0.00**	**0.00**	**0.00**	**0.00**
OVERALL V-22 LTO CYCLE AND MISSION OPERATIONS AIR EMISSIONS TOTALS (TONS)																		**26.40**	**1.39**	**13.52**	**4.73**	**0.21**
																		NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table B1-55. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Yuma (2 Pages)

AIRCRAFT TYPE:	**V-22**	REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE:	**T406-AD-400**	1/b

TOTAL OPERATIONS:	**8,335**	SCENARIO: 2 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**3,767**	TOTAL OPS:	**3,770**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
942	4	APU USE	1	1	ON	1	942	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.29	0.02	0.29	0.01	0.01
VERTICAL DEPARTURE		START/WARM UP	2	1	G IDLE	1	942	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.12	0.01	0.25	0.04	0.00
		WARM UP	2	1	F IDLE	1	942	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.62	0.04	0.35	0.16	0.00
		TAXI OUT	2	1	F IDLE	1	942	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.31	0.02	0.17	0.08	0.00
		ENGINE RUN-UP	2	1			942	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.07	0.00	0.01	0.01	0.00
		TAKEOFF TO HOVER	2	1			942	4	1.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01		0.42	0.01	0.02	0.05	0.00
		HOVER	2	1			942	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.32	0.01	0.02	0.04	0.00
		HELO CLIMBOUT	2	1			942	4	2.00	1	1,770	1	13.19	0.40	0.60	1.58	0.01		0.73	0.02	0.03	0.09	0.00
		FW CLIMBOUT	2	1			942	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.32	0.01	0.02	0.04	0.00
DEPARTURE TOTALS																			**3.20**	**0.15**	**1.15**	**0.53**	**0.02**
2,825	4	APU USE	1	1	ON	1	2,825	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.87	0.06	0.86	0.03	0.03
SHORT DEPARTURE		START/WARM UP	2	1	G IDLE	1	2825	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.35	0.03	0.75	0.13	0.01
		WARM UP	2	1	F IDLE	1	2825	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.87	0.12	1.03	0.49	0.01
		TAXI OUT	2	1	F IDLE	1	2825	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.94	0.06	0.52	0.25	0.00
		ENGINE RUN-UP	2	1			2825	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.20	0.01	0.04	0.04	0.00
		TAKEOFF	2	1			2825	4	1.00	1	2,060	1	15.06	0.40	0.45	1.58	0.01		1.46	0.04	0.04	0.15	0.00
		FW CLIMBOUT	2	1			2825	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		1.91	0.06	0.11	0.24	0.00
DEPARTURE TOTALS																			**7.59**	**0.39**	**3.35**	**1.34**	**0.05**
189	4	FW (0°) APPROACH	2	1			189	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.11	0.00	0.01	0.02	0.00
SHORT ARRIVAL		TRANSITION (16°) LANDING	2	1			189	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.04	0.00	0.00	0.01	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	189	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.06	0.01	0.13	0.02	0.00
		HOT REFUEL (APU)	1	1	ON	1	189	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.05	0.00	0.05	0.00	0.00
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	189	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.01	0.00	0.02	0.00	0.00
		APU USE	1	1	ON	1	189	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.02	0.00	0.02	0.00	0.00
ARRIVAL TOTALS																			**0.37**	**0.02**	**0.28**	**0.07**	**0.00**
189	4	FW (0°) APPROACH	2	1			189	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		0.11	0.00	0.01	0.02	0.00
VERTICAL ARRIVAL		TRANSITION (90°) LANDING	2	1			189	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.04	0.00	0.00	0.01	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	189	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.06	0.01	0.13	0.02	0.00
		HOT REFUEL (APU)	1	1	ON	1	189	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.05	0.00	0.05	0.00	0.00
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	189	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.04	0.00	0.02	0.01	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	189	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.01	0.00	0.02	0.00	0.00
		APU USE	1	1	ON	1	189	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.02	0.00	0.02	0.00	0.00
ARRIVAL TOTALS																			**0.37**	**0.02**	**0.28**	**0.07**	**0.00**
3392	4	FW APPROACH TO BREAK	2	1			3392	4	2.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		2.01	0.07	0.14	0.27	0.00
ARRIVAL (WITH BREAK)		BREAK	2	1			3392	4	1.00	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.49	0.02	0.09	0.09	0.00
		CIRCLE	2	1			3392	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		2.29	0.07	0.13	0.29	0.00
		FW APPROACH	2	1			3392	4	1.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		1.01	0.03	0.07	0.14	0.00
		TRANSITION (16°) LANDING	2	1			3392	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.76	0.03	0.08	0.12	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	3392	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.67	0.04	0.37	0.18	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	3392	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.08	0.11	2.35	0.42	0.03
		HOT REFUEL (APU)	1	1	ON	1	3392	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.90	0.06	0.89	0.03	0.03
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	3392	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.67	0.04	0.37	0.18	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	3392	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.17	0.02	0.36	0.06	0.00
		APU USE	1	1	ON	1	3392	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.35	0.02	0.34	0.01	0.01
ARRIVAL TOTALS																			**10.40**	**0.53**	**5.20**	**1.79**	**0.08**

Table B1-55. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Yuma (2 Pages)

		REF
AIRCRAFT TYPE:	**V-22**	
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE:	**T406-AD-400**	1/b

TOTAL OPERATIONS:	**8,335**	SCENARIO: 2 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**3,767**	TOTAL OPS:	**3,770**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY	ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE	ENGINE POWER (% Q_{TRANS})	ANNUAL NUMBER OF OPERATIONS	TIME IN MODE PER ENGINE (MINUTES)	FUEL FLOW RATE PER ENGINE (LBS/HR)	EMISSION FACTORS (LB/1,000 LB OF FUEL)					EMISSIONS[b] (TONS/YR)				
							NOx	SO2	CO	PM10	ROG	NOx	SO2	CO	PM10	ROG
0 [4]																
FW (0°) CRUISE (<3,000 FEET MSL)	CRUISE	2 [1]		0 [4] [4]	60.00 [1]	1,910 [1]	14.09	0.40	0.52	1.58	0.01	0.00	0.00	0.00	0.00	0.00
CRUISE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0 [4]																
HELO (16°) CRUISE (<3,000 FEET MSL)	CRUISE	2 [1]		0 [4] [4]	60.00 [1]	1,530 [1]	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
CRUISE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
348 [4]	APPROACH	2 [3]		348 [4]	2.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.21	0.01	0.01	0.03	0.00
T & G	CLIMBOUT	2 [3]		348 [4]	1.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.18	0.00	0.01	0.02	0.00
	CIRCLE	2 [3]		348 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	0.23	0.01	0.01	0.03	0.00
TOUCH AND GO TOTALS												**0.62**	**0.02**	**0.03**	**0.08**	**0.00**
435 [4]	APPROACH	2 [3]		435 [4]	3.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.39	0.01	0.03	0.05	0.00
GCA BOX PATTERN	CLIMBOUT	2 [3]		435 [4]	2.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.45	0.01	0.01	0.05	0.00
	CIRCLE	2 [3]		435 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	0.29	0.01	0.02	0.04	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS												**1.13**	**0.03**	**0.06**	**0.14**	**0.00**
[4]	APPROACH	2 [3]		0 [4]	2.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FCLP	CLIMBOUT	2 [3]		0 [4]	2.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.00	0.00	0.00	0.00	0.00
	CIRCLE	2 [3]		0 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
15 [4]																
LOW WORK	HOVER	2 [1]		15 [4]	7.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	0.03	0.00	0.00	0.00	0.00
LOW WORK TOTALS												**0.03**	**0.00**	**0.00**	**0.00**	**0.00**
OVERALL V-22 LTO CYCLE AND MISSION OPERATIONS AIR EMISSIONS TOTALS (TONS)												**23.71**	**1.17**	**10.36**	**4.03**	**0.16**
												NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table B1-56. Aircraft Engine Maintenance and Testing Emissions for MV-22 Aircraft - 10 Squadrons

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT STATIONED AT BASE:	**102**	d
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**10,506**	**SCENARIO: 10 SQUADRONS**	

MAINTENANCE AND TESTING OPERATIONS

TOTAL NUMBER OF OPERATIONS / MAINTENANCE OPERATION		ENGINE MODE		NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS (PER AIRCRAFT)		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS (TONS/YR)[c] NOx	SO2	CO	PM10	ROG
2040	a																							
APU CHECK		APU USE	1	1	1	ON	1	20	1	30.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.25	0.08	1.24	0.05	0.04
APU CHECK TOTALS																				**1.25**	**0.08**	**1.24**	**0.05**	**0.04**
816	a	APU USE	1	1	1	ON	1	8	1	40.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.67	0.04	0.66	0.02	0.02
WATER WASH		MAIN ENGINE RUN	1	2	1	G IDLE	1	8	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.40	0.04	0.87	0.15	0.01
WATER WASH TOTALS																				**1.07**	**0.08**	**1.53**	**0.18**	**0.03**
2040	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.42	0.03	0.41	0.02	0.01
LOW POWER -		LOW POWER	1	1	1	G IDLE	1	20	1	15.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.38	0.04	0.82	0.15	0.01
ONE ENG		INTERMED. POWER	1	1	1	F IDLE	1	20	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.68	0.04	0.37	0.18	0.00
SINGLE LOW POWER - ONE ENGINE TOTALS																				**1.47**	**0.11**	**1.60**	**0.34**	**0.02**
3060	a	APU USE	1	1	1	ON	1	30	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.63	0.04	0.62	0.02	0.02
LOW POWER -		LOW POWER	1	2	1	G IDLE	1	30	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.50	0.15	3.27	0.58	0.04
TWO ENG		INTERMED. POWER	1	2	1	F IDLE	1	30	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		2.03	0.13	1.12	0.53	0.01
SINGLE LOW POWER - TWO ENGINE TOTALS																				**4.15**	**0.32**	**5.01**	**1.14**	**0.06**
2,040	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.42	0.03	0.41	0.02	0.01
HIGH POWER		MAIN ENGINE START	1	2	1	G IDLE	1	20	1	10.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.50	0.05	1.09	0.19	0.01
CHECK		TAXI OUT/TIE DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.68	0.04	0.37	0.18	0.00
		LOW POWER	1	2	1	G IDLE	1	20	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.00	0.10	2.18	0.39	0.02
		INTERMED. POWER	1	2	1			20	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		6.06	0.21	0.41	0.82	0.01
		HIGH POWER	1	2	1			20	1	5.00	1	2,510	1	17.97	0.40	0.29	1.58	0.01		7.67	0.17	0.12	0.67	0.00
		TAXI IN/SHUT DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.68	0.04	0.37	0.18	0.00
SINGLE HIGH POWER TOTALS																				16.99	0.64	4.96	2.45	0.06
510	a	APU USE	1	1	1	ON	1	5	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.10	0.01	0.10	0.00	0.00
PROP BALANCE		LOW POWER	1	2	1	G IDLE	1	5	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.25	0.02	0.54	0.10	0.01
		INTERMED. POWER	1	2	1			5	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		1.51	0.05	0.10	0.21	0.00
PROP BALANCE TOTALS																				**1.87**	**0.08**	**0.75**	**0.31**	**0.01**
OVERALL V-22 IN-FRAME MAINTENANCE TESTING AIR EMISSIONS TOTALS (TONS)																				**26.81**	**1.33**	**15.10**	**4.45**	**0.23**
																				NOx	SO2	CO	PM10	ROG

REFERENCES: [1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).

NOTES: [a] REFERENCE 1 CALCULATES MAINTENANCE EMISSIONS PER AIRCRAFT. CALCULATION ASSUMES THAT ALL AIRCRAFT NEED IDENTICAL SCHEDULED MAINTENANCE.

[b] SEE NOTE 1 FOR TABLE 1, REFERENCE 1

[c] EMISSIONS CALCULATION: {(MAINTENANCE TEST PER AIRCRAFT PER YEAR) x (NO. OF AIRCRAFT)} x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000

[d] At full build-out, one MV-22 squadron would be deployed overseas. The 2 MV-22 reserve squadrons present at base = 1.5 equivalent fleet squadrons operations. Therefore, the total number of MV-22 equivalent fleet squadron aircraft that undergo maintenance at the base each year is 102.

Table B1-57. Aircraft Engine Maintenance and Testing Emissions for MV-22 Aircraft - 8 Squadrons

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT STATIONED AT BASE:	**84**	d
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**8,652**	**SCENARIO: 8 SQUADRONS**	

MAINTENANCE AND TESTING OPERATIONS

TOTAL NUMBER OF OPERATIONS / MAINTENANCE OPERATION		ENGINE MODE		NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS (PER AIRCRAFT)		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS (TONS/YR)[c] NOx	SO2	CO	PM10	ROG
1680	a																							
APU CHECK		APU USE	1	1	1	ON	1	20	1	30.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.03	0.07	1.02	0.04	0.03
APU CHECK TOTALS																				**1.03**	**0.07**	**1.02**	**0.04**	**0.03**
672	a	APU USE	1	1	1	ON	1	8	1	40.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.55	0.04	0.54	0.02	0.02
WATER WASH		MAIN ENGINE RUN	1	2	1	G IDLE	1	8	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.33	0.03	0.72	0.13	0.01
WATER WASH TOTALS																				**0.88**	**0.07**	**1.26**	**0.15**	**0.03**
1680	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.34	0.02	0.34	0.01	0.01
LOW POWER -		LOW POWER	1	1	1	G IDLE	1	20	1	15.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.31	0.03	0.67	0.12	0.01
ONE ENG		INTERMED. POWER	1	1	1	F IDLE	1	20	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.56	0.04	0.31	0.15	0.00
SINGLE LOW POWER - ONE ENGINE TOTALS																				**1.21**	**0.09**	**1.32**	**0.28**	**0.02**
2520	a	APU USE	1	1	1	ON	1	30	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.52	0.03	0.51	0.02	0.02
LOW POWER -		LOW POWER	1	2	1	G IDLE	1	30	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.24	0.12	2.69	0.48	0.03
TWO ENG		INTERMED. POWER	1	2	1	F IDLE	1	30	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.67	0.11	0.92	0.44	0.01
SINGLE LOW POWER - TWO ENGINE TOTALS																				**3.42**	**0.27**	**4.13**	**0.93**	**0.05**
1,680	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.34	0.02	0.34	0.01	0.01
HIGH POWER		MAIN ENGINE START	1	2	1	G IDLE	1	20	1	10.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.41	0.04	0.90	0.16	0.01
CHECK		TAXI OUT/TIE DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.56	0.04	0.31	0.15	0.00
		LOW POWER	1	2	1	G IDLE	1	20	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.82	0.08	1.79	0.32	0.02
		INTERMED. POWER	1	2	1			20	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		4.99	0.17	0.34	0.68	0.00
		HIGH POWER	1	2	1			20	1	5.00	1	2,510	1	17.97	0.40	0.29	1.58	0.01		6.31	0.14	0.10	0.56	0.00
		TAXI IN/SHUT DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.56	0.04	0.31	0.15	0.00
SINGLE HIGH POWER TOTALS																				13.99	0.53	4.09	2.01	0.05
420	a	APU USE	1	1	1	ON	1	5	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.09	0.01	0.09	0.00	0.00
PROP BALANCE		LOW POWER	1	2	1	G IDLE	1	5	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.21	0.02	0.45	0.08	0.01
		INTERMED. POWER	1	2	1			5	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		1.25	0.04	0.08	0.17	0.00
PROP BALANCE TOTALS																				**1.54**	**0.07**	**0.62**	**0.25**	**0.01**
OVERALL V-22 IN-FRAME MAINTENANCE TESTING AIR EMISSIONS TOTALS (TONS)																				**22.08**	**1.09**	**12.44**	**3.67**	**0.19**
																				NOx	SO2	CO	PM10	ROG

REFERENCES: [1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).

NOTES: [a] REFERENCE 1 CALCULATES MAINTENANCE EMISSIONS PER AIRCRAFT. CALCULATION ASSUMES THAT ALL AIRCRAFT NEED IDENTICAL SCHEDULED MAINTENANCE.

[b] SEE NOTE 1 FOR TABLE 1, REFERENCE 1

[c] EMISSIONS CALCULATION: {(MAINTENANCE TEST PER AIRCRAFT PER YEAR) x (NO. OF AIRCRAFT)} x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000

[d] At full build-out, one MV-22 squadron would be deployed overseas. Therefore, the total number of MV-22 equivalent fleet squadron aircraft that undergo maintenance at the base each year is 84.

Table B1-58. Aircraft Engine Maintenance and Testing Emissions for MV-22 Aircraft - 2 Squadrons

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT STATIONED AT BASE:	**18**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**1,854**	**SCENARIO: 2 SQUADRONS**	

MAINTENANCE AND TESTING OPERATIONS

TOTAL NUMBER OF OPERATIONS / MAINTENANCE OPERATION		ENGINE MODE		NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS (PER AIRCRAFT)		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS (TONS/YR)[c] NOx	SO2	CO	PM10	ROG
360	a																							
APU CHECK		APU USE	1	1	1	ON	1	20	1	30.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.22	0.01	0.22	0.01	0.01
APU CHECK TOTALS																				**0.22**	**0.01**	**0.22**	**0.01**	**0.01**
144	a	APU USE	1	1	1	ON	1	8	1	40.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.12	0.01	0.12	0.00	0.00
WATER WASH		MAIN ENGINE RUN	1	2	1	G IDLE	1	8	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.07	0.01	0.15	0.03	0.00
WATER WASH TOTALS																				**0.19**	**0.01**	**0.27**	**0.03**	**0.01**
360	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.07	0.00	0.07	0.00	0.00
LOW POWER -		LOW POWER	1	1	1	G IDLE	1	20	1	15.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.07	0.01	0.14	0.03	0.00
ONE ENG		INTERMED. POWER	1	1	1	F IDLE	1	20	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.12	0.01	0.07	0.03	0.00
SINGLE LOW POWER - ONE ENGINE TOTALS																				**0.26**	**0.02**	**0.28**	**0.06**	**0.00**
540	a	APU USE	1	1	1	ON	1	30	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.11	0.01	0.11	0.00	0.00
LOW POWER -		LOW POWER	1	2	1	G IDLE	1	30	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.27	0.03	0.58	0.10	0.01
TWO ENG		INTERMED. POWER	1	2	1	F IDLE	1	30	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.36	0.02	0.20	0.09	0.00
SINGLE LOW POWER - TWO ENGINE TOTALS																				**0.73**	**0.06**	**0.88**	**0.20**	**0.01**
360	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.07	0.00	0.07	0.00	0.00
HIGH POWER		MAIN ENGINE START	1	2	1	G IDLE	1	20	1	10.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.09	0.01	0.19	0.03	0.00
CHECK		TAXI OUT/TIE DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.12	0.01	0.07	0.03	0.00
		LOW POWER	1	2	1	G IDLE	1	20	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.18	0.02	0.38	0.07	0.00
		INTERMED. POWER	1	2	1			20	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		1.07	0.04	0.07	0.15	0.00
		HIGH POWER	1	2	1			20	1	5.00	1	2,510	1	17.97	0.40	0.29	1.58	0.01		1.35	0.03	0.02	0.12	0.00
		TAXI IN/SHUT DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.12	0.01	0.07	0.03	0.00
SINGLE HIGH POWER TOTALS																				3.00	0.11	0.88	0.43	0.01
90	a	APU USE	1	1	1	ON	1	5	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.02	0.00	0.02	0.00	0.00
PROP BALANCE		LOW POWER	1	2	1	G IDLE	1	5	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.04	0.00	0.10	0.02	0.00
		INTERMED. POWER	1	2	1			5	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		0.27	0.01	0.02	0.04	0.00
PROP BALANCE TOTALS																				**0.33**	**0.01**	**0.13**	**0.05**	**0.00**
OVERALL V-22 IN-FRAME MAINTENANCE TESTING AIR EMISSIONS TOTALS (TONS)																				**4.73**	**0.23**	**2.66**	**0.79**	**0.04**

REFERENCES: [1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).

NOTES: [a] REFERENCE 1 CALCULATES MAINTENANCE EMISSIONS PER AIRCRAFT. CALCULATION ASSUMES THAT ALL AIRCRAFT NEED IDENTICAL SCHEDULED MAINTENANCE.

[b] SEE NOTE 1 FOR TABLE 1, REFERENCE 1

[c] EMISSIONS CALCULATION: {(MAINTENANCE TEST PER AIRCRAFT PER YEAR) x (NO. OF AIRCRAFT)} x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000

[d] This scenario equates to 2 MV-22 reserve squadrons present at base = 1.5 equivalent fleet squadrons operations, or 18 aircraft.

Table B1-59. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2010

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.03	1.54	4.26	0.20	0.71	0.71	1,619.47	0.23	0.02	1,629.39
Short Departure	0.06	4.46	10.14	0.53	1.79	1.79	4,174.94	0.58	0.04	4,200.49
Short Arrival	0.01	0.37	0.49	0.03	0.10	0.10	243.06	0.03	0.00	244.54
Vertical Arrival	0.01	0.37	0.49	0.03	0.10	0.10	243.06	0.03	0.00	244.54
Arrival (with Break)	0.11	6.94	13.86	0.70	2.40	2.40	5,650.12	0.79	0.06	5,684.70
Touch and Go	0.00	0.04	0.83	0.03	0.10	0.10	208.57	0.03	0.00	209.84
GCA Box Pattern	0.00	0.08	1.51	0.05	0.18	0.18	371.92	0.05	0.00	374.20
Hover	0.00	0.00	0.11	0.00	0.01	0.01	25.73	0.00	0.00	25.89
Subtotal	0.21	13.81	31.67	1.56	5.39	5.39	12,537	1.76	0.12	12,613.60
Engine Maintenance&Testing										
APU Check	0.01	0.29	0.29	0.02	0.01	0.01	160.31	0.02	0.00	161.29
Water Wash	0.01	0.36	0.25	0.02	0.04	0.04	159.71	0.02	0.00	160.69
Low Power - One Engine	0.01	0.38	0.35	0.03	0.08	0.08	207.98	0.03	0.00	209.26
Low Power - Two Engines	0.01	1.18	0.98	0.08	0.27	0.27	613.39	0.09	0.01	617.15
High Power	0.02	1.17	4.00	0.15	0.58	0.58	1,216.52	0.17	0.01	1,223.97
Prop Balance	0.00	0.18	0.44	0.02	0.07	0.07	158.03	0.02	0.00	159.00
Subtotal	0.06	3.55	6.31	0.31	1.05	1.05	2,516	0.35	0.02	2,531.34

Note: Equal to 2 squadrons in fleet and 2 on-station

Table B1-60. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2011

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.05	3.08	8.53	0.40	1.42	1.42	3,238.95	0.45	0.03	3,258.77
Short Departure	0.11	8.93	20.27	1.05	3.58	3.58	8,349.87	1.17	0.08	8,400.98
Short Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Vertical Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Arrival (with Break)	0.23	13.88	27.72	1.40	4.79	4.79	11,300.24	1.58	0.11	11,369.40
Touch and Go	0.00	0.09	1.66	0.05	0.20	0.20	417.14	0.06	0.00	419.69
GCA Box Pattern	0.00	0.15	3.01	0.09	0.37	0.37	743.84	0.10	0.01	748.39
Hover	0.00	0.01	0.21	0.01	0.03	0.03	51.47	0.01	0.00	51.78
Subtotal	0.42	27.63	63.35	3.13	10.78	10.78	25,074	3.51	0.25	25,227.20
Engine Maintenance&Testing										
APU Check	0.02	0.58	0.59	0.04	0.02	0.02	320.62	0.04	0.00	322.58
Water Wash	0.01	0.72	0.50	0.04	0.08	0.08	319.42	0.04	0.00	321.37
Low Power - One Engine	0.01	0.75	0.69	0.05	0.16	0.16	415.97	0.06	0.00	418.51
Low Power - Two Engines	0.03	2.36	1.96	0.15	0.53	0.53	1,226.78	0.17	0.01	1,234.29
High Power	0.03	2.34	8.00	0.30	1.15	1.15	2,433.05	0.34	0.02	2,447.94
Prop Balance	0.01	0.35	0.88	0.04	0.14	0.14	316.06	0.04	0.00	317.99
Subtotal	0.11	7.11	12.62	0.63	2.09	2.09	5,032	0.70	0.05	5,062.69

Note: Equal to 4 squadrons in fleet and 3 on-station (1 squadron deployed)

Table B1-61. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2012

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.06	3.85	10.66	0.50	1.77	1.77	4,048.68	0.57	0.04	4,073.46
Short Departure	0.14	11.16	25.34	1.32	4.47	4.47	10,437.34	1.46	0.10	10,501.23
Short Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Vertical Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Arrival (with Break)	0.28	17.35	34.65	1.75	5.99	5.99	14,125.30	1.98	0.14	14,211.76
Touch and Go	0.00	0.11	2.07	0.06	0.26	0.26	521.42	0.07	0.01	524.61
GCA Box Pattern	0.00	0.19	3.77	0.12	0.46	0.46	929.80	0.13	0.01	935.49
Hover	0.00	0.01	0.26	0.01	0.03	0.03	64.34	0.01	0.00	64.73
Subtotal	0.52	34.53	79.19	3.91	13.47	13.47	31,342	4.39	0.31	31,534.00
Engine Maintenance&Testing										
APU Check	0.02	0.73	0.74	0.05	0.03	0.03	400.77	0.06	0.00	403.22
Water Wash	0.02	0.90	0.63	0.05	0.11	0.11	399.27	0.06	0.00	401.71
Low Power - One Engine	0.01	0.94	0.86	0.06	0.20	0.20	519.96	0.07	0.01	523.14
Low Power - Two Engines	0.04	2.95	2.44	0.19	0.67	0.67	1,533.48	0.21	0.02	1,542.87
High Power	0.04	2.92	10.00	0.38	1.44	1.44	3,041.31	0.43	0.03	3,059.93
Prop Balance	0.01	0.44	1.10	0.05	0.18	0.18	395.07	0.06	0.00	397.49
Subtotal	0.14	8.88	15.77	0.78	2.62	2.62	6,290	0.88	0.06	6,328.36

Note: Equal to 6 squadrons in fleet and 5 on-station (1 squadron deployed)

Table B1-62. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2013

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.05	3.08	8.53	0.40	1.42	1.42	3,238.95	0.45	0.03	3,258.77
Short Departure	0.11	8.93	20.27	1.05	3.58	3.58	8,349.87	1.17	0.08	8,400.98
Short Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Vertical Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Arrival (with Break)	0.23	13.88	27.72	1.40	4.79	4.79	11,300.24	1.58	0.11	11,369.40
Touch and Go	0.00	0.09	1.66	0.05	0.20	0.20	417.14	0.06	0.00	419.69
GCA Box Pattern	0.00	0.15	3.01	0.09	0.37	0.37	743.84	0.10	0.01	748.39
Hover	0.00	0.01	0.21	0.01	0.03	0.03	51.47	0.01	0.00	51.78
Subtotal	0.42	27.63	63.35	3.13	10.78	10.78	25,074	3.51	0.25	25,227.20
Engine Maintenance&Testing										
APU Check	0.02	0.58	0.59	0.04	0.02	0.02	320.62	0.04	0.00	322.58
Water Wash	0.01	0.72	0.50	0.04	0.08	0.08	319.42	0.04	0.00	321.37
Low Power - One Engine	0.01	0.75	0.69	0.05	0.16	0.16	415.97	0.06	0.00	418.51
Low Power - Two Engines	0.03	2.36	1.96	0.15	0.53	0.53	1,226.78	0.17	0.01	1,234.29
High Power	0.03	2.34	8.00	0.30	1.15	1.15	2,433.05	0.34	0.02	2,447.94
Prop Balance	0.01	0.35	0.88	0.04	0.14	0.14	316.06	0.04	0.00	317.99
Subtotal	0.11	7.11	12.62	0.63	2.09	2.09	5,032	0.70	0.05	5,062.69

Note: Equal to 5 squadrons in fleet and 4 on-station (1 squadron deployed).

Table B1-63. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2014

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.06	3.85	10.66	0.50	1.77	1.77	4,048.68	0.57	0.04	4,073.46
Short Departure	0.14	11.16	25.34	1.32	4.47	4.47	10,437.34	1.46	0.10	10,501.23
Short Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Vertical Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Arrival (with Break)	0.28	17.35	34.65	1.75	5.99	5.99	14,125.30	1.98	0.14	14,211.76
Touch and Go	0.00	0.11	2.07	0.06	0.26	0.26	521.42	0.07	0.01	524.61
GCA Box Pattern	0.00	0.19	3.77	0.12	0.46	0.46	929.80	0.13	0.01	935.49
Hover	0.00	0.01	0.26	0.01	0.03	0.03	64.34	0.01	0.00	64.73
Subtotal	0.52	34.53	79.19	3.91	13.47	13.47	31,342	4.39	0.31	31,534.00
Engine Maintenance&Testing										
APU Check	0.02	0.73	0.74	0.05	0.03	0.03	400.77	0.06	0.00	403.22
Water Wash	0.02	0.90	0.63	0.05	0.11	0.11	399.27	0.06	0.00	401.71
Low Power - One Engine	0.01	0.94	0.86	0.06	0.20	0.20	519.96	0.07	0.01	523.14
Low Power - Two Engines	0.04	2.95	2.44	0.19	0.67	0.67	1,533.48	0.21	0.02	1,542.87
High Power	0.04	2.92	10.00	0.38	1.44	1.44	3,041.31	0.43	0.03	3,059.93
Prop Balance	0.01	0.44	1.10	0.05	0.18	0.18	395.07	0.06	0.00	397.49
Subtotal	0.14	8.88	15.77	0.78	2.62	2.62	6,290	0.88	0.06	6,328.36

Note: Equal to 6 squadrons in fleet and 5 on-station (1 squadron deployed)

Table B1-64. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2015

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.09	5.38	14.92	0.70	2.48	2.48	5,668.16	0.79	0.06	5,702.85
Short Departure	0.20	15.63	35.47	1.85	6.26	6.26	14,612.28	2.05	0.14	14,701.72
Short Arrival	0.02	1.30	1.70	0.11	0.34	0.34	850.70	0.12	0.01	855.90
Vertical Arrival	0.02	1.30	1.70	0.11	0.34	0.34	850.70	0.12	0.01	855.90
Arrival (with Break)	0.40	24.30	48.51	2.45	8.39	8.39	19,775.42	2.77	0.19	19,896.46
Touch and Go	0.00	0.15	2.90	0.09	0.36	0.36	729.99	0.10	0.01	734.46
GCA Box Pattern	0.00	0.26	5.28	0.16	0.64	0.64	1,301.72	0.18	0.01	1,309.68
Hover	0.00	0.02	0.37	0.01	0.04	0.04	90.07	0.01	0.00	90.62
Subtotal	0.73	48.35	110.86	5.48	18.86	18.86	43,879	6.14	0.43	44,147.60
Engine Maintenance&Testing										
APU Check	0.03	1.02	1.03	0.07	0.04	0.04	561.08	0.08	0.01	564.51
Water Wash	0.03	1.26	0.88	0.07	0.15	0.15	558.98	0.08	0.01	562.40
Low Power - One Engine	0.02	1.32	1.21	0.09	0.28	0.28	727.94	0.10	0.01	732.40
Low Power - Two Engines	0.05	4.13	3.42	0.27	0.93	0.93	2,146.87	0.30	0.02	2,160.01
High Power	0.05	4.09	13.99	0.53	2.01	2.01	4,257.83	0.60	0.04	4,283.90
Prop Balance	0.01	0.62	1.54	0.07	0.25	0.25	553.10	0.08	0.01	556.48
Subtotal	0.19	12.44	22.08	1.09	3.67	3.67	8,806	1.23	0.09	8,859.70

Note: Equal to 8 squadrons in fleet and 7 on-station (1 squadron deployed)

Table B1-65. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2016

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.09	5.38	14.92	0.70	2.48	2.48	5,668.16	0.79	0.06	5,702.85
Short Departure	0.20	15.63	35.47	1.85	6.26	6.26	14,612.28	2.05	0.14	14,701.72
Short Arrival	0.02	1.30	1.70	0.11	0.34	0.34	850.70	0.12	0.01	855.90
Vertical Arrival	0.02	1.30	1.70	0.11	0.34	0.34	850.70	0.12	0.01	855.90
Arrival (with Break)	0.40	24.30	48.51	2.45	8.39	8.39	19,775.42	2.77	0.19	19,896.46
Touch and Go	0.00	0.15	2.90	0.09	0.36	0.36	729.99	0.10	0.01	734.46
GCA Box Pattern	0.00	0.26	5.28	0.16	0.64	0.64	1,301.72	0.18	0.01	1,309.68
Hover	0.00	0.02	0.37	0.01	0.04	0.04	90.07	0.01	0.00	90.62
Subtotal	0.73	48.35	110.86	5.48	18.86	18.86	43,879	6.14	0.43	44,147.60
Engine Maintenance&Testing										
APU Check	0.03	1.02	1.03	0.07	0.04	0.04	561.08	0.08	0.01	564.51
Water Wash	0.03	1.26	0.88	0.07	0.15	0.15	558.98	0.08	0.01	562.40
Low Power - One Engine	0.02	1.32	1.21	0.09	0.28	0.28	727.94	0.10	0.01	732.40
Low Power - Two Engines	0.05	4.13	3.42	0.27	0.93	0.93	2,146.87	0.30	0.02	2,160.01
High Power	0.05	4.09	13.99	0.53	2.01	2.01	4,257.83	0.60	0.04	4,283.90
Prop Balance	0.01	0.62	1.54	0.07	0.25	0.25	553.10	0.08	0.01	556.48
Subtotal	0.19	12.44	22.08	1.09	3.67	3.67	8,806	1.23	0.09	8,859.70

Note: Equal to 8 squadrons in fleet and 7 on-station (1 squadron deployed)

Table B1-66. MV-22 Aircraft Emissions for the Fielding of 10 Squadrons at MCAS Miramar - Year 2017

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.11	6.54	18.12	0.85	3.02	3.02	6,882.76	0.96	0.07	6,924.89
Short Departure	0.24	18.98	43.08	2.24	7.61	7.61	17,743.48	2.48	0.17	17,852.09
Short Arrival	0.03	1.58	2.07	0.13	0.42	0.42	1,032.99	0.14	0.01	1,039.31
Vertical Arrival	0.03	1.58	2.07	0.13	0.42	0.42	1,032.99	0.14	0.01	1,039.31
Arrival (with Break)	0.48	29.50	58.91	2.98	10.19	10.19	24,013.01	3.36	0.24	24,159.99
Touch and Go	0.00	0.19	3.52	0.11	0.43	0.43	886.41	0.12	0.01	891.84
GCA Box Pattern	0.00	0.32	6.41	0.20	0.78	0.78	1,580.66	0.22	0.02	1,590.33
Hover	0.00	0.02	0.45	0.01	0.05	0.05	109.37	0.02	0.00	110.04
Subtotal	0.89	58.71	134.62	6.65	22.91	22.91	53,282	7.46	0.52	53,607.80
Engine Maintenance&Testing										
APU Check	0.04	1.24	1.25	0.08	0.05	0.05	681.31	0.10	0.01	685.48
Water Wash	0.03	1.53	1.07	0.08	0.18	0.18	678.76	0.10	0.01	682.91
Low Power - One Engine	0.02	1.60	1.47	0.11	0.34	0.34	883.93	0.12	0.01	889.34
Low Power - Two Engines	0.06	5.01	4.15	0.32	1.14	1.14	2,606.92	0.36	0.03	2,622.87
High Power	0.06	4.96	16.99	0.64	2.45	2.45	5,170.23	0.72	0.05	5,201.87
Prop Balance	0.01	0.75	1.87	0.08	0.31	0.31	671.62	0.09	0.01	675.73
Subtotal	0.23	15.10	26.81	1.33	4.45	4.45	10,693	1.50	0.10	10,758.21

Note: Equal to 10 squadrons in fleet (2 reserve), 9 on-station (1 fleet squadron deployed), for an equivalent fleet on-station of 8.5 squadron

Table B1-67. MV-22 Aircraft Emissions for the Fielding of 2 Reserve Squadrons at a MCAS - Year 2017

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.02	1.15	3.20	0.15	0.53	0.53	1,214.61	0.17	0.01	1,222.04
Short Departure	0.04	3.35	7.60	0.40	1.34	1.34	3,131.20	0.44	0.03	3,150.37
Short Arrival	0.00	0.28	0.36	0.02	0.07	0.07	182.29	0.03	0.00	183.41
Vertical Arrival	0.00	0.28	0.36	0.02	0.07	0.07	182.29	0.03	0.00	183.41
Arrival (with Break)	0.08	5.21	10.40	0.53	1.80	1.80	4,237.59	0.59	0.04	4,263.53
Touch and Go	0.00	0.03	0.62	0.02	0.08	0.08	156.43	0.02	0.00	157.38
GCA Box Pattern	0.00	0.06	1.13	0.03	0.14	0.14	278.94	0.04	0.00	280.65
Hover	0.00	0.00	0.08	0.00	0.01	0.01	19.30	0.00	0.00	19.42
Subtotal	0.16	10.36	23.76	1.17	4.04	4.04	9,402.65	1.32	0.09	9,460.20
Engine Maintenance&Testing										
APU Check	0.01	0.22	0.22	0.01	0.01	0.01	120.23	0.02	0.00	120.97
Water Wash	0.01	0.27	0.19	0.01	0.03	0.03	119.78	0.02	0.00	120.51
Low Power - One Engine	0.00	0.28	0.26	0.02	0.06	0.06	155.99	0.02	0.00	156.94
Low Power - Two Engines	0.01	0.88	0.73	0.06	0.20	0.20	460.04	0.06	0.00	462.86
High Power	0.01	0.88	3.00	0.11	0.43	0.43	912.39	0.13	0.01	917.98
Prop Balance	0.00	0.13	0.33	0.01	0.05	0.05	118.52	0.02	0.00	119.25
Subtotal	0.04	2.66	4.73	0.23	0.79	0.79	1,886.96	0.26	0.02	1,898.51

Note: 2 reserve squadrons = 1.5 equivalent fleet squadrons operations

Table B1-68. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2010

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.21	13.81	31.67	1.56	5.39	5.39	12,536.86	1.76	0.12	12,613.60
MV-22 Engine Maintenance/Testing	0.06	3.55	6.31	0.31	1.05	1.05	2,515.94	0.35	0.02	2,531.34
Personal-Owned Vehicles	1.31	9.55	1.22	0.01	0.09	0.08	1,220.36	0.02	0.00	1,221.38
Government-Owned Vehicles	0.13	0.85	0.42	0.00	0.03	0.03	109.04	0.00	0.00	109.14
Ground/Tactical Support Equipment	4.82	47.52	4.13	0.02	0.45	0.45	6,071.21	0.11	0.01	6,076.30
Construction	0.05	0.55	0.22	0.00	0.02	0.02	69.68	0.00	0.00	69.74
Other Sources	0.27	1.31	0.27	0.02	0.15	0.04	167.24	0.00	0.00	167.38
Stationary Sources (1)	1.34	1.12	4.11	0.19	4.69	3.00	142.79	0.00	0.00	142.91
Total Emissions - 2 Squadrons	8.20	78.26	48.35	2.12	11.87	10.06	22,833.13	2.25	0.16	22,931.80

Table B1-69. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2011

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.42	27.63	63.35	3.13	10.78	10.78	25,073.73	3.51	0.25	25,227.20
MV-22 Engine Maintenance/Testing	0.11	7.11	12.62	0.63	2.09	2.09	5,031.89	0.70	0.05	5,062.69
Personal-Owned Vehicles	2.63	19.10	2.44	0.01	0.17	0.17	2,440.72	0.04	0.00	2,442.77
Government-Owned Vehicles	0.27	1.71	0.83	0.00	0.06	0.06	218.09	0.00	0.00	218.27
Ground/Tactical Support Equipment	9.64	95.04	8.26	0.04	0.91	0.89	12,142.42	0.22	0.02	12,152.61
Construction	0.11	1.09	0.44	0.00	0.05	0.05	139.37	0.00	0.00	139.48
Other Sources	0.55	2.62	0.55	0.04	0.31	0.09	334.48	0.01	0.00	334.76
Stationary Sources (1)	2.68	2.24	8.23	0.38	9.38	6.00	285.58	0.01	0.00	285.82
Total Emissions - 4 Squadrons	16.40	156.52	96.71	4.23	23.75	20.13	45,666.27	4.50	0.32	45,863.60

Table B1-70. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2012

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.52	34.53	79.19	3.91	13.47	13.47	31,342.16	4.39	0.31	31,534.00
MV-22 Engine Maintenance/Testing	0.14	8.88	15.77	0.78	2.62	2.62	6,289.86	0.88	0.06	6,328.36
Personal-Owned Vehicles	3.29	23.88	3.05	0.02	0.22	0.21	3,050.90	0.06	0.00	3,053.46
Government-Owned Vehicles	0.33	2.13	1.04	0.01	0.07	0.07	272.61	0.00	0.00	272.84
Ground/Tactical Support Equipment	12.05	118.79	10.33	0.05	1.14	1.11	15,178.02	0.28	0.02	15,190.76
Construction	0.14	1.36	0.55	0.00	0.06	0.06	174.21	0.00	0.00	174.35
Other Sources	0.68	3.27	0.68	0.04	0.38	0.11	418.10	0.01	0.00	418.45
Stationary Sources (1)	3.35	2.79	10.28	0.47	11.72	7.50	356.98	0.01	0.00	357.28
Total Emissions - 6 Squadrons	20.50	195.65	120.89	5.29	29.68	25.16	57,082.83	5.63	0.40	57,329.50

Table B1-71. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2013

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.42	27.63	63.35	3.13	10.78	10.78	25,073.73	3.51	0.25	25,227.20
MV-22 Engine Maintenance/Testing	0.11	7.11	12.62	0.63	2.09	2.09	5,031.89	0.70	0.05	5,062.69
Personal-Owned Vehicles	2.63	19.10	2.44	0.01	0.17	0.17	2,440.72	0.04	0.00	2,442.77
Government-Owned Vehicles	0.27	1.71	0.83	0.00	0.06	0.06	218.09	0.00	0.00	218.27
Ground/Tactical Support Equipment	9.64	95.04	8.26	0.04	0.91	0.89	12,142.42	0.22	0.02	12,152.61
Construction	0.11	1.09	0.44	0.00	0.05	0.05	139.37	0.00	0.00	139.48
Other Sources	0.55	2.62	0.55	0.04	0.31	0.09	334.48	0.01	0.00	334.76
Stationary Sources (1)	2.68	2.24	8.23	0.38	9.38	6.00	285.58	0.01	0.00	285.82
Total Emissions - 5 Squadrons	16.40	156.52	96.71	4.23	23.75	20.13	45,666.27	4.50	0.32	45,863.60

Table B1-72. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2014

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.52	34.53	79.19	3.91	13.47	13.47	31,342.16	4.39	0.31	31,534.00
MV-22 Engine Maintenance/Testing	0.14	8.88	15.77	0.78	2.62	2.62	6,289.86	0.88	0.06	6,328.36
Personal-Owned Vehicles	3.29	23.88	3.05	0.02	0.22	0.21	3,050.90	0.06	0.00	3,053.46
Government-Owned Vehicles	0.33	2.13	1.04	0.01	0.07	0.07	272.61	0.00	0.00	272.84
Ground/Tactical Support Equipment	12.05	118.79	10.33	0.05	1.14	1.11	15,178.02	0.28	0.02	15,190.76
Construction	0.14	1.36	0.55	0.00	0.06	0.06	174.21	0.00	0.00	174.35
Other Sources	0.68	3.27	0.68	0.04	0.38	0.11	418.10	0.01	0.00	418.45
Stationary Sources (1)	3.35	2.79	10.28	0.47	11.72	7.50	356.98	0.01	0.00	357.28
Total Emissions - 6 Squadrons	20.50	195.65	120.89	5.29	29.68	25.16	57,082.83	5.63	0.40	57,329.50

Table B1-73. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2015

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.73	48.35	110.86	5.48	18.86	18.86	43,879.02	6.14	0.43	44,147.60
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67	8,805.80	1.23	0.09	8,859.70
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30	4,271.26	0.08	0.01	4,274.85
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10	381.65	0.01	0.00	381.97
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56	21,249.23	0.39	0.03	21,267.07
Construction	0.19	1.91	0.76	0.00	0.08	0.08	243.89	0.00	0.00	244.09
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15	585.33	0.01	0.00	585.82
Stationary Sources (1)	4.69	3.91	14.39	0.66	16.41	10.50	499.77	0.01	0.00	500.19
Total Emissions - 8 Squadrons	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97	7.88	0.55	80,261.30

Notes: Emissions from source categories other than aircraft or G/TSE were estimated by multiplying emissions from current CH-46 operations at MCAS Miramar (Table B1-4) by the ratio of the proposed MV-22 and current CH-46 basing populations (2,015/1,269). Emissions from G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Miramar (Table B1-4) by the ratio of proposed MV-22 and current CH-46 aircraft numbers (96/48).

Table B1-74. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2016

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.73	48.35	110.86	5.48	18.86	18.86	43,879.02	6.14	0.43	44,147.60
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67	8,805.80	1.23	0.09	8,859.70
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30	4,271.26	0.08	0.01	4,274.85
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10	381.65	0.01	0.00	381.97
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56	21,249.23	0.39	0.03	21,267.07
Construction	0.19	1.91	0.76	0.00	0.08	0.08	243.89	0.00	0.00	244.09
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15	585.33	0.01	0.00	585.82
Stationary Sources (1)	4.69	3.91	14.39	0.66	16.41	10.50	499.77	0.01	0.00	500.19
Total Emissions - 8 Squadrons	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97	7.88	0.55	80,261.30

Table B1-75. Annual Operational Emissions for the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Year 2017

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.89	58.71	134.62	6.65	22.91	22.91	53,281.67	7.46	0.52	53,607.80
MV-22 Engine Maintenance/Testing	0.23	15.10	26.81	1.33	4.45	4.45	10,692.76	1.50	0.10	10,758.21
Personal-Owned Vehicles	5.59	40.59	5.19	0.03	0.37	0.36	5,186.53	0.10	0.01	5,190.89
Government-Owned Vehicles	0.57	3.63	1.76	0.01	0.12	0.12	463.44	0.01	0.00	463.82
Ground/Tactical Support Equipment	20.49	201.95	17.56	0.09	1.93	1.89	25,802.63	0.47	0.04	25,824.29
Construction	0.23	2.32	0.93	0.00	0.10	0.10	296.15	0.01	0.00	296.40
Other Sources	1.16	5.56	1.16	0.08	0.65	0.18	710.76	0.01	0.00	711.36
Stationary Sources (1)	5.70	4.75	17.48	0.80	19.93	12.75	606.87	0.01	0.00	607.38
Total Emissions - 10 Squadrons	34.85	332.61	205.51	8.99	50.46	42.77	97,040.82	9.56	0.67	97,460.15
Net Change from Existing Conditions	(27.35)	14.28	161.01	5.78	14.38	10.73	68,426.64	8.00	0.56	68,777.00

Notes: Emissions from source categories other than aircraft or G/TSE were estimated by multiplying emissions from current CH-46 operations at MCAS Miramar (Table B1-4) by the ratio of the proposed MV-22 and current CH-46 basing populations (2,411/1,269). Emissions from G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Miramar (Table B1-4) by the ratio of proposed MV-22 and current CH-46 aircraft numbers (120/48).

Table B1-76. Total Operational Emissions for the Fielding of 2 MV-22 Squadrons at MCAS Miramar - Calendar Year 2017

	Emissions (Tons per Year)					
Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MV-22 Operations	0.16	10.36	23.76	1.17	4.04	4.04
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	1.65	11.99	1.53	0.01	0.11	0.11
Government-Owned Vehicles	0.17	1.07	0.52	0.00	0.04	0.04
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.07	0.68	0.27	0.00	0.03	0.03
Other Sources	0.34	1.64	0.34	0.02	0.19	0.05
Stationary Sources	1.68	1.40	5.16	0.24	5.88	3.77
Total Emissions - 2 Squadrons	8.21	70.20	39.83	1.70	11.47	9.20
Net Change from Existing Conditions	(53.99)	(248.13)	(4.67)	(1.51)	(24.61)	(22.84)
SDCAPCD Conformity De Minimis Thresholds	100	100	100	NA	NA	NA

Notes: Emissions from source categories other than aircraft or G/TSE were estimated by multiplying emissions from current CH-46 operations at MCAS Miramar (Table B1-4) by the ratio of the proposed MV-22 and current CH-46 basing populations (712/1,269). Emissions from G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Miramar (Table B1-4) by the ratio of proposed MV-22 and current CH-46 aircraft numbers (24/48).

Table B1-77. Total Operational Emissions for the Fielding of 2 MV-22 Squadrons at MCAS Camp Pendleton - Calendar Year 2017

	Emissions (Tons per Year)					
Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MV-22 Operations	0.21	13.52	26.40	1.39	4.73	4.73
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	3.92	29.01	3.14	0.02	0.11	0.11
Government-Owned Vehicles	0.78	3.14	0.78	0.00	0.03	0.03
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.78	1.68	2.81	0.01	0.31	0.30
Other Sources	-	-	0.78	0.05	0.44	0.12
Stationary Sources (1)	0.55	3.06	3.84	0.18	4.38	2.80
Total Emissions - 2 Squadrons	10.38	93.47	46.00	1.91	11.17	9.26
Net Change from Existing Conditions	(48.32)	(194.43)	4.10	(1.27)	(21.77)	(21.24)
SDCAPCD Conformity De Minimis Thresholds	100	100	100	NA	NA	NA

Notes: Emissions from source categories other than aircraft or G/TSE were estimated by multiplying emissions from current CH-46 operations at MCAS Camp Pendleton (Table B1-5) by the ratio of the proposed MV-22 and current CH-46 basing populations (712/908). Emissions from G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Camp Pendleton (Table B1-5) by the ratio of proposed MV-22 and current CH-46 aircraft numbers (24/41).

Table B1-78. Total Operational Emissions for the Fielding of 8 MV-22 Squadrons at MCAS Yuma - Calendar Year 2015

	Emissions (Tons per Year)					
Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MV-22 Operations	0.74	48.34	110.66	5.45	18.80	18.80
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56
Construction	0.19	1.91	0.76	0.00	0.08	0.08
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15
Stationary Sources	5.32	2.39	2.09	0.06	0.25	0.11
Total Emissions - 8 Squadrons	29.33	272.38	156.74	6.77	25.33	24.77
Reduction of CH-46 Ops	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
Net Change from Existing Conditions	24.57	257.42	155.98	6.67	24.37	23.81
Yuma Conformity De Minimis Thresholds	NA	NA	NA	NA	100	NA

Notes: Emissions from stationary sources were estimated by multiplying emissions from current MCAS Yuma activities (Table B1-6) by the ratio of proposed MV-22 and current MCAS Yuma personnel (2,015/6,000). Emissions from all other source categories were estimated equal to those estimated for the Maximum Partial Basing Alternative at MCAS Miramar (Tables B1-73).

Table B1-79. Total Operational Emissions for the Fielding of 2 MV-22 Squadrons at MCAS Yuma - Calendar Year 2017

	Emissions (Tons per Year)					
Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MV-22 Operations	0.16	10.36	23.71	1.17	4.03	4.03
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	1.65	11.99	1.53	0.01	0.11	0.11
Government-Owned Vehicles	0.17	1.07	0.52	0.00	0.04	0.04
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.07	0.68	0.27	0.00	0.03	0.03
Other Sources	0.34	1.64	0.34	0.02	0.19	0.05
Stationary Sources	1.88	0.84	0.74	0.02	0.09	0.04
Total Emissions - 2 Squadrons	8.40	69.64	35.37	1.48	5.65	5.46
Reduction of CH-46 Ops	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
Net Change from Existing Conditions	3.64	54.69	34.61	1.38	4.70	4.51
Yuma Conformity De Minimis Thresholds	NA	NA	NA	NA	100	NA

Notes: Emissions from stationary sources were estimated by multiplying emissions from current MCAS Yuma activities (Table B1-6) by the ratio of proposed MV-22 and current MCAS Yuma personnel (712/6,000). Emissions from all other source categories were estimated equal to those estimated for the Maximum Partial Basing Alternative at MCAS Miramar (Tables B1-74).

Table B1-80. Existing CH-46 and Proposed MV-22 Emissions within the 29 Palms Air Spaces

	Annual Emissions (Tons)					
	ROG	CO	NOx	SO2	PM10	PM2.5
EAF/CH-46E	1.26	3.96	0.20	0.03	0.25	0.25
Airspaces/CH-46E	2.38	13.36	2.71	0.28	1.25	1.25
Total Existing CH-46 Emissions	3.64	17.33	2.90	0.30	1.51	1.51
EAF/MV-22	0.05	3.41	7.96	0.39	1.35	1.35
Airspaces/MV-22	0.00	0.12	3.25	0.09	0.36	0.36
Total Proposed MV-22 Emissions	0.05	3.53	11.21	0.48	1.71	1.71
Total	(3.59)	(13.80)	8.30	0.18	0.20	0.20

	A	B	C	D	E	F	G	H	I	J
1	Table B1-81. Proposed Annual MV-22 Operations - MCB Pendleton Range									
2		*Fiscal Year/Annual Operations*								*Cruise*
3	*Flight Activity/Flight Details*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Duration (Hrs)*
4	*Confined Area Landing (CAL)*									
5	CAL + Cruise	39	78	97	78	97	136	136	165	0.85
6	Subtotal Ops	39	78	97	78	97	136	136	165	
7	*Drop Zone*									
8	Paratroop Drop + Cruise	10	20	25	20	25	35	35	42	0.92
9	Subtotal Ops	10	20	25	20	25	35	35	42	
10	*Landing Zone*									
11	CAL + Cruise	20	39	49	39	49	69	69	84	0.85
12	Subtotal Ops	20	39	49	39	49	69	69	84	
13	*PAD, etc.*									
14	CAL + Cruise	570	1,140	1,425	1,140	1,425	1,995	1,995	2,423	0.85
15	Subtotal Ops	570	1,140	1,425	1,140	1,425	1,995	1,995	2,423	
16	*RWR-1*									
17	Cruise Only	419	838	1,048	838	1,048	1,467	1,467	1,781	0.23
18	Subtotal Ops	419	838	1,048	838	1,048	1,467	1,467	1,781	
19	*RWR-2*									
20	Cruise Only	419	838	1,048	838	1,048	1,467	1,467	1,781	0.16
21	Subtotal Ops	419	838	1,048	838	1,048	1,467	1,467	1,781	
22	*RWR-3*									
23	Cruise Only	419	838	1,048	838	1,048	1,467	1,467	1,781	0.18
24	Subtotal Ops	419	838	1,048	838	1,048	1,467	1,467	1,781	
25	Total Ops	1,896	3,792	4,739	3,792	4,739	6,635	6,635	8,057	
26	Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.2.8 - Modeled									
27	Airspace MCBCP Flight Profiles Data Base.									

	A	B	C	D	E	F	G	H	I	J
29	Table B1-82. Proposed Annual MV-22 Operations - BMG Range									
30		*Fiscal Year/Annual Operations*								*Cruise*
31	*Flight Activity/Flight Details*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Duration (Hrs)*
32	*Max PB Alt/AUX-2*									
33	Vertical Departure	63	94	157	126	157	220	220	220	
34	Short Departure	188	283	471	377	471	659	659	659	
35	Short Arrival	-	-	-	-	-	-	-	-	
36	Vertical Arrival	-	-	-	-	-	-	-	-	
37	Arrival (with Break)	-	-	-	-	-	-	-	-	
38	FCLP	966	1,449	2,415	1,932	2,415	3,382	3,382	3,382	
39	Subtotal Ops	1,217	1,826	3,043	2,435	3,043	4,261	4,261	4,261	
40	*Min PB Alt/AUX-2*									
41	Vertical Departure	-						24	47	
42	Short Departure	-						71	142	
43	Short Arrival	-						-	-	
44	Vertical Arrival	-						-	-	
45	Arrival (with Break)	-						-	-	
46	FCLP	-						362	725	
47	Subtotal Ops	-						457	914	
48	*No MCAS Basing/AUX-2*									
49	FCLP	67	135	168	135	168	236	236	286	
50	Subtotal Ops	67	135	168	135	168	236	236	286	
51	*Area*									
52	CAL + Cruise	1,519	3,039	3,798	3,039	3,798	5,317	5,317	6,457	0.98
53	Subtotal Ops	1,519	3,039	3,798	3,039	3,798	5,317	5,317	6,457	
54	*Area Routes*									
55	Cruise Only	675	1,349	1,687	1,349	1,687	2,361	2,361	2,868	1.01
56	Subtotal Ops	675	1,349	1,687	1,349	1,687	2,361	2,361	2,868	
57	*WTI Routes*									
58	CAL + Cruise	23	45	56	45	56	79	79	96	0.22
59	Subtotal Ops	23	45	56	45	56	79	79	96	
60	Maximum Total Ops (1)	3,434	6,259	8,585	6,868	8,585	12,019	12,019	13,681	
61	Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.3.8 - Modelec									
62	Airspace BMGRW Flight Profiles Data Base. (1) Assumes the maximum proposed operations due to 8 MV-22 squadrons at MCAS Yuma									

	A	B	C	D	E	F	G	H	I	J
64	Table B1-83. Proposed Annual MV-22 Operations - Chocolate Mt. Range									
65		*Fiscal Year/Annual Operations*								*Cruise*
66	*Flight Activity/Flight Details*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Duration (Hrs)*
67	*Area Ops*									
68	CAL + Cruise	764	1,528	1,911	1,528	1,911	2,675	2,675	3,248	0.79
69	Cruise Only	179	359	448	359	448	628	628	762	1.00
70	Subtotal Ops	944	1,887	2,359	1,887	2,359	3,302	3,302	4,010	
71	*Route Ops*									
72	Cruise Only	1,074	2,149	2,686	2,149	2,686	3,760	3,760	4,566	0.02
73	Subtotal Ops	1,074	2,149	2,686	2,149	2,686	3,760	3,760	4,566	
74	Total Ops	2,018	4,036	5,045	4,036	5,045	7,063	7,063	8,576	
75	Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.3.11 - Modelec									
76	Airspace CMAGR Flight Profiles Data Base.									
77										
78	Table B1-84. Proposed Annual MV-22 Operations - El Centro Range									
79		*Fiscal Year/Annual Operations*								*Cruise*
80	*Flight Activity/Flight Details*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Duration (Hrs)*
81	*Area Ops*									
82	Cruise Only	35	70	87	70	87	122	122	148	1.00
83	Total Ops	35	70	87	70	87	122	122	148	
84	Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.3.14 - Modelec									
85	Airspace NAFECRC Flight Profiles Data Base.									
86										
87	Table B1-85. Proposed Annual MV-22 Operations - 29 Palms Range									
88		*Fiscal Year/Annual Operations*								*Cruise*
89	*Flight Activity/Flight Details*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Duration (Hrs)*
90	*Area Ops*									
91	CAL + Cruise	70	141	176	141	176	246	246	299	0.85
92	Subtotal Ops	70	141	176	141	176	246	246	299	
93	*Route Perimeter Ops*									
94	Cruise Only	108	215	269	215	269	376	376	457	0.57
95	Subtotal Ops	108	215	269	215	269	376	376	457	
96	Total Ops	178	356	445	356	445	623	623	756	
97	Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.4.8 - Modelec									
98	Airspace MCAGCCTP Flight Profiles Data Base.									

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Table B1-86. Emission Factors/Activity Data for MV-22 Aircraft																		
2–5	FLIGHT ACTIVITY	ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		Emission Factors (Pounds/Operation) (1)(4)								
											ROG	CO	NOx	SO2	PM10	PM2.5	*CO2*	*CH4*	*N2O*
15	Vertical Departure Total (2)										0.04	2.45	6.79	0.32	1.13	1.13	2,579	0.36	0.03
23	Short Departure Total (2)										0.03	2.37	5.38	0.28	0.95	0.95	2,216	0.31	0.02
32	Short Arrival Total (2)										0.05	2.96	3.87	0.24	0.78	0.78	1,935	0.27	0.02
41	Vertical Arrival Total (2)										0.05	2.96	3.87	0.24	0.78	0.78	1,935	0.27	0.02
53	Arrival (with Break) Total (2)										0.05	3.07	6.13	0.31	1.06	1.06	2,499	0.35	0.02
55	FW (0°) Cruise (Lb/1,000 Lb of Fuel) (2)	Cruise	2						1,910		0.01	0.52	14.09	0.40	1.58	1.58	3,209	0.45	0.03
58	HELO (16°) Cruise (Lb/1,000 Lb of Fuel) (2)	Cruise	2						1,530		0.01	0.79	11.64	0.40	1.58	1.58	3,212	0.45	0.03
63	T&G Total (3)										0.003	0.19	3.57	0.11	0.44	0.44	899	0.13	0.01
67	GCA Box Pattern Total (3)										0.004	0.26	5.20	0.16	0.63	0.63	1,283	0.18	0.01
71	FCLP Total (3)										0.003	0.22	4.61	0.14	0.55	0.55	1,119	0.16	0.01
73	Hover (Lb/1,000 Lb of Fuel) (3)		2						1,770		0.01	0.60	13.19	0.40	1.58	1.58	3,210	0.45	0.03
76	Single Pad or Confined Area Landing Total (3)										0.01	0.29	8.87	0.24	0.94	0.94	1,899	0.27	0.02
79	Paratroop Drop Total (3)										0.003	0.18	3.85	0.12	0.46	0.46	932	0.13	0.01

81 Notes: (1) Units in pounds of emissions per operation, except for cruise and hover modes, units in pounds per 1,000 pounds of fuel comsumed.

82 (2) AESO Memorandum Report No. 9946, Revision E, Aircraft Emissions Estimates: V-22 Takeoff and Landing Cycle and In-Frame, Maintenance Testing Using JP-5, January 2001 (Reference 3).

83 (3) AESO Memorandum Report No. 9965, Revision B, Aircraft Emissions Estimates: V-22 Mission Operations Using JP-5, January 2001 (Reference 4).

84 (4) PM2.5 factor based upon AESO report No. 2001-30 (AESO 2001). Emission factors for CH4 and N2O obtained from the California Climate Action Registry

85 General Reporting Protocol, Version 3.0, source type commercial/institutional kerosene combustion (CCAR 2008).

	A	B	C	D	E	F	G	H	I	J	K
1	Table B1-87. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2010										
2		*Annual Emissions (Tons)*									
3	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
4	*Confined Area Landing (CAL)*										
5	CAL	0.00	0.01	0.17	0.00	0.02	0.02	36.92	0.01	0.00	37.14
6	Cruise (from CAL)	0.00	0.03	0.89	0.03	0.10	0.10	202.56	0.03	0.00	203.80
7	Subtotal Ops	0.00	0.04	1.06	0.03	0.12	0.12	239.47	0.03	0.00	240.94
8	*Drop Zone*										
9	Paratroop Drop (PT)	0.00	0.00	0.02	0.00	0.00	0.00	4.62	0.00	0.00	4.65
10	Cruise (from PT)	0.00	0.01	0.24	0.01	0.03	0.03	55.68	0.01	0.00	56.02
11	Subtotal Ops	0.00	0.01	0.26	0.01	0.03	0.03	60.30	0.01	0.00	60.67
12	*Landing Zone*										
13	CAL	0.00	0.00	0.09	0.00	0.01	0.01	18.74	0.00	0.00	18.85
14	Cruise (from CAL)	0.00	0.02	0.45	0.01	0.05	0.05	102.82	0.01	0.00	103.45
15	Subtotal Ops	0.00	0.02	0.54	0.02	0.06	0.06	121.56	0.02	0.00	122.31
16	*PAD, etc.*										
17	CAL	0.00	0.08	2.53	0.07	0.27	0.27	541.34	0.08	0.01	544.65
18	Cruise (from CAL)	0.01	0.48	13.04	0.37	1.46	1.46	2,970.25	0.42	0.03	2,988.43
19	Subtotal Ops	0.01	0.56	15.57	0.44	1.73	1.73	3,511.59	0.49	0.03	3,533.08
20	*RWR-1*										
21	Cruise	0.00	0.10	2.62	0.07	0.29	0.29	596.93	0.08	0.01	600.58
22	Subtotal Ops	0.00	0.10	2.62	0.07	0.29	0.29	596.93	0.08	0.01	600.58
23	*RWR-2*										
24	Cruise	0.00	0.07	1.79	0.05	0.20	0.20	408.71	0.06	0.00	411.21
25	Subtotal Ops	0.00	0.07	1.79	0.05	0.20	0.20	408.71	0.06	0.00	411.21
26	*RWR-3*										
27	Cruise	0.00	0.08	2.05	0.06	0.23	0.23	467.86	0.07	0.00	470.72
28	Subtotal Ops	0.00	0.08	2.05	0.06	0.23	0.23	467.86	0.07	0.00	470.72
29	Total Ops	0.02	0.87	23.90	0.67	2.66	2.66	5,406.42	0.76	0.05	5,439.51

	A	B	C	D	E	F	G	H	I	J	K
33	Table B1-88. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2011										
34		*Annual Emissions (Tons)*									
35	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
36	*Confined Area Landing (CAL)*										
37	CAL	0.00	0.01	0.34	0.01	0.04	0.04	73.83	0.01	0.00	74.29
38	Cruise (from CAL)	0.00	0.07	1.78	0.05	0.20	0.20	405.11	0.06	0.00	407.59
39	Subtotal Ops	0.00	0.08	2.12	0.06	0.24	0.24	478.95	0.07	0.00	481.88
40	*Drop Zone*										
41	Paratroop Drop (PT)	0.00	0.00	0.04	0.00	0.00	0.00	9.24	0.00	0.00	9.29
42	Cruise (from PT)	0.00	0.02	0.49	0.01	0.05	0.05	111.36	0.02	0.00	112.05
43	Subtotal Ops	0.00	0.02	0.53	0.02	0.06	0.06	120.60	0.02	0.00	121.34
44	*Landing Zone*										
45	CAL	0.00	0.01	0.18	0.00	0.02	0.02	37.48	0.01	0.00	37.71
46	Cruise (from CAL)	0.00	0.03	0.90	0.03	0.10	0.10	205.65	0.03	0.00	206.91
47	Subtotal Ops	0.00	0.04	1.08	0.03	0.12	0.12	243.13	0.03	0.00	244.61
48	*PAD, etc.*										
49	CAL	0.01	0.17	5.06	0.14	0.54	0.54	1,082.67	0.15	0.01	1,089.30
50	Cruise (from CAL)	0.02	0.96	26.08	0.74	2.92	2.92	5,940.51	0.83	0.06	5,976.87
51	Subtotal Ops	0.02	1.13	31.14	0.88	3.46	3.46	7,023.18	0.98	0.07	7,066.17
52	*RWR-1*										
53	Cruise	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
54	Subtotal Ops	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
55	*RWR-2*										
56	Cruise	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
57	Subtotal Ops	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
58	*RWR-3*										
59	Cruise	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
60	Subtotal Ops	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
61	Total Ops	0.04	1.74	47.81	1.35	5.33	5.33	10,812.84	1.51	0.11	10,879.02

	A	B	C	D	E	F	G	H	I	J	K
65	Table B1-89. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2012										
66		*Annual Emissions (Tons)*									
67	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
68	*Confined Area Landing (CAL)*										
69	CAL	0.00	0.01	0.43	0.01	0.05	0.05	92.29	0.01	0.00	92.86
70	Cruise (from CAL)	0.00	0.08	2.22	0.06	0.25	0.25	506.39	0.07	0.00	509.49
71	Subtotal Ops	0.00	0.10	2.65	0.07	0.30	0.30	598.69	0.08	0.01	602.35
72	*Drop Zone*										
73	Paratroop Drop (PT)	0.00	0.00	0.05	0.00	0.01	0.01	11.55	0.00	0.00	11.62
74	Cruise (from PT)	0.00	0.02	0.61	0.02	0.07	0.07	139.20	0.02	0.00	140.06
75	Subtotal Ops	0.00	0.02	0.66	0.02	0.07	0.07	150.75	0.02	0.00	151.67
76	*Landing Zone*										
77	CAL	0.00	0.01	0.22	0.01	0.02	0.02	46.85	0.01	0.00	47.14
78	Cruise (from CAL)	0.00	0.04	1.13	0.03	0.13	0.13	257.06	0.04	0.00	258.63
79	Subtotal Ops	0.00	0.05	1.35	0.04	0.15	0.15	303.91	0.04	0.00	305.77
80	*PAD, etc.*										
81	CAL	0.01	0.21	6.32	0.17	0.67	0.67	1,353.34	0.19	0.01	1,361.62
82	Cruise (from CAL)	0.02	1.20	32.60	0.93	3.66	3.66	7,425.64	1.04	0.07	7,471.09
83	Subtotal Ops	0.03	1.41	38.93	1.10	4.33	4.33	8,778.98	1.23	0.09	8,832.71
84	*RWR-1*										
85	Cruise	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
86	Subtotal Ops	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
87	*RWR-2*										
88	Cruise	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
89	Subtotal Ops	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
90	*RWR-3*										
91	Cruise	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
92	Subtotal Ops	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
93	Total Ops	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05	1.89	0.13	13,598.78

	A	B	C	D	E	F	G	H	I	J	K
97	Table B1-90. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2013										
98		*Annual Emissions (Tons)*									
99	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
100	*Confined Area Landing (CAL)*										
101	CAL	0.00	0.01	0.34	0.01	0.04	0.04	73.83	0.01	0.00	74.29
102	Cruise (from CAL)	0.00	0.07	1.78	0.05	0.20	0.20	405.11	0.06	0.00	407.59
103	Subtotal Ops	0.00	0.08	2.12	0.06	0.24	0.24	478.95	0.07	0.00	481.88
104	*Drop Zone*										
105	Paratroop Drop (PT)	0.00	0.00	0.04	0.00	0.00	0.00	9.24	0.00	0.00	9.29
106	Cruise (from PT)	0.00	0.02	0.49	0.01	0.05	0.05	111.36	0.02	0.00	112.05
107	Subtotal Ops	0.00	0.02	0.53	0.02	0.06	0.06	120.60	0.02	0.00	121.34
108	*Landing Zone*										
109	CAL	0.00	0.01	0.18	0.00	0.02	0.02	37.48	0.01	0.00	37.71
110	Cruise (from CAL)	0.00	0.03	0.90	0.03	0.10	0.10	205.65	0.03	0.00	206.91
111	Subtotal Ops	0.00	0.04	1.08	0.03	0.12	0.12	243.13	0.03	0.00	244.61
112	*PAD, etc.*										
113	CAL	0.01	0.17	5.06	0.14	0.54	0.54	1,082.67	0.15	0.01	1,089.30
114	Cruise (from CAL)	0.02	0.96	26.08	0.74	2.92	2.92	5,940.51	0.83	0.06	5,976.87
115	Subtotal Ops	0.02	1.13	31.14	0.88	3.46	3.46	7,023.18	0.98	0.07	7,066.17
116	*RWR-1*										
117	Cruise	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
118	Subtotal Ops	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
119	*RWR-2*										
120	Cruise	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
121	Subtotal Ops	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
122	*RWR-3*										
123	Cruise	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
124	Subtotal Ops	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
125	Total Ops	0.04	1.74	47.81	1.35	5.33	5.33	10,812.84	1.51	0.11	10,879.02

	A	B	C	D	E	F	G	H	I	J	K
129	Table B1-91. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2014										
130		*Annual Emissions (Tons)*									
131	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
132	*Confined Area Landing (CAL)*										
133	CAL	0.00	0.01	0.43	0.01	0.05	0.05	92.29	0.01	0.00	92.86
134	Cruise (from CAL)	0.00	0.08	2.22	0.06	0.25	0.25	506.39	0.07	0.00	509.49
135	Subtotal Ops	0.00	0.10	2.65	0.07	0.30	0.30	598.69	0.08	0.01	602.35
136	*Drop Zone*										
137	Paratroop Drop (PT)	0.00	0.00	0.05	0.00	0.01	0.01	11.55	0.00	0.00	11.62
138	Cruise (from PT)	0.00	0.02	0.61	0.02	0.07	0.07	139.20	0.02	0.00	140.06
139	Subtotal Ops	0.00	0.02	0.66	0.02	0.07	0.07	150.75	0.02	0.00	151.67
140	*Landing Zone*										
141	CAL	0.00	0.01	0.22	0.01	0.02	0.02	46.85	0.01	0.00	47.14
142	Cruise (from CAL)	0.00	0.04	1.13	0.03	0.13	0.13	257.06	0.04	0.00	258.63
143	Subtotal Ops	0.00	0.05	1.35	0.04	0.15	0.15	303.91	0.04	0.00	305.77
144	*PAD, etc.*										
145	CAL	0.01	0.21	6.32	0.17	0.67	0.67	1,353.34	0.19	0.01	1,361.62
146	Cruise (from CAL)	0.02	1.20	32.60	0.93	3.66	3.66	7,425.64	1.04	0.07	7,471.09
147	Subtotal Ops	0.03	1.41	38.93	1.10	4.33	4.33	8,778.98	1.23	0.09	8,832.71
148	*RWR-1*										
149	Cruise	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
150	Subtotal Ops	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
151	*RWR-2*										
152	Cruise	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
153	Subtotal Ops	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
154	*RWR-3*										
155	Cruise	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
156	Subtotal Ops	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
157	Total Ops	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05	1.89	0.13	13,598.78

	A	B	C	D	E	F	G	H	I	J	K
161	Table B1-92. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2015										
162		*Annual Emissions (Tons)*									
163	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
164	*Confined Area Landing (CAL)*										
165	CAL	0.00	0.02	0.60	0.02	0.06	0.06	129.21	0.02	0.00	130.00
166	Cruise (from CAL)	0.00	0.11	3.11	0.09	0.35	0.35	708.95	0.10	0.01	713.29
167	Subtotal Ops	0.00	0.13	3.72	0.10	0.41	0.41	838.16	0.12	0.01	843.29
168	*Drop Zone*										
169	Paratroop Drop (PT)	0.00	0.00	0.07	0.00	0.01	0.01	16.16	0.00	0.00	16.26
170	Cruise (from PT)	0.00	0.03	0.86	0.02	0.10	0.10	194.89	0.03	0.00	196.08
171	Subtotal Ops	0.00	0.03	0.92	0.03	0.10	0.10	211.05	0.03	0.00	212.34
172	*Landing Zone*										
173	CAL	0.00	0.01	0.31	0.01	0.03	0.03	65.59	0.01	0.00	65.99
174	Cruise (from CAL)	0.00	0.06	1.58	0.04	0.18	0.18	359.88	0.05	0.00	362.08
175	Subtotal Ops	0.00	0.07	1.89	0.05	0.21	0.21	425.47	0.06	0.00	428.07
176	*PAD, etc.*										
177	CAL	0.01	0.29	8.85	0.24	0.94	0.94	1,894.67	0.27	0.02	1,906.27
178	Cruise (from CAL)	0.03	1.68	45.65	1.30	5.12	5.12	10,395.89	1.46	0.10	10,459.52
179	Subtotal Ops	0.04	1.97	54.50	1.54	6.06	6.06	12,290.57	1.72	0.12	12,365.79
180	*RWR-1*										
181	Cruise	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
182	Subtotal Ops	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
183	*RWR-2*										
184	Cruise	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
185	Subtotal Ops	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
186	*RWR-3*										
187	Cruise	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
188	Subtotal Ops	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
189	Total Ops	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47	2.65	0.19	19,038.29

	A	B	C	D	E	F	G	H	I	J	K
193	Table B1-93. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2016										
194		*Annual Emissions (Tons)*									
195	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
196	*Confined Area Landing (CAL)*										
197	CAL	0.00	0.02	0.60	0.02	0.06	0.06	129.21	0.02	0.00	130.00
198	Cruise (from CAL)	0.00	0.11	3.11	0.09	0.35	0.35	708.95	0.10	0.01	713.29
199	Subtotal Ops	0.00	0.13	3.72	0.10	0.41	0.41	838.16	0.12	0.01	843.29
200	*Drop Zone*										
201	Paratroop Drop (PT)	0.00	0.00	0.07	0.00	0.01	0.01	16.16	0.00	0.00	16.26
202	Cruise (from PT)	0.00	0.03	0.86	0.02	0.10	0.10	194.89	0.03	0.00	196.08
203	Subtotal Ops	0.00	0.03	0.92	0.03	0.10	0.10	211.05	0.03	0.00	212.34
204	*Landing Zone*										
205	CAL	0.00	0.01	0.31	0.01	0.03	0.03	65.59	0.01	0.00	65.99
206	Cruise (from CAL)	0.00	0.06	1.58	0.04	0.18	0.18	359.88	0.05	0.00	362.08
207	Subtotal Ops	0.00	0.07	1.89	0.05	0.21	0.21	425.47	0.06	0.00	428.07
208	*PAD, etc.*										
209	CAL	0.01	0.29	8.85	0.24	0.94	0.94	1,894.67	0.27	0.02	1,906.27
210	Cruise (from CAL)	0.03	1.68	45.65	1.30	5.12	5.12	10,395.89	1.46	0.10	10,459.52
211	Subtotal Ops	0.04	1.97	54.50	1.54	6.06	6.06	12,290.57	1.72	0.12	12,365.79
212	*RWR-1*										
213	Cruise	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
214	Subtotal Ops	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
215	*RWR-2*										
216	Cruise	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
217	Subtotal Ops	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
218	*RWR-3*										
219	Cruise	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
220	Subtotal Ops	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
221	Total Ops	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47	2.65	0.19	19,038.29

	A	B	C	D	E	F	G	H	I	J	K
225	Table B1-94. MCB Pendleton Range MV-22 Aircraft Emissions - Fiscal Year 2017										
226		*Annual Emissions (Tons)*									
227	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
228	*Confined Area Landing (CAL)*										
229	CAL	0.00	0.02	0.73	0.02	0.08	0.08	156.90	0.02	0.00	157.86
230	Cruise (from CAL)	0.00	0.14	3.78	0.11	0.42	0.42	860.87	0.12	0.01	866.14
231	Subtotal Ops	0.00	0.16	4.51	0.13	0.50	0.50	1,017.76	0.14	0.01	1,023.99
232	*Drop Zone*										
233	Paratroop Drop (PT)	0.00	0.00	0.08	0.00	0.01	0.01	19.63	0.00	0.00	19.75
234	Cruise (from PT)	0.00	0.04	1.04	0.03	0.12	0.12	236.65	0.03	0.00	238.10
235	Subtotal Ops	0.00	0.04	1.12	0.03	0.13	0.13	256.28	0.04	0.00	257.84
236	*Landing Zone*										
237	CAL	0.00	0.01	0.37	0.01	0.04	0.04	79.64	0.01	0.00	80.13
238	Cruise (from CAL)	0.00	0.07	1.92	0.05	0.22	0.22	437.00	0.06	0.00	439.67
239	Subtotal Ops	0.00	0.08	2.29	0.06	0.25	0.25	516.64	0.07	0.01	519.81
240	*PAD, etc.*										
241	CAL	0.01	0.35	10.75	0.29	1.14	1.14	2,300.68	0.32	0.02	2,314.76
242	Cruise (from CAL)	0.04	2.05	55.43	1.57	6.22	6.22	12,623.58	1.77	0.12	12,700.85
243	Subtotal Ops	0.05	2.40	66.17	1.86	7.35	7.35	14,924.26	2.09	0.15	15,015.61
244	*RWR-1*										
245	Cruise	0.01	0.41	11.14	0.32	1.25	1.25	2,536.94	0.36	0.02	2,552.46
246	Subtotal Ops	0.01	0.41	11.14	0.32	1.25	1.25	2,536.94	0.36	0.02	2,552.46
247	*RWR-2*										
248	Cruise	0.01	0.28	7.63	0.22	0.86	0.86	1,737.00	0.24	0.02	1,747.63
249	Subtotal Ops	0.01	0.28	7.63	0.22	0.86	0.86	1,737.00	0.24	0.02	1,747.63
250	*RWR-3*										
251	Cruise	0.01	0.32	8.73	0.25	0.98	0.98	1,988.41	0.28	0.02	2,000.58
252	Subtotal Ops	0.01	0.32	8.73	0.25	0.98	0.98	1,988.41	0.28	0.02	2,000.58
253	Total Ops	0.08	3.70	101.59	2.87	11.32	11.32	22,977.29	3.22	0.23	23,117.93

Table B1-95. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.00	0.11	3.39	0.09	0.36	0.36	725.66	0.10	0.01	730.11
Cruise (from CAL)	0.01	0.60	16.31	0.46	1.83	1.83	3,714.31	0.52	0.04	3,737.05
Cruise Only	0.00	0.18	4.82	0.14	0.54	0.54	1,098.78	0.15	0.01	1,105.51
Subtotal Ops	0.02	0.89	24.52	0.69	2.73	2.73	5,538.76	0.78	0.05	5,572.66
Route Ops										
Cruise Only	0.00	0.02	0.67	0.02	0.08	0.08	152.90	0.02	0.00	153.84
Subtotal Ops	0.00	0.02	0.67	0.02	0.08	0.08	152.90	0.02	0.00	153.84
Total Ops	0.02	0.92	25.19	0.71	2.80	2.80	5,691.66	0.80	0.06	5,726.50

Table B1-96. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.01	0.22	6.78	0.18	0.72	0.72	1,451.33	0.20	0.01	1,460.21
Cruise (from CAL)	0.02	1.20	32.62	0.93	3.66	3.66	7,428.63	1.04	0.07	7,474.10
Cruise Only	0.01	0.36	9.65	0.27	1.08	1.08	2,197.57	0.31	0.02	2,211.02
Subtotal Ops	0.04	1.78	49.05	1.38	5.46	5.46	11,077.52	1.55	0.11	11,145.33
Route Ops										
Cruise Only	0.00	0.05	1.34	0.04	0.15	0.15	305.80	0.04	0.00	307.67
Subtotal Ops	0.00	0.05	1.34	0.04	0.15	0.15	305.80	0.04	0.00	307.67
Total Ops	0.04	1.83	50.39	1.42	5.61	5.61	11,383.33	1.59	0.11	11,453.00

Table B1-97. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.01	0.28	8.47	0.23	0.90	0.90	1,814.16	0.25	0.02	1,825.26
Cruise (from CAL)	0.03	1.50	40.77	1.16	4.57	4.57	9,285.79	1.30	0.09	9,342.62
Cruise Only	0.01	0.45	12.06	0.34	1.35	1.35	2,746.96	0.38	0.03	2,763.77
Subtotal Ops	0.05	2.23	61.31	1.73	6.82	6.82	13,846.90	1.94	0.14	13,931.66
Route Ops										
Cruise Only	0.00	0.06	1.68	0.05	0.19	0.19	382.25	0.05	0.00	384.59
Subtotal Ops	0.00	0.06	1.68	0.05	0.19	0.19	382.25	0.05	0.00	384.59
Total Ops	0.05	2.29	62.99	1.78	7.01	7.01	14,229.16	1.99	0.14	14,316.25

Table B1-98. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.01	0.22	6.78	0.18	0.72	0.72	1,451.33	0.20	0.01	1,460.21
Cruise (from CAL)	0.02	1.20	32.62	0.93	3.66	3.66	7,428.63	1.04	0.07	7,474.10
Cruise Only	0.01	0.36	9.65	0.27	1.08	1.08	2,197.57	0.31	0.02	2,211.02
Subtotal Ops	0.04	1.78	49.05	1.38	5.46	5.46	11,077.52	1.55	0.11	11,145.33
Route Ops										
Cruise Only	0.00	0.05	1.34	0.04	0.15	0.15	305.80	0.04	0.00	307.67
Subtotal Ops	0.00	0.05	1.34	0.04	0.15	0.15	305.80	0.04	0.00	307.67
Total Ops	0.04	1.83	50.39	1.42	5.61	5.61	11,383.33	1.59	0.11	11,453.00

Table B1-99. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.01	0.28	8.47	0.23	0.90	0.90	1,814.16	0.25	0.02	1,825.26
Cruise (from CAL)	0.03	1.50	40.77	1.16	4.57	4.57	9,285.79	1.30	0.09	9,342.62
Cruise Only	0.01	0.45	12.06	0.34	1.35	1.35	2,746.96	0.38	0.03	2,763.77
Subtotal Ops	0.05	2.23	61.31	1.73	6.82	6.82	13,846.90	1.94	0.14	13,931.66
Route Ops										
Cruise Only	0.00	0.06	1.68	0.05	0.19	0.19	382.25	0.05	0.00	384.59
Subtotal Ops	0.00	0.06	1.68	0.05	0.19	0.19	382.25	0.05	0.00	384.59
Total Ops	0.05	2.29	62.99	1.78	7.01	7.01	14,229.16	1.99	0.14	14,316.25

Table B1-100. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2015

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.01	0.39	11.86	0.32	1.26	1.26	2,539.82	0.36	0.02	2,555.37
Cruise (from CAL)	0.04	2.11	57.08	1.62	6.40	6.40	13,000.10	1.82	0.13	13,079.67
Cruise Only	0.01	0.62	16.89	0.48	1.89	1.89	3,845.74	0.54	0.04	3,869.28
Subtotal Ops	0.07	3.12	85.83	2.42	9.55	9.55	19,385.67	2.71	0.19	19,504.32
Route Ops										
Cruise Only	0.00	0.09	2.35	0.07	0.26	0.26	535.16	0.07	0.01	538.43
Subtotal Ops	0.00	0.09	2.35	0.07	0.26	0.26	535.16	0.07	0.01	538.43
Total Ops	0.07	3.20	88.18	2.49	9.82	9.82	19,920.82	2.79	0.20	20,042.75

Table B1-101. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2016

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.01	0.39	11.86	0.32	1.26	1.26	2,539.82	0.36	0.02	2,555.37
Cruise (from CAL)	0.04	2.11	57.08	1.62	6.40	6.40	13,000.10	1.82	0.13	13,079.67
Cruise Only	0.01	0.62	16.89	0.48	1.89	1.89	3,845.74	0.54	0.04	3,869.28
Subtotal Ops	0.07	3.12	85.83	2.42	9.55	9.55	19,385.67	2.71	0.19	19,504.32
Route Ops										
Cruise Only	0.00	0.09	2.35	0.07	0.26	0.26	535.16	0.07	0.01	538.43
Subtotal Ops	0.00	0.09	2.35	0.07	0.26	0.26	535.16	0.07	0.01	538.43
Total Ops	0.07	3.20	88.18	2.49	9.82	9.82	19,920.82	2.79	0.20	20,042.75

Table B1-102. Chocolate Mountain Range MV-22 Aircraft Emissions - Fiscal Year 2017

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
CAL	0.02	0.47	14.41	0.39	1.53	1.53	3,084.07	0.43	0.03	3,102.95
Cruise (from CAL)	0.05	2.56	69.31	1.97	7.77	7.77	15,785.84	2.21	0.15	15,882.46
Cruise Only	0.01	0.76	20.50	0.58	2.30	2.30	4,669.83	0.65	0.05	4,698.41
Subtotal Ops	0.08	3.79	104.22	2.94	11.60	11.60	23,539.74	3.30	0.23	23,683.82
Route Ops										
Cruise Only	0.00	0.11	2.85	0.08	0.32	0.32	649.83	0.09	0.01	653.81
Subtotal Ops	0.00	0.11	2.85	0.08	0.32	0.32	649.83	0.09	0.01	653.81
Total Ops	0.08	3.89	107.07	3.02	11.92	11.92	24,189.57	3.39	0.24	24,337.63

Table B1-103. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.03	0.94	0.03	0.11	0.11	213.56	0.03	0.00	214.86
Total Ops	0.00	0.03	0.94	0.03	0.11	0.11	213.56	0.03	0.00	214.86

Table B1-104. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.07	1.88	0.05	0.21	0.21	427.11	0.06	0.00	429.73
Total Ops	0.00	0.07	1.88	0.05	0.21	0.21	427.11	0.06	0.00	429.73

Table B1-105. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.09	2.34	0.07	0.26	0.26	533.89	0.07	0.01	537.16
Total Ops	0.00	0.09	2.34	0.07	0.26	0.26	533.89	0.07	0.01	537.16

Table B1-106. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.07	1.88	0.05	0.21	0.21	427.11	0.06	0.00	429.73
Total Ops	0.00	0.07	1.88	0.05	0.21	0.21	427.11	0.06	0.00	429.73

Table B1-107. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.09	2.34	0.07	0.26	0.26	533.89	0.07	0.01	537.16
Total Ops	0.00	0.09	2.34	0.07	0.26	0.26	533.89	0.07	0.01	537.16

Table B1-108. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2015

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.12	3.28	0.09	0.37	0.37	747.44	0.10	0.01	752.02
Total Ops	0.00	0.12	3.28	0.09	0.37	0.37	747.44	0.10	0.01	752.02

Table B1-109. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2016

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.12	3.28	0.09	0.37	0.37	747.44	0.10	0.01	752.02
Total Ops	0.00	0.12	3.28	0.09	0.37	0.37	747.44	0.10	0.01	752.02

Table B1-110. El Centro Range MV-22 Aircraft Emissions - Fiscal Year 2017

	Annual Emissions (Tons)									
Flight Activity/Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
Area Ops										
Cruise Only	0.00	0.15	3.99	0.11	0.45	0.45	907.61	0.13	0.01	913.17
Total Ops	0.00	0.15	3.99	0.11	0.45	0.45	907.61	0.13	0.01	913.17

Table B1-111. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2010

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.08	0.21	0.01	0.04	0.04	80.96	0.01	0.00	81.45
Short Departure	0.00	0.22	0.51	0.03	0.09	0.09	208.71	0.03	0.00	209.99
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.11	2.23	0.07	0.27	0.27	540.56	0.08	0.01	543.87
Subtotal Ops	0.01	0.41	2.95	0.10	0.39	0.39	830.23	0.12	0.01	835.31
AUX-2/Min PB Alt (1)										
Vertical Departure	-	-	-	-	-	-	-	-	-	-
Short Departure	-	-	-	-	-	-	-	-	-	-
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	-	-	-	-	-	-	-	-	-	-
Subtotal Ops	-	-	-	-	-	-	-	-	-	-
Airspace F1D										
CAL	0.01	0.22	6.74	0.18	0.71	0.71	1,442.56	0.20	0.01	1,451.39
Cruise (from CAL)	0.03	1.48	40.11	1.14	4.50	4.50	9,135.98	1.28	0.09	9,191.90
Subtotal Ops	0.04	1.70	46.85	1.32	5.21	5.21	10,578.54	1.48	0.10	10,643.29
Airspaces F1D, F5B, F9C										
Cruise Only	0.01	0.68	18.31	0.52	2.05	2.05	4,170.04	0.58	0.04	4,195.57
Subtotal Ops	0.01	0.68	18.31	0.52	2.05	2.05	4,170.04	0.58	0.04	4,195.57
LONESOME_D										
CAL	0.00	0.00	0.10	0.00	0.01	0.01	21.45	0.00	0.00	21.58
Cruise (from CAL)	0.00	0.00	0.13	0.00	0.02	0.02	30.56	0.00	0.00	30.75
Subtotal Ops	0.00	0.01	0.23	0.01	0.03	0.03	52.01	0.01	0.00	52.33
Total Ops	0.05	2.79	68.34	1.95	7.68	7.68	15,630.82	2.19	0.15	15,726.49
Total without AUX-2	0.05	2.38	65.40	1.85	7.29	7.29	14,800.59	2.07	0.15	14,891.18

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-112. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2011

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.12	0.32	0.02	0.05	0.05	121.44	0.02	0.00	122.18
Short Departure	0.00	0.33	0.76	0.04	0.13	0.13	313.06	0.04	0.00	314.98
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.16	3.34	0.10	0.40	0.40	810.84	0.11	0.01	815.80
Subtotal Ops	0.01	0.61	4.42	0.16	0.59	0.59	1,245.34	0.17	0.01	1,252.96
AUX-2/Min PB Alt (1)										
Vertical Departure	-	-	-	-	-	-	-	-	-	-
Short Departure	-	-	-	-	-	-	-	-	-	-
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	-	-	-	-	-	-	-	-	-	-
Subtotal Ops	-	-	-	-	-	-	-	-	-	-
Airspace F1D										
CAL	0.02	0.44	13.48	0.36	1.43	1.43	2,885.12	0.40	0.03	2,902.78
Cruise (from CAL)	0.06	2.96	80.23	2.28	9.00	9.00	18,271.97	2.56	0.18	18,383.81
Subtotal Ops	0.07	3.40	93.70	2.64	10.42	10.42	21,157.09	2.96	0.21	21,286.59
Airspaces F1D, F5B, F9C										
Cruise Only	0.03	1.35	36.62	1.04	4.11	4.11	8,340.08	1.17	0.08	8,391.13
Subtotal Ops	0.03	1.35	36.62	1.04	4.11	4.11	8,340.08	1.17	0.08	8,391.13
LONESOME_D										
CAL	0.00	0.01	0.20	0.01	0.02	0.02	42.90	0.01	0.00	43.16
Cruise (from CAL)	0.00	0.01	0.27	0.01	0.03	0.03	61.12	0.01	0.00	61.49
Subtotal Ops	0.00	0.02	0.47	0.01	0.05	0.05	104.01	0.01	0.00	104.65
Total Ops	0.11	5.38	135.21	3.85	15.17	15.17	30,846.52	4.32	0.30	31,035.33
Total without AUX-2	0.10	4.77	130.79	3.69	14.58	14.58	29,601.18	4.14	0.29	29,782.37

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-113. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2012

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.19	0.53	0.03	0.09	0.09	202.40	0.03	0.00	203.64
Short Departure	0.01	0.56	1.27	0.07	0.22	0.22	521.77	0.07	0.01	524.97
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.27	5.57	0.17	0.66	0.66	1,351.39	0.19	0.01	1,359.66
Subtotal Ops	0.01	1.02	7.37	0.26	0.98	0.98	2,075.56	0.29	0.02	2,088.27
AUX-2/Min PB Alt (1)										
Vertical Departure	-	-	-	-	-	-	-	-	-	-
Short Departure	-	-	-	-	-	-	-	-	-	-
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	-	-	-	-	-	-	-	-	-	-
Subtotal Ops	-	-	-	-	-	-	-	-	-	-
Airspace F1D										
CAL	0.02	0.55	16.85	0.46	1.79	1.79	3,606.40	0.50	0.04	3,628.48
Cruise (from CAL)	0.07	3.70	100.29	2.85	11.25	11.25	22,839.96	3.20	0.22	22,979.76
Subtotal Ops	0.09	4.25	117.13	3.30	13.03	13.03	26,446.36	3.70	0.26	26,608.23
Airspaces F1D, F5B, F9C										
Cruise Only	0.03	1.69	45.77	1.30	5.13	5.13	10,425.10	1.46	0.10	10,488.91
Subtotal Ops	0.03	1.69	45.77	1.30	5.13	5.13	10,425.10	1.46	0.10	10,488.91
LONESOME_D										
CAL	0.00	0.01	0.25	0.01	0.03	0.03	53.62	0.01	0.00	53.95
Cruise (from CAL)	0.00	0.01	0.34	0.01	0.04	0.04	76.40	0.01	0.00	76.87
Subtotal Ops	0.00	0.02	0.59	0.02	0.06	0.06	130.02	0.02	0.00	130.81
Total Ops	0.14	6.98	170.86	4.88	19.20	19.20	39,077.04	5.47	0.38	39,316.23
Total without AUX-2	0.12	5.96	163.49	4.62	18.23	18.23	37,001.48	5.18	0.36	37,227.96

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-114. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2013

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.15	0.43	0.02	0.07	0.07	161.92	0.02	0.00	162.91
Short Departure	0.01	0.45	1.01	0.05	0.18	0.18	417.42	0.06	0.00	419.97
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.21	4.45	0.14	0.53	0.53	1,081.11	0.15	0.01	1,087.73
Subtotal Ops	0.01	0.81	5.89	0.21	0.78	0.78	1,660.45	0.23	0.02	1,670.61
AUX-2/Min PB Alt (1)										
Vertical Departure	-	-	-	-	-	-	-	-	-	-
Short Departure	-	-	-	-	-	-	-	-	-	-
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	-	-	-	-	-	-	-	-	-	-
Subtotal Ops	-	-	-	-	-	-	-	-	-	-
Airspace F1D										
CAL	0.02	0.44	13.48	0.36	1.43	1.43	2,885.12	0.40	0.03	2,902.78
Cruise (from CAL)	0.06	2.96	80.23	2.28	9.00	9.00	18,271.97	2.56	0.18	18,383.81
Subtotal Ops	0.07	3.40	93.70	2.64	10.42	10.42	21,157.09	2.96	0.21	21,286.59
Airspaces F1D, F5B, F9C										
Cruise Only	0.03	1.35	36.62	1.04	4.11	4.11	8,340.08	1.17	0.08	8,391.13
Subtotal Ops	0.03	1.35	36.62	1.04	4.11	4.11	8,340.08	1.17	0.08	8,391.13
LONESOME_D										
CAL	0.00	0.01	0.20	0.01	0.02	0.02	42.90	0.01	0.00	43.16
Cruise (from CAL)	0.00	0.01	0.27	0.01	0.03	0.03	61.12	0.01	0.00	61.49
Subtotal Ops	0.00	0.02	0.47	0.01	0.05	0.05	104.01	0.01	0.00	104.65
Total Ops	0.11	5.58	136.69	3.90	15.36	15.36	31,261.64	4.38	0.31	31,452.98
Total without AUX-2	0.10	4.77	130.79	3.69	14.58	14.58	29,601.18	4.14	0.29	29,782.37

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-115. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2014

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.19	0.53	0.03	0.09	0.09	202.40	0.03	0.00	203.64
Short Departure	0.01	0.56	1.27	0.07	0.22	0.22	521.77	0.07	0.01	524.97
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.27	5.57	0.17	0.66	0.66	1,351.39	0.19	0.01	1,359.66
Subtotal Ops	0.01	1.02	7.37	0.26	0.98	0.98	2,075.56	0.29	0.02	2,088.27
AUX-2/Min PB Alt (1)										
Vertical Departure	-	-	-	-	-	-	-	-	-	-
Short Departure	-	-	-	-	-	-	-	-	-	-
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	-	-	-	-	-	-	-	-	-	-
Subtotal Ops	-	-	-	-	-	-	-	-	-	-
Airspace F1D										
CAL	0.02	0.55	16.85	0.46	1.79	1.79	3,606.40	0.50	0.04	3,628.48
Cruise (from CAL)	0.07	3.70	100.29	2.85	11.25	11.25	22,839.96	3.20	0.22	22,979.76
Subtotal Ops	0.09	4.25	117.13	3.30	13.03	13.03	26,446.36	3.70	0.26	26,608.23
Airspaces F1D, F5B, F9C										
Cruise Only	0.03	1.69	45.77	1.30	5.13	5.13	10,425.10	1.46	0.10	10,488.91
Subtotal Ops	0.03	1.69	45.77	1.30	5.13	5.13	10,425.10	1.46	0.10	10,488.91
LONESOME_D										
CAL	0.00	0.01	0.25	0.01	0.03	0.03	53.62	0.01	0.00	53.95
Cruise (from CAL)	0.00	0.01	0.34	0.01	0.04	0.04	76.40	0.01	0.00	76.87
Subtotal Ops	0.00	0.02	0.59	0.02	0.06	0.06	130.02	0.02	0.00	130.81
Total Ops	0.14	6.98	170.86	4.88	19.20	19.20	39,077.04	5.47	0.38	39,316.23
Total without AUX-2	0.12	5.96	163.49	4.62	18.23	18.23	37,001.48	5.18	0.36	37,227.96

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-116. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2015

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.27	0.75	0.04	0.12	0.12	283.36	0.04	0.00	285.09
Short Departure	0.01	0.78	1.77	0.09	0.31	0.31	730.48	0.10	0.01	734.95
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.37	7.79	0.24	0.93	0.93	1,891.95	0.26	0.02	1,903.53
Subtotal Ops	0.01	1.42	10.31	0.36	1.37	1.37	2,905.79	0.41	0.03	2,923.57
AUX-2/Min PB Alt (1)										
Vertical Departure	-	-	-	-	-	-	-	-	-	-
Short Departure	-	-	-	-	-	-	-	-	-	-
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	-	-	-	-	-	-	-	-	-	-
Subtotal Ops	-	-	-	-	-	-	-	-	-	-
Airspace F1D										
CAL	0.03	0.77	23.58	0.64	2.50	2.50	5,048.96	0.71	0.05	5,079.87
Cruise (from CAL)	0.10	5.18	140.40	3.99	15.74	15.74	31,975.94	4.48	0.31	32,171.66
Subtotal Ops	0.13	5.95	163.98	4.62	18.24	18.24	37,024.90	5.18	0.36	37,251.53
Airspaces F1D, F5B, F9C										
Cruise Only	0.05	2.37	64.08	1.82	7.19	7.19	14,595.14	2.04	0.14	14,684.48
Subtotal Ops	0.05	2.37	64.08	1.82	7.19	7.19	14,595.14	2.04	0.14	14,684.48
LONESOME_D										
CAL	0.00	0.01	0.35	0.01	0.04	0.04	75.07	0.01	0.00	75.53
Cruise (from CAL)	0.00	0.02	0.47	0.01	0.05	0.05	106.96	0.01	0.00	107.61
Subtotal Ops	0.00	0.03	0.82	0.02	0.09	0.09	182.03	0.03	0.00	183.14
Total Ops	0.19	9.77	239.20	6.83	26.89	26.89	54,707.86	7.66	0.54	55,042.72
Total without AUX-2	0.17	8.35	228.89	6.47	25.52	25.52	51,802.07	7.25	0.51	52,119.14

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-117. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2016

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.27	0.75	0.04	0.12	0.12	283.36	0.04	0.00	285.09
Short Departure	0.01	0.78	1.77	0.09	0.31	0.31	730.48	0.10	0.01	734.95
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.37	7.79	0.24	0.93	0.93	1,891.95	0.26	0.02	1,903.53
Subtotal Ops	0.01	1.42	10.31	0.36	1.37	1.37	2,905.79	0.41	0.03	2,923.57
AUX-2/Min PB Alt (1)										
Vertical Departure	0.00	0.03	0.08	0.00	0.01	0.01	30.46	0.00	0.00	30.65
Short Departure	0.00	0.08	0.19	0.01	0.03	0.03	78.53	0.01	0.00	79.01
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.04	0.83	0.03	0.10	0.10	202.68	0.03	0.00	203.92
Subtotal Ops	0.00	0.15	1.11	0.04	0.15	0.15	311.68	0.04	0.00	313.58
Airspace F1D										
CAL	0.03	0.77	23.58	0.64	2.50	2.50	5,048.96	0.71	0.05	5,079.87
Cruise (from CAL)	0.10	5.18	140.40	3.99	15.74	15.74	31,975.94	4.48	0.31	32,171.66
Subtotal Ops	0.13	5.95	163.98	4.62	18.24	18.24	37,024.90	5.18	0.36	37,251.53
Airspaces F1D, F5B, F9C										
Cruise Only	0.05	2.37	64.08	1.82	7.19	7.19	14,595.14	2.04	0.14	14,684.48
Subtotal Ops	0.05	2.37	64.08	1.82	7.19	7.19	14,595.14	2.04	0.14	14,684.48
LONESOME_D										
CAL	0.00	0.01	0.35	0.01	0.04	0.04	75.07	0.01	0.00	75.53
Cruise (from CAL)	0.00	0.02	0.47	0.01	0.05	0.05	106.96	0.01	0.00	107.61
Subtotal Ops	0.00	0.03	0.82	0.02	0.09	0.09	182.03	0.03	0.00	183.14
Total Emissions - Max PB Alt	0.19	9.77	239.20	6.83	26.89	26.89	54,708	7.66	0.54	55,043
Total Emissions - Min PB Alt	0.17	8.50	229.99	6.51	25.67	25.67	52,114	7.30	0.51	52,433
Total Max PB Alt w/o AUX-2	0.17	8.35	228.89	6.47	25.52	25.52	51,802	7.25	0.51	52,119

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-118. BMG Range MV-22 Aircraft Emissions - Fiscal Year 2017

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2/Max PB Alt (1)										
Vertical Departure	0.00	0.27	0.75	0.04	0.12	0.12	283	0.04	0.00	285
Short Departure	0.01	0.78	1.77	0.09	0.31	0.31	730	0.10	0.01	735
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.37	7.79	0.24	0.93	0.93	1,892	0.26	0.02	1,904
Subtotal Ops	0.01	1.42	10.31	0.36	1.37	1.37	2,906	0.41	0.03	2,924
AUX-2/Min PB Alt (1)										
Vertical Departure	0.00	0.06	0.16	0.01	0.03	0.03	61	0.01	0.00	61
Short Departure	0.00	0.17	0.38	0.02	0.07	0.07	157	0.02	0.00	158
Short Arrival	-	-	-	-	-	-	-	-	-	-
Vertical Arrival	-	-	-	-	-	-	-	-	-	-
Arrival (with Break)	-	-	-	-	-	-	-	-	-	-
FCLP	0.00	0.08	1.67	0.05	0.20	0.20	405	0.06	0.00	408
Subtotal Ops	0.00	0.31	2.21	0.08	0.29	0.29	623	0.09	0.01	627
Airspace F1D										
CAL	0.03	0.94	28.64	0.77	3.03	3.03	6,131	0.86	0.06	6,168
Cruise (from CAL)	0.12	6.29	170.48	4.84	19.12	19.12	38,828	5.44	0.38	39,066
Subtotal Ops	0.15	7.23	199.12	5.61	22.15	22.15	44,959	6.29	0.44	45,234
Airspaces F1D, F5B, F9C										
Cruise Only	0.06	2.87	77.82	2.21	8.73	8.73	17,723	2.48	0.17	17,831
Subtotal Ops	0.06	2.87	77.82	2.21	8.73	8.73	17,723	2.48	0.17	17,831
LONESOME_D										
CAL	0.00	0.01	0.43	0.01	0.05	0.05	91	0.01	0.00	92
Cruise (from CAL)	0.00	0.02	0.57	0.02	0.06	0.06	130	0.02	0.00	131
Subtotal Ops	0.00	0.03	1.00	0.03	0.11	0.11	221	0.03	0.00	222
Total Emissions - Max PB Alt	0.22	11.56	288.25	8.22	32.35	32.35	65,808	9.21	0.64	66,211
Total Emissions - Min PB Alt	0.21	10.44	280.15	7.93	31.28	31.28	63,526	8.89	0.62	63,915
Total Max PB Alt w/o AUX-2	0.21	10.13	277.93	7.85	30.99	30.99	62,903	8.81	0.62	63,288

Notes: (1) Max PB Alt = Maximum Partial Basing Alternative and Min PB Alt = Minimum Partial Basing Alternative

Table B1-119. AUX-2 MV-22 Aircraft Emissions for Non-Basing Actions at MCAS Yuma

	Annual Emissions (Tons)									
Location/Flight Mode	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
AUX-2 Year 2011										
FCLP	0.00	0.01	0.31	0.01	0.04	0.04	75	0.01	0.00	76
Subtotal Ops	0.00	0.01	0.31	0.01	0.04	0.04	75	0.01	0.00	76
AUX-2 Year 2012										
FCLP	0.00	0.02	0.39	0.01	0.05	0.05	94	0.01	0.00	95
Subtotal Ops	0.00	0.02	0.39	0.01	0.05	0.05	94	0.01	0.00	95
AUX-2 Year 2013										
FCLP	0.00	0.01	0.31	0.01	0.04	0.04	75	0.01	0.00	76
Subtotal Ops	0.00	0.01	0.31	0.01	0.04	0.04	75	0.01	0.00	76
AUX-2 Year 2014										
FCLP	0.00	0.02	0.39	0.01	0.05	0.05	94	0.01	0.00	95
Subtotal Ops	0.00	0.02	0.39	0.01	0.05	0.05	94	0.01	0.00	95
AUX-2 Year 2015										
FCLP	0.00	0.03	0.54	0.02	0.06	0.06	132	0.02	0.00	133
Subtotal Ops	0.00	0.03	0.54	0.02	0.06	0.06	132	0.02	0.00	133
AUX-2 Year 2016										
FCLP	0.00	0.03	0.54	0.02	0.06	0.06	132	0.02	0.00	133
Subtotal Ops	0.00	0.03	0.54	0.02	0.06	0.06	132	0.02	0.00	133
AUX-2 Year 2017										
FCLP	0.00	0.03	0.66	0.02	0.08	0.08	160	0.02	0.00	161
Subtotal Ops	0.00	0.03	0.66	0.02	0.08	0.08	160	0.02	0.00	161

Table B1-120. Existing CH-46 and Proposed MV-22 Emissions within Proposed Training Ranges - Year 2017

	Emissions (Tons per Year)					
Range Location/Aircraft Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MCB Camp Pendleton						
MV-22 Operations	0.08	3.70	101.59	2.87	11.32	11.32
CH-46 Operations	(7.67)	(41.49)	(8.38)	(0.85)	(3.81)	(3.81)
Total Emissions - MCB Camp Pendleton	(7.59)	(37.79)	93.22	2.02	7.51	7.51
Chocolate Mt. AG						
MV-22 Operations	0.08	3.89	107.07	3.02	11.92	11.92
CH-46 Operations	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
Total Emissions - Chocolate Mt. AG	(1.18)	(3.35)	105.63	2.87	11.26	11.26
BMG - 8 Squadrons at MCAS Yuma						
MV-22 Operations	0.22	11.56	288.25	8.22	32.35	32.35
CH-46 Operations	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Emissions - BMG 8 Squadrons at MCAS Yuma	(4.36)	(14.86)	282.97	7.68	29.97	29.97
BMG - 2 Squadrons at MCAS Yuma						
MV-22 Operations	0.21	10.44	280.15	7.93	31.28	31.28
CH-46 Operations	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Emissions - BMG 2 Squadrons at MCAS Yuma	(4.37)	(15.97)	274.87	7.39	28.90	28.90
BMG - 0 Squadrons at MCAS Yuma						
MV-22 Operations	0.21	10.17	278.59	7.87	31.07	31.07
CH-46 Operations	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Emissions - BMG 0 Squadrons at MCAS Yuma	(4.38)	(16.25)	273.31	7.34	28.68	28.68
R-2510/2512						
MV-22 Operations	0.00	0.15	3.99	0.11	0.45	0.45
CH-46 Operations	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Emissions - R-2510/2512	(0.02)	0.05	3.96	0.11	0.44	0.44

Table B1-121. Existing CH-46 and Proposed MV-22 Emissions within Proposed Training Ranges - Year 2017
Chocolate Mt. AG Range Emissions by Air Basin

	Emissions (Tons per Year)					
Range Location/Aircraft Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Chocolate Mt. AG						
MV-22 Operations	0.08	3.89	107.07	3.02	11.92	11.92
CH-46 Operations	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
Total Emissions - Chocolate Mt. AG	(1.18)	(3.35)	105.63	2.87	11.26	11.26
Total Emissions - Within Imperial County (1)	(0.94)	(2.68)	84.50	2.30	9.01	9.01
Total Emissions - Within Riverside Co. (SSAB) (1)	(0.24)	(0.67)	21.13	0.57	2.25	2.25

Note: (1) Since ~80/20% of the CMAGR occurs within the Imperial/Riverside County portions of the SSAB, the existing/proposed emissions within the CMAGR were distributed by these amounts into these areas.

	A	B	C	D	E	F	G	H	I	J	K
1	Table B1-122. Annual MV-22 Operational Fielding Rates and Associated Military Training Route Operations										
2		*MTR*	*Sortie Duration*	*Fiscal Year/Annual Operations*							
3	*MTR/Flight Activity*	*Length (NM)*	*(Hrs) (2)*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
4	*MV-22 Annual Fielding Rate*										
5	% of Year 2017 Operations (1)	NA	NA	24	47	59	47	59	82	82	100
6	*IR 216*										
7	Criuse	52.6	0.24	28	57	71	57	71	100	100	121
8	*IR 217*										
9	Criuse	267.8	1.22	133	265	332	265	332	464	464	564
10	*IR 218*										
11	Criuse	142.9	0.65	249	497	622	497	622	870	870	1,057
12	*VR 1266*										
13	Criuse	158.5	0.72	28	57	71	57	71	100	100	121
14	*VR 1267*										
15	Criuse	216.1	0.98	28	57	71	57	71	100	100	121
16	*VR 1267A*										
17	Criuse	101.0	0.46	28	57	71	57	71	100	100	121
18	*VR 1268*										
19	Criuse	371.9	1.69	28	57	71	57	71	100	100	121
20	Notes: (1) Equates to percentage of annual MV-22 aircraft operations relative to full build-out year 2017 operations.										
21	(2) Cruising speed = 220 knots.										

	A	B	C	D	E	F	G	H	I	J	K
1	Table B1-123. MV-22 AircraftEmissions - Military Training Routes - Fiscal Year 2010										
2		*Tons per Year*									
3	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
4	*IR 216*	0.00	0.01	0.18	0.01	0.02	0.02	41.72	0.01	0.00	41.98
5	*IR 217*	0.00	0.16	4.35	0.12	0.49	0.49	990.10	0.14	0.01	996.16
6	*IR 218*	0.00	0.16	4.35	0.12	0.49	0.49	990.14	0.14	0.01	996.21
7	*VR 1266*	0.00	0.02	0.55	0.02	0.06	0.06	125.72	0.02	0.00	126.49
8	*VR 1267*	0.00	0.03	0.75	0.02	0.08	0.08	171.41	0.02	0.00	172.46
9	*VR 1267A*	0.00	0.01	0.35	0.01	0.04	0.04	80.11	0.01	0.00	80.60
10	*VR 1268*	0.00	0.05	1.30	0.04	0.15	0.15	294.99	0.04	0.00	296.79
11	TOTAL	0.01	0.44	11.83	0.34	1.33	1.33	2,694.20	0.38	0.03	2,710.69
12	Notes: (1) All activities occur in cruise mode.										
13											
14											
15											
16	Table B1-124. MV-22 AircraftEmissions - Military Training Routes - Fiscal Year 2011										
17		*Tons per Year*									
18	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
19	*IR 216*	0.00	0.01	0.37	0.01	0.04	0.04	83.44	0.01	0.00	83.95
20	*IR 217*	0.01	0.32	8.69	0.25	0.97	0.97	1,980.21	0.28	0.02	1,992.33
21	*IR 218*	0.01	0.32	8.70	0.25	0.98	0.98	1,980.29	0.28	0.02	1,992.41
22	*VR 1266*	0.00	0.04	1.10	0.03	0.12	0.12	251.44	0.04	0.00	252.98
23	*VR 1267*	0.00	0.06	1.51	0.04	0.17	0.17	342.82	0.05	0.00	344.91
24	*VR 1267A*	0.00	0.03	0.70	0.02	0.08	0.08	160.22	0.02	0.00	161.20
25	*VR 1268*	0.00	0.10	2.59	0.07	0.29	0.29	589.97	0.08	0.01	593.59
26	TOTAL	0.02	0.87	23.66	0.67	2.65	2.65	5,388.40	0.75	0.05	5,421.38
27	Notes: (1) All activities occur in cruise mode.										
28											
29											
30											
31	Table B1-125. MV-22 Aircraft Emissions - Military Training Routes - Fiscal Year 2012										
32		*Tons per Year*									
33	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
34	*IR 216*	0.00	0.02	0.46	0.01	0.05	0.05	104.30	0.01	0.00	104.94
35	*IR 217*	0.01	0.40	10.87	0.31	1.22	1.22	2,475.26	0.35	0.02	2,490.41
36	*IR 218*	0.01	0.40	10.87	0.31	1.22	1.22	2,475.36	0.35	0.02	2,490.51
37	*VR 1266*	0.00	0.05	1.38	0.04	0.15	0.15	314.30	0.04	0.00	316.23
38	*VR 1267*	0.00	0.07	1.88	0.05	0.21	0.21	428.52	0.06	0.00	431.14
39	*VR 1267A*	0.00	0.03	0.88	0.02	0.10	0.10	200.28	0.03	0.00	201.51
40	*VR 1268*	0.00	0.12	3.24	0.09	0.36	0.36	737.47	0.10	0.01	741.98
41	TOTAL	0.02	1.09	29.57	0.84	3.32	3.32	6,735.50	0.94	0.07	6,776.72
42	Notes: (1) All activities occur in cruise mode.										

	A	B	C	D	E	F	G	H	I	J	K
47	Table B1-126. MV-22 Aircraft Emissions - Military Training Routes - Fiscal Year 2013										
48		*Tons per Year*									
49	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
50	*IR 216*	0.00	0.01	0.37	0.01	0.04	0.04	83.44	0.01	0.00	83.95
51	*IR 217*	0.01	0.32	8.69	0.25	0.97	0.97	1,980.21	0.28	0.02	1,992.33
52	*IR 218*	0.01	0.32	8.70	0.25	0.98	0.98	1,980.29	0.28	0.02	1,992.41
53	*VR 1266*	0.00	0.04	1.10	0.03	0.12	0.12	251.44	0.04	0.00	252.98
54	*VR 1267*	0.00	0.06	1.51	0.04	0.17	0.17	342.82	0.05	0.00	344.91
55	*VR 1267A*	0.00	0.03	0.70	0.02	0.08	0.08	160.22	0.02	0.00	161.20
56	*VR 1268*	0.00	0.10	2.59	0.07	0.29	0.29	589.97	0.08	0.01	593.59
57	TOTAL	0.02	0.87	23.66	0.67	2.65	2.65	5,388.40	0.75	0.05	5,421.38
58	Notes: (1) All activities occur in cruise mode.										
59											
60											
61											
62											
63	Table B1-127. MV-22 Aircraft Emissions - Military Training Routes - Fiscal Year 2014										
64		*Tons per Year*									
65	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
66	*IR 216*	0.00	0.02	0.46	0.01	0.05	0.05	104.30	0.01	0.00	108.96
67	*IR 217*	0.01	0.40	10.87	0.31	1.22	1.22	2,475.26	0.35	0.02	2,585.81
68	*IR 218*	0.01	0.40	10.87	0.31	1.22	1.22	2,475.36	0.35	0.02	2,585.91
69	*VR 1266*	0.00	0.05	1.38	0.04	0.15	0.15	314.30	0.04	0.00	328.34
70	*VR 1267*	0.00	0.07	1.88	0.05	0.21	0.21	428.52	0.06	0.00	447.66
71	*VR 1267A*	0.00	0.03	0.88	0.02	0.10	0.10	200.28	0.03	0.00	209.22
72	*VR 1268*	0.00	0.12	3.24	0.09	0.36	0.36	737.47	0.10	0.01	770.40
73	TOTAL	0.02	1.09	29.57	0.84	3.32	3.32	6,735.50	0.94	0.07	7,036.31
74	Notes: (1) All activities occur in cruise mode.										
75											
76											
77											
78											
79	Table B1-128. MV-22 Aircraft Emissions - Military Training Routes - Fiscal Year 2015										
80		*Tons per Year*									
81	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
82	*IR 216*	0.00	0.02	0.64	0.02	0.07	0.07	146.03	0.02	0.00	152.55
83	*IR 217*	0.01	0.56	15.22	0.43	1.71	1.71	3,465.37	0.49	0.03	3,620.13
84	*IR 218*	0.01	0.56	15.22	0.43	1.71	1.71	3,465.51	0.49	0.03	3,620.28
85	*VR 1266*	0.00	0.07	1.93	0.05	0.22	0.22	440.02	0.06	0.00	459.67
86	*VR 1267*	0.00	0.10	2.63	0.07	0.30	0.30	599.93	0.08	0.01	626.72
87	*VR 1267A*	0.00	0.05	1.23	0.03	0.14	0.14	280.39	0.04	0.00	292.91
88	*VR 1268*	0.00	0.17	4.53	0.13	0.51	0.51	1,032.45	0.14	0.01	1,078.56
89	TOTAL	0.03	1.53	41.40	1.18	4.64	4.64	9,429.70	1.32	0.09	9,850.83
90	Notes: (1) All activities occur in cruise mode.										

	A	B	C	D	E	F	G	H	I	J	K
95	Table B1-129. MV-22 Aircraft Emissions - Military Training Routes - Fiscal Year 2016										
96		*Tons per Year*									
97	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
98	*IR 216*	0.00	0.02	0.64	0.02	0.07	0.07	146.03	0.02	0.00	152.55
99	*IR 217*	0.01	0.56	15.22	0.43	1.71	1.71	3,465.37	0.49	0.03	3,620.13
100	*IR 218*	0.01	0.56	15.22	0.43	1.71	1.71	3,465.51	0.49	0.03	3,620.28
101	*VR 1266*	0.00	0.07	1.93	0.05	0.22	0.22	440.02	0.06	0.00	459.67
102	*VR 1267*	0.00	0.10	2.63	0.07	0.30	0.30	599.93	0.08	0.01	626.72
103	*VR 1267A*	0.00	0.05	1.23	0.03	0.14	0.14	280.39	0.04	0.00	292.91
104	*VR 1268*	0.00	0.17	4.53	0.13	0.51	0.51	1,032.45	0.14	0.01	1,078.56
105	TOTAL	0.03	1.53	41.40	1.18	4.64	4.64	9,429.70	1.32	0.09	9,850.83
106	Notes: (1) All activities occur in cruise mode.										
107											
108											
109											
110											
111	Table B1-130. MV-22 Aircraft Emissions - Military Training Routes - Fiscal Year 2017										
112		*Tons per Year*									
113	*MTR*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
114	*IR 216*	0.00	0.03	0.78	0.02	0.09	0.09	177.32	0.02	0.00	185.24
115	*IR 217*	0.01	0.68	18.48	0.52	2.07	2.07	4,207.95	0.59	0.04	4,395.87
116	*IR 218*	0.01	0.68	18.48	0.52	2.07	2.07	4,208.12	0.59	0.04	4,396.05
117	*VR 1266*	0.00	0.09	2.35	0.07	0.26	0.26	534.31	0.07	0.01	558.17
118	*VR 1267*	0.00	0.12	3.20	0.09	0.36	0.36	728.48	0.10	0.01	761.02
119	*VR 1267A*	0.00	0.06	1.49	0.04	0.17	0.17	340.48	0.05	0.00	355.68
120	*VR 1268*	0.00	0.20	5.50	0.16	0.62	0.62	1,253.70	0.18	0.01	1,309.69
121	TOTAL	0.04	1.86	50.28	1.43	5.64	5.64	11,450.35	1.60	0.11	11,961.72
122	Notes: (1) All activities occur in cruise mode.										

Table B1-131. Fraction of Total MTR Lengths within Affected Air Basins/Nonattainment Areas.

MTR	San Diego Air Basin Total (1) (3)	Salton Sea Air Basin Total (3)	Fraction within SSAB Nonattainment Areas					Mojave Desert Air Basin Total (3)	Fraction within MDAB Nonattainment Areas					Arizona (2)(3)
			NAAQS O_3 Severe Non-Attainment	NAAQS O_3 Marginal Non-Attainment	NAAQS PM_{10} Serious Non-Attainment	CAAQS O_3 Non-Attainment	CAAQS PM_{10} Non-Attainment		NAAQS O_3 Severe Non-Attainment	NAAQS PM_{10} Moderate Non-Attainment	CAAQS O_3 Non-Attainment	CAAQS PM_{10} Non-Attainment	CAAQS $PM_{2.5}$ Non-Attainment	
IR 216	-	-	-	-	-	-	-	1.00	-	0.33	1.00	1.00	-	-
IR 217	-	0.16	0.60	0.40	1.00	1.00	1.00	0.84	0.37	0.84	1.00	1.00	0.27	-
IR 218	-	0.07	1.00	-	1.00	1.00	1.00	0.39	-	-	1.00	1.00	-	0.54
VR 1266	0.53	0.36	0.85	0.15	1.00	1.00	1.00	0.11	-	-	1.00	1.00	-	-
VR 1267	-	0.18	-	1.00	-	1.00	1.00	0.24	-	-	1.00	1.00	-	0.58
VR 1267A	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00
VR 1268	-	0.10	-	1.00	-	1.00	1.00	0.14	-	-	1.00	1.00	-	0.76

Notes: (1) SDAB includes all nonattainment/attainment areas.

(2) All emissions in Arizona occur within attainment areas.

(3) Fractions of MTR lengths within these 4 air basins add up to 1.

Table B1-132. MV-22 Aircraft Emissions within Military Training Routes - SDAB

	Tons per Year									
MTR/Year	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
VR 1266										
2010	0.00	0.01	0.29	0.01	0.03	0.03	66.63	0.01	0.00	67.04
2011	0.00	0.02	0.59	0.02	0.07	0.07	133.26	0.02	0.00	134.08
2012	0.00	0.03	0.73	0.02	0.08	0.08	166.58	0.02	0.00	167.60
2013	0.00	0.02	0.59	0.02	0.07	0.07	133.26	0.02	0.00	134.08
2014	0.00	0.03	0.73	0.02	0.08	0.08	166.58	0.02	0.00	167.60
2015	0.00	0.04	1.02	0.03	0.11	0.11	233.21	0.03	0.00	234.64
2016	0.00	0.04	1.02	0.03	0.11	0.11	233.21	0.03	0.00	234.64
2017	0.00	0.05	1.24	0.04	0.14	0.14	283.19	0.04	0.00	284.92

Notes: (1) All activities occur in cruise mode.

Table B1-133. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2010

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.02	0.42	0.01	0.05	0.05	95.05	0.01	0.00	95.63
NAAQS Marginal O3	0.00	0.01	0.28	0.01	0.03	0.03	63.37	0.01	0.00	63.75
NAAQS Serious PM10	0.00	0.03	0.70	0.02	0.08	0.08	158.42	0.02	0.00	159.39
CAAQS O3	0.00	0.03	0.70	0.02	0.08	0.08	158.42	0.02	0.00	159.39
CAAQS PM10	0.00	0.03	0.70	0.02	0.08	0.08	158.42	0.02	0.00	159.39
IR 218										
NAAQS Severe O3	0.00	0.01	0.30	0.01	0.03	0.03	69.31	0.01	0.00	69.73
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.01	0.30	0.01	0.03	0.03	69.31	0.01	0.00	69.73
CAAQS O3	0.00	0.01	0.30	0.01	0.03	0.03	69.31	0.01	0.00	69.73
CAAQS PM10	0.00	0.01	0.30	0.01	0.03	0.03	69.31	0.01	0.00	69.73
VR 1266										
NAAQS Severe O3	0.00	0.01	0.17	0.00	0.02	0.02	38.47	0.01	0.00	38.71
NAAQS Marginal O3	0.00	0.00	0.03	0.00	0.00	0.00	6.79	0.00	0.00	6.83
NAAQS Serious PM10	0.00	0.01	0.20	0.01	0.02	0.02	45.26	0.01	0.00	45.54
CAAQS O3	0.00	0.01	0.20	0.01	0.02	0.02	45.26	0.01	0.00	45.54
CAAQS PM10	0.00	0.01	0.20	0.01	0.02	0.02	45.26	0.01	0.00	45.54
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.00	0.14	0.00	0.02	0.02	30.85	0.00	0.00	31.04
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.00	0.14	0.00	0.02	0.02	30.85	0.00	0.00	31.04
CAAQS PM10	0.00	0.00	0.14	0.00	0.02	0.02	30.85	0.00	0.00	31.04
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.00	0.13	0.00	0.01	0.01	29.50	0.00	0.00	29.68
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.00	0.13	0.00	0.01	0.01	29.50	0.00	0.00	29.68
CAAQS PM10	0.00	0.00	0.13	0.00	0.01	0.01	29.50	0.00	0.00	29.68

Notes: (1) All activities occur in cruise mode.

Table B1-134. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2011

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.03	0.83	0.02	0.09	0.09	190.10	0.03	0.00	191.26
NAAQS Marginal O3	0.00	0.02	0.56	0.02	0.06	0.06	126.73	0.02	0.00	127.51
NAAQS Serious PM10	0.00	0.05	1.39	0.04	0.16	0.16	316.83	0.04	0.00	318.77
CAAQS O3	0.00	0.05	1.39	0.04	0.16	0.16	316.83	0.04	0.00	318.77
CAAQS PM10	0.00	0.05	1.39	0.04	0.16	0.16	316.83	0.04	0.00	318.77
IR 218										
NAAQS Severe O3	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
CAAQS O3	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
CAAQS PM10	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
VR 1266										
NAAQS Severe O3	0.00	0.01	0.34	0.01	0.04	0.04	76.94	0.01	0.00	77.41
NAAQS Marginal O3	0.00	0.00	0.06	0.00	0.01	0.01	13.58	0.00	0.00	13.66
NAAQS Serious PM10	0.00	0.01	0.40	0.01	0.04	0.04	90.52	0.01	0.00	91.07
CAAQS O3	0.00	0.01	0.40	0.01	0.04	0.04	90.52	0.01	0.00	91.07
CAAQS PM10	0.00	0.01	0.40	0.01	0.04	0.04	90.52	0.01	0.00	91.07
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.27	0.01	0.03	0.03	61.71	0.01	0.00	62.08
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.27	0.01	0.03	0.03	61.71	0.01	0.00	62.08
CAAQS PM10	0.00	0.01	0.27	0.01	0.03	0.03	61.71	0.01	0.00	62.08
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.26	0.01	0.03	0.03	59.00	0.01	0.00	59.36
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.26	0.01	0.03	0.03	59.00	0.01	0.00	59.36
CAAQS PM10	0.00	0.01	0.26	0.01	0.03	0.03	59.00	0.01	0.00	59.36

Notes: (1) All activities occur in cruise mode.

Table B1-135. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2012

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.04	1.04	0.03	0.12	0.12	237.63	0.03	0.00	239.08
NAAQS Marginal O3	0.00	0.03	0.70	0.02	0.08	0.08	158.42	0.02	0.00	159.39
NAAQS Serious PM10	0.00	0.06	1.74	0.05	0.19	0.19	396.04	0.06	0.00	398.47
CAAQS O3	0.00	0.06	1.74	0.05	0.19	0.19	396.04	0.06	0.00	398.47
CAAQS PM10	0.00	0.06	1.74	0.05	0.19	0.19	396.04	0.06	0.00	398.47
IR 218										
NAAQS Severe O3	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
CAAQS O3	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
CAAQS PM10	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
VR 1266										
NAAQS Severe O3	0.00	0.02	0.42	0.01	0.05	0.05	96.18	0.01	0.00	96.76
NAAQS Marginal O3	0.00	0.00	0.07	0.00	0.01	0.01	16.97	0.00	0.00	17.08
NAAQS Serious PM10	0.00	0.02	0.50	0.01	0.06	0.06	113.15	0.02	0.00	113.84
CAAQS O3	0.00	0.02	0.50	0.01	0.06	0.06	113.15	0.02	0.00	113.84
CAAQS PM10	0.00	0.02	0.50	0.01	0.06	0.06	113.15	0.02	0.00	113.84
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.34	0.01	0.04	0.04	77.13	0.01	0.00	77.61
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.34	0.01	0.04	0.04	77.13	0.01	0.00	77.61
CAAQS PM10	0.00	0.01	0.34	0.01	0.04	0.04	77.13	0.01	0.00	77.61
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.32	0.01	0.04	0.04	73.75	0.01	0.00	74.20
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.32	0.01	0.04	0.04	73.75	0.01	0.00	74.20
CAAQS PM10	0.00	0.01	0.26	0.01	0.03	0.03	59.00	0.01	0.00	59.36

Notes: (1) All activities occur in cruise mode.

Table B1-136. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2013

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.03	0.83	0.02	0.09	0.09	190.10	0.03	0.00	191.26
NAAQS Marginal O3	0.00	0.02	0.56	0.02	0.06	0.06	126.73	0.02	0.00	127.51
NAAQS Serious PM10	0.00	0.05	1.39	0.04	0.16	0.16	316.83	0.04	0.00	318.77
CAAQS O3	0.00	0.05	1.39	0.04	0.16	0.16	316.83	0.04	0.00	318.77
CAAQS PM10	0.00	0.05	1.39	0.04	0.16	0.16	316.83	0.04	0.00	318.77
IR 218										
NAAQS Severe O3	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
CAAQS O3	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
CAAQS PM10	0.00	0.02	0.61	0.02	0.07	0.07	138.62	0.02	0.00	139.47
VR 1266										
NAAQS Severe O3	0.00	0.01	0.34	0.01	0.04	0.04	76.94	0.01	0.00	77.41
NAAQS Marginal O3	0.00	0.00	0.06	0.00	0.01	0.01	13.58	0.00	0.00	13.66
NAAQS Serious PM10	0.00	0.01	0.40	0.01	0.04	0.04	90.52	0.01	0.00	91.07
CAAQS O3	0.00	0.01	0.40	0.01	0.04	0.04	90.52	0.01	0.00	91.07
CAAQS PM10	0.00	0.01	0.40	0.01	0.04	0.04	90.52	0.01	0.00	91.07
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.27	0.01	0.03	0.03	61.71	0.01	0.00	62.08
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.27	0.01	0.03	0.03	61.71	0.01	0.00	62.08
CAAQS PM10	0.00	0.01	0.27	0.01	0.03	0.03	61.71	0.01	0.00	62.08
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.26	0.01	0.03	0.03	59.00	0.01	0.00	59.36
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.26	0.01	0.03	0.03	59.00	0.01	0.00	59.36
CAAQS PM10	0.00	0.01	0.26	0.01	0.03	0.03	59.00	0.01	0.00	59.36

Notes: (1) All activities occur in cruise mode.

Table B1-137. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2014

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.04	1.04	0.03	0.12	0.12	237.63	0.03	0.00	239.08
NAAQS Marginal O3	0.00	0.03	0.70	0.02	0.08	0.08	158.42	0.02	0.00	159.39
NAAQS Serious PM10	0.00	0.06	1.74	0.05	0.19	0.19	396.04	0.06	0.00	398.47
CAAQS O3	0.00	0.06	1.74	0.05	0.19	0.19	396.04	0.06	0.00	398.47
CAAQS PM10	0.00	0.06	1.74	0.05	0.19	0.19	396.04	0.06	0.00	398.47
IR 218										
NAAQS Severe O3	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
CAAQS O3	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
CAAQS PM10	0.00	0.03	0.76	0.02	0.09	0.09	173.28	0.02	0.00	174.34
VR 1266										
NAAQS Severe O3	0.00	0.02	0.42	0.01	0.05	0.05	96.18	0.01	0.00	96.76
NAAQS Marginal O3	0.00	0.00	0.07	0.00	0.01	0.01	16.97	0.00	0.00	17.08
NAAQS Serious PM10	0.00	0.02	0.50	0.01	0.06	0.06	113.15	0.02	0.00	113.84
CAAQS O3	0.00	0.02	0.50	0.01	0.06	0.06	113.15	0.02	0.00	113.84
CAAQS PM10	0.00	0.02	0.50	0.01	0.06	0.06	113.15	0.02	0.00	113.84
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.34	0.01	0.04	0.04	77.13	0.01	0.00	77.61
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.34	0.01	0.04	0.04	77.13	0.01	0.00	77.61
CAAQS PM10	0.00	0.01	0.34	0.01	0.04	0.04	77.13	0.01	0.00	77.61
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.01	0.32	0.01	0.04	0.04	73.75	0.01	0.00	74.20
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.32	0.01	0.04	0.04	73.75	0.01	0.00	74.20
CAAQS PM10	0.00	0.01	0.32	0.01	0.04	0.04	73.75	0.01	0.00	74.20

Notes: (1) All activities occur in cruise mode.

Table B1-138. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2015

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.05	1.46	0.04	0.16	0.16	332.68	0.05	0.00	334.71
NAAQS Marginal O3	0.00	0.04	0.97	0.03	0.11	0.11	221.78	0.03	0.00	223.14
NAAQS Serious PM10	0.00	0.09	2.43	0.07	0.27	0.27	554.46	0.08	0.01	557.85
CAAQS O3	0.00	0.09	2.43	0.07	0.27	0.27	554.46	0.08	0.01	557.85
CAAQS PM10	0.00	0.09	2.43	0.07	0.27	0.27	554.46	0.08	0.01	557.85
IR 218										
NAAQS Severe O3	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
CAAQS O3	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
CAAQS PM10	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
VR 1266										
NAAQS Severe O3	0.00	0.02	0.59	0.02	0.07	0.07	134.65	0.02	0.00	135.47
NAAQS Marginal O3	0.00	0.00	0.10	0.00	0.01	0.01	23.76	0.00	0.00	23.91
NAAQS Serious PM10	0.00	0.03	0.70	0.02	0.08	0.08	158.41	0.02	0.00	159.38
CAAQS O3	0.00	0.03	0.70	0.02	0.08	0.08	158.41	0.02	0.00	159.38
CAAQS PM10	0.00	0.03	0.70	0.02	0.08	0.08	158.41	0.02	0.00	159.38
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.02	0.47	0.01	0.05	0.05	107.99	0.02	0.00	108.65
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.47	0.01	0.05	0.05	107.99	0.02	0.00	108.65
CAAQS PM10	0.00	0.02	0.47	0.01	0.05	0.05	107.99	0.02	0.00	108.65
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
CAAQS PM10	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88

Notes: (1) All activities occur in cruise mode.

Table B1-139. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2016

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.05	1.46	0.04	0.16	0.16	332.68	0.05	0.00	334.71
NAAQS Marginal O3	0.00	0.04	0.97	0.03	0.11	0.11	221.78	0.03	0.00	223.14
NAAQS Serious PM10	0.00	0.09	2.43	0.07	0.27	0.27	554.46	0.08	0.01	557.85
CAAQS O3	0.00	0.09	2.43	0.07	0.27	0.27	554.46	0.08	0.01	557.85
CAAQS PM10	0.00	0.09	2.43	0.07	0.27	0.27	554.46	0.08	0.01	557.85
IR 218										
NAAQS Severe O3	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
CAAQS O3	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
CAAQS PM10	0.00	0.04	1.07	0.03	0.12	0.12	242.59	0.03	0.00	244.07
VR 1266										
NAAQS Severe O3	0.00	0.02	0.59	0.02	0.07	0.07	134.65	0.02	0.00	135.47
NAAQS Marginal O3	0.00	0.00	0.10	0.00	0.01	0.01	23.76	0.00	0.00	23.91
NAAQS Serious PM10	0.00	0.03	0.70	0.02	0.08	0.08	158.41	0.02	0.00	159.38
CAAQS O3	0.00	0.03	0.70	0.02	0.08	0.08	158.41	0.02	0.00	159.38
CAAQS PM10	0.00	0.03	0.70	0.02	0.08	0.08	158.41	0.02	0.00	159.38
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.02	0.47	0.01	0.05	0.05	107.99	0.02	0.00	108.65
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.47	0.01	0.05	0.05	107.99	0.02	0.00	108.65
CAAQS PM10	0.00	0.02	0.47	0.01	0.05	0.05	107.99	0.02	0.00	108.65
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
CAAQS PM10	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88

Notes: (1) All activities occur in cruise mode.

Table B1-140. MV-22 Aircraft Military Training Route Emissions the Salton Sea Air Basin - Fiscal Year 2017

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.07	1.77	0.05	0.20	0.20	403.96	0.06	0.00	406.44
NAAQS Marginal O3	0.00	0.04	1.18	0.03	0.13	0.13	269.31	0.04	0.00	270.96
NAAQS Serious PM10	0.00	0.11	2.96	0.08	0.33	0.33	673.27	0.09	0.01	677.39
CAAQS O3	0.00	0.11	2.96	0.08	0.33	0.33	673.27	0.09	0.01	677.39
CAAQS PM10	0.00	0.11	2.96	0.08	0.33	0.33	673.27	0.09	0.01	677.39
IR 218										
NAAQS Severe O3	0.00	0.05	1.29	0.04	0.15	0.15	294.57	0.04	0.00	296.37
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	0.00	0.05	1.29	0.04	0.15	0.15	294.57	0.04	0.00	296.37
CAAQS O3	0.00	0.05	1.29	0.04	0.15	0.15	294.57	0.04	0.00	296.37
CAAQS PM10	0.00	0.05	1.29	0.04	0.15	0.15	294.57	0.04	0.00	296.37
VR 1266										
NAAQS Severe O3	0.00	0.03	0.72	0.02	0.08	0.08	163.50	0.02	0.00	164.50
NAAQS Marginal O3	0.00	0.00	0.13	0.00	0.01	0.01	28.85	0.00	0.00	29.03
NAAQS Serious PM10	0.00	0.03	0.84	0.02	0.09	0.09	192.35	0.03	0.00	193.53
CAAQS O3	0.00	0.03	0.84	0.02	0.09	0.09	192.35	0.03	0.00	193.53
CAAQS PM10	0.00	0.03	0.84	0.02	0.09	0.09	192.35	0.03	0.00	193.53
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.02	0.58	0.02	0.06	0.06	131.13	0.02	0.00	131.93
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.58	0.02	0.06	0.06	131.13	0.02	0.00	131.93
CAAQS PM10	0.00	0.02	0.58	0.02	0.06	0.06	131.13	0.02	0.00	131.93
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	-	-	-	-	-	-	-	-	-	-
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Marginal O3	0.00	0.02	0.55	0.02	0.06	0.06	125.37	0.02	0.00	126.14
NAAQS Serious PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.55	0.02	0.06	0.06	125.37	0.02	0.00	126.14
CAAQS PM10	0.00	0.02	0.55	0.02	0.06	0.06	125.37	0.02	0.00	126.14

Notes: (1) All activities occur in cruise mode.

Table B1-141. Annual MV-22 Military Training Route Emissions within the Salton Sea Air Basin Nonattainment Areas

	Tons per Year									
Year/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
2011										
NAAQS Severe O3	0.00	0.07	1.78	0.05	0.20	0.20	405.66	0.06	0.00	408.14
NAAQS Marginal O3	0.00	0.04	1.15	0.03	0.13	0.13	261.02	0.04	0.00	262.61
NAAQS Serious PM10	0.00	0.09	2.40	0.07	0.27	0.27	545.97	0.08	0.01	549.31
CAAQS O3	0.00	0.11	2.93	0.08	0.33	0.33	666.68	0.09	0.01	670.76
CAAQS PM10	0.00	0.11	2.93	0.08	0.33	0.33	666.68	0.09	0.01	670.76
2012										
NAAQS Severe O3	0.00	0.08	2.23	0.06	0.25	0.25	507.08	0.07	0.00	510.18
NAAQS Marginal O3	0.00	0.05	1.43	0.04	0.16	0.16	326.27	0.05	0.00	328.27
NAAQS Serious PM10	0.00	0.11	3.00	0.09	0.34	0.34	682.47	0.10	0.01	686.64
CAAQS O3	0.00	0.14	3.66	0.10	0.41	0.41	833.35	0.12	0.01	838.45
CAAQS PM10	0.00	0.13	3.59	0.10	0.40	0.40	818.60	0.11	0.01	823.61
2013										
NAAQS Severe O3	0.00	0.07	1.78	0.05	0.20	0.20	405.66	0.06	0.00	408.14
NAAQS Marginal O3	0.00	0.04	1.15	0.03	0.13	0.13	261.02	0.04	0.00	262.61
NAAQS Serious PM10	0.00	0.09	2.40	0.07	0.27	0.27	545.97	0.08	0.01	549.31
CAAQS O3	0.00	0.11	2.93	0.08	0.33	0.33	666.68	0.09	0.01	670.76
CAAQS PM10	0.00	0.11	2.93	0.08	0.33	0.33	666.68	0.09	0.01	670.76
2014										
NAAQS Severe O3	0.00	0.08	2.23	0.06	0.25	0.25	507.08	0.07	0.00	510.18
NAAQS Marginal O3	0.00	0.05	1.43	0.04	0.16	0.16	326.27	0.05	0.00	328.27
NAAQS Serious PM10	0.00	0.11	3.00	0.09	0.34	0.34	682.47	0.10	0.01	686.64
CAAQS O3	0.00	0.14	3.66	0.10	0.41	0.41	833.35	0.12	0.01	838.45
CAAQS PM10	0.00	0.14	3.66	0.10	0.41	0.41	833.35	0.12	0.01	838.45
2015										
NAAQS Severe O3	0.00	0.12	3.12	0.09	0.35	0.35	709.91	0.10	0.01	714.25
NAAQS Marginal O3	0.00	0.07	2.01	0.06	0.22	0.22	456.78	0.06	0.00	459.57
NAAQS Serious PM10	0.00	0.15	4.20	0.12	0.47	0.47	955.45	0.13	0.01	961.30
CAAQS O3	0.00	0.19	5.12	0.15	0.57	0.57	1,166.68	0.16	0.01	1,173.83
CAAQS PM10	0.00	0.19	5.12	0.15	0.57	0.57	1,166.68	0.16	0.01	1,173.83
2016										
NAAQS Severe O3	0.00	0.12	3.12	0.09	0.35	0.35	709.91	0.10	0.01	714.25
NAAQS Marginal O3	0.00	0.07	2.01	0.06	0.22	0.22	456.78	0.06	0.00	459.57
NAAQS Serious PM10	0.00	0.15	4.20	0.12	0.47	0.47	955.45	0.13	0.01	961.30
CAAQS O3	0.00	0.19	5.12	0.15	0.57	0.57	1,166.68	0.16	0.01	1,173.83
CAAQS PM10	0.00	0.19	5.12	0.15	0.57	0.57	1,166.68	0.16	0.01	1,173.83
2017										
NAAQS Severe O3	0.00	0.14	3.78	0.11	0.42	0.42	862.03	0.12	0.01	867.31
NAAQS Marginal O3	0.00	0.09	2.44	0.07	0.27	0.27	554.66	0.08	0.01	558.05
NAAQS Serious PM10	0.00	0.19	5.09	0.14	0.57	0.57	1,160.19	0.16	0.01	1,167.29
CAAQS O3	0.00	0.23	6.22	0.18	0.70	0.70	1,416.69	0.20	0.01	1,425.36
CAAQS PM10	0.00	0.23	6.22	0.18	0.70	0.70	1,416.69	0.20	0.01	1,425.36

Notes: (1) All activities occur in cruise mode.

Table B1-142. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2010

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.00	0.06	0.00	0.01	0.01	13.77	0.00	0.00	13.85
CAAQS O3	0.00	0.01	0.18	0.01	0.02	0.02	41.72	0.01	0.00	41.98
CAAQS PM10	0.00	0.01	0.18	0.01	0.02	0.02	41.72	0.01	0.00	41.98
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.05	1.35	0.04	0.15	0.15	307.72	0.04	0.00	309.61
NAAQS Moderate PM10	0.00	0.11	3.07	0.09	0.34	0.34	698.62	0.10	0.01	702.89
CAAQS O3	0.00	0.13	3.65	0.10	0.41	0.41	831.69	0.12	0.01	836.78
CAAQS PM10	0.00	0.13	3.65	0.10	0.41	0.41	831.69	0.12	0.01	836.78
CAAQS PM2.5	0.00	0.04	0.99	0.03	0.11	0.11	224.56	0.03	0.00	225.93
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.06	1.70	0.05	0.19	0.19	386.16	0.05	0.00	388.52
CAAQS PM10	0.00	0.06	1.70	0.05	0.19	0.19	386.16	0.05	0.00	388.52
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.00	0.06	0.00	0.01	0.01	13.83	0.00	0.00	13.91
CAAQS PM10	0.00	0.00	0.06	0.00	0.01	0.01	13.83	0.00	0.00	13.91
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.18	0.01	0.02	0.02	41.14	0.01	0.00	41.39
CAAQS PM10	0.00	0.01	0.18	0.01	0.02	0.02	41.14	0.01	0.00	41.39
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.18	0.01	0.02	0.02	41.30	0.01	0.00	41.55
CAAQS PM10	0.00	0.01	0.18	0.01	0.02	0.02	41.30	0.01	0.00	41.55
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-143. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2011

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.00	0.12	0.00	0.01	0.01	27.54	0.00	0.00	27.70
CAAQS O3	0.00	0.01	0.37	0.01	0.04	0.04	83.44	0.01	0.00	83.95
CAAQS PM10	0.00	0.01	0.37	0.01	0.04	0.04	83.44	0.01	0.00	83.95
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.10	2.70	0.08	0.30	0.30	615.45	0.09	0.01	619.22
NAAQS Moderate PM10	0.00	0.23	6.13	0.17	0.69	0.69	1,397.24	0.20	0.01	1,405.79
CAAQS O3	0.01	0.27	7.30	0.21	0.82	0.82	1,663.38	0.23	0.02	1,673.56
CAAQS PM10	0.01	0.27	7.30	0.21	0.82	0.82	1,663.38	0.23	0.02	1,673.56
CAAQS PM2.5	0.00	0.07	1.97	0.06	0.22	0.22	449.11	0.06	0.00	451.86
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.13	3.39	0.10	0.38	0.38	772.31	0.11	0.01	777.04
CAAQS PM10	0.00	0.13	3.39	0.10	0.38	0.38	772.31	0.11	0.01	777.04
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.00	0.12	0.00	0.01	0.01	27.66	0.00	0.00	27.83
CAAQS PM10	0.00	0.00	0.12	0.00	0.01	0.01	27.66	0.00	0.00	27.83
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.36	0.01	0.04	0.04	82.28	0.01	0.00	82.78
CAAQS PM10	0.00	0.01	0.36	0.01	0.04	0.04	82.28	0.01	0.00	82.78
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.36	0.01	0.04	0.04	82.60	0.01	0.00	83.10
CAAQS PM10	0.00	0.01	0.36	0.01	0.04	0.04	82.60	0.01	0.00	83.10
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-144. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2012

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.01	0.15	0.00	0.02	0.02	34.42	0.00	0.00	34.63
CAAQS O3	0.00	0.02	0.46	0.01	0.05	0.05	104.30	0.01	0.00	104.94
CAAQS PM10	0.00	0.02	0.46	0.01	0.05	0.05	104.30	0.01	0.00	104.94
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.12	3.38	0.10	0.38	0.38	769.31	0.11	0.01	774.02
NAAQS Moderate PM10	0.01	0.28	7.67	0.22	0.86	0.86	1,746.54	0.24	0.02	1,757.24
CAAQS O3	0.01	0.34	9.13	0.26	1.02	1.02	2,079.22	0.29	0.02	2,091.95
CAAQS PM10	0.01	0.34	9.13	0.26	1.02	1.02	2,079.22	0.29	0.02	2,091.95
CAAQS PM2.5	0.00	0.09	2.46	0.07	0.28	0.28	561.39	0.08	0.01	564.83
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.16	4.24	0.12	0.48	0.48	965.39	0.14	0.01	971.30
CAAQS PM10	0.00	0.16	4.24	0.12	0.48	0.48	965.39	0.14	0.01	971.30
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.15	0.00	0.02	0.02	34.57	0.00	0.00	34.78
CAAQS PM10	0.00	0.01	0.15	0.00	0.02	0.02	34.57	0.00	0.00	34.78
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.45	0.01	0.05	0.05	102.84	0.01	0.00	103.47
CAAQS PM10	0.00	0.02	0.45	0.01	0.05	0.05	102.84	0.01	0.00	103.47
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
CAAQS PM10	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-145. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2013

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.00	0.12	0.00	0.01	0.01	27.54	0.00	0.00	27.70
CAAQS O3	0.00	0.01	0.37	0.01	0.04	0.04	83.44	0.01	0.00	83.95
CAAQS PM10	0.00	0.01	0.37	0.01	0.04	0.04	83.44	0.01	0.00	83.95
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.10	2.70	0.08	0.30	0.30	615.45	0.09	0.01	619.22
NAAQS Moderate PM10	0.00	0.23	6.13	0.17	0.69	0.69	1,397.24	0.20	0.01	1,405.79
CAAQS O3	0.01	0.27	7.30	0.21	0.82	0.82	1,663.38	0.23	0.02	1,673.56
CAAQS PM10	0.01	0.27	7.30	0.21	0.82	0.82	1,663.38	0.23	0.02	1,673.56
CAAQS PM2.5	0.00	0.07	1.97	0.06	0.22	0.22	449.11	0.06	0.00	451.86
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.13	3.39	0.10	0.38	0.38	772.31	0.11	0.01	777.04
CAAQS PM10	0.00	0.13	3.39	0.10	0.38	0.38	772.31	0.11	0.01	777.04
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.00	0.12	0.00	0.01	0.01	27.66	0.00	0.00	27.83
CAAQS PM10	0.00	0.00	0.12	0.00	0.01	0.01	27.66	0.00	0.00	27.83
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.36	0.01	0.04	0.04	82.28	0.01	0.00	82.78
CAAQS PM10	0.00	0.01	0.36	0.01	0.04	0.04	82.28	0.01	0.00	82.78
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.36	0.01	0.04	0.04	82.60	0.01	0.00	83.10
CAAQS PM10	0.00	0.01	0.36	0.01	0.04	0.04	82.60	0.01	0.00	83.10
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-146. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2014

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.01	0.15	0.00	0.02	0.02	34.42	0.00	0.00	34.63
CAAQS O3	0.00	0.02	0.46	0.01	0.05	0.05	104.30	0.01	0.00	104.94
CAAQS PM10	0.00	0.02	0.46	0.01	0.05	0.05	104.30	0.01	0.00	104.94
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.12	3.38	0.10	0.38	0.38	769.31	0.11	0.01	774.02
NAAQS Moderate PM10	0.01	0.28	7.67	0.22	0.86	0.86	1,746.54	0.24	0.02	1,757.24
CAAQS O3	0.01	0.34	9.13	0.26	1.02	1.02	2,079.22	0.29	0.02	2,091.95
CAAQS PM10	0.01	0.34	9.13	0.26	1.02	1.02	2,079.22	0.29	0.02	2,091.95
CAAQS PM2.5	0.00	0.09	2.46	0.07	0.28	0.28	561.39	0.08	0.01	564.83
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.16	4.24	0.12	0.48	0.48	965.39	0.14	0.01	971.30
CAAQS PM10	0.00	0.16	4.24	0.12	0.48	0.48	965.39	0.14	0.01	971.30
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.15	0.00	0.02	0.02	34.57	0.00	0.00	34.78
CAAQS PM10	0.00	0.01	0.15	0.00	0.02	0.02	34.57	0.00	0.00	34.78
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.45	0.01	0.05	0.05	102.84	0.01	0.00	103.47
CAAQS PM10	0.00	0.02	0.45	0.01	0.05	0.05	102.84	0.01	0.00	103.47
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
CAAQS PM10	0.00	0.02	0.45	0.01	0.05	0.05	103.25	0.01	0.00	103.88
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-147. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2015

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.01	0.21	0.01	0.02	0.02	48.19	0.01	0.00	48.48
CAAQS O3	0.00	0.02	0.64	0.02	0.07	0.07	146.03	0.02	0.00	146.92
CAAQS PM10	0.00	0.02	0.64	0.02	0.07	0.07	146.03	0.02	0.00	146.92
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.17	4.73	0.13	0.53	0.53	1,077.04	0.15	0.01	1,083.63
NAAQS Moderate PM10	0.01	0.40	10.74	0.30	1.20	1.20	2,445.16	0.34	0.02	2,460.13
CAAQS O3	0.01	0.47	12.78	0.36	1.43	1.43	2,910.91	0.41	0.03	2,928.73
CAAQS PM10	0.01	0.47	12.78	0.36	1.43	1.43	2,910.91	0.41	0.03	2,928.73
CAAQS PM2.5	0.00	0.13	3.45	0.10	0.39	0.39	785.95	0.11	0.01	790.76
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.22	5.93	0.17	0.67	0.67	1,351.55	0.19	0.01	1,359.82
CAAQS PM10	0.00	0.22	5.93	0.17	0.67	0.67	1,351.55	0.19	0.01	1,359.82
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.21	0.01	0.02	0.02	48.40	0.01	0.00	48.70
CAAQS PM10	0.00	0.01	0.21	0.01	0.02	0.02	48.40	0.01	0.00	48.70
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.63	0.02	0.07	0.07	143.98	0.02	0.00	144.86
CAAQS PM10	0.00	0.02	0.63	0.02	0.07	0.07	143.98	0.02	0.00	144.86
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.63	0.02	0.07	0.07	144.54	0.02	0.00	145.43
CAAQS PM10	0.00	0.02	0.63	0.02	0.07	0.07	144.54	0.02	0.00	145.43
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-148. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2016

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.01	0.21	0.01	0.02	0.02	48.19	0.01	0.00	48.48
CAAQS O3	0.00	0.02	0.64	0.02	0.07	0.07	146.03	0.02	0.00	146.92
CAAQS PM10	0.00	0.02	0.64	0.02	0.07	0.07	146.03	0.02	0.00	146.92
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.17	4.73	0.13	0.53	0.53	1,077.04	0.15	0.01	1,083.63
NAAQS Moderate PM10	0.01	0.40	10.74	0.30	1.20	1.20	2,445.16	0.34	0.02	2,460.13
CAAQS O3	0.01	0.47	12.78	0.36	1.43	1.43	2,910.91	0.41	0.03	2,928.73
CAAQS PM10	0.01	0.47	12.78	0.36	1.43	1.43	2,910.91	0.41	0.03	2,928.73
CAAQS PM2.5	0.00	0.13	3.45	0.10	0.39	0.39	785.95	0.11	0.01	790.76
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.22	5.93	0.17	0.67	0.67	1,351.55	0.19	0.01	1,359.82
CAAQS PM10	0.00	0.22	5.93	0.17	0.67	0.67	1,351.55	0.19	0.01	1,359.82
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.21	0.01	0.02	0.02	48.40	0.01	0.00	48.70
CAAQS PM10	0.00	0.01	0.21	0.01	0.02	0.02	48.40	0.01	0.00	48.70
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.63	0.02	0.07	0.07	143.98	0.02	0.00	144.86
CAAQS PM10	0.00	0.02	0.63	0.02	0.07	0.07	143.98	0.02	0.00	144.86
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.02	0.63	0.02	0.07	0.07	144.54	0.02	0.00	145.43
CAAQS PM10	0.00	0.02	0.63	0.02	0.07	0.07	144.54	0.02	0.00	145.43
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-149. MV-22 Aircraft Military Training Route Emissions the Mojave DesertAir Basin - Fiscal Year 2017

	Tons per Year									
MTR/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
IR 216										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	0.00	0.01	0.26	0.01	0.03	0.03	58.51	0.01	0.00	58.87
CAAQS O3	0.00	0.03	0.78	0.02	0.09	0.09	177.32	0.02	0.00	178.40
CAAQS PM10	0.00	0.03	0.78	0.02	0.09	0.09	177.32	0.02	0.00	178.40
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
IR 217										
NAAQS Severe O3	0.00	0.21	5.74	0.16	0.64	0.64	1,307.83	0.18	0.01	1,315.83
NAAQS Moderate PM10	0.01	0.48	13.04	0.37	1.46	1.46	2,969.13	0.42	0.03	2,987.30
CAAQS O3	0.01	0.57	15.52	0.44	1.74	1.74	3,534.67	0.49	0.03	3,556.31
CAAQS PM10	0.01	0.57	15.52	0.44	1.74	1.74	3,534.67	0.49	0.03	3,556.31
CAAQS PM2.5	0.00	0.15	4.19	0.12	0.47	0.47	954.36	0.13	0.01	960.20
IR 218										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.01	0.27	7.21	0.20	0.81	0.81	1,641.16	0.23	0.02	1,651.21
CAAQS PM10	0.01	0.27	7.21	0.20	0.81	0.81	1,641.16	0.23	0.02	1,651.21
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1266										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.01	0.26	0.01	0.03	0.03	58.77	0.01	0.00	59.13
CAAQS PM10	0.00	0.01	0.26	0.01	0.03	0.03	58.77	0.01	0.00	59.13
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.03	0.77	0.02	0.09	0.09	174.84	0.02	0.00	175.91
CAAQS PM10	0.00	0.03	0.77	0.02	0.09	0.09	174.84	0.02	0.00	175.91
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1267A										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	-	-	-	-	-	-	-	-	-	-
CAAQS PM10	-	-	-	-	-	-	-	-	-	-
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-
VR 1268										
NAAQS Severe O3	-	-	-	-	-	-	-	-	-	-
NAAQS Moderate PM10	-	-	-	-	-	-	-	-	-	-
CAAQS O3	0.00	0.03	0.77	0.02	0.09	0.09	175.52	0.02	0.00	176.59
CAAQS PM10	0.00	0.03	0.77	0.02	0.09	0.09	175.52	0.02	0.00	176.59
CAAQS PM2.5	-	-	-	-	-	-	-	-	-	-

Notes: (1) All activities occur in cruise mode.

Table B1-150. Annual MV-22 Military Training Route Emissions within the Mojave Desert Air Basin Nonattainment Areas

	Tons per Year									
Year/Nonattainment Area	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
2011										
NAAQS Severe O3	0.00	0.10	2.70	0.08	0.30	0.30	615.45	0.09	0.01	619.22
NAAQS Moderate PM10	0.00	0.23	6.26	0.18	0.70	0.70	1,424.77	0.20	0.01	1,433.49
CAAQS O3	0.01	0.44	11.91	0.34	1.34	1.34	2,711.66	0.38	0.03	2,728.26
CAAQS PM10	0.01	0.44	11.91	0.34	1.34	1.34	2,711.66	0.38	0.03	2,728.26
CAAQS PM2.5	0.00	0.07	1.97	0.06	0.22	0.22	449.11	0.06	0.00	451.86
2012										
NAAQS Severe O3	0.00	0.12	3.38	0.10	0.38	0.38	769.31	0.11	0.01	774.02
NAAQS Moderate PM10	0.01	0.29	7.82	0.22	0.88	0.88	1,780.97	0.25	0.02	1,791.87
CAAQS O3	0.01	0.55	14.88	0.42	1.67	1.67	3,389.58	0.47	0.03	3,410.33
CAAQS PM10	0.01	0.55	14.88	0.42	1.67	1.67	3,389.58	0.47	0.03	3,410.33
CAAQS PM2.5	0.00	0.09	2.46	0.07	0.28	0.28	561.39	0.08	0.01	564.83
2013										
NAAQS Severe O3	0.00	0.10	2.70	0.08	0.30	0.30	615.45	0.09	0.01	619.22
NAAQS Moderate PM10	0.00	0.23	6.26	0.18	0.70	0.70	1,424.77	0.20	0.01	1,433.49
CAAQS O3	0.01	0.44	11.91	0.34	1.34	1.34	2,711.66	0.38	0.03	2,728.26
CAAQS PM10	0.01	0.44	11.91	0.34	1.34	1.34	2,711.66	0.38	0.03	2,728.26
CAAQS PM2.5	0.00	0.07	1.97	0.06	0.22	0.22	449.11	0.06	0.00	451.86
2014										
NAAQS Severe O3	0.00	0.12	3.38	0.10	0.38	0.38	769.31	0.11	0.01	774.02
NAAQS Moderate PM10	0.01	0.29	7.82	0.22	0.88	0.88	1,780.97	0.25	0.02	1,791.87
CAAQS O3	0.01	0.55	14.88	0.42	1.67	1.67	3,389.58	0.47	0.03	3,410.33
CAAQS PM10	0.01	0.55	14.88	0.42	1.67	1.67	3,389.58	0.47	0.03	3,410.33
CAAQS PM2.5	0.00	0.09	2.46	0.07	0.28	0.28	561.39	0.08	0.01	564.83
2015										
NAAQS Severe O3	0.00	0.17	4.73	0.13	0.53	0.53	1,077.04	0.15	0.01	1,083.63
NAAQS Moderate PM10	0.01	0.40	10.95	0.31	1.23	1.23	2,493.35	0.35	0.02	2,508.61
CAAQS O3	0.01	0.77	20.84	0.59	2.34	2.34	4,745.41	0.66	0.05	4,774.46
CAAQS PM10	0.01	0.77	20.84	0.59	2.34	2.34	4,745.41	0.66	0.05	4,774.46
CAAQS PM2.5	0.00	0.13	3.45	0.10	0.39	0.39	785.95	0.11	0.01	790.76
2016										
NAAQS Severe O3	0.00	0.17	4.73	0.13	0.53	0.53	1,077.04	0.15	0.01	1,083.63
NAAQS Moderate PM10	0.01	0.40	10.95	0.31	1.23	1.23	2,493.35	0.35	0.02	2,508.61
CAAQS O3	0.01	0.77	20.84	0.59	2.34	2.34	4,745.41	0.66	0.05	4,774.46
CAAQS PM10	0.01	0.77	20.84	0.59	2.34	2.34	4,745.41	0.66	0.05	4,774.46
CAAQS PM2.5	0.00	0.13	3.45	0.10	0.39	0.39	785.95	0.11	0.01	790.76
2017										
NAAQS Severe O3	0.00	0.21	5.74	0.16	0.64	0.64	1,307.83	0.18	0.01	1,315.83
NAAQS Moderate PM10	0.01	0.49	13.29	0.38	1.49	1.49	3,027.64	0.42	0.03	3,046.17
CAAQS O3	0.02	0.93	25.30	0.72	2.84	2.84	5,762.28	0.81	0.06	5,797.55
CAAQS PM10	0.02	0.93	25.30	0.72	2.84	2.84	5,762.28	0.81	0.06	5,797.55
CAAQS PM2.5	0.00	0.15	4.19	0.12	0.47	0.47	954.36	0.13	0.01	960.20

Table B1-151. MV-22 Aircraft Emissions within Military Training Routes - Arizona

	Tons per Year									
Year/MTR	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
2010										
VR 218	0.00	0.09	2.35	0.07	0.26	0.26	534.68	0.07	0.01	537.95
VR 1267	0.00	0.02	0.44	0.01	0.05	0.05	99.42	0.01	0.00	100.03
VR 1267A	0.00	0.01	0.35	0.01	0.04	0.04	80.11	0.01	0.00	80.60
VR 1268	0.00	0.04	0.98	0.03	0.11	0.11	224.19	0.03	0.00	225.56
Subtotal	0.00	0.15	4.12	0.12	0.46	0.46	938.40	0.13	0.01	944.14
2011										
VR 218	0.00	0.17	4.70	0.13	0.53	0.53	1,069.36	0.15	0.01	1,075.90
VR 1267	0.00	0.03	0.87	0.02	0.10	0.10	198.83	0.03	0.00	200.05
VR 1267A	0.00	0.03	0.70	0.02	0.08	0.08	160.22	0.02	0.00	161.20
VR 1268	0.00	0.07	1.97	0.06	0.22	0.22	448.38	0.06	0.00	451.12
Subtotal	0.01	0.30	8.24	0.23	0.92	0.92	1,876.79	0.26	0.02	1,888.28
2012										
VR 218	0.00	0.22	5.87	0.17	0.66	0.66	1,336.70	0.19	0.01	1,344.88
VR 1267	0.00	0.04	1.09	0.03	0.12	0.12	248.54	0.03	0.00	250.06
VR 1267A	0.00	0.03	0.88	0.02	0.10	0.10	200.28	0.03	0.00	201.51
VR 1268	0.00	0.09	2.46	0.07	0.28	0.28	560.48	0.08	0.01	563.91
Subtotal	0.01	0.38	10.30	0.29	1.16	1.16	2,345.99	0.33	0.02	2,360.35
2013										
VR 218	0.00	0.17	4.70	0.13	0.53	0.53	1,069.36	0.15	0.01	1,075.90
VR 1267	0.00	0.03	0.87	0.02	0.10	0.10	198.83	0.03	0.00	200.05
VR 1267A	0.00	0.03	0.70	0.02	0.08	0.08	160.22	0.02	0.00	161.20
VR 1268	0.00	0.07	1.97	0.06	0.22	0.22	448.38	0.06	0.00	451.12
Subtotal	0.01	0.30	8.24	0.23	0.92	0.92	1,876.79	0.26	0.02	1,888.28
2014										
VR 218	0.00	0.22	5.87	0.17	0.66	0.66	1,336.70	0.19	0.01	1,344.88
VR 1267	0.00	0.04	1.09	0.03	0.12	0.12	248.54	0.03	0.00	250.06
VR 1267A	0.00	0.03	0.88	0.02	0.10	0.10	200.28	0.03	0.00	201.51
VR 1268	0.00	0.09	2.46	0.07	0.28	0.28	560.48	0.08	0.01	563.91
Subtotal	0.01	0.38	10.30	0.29	1.16	1.16	2,345.99	0.33	0.02	2,360.35
2015										
VR 218	0.01	0.30	8.22	0.23	0.92	0.92	1,871.37	0.26	0.02	1,882.83
VR 1267	0.00	0.06	1.53	0.04	0.17	0.17	347.96	0.05	0.00	350.09
VR 1267A	0.00	0.05	1.23	0.03	0.14	0.14	280.39	0.04	0.00	282.11
VR 1268	0.00	0.13	3.45	0.10	0.39	0.39	784.67	0.11	0.01	789.47
Subtotal	0.01	0.53	14.42	0.41	1.62	1.62	3,284.39	0.46	0.03	3,304.49
2016										
VR 218	0.01	0.30	8.22	0.23	0.92	0.92	1,871.37	0.26	0.02	1,882.83
VR 1267	0.00	0.06	1.53	0.04	0.17	0.17	347.96	0.05	0.00	350.09
VR 1267A	0.00	0.05	1.23	0.03	0.14	0.14	280.39	0.04	0.00	282.11
VR 1268	0.00	0.13	3.45	0.10	0.39	0.39	784.67	0.11	0.01	789.47
Subtotal	0.01	0.53	14.42	0.41	1.62	1.62	3,284.39	0.46	0.03	3,304.49
2017										
VR 218	0.01	0.37	9.98	0.28	1.12	1.12	2,272.38	0.32	0.02	2,286.29
VR 1267	0.00	0.07	1.86	0.05	0.21	0.21	422.52	0.06	0.00	425.11
VR 1267A	0.00	0.06	1.49	0.04	0.17	0.17	340.48	0.05	0.00	342.56
VR 1268	0.00	0.15	4.18	0.12	0.47	0.47	952.81	0.13	0.01	958.64
Subtotal	0.01	0.65	17.51	0.50	1.96	1.96	3,988.19	0.56	0.04	4,012.60

Notes: (1) All activities occur in cruise mode.

Table B1-152. Summary of Existing Operational Emissions from Facilities Affected by the MV-22 Project Alternatives - Calendar Year 2000

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MCAS Miramar - Existing Emissions						
CH-46E Aircraft	41.00	161.00	19.00	2.66	24.13	24.13
Personal-Owned Vehicles	8.42	64.17	6.10	0.04	0.22	0.22
Government-Owned Vehicles	0.85	5.73	2.07	0.01	0.07	0.07
Ground/Tactical Support Equipment	8.20	80.78	7.02	0.04	0.77	0.76
Construction	0.12	1.22	0.49	0.00	0.05	0.05
Other Sources	0.61	2.93	0.61	0.04	0.34	0.10
Stationary Sources (1)	3.00	2.50	9.20	0.42	10.49	6.71
Total Existing Emissions - MCAS Miramar	62.20	318.33	44.50	3.21	36.08	32.04
MCAS Pendleton - Existing Emissions						
CH-46E Aircraft	44.00	171.00	20.00	2.80	25.40	25.40
Personal-Owned Vehicles	5.00	37.00	4.00	0.02	0.14	0.14
Government-Owned Vehicles	1.00	4.00	1.00	0.01	0.04	0.04
Ground/Tactical Support Equipment	7.00	69.00	6.00	0.03	0.66	0.65
Construction	1.00	3.00	5.00	0.03	0.55	0.54
Other Sources	-	-	1.00	0.07	0.56	0.16
Stationary Sources (1)	0.70	3.90	4.90	0.23	5.59	3.58
Total Existing Emissions - MCAS Pendleton	58.70	287.90	41.90	3.18	32.94	30.49
29 Palms EAF Existing Emissions						
CH-46E Aircraft	1.26	3.96	0.20	0.03	0.25	0.25
Total Existing Emissions - 29 Palms EAF	1.26	3.96	0.20	0.03	0.25	0.25
MCAS Yuma Existing Emissions						
CH-46E Aircraft	4.76	14.96	0.75	0.10	0.95	0.95
Total Existing Emissions - MCAS Yuma	4.76	14.96	0.75	0.10	0.95	0.95
MCB Pendleton Ranges Existing Emissions						
CH-46E Aircraft	7.67	41.49	8.38	0.85	3.81	3.81
Total Existing Emissions - MCB Pendleton Ranges	7.67	41.49	8.38	0.85	3.81	3.81
29 Palms Air Spaces - Existing Emissions						
CH-46E Aircraft	2.38	13.36	2.71	0.28	1.25	1.24
Total Existing Emissions - 29 Palms Air Spaces	2.38	13.36	2.71	0.28	1.25	1.24
Chocolate Mt. AG Range Existing Emissions						
CH-46E Aircraft	1.26	7.24	1.45	0.15	0.66	0.66
Total Existing Emissions - Chocolate Mt. AG Range	1.26	7.24	1.45	0.15	0.66	0.66
BMG Range Existing Emissions						
CH-46E Aircraft	4.59	26.41	5.28	0.54	2.39	2.39
Total Existing Emissions - BMG Range	4.59	26.41	5.28	0.54	2.39	2.39
R-2510/2512 Existing Emissions						
CH-46E Aircraft	0.02	0.10	0.02	0.00	0.01	0.01
Total Existing Emissions - R-2510/2512	0.02	0.10	0.02	0.00	0.01	0.01
Total Existing Emissions	142.84	713.77	105.18	8.33	78.33	71.83

Table B1-153. Summary of Operational Emissions from the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MCAS Miramar Proposed Emissions						
MV-22 Operations	0.89	58.71	134.62	6.65	22.91	22.91
MV-22 Engine Maintenance/Testing	0.23	15.10	26.81	1.33	4.45	4.45
Personal-Owned Vehicles	5.59	40.59	5.19	0.03	0.37	0.36
Government-Owned Vehicles	0.57	3.63	1.76	0.01	0.12	0.12
Ground/Tactical Support Equipment	20.49	201.95	17.56	0.09	1.93	1.89
Construction	0.23	2.32	0.93	0.00	0.10	0.10
Other Sources	1.16	5.56	1.16	0.08	0.65	0.18
Stationary Sources (1)	5.70	4.75	17.48	0.80	19.93	12.75
Total Proposed Emissions - MCAS Miramar	34.85	332.61	205.51	8.99	50.46	42.77
MCAS Pendleton Proposed Emissions						
MV-22 Operations	-	-	-	-	-	-
MV-22 Engine Maintenance/Testing	-	-	-	-	-	-
Personal-Owned Vehicles	-	-	-	-	-	-
Government-Owned Vehicles	-	-	-	-	-	-
Ground/Tactical Support Equipment	-	-	-	-	-	-
Construction	-	-	-	-	-	-
Other Sources	-	-	-	-	-	-
Stationary Sources (1)	-	-	-	-	-	-
Total Proposed Emissions - MCAS Pendleton	-	-	-	-	-	-
29 Palms EAF Proposed Emissions						
MV-22 Operations	0.05	3.41	7.96	0.39	1.35	1.35
Total Proposed Emissions - 29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
MCB Pendleton Ranges Proposed Emissions						
MV-22 Operations	0.08	3.70	101.59	2.87	11.32	11.32
Total Proposed Emissions - MCB Pendleton Ranges	0.08	3.70	101.59	2.87	11.32	11.32
29 Palms Air Spaces - Proposed Emissions						
MV-22 Operations	0.00	0.12	3.25	0.09	0.36	0.36
Total Proposed Emissions - 29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
Chocolate Mt. AG Range Proposed Emissions						
MV-22 Operations	0.08	3.89	107.07	3.02	11.92	11.92
Total Proposed Emissions - Chocolate Mt. AG Range	0.08	3.89	107.07	3.02	11.92	11.92
BMG Range Proposed Emissions						
MV-22 Operations	0.21	10.17	278.59	7.87	31.07	31.07
Total Proposed Emissions - BMG Range	0.21	10.17	278.59	7.87	31.07	31.07
R-2510/2512 Proposed Emissions						
MV-22 Operations	0.00	0.15	3.99	0.11	0.45	0.45
Total Proposed Emissions - R-2510/2512	0.00	0.15	3.99	0.11	0.45	0.45
MTRs						
MV-22 Operations	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions - MTRs	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions	35.31	355.90	758.24	24.77	112.56	104.87
Total Existing Emissions	142.84	713.77	105.18	8.33	78.33	71.83
Total Proposed - Existing Emissions	(107.52)	(357.87)	653.06	16.45	34.23	33.04

Table B1-154. Summary of Operational Emissions within the San Diego Air Basin from the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Miramar Existing Emissions	(62.20)	(318.33)	(44.50)	(3.21)	(36.08)	(32.04)
MCAS Pendleton Existing Emissions	(58.70)	(287.90)	(41.90)	(3.18)	(32.94)	(30.49)
MCB Pendleton Ranges Existing Emissions	(7.67)	(41.49)	(8.38)	(0.85)	(3.81)	(3.81)
Total Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)
Proposed Facility Emissions						
MCAS Miramar Proposed Emissions	34.85	332.61	205.51	8.99	50.46	42.77
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.08	3.70	101.59	2.87	11.32	11.32
VR-1266	0.00	0.05	1.24	0.04	0.14	0.14
Total Proposed Emissions	34.93	336.36	308.34	11.90	61.92	54.23
Total Proposed Emissions - SDAB	(93.64)	(311.37)	213.57	4.66	(10.90)	(12.11)
SDAB NEPA SignificanceThresholds	100	100	100	100	100	100

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-155. Summary of Operational Emissions within the Salton Sea Air Basin from the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range Existing	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
R-2510/2512 Existing	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Existing Emissions	(1.28)	(7.34)	(1.47)	(0.15)	(0.66)	(0.66)
Proposed Facility Emissions						
Chocolate Mt. AG Range Proposed	0.08	3.89	107.07	3.02	11.92	11.92
R-2510/2512 Proposed	0.00	0.15	3.99	0.11	0.45	0.45
MTRs	0.02	0.88	23.76	0.67	2.66	2.66
Total Proposed Emissions	0.10	4.91	134.82	3.81	15.03	15.03
Total Proposed Emissions - SSAB	(1.18)	(2.43)	133.35	3.66	14.36	14.36
SSAB NEPA SignificanceThresholds	25	100	25	100	70	100

Note: The SSAB has a severe O3 and serious PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used

Table B1-156. Summary of Operational Emissions within the Mojave Desert Air Basin from the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
29 Palms EAF	(1.26)	(3.96)	(0.20)	(0.03)	(0.25)	(0.25)
29 Palms Air Spaces	(2.38)	(13.36)	(2.71)	(0.28)	(1.25)	(1.25)
Total Existing Emissions	(3.64)	(17.33)	(2.90)	(0.30)	(1.51)	(1.51)
Proposed Facility Emissions						
29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
MTRs	0.02	0.93	25.30	0.72	2.84	2.84
Total Proposed Emissions	0.07	4.46	36.51	1.20	4.55	4.55
Total Proposed Emissions - SSAB	(3.57)	(12.86)	33.60	0.90	3.04	3.04
SSAB NEPA SignificanceThresholds	25	100	25	25	15	100

Note: The MDAB has a severe O3 and moderate PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the MDAB are u

Table B1-157. Summary of Operational Emissions within Arizona from the Fielding of 10 MV-22 Squadrons at MCAS Miramar - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Yuma	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
BMG Range	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Existing Emissions	(9.35)	(41.37)	(6.03)	(0.63)	(3.34)	(3.34)
Proposed Facility Emissions						
BMG Range	0.21	10.17	278.59	7.87	31.07	31.07
MTRs	0.01	0.65	17.51	0.50	1.96	1.96
Total Proposed Emissions - Arizona	0.22	10.81	296.10	8.37	33.03	33.03
Net Change in Emissions - Arizona	(9.13)	(30.56)	290.07	7.73	29.69	29.69
Arizona NEPA SignificanceThresholds	100	100	100	100	100	100

Note: The Yuma Area is a moderate PM10 nonattainment area.

Table B1-158. Summary of Operational Emissions from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Pendleton - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MCAS Miramar Proposed Emissions						
MV-22 Operations	0.73	48.35	110.86	5.48	18.86	18.86
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56
Construction	0.19	1.91	0.76	0.00	0.08	0.08
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15
Stationary Sources (1)	4.69	3.91	14.39	0.66	16.41	10.50
Total Proposed Emissions - MCAS Miramar	28.70	273.91	169.24	7.40	41.55	35.22
MCAS Pendleton Proposed Emissions						
MV-22 Operations	0.21	13.52	26.40	1.39	4.73	4.73
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	3.92	29.01	3.14	0.02	0.11	0.11
Government-Owned Vehicles	0.78	3.14	0.78	0.00	0.03	0.03
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.78	1.68	2.81	0.01	0.31	0.30
Other Sources	-	-	0.78	0.05	0.44	0.12
Stationary Sources (1)	0.55	3.06	3.84	0.18	4.38	2.80
Total Proposed Emissions - MCAS Pendleton	10.38	93.47	46.00	1.91	11.17	9.26
29 Palms EAF Proposed Emissions						
MV-22 Operations	0.05	3.41	7.96	0.39	1.35	1.35
Total Proposed Emissions - 29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
MCB Pendleton Ranges Proposed Emissions						
MV-22 Operations	0.08	3.70	101.59	2.87	11.32	11.32
Total Proposed Emissions - MCB Pendleton Ranges	0.08	3.70	101.59	2.87	11.32	11.32
29 Palms Air Spaces - Proposed Emissions						
MV-22 Operations	0.00	0.12	3.25	0.09	0.36	0.36
Total Proposed Emissions - 29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
Chocolate Mt. AG Range Proposed Emissions						
MV-22 Operations	0.08	3.89	107.07	3.02	11.92	11.92
Total Proposed Emissions - Chocolate Mt. AG Range	0.08	3.89	107.07	3.02	11.92	11.92
BMG Range Proposed Emissions						
MV-22 Operations	0.21	10.17	278.59	7.87	31.07	31.07
Total Proposed Emissions - BMG Range	0.21	10.17	278.59	7.87	31.07	31.07
R-2510/2512 Proposed Emissions						
MV-22 Operations	0.00	0.15	3.99	0.11	0.45	0.45
Total Proposed Emissions - R-2510/2512	0.00	0.15	3.99	0.11	0.45	0.45
MTRs						
MV-22 Operations	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions - MTRs	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions	39.55	390.67	767.97	25.10	114.82	106.57
Total Existing Emissions	142.84	713.77	105.18	8.33	78.33	71.84
Total Proposed - Existing Emissions	(103.29)	(323.10)	662.79	16.77	36.49	34.73

Table B1-159. Summary of Operational Emissions within the San Diego Air Basin from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Pendleton - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Miramar Existing Emissions	(62.20)	(318.33)	(44.50)	(3.21)	(36.08)	(32.04)
MCAS Pendleton Existing Emissions	(58.70)	(287.90)	(41.90)	(3.18)	(32.94)	(30.49)
MCB Pendleton Ranges Existing Emissions	(7.67)	(41.49)	(8.38)	(0.85)	(3.81)	(3.81)
Total Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)
Proposed Facility Emissions						
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22
MCAS Pendleton Proposed Emissions	10.38	93.47	46.00	1.91	11.17	9.26
MCB Pendleton Ranges Proposed Emissions	0.08	3.70	101.59	2.87	11.32	11.32
VR-1266	0.00	0.05	1.24	0.04	0.14	0.14
Total Proposed Emissions	39.16	371.13	318.07	12.22	64.18	55.94
Total Proposed Emissions - SDAB	(89.40)	(276.59)	223.30	4.98	(8.64)	(10.40)
SDAB NEPA SignificanceThresholds	100	100	100	100	100	100

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-160. Summary of Operational Emissions within the Salton Sea Air Basin from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Pendleton - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range Existing	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
R-2510/2512 Existing	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Existing Emissions	(1.28)	(7.34)	(1.47)	(0.15)	(0.66)	(0.66)
Proposed Facility Emissions						
Chocolate Mt. AG Range Proposed	0.08	3.89	107.07	3.02	11.92	11.92
R-2510/2512 Proposed	0.00	0.15	3.99	0.11	0.45	0.45
MTRs	0.02	0.88	23.76	0.67	2.66	2.66
Total Proposed Emissions	0.10	4.91	134.82	3.81	15.03	15.03
Total Proposed Emissions - SSAB	(1.18)	(2.43)	133.35	3.66	14.36	14.36
SSAB NEPA SignificanceThresholds	25	100	25	100	70	100

Note: The SSAB has a severe O3 and serious PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analysis.

Table B1-161. Summary of Operational Emissions within the Mojave Desert Air Basin from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Pendleton - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
29 Palms EAF	(1.26)	(3.96)	(0.20)	(0.03)	(0.25)	(0.25)
29 Palms Air Spaces	(2.38)	(13.36)	(2.71)	(0.28)	(1.25)	(1.25)
Total Existing Emissions	(3.64)	(17.33)	(2.90)	(0.30)	(1.51)	(1.51)
Proposed Facility Emissions						
29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
MTRs	0.02	0.93	25.30	0.72	2.84	2.84
Total Proposed Emissions	0.07	4.46	36.51	1.20	4.55	4.54
Total Proposed Emissions - SSAB	(3.57)	(12.86)	33.60	0.90	3.04	3.04
SSAB NEPA SignificanceThresholds	25	100	25	25	15	100

Note: The SSAB has a severe O3 and moderate PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analysis.

Table B1-162. Summary of Operational Emissions within Arizona from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Pendleton - Calendar Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Yuma	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
BMG Range	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Existing Emissions	(9.35)	(41.37)	(6.03)	(0.63)	(3.34)	(3.34)
Proposed Facility Emissions						
BMG Range	0.21	10.17	278.59	7.87	31.07	31.07
MTRs	0.01	0.65	17.51	0.50	1.96	1.96
Total Proposed Emissions - Arizona	0.22	10.81	296.10	8.37	33.03	33.03
Total Proposed Emissions - Arizona	(9.13)	(30.56)	290.07	7.73	29.69	29.69
Arizona NEPA SignificanceThresholds	100	100	100	100	100	100

Note: The Yuma Area is a moderate PM10 nonattainment area. existing/proposed

Table B1-163. Summary of Operational Emissions from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MCAS Miramar Proposed Emissions						
MV-22 Operations	0.73	48.35	110.86	5.48	18.86	18.86
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56
Construction	0.19	1.91	0.76	0.00	0.08	0.08
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15
Stationary Sources (1)	4.69	3.91	14.39	0.66	16.41	10.50
Total Proposed Emissions - MCAS Miramar	28.70	273.91	169.24	7.40	41.55	35.22
MCAS Pendleton Proposed Emissions						
MV-22 Operations	-	-	-	-	-	-
MV-22 Engine Maintenance/Testing	-	-	-	-	-	-
Personal-Owned Vehicles	-	-	-	-	-	-
Government-Owned Vehicles	-	-	-	-	-	-
Ground/Tactical Support Equipment	-	-	-	-	-	-
Construction	-	-	-	-	-	-
Other Sources	-	-	-	-	-	-
Stationary Sources (1)	-	-	-	-	-	-
Total Proposed Emissions - MCAS Pendleton	-	-	-	-	-	-
29 Palms EAF Proposed Emissions						
MV-22 Operations	0.05	3.41	7.96	0.39	1.35	1.35
Total Proposed Emissions - 29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
MCAS Yuma Proposed Emissions						
MV-22 Operations	0.16	10.36	23.71	1.17	4.03	4.03
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	1.65	11.99	1.53	0.01	0.11	0.11
Government-Owned Vehicles	0.17	1.07	0.52	0.00	0.04	0.04
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.07	0.68	0.27	0.00	0.03	0.03
Other Sources	0.34	1.64	0.34	0.02	0.19	0.05
Stationary Sources (1)	1.88	0.84	0.74	0.02	0.09	0.04
Total Emissions - 2 Squadrons	8.40	69.64	35.37	1.48	5.65	5.46
MCB Pendleton Ranges Proposed Emissions						
MV-22 Operations	0.08	3.70	101.59	2.87	11.32	11.32
Total Proposed Emissions - MCB Pendleton Ranges	0.08	3.70	101.59	2.87	11.32	11.32
29 Palms Air Spaces - Proposed Emissions						
MV-22 Operations	0.00	0.12	3.25	0.09	0.36	0.36
Total Proposed Emissions - 29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
Chocolate Mt. AG Range Proposed Emissions						
MV-22 Operations	0.08	3.89	107.07	3.02	11.92	11.92
Total Proposed Emissions - Chocolate Mt. AG Range	0.08	3.89	107.07	3.02	11.92	11.92
BMG Range Proposed Emissions						
MV-22 Operations	0.21	10.44	280.15	7.93	31.28	31.28
Total Proposed Emissions - BMG Range	0.21	10.44	280.15	7.93	31.28	31.28
R-2510/2512 Proposed Emissions						
MV-22 Operations	0.00	0.15	3.99	0.11	0.45	0.45
Total Proposed Emissions - R-2510/2512	0.00	0.15	3.99	0.11	0.45	0.45
MTRs						
MV-22 Operations	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions - MTRs	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions	37.57	367.12	758.89	24.72	109.52	102.99
Total Existing Emissions	142.84	713.77	105.18	8.33	78.33	71.84
Total Proposed - Existing Emissions	(105.27)	(346.65)	653.71	16.40	31.19	31.15

Table B1-164. Summary of Operational Emissions within the San Diego Air Basin from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Miramar Existing Emissions	(62.20)	(318.33)	(44.50)	(3.21)	(36.08)	(32.04)
MCAS Pendleton Existing Emissions	(58.70)	(287.90)	(41.90)	(3.18)	(32.94)	(30.49)
MCB Pendleton Ranges Existing Emissions	(7.67)	(41.49)	(8.38)	(0.85)	(3.81)	(3.81)
Total Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)
Proposed Facility Emissions						
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.08	3.70	101.59	2.87	11.32	11.32
VR-1266	0.00	0.05	1.24	0.04	0.14	0.14
Total Proposed Emissions	28.78	277.66	272.08	10.31	53.01	46.68
Total Proposed Emissions - SDAB	(99.79)	(370.06)	177.30	3.07	(19.81)	(19.66)
SDAB NEPA SignificanceThresholds	100	100	100	100	100	100

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-165. Summary of Operational Emissions within the Salton Sea Air Basin from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range Existing	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
R-2510/2512 Existing	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Existing Emissions	(1.28)	(7.34)	(1.47)	(0.15)	(0.66)	(0.66)
Proposed Facility Emissions						
Chocolate Mt. AG Range Proposed	0.08	3.89	107.07	3.02	11.92	11.92
R-2510/2512 Proposed	0.00	0.15	3.99	0.11	0.45	0.45
MTRs	0.02	0.88	23.76	0.67	2.66	2.66
Total Proposed Emissions	0.10	4.91	134.82	3.81	15.03	15.03
Total Proposed Emissions - SSAB	(1.18)	(2.43)	133.35	3.66	14.36	14.36
SSAB NEPA SignificanceThresholds	50	100	50	100	70	100

Note: The SSAB has a serious O3 and PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analy

Table B1-166. Summary of Operational Emissions within the Mojave Desert Air Basin from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
29 Palms EAF	(1.26)	(3.96)	(0.20)	(0.03)	(0.25)	(0.25)
29 Palms Air Spaces	(2.38)	(13.36)	(2.71)	(0.28)	(1.25)	(1.25)
Total Existing Emissions	(3.64)	(17.33)	(2.90)	(0.30)	(1.51)	(1.51)
Proposed Facility Emissions						
29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
MTRs	0.02	0.93	25.30	0.72	2.84	2.84
Total Proposed Emissions	0.07	4.46	36.51	1.20	4.55	4.55
Total Proposed Emissions - SSAB	(3.57)	(12.86)	33.60	0.90	3.04	3.04
SSAB NEPA SignificanceThresholds	25	100	25	25	15	100

Note: The SSAB has a serious O3 and PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analy

Table B1-167. Summary of Operational Emissions within Arizona from the Fielding of 8/2 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Yuma	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
BMG Range	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Existing Emissions	(9.35)	(41.37)	(6.03)	(0.63)	(3.34)	(3.34)
Proposed Facility Emissions						
MCAS Yuma	8.40	69.64	35.37	1.48	5.65	5.46
BMG Range	0.21	10.44	280.15	7.93	31.28	31.28
MTRs	0.01	0.65	17.51	0.50	1.96	1.96
Total Proposed Emissions - Arizona	8.63	80.73	333.02	9.90	38.90	38.70
Net Change in Emissions - Arizona	(0.72)	39.36	326.99	9.27	35.56	35.37
Arizona NEPA SignificanceThresholds	100	100	100	100	100	100

Table B1-168. Summary of Operational Emissions from the Fielding of 2/8 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MCAS Miramar Proposed Emissions						
MV-22 Operations	0.16	10.36	23.76	1.17	4.04	4.04
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	1.65	11.99	1.53	0.01	0.11	0.11
Government-Owned Vehicles	0.17	1.07	0.52	0.00	0.04	0.04
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.07	0.68	0.27	0.00	0.03	0.03
Other Sources	0.34	1.64	0.34	0.02	0.19	0.05
Stationary Sources (1)	1.68	1.40	5.16	0.24	5.88	3.77
Total Proposed Emissions - MCAS Miramar	8.21	70.20	39.83	1.70	11.47	9.20
MCAS Pendleton Proposed Emissions						
MV-22 Operations	-	-	-	-	-	-
MV-22 Engine Maintenance/Testing	-	-	-	-	-	-
Personal-Owned Vehicles	-	-	-	-	-	-
Government-Owned Vehicles	-	-	-	-	-	-
Ground/Tactical Support Equipment	-	-	-	-	-	-
Construction	-	-	-	-	-	-
Other Sources	-	-	-	-	-	-
Stationary Sources (1)	-	-	-	-	-	-
Total Proposed Emissions - MCAS Pendleton	-	-	-	-	-	-
29 Palms EAF Proposed Emissions						
MV-22 Operations	0.05	3.41	7.96	0.39	1.35	1.35
Total Proposed Emissions - 29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
MCAS Yuma Proposed Emissions						
MV-22 Operations	0.74	48.34	110.66	5.45	18.80	18.80
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56
Construction	0.19	1.91	0.76	0.00	0.08	0.08
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15
Stationary Sources (1)	5.32	2.39	2.09	0.06	0.25	0.11
Total Emissions - 8 Squadrons	29.33	272.38	156.74	6.77	25.33	24.77
MCB Pendleton Ranges Proposed Emissions						
MV-22 Operations	0.08	3.70	101.59	2.87	11.32	11.32
Total Proposed Emissions - MCB Pendleton Ranges	0.08	3.70	101.59	2.87	11.32	11.32
29 Palms Air Spaces - Proposed Emissions						
MV-22 Operations	0.00	0.12	3.25	0.09	0.36	0.36
Total Proposed Emissions - 29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
Chocolate Mt. AG Range Proposed Emissions						
MV-22 Operations	0.08	3.89	107.07	3.02	11.92	11.92
Total Proposed Emissions - Chocolate Mt. AG Range	0.08	3.89	107.07	3.02	11.92	11.92
BMG Range Proposed Emissions						
MV-22 Operations	0.22	11.56	288.25	8.22	32.35	32.35
Total Proposed Emissions - BMG Range	0.22	11.56	288.25	8.22	32.35	32.35
R-2510/2512 Proposed Emissions						
MV-22 Operations	0.00	0.15	3.99	0.11	0.45	0.45
Total Proposed Emissions - R-2510/2512	0.00	0.15	3.99	0.11	0.45	0.45
MTRs						
MV-22 Operations	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions - MTRs	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions	38.01	367.27	758.95	24.60	100.18	97.35
Total Existing Emissions	142.84	713.77	105.18	8.33	78.33	71.84
Total Proposed - Existing Emissions	(104.82)	(346.50)	653.77	16.27	21.85	25.51

Table B1-169. Summary of Operational Emissions within the San Diego Air Basin from the Fielding of 2/8 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Miramar Existing Emissions	(62.20)	(318.33)	(44.50)	(3.21)	(36.08)	(32.04)
MCAS Pendleton Existing Emissions	(58.70)	(287.90)	(41.90)	(3.18)	(32.94)	(30.49)
MCB Pendleton Ranges Existing Emissions	(7.67)	(41.49)	(8.38)	(0.85)	(3.81)	(3.81)
Total Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)
Proposed Facility Emissions						
MCAS Miramar Proposed Emissions	8.21	70.20	39.83	1.70	11.47	9.20
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.08	3.70	101.59	2.87	11.32	11.32
VR-1266	0.00	0.05	1.24	0.04	0.14	0.14
Total Proposed Emissions	8.28	73.95	142.67	4.60	22.93	20.66
Total Proposed Emissions - SDAB	(120.28)	(573.77)	47.89	(2.64)	(49.90)	(45.68)
SDAB NEPA SignificanceThresholds	100	100	100	100	100	100

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-170. Summary of Operational Emissions within the Salton Sea Air Basin from the Fielding of 2/8 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range Existing	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
R-2510/2512 Existing	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Existing Emissions	(1.28)	(7.34)	(1.47)	(0.15)	(0.66)	(0.66)
Proposed Facility Emissions						
Chocolate Mt. AG Range Proposed	0.08	3.89	107.07	3.02	11.92	11.92
R-2510/2512 Proposed	0.00	0.15	3.99	0.11	0.45	0.45
MTRs	0.02	0.88	23.76	0.67	2.66	2.66
Total Proposed Emissions	0.10	4.91	134.82	3.81	15.03	15.03
Total Proposed Emissions - SSAB	(1.18)	(2.43)	133.35	3.66	14.36	14.36
SSAB NEPA SignificanceThresholds	50	100	50	100	70	100

Note: The SSAB has a serious O3 and PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analy

Table B1-171. Summary of Operational Emissions within the Mojave Desert Air Basin from the Fielding of 2/8 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
29 Palms EAF	(1.26)	(3.96)	(0.20)	(0.03)	(0.25)	(0.25)
29 Palms Air Spaces	(2.38)	(13.36)	(2.71)	(0.28)	(1.25)	(1.25)
Total Existing Emissions	(3.64)	(17.33)	(2.90)	(0.30)	(1.51)	(1.51)
Proposed Facility Emissions						
29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
MTRs	0.02	0.93	25.30	0.72	2.84	2.84
Total Proposed Emissions	0.07	4.46	36.51	1.20	4.55	4.55
Total Proposed Emissions - SSAB	(3.57)	(12.86)	33.60	0.90	3.04	3.04
SSAB NEPA SignificanceThresholds	25	100	25	100	100	100

Note: The SSAB has a serious O3 and PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analy

Table B1-172. Summary of Operational Emissions within Arizona from the Fielding of 2/8 MV-22 Squadrons at MCAS Miramar/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Yuma	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
BMG Range	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Existing Emissions	(9.35)	(41.37)	(6.03)	(0.63)	(3.34)	(3.34)
Proposed Facility Emissions						
MCAS Yuma	29.33	272.38	156.74	6.77	25.33	24.77
BMG Range	0.22	11.56	288.25	8.22	32.35	32.35
MTRs	0.01	0.65	17.51	0.50	1.96	1.96
Total Proposed Emissions - Arizona	29.57	284.59	462.49	15.49	59.64	59.08
Net Change in Emissions - Arizona	20.22	243.21	456.46	14.85	56.31	55.75
Arizona NEPA SignificanceThresholds	100	100	100	100	100	100

Table B1-173. Proposed Operational Emissions from the Fielding of 2/8 MV-22 Squadrons at MCAS Pendleton/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MCAS Miramar Proposed Emissions						
MV-22 Operations	-	-	-	-	-	-
MV-22 Engine Maintenance/Testing	-	-	-	-	-	-
Personal-Owned Vehicles	-	-	-	-	-	-
Government-Owned Vehicles	-	-	-	-	-	-
Ground/Tactical Support Equipment	-	-	-	-	-	-
Construction	-	-	-	-	-	-
Other Sources	-	-	-	-	-	-
Stationary Sources (1)	-	-	-	-	-	-
Total Proposed Emissions - MCAS Miramar	-	-	-	-	-	-
MCAS Pendleton Proposed Emissions						
MV-22 Operations	0.21	13.52	26.40	1.39	4.73	4.73
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	3.92	29.01	3.14	0.02	0.11	0.11
Government-Owned Vehicles	0.78	3.14	0.78	0.00	0.03	0.03
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.78	1.68	2.81	0.01	0.31	0.30
Other Sources	-	-	0.78	0.05	0.44	0.12
Stationary Sources (1)	0.55	3.06	3.84	0.18	4.38	2.80
Total Proposed Emissions - MCAS Pendleton	10.38	93.47	46.00	1.91	11.17	9.26
29 Palms EAF Proposed Emissions						
MV-22 Operations	0.05	3.41	7.96	0.39	1.35	1.35
Total Proposed Emissions - 29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
MCAS Yuma Proposed Emissions						
MV-22 Operations	0.74	48.34	110.66	5.45	18.80	18.80
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56
Construction	0.19	1.91	0.76	0.00	0.08	0.08
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15
Stationary Sources (1)	5.32	2.39	2.09	0.06	0.25	0.11
Total Emissions - 8 Squadrons	29.33	272.38	156.74	6.77	25.33	24.77
MCB Pendleton Ranges Proposed Emissions						
MV-22 Operations	0.08	3.70	101.59	2.87	11.32	11.32
Total Proposed Emissions - MCB Pendleton Ranges	0.08	3.70	101.59	2.87	11.32	11.32
29 Palms Air Spaces - Proposed Emissions						
MV-22 Operations	0.00	0.12	3.25	0.09	0.36	0.36
Total Proposed Emissions - 29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
Chocolate Mt. AG Range Proposed Emissions						
MV-22 Operations	0.08	3.89	107.07	3.02	11.92	11.92
Total Proposed Emissions - Chocolate Mt. AG Range	0.08	3.89	107.07	3.02	11.92	11.92
BMG Range Proposed Emissions						
MV-22 Operations	0.22	11.56	288.25	8.22	32.35	32.35
Total Proposed Emissions - BMG Range	0.22	11.56	288.25	8.22	32.35	32.35
R-2510/2512 Proposed Emissions						
MV-22 Operations	0.00	0.15	3.99	0.11	0.45	0.45
Total Proposed Emissions - R-2510/2512	0.00	0.15	3.99	0.11	0.45	0.45
MTRs						
MV-22 Operations	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions - MTRs	0.04	1.86	50.28	1.43	5.64	5.64
Total Proposed Emissions	40.19	390.53	765.12	24.81	99.88	97.41
Total Existing Emissions	142.84	713.77	105.18	8.33	78.33	71.84
Total Proposed - Existing Emissions	(102.65)	(323.24)	659.94	16.48	21.55	25.56

Table B1-174. Summary of Operational Emissions within the San Diego Air Basin from the Fielding of 2/8 MV-22 Squadrons at MCAS Pendleton/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Miramar Existing Emissions	(62.20)	(318.33)	(44.50)	(3.21)	(36.08)	(32.04)
MCAS Pendleton Existing Emissions	(58.70)	(287.90)	(41.90)	(3.18)	(32.94)	(30.49)
MCB Pendleton Ranges Existing Emissions	(7.67)	(41.49)	(8.38)	(0.85)	(3.81)	(3.81)
Total Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)
Proposed Facility Emissions						
MCAS Miramar Proposed Emissions	-	-	-	-	-	-
MCAS Pendleton Proposed Emissions	10.38	93.47	46.00	1.91	11.17	9.26
MCB Pendleton Ranges Proposed Emissions	0.08	3.70	101.59	2.87	11.32	11.32
VR-1266	0.00	0.05	1.24	0.04	0.14	0.14
Total Proposed Emissions	10.46	97.21	148.83	4.81	22.63	20.72
Total Proposed Emissions - SDAB	(118.11)	(550.51)	54.06	(2.43)	(50.20)	(45.62)
SDAB NEPA SignificanceThresholds	100	100	100	100	100	100

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-175. Summary of Operational Emissions within the Salton Sea Air Basin from the Fielding of 2/8 MV-22 Squadrons at MCAS Pendleton/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range Existing	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
R-2510/2512 Existing	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Existing Emissions	(1.28)	(7.34)	(1.47)	(0.15)	(0.66)	(0.66)
Proposed Facility Emissions						
Chocolate Mt. AG Range Proposed	0.08	3.89	107.07	3.02	11.92	11.92
R-2510/2512 Proposed	0.00	0.15	3.99	0.11	0.45	0.45
MTRs	0.02	0.88	23.76	0.67	2.66	2.66
Total Proposed Emissions	0.10	4.91	134.82	3.81	15.03	15.03
Total Proposed Emissions - SSAB	(1.18)	(2.43)	133.35	3.66	14.36	14.36
SSAB NEPA SignificanceThresholds	50	100	50	100	70	100

Note: The SSAB has a serious O3 and PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analy

Table B1-176. Summary of Operational Emissions within the Mojave Desert Air Basin from the Fielding of 2/8 MV-22 Squadrons at MCAS Pendleton/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
29 Palms EAF	(1.26)	(3.96)	(0.20)	(0.03)	(0.25)	(0.25)
29 Palms Air Spaces	(2.38)	(13.36)	(2.71)	(0.28)	(1.25)	(1.25)
Total Existing Emissions	(3.64)	(17.33)	(2.90)	(0.30)	(1.51)	(1.51)
Proposed Facility Emissions						
29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
MTRs	0.02	0.93	25.30	0.72	2.84	2.84
Total Proposed Emissions	0.07	4.46	36.51	1.20	4.55	4.54
Total Proposed Emissions - SSAB	(3.57)	(12.86)	33.60	0.90	3.04	3.04
SSAB NEPA SignificanceThresholds	25	100	25	25	15	100

Note: The SSAB has a serious O3 and PM10 nonattainment area. The most stringent conformity thresholds of anywhere in the SSAB are used in the analy

Table B1-177. Summary of Operational Emissions within Arizona from the Fielding of 2/8 MV-22 Squadrons at MCAS Pendleton/MCAS Yuma - Calendar Year 2017.

	Emissions (Tons per Year)					
Scenario/Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Yuma	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
BMG Range	(4.59)	(26.41)	(5.28)	(0.54)	(2.39)	(2.39)
Total Existing Emissions	(9.35)	(41.37)	(6.03)	(0.63)	(3.34)	(3.34)
Proposed Facility Emissions						
MCAS Yuma	29.33	272.38	156.74	6.77	25.33	24.77
BMG Range	0.22	11.56	288.25	8.22	32.35	32.35
MTRs	0.01	0.65	17.51	0.50	1.96	1.96
Total Proposed Emissions - Arizona	29.57	284.59	462.49	15.49	59.64	59.08
Net Change in Emissions - Arizona	20.22	243.21	456.46	14.85	56.31	55.75
Arizona NEPA SignificanceThresholds	100	100	100	100	100	100

	A	B	C	D	E	F	G	H
32	Table B1-178. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2010							
33		*Tons per Year*						
34	*Source Scenario/Location*	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
35	*CH-46 Emissions*							
36	MCAS Miramar Existing Emissions	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09
37	MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
38	MCB Pendleton Ranges Existing Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08
39	Total CH-46 Emissions	95.28	478.54	70.50	5.43	53.86	49.02	31,389.52
40	*MV-22 Emissions*							
41	MCAS Miramar Proposed Emissions	8.20	78.26	48.35	2.12	11.87	10.00	22,833.13
42	MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
43	MCB Pendleton Ranges Proposed Emissions	0.02	0.87	23.90	0.67	2.66	2.66	5,406.42
44	VR-1266	0.00	0.01	0.29	0.01	0.03	0.03	66.63
45	Total MV-22 Emissions	8.22	79.14	72.55	2.80	14.57	12.69	28,306.19
46	Total Proposed Emissions (SDAB)	103.50	557.68	143.05	8.23	68.43	61.72	59,695.70
47	Construction - MCAS Miramar	1.24	5.12	10.01	0.01	3.41	1.19	
48	Construction - MCAS Camp Pendleton	0.54	1.75	2.67	0.00	0.69	0.28	
49	Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
50	Proposed minus Year 2000 Emissions	(23.29)	(83.16)	60.95	1.00	(0.29)	(3.14)	(175.58)
51	SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA
52	Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.							

Table B1-179. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2011

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09
MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
MCB Pendleton Ranges Existing Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08
Total CH-46 Emissions	95.28	478.54	70.50	5.43	53.86	49.02	31,389.52
MV-22 Emissions							
MCAS Miramar Proposed Emissions	16.40	156.52	96.71	4.23	23.75	20.00	45,666.27
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.04	1.74	47.81	1.35	5.33	5.33	10,812.84
VR-1266	0.00	0.02	0.59	0.02	0.07	0.07	133.26
Total MV-22 Emissions	16.44	158.29	145.10	5.60	29.14	25.39	56,612.37
Total Proposed Emissions (SDAB)	111.72	636.83	215.60	11.02	83.00	74.41	88,001.89
Construction - MCAS Miramar	1.24	5.12	10.01	0.01	3.41	1.19	
Construction - MCAS Camp Pendleton	0.54	1.75	2.67	0.00	0.69	0.28	
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
Proposed minus Year 2000 Emissions	(15.07)	(4.02)	133.50	3.80	14.27	9.55	28,130.61
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-180. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2012

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
MCB Pendleton Ranges Existing Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45
Total CH-46 Emissions	61.99	306.78	45.71	3.56	34.67	31.97	15,044.80
MV-22 Emissions							
MCAS Miramar Proposed Emissions	20.50	195.65	120.89	5.29	29.68	25.00	57,082.83
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05
VR-1266	0.00	0.03	0.73	0.02	0.08	0.08	166.58
Total MV-22 Emissions	20.55	197.86	181.38	7.00	36.42	31.74	70,765.46
Total Proposed Emissions (SDAB)	82.53	504.64	227.09	10.56	71.09	63.71	85,810.26
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
Proposed minus Year 2000 Emissions	(46.03)	(143.08)	132.31	3.32	(1.73)	(2.63)	25,938.98
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-181. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2013

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
MCB Pendleton Ranges Existing Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45
Total CH-46 Emissions	61.99	306.78	45.71	3.56	34.67	31.97	15,044.80
MV-22 Emissions							
MCAS Miramar Proposed Emissions	16.40	156.52	96.71	4.23	23.75	20.00	45,666.27
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.04	1.74	47.81	1.35	5.33	5.27	10,812.84
VR-1266	0.00	0.02	0.59	0.02	0.07	0.07	133.26
Total MV-22 Emissions	16.44	158.29	145.10	5.60	29.14	25.34	56,612.37
Total Proposed Emissions (SDAB)	78.42	465.07	190.81	9.16	63.80	57.31	71,657.17
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
Proposed minus Year 2000 Emissions	(50.14)	(182.65)	96.04	1.92	(9.02)	(9.03)	11,785.89
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-182. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2014

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	39.33	192.89	28.07	2.13	22.07	20.26	-
MCB Pendleton Ranges Existing Emissions	2.19	12.59	2.54	0.26	1.15	1.15	2,037.63
Total CH-46 Emissions	41.52	205.48	30.61	2.39	23.22	21.41	2,037.63
MV-22 Emissions							
MCAS Miramar Proposed Emissions	20.50	195.65	120.89	5.29	29.68	25.00	57,082.83
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05
VR-1266	0.00	0.03	0.73	0.02	0.08	0.08	166.58
Total MV-22 Emissions	20.55	197.86	181.38	7.00	36.42	31.74	70,765.46
Total Proposed Emissions (SDAB)	62.07	403.34	211.99	9.38	59.64	53.15	72,803.10
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
Proposed minus Year 2000 Emissions	(66.50)	(244.38)	117.22	2.14	(13.18)	(13.18)	12,931.82
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-183. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2015

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Existing Emissions	-	-	-	-	-	-	-
Total CH-46 Emissions	-	-	-	-	-	-	-
MV-22 Emissions							
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47
VR-1266	0.00	0.04	1.02	0.03	0.11	0.11	233.21
Total MV-22 Emissions	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Total Proposed Emissions (SDAB)	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
Proposed minus Year 2000 Emissions	(99.80)	(370.72)	159.15	2.56	(21.83)	(21.68)	39,200.37
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-184. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2016

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Existing Emissions	-	-	-	-	-	-	-
Total CH-46 Emissions	-	-	-	-	-	-	-
MV-22 Emissions							
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47
VR-1266	0.00	0.04	1.02	0.03	0.11	0.11	233.21
Total MV-22 Emissions	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Total Proposed Emissions (SDAB)	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
Proposed minus Year 2000 Emissions	(99.80)	(370.72)	159.15	2.56	(21.83)	(21.68)	39,200.37
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-185. Summary of Operational Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2017

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Existing Emissions	-	-	-	-	-	-	-
Total CH-46 Emissions	-	-	-	-	-	-	-
MV-22 Emissions							
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97
MCAS Pendleton Proposed Emissions	10.38	93.47	46.00	1.91	11.17	9.26	24,473.78
MCB Pendleton Ranges Proposed Emissions	0.08	3.70	101.59	2.87	11.32	11.32	22,977.29
VR-1266	0.00	0.05	1.24	0.04	0.14	0.14	283.19
Total MV-22 Emissions	39.16	371.13	318.07	12.22	64.18	55.94	127,650.22
Total Proposed Emissions (SDAB)	39.16	371.13	318.07	12.22	64.18	55.94	127,650.22
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.34)	(59,871.28)
Proposed minus Year 2000 Emissions	(89.40)	(276.59)	223.30	4.98	(8.64)	(10.40)	67,778.94
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table B1-186. Summary of Annual Emissions from the MV-22 Proposed Action - Salton Sea Air Basin Marginal O3 Nonattainment Area - Imperial County - Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*VOC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range (1)	(1.01)	(5.79)	(1.16)	(0.12)	(0.52)	(0.52)
R-2510/2512 Existing	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Existing Emissions	(1.03)	(5.90)	(1.18)	(0.12)	(0.53)	(0.53)
Proposed Facility Emissions						
Chocolate Mt. AG Range (1)	0.07	3.11	85.66	2.42	9.53	9.53
R-2510/2512 Proposed	0.00	0.15	3.99	0.11	0.45	0.45
MTRs	0.00	0.09	2.44	0.07	0.27	0.27
Total Proposed Emissions	0.07	3.35	92.08	2.60	10.25	10.25
Total Proposed Emissions - SSAB	(0.96)	(2.55)	90.90	2.48	9.72	9.72
SSAB Conformity Thresholds	100	NA	100	NA	NA	NA

Note: The Imperial County portion of the SSAB is a marginal O3 nonattainment area. Since ~80% of the CMAGR occurs within Imperial County, the existing/proposed emissions within the CMAGR were distributed by these amounts into these areas.

Table B1-187. Summary of Annual Emissions from the MV-22 Proposed Action - Salton Sea Air Basin Severe O3 Nonattainment Area - Riverside County - Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*VOC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range (1)	(0.25)	(1.45)	(0.29)	(0.03)	(0.13)	(0.13)
Total Existing Emissions	(0.25)	(1.45)	(0.29)	(0.03)	(0.13)	(0.13)
Proposed Facility Emissions						
Chocolate Mt. AG Range (1)	0.02	0.78	21.41	0.60	2.38	2.38
MTRs	0.00	0.14	3.78	0.11	0.42	0.42
Total Proposed Emissions	0.02	0.92	25.20	0.71	2.81	2.81
Total Proposed Emissions - SSAB	(0.23)	(0.53)	24.91	0.68	2.68	2.68
SSAB Conformity Thresholds	25	NA	25	NA	NA	NA

Note: The Riverside County portion of the SSAB is a severe O3 nonattainment area. Since ~20% of the CMAGR occurs within the Coachella O3 nonattainment area, the existing/proposed emissions within the CMAGR were distributed by these amounts into these areas.

Table B1-188. Summary of Annual Emissions from the MV-22 Proposed Action - Salton Sea Air Basin Serious PM10 Nonattainment Area - Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*VOC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
Chocolate Mt. AG Range Existing	(1.26)	(7.24)	(1.45)	(0.15)	(0.66)	(0.66)
R-2510/2512 Existing	(0.02)	(0.10)	(0.02)	(0.00)	(0.01)	(0.01)
Total Existing Emissions	(1.28)	(7.34)	(1.47)	(0.15)	(0.66)	(0.66)
Proposed Facility Emissions						
Chocolate Mt. AG Range Proposed	0.08	3.89	107.07	3.02	11.92	11.92
R-2510/2512 Proposed	0.00	0.15	3.99	0.11	0.45	0.45
MTRs	0.00	0.19	5.09	0.14	0.57	0.57
Total Proposed Emissions	0.09	4.23	116.15	3.28	12.94	12.94
Total Proposed Emissions - SSAB	(1.19)	(3.12)	114.69	3.13	12.27	12.27
SSAB Conformity Thresholds	NA	NA	NA	NA	70	NA

Note: The SSAB serious PM10 nonattainment area includes portions of Imperial\Riverside Counties.

Table B1-189. Summary of Annual Emissions from the MV-22 Proposed Action - Mojave Desert Air Basin Severe O3 Nonattainment Area - San Bernardino County - Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*VOC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
29 Palms EAF	(1.26)	(3.96)	(0.20)	(0.03)	(0.25)	(0.25)
29 Palms Air Spaces	(2.38)	(13.36)	(2.71)	(0.28)	(1.25)	(1.25)
Total Existing Emissions	(3.64)	(17.33)	(2.90)	(0.30)	(1.51)	(1.51)
Proposed Facility Emissions						
29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
MTRs	0.00	0.21	5.74	0.16	0.64	0.64
Total Proposed Emissions	0.06	3.74	16.95	0.64	2.35	2.35
Total Proposed Emissions - SSAB	(3.58)	(13.59)	14.05	0.34	0.85	0.84
MDAB Conformity Thresholds	25	NA	25	NA	NA	NA

Note: The MDAB severe O3 nonattainment area is in San Bernardino County.

Table B1-190. Summary of Annual Emissions from the MV-22 Proposed Action - Mojave Desert Air Basin Moderate PM10 Nonattainment Area - San Bernardino County - Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*VOC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
29 Palms EAF	(1.26)	(3.96)	(0.20)	(0.03)	(0.25)	(0.25)
29 Palms Air Spaces	(2.38)	(13.36)	(2.71)	(0.28)	(1.25)	(1.25)
Total Existing Emissions	(3.64)	(17.33)	(2.90)	(0.30)	(1.51)	(1.51)
Proposed Facility Emissions						
29 Palms EAF	0.05	3.41	7.96	0.39	1.35	1.35
29 Palms Air Spaces	0.00	0.12	3.25	0.09	0.36	0.36
MTRs	0.01	0.49	13.29	0.38	1.49	1.49
Total Proposed Emissions	0.06	4.02	24.50	0.86	3.20	3.20
Total Proposed Emissions - SSAB	(3.58)	(13.31)	21.60	0.56	1.69	1.69
MDAB Conformity Thresholds	NA	NA	NA	NA	100	NA

Note: The MDAB moderate PM10 nonattainment area is in San Bernardino County.

Table B1-191. Summary of Annual Emissions from the MV-22 Proposed Action - Yuma Moderate PM10 Nonattainment Area - Year 2017

	Emissions (Tons per Year)					
Scenario/Source Type	*VOC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Existing Facility Emissions						
MCAS Yuma	(4.76)	(14.96)	(0.75)	(0.10)	(0.95)	(0.95)
BMG Range	(0.46)	(2.64)	(0.53)	(0.05)	(0.24)	(0.24)
Total Existing Emissions	(5.22)	(17.60)	(1.28)	(0.15)	(1.19)	(1.19)
Proposed Facility Emissions						
BMG Range	0.02	1.02	27.86	0.79	3.11	3.11
Total Proposed Emissions	0.02	1.02	27.86	0.79	3.11	3.11
Total Proposed Emissions - Yuma	(5.20)	(16.58)	26.58	0.64	1.92	1.92
Yuma Area Conformity Thresholds	NA	NA	NA	NA	100	NA

Note: The Yuma Area is a moderate PM10 nonattainment area. Since ~10% of R-2301W occurs within this area, the existing/proposed emissions within the BMG Range were included within this area.

Table B1-192. Construction Equipment Source Data for MCAS Miramar - 10 MV-22 Squadrons Alternative

Construction Activity/Equipment Type	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days*	*Total Hp-Hrs*
Demolition - Building Facilities								
Backhoe	160	0.50	2	160	8	1,280	22	28,763
Bulldozer	310	0.50	2	310	8	2,480	22	55,728
Crane w/Wrecking Ball	180	0.50	1	90	8	720	22	16,179
Loader	215	0.50	3	323	8	2,580	22	57,975
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	22	6,292
Haul Truck (1)	NA	NA	10	NA	20	200	22	4,494
Building Demolition (3)	NA	NA	NA	NA	8	NA	22	2,002,425
Demolition - Apron								
Bulldozer - D9	405	0.50	1	203	8	1,620	53	86,242
Haul Truck - 20 CY - Asphalt (1)	NA	NA	4	NA	23	92	53	4,916
Haul Truck - 20 CY - Runway Base (1)	NA	NA	4	NA	8	31	53	1,640
Fugitive Dust (2)	NA	NA	2	NA	8	NA	53	106
Loader - 938G	160	0.50	2	160	8	1,280	106	136,284
Water Truck - 5000 Gallons	175	0.40	2	140	4	560	106	59,624
Demolition - Airfield Facilities - Other								
Backhoe	160	0.50	2	160	8	1,280	79	101,066
Bulldozer	310	0.50	2	310	8	2,480	79	195,815
Crane w/Wrecking Ball	180	0.50	1	90	8	720	79	56,849
Loader	215	0.50	3	323	8	2,580	79	203,711
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	79	22,108
Haul Truck (1)	NA	NA	10	NA	20	200	79	15,792
Building Demolition (3)	NA	NA	NA	NA	8	NA	79	7,036,000
Construction - Building Facilities								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	605	108,813
Concrete/Industrial Saw	84	0.73	1	61	6	368	605	222,414
Crane	190	0.30	1	57	6	342	605	206,745
Forklift	94	0.48	1	45	6	268	605	161,950
Generator	45	0.60	1	27	8	216	605	130,576
Concrete Trucks (1)	NA	NA	15	NA	14	210	27	5,770
Supply Trucks (1)	NA	NA	20	NA	10	200	46	9,159
Fugitive Dust (2)	NA	NA	1	NA	8	NA	147	147
Construction - New Apron								
Haul Truck - 20 CY - Asphalt (1)	NA	NA	10	NA	18	179	91	16,340
Asphalt Spreader - BG 240C	153	0.60	2	184	8	1,469	91	134,126
Compactive Roller	165	0.50	2	165	8	1,320	91	120,538
Fugitive Dust (2)	NA	NA	2	NA	8	NA	183	365
Grader - 14H	215	0.50	2	215	8	1,720	91	157,065
Loader - 938G	160	0.50	2	160	8	1,280	91	116,885
Oil Truck	300	0.40	1	120	8	960	91	87,664
Vibratory Compactor - CB 355D	105	0.75	2	158	8	1,260	183	230,118
Construction - Airfield Facilities - Other								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	900	161,931
Concrete/Industrial Saw	84	0.73	1	61	6	368	900	330,986
Crane	190	0.30	1	57	6	342	900	307,668
Forklift	94	0.48	1	45	6	268	900	241,007
Generator	45	0.60	1	27	8	216	900	194,317
Concrete Trucks (1)	NA	NA	15	NA	14	210	41	8,587
Supply Trucks (1)	NA	NA	20	NA	10	200	68	13,631
Fugitive Dust (2)	NA	NA	1	NA	8	NA	218	218

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

(2) Number Active is acres disturbed at one time and Total Fuel Use is acre-days disturbed.

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

Table B1-193. Air Emission Factors for Construction Equipment MCAS Miramar/Camp Pendleton MV-22 Alternatives

Equipment Type	*Fuel Type*	*Emission Factors (Grams/Horsepower-Hour)*						
		ROG	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*	*Reference*
Year 2010								
Off-Road Equipment - 25-50 Hp	D	0.64	2.34	5.79	0.01	0.38	0.35	(1)
Off-Road Equipment - 51-120 Hp	D	1.45	4.10	5.55	0.01	0.60	0.55	(1)
Off-Road Equipment - 121-175 Hp	D	0.46	3.23	5.64	0.01	0.39	0.36	(1)
Off-Road Equipment - 176-250 Hp	D	0.33	2.70	5.26	0.01	0.24	0.22	(1)
Off-Road Equipment - 251-500 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
Off-Road Equipment - 501-750 Hp	D	0.19	0.92	4.95	0.01	0.12	0.11	(1)
Off-Road Equipment - >750 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
On-road Truck - Idle (Gms/Hr)	D	12.26	46.77	105.83	0.06	1.82	1.67	(2)
On-road Truck - 5 mph (Gms/Mi)	D	11.33	25.15	38.73	0.04	2.38	2.19	(2)
On-road Truck - 25 mph (Gms/Mi)	D	1.41	8.04	16.11	0.02	0.66	0.60	(2)
On-road Truck - 55 mph (Gms/Mi)	D	0.81	4.67	14.73	0.02	0.61	0.56	(2)
Other On-Road Trucks - Composite (Gms/Mi	D	1.45	6.37	16.21	0.02	0.71	0.65	(3)
Year 2011								
Off-Road Equipment - 25-50 Hp	D	0.64	2.34	5.79	0.01	0.38	0.35	(1)
Off-Road Equipment - 51-120 Hp	D	1.45	4.10	5.55	0.01	0.60	0.55	(1)
Off-Road Equipment - 121-175 Hp	D	0.46	3.23	5.64	0.01	0.39	0.36	(1)
Off-Road Equipment - 176-250 Hp	D	0.33	2.70	5.26	0.01	0.24	0.22	(1)
Off-Road Equipment - 251-500 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
Off-Road Equipment - 501-750 Hp	D	0.19	0.92	4.95	0.01	0.12	0.11	(1)
Off-Road Equipment - >750 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
On-road Truck - Idle (Gms/Hr)	D	11.67	46.09	107.88	0.06	1.65	1.67	(2)
On-road Truck - 5 mph (Gms/Mi)	D	10.46	23.08	35.85	0.04	2.08	2.19	(2)
On-road Truck - 25 mph (Gms/Mi)	D	1.30	7.22	14.91	0.02	0.59	0.60	(2)
On-road Truck - 55 mph (Gms/Mi)	D	0.74	4.33	13.42	0.02	0.57	0.56	(2)
Other On-Road Trucks - Composite (Gms/Mi	D	1.34	5.84	14.84	0.02	0.65	0.65	(3)
All Years								
Fugitive Dust (Lbs/acre-day)	---	---	---	---	---	13.45	2.81	(4)
Building Demolition (Lbs/1000 cf)	---	---	---	---	---	0.41	0.09	(5)

Notes: (1) Composite emission factors developed from ARB OFFROAD2007 emissions model (2006) and based on average SCAB equipment fleet age distributions for project years 2010 and 2011.

(2) Heavy duty diesel truck running emission factors developed from EMFAC2007 (ARB 2006). Units in grams/mile for project years 2010 and 2011. Based on annual average conditions at 60 degrees and 50% humidity. PM emission factors include combustive and tire/brake wear contributions.

(3) For on-road trucks, composite factor based on a round trip of 75% at 55 mph, 20% at 25 mph, and 5% at 5 mph. Although not shown in these calculations, emissions from 5 minutes. Units in grams/mile. of idling mode included for each truck round trip.

(4) Units in lbs/acre-day from section 11.2.3 of AP-42 (EPA 1995). Emissions reduced by 75% from uncontrolled levels to represent compliance with SCAQMD Rule 403 - Fugitive Dust.

(5) CEQA Air Quality Handbook, Table A9-9-H (SCAQMD 1993). Units in lbs/1000 cubic feet (cf) of demolished building.

Table B1-194. Construction Emissions for MCAS Miramar - 10 MV-22 Squadrons Alternative

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Demolition - Building Facilities						
Backhoe	0.01	0.10	0.18	0.00	0.01	0.01
Bulldozer	0.02	0.06	0.38	0.00	0.01	0.01
Crane w/Wrecking Ball	0.01	0.06	0.10	0.00	0.01	0.01
Loader	0.02	0.17	0.34	0.00	0.02	0.01
Water Truck - 5000 Gallons	0.00	0.02	0.04	0.00	0.00	0.00
Haul Truck	0.01	0.03	0.08	0.00	0.00	0.00
Building Demolition	-	-	-	-	0.41	0.09
Subtotal - Building Demolition	0.07	0.44	1.12	0.00	0.46	0.13
Demolition - Apron						
Bulldozer - D9	0.03	0.09	0.59	0.00	0.01	0.01
Haul Truck - 20 CY - Asphalt	0.01	0.04	0.10	0.00	0.00	0.00
Haul Truck - 20 CY - Runway Base	0.00	0.01	0.03	0.00	0.00	0.00
Fugitive Dust (2)	-	-	-	-	0.72	0.15
Loader - 938G	0.07	0.49	0.85	0.00	0.06	0.05
Water Truck - 5000 Gallons	0.03	0.21	0.37	0.00	0.03	0.02
Subtotal - Apron Demolition	0.14	0.84	1.94	0.00	0.82	0.24
Demolition - Airfield Facilities - Other						
Backhoe	0.05	0.36	0.63	0.00	0.04	0.04
Bulldozer	0.07	0.20	1.35	0.00	0.03	0.03
Crane w/Wrecking Ball	0.03	0.20	0.35	0.00	0.02	0.02
Loader	0.07	0.61	1.18	0.00	0.05	0.05
Water Truck - 5000 Gallons	0.01	0.08	0.14	0.00	0.01	0.01
Haul Truck (1)	0.03	0.11	0.29	0.00	0.01	0.01
Building Demolition	-	-	-	-	1.45	0.30
Subtotal - Airfield Demolition	0.26	1.56	3.94	0.00	1.62	0.46
Construction - Building Facilities						
Air Compressor - 100 CFM	0.08	0.28	0.69	0.00	0.05	0.04
Concrete/Industrial Saw	0.36	1.01	1.36	0.00	0.15	0.14
Crane	0.10	0.74	1.29	0.00	0.09	0.08
Forklift	0.26	0.73	0.99	0.00	0.11	0.10
Generator	0.09	0.34	0.83	0.00	0.05	0.05
Concrete Trucks	0.01	0.04	0.10	0.00	0.00	0.00
Supply Trucks	0.01	0.06	0.16	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	0.99	0.21
Subtotal - Building Construction	0.91	3.19	5.43	0.01	1.44	0.62
Construction - New Apron						
Haul Truck - 20 CY - Asphalt (1)	0.03	0.12	0.30	0.00	0.01	0.01
Asphalt Spreader - BG 240C	0.07	0.48	0.83	0.00	0.06	0.05
Compactive Roller	0.06	0.43	0.75	0.00	0.05	0.05
Fugitive Dust	-	-	-	-	2.46	0.51
Grader - 14H	0.06	0.47	0.91	0.00	0.04	0.04
Loader - 938G	0.06	0.42	0.73	0.00	0.05	0.05
Oil Truck	0.03	0.09	0.60	0.00	0.01	0.01
Vibratory Compactor - CB 355D	0.37	1.04	1.41	0.00	0.15	0.14
Subtotal - Apron Construction	0.67	3.04	5.53	0.01	2.84	0.86
Construction - Airfield Facilities - Other						
Air Compressor - 100 CFM	0.11	0.42	1.03	0.00	0.07	0.06
Concrete/Industrial Saw	0.53	1.50	2.02	0.00	0.22	0.20
Crane	0.16	1.10	1.91	0.00	0.13	0.12
Forklift	0.39	1.09	1.47	0.00	0.16	0.15
Generator	0.14	0.50	1.24	0.00	0.08	0.07
Concrete Trucks	0.01	0.06	0.15	0.00	0.01	0.01
Supply Trucks	0.02	0.09	0.24	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	1.47	0.31
Subtotal - Airfield Construction	1.36	4.75	8.08	0.01	2.14	0.93
Total Emissions - 10 squadrons	3.42	13.82	26.03	0.03	9.32	3.26
Annual Emissions - 10 squadrons	1.71	6.91	13.02	0.01	4.66	1.63
SDAB Conformity De Minimis Thresholds	100	100	100	NA	NA	NA

Table B1-195. Construction Equipment Source Data for MCAS Miramar - 8 MV-22 Squadrons Alternative

Construction Activity/Equipment Typ	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days*	*Total Hp-Hrs*
Demolition - Building Facilities								
Backhoe	160	0.50	2	160	8	1,280	26	33,827
Bulldozer	310	0.50	2	310	8	2,480	26	65,540
Crane w/Wrecking Ball	180	0.50	1	90	8	720	26	19,028
Loader	215	0.50	3	323	8	2,580	26	68,183
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	26	7,400
Haul Truck (1)	NA	NA	10	NA	20	200	26	5,285
Building Demolition (3)	NA	NA	NA	NA	8	NA	26	2,354,970
Demolition - Apron								
Bulldozer - D9	405	0.50	1	203	8	1,620	62	100,762
Haul Truck - 20 CY - Asphalt (1)	NA	NA	4	NA	20	79	62	4,916
Haul Truck - 20 CY - Runway Base (	NA	NA	4	NA	7	26	62	1,640
Fugitive Dust (2)	NA	NA	2	NA	8	NA	62	124
Loader - 938G	160	0.50	2	160	8	1,280	124	159,229
Water Truck - 5000 Gallons	175	0.40	2	140	4	560	124	69,663
Demolition - Airfield Facilities - Other								
Backhoe	160	0.50	2	160	8	1,280	87	111,780
Bulldozer	310	0.50	2	310	8	2,480	87	216,574
Crane w/Wrecking Ball	180	0.50	1	90	8	720	87	62,876
Loader	215	0.50	3	323	8	2,580	87	225,307
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	87	24,452
Haul Truck (1)	NA	NA	10	NA	20	200	87	17,466
Building Demolition (3)	NA	NA	NA	NA	8	NA	87	7,781,910
Construction - Building Facilities								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	502	90,379
Concrete/Industrial Saw	84	0.73	1	61	6	368	502	184,734
Crane	190	0.30	1	57	6	342	502	171,719
Forklift	94	0.48	1	45	6	268	502	134,513
Generator	45	0.60	1	27	8	216	502	108,454
Concrete Trucks (1)	NA	NA	15	NA	14	210	23	4,793
Supply Trucks (1)	NA	NA	20	NA	10	200	38	7,608
Fugitive Dust (2)	NA	NA	1	NA	8	NA	122	122
Construction - New Apron								
Haul Truck - 20 CY - Asphalt (1)	NA	NA	10	NA	68	681	24	16,340
Asphalt Spreader - BG 240C	153	0.60	2	184	8	1,469	24	35,227
Compactive Roller	165	0.50	2	165	8	1,320	24	31,658
Fugitive Dust (2)	NA	NA	2	NA	8	NA	48	96
Grader - 14H	215	0.50	2	215	8	1,720	24	41,251
Loader - 938G	160	0.50	2	160	8	1,280	24	30,699
Oil Truck	300	0.40	1	120	8	960	24	23,024
Vibratory Compactor - CB 355D	105	0.75	2	158	8	1,260	48	60,438
Construction - Airfield Facilities - Other								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	661	118,899
Concrete/Industrial Saw	84	0.73	1	61	6	368	661	243,029
Crane	190	0.30	1	57	6	342	661	225,908
Forklift	94	0.48	1	45	6	268	661	176,961
Generator	45	0.60	1	27	8	216	661	142,679
Concrete Trucks (1)	NA	NA	15	NA	14	210	30	6,305
Supply Trucks (1)	NA	NA	20	NA	10	200	50	10,008
Fugitive Dust (2)	NA	NA	1	NA	8	NA	160	160

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

(2) Number Active is acres disturbed at one time and Total Fuel Use is acre-days disturbed

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

Table B1-196. Construction Emissions for MCAS Miramar - 8 MV-22 Squadrons Alternative

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Demolition - Building Facilities						
Backhoe	0.02	0.12	0.21	0.00	0.01	0.01
Bulldozer	0.02	0.07	0.45	0.00	0.01	0.01
Crane w/Wrecking Ball	0.01	0.07	0.12	0.00	0.01	0.01
Loader	0.02	0.20	0.40	0.00	0.02	0.02
Water Truck - 5000 Gallons	0.00	0.03	0.05	0.00	0.00	0.00
Haul Truck	0.01	0.04	0.10	0.00	0.00	0.00
Building Demolition	-	-	-	-	0.48	0.10
Subtotal - Building Demolition	0.09	0.52	1.32	0.00	0.54	0.16
Demolition - Apron						
Bulldozer - D9	0.04	0.10	0.69	0.00	0.02	0.02
Haul Truck - 20 CY - Asphalt	0.01	0.04	0.10	0.00	0.00	0.00
Haul Truck - 20 CY - Runway Base	0.00	0.01	0.03	0.00	0.00	0.00
Fugitive Dust (2)	-	-	-	-	0.84	0.17
Loader - 938G	0.08	0.57	0.99	0.00	0.07	0.06
Water Truck - 5000 Gallons	0.04	0.25	0.43	0.00	0.03	0.03
Subtotal - Apron Demolition	0.16	0.97	2.25	0.00	0.96	0.29
Demolition - Airfield Facilities - Other						
Backhoe	0.06	0.40	0.69	0.00	0.05	0.04
Bulldozer	0.08	0.22	1.49	0.00	0.04	0.03
Crane w/Wrecking Ball	0.03	0.22	0.39	0.00	0.03	0.02
Loader	0.08	0.67	1.31	0.00	0.06	0.05
Water Truck - 5000 Gallons	0.01	0.09	0.15	0.00	0.01	0.01
Haul Truck (1)	0.03	0.12	0.32	0.00	0.01	0.01
Building Demolition	-	-	-	-	1.60	0.33
Subtotal - Airfield Demolition	0.29	1.72	4.35	0.00	1.79	0.51
Construction - Building Facilities						
Air Compressor - 100 CFM	0.06	0.23	0.58	0.00	0.04	0.03
Concrete/Industrial Saw	0.30	0.83	1.13	0.00	0.12	0.11
Crane	0.09	0.61	1.07	0.00	0.07	0.07
Forklift	0.22	0.61	0.82	0.00	0.09	0.08
Generator	0.08	0.28	0.69	0.00	0.05	0.04
Concrete Trucks	0.01	0.03	0.09	0.00	0.00	0.00
Supply Trucks	0.01	0.05	0.13	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	0.82	0.17
Subtotal - Building Construction	0.76	2.65	4.51	0.00	1.20	0.52
Construction - New Apron						
Haul Truck - 20 CY - Asphalt (1)	0.03	0.12	0.30	0.00	0.01	0.01
Asphalt Spreader - BG 240C	0.02	0.13	0.22	0.00	0.02	0.01
Compactive Roller	0.02	0.11	0.20	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	0.65	0.13
Grader - 14H	0.02	0.12	0.24	0.00	0.01	0.01
Loader - 938G	0.02	0.11	0.19	0.00	0.01	0.01
Oil Truck	0.01	0.02	0.16	0.00	0.00	0.00
Vibratory Compactor - CB 355D	0.10	0.27	0.37	0.00	0.04	0.04
Subtotal - Apron Construction	0.20	0.88	1.67	0.00	0.75	0.24
Construction - Airfield Facilities - Other						
Air Compressor - 100 CFM	0.08	0.31	0.76	0.00	0.05	0.05
Concrete/Industrial Saw	0.39	1.10	1.49	0.00	0.16	0.15
Crane	0.11	0.80	1.40	0.00	0.10	0.09
Forklift	0.28	0.80	1.08	0.00	0.12	0.11
Generator	0.10	0.37	0.91	0.00	0.06	0.05
Concrete Trucks	0.01	0.04	0.11	0.00	0.00	0.00
Supply Trucks	0.02	0.07	0.18	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	1.08	0.22
Subtotal - Airfield Construction	1.00	3.49	5.93	0.01	1.57	0.68
Total Emissions - 8 squadrons	2.49	10.24	20.03	0.02	6.82	2.39
Annual Emissions - 8 squadrons	1.24	5.12	10.01	0.01	3.41	1.19
SDAB Conformity De Minimis Thresholds	100	100	100	NA	NA	NA

Table B1-197. Construction Equipment Source Data for MCAS Camp Pendleton - 2 MV-22 Squadrons Alternative

Construction Activity/Equipment Typ	Hp Rating	Ave. Daily Load Factor	Number Active	Hourly Hp-Hrs	Hours/ Day	Daily Hp-Hrs	Work Days	Total Hp-Hrs
Demolition - Building Facilities								
Backhoe	160	0.50	2	160	8	1,280	0.23	290
Bulldozer	310	0.50	2	310	8	2,480	0.23	561
Crane w/Wrecking Ball	180	0.50	1	90	8	720	0.23	163
Loader	215	0.50	3	323	8	2,580	0.23	584
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	0.23	63
Haul Truck (1)	NA	NA	10	NA	20	200	0.23	45
Building Demolition (3)	NA	NA	NA	NA	8	NA	0.23	20,160
Demolition - Apron								
Bulldozer - D9	405	0.50	1	203	8	1,620	-	-
Haul Truck - 20 CY - Asphalt (1)	NA	NA	4	NA	20	#REF!	-	-
Haul Truck - 20 CY - Runway Base (	NA	NA	4	NA	7	#REF!	-	-
Fugitive Dust (2)	NA	NA	2	NA	8	NA	-	-
Loader - 938G	160	0.50	2	160	8	1,280	-	-
Water Truck - 5000 Gallons	175	0.40	2	140	4	560	-	-
Demolition - Airfield Facilities - Other								
Backhoe	160	0.50	2	160	8	1,280	-	-
Bulldozer	310	0.50	2	310	8	2,480	-	-
Crane w/Wrecking Ball	180	0.50	1	90	8	720	-	-
Loader	215	0.50	3	323	8	2,580	-	-
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	-	-
Haul Truck (1)	NA	NA	10	NA	20	200	-	-
Building Demolition (3)	NA	NA	NA	NA	8	NA	-	-
Construction - Building Facilities								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	180	32,443
Concrete/Industrial Saw	84	0.73	1	61	6	368	180	66,313
Crane	190	0.30	1	57	6	342	180	61,642
Forklift	94	0.48	1	45	6	268	180	48,286
Generator	45	0.60	1	27	8	216	180	38,932
Concrete Trucks (1)	NA	NA	15	NA	14	210	8	1,720
Supply Trucks (1)	NA	NA	20	NA	10	200	14	2,731
Fugitive Dust (2)	NA	NA	1	NA	8	NA	44	44
Construction - New Apron								
Haul Truck - 20 CY - Asphalt (1)	NA	NA	10	NA	525	5,248	3	16,340
Asphalt Spreader - BG 240C	153	0.60	2	184	8	1,469	3	4,573
Compactive Roller	165	0.50	2	165	8	1,320	3	4,110
Fugitive Dust (2)	NA	NA	2	NA	8	NA	6	12
Grader - 14H	215	0.50	2	215	8	1,720	3	5,355
Loader - 938G	160	0.50	2	160	8	1,280	3	3,985
Oil Truck	300	0.40	1	120	8	960	3	2,989
Vibratory Compactor - CB 355D	105	0.75	2	158	8	1,260	6	7,846
Construction - Airfield Facilities - Other								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	374	67,328
Concrete/Industrial Saw	84	0.73	1	61	6	368	374	137,619
Crane	190	0.30	1	57	6	342	374	127,923
Forklift	94	0.48	1	45	6	268	374	100,207
Generator	45	0.60	1	27	8	216	374	80,794
Concrete Trucks (1)	NA	NA	15	NA	14	210	17	3,570
Supply Trucks (1)	NA	NA	20	NA	10	200	28	5,667
Fugitive Dust (2)	NA	NA	1	NA	8	NA	91	91

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

(2) Number Active is acres disturbed at one time and Total Fuel Use is acre-days disturbed

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

Table B1-198. Construction Emissions for MCAS Camp Pendleton - 2 MV-22 Squadrons Alternative

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Demolition - Building Facilities						
Backhoe	0.000	0.001	0.002	0.000	0.000	0.000
Bulldozer	0.000	0.002	0.004	0.000	0.000	0.000
Crane w/Wrecking Ball	0.000	0.000	0.001	0.000	0.000	0.000
Loader	0.000	0.001	0.004	0.000	0.000	0.000
Water Truck - 5000 Gallons	0.000	0.000	0.000	0.000	0.000	0.000
Haul Truck	0.000	0.000	0.001	0.000	0.000	0.000
Building Demolition	-	-	-	-	0.004	0.001
Subtotal - Building Demolition	0.00	0.01	0.01	0.00	0.00	0.00
Demolition - Apron						
Bulldozer - D9	-	-	-	-	-	-
Haul Truck - 20 CY - Asphalt	-	-	-	-	-	-
Haul Truck - 20 CY - Runway Base	-	-	-	-	-	-
Fugitive Dust (2)	-	-	-	-	-	-
Loader - 938G	-	-	-	-	-	-
Water Truck - 5000 Gallons	-	-	-	-	-	-
Demolition - Airfield Facilities - Other						
Backhoe	-	-	-	-	-	-
Bulldozer	-	-	-	-	-	-
Crane w/Wrecking Ball	-	-	-	-	-	-
Loader	-	-	-	-	-	-
Water Truck - 5000 Gallons	-	-	-	-	-	-
Haul Truck (1)	-	-	-	-	-	-
Building Demolition	-	-	-	-	-	-
Construction - Building Facilities						
Air Compressor - 100 CFM	0.08	0.24	0.21	0.00	0.02	0.02
Concrete/Industrial Saw	0.08	0.27	0.46	0.00	0.04	0.04
Crane	0.04	0.12	0.40	0.00	0.01	0.01
Forklift	0.03	0.20	0.33	0.00	0.03	0.03
Generator	0.10	0.28	0.25	0.00	0.02	0.02
Concrete Trucks	0.00	0.01	0.02	0.00	0.00	0.00
Supply Trucks	0.00	0.02	0.04	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.29	0.06
Subtotal - Building Construction	0.33	1.14	1.71	0.00	0.42	0.18
Construction - New Apron						
Haul Truck - 20 CY - Asphalt (1)	0.02	0.11	0.23	0.00	0.01	0.01
Asphalt Spreader - BG 240C	0.00	0.02	0.03	0.00	0.00	0.00
Compactive Roller	0.00	0.02	0.03	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.08	0.02
Grader - 14H	0.00	0.01	0.03	0.00	0.00	0.00
Loader - 938G	0.00	0.01	0.03	0.00	0.00	0.00
Oil Truck	0.00	0.01	0.02	0.00	0.00	0.00
Vibratory Compactor - CB 355D	0.01	0.03	0.05	0.00	0.00	0.00
Subtotal - Apron Construction	0.04	0.21	0.41	0.00	0.10	0.03
Construction - Airfield Facilities - Other						
Air Compressor - 100 CFM	0.17	0.49	0.43	0.00	0.04	0.04
Concrete/Industrial Saw	0.16	0.57	0.95	0.00	0.08	0.08
Crane	0.09	0.24	0.83	0.00	0.03	0.03
Forklift	0.06	0.21	0.35	0.00	0.03	0.03
Generator	0.21	0.59	0.52	0.00	0.05	0.05
Concrete Trucks	0.00	0.02	0.05	0.00	0.00	0.00
Supply Trucks	0.01	0.04	0.08	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.6097	0.1272
Subtotal - Airfield Construction	0.69	2.16	3.20	0.00	0.85	0.35
Total Emissions - 2 squadrons	1.07	3.51	5.33	0.01	1.38	0.57
Annual Emissions - 2 squadrons	0.54	1.75	2.67	0.00	0.69	0.28
SDAB Conformity De Minimis Thresholds	100	100	100	NA	NA	NA

Table B1-199. Construction Equipment Source Data for MCAS Yuma - 8 MV-22 Squadrons Alternative

Construction Activity/Equipment Typ	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days*	*Total Hp-Hrs*
Demolition - Building Facilities								
Backhoe	160	0.50	2	160	8	1,280	22	28,763
Bulldozer	310	0.50	2	310	8	2,480	22	55,728
Crane w/Wrecking Ball	180	0.50	1	90	8	720	22	16,179
Loader	215	0.50	3	323	8	2,580	22	57,975
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	22	6,292
Haul Truck (1)	NA	NA	10	NA	20	200	22	4,494
Building Demolition (3)	NA	NA	NA	NA	8	NA	22	2,002,425
Demolition - Apron								
Bulldozer - D9	405	0.50	1	203	8	1,620	53	86,242
Haul Truck - 20 CY - Asphalt (1)	NA	NA	4	NA	23	92	53	4,916
Haul Truck - 20 CY - Runway Base (	NA	NA	4	NA	8	31	53	1,640
Fugitive Dust (2)	NA	NA	2	NA	8	NA	53	106
Loader - 938G	160	0.50	2	160	8	1,280	106	136,284
Water Truck - 5000 Gallons	175	0.40	2	140	4	560	106	59,624
Demolition - Airfield Facilities - Other								
Backhoe	160	0.50	2	160	8	1,280	79	101,066
Bulldozer	310	0.50	2	310	8	2,480	79	195,815
Crane w/Wrecking Ball	180	0.50	1	90	8	720	79	56,849
Loader	215	0.50	3	323	8	2,580	79	203,711
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	79	22,108
Haul Truck (1)	NA	NA	10	NA	20	200	79	15,792
Building Demolition (3)	NA	NA	NA	NA	8	NA	79	7,036,000
Construction - Building Facilities								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	605	108,813
Concrete/Industrial Saw	84	0.73	1	61	6	368	605	222,414
Crane	190	0.30	1	57	6	342	605	206,745
Forklift	94	0.48	1	45	6	268	605	161,950
Generator	45	0.60	1	27	8	216	605	130,576
Concrete Trucks (1)	NA	NA	15	NA	14	210	27	5,770
Supply Trucks (1)	NA	NA	20	NA	10	200	46	9,159
Fugitive Dust (2)	NA	NA	1	NA	8	NA	147	147
Construction - New Apron								
Haul Truck - 20 CY - Asphalt (1)	NA	NA	10	NA	18	179	91	16,340
Asphalt Spreader - BG 240C	153	0.60	2	184	8	1,469	91	134,126
Compactive Roller	165	0.50	2	165	8	1,320	91	120,538
Fugitive Dust (2)	NA	NA	2	NA	8	NA	183	365
Grader - 14H	215	0.50	2	215	8	1,720	91	157,065
Loader - 938G	160	0.50	2	160	8	1,280	91	116,885
Oil Truck	300	0.40	1	120	8	960	91	87,664
Vibratory Compactor - CB 355D	105	0.75	2	158	8	1,260	183	230,118
Construction - Airfield Facilities - Other								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	900	161,931
Concrete/Industrial Saw	84	0.73	1	61	6	368	900	330,986
Crane	190	0.30	1	57	6	342	900	307,668
Forklift	94	0.48	1	45	6	268	900	241,007
Generator	45	0.60	1	27	8	216	900	194,317
Concrete Trucks (1)	NA	NA	15	NA	14	210	41	8,587
Supply Trucks (1)	NA	NA	20	NA	10	200	68	13,631
Fugitive Dust (2)	NA	NA	1	NA	8	NA	218	218

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

(2) Number Active is acres disturbed at one time and Total Fuel Use is acre-days disturbed.

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

Table B1-200. Air Emission Factors for Construction Equipment MCAS Yuma MV-22 Alternatives

Equipment Type	*Fuel Type*	*Emission Factors (Grams/Horsepower-Hour)*						
		ROG	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*	*Reference*
Year 2010								
Off-Road Equipment - 25-40 Hp	D	0.62	2.73	4.53	0.76	0.53	0.51	(1)
Off-Road Equipment - 41-50 Hp	D	0.58	3.79	5.00	0.82	0.63	0.61	(1)
Off-Road Equipment - 51-75 Hp	D	0.65	4.04	5.06	0.82	0.69	0.67	(1)
Off-Road Equipment - 76-100 Hp	D	0.67	1.94	4.70	0.74	0.44	0.42	(1)
Off-Road Equipment - 101-175 Hp	D	0.47	1.46	4.43	0.75	0.33	0.32	(1)
Off-Road Equipment - 176-300 Hp	D	0.36	2.00	4.78	0.72	0.33	0.32	(1)
Off-Road Equipment - 301-600 Hp	D	0.34	29.77	68.36	0.04	1.26	1.15	(1)
Heavy Duty Diesel Vehicles - Idle (Gms/Hr)	D	4.96	29.77	68.36	0.04	1.26	1.15	(2)
Heavy Duty Diesel Vehicles - 5 mph (Gms/Mile)	D	1.11	7.04	11.07	0.04	0.22	0.18	(4)
Heavy Duty Diesel Vehicles - 25 mph (Gms/Mile)	D	0.48	2.09	6.95	0.04	0.22	0.18	(4)
Heavy Duty Diesel Vehicles - 55 mph (Gms/Mile)	D	0.26	1.33	8.71	0.04	0.22	0.18	(4)
Truck - <10 mile trip - Composite (Gms/Mi)	D	0.58	3.00	7.95	0.04	0.22	0.18	(5)
Truck - >10 mile trip - Composite (Gms/Mi)	D	0.43	2.20	8.24	0.04	0.22	0.18	(6)
Year 2011								
Off-Road Equipment - 25-40 Hp	D	0.56	2.53	4.49	0.76	0.49	0.47	(1)
Off-Road Equipment - 41-50 Hp	D	0.53	2.41	4.28	0.73	0.46	0.45	(1)
Off-Road Equipment - 51-75 Hp	D	0.61	3.65	4.78	0.82	0.60	0.58	(1)
Off-Road Equipment - 76-100 Hp	D	0.62	3.98	4.84	0.82	0.67	0.65	(1)
Off-Road Equipment - 101-175 Hp	D	0.44	1.86	4.45	0.74	0.43	0.41	(1)
Off-Road Equipment - 176-300 Hp	D	0.34	1.32	4.09	0.73	0.38	0.36	(1)
Off-Road Equipment - 301-600 Hp	D	0.31	1.82	4.46	0.71	0.36	0.35	(1)
Heavy Duty Diesel Vehicles - Idle (Gms/Hr)	D	4.95	29.68	68.64	0.04	1.21	1.11	(4)
Heavy Duty Diesel Vehicles - 5 mph (Gms/Mile)	D	1.03	6.09	9.69	0.04	0.19	0.15	(4)
Heavy Duty Diesel Vehicles - 25 mph (Gms/Mile)	D	0.45	1.81	6.07	0.04	0.19	0.15	(4)
Heavy Duty Diesel Vehicles - 55 mph (Gms/Mile)	D	0.25	1.15	7.62	0.04	0.19	0.15	(4)
Truck - <10 mile trip - Composite (Gms/Mi)	D	0.54	2.60	6.95	0.04	0.19	0.15	(5)
Truck - >10 mile trip - Composite (Gms/Mi)	D	0.41	1.90	7.20	0.04	0.19	0.15	(6)
All Years								
Fugitive Dust (Lbs/acre-day)	---	---	---	---	---	13.45	2.81	(7)
Building Demolition (Lbs/1000 cf)	---	---	---	---	---	0.41	0.09	(8)

Notes: (1) Generated using the USEPA's NONROAD2005 model. Emissions factors were generated for Maricopa County, Arizona, assuming average annual low and high temperatures of 60 deg. F and 86 deg. F, and an annual average of 73 deg. F, and a RVP of 7.0. Composite emission factors were then calculated for each Hp category by averaging all of the different types of equipment wihin the same hp category. Model was used to produce factors for 2008 and 2012.

(2) Idling emission factors developed from EMFAC2002 (ARB 2003). Units in grams/hour.

(3) Generated using the USEPA's Mobile6 model. Emissions factors were generated for default conditions, assuming average annual low and high temperatures of 60 deg. F and 86 deg. F, a fuel RVP of 7.0, and a diesel sulfur content of 43 ppm. Model was used to produce factors for 2008 and 2012. Units in grams per mile.

(4) Interpolated between 2008 and 2012 to calculate these factors

(5) Composite factors based on a round trip of 20% at 5 mph, 70% at 25 mph, and 10% at 55 mph. Units in grams/mile. Although not shown in these calculations, emissions from 5 minutes of idling mode included for each truck round trip.

(6) Composite factors based on a round trip of 10% at 5 mph, 40% at 25 mph, and 50% at 55 mph. Units in grams/mile. Although not shown in these calculations, emissions from 5 minutes of idling mode included for each truck round trip.

(7) Units in lbs/acre-day from section 11.2.3 of AP-42 (EPA 1995). Emissions reduced by 75% from uncontrolled levels to represent compliance with SCAQMD Rule 403 - Fugitive Dust.

(8) CEQA Air Quality Handbook, Table A9-9-H (SCAQMD 1993). Units in lbs/1000 cubic feet (cf) of demolished building.

Table B1-201. Construction Emissions for MCAS Yuma - 8 MV-22 Squadrons Alternative

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Demolition - Building Facilities						
Backhoe	0.01	0.09	0.15	0.02	0.02	0.02
Bulldozer	0.02	0.10	0.27	0.04	0.02	0.02
Crane w/Wrecking Ball	0.01	0.05	0.09	0.01	0.01	0.01
Loader	0.02	0.11	0.28	0.05	0.02	0.02
Water Truck - 5000 Gallons	0.00	0.02	0.03	0.01	0.00	0.00
Haul Truck	0.00	0.01	0.04	0.00	0.00	0.00
Building Demolition	-	-	-	-	0.00	0.00
Subtotal - Building Demolition	0.07	0.39	0.86	0.14	0.08	0.08
Demolition - Apron						
Bulldozer - D9	0.03	0.16	0.42	0.07	0.03	0.03
Haul Truck - 20 CY - Asphalt	0.00	0.01	0.05	0.00	0.00	0.00
Haul Truck - 20 CY - Runway Base	0.00	0.00	0.02	0.00	0.00	0.00
Fugitive Dust (2)	0.05	-	0.21	-	1.42	2.83
Loader - 938G	0.07	0.44	0.72	0.12	0.08	0.08
Water Truck - 5000 Gallons	0.03	0.19	0.31	0.05	0.04	0.04
Subtotal - Apron Demolition	0.19	0.81	1.73	0.24	1.57	2.98
Demolition - Airfield Facilities - Other						
Backhoe	0.05	0.33	0.53	0.09	0.06	0.06
Bulldozer	0.07	0.36	0.96	0.16	0.08	0.07
Crane w/Wrecking Ball	0.04	0.24	0.31	0.05	0.04	0.04
Loader	0.07	0.37	1.00	0.16	0.08	0.08
Water Truck - 5000 Gallons	0.02	0.08	0.11	0.02	0.01	0.01
Haul Truck (1)	0.01	0.05	0.13	0.00	0.00	0.00
Building Demolition	-	-	-	-	0.00	0.00
Subtotal - Airfield Demolition	0.26	1.43	3.04	0.48	0.27	0.27
Construction - Building Facilities						
Air Compressor - 100 CFM	0.06	0.35	0.57	0.09	0.07	0.06
Concrete/Industrial Saw	0.11	0.73	1.17	0.19	0.14	0.13
Crane	0.10	0.67	1.09	0.18	0.13	0.12
Forklift	0.08	0.53	0.85	0.14	0.10	0.10
Generator	0.07	0.43	0.69	0.11	0.08	0.08
Concrete Trucks	0.00	0.02	0.04	0.00	0.00	0.00
Supply Trucks	0.00	0.03	0.06	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	-	-
Subtotal - Building Construction	0.43	2.75	4.46	0.72	0.51	0.50
Construction - New Apron						
Haul Truck - 20 CY - Asphalt (1)	0.01	0.02	0.15	0.00	0.00	0.00
Asphalt Spreader - BG 240C	0.07	0.44	0.71	0.12	0.08	0.08
Compactive Roller	0.06	0.39	0.63	0.10	0.07	0.07
Fugitive Dust	-	-	-	-	-	-
Grader - 14H	0.06	0.29	0.77	0.13	0.07	0.06
Loader - 938G	0.06	0.38	0.61	0.10	0.07	0.07
Oil Truck	0.03	0.16	0.43	0.07	0.04	0.04
Vibratory Compactor - CB 355D	0.14	0.75	1.21	0.20	0.14	0.14
Subtotal - Apron Construction	0.43	2.44	4.52	0.72	0.47	0.46
Construction - Airfield Facilities - Other						
Air Compressor - 100 CFM	0.11	0.47	0.81	0.14	0.09	0.09
Concrete/Industrial Saw	0.23	1.40	1.79	0.30	0.23	0.23
Crane	0.16	0.56	1.51	0.25	0.13	0.12
Forklift	0.17	1.02	1.31	0.22	0.17	0.17
Generator	0.12	0.66	0.99	0.17	0.12	0.11
Concrete Trucks	0.00	0.03	0.06	0.00	0.00	0.00
Supply Trucks	0.01	0.04	0.09	0.01	0.01	0.01
Fugitive Dust	-	-	-	-	-	-
Subtotal - Airfield Construction	0.79	4.19	6.56	1.08	0.75	0.73
Total Emissions - 8 squadrons	2.16	12.00	21.16	3.37	3.66	5.01
Annual Emissions - 8 squadrons	1.08	6.00	10.58	1.68	1.83	2.50
Arizona Conformity De Minimis Thresholds	NA	NA	NA	NA	100	NA

Table B1-202. Construction Equipment Source Data for MCAS Yuma - 2 MV-22 Squadrons Alternative

Construction Activity/Equipment Typ	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days*	*Total Hp-Hrs*
Demolition - Building Facilities								
Backhoe	160	0.50	2	160	8	1,280	2	2,005
Bulldozer	310	0.50	2	310	8	2,480	2	3,885
Crane w/Wrecking Ball	180	0.50	1	90	8	720	2	1,128
Loader	215	0.50	3	323	8	2,580	2	4,041
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	2	439
Haul Truck (1)	NA	NA	10	NA	20	200	2	313
Building Demolition (3)	NA	NA	NA	NA	8	NA	2	139,590
Demolition - Apron								
Bulldozer - D9	405	0.50	1	203	8	1,620	-	-
Haul Truck - 20 CY - Asphalt (1)	NA	NA	4	NA	-	#DIV/0!	-	-
Haul Truck - 20 CY - Runway Base (	NA	NA	4	NA	-	#DIV/0!	-	-
Fugitive Dust (2)	NA	NA	2	NA	8	NA	-	-
Loader - 938G	160	0.50	2	160	8	1,280	-	-
Water Truck - 5000 Gallons	175	0.40	2	140	4	560	-	-
Demolition - Airfield Facilities - Other								
Backhoe	160	0.50	2	160	8	1,280	0	-
Bulldozer	310	0.50	2	310	8	2,480	0	-
Crane w/Wrecking Ball	180	0.50	1	90	8	720	0	-
Loader	215	0.50	3	323	8	2,580	0	-
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	0	-
Haul Truck (1)	NA	NA	10	NA	20	200	0	-
Building Demolition (3)	NA	NA	NA	NA	8	NA	0	-
Construction - Building Facilities								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	189	33,980
Concrete/Industrial Saw	84	0.73	1	61	6	368	189	69,454
Crane	190	0.30	1	57	6	342	189	64,561
Forklift	94	0.48	1	45	6	268	189	50,573
Generator	45	0.60	1	27	8	216	189	40,775
Concrete Trucks (1)	NA	NA	15	NA	14	210	9	1,802
Supply Trucks (1)	NA	NA	20	NA	10	200	14	2,860
Fugitive Dust (2)	NA	NA	1	NA	8	NA	46	46
Construction - New Apron								
Haul Truck - 20 CY - Asphalt (1)	NA	NA	10	NA	198	1,981	8	16,340
Asphalt Spreader - BG 240C	153	0.60	2	184	8	1,469	8	12,118
Compactive Roller	165	0.50	2	165	8	1,320	8	10,890
Fugitive Dust (2)	NA	NA	2	NA	8	NA	17	33
Grader - 14H	215	0.50	2	215	8	1,720	8	14,190
Loader - 938G	160	0.50	2	160	8	1,280	8	10,560
Oil Truck	300	0.40	1	120	8	960	8	7,920
Vibratory Compactor - CB 355D	105	0.75	2	158	8	1,260	17	20,790
Construction - Airfield Facilities - Other								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	290	52,261
Concrete/Industrial Saw	84	0.73	1	61	6	368	290	106,821
Crane	190	0.30	1	57	6	342	290	99,296
Forklift	94	0.48	1	45	6	268	290	77,781
Generator	45	0.60	1	27	8	216	290	62,713
Concrete Trucks (1)	NA	NA	15	NA	14	210	13	2,771
Supply Trucks (1)	NA	NA	20	NA	10	200	22	4,399
Fugitive Dust (2)	NA	NA	1	NA	8	NA	70	70

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

(2) Number Active is acres disturbed at one time and Total Fuel Use is acre-days disturbed.

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

Table B1-203. Construction Emissions for MCAS Yuma - 2 MV-22 Squadrons Alternative

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Demolition - Building Facilities						
Backhoe	0.00	0.01	0.01	0.00	0.00	0.00
Bulldozer	0.00	0.01	0.02	0.00	0.00	0.00
Crane w/Wrecking Ball	0.00	0.00	0.01	0.00	0.00	0.00
Loader	0.00	0.01	0.02	0.00	0.00	0.00
Water Truck - 5000 Gallons	0.00	0.00	0.00	0.00	0.00	0.00
Haul Truck	0.00	0.00	0.00	0.00	0.00	0.00
Building Demolition	-	-	-	-	0.03	0.01
Subtotal - Building Demolition	0.00	0.03	0.06	0.01	0.03	0.01
Demolition - Apron						
Bulldozer - D9	-	-	-	-	-	-
Haul Truck - 20 CY - Asphalt	-	-	-	-	-	-
Haul Truck - 20 CY - Runway Base	-	-	-	-	-	-
Fugitive Dust (2)	-	-	-	-	-	-
Loader - 938G	-	-	-	-	-	-
Water Truck - 5000 Gallons	-	-	-	-	-	-
Demolition - Airfield Facilities - Other						
Backhoe	-	-	-	-	-	-
Bulldozer	-	-	-	-	-	-
Crane w/Wrecking Ball	-	-	-	-	-	-
Loader	-	-	-	-	-	-
Water Truck - 5000 Gallons	-	-	-	-	-	-
Haul Truck (1)	-	-	-	-	-	-
Building Demolition	-	-	-	-	-	-
Construction - Building Facilities						
Air Compressor - 100 CFM	0.02	0.11	0.18	0.03	0.02	0.02
Concrete/Industrial Saw	0.04	0.23	0.37	0.06	0.04	0.04
Crane	0.03	0.21	0.34	0.06	0.04	0.04
Forklift	0.03	0.16	0.27	0.04	0.03	0.03
Generator	0.02	0.13	0.21	0.03	0.02	0.02
Concrete Trucks	0.00	0.01	0.01	0.00	0.00	0.00
Supply Trucks	0.00	0.01	0.02	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.31	0.06
Subtotal - Building Construction	0.13	0.86	1.39	0.22	0.47	0.22
Construction - New Apron						
Haul Truck - 20 CY - Asphalt (1)	0.01	0.02	0.15	0.00	0.00	0.00
Asphalt Spreader - BG 240C	0.01	0.04	0.06	0.01	0.01	0.01
Compactive Roller	0.01	0.04	0.06	0.01	0.01	0.01
Fugitive Dust	-	-	-	-	0.31	0.06
Grader - 14H	0.01	0.03	0.07	0.01	0.01	0.01
Loader - 938G	0.01	0.03	0.06	0.01	0.01	0.01
Oil Truck	0.00	0.01	0.04	0.01	0.00	0.00
Vibratory Compactor - CB 355D	0.01	0.07	0.11	0.02	0.01	0.01
Subtotal - Apron Construction	0.05	0.24	0.55	0.07	0.35	0.11
Construction - Airfield Facilities - Other						
Air Compressor - 100 CFM	0.03	0.15	0.26	0.04	0.03	0.03
Concrete/Industrial Saw	0.07	0.45	0.58	0.10	0.08	0.07
Crane	0.05	0.18	0.49	0.08	0.04	0.04
Forklift	0.05	0.33	0.42	0.07	0.06	0.05
Generator	0.04	0.21	0.32	0.05	0.04	0.04
Concrete Trucks	0.00	0.01	0.02	0.00	0.00	0.00
Supply Trucks	0.00	0.01	0.03	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.31	0.06
Subtotal - Airfield Construction	0.25	1.35	2.12	0.35	0.55	0.30
Total Emissions - 2 squadrons	0.44	2.48	4.12	0.65	1.41	0.64
Annual Emissions - 2 squadrons	0.22	1.24	2.06	0.32	0.70	0.32
Arizona Conformity De Minimis Thresholds	NA	NA	NA	NA	100	NA

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APPENDIX B-2

SDAB Clean Air Act Conformity Determination

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CONFORMITY DETERMINATION

WEST COAST BASING OF THE MV-22 AIRCRAFT

WITHIN SAN DIEGO COUNTY, CALIFORNIA

EXECUTIVE SUMMARY

This report presents the Clean Air Act general conformity determination for the West Coast Basing of the MV-22 aircraft within San Diego County, California, as proposed by the Department of the Navy (DON) in the *Draft Environmental Statement for West Coast Basing of the MV-22* (DON 2009a). The San Diego Air Basin (SDAB) is in non-attainment of the national ambient air quality standards for ozone (O_3), and the western portion of the SDAB is a maintenance area for carbon monoxide (CO). This general conformity determination is required for ozone because the proposed action would exceed the annual conformity *de minimis* threshold of 100 tons per year of nitrogen oxides (NO_x) within the SDAB, as defined in San Diego County Air Pollution Control District (SDAPCD) Rule 1501, Section 1551.853(b). Because CO emissions associated with the proposed action are less than the existing baseline, a conformity determination is not required for this criteria pollutant.

Within the SDAB, comprised of San Diego County, the proposed MV-22 action would replace seven CH-46E active duty squadrons (90 aircraft) with 10 MV-22 squadrons (120 aircraft). Of the seven CH-46E active duty squadrons, three are based at Marine Corps Air Station (MCAS) Camp Pendleton and four are based at MCAS Miramar. The proposed action would base eight MV-22 active duty squadrons at MCAS Miramar and two MV-22 reserve squadrons at MCAS Camp Pendleton. The areas of proposed activities within San Diego County include the vicinities of (1) MCAS Miramar, (2) MCAS Camp Pendleton, (3) MCB Camp Pendleton, and (4) military training route (MTR) VR-1266. The action also would result in construction activities at both bases.

Existing and proposed emissions were calculated with the use of the most current methodologies and were based upon activity data derived from the Navy and Marine Corps and emission factors approved by the U.S. Environmental Protection Agency (EPA), California Air Resources Board (ARB), and the DON Aircraft Environmental Support Office (AESO). The Net Emissions Analysis presented in Attachment 1 to this report includes all supporting conformity-related emission calculations.

Table ES-1 summarizes the net change in conformity-related emissions that would occur from the proposed West Coast Basing of the MV-22 within the SDAB. These data show that the proposed action within the SDAB would exceed the NO_x conformity *de minimis* threshold beginning in 2011 and that they would reach a build-out maximum of 223.3 tons of NO_x in 2017 upon completion of the MV-22 replacement action. The most recent federally-approved O_3 State Implementation Plan (SIP) for the SDAB includes a Military Growth Increment budgeting for 4,161 tons per year of additional NO_x emissions from mobile sources associated with new military federal actions between 2005 and 2014 (SDAPCD 2002). NO_x emissions from the proposed action would be covered by this Military Growth Increment. Therefore, NO_x emissions from the proposed action,

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in combination with all other emissions in the SDAB, would not exceed the NO_x emissions budget in the SIP. Pursuant to Section 1551.858(a)(1), the proposed action within the SDAB would conform to the applicable SIP.

Table ES-1. Summary of the Net Change in Conformity-Related Emissions within the SDAB due to the Proposed West Coast Basing of the MV-22

YEAR/ACTIVITY	*ANNUAL EMISSIONS (TONS)* (1)		
	VOC	*CO*	*NO_x*
YEAR 2010			
Construction	1.78	6.87	12.68
(+2) MV-22 Squadrons	8.22	79.14	72.55
(-2) CH-46 Squadrons	-33.29	-169.18	-24.28
Net Emissions – 2010	**-23.29**	**-83.17**	**60.96**
YEAR 2011(2)			
Construction	1.78	6.87	12.68
(+4) MV-22 Squadrons	16.44	158.29	145.10
(-2) CH-46 Squadrons	-33.29	-169.18	-24.28
Net Emissions – 2011	**-15.07**	**-4.02**	**133.50**
YEAR 2014(3)			
(+6) MV-22 Squadrons	20.55	197.86	181.38
(-5) CH-46 Squadrons	-87.05	-442.24	-64.16
Total Emissions – 2014	**-66.50**	**-244.38**	**117.22**
YEAR 2017			
(+10) MV-22 Squadrons	39.16	371.13	318.07
(-7) CH-46 Squadrons	-128.57	-647.72	-94.78
Net Emissions – 2017	**-89.40**	**-276.59**	**223.30**
SDAB Conformity Thresholds	**100.00**	**100.00**	**100.00**

Note: (1) – indicates a reduction in pollutant emissions.
(2) Year when proposed action first would exceed the 100 TPY NOx *de minimis* threshold.
(3)Year 2014 is the furthest year when the applicable SIP projects an emissions budget.

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1.0 INTRODUCTION

This report presents the draft Clean Air Act general conformity determination for the West Coast Basing of the MV-22 aircraft within San Diego County, California, as proposed by the Department of the Navy (DON) in the *Draft Environmental Statement for West Coast Basing of the MV-22* (DON 2009a). This report includes (1) a discussion of the Clean Air Act general conformity requirements promulgated by the U.S. Environmental Protection Agency (EPA) and implemented by San Diego County Air Pollution Control District (SDAPCD) Rule 1501 and how they relate to the proposed action within the San Diego Air Basin (SDAB) (comprised of San Diego County), (2) the conformity applicability analysis for the proposed action, and (3) the conformity determination for the proposed action within the SDAB.

2.0 CLEAN AIR ACT CONFORMITY REQUIREMENTS

2.1 Introduction

The Clean Air Act (CAA) required the Environmental Protection Agency (EPA) to establish a list of air pollutants that "may reasonably be anticipated to endanger public health and welfare" and to set National Ambient Air Quality Standards (NAAQS) to protect public health. The EPA listed the following as criteria pollutants: sulfur dioxide (SO2), respirable and fine particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and lead (Pb). The EPA was also charged with designating geographic areas where the air quality fails to meet the NAAQS for one or more of these criteria pollutants. These geographic areas are known as nonattainment areas. Each State that has a nonattainment area or areas must develop a plan, a State Implementation Plan (SIP), to demonstrate how it will achieve and maintain the NAAQS. Once a nonattainment area has achieved compliance with the NAAQS, its designation is changed to that of a maintenance area and is then subject to an air quality maintenance plan.

In 1993, the EPA promulgated the General Conformity Rule to implement a 1990 amendment to the CAA. Specifically, the Conformity Rule requires that "[n]o department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license to permit, or approve any activity that does not conform to an applicable implementation plan."[1] The Rule divides the air conformity process into two distinct phases: applicability and determination. It is the responsibility of the federal agency proposing the action to engage in this process to determine conformity to the applicable SIP before the proposed action is taken.[2]

2.2 Purpose of the General Conformity Rule

The EPA General Conformity Rule requires federal agencies to analyze proposed actions according to standardized procedures and to provide a public review and comment process. The conformity determination process is intended to demonstrate that the proposed federal action will not cause or contribute to new violations of a national ambient air quality standard (NAAQS); will not increase the frequency or severity of existing violations of any standard; and will not delay the timely attainment of any standard.

[1] 40 CFR §§ 51.850(a), 93.150 (Note: Part 51, Subpart W applies when a state or area in which a federal action occurs has an EPA approved rule in its SIP; Part 93, Subpart B applies in the absence of an EPA approved rule; SDAPCD Rule 1501 was approved by EPA on 22 Jun 99)

[2] 40 CFR § 51.850(b)

2.3 Applicability of the General Conformity Rule in the San Diego Air Basin

In accordance with EPA regulations, the SDAPCD promulgated Rule 1501 to establish conformity criteria and procedures governing the "Conformity of General Federal Actions."[3] Rule 1501 applies to federal actions proposed within the SDAB. A federal agency proposing an action in the SDAB must determine the rule's applicability by conducting a conformity applicability analysis.[4] This analysis must calculate the total of direct and indirect emissions from all non-exempt sources, including mobile, area, and non-permitted stationary sources that are not subject to New Source Review or Prevention of Significant Deterioration regulations.[5] Depending upon the results of the analysis, the inquiry either ends with the conformity applicability analysis or proceeds to a conformity determination.

A conformity determination is not required if total net direct and indirect emissions associated with the proposed action do not equal or exceed the applicable *de minimis* thresholds and are not "regionally significant."[6] Additionally, a conformity determination is not required for actions listed in Rule 1501 "which would result in no emissions or an increase in emissions that are clearly *de minimis*." [7]

The proposed action includes MV-22 operations within the SDAB in the vicinity of Marine Corps Air Station (MCAS) Miramar, MCAS Camp Pendleton, Marine Corps Base (MCB) Camp Pendleton, and military training route (MTR) VR-1266. The SDAB is designated a nonattainment area for the 8-hour ozone NAAQS. Additionally, the western portion of the SDAB (the portion of San Diego County generally west of the interior desert region) is a maintenance area for the CO NAAQS. Therefore, a conformity applicability analysis is required for emissions of VOC, NO_x, and CO associated with the proposed action in the SDAB. The *de minimis* theshold for VOC, NO_x and CO is 100 tons per year for each pollutant.

2.4 Conformity Determination Process

If the total net direct and indirect emissions associated with the proposed action equal or exceed the applicable *de minimis* threshold or are "regionally significant" the federal agency must make a conformity determination.[8] In other words, the federal agency must demonstrate that the proposed action conforms to the applicable SIP. The applicable ozone SIP for the SDAB is the *Ozone Redesignation Request and Maintenance Plan for San Diego County* (*1-Hour Ozone Maintenance Plan*), which is the most recent federally-approved O_3 SIP for the SDAB (SDAPCD 2002).

The federal agency undertaking the action is responsible for preparing and issuing the conformity determination under the EPA conformity rules. Other federal, state, and local agencies have review and comment responsibility, but no agency has approval/denial authority over the conformity determination.

The demonstration of conformity is accomplished through a public process following the criteria and procedures outlined in Rule 1501, specifically §§ 1551.856, 1551.858, and 1551.859. This

[3] SDAPCD Rule 1501 substantially mirrors the requirements listed in 40 CFR Part 51, Subpart W and Part 93, Subpart B
[4] Rule 1501, § 1551.850(b)
[5] Id. at § 1551.853(b) & (d)(1)
[6] Id. at § 1551.853(c)(1) & (i). Cite to the appropriate table for thresholds. "Regionally Significant" means that the total net direct and indirect emissions of any pollutant of concern represents 10% or more of a nonattainment or maintenance area's total emissions of that pollutant.
[7] Id. at § 1551.853(c)(2)
[8] Id. at § 1551.853(b) & (i)

process must result in a "positive" conformity determination before the proposed federal action may be implemented.[9] The federal agency's conformity determination must demonstrate conformity for (1) the Clean Air Act mandated attainment year, or if applicable, the farthest year for which emissions are projected in a maintenance plan; (2) the year when the total annual emissions from the proposed action are the greatest; and (3) any year for which the applicable SIP specifies an annual emissions budget. For the proposed action, the years of analysis are Year 2017, when total annual emissions from the proposed action are greatest; and Years 2010 and 2014, when the most recent federally-approved SIP for the SDAB specifies annual emissions budgets.

The federal agency provides a copy of its draft conformity determination to the applicable EPA Region, State and local air quality regulators, impacted federal land managers, and the relevant metropolitan planning organization. These agencies have 30 days to review and comment. The draft is made available for public review (30-day review period). The comment period may be concurrent with the review and comment period for a related environmental analysis under the National Environmental Policy Act.

2.5 Demonstrating Conformity

SDAPCD Rule 1501 provides several methods by which a federal agency may demonstrate Clean Air Act conformity for actions in the SDAB.

- Conformity is presumed if direct and indirect emissions from the activity are specifically identified and accounted for in the attainment or maintenance demonstration of a SIP approved after 1990 (Section 1551.858[a][1]).

- Conformity is demonstrated if direct and indirect emissions from the action are fully offset through compensating emission reductions implemented through a federally enforceable mechanism (Sections 1551.858[a][2] and 1551.858[a][5][iii]).

- Conformity also can be demonstrated if the agency responsible for SIP preparation provides documentation that direct and indirect emissions associated with the federal agency action are accommodated within the emission forecasts contained in an approved SIP (Section 1551.858[a][5][i][A]).

- If conformity cannot be demonstrated through one of the procedures noted above, conformity may be determined if the SDAPCD notifies EPA that appropriate changes will be made in the applicable SIP documents. The SDAPCD would have to commit to a schedule for preparing an acceptable SIP amendment that accommodates the net increase in direct and indirect emissions from the federal action without causing any delay in the schedule for attaining the relevant NAAQS (Section 1551.858[a][5][i][B]).

All conformity determinations must also demonstrate that total direct and indirect emissions are consistent with all relevant requirements and milestones in the applicable SIP including reasonable further progress schedules; assumptions specified in the attainment or maintenance demonstration; and SIP prohibitions, numerical emission limits, and work practice requirements.

[9] Id. at § 1551.860

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3.0 CONFORMITY DETERMINATION FOR THE PROPOSED ACTION WITHIN THE SAN DIEGO AIR BASIN

The proposed West Coast Basing of the MV-22 would replace seven CH-46E active duty squadrons (90 aircraft) with 10 MV-22 squadrons consisting of eight active duty squadrons and two reserve squadrons with a combined total of 120 aircraft. Of the seven CH-46E active duty squadrons, three are based at MCAS Camp Pendleton and four are based at MCAS Miramar. The proposed action would base eight MV-22 active duty squadrons at MCAS Miramar and two MV-22 reserve squadrons at MCAS Camp Pendleton. The areas of proposed activities within the SDAB include the vicinities of MCAS Miramar, MCAS Camp Pendleton, MCB Camp Pendleton, and MTR VR-1266, as described in section 2.1.3 of the project Draft EIS. In addition to aircraft operations in these areas, the proposed action would result in construction activities at MCAS Miramar and MCAS Camp Pendleton.

The proposed action would result in a net change in emissions within the SDAB. The EPA considers the SDAB to be in nonattainment of the O_3 standard and in maintenance of the CO standard. The applicable conformity *de minimis* thresholds for the SDAB are 100 tons per year (each) of VOC, NO_x, and CO. The air quality analysis in this section estimates that net emissions of CO and VOC would decrease in all years (2010 through 2017). Net emissions of NOx would exceed the *de minimis* threshold beginning in year 2011. The discussion below demonstrates conformity of the proposed action based on Section 1551.858(a)(1): "The total of direct and indirect emissions from the action are specifically identified and accounted for in the applicable SIP's attainment or maintenance demonstration."

3.1 Emission Estimates

The following presents the methods used to estimate conformity-related emissions generated by the proposed action within the SDAB. The Net Emissions Analysis presented in Attachment 1 to this report includes all supporting conformity-related emission calculations.

Construction

The proposed action would require construction and/or renovation of airfield facilities to accommodate the basing decision. Basing eight squadrons of MV-22 aircraft at MCAS Miramar would require the demolition of existing facilities and construction of new hangar modules, parking apron, fueling pits, and wash racks. Basing two squadrons of MV-22 aircraft at MCAS Camp Pendleton would require the construction of a new hangar module, modifications to an existing hangar, a new wash rack, and a new parking apron. New facilities would require the demolition and relocation of an existing ordnance operations building, either as an addition to the proposed new hangar or as a standalone facility. The analysis assumes that construction activities would be evenly split between years 2010 and 2011.

Emissions of VOC, CO, and NO_x generated by proposed construction activities would occur from combustive emissions due to the use of fossil fuel-powered construction equipment. Activity data needed to estimate equipment usage for proposed construction activities were used to estimate project combustive emissions (DON 2007). Factors needed to derive construction source emission rates were obtained from the *EMFAC2007 Model* for on-road vehicles (ARB 2006a) and *OFFROAD2007 Model* for off-road construction equipment (ARB 2006b).

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Table 3-1 presents a summary of conformity-related construction emissions that would occur from the proposed action within the SDAB. Annual construction emissions would be the same in either 2010 or 2011.

Table 3-1. Annual Conformity-Related Emissions within the SDAB due to Construction of the Proposed West Coast Basing of the MV-22

PROJECT SCENARIO/ACTIVITY	*ANNUAL EMISSIONS (TONS)*		
	VOC	*CO*	*NO_x*
MCAS MIRAMAR – 2010			
Demolition – Building Facilities	0.04	0.26	0.66
Demolition – Airfield Facilities	0.23	1.35	3.30
Construction – Building Facilities	0.38	1.33	2.25
Construction – Airfield Facilities	0.60	2.19	3.80
Annual Emissions	**1.24**	**5.12**	**10.01**
MCAS CAMP PENDLETON – 2010			
Demolition – Building Facilities	0.00	0.00	0.01
Construction – Building Facilities	0.17	0.57	0.85
Construction – Airfield Facilities	0.37	1.18	1.81
Annual Emissions	**0.54**	**1.75**	**2.67**
SDAB Annual Construction Emissions	**1.78**	**6.87**	**12.68**
Note: Emissions would be the same in either 2010 or 2011.			

Operations

The net change in emissions associated with the proposed action within the SDAB was estimated by subtracting baseline CH-46 emissions from those associated with the MV-22. Existing and proposed sources affected by the proposed action would include (1) operations and engine maintenance/testing of CH-46 and MV-22 aircraft, (2) personal- and government-owned vehicles (POVs and GOVs), (3) ground/tactical support equipment (G/TSE), (4) routine construction, and (5) non-permitted stationary and other sources. Annual emissions are estimated for 2010, when the first MV-22 squadrons begin operating in the SDAB, through 2017 when all ten MV-22 squadrons are based and operating in the SDAB.

Emissions associated with existing CH-46 operations at MCAS Miramar and MCAS Camp Pendleton were obtained from the "build-out" scenario identified in the conformity analyses prepared for the planned realignment at Naval Air Station (NAS)/ MCAS Miramar and MCAS Camp Pendleton in response to the Base Realignment and Closure (BRAC) directives of 1993 and 1995. The report compares the annual emissions for NAS Miramar as a fully operational Navy master jet base and MCAS Camp Pendleton prior to the federal action (i.e., "base case") to annual emissions from MCAS Miramar and MCAS Camp Pendleton as fully operational USMC air stations (URS 2004). Operational data used to calculate emissions due to existing CH-46 aircraft operations within the MCB Camp Pendleton Ranges were obtained from the project Draft EIS noise analyses (Wyle 2008). Factors used to calculate CH-46 combustive emissions were obtained from the DON (Aircraft Environmental Support Office [AESO] 2001a and 2001b). Table 3-2 summarizes the conformity-related emissions associated with existing CH-46 operations within the SDAB.

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Table 3-2. Annual Conformity-Related Emissions within the SDAB Associated with Existing Conditions of the Proposed West Coast Basing of the MV-22 (CH-46E Operations)

PROJECT AREA/ACTIVITY	*ANNUAL EMISSIONS (TONS)*		
	VOC	*CO*	*NO_x*
MCAS MIRAMAR			
CH-46E Aircraft	41.00	161.00	19.00
Personal-Owned Vehicles	8.42	64.17	6.10
Government-Owned Vehicles	0.85	5.73	2.07
Ground/Tactical Support Equipment	8.20	80.78	7.02
Construction	0.12	1.22	0.49
Other Sources	0.61	2.93	0.61
Stationary Sources	3.00	2.50	9.20
Total Existing MCAS Miramar Emissions	**62.20**	**318.33**	**44.50**
MCAS CAMP PENDLETON			
CH-46E Aircraft	44.00	171.00	20.00
Personal-Owned Vehicles	5.00	37.00	4.00
Government-Owned Vehicles	1.00	4.00	1.00
Ground/Tactical Support Equipment	7.00	69.00	6.00
Construction	1.00	3.00	5.00
Other Sources	---	---	1.00
Stationary Sources	0.70	3.90	4.90
Total Existing MCAS Camp Pendleton Emissions	**58.70**	**287.90**	**41.90**
MCB CAMP PENDLETON RANGES			
CH-46E Aircraft	7.67	41.48	8.38
Total Existing MCB Camp Pen. Ranges Emissions	**7.67**	**41.48**	**8.38**
Total Annual Existing CH-46 Emissions – SDAB	**128.57**	**647.72**	**94.78**
Note:			

Operational data used to calculate proposed MV-22 aircraft emissions within the SDAB were obtained from the project EIS noise analyses (Wyle 2008). Factors used to calculate combustive emissions for the MV-22 aircraft were obtained from the DON (AESO 2001c and 2001d).

At MCAS Miramar, annual emissions from proposed construction, other, and stationary source categories were estimated by multiplying annual emissions for these sources due to current CH-46 operations at MCAS Miramar to the ratio of the annual population associated with the MV-22 action and current CH-46 basing population (1,269). The population associated with the full build-out at MCAS Miramar in year 2017 is equal to 2,411 personnel. Annual emissions from proposed G/TSE were estimated by multiplying annual G/TSE emissions due to current CH-46 operations at MCAS Miramar to the ratio of the annual number of MV-22 aircraft associated with the proposed action and current CH-46 aircraft numbers (48). It is expected that this technique overstates proposed G/TSE emissions, as it does not consider the replacement of existing equipment with newer and cleaner emitting equipment. Annual emissions from proposed POVs/GOVs were estimated by multiplying existing annual emissions to the ratio of the annual populations associated with the MV-22 action and current CH-46 basing condition and the ratio of

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2012/2000 San Diego County average emission factors obtained from the *EMFAC2007 Model* Burden output.

At MCAS Camp Pendleton, annual emissions from proposed construction, other, and stationary source categories were estimated by multiplying annual emissions from these sources due to current CH-46 operations at MCAS Camp Pendleton to the ratio of the annual population associated with the MV-22 action and current CH-46 basing population (908). The population associated with the full build-out at MCAS Camp Pendleton in year 2017 is equal to 712 personnel. Annual emissions from proposed G/TSE were estimated by multiplying annual emissions from current CH-46 operations at MCAS Camp Pendleton to the ratio of the annual number of MV-22 aircraft associated with the proposed action and current CH-46 aircraft numbers (41). Annual emissions of proposed POVs/GOVs were estimated by multiplying existing annual emissions to the ratio of the annual populations associated with the MV-22 action and current CH-46 basing condition and the ratio of 2012/2000 San Diego County average emission factors obtained from the *EMFAC2007 Model* Burden output. Table 3-3 summarizes the conformity-related emissions that would occur from the proposed MV-22 operations within the SDAB upon full build-out in year 2017.

3.2 Conformity Applicability Analysis

Table 3-4 summarizes the net change in annual conformity-related emissions that would occur from the proposed West Coast Basing of the MV-22 within the SDAB, including (1) the first year of construction and operational emissions (2010), (2) the final year of construction and year when the proposed action first would exceed the 100 tons per year NO_x *de minimis* threshold (2011), and (3) the maximum year of emissions that would occur upon completion of the MV-22 replacement action (2017). These data show that net NO_x emissions from the proposed action within the SDAB would exceed the NO_x conformity *de minimis* threshold beginning in 2011 and would peak at the completion of the West Coast Basing of the MV-22 in 2017. Therefore, pursuant to Section 1551.853(b) of SDAPCD Rule 1501, the DON must perform a conformity determination to demonstrate how proposed NO_x emissions will conform to the applicable SIP. Table 3-4 also shows that conformity-related emissions of VOC and CO from the proposed action would not exceed the *de minimis* thresholds. Additionally, all conformity-related emissions would be well below 10 percent of the SDAB emission inventories for these pollutants. Consequently, emissions of VOC and CO from the proposed action within the SDAB would be exempt from the conformity determination requirements of Section 1551.853(c)(1).

3.3 Conformity Determination

The conformity applicability analysis for the proposed action identifies that net NO_x emissions within the SDAB would exceed the *de minimis* threshold beginning in 2011. Section 1551.853(b) of SDAPCD Rule 1501, therefore, requires the DON to demonstrate that NO_x emissions from the proposed action conform to the applicable SIP

Section 1551.858(a)(1) provides that a conformity demonstration may be presumed if direct and indirect emissions from the activity are specifically identified and accounted for in the applicable SIP. Section 1551.852 defines the applicable SIP as the most recent SIP approved by the U.S. Environmental Protection Agency. The applicable SIP for the SDAB is the December 2002 *Ozone Redesignation Request and Maintenance Plan for San Diego County* (SDAPCD 2002).

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Table 3-3. Annual Conformity-Related Emissions within the SDAB due to Operation of the Proposed West Coast Basing of the MV-22s – Full Build-out Year 2017

PROJECT AREA/ACTIVITY	*ANNUAL EMISSIONS (TONS)*		
	VOC	*CO*	*NO_x*
MCAS MIRAMAR			
MV-22 Operations	0.73	48.35	110.86
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08
Personal-Owned Vehicles	4.60	33.43	4.27
Government-Owned Vehicles	0.47	2.99	1.45
Ground/Tactical Support Equipment	16.87	166.31	14.46
Construction	0.19	1.91	0.76
Other Sources	0.95	4.58	0.95
Stationary Sources	4.69	3.91	14.39
Total Proposed MCAS Miramar Emissions	**28.70**	**273.91**	**169.24**
MCAS CAMP PENDLETON			
MV-22 Operations	0.21	13.52	26.40
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73
Personal-Owned Vehicles	3.92	29.01	3.14
Government-Owned Vehicles	0.78	3.14	0.78
Ground/Tactical Support Equipment	4.10	40.39	3.51
Construction	0.78	1.68	2.81
Other Sources	-	-	0.78
Stationary Sources	0.55	3.06	3.84
Total Proposed MCAS Camp Pendleton Emissions	**10.38**	**93.47**	**46.00**
MCB CAMP PENDLETON RANGES			
MV-22 Operations	0.08	3.70	101.59
Total Proposed MCB Camp Pen. Ranges Emissions	**0.08**	**3.70**	**101.59**
MTR VR-1266			
MV-22 Operations	0.00	0.05	1.24
Total Proposed MTR Emissions	**0.00**	**0.05**	**1.24**
Total Annual Proposed MV-22 Emissions – SDAB	**39.16**	**371.13**	**318.07**

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Table 3-4. Net Change in Annual Conformity-Related Emissions within the SDAB due to Implementation of the Proposed West Coast Basing of the MV-22

YEAR/ACTIVITY	*ANNUAL EMISSIONS (TONS)* [1]		
	VOC	*CO*	*NOx*
YEAR 2010			
Construction - MCAS Miramar	1.24	5.12	10.01
Construction - MCAS Camp Pendleton	0.54	1.75	2.67
(+2) MV-22 Squadrons at MCAS Miramar	8.20	78.26	48.35
(-2) CH-46 Squadrons at MCAS Miramar	-31.10	-159.17	-22.25
(+2) MV-22 Squadrons at MCB Camp Pendleton Range	0.02	0.87	23.90
(-2) CH-46 Squadrons at MCB Camp Pendleton Range	-2.19	-10.02	-2.03
(+2) MV-22 Operations within VR-1266	0.00	0.01	0.29
Net Emissions – 2010	**-23.29**	**-83.17**	**60.96**
YEAR 2011 [2]			
Construction - MCAS Miramar	1.24	5.12	10.01
Construction - MCAS Camp Pendleton	0.54	1.75	2.67
(+4) MV-22 Squadrons at MCAS Miramar	16.40	156.52	96.71
(-2) CH-46 Squadrons at MCAS Miramar	-31.10	-159.17	-22.25
(+4) MV-22 Squadrons at MCB Camp Pendleton Range	0.04	1.74	47.81
(-2) CH-46 Squadrons at MCB Camp Pendleton Range	-2.19	-10.02	-2.03
(+4) MV-22 Operations within VR-1266	0.00	0.02	0.59
Net Emissions – 2011	**-15.07**	**-4.02**	**133.50**
YEAR 2014 [3]			
(+6) MV-22 Squadrons at MCAS Miramar	20.50	195.65	120.89
(-4) CH-46 Squadrons at MCAS Miramar	-62.20	-318.33	-44.50
(-1) CH-46 Squadrons at MCAS Camp Pendleton	-19.37	-95.01	-13.83
(+6) MV-22 Squadrons at MCB Camp Pendleton Range	0.05	2.18	59.76
(-5) CH-46 Squadrons at MCB Camp Pendleton Range	-5.48	-28.90	-5.84
(+6) MV-22 Operations within VR-1266	0.00	0.03	0.73
Net Emissions – 2014	**-66.50**	**-244.38**	**117.22**
YEAR 2017			
(+8) MV-22 Squadrons at MCAS Miramar	28.70	273.91	169.24
(+2) MV-22 Squadrons at MCAS Camp Pendleton	10.38	93.47	46.00
(-4) CH-46 Squadrons at MCAS Miramar	-62.20	-318.33	-44.50
(-3) CH-46 Squadrons at MCAS Camp Pendleton	-58.70	-287.90	-41.90
(+10) MV-22 Squadrons at MCB Camp Pen. Range	0.08	3.70	101.59
(-7) CH-46 Squadrons at MCB Camp Pendleton Range	-7.67	-41.49	-8.38
(+10) MV-22 Operations within VR-1266	0.00	0.05	1.24
Net Emissions – 2017	**-89.40**	**-276.59**	**223.30**
SDAB Conformity Thresholds	**100.00**	**100.00**	**100.00**
SDAB Annual Emissions[4]	**67,258**	**333,763**	**77,044**

Note: (1) – indicates a reduction in pollutant emissions.
(2) Year when proposed action first would exceed the 100 TPY NOx *de minimis* threshold.
(3) Year 2014 = furthest year when the applicable SIP projects an emissions budget.
(4) Tons per year of emissions estimated for the SDAB in 2006 (ARB 2007).

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Section 5.3.2 of the 2002 SIP specifically identifies and accounts for a Military Growth Increment in anticipation of "potential actions at Navy and Marine Corps facilities in San Diego County over the next decade that could require conformity determinations." The Military Growth Increment totals 11.4 tons per day, or 4,161 tons per year.

Table 3-4 presents the net NO_x emissions associated with the proposed MV-22 action within the SDAB for the first year of the proposed action (2010), the first year net emissions exceed the *de minimis* threshold (2011), the furthest year of applicable SIP's maintenance plan (2014), and the year of greatest emissions (2017). Table 3-5 identifies continuing NO_x emissions associated with other DON actions that have been undertaken within the SDAB during the period covered by the applicable SIP and its Military Growth Increment, such that 3,770.59 tons of annual emissions growth remains available. As shown in Table 3-5, this remaining Military Growth Increment is more than sufficient to cover the net NO_x emissions associated with the proposed MV-22 action. Therefore, applying section 1551.858(a)(1), the proposed MV-22 action is presumed to conform to the SIP because the net NO_x emissions are covered by the Military Growth Increment that is specifically identified and accounted for in the 2002 SIP.

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Table 3-5. NOx Emissions from DON Actions in San Diego County - 2002 through 2009

San Diego DoD Projects	*Installation*	*Decision Date*	*Year of Maximum Emissions*	*Maximum NOx Emissions (TPY)*
P-013 ABV (Assault Breacher Vehicle)	MCB CPen	Jan-06	2006	3.91
Hydrogen Fueling Station	MCB CPen	Sep-06	2005	0.01
Expeditionary Fighting Vehicle (EFV) Testing	MCB CPen	Jul-04	2005	26.69
MILCON P613 -Battle Range	MCB CPen	Jun-05	2005	1.30
San Jacinto Ext. and Temp Lodging	MCB CPen	Jan-08	2008	1.20
Advanced Amphibious Assault Vehicle (AAAV)	MCB CPen	May-03	2016	42.50
East Miramar PPV Family Housing	MCAS Miramar	Aug-09	2012	26.30
Las Pulgas Landfill Expansion	MCB CPen	Aug 02	2002	27.1
PPV South Mesa *I* Trailer Park	MCB CPen	Aug-06	2009	4.60
San Onofre Landfill Expansion	MCB CPen	Aug 02	2002	11.4
GTF Temporary Facilities	MCB CPen	*N/A*	2010	6.70
Tertiary Treatment Plant	MCB CPen	Sep-03	2006	39.40
Navy Lodge Expansion	NASNI	Jan-06	2014	3.87
Navy Broadway Complex	Navy Broadway Complex	Jun-06	2016	6.70
C-40	NBC	*N/A*	*N/A*	0.84
Phase I BRAC, San Diego	NBPL and NBSD	May-07	2007	4.10
BRAC MCM Realignment: Ingleside to San Diego	NBPL and NBSD	Feb-08	2008	38.24
Unaccompanied Housing PPV NAVSTA and FASW	NBSD	JuJ-06	2006	1.30
P-793 BRAC Phase II MCM Realignment	NBPL and NBSD	Apr 09	2009	13.29
La Posta MWTF	San Diego	Jun-07	2008	0.96
BRAC MCAS Miramar/MCAS Camp Pendleton	MCAS Miramar/CPen	Jan-04	2000	130.00
Total NOx Emissions (Tons per Year)				**390.41**
Military Growth Increment in Applicable SIP				**4,161.00**
Military Growth Increment Available for Proposed Action				**3,770.59**
Maximum NOx Emissions from Proposed Action				**223.30**
Conforms Based on Section 1551.858(a)(1)?				**Yes**

Installation Acronyms:
- MCAS Miramar -Marine Corps Air Station Miramar
- MCB CPen -Marine Corps Base Camp Pendleton
- NASNI -Naval Air Station North Island
- NBC -Naval Base Coronado
- NBPL -Naval Base Point Loma
- NBSD -Naval Base San Diego

GTF -Grow the Force
N/A -Not available (assumes emissions occur)

Source: DON 2009b

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Attachment 1
Net Emissions Analysis
Proposed MV-22 Basing in the SDAB
Conformity Determination

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Attachment 1 - Net Emissions Analysis - Proposed MV-22 Basing in the SDAB - Conformity Determination

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Table CD-1. Existing and Proposed Annual CH-46 Operations - Air Stations

	Year/Annual Operations							
Location/Flight Activity	*09*	*10*	*11*	*12*	*13*	*14*	*15*	
MCAS Miramar								
CH-46 Operations - % of Year 2000 Activity (1)	100	50	50	-	-	-	-	-
MCAS Camp Pendleton								
CH-46 Operations - % of Year 2000 Activity (1)	100	100	100	100	100	67	-	-
Air Spaces								
CH-46 Operations - % of Year 2000 Activity (1)(2)	100	71	71	43	43	29	-	-

Notes: (1) Equates to percentage of annual CH-46 aircraft operations relative to year 2000 baseline conditions. These data were applied to emissions from current CH-46 operations in Tables B1-4 and B1-5 to estimate emissions due to future CH-46 activities at MCAS Miramar and Camp Pendleton, respectively.

(2) Based upon the replacement of 7 existing CH-46 squadrons according to the following schedule: (1) -2 from MCAS Miramar in 2010, (2) -2 in 2012 from MCAS Miramar, (3) -1 in 2014 from MCAS Camp Pendleton, and (4) -2 in 2015 from MCAS Camp Pendleton.

Table CD-2. Emission Factors for CH-46 Aircraft Operations.

FLIGHT ACTIVITY	NUMBER OF ENGINES IN USE	ENGINE POWER (% NG RPM)	TIME IN MODE PER ENGINE (MINUTES)	FUEL FLOW RATE PER ENGINE (LBS/HR)	Emission Factors (Pounds/Operation) (1)(4)								
					ROG/HC	CO	NOx	SO2	PM10	PM2.5	*CO2*	*CH4*	*N2O*
Departure Total (2)					2.41	7.81	0.53	0.06	0.51	0.51	496	0.07	0.00
Arrival Total (2)					4.40	13.57	0.54	0.08	0.85	0.85	634	0.09	0.01
Cruise (Lb/1,000 Lb of Fuel) (2)	2	91		560	3.43	19.74	3.94	0.40	1.78	1.78	3,176	0.44	0.03
Touch and Go Total (3)					0.22	1.38	0.33	0.03	0.15	0.15	255	0.04	0.00
GCA Box Pattern Total (3)					0.38	2.41	0.58	0.06	0.26	0.26	446	0.06	0.00
FCLP Total (3)					0.22	1.38	0.33	0.03	0.15	0.15	255	0.04	0.00
Single Pad Landing Total (3)					0.35	1.87	0.39	0.04	0.19	0.19	302	0.04	0.00

Notes: (1) Units in pounds of emissions per operation, except for cruise mode, units in pounds per 1,000 pounds of fuel comsumed.

(2) AESO Memorandum Report No. 9816, Revision F, Aircraft Emissions Estimates: H-46 Takeoff and Landing Cycle and In-Frame, Maintenance Testing Using JP-5, January 2001 (Reference 1).

(3) AESO Memorandum Report No. 9959, Revision B, Aircraft Emissions Estimates: H-46 Mission Operations Using JP-5, January 2001 (Reference 2).

(4) PM2.5 factor based upon AESO report No. 2001-30 (AESO 2001). Emission factors for CH4 and N2O obtained from the California Climate Action Registry General Reporting Protocol, Version 3.0, source type commercial/institutional kerosene combustion (CCAR 2008).

Table CD-3. BRAC Total Annual Emissions at MCAS Miramar - Year 2000.

	Emissions (Tons per Year)					
Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Aircraft	736.00	1,973.00	413.00	20.65	41.30	41.30
Personal-Owned Vehicles	69.00	526.00	50.00	0.30	1.80	1.76
Government-Owned Vehicles	7.00	47.00	17.00	0.10	0.61	0.60
Ground/Tactical Support Equipment	45.00	277.00	299.00	1.50	32.89	32.23
Construction	1.00	10.00	4.00	0.02	0.44	0.43
Other Sources	5.00	24.00	5.00	0.33	2.80	0.78
Total Emissions Year 2000	863.00	2,857.00	788.00	22.90	79.84	77.11

Notes: The above data represent year 2000 emissions for MCAS Miramar that were developed for a conformity analysis and they do not include emissions from sources that require SDCAPCD air permits, such as certain stationary sources (URS 2004).
These data were used to obtain non-aircraft emissions for existing CH-46 activities at MCAS Miramar, as presented in Table CD-4 below.

Table CD-4. Annual Emissions from Current CH-46E Operations at MCAS Miramar - Year 2000.

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
CH-46E Aircraft (1)	41.00	161.00	19.00	2.66	24.13	24.13	8,512.07	1.19	0.08	8,564
Personal-Owned Vehicles	8.42	64.17	6.10	0.04	0.22	0.22	8,199	0.15	0.01	8,206
Government-Owned Vehicles	0.85	5.73	2.07	0.01	0.07	0.07	733	0.01	0.00	733
Ground/Tactical Support Equipment	8.20	80.78	7.02	0.04	0.77	0.76	10,321	0.19	0.01	10,330
Construction	0.12	1.22	0.49	0.00	0.05	0.05	156	0.00	0.00	156
Other Sources	0.61	2.93	0.61	0.04	0.34	0.10	374	0.01	0.00	374
Stationary Sources (3)	3.00	2.50	9.20	0.42	10.49	6.71	319	0.01	0.00	320
Total Emissions - Year 2000	62.20	318.33	44.50	3.21	36.08	32.04	28,614	1.56	0.11	28,683

Notes: (1) Equates to emissions from operations and engine maintenance and testing activities.

(2) Data for POVs, GOVs, construction, and other sources calculated by multiplying the total emissions for each of these source category for MCAS Miramar in Table CD-3 by 0.122, which is equal to the personnel population associated with the CH-46Es at MCAS Miramar (1,269) / total personnel at MCAS Miramar identified in the conformity analysis (10,377). Emissions for G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Camp Pendleton (Table CD-5) by the ratio of existing CH-46 aircraft numbers at MCAS Miramar / MCAS Pendleton (48/41).

(3) Data estimated by multiplying stationary source emissions in Table 4.2-3, FEIS for Realignment of MCAS Miramar (DoN 1996) by the MCAS Miramar population associated with the current CH-46E basing (1,269) / total MCAS Miramar population generating the emissions in Table 4.2-3 (12,600).

Table CD-5. Annual Emissions from Current CH-46E Operations at MCAS Camp Pendleton - Year 2000.

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
CH-46E Aircraft (1)	44.00	171.00	20.00	2.80	25.40	25.40	9,041	1.27	0.09	9,096
Personal-Owned Vehicles	5.00	37.00	4.00	0.02	0.14	0.14	4,727	0.09	0.01	4,731
Government-Owned Vehicles	1.00	4.00	1.00	0.01	0.04	0.04	511	0.01	0.00	511
Ground/Tactical Support Equipment	7.00	69.00	6.00	0.03	0.66	0.65	8,816	0.16	0.01	8,823
Construction	1.00	3.00	5.00	0.03	0.55	0.54	383	0.01	0.00	384
Other Sources	-	-	1.00	0.07	0.56	0.16	-	-	-	-
Stationary Sources (2)	0.70	3.90	4.90	0.23	5.59	3.58	498	0.01	0.00	499
Total Emissions - Year 2000	58.70	287.90	41.90	3.18	32.94	30.49	23,977	1.54	0.11	24,045

Notes: The above data represent year 2000 emissions for existing CH-46 activities at MCAS Camp Pendleton that were developed for a conformity analysis and they do not include emissions from sources that require SDCAPCD air permits, such as certain stationary sources (URS 2004).

(1) Equates to emissions from operations and engine maintenance and testing activities.

(2) Data estimated by multiplying stationary source emissions in Table 4.2-3, FEIS for Realignment of MCAS Miramar (DoN 1996) by the MCAS Camp Pendleton population associated with the current CH-46E basing (908) / total MCAS Camp Pendleton population generating the emissions in Table 4.2-3 (3983).

Table CD-6. Factors to Convert 2000 MCAS Miramar/Camp Pendleton POV/GOV Emissions to 2010+ Emissions.

	Daily	*San Diego County Vehicle Emissions (Tons per Day)*					
Year	*VMT*	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
2000	74,567	96.20	1,007.06	145.52	0.91	5.21	4.79
2012	88,384	39.82	397.43	77.25	0.45	5.44	5.00
Factor applied to 2000 emissions (1)		0.35	0.33	0.45	0.42	0.88	0.88

Notes: (1) Equates to (year 2012/2000 emissions) * (year 2000/2012 VMT).

Table CD-7. Emissions due to CH-46E Operations at Project Air Stations - Year 2009

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*	*CO2*	*CH4*	*N2O*	CO_2e
MCAS Miramar										
2009	62.20	318.33	44.50	3.21	36.08	32.04	28,614.17	1.56	0.11	28,683.15
MCAS Camp Pendleton										
2009	58.70	287.90	41.90	3.18	32.94	30.49	23,976.69	1.54	0.11	24,044.57

Table CD-8. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2010

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
MCAS Miramar										
2010	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09	0.78	0.06	14,341.57
MCAS Camp Pendleton										
2010	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35	0.77	0.05	12,022.28

Table CD-9. Emissions due to CH-46E Operations at Project Air Stations - Year 2011

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2011	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09	0.78	0.06	14,341.57
MCAS Camp Pendleton										
2011	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35	0.77	0.05	12,022.28

Table CD-10. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2012

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2012	-	-	-	-	-	-	-	-	-	-
MCAS Camp Pendleton										
2012	58.70	287.90	41.90	3.18	32.94	30.24	-	-	-	-

Table CD-11. Emissions due to CH-46E Operations at Project Air Stations - Year 2013

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2013	-	-	-	-	-	-	-	-	-	-
MCAS Camp Pendleton										
2013	58.70	287.90	41.90	3.18	32.94	30.24	-	-	-	-

Table CD-12. Emissions due to CH-46E Operations at Project Air Stations - Fiscal Year 2014

	Annual Emissions (Tons)									
MCAS/Fiscal Year	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
MCAS Miramar										
2014	-	-	-	-	-	-	-	-	-	-
MCAS Camp Pendleton										
2014	39.33	192.89	28.07	2.13	22.07	20.26	-	-	-	-

Table CD-13. Existing and Proposed Annual CH-46 Operations - MCB Pendleton Range

Flight Activity/Flight Details	*Year/Annual Operations*								*Cruise Duration (Hrs)*
	09	*10*	*11*	*12*	*13*	*14*	*15*		
CAL									
Pad Landing + Cruise	933	666	666	400	400	267	-	-	0.25
Cruise Only	502	359	359	215	215	144	-	-	0.33
Subtotal Ops	1,435	1,025	1,025	615	615	410	-	-	
Drop Zone									
GCA Box + Cruise	1,397	998	998	599	599	399	-	-	0.38
Cruise Only	155	111	111	67	67	44	-	-	0.50
Subtotal Ops	1,552	1,109	1,109	665	665	443	-	-	
IP									
Cruise Only	493	352	352	211	211	141	-	-	0.08
Subtotal Ops	493	352	352	211	211	141	-	-	
Landing Zone									
Pad Landing + Cruise	714	510	510	306	306	204	-	-	0.25
Cruise Only	384	275	275	165	165	110	-	-	0.33
Subtotal Ops	1,098	784	784	471	471	314	-	-	
PAD, etc.									
Pad Landing + Cruise	1,426	1,018	1,018	611	611	407	-	-	0.25
Cruise Only	768	548	548	329	329	219	-	-	0.33
Subtotal Ops	2,193	1,567	1,567	940	940	627	-	-	
TERF									
Cruise Only	181	129	129	78	78	52	-	-	1.67
Subtotal Ops	181	129	129	78	78	52	-	-	
Impact Areas									
Pad Landing + Cruise	75	54	54	32	32	21	-	-	0.83
Cruise Only	75	54	54	32	32	21	-	-	0.92
Subtotal Ops	150	107	107	64	64	43	-	-	
RWR-1									
Cruise	1,990	1,421	1,421	853	853	569	-	-	0.23
Subtotal Ops	1,990	1,421	1,421	853	853	569	-	-	
RWR-2									
Cruise	1,990	1,421	1,421	853	853	569	-	-	0.16
Subtotal Ops	1,990	1,421	1,421	853	853	569	-	-	
RWR-3									
Cruise	1,990	1,421	1,421	853	853	569	-	-	0.18
Subtotal Ops	1,990	1,421	1,421	853	853	569	-	-	
RWR-4									
Cruise	50	36	36	21	21	14	-	-	0.19
Subtotal Ops	50	36	36	21	21	14	-	-	
RWR-5									
Cruise	50	36	36	21	21	14	-	-	0.19
Subtotal Ops	50	36	36	21	21	14	-	-	
Total Ops	13,173	9,409	9,409	5,645	5,645	3,764	-	-	

Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.2.8 - Modeled Airspace MCBCP Flight Profiles Data Base.

Table CD-14. MCB Pendleton Range CH-46 Aircraft Emissions - Year 2009

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.16	0.87	0.18	0.02	0.09	0.09	140.86	0.02	0.00	141.73
Cruise (from Pad Landing)	0.45	-	0.00	0.00	0.00	0.00	1.32	0.00	0.02	8.15
Cruise Only	0.32	1.85	0.37	0.04	0.17	0.17	297.80	0.04	0.00	299.62
Subtotal Ops	0.93	2.72	0.55	0.06	0.26	0.26	439.99	0.06	0.03	449.50
Drop Zone										
GCA Box	0.27	1.68	0.41	0.04	0.18	0.18	311.48	0.04	0.00	313.38
Cruise (from GCA Box)	1.03	5.92	1.18	0.12	0.53	0.53	952.29	0.13	0.01	958.12
Cruise Only	0.15	0.86	0.17	0.02	0.08	0.08	138.01	0.02	0.00	138.86
Subtotal Ops	1.44	8.46	1.76	0.18	0.79	0.79	1,401.78	0.20	0.01	1,410.36
IP										
Cruise Only	0.08	0.45	0.09	0.01	0.04	0.04	73.08	0.01	0.00	73.53
Subtotal Ops	0.08	0.45	0.09	0.01	0.04	0.04	73.08	0.01	0.00	73.53
Landing Zone										
Pad Landing	0.12	0.67	0.14	0.01	0.07	0.07	107.78	0.02	0.00	108.44
Cruise (from Pad Landing)	0.34	1.97	0.39	0.04	0.18	0.18	317.37	0.04	0.00	319.32
Cruise Only	0.25	1.42	0.28	0.03	0.13	0.13	227.86	0.03	0.00	229.25
Subtotal Ops	0.71	4.06	0.82	0.08	0.37	0.37	653.01	0.09	0.01	657.01
PAD, etc.										
Pad Landing	0.25	1.33	0.28	0.03	0.14	0.14	215.28	0.03	0.00	216.60
Cruise (from Pad Landing)	0.68	3.94	0.79	0.08	0.36	0.36	633.92	0.09	0.01	637.80
Cruise Only	0.49	2.83	0.56	0.06	0.26	0.26	455.12	0.06	0.00	457.90
Subtotal Ops	1.43	8.10	1.63	0.17	0.75	0.75	1,304.31	0.18	0.01	1,312.30
TERF										
Cruise Only	0.58	3.34	0.67	0.07	0.30	0.30	536.77	0.08	0.01	540.05
Subtotal Ops	0.58	3.34	0.67	0.07	0.30	0.30	536.77	0.08	0.01	540.05
Impact Areas										
Pad Landing	0.01	0.07	0.01	0.00	0.01	0.01	11.33	0.00	0.00	11.39
Cruise (from Pad Landing)	0.12	0.69	0.14	0.01	0.06	0.06	111.16	0.02	0.00	111.84
Cruise Only	0.13	0.76	0.15	0.02	0.07	0.07	122.28	0.02	0.00	123.02
Subtotal Ops	0.27	1.52	0.30	0.03	0.14	0.14	244.76	0.03	0.00	246.26
RWR-1										
Cruise	0.89	5.11	1.02	0.10	0.46	0.46	822.57	0.12	0.01	827.61
Subtotal Ops	0.89	5.11	1.02	0.10	0.46	0.46	822.57	0.12	0.01	827.61
RWR-2										
Cruise	0.61	3.50	0.70	0.07	0.32	0.32	563.20	0.08	0.01	566.65
Subtotal Ops	0.61	3.50	0.70	0.07	0.32	0.32	563.20	0.08	0.01	566.65
RWR-3										
Cruise	0.70	4.01	0.80	0.08	0.36	0.36	644.72	0.09	0.01	648.67
Subtotal Ops	0.70	4.01	0.80	0.08	0.36	0.36	644.72	0.09	0.01	648.67
RWR-4										
Cruise	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
Subtotal Ops	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
RWR-5										
Cruise	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
Subtotal Ops	0.02	0.11	0.02	0.00	0.01	0.01	17.02	0.00	0.00	17.12
Total Emissions	7.67	41.48	8.38	0.85	3.81	3.80	6,718.24	0.94	0.09	6,766.18

Table CD-15. MCB Pendleton Range CH-46 Aircraft Emissions - Year 2010

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.12	0.62	0.13	0.01	0.06	0.06	100.62	0.01	0.00	101.23
Cruise (from Pad Landing)	0.32	1.84	0.37	0.04	0.17	0.17	296.28	0.04	0.00	298.10
Cruise Only	0.23	1.32	0.26	0.03	0.12	0.12	212.72	0.03	0.00	214.02
Subtotal Ops	0.67	3.79	0.76	0.08	0.35	0.35	609.62	0.09	0.01	613.35
Drop Zone										
GCA Box	0.19	1.20	0.29	0.03	0.13	0.13	222.48	0.03	0.00	223.85
Cruise (from GCA Box)	0.73	4.23	0.84	0.09	0.38	0.38	680.21	0.10	0.01	684.37
Cruise Only	0.11	0.61	0.12	0.01	0.06	0.06	98.58	0.01	0.00	99.18
Subtotal Ops	1.03	6.04	1.26	0.13	0.57	0.57	1,001.27	0.14	0.01	1,007.40
IP										
Cruise Only	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Subtotal Ops	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Landing Zone										
Pad Landing	0.09	0.48	0.10	0.01	0.05	0.05	76.99	0.01	0.00	77.46
Cruise (from Pad Landing)	0.24	1.41	0.28	0.03	0.13	0.13	226.70	0.03	0.00	228.08
Cruise Only	0.18	1.01	0.20	0.02	0.09	0.09	162.76	0.02	0.00	163.75
Subtotal Ops	0.51	2.90	0.58	0.06	0.27	0.27	466.44	0.07	0.00	469.29
PAD, etc.										
Pad Landing	0.18	0.95	0.20	0.02	0.10	0.10	153.77	0.02	0.00	154.71
Cruise (from Pad Landing)	0.49	2.81	0.56	0.06	0.25	0.25	452.80	0.06	0.00	455.57
Cruise Only	0.35	2.02	0.40	0.04	0.18	0.18	325.09	0.05	0.00	327.07
Subtotal Ops	1.02	5.79	1.16	0.12	0.53	0.53	931.65	0.13	0.01	937.36
TERF										
Cruise Only	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Subtotal Ops	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Impact Areas										
Pad Landing	0.01	0.05	0.01	0.00	0.01	0.01	8.09	0.00	0.00	8.14
Cruise (from Pad Landing)	0.09	0.49	0.10	0.01	0.04	0.04	79.40	0.01	0.00	79.89
Cruise Only	0.09	0.54	0.11	0.01	0.05	0.05	87.34	0.01	0.00	87.87
Subtotal Ops	0.19	1.09	0.22	0.02	0.10	0.10	174.83	0.02	0.00	175.90
RWR-1										
Cruise	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
Subtotal Ops	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
RWR-2										
Cruise	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
Subtotal Ops	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
RWR-3										
Cruise	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
Subtotal Ops	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
RWR-4										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
RWR-5										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Total Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08	0.71	0.05	5,125.26

Table CD-16. MCB Pendleton Range CH-46 Aircraft Emissions - Year 2011

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.12	0.62	0.13	0.01	0.06	0.06	100.62	0.01	0.00	101.23
Cruise (from Pad Landing)	0.32	1.84	0.37	0.04	0.17	0.17	296.28	0.04	0.00	298.10
Cruise Only	0.23	1.32	0.26	0.03	0.12	0.12	212.72	0.03	0.00	214.02
Subtotal Ops	0.67	3.79	0.76	0.08	0.35	0.35	609.62	0.09	0.01	613.35
Drop Zone										
GCA Box	0.19	1.20	0.29	0.03	0.13	0.13	222.48	0.03	0.00	223.85
Cruise (from GCA Box)	0.73	4.23	0.84	0.09	0.38	0.38	680.21	0.10	0.01	684.37
Cruise Only	0.11	0.61	0.12	0.01	0.06	0.06	98.58	0.01	0.00	99.18
Subtotal Ops	1.03	6.04	1.26	0.13	0.57	0.57	1,001.27	0.14	0.01	1,007.40
IP										
Cruise Only	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Subtotal Ops	0.06	0.32	0.06	0.01	0.03	0.03	52.20	0.01	0.00	52.52
Landing Zone										
Pad Landing	0.09	0.48	0.10	0.01	0.05	0.05	76.99	0.01	0.00	77.46
Cruise (from Pad Landing)	0.24	1.41	0.28	0.03	0.13	0.13	226.70	0.03	0.00	228.08
Cruise Only	0.18	1.01	0.20	0.02	0.09	0.09	162.76	0.02	0.00	163.75
Subtotal Ops	0.51	2.90	0.58	0.06	0.27	0.27	466.44	0.07	0.00	469.29
PAD, etc.										
Pad Landing	0.18	0.95	0.20	0.02	0.10	0.10	153.77	0.02	0.00	154.71
Cruise (from Pad Landing)	0.49	2.81	0.56	0.06	0.25	0.25	452.80	0.06	0.00	455.57
Cruise Only	0.35	2.02	0.40	0.04	0.18	0.18	325.09	0.05	0.00	327.07
Subtotal Ops	1.02	5.79	1.16	0.12	0.53	0.53	931.65	0.13	0.01	937.36
TERF										
Cruise Only	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Subtotal Ops	0.41	2.38	0.48	0.05	0.21	0.21	383.41	0.05	0.00	385.75
Impact Areas										
Pad Landing	0.01	0.05	0.01	0.00	0.01	0.01	8.09	0.00	0.00	8.14
Cruise (from Pad Landing)	0.09	0.49	0.10	0.01	0.04	0.04	79.40	0.01	0.00	79.89
Cruise Only	0.09	0.54	0.11	0.01	0.05	0.05	87.34	0.01	0.00	87.87
Subtotal Ops	0.19	1.09	0.22	0.02	0.10	0.10	174.83	0.02	0.00	175.90
RWR-1										
Cruise	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
Subtotal Ops	0.63	3.65	0.73	0.07	0.33	0.33	587.55	0.08	0.01	591.15
RWR-2										
Cruise	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
Subtotal Ops	0.43	2.50	0.50	0.05	0.23	0.23	402.29	0.06	0.00	404.75
RWR-3										
Cruise	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
Subtotal Ops	0.50	2.86	0.57	0.06	0.26	0.26	460.51	0.06	0.00	463.33
RWR-4										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
RWR-5										
Cruise	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Subtotal Ops	0.01	0.08	0.02	0.00	0.01	0.01	12.16	0.00	0.00	12.23
Total Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08	0.71	0.05	5,125.26

Table CD-17. MCB Pendleton Range CH-46 Aircraft Emissions - Year 2012

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.07	0.37	0.08	0.01	0.04	0.04	60.37	0.01	0.00	60.74
Cruise (from Pad Landing)	0.19	1.10	0.22	0.02	0.10	0.10	177.77	0.02	0.00	178.86
Cruise Only	0.14	0.79	0.16	0.02	0.07	0.07	127.63	0.02	0.00	128.41
Subtotal Ops	0.40	2.27	0.46	0.05	0.21	0.21	365.77	0.05	0.00	368.01
Drop Zone										
GCA Box	0.11	0.72	0.17	0.02	0.08	0.08	133.49	0.02	0.00	134.31
Cruise (from GCA Box)	0.44	2.54	0.51	0.05	0.23	0.23	408.12	0.06	0.00	410.62
Cruise Only	0.06	0.37	0.07	0.01	0.03	0.03	59.15	0.01	0.00	59.51
Subtotal Ops	0.62	3.63	0.75	0.08	0.34	0.34	600.76	0.08	0.01	604.44
IP										
Cruise Only	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Subtotal Ops	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Landing Zone										
Pad Landing	0.05	0.29	0.06	0.01	0.03	0.03	46.19	0.01	0.00	46.47
Cruise (from Pad Landing)	0.15	0.85	0.17	0.02	0.08	0.08	136.02	0.02	0.00	136.85
Cruise Only	0.11	0.61	0.12	0.01	0.05	0.05	97.65	0.01	0.00	98.25
Subtotal Ops	0.31	1.74	0.35	0.04	0.16	0.16	279.86	0.04	0.00	281.58
PAD, etc.										
Pad Landing	0.11	0.57	0.12	0.01	0.06	0.06	92.26	0.01	0.00	92.83
Cruise (from Pad Landing)	0.29	1.69	0.34	0.03	0.15	0.15	271.68	0.04	0.00	273.34
Cruise Only	0.21	1.21	0.24	0.02	0.11	0.11	195.05	0.03	0.00	196.24
Subtotal Ops	0.61	3.47	0.70	0.07	0.32	0.32	558.99	0.08	0.01	562.41
TERF										
Cruise Only	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Subtotal Ops	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Impact Areas										
Pad Landing	0.01	0.03	0.01	0.00	0.00	0.00	4.85	0.00	0.00	4.88
Cruise (from Pad Landing)	0.05	0.30	0.06	0.01	0.03	0.03	47.64	0.01	0.00	47.93
Cruise Only	0.06	0.33	0.07	0.01	0.03	0.03	52.40	0.01	0.00	52.72
Subtotal Ops	0.11	0.65	0.13	0.01	0.06	0.06	104.90	0.01	0.00	105.54
RWR-1										
Cruise	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
Subtotal Ops	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
RWR-2										
Cruise	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
Subtotal Ops	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
RWR-3										
Cruise	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
Subtotal Ops	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
RWR-4										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
RWR-5										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Total Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45	0.43	0.03	3,075.16

Table CD-18. MCB Pendleton Range CH-46 Aircraft Emissions - Year 2013

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.07	0.37	0.08	0.01	0.04	0.04	60.37	0.01	0.00	60.74
Cruise (from Pad Landing)	0.19	1.10	0.22	0.02	0.10	0.10	177.77	0.02	0.00	178.86
Cruise Only	0.14	0.79	0.16	0.02	0.07	0.07	127.63	0.02	0.00	128.41
Subtotal Ops	0.40	2.27	0.46	0.05	0.21	0.21	365.77	0.05	0.00	368.01
Drop Zone										
GCA Box	0.11	0.72	0.17	0.02	0.08	0.08	133.49	0.02	0.00	134.31
Cruise (from GCA Box)	0.44	2.54	0.51	0.05	0.23	0.23	408.12	0.06	0.00	410.62
Cruise Only	0.06	0.37	0.07	0.01	0.03	0.03	59.15	0.01	0.00	59.51
Subtotal Ops	0.62	3.63	0.75	0.08	0.34	0.34	600.76	0.08	0.01	604.44
IP										
Cruise Only	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Subtotal Ops	0.03	0.19	0.04	0.00	0.02	0.02	31.32	0.00	0.00	31.51
Landing Zone										
Pad Landing	0.05	0.29	0.06	0.01	0.03	0.03	46.19	0.01	0.00	46.47
Cruise (from Pad Landing)	0.15	0.85	0.17	0.02	0.08	0.08	136.02	0.02	0.00	136.85
Cruise Only	0.11	0.61	0.12	0.01	0.05	0.05	97.65	0.01	0.00	98.25
Subtotal Ops	0.31	1.74	0.35	0.04	0.16	0.16	279.86	0.04	0.00	281.58
PAD, etc.										
Pad Landing	0.11	0.57	0.12	0.01	0.06	0.06	92.26	0.01	0.00	92.83
Cruise (from Pad Landing)	0.29	1.69	0.34	0.03	0.15	0.15	271.68	0.04	0.00	273.34
Cruise Only	0.21	1.21	0.24	0.02	0.11	0.11	195.05	0.03	0.00	196.24
Subtotal Ops	0.61	3.47	0.70	0.07	0.32	0.32	558.99	0.08	0.01	562.41
TERF										
Cruise Only	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Subtotal Ops	0.25	1.43	0.29	0.03	0.13	0.13	230.04	0.03	0.00	231.45
Impact Areas										
Pad Landing	0.01	0.03	0.01	0.00	0.00	0.00	4.85	0.00	0.00	4.88
Cruise (from Pad Landing)	0.05	0.30	0.06	0.01	0.03	0.03	47.64	0.01	0.00	47.93
Cruise Only	0.06	0.33	0.07	0.01	0.03	0.03	52.40	0.01	0.00	52.72
Subtotal Ops	0.11	0.65	0.13	0.01	0.06	0.06	104.90	0.01	0.00	105.54
RWR-1										
Cruise	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
Subtotal Ops	0.38	2.19	0.44	0.04	0.20	0.20	352.53	0.05	0.00	354.69
RWR-2										
Cruise	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
Subtotal Ops	0.26	1.50	0.30	0.03	0.14	0.14	241.37	0.03	0.00	242.85
RWR-3										
Cruise	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
Subtotal Ops	0.30	1.72	0.34	0.03	0.15	0.15	276.31	0.04	0.00	278.00
RWR-4										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
RWR-5										
Cruise	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Subtotal Ops	0.01	0.05	0.01	0.00	0.00	0.00	7.29	0.00	0.00	7.34
Total Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45	0.43	0.03	3,075.16

Table CD-19. MCB Pendleton Range CH-46 Aircraft Emissions - Year 2014

	Annual Emissions (Tons)									
Flight Activity/Flight Details	*ROG/HC*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
CAL										
Pad Landing	0.05	0.25	0.05	0.01	0.03	0.03	40.25	0.01	0.00	40.49
Cruise (from Pad Landing)	0.13	0.74	0.15	0.01	0.07	0.07	118.51	0.02	0.00	119.24
Cruise Only	0.09	0.53	0.11	0.01	0.05	0.05	85.09	0.01	0.00	85.61
Subtotal Ops	0.27	1.51	0.30	0.03	0.14	0.14	243.85	0.03	0.00	245.34
Drop Zone										
GCA Box	0.08	0.48	0.12	0.01	0.05	0.05	88.99	0.01	0.00	89.54
Cruise (from GCA Box)	0.29	1.69	0.34	0.03	0.15	0.15	272.08	0.04	0.00	273.75
Cruise Only	0.04	0.25	0.05	0.00	0.02	0.02	39.43	0.01	0.00	39.67
Subtotal Ops	0.41	2.42	0.50	0.05	0.23	0.23	400.51	0.06	0.00	402.96
IP										
Cruise Only	0.02	0.13	0.03	0.00	0.01	0.01	20.88	0.00	0.00	21.01
Subtotal Ops	0.02	0.13	0.03	0.00	0.01	0.01	20.88	0.00	0.00	21.01
Landing Zone										
Pad Landing	0.04	0.19	0.04	0.00	0.02	0.02	30.79	0.00	0.00	30.98
Cruise (from Pad Landing)	0.10	0.56	0.11	0.01	0.05	0.05	90.68	0.01	0.00	91.23
Cruise Only	0.07	0.40	0.08	0.01	0.04	0.04	65.10	0.01	0.00	65.50
Subtotal Ops	0.20	1.16	0.23	0.02	0.11	0.11	186.58	0.03	0.00	187.72
PAD, etc.										
Pad Landing	0.07	0.38	0.08	0.01	0.04	0.04	61.51	0.01	0.00	61.88
Cruise (from Pad Landing)	0.20	1.13	0.22	0.02	0.10	0.10	181.12	0.03	0.00	182.23
Cruise Only	0.14	0.81	0.16	0.02	0.07	0.07	130.03	0.02	0.00	130.83
Subtotal Ops	0.41	2.31	0.47	0.05	0.21	0.21	372.66	0.05	0.00	374.94
TERF										
Cruise Only	0.17	0.95	0.19	0.02	0.09	0.09	153.36	0.02	0.00	154.30
Subtotal Ops	0.17	0.95	0.19	0.02	0.09	0.09	153.36	0.02	0.00	154.30
Impact Areas										
Pad Landing	0.00	0.02	0.00	0.00	0.00	0.00	3.24	0.00	0.00	3.26
Cruise (from Pad Landing)	0.03	0.20	0.04	0.00	0.02	0.02	31.76	0.00	0.00	31.95
Cruise Only	0.04	0.22	0.04	0.00	0.02	0.02	34.94	0.00	0.00	35.15
Subtotal Ops	0.08	0.43	0.09	0.01	0.04	0.04	69.93	0.01	0.00	70.36
RWR-1										
Cruise	0.25	1.46	0.29	0.03	0.13	0.13	235.02	0.03	0.00	236.46
Subtotal Ops	0.25	1.46	0.29	0.03	0.13	0.13	235.02	0.03	0.00	236.46
RWR-2										
Cruise	0.17	1.00	0.20	0.02	0.09	0.09	160.92	0.02	0.00	161.90
Subtotal Ops	0.17	1.00	0.20	0.02	0.09	0.09	160.92	0.02	0.00	161.90
RWR-3										
Cruise	0.20	1.14	0.23	0.02	0.10	0.10	184.21	0.03	0.00	185.33
Subtotal Ops	0.20	1.14	0.23	0.02	0.10	0.10	184.21	0.03	0.00	185.33
RWR-4										
Cruise	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
Subtotal Ops	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
RWR-5										
Cruise	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
Subtotal Ops	0.01	0.03	0.01	0.00	0.00	0.00	4.86	0.00	0.00	4.89
Total Emissions	2.19	12.59	2.54	0.26	1.15	1.15	2,037.63	0.29	0.02	2,050.11

Table CD-20. Annual MV-22 Operational Fielding Rates

Flight Activity/Annual Rate	*Year/Annual Operations*							
	10	*11*	*12*	*13*	*14*	*15*	*16*	*17*
MV-22 Annual Fielding Rate								
MV-22 Operations - % of Year 2017 Activity (1)	24	47	59	47	59	82	82	100

Notes: (1) Equates to percentage of annual MV-22 aircraft operations relative to full build-out year 2017 operations.

Table CD-21. Annual Number of MV-22 Squadrons Proposed for San Diego County

Fiscal Year	Fleet Squadrons (1)		Reserve Squadrons (1)	Total On-Station (A - B + C)	Equivalent Fleet On-Station (2)	% of Peak Operations
	On-Station	Deployed				
2010	2	0	0	2	2	24%
2011	4	0	0	4	4	47%
2012	6	1	0	5	5	59%
2013	5	1	0	4	4	47%
2014	6	1	0	5	5	59%
2015	8	1	0	7	7	82%
2016	8	1	0	7	7	82%
2017	8	1	2	9	8.5	100%

Notes: 1) Source: Headquarters Marine Corps. 2008. FY2009 Marine Aviation Plan, MV-22 Transition Timeline, page 5-

URL http://hqinet001.hqmc.usmc.mil/AVN/FY2009%20AVPLAN.pdf.

(2) One reserve squadron activity level equal to 75% of a fleet squadron.

Table CD-22. Annual MV-22 Aircraft Operations - Air Bases - 10 Squadrons

	Year/Annual Operations								
Activity/Mode	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Reserves*
Flight Operations									
Vertical Departure	1,256	2,512	3,140	2,512	3,140	4,396	4,396	5,338	942
Short Departure	3,768	7,536	9,420	7,536	9,420	13,187	13,187	16,013	2,826
Short Arrival	251	502	628	502	628	879	879	1,068	188
Vertical Arrival	251	502	628	502	628	879	879	1,068	188
Arrival (with Break)	4,522	9,045	11,306	9,045	11,306	15,829	15,829	19,220	3,392
Touch and Go	464	928	1,160	928	1,160	1,624	1,624	1,972	348
GCA Box Pattern	580	1,160	1,449	1,160	1,449	2,029	2,029	2,464	435
Hover (1)	4.5	9.1	11.3	9.1	11.3	15.9	15.9	19.3	3
Engine Maintenance&Testing									
APU Check	24	48	60	48	60	84	84	102	18
Water Wash	24	48	60	48	60	84	84	102	18
Low Power - One Engine	24	48	60	48	60	84	84	102	18
Low Power - Two Engines	24	48	60	48	60	84	84	102	18
High Power	24	48	60	48	60	84	84	102	18
Prop Balance	24	48	60	48	60	84	84	102	18

Notes: (1) Hours of low work per year, based upon 7 minutes of operation per sortie.

Table CD-23. MV-22 Aircraft Emissions for Air Base Operations - 8 Squadrons at MCAS Miramar (2 Pages)

		REF
AIRCRAFT TYPE:	**V-22**	
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**96**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE:	**T406-AD-400**	1/b

TOTAL OPERATIONS:	**36,113**	SCENARIO: 8 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**16,327**	TOTAL OPS:	**16,331**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY	ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE	ENGINE POWER (% Q_{TRANS})	ANNUAL NUMBER OF OPERATIONS	TIME IN MODE PER ENGINE (MINUTES)	FUEL FLOW RATE PER ENGINE (LBS/HR)	EMISSION FACTORS (LB/1,000 LB OF FUEL)					EMISSIONS[b] (TONS/YR)				
							NOx	SO2	CO	PM10	ROG	NOx	SO2	CO	PM10	ROG
4,082 [4]	APU USE	1 [1]	ON [1]	4082 [4]	15.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	1.25	0.08	1.24	0.05	0.04
VERTICAL DEPARTURE	START/WARM UP	2 [1]	G IDLE [1]	4082 [4]	5.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.50	0.05	1.09	0.19	0.01
	WARM UP	2 [1]	F IDLE [1]	4082 [4]	10.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	2.70	0.18	1.50	0.71	0.01
	TAXI OUT	2 [1]	F IDLE [1]	4082 [4]	5.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	1.35	0.09	0.75	0.35	0.00
	ENGINE RUN-UP	2 [1]		4082 [4]	0.50 [1]	1,030 [1]	8.41	0.40	1.58	1.58	0.02	0.29	0.01	0.06	0.06	0.00
	TAKEOFF TO HOVER	2 [1]		4082 [4]	1.00 [1]	1,910 [1]	14.09	0.40	0.52	1.58	0.01	1.83	0.05	0.07	0.21	0.00
	HOVER	2 [1]		4082 [4]	1.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	1.38	0.04	0.08	0.18	0.00
	HELO CLIMBOUT	2 [1]		4082 [4]	2.00 [1]	1,770 [1]	13.19	0.40	0.60	1.58	0.01	3.18	0.10	0.14	0.38	0.00
	FW CLIMBOUT	2 [1]		4082 [4]	1.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	1.38	0.04	0.08	0.18	0.00
DEPARTURE TOTALS												**13.87**	**0.65**	**5.00**	**2.30**	**0.07**
12,245 [4]	APU USE	1 [1]	ON [1]	12,245 [4]	15.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	3.76	0.25	3.72	0.14	0.12
SHORT DEPARTURE	START/WARM UP	2 [1]	G IDLE [1]	12245 [4]	5.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	1.50	0.15	3.27	0.58	0.04
	WARM UP	2 [1]	F IDLE [1]	12245 [4]	10.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	8.11	0.54	4.49	2.13	0.03
	TAXI OUT	2 [1]	F IDLE [1]	12245 [4]	5.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	4.05	0.27	2.24	1.06	0.01
	ENGINE RUN-UP	2 [1]		12245 [4]	0.50 [1]	1,030 [1]	8.41	0.40	1.58	1.58	0.02	0.88	0.04	0.17	0.17	0.00
	TAKEOFF	2 [1]		12245 [4]	1.00 [1]	2,060 [1]	15.06	0.40	0.45	1.58	0.01	6.33	0.17	0.19	0.66	0.00
	FW CLIMBOUT	2 [1]		12245 [4]	2.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	8.27	0.27	0.46	1.06	0.01
DEPARTURE TOTALS												**32.91**	**1.69**	**14.54**	**5.80**	**0.21**
817.5 [4]	FW (0°) APPROACH	2 [1]		818 [4]	3.00 [1]	1,210 [1]	9.57	0.40	1.20	1.58	0.02	0.47	0.02	0.06	0.08	0.00
SHORT ARRIVAL	TRANSITION (16°) LANDING	2 [1]		817.5 [4]	1.00 [1]	1,310 [1]	10.22	0.40	1.04	1.58	0.02	0.18	0.01	0.02	0.03	0.00
	TAXI TO HOT REFUEL	2 [1]	F IDLE [1]	817.5 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	HOT REFUEL (MAIN ENGS)	2 [1]	G IDLE [1]	817.5 [4]	13.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.26	0.03	0.57	0.10	0.01
	HOT REFUEL (APU)	1 [1]	ON [1]	817.5 [4]	13.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.22	0.01	0.22	0.01	0.01
	TAXI TO SQUAD. APRON	2 [1]	F IDLE [1]	817.5 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	COOL/SHUT DOWN	2 [1]	G IDLE [1]	817.5 [4]	2.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.04	0.00	0.09	0.02	0.00
	APU USE	1 [1]	ON [1]	817.5 [4]	5.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.08	0.01	0.08	0.00	0.00
ARRIVAL TOTALS												**1.58**	**0.10**	**1.21**	**0.32**	**0.02**
817.5 [4]	FW (0°) APPROACH	2 [1]		818 [4]	3.00 [1]	1,210 [1]	9.57	0.40	1.20	1.58	0.02	0.47	0.02	0.06	0.08	0.00
VERTICAL ARRIVAL	TRANSITION (90°) LANDING	2 [1]		818 [4]	1.00 [1]	1,310 [1]	10.22	0.40	1.04	1.58	0.02	0.18	0.01	0.02	0.03	0.00
	TAXI TO HOT REFUEL	2 [1]	F IDLE [1]	818 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	HOT REFUEL (MAIN ENGS)	2 [1]	G IDLE [1]	818 [4]	13.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.26	0.03	0.57	0.10	0.01
	HOT REFUEL (APU)	1 [1]	ON [1]	818 [4]	13.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.22	0.01	0.22	0.01	0.01
	TAXI TO SQUAD. APRON	2 [1]	F IDLE [1]	818 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	0.16	0.01	0.09	0.04	0.00
	COOL/SHUT DOWN	2 [1]	G IDLE [1]	818 [4]	2.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.04	0.00	0.09	0.02	0.00
	APU USE	1 [1]	ON [1]	818 [4]	5.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	0.08	0.01	0.08	0.00	0.00
ARRIVAL TOTALS												**1.58**	**0.10**	**1.21**	**0.32**	**0.02**
14696 [4]	FW APPROACH TO BREAK	2 [1]		14696 [4]	2.00 [1]	1,530 [1]	11.64	0.40	0.79	1.58	0.01	8.72	0.30	0.59	1.18	0.01
ARRIVAL (WITH BREAK)	BREAK	2 [1]		14696 [4]	1.00 [1]	1,030 [1]	8.41	0.40	1.58	1.58	0.02	2.12	0.10	0.40	0.40	0.01
	CIRCLE	2 [1]		14696 [4]	2.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	9.92	0.32	0.55	1.27	0.01
	FW APPROACH	2 [1]		14696 [4]	1.00 [1]	1,530 [1]	11.64	0.40	0.79	1.58	0.01	4.36	0.15	0.30	0.59	0.00
	TRANSITION (16°) LANDING	2 [1]		14696 [4]	1.00 [1]	1,310 [1]	10.22	0.40	1.04	1.58	0.02	3.28	0.13	0.33	0.51	0.01
	TAXI TO HOT REFUEL	2 [1]	F IDLE [1]	14696 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	2.92	0.19	1.61	0.77	0.01
	HOT REFUEL (MAIN ENGS)	2 [1]	G IDLE [1]	14696 [4]	13.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	4.69	0.46	10.20	1.81	0.11
	HOT REFUEL (APU)	1 [1]	ON [1]	14696 [4]	13.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	3.91	0.26	3.87	0.14	0.12
	TAXI TO SQUAD. APRON	2 [1]	F IDLE [1]	14696 [4]	3.00 [1]	660 [1]	6.02	0.40	3.33	1.58	0.02	2.92	0.19	1.61	0.77	0.01
	COOL/SHUT DOWN	2 [1]	G IDLE [1]	14696 [4]	2.00 [1]	360 [1]	4.09	0.40	8.90	1.58	0.10	0.72	0.07	1.57	0.28	0.02
	APU USE	1 [1]	ON [1]	14696 [4]	5.00 [1]	413 [1]	5.95	0.40	5.89	0.22	0.19	1.50	0.10	1.49	0.06	0.05
ARRIVAL TOTALS												**45.07**	**2.28**	**22.54**	**7.77**	**0.36**

Table CD-23. MV-22 Aircraft Emissions for Air Base Operations - 8 Squadrons at MCAS Miramar (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**96**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**36,113**	SCENARIO: 8 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**16,327**	TOTAL OPS:	**16,331**		TOTAL HRS:	**0**
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**5.0%** [d]	**5.0%** [d]	**90.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG	EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
0	4							4														
FW (0°) CRUISE		CRUISE	2	1			0	4	60.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01	0.00	0.00	0.00	0.00	0.00
(<3,000 FEET MSL)								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0	4							4														
HELO (16°) CRUISE		CRUISE	2	1			0	4	60.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
(<3,000 FEET MSL)								4														
CRUISE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1,508	4	APPROACH	2	3			1508	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.89	0.03	0.06	0.12	0.00
T & G		CLIMBOUT	2	3			1508	4	1.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.78	0.02	0.02	0.08	0.00
		CIRCLE	2	3			1508	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	1.02	0.03	0.06	0.13	0.00
TOUCH AND GO TOTALS																		**2.69**	**0.08**	**0.14**	**0.33**	**0.00**
1,885	4	APPROACH	2	3			1885	4	3.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	1.68	0.06	0.11	0.23	0.00
GCA BOX PATTERN		CLIMBOUT	2	3			1885	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	1.95	0.05	0.06	0.20	0.00
		CIRCLE	2	3			1885	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	1.27	0.04	0.07	0.16	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS																		**4.90**	**0.15**	**0.24**	**0.60**	**0.00**
	4	APPROACH	2	3			0	4	2.00	3	1,530	3	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FCLP		CLIMBOUT	2	3			0	4	2.00	3	2,060	3	15.06	0.40	0.45	1.58	0.01	0.00	0.00	0.00	0.00	0.00
		CIRCLE	2	3			0	4	2.00	3	1,640	3	12.35	0.40	0.69	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS																		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
63	4																					
LOW WORK		HOVER	2	1			63	4	7.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01	0.15	0.00	0.01	0.02	0.00
LOW WORK TOTALS																		**0.15**	**0.00**	**0.01**	**0.02**	**0.00**
TOTAL AIR EMISSIONS (TONS)																		**102.76**	**5.06**	**44.89**	**17.46**	**0.68**
																		NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table CD-24. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Camp Pendleton (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**11,069**	SCENARIO: 2 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS:	**5,005**	TOTAL OPS: **5,005**			TOTAL HRS: **0**	
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**50.0%** [d]	**50.0%** [d]	**0.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY		ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS[b] (TONS/YR) NOx	SO2	CO	PM10	ROG
1,252	4	APU USE	1	1	ON	1	1252	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.38	0.03	0.38	0.01	0.01
VERTICAL DEPARTURE		START/WARM UP	2	1	G IDLE	1	1252	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.15	0.02	0.33	0.06	0.00
		WARM UP	2	1	F IDLE	1	1252	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.83	0.06	0.46	0.22	0.00
		TAXI OUT	2	1	F IDLE	1	1252	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.41	0.03	0.23	0.11	0.00
		ENGINE RUN-UP	2	1			1252	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.09	0.00	0.02	0.02	0.00
		TAKEOFF TO HOVER	2	1			1252	4	1.00	1	1,910	1	14.09	0.40	0.52	1.58	0.01		0.56	0.02	0.02	0.06	0.00
		HOVER	2	1			1252	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.42	0.01	0.02	0.05	0.00
		HELO CLIMBOUT	2	1			1252	4	2.00	1	1,770	1	13.19	0.40	0.60	1.58	0.01		0.97	0.03	0.04	0.12	0.00
		FW CLIMBOUT	2	1			1252	4	1.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.42	0.01	0.02	0.05	0.00
DEPARTURE TOTALS																			**4.25**	**0.20**	**1.53**	**0.70**	**0.02**
3,754	4	APU USE	1	1	ON	1	3,754	4	15.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.15	0.08	1.14	0.04	0.04
SHORT DEPARTURE		START/WARM UP	2	1	G IDLE	1	3754	4	5.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.46	0.05	1.00	0.18	0.01
		WARM UP	2	1	F IDLE	1	3754	4	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		2.49	0.17	1.38	0.65	0.01
		TAXI OUT	2	1	F IDLE	1	3754	4	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.24	0.08	0.69	0.33	0.00
		ENGINE RUN-UP	2	1			3754	4	0.50	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.27	0.01	0.05	0.05	0.00
		TAKEOFF	2	1			3754	4	1.00	1	2,060	1	15.06	0.40	0.45	1.58	0.01		1.94	0.05	0.06	0.20	0.00
		FW CLIMBOUT	2	1			3754	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		2.53	0.08	0.14	0.32	0.00
DEPARTURE TOTALS																			**10.09**	**0.52**	**4.46**	**1.78**	**0.06**
2,503	4	FW (0°) APPROACH	2	1			2,503	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		1.45	0.06	0.18	0.24	0.00
SHORT ARRIVAL		TRANSITION (16°) LANDING	2	1			2503	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.56	0.02	0.06	0.09	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	2503	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.28	0.13	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	2503	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.80	0.08	1.74	0.31	0.02
		HOT REFUEL (APU)	1	1	ON	1	2503	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.67	0.04	0.66	0.02	0.02
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	2503	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.28	0.13	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	2503	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.12	0.01	0.27	0.05	0.00
		APU USE	1	1	ON	1	2503	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.26	0.02	0.25	0.01	0.01
ARRIVAL TOTALS																			**4.85**	**0.30**	**3.71**	**0.98**	**0.06**
2502	4	FW (0°) APPROACH	2	1			2502	4	3.00	1	1,210	1	9.57	0.40	1.20	1.58	0.02		1.45	0.06	0.18	0.24	0.00
VERTICAL ARRIVAL		TRANSITION (90°) LANDING	2	1			2502	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.56	0.02	0.06	0.09	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	2502	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.27	0.13	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	2502	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.80	0.08	1.74	0.31	0.02
		HOT REFUEL (APU)	1	1	ON	1	2502	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.67	0.04	0.66	0.02	0.02
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	2502	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.50	0.03	0.27	0.13	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	2502	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.12	0.01	0.27	0.05	0.00
		APU USE	1	1	ON	1	2502	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.26	0.02	0.25	0.01	0.01
ARRIVAL TOTALS																			**4.84**	**0.30**	**3.71**	**0.98**	**0.06**
0	4	FW APPROACH TO BREAK	2	1			0	4	2.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		0.00	0.00	0.00	0.00	0.00
ARRIVAL (WITH BREAK)		BREAK	2	1			0	4	1.00	1	1,030	1	8.41	0.40	1.58	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		CIRCLE	2	1			0	4	2.00	1	1,640	1	12.35	0.40	0.69	1.58	0.01		0.00	0.00	0.00	0.00	0.00
		FW APPROACH	2	1			0	4	1.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		0.00	0.00	0.00	0.00	0.00
		TRANSITION (16°) LANDING	2	1			0	4	1.00	1	1,310	1	10.22	0.40	1.04	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		TAXI TO HOT REFUEL	2	1	F IDLE	1	0	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		HOT REFUEL (MAIN ENGS)	2	1	G IDLE	1	0	4	13.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.00	0.00	0.00	0.00	0.00
		HOT REFUEL (APU)	1	1	ON	1	0	4	13.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.00	0.00	0.00	0.00	0.00
		TAXI TO SQUAD. APRON	2	1	F IDLE	1	0	4	3.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.00	0.00	0.00	0.00	0.00
		COOL/SHUT DOWN	2	1	G IDLE	1	0	4	2.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.00	0.00	0.00	0.00	0.00
		APU USE	1	1	ON	1	0	4	5.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.00	0.00	0.00	0.00	0.00
ARRIVAL TOTALS																			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Table CD-24. MV-22 Aircraft Emissions for Air Base Operations - 2 Squadrons at MCAS Camp Pendleton (2 Pages)

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT ASSIGNED AT BASE:	**24**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**11,069**	SCENARIO: 2 SQUADRONS				
DEPARTURES		ARRIVALS			CRUISE	
TOTAL OPS: **5,005**		TOTAL OPS: **5,005**			TOTAL HRS: **0**	
VERTICAL	SHORT	SHORT	VERTICAL	BREAK	FW MODE	HELO MODE
25.0% [d]	**75.0%** [d]	**50.0%** [d]	**50.0%** [d]	**0.0%** [d]	**85.0%** [d]	**15.0%** [d]

ROUTINE TRAINING OPERATIONS

TOTAL NUMBER OF OPERATIONS / FLIGHT ACTIVITY	ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE	ENGINE POWER (% Q_{TRANS})	ANNUAL NUMBER OF OPERATIONS	TIME IN MODE PER ENGINE (MINUTES)	FUEL FLOW RATE PER ENGINE (LBS/HR)	EMISSION FACTORS (LB/1,000 LB OF FUEL)					EMISSIONS[b] (TONS/YR)				
							NOx	SO2	CO	PM10	ROG	NOx	SO2	CO	PM10	ROG
0 [4]																
FW (0°) CRUISE (<3,000 FEET MSL)	CRUISE	2 [1]		0 [4] [4]	60.00 [1]	1,910 [1]	14.09	0.40	0.52	1.58	0.01	0.00	0.00	0.00	0.00	0.00
CRUISE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
0 [4]																
HELO (16°) CRUISE (<3,000 FEET MSL)	CRUISE	2 [1]		0 [4] [4]	60.00 [1]	1,530 [1]	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
CRUISE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
464 [4]	APPROACH	2 [3]		464 [4]	2.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.28	0.01	0.02	0.04	0.00
T & G	CLIMBOUT	2 [3]		464 [4]	1.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.24	0.01	0.01	0.03	0.00
	CIRCLE	2 [3]		464 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	0.31	0.01	0.02	0.04	0.00
TOUCH AND GO TOTALS												**0.83**	**0.03**	**0.04**	**0.10**	**0.00**
580 [4]	APPROACH	2 [3]		580 [4]	3.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.52	0.02	0.04	0.07	0.00
GCA BOX PATTERN	CLIMBOUT	2 [3]		580 [4]	2.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.60	0.02	0.02	0.06	0.00
	CIRCLE	2 [3]		580 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	0.39	0.01	0.02	0.05	0.00
GROUND CONTROL APPROACH BOX PATTERN TOTALS												**1.51**	**0.05**	**0.07**	**0.18**	**0.00**
[4]	APPROACH	2 [3]		0 [4]	2.00 [3]	1,530 [3]	11.64	0.40	0.79	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FCLP	CLIMBOUT	2 [3]		0 [4]	2.00 [3]	2,060 [3]	15.06	0.40	0.45	1.58	0.01	0.00	0.00	0.00	0.00	0.00
	CIRCLE	2 [3]		0 [4]	2.00 [3]	1,640 [3]	12.35	0.40	0.69	1.58	0.01	0.00	0.00	0.00	0.00	0.00
FIELD CARRIER LANDING PRACTICE TOTALS												**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
15 [4]																
LOW WORK	HOVER	2 [1]		15 [4]	7.00 [1]	1,640 [1]	12.35	0.40	0.69	1.58	0.01	0.03	0.00	0.00	0.00	0.00
LOW WORK TOTALS												**0.03**	**0.00**	**0.00**	**0.00**	**0.00**
OVERALL V-22 LTO CYCLE AND MISSION OPERATIONS AIR EMISSIONS TOTALS (TONS)												**26.40**	**1.39**	**13.52**	**4.73**	**0.21**
												NOx	**SO2**	**CO**	**PM10**	**ROG**

REFERENCES:
[1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).
[3] AESO MEMORANDUM REPORT NO. 9965, REVISION B, AIRCRAFT EMISSIONS ESTIMATES: V-22 MISSION OPERATIONS USING JP-5, JANUARY 2001 (REFERENCE 4).
[4] SEE APPENDIX B.

NOTES:
[a] SEE NOTE 1 FOR TABLE 1, REFERENCE 1
[b] EMISSIONS CALCULATION:
NUMBER OF AIRCRAFT OPERATIONS PER YEAR x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000
[d] PERCENTAGES TAKEN FROM APPENDIX E OF FINAL ENVIRONMENTAL IMPACT STATEMENT: INTRODUCTION OF THE V-22 TO THE SECOND MARINE AIRCRAFT WING, OCTOBER 1999, PAGE E-4 FOR AIRCRAFT STATIONED AT MCAS NEW RIVER.

Table CD-25. Aircraft Engine Maintenance and Testing Emissions for MV-22 Aircraft - 8 Squadrons

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT STATIONED AT BASE:	**84**	d
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**8,652**	**SCENARIO: 8 SQUADRONS**	

MAINTENANCE AND TESTING OPERATIONS

TOTAL NUMBER OF OPERATIONS / MAINTENANCE OPERATION		ENGINE MODE		NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS (PER AIRCRAFT)		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS (TONS/YR)[c] NOx	SO2	CO	PM10	ROG
1680	a																							
APU CHECK		APU USE	1	1	1	ON	1	20	1	30.00	1	413	1	5.95	0.40	5.89	0.22	0.19		1.03	0.07	1.02	0.04	0.03
APU CHECK TOTALS																				**1.03**	**0.07**	**1.02**	**0.04**	**0.03**
672	a	APU USE	1	1	1	ON	1	8	1	40.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.55	0.04	0.54	0.02	0.02
WATER WASH		MAIN ENGINE RUN	1	2	1	G IDLE	1	8	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.33	0.03	0.72	0.13	0.01
WATER WASH TOTALS																				**0.88**	**0.07**	**1.26**	**0.15**	**0.03**
1680	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.34	0.02	0.34	0.01	0.01
LOW POWER -		LOW POWER	1	1	1	G IDLE	1	20	1	15.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.31	0.03	0.67	0.12	0.01
ONE ENG		INTERMED. POWER	1	1	1	F IDLE	1	20	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.56	0.04	0.31	0.15	0.00
SINGLE LOW POWER - ONE ENGINE TOTALS																				**1.21**	**0.09**	**1.32**	**0.28**	**0.02**
2520	a	APU USE	1	1	1	ON	1	30	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.52	0.03	0.51	0.02	0.02
LOW POWER -		LOW POWER	1	2	1	G IDLE	1	30	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		1.24	0.12	2.69	0.48	0.03
TWO ENG		INTERMED. POWER	1	2	1	F IDLE	1	30	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		1.67	0.11	0.92	0.44	0.01
SINGLE LOW POWER - TWO ENGINE TOTALS																				**3.42**	**0.27**	**4.13**	**0.93**	**0.05**
1,680	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.34	0.02	0.34	0.01	0.01
HIGH POWER		MAIN ENGINE START	1	2	1	G IDLE	1	20	1	10.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.41	0.04	0.90	0.16	0.01
CHECK		TAXI OUT/TIE DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.56	0.04	0.31	0.15	0.00
		LOW POWER	1	2	1	G IDLE	1	20	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.82	0.08	1.79	0.32	0.02
		INTERMED. POWER	1	2	1			20	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		4.99	0.17	0.34	0.68	0.00
		HIGH POWER	1	2	1			20	1	5.00	1	2,510	1	17.97	0.40	0.29	1.58	0.01		6.31	0.14	0.10	0.56	0.00
		TAXI IN/SHUT DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.56	0.04	0.31	0.15	0.00
SINGLE HIGH POWER TOTALS																				13.99	0.53	4.09	2.01	0.05
420	a	APU USE	1	1	1	ON	1	5	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.09	0.01	0.09	0.00	0.00
PROP BALANCE		LOW POWER	1	2	1	G IDLE	1	5	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.21	0.02	0.45	0.08	0.01
		INTERMED. POWER	1	2	1			5	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		1.25	0.04	0.08	0.17	0.00
PROP BALANCE TOTALS																				**1.54**	**0.07**	**0.62**	**0.25**	**0.01**
OVERALL V-22 IN-FRAME MAINTENANCE TESTING AIR EMISSIONS TOTALS (TONS)																				**22.08**	**1.09**	**12.44**	**3.67**	**0.19**
																				NOx	SO2	CO	PM10	ROG

REFERENCES: [1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).

NOTES: [a] REFERENCE 1 CALCULATES MAINTENANCE EMISSIONS PER AIRCRAFT. CALCULATION ASSUMES THAT ALL AIRCRAFT NEED IDENTICAL SCHEDULED MAINTENANCE.

[b] SEE NOTE 1 FOR TABLE 1, REFERENCE 1

[c] EMISSIONS CALCULATION: {(MAINTENANCE TEST PER AIRCRAFT PER YEAR) x (NO. OF AIRCRAFT)} x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000

[d] At full build-out, one MV-22 squadron would be deployed overseas. Therefore, the total number of MV-22 equivalent fleet squadron aircraft that undergo maintenance at the base each year is 84.

Table CD-26. Aircraft Engine Maintenance and Testing Emissions for MV-22 Aircraft - 2 Squadrons

AIRCRAFT TYPE: **V-22**		REF
NUMBER OF AIRCRAFT STATIONED AT BASE:	**18**	
NUMBER OF ENGINES:	**2**	1/a
ENGINE TYPE: **T406-AD-400**		1/b

TOTAL OPERATIONS:	**1,854**	**SCENARIO: 2 SQUADRONS**	

MAINTENANCE AND TESTING OPERATIONS

TOTAL NUMBER OF OPERATIONS / MAINTENANCE OPERATION		ENGINE MODE		NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		ANNUAL NUMBER OF OPERATIONS (PER AIRCRAFT)		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		EMISSION FACTORS (LB/1,000 LB OF FUEL) NOx	SO2	CO	PM10	ROG		EMISSIONS (TONS/YR)[c] NOx	SO2	CO	PM10	ROG
360	a																							
APU CHECK		APU USE	1	1	1	ON	1	20	1	30.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.22	0.01	0.22	0.01	0.01
APU CHECK TOTALS																				**0.22**	**0.01**	**0.22**	**0.01**	**0.01**
144	a	APU USE	1	1	1	ON	1	8	1	40.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.12	0.01	0.12	0.00	0.00
WATER WASH		MAIN ENGINE RUN	1	2	1	G IDLE	1	8	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.07	0.01	0.15	0.03	0.00
WATER WASH TOTALS																				**0.19**	**0.01**	**0.27**	**0.03**	**0.01**
360	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.07	0.00	0.07	0.00	0.00
LOW POWER -		LOW POWER	1	1	1	G IDLE	1	20	1	15.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.07	0.01	0.14	0.03	0.00
ONE ENG		INTERMED. POWER	1	1	1	F IDLE	1	20	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.12	0.01	0.07	0.03	0.00
SINGLE LOW POWER - ONE ENGINE TOTALS																				**0.26**	**0.02**	**0.28**	**0.06**	**0.00**
540	a	APU USE	1	1	1	ON	1	30	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.11	0.01	0.11	0.00	0.00
LOW POWER -		LOW POWER	1	2	1	G IDLE	1	30	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.27	0.03	0.58	0.10	0.01
TWO ENG		INTERMED. POWER	1	2	1	F IDLE	1	30	1	10.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.36	0.02	0.20	0.09	0.00
SINGLE LOW POWER - TWO ENGINE TOTALS																				**0.73**	**0.06**	**0.88**	**0.20**	**0.01**
360	a	APU USE	1	1	1	ON	1	20	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.07	0.00	0.07	0.00	0.00
HIGH POWER		MAIN ENGINE START	1	2	1	G IDLE	1	20	1	10.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.09	0.01	0.19	0.03	0.00
CHECK		TAXI OUT/TIE DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.12	0.01	0.07	0.03	0.00
		LOW POWER	1	2	1	G IDLE	1	20	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.18	0.02	0.38	0.07	0.00
		INTERMED. POWER	1	2	1			20	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		1.07	0.04	0.07	0.15	0.00
		HIGH POWER	1	2	1			20	1	5.00	1	2,510	1	17.97	0.40	0.29	1.58	0.01		1.35	0.03	0.02	0.12	0.00
		TAXI IN/SHUT DOWN	1	2	1	F IDLE	1	20	1	5.00	1	660	1	6.02	0.40	3.33	1.58	0.02		0.12	0.01	0.07	0.03	0.00
SINGLE HIGH POWER TOTALS																				3.00	0.11	0.88	0.43	0.01
90	a	APU USE	1	1	1	ON	1	5	1	10.00	1	413	1	5.95	0.40	5.89	0.22	0.19		0.02	0.00	0.02	0.00	0.00
PROP BALANCE		LOW POWER	1	2	1	G IDLE	1	5	1	20.00	1	360	1	4.09	0.40	8.90	1.58	0.10		0.04	0.00	0.10	0.02	0.00
		INTERMED. POWER	1	2	1			5	1	10.00	1	1,530	1	11.64	0.40	0.79	1.58	0.01		0.27	0.01	0.02	0.04	0.00
PROP BALANCE TOTALS																				**0.33**	**0.01**	**0.13**	**0.05**	**0.00**
OVERALL V-22 IN-FRAME MAINTENANCE TESTING AIR EMISSIONS TOTALS (TONS)																				**4.73**	**0.23**	**2.66**	**0.79**	**0.04**

REFERENCES: [1] AESO MEMORANDUM REPORT NO. 9946, REVISION E, AIRCRAFT EMISSIONS ESTIMATES: V-22 TAKEOFF AND LANDING CYCLE AND IN-FRAME, MAINTENANCE TESTING USING JP-5, JANUARY 2001 (REFERENCE 3).

NOTES: [a] REFERENCE 1 CALCULATES MAINTENANCE EMISSIONS PER AIRCRAFT. CALCULATION ASSUMES THAT ALL AIRCRAFT NEED IDENTICAL SCHEDULED MAINTENANCE.

[b] SEE NOTE 1 FOR TABLE 1, REFERENCE 1

[c] EMISSIONS CALCULATION: {(MAINTENANCE TEST PER AIRCRAFT PER YEAR) x (NO. OF AIRCRAFT)} x {[(FUEL FLOW RATE PER ENGINE x TIME-IN-MODE/60 x NUMBER OF ENGINES IN USE) / 1000] x EMISSION INDEX}/2000

[d] This scenario equates to 2 MV-22 reserve squadrons present at base = 1.5 equivalent fleet squadrons operations, or 18 aircraft.

Table CD-27. MV-22 Aircraft Emissions for the Proposed Action at MCAS Miramar - Year 2010

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.03	1.54	4.26	0.20	0.71	0.71	1,619.47	0.23	0.02	1,629.39
Short Departure	0.06	4.46	10.14	0.53	1.79	1.79	4,174.94	0.58	0.04	4,200.49
Short Arrival	0.01	0.37	0.49	0.03	0.10	0.10	243.06	0.03	0.00	244.54
Vertical Arrival	0.01	0.37	0.49	0.03	0.10	0.10	243.06	0.03	0.00	244.54
Arrival (with Break)	0.11	6.94	13.86	0.70	2.40	2.40	5,650.12	0.79	0.06	5,684.70
Touch and Go	0.00	0.04	0.83	0.03	0.10	0.10	208.57	0.03	0.00	209.84
GCA Box Pattern	0.00	0.08	1.51	0.05	0.18	0.18	371.92	0.05	0.00	374.20
Hover	0.00	0.00	0.11	0.00	0.01	0.01	25.73	0.00	0.00	25.89
Subtotal	0.21	13.81	31.67	1.56	5.39	5.39	12,537	1.76	0.12	12,613.60
Engine Maintenance&Testing										
APU Check	0.01	0.29	0.29	0.02	0.01	0.01	160.31	0.02	0.00	161.29
Water Wash	0.01	0.36	0.25	0.02	0.04	0.04	159.71	0.02	0.00	160.69
Low Power - One Engine	0.01	0.38	0.35	0.03	0.08	0.08	207.98	0.03	0.00	209.26
Low Power - Two Engines	0.01	1.18	0.98	0.08	0.27	0.27	613.39	0.09	0.01	617.15
High Power	0.02	1.17	4.00	0.15	0.58	0.58	1,216.52	0.17	0.01	1,223.97
Prop Balance	0.00	0.18	0.44	0.02	0.07	0.07	158.03	0.02	0.00	159.00
Subtotal	0.06	3.55	6.31	0.31	1.05	1.05	2,516	0.35	0.02	2,531.34

Note: Equal to 2 squadrons in fleet and 2 on-station

Table CD-28. MV-22 Aircraft Emissions for the Proposed Action at MCAS Miramar - Year 2011

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.05	3.08	8.53	0.40	1.42	1.42	3,238.95	0.45	0.03	3,258.77
Short Departure	0.11	8.93	20.27	1.05	3.58	3.58	8,349.87	1.17	0.08	8,400.98
Short Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Vertical Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Arrival (with Break)	0.23	13.88	27.72	1.40	4.79	4.79	11,300.24	1.58	0.11	11,369.40
Touch and Go	0.00	0.09	1.66	0.05	0.20	0.20	417.14	0.06	0.00	419.69
GCA Box Pattern	0.00	0.15	3.01	0.09	0.37	0.37	743.84	0.10	0.01	748.39
Hover	0.00	0.01	0.21	0.01	0.03	0.03	51.47	0.01	0.00	51.78
Subtotal	0.42	27.63	63.35	3.13	10.78	10.78	25,074	3.51	0.25	25,227.20
Engine Maintenance&Testing										
APU Check	0.02	0.58	0.59	0.04	0.02	0.02	320.62	0.04	0.00	322.58
Water Wash	0.01	0.72	0.50	0.04	0.08	0.08	319.42	0.04	0.00	321.37
Low Power - One Engine	0.01	0.75	0.69	0.05	0.16	0.16	415.97	0.06	0.00	418.51
Low Power - Two Engines	0.03	2.36	1.96	0.15	0.53	0.53	1,226.78	0.17	0.01	1,234.29
High Power	0.03	2.34	8.00	0.30	1.15	1.15	2,433.05	0.34	0.02	2,447.94
Prop Balance	0.01	0.35	0.88	0.04	0.14	0.14	316.06	0.04	0.00	317.99
Subtotal	0.11	7.11	12.62	0.63	2.09	2.09	5,032	0.70	0.05	5,062.69

Note: Equal to 4 squadrons in fleet and 3 on-station (1 squadron deployed)

Table CD-29. MV-22 Aircraft Emissions for the Proposed Action at MCAS Miramar - Year 2012

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.06	3.85	10.66	0.50	1.77	1.77	4,048.68	0.57	0.04	4,073.46
Short Departure	0.14	11.16	25.34	1.32	4.47	4.47	10,437.34	1.46	0.10	10,501.23
Short Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Vertical Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Arrival (with Break)	0.28	17.35	34.65	1.75	5.99	5.99	14,125.30	1.98	0.14	14,211.76
Touch and Go	0.00	0.11	2.07	0.06	0.26	0.26	521.42	0.07	0.01	524.61
GCA Box Pattern	0.00	0.19	3.77	0.12	0.46	0.46	929.80	0.13	0.01	935.49
Hover	0.00	0.01	0.26	0.01	0.03	0.03	64.34	0.01	0.00	64.73
Subtotal	0.52	34.53	79.19	3.91	13.47	13.47	31,342	4.39	0.31	31,534.00
Engine Maintenance&Testing										
APU Check	0.02	0.73	0.74	0.05	0.03	0.03	400.77	0.06	0.00	403.22
Water Wash	0.02	0.90	0.63	0.05	0.11	0.11	399.27	0.06	0.00	401.71
Low Power - One Engine	0.01	0.94	0.86	0.06	0.20	0.20	519.96	0.07	0.01	523.14
Low Power - Two Engines	0.04	2.95	2.44	0.19	0.67	0.67	1,533.48	0.21	0.02	1,542.87
High Power	0.04	2.92	10.00	0.38	1.44	1.44	3,041.31	0.43	0.03	3,059.93
Prop Balance	0.01	0.44	1.10	0.05	0.18	0.18	395.07	0.06	0.00	397.49
Subtotal	0.14	8.88	15.77	0.78	2.62	2.62	6,290	0.88	0.06	6,328.36

Note: Equal to 6 squadrons in fleet and 5 on-station (1 squadron deployed)

Table CD-30. MV-22 Aircraft Emissions for the Proposed Action at MCAS Miramar - Year 2013

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.05	3.08	8.53	0.40	1.42	1.42	3,238.95	0.45	0.03	3,258.77
Short Departure	0.11	8.93	20.27	1.05	3.58	3.58	8,349.87	1.17	0.08	8,400.98
Short Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Vertical Arrival	0.01	0.74	0.97	0.06	0.20	0.20	486.11	0.07	0.00	489.09
Arrival (with Break)	0.23	13.88	27.72	1.40	4.79	4.79	11,300.24	1.58	0.11	11,369.40
Touch and Go	0.00	0.09	1.66	0.05	0.20	0.20	417.14	0.06	0.00	419.69
GCA Box Pattern	0.00	0.15	3.01	0.09	0.37	0.37	743.84	0.10	0.01	748.39
Hover	0.00	0.01	0.21	0.01	0.03	0.03	51.47	0.01	0.00	51.78
Subtotal	0.42	27.63	63.35	3.13	10.78	10.78	25,074	3.51	0.25	25,227.20
Engine Maintenance&Testing										
APU Check	0.02	0.58	0.59	0.04	0.02	0.02	320.62	0.04	0.00	322.58
Water Wash	0.01	0.72	0.50	0.04	0.08	0.08	319.42	0.04	0.00	321.37
Low Power - One Engine	0.01	0.75	0.69	0.05	0.16	0.16	415.97	0.06	0.00	418.51
Low Power - Two Engines	0.03	2.36	1.96	0.15	0.53	0.53	1,226.78	0.17	0.01	1,234.29
High Power	0.03	2.34	8.00	0.30	1.15	1.15	2,433.05	0.34	0.02	2,447.94
Prop Balance	0.01	0.35	0.88	0.04	0.14	0.14	316.06	0.04	0.00	317.99
Subtotal	0.11	7.11	12.62	0.63	2.09	2.09	5,032	0.70	0.05	5,062.69

Note: Equal to 5 squadrons in fleet and 4 on-station (1 squadron deployed).

Table CD-31. MV-22 Aircraft Emissions for the Proposed Action at MCAS Miramar - Year 2014

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.06	3.85	10.66	0.50	1.77	1.77	4,048.68	0.57	0.04	4,073.46
Short Departure	0.14	11.16	25.34	1.32	4.47	4.47	10,437.34	1.46	0.10	10,501.23
Short Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Vertical Arrival	0.02	0.93	1.22	0.08	0.24	0.24	607.64	0.09	0.01	611.36
Arrival (with Break)	0.28	17.35	34.65	1.75	5.99	5.99	14,125.30	1.98	0.14	14,211.76
Touch and Go	0.00	0.11	2.07	0.06	0.26	0.26	521.42	0.07	0.01	524.61
GCA Box Pattern	0.00	0.19	3.77	0.12	0.46	0.46	929.80	0.13	0.01	935.49
Hover	0.00	0.01	0.26	0.01	0.03	0.03	64.34	0.01	0.00	64.73
Subtotal	0.52	34.53	79.19	3.91	13.47	13.47	31,342	4.39	0.31	31,534.00
Engine Maintenance&Testing										
APU Check	0.02	0.73	0.74	0.05	0.03	0.03	400.77	0.06	0.00	403.22
Water Wash	0.02	0.90	0.63	0.05	0.11	0.11	399.27	0.06	0.00	401.71
Low Power - One Engine	0.01	0.94	0.86	0.06	0.20	0.20	519.96	0.07	0.01	523.14
Low Power - Two Engines	0.04	2.95	2.44	0.19	0.67	0.67	1,533.48	0.21	0.02	1,542.87
High Power	0.04	2.92	10.00	0.38	1.44	1.44	3,041.31	0.43	0.03	3,059.93
Prop Balance	0.01	0.44	1.10	0.05	0.18	0.18	395.07	0.06	0.00	397.49
Subtotal	0.14	8.88	15.77	0.78	2.62	2.62	6,290	0.88	0.06	6,328.36

Note: Equal to 6 squadrons in fleet and 5 on-station (1 squadron deployed)

Table CD-32. MV-22 Aircraft Emissions for the Proposed Action at MCAS Miramar - Years 2015+

	Tons per Year									
Activity/Mode	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
Flight Operations										
Vertical Departure	0.09	5.38	14.92	0.70	2.48	2.48	5,668.16	0.79	0.06	5,702.85
Short Departure	0.20	15.63	35.47	1.85	6.26	6.26	14,612.28	2.05	0.14	14,701.72
Short Arrival	0.02	1.30	1.70	0.11	0.34	0.34	850.70	0.12	0.01	855.90
Vertical Arrival	0.02	1.30	1.70	0.11	0.34	0.34	850.70	0.12	0.01	855.90
Arrival (with Break)	0.40	24.30	48.51	2.45	8.39	8.39	19,775.42	2.77	0.19	19,896.46
Touch and Go	0.00	0.15	2.90	0.09	0.36	0.36	729.99	0.10	0.01	734.46
GCA Box Pattern	0.00	0.26	5.28	0.16	0.64	0.64	1,301.72	0.18	0.01	1,309.68
Hover	0.00	0.02	0.37	0.01	0.04	0.04	90.07	0.01	0.00	90.62
Subtotal	0.73	48.35	110.86	5.48	18.86	18.86	43,879	6.14	0.43	44,147.60
Engine Maintenance&Testing										
APU Check	0.03	1.02	1.03	0.07	0.04	0.04	561.08	0.08	0.01	564.51
Water Wash	0.03	1.26	0.88	0.07	0.15	0.15	558.98	0.08	0.01	562.40
Low Power - One Engine	0.02	1.32	1.21	0.09	0.28	0.28	727.94	0.10	0.01	732.40
Low Power - Two Engines	0.05	4.13	3.42	0.27	0.93	0.93	2,146.87	0.30	0.02	2,160.01
High Power	0.05	4.09	13.99	0.53	2.01	2.01	4,257.83	0.60	0.04	4,283.90
Prop Balance	0.01	0.62	1.54	0.07	0.25	0.25	553.10	0.08	0.01	556.48
Subtotal	0.19	12.44	22.08	1.09	3.67	3.67	8,806	1.23	0.09	8,859.70

Note: Equal to 8 squadrons in fleet and 7 on-station (1 squadron deployed)

Table CD-33. Annual Operational Emissions for the MV-22 Proposed Action at MCAS Miramar - Year 2010

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.21	13.81	31.67	1.56	5.39	5.39	12,536.86	1.76	0.12	12,613.60
MV-22 Engine Maintenance/Testing	0.06	3.55	6.31	0.31	1.05	1.05	2,515.94	0.35	0.02	2,531.34
Personal-Owned Vehicles	1.31	9.55	1.22	0.01	0.09	0.08	1,220.36	0.02	0.00	1,221.38
Government-Owned Vehicles	0.13	0.85	0.42	0.00	0.03	0.03	109.04	0.00	0.00	109.14
Ground/Tactical Support Equipment	4.82	47.52	4.13	0.02	0.45	0.45	6,071.21	0.11	0.01	6,076.30
Construction	0.05	0.55	0.22	0.00	0.02	0.02	69.68	0.00	0.00	69.74
Other Sources	0.27	1.31	0.27	0.02	0.15	0.04	167.24	0.00	0.00	167.38
Stationary Sources (1)	1.34	1.12	4.11	0.19	4.69	3.00	142.79	0.00	0.00	142.91
Total Emissions - 2 Squadrons	8.20	78.26	48.35	2.12	11.87	10.06	22,833.13	2.25	0.16	22,931.80

Table CD-34. Annual Operational Emissions for the MV-22 Proposed Action at MCAS Miramar - Year 2011

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.42	27.63	63.35	3.13	10.78	10.78	25,073.73	3.51	0.25	25,227.20
MV-22 Engine Maintenance/Testing	0.11	7.11	12.62	0.63	2.09	2.09	5,031.89	0.70	0.05	5,062.69
Personal-Owned Vehicles	2.63	19.10	2.44	0.01	0.17	0.17	2,440.72	0.04	0.00	2,442.77
Government-Owned Vehicles	0.27	1.71	0.83	0.00	0.06	0.06	218.09	0.00	0.00	218.27
Ground/Tactical Support Equipment	9.64	95.04	8.26	0.04	0.91	0.89	12,142.42	0.22	0.02	12,152.61
Construction	0.11	1.09	0.44	0.00	0.05	0.05	139.37	0.00	0.00	139.48
Other Sources	0.55	2.62	0.55	0.04	0.31	0.09	334.48	0.01	0.00	334.76
Stationary Sources (1)	2.68	2.24	8.23	0.38	9.38	6.00	285.58	0.01	0.00	285.82
Total Emissions - 4 Squadrons	16.40	156.52	96.71	4.23	23.75	20.13	45,666.27	4.50	0.32	45,863.60

Table CD-35. Annual Operational Emissions for the MV-22 Proposed Action at MCAS Miramar - Year 2012

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.52	34.53	79.19	3.91	13.47	13.47	31,342.16	4.39	0.31	31,534.00
MV-22 Engine Maintenance/Testing	0.14	8.88	15.77	0.78	2.62	2.62	6,289.86	0.88	0.06	6,328.36
Personal-Owned Vehicles	3.29	23.88	3.05	0.02	0.22	0.21	3,050.90	0.06	0.00	3,053.46
Government-Owned Vehicles	0.33	2.13	1.04	0.01	0.07	0.07	272.61	0.00	0.00	272.84
Ground/Tactical Support Equipment	12.05	118.79	10.33	0.05	1.14	1.11	15,178.02	0.28	0.02	15,190.76
Construction	0.14	1.36	0.55	0.00	0.06	0.06	174.21	0.00	0.00	174.35
Other Sources	0.68	3.27	0.68	0.04	0.38	0.11	418.10	0.01	0.00	418.45
Stationary Sources (1)	3.35	2.79	10.28	0.47	11.72	7.50	356.98	0.01	0.00	357.28
Total Emissions - 6 Squadrons	20.50	195.65	120.89	5.29	29.68	25.16	57,082.83	5.63	0.40	57,329.50

Table CD-36. Annual Operational Emissions for the MV-22 Proposed Action at MCAS Miramar - Year 2013

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.42	27.63	63.35	3.13	10.78	10.78	25,073.73	3.51	0.25	25,227.20
MV-22 Engine Maintenance/Testing	0.11	7.11	12.62	0.63	2.09	2.09	5,031.89	0.70	0.05	5,062.69
Personal-Owned Vehicles	2.63	19.10	2.44	0.01	0.17	0.17	2,440.72	0.04	0.00	2,442.77
Government-Owned Vehicles	0.27	1.71	0.83	0.00	0.06	0.06	218.09	0.00	0.00	218.27
Ground/Tactical Support Equipment	9.64	95.04	8.26	0.04	0.91	0.89	12,142.42	0.22	0.02	12,152.61
Construction	0.11	1.09	0.44	0.00	0.05	0.05	139.37	0.00	0.00	139.48
Other Sources	0.55	2.62	0.55	0.04	0.31	0.09	334.48	0.01	0.00	334.76
Stationary Sources (1)	2.68	2.24	8.23	0.38	9.38	6.00	285.58	0.01	0.00	285.82
Total Emissions - 5 Squadrons	16.40	156.52	96.71	4.23	23.75	20.13	45,666.27	4.50	0.32	45,863.60

Table CD-37. Annual Operational Emissions for the MV-22 Proposed Action at MCAS Miramar - Year 2014

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.52	34.53	79.19	3.91	13.47	13.47	31,342.16	4.39	0.31	31,534.00
MV-22 Engine Maintenance/Testing	0.14	8.88	15.77	0.78	2.62	2.62	6,289.86	0.88	0.06	6,328.36
Personal-Owned Vehicles	3.29	23.88	3.05	0.02	0.22	0.21	3,050.90	0.06	0.00	3,053.46
Government-Owned Vehicles	0.33	2.13	1.04	0.01	0.07	0.07	272.61	0.00	0.00	272.84
Ground/Tactical Support Equipment	12.05	118.79	10.33	0.05	1.14	1.11	15,178.02	0.28	0.02	15,190.76
Construction	0.14	1.36	0.55	0.00	0.06	0.06	174.21	0.00	0.00	174.35
Other Sources	0.68	3.27	0.68	0.04	0.38	0.11	418.10	0.01	0.00	418.45
Stationary Sources (1)	3.35	2.79	10.28	0.47	11.72	7.50	356.98	0.01	0.00	357.28
Total Emissions - 6 Squadrons	20.50	195.65	120.89	5.29	29.68	25.16	57,082.83	5.63	0.40	57,329.50

Table CD-38. Annual Operational Emissions for the MV-22 Proposed Action at MCAS Miramar - Years 2015+

	Tons per Year									
Source Type	*ROG/HC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	*CO_2e*
MV-22 Operations	0.73	48.35	110.86	5.48	18.86	18.86	43,879.02	6.14	0.43	44,147.60
MV-22 Engine Maintenance/Testing	0.19	12.44	22.08	1.09	3.67	3.67	8,805.80	1.23	0.09	8,859.70
Personal-Owned Vehicles	4.60	33.43	4.27	0.02	0.30	0.30	4,271.26	0.08	0.01	4,274.85
Government-Owned Vehicles	0.47	2.99	1.45	0.01	0.10	0.10	381.65	0.01	0.00	381.97
Ground/Tactical Support Equipment	16.87	166.31	14.46	0.07	1.59	1.56	21,249.23	0.39	0.03	21,267.07
Construction	0.19	1.91	0.76	0.00	0.08	0.08	243.89	0.00	0.00	244.09
Other Sources	0.95	4.58	0.95	0.06	0.53	0.15	585.33	0.01	0.00	585.82
Stationary Sources (1)	4.69	3.91	14.39	0.66	16.41	10.50	499.77	0.01	0.00	500.19
Total Emissions - 8 Squadrons	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97	7.88	0.55	80,261.30

Notes: Emissions from source categories other than aircraft or G/TSE were estimated by multiplying emissions from current CH-46 operations at MCAS Miramar (Table CD-4) by the ratio of the proposed MV-22 and current CH-46 basing populations (2,015/1,269). Emissions from G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Miramar (Table CD-4) by the ratio of proposed MV-22 and current CH-46 aircraft numbers (96/48).

Table CD-39. Total Operational Emissions for the Fielding of 2 MV-22 Squadrons at MCAS Camp Pendleton - Year 2017

	Emissions (Tons per Year)					
Source Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
MV-22 Operations	0.21	13.52	26.40	1.39	4.73	4.73
MV-22 Engine Maintenance/Testing	0.04	2.66	4.73	0.23	0.79	0.79
Personal-Owned Vehicles	3.92	29.01	3.14	0.02	0.11	0.11
Government-Owned Vehicles	0.78	3.14	0.78	0.00	0.03	0.03
Ground/Tactical Support Equipment	4.10	40.39	3.51	0.02	0.39	0.38
Construction	0.78	1.68	2.81	0.01	0.31	0.30
Other Sources	-	-	0.78	0.05	0.44	0.12
Stationary Sources (1)	0.55	3.06	3.84	0.18	4.38	2.80
Total Emissions - 2 Squadrons	10.38	93.47	46.00	1.91	11.17	9.26
Net Change from Existing Conditions	(48.32)	(194.43)	4.10	(1.27)	(21.77)	(21.24)

Notes: Emissions from source categories other than aircraft or G/TSE were estimated by multiplying emissions from current CH-46 operations at MCAS Camp Pendleton (Table B1-5) by the ratio of the proposed MV-22 and current CH-46 basing populations (712/908). Emissions from G/TSE were estimated by multiplying G/TSE emissions due to current CH-46 operations at MCAS Camp Pendleton (Table B1-5) by the ratio of proposed MV-22 and current CH-46 aircraft numbers (24/41).

	A	B	C	D	E	F	G	H	I	J	K
1	Table CD-40. Proposed Annual MV-22 Operations - MCB Pendleton Range										
2		*Year/Annual Operations*								*Cruise*	
3	*Flight Activity/Flight Details*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*Duration (Hrs)*	
4	*Confined Area Landing (CAL)*										
5	CAL + Cruise	39	78	97	78	97	136	136	165	0.85	
6	Subtotal Ops	39	78	97	78	97	136	136	165		
7	*Drop Zone*										
8	Paratroop Drop + Cruise	10	20	25	20	25	35	35	42	0.92	
9	Subtotal Ops	10	20	25	20	25	35	35	42		
10	*Landing Zone*										
11	CAL + Cruise	20	39	49	39	49	69	69	84	0.85	
12	Subtotal Ops	20	39	49	39	49	69	69	84		
13	*PAD, etc.*										
14	CAL + Cruise	570	1,140	1,425	1,140	1,425	1,995	1,995	2,423	0.85	
15	Subtotal Ops	570	1,140	1,425	1,140	1,425	1,995	1,995	2,423		
16	*RWR-1*										
17	Cruise Only	419	838	1,048	838	1,048	1,467	1,467	1,781	0.23	
18	Subtotal Ops	419	838	1,048	838	1,048	1,467	1,467	1,781		
19	*RWR-2*										
20	Cruise Only	419	838	1,048	838	1,048	1,467	1,467	1,781	0.16	
21	Subtotal Ops	419	838	1,048	838	1,048	1,467	1,467	1,781		
22	*RWR-3*										
23	Cruise Only	419	838	1,048	838	1,048	1,467	1,467	1,781	0.18	
24	Subtotal Ops	419	838	1,048	838	1,048	1,467	1,467	1,781		
25	Total Ops	1,896	3,792	4,739	3,792	4,739	6,635	6,635	8,057		
26	Note: The above flight activities developed from data used for the Project noise analysis, as presented in EIS Appendix C.2.8 - Modeled										
27	Airspace MCBCP Flight Profiles Data Base.										

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Table CD-41. Emission Factors/Activity Data for MV-22 Aircraft																		
2–5	FLIGHT ACTIVITY	ENGINE POWER SETTINGS	NUMBER OF ENGINES IN USE		ENGINE POWER (% Q_{TRANS})		TIME IN MODE PER ENGINE (MINUTES)		FUEL FLOW RATE PER ENGINE (LBS/HR)		Emission Factors (Pounds/Operation) (1)(4)								
											ROG	CO	NOx	SO2	PM10	PM2.5	*CO2*	*CH4*	*N2O*
15	Vertical Departure Total (2)										0.04	2.45	6.79	0.32	1.13	1.13	2,579	0.36	0.03
23	Short Departure Total (2)										0.03	2.37	5.38	0.28	0.95	0.95	2,216	0.31	0.02
32	Short Arrival Total (2)										0.05	2.96	3.87	0.24	0.78	0.78	1,935	0.27	0.02
41	Vertical Arrival Total (2)										0.05	2.96	3.87	0.24	0.78	0.78	1,935	0.27	0.02
53	Arrival (with Break) Total (2)										0.05	3.07	6.13	0.31	1.06	1.06	2,499	0.35	0.02
55	FW (0°) Cruise (Lb/1,000 Lb of Fuel) (2)	Cruise	2						1,910		0.01	0.52	14.09	0.40	1.58	1.58	3,209	0.45	0.03
58	HELO (16°) Cruise (Lb/1,000 Lb of Fuel) (2)	Cruise	2						1,530		0.01	0.79	11.64	0.40	1.58	1.58	3,212	0.45	0.03
63	T&G Total (3)										0.003	0.19	3.57	0.11	0.44	0.44	899	0.13	0.01
67	GCA Box Pattern Total (3)										0.004	0.26	5.20	0.16	0.63	0.63	1,283	0.18	0.01
71	FCLP Total (3)										0.003	0.22	4.61	0.14	0.55	0.55	1,119	0.16	0.01
73	Hover (Lb/1,000 Lb of Fuel) (3)		2						1,770		0.01	0.60	13.19	0.40	1.58	1.58	3,210	0.45	0.03
76	Single Pad or Confined Area Landing Total (3)										0.01	0.29	8.87	0.24	0.94	0.94	1,899	0.27	0.02
79	Paratroop Drop Total (3)										0.003	0.18	3.85	0.12	0.46	0.46	932	0.13	0.01

81 Notes: (1) Units in pounds of emissions per operation, except for cruise and hover modes, units in pounds per 1,000 pounds of fuel comsumed.

82 (2) AESO Memorandum Report No. 9946, Revision E, Aircraft Emissions Estimates: V-22 Takeoff and Landing Cycle and In-Frame, Maintenance Testing Using JP-5, January 2001 (Reference 3).

83 (3) AESO Memorandum Report No. 9965, Revision B, Aircraft Emissions Estimates: V-22 Mission Operations Using JP-5, January 2001 (Reference 4).

84 (4) PM2.5 factor based upon AESO report No. 2001-30 (AESO 2001). Emission factors for CH4 and N2O obtained from the California Climate Action Registry

85 General Reporting Protocol, Version 3.0, source type commercial/institutional kerosene combustion (CCAR 2008).

	A	B	C	D	E	F	G	H	I	J	K
1	Table CD-42. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2010										
2		*Annual Emissions (Tons)*									
3	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
4	*Confined Area Landing (CAL)*										
5	CAL	0.00	0.01	0.17	0.00	0.02	0.02	36.92	0.01	0.00	37.14
6	Cruise (from CAL)	0.00	0.03	0.89	0.03	0.10	0.10	202.56	0.03	0.00	203.80
7	Subtotal Ops	0.00	0.04	1.06	0.03	0.12	0.12	239.47	0.03	0.00	240.94
8	*Drop Zone*										
9	Paratroop Drop (PT)	0.00	0.00	0.02	0.00	0.00	0.00	4.62	0.00	0.00	4.65
10	Cruise (from PT)	0.00	0.01	0.24	0.01	0.03	0.03	55.68	0.01	0.00	56.02
11	Subtotal Ops	0.00	0.01	0.26	0.01	0.03	0.03	60.30	0.01	0.00	60.67
12	*Landing Zone*										
13	CAL	0.00	0.00	0.09	0.00	0.01	0.01	18.74	0.00	0.00	18.85
14	Cruise (from CAL)	0.00	0.02	0.45	0.01	0.05	0.05	102.82	0.01	0.00	103.45
15	Subtotal Ops	0.00	0.02	0.54	0.02	0.06	0.06	121.56	0.02	0.00	122.31
16	*PAD, etc.*										
17	CAL	0.00	0.08	2.53	0.07	0.27	0.27	541.34	0.08	0.01	544.65
18	Cruise (from CAL)	0.01	0.48	13.04	0.37	1.46	1.46	2,970.25	0.42	0.03	2,988.43
19	Subtotal Ops	0.01	0.56	15.57	0.44	1.73	1.73	3,511.59	0.49	0.03	3,533.08
20	*RWR-1*										
21	Cruise	0.00	0.10	2.62	0.07	0.29	0.29	596.93	0.08	0.01	600.58
22	Subtotal Ops	0.00	0.10	2.62	0.07	0.29	0.29	596.93	0.08	0.01	600.58
23	*RWR-2*										
24	Cruise	0.00	0.07	1.79	0.05	0.20	0.20	408.71	0.06	0.00	411.21
25	Subtotal Ops	0.00	0.07	1.79	0.05	0.20	0.20	408.71	0.06	0.00	411.21
26	*RWR-3*										
27	Cruise	0.00	0.08	2.05	0.06	0.23	0.23	467.86	0.07	0.00	470.72
28	Subtotal Ops	0.00	0.08	2.05	0.06	0.23	0.23	467.86	0.07	0.00	470.72
29	Total Ops	0.02	0.87	23.90	0.67	2.66	2.66	5,406.42	0.76	0.05	5,439.51

	A	B	C	D	E	F	G	H	I	J	K
33	Table CD-43. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2011										
34		*Annual Emissions (Tons)*									
35	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
36	*Confined Area Landing (CAL)*										
37	CAL	0.00	0.01	0.34	0.01	0.04	0.04	73.83	0.01	0.00	74.29
38	Cruise (from CAL)	0.00	0.07	1.78	0.05	0.20	0.20	405.11	0.06	0.00	407.59
39	Subtotal Ops	0.00	0.08	2.12	0.06	0.24	0.24	478.95	0.07	0.00	481.88
40	*Drop Zone*										
41	Paratroop Drop (PT)	0.00	0.00	0.04	0.00	0.00	0.00	9.24	0.00	0.00	9.29
42	Cruise (from PT)	0.00	0.02	0.49	0.01	0.05	0.05	111.36	0.02	0.00	112.05
43	Subtotal Ops	0.00	0.02	0.53	0.02	0.06	0.06	120.60	0.02	0.00	121.34
44	*Landing Zone*										
45	CAL	0.00	0.01	0.18	0.00	0.02	0.02	37.48	0.01	0.00	37.71
46	Cruise (from CAL)	0.00	0.03	0.90	0.03	0.10	0.10	205.65	0.03	0.00	206.91
47	Subtotal Ops	0.00	0.04	1.08	0.03	0.12	0.12	243.13	0.03	0.00	244.61
48	*PAD, etc.*										
49	CAL	0.01	0.17	5.06	0.14	0.54	0.54	1,082.67	0.15	0.01	1,089.30
50	Cruise (from CAL)	0.02	0.96	26.08	0.74	2.92	2.92	5,940.51	0.83	0.06	5,976.87
51	Subtotal Ops	0.02	1.13	31.14	0.88	3.46	3.46	7,023.18	0.98	0.07	7,066.17
52	*RWR-1*										
53	Cruise	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
54	Subtotal Ops	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
55	*RWR-2*										
56	Cruise	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
57	Subtotal Ops	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
58	*RWR-3*										
59	Cruise	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
60	Subtotal Ops	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
61	Total Ops	0.04	1.74	47.81	1.35	5.33	5.33	10,812.84	1.51	0.11	10,879.02

	A	B	C	D	E	F	G	H	I	J	K
65	Table CD-44. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2012										
66		*Annual Emissions (Tons)*									
67	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
68	*Confined Area Landing (CAL)*										
69	CAL	0.00	0.01	0.43	0.01	0.05	0.05	92.29	0.01	0.00	92.86
70	Cruise (from CAL)	0.00	0.08	2.22	0.06	0.25	0.25	506.39	0.07	0.00	509.49
71	Subtotal Ops	0.00	0.10	2.65	0.07	0.30	0.30	598.69	0.08	0.01	602.35
72	*Drop Zone*										
73	Paratroop Drop (PT)	0.00	0.00	0.05	0.00	0.01	0.01	11.55	0.00	0.00	11.62
74	Cruise (from PT)	0.00	0.02	0.61	0.02	0.07	0.07	139.20	0.02	0.00	140.06
75	Subtotal Ops	0.00	0.02	0.66	0.02	0.07	0.07	150.75	0.02	0.00	151.67
76	*Landing Zone*										
77	CAL	0.00	0.01	0.22	0.01	0.02	0.02	46.85	0.01	0.00	47.14
78	Cruise (from CAL)	0.00	0.04	1.13	0.03	0.13	0.13	257.06	0.04	0.00	258.63
79	Subtotal Ops	0.00	0.05	1.35	0.04	0.15	0.15	303.91	0.04	0.00	305.77
80	*PAD, etc.*										
81	CAL	0.01	0.21	6.32	0.17	0.67	0.67	1,353.34	0.19	0.01	1,361.62
82	Cruise (from CAL)	0.02	1.20	32.60	0.93	3.66	3.66	7,425.64	1.04	0.07	7,471.09
83	Subtotal Ops	0.03	1.41	38.93	1.10	4.33	4.33	8,778.98	1.23	0.09	8,832.71
84	*RWR-1*										
85	Cruise	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
86	Subtotal Ops	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
87	*RWR-2*										
88	Cruise	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
89	Subtotal Ops	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
90	*RWR-3*										
91	Cruise	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
92	Subtotal Ops	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
93	Total Ops	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05	1.89	0.13	13,598.78

	A	B	C	D	E	F	G	H	I	J	K
97	Table CD-45. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2013										
98		*Annual Emissions (Tons)*									
99	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
100	*Confined Area Landing (CAL)*										
101	CAL	0.00	0.01	0.34	0.01	0.04	0.04	73.83	0.01	0.00	74.29
102	Cruise (from CAL)	0.00	0.07	1.78	0.05	0.20	0.20	405.11	0.06	0.00	407.59
103	Subtotal Ops	0.00	0.08	2.12	0.06	0.24	0.24	478.95	0.07	0.00	481.88
104	*Drop Zone*										
105	Paratroop Drop (PT)	0.00	0.00	0.04	0.00	0.00	0.00	9.24	0.00	0.00	9.29
106	Cruise (from PT)	0.00	0.02	0.49	0.01	0.05	0.05	111.36	0.02	0.00	112.05
107	Subtotal Ops	0.00	0.02	0.53	0.02	0.06	0.06	120.60	0.02	0.00	121.34
108	*Landing Zone*										
109	CAL	0.00	0.01	0.18	0.00	0.02	0.02	37.48	0.01	0.00	37.71
110	Cruise (from CAL)	0.00	0.03	0.90	0.03	0.10	0.10	205.65	0.03	0.00	206.91
111	Subtotal Ops	0.00	0.04	1.08	0.03	0.12	0.12	243.13	0.03	0.00	244.61
112	*PAD, etc.*										
113	CAL	0.01	0.17	5.06	0.14	0.54	0.54	1,082.67	0.15	0.01	1,089.30
114	Cruise (from CAL)	0.02	0.96	26.08	0.74	2.92	2.92	5,940.51	0.83	0.06	5,976.87
115	Subtotal Ops	0.02	1.13	31.14	0.88	3.46	3.46	7,023.18	0.98	0.07	7,066.17
116	*RWR-1*										
117	Cruise	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
118	Subtotal Ops	0.00	0.19	5.24	0.15	0.59	0.59	1,193.85	0.17	0.01	1,201.16
119	*RWR-2*										
120	Cruise	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
121	Subtotal Ops	0.00	0.13	3.59	0.10	0.40	0.40	817.41	0.11	0.01	822.42
122	*RWR-3*										
123	Cruise	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
124	Subtotal Ops	0.00	0.15	4.11	0.12	0.46	0.46	935.72	0.13	0.01	941.45
125	Total Ops	0.04	1.74	47.81	1.35	5.33	5.33	10,812.84	1.51	0.11	10,879.02

	A	B	C	D	E	F	G	H	I	J	K
129	Table CD-46. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2014										
130		*Annual Emissions (Tons)*									
131	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
132	*Confined Area Landing (CAL)*										
133	CAL	0.00	0.01	0.43	0.01	0.05	0.05	92.29	0.01	0.00	92.86
134	Cruise (from CAL)	0.00	0.08	2.22	0.06	0.25	0.25	506.39	0.07	0.00	509.49
135	Subtotal Ops	0.00	0.10	2.65	0.07	0.30	0.30	598.69	0.08	0.01	602.35
136	*Drop Zone*										
137	Paratroop Drop (PT)	0.00	0.00	0.05	0.00	0.01	0.01	11.55	0.00	0.00	11.62
138	Cruise (from PT)	0.00	0.02	0.61	0.02	0.07	0.07	139.20	0.02	0.00	140.06
139	Subtotal Ops	0.00	0.02	0.66	0.02	0.07	0.07	150.75	0.02	0.00	151.67
140	*Landing Zone*										
141	CAL	0.00	0.01	0.22	0.01	0.02	0.02	46.85	0.01	0.00	47.14
142	Cruise (from CAL)	0.00	0.04	1.13	0.03	0.13	0.13	257.06	0.04	0.00	258.63
143	Subtotal Ops	0.00	0.05	1.35	0.04	0.15	0.15	303.91	0.04	0.00	305.77
144	*PAD, etc.*										
145	CAL	0.01	0.21	6.32	0.17	0.67	0.67	1,353.34	0.19	0.01	1,361.62
146	Cruise (from CAL)	0.02	1.20	32.60	0.93	3.66	3.66	7,425.64	1.04	0.07	7,471.09
147	Subtotal Ops	0.03	1.41	38.93	1.10	4.33	4.33	8,778.98	1.23	0.09	8,832.71
148	*RWR-1*										
149	Cruise	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
150	Subtotal Ops	0.00	0.24	6.55	0.19	0.73	0.73	1,492.32	0.21	0.01	1,501.45
151	*RWR-2*										
152	Cruise	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
153	Subtotal Ops	0.00	0.17	4.49	0.13	0.50	0.50	1,021.77	0.14	0.01	1,028.02
154	*RWR-3*										
155	Cruise	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
156	Subtotal Ops	0.00	0.19	5.14	0.15	0.58	0.58	1,169.65	0.16	0.01	1,176.81
157	Total Ops	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05	1.89	0.13	13,598.78

	A	B	C	D	E	F	G	H	I	J	K
161	Table CD-47. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2015										
162		*Annual Emissions (Tons)*									
163	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
164	*Confined Area Landing (CAL)*										
165	CAL	0.00	0.02	0.60	0.02	0.06	0.06	129.21	0.02	0.00	130.00
166	Cruise (from CAL)	0.00	0.11	3.11	0.09	0.35	0.35	708.95	0.10	0.01	713.29
167	Subtotal Ops	0.00	0.13	3.72	0.10	0.41	0.41	838.16	0.12	0.01	843.29
168	*Drop Zone*										
169	Paratroop Drop (PT)	0.00	0.00	0.07	0.00	0.01	0.01	16.16	0.00	0.00	16.26
170	Cruise (from PT)	0.00	0.03	0.86	0.02	0.10	0.10	194.89	0.03	0.00	196.08
171	Subtotal Ops	0.00	0.03	0.92	0.03	0.10	0.10	211.05	0.03	0.00	212.34
172	*Landing Zone*										
173	CAL	0.00	0.01	0.31	0.01	0.03	0.03	65.59	0.01	0.00	65.99
174	Cruise (from CAL)	0.00	0.06	1.58	0.04	0.18	0.18	359.88	0.05	0.00	362.08
175	Subtotal Ops	0.00	0.07	1.89	0.05	0.21	0.21	425.47	0.06	0.00	428.07
176	*PAD, etc.*										
177	CAL	0.01	0.29	8.85	0.24	0.94	0.94	1,894.67	0.27	0.02	1,906.27
178	Cruise (from CAL)	0.03	1.68	45.65	1.30	5.12	5.12	10,395.89	1.46	0.10	10,459.52
179	Subtotal Ops	0.04	1.97	54.50	1.54	6.06	6.06	12,290.57	1.72	0.12	12,365.79
180	*RWR-1*										
181	Cruise	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
182	Subtotal Ops	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
183	*RWR-2*										
184	Cruise	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
185	Subtotal Ops	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
186	*RWR-3*										
187	Cruise	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
188	Subtotal Ops	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
189	Total Ops	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47	2.65	0.19	19,038.29

	A	B	C	D	E	F	G	H	I	J	K
193	Table CD-48. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2016										
194		*Annual Emissions (Tons)*									
195	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
196	*Confined Area Landing (CAL)*										
197	CAL	0.00	0.02	0.60	0.02	0.06	0.06	129.21	0.02	0.00	130.00
198	Cruise (from CAL)	0.00	0.11	3.11	0.09	0.35	0.35	708.95	0.10	0.01	713.29
199	Subtotal Ops	0.00	0.13	3.72	0.10	0.41	0.41	838.16	0.12	0.01	843.29
200	*Drop Zone*										
201	Paratroop Drop (PT)	0.00	0.00	0.07	0.00	0.01	0.01	16.16	0.00	0.00	16.26
202	Cruise (from PT)	0.00	0.03	0.86	0.02	0.10	0.10	194.89	0.03	0.00	196.08
203	Subtotal Ops	0.00	0.03	0.92	0.03	0.10	0.10	211.05	0.03	0.00	212.34
204	*Landing Zone*										
205	CAL	0.00	0.01	0.31	0.01	0.03	0.03	65.59	0.01	0.00	65.99
206	Cruise (from CAL)	0.00	0.06	1.58	0.04	0.18	0.18	359.88	0.05	0.00	362.08
207	Subtotal Ops	0.00	0.07	1.89	0.05	0.21	0.21	425.47	0.06	0.00	428.07
208	*PAD, etc.*										
209	CAL	0.01	0.29	8.85	0.24	0.94	0.94	1,894.67	0.27	0.02	1,906.27
210	Cruise (from CAL)	0.03	1.68	45.65	1.30	5.12	5.12	10,395.89	1.46	0.10	10,459.52
211	Subtotal Ops	0.04	1.97	54.50	1.54	6.06	6.06	12,290.57	1.72	0.12	12,365.79
212	*RWR-1*										
213	Cruise	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
214	Subtotal Ops	0.01	0.34	9.17	0.26	1.03	1.03	2,089.24	0.29	0.02	2,102.03
215	*RWR-2*										
216	Cruise	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
217	Subtotal Ops	0.00	0.23	6.28	0.18	0.70	0.70	1,430.47	0.20	0.01	1,439.23
218	*RWR-3*										
219	Cruise	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
220	Subtotal Ops	0.01	0.27	7.19	0.20	0.81	0.81	1,637.51	0.23	0.02	1,647.54
221	Total Ops	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47	2.65	0.19	19,038.29

	A	B	C	D	E	F	G	H	I	J	K
225	Table CD-49. MCB Pendleton Range MV-22 Aircraft Emissions - Year 2017										
226		*Annual Emissions (Tons)*									
227	*Location/Flight Mode*	*ROG*	*CO*	*NOx*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*CH_4*	*N_2O*	CO_2e
228	*Confined Area Landing (CAL)*										
229	CAL	0.00	0.02	0.73	0.02	0.08	0.08	156.90	0.02	0.00	157.86
230	Cruise (from CAL)	0.00	0.14	3.78	0.11	0.42	0.42	860.87	0.12	0.01	866.14
231	Subtotal Ops	0.00	0.16	4.51	0.13	0.50	0.50	1,017.76	0.14	0.01	1,023.99
232	*Drop Zone*										
233	Paratroop Drop (PT)	0.00	0.00	0.08	0.00	0.01	0.01	19.63	0.00	0.00	19.75
234	Cruise (from PT)	0.00	0.04	1.04	0.03	0.12	0.12	236.65	0.03	0.00	238.10
235	Subtotal Ops	0.00	0.04	1.12	0.03	0.13	0.13	256.28	0.04	0.00	257.84
236	*Landing Zone*										
237	CAL	0.00	0.01	0.37	0.01	0.04	0.04	79.64	0.01	0.00	80.13
238	Cruise (from CAL)	0.00	0.07	1.92	0.05	0.22	0.22	437.00	0.06	0.00	439.67
239	Subtotal Ops	0.00	0.08	2.29	0.06	0.25	0.25	516.64	0.07	0.01	519.81
240	*PAD, etc.*										
241	CAL	0.01	0.35	10.75	0.29	1.14	1.14	2,300.68	0.32	0.02	2,314.76
242	Cruise (from CAL)	0.04	2.05	55.43	1.57	6.22	6.22	12,623.58	1.77	0.12	12,700.85
243	Subtotal Ops	0.05	2.40	66.17	1.86	7.35	7.35	14,924.26	2.09	0.15	15,015.61
244	*RWR-1*										
245	Cruise	0.01	0.41	11.14	0.32	1.25	1.25	2,536.94	0.36	0.02	2,552.46
246	Subtotal Ops	0.01	0.41	11.14	0.32	1.25	1.25	2,536.94	0.36	0.02	2,552.46
247	*RWR-2*										
248	Cruise	0.01	0.28	7.63	0.22	0.86	0.86	1,737.00	0.24	0.02	1,747.63
249	Subtotal Ops	0.01	0.28	7.63	0.22	0.86	0.86	1,737.00	0.24	0.02	1,747.63
250	*RWR-3*										
251	Cruise	0.01	0.32	8.73	0.25	0.98	0.98	1,988.41	0.28	0.02	2,000.58
252	Subtotal Ops	0.01	0.32	8.73	0.25	0.98	0.98	1,988.41	0.28	0.02	2,000.58
253	Total Ops	0.08	3.70	101.59	2.87	11.32	11.32	22,977.29	3.22	0.23	23,117.93

	A	B	C	D	E	F	G	H	I	J	K
1	Table CD-50. Annual MV-22 Operational Fielding Rates and Associated Military Training Route Operations										
2		*MTR*	*Sortie Duration*	*Year/Annual Operations*							
3	*MTR/Flight Activity*	*Length (NM)*	*(Hrs) (2)*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
4	*MV-22 Annual Fielding Rate*										
5	% of Year 2017 Operations (1)	NA	NA	24	47	59	47	59	82	82	100
6	*VR 1266*										
7	Criuse	158.5	0.72	28	57	71	57	71	100	100	121
8	Notes: (1) Equates to percentage of annual MV-22 aircraft operations relative to full build-out year 2017 operations.										
9	(2) Cruising speed = 220 knots.										

	A	B	C	D	E	F	G	H
1	Table CD-51. MV-22 Aircraft Emissions - Military Training Route VR-1266 Total Length							
2		*Tons per Year*						
3	*Year*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
4	*2010*	0.00	0.02	0.55	0.02	0.06	0.06	125.72
5	*2011*	0.00	0.04	1.10	0.03	0.12	0.12	251.44
6	*2012*	0.00	0.05	1.38	0.04	0.15	0.15	314.30
7	*2013*	0.00	0.04	1.10	0.03	0.12	0.12	251.44
8	*2014*	0.00	0.05	1.38	0.04	0.15	0.15	314.30
9	*2015*	0.00	0.07	1.93	0.05	0.22	0.22	440.02
10	*2016*	0.00	0.07	1.93	0.05	0.22	0.22	440.02
11	*2017*	0.00	0.09	2.35	0.07	0.26	0.26	534.31
12	Notes: (1) All activities occur in cruise mode.							
13								
14								
15	Table CD-52. Fraction of Total MTR Lengths within Affected Air Basins/Nonattainment Areas.							
16		*San Diego Air Basin*	*Salton Sea Air Basin*	*Mojave Desert Air Basin*				
17	*MTR*	*Total (1) (2)*	*Total (2)*	*Total (2)*	*Arizona (2)*			
18	VR 1266	0.53	0.36	0.11	-			
19	Notes: (1) SDAB includes all nonattainment/attainment areas.							
20	(2) MTR fractions of total length within these 4 air basins add up to 1.							
21								
22								
23	Table CD-53. MV-22 Aircraft Emissions within Military Training Routes - SDAB							
24		*Tons per Year*						
25	*MTR/Year*	*ROG*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
26	*VR 1266*							
27	*2010*	0.00	0.01	0.29	0.01	0.03	0.03	66.63
28	*2011*	0.00	0.02	0.59	0.02	0.07	0.07	133.26
29	*2012*	0.00	0.03	0.73	0.02	0.08	0.08	166.58
30	*2013*	0.00	0.02	0.59	0.02	0.07	0.07	133.26
31	*2014*	0.00	0.03	0.73	0.02	0.08	0.08	166.58
32	*2015*	0.00	0.04	1.02	0.03	0.11	0.11	233.21
33	*2016*	0.00	0.04	1.02	0.03	0.11	0.11	233.21
34	*2017*	0.00	0.05	1.24	0.04	0.14	0.14	283.19
35	Notes: (1) All activities occur in cruise mode.							

Table CD-54. Construction Equipment Source Data for MCAS Miramar - 8 MV-22 Squadrons Alternative

Construction Activity/Equipment Ty	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days*	*Total Hp-Hrs*
Demolition - Building Facilities								
Backhoe	160	0.50	2	160	8	1,280	26	33,827
Bulldozer	310	0.50	2	310	8	2,480	26	65,540
Crane w/Wrecking Ball	180	0.50	1	90	8	720	26	19,028
Loader	215	0.50	3	323	8	2,580	26	68,183
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	26	7,400
Haul Truck (1)	NA	NA	10	NA	20	200	26	5,285
Building Demolition (3)	NA	NA	NA	NA	8	NA	26	2,354,970
Demolition - Apron								
Bulldozer - D9	405	0.50	1	203	8	1,620	62	100,762
Haul Truck - 20 CY - Asphalt (1)	NA	NA	4	NA	20	79	62	4,916
Haul Truck - 20 CY - Runway Base	NA	NA	4	NA	7	26	62	1,640
Fugitive Dust (2)	NA	NA	2	NA	8	NA	62	124
Loader - 938G	160	0.50	2	160	8	1,280	124	159,229
Water Truck - 5000 Gallons	175	0.40	2	140	4	560	124	69,663
Demolition - Airfield Facilities - Other								
Backhoe	160	0.50	2	160	8	1,280	87	111,780
Bulldozer	310	0.50	2	310	8	2,480	87	216,574
Crane w/Wrecking Ball	180	0.50	1	90	8	720	87	62,876
Loader	215	0.50	3	323	8	2,580	87	225,307
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	87	24,452
Haul Truck (1)	NA	NA	10	NA	20	200	87	17,466
Building Demolition (3)	NA	NA	NA	NA	8	NA	87	7,781,910
Construction - Building Facilities								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	502	90,379
Concrete/Industrial Saw	84	0.73	1	61	6	368	502	184,734
Crane	190	0.30	1	57	6	342	502	171,719
Forklift	94	0.48	1	45	6	268	502	134,513
Generator	45	0.60	1	27	8	216	502	108,454
Concrete Trucks (1)	NA	NA	15	NA	14	210	23	4,793
Supply Trucks (1)	NA	NA	20	NA	10	200	38	7,608
Fugitive Dust (2)	NA	NA	1	NA	8	NA	122	122
Construction - New Apron								
Haul Truck - 20 CY - Asphalt (1)	NA	NA	10	NA	68	681	24	16,340
Asphalt Spreader - BG 240C	153	0.60	2	184	8	1,469	24	35,227
Compactive Roller	165	0.50	2	165	8	1,320	24	31,658
Fugitive Dust (2)	NA	NA	2	NA	8	NA	48	96
Grader - 14H	215	0.50	2	215	8	1,720	24	41,251
Loader - 938G	160	0.50	2	160	8	1,280	24	30,699
Oil Truck	300	0.40	1	120	8	960	24	23,024
Vibratory Compactor - CB 355D	105	0.75	2	158	8	1,260	48	60,438
Construction - Airfield Facilities - Other								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	661	118,899
Concrete/Industrial Saw	84	0.73	1	61	6	368	661	243,029
Crane	190	0.30	1	57	6	342	661	225,908
Forklift	94	0.48	1	45	6	268	661	176,961
Generator	45	0.60	1	27	8	216	661	142,679
Concrete Trucks (1)	NA	NA	15	NA	14	210	30	6,305
Supply Trucks (1)	NA	NA	20	NA	10	200	50	10,008
Fugitive Dust (2)	NA	NA	1	NA	8	NA	160	160

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

(2) Number Active is acres disturbed at one time and Total Fuel Use is acre-days disturbed.

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

Table CD-55. Air Emission Factors for Construction Equipment MCAS Miramar/Camp Pendleton MV-22 Alternatives

Equipment Type	*Fuel Type*	*Emission Factors (Grams/Horsepower-Hour)*						
		ROG	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*	*Reference*
Year 2010								
Off-Road Equipment - 25-50 Hp	D	0.64	2.34	5.79	0.01	0.38	0.35	(1)
Off-Road Equipment - 51-120 Hp	D	1.45	4.10	5.55	0.01	0.60	0.55	(1)
Off-Road Equipment - 121-175 Hp	D	0.46	3.23	5.64	0.01	0.39	0.36	(1)
Off-Road Equipment - 176-250 Hp	D	0.33	2.70	5.26	0.01	0.24	0.22	(1)
Off-Road Equipment - 251-500 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
Off-Road Equipment - 501-750 Hp	D	0.19	0.92	4.95	0.01	0.12	0.11	(1)
Off-Road Equipment - >750 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
On-road Truck - Idle (Gms/Hr)	D	12.26	46.77	105.83	0.06	1.82	1.67	(2)
On-road Truck - 5 mph (Gms/Mi)	D	11.33	25.15	38.73	0.04	2.38	2.19	(2)
On-road Truck - 25 mph (Gms/Mi)	D	1.41	8.04	16.11	0.02	0.66	0.60	(2)
On-road Truck - 55 mph (Gms/Mi)	D	0.81	4.67	14.73	0.02	0.61	0.56	(2)
Other On-Road Trucks - Composite (Gms	D	1.45	6.37	16.21	0.02	0.71	0.65	(3)
Year 2011								
Off-Road Equipment - 25-50 Hp	D	0.64	2.34	5.79	0.01	0.38	0.35	(1)
Off-Road Equipment - 51-120 Hp	D	1.45	4.10	5.55	0.01	0.60	0.55	(1)
Off-Road Equipment - 121-175 Hp	D	0.46	3.23	5.64	0.01	0.39	0.36	(1)
Off-Road Equipment - 176-250 Hp	D	0.33	2.70	5.26	0.01	0.24	0.22	(1)
Off-Road Equipment - 251-500 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
Off-Road Equipment - 501-750 Hp	D	0.19	0.92	4.95	0.01	0.12	0.11	(1)
Off-Road Equipment - >750 Hp	D	0.32	0.92	6.25	0.01	0.15	0.14	(1)
On-road Truck - Idle (Gms/Hr)	D	11.67	46.09	107.88	0.06	1.65	1.67	(2)
On-road Truck - 5 mph (Gms/Mi)	D	10.46	23.08	35.85	0.04	2.08	2.19	(2)
On-road Truck - 25 mph (Gms/Mi)	D	1.30	7.22	14.91	0.02	0.59	0.60	(2)
On-road Truck - 55 mph (Gms/Mi)	D	0.74	4.33	13.42	0.02	0.57	0.56	(2)
Other On-Road Trucks - Composite (Gms	D	1.34	5.84	14.84	0.02	0.65	0.65	(3)
All Years								
Fugitive Dust (Lbs/acre-day)	---	---	---	---	---	13.45	2.81	(4)
Building Demolition (Lbs/1000 cf)	---	---	---	---	---	0.41	0.09	(5)

Notes: (1) Composite emission factors developed from ARB OFFROAD2007 emissions model (2006) and based on average SCAB equipment fleet age distributions for project years 2010 and 2011.

(2) Heavy duty diesel truck running emission factors developed from EMFAC2007 (ARB 2006). Units in grams/mile for project years 2010 and 2011. Based on annual average conditions at 60 degrees and 50% humidity. PM emission factors include combustive and tire/brake wear contributions.

(3) For on-road trucks, composite factor based on a round trip of 75% at 55 mph, 20% at 25 mph, and 5% at 5 mph. Although not shown in these calculations, emissions from 5 minutes. Units in grams/mile. of idling mode included for each truck round trip.

(4) Units in lbs/acre-day from section 11.2.3 of AP-42 (EPA 1995). Emissions reduced by 75% from uncontrolled levels to represent compliance with SCAQMD Rule 403 - Fugitive Dust.

(5) CEQA Air Quality Handbook, Table A9-9-H (SCAQMD 1993). Units in lbs/1000 cubic feet (cf) of demolished building.

Table CD-56. Construction Emissions for MCAS Miramar - 8 MV-22 Squadrons Alternative

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Demolition - Building Facilities						
Backhoe	0.02	0.12	0.21	0.00	0.01	0.01
Bulldozer	0.02	0.07	0.45	0.00	0.01	0.01
Crane w/Wrecking Ball	0.01	0.07	0.12	0.00	0.01	0.01
Loader	0.02	0.20	0.40	0.00	0.02	0.02
Water Truck - 5000 Gallons	0.00	0.03	0.05	0.00	0.00	0.00
Haul Truck	0.01	0.04	0.10	0.00	0.00	0.00
Building Demolition	-	-	-	-	0.48	0.10
Subtotal - Building Demolition	0.09	0.52	1.32	0.00	0.54	0.16
Demolition - Apron						
Bulldozer - D9	0.04	0.10	0.69	0.00	0.02	0.02
Haul Truck - 20 CY - Asphalt	0.01	0.04	0.10	0.00	0.00	0.00
Haul Truck - 20 CY - Runway Base	0.00	0.01	0.03	0.00	0.00	0.00
Fugitive Dust (2)	-	-	-	-	0.84	0.17
Loader - 938G	0.08	0.57	0.99	0.00	0.07	0.06
Water Truck - 5000 Gallons	0.04	0.25	0.43	0.00	0.03	0.03
Subtotal - Apron Demolition	0.16	0.97	2.25	0.00	0.96	0.29
Demolition - Airfield Facilities - Other						
Backhoe	0.06	0.40	0.69	0.00	0.05	0.04
Bulldozer	0.08	0.22	1.49	0.00	0.04	0.03
Crane w/Wrecking Ball	0.03	0.22	0.39	0.00	0.03	0.02
Loader	0.08	0.67	1.31	0.00	0.06	0.05
Water Truck - 5000 Gallons	0.01	0.09	0.15	0.00	0.01	0.01
Haul Truck (1)	0.03	0.12	0.32	0.00	0.01	0.01
Building Demolition	-	-	-	-	1.60	0.33
Subtotal - Airfield Demolition	0.29	1.72	4.35	0.00	1.79	0.51
Construction - Building Facilities						
Air Compressor - 100 CFM	0.06	0.23	0.58	0.00	0.04	0.03
Concrete/Industrial Saw	0.30	0.83	1.13	0.00	0.12	0.11
Crane	0.09	0.61	1.07	0.00	0.07	0.07
Forklift	0.22	0.61	0.82	0.00	0.09	0.08
Generator	0.08	0.28	0.69	0.00	0.05	0.04
Concrete Trucks	0.01	0.03	0.09	0.00	0.00	0.00
Supply Trucks	0.01	0.05	0.13	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	0.82	0.17
Subtotal - Building Construction	0.76	2.65	4.51	0.00	1.20	0.52
Construction - New Apron						
Haul Truck - 20 CY - Asphalt (1)	0.03	0.12	0.30	0.00	0.01	0.01
Asphalt Spreader - BG 240C	0.02	0.13	0.22	0.00	0.02	0.01
Compactive Roller	0.02	0.11	0.20	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	0.65	0.13
Grader - 14H	0.02	0.12	0.24	0.00	0.01	0.01
Loader - 938G	0.02	0.11	0.19	0.00	0.01	0.01
Oil Truck	0.01	0.02	0.16	0.00	0.00	0.00
Vibratory Compactor - CB 355D	0.10	0.27	0.37	0.00	0.04	0.04
Subtotal - Apron Construction	0.20	0.88	1.67	0.00	0.75	0.24
Construction - Airfield Facilities - Other						
Air Compressor - 100 CFM	0.08	0.31	0.76	0.00	0.05	0.05
Concrete/Industrial Saw	0.39	1.10	1.49	0.00	0.16	0.15
Crane	0.11	0.80	1.40	0.00	0.10	0.09
Forklift	0.28	0.80	1.08	0.00	0.12	0.11
Generator	0.10	0.37	0.91	0.00	0.06	0.05
Concrete Trucks	0.01	0.04	0.11	0.00	0.00	0.00
Supply Trucks	0.02	0.07	0.18	0.00	0.01	0.01
Fugitive Dust	-	-	-	-	1.08	0.22
Subtotal - Airfield Construction	1.00	3.49	5.93	0.01	1.57	0.68
Total Emissions - 8 squadrons	2.49	10.24	20.03	0.02	6.82	2.39
Annual Emissions - 8 squadrons	1.24	5.12	10.01	0.01	3.41	1.19
SDAB Conformity De Minimis Thresholds	100	100	100	NA	NA	NA

Table CD-57. Construction Equipment Source Data for MCAS Camp Pendleton - 2 MV-22 Squadrons Alternative

Construction Activity/Equipment Typ	*Hp Rating*	*Ave. Daily Load Factor*	*Number Active*	*Hourly Hp-Hrs*	*Hours/ Day*	*Daily Hp-Hrs*	*Work Days*	*Total Hp-Hrs*
Demolition - Building Facilities								
Backhoe	160	0.50	2	160	8	1,280	0.23	290
Bulldozer	310	0.50	2	310	8	2,480	0.23	561
Crane w/Wrecking Ball	180	0.50	1	90	8	720	0.23	163
Loader	215	0.50	3	323	8	2,580	0.23	584
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	0.23	63
Haul Truck (1)	NA	NA	10	NA	20	200	0.23	45
Building Demolition (3)	NA	NA	NA	NA	8	NA	0.23	20,160
Demolition - Apron								
Bulldozer - D9	405	0.50	1	203	8	1,620	-	-
Haul Truck - 20 CY - Asphalt (1)	NA	NA	4	NA	20	#REF!	-	-
Haul Truck - 20 CY - Runway Base	NA	NA	4	NA	7	#REF!	-	-
Fugitive Dust (2)	NA	NA	2	NA	8	NA	-	-
Loader - 938G	160	0.50	2	160	8	1,280	-	-
Water Truck - 5000 Gallons	175	0.40	2	140	4	560	-	-
Demolition - Airfield Facilities - Other								
Backhoe	160	0.50	2	160	8	1,280	-	-
Bulldozer	310	0.50	2	310	8	2,480	-	-
Crane w/Wrecking Ball	180	0.50	1	90	8	720	-	-
Loader	215	0.50	3	323	8	2,580	-	-
Water Truck - 5000 Gallons	175	0.40	1	70	4	280	-	-
Haul Truck (1)	NA	NA	10	NA	20	200	-	-
Building Demolition (3)	NA	NA	NA	NA	8	NA	-	-
Construction - Building Facilities								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	180	32,443
Concrete/Industrial Saw	84	0.73	1	61	6	368	180	66,313
Crane	190	0.30	1	57	6	342	180	61,642
Forklift	94	0.48	1	45	6	268	180	48,286
Generator	45	0.60	1	27	8	216	180	38,932
Concrete Trucks (1)	NA	NA	15	NA	14	210	8	1,720
Supply Trucks (1)	NA	NA	20	NA	10	200	14	2,731
Fugitive Dust (2)	NA	NA	1	NA	8	NA	44	44
Construction - New Apron								
Haul Truck - 20 CY - Asphalt (1)	NA	NA	10	NA	525	5,248	3	16,340
Asphalt Spreader - BG 240C	153	0.60	2	184	8	1,469	3	4,573
Compactive Roller	165	0.50	2	165	8	1,320	3	4,110
Fugitive Dust (2)	NA	NA	2	NA	8	NA	6	12
Grader - 14H	215	0.50	2	215	8	1,720	3	5,355
Loader - 938G	160	0.50	2	160	8	1,280	3	3,985
Oil Truck	300	0.40	1	120	8	960	3	2,989
Vibratory Compactor - CB 355D	105	0.75	2	158	8	1,260	6	7,846
Construction - Airfield Facilities - Other								
Air Compressor - 100 CFM	50	0.60	1	30	6	180	374	67,328
Concrete/Industrial Saw	84	0.73	1	61	6	368	374	137,619
Crane	190	0.30	1	57	6	342	374	127,923
Forklift	94	0.48	1	45	6	268	374	100,207
Generator	45	0.60	1	27	8	216	374	80,794
Concrete Trucks (1)	NA	NA	15	NA	14	210	17	3,570
Supply Trucks (1)	NA	NA	20	NA	10	200	28	5,667
Fugitive Dust (2)	NA	NA	1	NA	8	NA	91	91

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

(2) Number Active is acres disturbed at one time and Total Fuel Use is acre-days disturbed.

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

Table CD-58. Construction Emissions for MCAS Camp Pendleton - 2 MV-22 Squadrons Alternative

	Total Emissions (Tons)					
Construction Activity/Equipment Type	*ROG*	*CO*	*NOx*	*SO2*	*PM10*	*PM2.5*
Demolition - Building Facilities						
Backhoe	0.000	0.001	0.002	0.000	0.000	0.000
Bulldozer	0.000	0.002	0.004	0.000	0.000	0.000
Crane w/Wrecking Ball	0.000	0.000	0.001	0.000	0.000	0.000
Loader	0.000	0.001	0.004	0.000	0.000	0.000
Water Truck - 5000 Gallons	0.000	0.000	0.000	0.000	0.000	0.000
Haul Truck	0.000	0.000	0.001	0.000	0.000	0.000
Building Demolition	-	-	-	-	0.004	0.001
Subtotal - Building Demolition	0.00	0.01	0.01	0.00	0.00	0.00
Demolition - Apron						
Bulldozer - D9	-	-	-	-	-	-
Haul Truck - 20 CY - Asphalt	-	-	-	-	-	-
Haul Truck - 20 CY - Runway Base	-	-	-	-	-	-
Fugitive Dust (2)	-	-	-	-	-	-
Loader - 938G	-	-	-	-	-	-
Water Truck - 5000 Gallons	-	-	-	-	-	-
Demolition - Airfield Facilities - Other						
Backhoe	-	-	-	-	-	-
Bulldozer	-	-	-	-	-	-
Crane w/Wrecking Ball	-	-	-	-	-	-
Loader	-	-	-	-	-	-
Water Truck - 5000 Gallons	-	-	-	-	-	-
Haul Truck (1)	-	-	-	-	-	-
Building Demolition	-	-	-	-	-	-
Construction - Building Facilities						
Air Compressor - 100 CFM	0.08	0.24	0.21	0.00	0.02	0.02
Concrete/Industrial Saw	0.08	0.27	0.46	0.00	0.04	0.04
Crane	0.04	0.12	0.40	0.00	0.01	0.01
Forklift	0.03	0.20	0.33	0.00	0.03	0.03
Generator	0.10	0.28	0.25	0.00	0.02	0.02
Concrete Trucks	0.00	0.01	0.02	0.00	0.00	0.00
Supply Trucks	0.00	0.02	0.04	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.29	0.06
Subtotal - Building Construction	0.33	1.14	1.71	0.00	0.42	0.18
Construction - New Apron						
Haul Truck - 20 CY - Asphalt (1)	0.02	0.11	0.23	0.00	0.01	0.01
Asphalt Spreader - BG 240C	0.00	0.02	0.03	0.00	0.00	0.00
Compactive Roller	0.00	0.02	0.03	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.08	0.02
Grader - 14H	0.00	0.01	0.03	0.00	0.00	0.00
Loader - 938G	0.00	0.01	0.03	0.00	0.00	0.00
Oil Truck	0.00	0.01	0.02	0.00	0.00	0.00
Vibratory Compactor - CB 355D	0.01	0.03	0.05	0.00	0.00	0.00
Subtotal - Apron Construction	0.04	0.21	0.41	0.00	0.10	0.03
Construction - Airfield Facilities - Other						
Air Compressor - 100 CFM	0.17	0.49	0.43	0.00	0.04	0.04
Concrete/Industrial Saw	0.16	0.57	0.95	0.00	0.08	0.08
Crane	0.09	0.24	0.83	0.00	0.03	0.03
Forklift	0.06	0.21	0.35	0.00	0.03	0.03
Generator	0.21	0.59	0.52	0.00	0.05	0.05
Concrete Trucks	0.00	0.02	0.05	0.00	0.00	0.00
Supply Trucks	0.01	0.04	0.08	0.00	0.00	0.00
Fugitive Dust	-	-	-	-	0.6097	0.1272
Subtotal - Airfield Construction	0.69	2.16	3.20	0.00	0.85	0.35
Total Emissions - 2 squadrons	1.07	3.51	5.33	0.01	1.38	0.57
Annual Emissions - 2 squadrons	0.54	1.75	2.67	0.00	0.69	0.28
SDAB Conformity De Minimis Thresholds	100	100	100	NA	NA	NA

	A	B	C	D	E	F	G	H
21	Table CD-59. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2010							
22		*Tons per Year*						
23	*Source Scenario/Location*	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
24	*CH-46 Emissions*							
25	MCAS Miramar Existing Emissions	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09
26	MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
27	MCB Pendleton Ranges Existing Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08
28	Total CH-46 Emissions	95.28	478.54	70.50	5.43	53.86	49.02	31,389.52
29	*MV-22 Emissions*							
30	MCAS Miramar Proposed Emissions	8.20	78.26	48.35	2.12	11.87	10.00	22,833.13
31	MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
32	MCB Pendleton Ranges Proposed Emissions	0.02	0.87	23.90	0.67	2.66	2.66	5,406.42
33	VR-1266	0.00	0.01	0.29	0.01	0.03	0.03	66.63
34	Total MV-22 Emissions	8.22	79.14	72.55	2.80	14.57	12.69	28,306.19
35	Total Proposed Emissions (SDAB)	103.50	557.68	143.05	8.23	68.43	61.72	59,695.70
36	Construction - MCAS Miramar	1.24	5.12	10.01	0.01	3.41	1.19	
37	Construction - MCAS Camp Pendleton	0.54	1.75	2.67	0.00	0.69	0.28	
38	Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
39	Proposed minus Year 2000 Emissions	(23.29)	(83.16)	60.95	1.00	(0.29)	(2.86)	59,695.70
40	SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA
41	Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.							

Table CD-60. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2011

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	31.10	159.17	22.25	1.61	18.04	15.90	14,307.09
MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
MCB Pendleton Ranges Existing Emissions	5.48	31.47	6.35	0.65	2.88	2.88	5,094.08
Total CH-46 Emissions	95.28	478.54	70.50	5.43	53.86	49.02	31,389.52
MV-22 Emissions							
MCAS Miramar Proposed Emissions	16.40	156.52	96.71	4.23	23.75	20.00	45,666.27
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.04	1.74	47.81	1.35	5.33	5.33	10,812.84
VR-1266	0.00	0.02	0.59	0.02	0.07	0.07	133.26
Total MV-22 Emissions	16.44	158.29	145.10	5.60	29.14	25.39	56,612.37
Total Proposed Emissions (SDAB)	111.72	636.83	215.60	11.02	83.00	74.41	88,001.89
Construction - MCAS Miramar	1.24	5.12	10.01	0.01	3.41	1.19	
Construction - MCAS Camp Pendleton	0.54	1.75	2.67	0.00	0.69	0.28	
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
Proposed minus Year 2000 Emissions	(15.07)	(4.02)	133.50	3.80	14.27	9.83	88,001.89
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table CD-61. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2012

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
MCB Pendleton Ranges Existing Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45
Total CH-46 Emissions	61.99	306.78	45.71	3.56	34.67	31.97	15,044.80
MV-22 Emissions							
MCAS Miramar Proposed Emissions	20.50	195.65	120.89	5.29	29.68	25.00	57,082.83
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05
VR-1266	0.00	0.03	0.73	0.02	0.08	0.08	166.58
Total MV-22 Emissions	20.55	197.86	181.38	7.00	36.42	31.74	70,765.46
Total Proposed Emissions (SDAB)	82.53	504.64	227.09	10.56	71.09	63.71	85,810.26
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
Proposed minus Year 2000 Emissions	(46.03)	(143.08)	132.31	3.32	(1.73)	(2.35)	85,810.26
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table CD-62. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2013

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	58.70	287.90	41.90	3.18	32.94	30.24	11,988.35
MCB Pendleton Ranges Existing Emissions	3.29	18.88	3.81	0.39	1.73	1.73	3,056.45
Total CH-46 Emissions	61.99	306.78	45.71	3.56	34.67	31.97	15,044.80
MV-22 Emissions							
MCAS Miramar Proposed Emissions	16.40	156.52	96.71	4.23	23.75	20.00	45,666.27
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.04	1.74	47.81	1.35	5.33	5.27	10,812.84
VR-1266	0.00	0.02	0.59	0.02	0.07	0.07	133.26
Total MV-22 Emissions	16.44	158.29	145.10	5.60	29.14	25.34	56,612.37
Total Proposed Emissions (SDAB)	78.42	465.07	190.81	9.16	63.80	57.31	71,657.17
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
Proposed minus Year 2000 Emissions	(50.14)	(182.65)	96.04	1.92	(9.02)	(8.75)	71,657.17
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table CD-63. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2014

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	39.33	192.89	28.07	2.13	22.07	20.26	-
MCB Pendleton Ranges Existing Emissions	2.19	12.59	2.54	0.26	1.15	1.15	2,037.63
Total CH-46 Emissions	41.52	205.48	30.61	2.39	23.22	21.41	2,037.63
MV-22 Emissions							
MCAS Miramar Proposed Emissions	20.50	195.65	120.89	5.29	29.68	25.00	57,082.83
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.05	2.18	59.76	1.69	6.66	6.66	13,516.05
VR-1266	0.00	0.03	0.73	0.02	0.08	0.08	166.58
Total MV-22 Emissions	20.55	197.86	181.38	7.00	36.42	31.74	70,765.46
Total Proposed Emissions (SDAB)	62.07	403.34	211.99	9.38	59.64	53.15	72,803.10
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
Proposed minus Year 2000 Emissions	(66.50)	(244.38)	117.22	2.14	(13.18)	(12.90)	72,803.10
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table CD-64. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2015

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Existing Emissions	-	-	-	-	-	-	-
Total CH-46 Emissions	-	-	-	-	-	-	-
MV-22 Emissions							
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47
VR-1266	0.00	0.04	1.02	0.03	0.11	0.11	233.21
Total MV-22 Emissions	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Total Proposed Emissions (SDAB)	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
Proposed minus Year 2000 Emissions	(99.80)	(370.72)	159.15	2.56	(21.83)	(21.40)	99,071.65
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table CD-65. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2016

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Existing Emissions	-	-	-	-	-	-	-
Total CH-46 Emissions	-	-	-	-	-	-	-
MV-22 Emissions							
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97
MCAS Pendleton Proposed Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Proposed Emissions	0.06	3.05	83.67	2.36	9.32	9.32	18,922.47
VR-1266	0.00	0.04	1.02	0.03	0.11	0.11	233.21
Total MV-22 Emissions	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Total Proposed Emissions (SDAB)	28.77	277.00	253.93	9.80	50.99	44.66	99,071.65
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
Proposed minus Year 2000 Emissions	(99.80)	(370.72)	159.15	2.56	(21.83)	(21.40)	99,071.65
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

Table CD-66. Summary of Conformity Emissions from the MV-22 Proposed Action within the San Diego Air Basin - Year 2017

	Tons per Year						
Source Scenario/Location	*VOC*	*CO*	*NO_X*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
CH-46 Emissions							
MCAS Miramar Existing Emissions	-	-	-	-	-	-	-
MCAS Pendleton Existing Emissions	-	-	-	-	-	-	-
MCB Pendleton Ranges Existing Emissions	-	-	-	-	-	-	-
Total CH-46 Emissions	-	-	-	-	-	-	-
MV-22 Emissions							
MCAS Miramar Proposed Emissions	28.70	273.91	169.24	7.40	41.55	35.22	79,915.97
MCAS Pendleton Proposed Emissions	10.38	93.47	46.00	1.91	11.17	9.26	24,473.78
MCB Pendleton Ranges Proposed Emissions	0.08	3.70	101.59	2.87	11.32	11.32	22,977.29
VR-1266	0.00	0.05	1.24	0.04	0.14	0.14	283.19
Total MV-22 Emissions	39.16	371.13	318.07	12.22	64.18	55.94	127,650.22
Total Proposed Emissions (SDAB)	39.16	371.13	318.07	12.22	64.18	55.94	127,650.22
Year 2000 Existing Emissions	(128.57)	(647.72)	(94.78)	(7.24)	(72.82)	(66.06)	-
Proposed minus Year 2000 Emissions	(89.40)	(276.59)	223.30	4.98	(8.64)	(10.12)	127,650.22
SDAB Conformity Thresholds	100	100	100	NA	NA	NA	NA

Note: The SDAB is a Subpart 1 O3 nonattainment area and a CO maintenance area.

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APPENDIX B-3

Clean Air Act Conformity Record of Non-Applicability

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APPENDIX B.3

RECORD OF NON-APPLICABILITY

WEST COAST BASING OF THE MV-22 AIRCRAFT

1.0 INTRODUCTION

This appendix presents the Clean Air Act conformity applicability analyses for the West Coast Basing of the MV-22 aircraft, as proposed by the Department of Navy (DON) in the *Final Environmental Statement for West Coast Basing of the MV-22* (DON 2009). Included are analyses of nonattainment areas in California and Arizona affected by the proposed MV-22 action, excluding San Diego County. Appendix B.2 of this EIS includes the conformity applicability analysis and conformity determination for the proposed MV-22 action within San Diego County.

2.0 CLEAN AIR ACT CONFORMITY REQUIREMENTS

The Clean Air Act (CAA) required the Environmental Protection Agency (EPA) to establish a list of air pollutants that "may reasonably be anticipated to endanger public health and welfare" and to set National Ambient Air Quality Standards (NAAQS) to protect public health. The EPA listed the following as criteria pollutants: sulfur dioxide (SO2), respirable and fine particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and lead (Pb). The EPA was also charged with designating geographic areas where the air quality fails to meet the NAAQS for one or more of these criteria pollutants. These geographic areas are known as nonattainment areas. Each State that has a nonattainment area or areas must develop a plan, a State Implementation Plan (SIP), to demonstrate how it will achieve and maintain the NAAQS. Once a nonattainment area has achieved compliance with the NAAQS, its designation is changed to that of a maintenance area and is then subject to an air quality maintenance plan.

2.1 Purpose and Applicability of the Conformity Rule

The EPA promulgated the General Conformity Rule on 30 November 1993 *Federal Register* (58 FR 63214-63259) and it became effective on 31 January 1994. The West Coast MV-22 Basing action proposed by the DON is subject to the General Conformity Rule (40 CFR Part 93 Subpart B; duplicated in 40 CFR Part 51 Subpart W). The Conformity Rule requires federal agencies to analyze proposed actions according to standardized procedures and to provide a public review and comment process. The conformity determination process is intended to demonstrate that the proposed federal action:

- Will not cause or contribute to new violations of a national ambient air quality standard (NAAQS);
- Will not increase the frequency or severity of existing violations of any standard; and
- Will not delay the timely attainment of any standard.

The Conformity Rule applies to general federal actions affecting areas that are in nonattainment of a NAAQS and to designated maintenance areas (attainment areas that have been reclassified from a previous nonattainment status and which are required to prepare an air quality maintenance plan). Conformity requirements apply only to nonattainment and maintenance pollutants. Emissions of attainment pollutants are exempt from conformity analyses.

Conformity determinations are required when the annual direct and indirect emissions from an action exceed an applicable "*de minimis*" threshold (Section 51.853[c][1]). For actions that are *de minimis*, the DON documents the conformity applicability analysis with a record of non-applicability (RONA). Applicable *de minimis* levels vary by pollutant and the severity of nonattainment conditions. Regardless of the applicable *de minimis* level, conformity determinations are required for "regionally significant" actions whose direct and indirect emissions exceed 10 percent of the applicable SIP emissions inventory, regardless of numerical value.

The proposed MV-22 action would replace seven CH-46E active duty squadrons (90 aircraft) with 10 MV-22 squadrons (120 aircraft). Of the seven CH-46E active duty squadrons, three are based at Marine Corps Air Station (MCAS) Camp Pendleton and four are based at MCAS Miramar. The proposed action would base eight MV-22 active duty squadrons at MCAS Miramar and two MV-22 reserve squadrons at MCAS Camp Pendleton. The aircraft operations associated with the proposed action would occur within the following facilities and air spaces, as described in section 2.1.3 of this EIS: (1) MCAS Miramar, (2) MCAS Camp Pendleton, (3) MCAS Yuma, (4) MCB Camp Pendleton, (5) the Chocolate Mountain Aerial Bombing and Gunnery Range in Imperial and Riverside Counties (R-2507), (6) Ranges R-2510 and R-2512 in Imperial County, (7) Marine Corps Air Ground Combat Center (MCAGCC) in San Bernardino County, (8) Barry M. Goldwater Range (West) in Arizona (R-2301W), and (9) military training routes (MTRs) in Southern California and Western Arizona. Several of these proposed areas of operation (outside of San Diego County) occur within areas that are in nonattainment of a NAAQS, including the following.

1. The Salton Sea Air Basin (SSAB), which includes all of Imperial County and the southwest third of Riverside County. The Imperial and Riverside County portions of the SSAB are in marginal and severe-15 nonattainment, respectively, of the O_3 national standard. Additionally, the western two-thirds of Imperial County and all of the Riverside County portions of the SSAB are in serious nonattainment of the PM_{10} standard.

2. The southwestern half of the Mojave Desert Air Basin (MDAB), which encompasses the MCAGCC project region, is in severe-17 nonattainment of the O_3 national standard. Additionally, the San Bernardino County portion of the MDAB is in moderate nonattainment of the PM_{10} standard.

3. The southwest corner of Arizona that encompasses the Yuma metropolitan area is in moderate nonattainment of the PM_{10} standard. MCAS Yuma and the northwest corner of R-2301W (about four percent of its total area) occur within this area.

Therefore, conformity applicability analyses are required to estimate proposed emissions that would occur within these areas.

3.0 RECORD OF NON-APPLICABILITY FOR THE SSAB, MDAB, AND ARIZONA NONATTAINMENT AREAS

The nonattainment areas affected by the proposed West Coast MV-22 Basing action have the following conformity *de minimis* thresholds:

1. The marginal O_3 nonattainment area within the Imperial County portion of the SSAB - 100 tons per year of volatile organic compounds (VOC) and nitrogen oxides (NO_x).

2. The severe-15 O_3 nonattainment area within the Riverside County portion of the SSAB - 25 tons per year of VOC and NO_x.

3. The serious PM_{10} nonattainment area within the SSAB - 70 tons per year of PM_{10}.

4. The severe-17 O_3 nonattainment area within the MDAB - 25 tons per year of VOC and NO_x.

5. The moderate PM_{10} nonattainment area within the MDAB - 100 tons per year of PM_{10}.

6. The moderate PM_{10} nonattainment area within the Yuma metropolitan area - 100 tons per year of PM_{10}.

The net change in emissions associated with the proposed action within these areas was estimated by subtracting emissions from existing CH-46 operations in year 2000 to those associated with the full MV-22 aircraft replacement action in year 2017. Operational data used to calculate conformity-related emissions from existing CH-46 and proposed MV-22 operations within proposed areas of operation were obtained from the project noise analyses (Wyle 2008). Factors used to calculate CH-46 and MV-22 combustive emissions were obtained from the DON (Aircraft Environmental Support Office 2001a, 2001b, 2001c, and 2001d). Appendix B.1 of this EIS documents the emission calculations for the project conformity applicability analyses.

3.1 Conformity Applicability Analyses

Table B.3-1 presents an estimation of the net change in annual conformity-related emissions that the proposed action would generate within each nonattainment area (other than San Diego County). These data represent the maximum year of emissions that would occur upon completion of the MV-22 replacement action (2017). Table B.3-1 shows that the proposed action would produce annual conformity-related emissions that would not exceed any conformity *de minimis* threshold in any of these areas. Additionally, these emissions would be well below 10 percent of the emission inventories for these pollutants within each affected air basin. Consequently, emissions from the proposed action within these areas would be exempt from the conformity determination requirements of Section 51.853(c)(1) and they would conform to the applicable SIPs.

Table B.3-1. Annual Conformity-Related Emissions for the Proposed West Coast Basing of the MV-22

Air Basin/Facility	*ANNUAL EMISSIONS (TONS)* (1)			
	VOC	*CO*	*NOx*	*PM10*
SALTON SEA AIR BASIN – MARGINAL O3 NONATTAINMENT AREA				
Existing Facility Emissions				
Chocolate Mountain Range	-1.01	NA	-1.16	NA
R-2510/2512	-0.02	NA	-0.02	NA
Total Existing Emissions	**-1.03**	**NA**	**-1.18**	**NA**
Proposed Facility Emissions				
Chocolate Mountain Range	0.07	NA	85.66	NA
R-2510/2512	0.00	NA	3.99	NA
MTRs	0.00	NA	2.44	NA
Total Proposed Emissions	**0.07**	**NA**	**92.08**	**NA**
Total Net Change – SSAB	**-0.96**	**NA**	**90.90**	**NA**
SSAB Conformity Thresholds	**100**	**NA**	**100**	**NA**
SSAB 2006 Emissions (3)	**11,994**	**NA**	**14,932**	**NA**
SALTON SEA AIR BASIN – SEVERE O3 NONATTAINMENT AREA				
Existing Facility Emissions				
Chocolate Mountain Range	-0.25	NA	-0.29	NA
Total Existing Emissions	**-0.25**	**NA**	**-0.29**	**NA**
Proposed Facility Emissions				
Chocolate Mountain Range	0.02	NA	21.41	NA
MTRs	0.00	NA	3.78	NA
Total Proposed Emissions	**0.02**	**NA**	**25.20**	**NA**
Total Net Change – SSAB	**-0.23**	**NA**	**24.91**	**NA**
SSAB Conformity Thresholds	**25**	**NA**	**25**	**NA**
SSAB 2006 Emissions (3)	**11,994**	**NA**	**14,932**	**NA**
SALTON SEA AIR BASIN – SERIOUS PM10 NONATTAINMENT AREA				
Existing Facility Emissions				
Chocolate Mountain Range	NA	NA	NA	-0.66
R-2510/2512 Existing	NA	NA	NA	-0.01
Total Existing Emissions	**NA**	**NA**	**NA**	**-0.66**
Proposed Facility Emissions				
Chocolate Mountain Range	NA	NA	NA	11.92
R-2510/2512 Proposed	NA	NA	NA	0.45
MTRs	NA	NA	NA	0.57
Total Proposed Emissions	**NA**	**NA**	**NA**	**12.94**
Total Net Change - SSAB	**NA**	**NA**	**NA**	**12.27**
SSAB Conformity Thresholds	**NA**	**NA**	**NA**	**70**
SSAB 2006 Emissions (3)	**NA**	**NA**	**NA**	**85,016**

Table B.3-1. Annual Conformity-Related Emissions for the Proposed West Coast Basing of the MV-22 (continued)

Air Basin/Facility	ANNUAL EMISSIONS (TONS) (1)			
	VOC	**CO**	**NOx**	**PM10**
MOJAVE DESERT AIR BASIN – SEVERE O3 NONATTAINMENT AREA				
Existing Facility Emissions				
MCAGCC EAF	-1.26	NA	-0.20	NA
MCAGCC Air Space	-2.38	NA	-2.71	NA
Total Existing Emissions	**-3.64**	**NA**	**-2.90**	**NA**
Proposed Facility Emissions				
MCAGCC EAF	0.05	NA	7.96	NA
MCAGCC Air Space	0.00	NA	3.25	NA
MTRs	0.00	NA	5.74	NA
Total Proposed Emissions	**0.06**	**NA**	**16.95**	**NA**
Total Net Change - MDAB	**-3.58**	**NA**	**14.05**	**NA**
MDAB Conformity Thresholds	**25**	**NA**	**25**	**NA**
SSAB 2006 Emissions (3)	**49,531**	**NA**	**105,485**	**NA**
MOJAVE DESERT AIR BASIN – MODERATE PM10 NONATTAINMENT AREA				
Existing Facility Emissions				
MCAGCC EAF	NA	NA	NA	-0.25
MCAGCC Air Space	NA	NA	NA	-1.25
Total Existing Emissions	**NA**	**NA**	**NA**	**-1.51**
Proposed Facility Emissions				
MCAGCC EAF	NA	NA	NA	1.35
MCAGCC Air Space	NA	NA	NA	0.36
MTRs	NA	NA	NA	1.49
Total Proposed Emissions	**NA**	**NA**	**NA**	**3.20**
Total Net Change - MDAB	**NA**	**NA**	**NA**	**1.69**
MDAB Conformity Thresholds	**NA**	**NA**	**NA**	**100**
SSAB 2006 Emissions (3)	**NA**	**NA**	**NA**	**68,584**
YUMA MODERATE PM10 NONATTAINMENT AREA				
Existing Facility Emissions				
MCAS Yuma	NA	NA	NA	-0.95
BMGR	NA	NA	NA	-0.24
Total Existing Emissions	**NA**	**NA**	**NA**	**-1.19**
Proposed Facility Emissions				
BMGR	NA	NA	NA	3.11
Total Proposed Emissions	**NA**	**NA**	**NA**	**3.11**
Total Net Change – Yuma Area	**NA**	**NA**	**NA**	**1.92**
Yuma Area Conformity Thresholds	**NA**	**NA**	**NA**	**100**
Yuma County 2002 Emissions (4)	**NA**	**NA**	**NA**	**11,503**

Note: (1) Year 2017 emissions.
(2) – indicates a reduction in pollutant emissions.
(3) Air basin annual emissions for 2006 (ARB 2007).
(4) (EPA 2008).

5.0 REFERENCES

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APPENDIX C

Noise

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APPENDIX C-1

Noise Analysis

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C-1.1 NOISE MODELING DATA FOR MCAS MIRAMAR

C-1.1.1 Modeled Flight Operations for MCAS Miramar

Modeled Annual Flight Operations for MCAS Miramar Baseline/No Action

Operation		CH-46E				CH-53				F/A-18C/D(-400)				F/A-18C/D(-402)				KC-130				All			
Category	Type	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
Departures	Unknown																					-	-	-	-
	Julian	-	-	-	-	-	-	-	-	4,264	539	98	4,901	4,264	539	98	4,901	377	29	4	410	8,905	1,107	200	10,212
	Seawolf	-	-	-	-	-	-	-	-	4,481	448	50	4,979	4,481	448	50	4,979	286	22	3	311	9,248	918	103	10,269
	Freeway	2,117	192	96	2,405	1,519	235	54	1,808	-	-	-	-	-	-	-	-	-	-	-	-	3,636	427	150	4,213
	Beach	529	48	24	601	380	59	14	453	-	-	-	-	-	-	-	-	-	-	-	-	909	107	38	1,054
	I-15	529	48	24	601	380	59	14	453	-	-	-	-	-	-	-	-	-	-	-	-	909	107	38	1,054
	Yuma	353	32	16	401	253	39	9	301	-	-	-	-	-	-	-	-	-	-	-	-	606	71	25	702
Arrivals	Unknown																					-	-	-	
	"Straight-In"	-	-	-	-	-	-	-	-	4,126	534	194	4,854	4,126	534	194	4,854	74	15	46	135	8,326	1,083	434	9,843
	Overhead Break	-	-	-	-	-	-	-	-	4,622	352	50	5,024	4,622	352	50	5,024	522	65	-	587	9,766	769	100	10,635
	Freeway	1,877	289	241	2,407	1,430	235	145	1,810	-	-	-	-	-	-	-	-	-	-	-	-	3,307	524	386	4,217
	Beach	469	72	60	601	358	59	36	453	-	-	-	-	-	-	-	-	-	-	-	-	827	131	96	1,054
	I-15	469	72	60	601	358	59	36	453	-	-	-	-	-	-	-	-	-	-	-	-	827	131	96	1,054
	Yuma	313	48	40	401	238	39	24	301	-	-	-	-	-	-	-	-	-	-	-	-	551	87	64	702
Closed Patterns	Touch and Go	5,812	2,593	536	8,941	5,536	911	561	7,008	6,341	1,364	321	8,026	6,341	1,364	321	8,026	4,920	1,836	587	7,343	28,950	8,068	2,326	39,344
	FCLP	-	-	-	-	-	-	-	-	2,958	1,560	860	5,378	2,958	1,560	860	5,378	-	-	-	-	5,916	3,120	1,720	10,756
	GCA Box	274	69	18	361	257	53	3	313	238	219	29	486	238	219	29	486	245	18	-	263	1,252	578	79	1,909
Departures		3,528	320	160	4,008	2,532	392	91	3,015	8,745	987	148	9,880	8,745	987	148	9,880	663	51	7	721	24,213	2,737	554	27,504
Arrivals		3,128	481	401	4,010	2,384	392	241	3,017	8,748	886	244	9,878	8,748	886	244	9,878	596	80	46	722	23,604	2,725	1,176	27,505
Closed Patterns		6,086	2,662	554	9,302	5,793	964	564	7,321	9,537	3,143	1,210	13,890	9,537	3,143	1,210	13,890	5,165	1,854	587	7,606	36,118	11,766	4,125	52,009
TOTAL		12,742	3,463	1,115	17,320	10,709	1,748	896	13,353	27,030	5,016	1,602	33,648	27,030	5,016	1,602	33,648	6,424	1,985	640	9,049	83,935	17,228	5,855	107,018

Notes: (1) FCLP - Field Carrier Landing Practice; GCA - Ground Controlled Approach
(2) Arrivals and departures adjusted to be equal; Totals for each aircraft type within 2 operations due to rounding
(3) GCA Box, Touch and Go, and FCLP are counted as two (2) operations
(4) Day = 7 am - 6:59 pm; Eve = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am

Source: WR 03-05, Tables 4.1 through 4.6, with adjustments as noted

Proposed Modeled Annual MV-22 Flight Operations for the Full Basing Alternative for MCAS Miramar

Operation Type	7 Fleet Squadrons				2 Reserve Squadrons				GRAND TOTAL			
	Day (0700-1859)	Evening (1900-2159)	Night (2200-0659)	Total	Day (0700-1859)	Evening (1900-2159)	Night (2200-0659)	Total	Day (0700-1859)	Evening (1900-2159)	Night (2200-0659)	Total
Departure	10,483	5,816	1,285	17,584	2,246	1,246	275	3,767	12,729	7,062	1,560	21,351
Arrival (no break)	1,048	582	129	1,759	225	125	28	378	1,273	707	157	2,137
Overhead Break Arrival	9,435	5,235	1,157	15,827	2,022	1,122	248	3,392	11,457	6,357	1,405	19,219
Touch and Go	2,922	325	-	3,247	626	70	-	696	3,548	395	-	3,943
FCLP	4,734	1,353	676	6,763	1,014	290	145	1,449	5,748	1,643	821	8,212
GCA Box	3,652	406	-	4,058	783	87	-	870	4,435	493	-	4,928
Low Work	122	14	-	136	26	3	-	29	148	17	-	165
Total	**32,396**	**13,731**	**3,247**	**49,374**	**6,942**	**2,943**	**696**	**10,581**	**39,338**	**16,674**	**3,943**	**59,955**

Note: Touch and Go, GCA Box and Low Work are counted as two operations each
Time are local
"Low Work" comprised of maintenance check flights, hover work and any other low work training ops conducted at less than 50 ft AGL, lasting 7 minutes, on average.
100% of FCLP operations would be conducted at HOLF at MCB Camp Pendleton; departures and arrival operations account for off-site FCLP missions
1 squadron of 10 would always be deployed

Source: Wyle Laboratories, 2007; USMC, 2007

Operation		MV-22(1, 5)			
Category	**Type**	**Day**	**Evening**	**Night**	**Total**
Departure	Julian	9,568	5,218	1,046	15,832
	Seawolf	1,888	1,140	356	3,384
	Freeway	259	105	37	401
	Beach	29	10	5	44
	I-15	94	107	24	225
	Yuma	891	481	93	1,465
Arrival	"Straight-In"	1,147	637	140	1,924
	Overhead Break	10,310	5,720	1,268	17,298
	Freeway	709	421	84	1,214
	Beach	78	47	10	135
	I-15	94	102	24	220
	Yuma	391	136	38	565
Closed Pattern	Touch and Go	3,548	395	-	3,943
	FCLP	-	-	-	-
	GCA Box	4,435	493	-	4,928
Departure		12,729	7,061	1,561	21,351
Arrival		12,729	7,063	1,564	21,356
Closed Pattern		7,983	888	-	8,871
TOTAL		33,441	15,012	3,125	51,578

Notes: (1) MV22 FCLP will be conducted at HOLF @ Camp Pendleton
(2) GCA Box, FCLP and Touch and Go are counted as two (2) operations each circuit
(3) Day = 7 am - 6:59 pm; Evening = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am
(4) MV-22 figures include 9 squadrons always on-station, i.e. Maximum Partial Alternative
(5) MV22 "Low-work" not included in this table; modeled as a "run-ups"

Proposed Modeled Annual MV-22 Flight Operations for the Maximum Partial Basing Alternative for MCAS Miramar

Operation Type	5 Fleet Squadrons + 2 Reserve Squadrons			
	Day (0700-1859)	Evening (1900-2159)	Night (2200-0659)	Total
Departure	9,734	5,400	1,193	16,327
Arrival (no break)	974	541	120	1,635
Overhead Break Arrival	8,761	4,861	1,074	14,696
Touch and Go	2,713	302	-	3,015
FCLP	4,395	1,256	628	6,279
GCA Box	3,392	377	-	3,769
Low Work	113	13	-	126
Total	**30,082**	**12,750**	**3,015**	**45,847**

Note: Touch and Go, GCA Box and Low Work are counted as two operations each
Time are local
"Low Work" comprised of maintenance check flights, hover work and any other low work training ops conducted at less than 50 ft AGL, lasting 7 minutes, on average.
100% of FCLP operations would be conducted at HOLF at MCB Camp Pendleton; departures and arrival operations account for off-site FCLP missions
1 squadron of 8 would always be deployed
Source: Wyle Laboratories, 2007; USMC, 2007

Operation		MV-22			
Category	**Type**	**Day**	**Evening**	**Night**	**Total**
Departure	Julian	7,317	3,990	800	12,107
	Seawolf	1,444	872	272	2,588
	Freeway	198	80	28	306
	Beach	22	8	4	34
	I-15	72	82	18	172
	Yuma	681	368	71	1,120
Arrival	"Straight-In"	877	487	107	1,471
	Overhead Break	7,884	4,374	970	13,228
	Freeway	542	322	64	928
	Beach	60	36	8	104
	I-15	72	78	18	168
	Yuma	299	104	29	432
Closed Pattern	Touch and Go	2,713	302	-	3,015
	FCLP	-	-	-	-
	GCA Box	3,392	377	-	3,769
Departure		9,734	5,400	1,193	16,327
Arrival		9,734	5,401	1,196	16,331
Closed Pattern		6,105	679	-	6,784
TOTAL		25,573	11,480	2,389	39,442

Notes: (1) MV22 FCLP will be conducted at HOLF @ Camp Pendleton
(2) GCA Box, FCLP and Touch and Go are counted as two (2) operations each circu
(3) Day = 7 am - 6:59 pm; Evening = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am
(4) MV-22 figures include 9 squadrons always on-station, i.e. Full Basing Alternative
(5) MV22 "Low-work" not included in this table; modeled as a "run-ups"

Proposed Modeled Annual MV-22 Flight Operations for the Minimum Partial Basing Alternative for MCAS Miramar

Operation Type	2 Reserve Squadrons			
	Day (0700-1859)	Evening (1900-2159)	Night (2200-0659)	Total
Departure	2,246	1,246	275	3,767
Arrival (no break)	225	125	28	378
Overhead Break Arrival	2,022	1,122	248	3,392
Touch and Go	626	70	-	696
FCLP	1,014	290	145	1,449
GCA Box	783	87	-	870
Low Work	26	3	-	29
Total	**6,942**	**2,943**	**696**	**10,581**

Note: Touch and Go, GCA Box and Low Work are counted as two operations each
Time are local
"Low Work" comprised of maintenance check flights, hover work and any other low work training ops conducted at less than 50 ft AGL, lasting 7 minutes, on average.
100% of FCLP operations would be conducted at HOLF at MCB Camp Pendleton; departures and arrival operations account for off-site FCLP missions
Source: Wyle Laboratories, 2007; USMC, 2007

Operation		MV-22			
Category	Type	Day	Evening	Night	Total
Departure	Julian	1,688	921	185	2,794
	Seawolf	333	201	63	597
	Freeway	46	18	6	70
	Beach	5	2	1	8
	I-15	17	19	4	40
	Yuma	157	85	16	258
Arrival	"Straight-In"	203	112	25	340
	Overhead Break	1,820	1,009	224	3,053
	Freeway	125	74	15	214
	Beach	14	8	2	24
	I-15	17	18	4	39
	Yuma	69	24	7	100
Closed Pattern	Touch and Go	626	70	-	696
	FCLP	-	-	-	-
	GCA Box	783	87	-	870
Departure		2,246	1,246	275	3,767
Arrival		2,248	1,245	277	3,770
Closed Pattern		1,409	157	-	1,566
TOTAL		5,903	2,648	552	9,103

Notes: (1) MV22 FCLP will be conducted at HOLF @ Camp Pendleton
(2) Arrivals and departures for modeled aircraft adjusted to be equal; Totals for each aircraft type within 2 operations due to rounding
(3) GCA Box, FCLP and Touch and Go are counted as two (2) operations each circuit
(4) Day = 7 am - 6:59 pm; Evening = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am
(5) MV-22 figures include 2 squadrons always on-station, i.e. Minimum Partial Basing Alternative
(6) MV22 "Low-work" not included in this table; modeled as a "run-ups"

C-1.1.2 Modeled Runway and Track Utilization for MCAS Miramar

F/A-18C/D Runway and Flight Track Utilization for Existing Conditions at MCAS Miramar

Runway	Operation Category	Util.% by Op.	Operation Type	Flight Track	Flight Track
24R	DEP	100.0%	SEAWOLF Departure	4RS1	50%
				4RS2	50%
		50.0%	JULIAN 1 Departure	4RJ1	50%
				4RJ2	50%
		50.0%	JULIAN 2 Departure	4RJ1	50%
				4RJ2	50%
24R	ARR		Straight-In Arrival	4RA1	10%
				4RA2	10%
				4RA3	10%
				4RA4	10%
				4RA5	10%
				4RA6	10%
				4RA7	30%
				4RA8	10%
		50.0%	Overhead Break Arrival (1,600' MSL and 2,100' MSL)	4O01	10%
				4O02	4%
				4O03	4%
				4O04	4%
				4O05	4%
				4O06	16%
				4O07	6%
				4O08	6%
				4O09	6%
				4O10	6%
				4O11	10%
				4O12	4%
				4O13	4%
				4O14	4%
				4O15	4%
				4O16	4%
				4O17	2%
				4O18	2%
				4O19	2%
				4O20	2%
24L	TGO	100.0%	TGO	4LT1	50%
				4RT1	50%
	FCLP	100.0%	FCLP	24F1	50%
				24F2	50%
24R	GCA	100.0%	GCA	4RG1	50%
				4RG2	50%

Source: MCAS Miramar, 2002

KC-130 Runway and Flight Track Utilization for Existing Conditions at MCAS Miramar

Runway	Operation Type	Flight Track	Flight Track
24R	SEAWOLF Departure	4RS1	50%
		4RS2	50%
	JULIAN Departure	4RJ1	50%
		4RJ2	50%
24R	Straight-In Arrival	4RA1	10%
		4RA2	10%
		4RA3	10%
		4RA4	10%
		4RA5	10%
		4RA6	10%
		4RA7	30%
		4RA8	10%
	Overhead Break Arrival (2,100' MSL)	4O01	10%
		4O02	4%
		4O03	4%
		4O04	4%
		4O05	4%
		4O06	16%
		4O07	6%
		4O08	6%
		4O09	6%
		4O10	6%
		4O11	10%
		4O12	4%
		4O13	4%
		4O14	4%
		4O15	4%
		4O16	4%
		4O17	2%
		4O18	2%
		4O19	2%
		4O20	2%
24L	TGO	4LT1	50%
		4RT1	50%
24R	GCA	4RG1	50%
		4RG2	50%

Source: MCAS Miramar, 2002

CH-53E Runway/Pad and Flight Track Utilization for Existing Conditions at MCAS Miramar

Operation Type	RWY / PAD Util.by Op Type	RWY / PAD ID	Util. By RWY / PAD	Flight Track Name	Flight Track ID	Flight Track Util.
DEP	30%	24R	100%	FWY	4PD1	60%
				BEACH	4PD2	15%
				I-15	4PD3	15%
				YUMA	4PD4	10%
	70%	Pad 5	100%	FWY	05D1	60%
				BEACH	05D2	15%
				I-15	05D3	15%
				Yuma L	5D4L	5%
				Yuma R	5D4R	5%
ARR	40%	24R	100%	FWY	4PA1	60%
				BEACH	4PA2	15%
				I-15	4PA3	15%
				YUMA	4PA4	10%
	60%	Pad 3	100%	FWY	03D1	60%
				BEACH	03D2	15%
				I-15	03D3	15%
				Yuma R	3D4R	5%
				Yuma SI	3D4S	5%
T&G	50%	LHD	100%	4ST1	4ST1	100%
	10%	24R	10%	4RT1	4RT1	100%
		24L	90%	4LT1	4LT1	100%
	40%	PAD 1	100%	4PT1	01T1	100%
GCA	100%	24R	100%	4RG4	4RG4	20%
				4RG5	4RG5	70%
				4RG6	4RG6	10%

Source: MCAS Miramar, 2002

CH-46E Runway/Pad and Flight Track Utilization for Existing Conditions at MCAS Miramar

Operation Type	RWY / PAD Util.by Op Type	RWY / PAD ID	Util. By RWY / PAD	Flight Track Name	Flight Track ID	Flight Track Util.
DEP	30%	24R	100%	FWY	4PD1	60%
				BEACH	4PD2	15%
				I-15	4PD3	15%
				YUMA	4PD4	10%
	70%	Pad 5	100%	FWY	05D1	60%
				BEACH	05D2	15%
				I-15	05D3	15%
				YUMA L	5D4L	5%
				YUMA R	5D4R	5%
ARR	40%	24R	100%	FWY	4PA1	60%
				BEACH	4PA2	15%
				I-15	4PA3	15%
				YUMA	4PA4	10%
	60%	Pad 3	100%	FWY	03A1	60%
				BEACH	03A2	15%
				I-15	03A3	15%
				YUMA R	3A4R	5%
				YUMA SI	3A4S	5%
T&G	50%	LHD	100%	4ST1	4ST1	100%
	10%	24R	10%	4RT1	4RT1	100%
		24L	90%	4LT1	4LT1	100%
	40%	PAD 1	100%	4PT1	01T1	100%
GCA	100%	24R	100%	4RG4	4RG4	20%
				4RG5	4RG5	70%
				4RG6	4RG6	10%

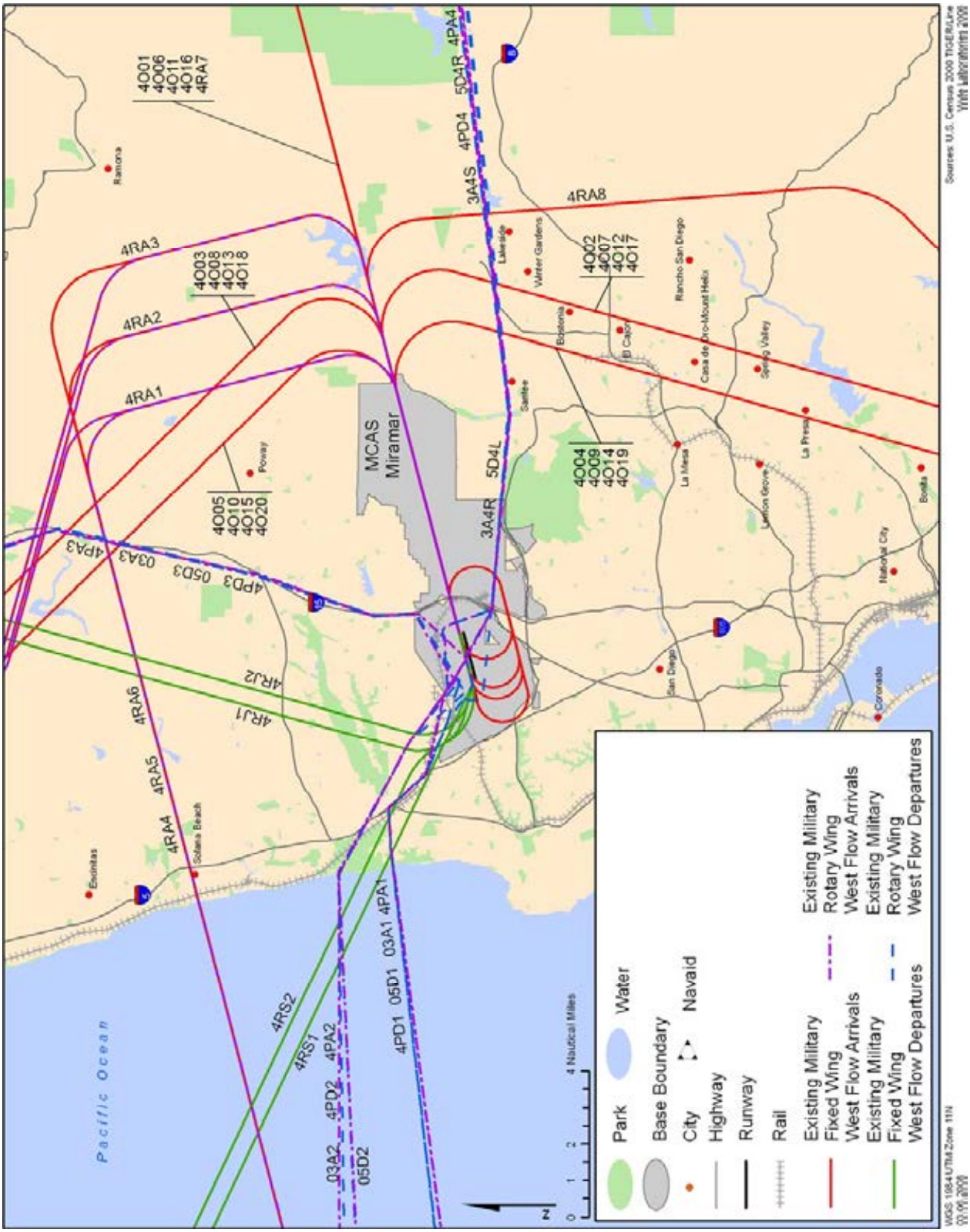
Source: MCAS Miramar, 2002

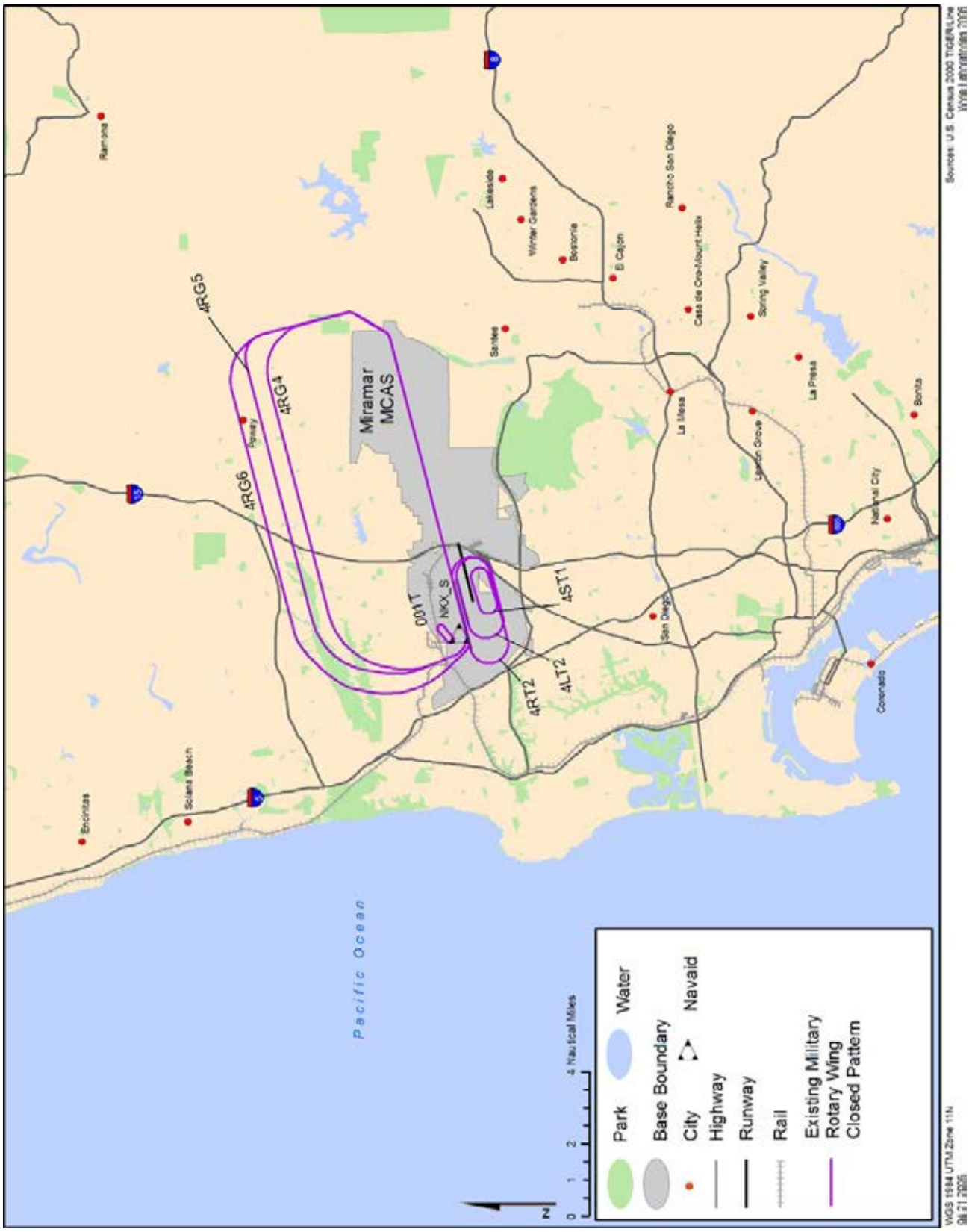
MV-22 Runway and Track Utilization at MCAS Miramar

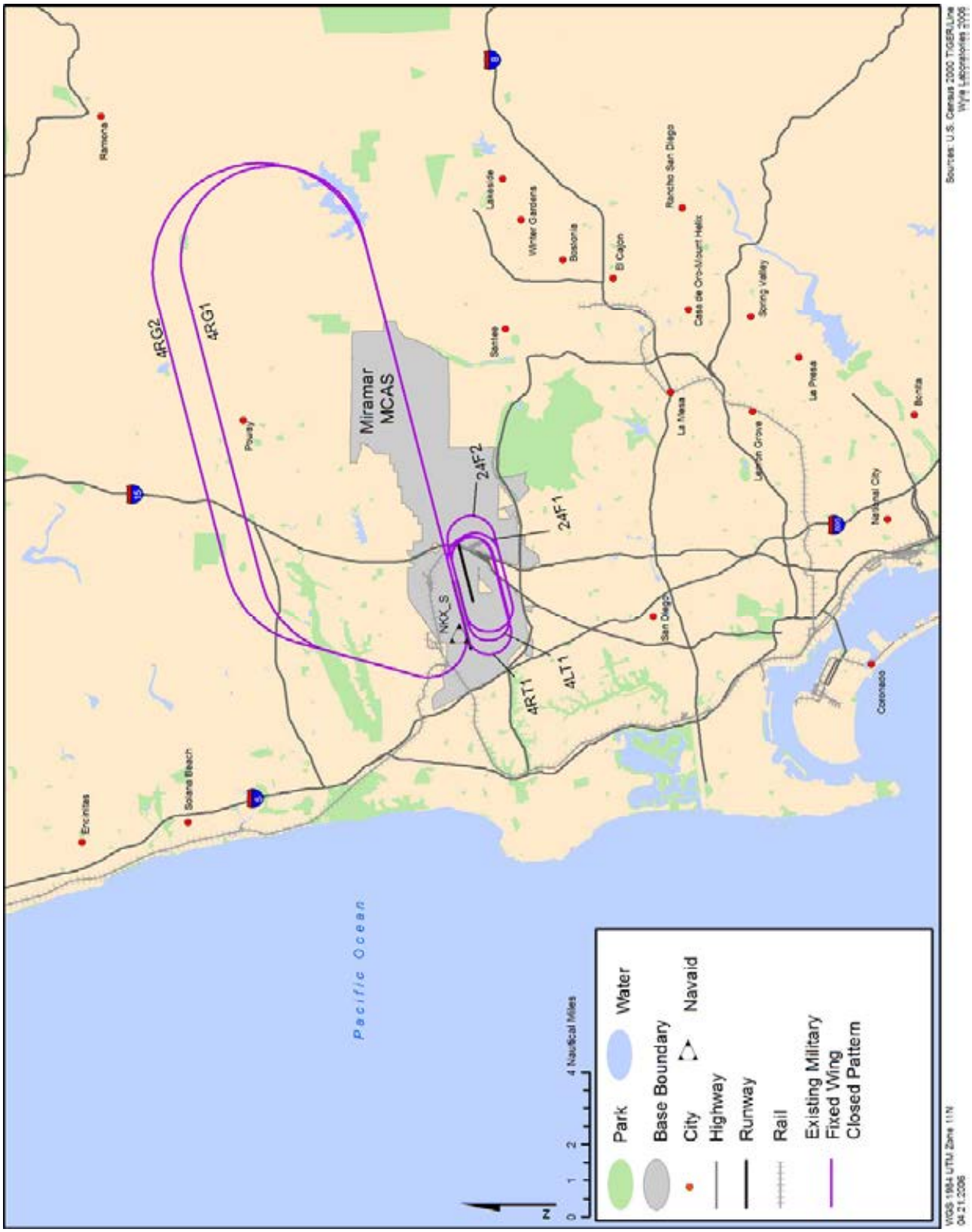
RUNWAY UTILIZATION					TRACK UTILIZATION			
Noise Track Group	Rwy / Pad	Rwy / Pad Split	Flight Track	Desc	1Track%	2Track%	3Track%	4Track%
4RJ1/2	24R	100%	4RJ1	Julian; Wider	50%	-	-	-
			4RJ2	Julian; Narrower		-	-	-
4RS1/2			4RS1	Seawolf; Left turn to 280 degrees; more southerly track	50%	-	-	-
			4RS2	Seawolf; Left turn to 280 degrees; crossover southerly track to the north		-	-	-
FAIRWAYS	005	50%	05D1	Fairway Departure from Pad 5	100%	-	-	-
	24P	50%	4PD1	Fairway Departure from Runway 24P	100%	-	-	-
YUMA	005	50%	5D4L	Yuma Departure from Pad 5 Left Pattern to cross South of Field	50%	-	-	-
			5D4R	Yuma Departure from Pad 5 Right Pattern crossing North of Field	50%	-	-	-
	24P	50%	4PD4	Yuma Departure from Runway 24P	100%	-	-	-
I 15	005	50%	05D3	I-15 Departure from Pad 5	100%	-	-	-
	24P	50%	4PD3	I-15 Departure from Runway 24P	100%	-	-	-
BEACH	005	50%	05D2	Beach Departure from Pad 5	100%	-	-	-
	24P	50%	4PD2	Beach Departure from Runway 24P	100%	-	-	-
4RA7	24R	100%	4RA7	Straight In Arrival (LOOTS)	10%	100%	-	-
			4O01	LOOTS (s.i.) #s break	90%	25%	-	-
			4O06	LOOTS (s.i.), midfield break		25%	-	-
			4O11	LOOTS (s.i.) 80% rwy break		25%	-	-
			4O16	LOOTS (s.i.) upwind #s break		25%	-	-
4RA1/2/3	24R	100%	4RA1	Straight In Arrival from OCN w/ 7nmi final	10%	33%	-	-
			4RA2	Straight In Arrival from OCN w/ 9nmi final		33%	-	-
			4RA3	Straight In Arrival from OCN w/ 11nmi final		33%	-	-
			4O03	WZKY (from North), 8nm to thresh., #s break	90%	25%	50%	-
			4O05	WZKY (from North), 7nm to thresh., #s break			50%	-
			4O08	WZKY (from North), 8nm to thresh., midfield break		25%	50%	-
			4O10	WZKY (from North), 7nm to thresh., midfield break			50%	-
			4O13	WZKY (from North), 8nm to thresh., 80% rwy break		25%	50%	-
			4O15	WZKY (from North), 7nm to thresh., 80% rwy break			50%	-
			4O18	WZKY (from North), 8nm to thresh., upwind #s break		25%	50%	-
			4O20	WZKY (from North), 7nm to thresh., upwind #s break			50%	-
4RA4/5/6	24R	100%	4RA4	Straight In Arrival from Delmar (W-291/WZKY) Trk 7nmi final	10%	33%	-	-
			4RA5	Straight In Arrival from Delmar (W-291/WZKY) Trk 9nmi final		33%	-	-
			4RA6	Straight In Arrival from Delmar (W-291/WZKY) Trk 11nmi final		33%	-	-
			4O03	WZKY (from North), 8nm to thresh., #s break	90%	25%	50%	-
			4O05	WZKY (from North), 7nm to thresh., #s break			50%	-
			4O08	WZKY (from North), 8nm to thresh., midfield break		25%	50%	-
			4O10	WZKY (from North), 7nm to thresh., midfield break			50%	-
			4O13	WZKY (from North), 8nm to thresh., 80% rwy break		25%	50%	-
			4O15	WZKY (from North), 7nm to thresh., 80% rwy break			50%	-
			4O18	WZKY (from North), 8nm to thresh., upwind #s break		25%	50%	-
			4O20	WZKY (from North), 7nm to thresh., upwind #s break			50%	-
4RA4/5/6/8	24R	100%	4RA4	Straight In Arrival from Delmar (W-291/WZKY) Trk 7nmi final	10%	33%	100%	50%
			4RA5	Straight In Arrival from Delmar (W-291/WZKY) Trk 9nmi final		33%	100%	50%
			4RA6	Straight In Arrival from Delmar (W-291/WZKY) Trk 11nmi final		33%	100%	50%
			4O03	WZKY (from North), 8nm to thresh., #s break	90%	25%	50%	50%
			4O05	WZKY (from North), 7nm to thresh., #s break			50%	50%
			4O08	WZKY (from North), 8nm to thresh., midfield break		25%	50%	50%
			4O10	WZKY (from North), 7nm to thresh., midfield break			50%	50%
			4O13	WZKY (from North), 8nm to thresh., 80% rwy break		25%	50%	50%
			4O15	WZKY (from North), 7nm to thresh., 80% rwy break			50%	50%
			4O18	WZKY (from North), 8nm to thresh., upwind #s break		25%	50%	50%
			4O20	WZKY (from North), 7nm to thresh., upwind #s break			50%	50%
			4RA8	Straight In Arrival (SIERA)	10%	100%	100%	50%
			4O02	SIERA (from South), 8nm to thresh., #s break	90%	25%	50%	50%
			4O04	SIERA (from South), 7nm to thresh., #s break			50%	50%
			4O07	SIERA (from South), 8nm to thresh., midfield break		25%	50%	50%
			4O09	SIERA (from South), 7nm to thresh., midfield break			50%	50%
			4O12	SIERA (from South), 8nm to thresh., 80% rwy break		25%	50%	50%
			4O14	SIERA (from South), 7nm to thresh., 80% rwy break			50%	50%
			4O17	SIERA (from South), 8nm to thresh., upwind #s break		25%	50%	50%
			4O19	SIERA (from South), 7nm to thresh., upwind #s break			50%	50%
FAIRWAYS	003	50%	03A1	Fairway Arrival to Pad 3	100%	-	-	-
	06P	50%	4PA1	Fairway Arrival to Runway 06P	100%	-	-	-
YUMA	003	50%	3A4R	Yuma arrival to Pad 3 to the north of field	50%	-	-	-
			3A4S	Yuma arrival to Pad 3 Straight-in	50%	-	-	-
	06P	50%	4PA4	Yuma arrival to Runway 06P	100%	-	-	-
I 15	003	50%	03A3	I-15 Arrival to Pad 3	100%	-	-	-
	06P	50%	4PA3	I-15 Arrival to Runway 06P	100%	-	-	-
BEACH	003	50%	03A2	Beach Arrival to Pad 3	100%	-	-	-
	06P	50%	4PA2	Beach Arrival to Runway 06P	100%	-	-	-
T&G	001	50%	001T	Helo Spot pattern (near West Ramp); RH; <=1200 ft upwind; 1000 ft MSL	50%	-	-	-
	24S	50%	4ST1	LHD pattern; LH; 3000 ft abeam; 5000 ft downwind; 800 ft MSL	50%	-	-	-
	24L	50%	4LT1	7000 ft abeam; 1.8nm (11000 ft) downwind; 1600 ft MSL	90%	0%	-	-
			4LT2	6000 ft abeam; 8000 ft downwind; 1600 ft MSL		100%	-	-
	24R	50%	4RT1	LH patt; 0.8nm abeam; 2.1nm (13000 ft) downwind; 1600 ft MSL	10%	0%	-	-
			4RT2	LH patt; 1nm abeam; 2nm downwind; 1600 ft MSL		100%	-	-
GCA Box	24R	100%	4RG1	FW GCA Box; 2.6nm abeam; 10nm final; 5000 ft MSL?	75%	50%	-	-
			4RG2	FW GCA Box; 3nm abeam; 10nm final; 5000 ft MSL?		50%	-	-
			4RG4	RW GCA Box; 3.5 nm abeam; 7nm final	25%	20%	-	-
			4RG5	RW GCA Box; 4 nm abeam; 7nm final		70%	-	-
			4RG6	RW GCA Box; 4.6 nm abeam; 7nm final		10%	-	-

Notes: (-) represents 100%

C-1.1.3 Modeled Flight Tracks for MCAS Miramar



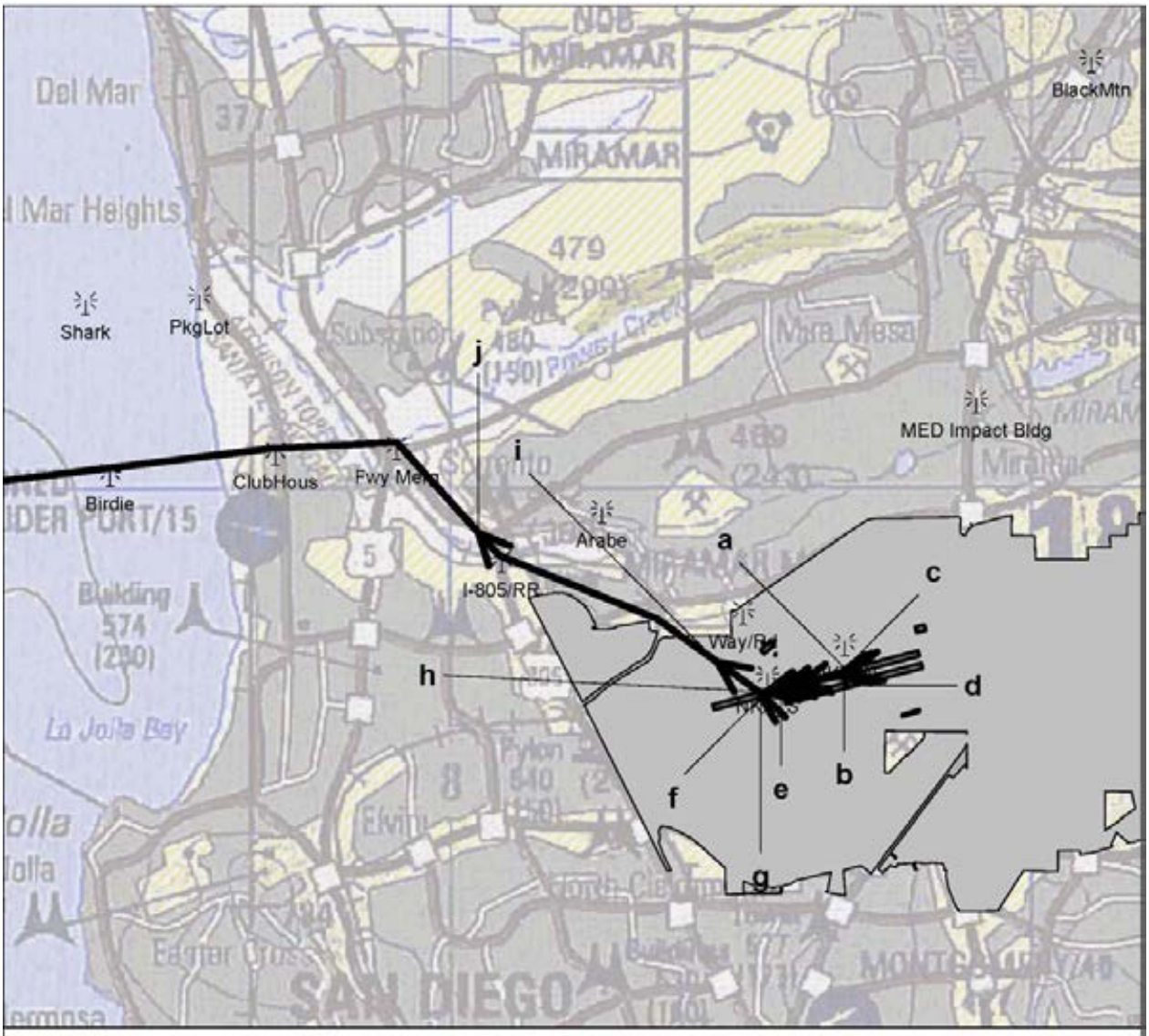

Pacific Ocean
Miramar MCAS
4RG5
4RG4
4RG6
00/T
NKXLS
4ST1
4LT2
4RT2
Ramona
Encinitas
Solana Beach
Santee
Lakeside
Winter Gardens
Bostonia
El Cajon
Rancho San Diego
Casa de Oro-Mount Helix
Spring Valley
La Mesa
Lemon Grove
La Presa
Bonita
National City
Coronado
San Diego
Park
Water
Base Boundary
City
Navaid
Highway
Runway
Rail
Existing Military
Rotary Wing
Closed Pattern
0 1 2 4 Nautical Miles
N


Ramona
Poway
Encinitas
Solana Beach
Santee
Lakeside
Winter Gardens
Bostonia
El Cajon
Rancho San Diego
Casa de Oro-Mount Helix
Spring Valley
La Mesa
Lemon Grove
La Presa
Bonita
National City
Coronado
San Diego
Miramar MCAS
NKX_S
4RG2
4RG1
24F2
24F1
4RT1
4LT1
Pacific Ocean
0 1 2 4 Nautical Miles
N
Park
Water
Base Boundary
City
Navaid
Highway
Runway
Rail
Existing Military
Fixed Wing
Closed Pattern
Sources: U.S. Census 2000 TIGER/Line
Wyle Laboratories 2006
WGS 1984 UTM Zone 11N
04.21.2006

C-1.1.4 Modeled MV-22 Flight Profiles for MCAS Miramar

The flight profile information on the following pages is shown in tabular fashion, captioned on each map. The columns of the flight profile data tables are described below:

Column Heading	Description
Point	Sequence letter along flight track denoting change in flight parameters
Distance (feet)	Distance along flight track from runway threshold in feet
Height (feet)	Altitude of aircraft in feet Above Ground Level (AGL) or relative to Mean Sea Level (MSL)
Power (Appropriate Unit)* Speed (kts)	Engine power setting and Drag Configuration/Interpolation Code (defines sets of interpolation code in NOISEMAP (F for FIXED, P for PARALLEL, V for VARIABLE)) Indicated airspeed of aircraft in knots
Yaw Angle (degrees)**	Angle of the aircraft relative to its vertical axis in degrees; positive nose left
Angle of Attack (degrees)**	Angle of the aircraft, not of the wing; angle between the climb angle and the pitch angle, in degrees, positive nose up. The climb angle is the angle between the horizontal and the velocity vector (same convention). The pitch angle is the angle between the horizontal and the thrust vector (same convention)
Roll Angle (degrees)**	Angle of the aircraft relative to its longitudinal axis in degrees; positive left side down.
Nacelle Angle (degrees)***	Angle of engine nacelle pylon relative to the horizontal (airplane) mode; positive up; maximum of 90



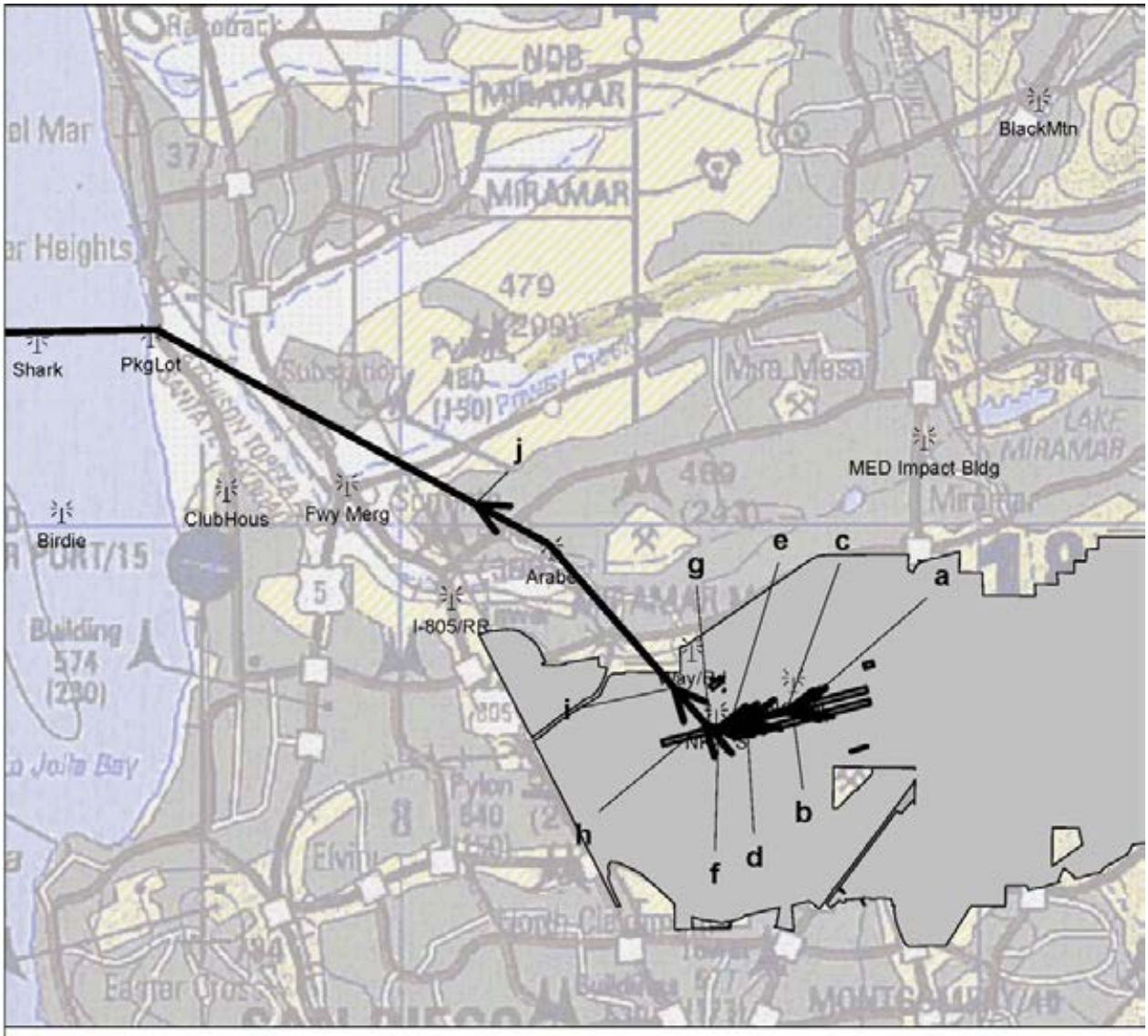
Flight Profile 501

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	0	60	
d	3,000	1,125 MSL	125	0	5	0	9	
e	4,000	1,298 MSL	135	0	10	0	0	
f	4,900	1,450 MSL	150	0	7	-25	0	added point at beginning of turn; interpolated
g	5,175	1,500 MSL	155	0	6	-25	0	roll added
h	5,311	1,500 MSL	170	0	7	0	0	added point at end of turn; interpolated
i	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
j	23,710	1,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
k	60,000	1,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 501
Based MV22B
on Runway 24P, Flight Track 4PD1 - Fairway Departure from Runway 24P

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,900 feet)



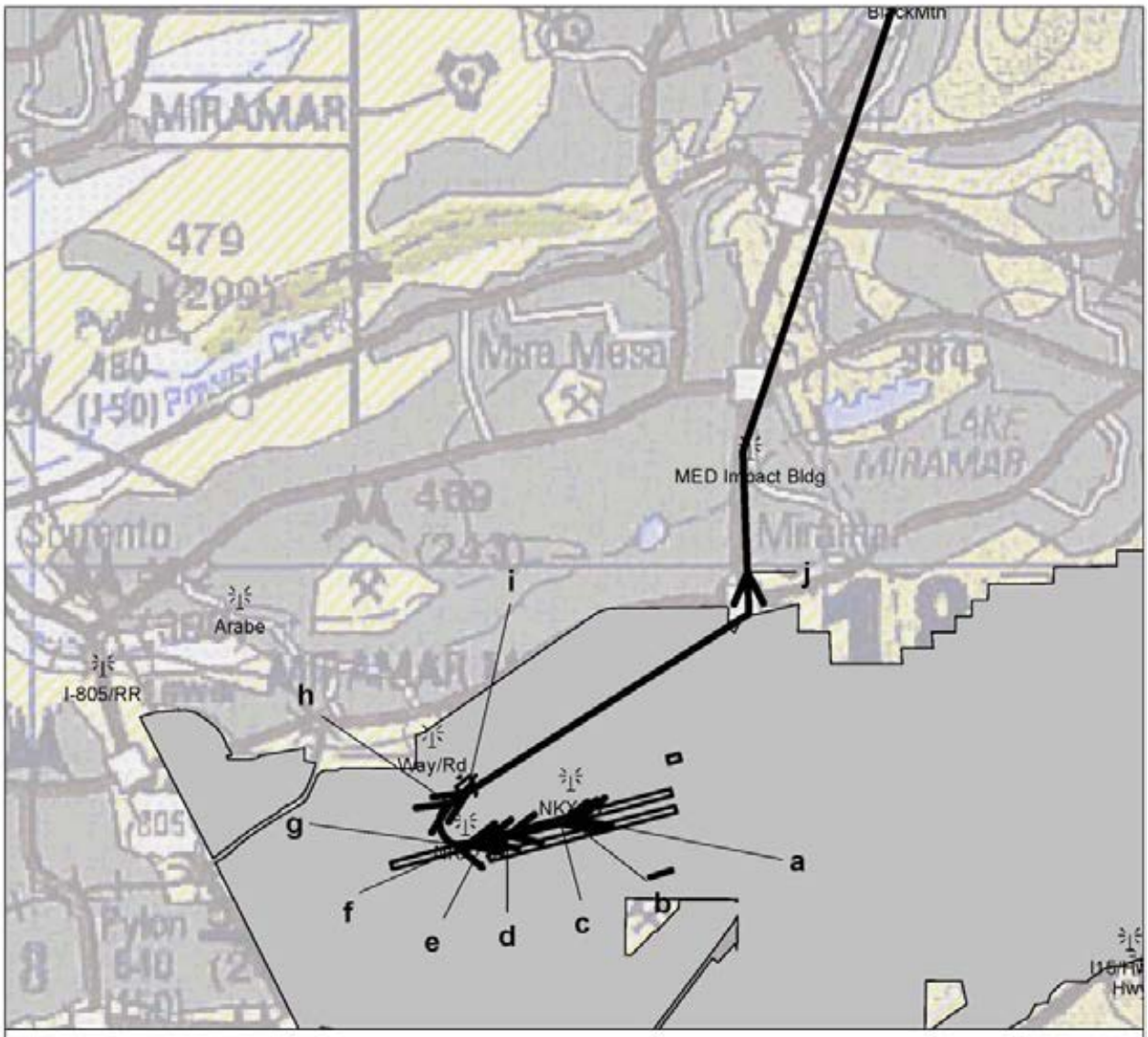
Flight Profile 502

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	0	60	
d	3,000	1,125 MSL	125	0	5	0	9	
e	4,000	1,298 MSL	135	0	10	0	0	
f	4,655	1,400 MSL	145	0	7	-25	0	point added at beginning of turn; interpolated
g	5,175	1,500 MSL	155	0	6	-25	0	roll added
h	5,500	1,500 MSL	170	0	7	0	0	point added at end of turn; interpolated
i	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
j	23,710	1,500 MSL	170	0	7	0	0	
k	60,000	1,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 502
Based MV22B
on Runway 24P, Flight Track 4PD2 - Beach Departure from Runway 24P

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,940 feet)



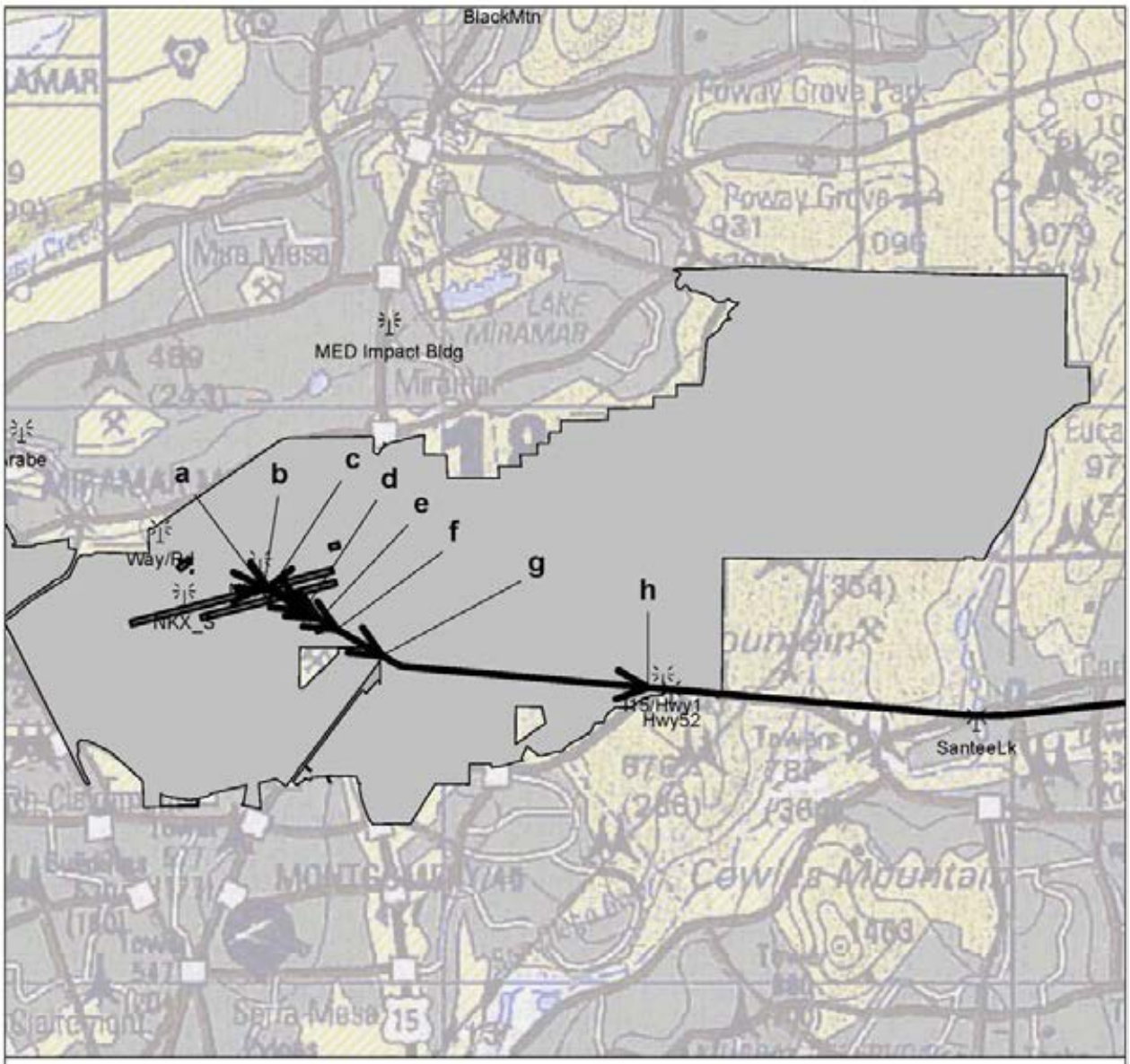
Flight Profile 503

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	0	60	
d	3,000	1,125 MSL	125	0	5	0	9	
e	4,000	1,298 MSL	135	0	10	0	0	
f	4,693	1,400 MSL	145	0	7	-25	0	point added at beginning of turn: interpolated
g	5,175	1,500 MSL	155	0	6	-25	0	
h	7,345	1,500 MSL	165	0	7	0	0	point added at end of turn: interpolated
i	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
j	23,710	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
k	100,000	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 503
Based MV22B
on Runway 24P, Flight Track 4PD3 - I-15 Departure from Runway 24P

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:87,200 (1 inch = 7,260 feet)



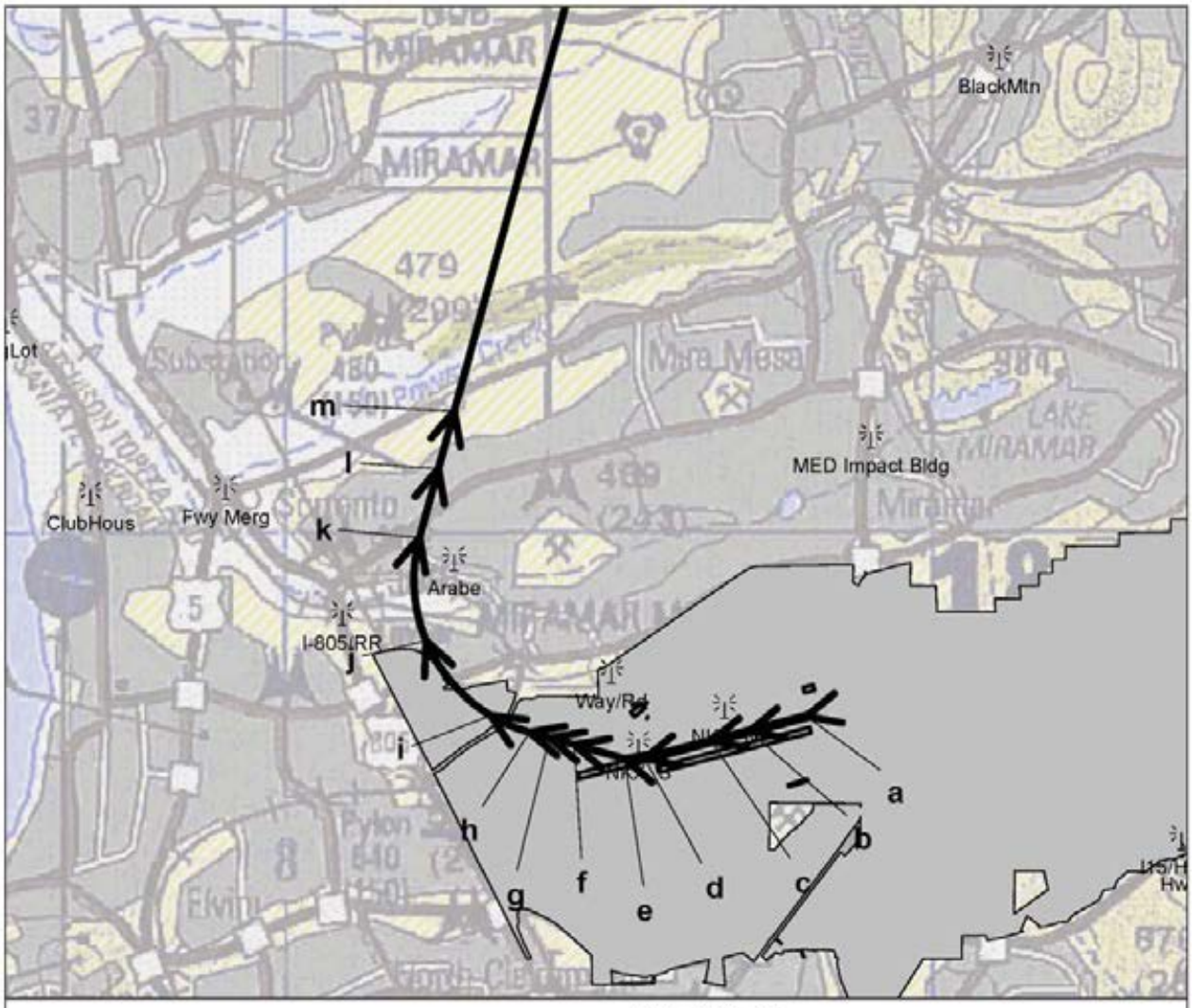
Flight Profile 504

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	0	60	
d	3,000	1,125 MSL	125	0	5	0	9	
e	4,000	1,298 MSL	135	0	10	0	0	
f	5,175	1,500 MSL	155	0	6	0	0	
g	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
h	23,710	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
i	140,000	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 504
Based MV22B
on Runway 24P, Flight Track 4PD4 - Yuma Departure from Runway 24P

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,920 feet)



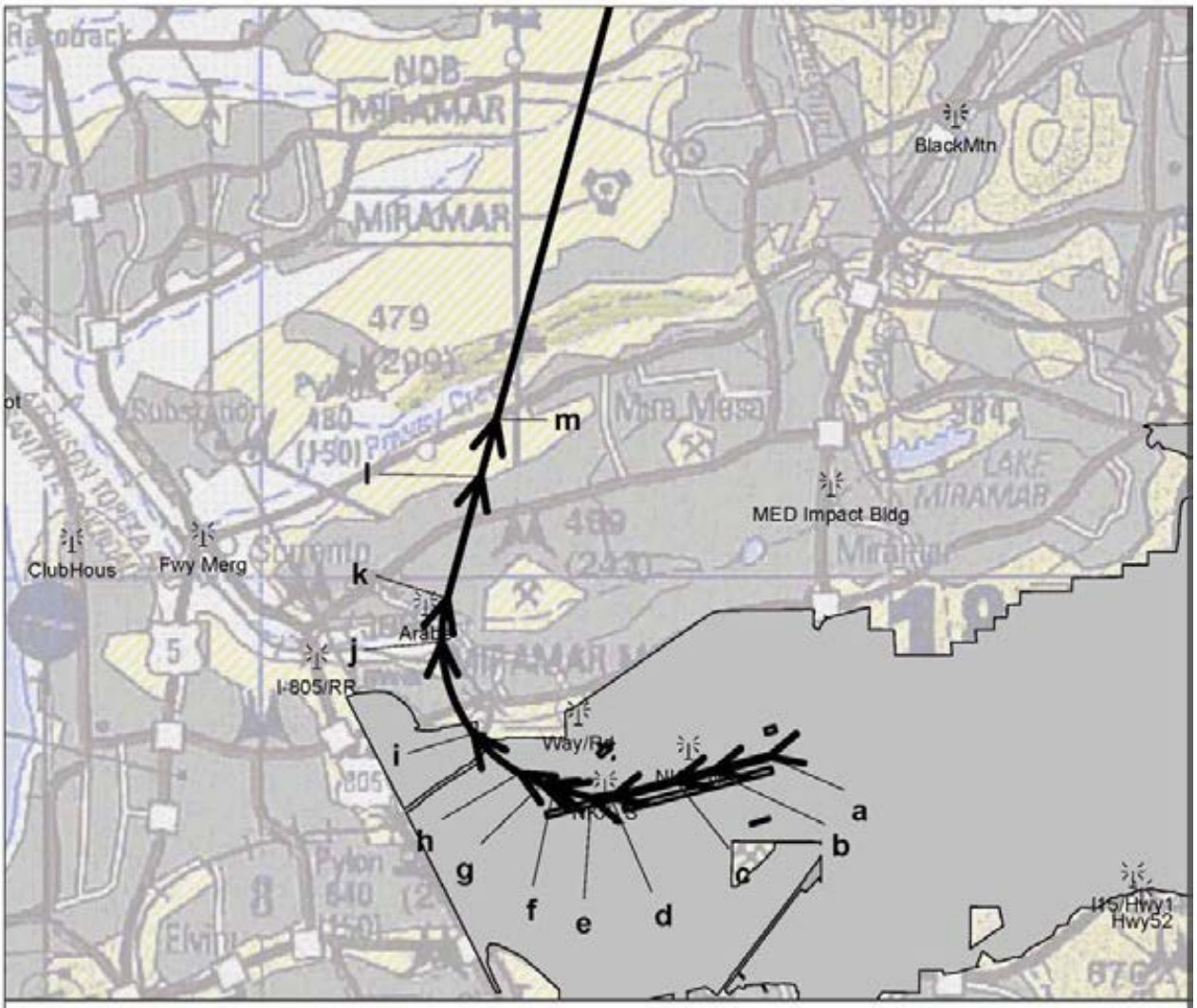
Flight Profile 603

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,500	357 AGL	130	0	0	-15	40	point added at beginning of turn; interpolated
e	9,547	414 AGL	145	0	0	0	30	point added at end of turn; interpolated
f	12,189	469 AGL	162	0	0	0	11	
g	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
h	14,547	685 AGL	170	0	6	-25	0	point added at beginning of turn; interpolated
i	16,700	872 AGL	170	0	6	-25	0	roll angle added
j	21,800	1,464 AGL	170	0	6	-25	0	roll angle added
k	27,114	2,500 AGL	170	0	6	0	0	point added at end of turn; interpolated - CHANGE
l	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
m	33,753	3,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts
n	110,000	3,000 AGL	220	0	5	0	0	near end of track

Flight Profile 603
Based MV22B
on Runway 24R, Flight Track 4RJ1 - Julian; Wider

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:111,000 (1 inch = 9,230 feet)



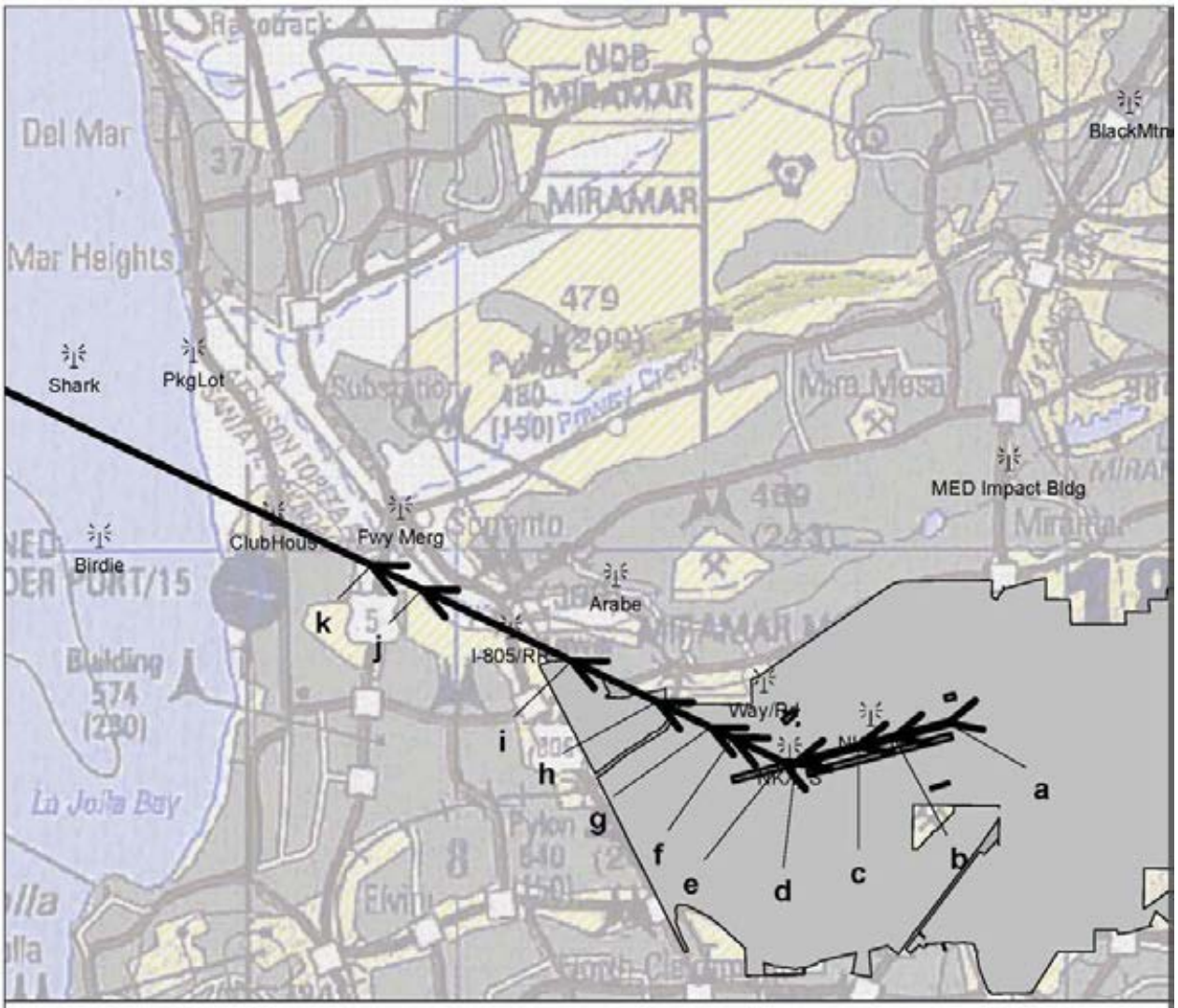
Flight Profile 604

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,500	357 AGL	130	0	0	-15	40	point added at beginning of turn; interpolated
e	9,547	414 AGL	145	0	0	0	30	point added at end of turn; interpolated
f	11,547	442 AGL	155	0	0	-25	18	point added at beginning of turn; interpolated
g	12,189	469 AGL	162	0	0	-25	11	roll angle added
h	13,500	500 AGL	170	0	6	-25	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; ro
i	16,700	872 AGL	170	0	6	-25	0	roll angle added
j	21,800	1,464 AGL	170	0	6	-25	0	roll angle added
k	24,114	2,500 AGL	170	0	6	0	0	point added at end of turn; interpolated - CHANGE
l	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
m	33,753	3,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts
n	110,000	3,000 AGL	220	0	5	0	0	near end of track

Flight Profile 604
Based MV22B
on Runway 24R, Flight Track 4RJ2 - Julian; Narrower

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:114,000 (1 inch = 9,510 feet)

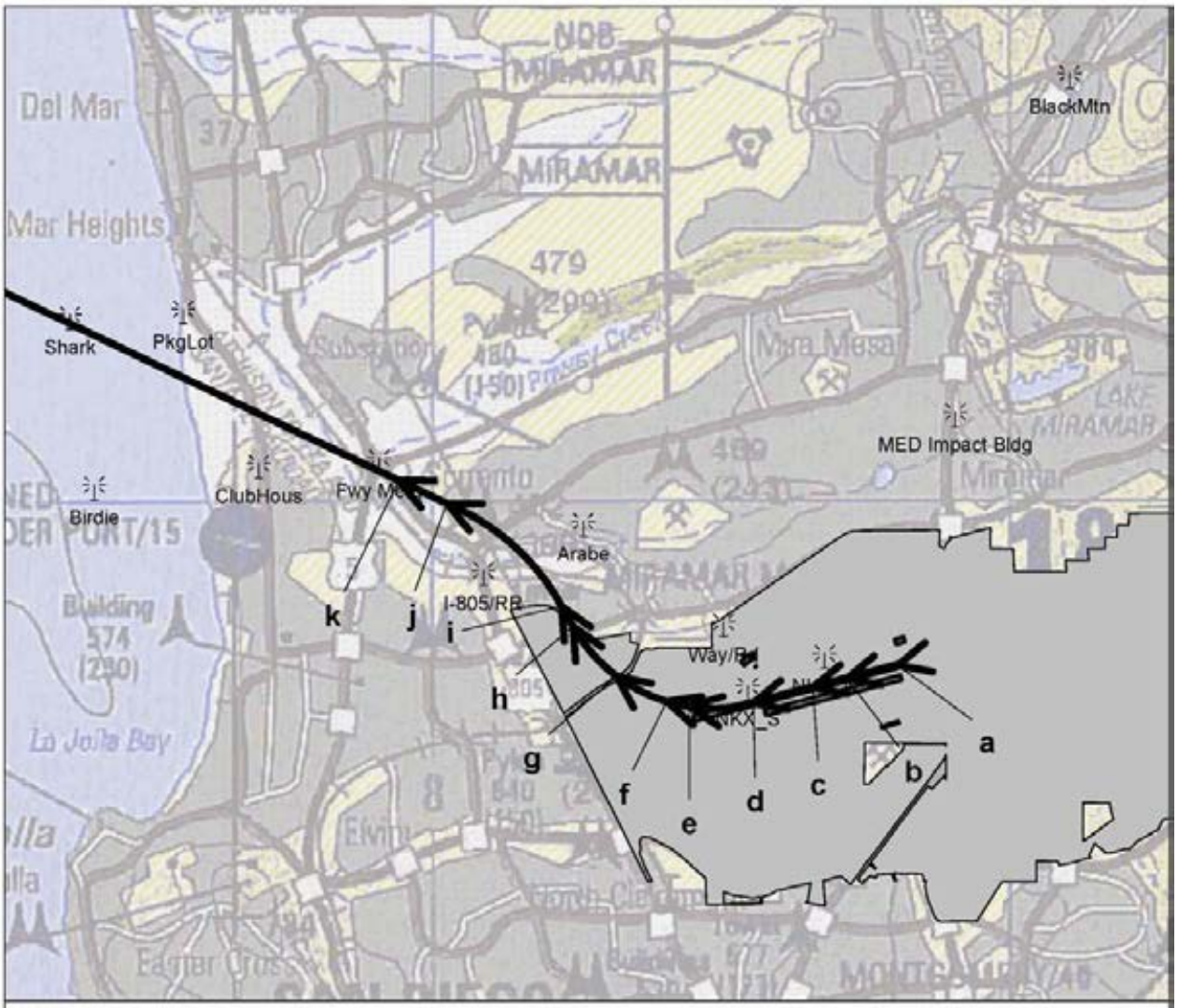


Flight Profile 601

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,500	357 AGL	130	0	0	-15	50	point added at beginning of turn; interpolated
e	9,198	414 AGL	145	0	0	0	30	point added at end of turn; interpolated
f	12,189	469 AGL	162	0	0	0	11	
g	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
h	16,700	872 AGL	170	0	6	0	0	
i	21,800	1,464 AGL	170	0	6	0	0	
j	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
k	33,753	3,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts
l	65,000	3,000 AGL	220	0	5	0	0	near end of track

Flight Profile 601
Based MV22B
on Runway 24R, Flight Track 4RS1 - Seawolf; Left turn to 280 degrees; more southerly track

Scale in Feet 1:116,000 (1 inch = 9,660 feet)



Flight Profile 602

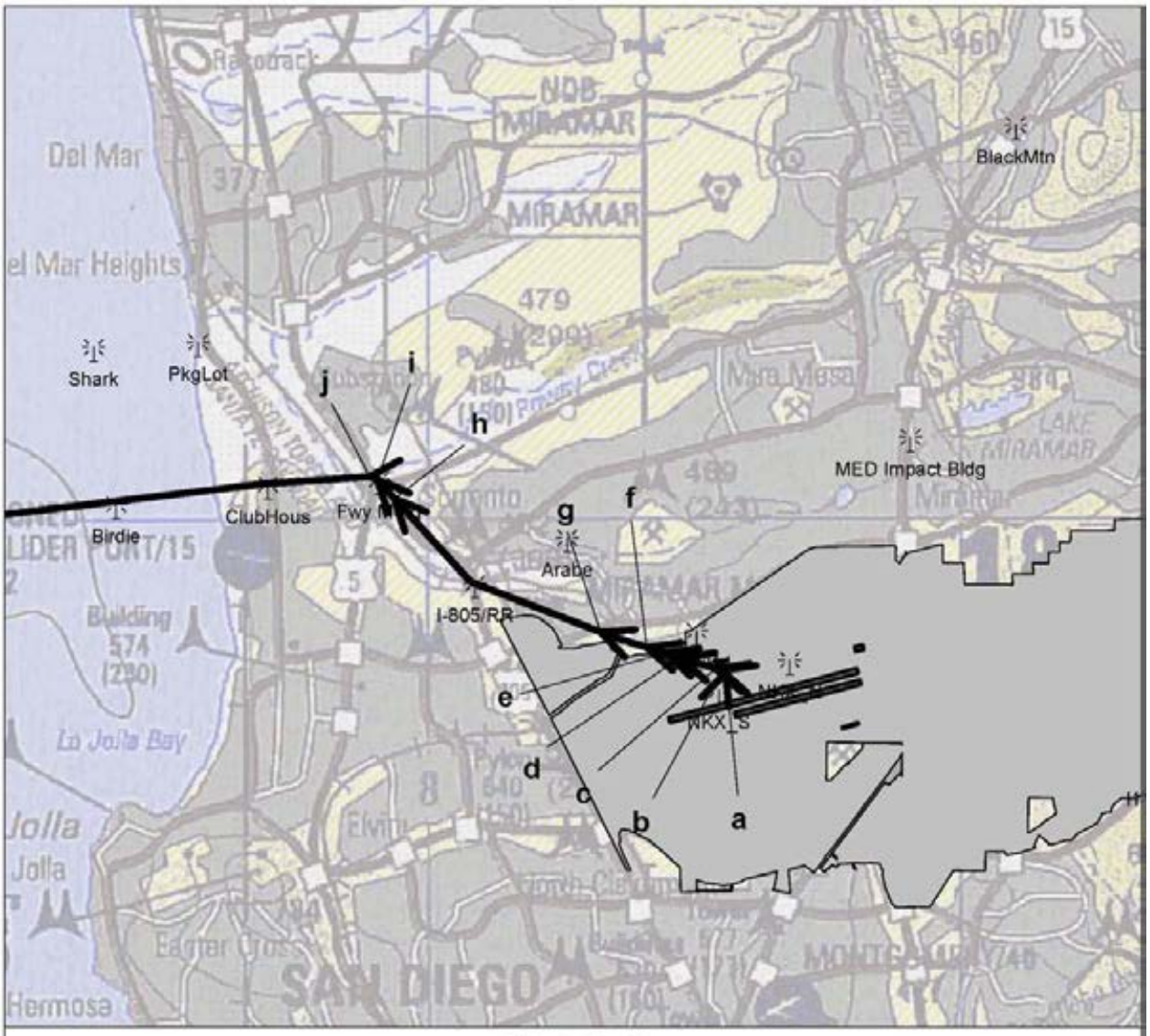
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,500	385 AGL	138	0	0	-15	40	point added at beginning of turn; interpolated
e	12,189	469 AGL	162	0	0	-15	11	
f	13,500	500 AGL	170	0	6	-15	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
g	16,700	872 AGL	170	0	6	-15	0	
h	20,492	1,200 AGL	170	0	5	0	0	point added at end of turn; interpolated
i	21,800	1,464 AGL	170	0	6	0	0	
j	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
k	33,753	3,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts
l	69,000	3,000 AGL	220	0	5	0	0	near end of track

Flight Profile 602
Based MV22B
on Runway 24R, Flight Track 4RS2 - Seawolf; Left turn to 280 degrees; cross over southerly track to the north

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:122,000 (1 inch = 10,200 feet)

N



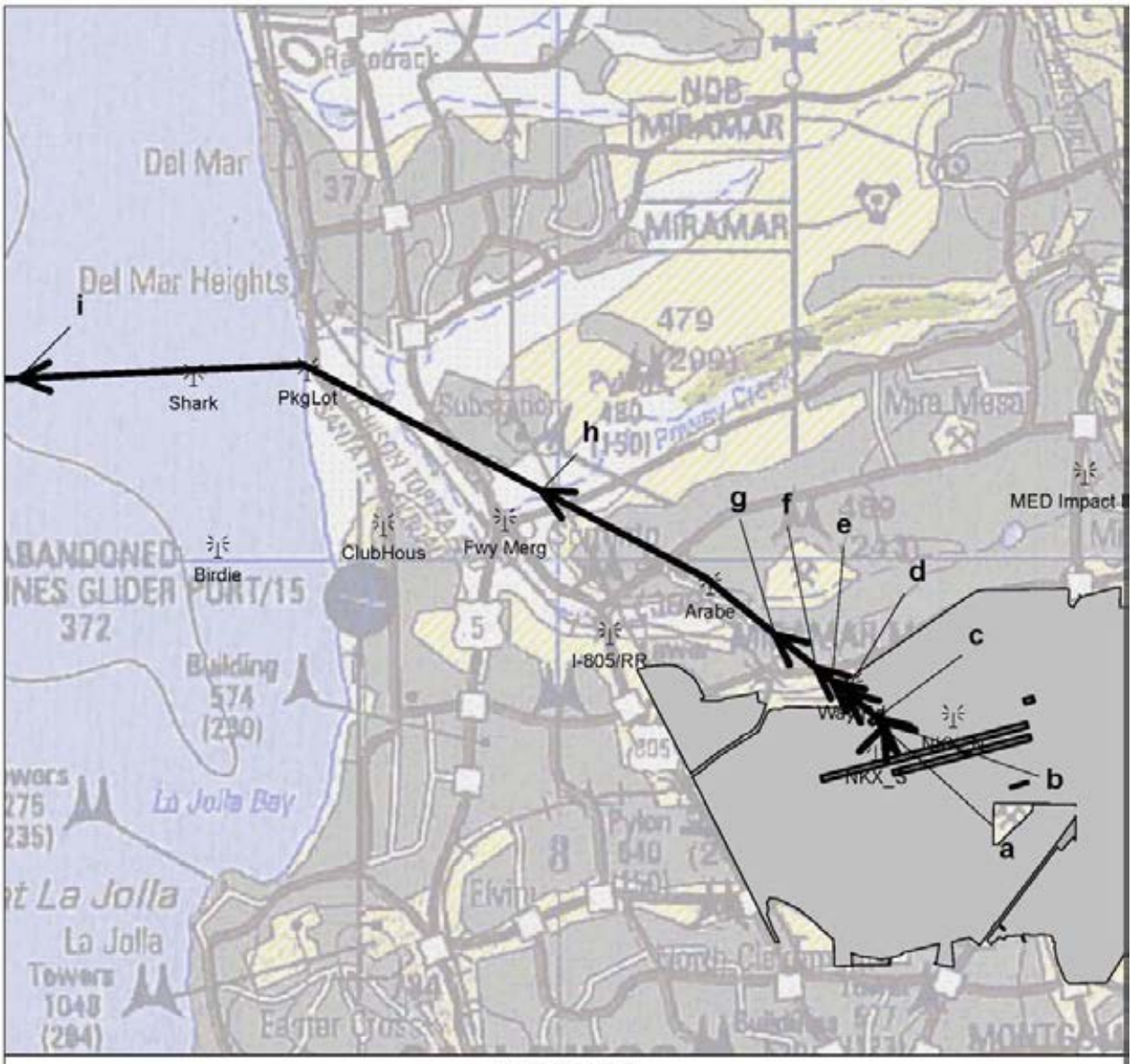
Flight Profile 505

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	0	60	
d	3,000	1,125 MSL	125	0	5	0	9	
e	4,000	1,298 MSL	135	0	10	0	0	
f	5,175	1,500 MSL	155	0	6	0	0	
g	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
h	23,710	1,500 MSL	170	0	7	0	0	level, 170 kts, 7 deg pitch
i	25,261	1,500 MSL	170	0	7	25	0	point added at beginning of turn; interpolated
j	25,801	1,500 MSL	170	0	7	0	0	point added at end of turn; interpolated
k	55,000	1,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 505
Based MV22B
on Runway 005, Flight Track 05D1 - Fairway Departure from Pad 5

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:129,000 (1 inch = 10,800 feet)



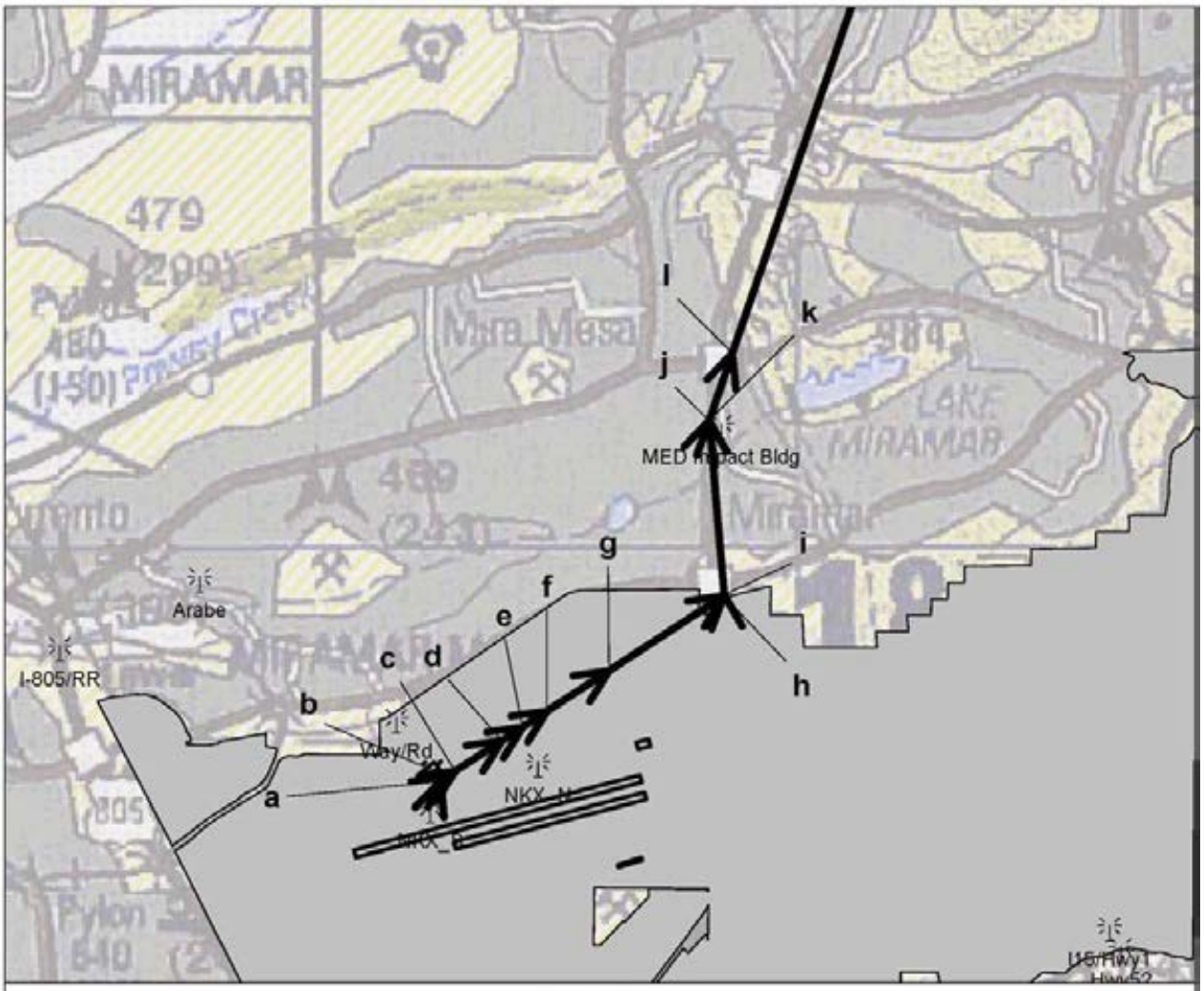
Flight Profile 506

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	0	60	
d	3,000	1,125 MSL	125	0	5	0	9	
e	4,000	1,298 MSL	135	0	10	0	0	
f	5,175	1,500 MSL	155	0	6	0	0	
g	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
h	23,710	1,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
i	55,000	1,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 506
Based MV22B
on Runway 005, Flight Track 05D2 - Beach Departure from Pad 5

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:117,000 (1 inch = 9,740 feet)



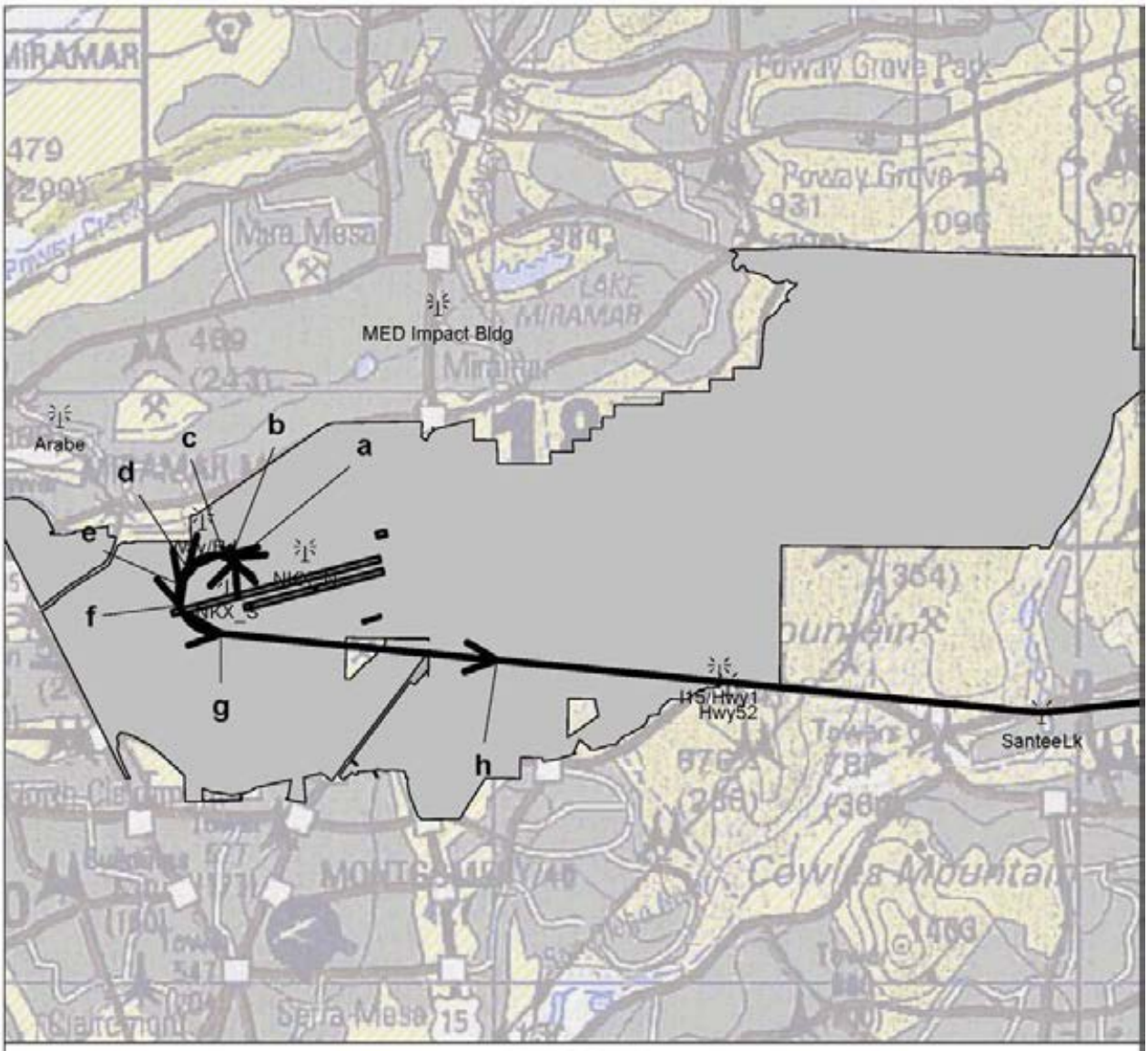
Flight Profile 507

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	0	60	
d	3,000	1,125 MSL	125	0	5	0	9	
e	4,000	1,298 MSL	135	0	10	0	0	
f	5,175	1,500 MSL	155	0	6	0	0	
g	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
h	13,724	2,210 MSL	170	0	7	25	0	point added at beginning of turn
i	13,778	2,217 MSL	170	0	7	0	0	point added at end of turn
j	20,828	3,120 MSL	170	0	7	-15	0	point added at beginning of turn
k	20,849	3,123 MSL	170	0	7	0	0	point added at end of turn
l	23,710	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
m	76,197	3,500 MSL	170	0	7	15	0	point added at beginning of turn
n	76,622	3,500 MSL	170	0	7	0	0	point added at end of turn
o	100,000	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 507
Based MV22B
on Runway 005, Flight Track 05D3 - I-15 Departure from Pad 5

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:89,200 (1 inch = 7,430 feet)



Flight Profile 508

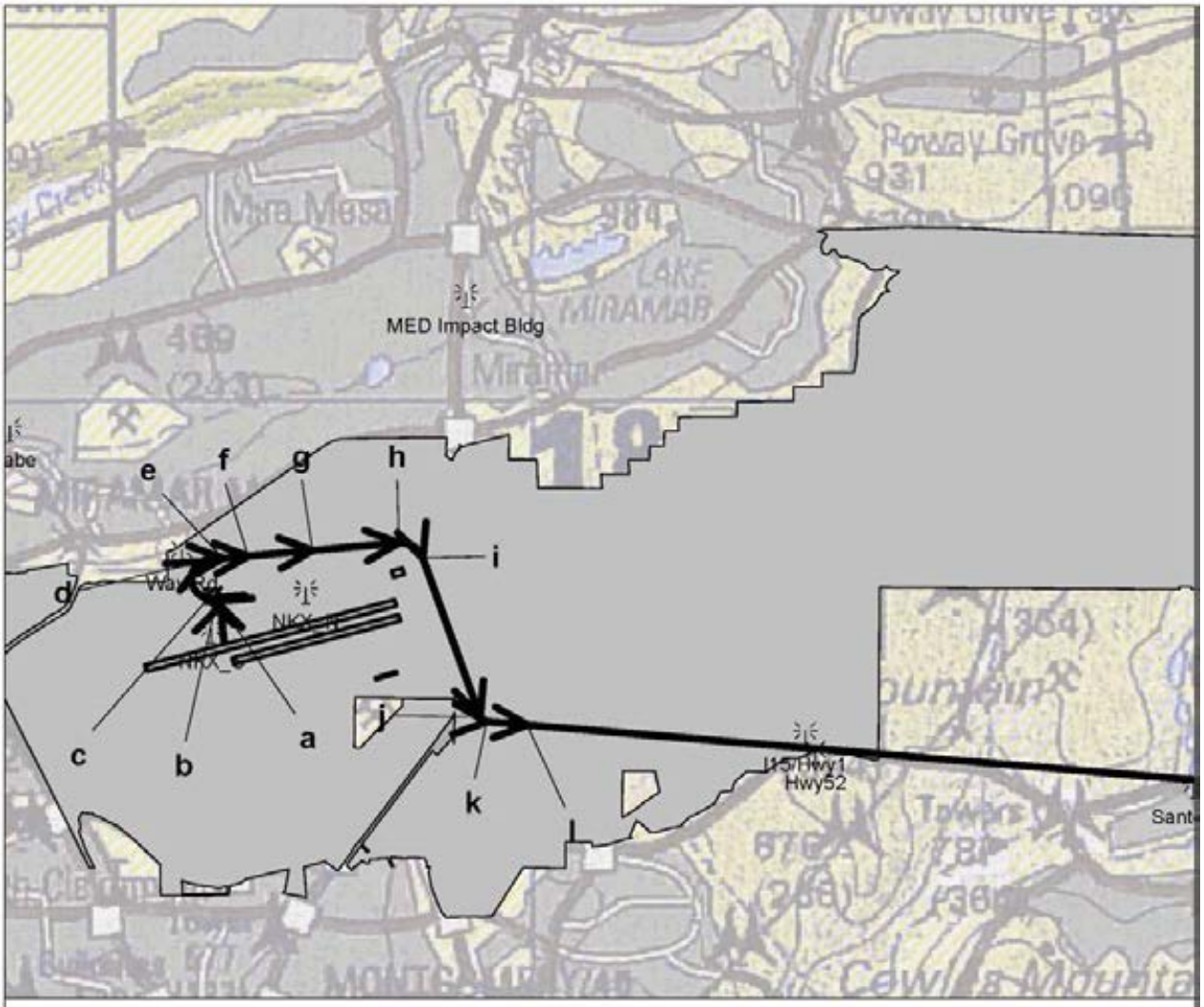
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	25	60	
c	730	642 MSL	66	0	-2	25	60	
d	3,000	1,125 MSL	125	0	5	25	9	
e	4,000	1,298 MSL	135	0	10	25	0	
f	5,175	1,500 MSL	155	0	6	25	0	
g	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
h	23,710	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
i	150,000	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 508
Based MV22B
on Runway 005, Flight Track 5D4L - Yuma Departure from Pad 5 Left Pattern to cross South of Field

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:117,000 (1 inch = 9,790 feet)

N



Flight Profile 509

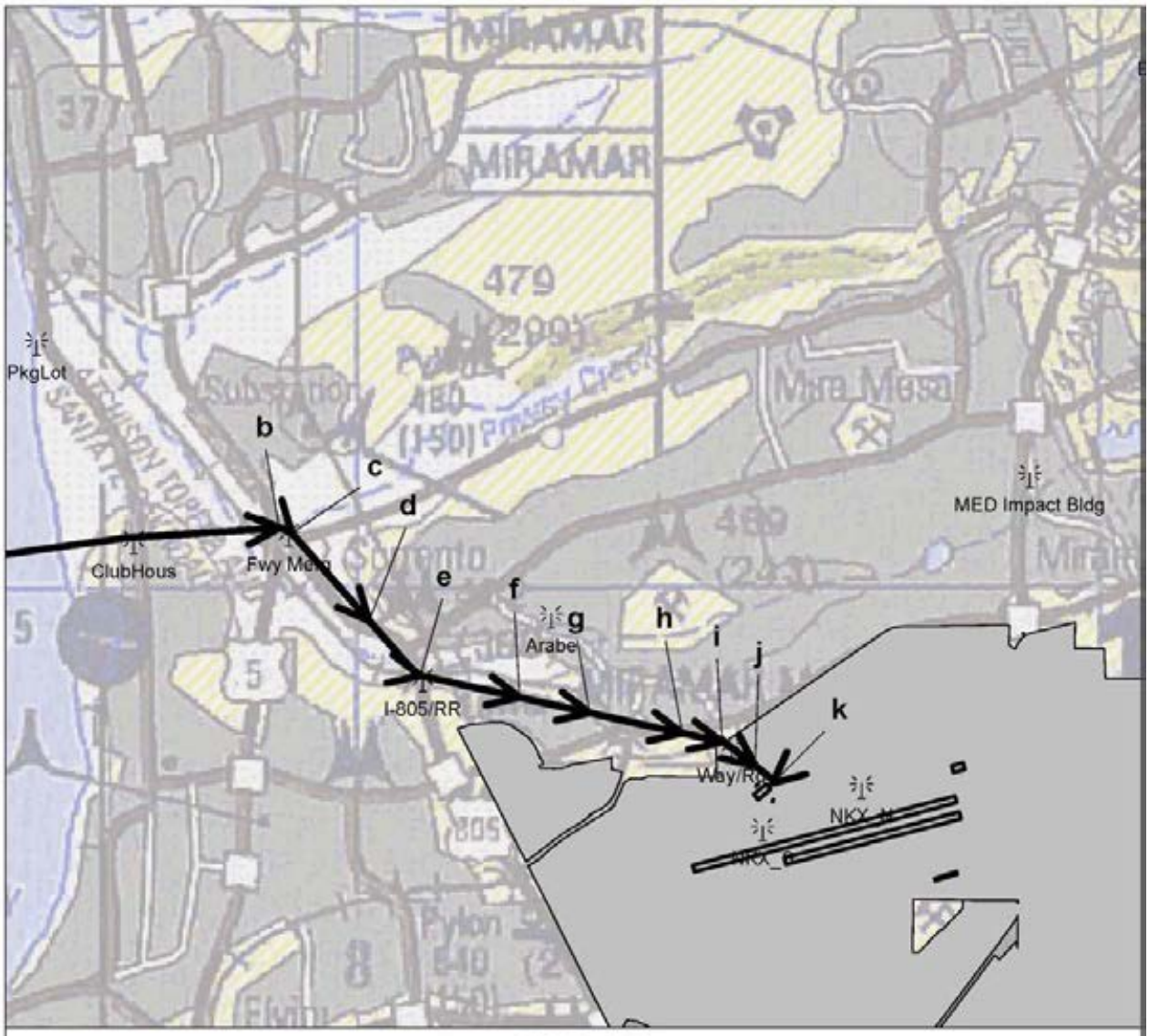
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	525 MSL	50	0	-4	0	60	
c	730	642 MSL	66	0	-2	-25	60	CHANGED roll angle from 0 to -25
d	3,000	1,125 MSL	125	0	5	-25	9	CHANGED roll angle from 0 to -25
e	4,000	1,298 MSL	135	0	10	0	0	
f	5,175	1,500 MSL	155	0	6	0	0	
g	8,175	1,500 MSL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
h	12,207	2,016 MSL	170	0	7	-25	0	added point at beginning of turn
i	13,630	2,198 MSL	170	0	7	0	0	added point at end of turn
j	21,423	3,197 MSL	170	0	7	25	0	added point at beginning of turn
k	21,824	3,248 MSL	170	0	7	0	0	added point at end of turn
l	23,710	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
m	150,000	3,500 MSL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

Flight Profile 509
Based MV22B
on Runway 005, Flight Track 5D4R - Yuma Departure from Pad 5 Right Pattern crossing North of Field

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:102,000 (1 inch = 8,500 feet)

N



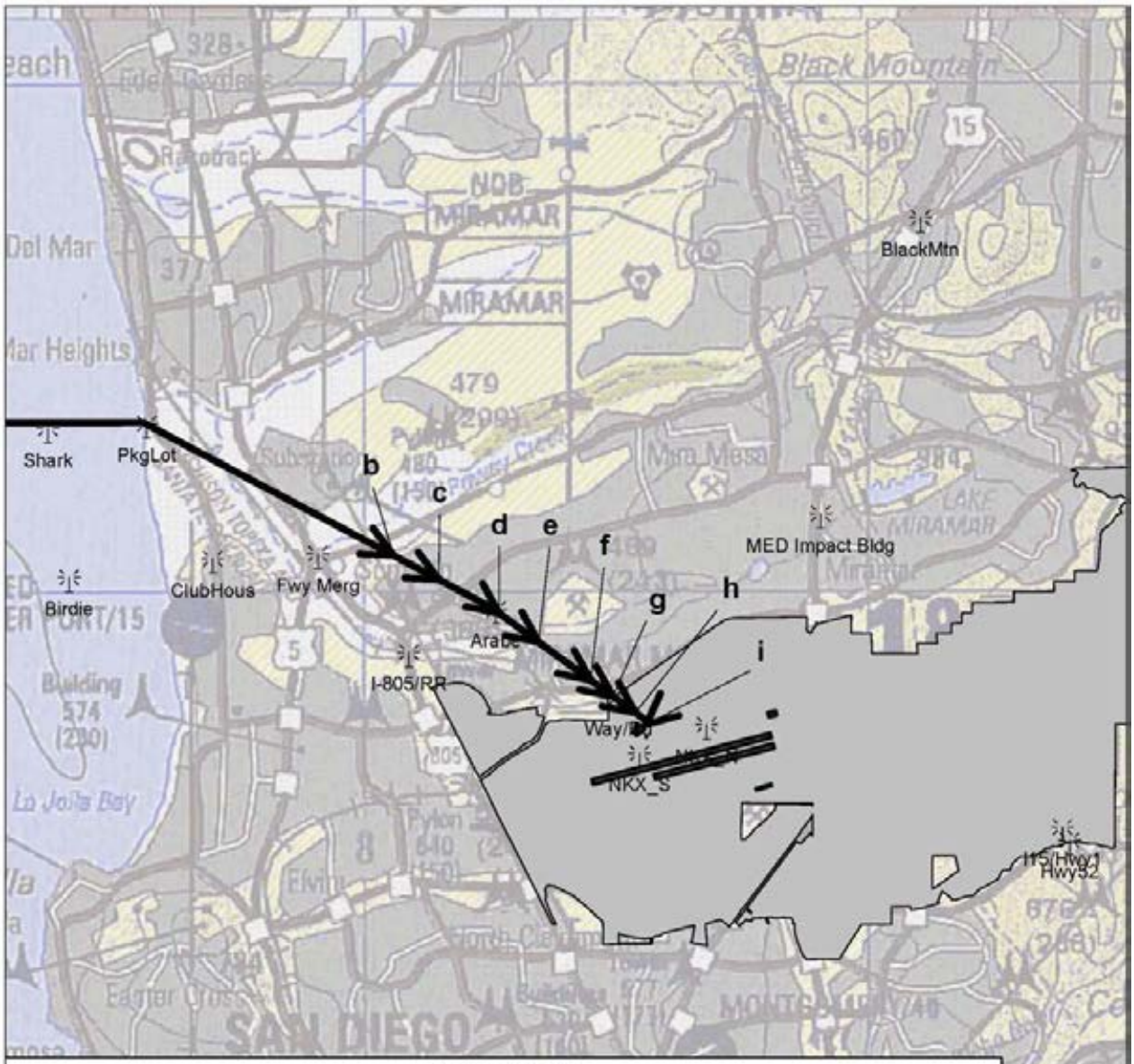
Flight Profile 514

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	1,500 MSL	220	0	5	0	0	+5deg aoa for level @220kts; begin 1800 fpm desc
b	25,777	1,500 MSL	220	0	5	-15	0	added point at beginning of turn
c	25,156	1,500 MSL	220	0	5	0	0	added point at end of turn
d	20,007	1,500 MSL	220	0	-1	0	0	
e	16,667	1,500 MSL	170	0	-1	0	10	700 fpm desc; begin 1800 fpm desc;
f	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
g	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
h	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
i	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
j	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
k	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 514
Based MV22B
on Runway 003, Flight Track 03A1 - Fairway Arrival to Pad 3

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:92,800 (1 inch = 7,730 feet)



Flight Profile 515

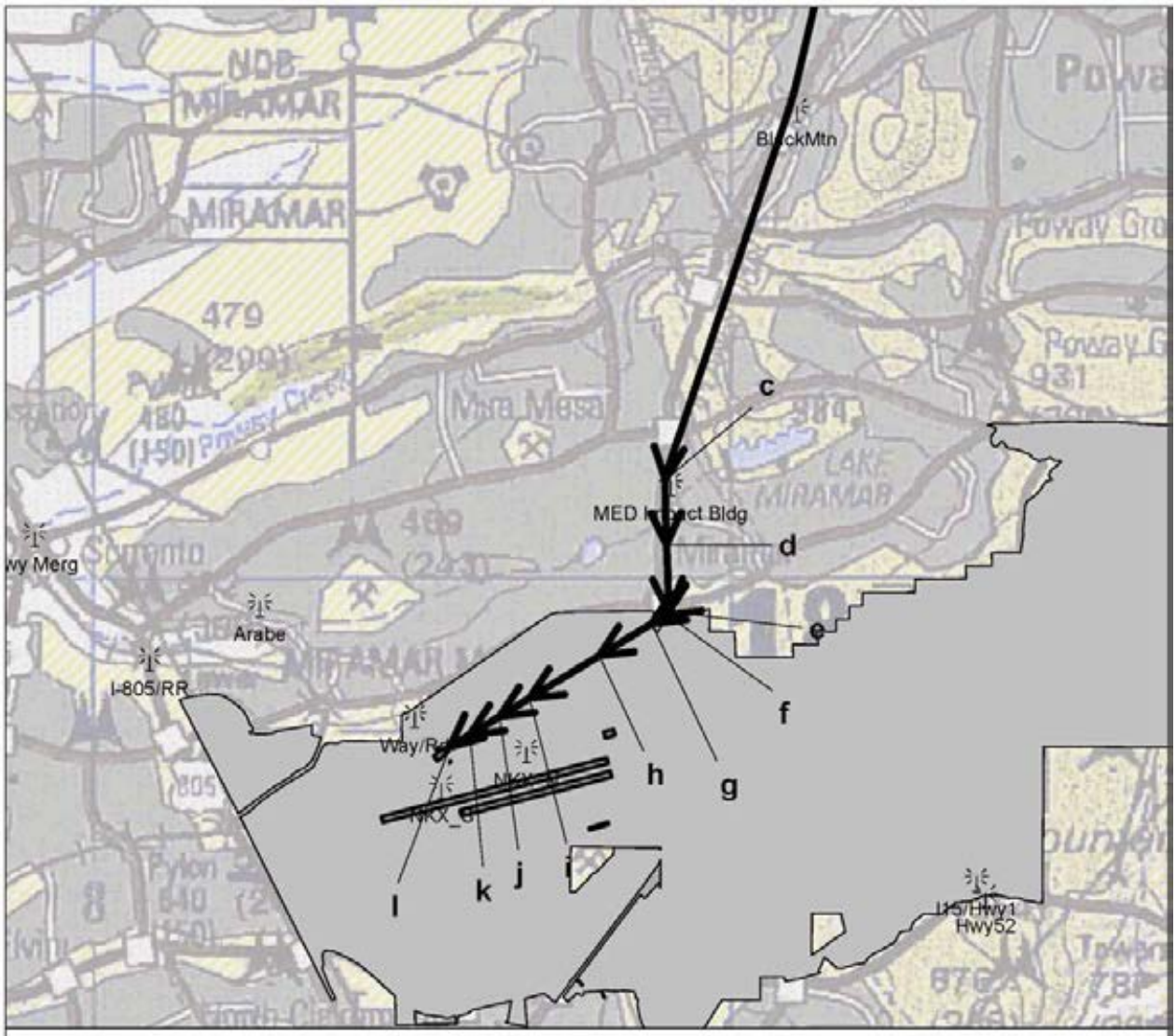
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	1,500 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	20,007	1,500 MSL	220	0	5	0	0	begin 1800 fpm desc;
c	16,667	1,500 MSL	150	0	-1	0	10	700 fpm desc
d	12,172	1,000 MSL	150	0	-1	0	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
f	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
g	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
h	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
i	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 515
Based MV22B
on Runway 003, Flight Track 03A2 - Beach Arrival to Pad 3

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:135,000 (1 inch = 11,200 feet)

N



Flight Profile 516

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	90,000	3,000 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	54,840	3,000 MSL	220	0	5	0	0	
c	20,007	1,500 MSL	220	0	-1	0	0	
d	16,667	1,500 MSL	170	0	-1	0	10	700 fpm desc
e	13,269	1,500 MSL	164	0	-1	-25	7	added point at beginning of turn; interpolated
f	13,064	1,500 MSL	157	0	-1	0	14	added point at end of turn; interpolated
g	12,172	1,500 MSL	150	0	-1	0	20	1800 fpm desc
h	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
i	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
j	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
k	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
l	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 516
Based MV22B
on Runway 003, Flight Track 03A3 - I-15 Arrival to Pad 3

Scale in Feet 1:111,000 (1 inch = 9,220 feet)

Flight Profile 518

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	120,000	3,000 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	54,840	3,000 MSL	220	0	5	0	0	
c	20,007	1,450 AGL	220	0	-1	0	0	begin 1800 fpm desc;
d	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
e	14,222	1,133 AGL	163	0	5	-15	13	added point at beginning of turn; interpolated
f	13,288	1,066 AGL	157	0	5	0	17	added point at end of turn; interpolated
g	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
h	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
i	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
j	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
k	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
l	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 518
Based MV22B
on Runway 003, Flight Track 3A4S - Yuma arrival to Pad 3 Straight-in

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:109,000 (1 inch = 9,120 feet)

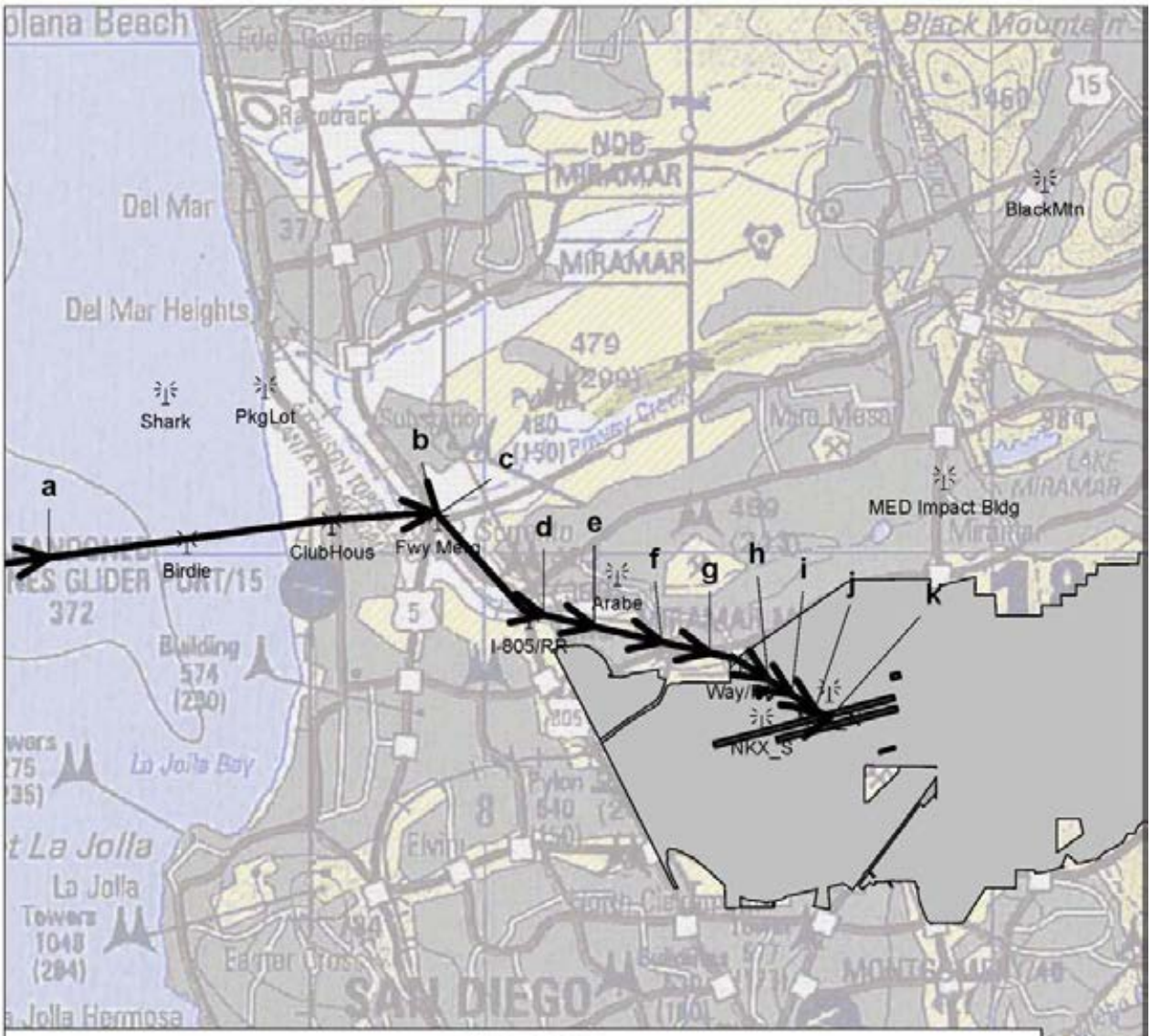
Flight Profile 518

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	120,000	3,000 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	54,840	3,000 MSL	220	0	5	0	0	
c	20,007	1,450 AGL	220	0	-1	0	0	begin 1800 fpm desc;
d	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
e	14,222	1,133 AGL	163	0	5	-15	13	added point at beginning of turn; interpolated
f	13,288	1,066 AGL	157	0	5	0	17	added point at end of turn; interpolated
g	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
h	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
i	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
j	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
k	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
l	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 518
Based MV22B
on Runway 003, Flight Track 3A4S - Yuma arrival to Pad 3 Straight-in

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:109,000 (1 inch = 9,120 feet)



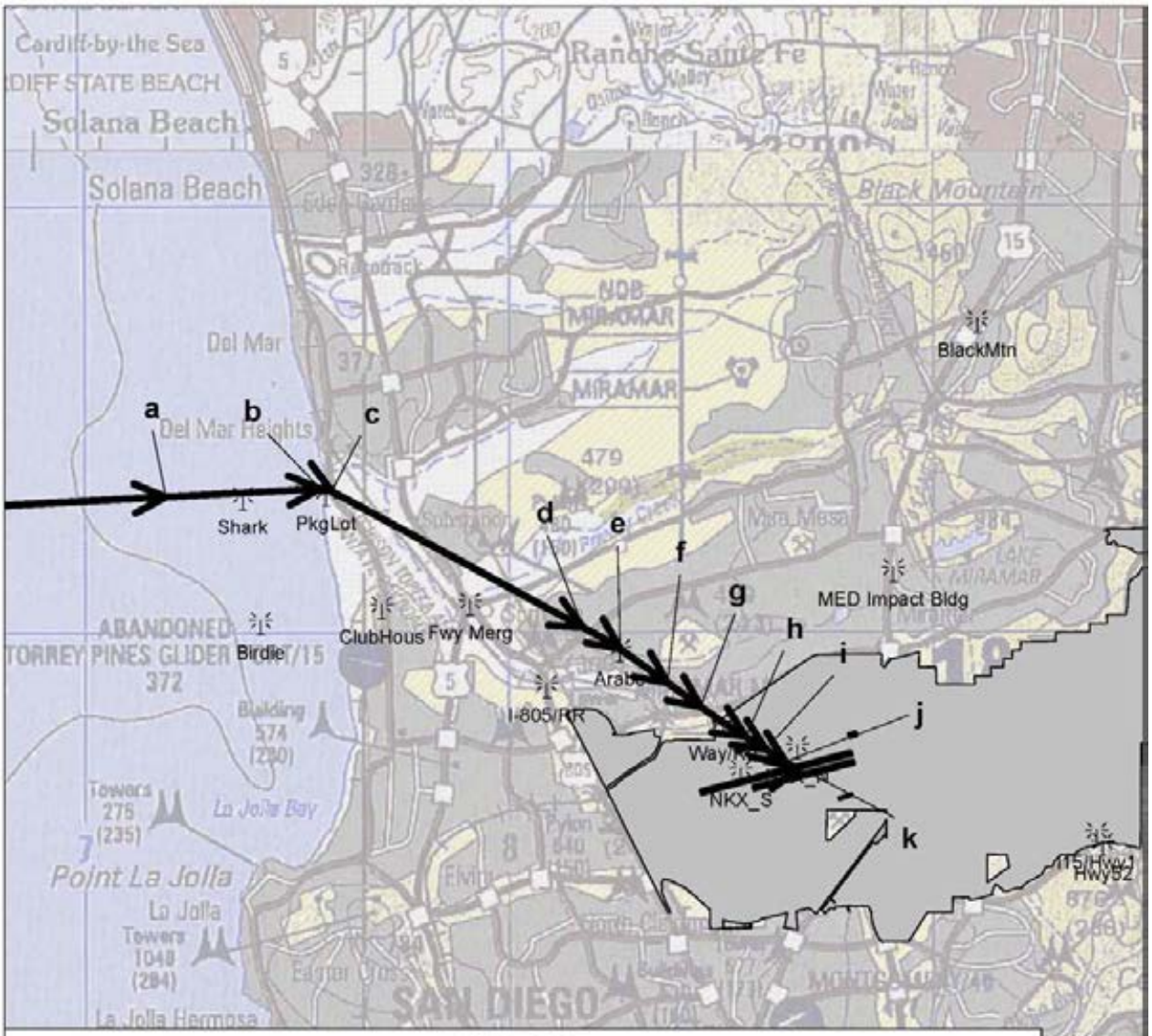
Flight Profile 510

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	55,000	1,500 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	29,899	1,500 MSL	220	0	5	-25	0	added point at beginning of turn
c	29,653	1,500 MSL	220	0	5	0	0	added point at end of turn
d	20,007	1,500 MSL	220	0	-1	0	0	begin 1800 fpm desc;
e	16,667	1,500 MSL	170	0	-1	0	10	
f	12,172	1,000 AGL	150	0	-1	0	20	begin 1800 fpm desc
g	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
h	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
i	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
j	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
k	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 510
Based MV22B
on Runway 06P, Flight Track 4PA1 - Fairway Arrival to Runway 06P

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:136,000 (1 inch = 11,300 feet)

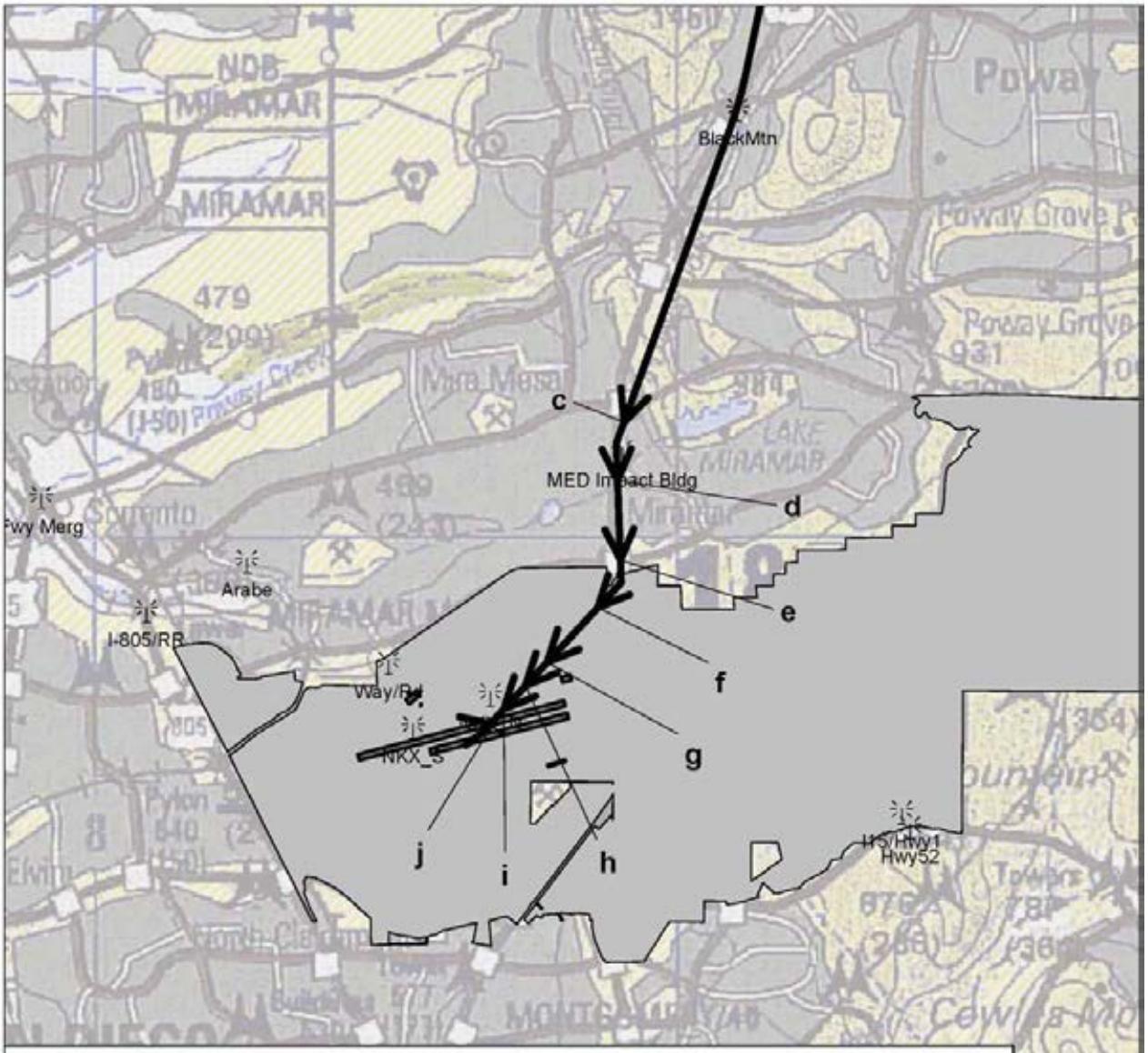


Flight Profile 511

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	55,000	1,500 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	43,017	1,500 MSL	220	0	5	-15	0	added point at beginning of turn
c	42,119	1,500 MSL	220	0	5	0	0	added point at end of turn
d	20,007	1,500 MSL	220	0	-1	0	0	
e	16,667	1,500 MSL	170	0	-1	0	10	
f	12,172	1,500 MSL	150	0	-1	0	20	1800 fpm dese
g	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
h	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
i	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
j	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
k	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 511
Based MV22B
on Runway 06P, Flight Track 4PA2 - Beach Arrival to Runway 06P

Scale in Feet 1:163,000 (1 inch = 13,600 feet)



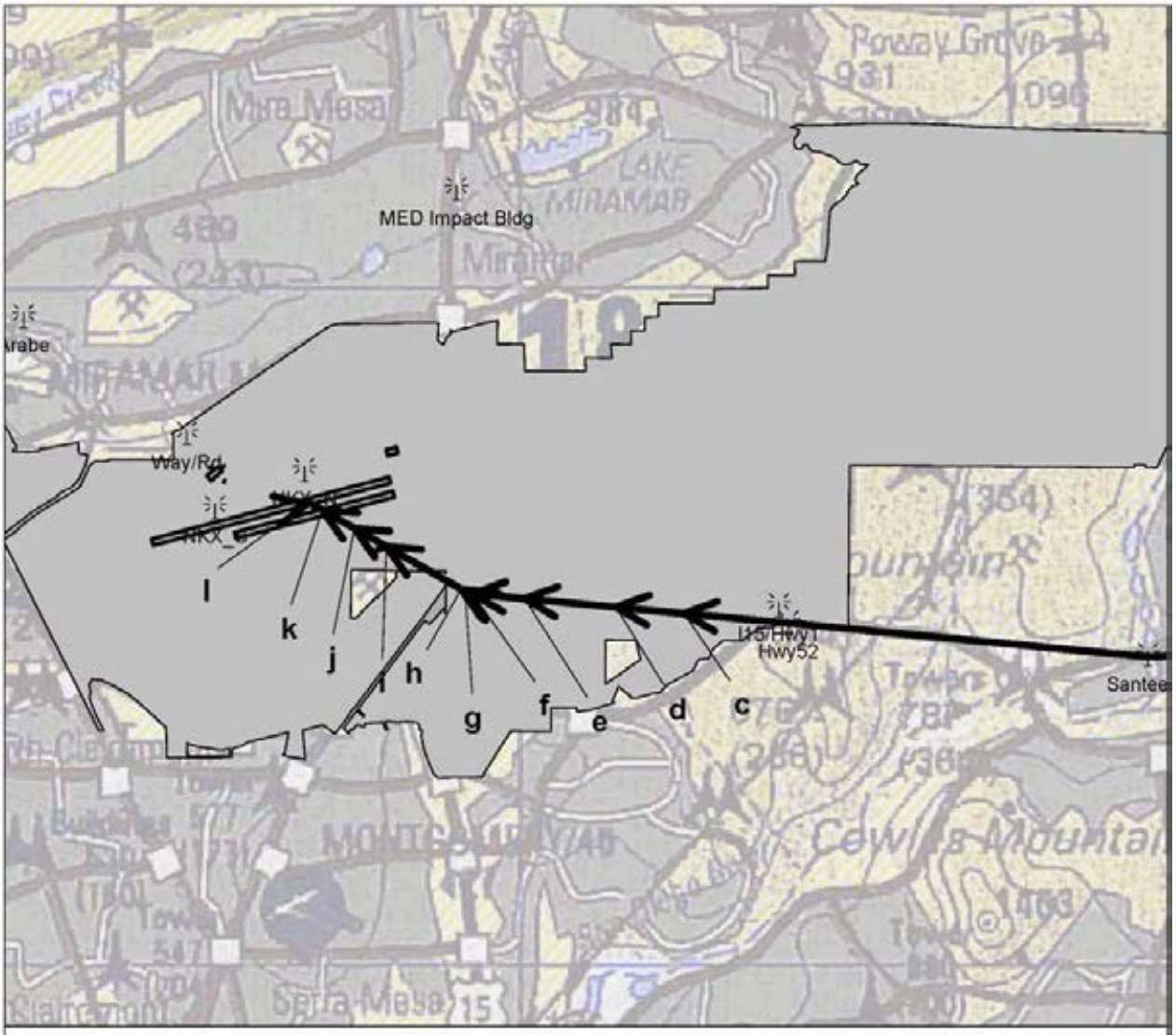
Flight Profile 512

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	90,000	3,000 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	54,840	3,000 MSL	220	0	5	0	0	
c	20,007	1,770 MSL	220	0	-1	0	0	
d	16,667	1,500 MSL	170	0	-1	0	10	700 fpm desc
e	12,172	1,500 MSL	150	0	-1	0	20	1800 fpm desc
f	9,000	1,000 MSL	80	0	0	0	79	400 fpm desc; 3deg gs
g	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
h	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
i	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
j	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 512
Based MV22B
on Runway 06P, Flight Track 4PA3 - I-15 Arrival to Runway 06P

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:118,000 (1 inch = 9,850 feet)



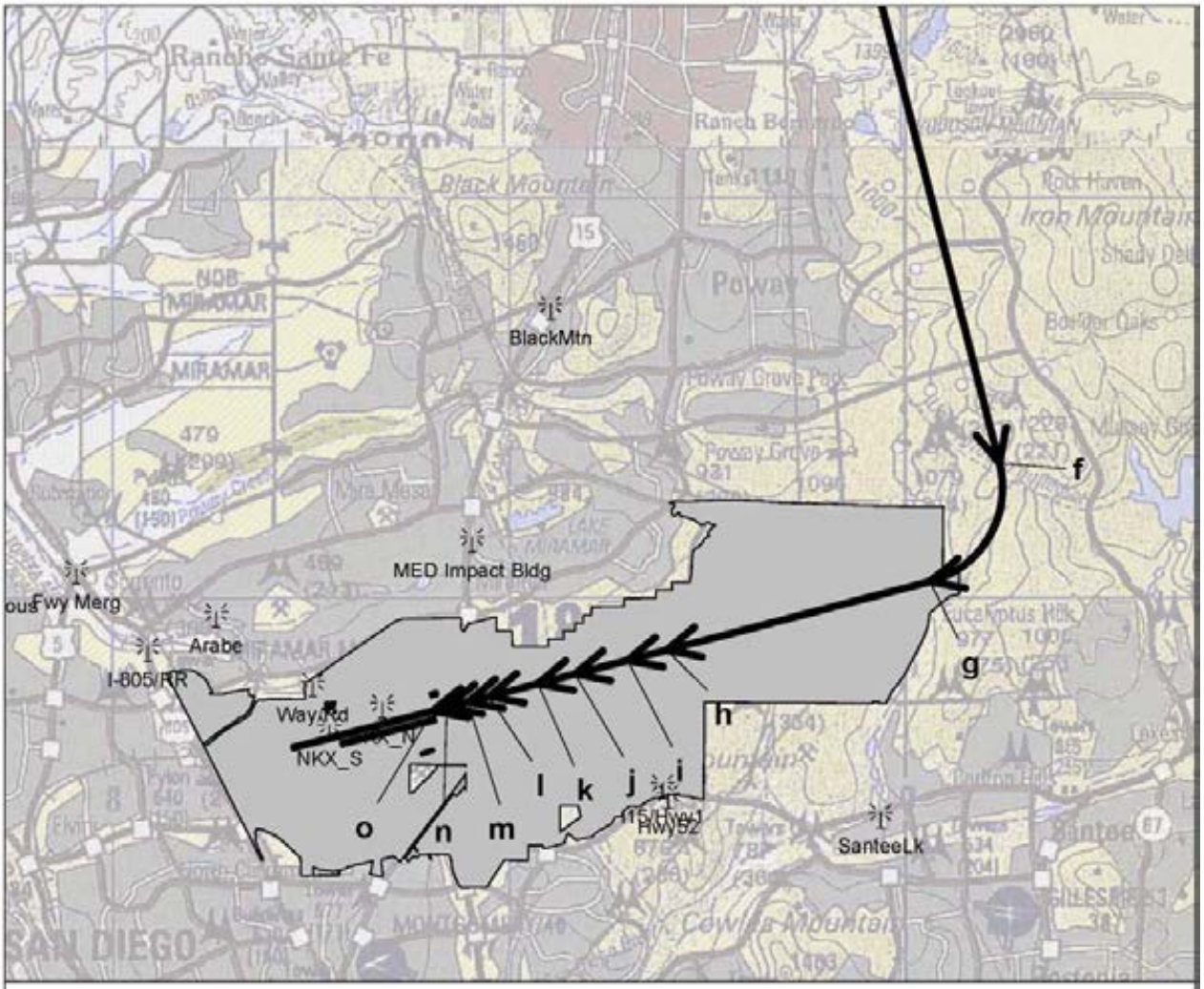
Flight Profile 513

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	120,000	3,000 MSL	220	0	5	0	0	+5deg aoa for level @220kts
b	54,840	3,000 MSL	220	0	5	0	0	
c	20,007	1,570 MSL	220	0	-1	0	0	begin 1800 fpm desc;
d	16,667	1,207 MSL	170	0	-1	0	10	
e	12,172	1,000 MSL	150	0	-1	0	20	
f	9,609	1,000 MSL	85	0	-1	-15	55	added point at beginning of turn; interpolated
g	9,230	1,000 MSL	82	0	-1	0	70	added point at end of turn; interpolated
h	9,000	1,000 MSL	80	0	0	0	79	400 fpm desc; 3deg gs
i	4,800	790 MSL	80	0	0	0	80	400 fpm desc; 3deg gs
j	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
k	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
l	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 513
Based MV22B
on Runway 06P, Flight Track 4PA4 - Yuma arrival to Runway 06P

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:105,000 (1 inch = 8,750 feet)



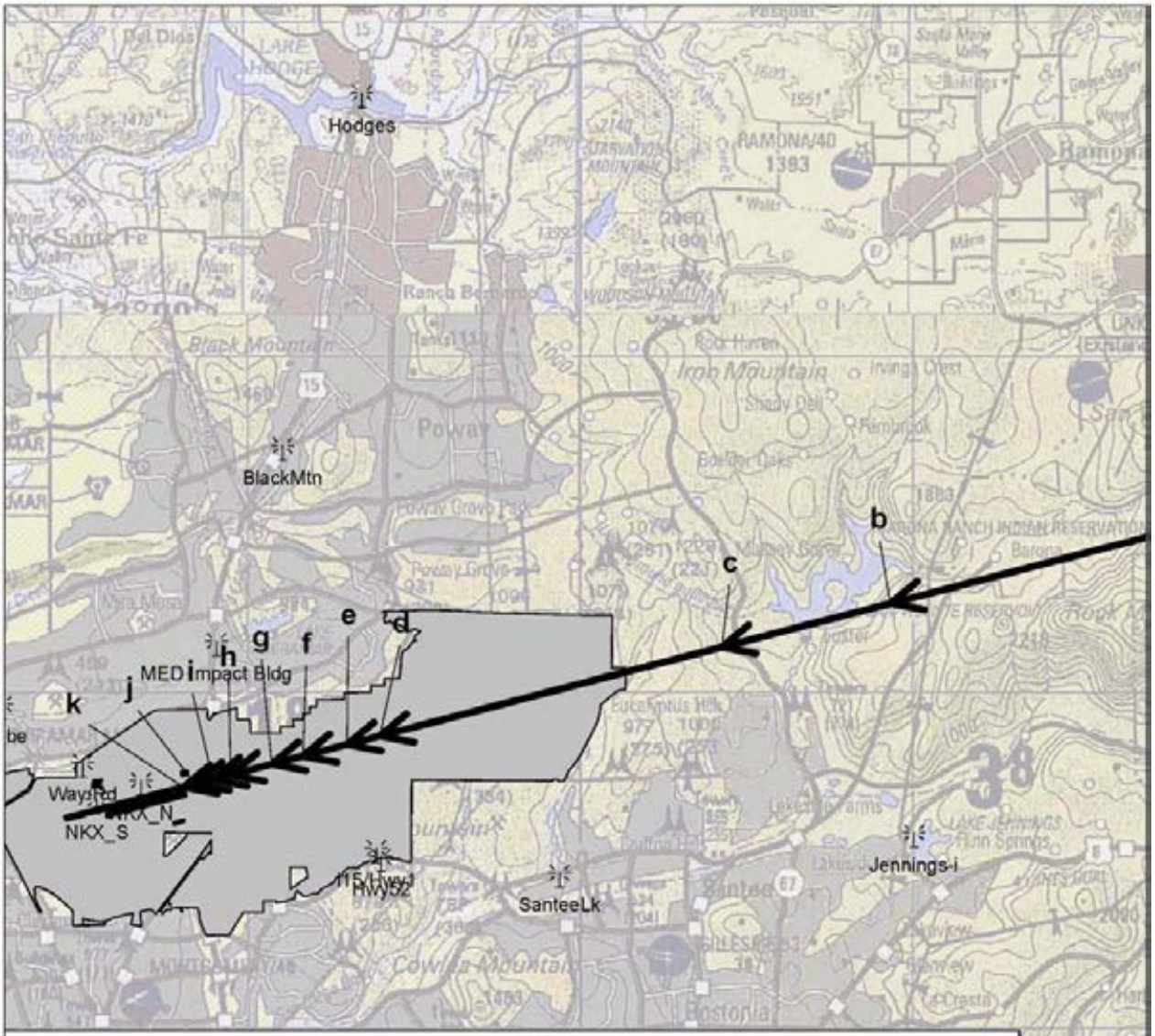
Flight Profile 605

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	170,000	7,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	143,366	7,000 AGL	220	0	5	15	0	point added at beginning of turn
c	141,620	7,000 AGL	220	0	5	0	0	point added at end of turn
d	105,920	7,000 AGL	220	0	5	-15	0	point added at beginning of turn
e	95,488	7,000 AGL	220	0	5	0	0	point added at end of turn
f	55,098	4,335 AGL	220	0	5	-25	0	point moved slightly back to catch beginning of turn
g	42,532	3,320 AGL	220	0	5	0	0	point added at end of turn
h	20,007	1,500 AGL	220	0	-1	0	0	begin 1800 fpm desc;
i	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
j	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
k	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
l	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
m	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
n	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
o	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 605
Based MV22B
on Runway 24R, Flight Track 4RA1 - Straight In Arrival from OCN w/ 7nmi final

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:182,000 (1 inch = 15,200 feet)



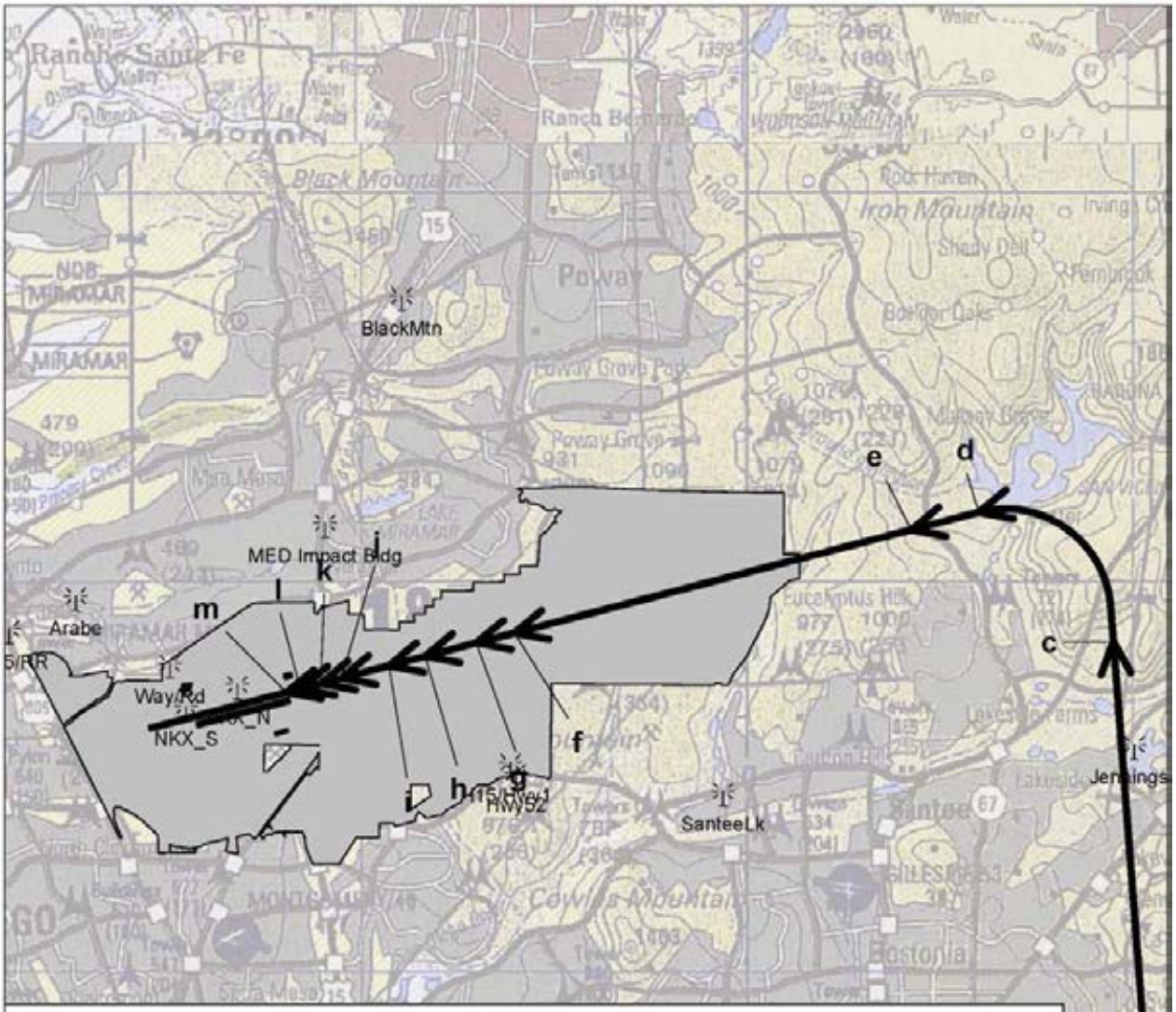
Flight Profile 611

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	120,000	7,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	72,000	7,000 AGL	220	0	5	0	0	begin 1800 fpm desc;
c	54,840	5,691 AGL	220	0	5	0	0	begin 1800 fpm desc;
d	20,007	1,500 AGL	220	0	-1	0	0	
e	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
f	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
g	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
h	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
i	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
j	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
k	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 611
Based MV22B
on Runway 24R, Flight Track 4RA7 - Straight In Arrival (LOOTS)

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:208,000 (1 inch = 17,300 feet)



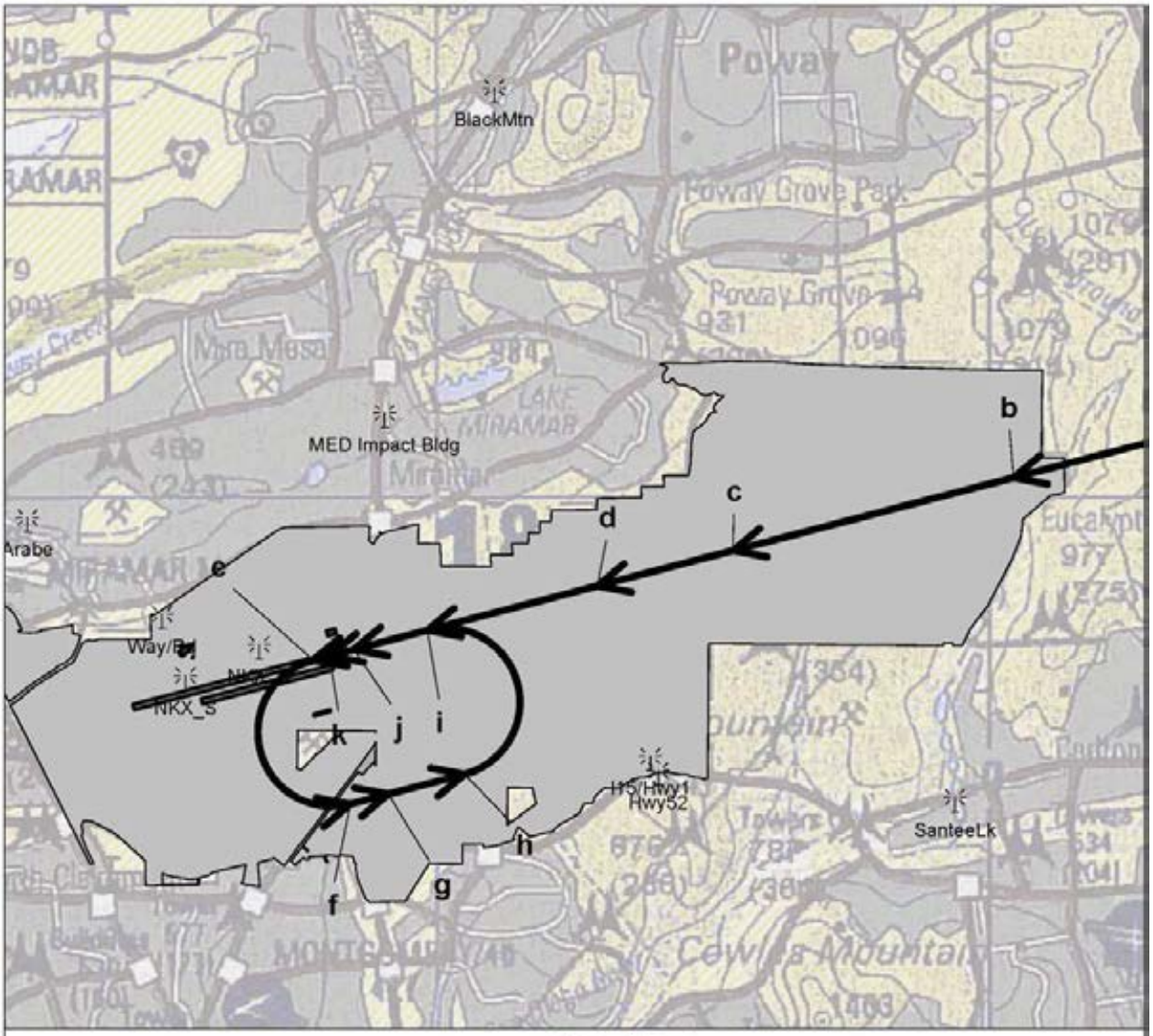
Flight Profile 695

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	160,000	7,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	145,068	7,000 AGL	220	0	5	0	0	point added at end of turn
c	79,402	5,580 AGL	220	0	5	-15	0	point added at beginning of turn
d	60,760	6,241 AGL	220	0	5	0	0	point added at end of turn
e	54,840	5,691 AGL	220	0	5	0	0	+5deg aoa for level @220kts
f	20,007	1,500 AGL	220	0	-1	0	0	begin 1800 fpm desc;
g	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
h	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
i	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
j	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
k	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
l	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
m	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 695
Based MV22B
on Runway 24R, Flight Track 4RA8 - Straight In Arrival (SIERA)

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:182,000 (1 inch = 15,200 feet)



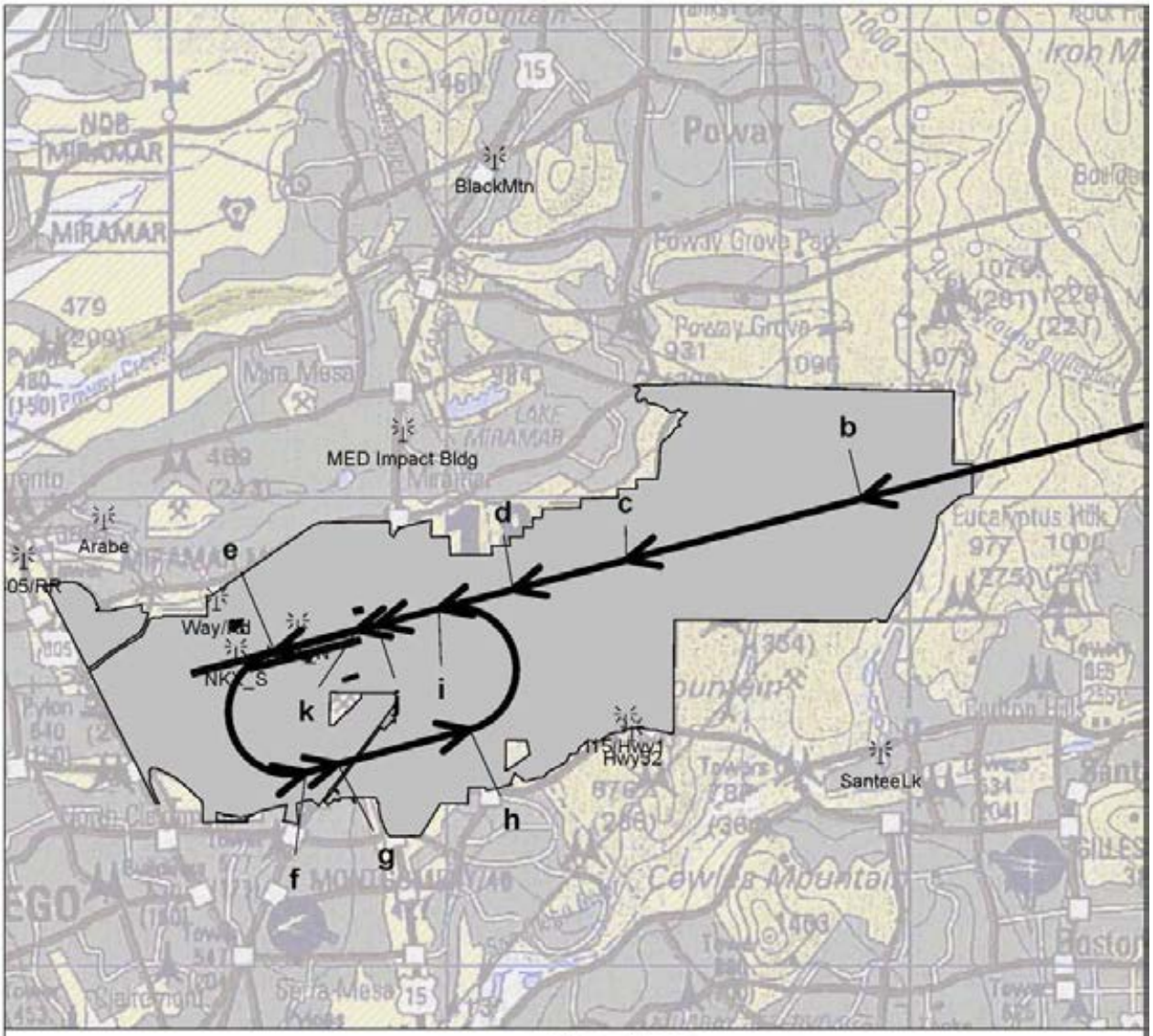
Flight Profile 612

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	180,000	10,000 MSL	220	0	0	0	0	near end of track
b	83,463	3,000 MSL	220	0	0	0	0	
c	66,280	1,700 MSL	200	0	0	0	0	
d	57,974	1,700 MSL	170	0	0	0	0	
e	40,552	1,600 MSL	110	0	0	20	60	Course Rules Break Alt =1600 MSL; break
f	26,776	1,600 MSL	110	0	0	0	60	Course Rules Break Alt =1600 MSL; begin downw
g	24,443	700 AGL	110	0	0	0	60	1/3 of downwind leg
h	19,776	500 AGL	80	0	0	15	73	end of downwind
i	6,000	350 AGL	65	0	7	0	79	~1nm out
j	1,500	300 AGL	50	0	10	0	85	1500ft out
k	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 612
Based MV22B
on Runway 24R, Flight Track 4O01 - LOOTS (s.i.) #s break

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:125,000 (1 inch = 10,400 feet)



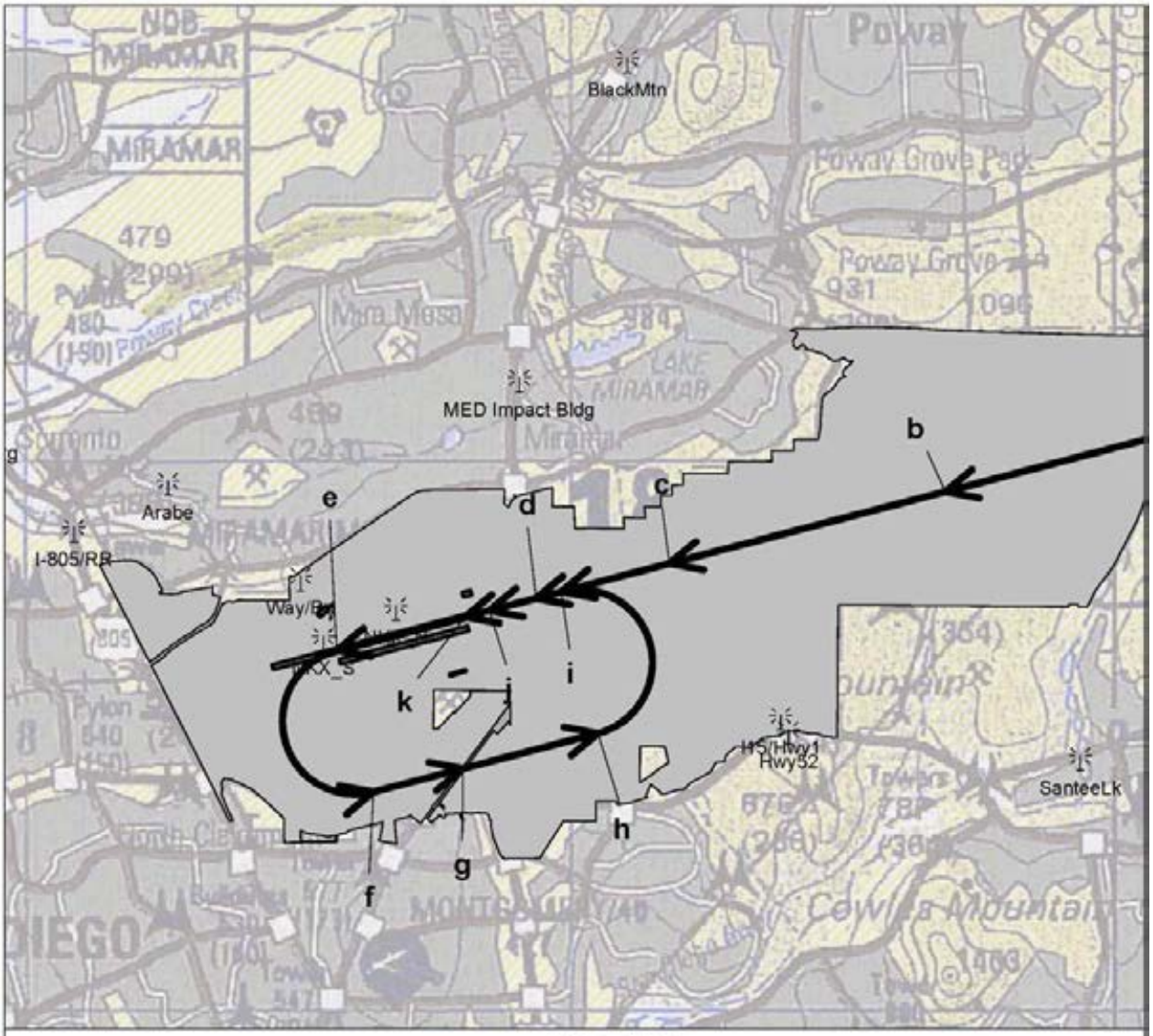
Flight Profile 617

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	180,000	16,000 MSL	220	0	0	0	0	near end of track
b	88,463	3,000 MSL	220	0	0	0	0	
c	71,280	1,700 MSL	200	0	0	0	0	
d	62,974	1,700 MSL	170	0	0	0	0	
e	45,552	1,600 MSL	110	0	0	20	60	Course Rules Break Alt =1600 MSL; break
f	31,776	1,600 MSL	110	0	0	0	60	Course Rules Break Alt =1600 MSL; begin downw
g	29,443	700 AGL	110	0	0	0	60	1/3 of downwind leg
h	19,776	500 AGL	80	0	0	15	73	end of downwind
i	6,000	350 AGL	65	0	7	0	79	~1nm out
j	1,500	300 AGL	50	0	10	0	85	1500ft out
k	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 617
Based MV22B
on Runway 24R, Flight Track 4O06 - LOOTS (s.i.) , midfield break

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:149,000 (1 inch = 12,400 feet)



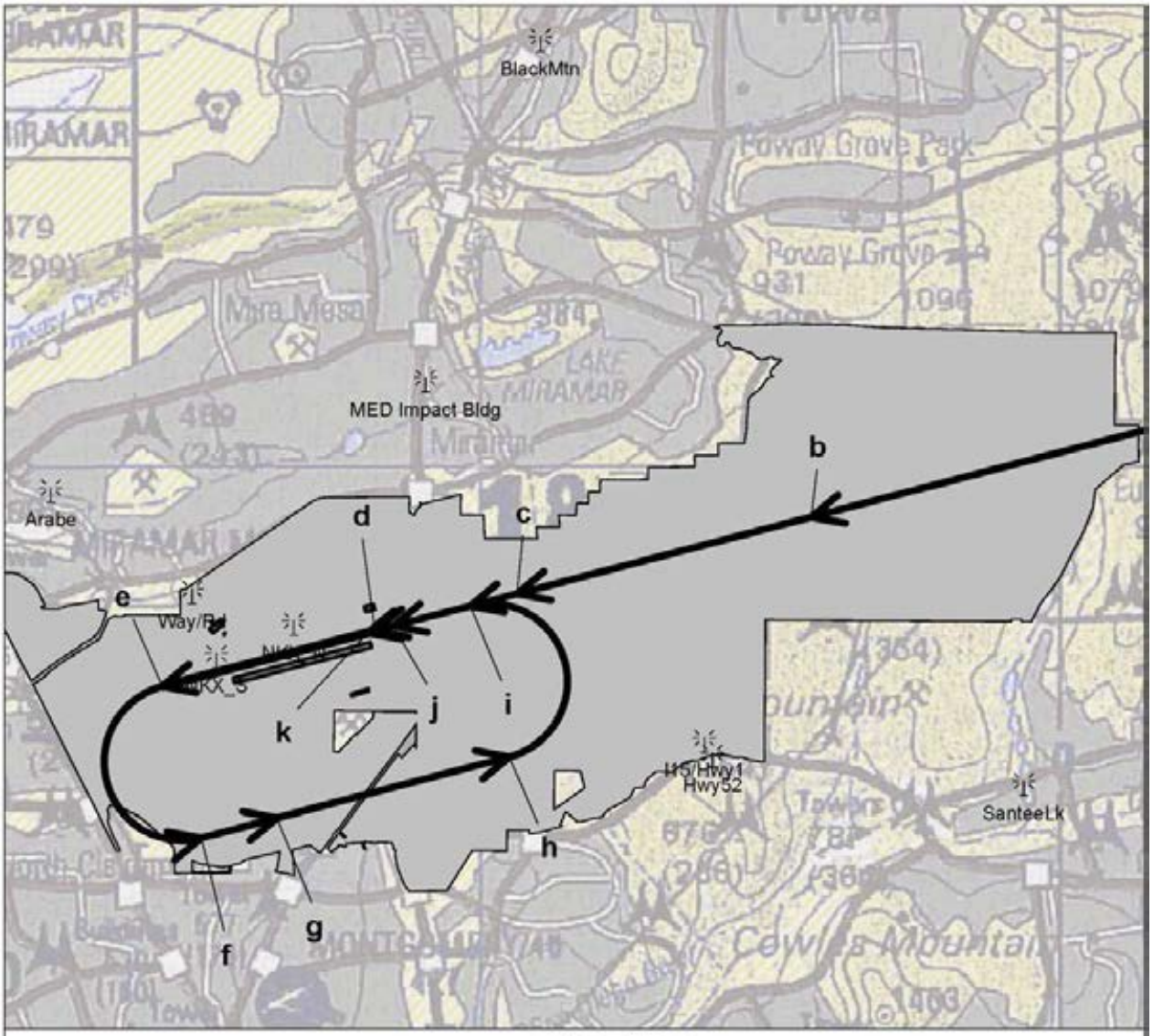
Flight Profile 622

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	180,000	16,000 MSL	220	0	0	0	0	near end of track
b	85,463	3,000 MSL	220	0	0	0	0	
c	68,280	1,700 MSL	200	0	0	0	0	
d	59,974	1,700 MSL	170	0	0	0	0	
e	47,552	1,600 MSL	110	0	0	20	60	Course Rules Break Alt =1600 MSL; break
f	33,776	1,600 MSL	110	0	0	0	60	Course Rules Break Alt =1600 MSL; begin downw
g	28,189	700 AGL	110	0	0	0	60	1/3 of downwind leg
h	19,776	500 AGL	80	0	0	15	73	end of downwind
i	6,000	350 AGL	65	0	7	0	79	~1nm out
j	1,500	300 AGL	50	0	10	0	85	1500ft out
k	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 622
Based MV22B
on Runway 24R, Flight Track 4O11 - LOOTS (s.i.) 80% rwy break

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:127,000 (1 inch = 10,600 feet)



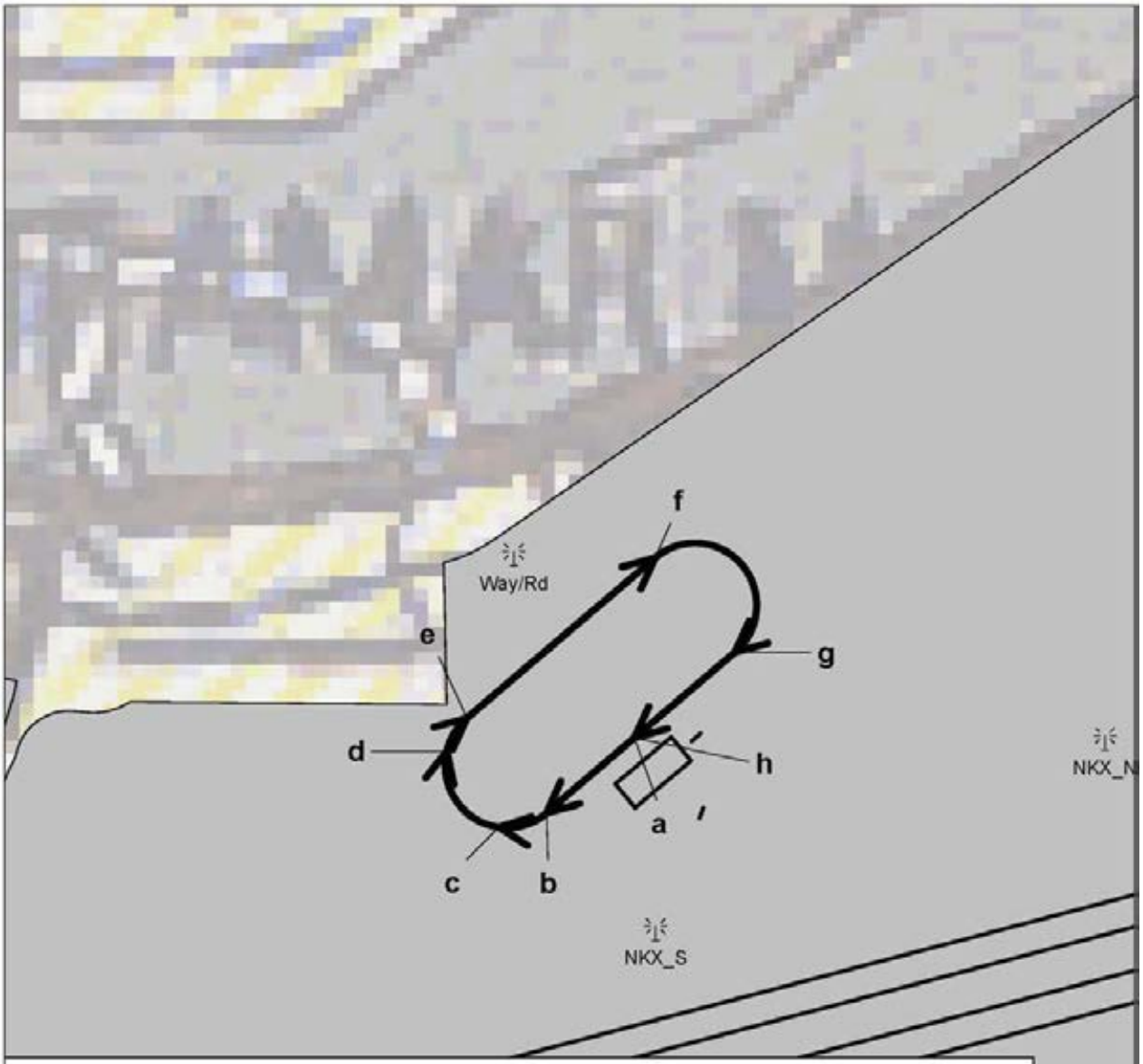
Flight Profile 627

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	180,000	16,000 MSL	220	0	0	0	0	near end of track
b	89,463	3,000 MSL	220	0	0	0	0	
c	72,280	1,700 MSL	200	0	0	0	0	
d	63,974	1,700 MSL	170	0	0	0	0	
e	51,552	1,600 MSL	110	0	0	20	60	Course Rules Break Alt =1600 MSL; break
f	37,776	1,600 MSL	110	0	0	0	60	Course Rules Break Alt =1600 MSL; begin downw
g	33,358	700 AGL	110	0	0	0	60	1/3 of downwind leg
h	19,776	500 AGL	80	0	0	15	73	end of downwind
i	6,000	350 AGL	65	0	7	0	79	~1nm out
j	1,500	300 AGL	50	0	10	0	85	1500ft out
k	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 627
Based MV22B
on Runway 24R, Flight Track 4O16 - LOOTS (s.i.) upwind #s break

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:119,000 (1 inch = 9,910 feet)



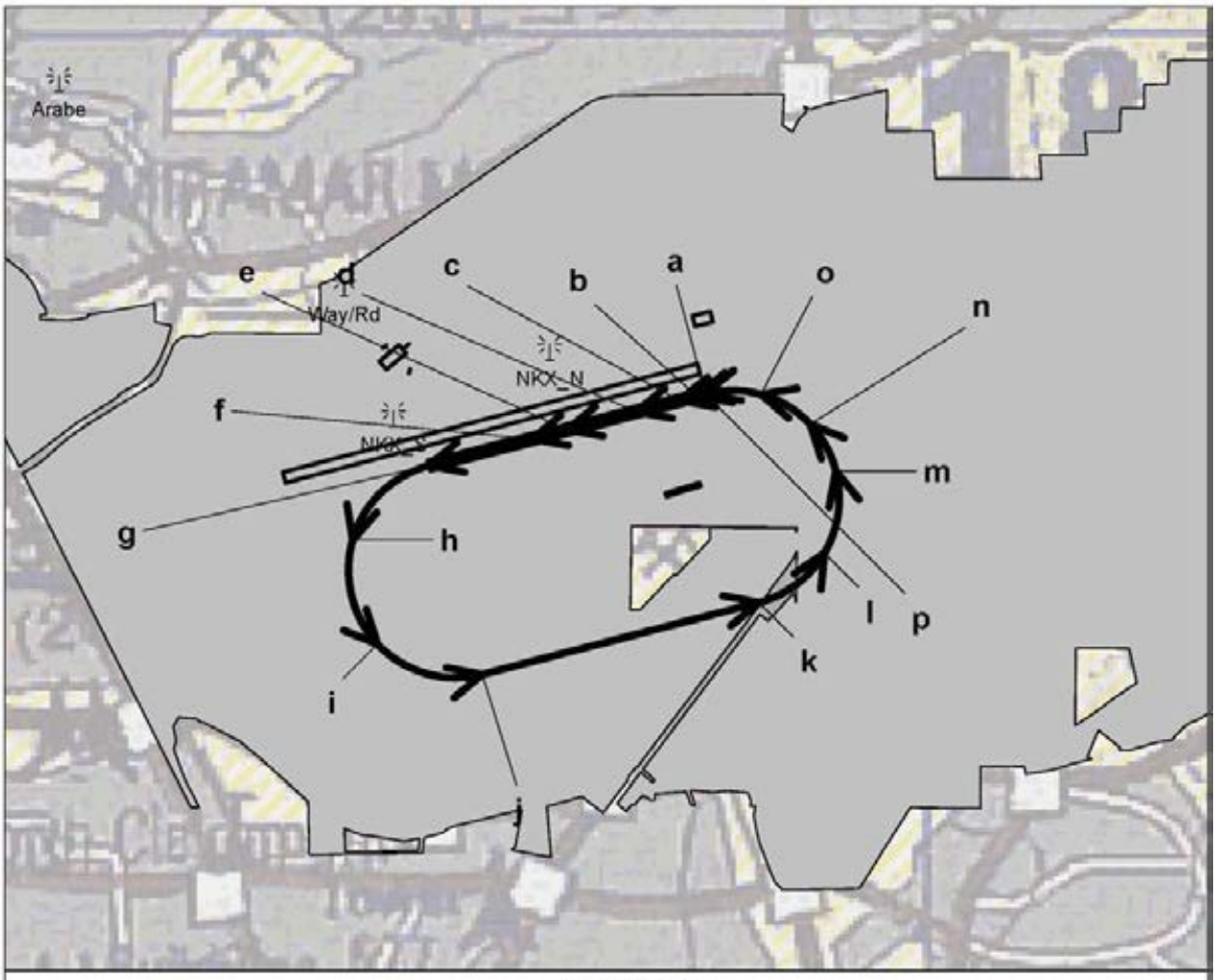
Flight Profile 522

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	490 MSL	0	0	0	0	90	
b	1,120	766 MSL	55	0	-5	-15	90	
c	1,620	890 MSL	80	0	-5	-15	90	
d	2,623	1,000 AGL	100	0	0	-15	90	
e	3,004	1,000 AGL	100	0	0	0	90	
f	5,404	1,000 AGL	100	0	5	-15	90	
g	7,288	800 MSL	80	0	5	0	90	
h	8,570	490 MSL	0	0	0	0	90	Changed 8568 to 8570 16Feb06

Flight Profile 522
Based MV22B
on Runway 001, Flight Track 001T - Helo Spot pattern (near West Ramp); RH;
<=1200 ft upwind; 1000 ft MSL

0 1,000 2,000 3,000 4,000 5,000 6,000

Scale in Feet 1:20,300 (1 inch = 1,690 feet)



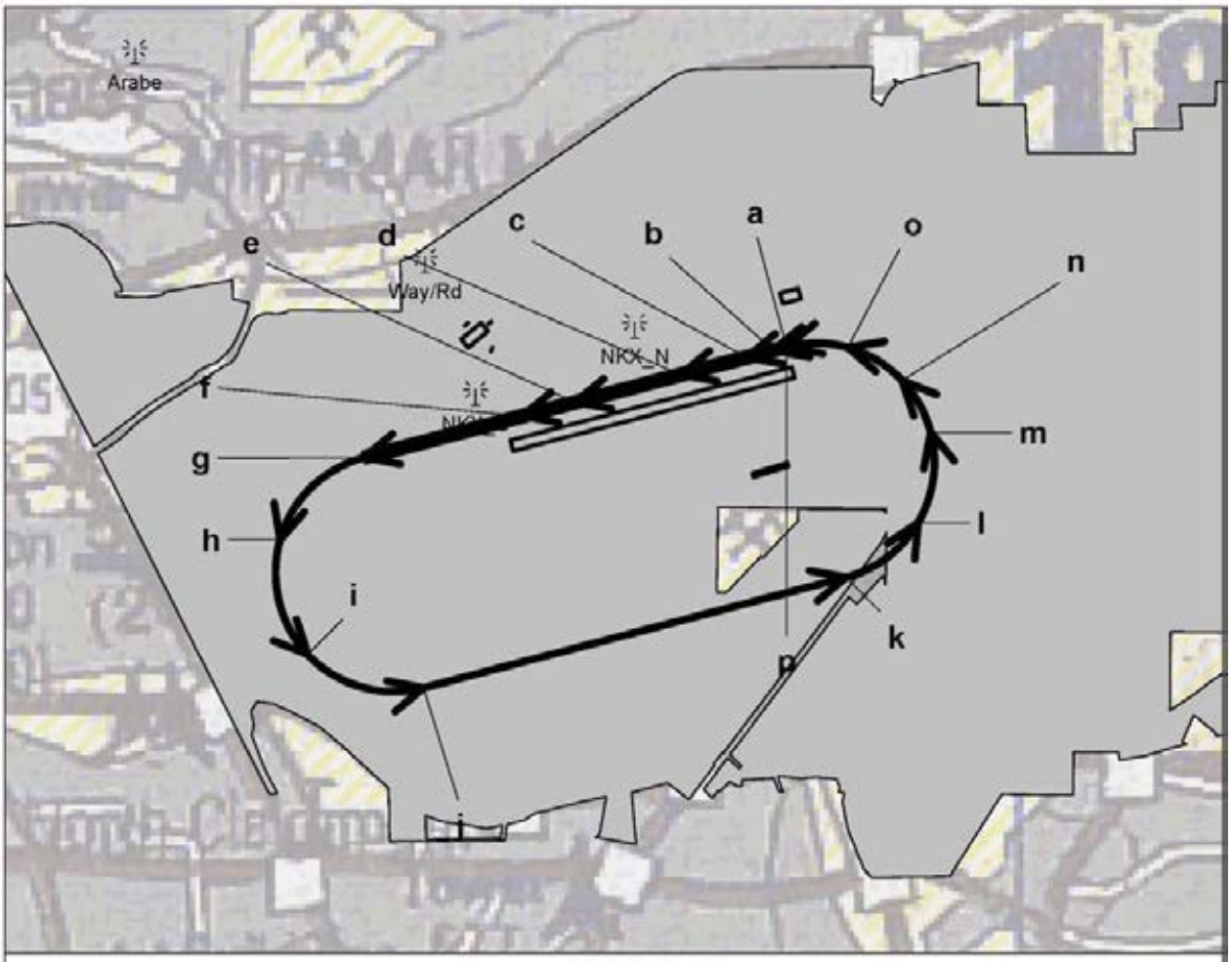
Flight Profile 521

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	800 AGL	135	0	10	0	0	
f	5,000	1,000 AGL	145	0	0	0	0	
g	8,000	1,000 AGL	170	0	7	25	0	begin turn to downwind
h	11,110	1,000 AGL	170	0	7	25	0	MOVE TO 1/3 turn - CHANGED from 150 to 170E
i	14,221	1,000 AGL	170	0	7	25	0	MOVE TO 2/3 turn
j	17,425	1,000 AGL	170	0	7	0	0	begin downwind
k	25,425	1,000 AGL	170	0	3	25	0	end downwind
l	27,781	750 AGL	140	0	3	25	0	1/4 thru turn
m	30,138	500 AGL	110	0	0	25	60	1/2 thru turn
n	31,646	200 AGL	60	0	0	25	87	2/3 thru turn
o	33,276	150 AGL	50	0	0	25	90	5/6 thru turn
p	34,850	20 AGL	5	0	0	0	90	

Flight Profile 521
Based MV22B
on Runway 24L, Flight Track 4LT2 - 6000 ft abeam; 8000 ft downwind; 1600 ft MSL

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000 20,000

Scale in Feet 1:62,200 (1 inch = 5,180 feet)

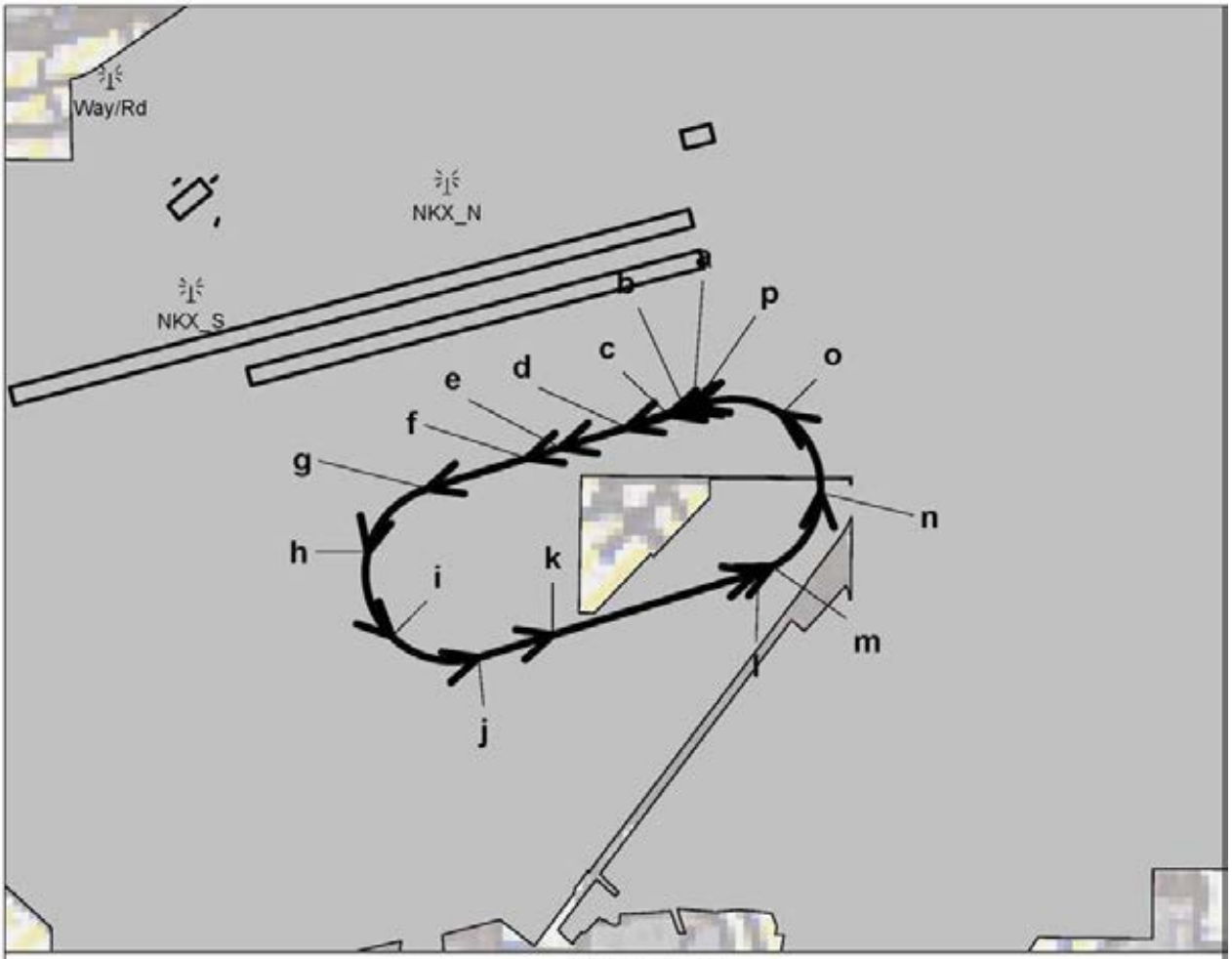


Flight Profile 520

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	375	30 AGL	45	0	-6	0	60	
c	1,125	150 AGL	65	0	0	0	60	
d	3,000	450 AGL	110	0	3	0	30	
e	6,000	800 AGL	135	0	10	0	0	
f	7,500	1,000 AGL	145	0	0	0	0	
g	12,000	1,000 AGL	170	0	7	25	0	begin turn to downwind
h	15,369	1,000 AGL	170	0	7	25	0	MOVE TO 1/3 turn - CHANGED from 150 to 170
i	18,739	1,000 AGL	170	0	7	25	0	MOVE TO 2/3 turn
j	22,210	1,000 AGL	170	0	7	0	0	begin downwind
k	34,210	1,000 AGL	170	0	3	25	0	end downwind
l	36,763	750 AGL	140	0	3	25	0	1/4 thru turn
m	39,315	500 AGL	110	0	0	25	60	1/2 thru turn
n	40,949	200 AGL	60	0	0	25	87	2/3 thru turn
o	42,715	150 AGL	50	0	0	25	90	5/6 thru turn
p	44,420	20 AGL	5	0	0	0	90	

Flight Profile 520
Based MV22B
on Runway 24R, Flight Track 4RT2 - LH patt; 1nm abeam; 2nm downwind; 1600 ft MSL

Scale in Feet 1:61,800 (1 inch = 5,150 feet)



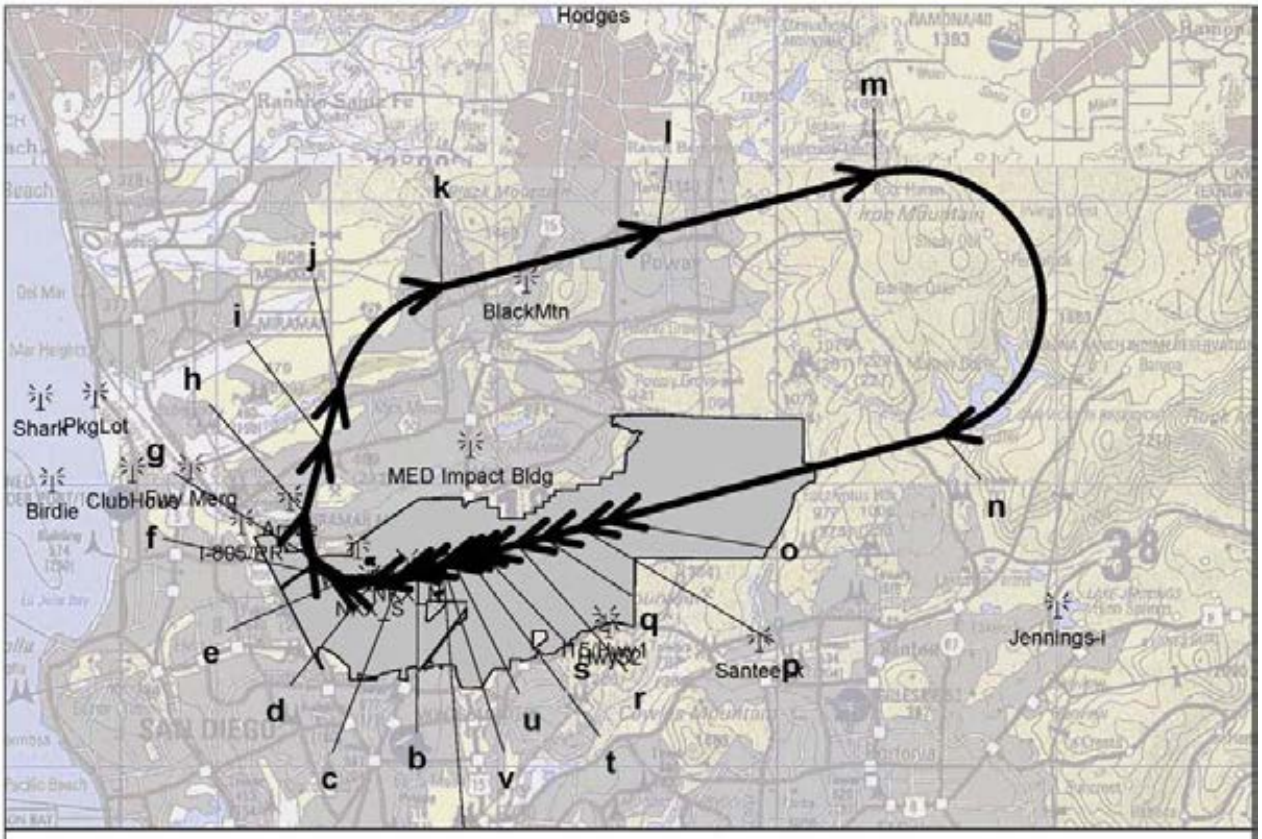
Flight Profile 519

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start.
b	148	30 AGL	45	0	-6	0	60	
c	445	150 AGL	65	0	0	0	60	
d	1,188	450 AGL	110	0	3	0	30	
e	2,375	800 AGL	135	0	10	0	0	
f	2,969	1,000 AGL	145	0	0	0	0	
g	4,750	1,000 AGL	170	0	7	25	0	begin turn to downwind
h	6,305	1,000 AGL	170	0	7	25	0	MOVE TO 1/3 turn - CHANGED from 150 to 170
i	7,860	1,000 AGL	170	0	7	25	0	MOVE TO 2/3 turn
j	9,462	1,000 AGL	170	0	7	0	0	begin downwind
k	10,784	750 AGL	140	0	3	0	0	begin descent
l	14,462	516 AGL	111	0	3	0	0	end downwind
m	14,712	500 AGL	110	0	0	25	60	
n	16,283	200 AGL	60	0	0	25	87	
o	17,854	150 AGL	50	0	0	25	90	
p	19,425	20 AGL	5	0	0	0	90	

Flight Profile 519
Based MV22B
on Runway 24S, Flight Track 4ST1 - LHD pattern; LH; 3000 ft abeam; 5000 ft downwind; 800 ft MSL

0 2,000 4,000 6,000 8,000 10,000 12,000

Scale in Feet 1:38,400 (1 inch = 3,200 feet)



Flight Profile 634

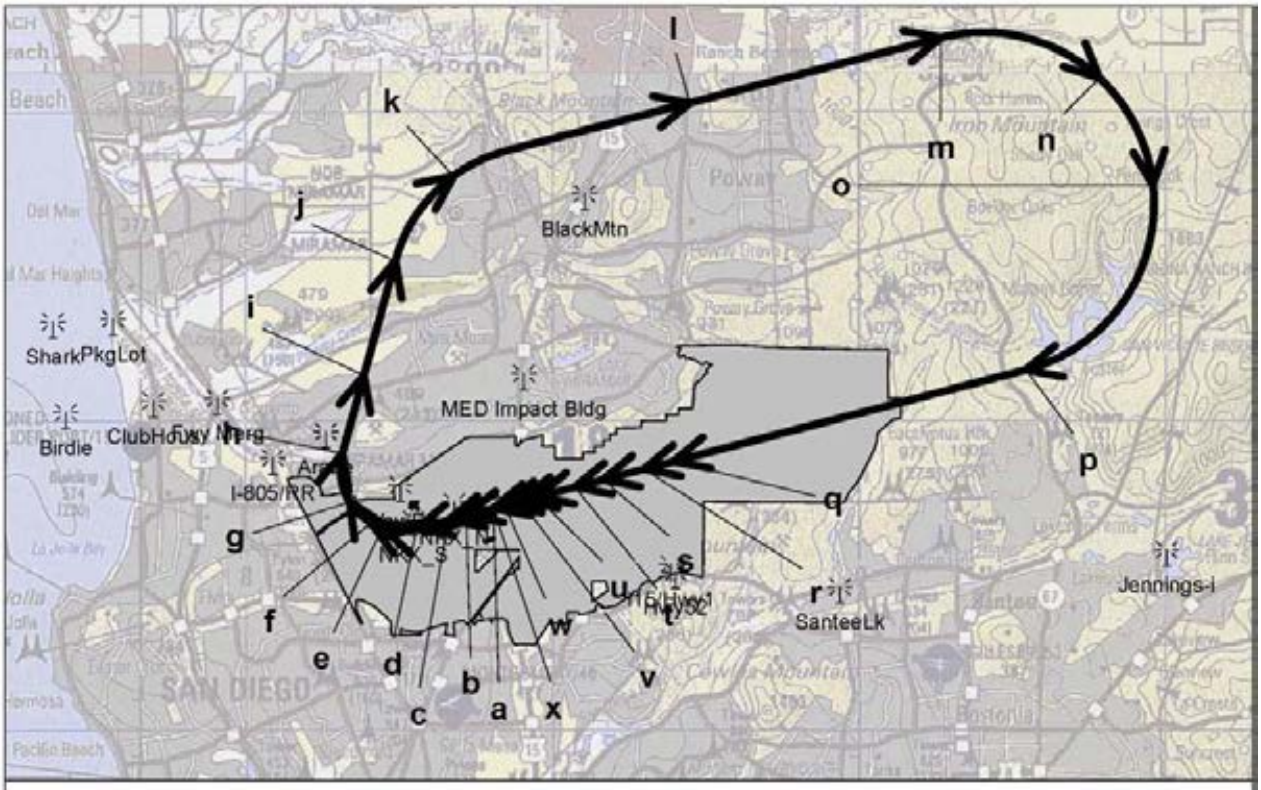
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,500	385 AGL	140	0	0	-25	60	begin turn to crosswind leg; interpolate
e	12,189	469 AGL	162	0	0	-25	11	
f	13,500	500 AGL	170	0	6	-25	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
g	16,700	872 AGL	170	0	6	-25	0	
h	22,114	2,000 MSL	170	0	6	0	0	increased distance by 400 ft; end of turn accel to 22
i	30,715	2,900 MSL	220	0	7	0	0	
j	37,287	3,500 MSL	220	0	7	-25	0	beg turn to downwind; interpolate
k	54,814	5,000 MSL	220	0	5	0	0	begin downwind- interpolate
l	81,062	5,000 MSL	220	0	5	0	0	~middle of downwind
m	107,314	5,000 MSL	220	0	-1	-25	0	end of downwind; begin 1100 fpm descent
n	156,417	2,500 MSL	220	0	-1	0	0	begin final
o	196,860	1,500 AGL	220	0	-1	0	0	continue 1800 fpm desc; 20kft out
p	200,200	1,200 AGL	170	0	-1	0	10	700 fpm desc; 16600 ft out
q	204,695	1,000 AGL	150	0	-1	0	20	1800 fpm desc; 2nm out
r	207,867	500 AGL	80	0	0	0	79	400 fpm desc; 3 deg gs; 9kft out
s	212,067	300 AGL	80	0	0	0	80	400 fpm desc; 3 deg gs; 4800 ft out
t	213,867	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs; 3kft out
u	215,667	145 AGL	50	0	5	0	90	300 fpm desc; 6deg gs; 1200 ft out
v	216,867	20 AGL	5	0	0	0	90	5 kt stop; end of track

Flight Profile 634
Based MV22B
on Runway 24R, Flight Track 4RG1 - FW GCA Box; 2.6nm abeam; 10nm final; 5000 ft MSL downwind

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:270,000 (1 inch = 22,500 feet)

N



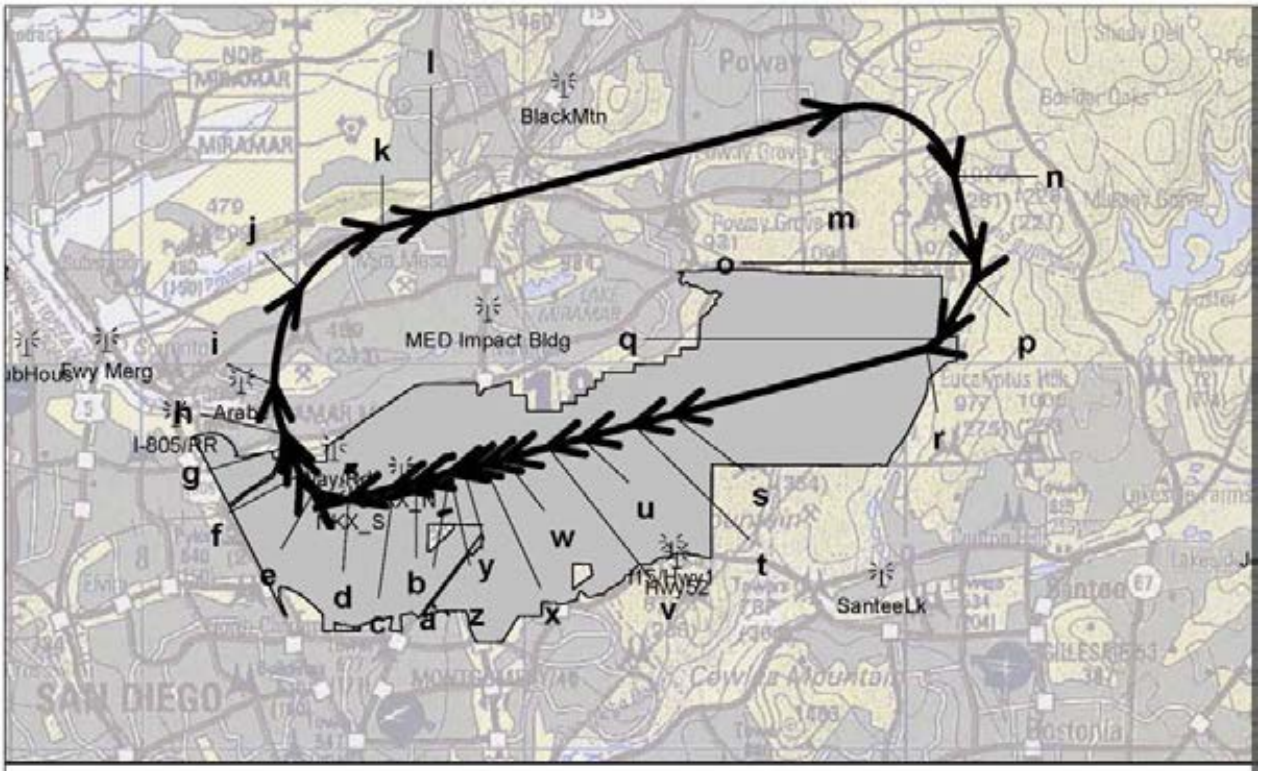
Flight Profile 635

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,500	385 AGL	140	0	0	-25	60	begin turn to crosswind leg; interpolate
e	12,189	469 AGL	162	0	0	-25	11	
f	13,500	500 AGL	170	0	6	-25	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
g	16,700	872 AGL	170	0	6	-25	0	
h	22,114	2,000 MSL	170	0	6	0	0	increased distance by 400 ft; end of turn accel to 22
i	30,715	2,900 MSL	220	0	7	0	0	
j	43,326	4,000 MSL	220	0	7	-25	0	beg turn to downwind; interpolate
k	54,500	5,000 MSL	220	0	5	0	0	begin downwind- interpolate
l	81,062	5,000 MSL	220	0	5	0	0	~middle of downwind
m	108,746	5,000 MSL	220	0	-1	-25	0	end of downwind; begin 1200 fpm desc
n	127,000	4,000 MSL	220	0	-1	-25	0	continue 1200 fpm descent
o	140,000	3,300 MSL	220	0	-1	-25	0	900 fpm descent
p	166,064	2,200 MSL	220	0	-1	0	0	end of turn; interpolated
q	205,000	1,500 AGL	220	0	-1	0	0	continue 1800 fpm desc; 20kft out
r	208,300	1,200 AGL	170	0	-1	0	10	700 fpm desc; 16600 ft out
s	212,800	1,000 AGL	150	0	-1	0	20	1800 fpm desc; 2nm out
t	215,900	500 AGL	80	0	0	0	79	400 fpm desc; 3 deg gs; 9kft out
u	220,100	300 AGL	80	0	0	0	80	400 fpm desc; 3 deg gs; 4800 ft out
v	221,900	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs; 3kft out
w	223,700	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs; 1200 ft out
x	224,939	20 AGL	5	0	0	0	90	5 kt stop; end of track

Flight Profile 635
Based MV22B
on Runway 24R, Flight Track 4RG2 - FW GCA Box; 3nm abeam; 10nm final; 5000 ft MSL downwind

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:246,000 (1 inch = 20,500 feet)



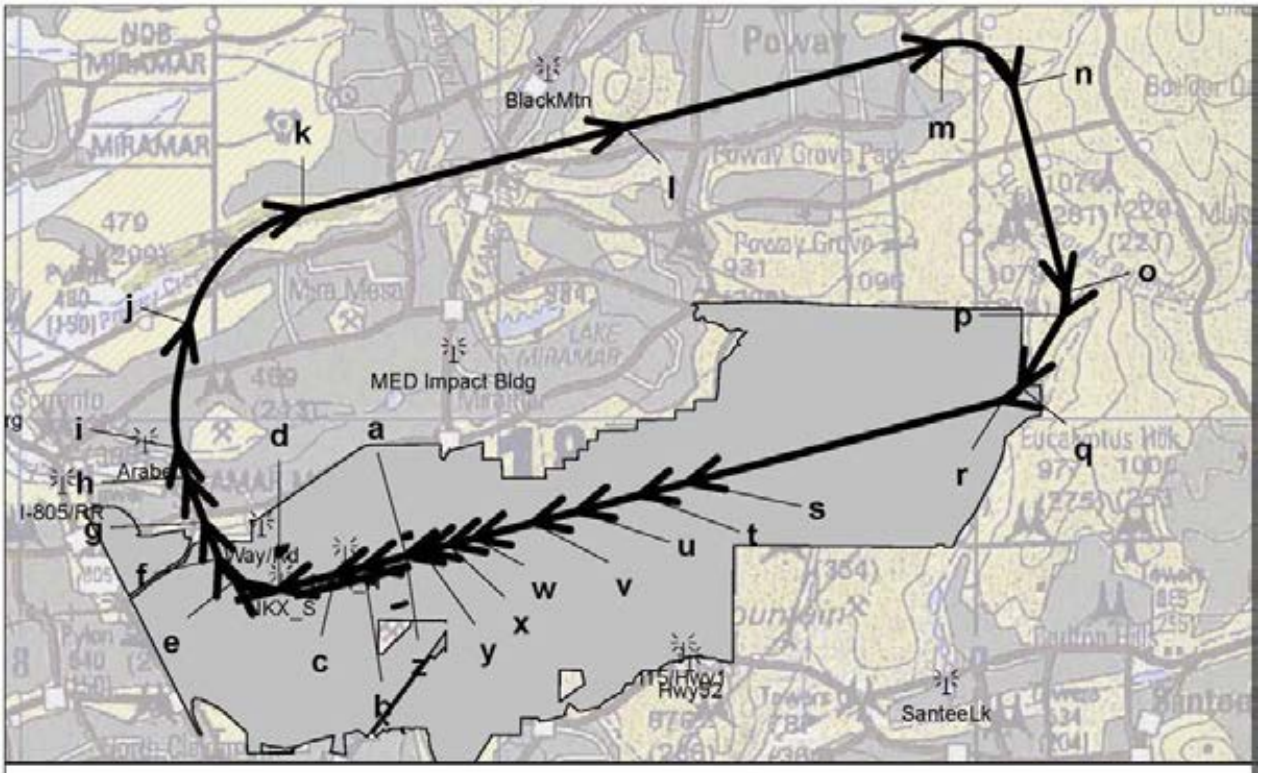
Flight Profile 523

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	9,000	385 AGL	140	0	0	-25	60	begin turn to crosswind leg; interpolate; increased d
e	12,189	469 AGL	162	0	0	-25	11	
f	14,070	500 AGL	170	0	6	0	0	increased distance by 500 ft; 2000 fpm climb; +7de
g	16,700	1,300 MSL	170	0	6	0	0	
h	17,870	1,425 MSL	170	0	6	-25	0	beg initial turn to downwind; interpolated
i	22,114	1,939 MSL	170	0	6	-25	0	increased distance by 400 ft; end of turn accel to 22
j	30,715	2,800 MSL	220	0	7	-25	0	
k	39,686	3,600 MSL	220	0	7	0	0	begin downwind; interpolate
l	44,000	4,000 MSL	220	0	5	0	0	attain pattern altitude @ ~2000 fpm
m	80,386	4,000 MSL	220	0	-1	-25	0	end of downwind; begin ~1100 fpm desc;
n	92,952	3,400 MSL	220	0	-1	0	0	begin base leg; interpolated
o	100,582	3,050 MSL	220	0	-1	-15	0	interpolated; begin 1st dogleg in base leg
p	102,153	2,975 MSL	220	0	-1	0	0	interpolated; end 1st dogleg in base leg
q	107,903	2,700 MSL	220	0	-1	-15	0	interpolated; begin 2nd dogleg in base leg
r	109,395	2,630 MSL	220	0	-1	0	0	interpolated; end 2nd dogleg in base leg -- begin fin
s	132,000	1,500 AGL	220	0	-1	0	0	continue 1800 fpm desc; 20kft out
t	135,400	1,200 AGL	170	0	-1	0	10	700 fpm desc; 16600 ft out
u	140,000	1,000 AGL	150	0	-1	0	20	1800 fpm desc; 2nm out
v	143,000	500 AGL	80	0	0	0	79	400 fpm desc; 3 deg gs; 9kft out
w	146,900	300 AGL	80	0	0	0	80	400 fpm desc; 3 deg gs; 4800 ft out
x	148,700	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs; 3kft out
y	150,500	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs; 1200 ft out
z	151,720	20 AGL	5	0	0	0	90	5 kt stop; end of track

Flight Profile 523
Based MV22B
on Runway 24R, Flight Track 4RG4 - RW GCA Box; 3.5 nm abeam; 7nm final

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:198,000 (1 inch = 16,500 feet)



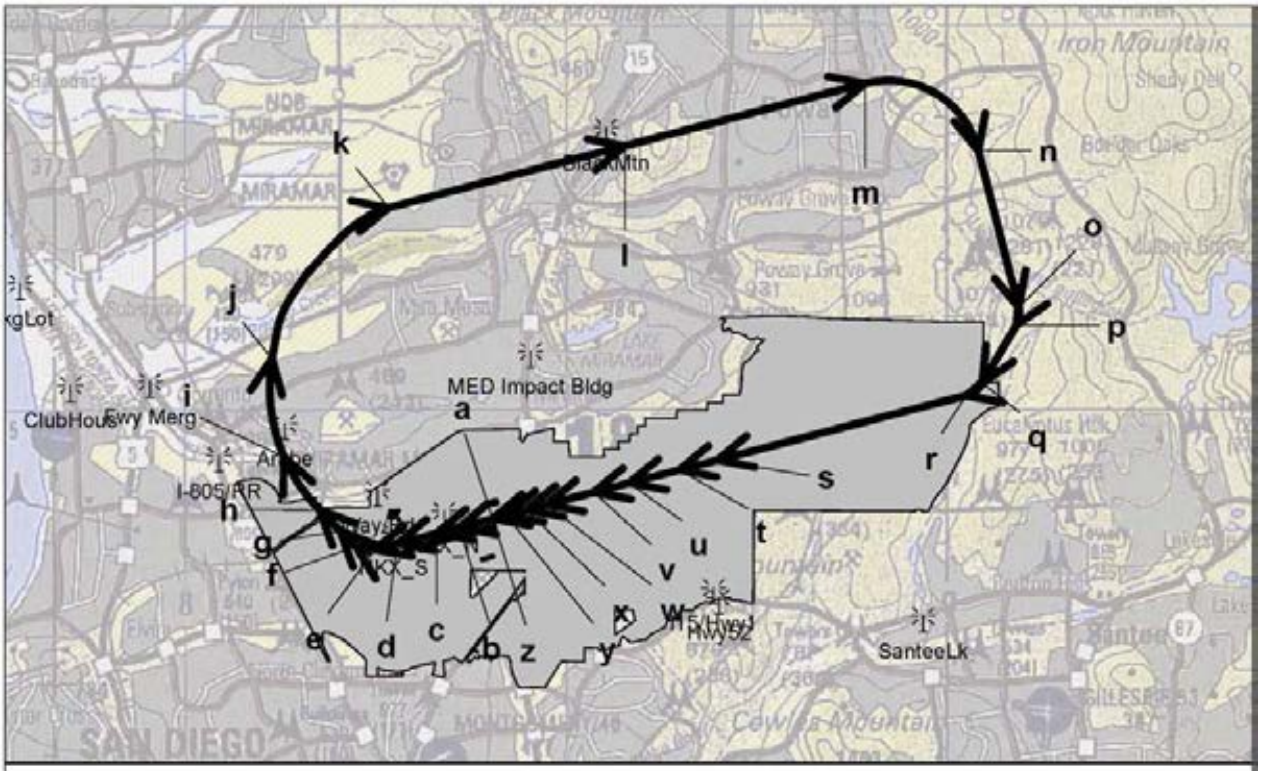
Flight Profile 524

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	9,000	385 AGL	140	0	0	-25	60	begin turn to crosswind leg; interpolate; increased d
e	12,189	469 AGL	162	0	0	-25	11	
f	14,070	1,100 MSL	170	0	6	0	0	increased distance by 500 ft; 2000 fpm climb; +7de
g	16,700	1,400 MSL	170	0	6	0	0	
h	20,000	1,775 MSL	170	0	6	-25	0	begin initial turn to downwind; interpolated
i	22,114	2,000 MSL	170	0	6	-25	0	increased distance by 400 ft; end of turn accel to 22
j	30,715	2,900 MSL	220	0	7	-25	0	
k	42,208	4,000 MSL	220	0	5	0	0	begin downwind; interpolate
l	65,000	4,000 MSL	220	0	5	0	0	~middle of downwind;
m	87,529	4,000 MSL	220	0	-1	-25	0	end of downwind; begin 1100 fpm desc;
n	93,813	3,700 MSL	220	0	-1	0	0	begin base leg; interpolated
o	108,337	3,000 MSL	220	0	-1	-15	0	interpolated; begin 1st dogleg in base leg
p	109,907	2,925 MSL	220	0	-1	0	0	interpolated; end 1st dogleg in base leg
q	115,657	2,650 MSL	220	0	-1	-15	0	interpolated; begin 2nd dogleg in base leg
r	117,228	2,575 MSL	220	0	-1	0	0	interpolated; end 2nd dogleg in base leg -- begin fin
s	139,555	1,500 AGL	220	0	-1	0	0	continue 1800 fpm desc; 20kft out
t	142,955	1,200 AGL	170	0	-1	0	10	700 fpm desc; 16600 ft out
u	147,400	1,000 AGL	150	0	-1	0	20	1800 fpm desc; 2nm out
v	150,555	500 AGL	80	0	0	0	79	400 fpm desc; 3 deg gs; 9kft out
w	154,755	300 AGL	80	0	0	0	80	400 fpm desc; 3 deg gs; 4800 ft out
x	156,555	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs; 3kft out
y	158,355	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs; 1200 ft out
z	159,555	20 AGL	5	0	0	0	90	5 kt stop; end of track

Flight Profile 524
Based MV22B
on Runway 24R, Flight Track 4RG5 - RW GCA Box; 4 nm abeam; 7nm final

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:158,000 (1 inch = 13,200 feet)



Flight Profile 525

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,500	385 AGL	140	0	0	0	60	
e	10,500	430 AGL	152	0	0	-25	33	begin turn to crosswind leg; interpolate
f	12,189	469 AGL	162	0	0	-25	11	
g	14,070	500 AGL	170	0	6	0	0	increased distance by 500 ft; 2000 fpm climb; +7de
h	16,594	1,300 MSL	170	0	6	-25	0	decreased distance by ~100 ft; begin initial turn to c
i	22,114	1,900 MSL	170	0	6	-25	0	increased distance by 400 ft; end of turn accel to 22
j	30,715	2,700 MSL	220	0	7	-25	0	
k	47,887	4,000 MSL	220	0	5	0	0	begin downwind; interpolate
l	68,900	4,000 MSL	220	0	5	0	0	~middle of downwind;
m	90,257	4,000 MSL	220	0	-1	-25	0	end of downwind; begin 1000 fpm desc;
n	102,823	3,450 MSL	220	0	-1	0	0	begin base leg; interpolated
o	116,723	2,850 MSL	220	0	-1	-15	0	interpolated; begin 1st dogleg in base leg
p	118,294	2,785 MSL	220	0	-1	0	0	interpolated; end 1st dogleg in base leg
q	124,044	2,535 MSL	220	0	-1	-15	0	interpolated; begin 2nd dogleg in base leg
r	125,850	2,460 MSL	220	0	-1	0	0	interpolated; end 2nd dogleg in base leg -- begin fin
s	147,970	1,500 AGL	220	0	-1	0	0	continue 1800 fpm desc; 20kft out
t	151,370	1,200 AGL	170	0	-1	0	10	700 fpm desc; 16600 ft out
u	155,820	1,000 AGL	150	0	-1	0	20	1800 fpm desc; 2nm out
v	158,970	500 AGL	80	0	0	0	79	400 fpm desc; 3 deg gs; 9kft out
w	163,170	300 AGL	80	0	0	0	80	400 fpm desc; 3 deg gs; 4800 ft out
x	164,970	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs; 3kft out
y	166,770	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs; 1200 ft out
z	167,970	20 AGL	5	0	0	0	90	5 kt stop; end of track

Flight Profile 525
Based MV22B
on Runway 24R, Flight Track 4RG6 - RW GCA Box; 4.6 nm abeam; 7nm final

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:198,000 (1 inch = 16,500 feet)

C-1.1.5 Modeled Run-Ups for MCAS Miramar

Existing Modeled Run-up Operations for MCAS Miramar

Aircraft Type (& engine designation)	Pad	Description	Magnetic Heading (degrees)	Power Setting	Duration (minutes)	Number of Engines	Annual Operations			
							Day	Eve	Night	Total
F-18A/C (F404-GE-400&402)	VMFAT101FL-Flight Line	Low Power	195	63% NC Variable	30	1	467	88	29	584
		Water Wash	195		10	1	33	7	0	40
		Low Power	105		30	2	469	88	29	586
	VMFA121FL-Flight Line	Low Power Check	195	63% NC Variable	30	1	142	26	11	179
		Water Wash	195		10	1	11	0	0	11
		Low Power	105		30	2	144	27	9	180
	VMFA225FL-Flight Line	Low Power Check	195	63% NC Variable	30	1	288	55	18	361
		Water Wash	195		10	1	11	0	0	11
		Low Power Check	105		30	2	144	27	9	180
	VMFA232FL-Flight Line	Low Power Check	195	63% NC Variable	30	1	142	15	4	161
		Water Wash	195		10	1	11	0	0	11
		Low Power Check	105		30	2	144	27	9	180
	VMFA314FL	Low Power Check	195	63% NC Variable	30	2	71	13	5	89
		Water Wash	195		10	1	11	0	0	11
		Water Wash	105		30	1	288	55	18	361
	RWY24R-Threshold	Preflight Run-up	240	80% NC Variable	0.5	2	17490	1974	296	19760
		High Power Check at Threshold	240	63% NC Variable	25	2	279	53	18	350
				80% NC Variable	10	2				
				94% NC Variable	3	2				
				95% NC Min A/B	3	2				
KC-130H&N&P (T56-A-15)	VMG352HP-High Power Runup Area	High Power	250	560 C TIT	10	4	34	6	2	42
				970 C TIT	45	4				
				820 C TIT	20	4				
		B&B Wash	250	560 C TIT	10	4	22	5	2	29
		Lower Power Check	250	600 C TIT	15	1	639	120	40	799
	RWY24R-Threshold	Preflight Run-up	240	840 C TIT Variable	2	4	663	51	7	721

(1) Run-ups modeled for a total of 87 F/A-18 aircraft
(2) Day = 7 am - 6:59 pm; Eve = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am

MV-22 Modeled Run-up Operations for MCAS Miramar

Modeled As Aircraft Type (& engine designation)	Pad	Description	Magnetic Heading (degrees)	Power Setting	Duration (minutes)	Number of Engines	Annual Operations			
							Day	Eve	Night	Total
CH-53E (T64-GE-416A)	HP6 - Hover Pad 6	Low Work (per full Sqn)	240	IGE Lite	7	1	10	4	0	14
	MV22FL - Hgr 4 Flight Line	In-Frame Engine Test	195	Gnd Idle	10	1	182	0	0	181.99
				Gnd Max	30	1				
				Gnd Max	30	1	5.2	0	2.8	8
				Gnd Idle	20	1	55	0	9.7	65
				Gnd Max	40	1				

(1) Run-ups modeled for a total of 87 F/A-18 aircraft
(2) Day = 7 am - 6:59 pm; Eve = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am

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C-1.2 NOISE MODELING DATA FOR MCAS CAMP PENDLETON AND MCB CAMP PENDLETON

C-1.2.1 Modeled Flight Operations for MCAS Camp Pendleton

Existing Modeled Annual Flight Operations for MCAS Camp Pendleton

Operation Type	Route Description	AH-1W				UH-1N				CH-46E				CH-53E				All			
		Day	Evening	Night	Total	Day	Evening	Night	Total	Day	Evening	Night	Total	Day	Evening	Night	Total	Day	Evening	Night	Total
Departure	Mass III	2,251	572	2	2,825	1,501	381	1	1,883	1,429	185	1	1,615	409	27	-	436	5,590	1,165	4	6,759
	Point Canyon	909	368	4	1,281	606	245	3	854	467	155	1	623	14	8	-	22	1,996	776	8	2,780
	Roblar/Basilone	1,082	422	3	1,507	721	281	1	1,003	991	160	-	1,151	42	5	-	47	2,836	868	4	3,708
	North Initial	43	-	-	43	29	-	-	29	29	-	-	29	-	-	-	-	101	-	-	101
	TALA	43	-	-	43	29	-	-	29	-	-	-	-	-	-	-	-	72	-	-	72
Arrival	Mass III	1,809	649	144	2,602	709	432	96	1,237	493	129	51	673	48	12	7	67	3,059	1,222	298	4,579
	Point Canyon	284	210	48	542	426	129	32	587	469	129	49	647	-	-	-	-	1,179	468	129	1,776
	Roblar/Basilone	248	193	48	489	426	140	32	598	469	122	51	642	4	5	7	16	1,147	460	138	1,745
	North Initial	1,135	701	160	1,996	756	467	107	1,330	1,036	299	119	1,454	385	23	13	421	3,312	1,490	399	5,201
	TALA	71	-	-	71	47	-	-	47	-	-	-	-	-	-	-	-	118	-	-	118
Pattern	Left Touch and Go	1,258	408	52	1,718	839	272	35	1,146	292	27	14	333	-	-	-	-	2,389	707	101	3,197
	Right Touch and Go	34,686	11,258	1,424	47,368	23,123	7,505	950	31,578	8,043	751	382	9,176	138	34	-	172	65,990	19,548	2,756	88,294
	GCA Box	2,538	848	140	3,526	1,692	566	94	2,352	1,124	469	59	1,652	65	33	5	103	5,419	1,916	298	7,633
Departure		4,328	1,362	9	5,699	2,886	907	5	3,798	2,916	500	2	3,418	465	40	-	505	10,595	2,809	16	13,420
Arrival		3,547	1,753	400	5,700	2,364	1,168	267	3,799	2,467	679	270	3,416	437	40	27	504	8,815	3,640	964	13,419
Pattern		38,482	12,514	1,616	52,612	25,654	8,343	1,079	35,076	9,459	1,247	455	11,161	203	67	5	275	73,798	22,171	3,155	99,124
TOTAL		**46,357**	**15,629**	**2,025**	**64,011**	**30,904**	**10,418**	**1,351**	**42,673**	**14,842**	**2,426**	**727**	**17,995**	**1,105**	**147**	**32**	**1,284**	**93,208**	**28,620**	**4,135**	**125,963**

Notes: (1) Day = 7 am - 6:59 pm; Evening = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am

Source: Wyle Laboratories, 1995 (WR 95-02, Table 4-1); MCAS Camp Pendleton, 2006 (2005 ATAR, McCoy emails)

C-1.2.2 Modeled Runway and Track Utilization for MCAS Camp Pendleton

AH-1W, UH-1N, CH-53E, and CH-46E Runway/Pad and Flight Track Utilization for Camp Pendleton Existing Conditions

Operation Type	RWY/PAD Util. by Op Type	RWY/PAD ID	Util. By RWY/PAD	Flight Track Description	Flight Track ID
Departure	4%	3	100%	Mass III	03DA
				Point Canyon	03DB
				Roblar/Basilone	03DC
	96%	21	100%	Mass III	21DA
				Point Canyon	21DB
				Roblar/Basilone	21DC
Arrival	2%	3	100%	Mass III	03AA
				Roblar/Basilone	03AB
	98%	21	100%	Mass III	21AA
				Roblar/Basilone	21AB
				North Initial	21AC
Touch & Go	4%	3	100%	Left Touch & Go	03PL
				Right Touch & Go	03PR
	96%	21	100%	Left Touch & Go	21PL
				Right Touch & Go	21PR
GCA	100%	21	100%	GCA Box	21G1

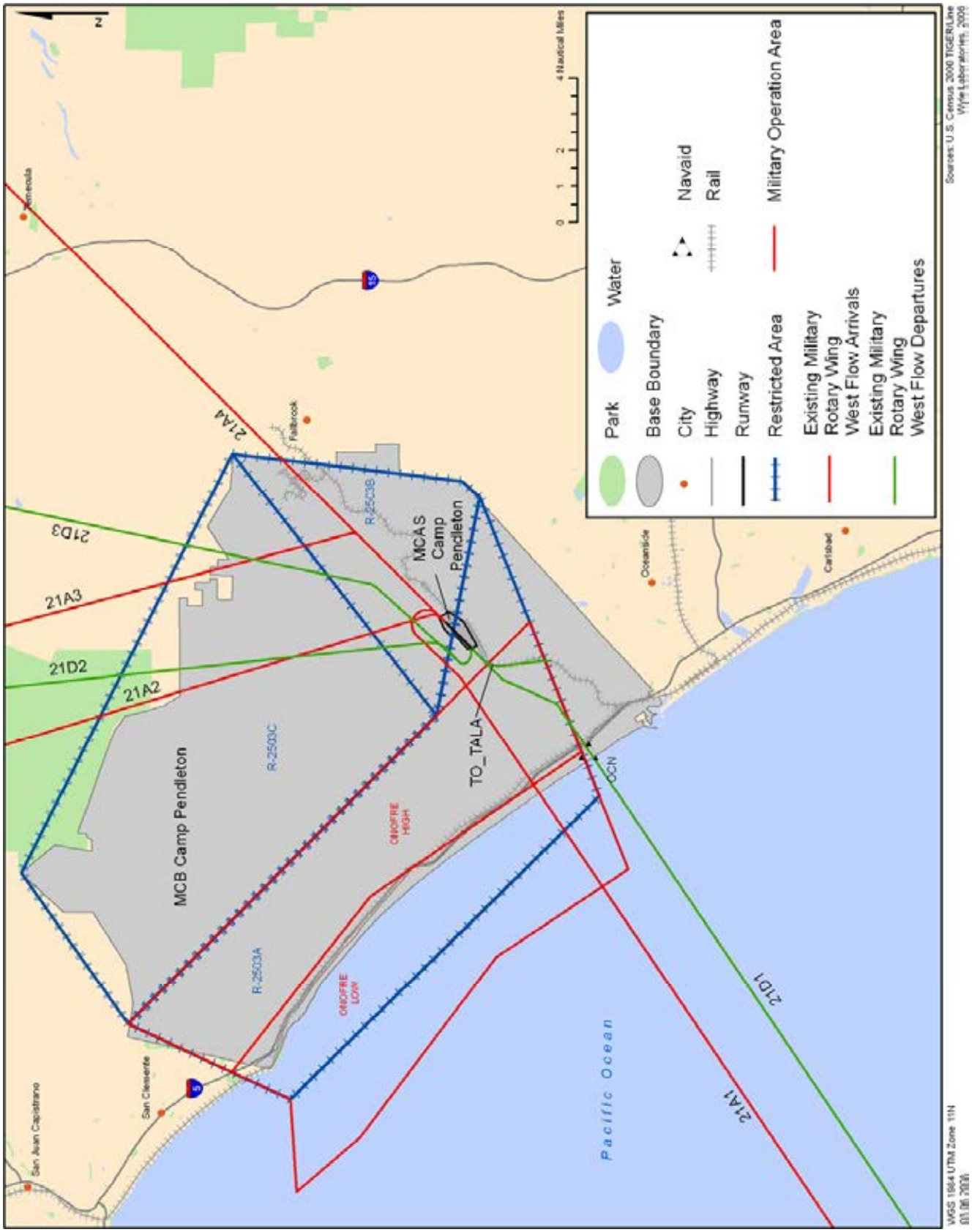
Source: WR95-02, Table 3-4

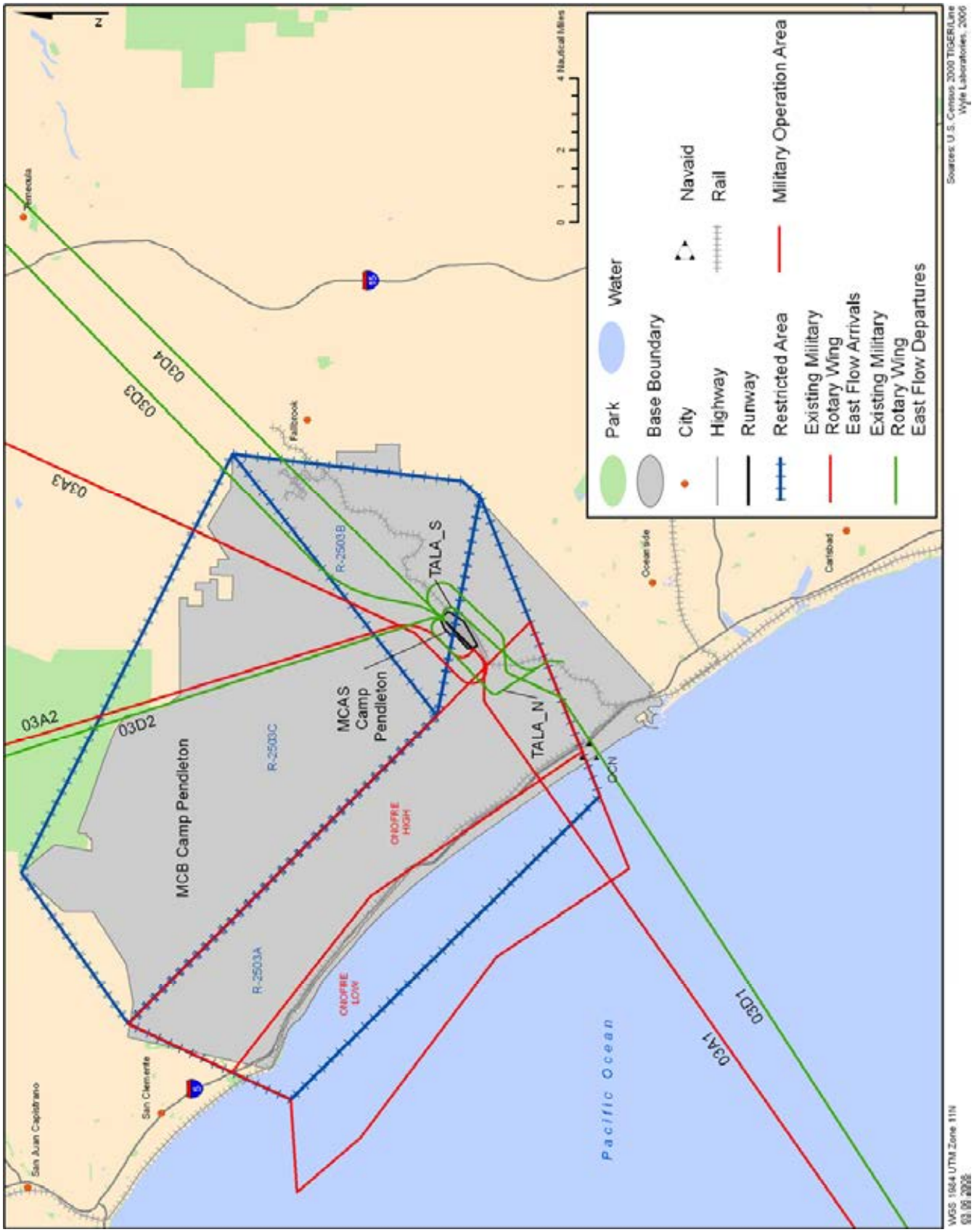
MV-22 Runway and Track Utilization at Camp Pendleton

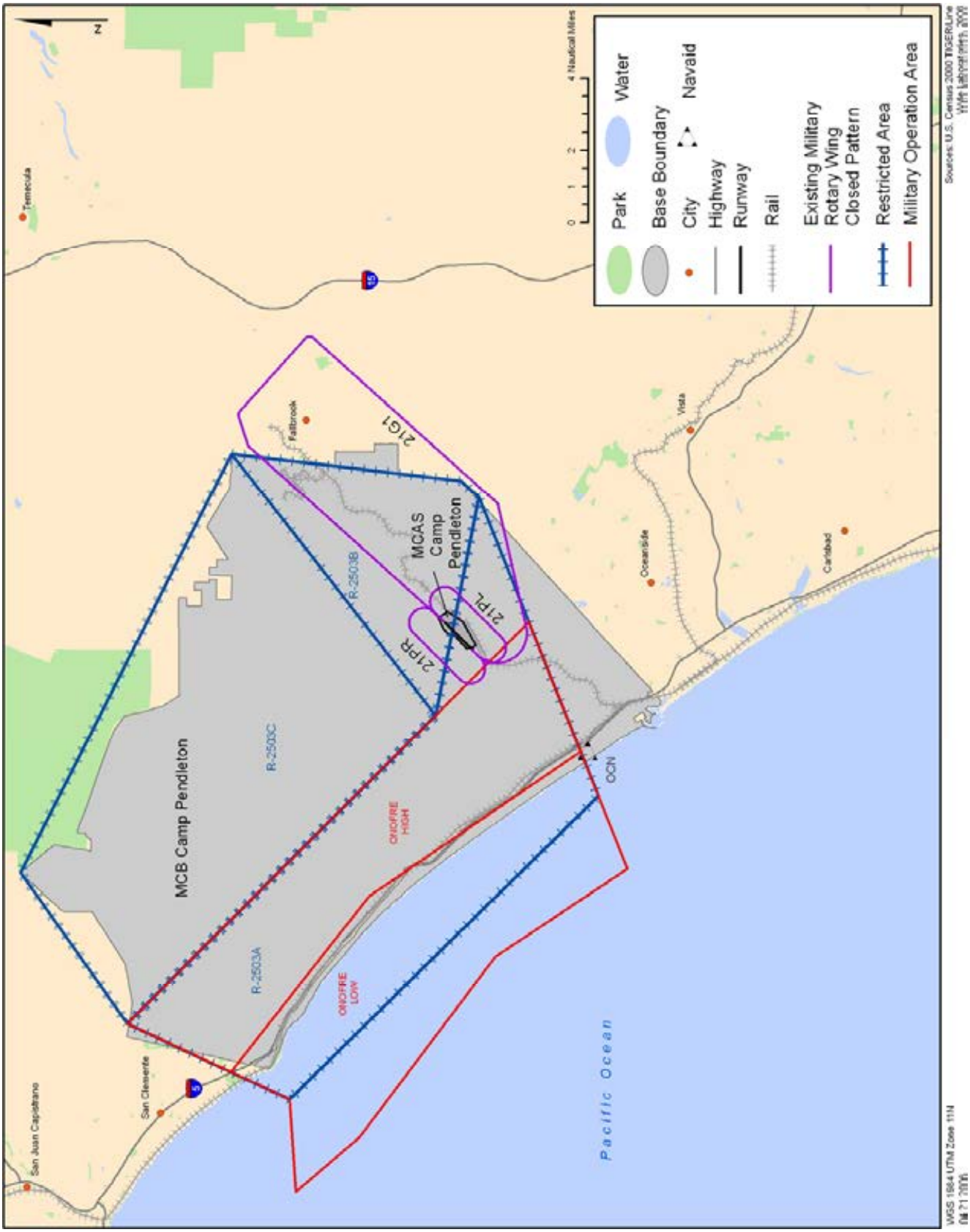
			Flight Track Utilization	
Noise Track Group	**Rwy / Pad**	**Rwy / Pad Split**	**Flight Track**	**Desc**
03D1/21D1	3	7%	03D1	Mass III/VORTAC departures
	21	93%	21D1	
03D2/21D2	3	7%	03D2	Roblar/Basilone/Intersection departures
	21	93%	21D2	
	3	7%	03D3	Point Canyon departures
	21	93%	21D3	
03D1/21D1/03D2/21D2	3	7%	03D1	Mass III/VORTAC departures
	3	7%	03D2	Roblar/Basilone/Intersection departures
	21	93%	21D1	Mass III/VORTAC departures
	21	93%	21D2	Roblar/Basilone/Intersection departures
03D3/03D4/21D3	3	7%	03D3	Point Canyon departures
	3	7%	03D4	North Initial departure
	21	93%	21D3	Point Canyon departures
03D4	3	100%	03D4	North Initial departure
03A1/21A1	3	7%	03A1	Mass III/LCAC arrivals
	21	93%	21A1	
03A2/21A2	3	7%	03A2	Roblar/Basilone/Intersection arrivals
	21	93%	21A2	
03A3/21A3	3	7%	03A3	Point Canyon arrivals
	21	93%	21A3	
03A3	3	100%	03A3	Point Canyon arrivals
VORTAC (a1)	3	7%	03A1	Mass III/LCAC arrivals
	21	93%	21A1	
Intersection (a2)	3	7%	03A2	Roblar/Basilone/Intersection arrivals
	21	93%	21A2	
Pt Canyon (a3)	3	7%	03A3	Point Canyon arrivals
	21	93%	21A3	
North Initial (a4)	21	100%	21A4	North Initial arrival
T&G	3	7%	03PL	Left Pattern
	3	7%	03PR	Right Pattern
	21	93%	21PL	Left Pattern
	21	93%	21PR	Right Pattern
FCLP				*at Pendleton's R-2503*
				at Pendleton's R-2503
GCA Box	21	100%	21G1	GCA-Small pattern

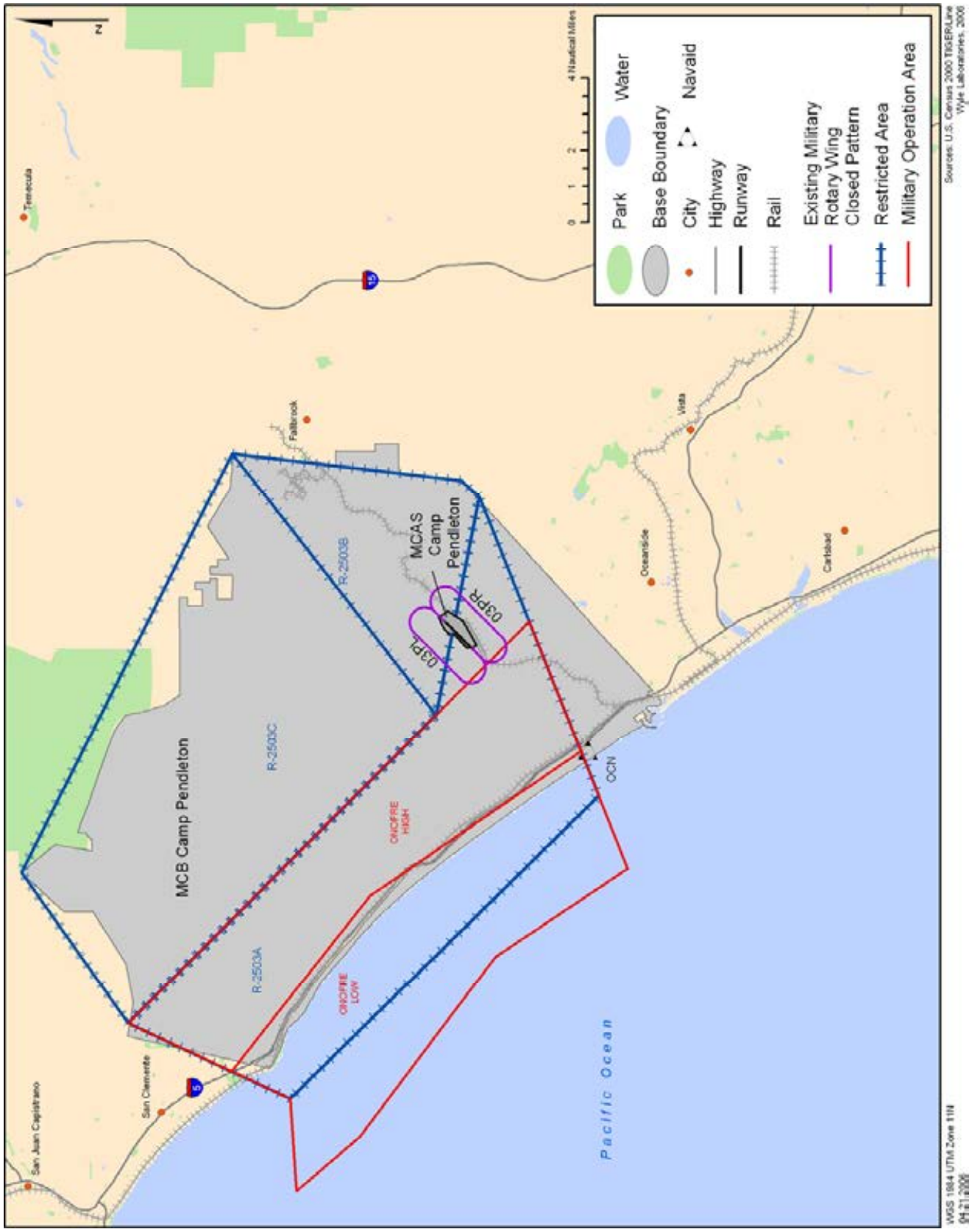
Note: (-) represents 100%

C-1.2.3 Modeled Flight Tracks for MCAS Camp Pendleton




Park
Water
Base Boundary
City
Navaid
Highway
Rail
Runway
Military Operation Area
Restricted Area
Existing Military Rotary Wing East Flow Arrivals
Existing Military Rotary Wing East Flow Departures
Sources: U.S. Census 2000 TIGER/Line
Wyle Laboratories, 2006
4 Nautical Miles
Temecula
Fallbrook
Oceanside
Carlsbad
San Clemente
San Juan Capistrano
MCB Camp Pendleton
MCAS Camp Pendleton
R-2503A
R-2503B
R-2503C
ONOFRE HIGH
ONOFRE LOW
TALA_S
TALA_N
DCN
Pacific Ocean
03A2
03D2
03A3
03D3
03D4
03A1
03D1
WGS 1984 UTM Zone 11N

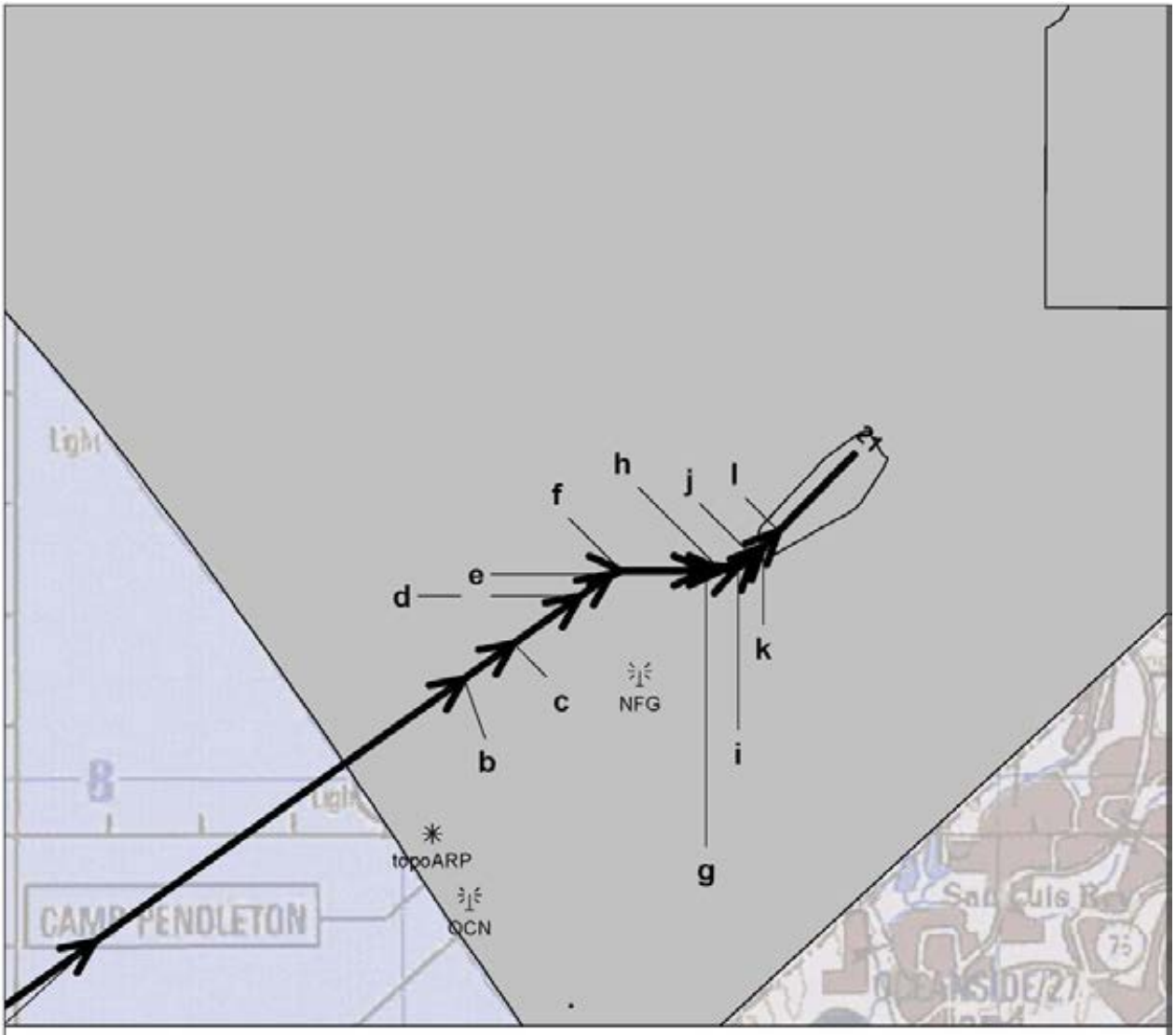

Park
Water
Base Boundary
City
Navaid
Highway
Runway
Rail
Existing Military
Rotary Wing
Closed Pattern
Restricted Area
Military Operation Area
0 1 2 4 Nautical Miles
N
Temecula
Fallbrook
Vista
Oceanside
Carlsbad
San Clemente
San Juan Capistrano
MCB Camp Pendleton
MCAS Camp Pendleton
R-2503A
R-2503B
R-2503C
21GT
21PL
21PR
ONOFRE LOW
ONOFRE HIGH
OCN
Pacific Ocean


Park
Water
Base Boundary
City
Navaid
Highway
Runway
Rail
Existing Military
Rotary Wing
Closed Pattern
Restricted Area
Military Operation Area
0 1 2 4 Nautical Miles
N
Temecula
Fallbrook
Vista
Oceanside
Carlsbad
San Clemente
San Juan Capistrano
MCB Camp Pendleton
MCAS Camp Pendleton
R-2503A
R-2503B
R-2503C
03PL
03PR
ONOFRE HIGH
ONOFRE LOW
OCN
Pacific Ocean
Sources: U.S. Census 2000 TIGER/Line
Wyle Laboratories, 2006
WGS 1984 UTM Zone 11N
04 21 2006

C-1.2.4 Modeled MV-22 Flight Profiles for MCAS Camp Pendleton

The flight profile information on the following pages is shown in tabular fashion, captioned on each map. The columns of the flight profile data tables are described below:

Column Heading	Description
Point	Sequence letter along flight track denoting change in flight parameters
Distance (feet)	Distance along flight track from runway threshold in feet
Height (feet)	Altitude of aircraft in feet Above Ground Level (AGL) or relative to Mean Sea Level (MSL)
Power (Appropriate Unit)* Speed (kts)	Engine power setting and Drag Configuration/Interpolation Code (defines sets of interpolation code in NOISEMAP (F for FIXED, P for PARALLEL, V for VARIABLE)) Indicated airspeed of aircraft in knots
Yaw Angle (degrees)**	Angle of the aircraft relative to its vertical axis in degrees; positive nose left
Angle of Attack (degrees)**	Angle of the aircraft, not of the wing; angle between the climb angle and the pitch angle, in degrees, positive nose up. The climb angle is the angle between the horizontal and the velocity vector (same convention). The pitch angle is the angle between the horizontal and the thrust vector (same convention)
Roll Angle (degrees)**	Angle of the aircraft relative to its longitudinal axis in degrees; positive left side down.
Nacelle Angle (degrees)***	Angle of engine nacelle pylon relative to the horizontal (airplane) mode; positive up; maximum of 90



Flight Profile V22_1

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	45,000	3,250 AGL	220	0	5	0	0	+5deg AoA for level cruse@ 220kts
b	20,007	1,500 AGL	170	0	-1	0	0	begin 1800fpm descent
c	16,667	1,200 AGL	150	0	-1	0	10	700 fpm desc
d	12,172	1,000 AGL	80	0	-1	0	20	1800 fpm desc
e	10,074	670 AGL	80	0	0	-15	59	Interpolated; begin turn
f	9,463	600 AGL	80	0	0	0	79	Shifted forward 500 ft; Adjusted Altitude up 100 ft;
g	4,800	300 AGL	60	0	0	0	80	400 fpm desc; 3deg gs
h	3,963	250 AGL	60	0	0	15	83	interpolated; begin turn
i	3,000	200 AGL	60	0	-1	15	87	200 fpm desc; 2deg gs
j	2,000	170 AGL	55	0	5	15	90	Interpolated; end turn
k	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
l	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22_1
Based MV22B
on Runway 03, Flight Track 03A1 - Mass III/LCAC arrivals

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:118,000 (1 inch = 9,870 feet)

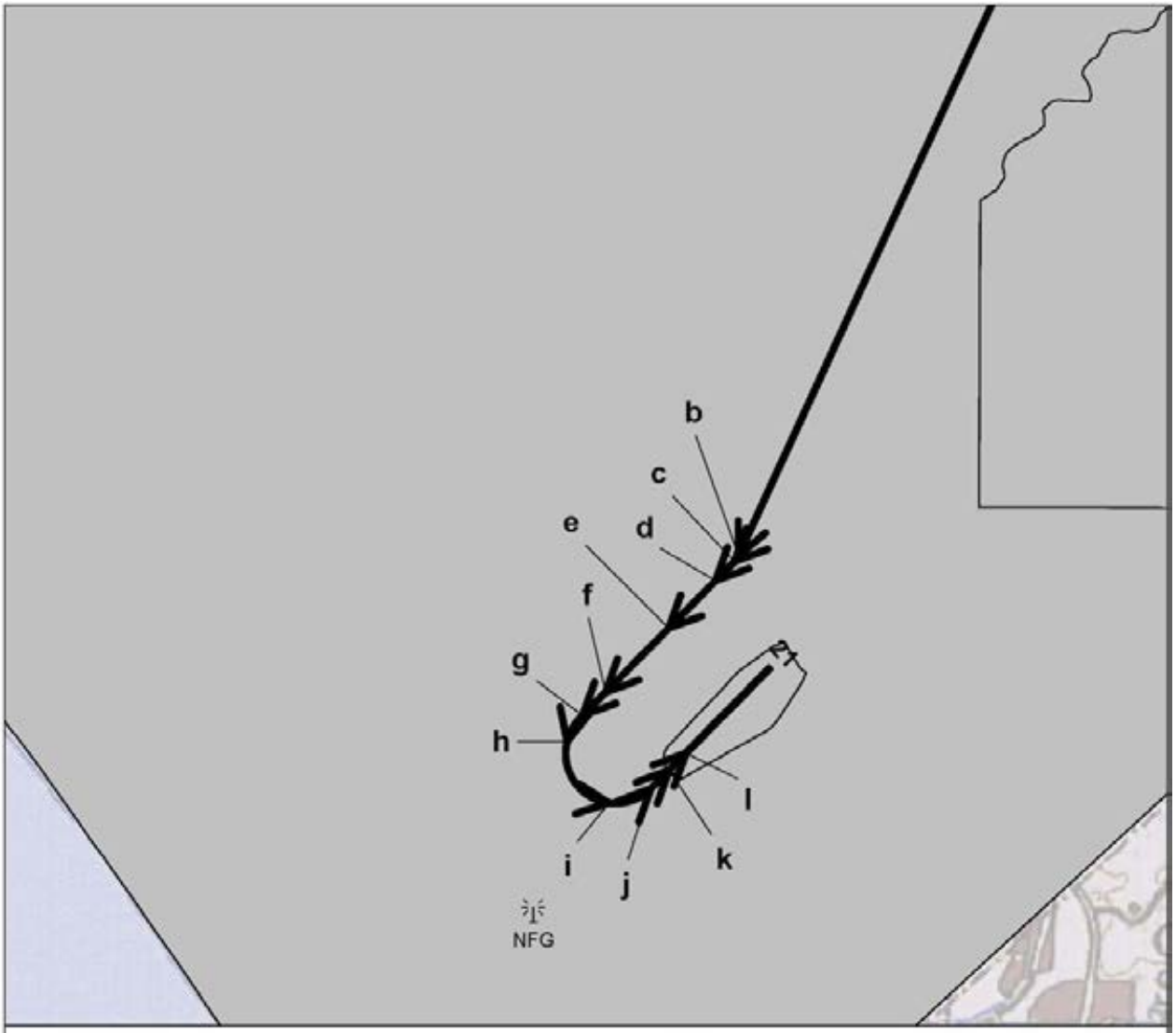
Flight Profile V22_2

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	70,000	5,000 AGL	220	0	5	0	0	+5deg AoA for level cruse@ 220kts
b	20,007	1,500 AGL	170	0	-1	0	0	begin 1800fpm descent
c	16,583	1,200 AGL	150	0	-1	-15	10	Shifted forward 100 ft; 700 fpm desc; begin turn
d	12,172	1,000 AGL	80	0	-1	-15	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	-15	79	400 fpm desc; 3deg gs
f	7,671	440 AGL	75	0	0	0	79	Interpolated; 3 deg gs; end turn
g	4,427	300 AGL	60	0	0	25	80	Shifted forwars 400 ft; 400 fpm desc; 3deg gs; begi
h	3,000	200 AGL	60	0	-1	25	87	200 fpm desc; 2deg gs
i	692	100 AGL	40	0	5	25	90	Shifted forward 500 ft; end turn; 300 fpm desc; 6de
j	588	84 AGL	28	0	0	25	90	Interpolated; 6 deg gs; begin turn
k	50	25 AGL	7	0	0	25	90	Interpolated; 6 deg gs; end turn
l	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22_2
Based MV22B
on Runway 03, Flight Track 03A2 - Roblar/Basilone/Intersection arrivals

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:96,700 (1 inch = 8,060 feet)



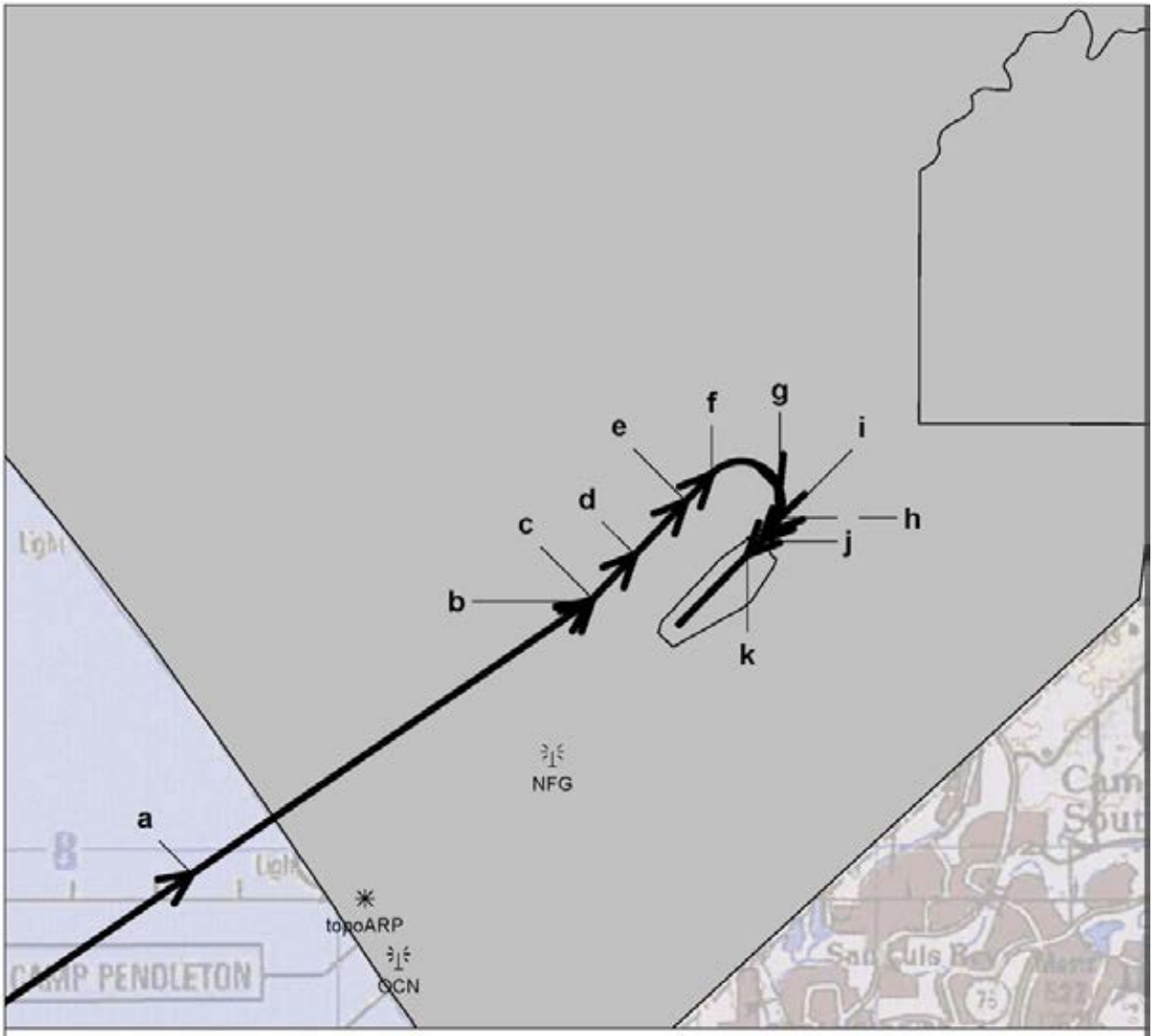
Flight Profile V22_3

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	70,000	5,000 AGL	220	0	5	0	0	+5deg AoA for level cruse@ 220kts
b	21,703	1,704 AGL	170	0	-1	-15	0	
c	21,354	1,662 AGL	170	0	-1	-15	0	Interpolated; end turn
d	20,007	1,500 AGL	170	0	-1	0	0	begin 1800fpm descent
e	16,667	1,200 AGL	150	0	-1	0	10	700 fpm desc
f	12,172	1,000 AGL	80	0	-1	0	20	1800 fpm desc
g	10,534	700 AGL	80	0	0	25	78	Interpolated; begin turn
h	9,000	500 AGL	80	0	0	25	79	400 fpm desc; 3deg gs
i	4,800	300 AGL	60	0	0	25	80	400 fpm desc; 3deg gs
j	2,500	200 AGL	60	0	-1	25	87	Shifted forward 500 ft; 200 fpm desc; 2deg gs; end
k	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
l	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22_3
Based MV22B
on Runway 03, Flight Track 03A3 - Point Canyon arrivals

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:108,000 (1 inch = 8,970 feet)

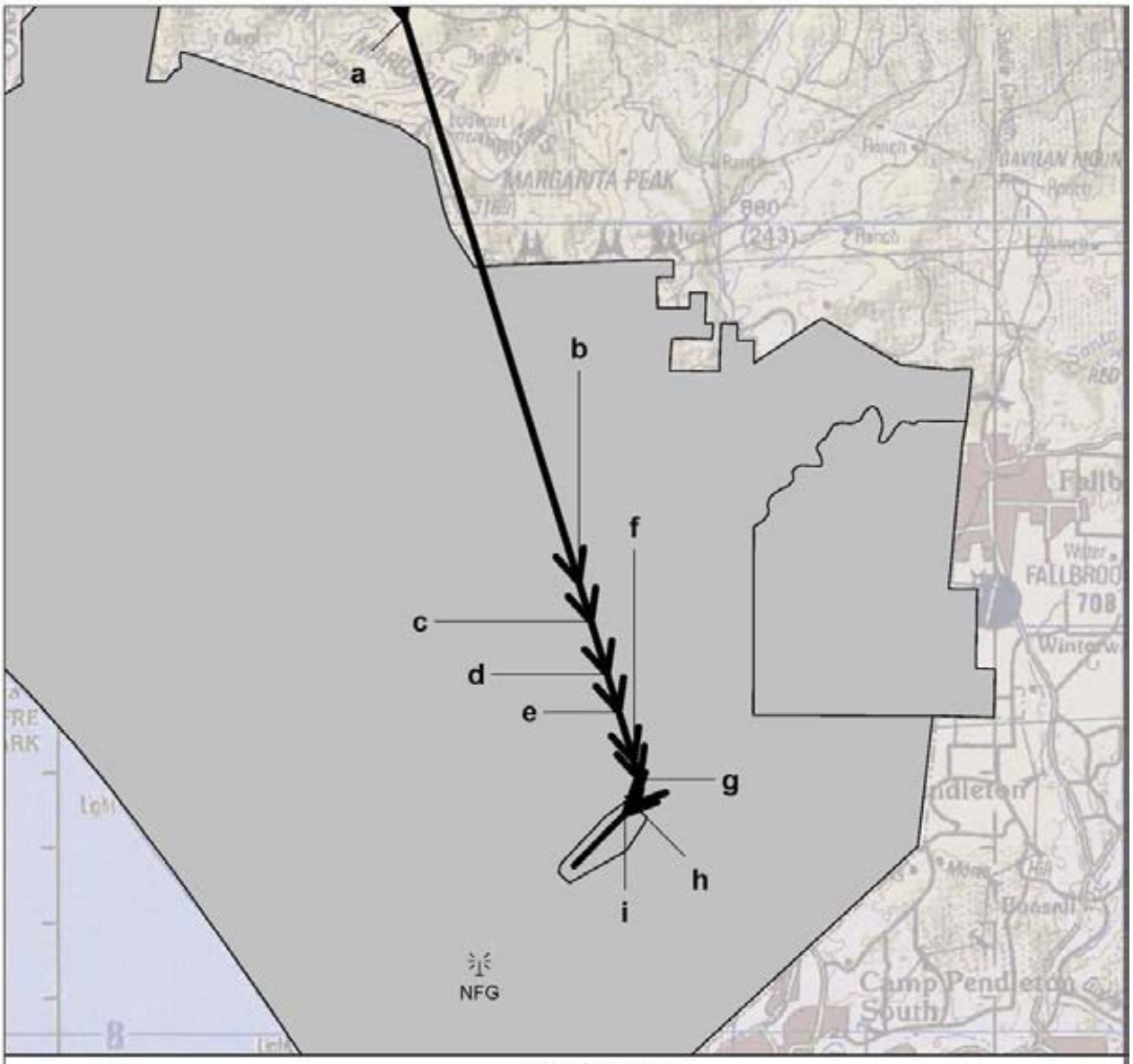


Flight Profile V22_4

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	1,500 AGL	220	0	5	0	0	+5deg AoA for level cruse@ 220kts
b	20,607	1,500 AGL	170	0	-1	0	0	Interpolated
c	20,398	1,500 AGL	170	0	-1	0	0	Shifted 300 ft; end turn; begin 1800fpm descent
d	16,667	1,200 AGL	150	0	-1	0	10	700 fpm desc
e	12,172	1,000 AGL	80	0	-1	0	20	1800 fpm desc
f	9,898	785 AGL	73	0	0	-25	40	Interpolated; 400 fpm desc; 3deg gs; begin turn
g	4,800	300 AGL	60	0	0	-25	80	400 fpm desc; 3deg gs
h	3,000	200 AGL	60	0	-1	-25	87	200 fpm desc; 2deg gs
i	2,000	172 AGL	55	0	-1	-25	88	Interpolated; 2 deg gs; end turn
j	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
k	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22_4
Based MV22B
on Runway 21, Flight Track 21A1 - Mass III/LCAC arrivals

Scale in Feet 1:129,000 (1 inch = 10,700 feet)



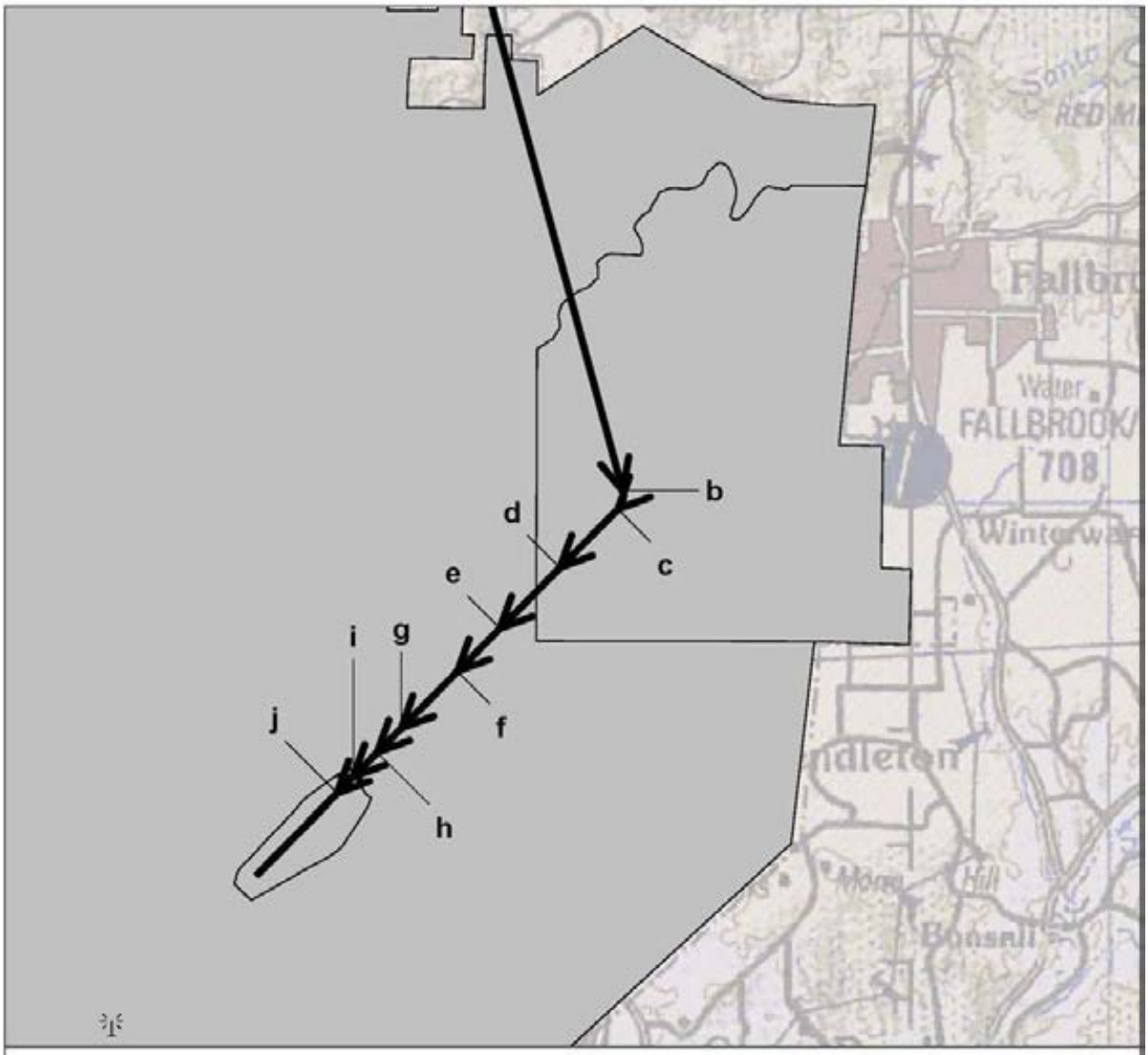
Flight Profile V22_5

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	68,000	5,000 AGL	220	0	5	0	0	+5deg AoA for level cruse@ 220kts
b	20,007	1,500 AGL	170	0	-1	0	0	begin 1800fpm descent
c	16,667	1,200 AGL	150	0	-1	0	10	700 fpm desc
d	12,172	1,000 AGL	80	0	-1	0	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
f	4,800	300 AGL	60	0	0	0	80	400 fpm desc; 3deg gs
g	3,200	200 AGL	60	0	-1	-25	87	shifted back 200 ft; 200 fpm desc; 2deg gs; begin tu
h	1,036	150 AGL	50	0	5	-25	90	Shifted forward 200 ft; 300 fpm desc; 6deg gs; end
i	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22_5
Based MV22B
on Runway 21, Flight Track 21A2 - Roblar/Basilone/Intersection arrivals

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:169,000 (1 inch = 14,100 feet)



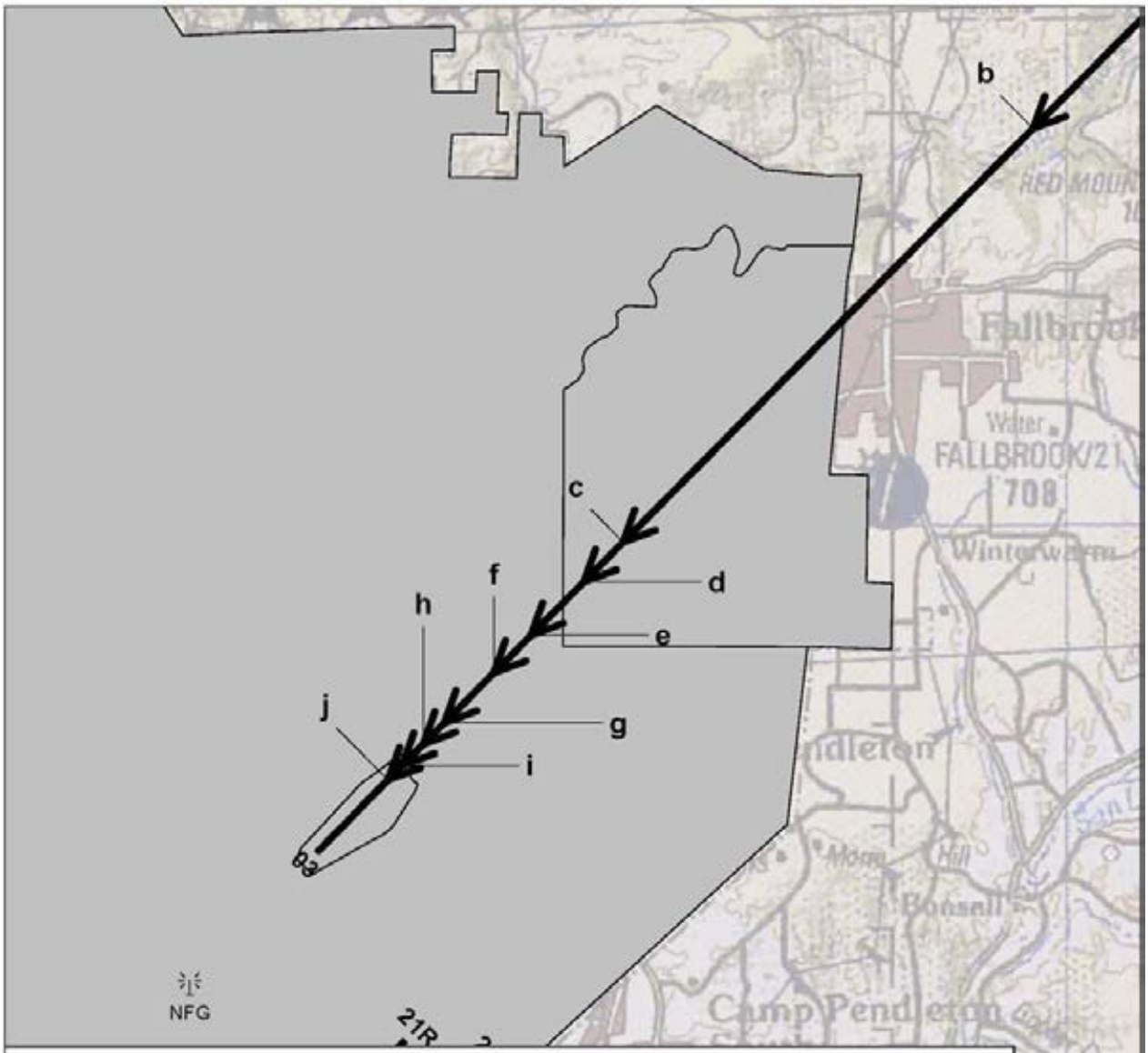
Flight Profile V22_6

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	70,000	5,000 AGL	220	0	5	0	0	+5deg AoA for level cruse@ 220kts
b	22,047	1,662 AGL	170	0	-1	-15	0	Interpolated; begin turn
c	21,000	1,500 AGL	170	0	-1	0	0	Shifted 900; end turn; begin 1800fpm descent
d	16,667	1,200 AGL	150	0	-1	0	10	700 fpm desc
e	12,172	1,000 AGL	80	0	-1	0	20	1800 fpm desc
f	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
g	4,800	300 AGL	60	0	0	0	80	400 fpm desc; 3deg gs
h	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
i	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
j	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22_6
Based MV22B
on Runway 21, Flight Track 21A3 - Point Canyon arrivals

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:111,000 (1 inch = 9,210 feet)



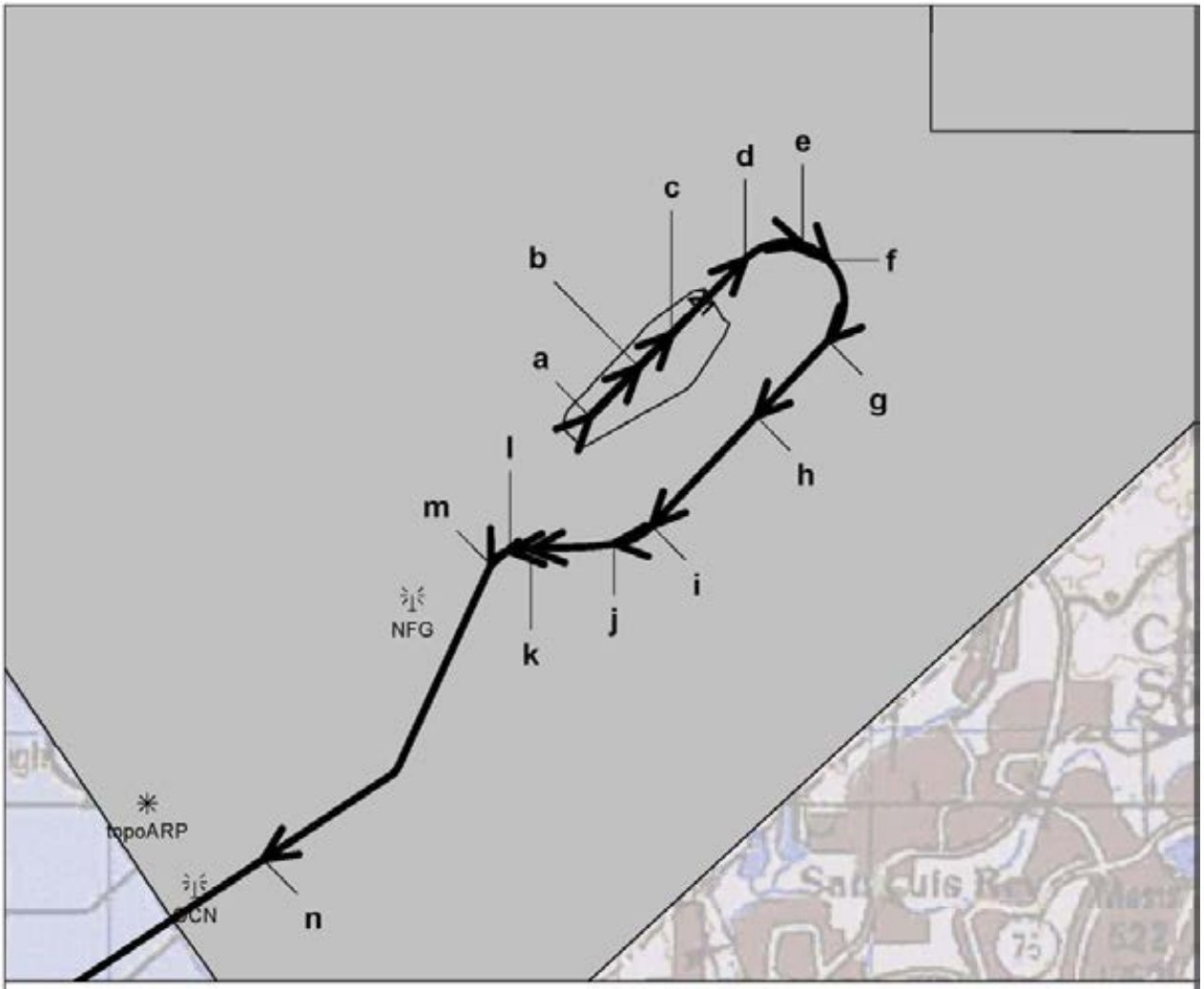
Flight Profile V22_7

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	70,000	5,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	54,840	4,314 AGL	170	0	-1	0	0	
c	20,007	1,500 AGL	170	0	-1	0	0	begin 1800 fpm desc;
d	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
e	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
f	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
g	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
h	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
i	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
j	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22_7
Based MV22B
on Runway 21, Flight Track 21A4 - North Initial arrival

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:126,000 (1 inch = 10,500 feet)



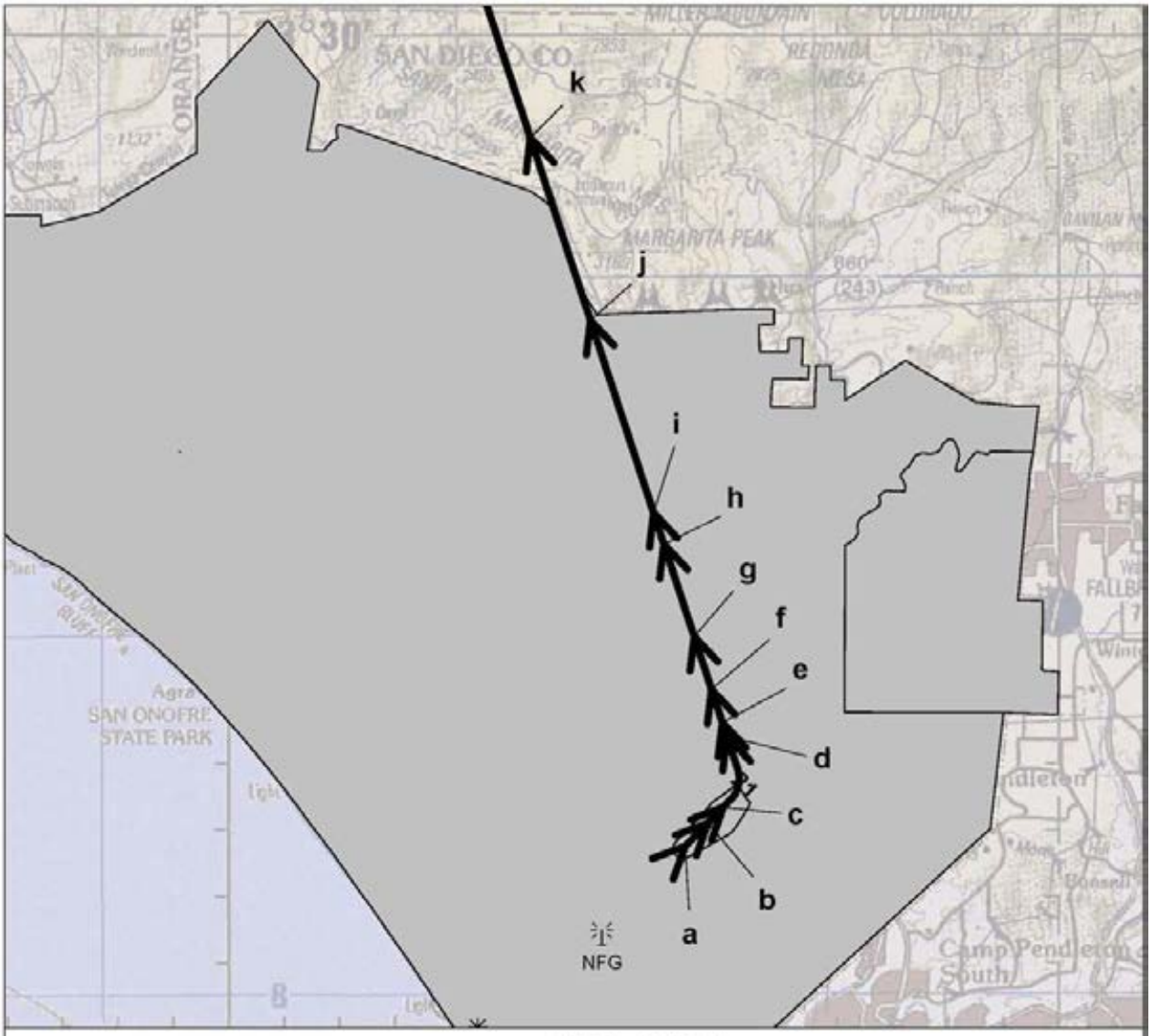
Flight Profile V22_10

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	9,500	430 AGL	150	0	0	-25	25	interpolated; begin turn
e	12,189	469 AGL	162	0	0	-25	11	
f	13,500	500 AGL	170	0	6	-25	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
g	17,310	872 AGL	170	0	6	0	0	increased distance by 600 ft; end turn
h	21,800	1,464 AGL	170	0	6	0	0	
i	28,310	2,250 AGL	170	0	6	-15	0	interpolated; begin turn
j	30,143	2,500 AGL	170	0	6	0	0	decreased distance by 600 ft; end turn
k	33,753	2,850 AGL	170	0	6	0	0	
l	34,643	3,000 AGL	170	0	6	15	0	interpolated; begin turn
m	35,708	3,100 AGL	170	0	6	0	0	interpolated; end turn
n	52,335	5,000 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
o	75,000	5,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile V22_10
Based MV22B
on Runway 03, Flight Track 03D1 - Mass III/VORTAC departures

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:94,800 (1 inch = 7,900 feet)



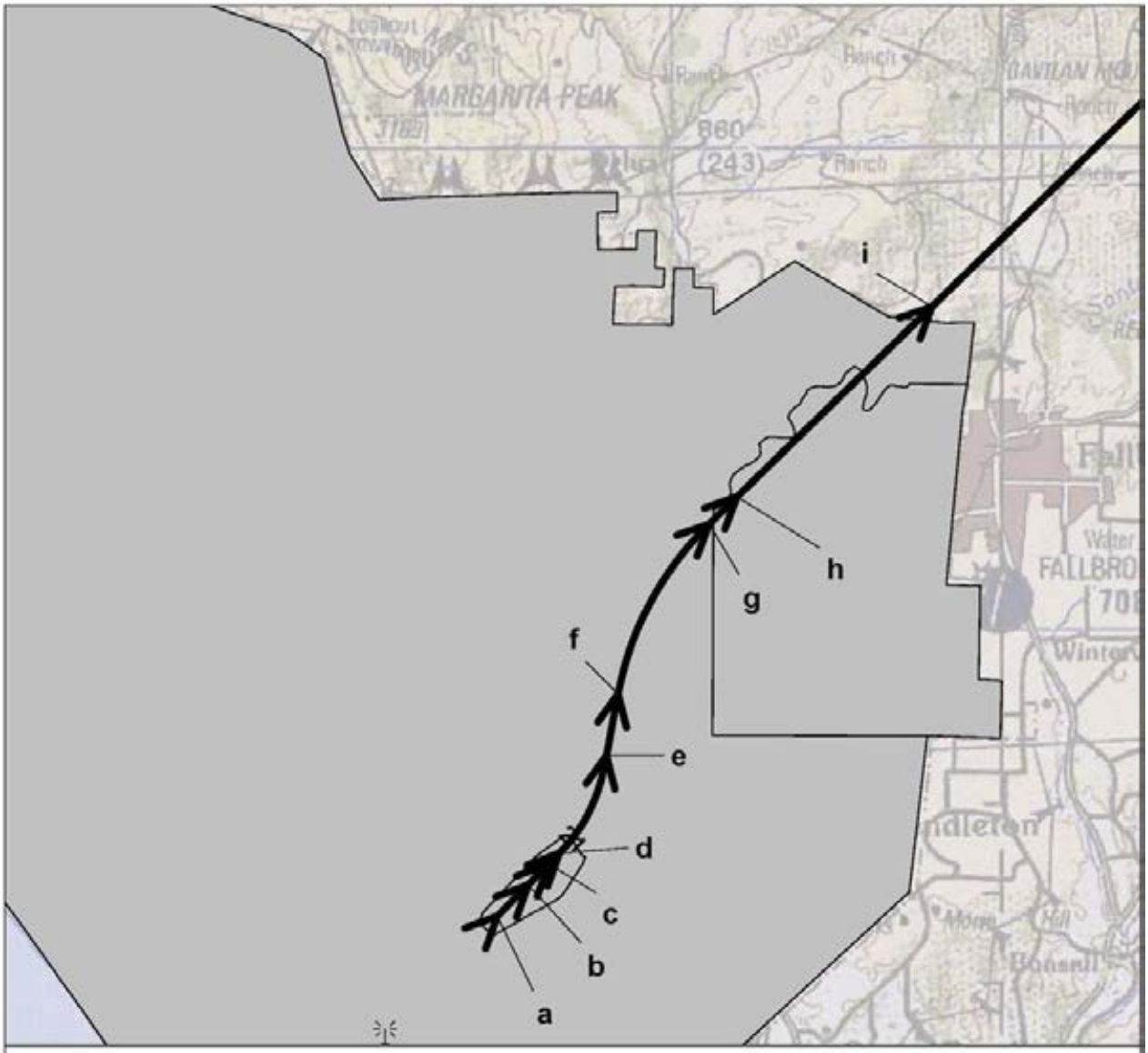
Flight Profile V22_11

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	15	70	begin turn
d	12,189	469 AGL	162	0	0	15	11	end turn
e	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
f	16,700	872 AGL	170	0	6	0	0	
g	21,800	1,464 AGL	170	0	6	0	0	
h	30,715	2,500 AGL	170	0	6	0	0	
i	33,753	2,850 AGL	170	0	6	0	0	
j	52,335	5,000 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
k	70,000	5,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile V22_11
Based MV22B
on Runway 03, Flight Track 03D2 - Roblar/Basilone/Intersection departures

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:194,000 (1 inch = 16,200 feet)



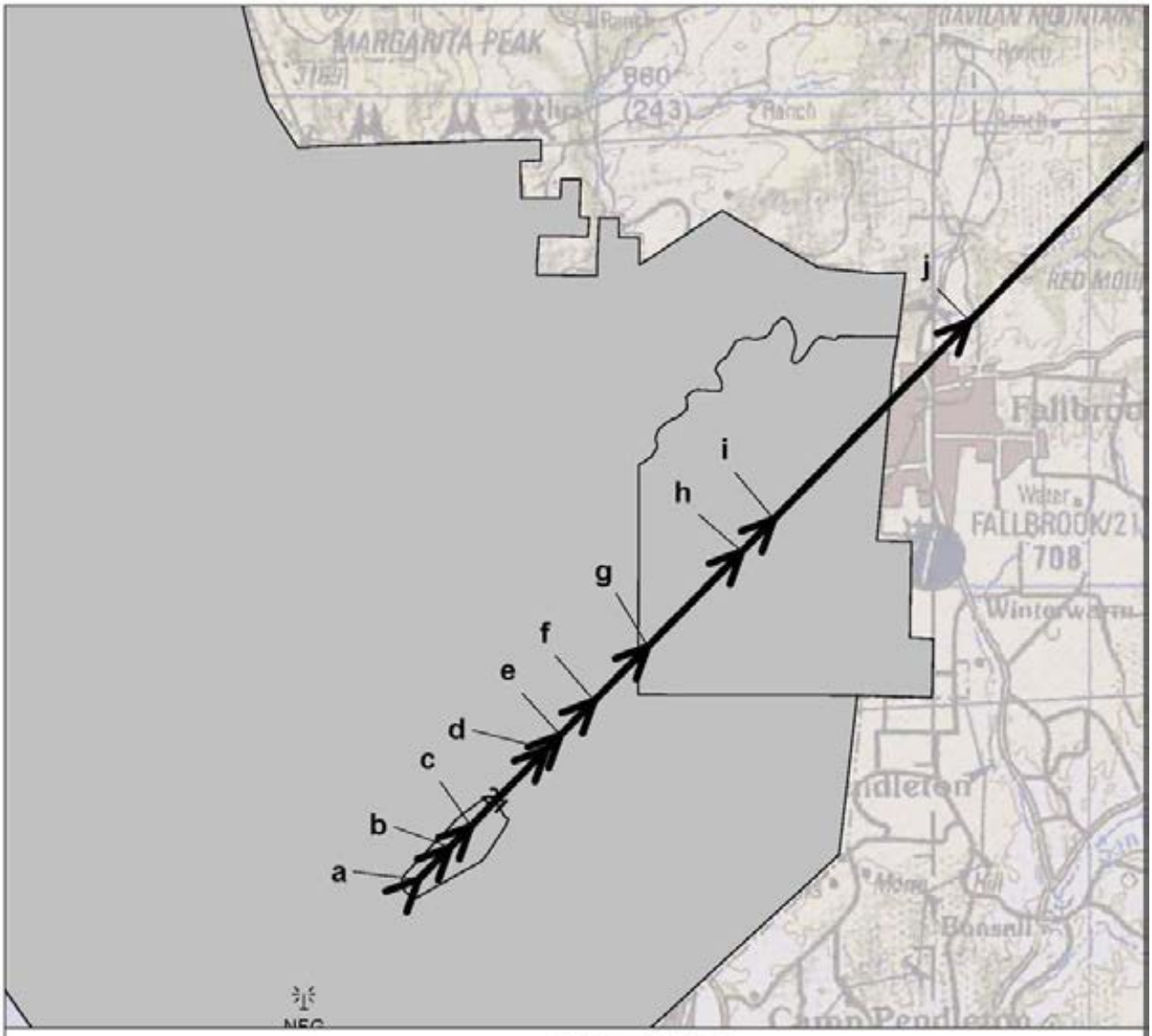
Flight Profile V22_12

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	+5deg for level cruise @ 220kts
d	6,020	324 AGL	130	0	6	15	11	begin turn
e	13,500	995 AGL	170	0	6	15	0	Interpolated; End turn ; 2000 fpm climb; +7deg aoa
f	17,765	5,000 AGL	170	0	6	0	0	begin turn
g	31,122	2,400 AGL	170	0	6	0	0	end turn
h	33,753	2,850 AGL	170	0	6	0	0	
i	52,335	5,000 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
j	90,000	5,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile V22_12
Based MV22B
on Runway 03, Flight Track 03D3 - Point Canyon departures

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:143,000 (1 inch = 11,900 feet)



Flight Profile V22_13

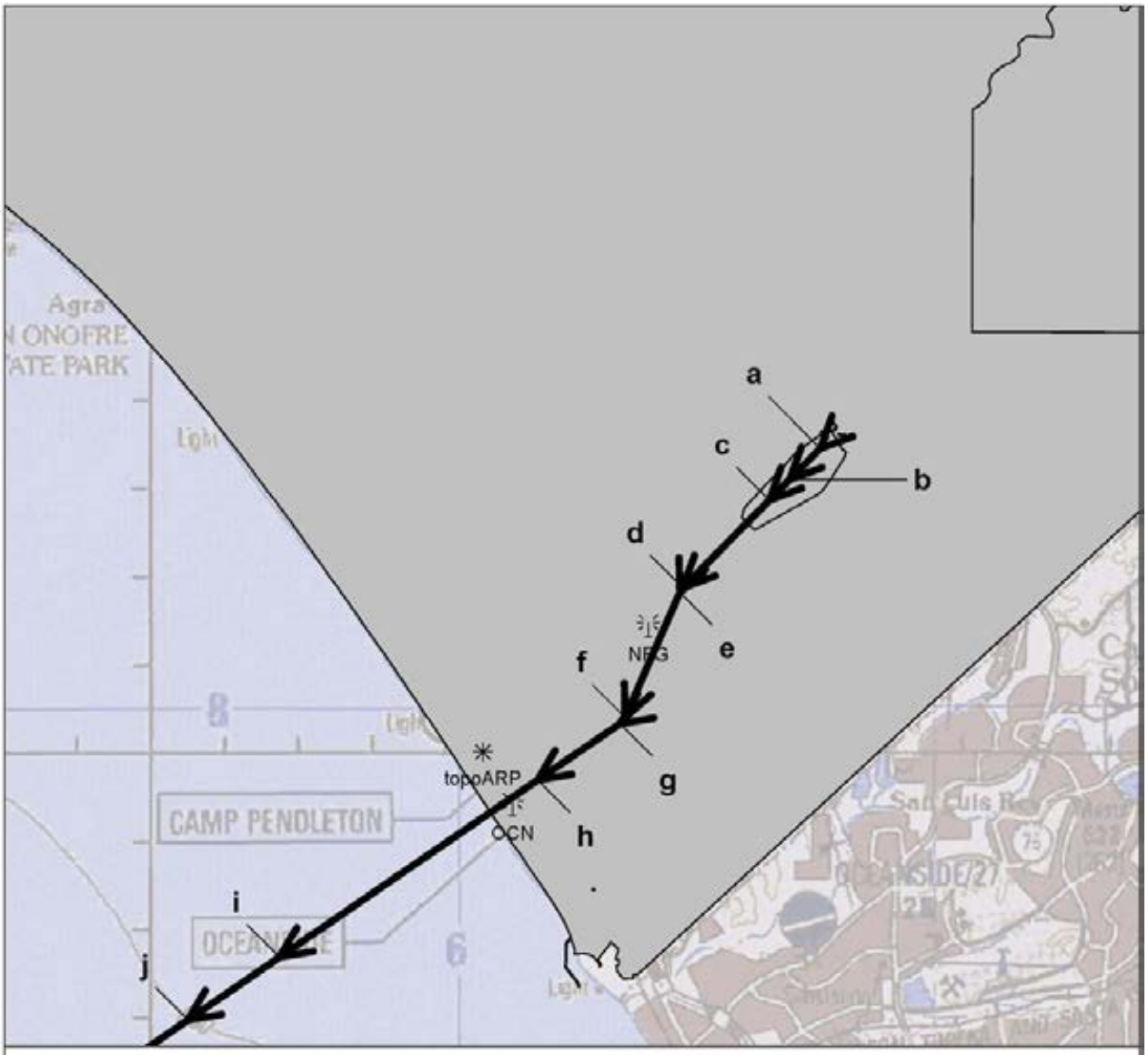
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	12,189	469 AGL	162	0	0	0	11	
e	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
f	16,700	872 AGL	170	0	6	0	0	
g	21,800	1,464 AGL	170	0	6	0	0	
h	30,715	2,500 AGL	170	0	6	0	0	
i	33,753	2,850 AGL	170	0	6	0	0	
j	52,335	5,000 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
k	90,000	5,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile V22_13
Based MV22B
on Runway 03, Flight Track 03D4 - North Initial departure

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:141,000 (1 inch = 11,700 feet)

N



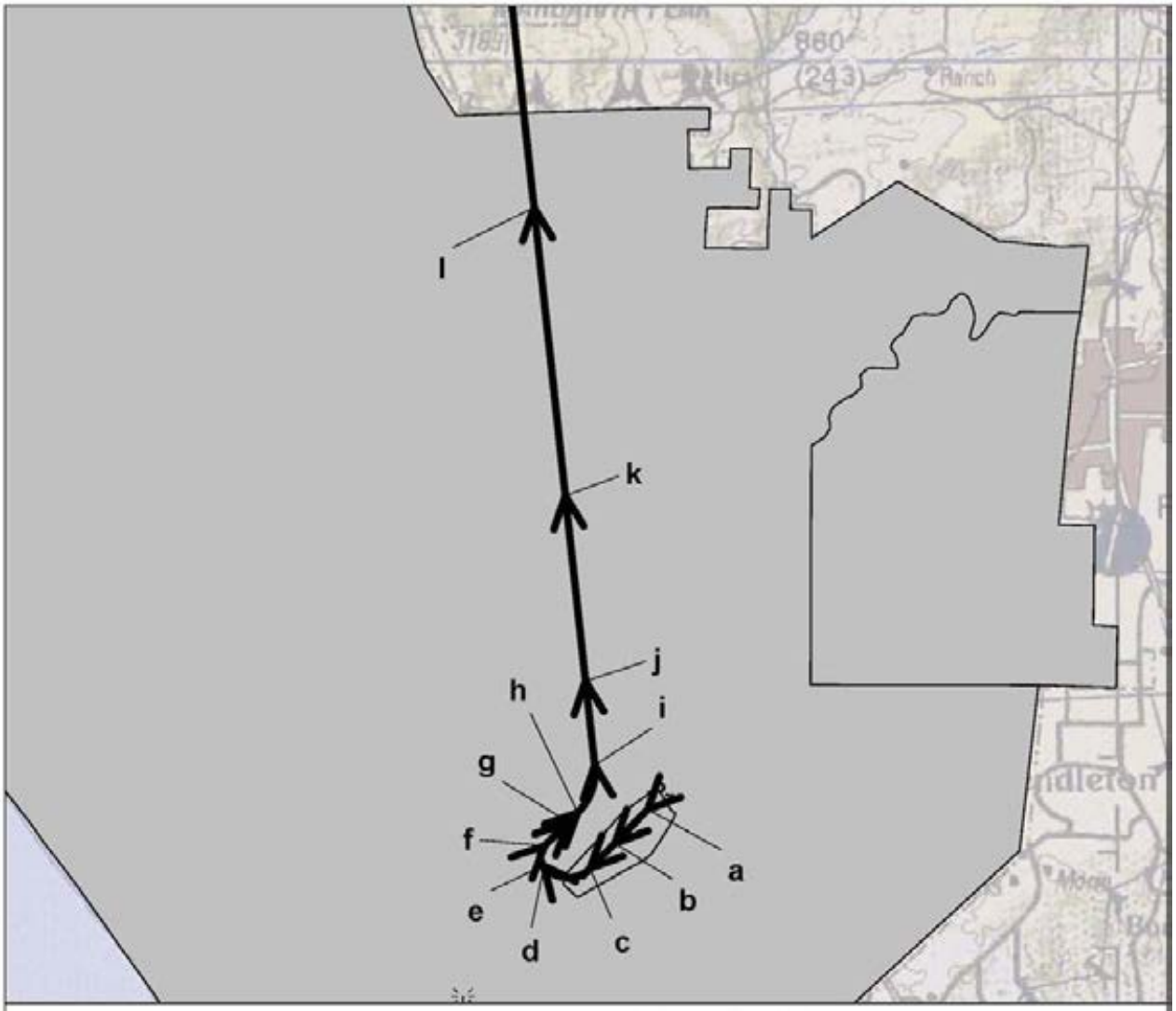
Flight Profile V22_14

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	13,500	500 AGL	170	0	6	0	0	ADJUST ALTITUDE TO COURSE RULES; +5de
e	13,867	600 AGL	170	0	6	0	0	Interpolate; 2000 fpm climb; +7deg aoa for 2500 fp
f	23,267	1,660 AGL	170	0	6	0	0	
g	23,825	1,722 AGL	170	0	6	0	0	Interpolate
h	30,715	2,500 AGL	170	0	6	0	0	
i	52,335	5,000 MSL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
j	60,000	5,000 MSL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile V22_14
Based MV22B
on Runway 21, Flight Track 21D1 - Mass III/VORTAC departures

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:145,000 (1 inch = 12,100 feet)



Flight Profile V22_15

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,266	320 AGL	115	0	0	-25	70	increased by 200 ft; begin turn
d	8,617	392 AGL	137	0	0	-25	41	interpolated; end turn
e	8,667	393 AGL	137	0	0	-25	40	shifted +50 ft; begin turn
f	10,069	423 AGL	147	0	0	0	28	interpolated; end turn
g	12,189	469 AGL	162	0	0	0	11	
h	13,045	490 AGL	162	0	0	15	0	shifted back 500 ft; begin turn left; 2000 fpm climb
i	16,381	861 AGL	165	0	0	15	0	interpolated; end turn
j	21,800	1,464 AGL	170	0	6	0	0	
k	33,753	2,850 AGL	170	0	6	0	0	
l	52,335	5,000 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
m	70,000	5,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile V22_15
Based MV22B
on Runway 21, Flight Track 21D2 - Roblar/Basilone/Intersection departures

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:138,000 (1 inch = 11,500 feet)

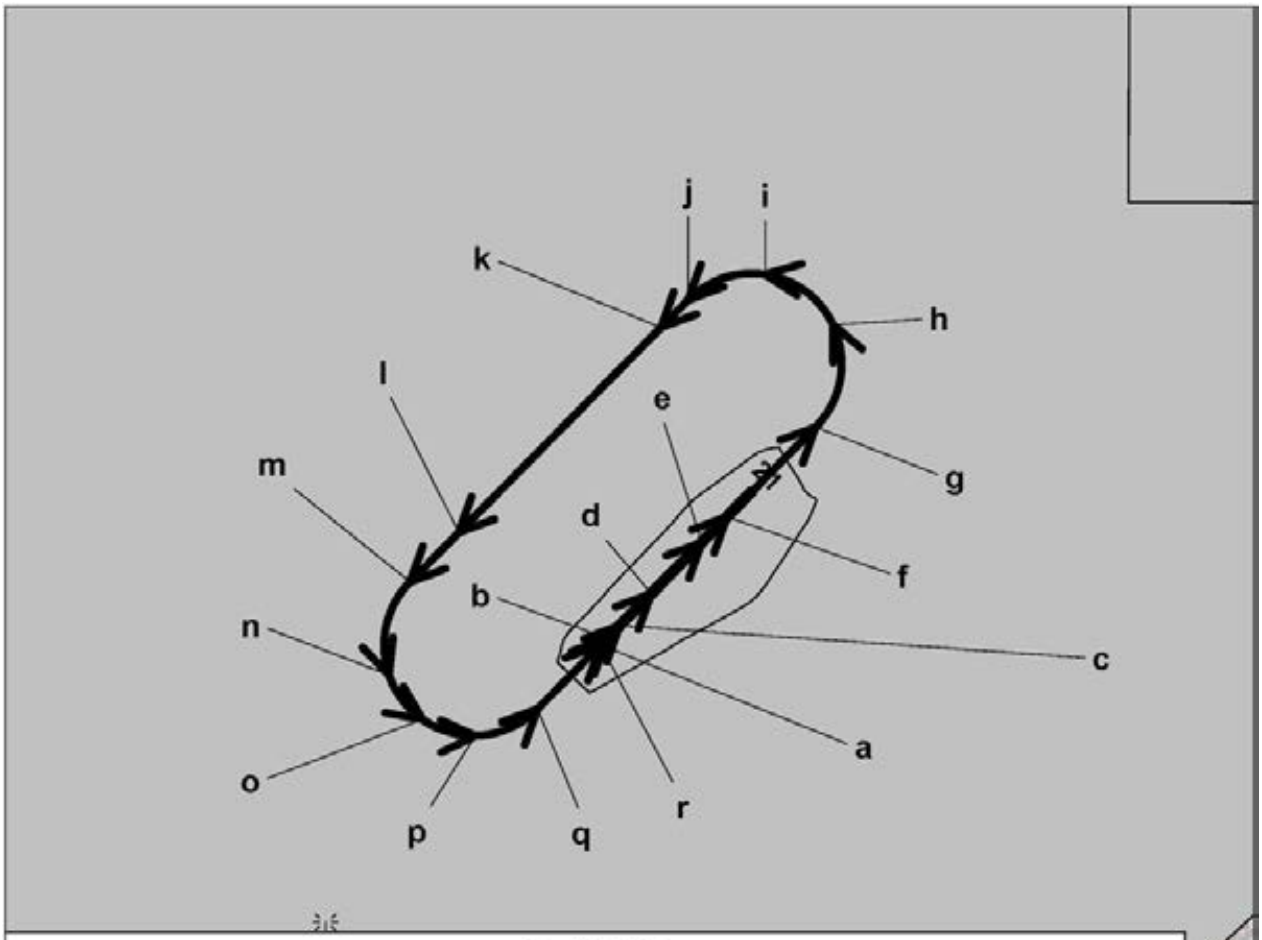
Flight Profile V22_16

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,269	320 AGL	120	0	0	-25	70	shifted 200 ft; begin turn
d	8,690	393 AGL	140	0	0	-25	42	interpolated; end turn
e	8,740	395 AGL	140	0	0	-25	40	interpolated; begin turn
f	9,953	420 AGL	148	0	0	0	30	interpolated; end turn
g	12,189	469 AGL	162	0	0	0	11	
h	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
i	52,335	5,000 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
j	75,000	5,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile V22_16
Based MV22B
on Runway 21, Flight Track 21D3 - Point Canyon departures

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:93,400 (1 inch = 7,780 feet)



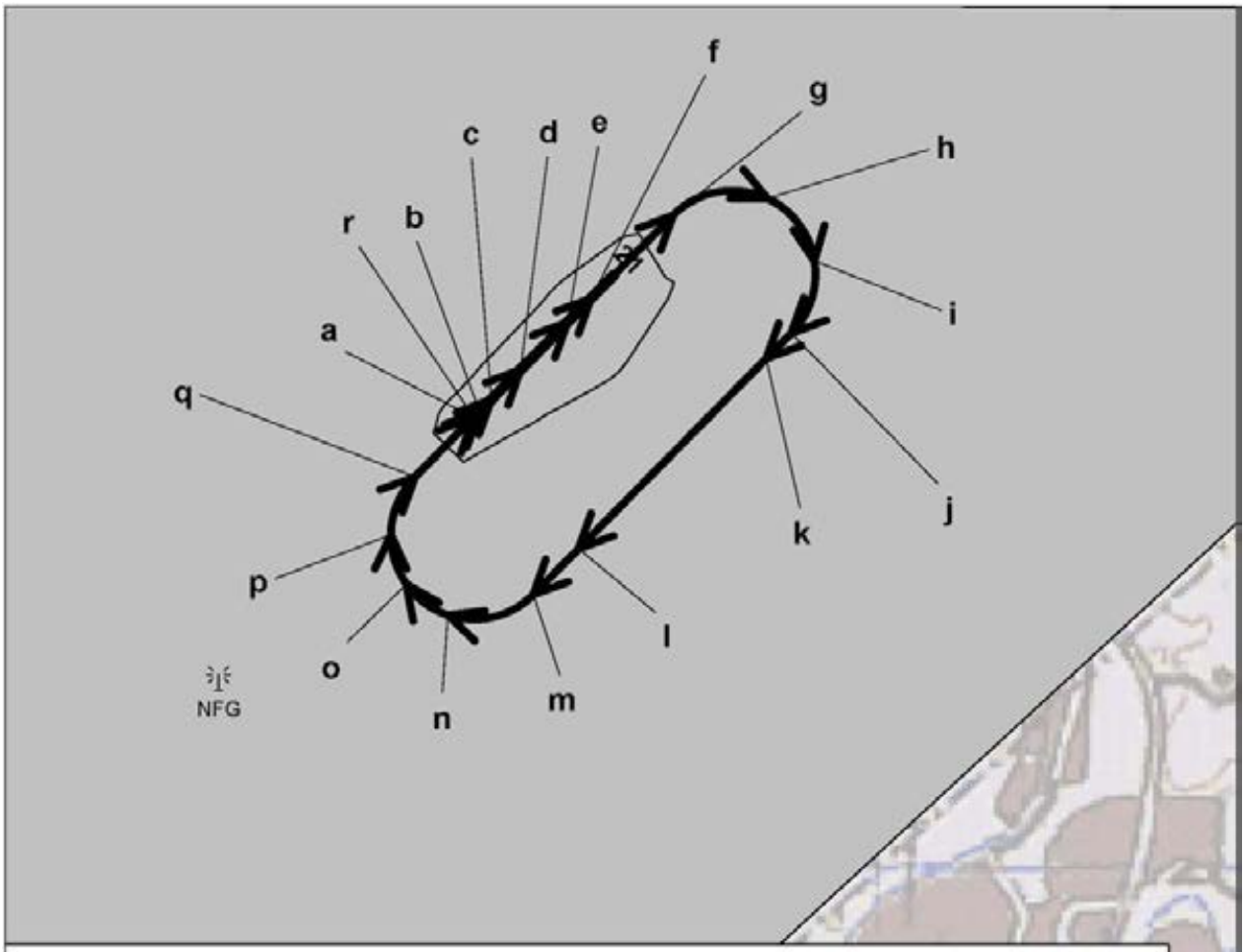
Based MV22B
on Runway 03, Flight Track 03PL - Left Pattern

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	500 AGL	135	0	10	0	0	
f	5,000	500 AGL	145	0	0	0	0	
g	8,500	500 AGL	170	0	7	25	0	Shifted 500 ft; begin turn to downwind
h	11,566	500 AGL	150	0	7	25	0	MOVE TO 1/3 turn
i	14,000	500 AGL	170	0	7	25	0	MOVE TO 2/3 turn
j	16,354	500 AGL	170	0	7	0	0	Interpolated; end turn
k	17,424	500 AGL	170	0	7	0	0	begin downwind
l	25,424	500 AGL	170	0	3	0	0	end downwind
m	27,354	500 AGL	140	0	3	25	0	Shifted 400ft; begin turn
n	30,138	500 AGL	110	0	0	25	60	1/2 thru turn
o	31,708	200 AGL	60	0	0	25	87	2/3 thru turn
p	33,279	95 AGL	50	0	0	25	90	5/6 thru turn
q	35,208	20 AGL	5	0	0	0	90	Interpolated; end turn
r	37,708	20 AGL	5	0	0	0	90	

Flight Profile V22_18
Based MV22B
on Runway 03, Flight Track 03PL - Left Pattern

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:64,200 (1 inch = 5,350 feet)



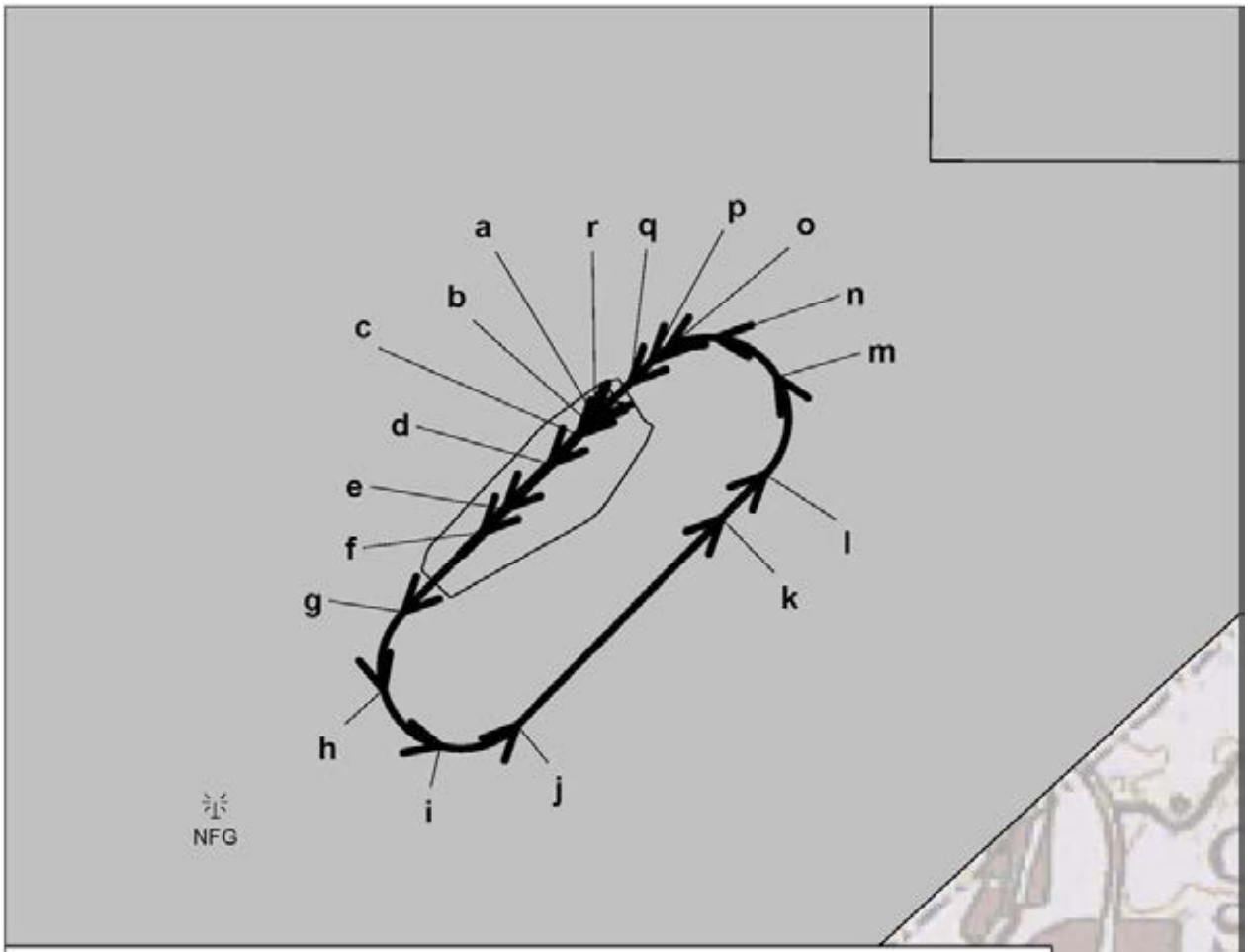
Flight Profile V22_19

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	800 AGL	135	0	10	0	0	
f	5,000	900 AGL	145	0	0	0	0	
g	8,500	900 AGL	170	0	7	-25	0	Shifted 500 ft; begin turn to downwind
h	11,566	900 AGL	150	0	7	-25	0	MOVE TO 1/3 turn
i	14,000	900 AGL	170	0	7	-25	0	MOVE TO 2/3 turn
j	16,354	900 AGL	170	0	7	0	0	Interpolated; end turn
k	17,424	900 AGL	170	0	7	0	0	begin downwind
l	25,424	860 AGL	115	0	3	0	20	end downwind
m	27,354	690 AGL	80	0	3	-25	54	Shifted 400ft; begin turn
n	30,138	478 AGL	70	0	0	-25	72	1/2 thru turn
o	31,708	377 AGL	60	0	0	-25	87	2/3 thru turn
p	33,279	278 AGL	50	0	0	-25	82	5/6 thru turn
q	35,208	185 AGL	57	0	0	0	88	Interpolated; end turn
r	37,708	20 AGL	5	0	0	0	90	

Flight Profile V22_19
Based MV22B
on Runway 03, Flight Track 03PR - Right Pattern

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:68,300 (1 inch = 5,690 feet)



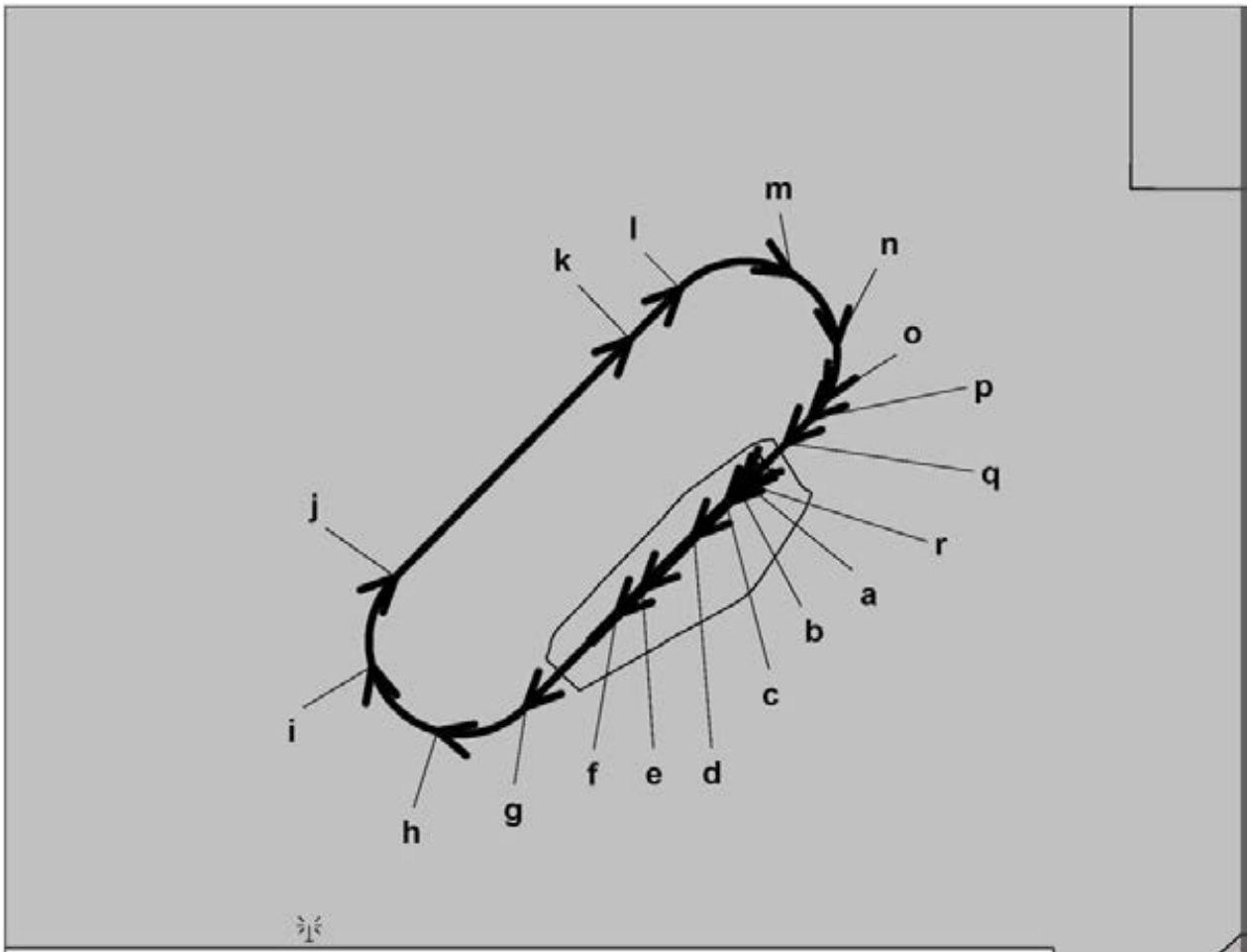
Flight Profile V22_20

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	800 AGL	135	0	10	0	0	
f	5,000	900 AGL	145	0	0	0	0	
g	8,500	900 AGL	170	0	7	25	0	shifted 500 ft; begin turn
h	11,118	900 AGL	150	0	7	25	0	MOVE TO 1/3 turn
i	13,736	900 AGL	170	0	7	25	0	MOVE TO 2/3 turn
j	16,354	900 AGL	170	0	7	0	0	Interpolated; end turn
k	25,424	900 AGL	170	0	3	0	0	
l	27,354	900 AGL	160	0	3	25	0	Interpolated; begin turn
m	30,639	750 AGL	140	0	3	25	0	
n	32,996	500 AGL	110	0	0	25	60	
o	34,566	200 AGL	60	0	0	25	87	
p	35,208	180 AGL	55	0	0	0	88	Interpolated; end turn
q	36,137	150 AGL	50	0	0	0	90	
r	37,708	20 AGL	5	0	0	0	90	

Flight Profile V22_20
Based MV22B
on Runway 21, Flight Track 21PL - Left Pattern

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:71,300 (1 inch = 5,940 feet)

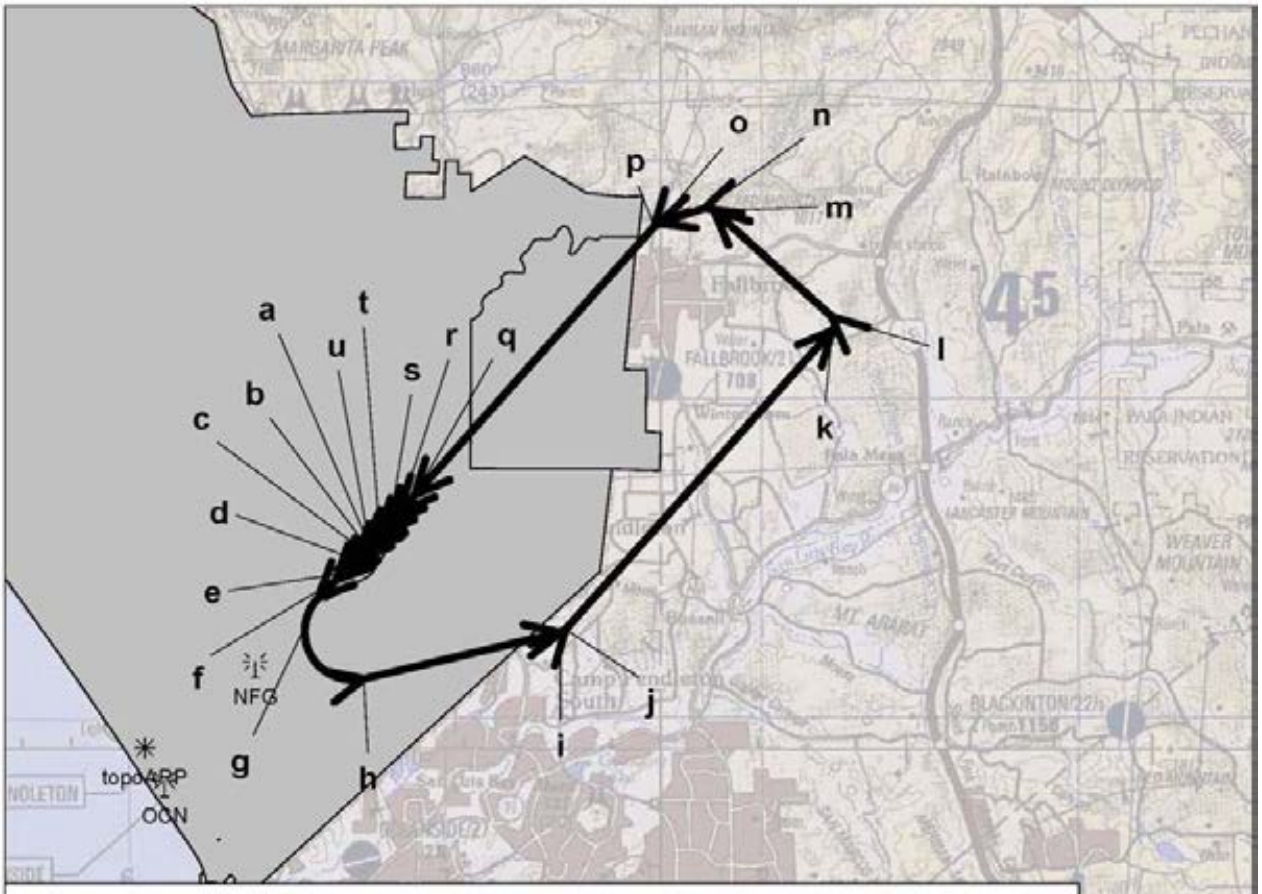


Flight Profile V22_21

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	500 AGL	135	0	10	0	0	
f	5,000	500 AGL	145	0	0	0	0	
g	8,500	500 AGL	170	0	7	-25	0	shifted 500 ft; begin turn
h	11,118	500 AGL	150	0	7	-25	0	MOVE TO 1/3 turn
i	13,736	500 AGL	170	0	7	-25	0	MOVE TO 2/3 turn
j	16,354	500 AGL	170	0	7	0	0	Interpolated; end turn
k	25,424	500 AGL	170	0	3	0	0	
l	27,354	500 AGL	160	0	3	-25	0	Interpolated; begin turn
m	30,639	500 AGL	140	0	3	-25	0	
n	32,996	500 AGL	110	0	0	-25	60	
o	34,566	200 AGL	60	0	0	-25	87	
p	35,208	180 AGL	55	0	0	0	88	Interpolated; end turn
q	36,137	150 AGL	50	0	0	0	90	
r	37,708	20 AGL	5	0	0	0	90	

Flight Profile V22_21
Based MV22B
on Runway 21, Flight Track 21PR - Right Pattern

Scale in Feet 1:62,200 (1 inch = 5,180 feet)



Flight Profile V22_22

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	800 AGL	135	0	10	0	0	
f	5,000	1,000 AGL	145	0	0	0	0	
g	7,500	1,464 AGL	170	0	7	25	0	shifted 500 ft; begin turn
h	20,415	3,000 AGL	220	0	7	0	0	Interpolated; end turn
i	41,415	3,000 AGL	220	0	7	15	0	begin turn
j	42,026	3,000 AGL	220	0	7	0	0	end turn
k	83,526	3,000 AGL	220	0	7	25	0	begin turn
l	85,097	3,000 AGL	220	0	7	0	0	end turn
m	101,522	1,500 AGL	220	0	7	25	0	begin turn
n	102,569	1,450 AGL	220	0	7	0	0	end turn
o	107,569	1,020 AGL	220	0	7	15	0	begin turn
p	108,093	1,000 AGL	170	0	7	0	0	end turn
q	145,359	750 AGL	140	0	0	0	90	
r	147,706	500 AGL	110	0	0	0	90	
s	149,276	200 AGL	60	0	0	0	87	
t	150,847	150 AGL	50	0	0	0	90	
u	152,418	20 AGL	5	0	0	0	90	

Flight Profile V22_22
Based MV22B
on Runway 21, Flight Track 21G1 - GCA-Small pattern

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:239,000 (1 inch = 19,900 feet)

C-1.2.5 Modeled Run-Ups for MCAS Camp Pendleton

Existing (2005) Annual Maintenance Run-Up Operations for MCAS Camp Pendleton

Aircraft ID	Location Name	Magnetic Heading (degrees)	Annual Run-Ups				Power Setting	Duration (Minutes)
			Day	Evening	Night	Total		
AH-1W (1)	South Grass	210	672	-	-	672	IGE LITE (4)	20
UH-1N (2)	South Grass	210	448	-	-	448	IGE LITE (4)	20
CH-46E (3)	South Grass	210	2,343	4,716	2,343	9,402	IGE LITE (5)	20

Notes:
(1) Modeled using NOISEFILE UH-1M designation with operations multiplied by 1.6 to provide acoustical equivalent sound level.
(2) Modeled using NOISEFILE UH-1M designation.
(3) Modeled as a UH-60A
(4) In Ground Effect, Low Gross Weight.
(5) In-Ground Effect, High Gross Weight

Source: Wyle Laboratories, 1995 (Tables 3-6 and 4-4); Wyle Laboratories, 2006 (factoring)

MV-22 Modeled Run-up Operations for MCAS Camp Pendleton

Modeled As Aircraft Type (& engine designation)	Pad	Description	Magnetic Heading (degrees)	Power Setting	Duration (minutes)	Simultaneous Number of Engines	Annual Operations			
							Day	Eve	Night	Total
CH-53E (T64-GE-416A)	MV22FL - Hgr 4 Flight Line	In-Frame Engine Test	195	Gnd Idle	10	1	182	0	0	181.99
				Gnd Max	30	1				
				Gnd Max	30	1	5.2	0	2.8	8
				Gnd Idle	20	1	55	0	9.7	65
				Gnd Max	40	1				

(2) Day = 7 am - 6:59 pm; Eve = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am

C-1.2.6 MCB Camp Pendleton Modeled Airspace Operations and Sorties

Existing Annual Route-Type Flight Events[1] for MCB Camp Pendleton/Miramar Airspace

Route		USMC AV-8B				USMC F/A-18C/D				Navy F/A-18C/D				USMC AH-1				USMC UH-1				USMC CH-46E				Navy CH-46E				USMC MV22			
Type	Name	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Terrain Flight (TERF) Routes	212T	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	2	2	-	4	-	-	-	-	-	-	-	-
	CASE	-	-	-	-	-	-	-	-	-	-	-	-	57	57	-	114	29	29	-	58	77	77	-	154	1	1	-	2	-	-	-	-
	DELUZ	-	-	-	-	-	-	-	-	-	-	-	-	28	28	-	56	18	18	-	36	36	36	-	72	-	-	-	-	-	-	-	-
	DELUZ 2	-	-	-	-	-	-	-	-	-	-	-	-	28	28	-	56	18	18	-	36	30	30	-	60	-	-	-	-	-	-	-	-
	DEVIL	-	-	-	-	-	-	-	-	-	-	-	-	49	49	-	98	11	11	-	22	30	30	-	60	-	-	-	-	-	-	-	-
	MIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5	-	10	-	-	-	-	-	-	-	-
	PULGAS	-	-	-	-	-	-	-	-	-	-	-	-	89	89	-	178	39	39	-	78	41	41	-	82	-	-	-	-	-	-	-	-
Close Air Support (CAS) Track[2]	CAS FW	29	10	-	39	9	3	-	12	13	4	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ingress / Egress[2]	FWR-1	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1A	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1B	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1C	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-2	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-3	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-4				-				-				-	489	163	-	652	234	78	-	312	50	17	-	67	-	-	-	-	-	-	-	-
	RWR-5				-				-				-	489	163	-	652	234	78	-	312	50	17	-	67	-	-	-	-	-	-	-	-
Transition[2]	FWT-1	6	2	-	8	20	7	-	27	5	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-1	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	843	281	-	1,124	25	8	-	33	-	-	-	-
	RWR-2	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	843	281	-	1,124	25	8	-	33	-	-	-	-
	RWR-3	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	843	281	-	1,124	25	8	-	33	-	-	-	-
Terrain Flight Routes		-	-	-	-	-	-	-	-	-	-	-	-	252	252	-	504	115	115	-	230	221	221	-	442	1	1	-	2	-	-	-	-
Close Air Support		29	10	-	39	9	3	-	12	13	4	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ingress / Egress		75	24	-	99	24	9	-	33	36	12	-	48	978	326	-	1,304	468	156	-	624	100	34	-	134	-	-	-	-	-	-	-	-
Transition		6	2	-	8	20	7	-	27	5	2	-	7	2,031	678	-	2,709	1,179	393	-	1,572	2,529	843	-	3,372	75	24	-	99	-	-	-	-
Grand Total		110	36	-	146	53	19	-	72	54	18	-	72	3,261	1,256	-	4,517	1,762	664	-	2,426	2,850	1,098	-	3,948	76	25	-	101	-	-	-	-

Route		Navy H-60				USAF (Modeled as CH46)				Other USA DoD (Modeled as CH46)				USMC CH-53E				Civilian Law Enforcement Modeled as CH-46				Civilian Medical Evacuation Modeled as CH-46				Other Civilian Modeled as CH-46				TOTAL			
Type	Name	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Terrain Flight (TERF) Routes	212T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	6
	CASE	27	27	-	54	1	1	-	2	-	-	-	-	17	17	-	34	-	-	-	-	-	-	-	-	-	-	-	-	209	209	-	418
	DELUZ	4	4	-	8	-	-	-	-	1	1	-	2	9	9	-	18	2	2	-	4	-	-	-	-	1	1	-	2	99	99	-	198
	DELUZ 2	4	4	-	8	-	-	-	-	1	1	-	2	9	9	-	18	2	2	-	4	-	-	-	-	1	1	-	2	93	93	-	186
	DEVIL	8	8	-	16	-	-	-	-	-	-	-	-	6	6	-	12	-	-	-	-	-	-	-	-	-	-	-	-	104	104	-	208
	MIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5	-	10
	PULGAS	1	1	-	2	-	-	-	-	-	-	-	-	16	16	-	32	-	-	-	-	-	-	-	-	1	1	-	2	187	187	-	374
Close Air Support (CAS) Track[2]	CAS FW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	17	-	68
Ingress / Egress[2]	FWR-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	FWR-1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-1B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-1C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	FWR-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	RWR-4	3	1	-	4	-	-	-	-	-	-	-	-	17	6	-	23	-	-	-	-	-	-	-	-	-	-	-	-	793	265	-	1,058
	RWR-5	3	1	-	4	-	-	-	-	-	-	-	-	17	6	-	23	-	-	-	-	-	-	-	-	-	-	-	-	793	265	-	1,058
Transition[2]	FWT-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	11	-	42
	RWR-1	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,461	1,154	-	4,615
	RWR-2	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,461	1,154	-	4,615
	RWR-3	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,461	1,154	-	4,615
Terrain Flight Routes		44	44	-	88	1	1	-	2	2	2	-	4	57	57	-	114	4	4	-	8	-	-	-	-	3	3	-	6	700	700	-	1,400
Close Air Support		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	17	-	68
Ingress / Egress		6	2	-	8	-	-	-	-	-	-	-	-	34	12	-	46	-	-	-	-	-	-	-	-	-	-	-	-	1,721	575	-	2,296
Transition		444	147	-	591	15	6	-	21	114	39	-	153	759	252	-	1,011	186	63	-	249	111	36	-	147	2,940	981	-	3,921	10,414	3,473	-	13,887
Grand Total		494	193	-	687	16	7	-	23	116	41	-	157	850	321	-	1,171	190	67	-	257	111	36	-	147	2,943	984	-	3,927	12,886	4,765	-	17,651

(1) Values rounded to the nearest whole operation
(2) Assumed 75% day / 25% evening operations from grouped transitions in WR 05-07

WR 05-07, Table 4-1 & Table 4-3 (FY2001)
WR 05-07 MRNmap input files
Wyle Laboratories, 2008

Existing Annual Area-Type Operations for MCB Camp Pendleton/Miramar Airspace
Page 1 of 2

Airspace		USMC AV-8B				USMC F/A-18C/D				Navy F/A-18C/D				USMC AH-1				USMC UH-1				USMC CH-46E				Navy CH-46E				USMC MV22			
Unit	Sub-area	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Confined Area Landing (CAL) Sites	CAL 01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2	2	-	4	-	-	-	-	-	-	-	-
	CAL 02	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	1	1	-	2	7	3	-	10	-	-	-	-	-	-	-	-
	CAL 03	-	-	-	-	-	-	-	-	-	-	-	-	84	35	-	119	110	47	-	157	63	28	-	91	1	-	-	1	-	-	-	-
	CAL 04	-	-	-	-	-	-	-	-	-	-	-	-	124	54	-	178	152	65	-	217	202	87	-	289	1	-	-	1	-	-	-	-
	CAL 05	-	-	-	-	-	-	-	-	-	-	-	-	458	197	-	655	428	184	-	612	73	31	-	104	1	1	-	2	-	-	-	-
	CAL 09	-	-	-	-	-	-	-	-	-	-	-	-	38	16	-	54	79	34	-	113	52	23	-	75	-	-	-	-	-	-	-	-
	CAL 10	-	-	-	-	-	-	-	-	-	-	-	-	35	16	-	51	60	26	-	86	7	3	-	10	-	-	-	-	-	-	-	-
	CAL 13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	5	2	-	7	-	-	-	-	-	-	-	-
	CAL 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	7	3	-	10	-	-	-	-	-	-	-	-
	CAL 15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	4	3	2	-	5	2	-	-	2	-	-	-	-
	CAL 16	-	-	-	-	-	-	-	-	-	-	-	-	14	7	-	21	49	21	-	70	8	3	-	11	-	-	-	-	-	-	-	-
	CAL 17	-	-	-	-	-	-	-	-	-	-	-	-	26	12	-	38	54	23	-	77	18	8	-	26	2	-	-	2	-	-	-	-
	CAL 18	-	-	-	-	-	-	-	-	-	-	-	-	35	14	-	49	68	29	-	97	67	28	-	95	1	-	-	1	-	-	-	-
	CAL 19	-	-	-	-	-	-	-	-	-	-	-	-	35	14	-	49	84	36	-	120	55	24	-	79	1	-	-	1	-	-	-	-
	CAL 20	-	-	-	-	-	-	-	-	-	-	-	-	309	132	-	441	237	101	-	338	135	57	-	192	-	-	-	-	-	-	-	-
	CAL 21	-	-	-	-	-	-	-	-	-	-	-	-	27	12	-	39	20	9	-	29	137	59	-	196	-	-	-	-	-	-	-	-
	CAL 22	-	-	-	-	-	-	-	-	-	-	-	-	9	4	-	13	6	3	-	9	135	57	-	192	-	-	-	-	-	-	-	-
	CAL 23	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	1	18	7	-	25	-	-	-	-	-	-	-	-
Pads	HLZ	-	-	-	-	-	-	-	-	-	-	-	-	163	70	-	233	66	28	-	94	348	149	-	497	2	1	-	3	-	-	-	-
	LHD PAD	-	-	-	-	-	-	-	-	-	-	-	-	636	273	-	909	232	100	-	332	600	257	-	857	11	5	-	16	-	-	-	-
Other Landing Zones (LZ)	LZ 01 VIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-
	LZ 06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 11 VIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-
	LZ 12	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	1	1	-	2	7	3	-	10	-	-	-	-	-	-	-	-
	LZ 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 16	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	1	5	2	-	7	1	-	-	1	-	-	-	-
	LZ 21	-	-	-	-	-	-	-	-	-	-	-	-	8	4	-	12	34	14	-	48	166	73	-	239	6	2	-	8	-	-	-	-
	LZ 22	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	7	2	-	9	-	-	-	-	-	-	-	-
	LZ 27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-
	LZ 31	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	24	11	-	35	-	-	-	-	-	-	-	-
	LZ 33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	6	-	18	-	-	-	-	-	-	-	-
	LZ 41	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	6	3	-	9	16	7	-	23	2	1	-	3	-	-	-	-
	LZ 43	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	2	1	-	3	8	3	-	11	-	-	-	-	-	-	-	-
	LZ 52 VIP	-	-	-	-	-	-	-	-	-	-	-	-	10	4	-	14	11	6	-	17	48	20	-	68	1	1	-	2	-	-	-	-
	LZ 53	-	-	-	-	-	-	-	-	-	-	-	-	48	20	-	68	32	15	-	47	325	142	-	467	2	1	-	3	-	-	-	-
	LZ 62	-	-	-	-	-	-	-	-	-	-	-	-	24	10	-	34	25	11	-	36	436	186	-	622	1	1	-	2	-	-	-	-
	LZ VIEW	-	-	-	-	-	-	-	-	-	-	-	-	227	97	-	324	165	68	-	233	190	81	-	271	8	3	-	11	-	-	-	-
	LZ Red Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Short Takeoff and Landing (STOL) Pads and	PAD 1	-	-	-	-	-	-	-	-	-	-	-	-	143	61	-	204	64	27	-	91	386	166	-	552	3	1	-	4	-	-	-	-
	PAD 2	-	-	-	-	-	-	-	-	-	-	-	-	131	56	-	187	69	29	-	98	78	33	-	111	1	1	-	2	-	-	-	-
	STOL 101	-	-	-	-	-	-	-	-	-	-	-	-	57	25	-	82	36	16	-	52	159	68	-	227	3	1	-	4	-	-	-	-
Drop Zones	BASOLINE	-	-	-	-	-	-	-	-	-	-	-	-	9	3	-	12	-	-	-	-	19	6	-	25	4	2	-	6	-	-	-	-
	CASE	-	-	-	-	-	-	-	-	2	1	-	3	306	102	-	408	140	46	-	186	303	101	-	404	2	-	-	2	-	-	-	-
	DELUZ	-	-	-	-	-	-	-	-	-	-	-	-	73	25	-	98	30	11	-	41	369	123	-	492	-	-	-	-	-	-	-	-
	FALLBROOK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15	-	-	-	-	-	-	-	-
	HORNO	-	-	-	-	-	-	-	-	-	-	-	-	5	2	-	7	1	-	-	1	18	6	-	24	-	-	-	-	-	-	-	-
	PAPA 3	-	-	-	-	-	-	-	-	-	-	-	-	103	34	-	137	95	32	-	127	687	229	-	916	5	2	-	7	-	-	-	-
	TANKPARK	-	-	-	-	-	-	-	-	-	-	-	-	68	23	-	91	22	7	-	29	98	33	-	131	2	-	-	2	-	-	-	-
	WILDEAGLE	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	4	2	1	-	3	1	-	-	1	-	-	-	-	-	-	-	-
Helicopter Initial Points (IPs) or Holding Positions	ALISO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
	BRIGDE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CAL 2	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	HORNO	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	4	1	-	5	-	-	-	-	-	-	-	-
	LCAC	-	-	-	-	-	-	-	-	-	-	-	-	437	146	-	583	277	92	-	369	459	153	-	612	13	4	-	17	-	-	-	-
	PULGAS	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-
	SONGS	-	-	-	-	-	-	-	-	-	-	-	-	6	2	-	8	1	-	-	1	5	2	-	7	-	-	-	-	-	-	-	-
Impact Areas	Whiskey	5	2	-	7	8	3	-	11	-	-	-	-	122	41	-	163	67	22	-	89	17	6	-	23	-	-	-	-	-	-	-	-
	Zulu	24	8	-	32	14	5	-	19	31	10	-	41	122	41	-	163	50	17	-	67	7	2	-	9	2	1	-	3	-	-	-	-
Confined Area Landing (CAL) Sites		-	-	-	-	-	-	-	-	-	-	-	-	1,197	514	-	1,711	1,355	581	-	1,936	994	427	-	1,421	9	1	-	10	-	-	-	-
Drop Zones		-	-	-	-	-	-	-	-	2	1	-	3	567	190	-	757	290	97	-	387	1,506	503	-	2,009	13	4	-	17	-	-	-	-
Helicopter Initial Points (IPs) or Holding Positions		-	-	-	-	-	-	-	-	-	-	-	-	449	151	-	600	280	93	-	373	469	156	-	625	13	4	-	17	-	-	-	-
Pads		-	-	-	-	-	-	-	-	-	-	-	-	799	343	-	1,142	298	128	-	426	948	406	-	1,354	13	6	-	19	-	-	-	-
Impact Areas		29	10	-	39	22	8	-	30	31	10	-	41	244	82	-	326	117	39	-	156	24	8	-	32	2	1	-	3	-	-	-	-
Other Landing Zones (LZ)		-	-	-	-	-	-	-	-	-	-	-	-	324	137	-	461	277	119	-	396	1,250	537	-	1,787	21	9	-	30	-	-	-	-
Short Takeoff and Landing (STOL) Pads and other pads		-	-	-	-	-	-	-	-	-	-	-	-	331	142	-	473	169	72	-	241	623	267	-	890	7	3	-	10	-	-	-	-
Grand Total		29	10	-	39	22	8	-	30	33	11	-	44	3,911	####	-	5,470	2,786	1,129	-	3,915	5,814	2,304	-	8,118	78	28	-	106	-	-	-	-

* Not an IP or Holding Position; Not Modeled

Sources:
WR05-07 Table 4-1, 4-2, 4-4
WR05-07 MRNmap modeling input files
Wyle Labs, 2006

Existing Annual Area-Type Operation/Sorties for MCB Camp Pendleton/Miramar Airspace (continued)
Page 2 of 2

Airspace		Navy H-60				USAF (Modeled as CH46)				Other USA DoD (Modeled as CH46)				USMC CH-53E				Civilian Law Enforcement Modeled as CH-46				Civilian Medical Evacuation Modeled as CH-46				Other Civilian Modeled as CH-46				TOTAL			
Unit	Sub-area	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Confined Area Landing (CAL) Sites	CAL 01	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	4	2	-	6
	CAL 02	1	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	12	5	-	17
	CAL 03	22	9	-	31	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	282	120	-	402
	CAL 04	19	9	-	28	-	-	-	-	-	-	-	-	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	501	216	-	717
	CAL 05	19	9	-	28	-	-	-	-	-	-	-	-	5	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	984	424	-	1,408
	CAL 09	16	6	-	22	-	-	-	-	-	-	-	-	5	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	190	81	-	271
	CAL 10	23	9	-	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	125	54	-	179
	CAL 13	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	3	-	10
	CAL 14	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	10	5	-	15
	CAL 15	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	9	3	-	12
	CAL 16	1	1	-	2	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	73	33	-	106
	CAL 17	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101	44	-	145
	CAL 18	1	1	-	2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	173	72	-	245
	CAL 19	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	178	75	-	253
	CAL 20	56	23	-	79	-	-	-	-	-	-	-	-	58	24	-	82	-	-	-	-	-	-	-	-	-	-	-	-	795	337	-	1,132
	CAL 21	5	3	-	8	-	-	-	-	-	-	-	-	231	101	-	332	-	-	-	-	-	-	-	-	-	-	-	-	420	184	-	604
	CAL 22	8	3	-	11	-	-	-	-	1	-	-	1	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	162	68	-	230
	CAL 23	5	3	-	8	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	11	-	38
Pads	HLZ	104	44	-	148	-	-	-	-	-	-	-	-	36	16	-	52	-	-	-	-	-	-	-	-	-	-	-	-	719	308	-	1,027
	LHD PAD	93	40	-	133	-	-	-	-	7	3	-	10	115	49	-	164	-	-	-	-	-	-	-	-	1	-	-	1	1,695	727	-	2,422
Other Landing Zones (LZ)	LZ 01 VIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
	LZ 06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 11 VIP	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	5
	LZ 12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	5	-	14
	LZ 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 16	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	9	3	-	12
	LZ 21	1	1	-	2	-	-	-	-	-	-	-	-	93	41	-	134	-	-	-	-	1	-	-	1	-	-	-	-	309	135	-	444
	LZ 22	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	9	2	-	11
	LZ 27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	3	-	-	3
	LZ 31	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	28	12	-	40
	LZ 33	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	15	7	-	22
	LZ 41	1	1	-	2	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	29	14	-	43
	LZ 43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	LZ 52 VIP	1	1	-	2	-	-	-	-	1	-	-	1	14	6	-	20	-	-	-	-	-	-	-	-	-	-	-	-	86	38	-	124
	LZ 53	1	-	-	1	-	-	-	-	2	2	-	4	67	29	-	96	-	-	-	-	-	-	-	-	-	-	-	-	477	209	-	686
	LZ 62	5	2	-	7	-	-	-	-	-	-	-	-	88	37	-	125	-	-	-	-	-	-	-	-	1	-	-	1	580	247	-	827
	LZ VIEW	106	46	-	152	1	-	-	1	2	-	-	2	35	14	-	49	1	-	-	1	-	-	-	-	1	-	-	1	736	309	-	1,045
	LZ Red Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Short Takeoff and Landing (STOL) Pads	PAD 1	39	17	-	56	-	-	-	-	4	2	-	6	11	5	-	16	-	-	-	-	-	-	-	-	-	-	-	-	650	279	-	929
	PAD 2	7	3	-	10	-	-	-	-	1	-	-	1	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	290	123	-	413
	STOL 101	25	11	-	36	-	-	-	-	-	-	-	-	6	3	-	9	-	-	-	-	-	-	-	-	-	-	-	-	286	124	-	410
Drop Zones	BASOLINE	-	-	-	-	2	1	-	3	5	1	-	6	5	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	44	14	-	58
	CASE	25	8	-	33	-	-	-	-	-	-	-	-	90	30	-	120	1	-	-	1	-	-	-	-	2	1	-	3	871	289	-	1,160
	DELUZ	20	7	-	27	-	-	-	-	-	-	-	-	89	29	-	118	-	-	-	-	-	-	-	-	21	-	-	21	602	195	-	797
	FALLBROOK	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	13	5	-	18
	HORNO	-	-	-	-	-	-	-	-	-	-	-	-	5	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	29	9	-	38
	PAPA 3	-	-	-	-	-	-	-	-	1	-	-	1	176	59	-	235	-	-	-	-	-	-	-	-	1	-	-	1	1,068	356	-	1,424
	TANKPARK	1	-	-	1	-	-	-	-	-	-	-	-	24	9	-	33	-	-	-	-	-	-	-	-	-	-	-	-	215	72	-	287
	WILDEAGLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	2	-	8
Helicopter Initial Points (IPs) or Holding Positions	ALISO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3
	BRIGDE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CAL 2 *	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3
	HORNO	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	7	2	-	9
	LCAC	21	7	-	28	-	-	-	-	5	2	-	7	46	15	-	61	-	-	-	-	1	-	-	1	1	-	-	1	1,260	419	-	1,679
	PULGAS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	4	1	-	5
	SONGS	-	-	-	-	-	-	-	-	2	1	-	3	2	1	-	3	-	-	-	-	-	-	-	-	1	-	-	1	17	6	-	23
Impact Areas	Whiskey	2	1	-	3	-	-	-	-	-	-	-	-	3	1	-	4	-	-	-	-	-	-	-	-	1	-	-	1	225	76	-	301
	Zulu	-	-	-	-	-	-	-	-	-	-	-	-	5	2	-	7	-	-	-	-	-	-	-	-	123	-	-	123	378	86	-	464
Confined Area Landing (CAL) Sites		181	79	-	260	-	-	-	-	3	1	-	4	314	134	-	448	-	-	-	-	-	-	-	-	-	-	-	-	4,053	1,737	-	5,790
Drop Zones		46	15	-	61	2	1	-	3	6	1	-	7	391	130	-	521	1	-	-	1	-	-	-	-	24	1	-	25	2,848	943	-	3,791
Helicopter Initial Points (IPs) or Holding Positions		21	7	-	28	-	-	-	-	7	3	-	10	49	16	-	65	-	-	-	-	1	-	-	1	3	-	-	3	1,292	430	-	1,722
Pads		197	84	-	281	-	-	-	-	7	3	-	10	151	65	-	216	-	-	-	-	-	-	-	-	1	-	-	1	2,414	1,035	-	3,449
Impact Areas		2	1	-	3	-	-	-	-	-	-	-	-	8	3	-	11	-	-	-	-	-	-	-	-	124	-	-	124	603	162	-	765
Other Landing Zones (LZ)		116	51	-	167	1	-	-	1	5	2	-	7	305	131	-	436	1	-	-	1	3	1	-	4	3	-	-	3	2,306	987	-	3,293
Short Takeoff and Landing (STOL) Pads and other pads		71	31	-	102	-	-	-	-	5	2	-	7	20	9	-	29	-	-	-	-	-	-	-	-	-	-	-	-	1,226	526	-	1,752
Grand Total		634	268	-	902	3	1	-	4	33	12	-	45	1,238	488	-	1,726	2	-	-	2	4	1	-	5	155	1	-	156	14,742	5,820	-	20,562

* Not an IP or Holding Position; Not Modeled

Sources:
WR05-07 Table 4-1, 4-2, 4-4
WR05-07 MRNmap modeling input files
Wyle Labs, 2006

Proposed Annual Route-Type Flight Events[1] for MCB Camp Pendleton/Miramar Airspace

Route		USMC AV-8B				USMC F/A-18C/D				Navy F/A-18C/D				USMC AH-1				USMC UH-1				USMC CH-46E				Navy CH-46E				USMC MV22			
Type	Name	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Terrain Flight (TERF) Routes	212T	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CASE	-	-	-	-	-	-	-	-	-	-	-	-	57	57	-	114	29	29	-	58	-	-	-	-	-	-	-	-	-	-	-	-
	DELUZ	-	-	-	-	-	-	-	-	-	-	-	-	28	28	-	56	18	18	-	36	-	-	-	-	-	-	-	-	-	-	-	-
	DELUZ 2	-	-	-	-	-	-	-	-	-	-	-	-	28	28	-	56	18	18	-	36	-	-	-	-	-	-	-	-	-	-	-	-
	DEVIL	-	-	-	-	-	-	-	-	-	-	-	-	49	49	-	98	11	11	-	22	-	-	-	-	-	-	-	-	-	-	-	-
	MIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	PULGAS	-	-	-	-	-	-	-	-	-	-	-	-	89	89	-	178	39	39	-	78	-	-	-	-	-	-	-	-	-	-	-	-
Close Air Support (CAS) Track[2]	CAS FW	29	10	-	39	9	3	-	12	13	4	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ingress / Egress[2]	FWR-1	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1A	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1B	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1C	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-2	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-3	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-4				-				-				-	489	163	-	652	234	78	-	312	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-5				-				-				-	489	163	-	652	234	78	-	312	-	-	-	-	-	-	-	-	-	-	-	-
Transition[2]	FWT-1	6	2	-	8	20	7	-	27	5	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-1	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	-	-	-	-	-	-	-	-	1,051	553	177	1,781
	RWR-2	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	-	-	-	-	-	-	-	-	1,051	553	177	1,781
	RWR-3	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	-	-	-	-	-	-	-	-	1,051	553	177	1,781
Terrain Flight Routes		-	-	-	-	-	-	-	-	-	-	-	-	252	252	-	504	115	115	-	230	-	-	-	-	-	-	-	-	-	-	-	-
Close Air Support		29	10	-	39	9	3	-	12	13	4	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ingress / Egress		75	24	-	99	24	9	-	33	36	12	-	48	978	326	-	1,304	468	156	-	624	-	-	-	-	-	-	-	-	-	-	-	-
Transition		6	2	-	8	20	7	-	27	5	2	-	7	2,031	678	-	2,709	1,179	393	-	1,572	-	-	-	-	-	-	-	-	3,153	1,659	531	5,343
Grand Total		110	36	-	146	53	19	-	72	54	18	-	72	3,261	1,256	-	4,517	1,762	664	-	2,426	-	-	-	-	-	-	-	-	3,153	1,659	531	5,343

Route		Navy H-60				USAF (Modeled as CH46)				Other USA DoD (Modeled as CH46)				USMC CH-53E				Civilian Law Enforcement Modeled as CH-46				Civilian Medical Evacuation Modeled as CH-46				Other Civilian Modeled as CH-46				TOTAL			
Type	Name	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Terrain Flight (TERF) Routes	212T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2
	CASE	27	27	-	54	1	1	-	2	-	-	-	-	17	17	-	34	-	-	-	-	-	-	-	-	-	-	-	-	131	131	-	262
	DELUZ	4	4	-	8	-	-	-	-	1	1	-	2	9	9	-	18	2	2	-	4	-	-	-	-	1	1	-	2	63	63	-	126
	DELUZ 2	4	4	-	8	-	-	-	-	1	1	-	2	9	9	-	18	2	2	-	4	-	-	-	-	1	1	-	2	63	63	-	126
	DEVIL	8	8	-	16	-	-	-	-	-	-	-	-	6	6	-	12	-	-	-	-	-	-	-	-	-	-	-	-	74	74	-	148
	MIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	PULGAS	1	1	-	2	-	-	-	-	-	-	-	-	16	16	-	32	-	-	-	-	-	-	-	-	1	1	-	2	146	146	-	292
Close Air Support (CAS) Track[2]	CAS FW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	17	-	68
Ingress / Egress[2]	FWR-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	FWR-1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-1B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-1C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	FWR-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	RWR-4	3	1	-	4	-	-	-	-	-	-	-	-	17	6	-	23	-	-	-	-	-	-	-	-	-	-	-	-	743	248	-	991
	RWR-5	3	1	-	4	-	-	-	-	-	-	-	-	17	6	-	23	-	-	-	-	-	-	-	-	-	-	-	-	743	248	-	991
Transition[2]	FWT-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	11	-	42
	RWR-1	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,644	1,418	177	5,239
	RWR-2	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,644	1,418	177	5,239
	RWR-3	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,644	1,418	177	5,239
Terrain Flight Routes		44	44	-	88	1	1	-	2	2	2	-	4	57	57	-	114	4	4	-	8	-	-	-	-	3	3	-	6	478	478	-	956
Close Air Support		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	17	-	68
Ingress / Egress		6	2	-	8	-	-	-	-	-	-	-	-	34	12	-	46	-	-	-	-	-	-	-	-	-	-	-	-	1,621	541	-	2,162
Transition		444	147	-	591	15	6	-	21	114	39	-	153	759	252	-	1,011	186	63	-	249	111	36	-	147	2,940	981	-	3,921	10,963	4,265	531	15,759
Grand Total		494	193	-	687	16	7	-	23	116	41	-	157	850	321	-	1,171	190	67	-	257	111	36	-	147	2,943	984	-	3,927	13,113	5,301	531	18,945

Notes: (1) Values rounded to the nearest whole event
(2) Assumed 75% day / 25% evening operations from grouped transitions in WR 05-07

Sources: WR 05-07, Table 4-1 & Table 4-3 (FY2001)
WR 05-07 MRNmap input files
Wyle Laboratories, 2008

Proposed Annual Route-Type Flight Events[1] for MCB Camp Pendleton/Miramar Airspace

Route		USMC AV-8B				USMC F/A-18C/D				Navy F/A-18C/D				USMC AH-1				USMC UH-1				USMC CH-46E				Navy CH-46E				USMC MV22			
Type	Name	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Terrain Flight (TERF) Routes	212T	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CASE	-	-	-	-	-	-	-	-	-	-	-	-	57	57	-	114	29	29	-	58	-	-	-	-	-	-	-	-	-	-	-	-
	DELUZ	-	-	-	-	-	-	-	-	-	-	-	-	28	28	-	56	18	18	-	36	-	-	-	-	-	-	-	-	-	-	-	-
	DELUZ 2	-	-	-	-	-	-	-	-	-	-	-	-	28	28	-	56	18	18	-	36	-	-	-	-	-	-	-	-	-	-	-	-
	DEVIL	-	-	-	-	-	-	-	-	-	-	-	-	49	49	-	98	11	11	-	22	-	-	-	-	-	-	-	-	-	-	-	-
	MIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	PULGAS	-	-	-	-	-	-	-	-	-	-	-	-	89	89	-	178	39	39	-	78	-	-	-	-	-	-	-	-	-	-	-	-
Close Air Support (CAS) Track[2]	CAS FW	29	10	-	39	9	3	-	12	13	4	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ingress / Egress[2]	FWR-1	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1A	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1B	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-1C	6	2	-	8	2	1	-	3	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-2	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FWR-3	19	6	-	25	6	2	-	8	9	3	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-4				-				-				-	489	163	-	652	234	78	-	312	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-5				-				-				-	489	163	-	652	234	78	-	312	-	-	-	-	-	-	-	-	-	-	-	-
Transition[2]	FWT-1	6	2	-	8	20	7	-	27	5	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RWR-1	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	-	-	-	-	-	-	-	-	1,051	553	177	1,781
	RWR-2	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	-	-	-	-	-	-	-	-	1,051	553	177	1,781
	RWR-3	-	-	-	-	-	-	-	-	-	-	-	-	677	226	-	903	393	131	-	524	-	-	-	-	-	-	-	-	1,051	553	177	1,781
Terrain Flight Routes		-	-	-	-	-	-	-	-	-	-	-	-	252	252	-	504	115	115	-	230	-	-	-	-	-	-	-	-	-	-	-	-
Close Air Support		29	10	-	39	9	3	-	12	13	4	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ingress / Egress		75	24	-	99	24	9	-	33	36	12	-	48	978	326	-	1,304	468	156	-	624	-	-	-	-	-	-	-	-	-	-	-	-
Transition		6	2	-	8	20	7	-	27	5	2	-	7	2,031	678	-	2,709	1,179	393	-	1,572	-	-	-	-	-	-	-	-	3,153	1,659	531	5,343
Grand Total		110	36	-	146	53	19	-	72	54	18	-	72	3,261	1,256	-	4,517	1,762	664	-	2,426	-	-	-	-	-	-	-	-	3,153	1,659	531	5,343

Route		Navy H-60				USAF (Modeled as CH46)				Other USA DoD (Modeled as CH46)				USMC CH-53E				Civilian Law Enforcement Modeled as CH-46				Civilian Medical Evacuation Modeled as CH-46				Other Civilian Modeled as CH-46				TOTAL			
Type	Name	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Terrain Flight (TERF) Routes	212T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2
	CASE	27	27	-	54	1	1	-	2	-	-	-	-	17	17	-	34	-	-	-	-	-	-	-	-	-	-	-	-	131	131	-	262
	DELUZ	4	4	-	8	-	-	-	-	1	1	-	2	9	9	-	18	2	2	-	4	-	-	-	-	1	1	-	2	63	63	-	126
	DELUZ 2	4	4	-	8	-	-	-	-	1	1	-	2	9	9	-	18	2	2	-	4	-	-	-	-	1	1	-	2	63	63	-	126
	DEVIL	8	8	-	16	-	-	-	-	-	-	-	-	6	6	-	12	-	-	-	-	-	-	-	-	-	-	-	-	74	74	-	148
	MIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	PULGAS	1	1	-	2	-	-	-	-	-	-	-	-	16	16	-	32	-	-	-	-	-	-	-	-	1	1	-	2	146	146	-	292
Close Air Support (CAS) Track[2]	CAS FW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	17	-	68
Ingress / Egress[2]	FWR-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	FWR-1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-1B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-1C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	4	-	15
	FWR-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	FWR-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	11	-	45
	RWR-4	3	1	-	4	-	-	-	-	-	-	-	-	17	6	-	23	-	-	-	-	-	-	-	-	-	-	-	-	743	248	-	991
	RWR-5	3	1	-	4	-	-	-	-	-	-	-	-	17	6	-	23	-	-	-	-	-	-	-	-	-	-	-	-	743	248	-	991
Transition[2]	FWT-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	11	-	42
	RWR-1	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,644	1,418	177	5,239
	RWR-2	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,644	1,418	177	5,239
	RWR-3	148	49	-	197	5	2	-	7	38	13	-	51	253	84	-	337	62	21	-	83	37	12	-	49	980	327	-	1,307	3,644	1,418	177	5,239
Terrain Flight Routes		44	44	-	88	1	1	-	2	2	2	-	4	57	57	-	114	4	4	-	8	-	-	-	-	3	3	-	6	478	478	-	956
Close Air Support		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	17	-	68
Ingress / Egress		6	2	-	8	-	-	-	-	-	-	-	-	34	12	-	46	-	-	-	-	-	-	-	-	-	-	-	-	1,621	541	-	2,162
Transition		444	147	-	591	15	6	-	21	114	39	-	153	759	252	-	1,011	186	63	-	249	111	36	-	147	2,940	981	-	3,921	10,963	4,265	531	15,759
Grand Total		494	193	-	687	16	7	-	23	116	41	-	157	850	321	-	1,171	190	67	-	257	111	36	-	147	2,943	984	-	3,927	13,113	5,301	531	18,945

Notes: (1) Values rounded to the nearest whole event
(2) Assumed 75% day / 25% evening operations from grouped transitions in WR 05-07

Sources: WR 05-07, Table 4-1 & Table 4-3 (FY2001)
WR 05-07 MRNmap input files
Wyle Laboratories, 2008

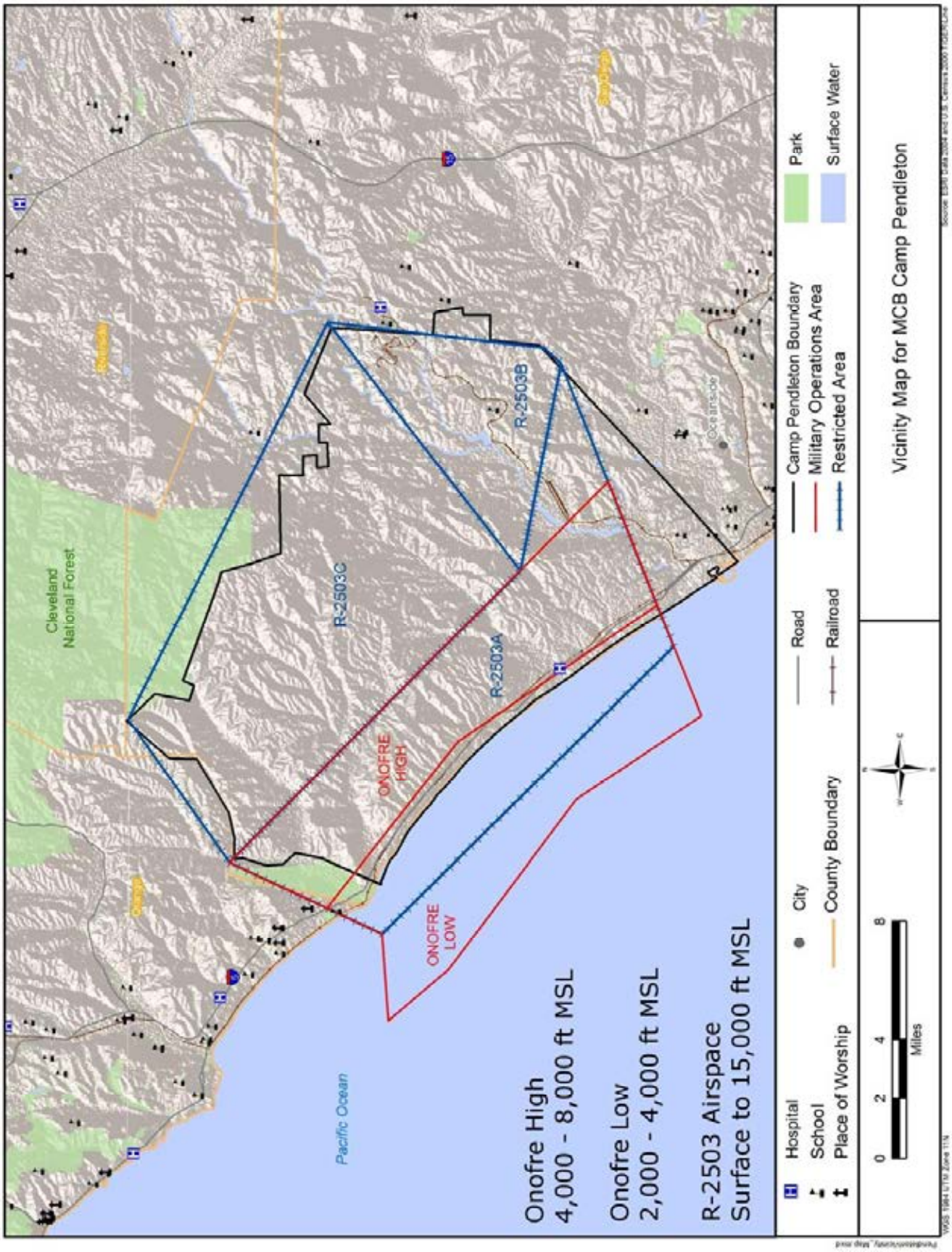
Proposed Annual Area-Type Operation/Sorties for MCB Camp Pendleton/Miramar Airspace (continued)
Page 2 of 2

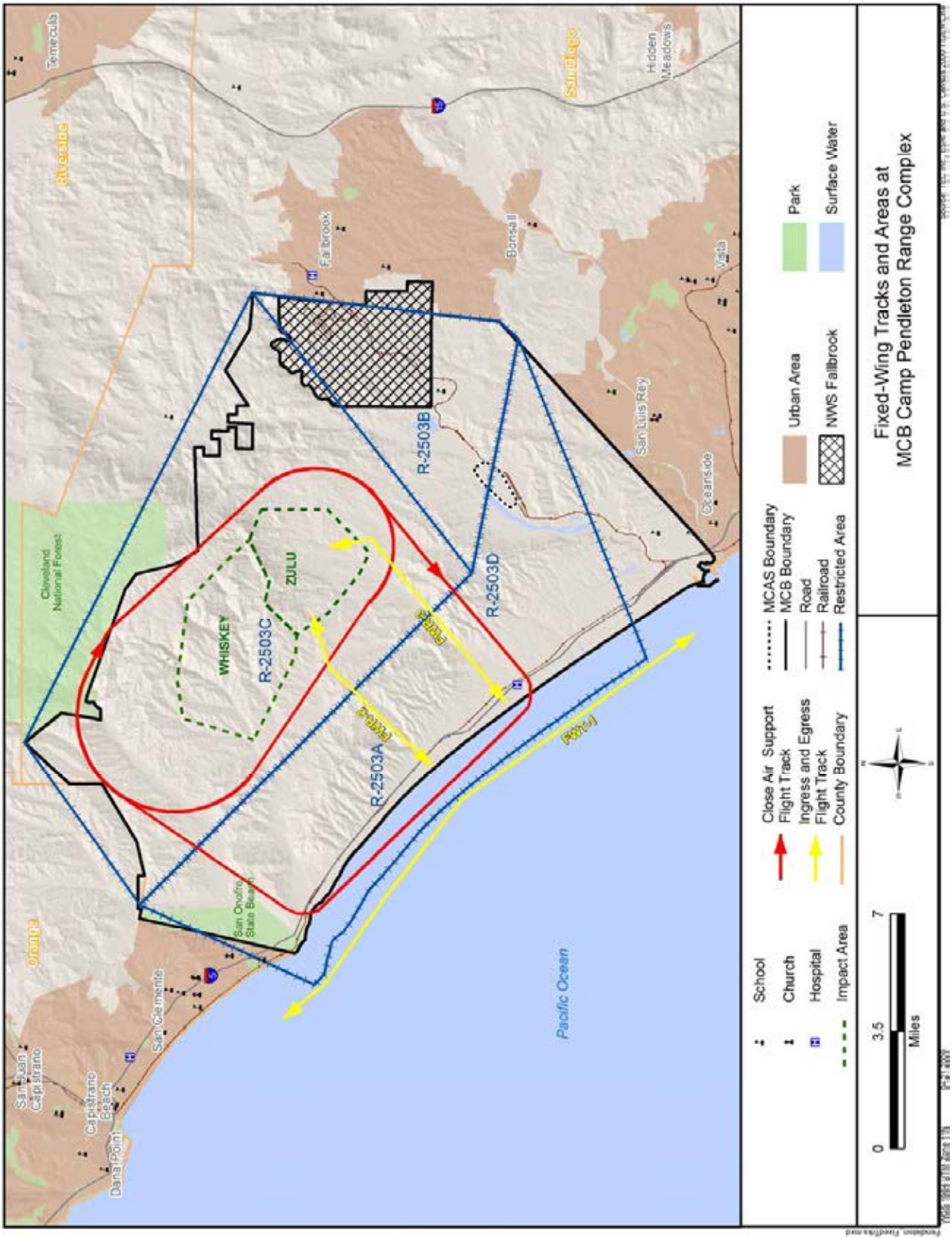
Airspace		Navy H-60				USAF (Modeled as CH46)				Other USA DoD (Modeled as CH46)				USMC CH-53E				Civilian Law Enforcement Modeled as CH-46				Civilian Medical Evacuation Modeled as CH-46				Other Civilian Modeled as CH-46				TOTAL			
Unit	Sub-area	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
Confined Area Landing (CAL) Sites	CAL 01	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	7	1	-	8
	CAL 02	1	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	9	3	-	12
	CAL 03	22	9	-	31	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	230	95	-	325
	CAL 04	19	9	-	28	-	-	-	-	-	-	-	-	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	310	132	-	442
	CAL 05	19	9	-	28	-	-	-	-	-	-	-	-	5	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	915	393	-	1,308
	CAL 09	16	6	-	22	-	-	-	-	-	-	-	-	5	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	149	62	-	211
	CAL 10	23	9	-	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	122	52	-	174
	CAL 13	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	2	-	8
	CAL 14	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	15	5	-	20
	CAL 15	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	9	2	-	11
	CAL 16	1	1	-	2	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	70	31	-	101
	CAL 17	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	85	37	-	122
	CAL 18	1	1	-	2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	110	45	-	155
	CAL 19	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	127	52	-	179
	CAL 20	56	23	-	79	-	-	-	-	-	-	-	-	58	24	-	82	-	-	-	-	-	-	-	-	-	-	-	-	672	283	-	955
	CAL 21	5	3	-	8	-	-	-	-	-	-	-	-	231	101	-	332	-	-	-	-	-	-	-	-	-	-	-	-	287	126	-	413
	CAL 22	8	3	-	11	-	-	-	-	1	-	-	1	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	39	14	-	53
	CAL 23	5	3	-	8	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	7	-	27
Pads	HLZ	104	44	-	148	-	-	-	-	-	-	-	-	36	16	-	52	-	-	-	-	-	-	-	-	-	-	-	-	775	416	74	1,265
	LHD PAD	93	40	-	133	-	-	-	-	7	3	-	10	115	49	-	164	-	-	-	-	-	-	-	-	1	-	-	1	1,491	724	74	2,289
Other Landing Zones (LZ)	LZ 01 VIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	3	-	12
	LZ 06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 11 VIP	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	4	2	-	6
	LZ 12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3	-	8
	LZ 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LZ 16	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	6	2	-	8
	LZ 21	1	1	-	2	-	-	-	-	-	-	-	-	93	41	-	134	-	-	-	-	1	-	-	1	-	-	-	-	140	61	-	201
	LZ 22	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	5	1	-	6
	LZ 27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	4	1	-	5
	LZ 31	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	7	2	-	9
	LZ 33	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	6	2	-	8
	LZ 41	1	1	-	2	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	14	7	-	21
	LZ 43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	4
	LZ 52 VIP	1	1	-	2	-	-	-	-	1	-	-	1	14	6	-	20	-	-	-	-	-	-	-	-	-	-	-	-	40	18	-	58
	LZ 53	1	-	-	1	-	-	-	-	2	2	-	4	67	29	-	96	-	-	-	-	-	-	-	-	-	-	-	-	159	68	-	227
	LZ 62	5	2	-	7	-	-	-	-	-	-	-	-	88	37	-	125	-	-	-	-	-	-	-	-	1	-	-	1	155	63	-	218
	LZ VIEW	106	46	-	152	1	-	-	1	2	-	-	2	35	14	-	49	1	-	-	1	-	-	-	-	1	-	-	1	541	225	-	766
	LZ Red Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3
Short Takeoff and Landing (STOL) Pads	PAD 1	39	17	-	56	-	-	-	-	4	2	-	6	11	5	-	16	-	-	-	-	-	-	-	-	-	-	-	-	272	115	-	387
	PAD 2	7	3	-	10	-	-	-	-	1	-	-	1	3	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	222	92	-	314
	STOL 101	25	11	-	36	-	-	-	-	-	-	-	-	6	3	-	9	-	-	-	-	-	-	-	-	-	-	-	-	135	58	-	193
Drop Zones	BASOLINE	-	-	-	-	2	1	-	3	5	1	-	6	5	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	24	7	-	31
	CASE	25	8	-	33	-	-	-	-	-	-	-	-	90	30	-	120	1	-	-	1	-	-	-	-	2	1	-	3	572	189	-	761
	DELUZ	20	7	-	27	-	-	-	-	-	-	-	-	89	29	-	118	-	-	-	-	-	-	-	-	21	-	-	21	236	73	-	309
	FALLBROOK	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	7	3	-	10
	HORNO	-	-	-	-	-	-	-	-	-	-	-	-	5	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	16	4	-	20
	PAPA 3	-	-	-	-	-	-	-	-	1	-	-	1	176	59	-	235	-	-	-	-	-	-	-	-	1	-	-	1	379	126	-	505
	TANKPARK	1	-	-	1	-	-	-	-	-	-	-	-	24	9	-	33	-	-	-	-	-	-	-	-	-	-	-	-	118	40	-	158
	WILDEAGLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	3	-	11
Helicopter Initial Points (IPs) or Holding Positions	ALISO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3
	BRIGDE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CAL 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3
	HORNO	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	4
	LCAC	21	7	-	28	-	-	-	-	5	2	-	7	46	15	-	61	-	-	-	-	1	-	-	1	1	-	-	1	788	262	-	1,050
	PULGAS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	3	1	-	4
	SONGS	-	-	-	-	-	-	-	-	2	1	-	3	2	1	-	3	-	-	-	-	-	-	-	-	1	-	-	1	12	4	-	16
Impact Areas	Whiskey	2	1	-	3	-	-	-	-	-	-	-	-	3	1	-	4	-	-	-	-	-	-	-	-	1	-	-	1	208	70	-	278
	Zulu	-	-	-	-	-	-	-	-	-	-	-	-	5	2	-	7	-	-	-	-	-	-	-	-	123	-	-	123	369	83	-	452
Confined Area Landing (CAL) Sites		181	79	-	260	-	-	-	-	3	1	-	4	314	134	-	448	-	-	-	-	-	-	-	-	-	-	-	-	3,182	1,342	-	4,524
Drop Zones		46	15	-	61	2	1	-	3	6	1	-	7	391	130	-	521	1	-	-	1	-	-	-	-	24	1	-	25	1,362	445	-	1,807
Helicopter Initial Points (IPs) or Holding Positions		21	7	-	28	-	-	-	-	7	3	-	10	49	16	-	65	-	-	-	-	1	-	-	1	3	-	-	3	810	270	-	1,080
Pads		197	84	-	281	-	-	-	-	7	3	-	10	151	65	-	216	-	-	-	-	-	-	-	-	1	-	-	1	2,266	1,140	148	3,554
Impact Areas		2	1	-	3	-	-	-	-	-	-	-	-	8	3	-	11	-	-	-	-	-	-	-	-	124	-	-	124	577	153	-	730
Other Landing Zones (LZ)		116	51	-	167	1	-	-	1	5	2	-	7	305	131	-	436	1	-	-	1	3	1	-	4	3	-	-	3	1,101	459	-	1,560
Short Takeoff and Landing (STOL) Pads and other pads		71	31	-	102	-	-	-	-	5	2	-	7	20	9	-	29	-	-	-	-	-	-	-	-	-	-	-	-	629	265	-	894
Grand Total		634	268	-	902	3	1	-	4	33	12	-	45	1,238	488	-	1,726	2	-	-	2	4	1	-	5	155	1	-	156	9,927	4,074	148	14,149

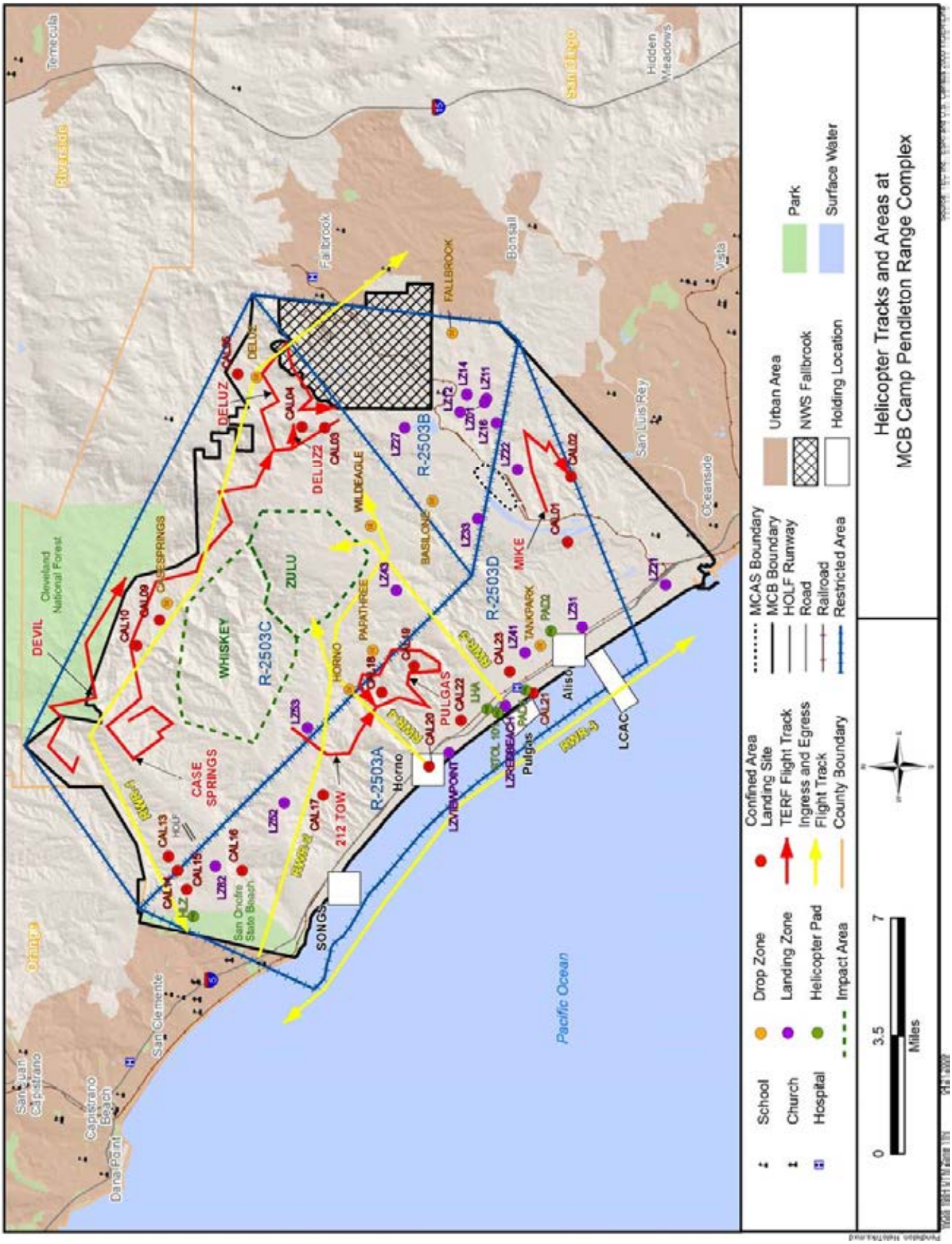
Note: (1) Counted as 2 operations (1 landing + 1 takeoff)
(2) Comprised of FCLP sorties from Camp Pendleton and MCAS Miramar

Sources: WR05-07 Table 4-1, 4-2, 4-4
WR05-07 MRNmap modeling input files
Wyle Labs, 2006

C-1.2.7 MCB Camp Pendleton Modeled Airspace Maps




Fixed-Wing Tracks and Areas at
MCB Camp Pendleton Range Complex
Urban Area
Park
NWS Fallbrook
Surface Water
MCAS Boundary
MCB Boundary
Road
Railroad
Restricted Area
Close Air Support Flight Track
Ingress and Egress Flight Track
County Boundary
School
Church
Hospital
Impact Area
0
3.5
7
Miles
R-2503A
R-2503B
R-2503C
R-2503D
WHISKEY
ZULU
Pacific Ocean
Fallbrook
Bonsall
Vista
San Luis Rey
Oceanside
Hidden Meadows
Temecula
Cleveland National Forest
San Onofre State Beach
San Clemente
Capistrano Beach
Dana Point
San Juan Capistrano


Helicopter Tracks and Areas at
MCB Camp Pendleton Range Complex
Urban Area
NWS Fallbrook
Holding Location
Park
Surface Water
MCAS Boundary
MCB Boundary
HOLF Runway
Road
Railroad
Restricted Area
Confined Area Landing Site
TERF Flight Track
Ingress and Egress Flight Track
County Boundary
Drop Zone
Landing Zone
Helicopter Pad
Impact Area
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Church
Hospital
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Miles
Pacific Ocean
Temecula
Riverside
Orange
San Diego
Hidden Meadows
Fallbrook
Bonsall
Vista
San Luis Rey
Oceanside
San Clemente
San Juan Capistrano
Capistrano Beach
Dana Point
Cleveland National Forest
San Onofre State Beach
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DELUZ
DELUZ2
WILDEAGLE
FALLBROOK
WHISKEY
ZULU
CASE SPRINGS
R-2503C
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R-2503D
R-2503A
BASILONE
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C-1.2.8 Modeled Airspace MCB Camp Pendleton – Flight Profiles Database

MODELED CONDITIONS								BUSY MONTH SORTIES	TIME PER SORTIE (MINUTES)	PERCENT IN RANGE OF ALTITUDE (FT AGL)				
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY			MIN: 200 MAX: 300	0 500	500 1000	1000 2000	TOTAL
CAL01	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	20		65	15	20	20
CAL01	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.17	20		65	15	20	20
CAL01	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.17	20		65	15	20	20
CAL01	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	daytime	0.08	20		65	15	20	20
CAL02	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.17	20		65	15	20	20
CAL02	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	0.08	20		65	15	20	20
CAL02	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	20		65	15	20	20
CAL02	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	0.08	20		65	15	20	20
CAL02	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.58	20		65	15	20	20
CAL02	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.25	20		65	15	20	20
CAL02	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	daytime	0.08	20		65	15	20	20
CAL02	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65	15	20	20
CAL03	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	7.00	20		65	15	20	20
CAL03	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	2.92	20		65	15	20	20
CAL03	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	9.25	20		65	15	20	20
CAL03	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	3.92	20		65	15	20	20
CAL03	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	5.25	20		65	15	20	20
CAL03	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	2.33	20		65	15	20	20
CAL03	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	daytime	0.17	20		65	15	20	20
CAL03	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	evening	0.08	20		65	15	20	20
CAL03	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.83	20		65	15	20	20
CAL03	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.75	20		65	15	20	20
CAL04	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	10.33	20		65	15	20	20
CAL04	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	4.50	20		65	15	20	20
CAL04	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	12.75	20		65	15	20	20
CAL04	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	5.42	20		65	15	20	20
CAL04	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	16.83	20		65	15	20	20
CAL04	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	7.25	20		65	15	20	20
CAL04	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	daytime	0.25	20		65	15	20	20
CAL04	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	evening	0.08	20		65	15	20	20
CAL04	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.58	20		65	15	20	20
CAL04	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.75	20		65	15	20	20
CAL05	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	38.17	20		65	15	20	20
CAL05	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	16.42	20		65	15	20	20
CAL05	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	35.67	20		65	15	20	20
CAL05	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	15.33	20		65	15	20	20
CAL05	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	6.17	20		65	15	20	20
CAL05	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	2.67	20		65	15	20	20
CAL05	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	daytime	0.42	20		65	15	20	20
CAL05	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	evening	0.17	20		65	15	20	20
CAL05	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.58	20		65	15	20	20
CAL05	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.75	20		65	15	20	20
CAL09	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	3.17	20		65	15	20	20
CAL09	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	1.33	20		65	15	20	20
CAL09	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	6.58	20		65	15	20	20
CAL09	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	2.83	20		65	15	20	20
CAL09	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	4.33	20		65	15	20	20
CAL09	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	1.92	20		65	15	20	20
CAL09	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	daytime	0.42	20		65	15	20	20
CAL09	CH-53_CAL	CH-53E	120	CRUISE POWER	69	%Q-BPA	evening	0.17	20		65	15	20	20
CAL09	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.33	20		65	15	20	20
CAL09	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.50	20		65	15	20	20
CAL10	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.92	20		65	15	20	20
CAL10	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	1.33	20		65	15	20	20
CAL10	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	5.00	20		65	15	20	20
CAL10	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	2.17	20		65	15	20	20
CAL10	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.58	20		65	15	20	20
CAL10	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.25	20		65	15	20	20
CAL10	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.92	20		65	15	20	20
CAL10	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.75	20		65	15	20	20

MODELED CONDITIONS								BUSY MONTH SORTIES	TIME PER SORTIE (MINUTES)	PERCENT IN RANGE OF ALTITUDE (FT AGL)				
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY			MIN: 200 MAX: 300	0 500	500 1000	1000 2000	TOTAL
CAL13	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	20		65	15	20	20
CAL13	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.42	20		65	15	20	20
CAL13	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.17	20		65	15	20	20
CAL13	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	daytime	0.08	20		65	15	20	20
CAL13	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	evening	0.08	20		65	15	20	20
CAL14	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	20		65	15	20	20
CAL14	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	0.08	20		65	15	20	20
CAL14	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.58	20		65	15	20	20
CAL14	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.25	20		65	15	20	20
CAL14	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.17	20		65	15	20	20
CAL14	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	evening	0.08	20		65	15	20	20
CAL15	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.25	20		65	15	20	20
CAL15	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	0.08	20		65	15	20	20
CAL15	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.42	20		65	15	20	20
CAL15	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.17	20		65	15	20	20
CAL15	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	20		65	15	20	20
CAL16	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	daytime	1.17	20		65	15	20	20
CAL16	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	evening	0.58	20		65	15	20	20
CAL16	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	4.08	20		65	15	20	20
CAL16	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	1.75	20		65	15	20	20
CAL16	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.67	20		65	15	20	20
CAL16	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.25	20		65	15	20	20
CAL16	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	20		65	15	20	20
CAL16	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	evening	0.08	20		65	15	20	20
CAL16	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	daytime	0.08	20		65	15	20	20
CAL16	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	evening	0.08	20		65	15	20	20
CAL17	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	daytime	2.17	20		65	15	20	20
CAL17	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	evening	1.00	20		65	15	20	20
CAL17	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	4.50	20		65	15	20	20
CAL17	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	1.92	20		65	15	20	20
CAL17	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	1.67	20		65	15	20	20
CAL17	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.67	20		65	15	20	20
CAL17	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	daytime	0.08	20		65	15	20	20
CAL17	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	evening	0.08	20		65	15	20	20
CAL18	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	daytime	2.92	20		65	15	20	20
CAL18	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	evening	1.17	20		65	15	20	20
CAL18	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	5.67	20		65	15	20	20
CAL18	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	2.42	20		65	15	20	20
CAL18	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	5.67	20		65	15	20	20
CAL18	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	2.33	20		65	15	20	20
CAL18	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	20		65	15	20	20
CAL18	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	daytime	0.08	20		65	15	20	20
CAL18	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	evening	0.08	20		65	15	20	20
CAL19	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	daytime	2.92	20		65	15	20	20
CAL19	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	evening	1.17	20		65	15	20	20
CAL19	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	7.00	20		65	15	20	20
CAL19	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	3.00	20		65	15	20	20
CAL19	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	4.67	20		65	15	20	20
CAL19	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	2.00	20		65	15	20	20
CAL19	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	daytime	0.25	20		65	15	20	20
CAL19	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	evening	0.08	20		65	15	20	20
CAL20	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	daytime	25.75	20		65	15	20	20
CAL20	AH-1_CAL	AH-1G	100	LFO UTE 100 KTS	100	KNOTS	evening	11.00	20		65	15	20	20
CAL20	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	19.75	20		65	15	20	20
CAL20	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	8.42	20		65	15	20	20
CAL20	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	11.25	20		65	15	20	20
CAL20	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	4.75	20		65	15	20	20
CAL20	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	4.83	20		65	15	20	20
CAL20	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	evening	2.00	20		65	15	20	20
CAL20	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	daytime	4.67	20		65	15	20	20
CAL20	UH-60_CAL	UH60A	100	LFO UTE 100 KTS	100	KNOTS	evening	1.92	20		65	15	20	20

MODELED CONDITIONS								BUSY MONTH SORTIES	TIME PER SORTIE (MINUTES)	PERCENT IN RANGE OF ALTITUDE (FT AGL)				
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY			MIN: 200 MAX: 300	0 500	500 1000	1000 2000	TOTAL
CAL21	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.25	20		65	15	20	20
CAL21	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	1.00	20		65	15	20	20
CAL21	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	1.67	20		65	15	20	20
CAL21	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	0.75	20		65	15	20	20
CAL21	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	11.42	20		65	15	20	20
CAL21	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	4.92	20		65	15	20	20
CAL21	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	19.25	20		65	15	20	20
CAL21	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	evening	8.42	20		65	15	20	20
CAL21	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.42	20		65	15	20	20
CAL21	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.25	20		65	15	20	20
CAL22	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.75	20		65	15	20	20
CAL22	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	0.33	20		65	15	20	20
CAL22	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.50	20		65	15	20	20
CAL22	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	0.25	20		65	15	20	20
CAL22	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	11.33	20		65	15	20	20
CAL22	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	4.75	20		65	15	20	20
CAL22	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.25	20		65	15	20	20
CAL22	CH-53_CAL	CH-53E	120	CRUISE POWER	68	%Q-BPA	evening	0.08	20		65	15	20	20
CAL22	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.67	20		65	15	20	20
CAL22	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.25	20		65	15	20	20
CAL23	AH-1_CAL	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65	15	20	20
CAL23	UH-1_CAL	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	20		65	15	20	20
CAL23	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	1.67	20		65	15	20	20
CAL23	CH-46_CAL	CH-46E	110	CRUISE POWER	79	%Q-BPA	evening	0.67	20		65	15	20	20
CAL23	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.42	20		65	15	20	20
CAL23	UH-60_CAL	UH60A	100	LFO LITE 100 KTS	100	KNOTS	evening	0.25	20		65	15	20	20

MODELED CONDITIONS						BUSY	TIME PER	PERCENT IN RANGE OF ALTITUDE (FT AGL)						
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER SETTING	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 200 MAX: 300	0 500	0 2000	0 1000	500 2000	1000 1500	1000 TOTAL
CAL 01	MV22_110	TAKEOFF PO	110	100	daytime	0.42	60		100					100
CAL 01	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 02	MV22_110	TAKEOFF PO	110	100	daytime	0.33	60		100					100
CAL 02	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 03	MV22_110	TAKEOFF PO	110	100	daytime	1.00	60		100					100
CAL 03	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100					100
CAL 03	MV22_110	TAKEOFF PO	110	100	daytime	1.00	60		100					100
CAL 03	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100					100
CAL 05	MV22_110	TAKEOFF PO	110	100	daytime	0.42	60		100					100
CAL 05	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 09	MV22_110	TAKEOFF PO	110	100	daytime	0.92	60		100					100
CAL 09	MV22_110	TAKEOFF PO	110	100	evening	0.33	60		100					100
CAL 10	MV22_110	TAKEOFF PO	110	100	daytime	0.33	60		100					100
CAL 10	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 13	MV22_110	TAKEOFF PO	110	100	daytime	0.33	60		100					100
CAL 13	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 14	MV22_110	TAKEOFF PO	110	100	daytime	1.00	60		100					100
CAL 14	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100					100
CAL 15	MV22_110	TAKEOFF PO	110	100	daytime	0.42	60		100					100
CAL 15	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 16	MV22_110	TAKEOFF PO	110	100	daytime	0.42	60		100					100
CAL 16	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 17	MV22_110	TAKEOFF PO	110	100	daytime	0.33	60		100					100
CAL 17	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 18	MV22_110	TAKEOFF PO	110	100	daytime	0.42	60		100					100
CAL 18	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 19	MV22_110	TAKEOFF PO	110	100	daytime	0.42	60		100					100
CAL 19	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 20	MV22_110	TAKEOFF PO	110	100	daytime	1.00	60		100					100
CAL 20	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100					100
CAL 21	MV22_110	TAKEOFF PO	110	100	daytime	0.33	60		100					100
CAL 21	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100					100
CAL 22	MV22_110	TAKEOFF PO	110	100	daytime	1.00	60		100					100
CAL 22	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100					100
CAL 23	MV22_110	TAKEOFF PO	110	100	daytime	0.92	60		100					100
CAL 23	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100					100

MODELED CONDITIONS								BUSY MONTH SORTIES	TIME PER SORTIE (MINUTES)	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)												
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY			MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 5000	1500 5000	1000 12000	2000 15000	12000 27000	TOTAL
DZBASILONE	AH-1_DZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.75	30				90						10		100
DZBASILONE	CH-46_DZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	2.50	30				90						10		100
DZBASILONE	CH-53_DZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.42	30				90						10		100
DZCASESPRIN	F-18_DZ	F-18	250	TRAFFIC PATTERN	82	% N C	daytime	0.17	30				90						10		100
DZCASESPRIN	AH-1_DZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	25.50	30				90						10		100
DZCASESPRIN	UH-1_DZ	UH-1N	80	FLT AT 80 KTS	100	% R PM	daytime	11.67	30				90						10		100
DZCASESPRIN	CH-46_DZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	25.67	30				90						10		100
DZCASESPRIN	CH-53_DZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	7.50	30				90						10		100
DZCASESPRIN	UH-60_DZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.08	30				90						10		100
DZDELUZ	AH-1_DZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	6.08	30				90						10		100
DZDELUZ	UH-1_DZ	UH-1N	80	FLT AT 80 KTS	100	% R PM	daytime	2.50	30				90						10		100
DZDELUZ	CH-46_DZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	32.50	30				90						10		100
DZDELUZ	CH-53_DZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	7.42	30				90						10		100
DZDELUZ	UH-60_DZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.67	30				90						10		100
DZFALLBROO	CH-46_DZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.92	30				90						10		100
DZFALLBROO	CH-53_DZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.17	30				90						10		100
DZHORNO	AH-1_DZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.42	30				90						10		100
DZHORNO	UH-1_DZ	UH-1N	80	FLT AT 80 KTS	100	% R PM	daytime	0.08	30				90						10		100
DZHORNO	CH-46_DZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	1.50	30				90						10		100
DZHORNO	CH-53_DZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.42	30				90						10		100
DZTANKPARK	AH-1_DZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	5.67	30				90						10		100
DZTANKPARK	UH-1_DZ	UH-1N	80	FLT AT 80 KTS	100	% R PM	daytime	1.83	30				90						10		100
DZTANKPARK	CH-46_DZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	8.33	30				90						10		100
DZTANKPARK	CH-53_DZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	2.00	30				90						10		100
DZTANKPARK	UH-60_DZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	30				90						10		100
DZWILDEAGLE	AH-1_DZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.25	30				90						10		100
DZWILDEAGLE	UH-1_DZ	UH-1N	80	FLT AT 80 KTS	100	% R PM	daytime	0.17	30				90						10		100
DZWILDEAGLE	CH-46_DZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.08	30				90						10		100

MODELED CONDITIONS						BUSY MONTH SORTIES	TIME PER SORTIE (MINUTES)	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)											
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER SETTING	PERIOD OF DAY			MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 1500	1500 5000	1000 12000	2000 15000	12000 27000	TOTAL
DZBASILONE	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100										100
DZBASILONE	MV22_110	TAKEOFF PO	110	100	nighttime	0.08	60		100										100
DZCASESPRIN	MV22_110	TAKEOFF PO	110	100	evening	0.50	60		100										100
DZCASESPRIN	MV22_110	TAKEOFF PO	110	100	nighttime	0.08	60		100										100
DZDELUZ	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100										100
DZDELUZ	MV22_110	TAKEOFF PO	110	100	nighttime	0.08	60		100										100
DZFALLBROO	MV22_110	TAKEOFF PO	110	100	evening	0.42	60		100										100
DZFALLBROO	MV22_110	TAKEOFF PO	110	100	nighttime	0.17	60		100										100
DZHORNO	MV22_110	TAKEOFF PO	110	100	evening	0.42	60		100										100
DZHORNO	MV22_110	TAKEOFF PO	110	100	nighttime	0.08	60		100										100
DZTANKPARK	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100										100
DZTANKPARK	MV22_110	TAKEOFF PO	110	100	nighttime	0.08	60		100										100
DZWILDEAGLE	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100										100
DZWILDEAGLE	MV22_110	TAKEOFF PO	110	100	nighttime	0.08	60		100										100

MODELED CONDITIONS								BUSY	TIME PER	S) IN RANGE OF ALTITUDE (FT AGL)												
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 1500	1500 5000	1000 12000	2000 15000	12000 27000	TOTAL
P ALISO	UH-1_IP	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	0.17	5						100						100
P SONGS	AH-1_IP	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.50	5						100						100
P SONGS	UH-1_IP	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	0.08	5						100						100
P SONGS	CH-46_IP	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.67	5						100						100
P SONGS	CH-53_IP	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.17	5						100						100
P HORNO	AH-1_IP	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.17	5						100						100
P HORNO	CH-46_IP	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.33	5						100						100
P HORNO	CH-53_IP	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	5						100						100
P PULGAS	AH-1_IP	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.17	5						100						100
P PULGAS	CH-46_IP	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.17	5						100						100
P LCAC	AH-1_IP	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	36.42	5						100						100
P LCAC	UH-1_IP	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	23.08	5						100						100
P LCAC	CH-46_IP	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	39.92	5						100						100
P LCAC	CH-53_IP	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	3.83	5						100						100
P LCAC	UH-60_IP	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	daytime	1.75	5						100						100
P CAL2	AH-1_IP	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.17	5						100						100

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)											
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 1500	1500 5000	1000 12000	2000 15000	12000 27000	TOTAL
LZ01	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.17	20		65			15	20						100
LZ11	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.17	20		65			15	20						100
LZ11	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	20		65			15	20						100
LZ12	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ12	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	20		65			15	20						100
LZ12	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.58	20		65			15	20						100
LZ16	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ16	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	20		65			15	20						100
LZ16	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.50	20		65			15	20						100
LZ16	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	20		65			15	20						100
LZ21	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.67	20		65			15	20						100
LZ21	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	2.83	20		65			15	20						100
LZ21	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	14.42	20		65			15	20						100
LZ21	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	7.75	20		65			15	20						100
LZ21	UH-60_LZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ22	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ22	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.58	20		65			15	20						100
LZ22	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	20		65			15	20						100
LZ27	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.25	20		65			15	20						100
LZ31	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ31	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	2.17	20		65			15	20						100
LZ31	UH-60_LZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ33	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	1.00	20		65			15	20						100
LZ33	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.25	20		65			15	20						100
LZ41	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.17	20		65			15	20						100
LZ41	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.50	20		65			15	20						100
LZ41	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	1.50	20		65			15	20						100
LZ41	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.17	20		65			15	20						100
LZ41	UH-60_LZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ43	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ43	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.17	20		65			15	20						100
LZ43	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.67	20		65			15	20						100
LZ52	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.83	20		65			15	20						100
LZ52	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.92	20		65			15	20						100
LZ52	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	4.17	20		65			15	20						100
LZ52	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	1.17	20		65			15	20						100
LZ52	UH-60_LZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ53	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	4.00	20		65			15	20						100
LZ53	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	2.67	20		65			15	20						100
LZ53	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	27.42	20		65			15	20						100
LZ53	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	5.58	20		65			15	20						100
LZ53	UH-60_LZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	20		65			15	20						100
LZ62	AH-1_LZ	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.00	20		65			15	20						100
LZ62	UH-1_LZ	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	2.08	20		65			15	20						100
LZ62	CH-46_LZ	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	36.50	20		65			15	20						100
LZ62	CH-53_LZ	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	7.33	20		65			15	20						100
LZ62	UH-60_LZ	UH60A	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.42	20		65			15	20						100

MODELED CONDITIONS						BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)											
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER SETTING	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 1500	1500 5000	1000 12000	2000 15000	12000 27000	TOTAL
LZ01	MV22_110	TAKEOFF PO	110	100	daytime	0.75	60		100										100
LZ01	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100										100
LZ11	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ11	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ12	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ12	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ16	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ16	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ21	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ21	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ22	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ22	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ27	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ27	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ31	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ31	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ33	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ33	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ41	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ41	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ52	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100
LZ52	MV22_110	TAKEOFF PO	110	100	evening	0.08	60		100										100
LZ53	MV22_110	TAKEOFF PO	110	100	daytime	0.75	60		100										100
LZ53	MV22_110	TAKEOFF PO	110	100	evening	0.17	60		100										100
LZ62	MV22_110	TAKEOFF PO	110	100	daytime	1.00	60		100										100
LZ62	MV22_110	TAKEOFF PO	110	100	evening	0.25	60		100										100
LZRB	MV22_110	TAKEOFF PO	110	100	daytime	0.25	60		100										100

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)												
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 1500	1500 5000	10000 12000	2000 15000	12000 27000	TOTAL
PAD1	AH-1_PAD	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	11.92		65			15	20						100
PAD1	UH-1_PAD	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	5.33		65			15	20						100
PAD1	CH-46_PAD	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	32.75		65			15	20						100
PAD1	CH-53_PAD	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	0.92		65			15	20						100
PAD1	UH-60_PAD	UH60A	100	LFO LITE 100 KTS		100	KNOTS	daytime	3.25		65			15	20						100
PAD2	AH-1_PAD	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	10.92		65			15	20						100
PAD2	UH-1_PAD	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	5.75		65			15	20						100
PAD2	CH-46_PAD	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	6.67		65			15	20						100
PAD2	CH-53_PAD	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	0.25		65			15	20						100
PAD2	UH-60_PAD	UH60A	100	LFO LITE 100 KTS		100	KNOTS	daytime	0.58		65			15	20						100
STOL 101	AH-1_PAD	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	4.75		65			15	20						100
STOL 101	UH-1_PAD	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	3		65			15	20						100
STOL 101	CH-46_PAD	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	13.5		65			15	20						100
STOL 101	CH-53_PAD	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	0.5		65			15	20						100
STOL 101	UH-60_PAD	UH60A	100	LFO LITE 100 KTS		100	KNOTS	daytime	2.08		65			15	20						100
HLZ	AH-1_PAD	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	13.58		65			15	20						100
HLZ	UH-1_PAD	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	5.5		65			15	20						100
HLZ	CH-46_PAD	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	29.17		65			15	20						100
HLZ	CH-53_PAD	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	3		65			15	20						100
HLZ	UH-60_PAD	UH60A	100	LFO LITE 100 KTS		100	KNOTS	daytime	8.67		65			15	20						100
LHA	AH-1_PAD	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	53		65			15	20						100
LHA	UH-1_PAD	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	19.33		65			15	20						100
LHA	CH-46_PAD	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	51.58		65			15	20						100
LHA	CH-53_PAD	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	9.58		65			15	20						100
LHA	UH-60_PAD	UH60A	100	LFO LITE 100 KTS		100	KNOTS	daytime	7.75		65			15	20						100
LZVP	AH-1_PAD	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	18.92		65			15	20						100
LZVP	UH-1_PAD	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	13.75		65			15	20						100
LZVP	CH-46_PAD	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	38.58		65			15	20						100
LZVP	CH-53_PAD	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	2.92		65			15	20						100
LZVP	UH-60_PAD	UH60A	100	LFO LITE 100 KTS		100	KNOTS	daytime	20.42		65			15	20						100

MODELED CONDITIONS						BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)											
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER SETTING	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 1500	1500 5000	10000 12000	2000 15000	12000 27000	TOTAL
PAD1	MV22_110	TAKEOFF PO	110	100	evening	0.92	60		100										100
PAD1	MV22_110	TAKEOFF PO	110	100	nighttime	0.25	60		100										100
PAD2	MV22_110	TAKEOFF PO	110	100	evening	0.92	60		100										100
PAD2	MV22_110	TAKEOFF PO	110	100	nighttime	0.25	60		100										100
STOL 101	MV22_110	TAKEOFF PO	110	100	evening	0.92	60		100										100
STOL 101	MV22_110	TAKEOFF PO	110	100	nighttime	0.25	60		100										100
HLZ	MV22_85	TAKEOFF PO	85	100	daytime	33.83	60		100										100
HLZ	MV22_85	TAKEOFF PO	85	100	evening	21.5	60		100										100
HLZ	MV22_85	TAKEOFF PO	85	100	nighttime	6.17	60		100										100
LHD	MV22_85	TAKEOFF PO	85	100	daytime	33.92	60		100										100
LHD	MV22_85	TAKEOFF PO	85	100	evening	21.58	60		100										100
LHD	MV22_85	TAKEOFF PO	85	100	nighttime	62.17	60		100										100
LZVP	MV22_85	TAKEOFF PO	85	100	nighttime	0.25	60		100										100

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)											
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 200 MAX: 300	0 500	0 1000	0 2000	500 1000	1000 2000	1000 1500	1500 5000	10000 12000	2000 15000	12000 27000	TOTAL
TERF 212 TOW	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	0.08	100											100
TERF 212 TOW	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	evening	0.08	100											100
TERF 212 TOW	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	0.17	100											100
TERF 212 TOW	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	evening	0.17	100											100
TERF PULGAS	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	7.42	100											100
TERF PULGAS	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	evening	7.42	100											100
TERF PULGAS	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	3.25	100											100
TERF PULGAS	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	evening	3.25	100											100
TERF PULGAS	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	3.50	100											100
TERF PULGAS	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	evening	3.50	100											100
TERF PULGAS	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	1.33	100											100
TERF PULGAS	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	evening	1.33	100											100
TERF PULGAS	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	daytime	0.08	100											100
TERF PULGAS	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	evening	0.08	100											100
TERF CASE S	NGS AH-1_T	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	4.75	100											100
TERF CASE S	NGS AH-1_T	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	evening	4.75	100											100
TERF CASE S	NGS UH-1_T	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	2.42	100											100
TERF CASE S	NGS UH-1_T	UH-1N	80	FLT AT 80 KTS		100	% RPM	evening	2.42	100											100
TERF CASE S	NGS CH-46_	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	6.58	100											100
TERF CASE S	NGS CH-46_	CH-46E	110	CRUISE POWER		79	%Q-BPA	evening	6.58	100											100
TERF CASE S	NGS CH-53_	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	1.42	100											100
TERF CASE S	NGS CH-53_	CH-53E	120	CRUISE POWER		68	%Q-BPA	evening	1.42	100											100
TERF CASE S	NGS UH-60_	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	daytime	2.25	100											100
TERF CASE S	NGS UH-60_	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	evening	2.25	100											100
TERF DELUZ	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	2.33	100											100
TERF DELUZ	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	evening	2.33	100											100
TERF DELUZ	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	1.50	100											100
TERF DELUZ	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	evening	1.50	100											100
TERF DELUZ	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	3.33	100											100
TERF DELUZ	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	evening	3.33	100											100
TERF DELUZ	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	0.75	100											100
TERF DELUZ	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	evening	0.75	100											100
TERF DELUZ	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	daytime	0.33	100											100
TERF DELUZ	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	evening	0.33	100											100
TERF DELUZ 2	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	2.33	100											100
TERF DELUZ 2	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	evening	2.33	100											100
TERF DELUZ 2	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	1.50	100											100
TERF DELUZ 2	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	evening	1.50	100											100
TERF DELUZ 2	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	2.83	100											100
TERF DELUZ 2	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	evening	2.83	100											100
TERF DELUZ 2	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	0.75	100											100
TERF DELUZ 2	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	evening	0.75	100											100
TERF DELUZ 2	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	daytime	0.33	100											100
TERF DELUZ 2	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	evening	0.33	100											100
TERF DEVIL	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	daytime	4.08	100											100
TERF DEVIL	AH-1_TERF	AH-1G	100	LFO LITE 100 KTS		100	KNOTS	evening	4.08	100											100
TERF DEVIL	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	daytime	0.92	100											100
TERF DEVIL	UH-1_TERF	UH-1N	80	FLT AT 80 KTS		100	% RPM	evening	0.92	100											100
TERF DEVIL	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	2.50	100											100
TERF DEVIL	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	evening	2.50	100											100
TERF DEVIL	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	daytime	0.50	100											100
TERF DEVIL	CH-53_TERF	CH-53E	120	CRUISE POWER		68	%Q-BPA	evening	0.50	100											100
TERF DEVIL	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	daytime	0.67	100											100
TERF DEVIL	UH-60_TERF	UH60A	100	LFO LOAD 100 KTS		100	KNOTS	evening	0.67	100											100
TERF MIKE	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	daytime	0.42	100											100
TERF MIKE	CH-46_TERF	CH-46E	110	CRUISE POWER		79	%Q-BPA	evening	0.42	100											100

MODELED CONDITIONS								BUSY	TIME PER	PERCENT IN RANGE OF ALTITUDE (FT AGL)				
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	0 500	1000 1500	1000 2000	10000 12000	TOTAL
RWR-1	AH-1_TRANS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	56.42		100				100
RWR-1	AH-1_TRANS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	18.83		100				100
RWR-1	UH-1_TRANS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	32.75		100				100
RWR-1	UH-1_TRANS	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	10.92		100				100
RWR-1	CH-46_TRAN	CH-46E	110	CRUISE POWER	79	%Q-BP	A daytime	165.83		100				100
RWR-1	CH-46_TRAN	CH-46E	110	CRUISE POWER	79	%Q-BP	A evening	55.33		100				100
RWR-1	CH-53_TRAN	CH-53E	120	CRUISE POWER	68	%Q-BP	A daytime	21.08		100				100
RWR-1	CH-53_TRAN	CH-53E	120	CRUISE POWER	68	%Q-BP	A evening	7.00		100				100
RWR-1	UH-60_TRAN	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	daytime	12.33		100				100
RWR-1	UH-60_TRAN	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	evening	4.08		100				100
RWR-2	AH-1_TRANS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	56.42		100				100
RWR-2	AH-1_TRANS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	18.83		100				100
RWR-2	UH-1_TRANS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	32.75		100				100
RWR-2	UH-1_TRANS	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	10.92		100				100
RWR-2	CH-46_TRAN	CH-46E	110	CRUISE POWER	79	%Q-BP	A daytime	165.83		100				100
RWR-2	CH-46_TRAN	CH-46E	110	CRUISE POWER	79	%Q-BP	A evening	55.33		100				100
RWR-2	CH-53_TRAN	CH-53E	120	CRUISE POWER	68	%Q-BP	A daytime	21.08		100				100
RWR-2	CH-53_TRAN	CH-53E	120	CRUISE POWER	68	%Q-BP	A evening	7.00		100				100
RWR-2	UH-60_TRAN	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	daytime	12.33		100				100
RWR-2	UH-60_TRAN	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	evening	4.08		100				100
RWR-3	AH-1_TRANS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	56.42		100				100
RWR-3	AH-1_TRANS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	18.83		100				100
RWR-3	UH-1_TRANS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	32.75		100				100
RWR-3	UH-1_TRANS	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	10.92		100				100
RWR-3	CH-46_TRAN	CH-46E	110	CRUISE POWER	79	%Q-BP	A daytime	165.83		100				100
RWR-3	CH-46_TRAN	CH-46E	110	CRUISE POWER	79	%Q-BP	A evening	55.33		100				100
RWR-3	CH-53_TRAN	CH-53E	120	CRUISE POWER	68	%Q-BP	A daytime	21.08		100				100
RWR-3	CH-53_TRAN	CH-53E	120	CRUISE POWER	68	%Q-BP	A evening	7.00		100				100
RWR-3	UH-60_TRAN	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	daytime	12.33		100				100
RWR-3	UH-60_TRAN	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	evening	4.08		100				100
RWR-4	AH-1_AR	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	40.75				100		100
RWR-4	AH-1_AR	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	13.58				100		100
RWR-4	UH-1_AR	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	19.50				100		100
RWR-4	UH-1_AR	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	6.50				100		100
RWR-4	CH-46_AR	CH-46E	110	CRUISE POWER	79	%Q-BP	A daytime	4.17				100		100
RWR-4	CH-46_AR	CH-46E	110	CRUISE POWER	79	%Q-BP	A evening	1.42				100		100
RWR-4	CH-53_AR	CH-53E	120	CRUISE POWER	68	%Q-BP	A daytime	1.42				100		100
RWR-4	CH-53_AR	CH-53E	120	CRUISE POWER	68	%Q-BP	A evening	0.50				100		100
RWR-4	UH-60_AR	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	daytime	0.25				100		100
RWR-4	UH-60_AR	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	evening	0.08				100		100
RWR-5	AH-1_AR	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	40.75				100		100
RWR-5	AH-1_AR	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	evening	13.58				100		100
RWR-5	UH-1_AR	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	19.50				100		100
RWR-5	UH-1_AR	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	6.50				100		100
RWR-5	CH-46_AR	CH-46E	110	CRUISE POWER	79	%Q-BP	A daytime	4.17				100		100
RWR-5	CH-46_AR	CH-46E	110	CRUISE POWER	79	%Q-BP	A evening	1.42				100		100
RWR-5	CH-53_AR	CH-53E	120	CRUISE POWER	68	%Q-BP	A daytime	1.42				100		100
RWR-5	CH-53_AR	CH-53E	120	CRUISE POWER	68	%Q-BP	A evening	0.50				100		100
RWR-5	UH-60_AR	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	daytime	0.25				100		100
RWR-5	UH-60_AR	UH60A	100	LFO LOAD 100 KTS	100	KNOTS	evening	0.08				100		100
FWT-1	F-18_TRANS	F-18	250	TRAFFIC PATTERN	82	% NC	daytime	2.08					100	100
FWT-1	F-18_TRANS	F-18	250	TRAFFIC PATTERN	82	% NC	evening	0.75					100	100
FWT-1	AV-8_TRANS	AV-8B	230	TRAFFIC PATTERN	70	% RPM	daytime	0.50					100	100
FWT-1	AV-8_TRANS	AV-8B	230	TRAFFIC PATTERN	70	% RPM	evening	0.17					100	100

MODELED CONDITIONS						BUSY	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)											
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER SETTING	PERIOD OF DAY	MONTH SORTIES	MIN: 200 MAX: 300	0 500	0 1000	0 2000	0 500	0 1000	0 2000	500 1000	1000 1500	1000 2000	5000 12000	TOTAL
RWR-1	MV22_110	TAKEOFF PO	110	100	daytime	87.58		100										100
RWR-1	MV22_110	TAKEOFF PO	110	100	evening	46.08		100										100
RWR-1	MV22_110	TAKEOFF PO	110	100	nighttime	14.75		100										100
RWR-2	MV22_110	TAKEOFF PO	110	100	daytime	87.58		100										100
RWR-2	MV22_110	TAKEOFF PO	110	100	evening	46.08		100										100
RWR-2	MV22_110	TAKEOFF PO	110	100	nighttime	14.75		100										100
RWR-3	MV22_110	TAKEOFF PO	110	100	daytime	87.58		100										100
RWR-3	MV22_110	TAKEOFF PO	110	100	evening	46.08		100										100
RWR-3	MV22_110	TAKEOFF PO	110	100	nighttime	14.75		100										100

C-1.2.9 Modeled Flight Operations for the HOLF at Camp Pendleton

Pendleton HOLF Baseline Scenario Operations

	Ingress(3)				FCLPs(1) at the HOLF				Egress(3)			
	Day	Eve	Night	total	Day	Eve	Night	total	Day	Eve	Night	total
CH-46E	160	68	-	228	1,600	680	-	2,280	160	68	-	228
CH-53E	19	8	-	27	190	80	-	270	19	8	-	27
AH-1	1,042	447	-	1,489	10,420	4,470	-	14,890	1,042	447	-	1,489
UH-1	643	275	-	918	6,430	2,750	-	9,180	643	275	-	918
MV22	-	-	-	-	-	-	-	-	-	-	-	-
Total	**1,864**	**798**	**-**	**2,662**	**18,640**	**7,980**	**-**	**26,620**	**1,864**	**798**	**-**	**2,662**

Day: 0700-1859; Eve: 1900-2159; Night 2200-0659

Notes: (1) counted here as two (2) operations each (1 arrival + 1 departure)
(2) 5 loops/pattern per sortie
(3) 1 ingress and 1 egress per sortie modeled for all aircraft

Pendleton HOLF Proposed Scenario Operations

	Ingress(3)				FCLPs(1,2) at the HOLF				Egress(3)			
	Day	Eve	Night	total	Day	Eve	Night	total	Day	Eve	Night	total
CH-46E	-	-	-	-	-	-	-	-	-	-	-	-
CH-53E	19	8	-	27	190	80	-	270	19	8	-	27
AH-1	1,042	447	-	1,489	10,420	4,470	-	14,890	1,042	447	-	1,489
UH-1	643	275	-	918	6,430	2,750	-	9,180	643	275	-	918
MV22	575	164	82	821	5,748	1,643	821	8,212	575	164	82	821
Total	**2,279**	**894**	**82**	**3,255**	**22,788**	**8,943**	**821**	**32,552**	**2,279**	**894**	**82**	**3,255**

Day: 0700-1859; Eve: 1900-2159; Night 2200-0659

Notes: (1) counted here as two (2) operations each (1 arrival + 1 departure)
(2) 5 loops/pattern per sortie
(3) 1 ingress and 1 egress per sortie modeled for all aircraft

C-1.2.10 Modeled Runway and Flight Track Utilization for the HOLF at MCB Camp Pendleton

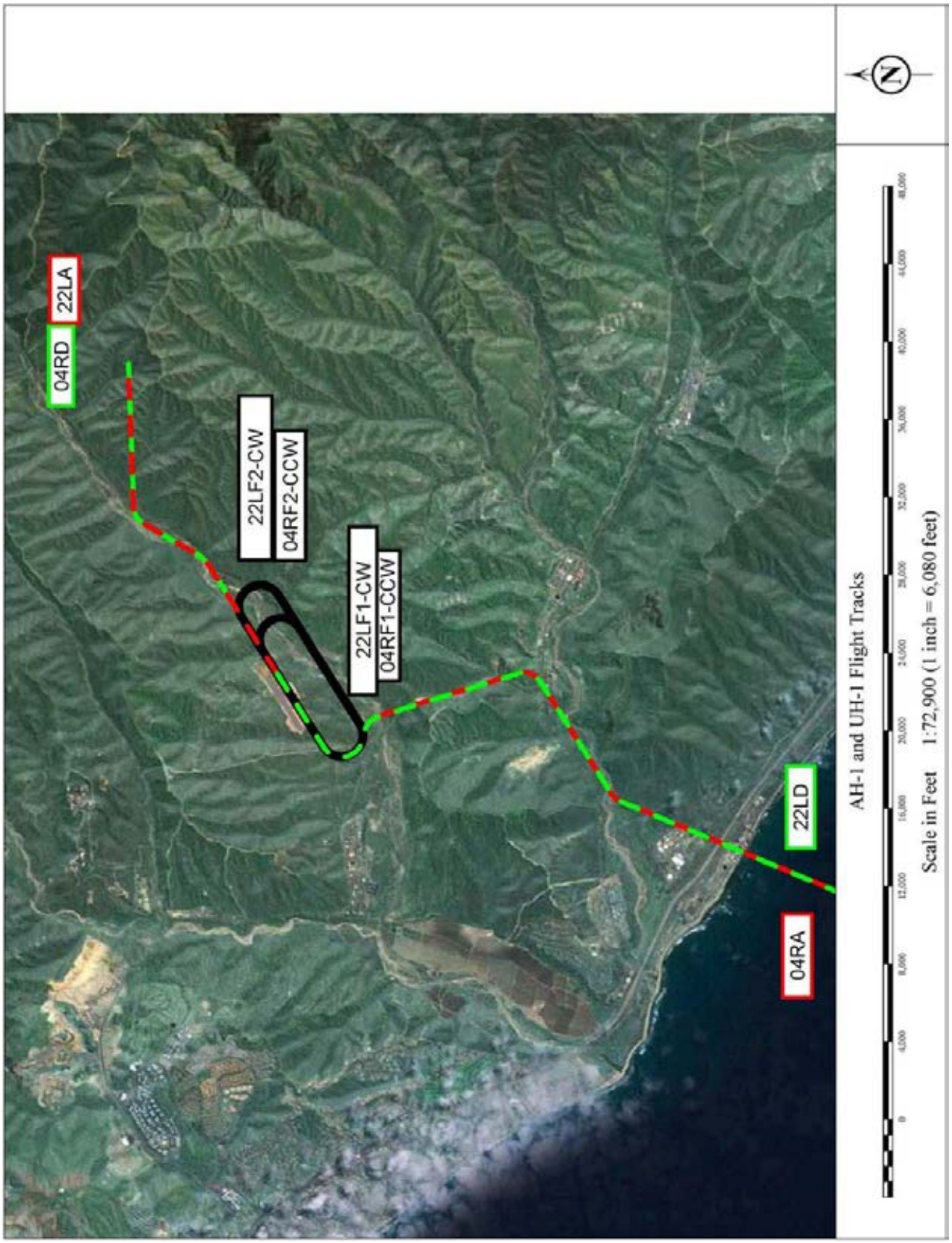
Pendleton HOLF Track Usage on Grass RWY 04R and 22L (AH-1: UH-1 only)

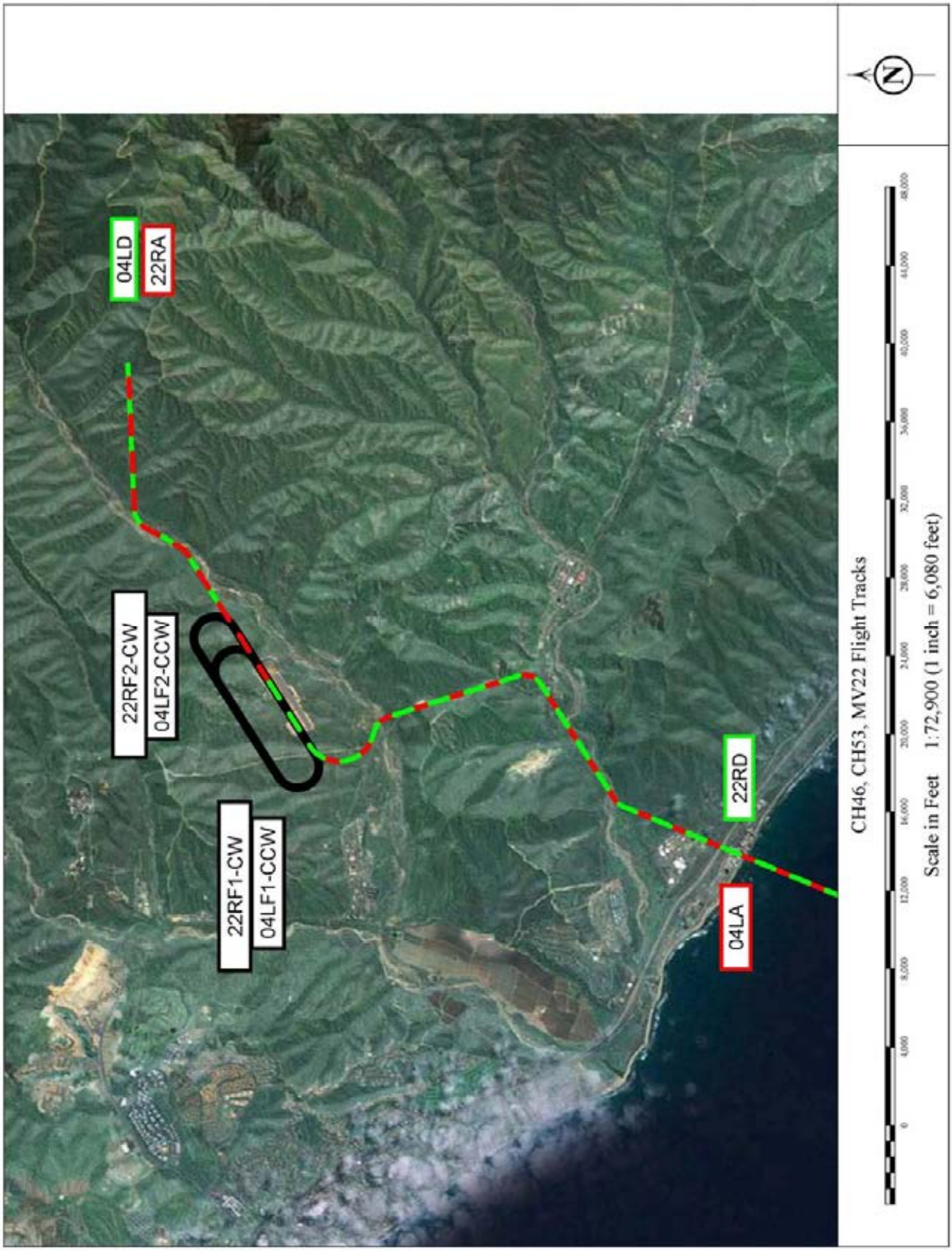
Op Type	Runway	Percentages D/E/N	Track ID	Track Description	Track Percent D/E/N	Norm vs Ext Patt D/E/N
Departure	04 to Offshore	***75%***	4LD	RWY 04L - Departure to Offshore	-	
		75%	4RD	RWY 04R - Departure to the Offshore	100%	
	22 to Case Spring	***25%***	22LD	RWY 22L - Departure to the Case Spring	100%	
		25%	22RD	RWY 22R - Departure to Case Spring	-	
Arrivals	04 from Offshore	***75%***	4LA	Arrival from East to RWY 04L	-	
		75%	4RA	Arrival from East to RWY 04R	100%	
	22 from Case Spring	***25%***	22LA	Arrival from West to RWY 22L	100%	
		25%	22RA	Arrival from West to RWY 22R	-	
Touch & Go	04 Offshore direction	***75%***	04LF1	Normal Pattern on RWY 04L	-	***50%***
		75%	04RF1	Normal Pattern on RWY 04R	100%	50%
		75%	04LF2	Extended Pattern on RWY 04L	-	***50%***
		75%	04RF2	Extended Pattern on RWY 04R	100%	50%
	22 Case Spring direction	***25%***	22LF1	Normal Pattern on RWY 22L	100%	***50%***
		25%	22RF1	Normal Pattern on RWY 22R	-	50%
		25%	22LF2	Extended Pattern on RWY 22L	100%	***50%***
		25%	22RF2	Extended Pattern on RWY 22R	-	50%

Pendleton HOLF Track Usage on Paved RWY 04L and 22R (CH53, CH46 & MV22 only)

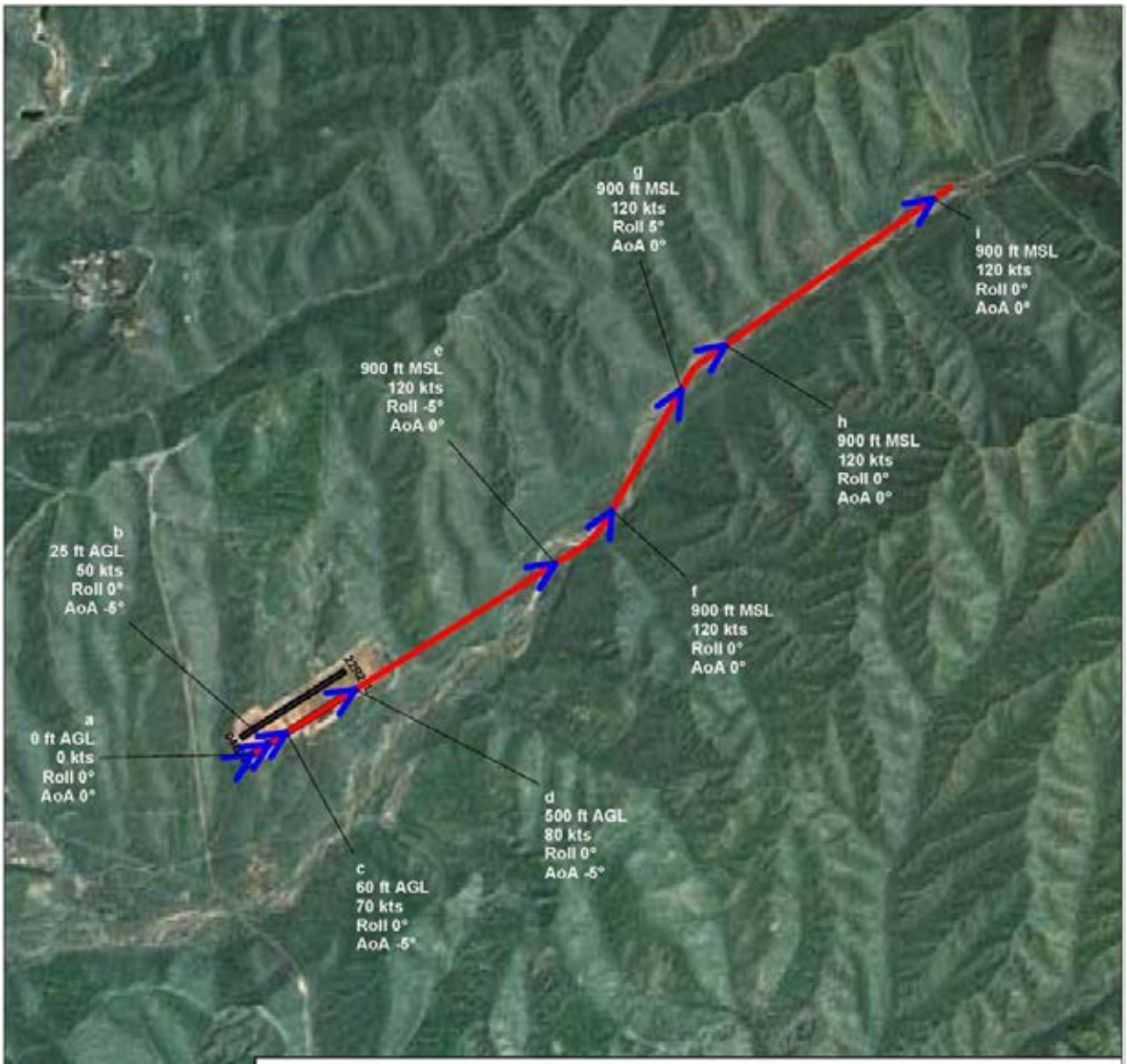
Op Type	Runway	Percentages D/E/N	Track ID	Track Description	Track Percent D/E/N	Norm vs Ext Patt D/E/N
Departure	04 to Offshore	***75%***	4LD	RWY 04L - Departure to Offshore	100%	
		75%	4RD	RWY 04R - Departure to the Offshore	-	
	22 to Case Spring	***25%***	22LD	RWY 22L - Departure to the Case Spring	-	
		25%	22RD	RWY 22R - Departure to Case Spring	100%	
Arrivals	04 from Offshore	***75%***	4LA	Arrival from East to RWY 04L	100%	
		75%	4RA	Arrival from East to RWY 04R	-	
	22 from Case Spring	***25%***	22LA	Arrival from West to RWY 22L	-	
		25%	22RA	Arrival from West to RWY 22R	100%	
Touch & Go	04 Offshore direction	***75%***	04LF1	Normal Pattern on RWY 04L	100%	***50%***
		75%	04RF1	Normal Pattern on RWY 04R	-	50%
		75%	04LF2	Extended Pattern on RWY 04L	100%	***50%***
		75%	04RF2	Extended Pattern on RWY 04R	-	50%
	22 Case Spring direction	***25%***	22LF1	Normal Pattern on RWY 22L	-	***50%***
		25%	22RF1	Normal Pattern on RWY 22R	100%	50%
		25%	22LF2	Extended Pattern on RWY 22L	-	***50%***
		25%	22RF2	Extended Pattern on RWY 22R	100%	50%

C-1.2.11 Modeled Flight Tracks for the HOLF at MCB Camp Pendleton




04LD
22RA
22RF2-CW
04LF2-CCW
22RF1-CW
04LF1-CCW
22RD
04LA
CH46, CH53, MV22 Flight Tracks
Scale in Feet 1:72,900 (1 inch = 6,080 feet)
N

C-1.2.12 Modeled Flight Profiles for the HOLF at MCB Camp Pendleton



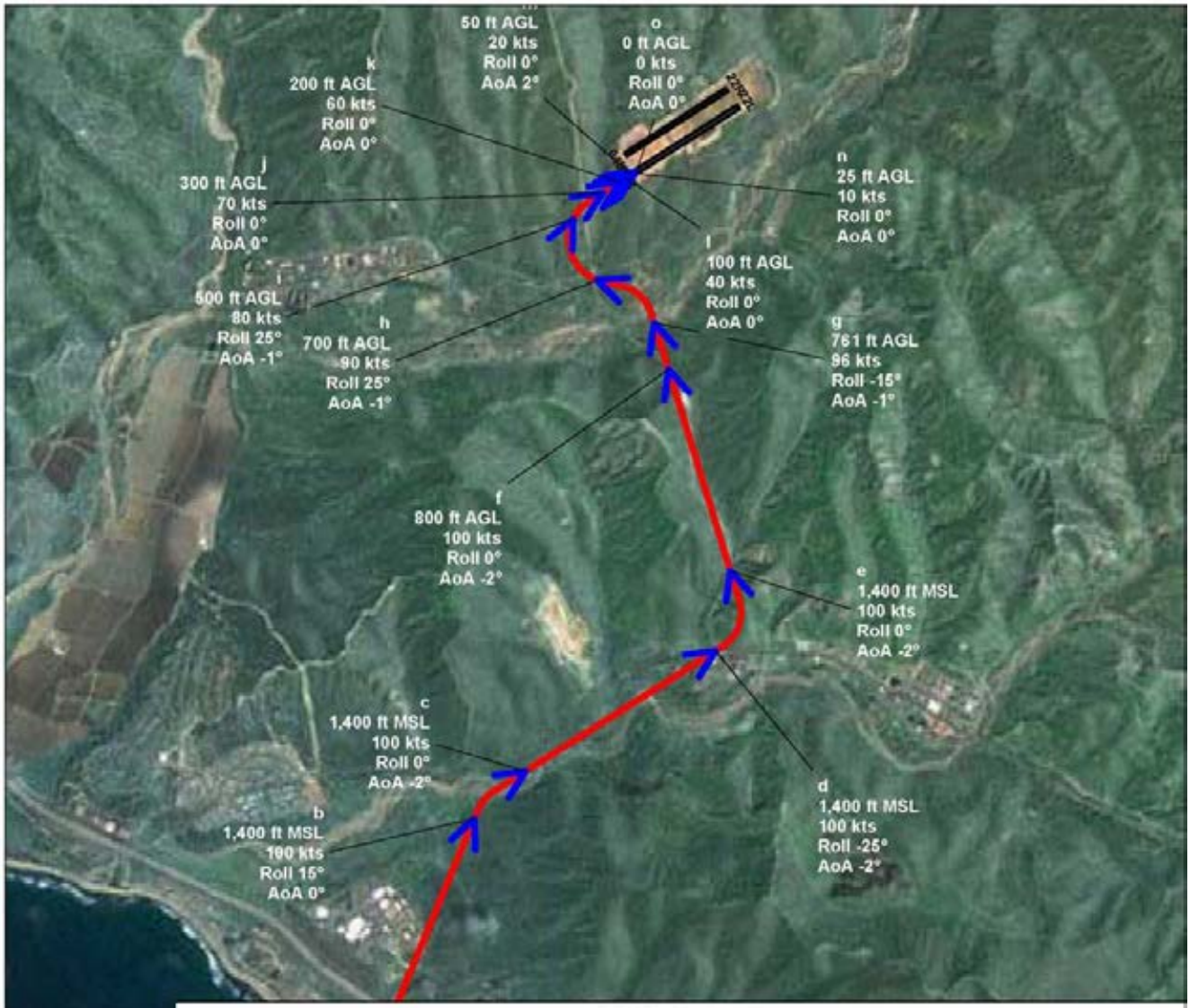
Flight Profile AH1D1

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	0 AGL	0	0	0	0	90	
b	500	25 AGL	50	0	-5	0	90	
c	1,000	60 AGL	70	0	-5	0	90	
d	3,000	500 AGL	80	0	-5	0	90	
e	8,814	900 MSL	120	0	0	-5	90	shifted forward 800'; begin turn
f	10,760	900 MSL	120	0	0	0	90	added pt; end turn
g	14,185	900 MSL	120	0	0	5	90	added pt; begin turn
h	15,748	900 MSL	120	0	0	0	90	added pt; end turn
i	22,000	900 MSL	120	0	0	0	90	

Flight Profile AH1D1
Based AH-1W
on Runway 04R, Flight Track 4RD - Departure to the Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000

Scale in Feet 1:44,000 (1 inch = 3,670 feet)



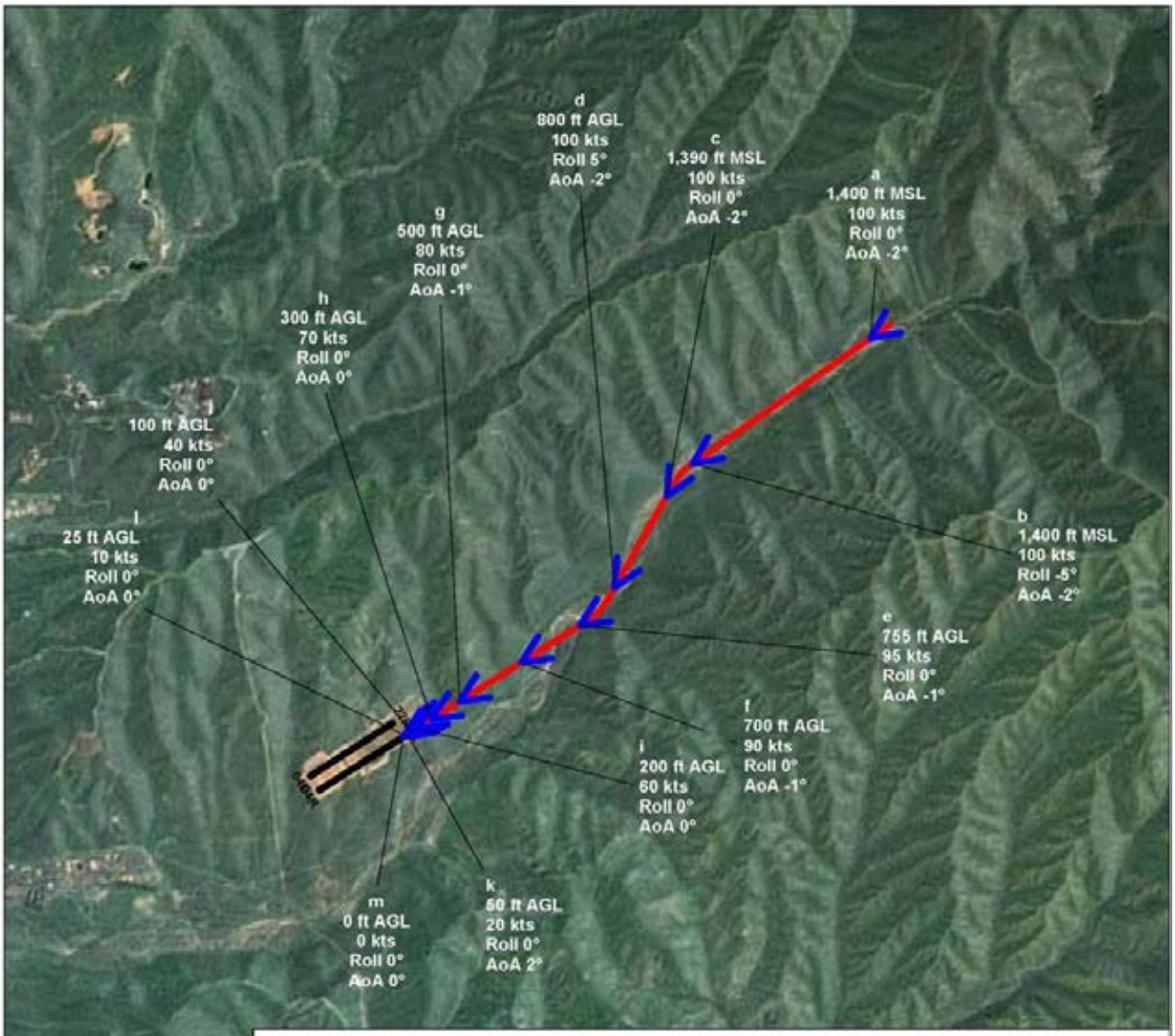
Flight Profile AH1A1

Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	6.58	1,400 MSL	120	0	0	0	90	
b	3.62	1,400 MSL	100	0	0	15	90	added pt; begin turn
c	3.32	1,400 MSL	100	0	-2	0	90	added pt; end turn
d	2.40	1,400 MSL	100	0	-2	-25	90	added pt; begin turn
e	2.02	1,400 MSL	100	0	-2	0	90	shifted forward 700'; end turn
f	1.15	800 AGL	100	0	-2	0	90	
g	0.95	761 AGL	96	0	-1	-15	90	interpolated; begin turn
h	0.63	700 AGL	90	0	-1	25	90	shifted back 500'; end turn; begin right turn
i	0.33	500 AGL	80	0	-1	25	90	
j	0.16	300 AGL	70	0	0	0	90	end turn
k	0.08	200 AGL	60	0	0	0	90	
l	0.05	100 AGL	40	0	0	0	90	
m	0.02	50 AGL	20	0	2	0	90	
n	0.01	25 AGL	10	0	0	0	90	
o	0.00	0 AGL	0	0	0	0	90	

Flight Profile AH1A1
Based AH-1W
on Runway 04R, Flight Track 4RA - Arrival from Offshore

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000

Scale in Feet 1:47,400 (1 inch = 3,950 feet)



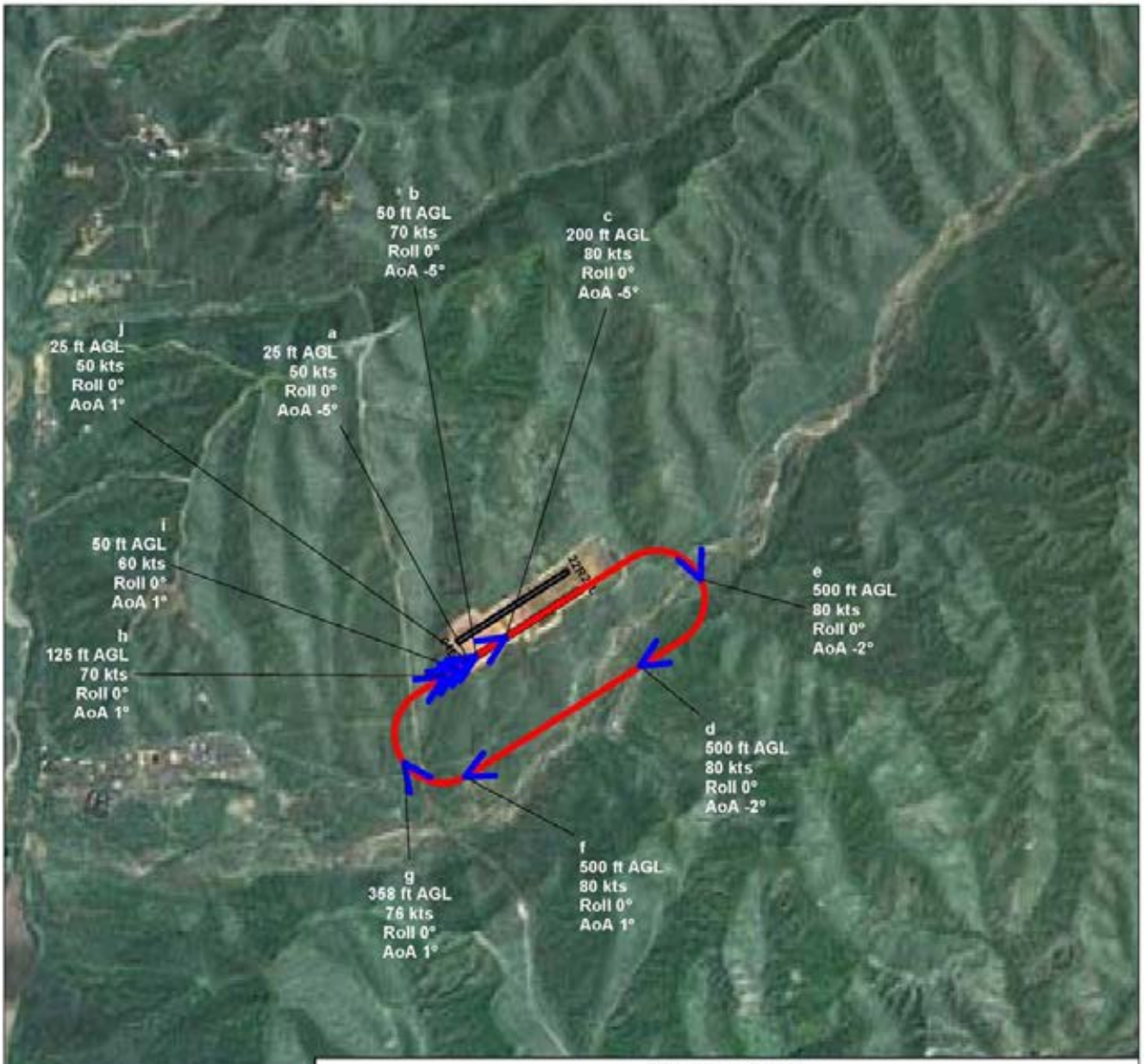
Flight Profile AH1A2

Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	3.09	1,400 MSL	100	0	-2	0	90	
b	2.02	1,400 MSL	100	0	-2	-5	90	shifted forward 700'; begin turn
c	1.81	1,390 MSL	100	0	-2	0	90	interpolated; end turn
d	1.29	800 AGL	100	0	-2	5	90	shifted back 200'; begin turn
e	1.03	755 AGL	95	0	-1	0	90	interpolated; end turn
f	0.69	700 AGL	90	0	-1	0	90	
g	0.33	500 AGL	80	0	-1	0	90	
h	0.16	300 AGL	70	0	0	0	90	end turn
i	0.08	200 AGL	60	0	0	0	90	
j	0.05	100 AGL	40	0	0	0	90	
k	0.02	50 AGL	20	0	2	0	90	
l	0.01	25 AGL	10	0	0	0	90	
m	0.00	0 AGL	0	0	0	0	90	

Flight Profile AH1A2
Based AH-1W
on Runway 22L, Flight Track 22LA - Arrival from Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:56,000 (1 inch = 4,670 feet)



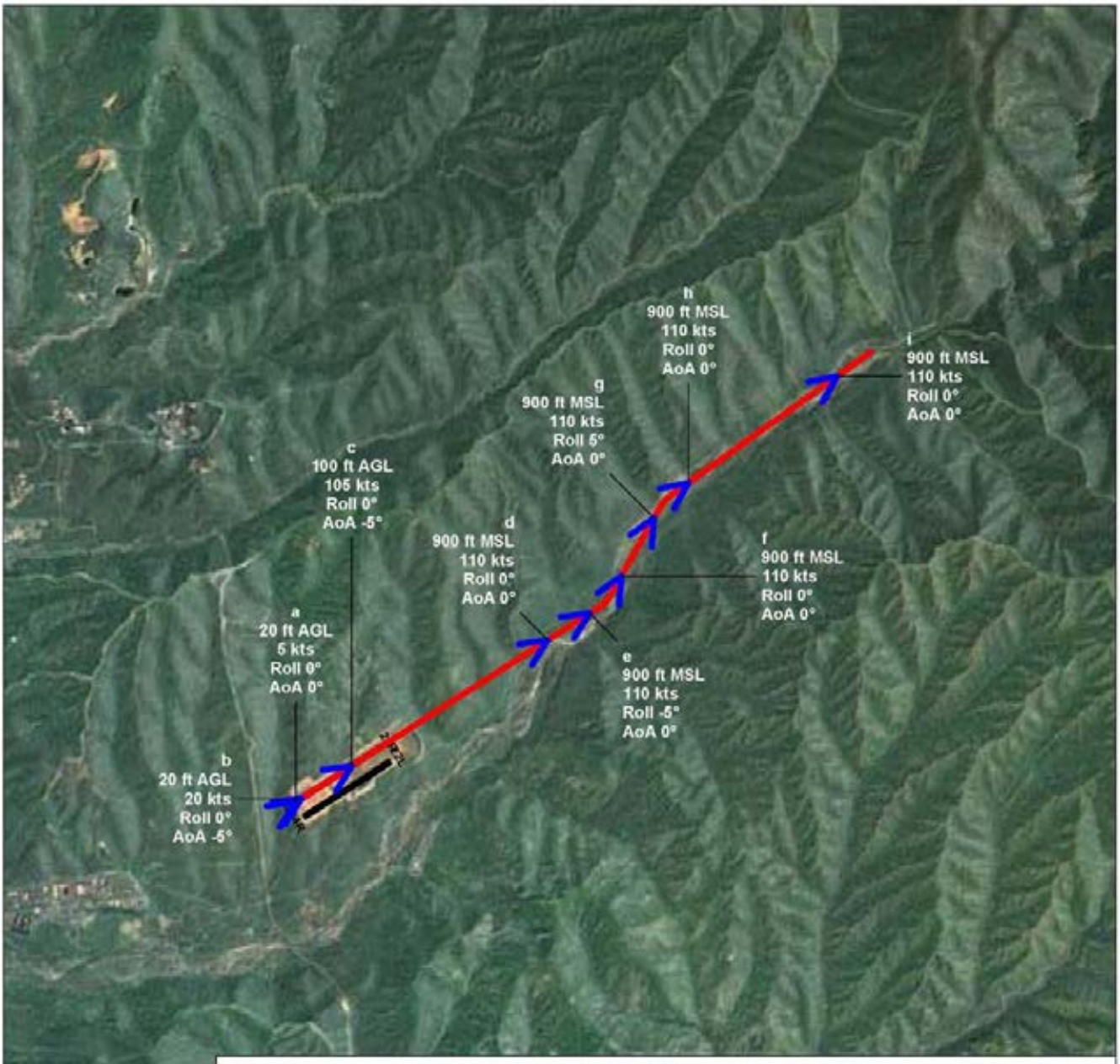
Flight Profile AH1T1

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	25 AGL	50	0	-5	0	90	
b	200	50 AGL	70	0	-5	0	90	
c	1,000	200 AGL	80	0	-5	0	90	
d	9,000	500 AGL	80	0	-2	0	90	
e	6,292	500 AGL	80	0	-2	0	90	interpolated; crosswind
f	13,740	500 AGL	80	0	1	0	90	end downwind
g	15,301	358 AGL	76	0	1	0	90	interpolated; crosswind
h	17,864	125 AGL	70	0	1	0	90	
i	18,187	50 AGL	60	0	1	0	90	
j	18,512	25 AGL	50	0	1	0	90	

Flight Profile AH1T1
Based AH-1W
on Runway 04R, Flight Track 04RF1 - NORM

0 2,000 4,000 6,000 8,000 10,000 12,000

Scale in Feet 1:41,600 (1 inch = 3,470 feet)



Flight Profile CH46D1

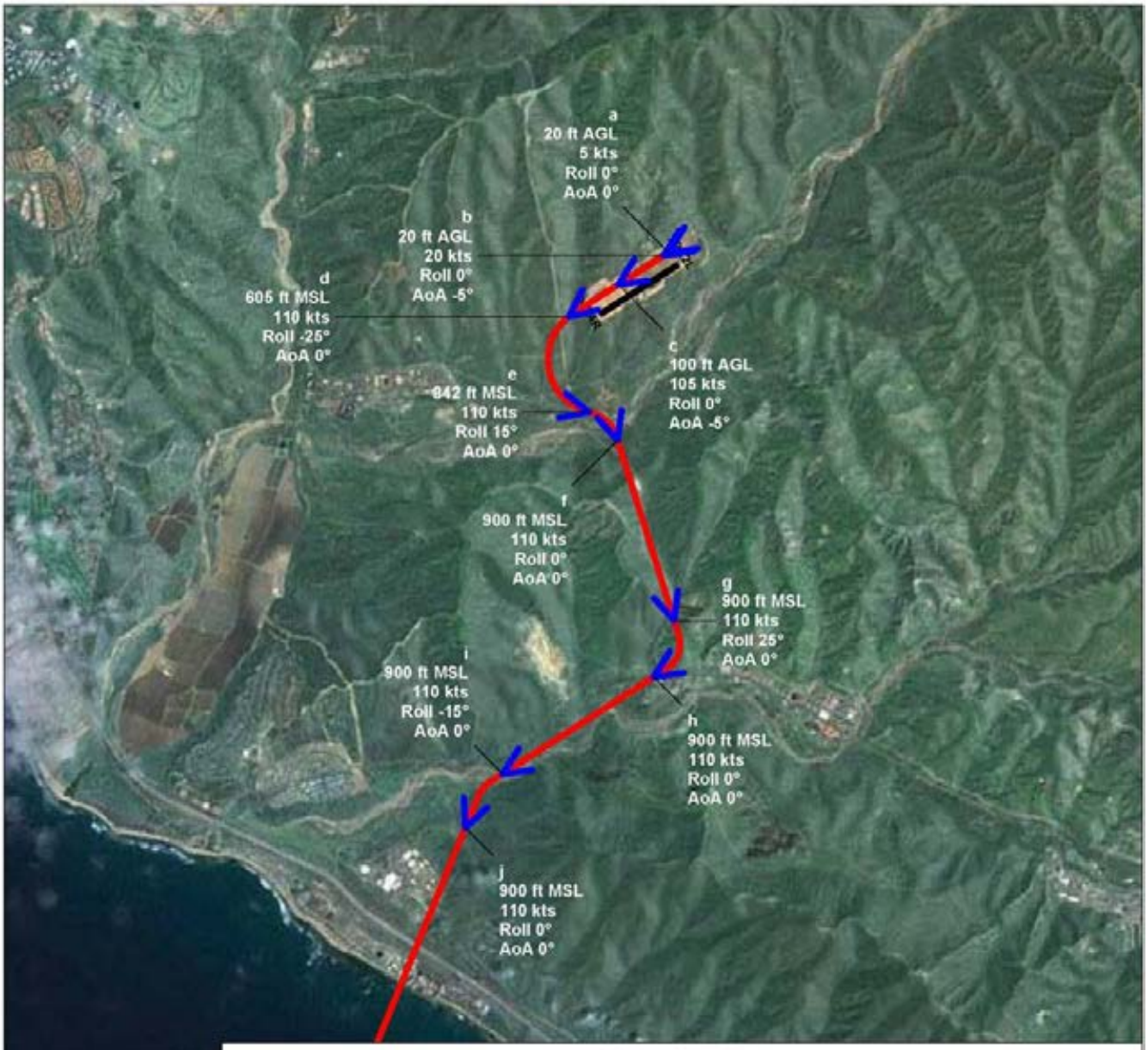
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	90	altitude changed from 0 to 20 ft AGL
b	200	20 AGL	20	0	-5	0	90	
c	2,000	100 AGL	105	0	-5	0	90	
d	9,000	900 MSL	110	0	0	0	90	
e	10,500	900 MSL	110	0	0	-5	90	added pt; begin turn
f	12,000	900 MSL	110	0	0	0	90	added pt; end turn
g	14,000	900 MSL	110	0	0	5	90	added pt; begin turn
h	15,500	900 MSL	110	0	0	0	90	shifted forward 500'; end turn
i	21,000	900 MSL	110	0	0	0	90	

Flight Profile CH46D1
Based CH46E
on Runway 04L, Flight Track 4LD - Departure to the Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:53,600 (1 inch = 4,460 feet)

N



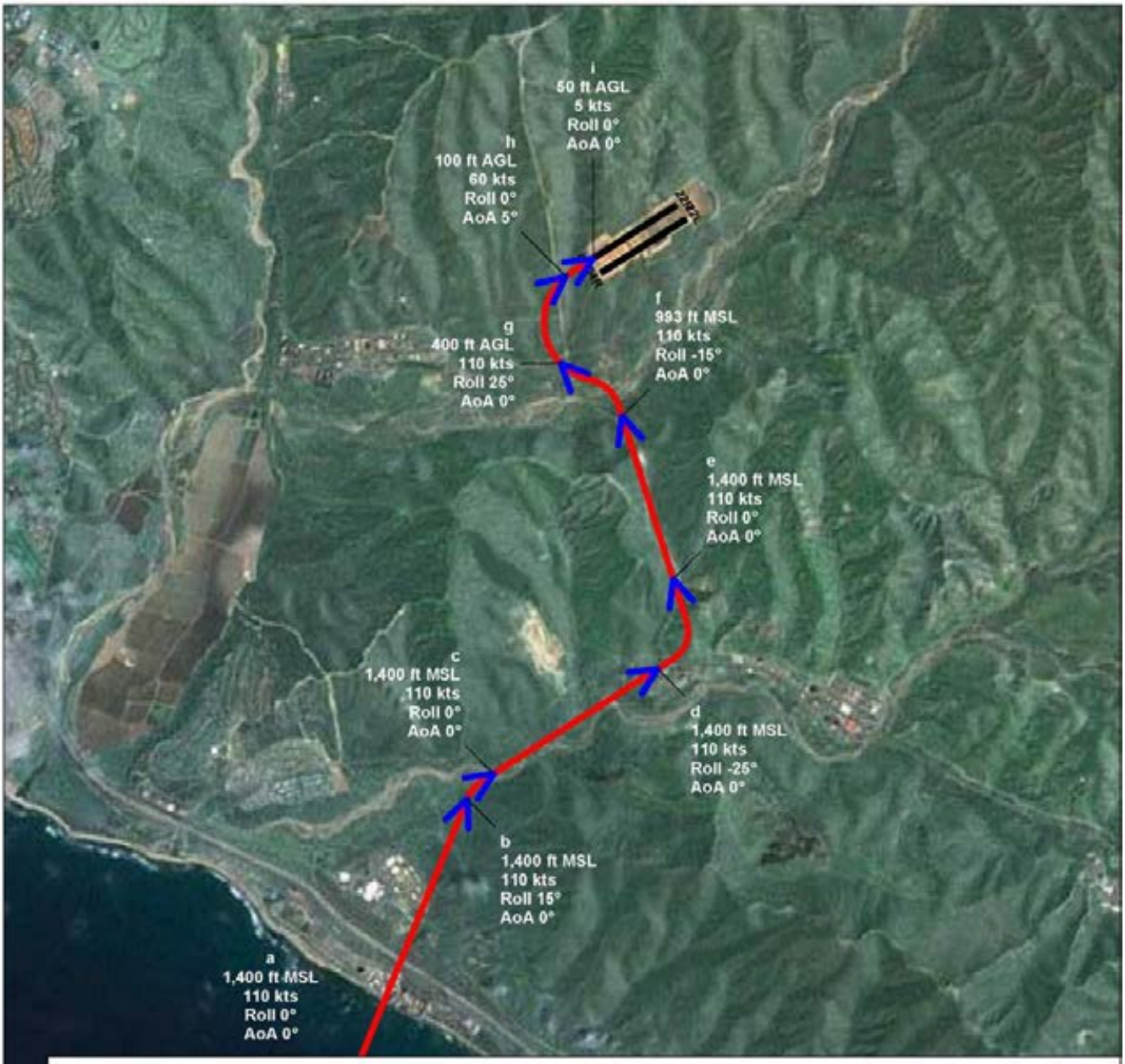
Flight Profile CH46D2

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	90	altitude changed from 0 to 20 ft AGL
b	200	20 AGL	20	0	-5	0	90	
c	2,000	100 AGL	105	0	-5	0	90	
d	3,962	605 MSL	110	0	0	-25	90	interpolated; begin turn
e	8,000	842 MSL	110	0	0	15	90	interpolated; turn to right
f	9,418	900 MSL	110	0	0	0	90	shifted forward 400'; end turn
g	15,701	900 MSL	110	0	0	25	90	pt added; begin turn
h	18,000	900 MSL	110	0	0	0	90	pt added; end turn
i	24,000	900 MSL	110	0	0	-15	90	pt added; begin turn
j	26,259	900 MSL	110	0	0	0	90	pt added; end turn
k	38,000	900 MSL	110	0	0	0	90	

Flight Profile CH46D2
Based CH46E
on Runway 22R, Flight Track 22RD - Departure to the Offshore

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000 20,000

Scale in Feet 1:60,900 (1 inch = 5,080 feet)



Flight Profile CH46A1

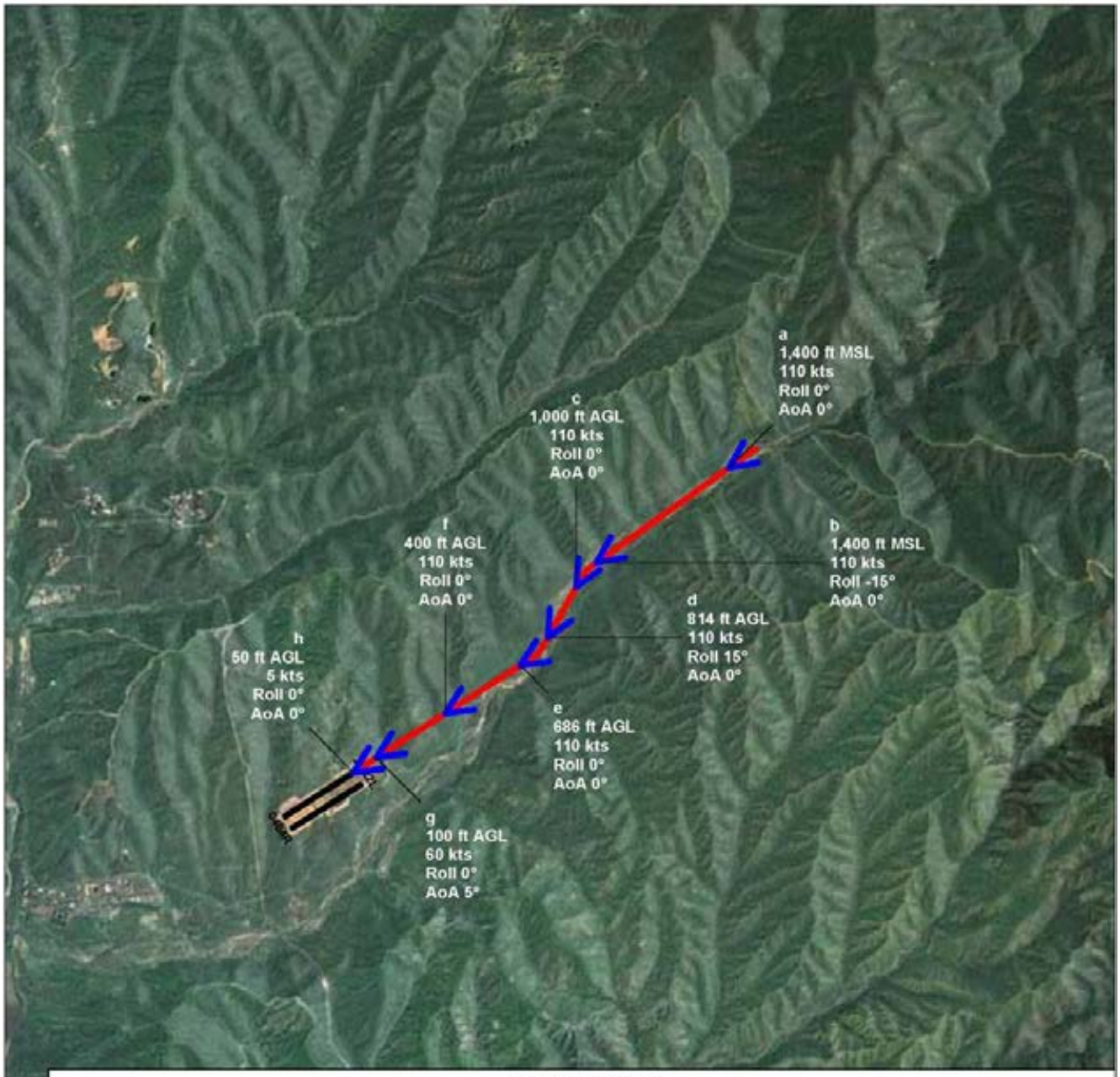
Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	6.25	1,400 MSL	110	0	0	0	90	Changed to 1400' MSL per course rules
b	3.65	1,400 MSL	110	0	0	15	90	pt added; begin turn; Changed to 1400' MSL per course rules
c	3.46	1,400 MSL	110	0	0	0	90	end turn
d	2.48	1,400 MSL	110	0	0	-25	90	pt added; begin turn; Changed to 1400' MSL per course rules
e	1.95	1,400 MSL	110	0	0	0	90	shifted back 700 ft; end turn
f	1.09	993 MSL	110	0	0	-15	90	begin turn; interpolated pt
g	0.66	400 AGL	110	0	0	25	90	begin turn to right
h	0.16	100 AGL	60	0	5	0	90	end turn
i	0.00	50 AGL	5	0	0	0	90	

Flight Profile CH46A1
Based CH46E
on Runway 04L, Flight Track 4LA - Arrival from Offshore

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:54,700 (1 inch = 4,560 feet)

N



Flight Profile CH46A2

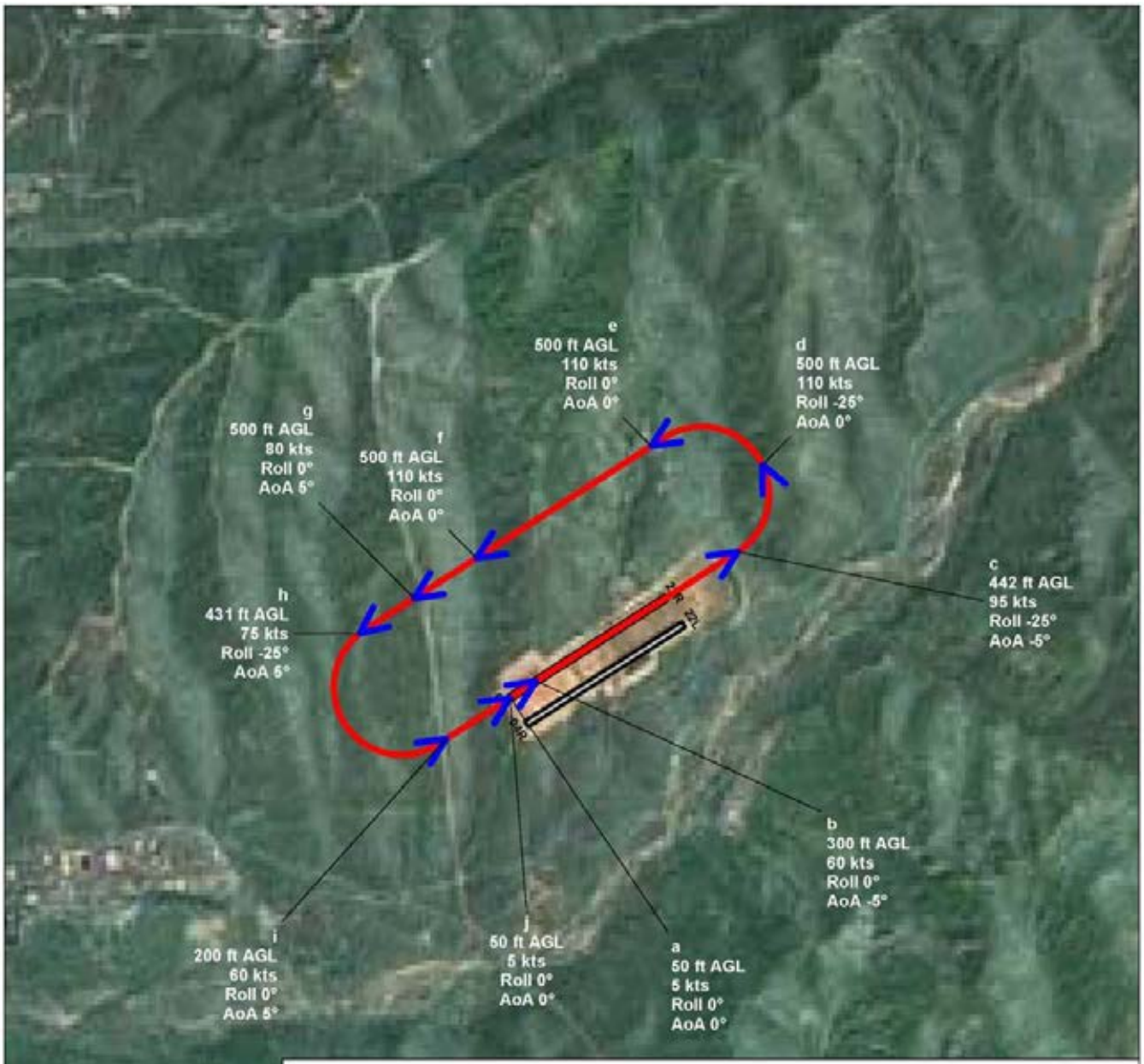
Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	2.96	1,400 MSL	110	0	0	0	90	Changed to 1400' MSL per course rules
b	1.98	1,400 MSL	110	0	0	-15	90	pt added; begin turn; Changed to 1400' MSL per course rules
c	1.79	1,000 AGL	110	0	0	0	90	end turn
d	1.44	814 AGL	110	0	0	15	90	pt interpolated; begin turn
e	1.20	686 AGL	110	0	0	0	90	pt interpolated; end turn
f	0.66	400 AGL	110	0	0	0	90	
g	0.16	100 AGL	60	0	5	0	90	
h	0.00	50 AGL	5	0	0	0	90	

Flight Profile CH46A2
Based CH46E
on Runway 22R, Flight Track 22RA - Arrival from Case Spring

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:65,100 (1 inch = 5,430 feet)

N



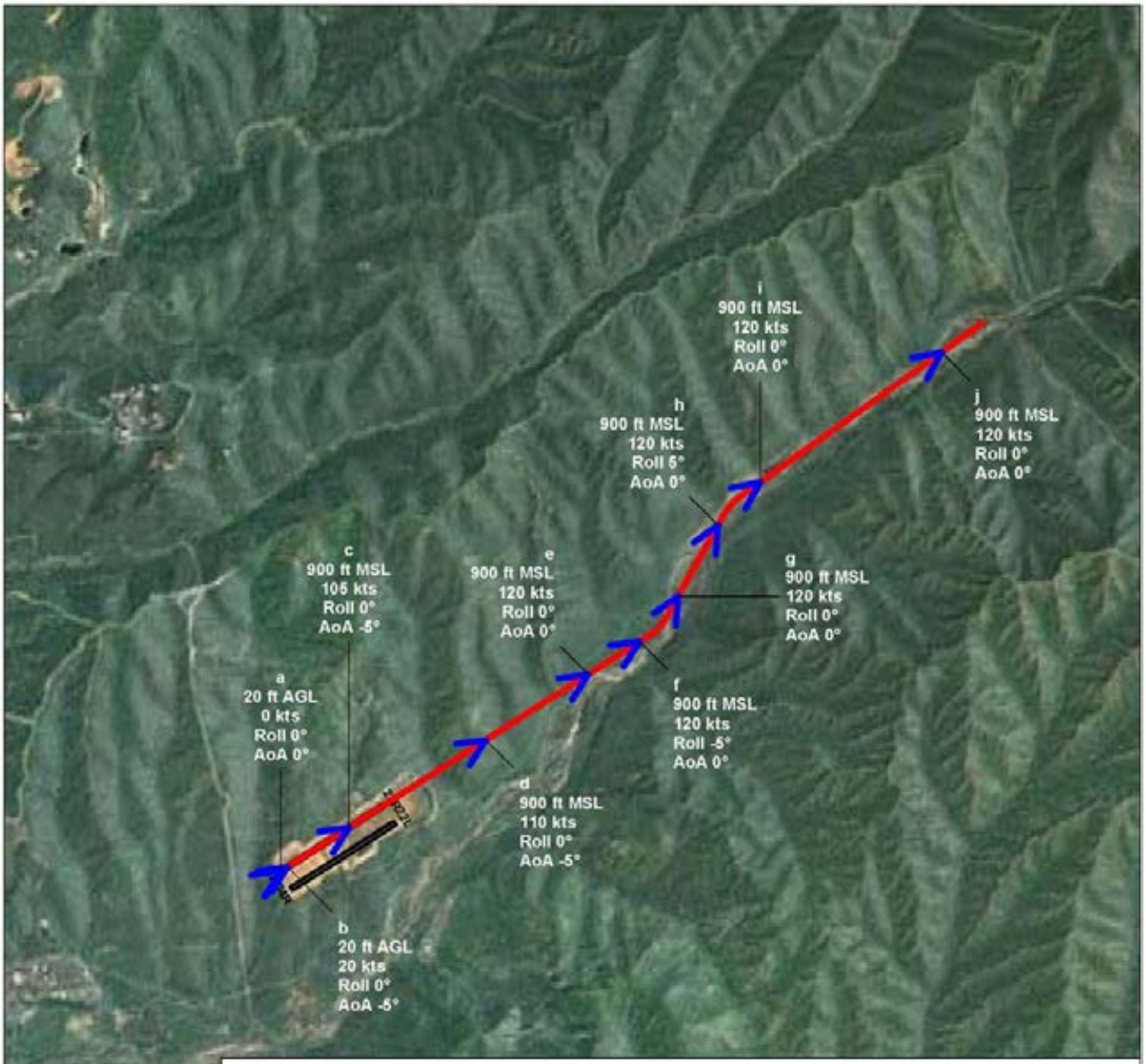
Flight Profile CH46T1

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	50 AGL	5	0	0	0	90	
b	500	300 AGL	60	0	-5	0	90	
c	4,396	442 AGL	95	0	-5	-25	90	interpolated; begin turn
d	6,000	500 AGL	110	0	0	-25	90	
e	8,123	500 AGL	110	0	0	0	90	shifted back 400 ft; end turn
f	11,500	500 AGL	110	0	0	0	90	
g	12,705	500 AGL	80	0	5	0	90	
h	13,758	431 AGL	75	0	5	-25	90	interpolated; begin turn
i	17,273	200 AGL	60	0	5	0	90	shifted back 300 ft; end turn
j	18,512	50 AGL	5	0	0	0	90	

Flight Profile CH46T1
Based CH46E
on Runway 04L, Flight Track 04LF1 - NORM

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000

Scale in Feet 1:29,600 (1 inch = 2,460 feet)



Flight Profile CH53D1

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	0	0	0	0	90	altitude changed from 0 to 20 ft AGL
b	200	20 AGL	20	0	-5	0	90	
c	2,000	900 MSL	105	0	-5	0	90	
d	6,000	900 MSL	110	0	-5	0	90	
e	9,000	900 MSL	120	0	0	0	90	
f	10,500	900 MSL	120	0	0	-5	90	pt added; begin turn
g	12,000	900 MSL	120	0	0	0	90	pt added; end turn
h	14,000	900 MSL	120	0	0	5	90	pt added; begin turn
i	15,500	900 MSL	120	0	0	0	90	pt added; end turn
j	21,000	900 MSL	120	0	0	0	90	

Flight Profile CH53D1
Based CH53E
on Runway 04L, Flight Track 4LD - Departure to the Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000

Scale in Feet 1:44,800 (1 inch = 3,730 feet)

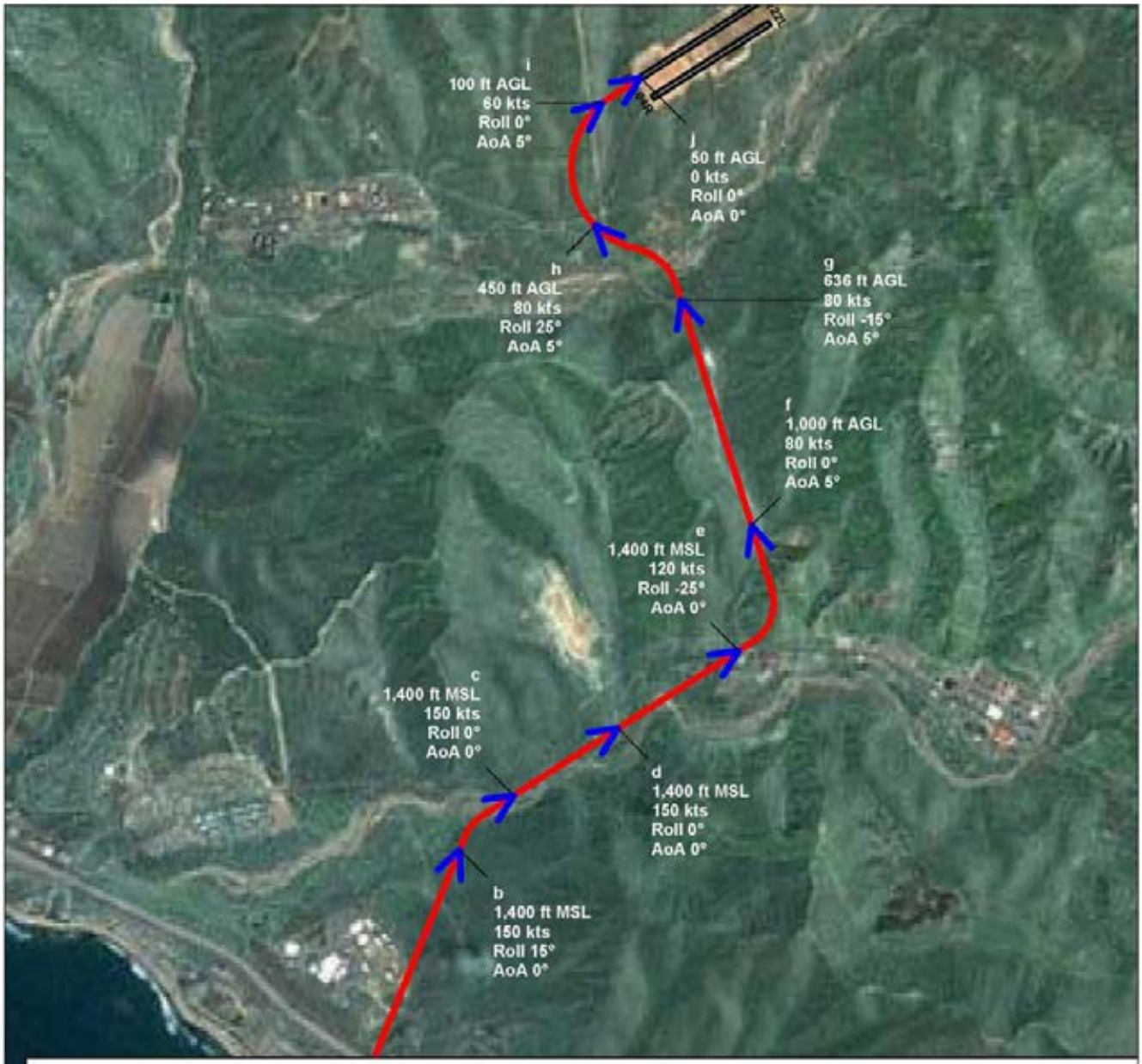
Flight Profile CH53D2

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	0	0	0	0	90	altitude changed from 0 to 20 ft AGL
b	200	20 AGL	20	0	-5	0	90	
c	2,000	900 MSL	105	0	-5	0	90	
d	3,900	900 MSL	110	0	-5	-25	90	interpolated; begin turn
e	6,000	900 MSL	110	0	-5	-25	90	
f	8,000	900 MSL	120	0	0	15	90	interpolated; end turn; begin turn right
g	9,400	900 MSL	120	0	0	0	90	shifted forward 400'; end turn
h	15,700	900 MSL	120	0	0	25	90	shifted forward 700'; begin turn
i	18,000	900 MSL	120	0	0	0	90	added pt; end turn
j	24,000	900 MSL	120	0	0	-15	90	added pt; begin turn
k	26,000	900 MSL	120	0	0	0	90	added pt; end turn
l	40,000	900 MSL	120	0	0	0	90	

Flight Profile CH53D2
Based CH53E
on Runway 22R, Flight Track 22RD - Departure to the Offshore

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000

Scale in Feet 1:49,300 (1 inch = 4,110 feet)



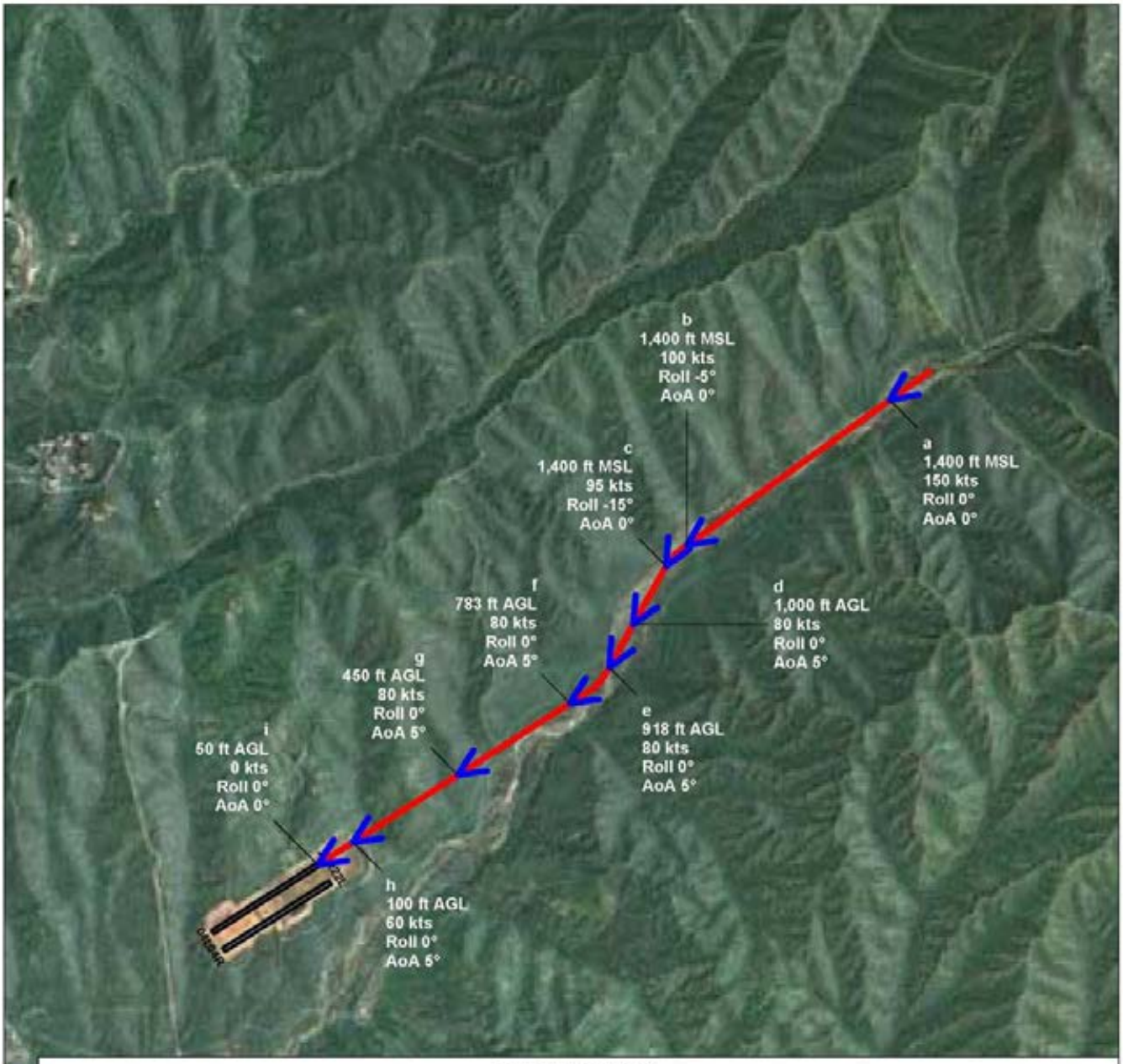
Flight Profile CH53A1

Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	5.76	1,400 MSL	150	0	0	0	90	Changed to 1400' MSL per course rules
b	3.69	1,400 MSL	150	0	0	15	90	pt added; begin turn
c	3.41	1,400 MSL	150	0	0	0	90	added pt; begin turn; Changed to 1400' MSL per course rules
d	2.96	1,400 MSL	150	0	0	0	90	end turn; Changed to 1400' MSL per course rules
e	2.45	1,400 MSL	120	0	0	-25	90	interpolated; begin turn; Changed to 1400' MSL per course rules
f	1.93	1,000 AGL	80	0	5	0	90	shifted back 500 ft; end turn
g	1.09	636 AGL	80	0	5	-15	90	interpolated; begin turn
h	0.66	450 AGL	80	0	5	25	90	shifted forward 500 ft; begin turn
i	0.16	100 AGL	60	0	5	0	90	end turn
j	0.00	50 AGL	0	0	0	0	90	

Flight Profile CH53A1
Based CH53E
on Runway 04L, Flight Track 4LA - Arrival from Offshore

0 2,000 4,000 6,000 8,000 10,000 12,000

Scale in Feet 1:39,600 (1 inch = 3,300 feet)



Flight Profile CH53A2

Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	2.96	1,400 MSL	150	0	0	0	90	Changed to 1400' MSL per course rules
b	1.97	1,400 MSL	100	0	0	-5	90	interpolated; begin turn
c	1.86	1,400 MSL	95	0	0	-15	90	interpolated; end turn; Changed to 1400' MSL per course rules
d	1.59	1,000 AGL	80	0	5	0	90	end turn
e	1.40	918 AGL	80	0	5	0	90	interpolated; begin turn
f	1.18	783 AGL	80	0	5	0	90	interpolated; end turn
g	0.66	450 AGL	80	0	5	0	90	
h	0.16	100 AGL	60	0	5	0	90	
i	0.00	50 AGL	0	0	0	0	90	

Flight Profile CH53A2
Based CH53E
on Runway 22R, Flight Track 22RA - Arrival from Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000

Scale in Feet 1:42,900 (1 inch = 3,580 feet)

N

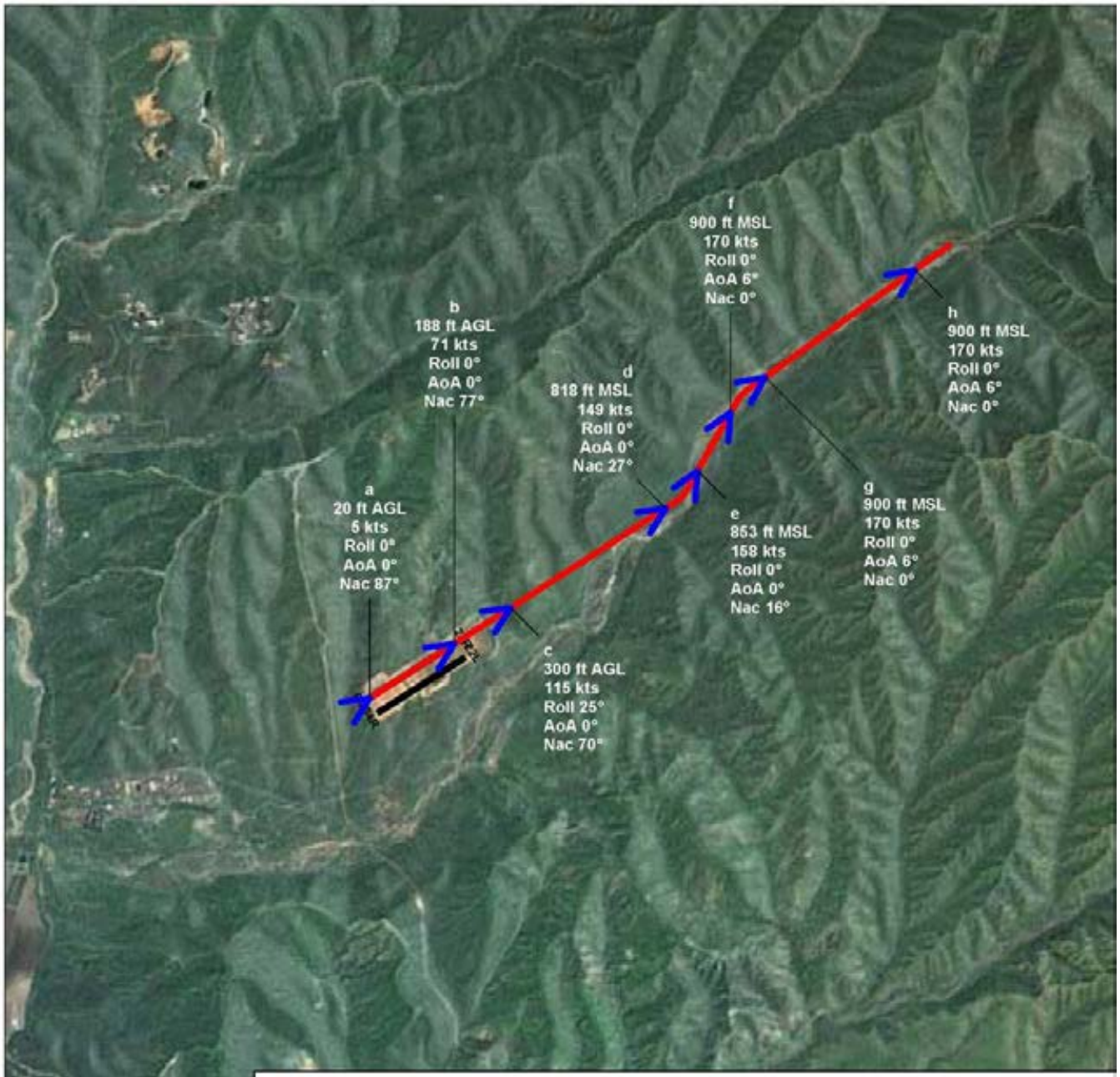
Flight Profile CH53T1

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	50 AGL	5	0	0	0	90	
b	500	200 AGL	60	0	-5	0	90	
c	4,500	200 AGL	103	0	0	-25	90	interpolated pt; begin turn
d	6,394	200 AGL	120	0	0	-25	90	
e	8,114	500 AGL	120	0	0	0	90	Shifted back 400 ft; end turn
f	10,000	500 AGL	120	0	0	0	90	
g	13,700	500 AGL	120	0	0	-25	90	shifted back 200 ft; begin turn
h	17,511	200 AGL	60	0	5	0	90	end turn
i	18,511	50 AGL	5	0	0	0	90	

Flight Profile CH53T1
Based CH53E
on Runway 04L, Flight Track 04LF1 - NORM

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000

Scale in Feet 1:23,600 (1 inch = 1,970 feet)



Flight Profile V22D1

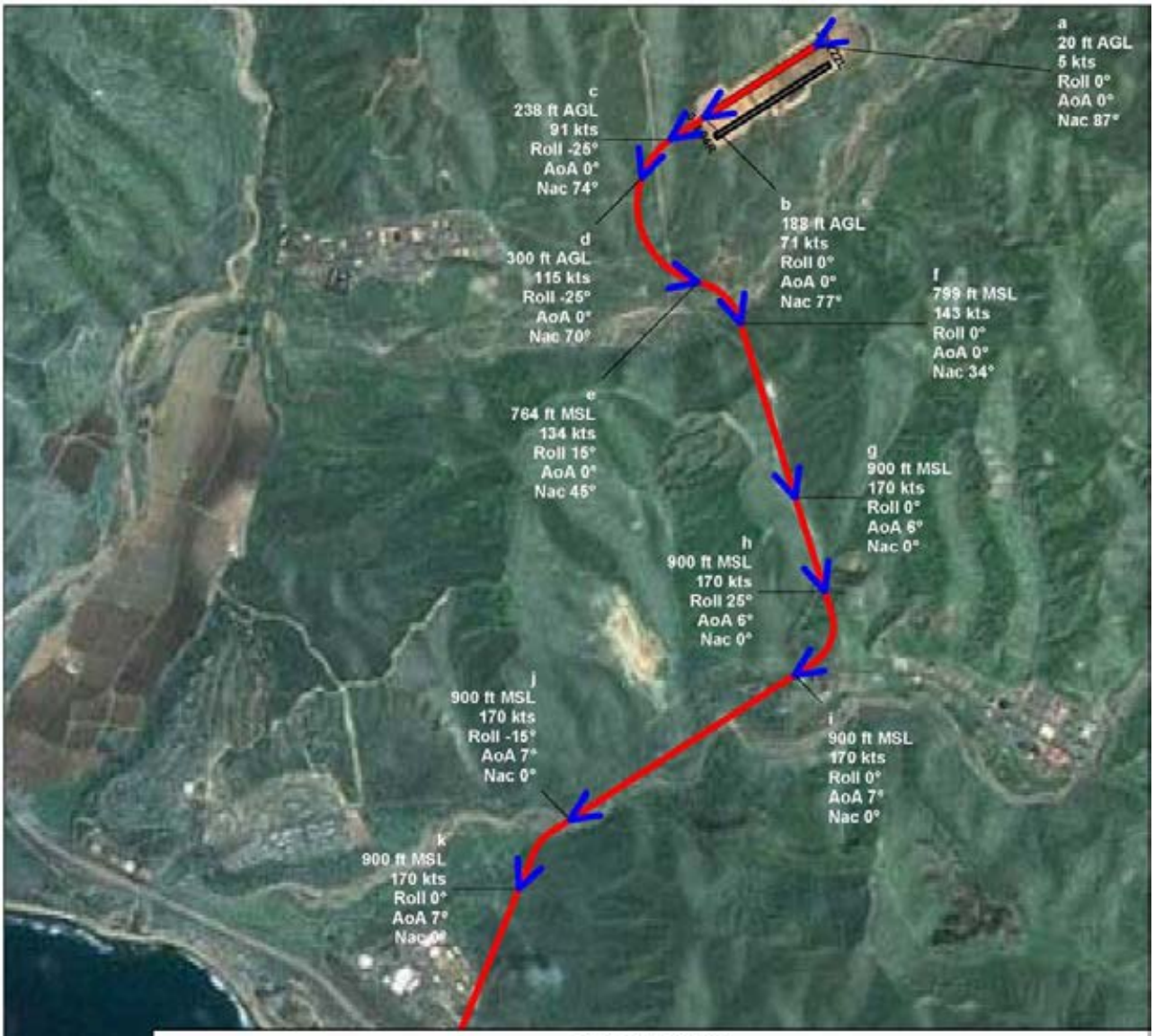
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	25	70	
d	10,500	818 MSL	149	0	0	0	27	interpolated; begin turn
e	12,000	853 MSL	158	0	0	0	16	interpolated; end turn
f	14,000	900 MSL	170	0	6	0	0	shifted forward 500'; begin turn
g	15,500	900 MSL	170	0	6	0	0	added pt; end turn
h	21,000	900 MSL	170	0	6	0	0	

Flight Profile V22D1
Based MV22B
on Runway 04L, Flight Track 4LD - Departure to the Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:53,100 (1 inch = 4,430 feet)

N



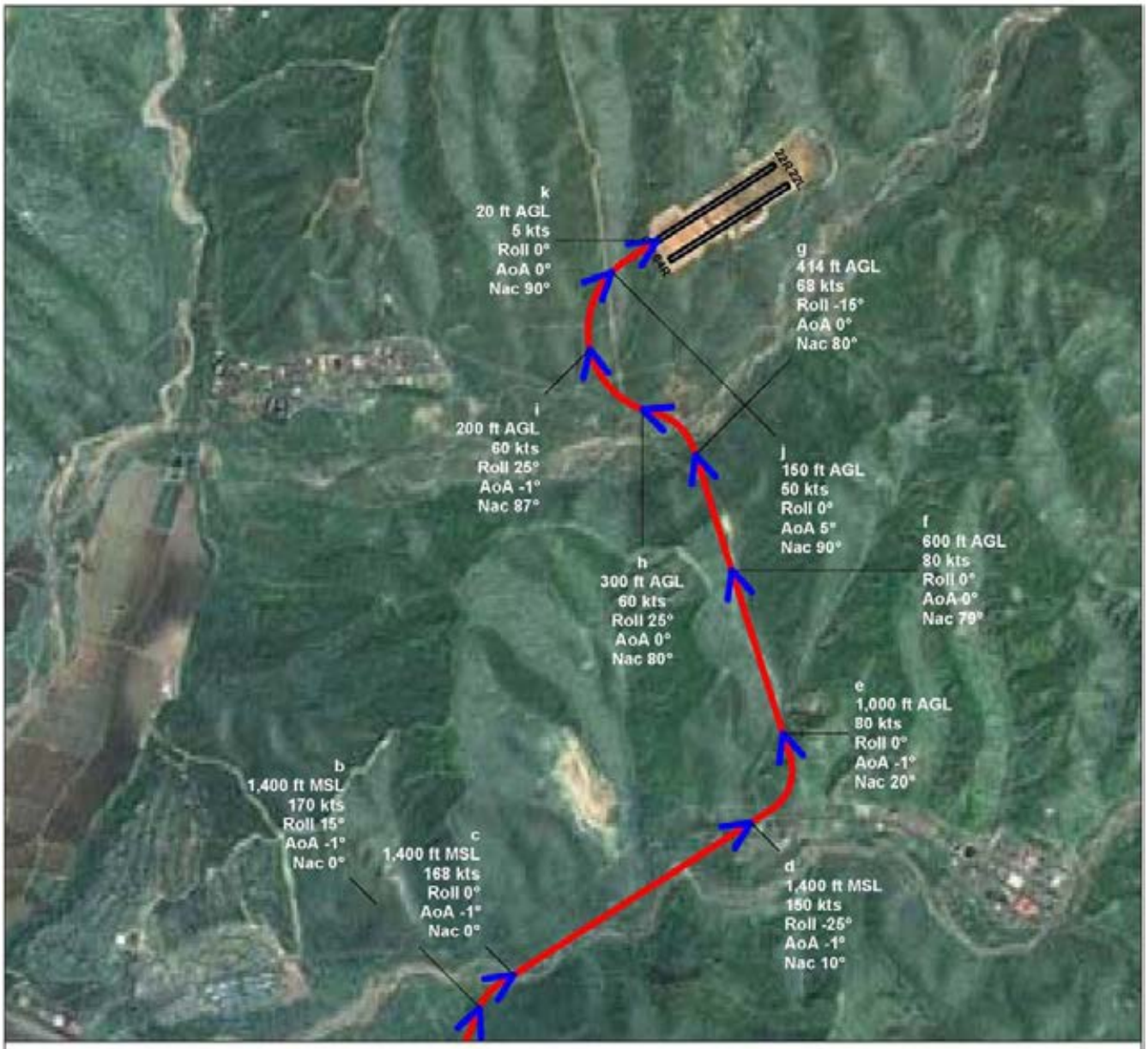
Flight Profile V22D2

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	3,900	238 AGL	91	0	0	-25	74	interpolated; begin turn
d	5,000	300 AGL	115	0	0	-25	70	
e	8,000	764 MSL	134	0	0	15	45	interpolated; end turn; begin turn to right
f	9,400	799 MSL	143	0	0	0	34	interpolated; end turn
g	13,500	900 MSL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb
h	15,700	900 MSL	170	0	6	25	0	pt added; begin turn
i	18,000	900 MSL	170	0	7	0	0	pt added; end turn
j	24,000	900 MSL	170	0	7	-15	0	pt added; begin turn
k	26,000	900 MSL	170	0	7	0	0	pt added; end turn
l	40,000	900 MSL	170	0	7	0	0	

Flight Profile V22D2
Based MV22B
on Runway 22R, Flight Track 22RD - Departure to the Offshore

0 2,000 4,000 6,000 8,000 10,000 12,000

Scale in Feet 1:41,300 (1 inch = 3,440 feet)



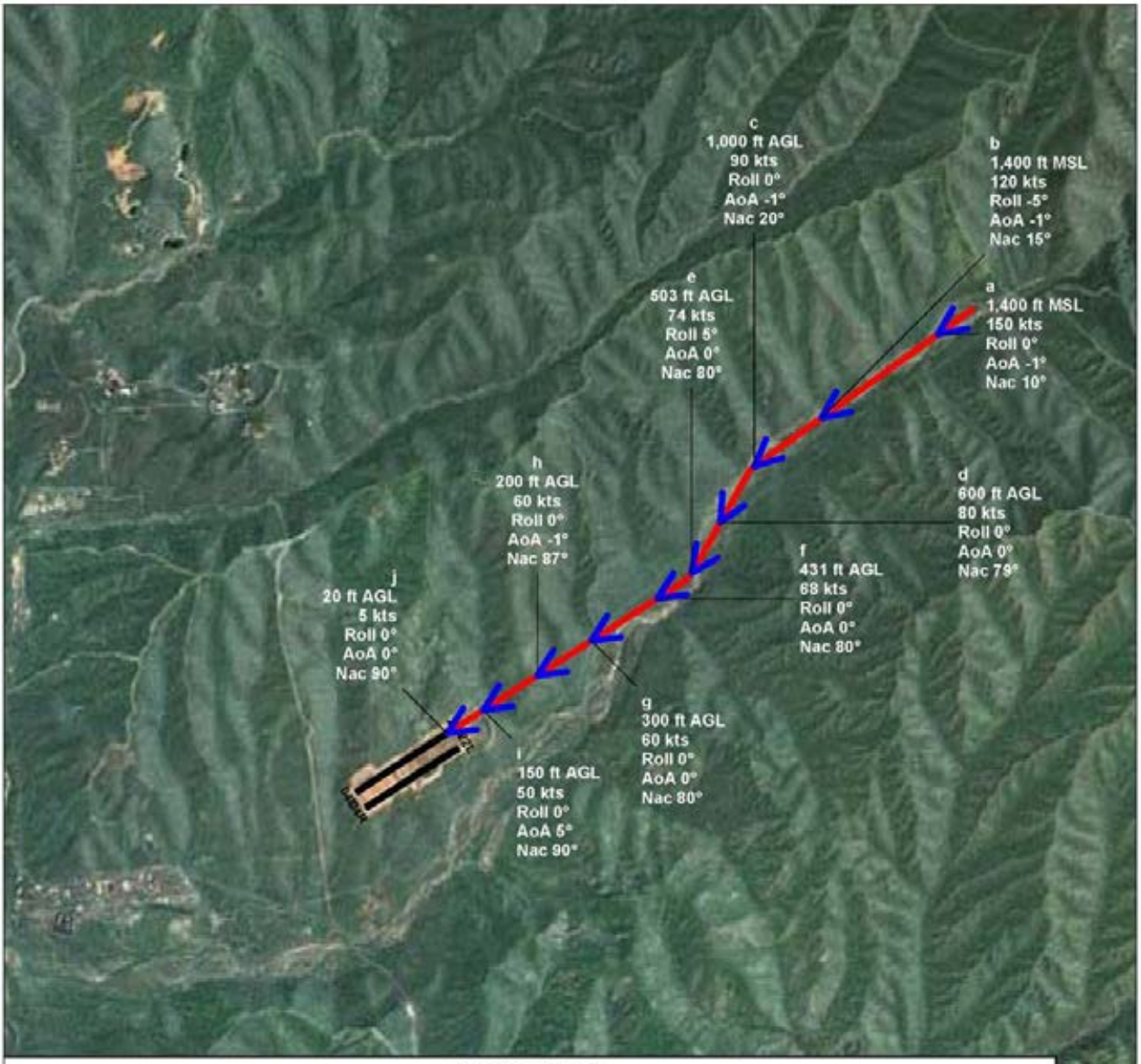
Flight Profile V22A1

Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	5.65	1,400 MSL	220	0	5	0	0	Changed to 1400' MSL per course rules
b	3.65	1,400 MSL	170	0	-1	15	0	added pt; begin turn; Changed to 1400' MSL per course rules
c	3.47	1,400 MSL	168	0	-1	0	0	end turn; Changed to 1400' MSL per course rules
d	2.47	1,400 MSL	150	0	-1	-25	10	shifted forward 200 ft; begin turn; Changed to 1400' MSL per course rules
e	2.09	1,000 AGL	80	0	-1	0	20	shifted back 300 ft; end turn; 1800 fpm desc;
f	1.48	600 AGL	80	0	0	0	79	Adjusted Altitude up 100 ft; 400 fpm desc; 3deg gs;
g	1.05	414 AGL	68	0	0	-15	80	interpolated; begin turn
h	0.79	300 AGL	60	0	0	25	80	400 fpm desc; 3deg gs; begin turn to right
i	0.49	200 AGL	60	0	-1	25	87	begin turn; 200 fpm desc; 2deg gs
j	0.20	150 AGL	50	0	5	0	90	end turn; 300 fpm desc; 6deg gs
k	0.00	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22A1
Based MV22B
on Runway 04L, Flight Track 4LA - Arrival from Offshore

0 2,000 4,000 6,000 8,000 10,000 12,000

Scale in Feet 1:39,300 (1 inch = 3,280 feet)



Flight Profile V22A2

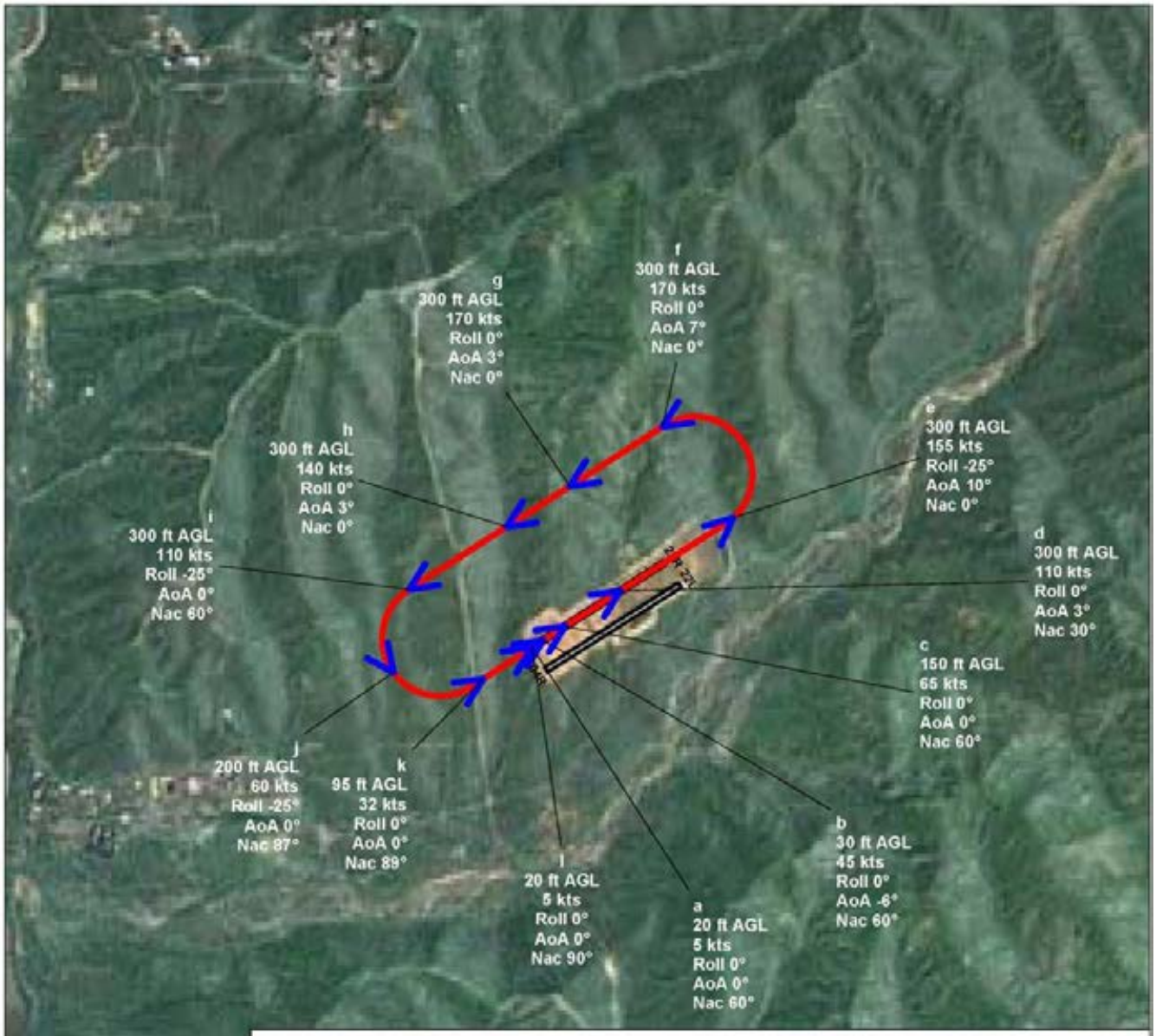
Point	Distance NM	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	2.96	1,400 MSL	150	0	-1	0	10	Changed to 1400' MSL per course rules
b	2.30	1,400 MSL	120	0	-1	-5	15	begin turn; Changed to 1400' MSL per course rules
c	1.92	1,000 AGL	90	0	-1	0	20	shifted forward 700 ft; end turn1800 fpm desc; end turn
d	1.62	600 AGL	80	0	0	0	79	Adjusted Altitude up 100 ft; 400 fpm desc; 3deg gs;
e	1.35	503 AGL	74	0	0	5	80	interpolated pt; begin turn
f	1.15	431 AGL	68	0	0	0	80	interpolated pt; end turn
g	0.79	300 AGL	60	0	0	0	80	400 fpm desc; 3deg gs
h	0.49	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
i	0.20	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
j	0.00	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile V22A2
Based MV22B
on Runway 22R, Flight Track 22RA - Arrival from Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000

Scale in Feet 1:50,900 (1 inch = 4,240 feet)

N



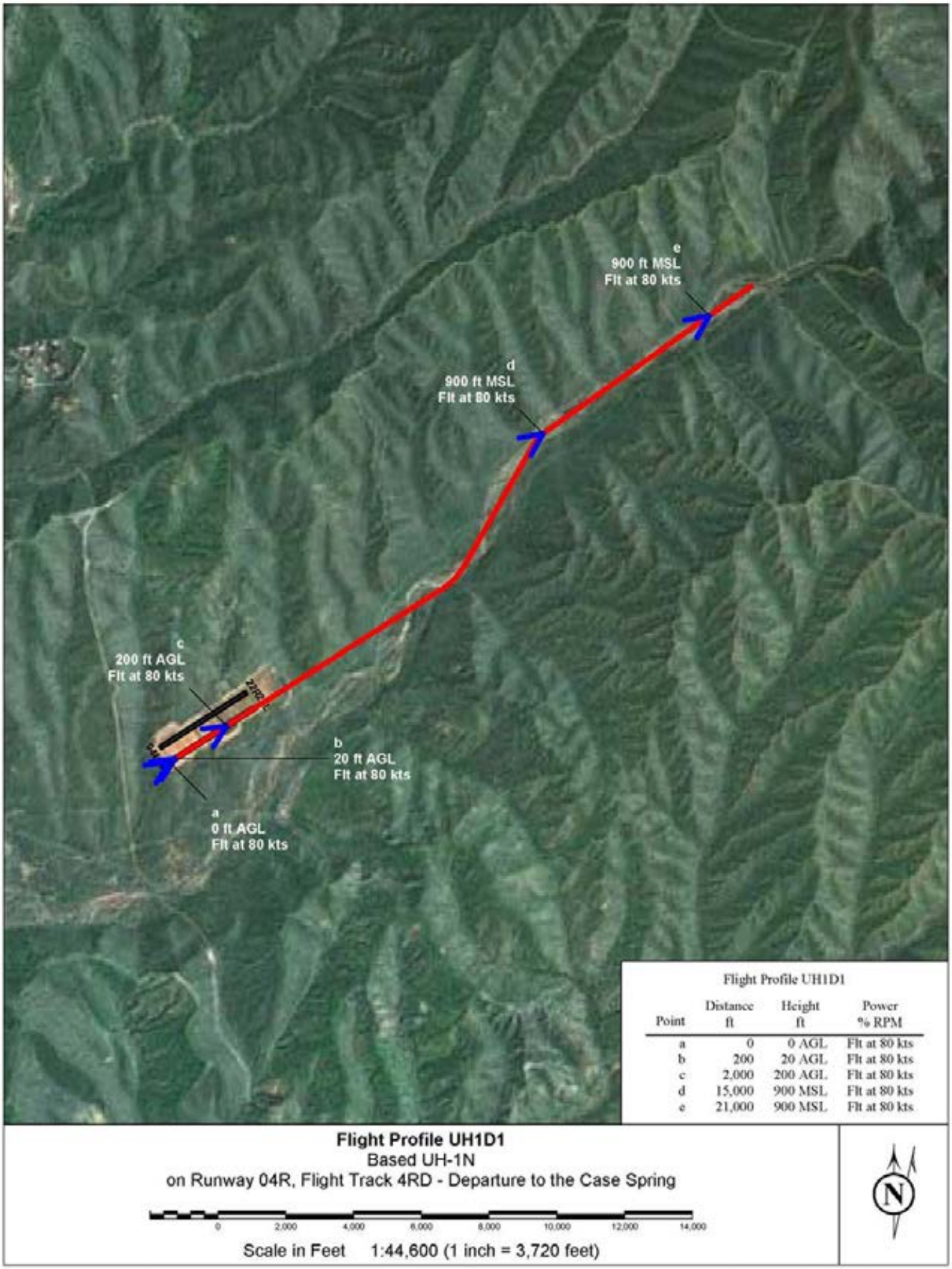
Flight Profile V22T1

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	300 AGL	110	0	3	0	30	
e	4,570	300 AGL	155	0	10	-25	0	shifted forward 500 ft; begin turn
f	7,895	300 AGL	170	0	7	0	0	shifted back 600 ft; end turn
g	10,000	300 AGL	170	0	3	0	0	
h	11,431	300 AGL	140	0	3	0	0	
i	13,650	300 AGL	110	0	0	-25	60	shifted back 200 ft; begin turn
j	15,458	200 AGL	60	0	0	-25	87	
k	17,400	95 AGL	32	0	0	0	89	Interpolated; end turn
l	18,512	20 AGL	5	0	0	0	90	

Flight Profile V22T1
Based MV22B
on Runway 04L, Flight Track 04LF1 - NORM

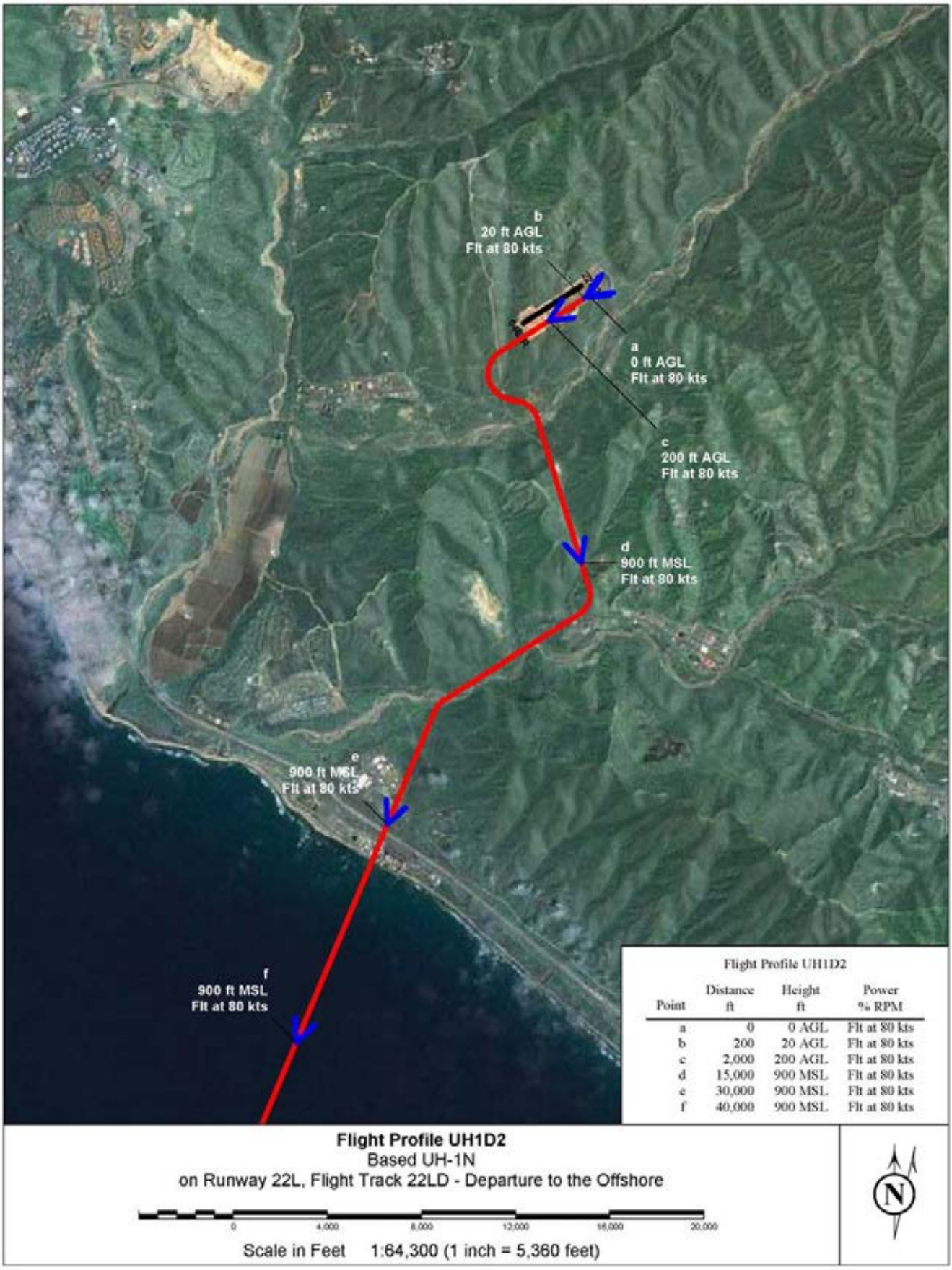
0 2,000 4,000 6,000 8,000 10,000

Scale in Feet 1:35,100 (1 inch = 2,920 feet)



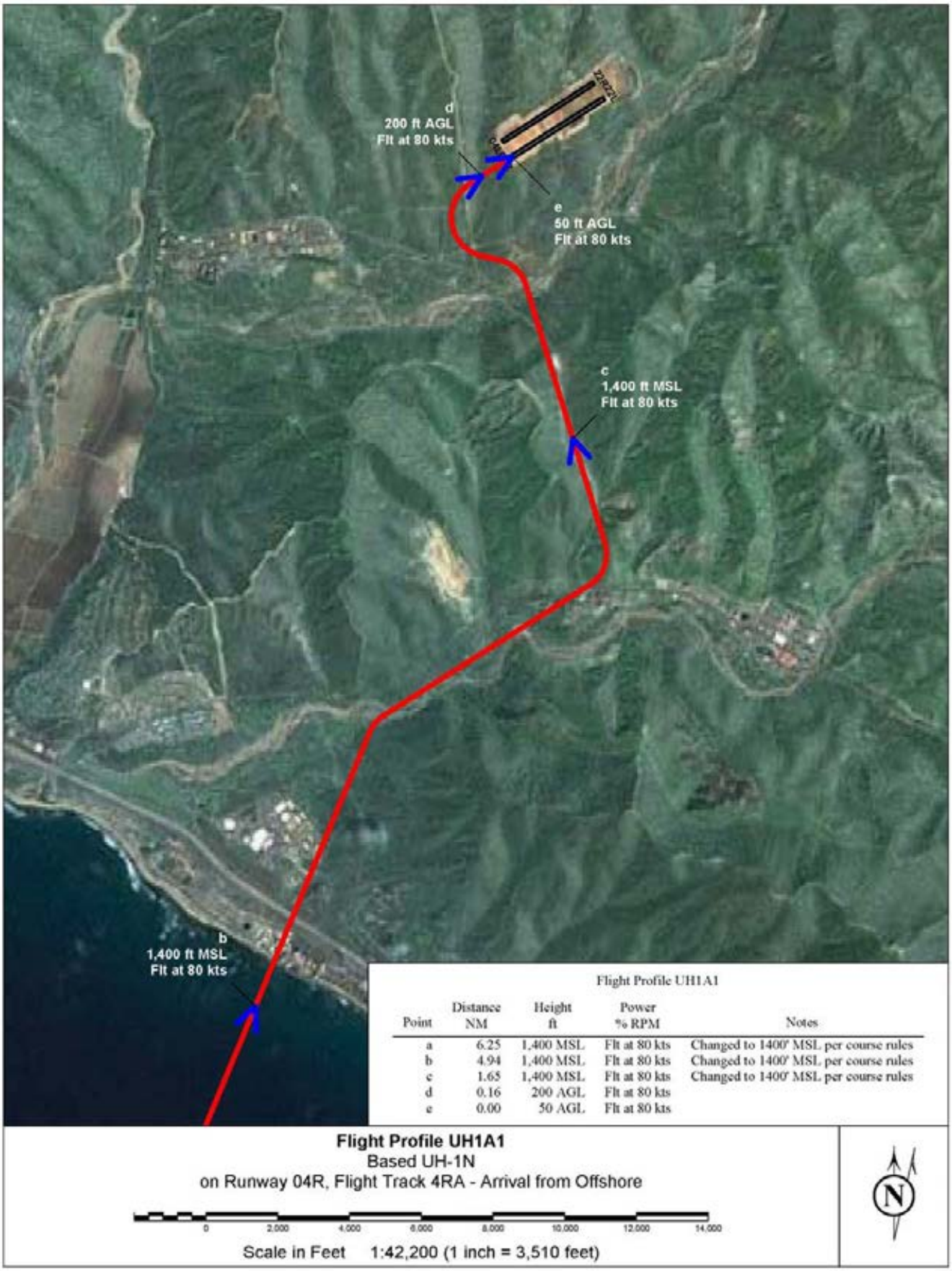
Flight Profile UH1D1

Point	Distance ft	Height ft	Power % RPM
a	0	0 AGL	Flt at 80 kts
b	200	20 AGL	Flt at 80 kts
c	2,000	200 AGL	Flt at 80 kts
d	15,000	900 MSL	Flt at 80 kts
e	21,000	900 MSL	Flt at 80 kts



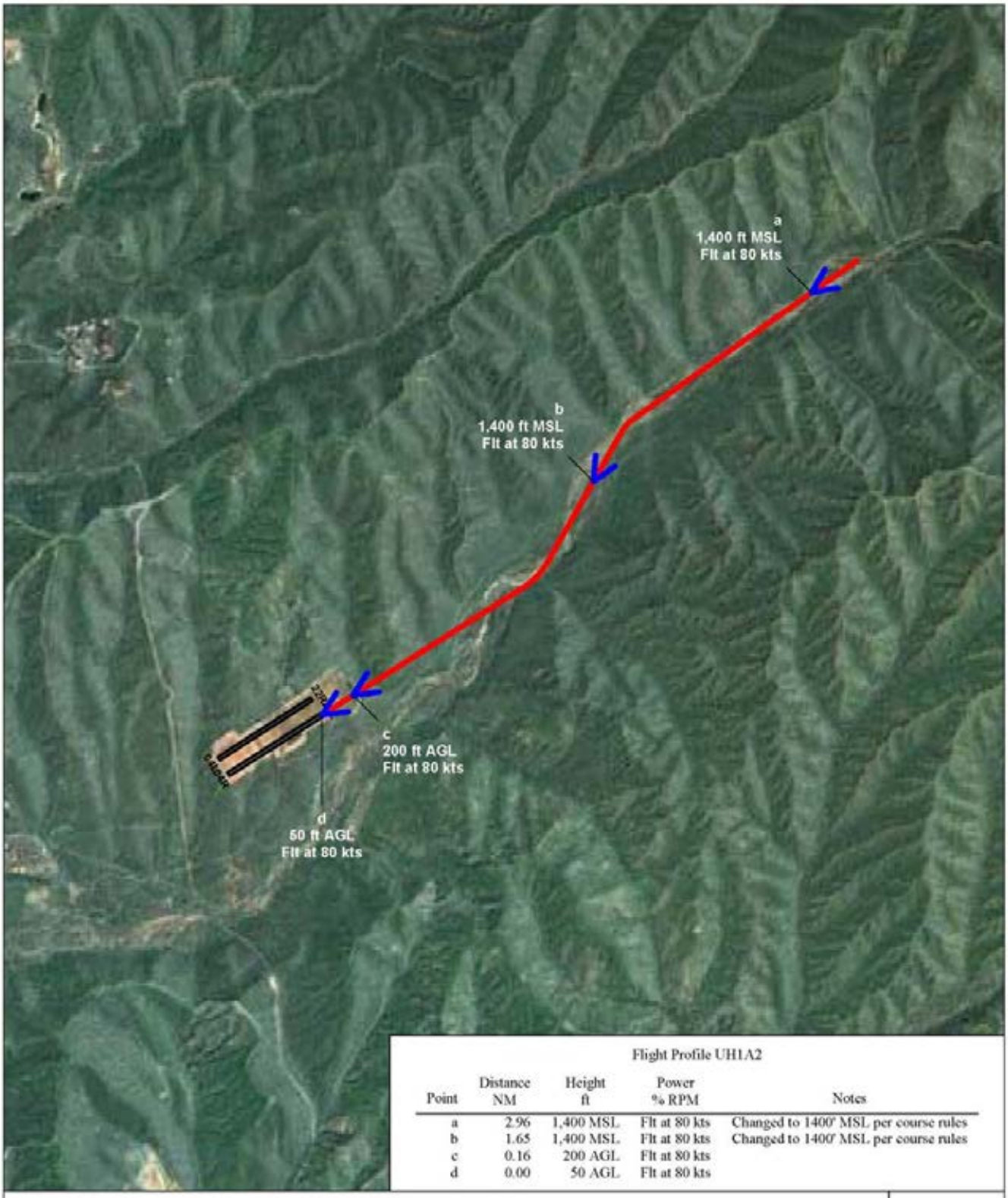
Flight Profile UH1D2

Point	Distance ft	Height ft	Power % RPM
a	0	0 AGL	Flt at 80 kts
b	200	20 AGL	Flt at 80 kts
c	2,000	200 AGL	Flt at 80 kts
d	15,000	900 MSL	Flt at 80 kts
e	30,000	900 MSL	Flt at 80 kts
f	40,000	900 MSL	Flt at 80 kts



Flight Profile UH1A1

Point	Distance NM	Height ft	Power % RPM	Notes
a	6.25	1,400 MSL	Flt at 80 kts	Changed to 1400' MSL per course rules
b	4.94	1,400 MSL	Flt at 80 kts	Changed to 1400' MSL per course rules
c	1.65	1,400 MSL	Flt at 80 kts	Changed to 1400' MSL per course rules
d	0.16	200 AGL	Flt at 80 kts	
e	0.00	50 AGL	Flt at 80 kts	



Flight Profile UH1A2

Point	Distance NM	Height ft	Power % RPM	Notes
a	2.96	1,400 MSL	Flt at 80 kts	Changed to 1400' MSL per course rules
b	1.65	1,400 MSL	Flt at 80 kts	Changed to 1400' MSL per course rules
c	0.16	200 AGL	Flt at 80 kts	
d	0.00	50 AGL	Flt at 80 kts	

Flight Profile UH1A2
Based UH-1N
on Runway 22L, Flight Track 22LA - Arrival from Case Spring

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000

Scale in Feet 1:43,800 (1 inch = 3,650 feet)

N

Flight Profile UH1T1

Point	Distance ft	Height ft	Power % RPM
a	0	50 AGL	Flt at 80 kts
b	500	200 AGL	Flt at 80 kts
c	6,000	500 AGL	Flt at 80 kts
d	8,500	500 AGL	Flt at 80 kts
e	13,512	500 AGL	Flt at 80 kts
f	17,512	200 AGL	Flt at 80 kts
g	18,512	50 AGL	Flt at 80 kts

C-1.3 NOISE MODELING DATA FOR MCAS YUMA, AUX2, AND ASSOCIATED AIRSPACE

C-1.3.1 Modeled Flight Operations for MCAS Yuma and Aux2

Estimated Historical Modeled Annual Flight Operations for Baseline at MCAS Yuma/Yuma International Airport

Operation Type	F-4			A-4			F-14			AV-8			A-7			Other Military		
	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total
Departure	16,012	3,020	19,032	10,619	2,003	12,622	3,031	572	3,603	4,007	756	4,763	6,560	1,237	7,797	4,548	858	5,406
Arrival (no break)	10,722	2,022	12,744	7,071	1,334	8,405	2,041	385	2,426	2,664	502	3,166	4,385	827	5,212	3,040	573	3,613
Overhead Break Arrival	5,290	998	6,288	3,524	665	4,189	1,014	191	1,205	1,344	253	1,597	2,175	410	2,585	1,496	282	1,778
Touch and Go	8,418	1,588	10,006	5,425	1,023	6,448	1,546	292	1,838	4,785	903	5,688	4,207	794	5,001	2,327	439	2,766
FCLP	2,234	421	2,655	1,380	260	1,640	-	-	-	519	98	617	-	-	-	594	112	706
GCA Box	94	18	112	48	9	57	386	73	459	47	9	56	48	9	57	24	4	28
Total	**42,770**	**8,067**	**50,837**	**28,067**	**5,294**	**33,361**	**8,018**	**1,513**	**9,531**	**13,366**	**2,521**	**15,887**	**17,375**	**3,277**	**20,652**	**12,029**	**2,268**	**14,297**

Operation Type	Military Helicopter			DC9 (Douglas)			DC10 (Douglas)			Air Carrier			General Aviation (GA)			All		
	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total	Day (0700-1859)	Night (2200-0659)	Total
Departure	6,015	1,134	7,149	-	-	-	-	-	-	2,009	20	2,029	21,593	218	21,811	74,394	9,818	84,212
Arrival (no break)	6,015	1,134	7,149	-	-	-	-	-	-	4,291	44	4,335	21,593	218	21,811	61,822	7,039	68,861
Overhead Break Arrival	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14,843	2,799	17,642
Touch and Go	-	-	-	651	80	731	5,854	724	6,578	-	-	-	2,807	28	2,835	36,020	5,871	41,891
FCLP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,727	891	5,618
GCA Box	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	647	122	769
Total	**12,030**	**2,268**	**14,298**	**651**	**80**	**731**	**5,854**	**724**	**6,578**	**6,300**	**64**	**6,364**	**45,993**	**464**	**46,457**	**192,453**	**26,540**	**218,993**

Notes: (1) Day = 0700 - 1859; Night = 2200 - 0659

Source: Van Houten, 1978

Proposed Modeled Annual MV-22 Flight Operations for the Maximum Partial Basing Alternative at MCAS Yuma

Operation Type	7 Fleet Squadrons		
	Day	Night	Total
Departure (non-interf)	15,484	1,221	16,705
Interfacility Departure	815	64	879
Arrival (no break; non-interf)	815	65	880
Interfacility Arrival (no break)	815	64	879
Overhead Break Arrival (non-interf)	14,670	1,157	15,827
Touch and Go	3,247	-	3,247
FCLP	6,087	676	6,763
GCA Box	4,058	-	4,058
Low Work	136	-	136
Total	**46,127**	**3,247**	**49,374**

Note: Touch and Go, GCA Box and Low Work are counted as two operations each
Day = 0700-2159 local; Night = 2200-0659 local
"Low Work" comprised of maintenance check flights, hover work and any other low work training ops conducted at less than 50 ft AGL, lasting 7 minutes, on average.
100% of FCLP operations would be conducted at Aux2

Source: Wyle Laboratories, 1999; Power, 2006 (re interfacility)

Proposed Modeled Annual MV-22 Flight Operations for the Minimum Partial Basing Alternative at MCAS Yuma

Operation Type	2 Reserve Squadrons		
	Day	Night	Total
Departure (non-interf)	3,317	261	3,578
Interfacility Departure	175	14	189
Arrival (no break; non-interf)	175	14	189
Interfacility Arrival (no break)	175	14	189
Overhead Break Arrival (non-interf)	3,144	248	3,392
Touch and Go	696	-	696
FCLP	1,304	145	1,449
GCA Box	870	-	870
Low Work	29	-	29
Total	**9,885**	**696**	**10,581**

Note: Touch and Go, GCA Box and Low Work are counted as two operations each
Day = 0700-2159 local; Night = 2200-0659 local
"Low Work" comprised of maintenance check flights, hover work and any other low work training ops conducted at less than 50 ft AGL, lasting 7 minutes, on average.
100% of FCLP operations would be conducted at Aux2

Source: Wyle Laboratories, 1999; Power, 2006 (re interfacility)

Proposed Modeled Annual MV-22 Flight Operations for the Maximum Partial Basing Alternative at Aux2

Aircraft Type	Interfacility from NYL			FCLP (1)			Interfacility to NYL			Total		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
MV-22B	815	64	879	6,087	676	6,763	815	64	879	7,717	804	8,521

Notes:
(1) counted as two operations each

Source: Wyle Laboratories, 1999; Power, 2006 (re interfacility)

Proposed Modeled Annual MV-22 Flight Operations for the Minimum Partial Basing Alternative at Aux2

Aircraft Type	Interfacility from NYL			FCLP (1)			Interfacility to NYL			Total		
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
MV-22B	175	14	189	1,304	145	1,449	175	14	189	1,654	173	1,827

Notes:
(1) counted as two operations each

Source: Powers, Sept 2006

C-1.3.2 Modeled Runway and Track Utilization for MCAS Yuma

Modeled Airfield Flight Track Utilizations for the MV-22 at MCAS Yuma

Operation Type	Flow Utilization		Runway Utilization			Flight Track Utilization (if not 100%)			
	Flow	Flow %	Runway	During Day	During Night	Track	Description	During Day	During Night
Departure (non-interf)	East	31%	08	100%	100%	08XD01	VFR std transition to east	100%	100%
						08XD02	SID Picacho		
						08XD03	SID Mohak		
						08XD04	VFR std transition to south		
						08XD05	VFR std transition to west		
						08XD06	SID Argus		
	West	26%	26	100%	100%	26XD01		100%	100%
						26XD02	SID Argus		
						26XD03	VFR & SID Picacho		
						26XD04	SID Mohawk		
						26XD05			
						26XD06			
	Northeast	23%	03L			03LD01			
						03LD02			
						03LD03			
						03LD04	SID Argus		
						03LD05	SID Picacho		
						03LD06	SID Mohak		
						03LD07	VFR dep transit NW		
						03LD08	VFR dep transit E		
						03LD09	VFR dep transit NE		
			03R	100%	100%	03RD01			
						03RD02			
						03RD03			
						03RD04	SID Argus	20%	20%
						03RD05	SID Picacho		
						03RD06	SID Mohak	20%	20%
						03RD07	VFR dep transit NW	20%	20%
						03RD08	VFR dep transit E	20%	20%
						03RD09	VFR dep transit NE	20%	20%
	Southwest	19%	21L	100%	100%	21LD01	VFR dep transit NW		
						21LD02	VFR to Mexico	25%	25%
						21LD03	VFR dep transit E		
						21LD04	VFR to Mexico & Aux 4/37 (BP & MV-22)		
						21LD05	SID Picacho	25%	25%
						21LD06	SID Mohak	25%	25%
						21LD07	SID Argus	25%	25%
						21LD08	VFR dep transit NE		
						21LD09	SID Argus		
			21R			21RD01	VFR dep transit NW		
						21RD02	VFR to Mexico		
						21RD03	VFR dep transit E		
						21RD04	VFR to Mexico & Aux 4/37 (BP & MV-22)		
						21RD05	SID Picacho		
						21RD06	SID Mohak		
						21RD07	SID Argus		
						21RD08	VFR dep transit NE		
						21RD09	SID Argus		
	North	0.75%	35	100%	100%	35XD01	VFR departure west		
						35XD02	SID Argus	50%	50%
						35XD03	SID Picacho &VFR		
						35XD04			
						35XD05	SID Mohak	50%	50%
						35XD06	VFR east departure (can leave initial @ any point?)		
	South	0.25%	17	100%	100%	17XD01	VFR departure to Pilot's Knob & westerly routes	33%	33%
						17XD02	VFR departure east	33%	33%
						17XD03	SID Mohak		
						17XD04	SID Argus		
						17XD05	SID Picacho	34%	34%

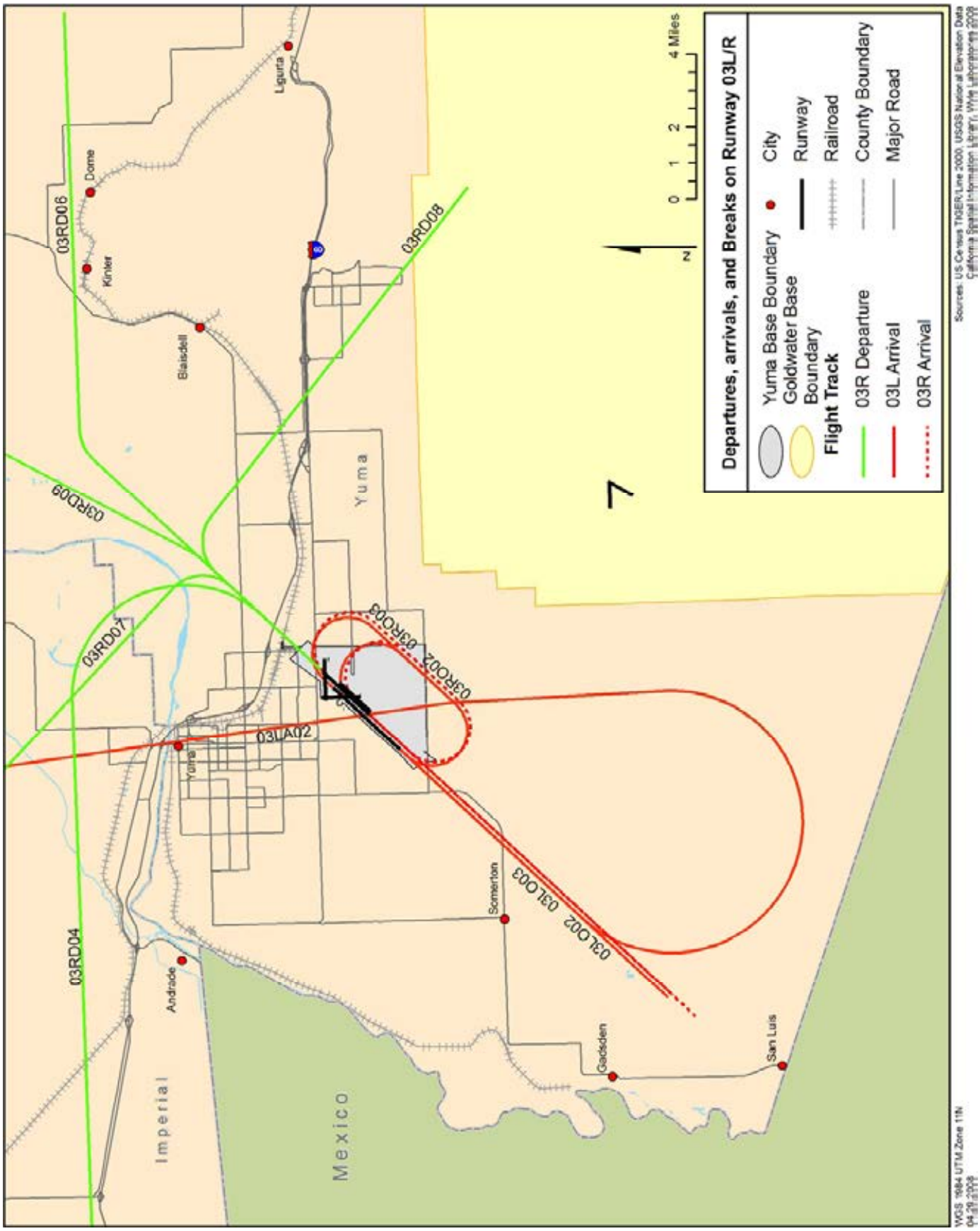
Modeled Airfield Flight Track Utilizations for the MV-22 at MCAS Yuma

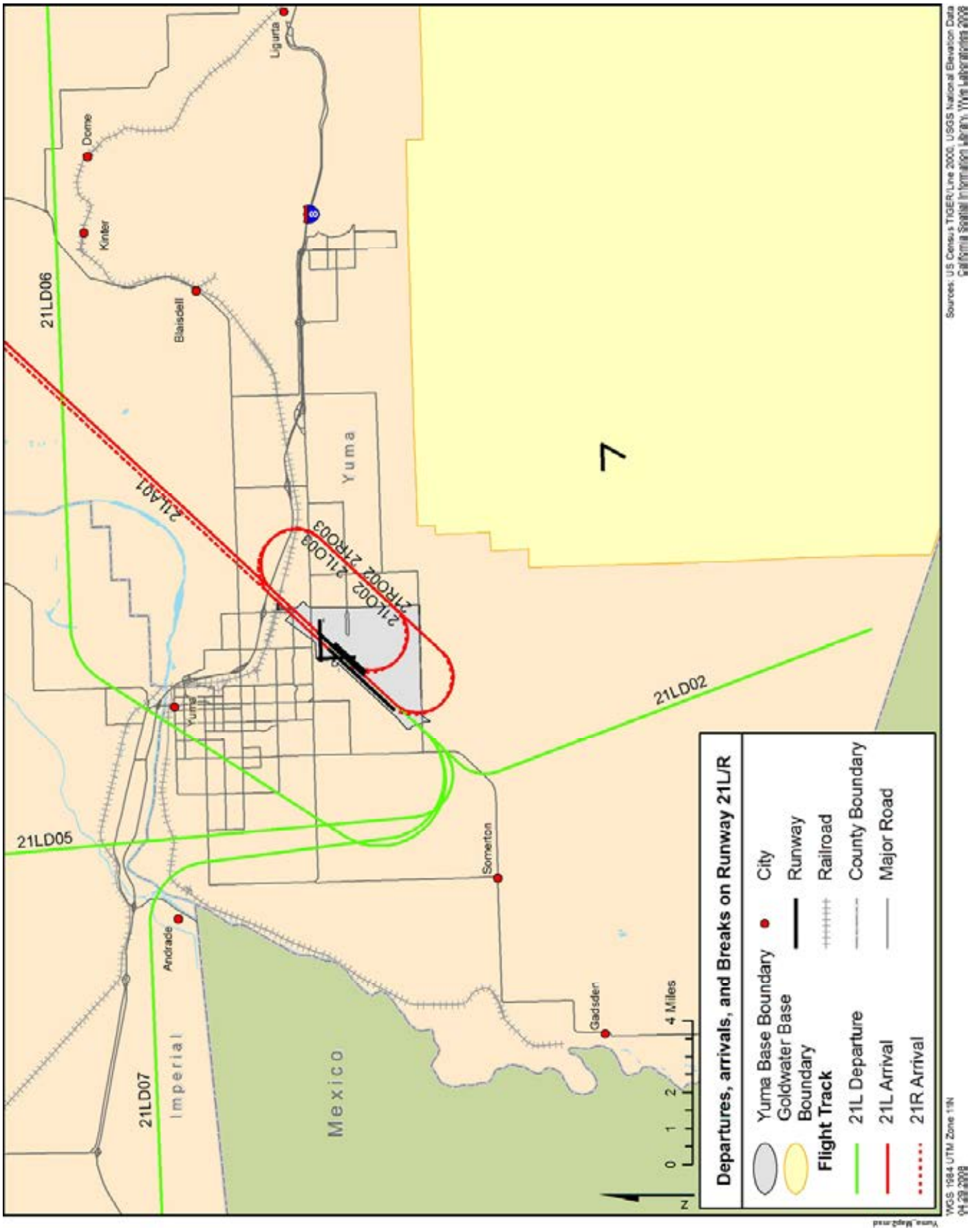
Arrival (no break; non-interf)	East	31%	08	100%	100%	08XA01	VFR arrival from Pilot's Knob	80%	80%
						08XA02	VFR arr from east	20%	20%
						08XA03			
	West	26%	26	100%	100%	26XA01	VFR arrival - duplicate?	80%	80%
						26XA02	VFR arr from Pt Tango (NASMOD) -duplicate?		
						26XA03	VFR recovery from west	20%	20%
						26XA04	VFR recovery from north (GA & C-12, no mil)		
	Northeast	23%	03L	100%	100%	03LA01	VFR GA arr from Mexico	100%	100%
						03LA02	HI-TACAN arrival (03L only)		
						03LA03	VFR arrival from North		
						03LA04	VFR arrival from due East		
						03LA05	VFR arrival from East		
			03R			03RA01	VFR GA arr from Mexico		
						03RA02	C-12 VFR arrival (?only 03R?)		
						03RA03	VFR arrival from North		
						03RA04	VFR arrival from due East		
						03RA05	VFR arrival from East		
	Southwest	19%	21L	100%	100%	21LA01	VFR arrival from NW or VFR left base from ?	100%	100%
						21LA02	VFR arrival from NW or VFR left base from ?		
			21R			21RA01	STARs & VFR arr from NW & left base from ?		
						21RA02	STARs		
	North	0.75%	35	100%	100%	35XA01	VFR arr from east (100% of east traffic)		
						35XA02	VFR left traffic arrival from NW (20% of west traffic)	100%	100%
						35XA03	VFR preferred arrival from NW (80% of west traffic)		
						35XA04	VFR arrival from N (BARD transition)		
						35XA05	VFR arr from Mexico		
	South	0.25%	17	100%	100%	17XA01	Arr from East		
						17XA02	VFR arr from west	100%	100%
						17XA03	preferred VFR arrival from east - check 1st radius		
						17XA04	STAR & VFR arr from North		
Overhead Break	Northeast	55%	03L	88%	88%	03LO01	numbers	33%	33%
						03LO02	midfield	33%	33%
						03LO03	upwind numbers	34%	34%
			03R	12%	12%	03RO01	numbers	33%	33%
						03RO02	midfield	33%	33%
						03RO03	upwind numbers	34%	34%
	Southwest	45%	21L	14%	14%	21LO02	midfield	50%	50%
						21LO03	upwind numbers	50%	50%
			21R	86%	86%	21RO02	midfield	50%	50%
						21RO03	upwind numbers	50%	50%
Touch and Go	East		26			26XT01			
	Northeast	55%	03L	88%	88%	03LT01		100%	100%
						03LT02			
			03R	12%	12%	03RT01		100%	100%
	Southwest	45%	21L	14%	14%	21LT01	outboard T&G	100%	100%
						21LT02	outboard T&G		
						21LT03	outboard T&G		
			21R	86%	86%	21RT02		100%	100%
	North		35			35XT01			
	South		17			17XT01			
GCA Box	Northeast	55%	03L	88%	88%	03LG02	Left Traffic, primarily FW GCA Box	100%	100%
			03R	12%	12%	03RG02	Left Traffic, primarily FW GCA Box	100%	100%
	Southwest	45%	21L	14%	14%	21LG02	Right Traffic, primarily FW GCA Box	100%	100%
			21R	86%	86%	21RG01	Right Traffic, primarily RW GCA Box		
						21RG02	Right Traffic, primarily FW GCA Box	100%	100%

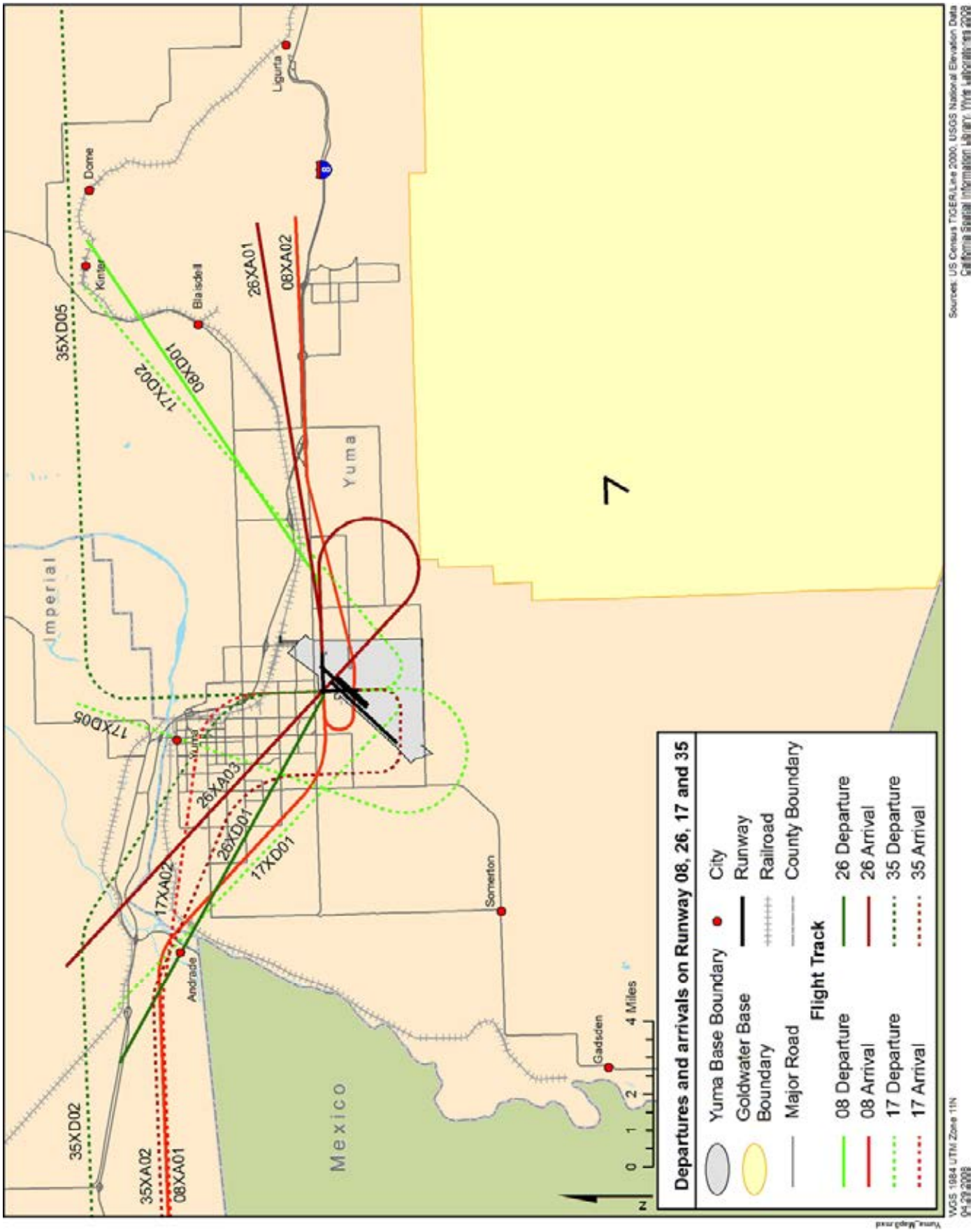
Modeled Airfield Flight Track Utilizations for the MV-22 at Aux2

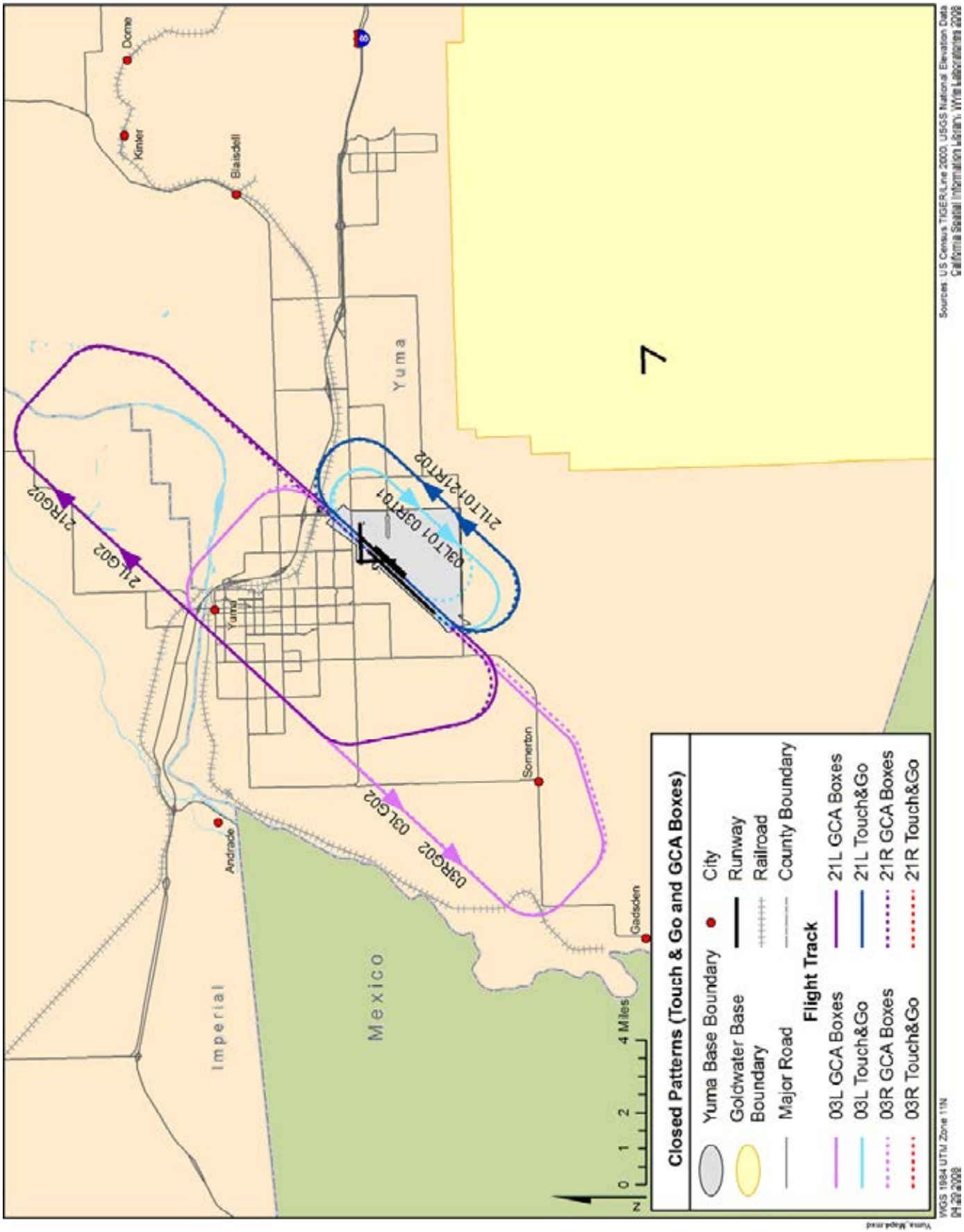
Operation Type	Flow Utilization		Runway Utilization			Flight Track Utilization			
	Flow	Flow %	Runway	During Day	During Night	Track	Description	During Day	During Night
Interfacility from MCAS Yuma	Northeast	55%	03L/04			03LI04	03L to 04		
			03R/04			03RI04	03R to 04		
			03L/09			03LI09	03L to 09		
			03R/09	100%	100%	03RI09	03R to 09	100%	100%
			21L/04			21LI04	21L to 04		
			21R/04			21RI04	21R to 04		
	Southwest	45%	03L/22			03LI22	03L to 22		
			03R/22			03RI22	03R to 22		
			21L/09	100%	100%	21LI09	21L to 09		
			21R/09			21RI09	21R to 09		
			21L/22			21LI22	21L to 22		
			21R/22			21RI22	21R to 22		
Touch and Go	Northeast	55%	04	100%	100%	04XT02	n/a		
	Southwest	45%	22	100%	100%	22XT01	n/a		
Interfacility to MCAS Yuma	Northeast	55%	04/03L			04XI03L	04 to 03L		
			04/03R			04XI03R	04 to 03R		
			04/21L			04XI21L	04 to 21L		
			04/21R			04XI21R	04 to 21R		
			27/03L	100%	100%	27XI21L	27 to 21L	100%	100%
			27/03R			27XI21R	27 to 21R		
	Southwest	45%	22/03L			27XI03L	22 to 03L		
			22/03R	100%	100%	27XI03R	22 to 03R	100%	100%
			27/03L			27XI21L	27 to 21L		
			27/03R			27XI21R	27 to 21R		
			22/21L			22XI21L	22 to 21L		
			22/21R			22XI21R	22 to 21R		

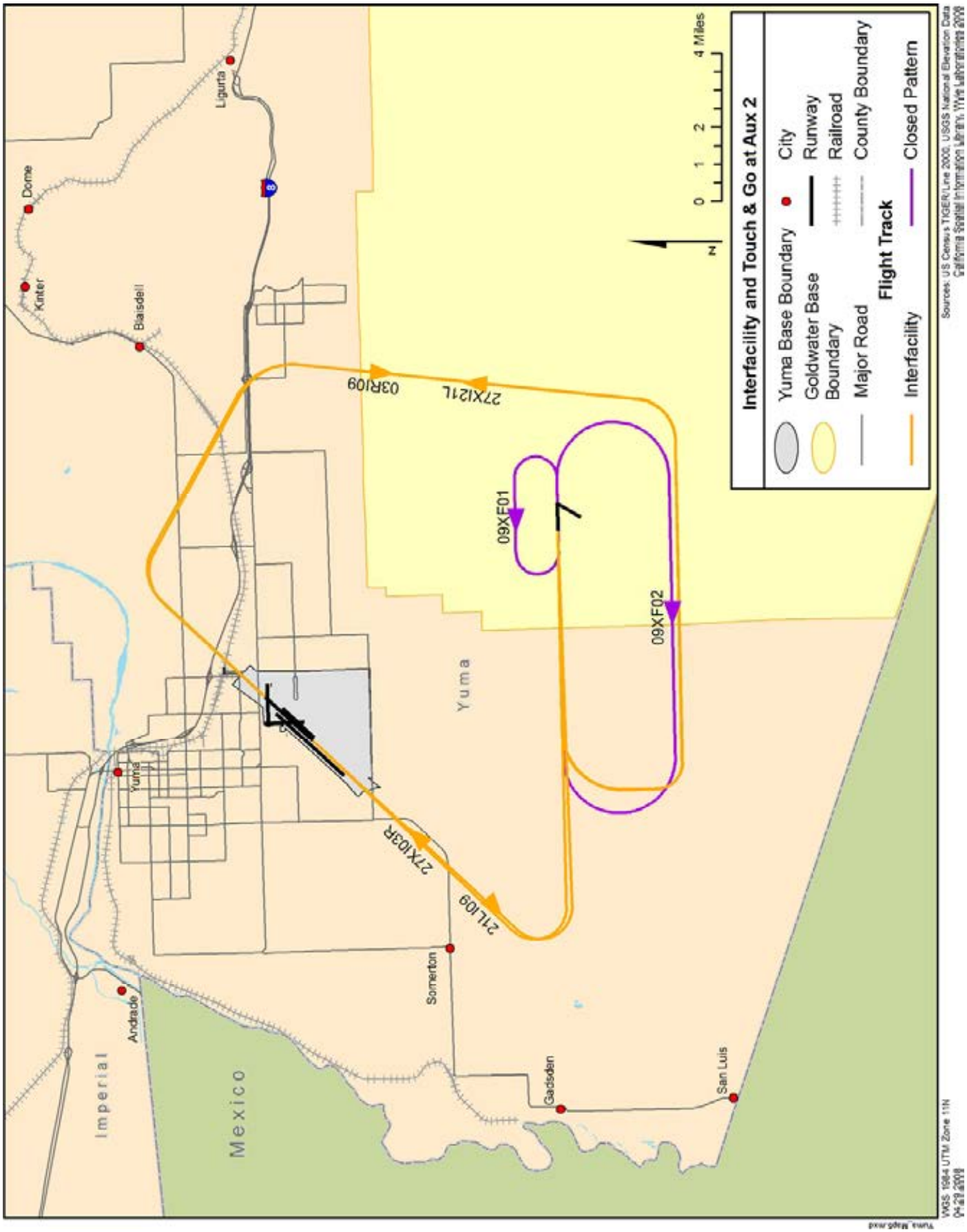
C-1.3.3 Modeled Flight Tracks for MCAS Yuma and Aux2




Departures, arrivals, and Breaks on Runway 21L/R
Yuma Base Boundary
Goldwater Base Boundary
City
Runway
Railroad
Flight Track
21L Departure
21L Arrival
21R Arrival
County Boundary
Major Road
0 1 2 4 Miles
N
Mexico
Imperial
Yuma
Ligurta
Dome
Kinter
Blaisdell
Andrade
Somerton
Gadsden
21LD06
21LD05
21LD07
21LD02
21LA01
21LD02
21LD03
21RD02
21RD03
Sources: US Census TIGER/Line 2000, USGS National Elevation Data
California Spatial Information Library, Yale Laboratories 2008
WGS 1984 UTM Zone 11N
04/29/2008


Departures and arrivals on Runway 08, 26, 17 and 35
Yuma Base Boundary
City
Goldwater Base Boundary
Runway
Railroad
Major Road
County Boundary
Flight Track
08 Departure
26 Departure
08 Arrival
26 Arrival
17 Departure
35 Departure
17 Arrival
35 Arrival
0 1 2 4 Miles
N
Mexico
Imperial
Yuma
Somerton
Gadsden
Andrade
Ligurta
Blaisdell
Dome
Kimler
35XD02
35XA02
08XA01
17XA02
17XD05
26XA03
26XD01
17XD01
35XD05
17XD02
08XD01
26XA01
08XA02
WGS 1984 UTM Zone 11N
04-29-2008
Sources: US Census TIGER/Line 2000, USGS National Elevation Data
California Spatial Information Library, Yuma Laboratories 2008

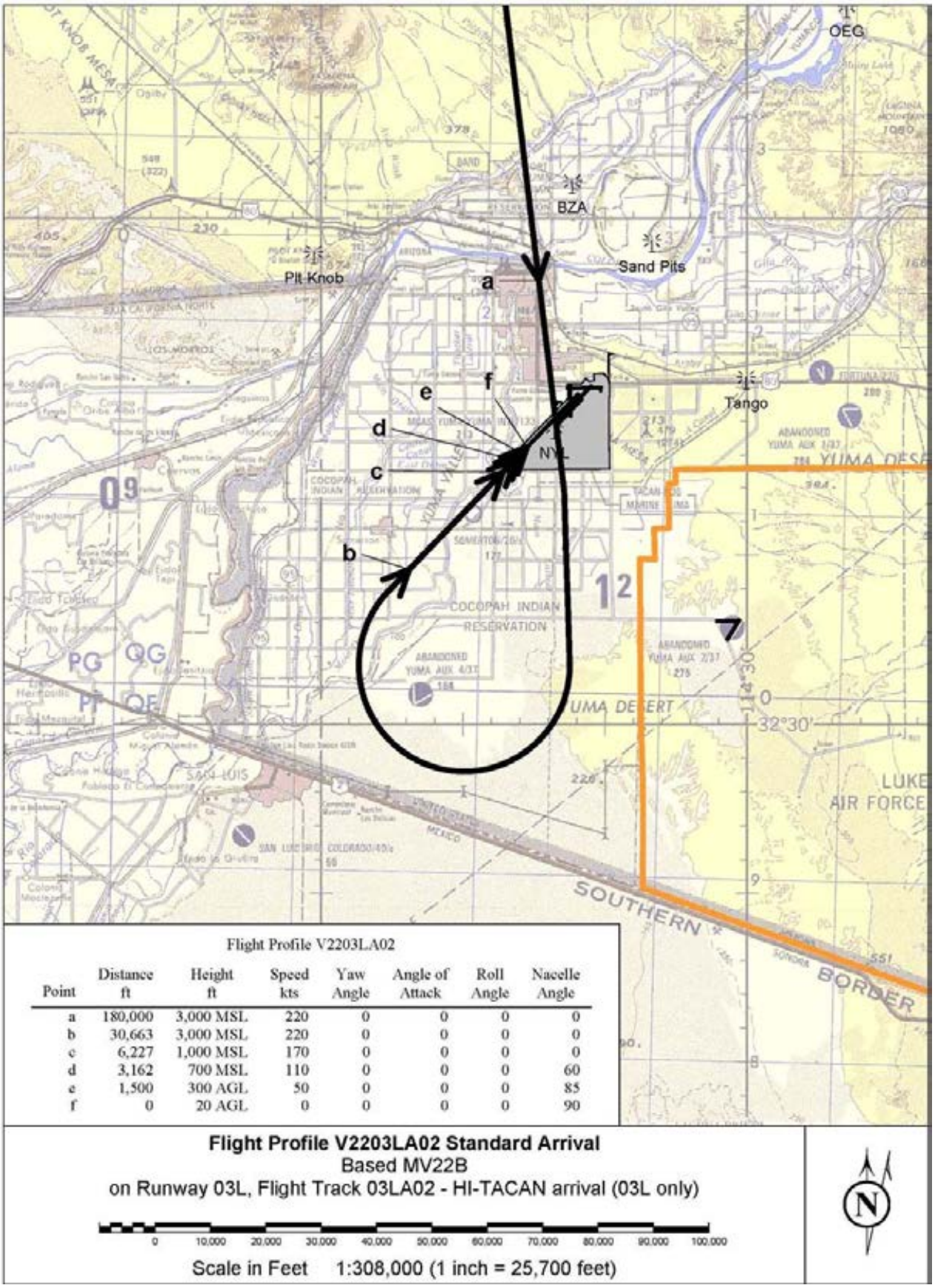

Closed Patterns (Touch & Go and GCA Boxes)
Yuma Base Boundary
City
Goldwater Base Boundary
Runway
Railroad
Major Road
County Boundary
Flight Track
03L GCA Boxes
21L GCA Boxes
03L Touch&Go
21L Touch&Go
03R GCA Boxes
21R GCA Boxes
03R Touch&Go
21R Touch&Go
0 1 2 4 Miles
N
Mexico
Imperial
Yuma
Andrade
Somerton
Gadsden
Dome
Kimker
Blaisdell
21RGO2
21LGO2
03LGO2
03RGO2
03LT01 03RT01
21LT01 21RT01
Sources: U.S. Census TIGER/Line 2000, USGS National Elevation Data
California Spatial Information Library, Wide Area Networks 2008
WGS 1984 UTM Zone 11N
04/29/2008
Yuma_Map4.mxd


Interfacility and Touch & Go at Aux 2
Yuma Base Boundary
City
Goldwater Base Boundary
Runway
Railroad
Major Road
County Boundary
Flight Track
Interfacility
Closed Pattern
0 1 2 4 Miles
N
Sources: US Census TIGER/Line 2000, USGS National Elevation Data
California Spatial Information Library, Wire Laboratories 2008
WGS 1984 UTM Zone 11N
04-29-2008
Yuma_Maps.mxd
09XF01
09XF02
27X121L
03R109
27X103R
27L109
Yuma
Imperial
Mexico
Andrade
Somerton
Gadsden
San Luis
Yuma
Blaisdell
Kinter
Dome
Ligurita
8

C-1.3.4 Modeled MV-22 Flight Profiles for MCAS Yuma and Aux2

The flight profile information on the following pages is shown in tabular fashion, captioned on each map. The columns of the flight profile data tables are described below:

Column Heading	Description
Point	Sequence letter along flight track denoting change in flight parameters
Distance (feet)	Distance along flight track from runway threshold in feet
Height (feet)	Altitude of aircraft in feet Above Ground Level (AGL) or relative to Mean Sea Level (MSL)
Power (Appropriate Unit)* Speed (kts)	Engine power setting and Drag Configuration/Interpolation Code (defines sets of interpolation code in NOISEMAP (F for FIXED, P for PARALLEL, V for VARIABLE)) Indicated airspeed of aircraft in knots
Yaw Angle (degrees)**	Angle of the aircraft relative to its vertical axis in degrees; positive nose left
Angle of Attack (degrees)**	Angle of the aircraft, not of the wing; angle between the climb angle and the pitch angle, in degrees, positive nose up. The climb angle is the angle between the horizontal and the velocity vector (same convention). The pitch angle is the angle between the horizontal and the thrust vector (same convention)
Roll Angle (degrees)**	Angle of the aircraft relative to its longitudinal axis in degrees; positive left side down.
Nacelle Angle (degrees)***	Angle of engine nacelle pylon relative to the horizontal (airplane) mode; positive up; maximum of 90



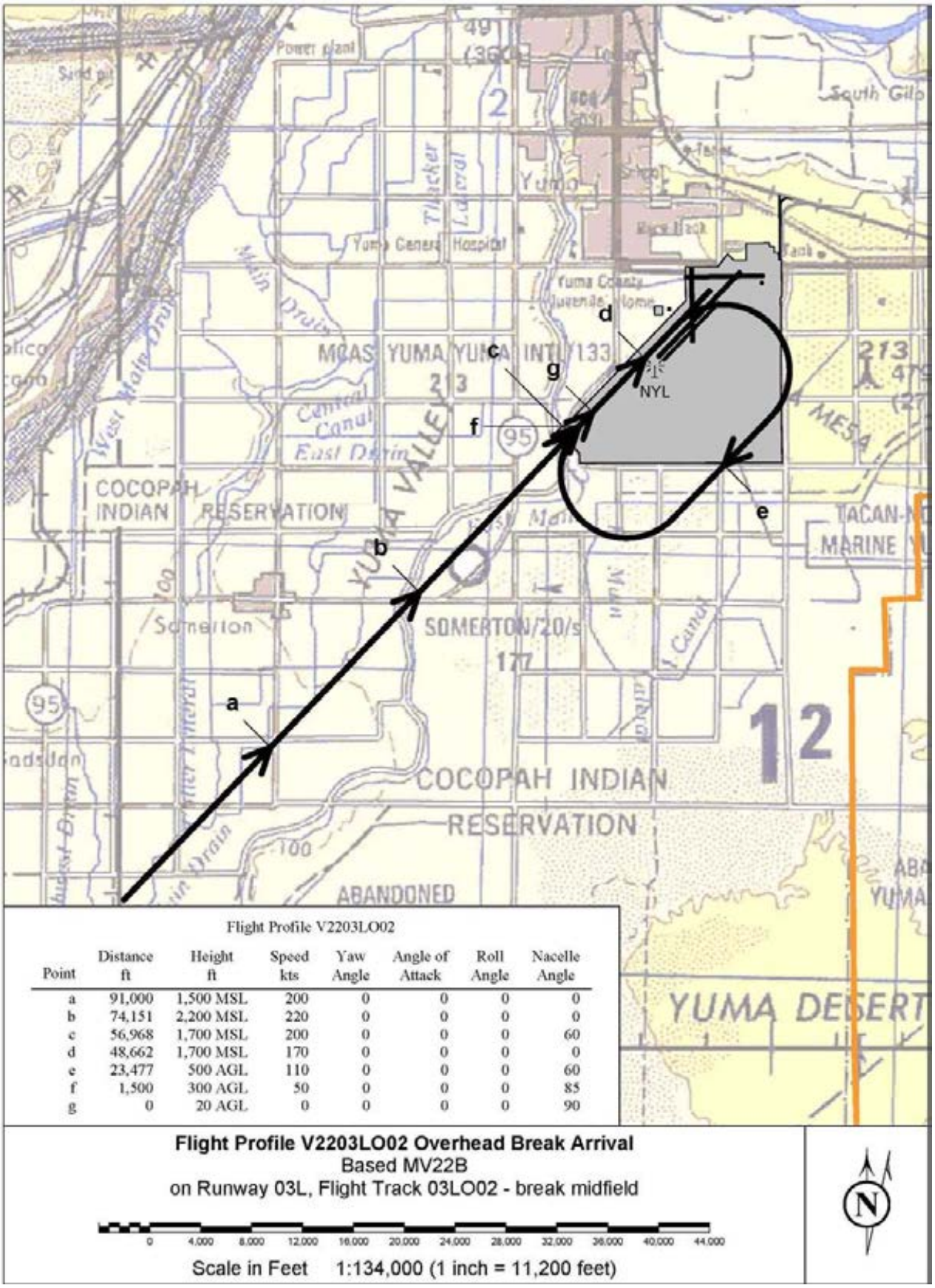
Flight Profile V2203LA02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	180,000	3,000 MSL	220	0	0	0	0
b	30,663	3,000 MSL	220	0	0	0	0
c	6,227	1,000 MSL	170	0	0	0	0
d	3,162	700 MSL	110	0	0	0	60
e	1,500	300 AGL	50	0	0	0	85
f	0	20 AGL	0	0	0	0	90

Flight Profile V2203LA02 Standard Arrival
Based MV22B
on Runway 03L, Flight Track 03LA02 - HI-TACAN arrival (03L only)

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 100,000

Scale in Feet 1:308,000 (1 inch = 25,700 feet)



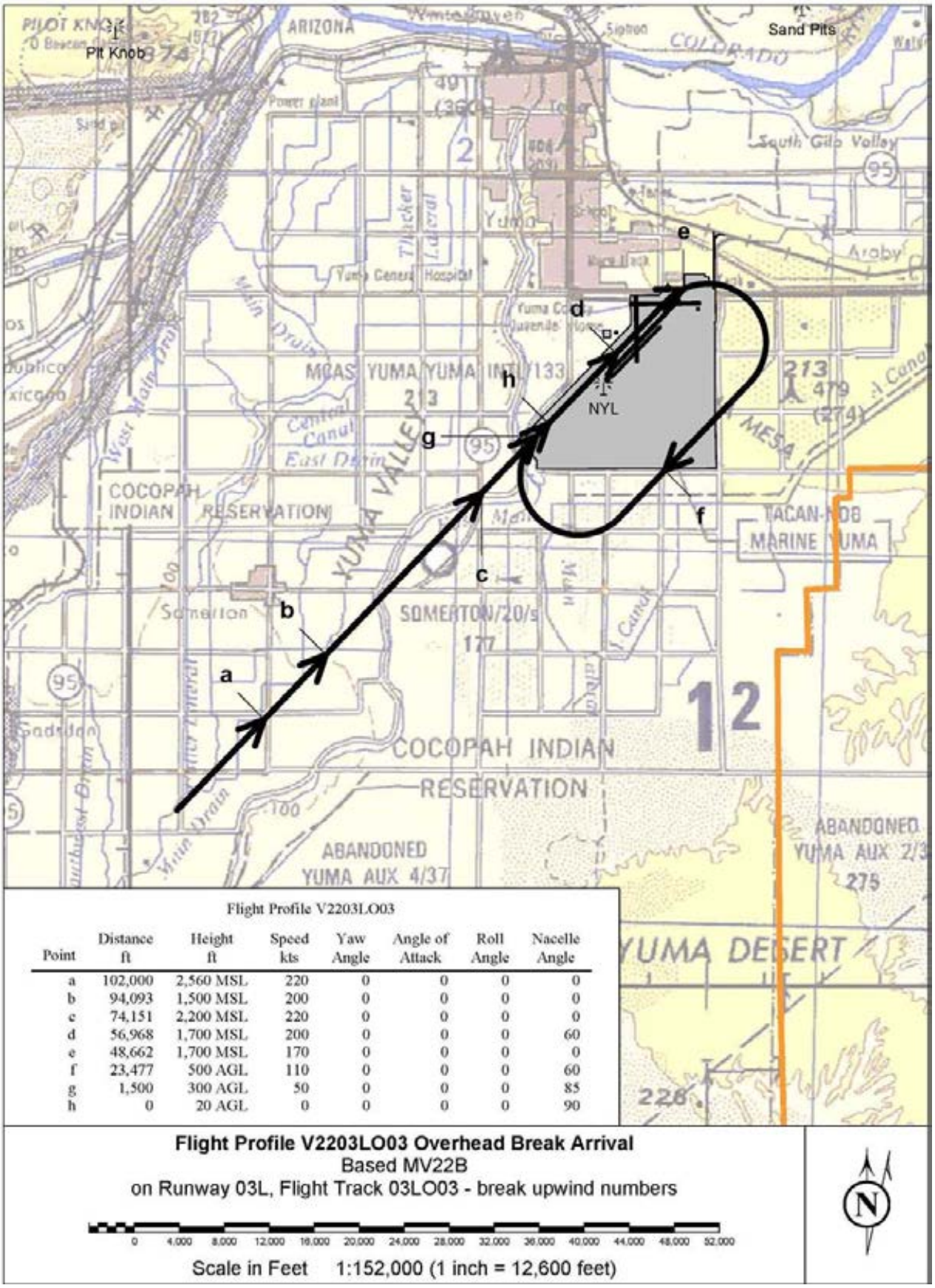
Flight Profile V2203LO02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	91,000	1,500 MSL	200	0	0	0	0
b	74,151	2,200 MSL	220	0	0	0	0
c	56,968	1,700 MSL	200	0	0	0	60
d	48,662	1,700 MSL	170	0	0	0	0
e	23,477	500 AGL	110	0	0	0	60
f	1,500	300 AGL	50	0	0	0	85
g	0	20 AGL	0	0	0	0	90

Flight Profile V2203LO02 Overhead Break Arrival
Based MV22B
on Runway 03L, Flight Track 03LO02 - break midfield

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:134,000 (1 inch = 11,200 feet)



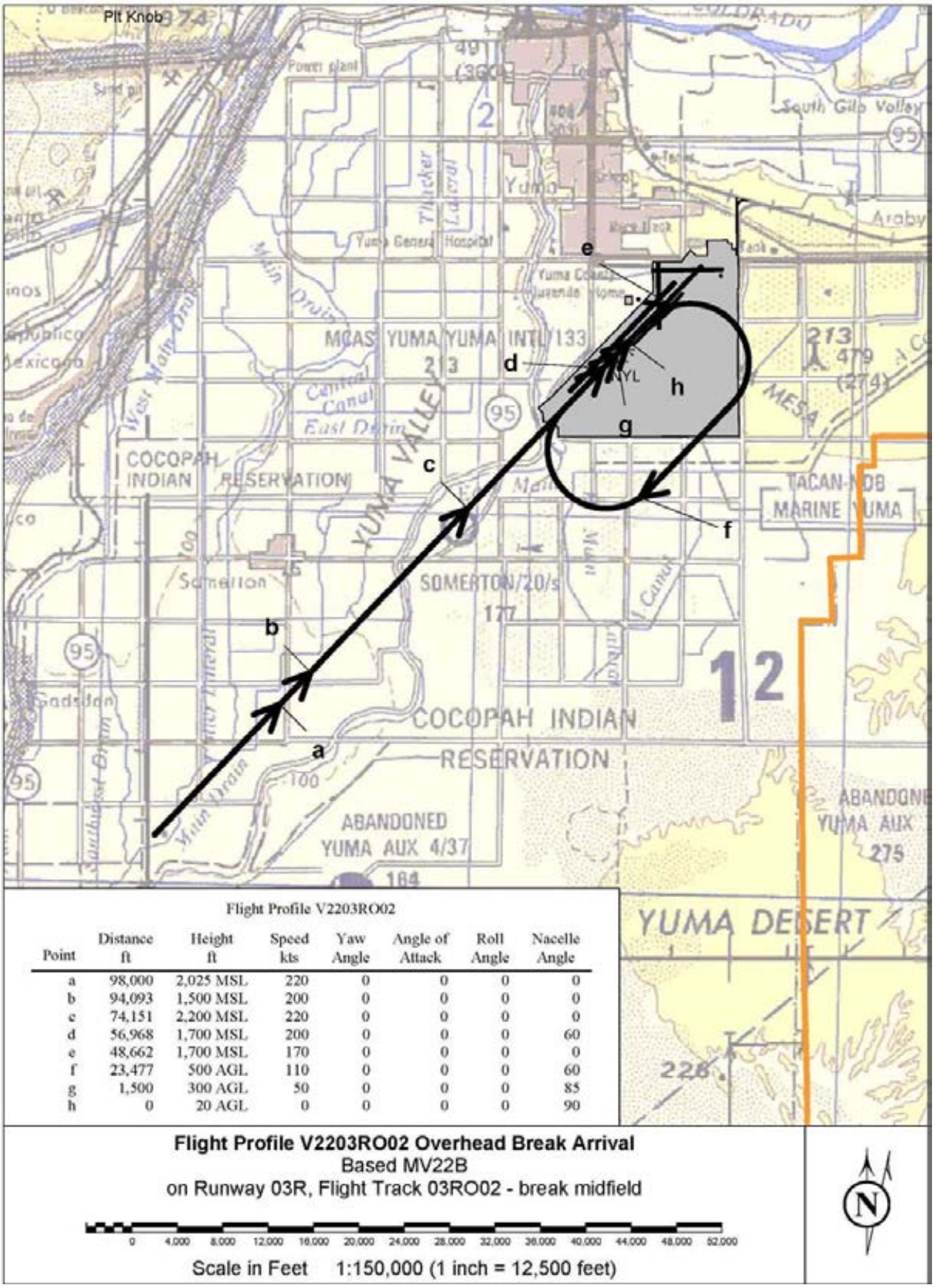
Flight Profile V2203LO03

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	102,000	2,560 MSL	220	0	0	0	0
b	94,093	1,500 MSL	200	0	0	0	0
c	74,151	2,200 MSL	220	0	0	0	0
d	56,968	1,700 MSL	200	0	0	0	60
e	48,662	1,700 MSL	170	0	0	0	0
f	23,477	500 AGL	110	0	0	0	60
g	1,500	300 AGL	50	0	0	0	85
h	0	20 AGL	0	0	0	0	90

Flight Profile V2203LO03 Overhead Break Arrival
Based MV22B
on Runway 03L, Flight Track 03LO03 - break upwind numbers

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:152,000 (1 inch = 12,600 feet)



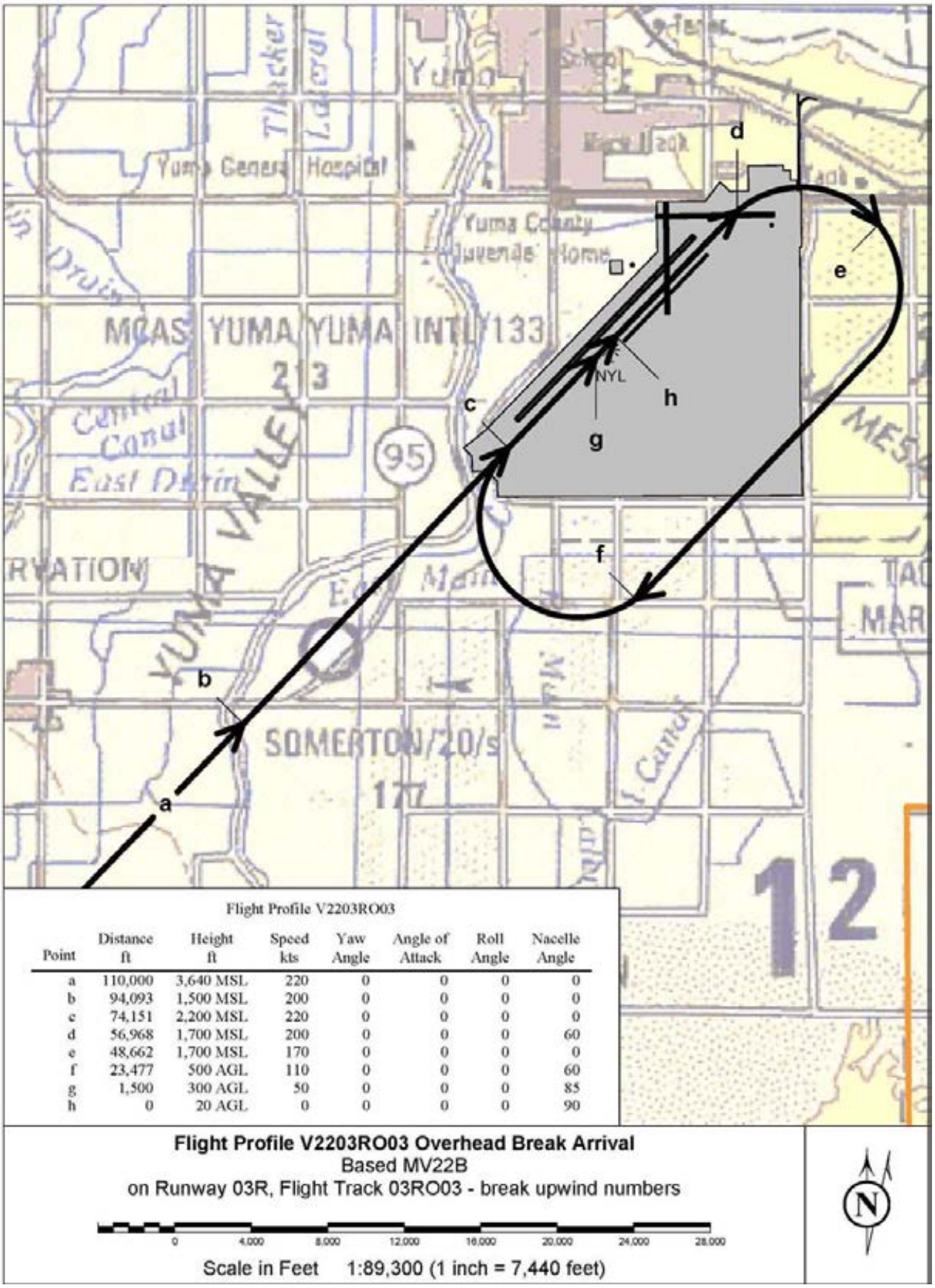
Flight Profile V2203RO02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	98,000	2,025 MSL	220	0	0	0	0
b	94,093	1,500 MSL	200	0	0	0	0
c	74,151	2,200 MSL	220	0	0	0	0
d	56,968	1,700 MSL	200	0	0	0	60
e	48,662	1,700 MSL	170	0	0	0	0
f	23,477	500 AGL	110	0	0	0	60
g	1,500	300 AGL	50	0	0	0	85
h	0	20 AGL	0	0	0	0	90

Flight Profile V2203RO02 Overhead Break Arrival
Based MV22B
on Runway 03R, Flight Track 03RO02 - break midfield

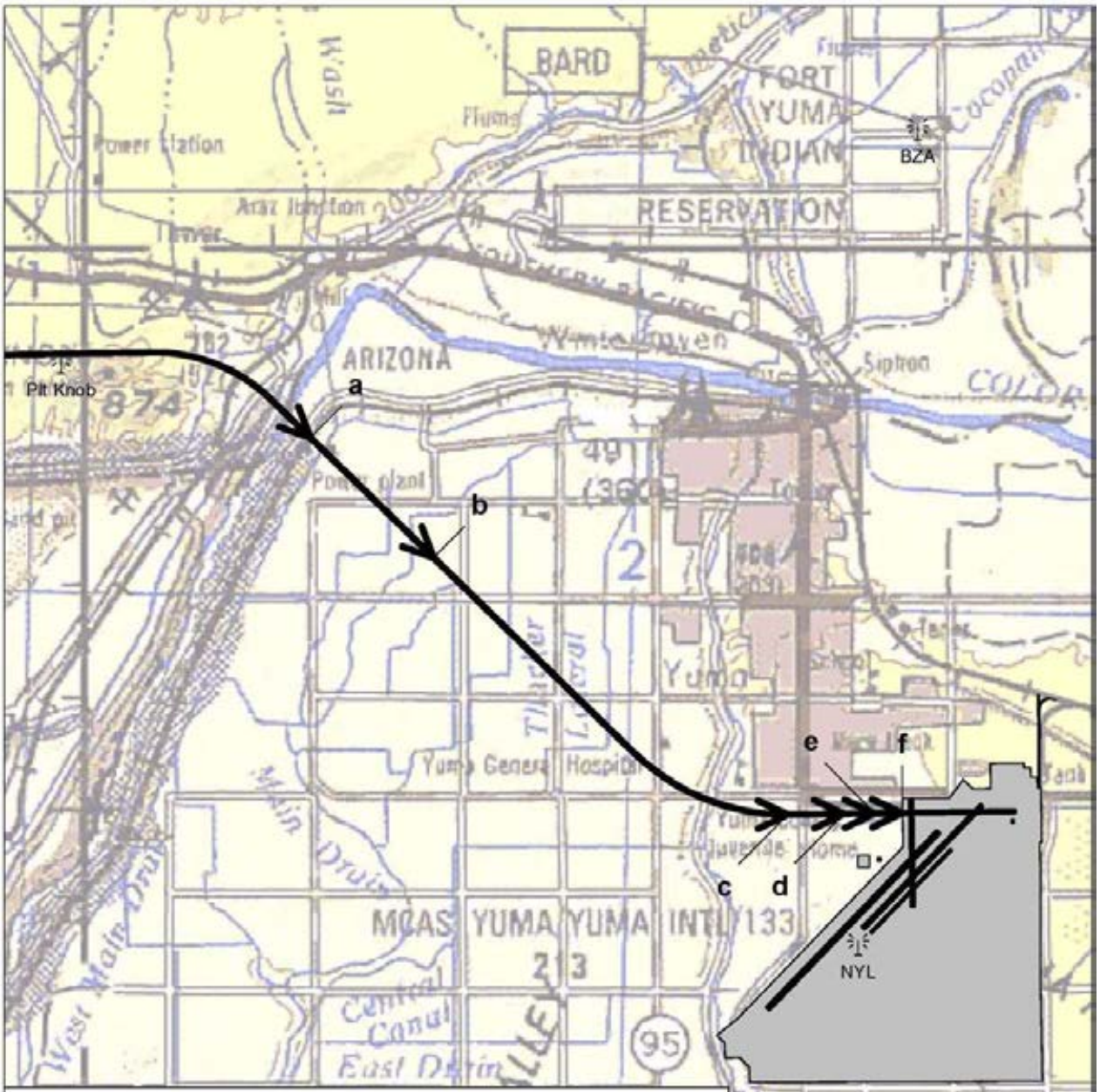
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:150,000 (1 inch = 12,500 feet)



Flight Profile V2203RO03

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	110,000	3,640 MSL	220	0	0	0	0
b	94,093	1,500 MSL	200	0	0	0	0
c	74,151	2,200 MSL	220	0	0	0	0
d	56,968	1,700 MSL	200	0	0	0	60
e	48,662	1,700 MSL	170	0	0	0	0
f	23,477	500 AGL	110	0	0	0	60
g	1,500	300 AGL	50	0	0	0	85
h	0	20 AGL	0	0	0	0	90



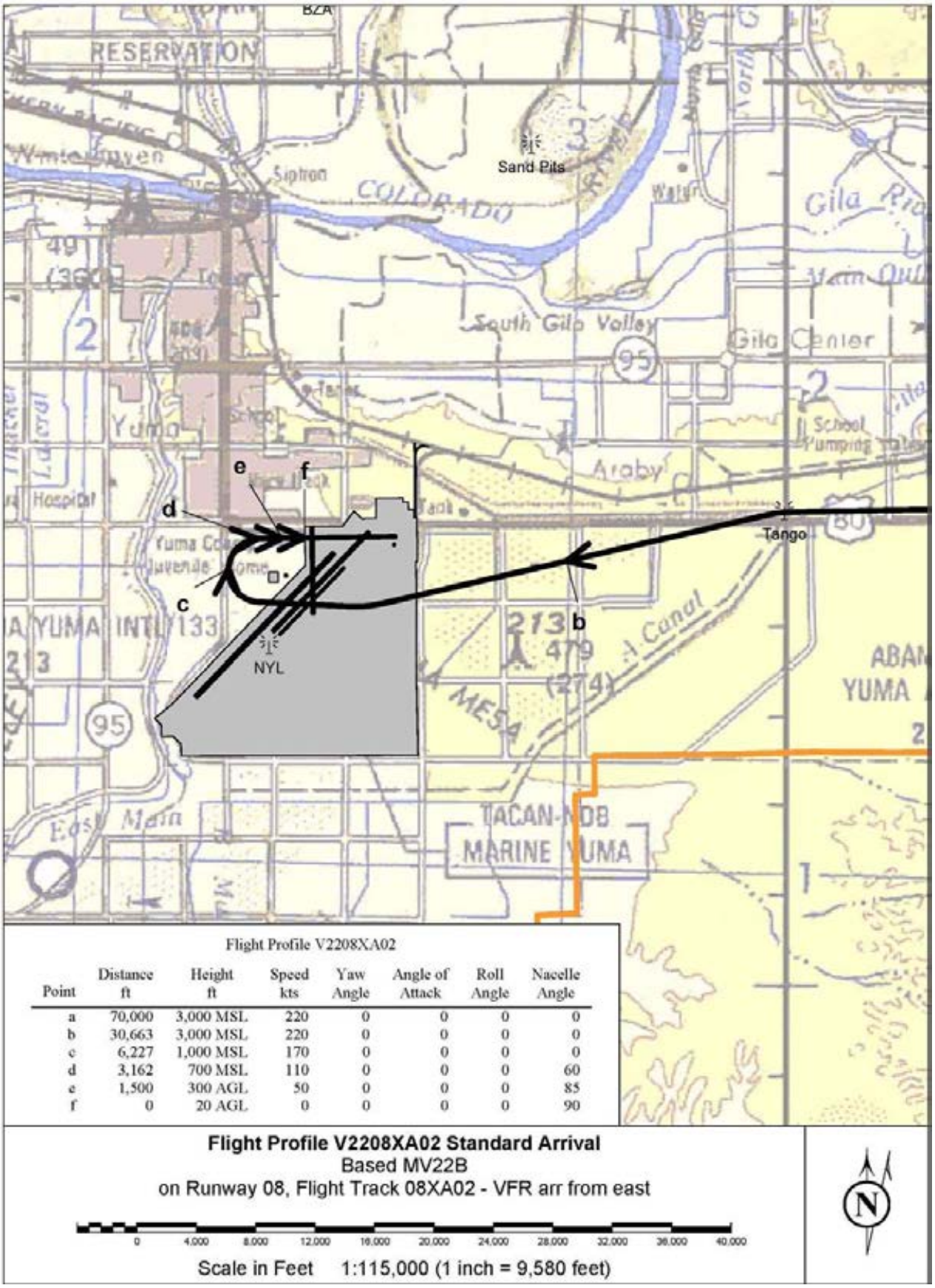
Flight Profile V2208XA01

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	40,000	3,000 MSL	220	0	0	0	0
b	30,663	3,000 MSL	220	0	0	0	0
c	6,227	1,000 MSL	170	0	0	0	0
d	3,162	700 MSL	110	0	0	0	60
e	1,500	300 AGL	50	0	0	0	85
f	0	20 AGL	0	0	0	0	90

Flight Profile V2208XA01 Standard Arrival
Based MV22B
on Runway 08, Flight Track 08XA01 - VFR arrival from Pilot's Knob

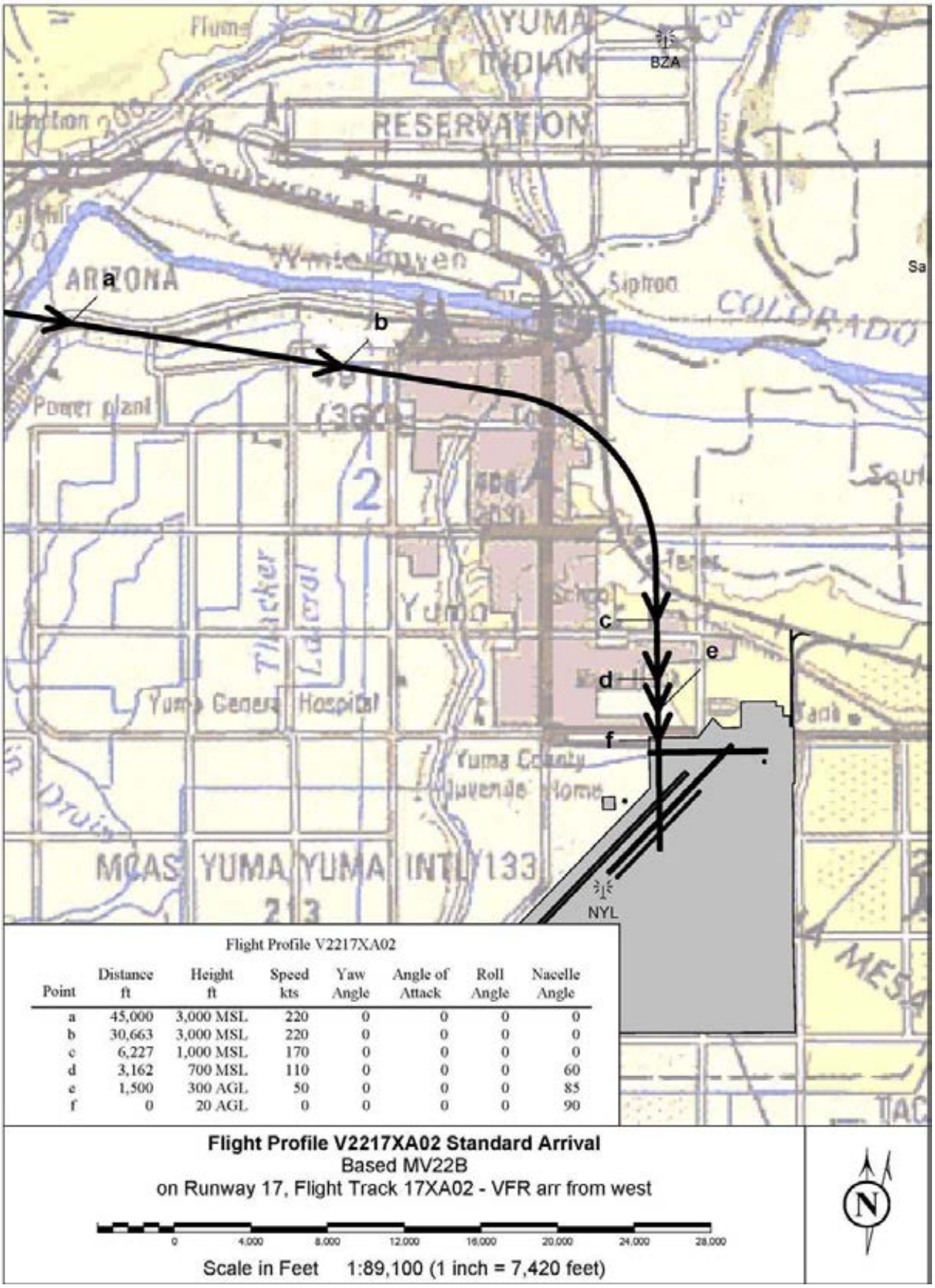
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:109,000 (1 inch = 9,110 feet)



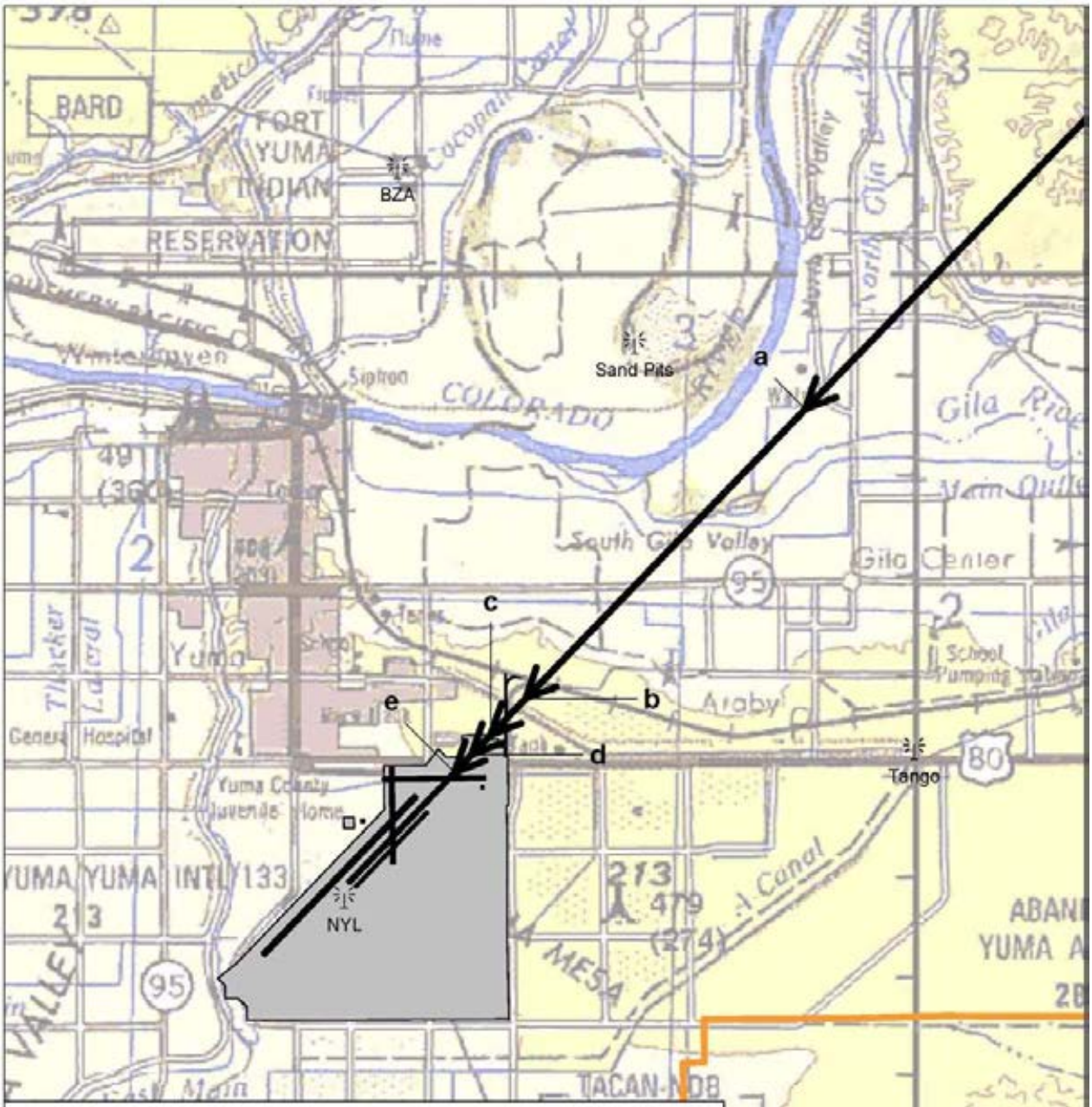
Flight Profile V2208XA02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	70,000	3,000 MSL	220	0	0	0	0
b	30,663	3,000 MSL	220	0	0	0	0
c	6,227	1,000 MSL	170	0	0	0	0
d	3,162	700 MSL	110	0	0	0	60
e	1,500	300 AGL	50	0	0	0	85
f	0	20 AGL	0	0	0	0	90



Flight Profile V2217XA02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	45,000	3,000 MSL	220	0	0	0	0
b	30,663	3,000 MSL	220	0	0	0	0
c	6,227	1,000 MSL	170	0	0	0	0
d	3,162	700 MSL	110	0	0	0	60
e	1,500	300 AGL	50	0	0	0	85
f	0	20 AGL	0	0	0	0	90



Flight Profile V2221LA01

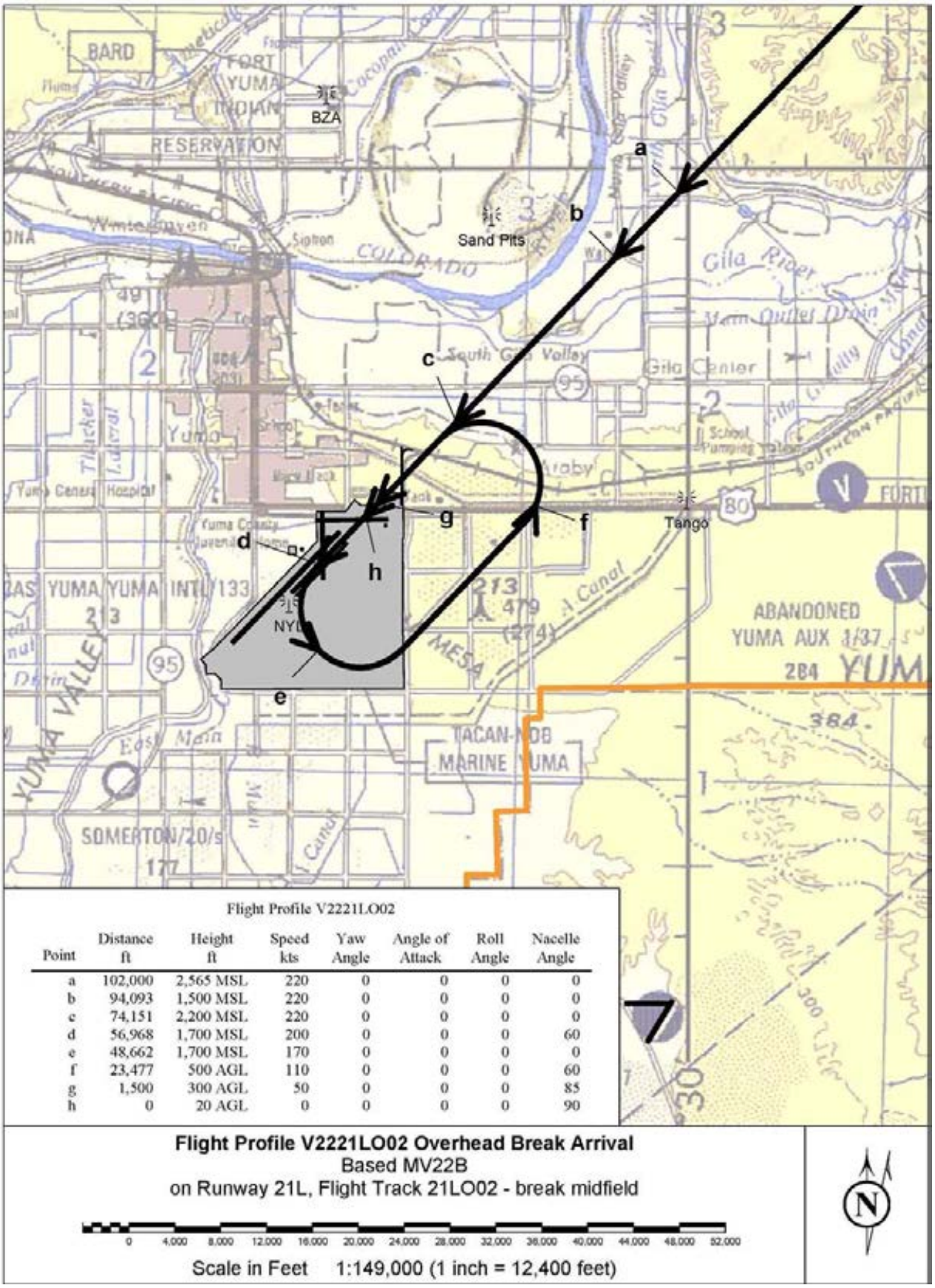
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	30,663	3,000 MSL	220	0	0	0	0
b	6,227	1,000 MSL	170	0	0	0	0
c	3,162	700 MSL	110	0	0	0	60
d	1,500	300 AGL	50	0	0	0	85
e	0	20 AGL	0	0	0	0	90

Flight Profile V2221LA01 Standard Arrival
Based MV22B
on Runway 21L, Flight Track 21LA01 - VFR arrival from NW or VFR left base from _?

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:121,000 (1 inch = 10,100 feet)

N



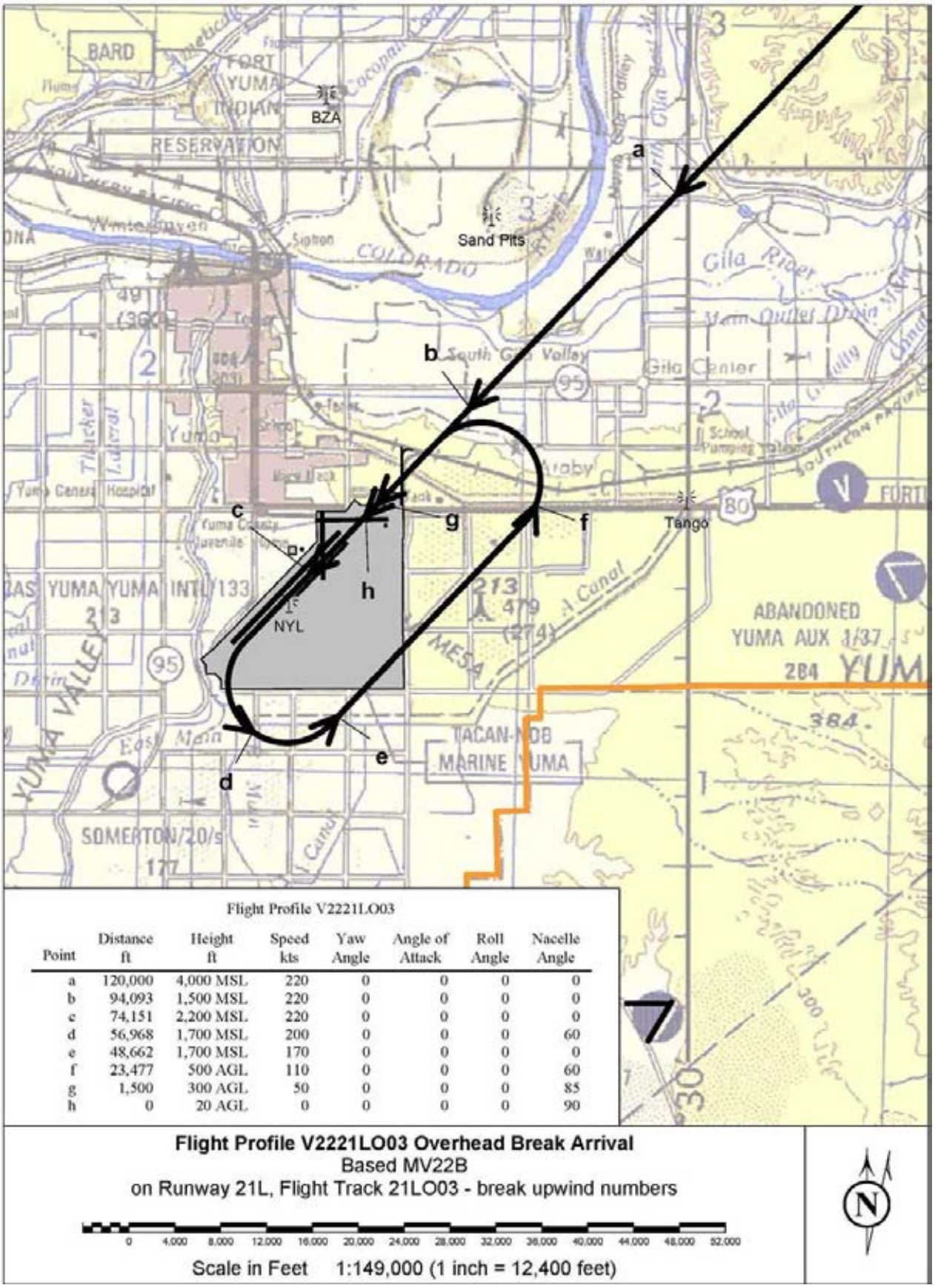
Flight Profile V2221LO02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	102,000	2,565 MSL	220	0	0	0	0
b	94,093	1,500 MSL	220	0	0	0	0
c	74,151	2,200 MSL	220	0	0	0	0
d	56,968	1,700 MSL	200	0	0	0	60
e	48,662	1,700 MSL	170	0	0	0	0
f	23,477	500 AGL	110	0	0	0	60
g	1,500	300 AGL	50	0	0	0	85
h	0	20 AGL	0	0	0	0	90

Flight Profile V2221LO02 Overhead Break Arrival
Based MV22B
on Runway 21L, Flight Track 21LO02 - break midfield

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:149,000 (1 inch = 12,400 feet)



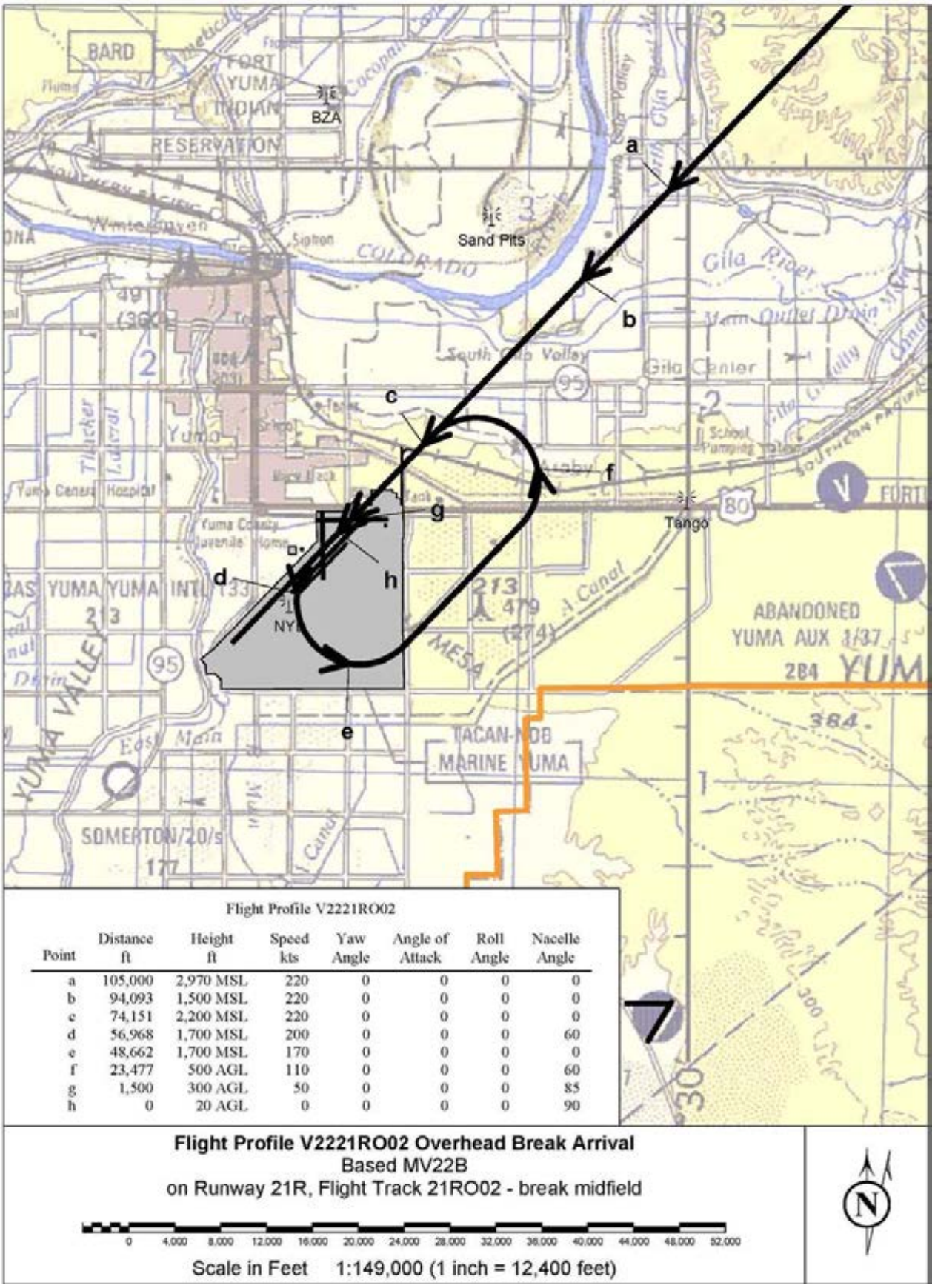
Flight Profile V2221LO03

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	120,000	4,000 MSL	220	0	0	0	0
b	94,093	1,500 MSL	220	0	0	0	0
c	74,151	2,200 MSL	220	0	0	0	0
d	56,968	1,700 MSL	200	0	0	0	60
e	48,662	1,700 MSL	170	0	0	0	0
f	23,477	500 AGL	110	0	0	0	60
g	1,500	300 AGL	50	0	0	0	85
h	0	20 AGL	0	0	0	0	90

Flight Profile V2221LO03 Overhead Break Arrival
Based MV22B
on Runway 21L, Flight Track 21LO03 - break upwind numbers

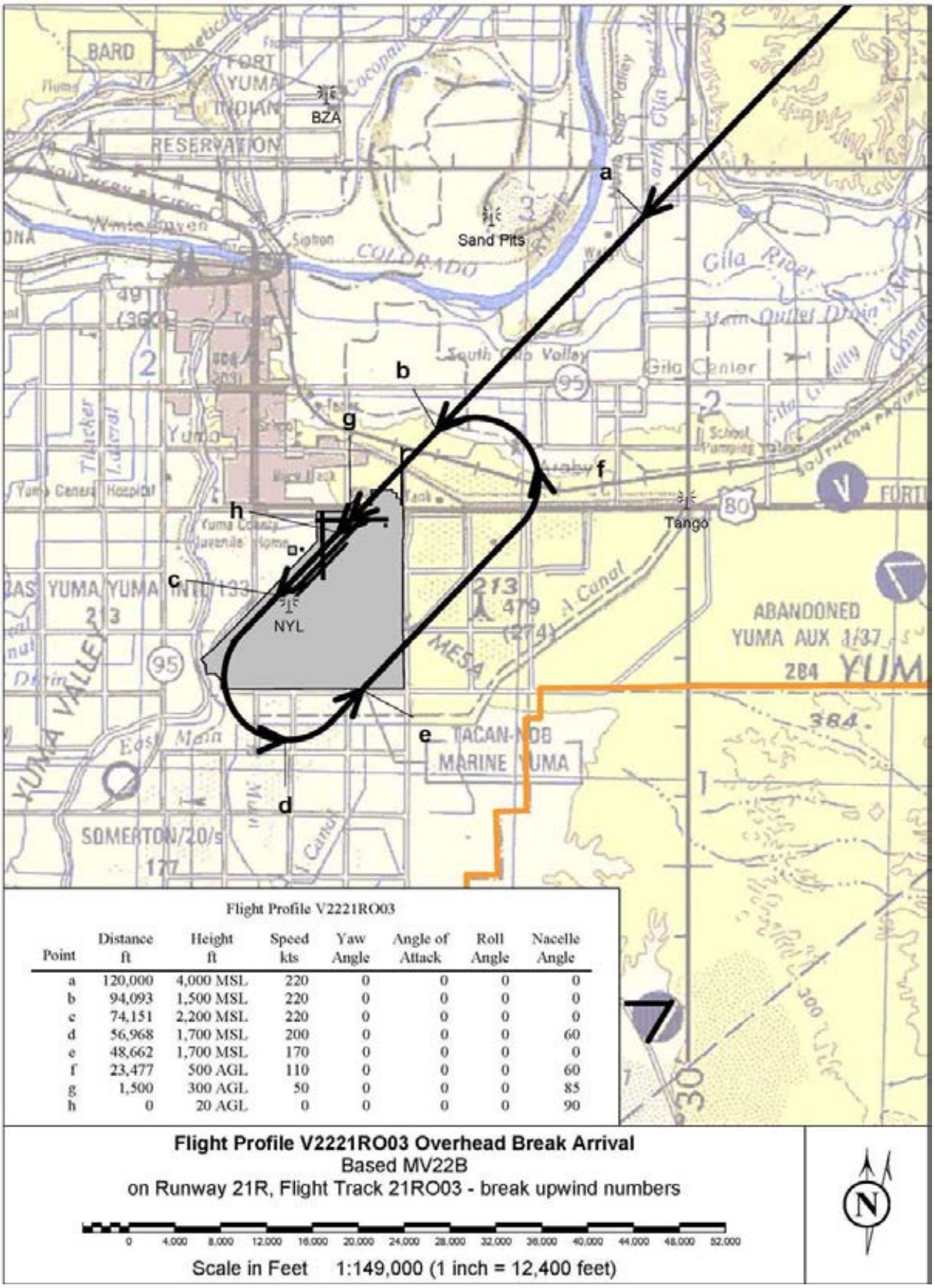
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:149,000 (1 inch = 12,400 feet)



Flight Profile V2221RO02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	105,000	2,970 MSL	220	0	0	0	0
b	94,093	1,500 MSL	220	0	0	0	0
c	74,151	2,200 MSL	220	0	0	0	0
d	56,968	1,700 MSL	200	0	0	0	60
e	48,662	1,700 MSL	170	0	0	0	0
f	23,477	500 AGL	110	0	0	0	60
g	1,500	300 AGL	50	0	0	0	85
h	0	20 AGL	0	0	0	0	90



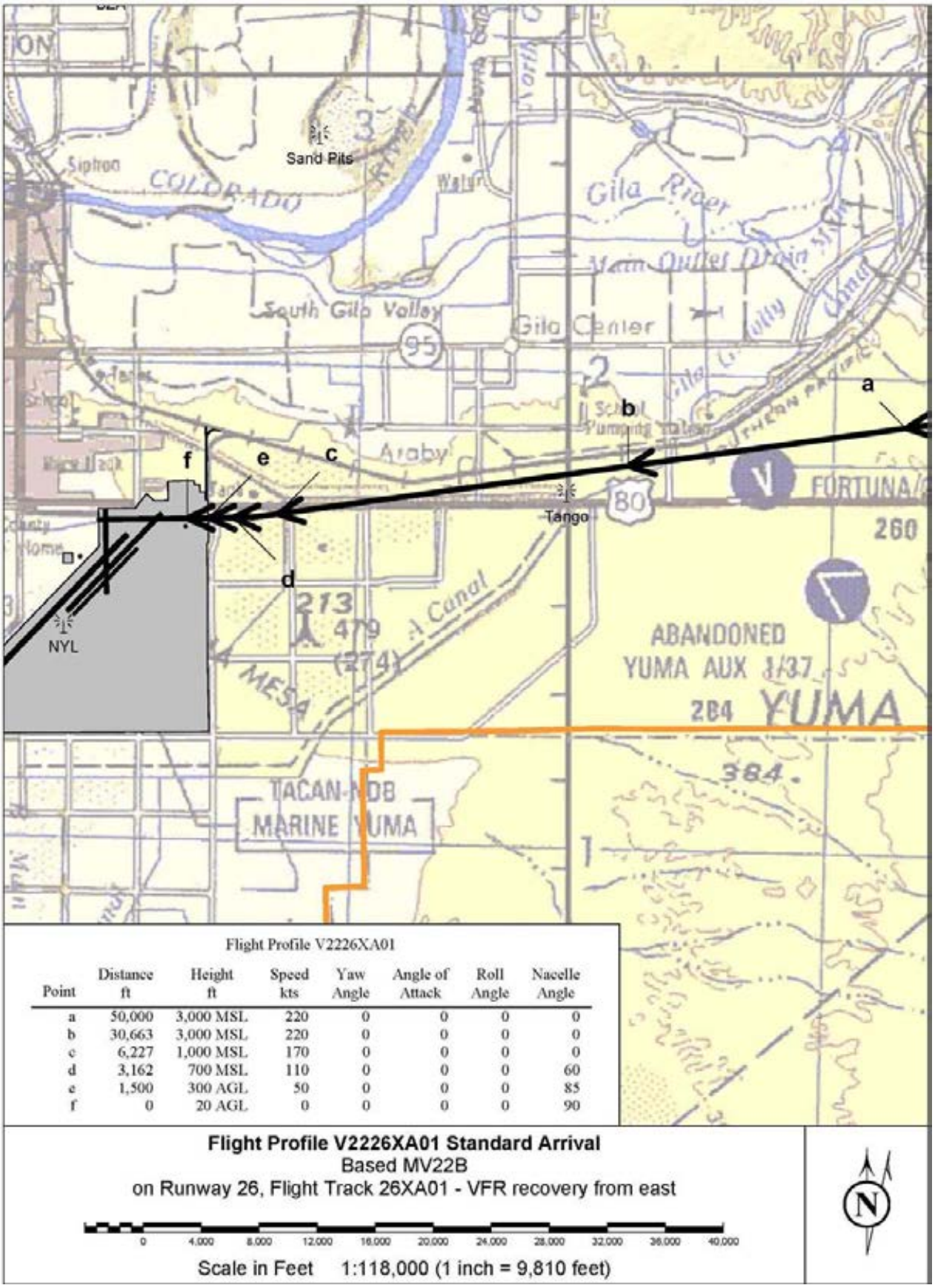
Flight Profile V2221RO03

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	120,000	4,000 MSL	220	0	0	0	0
b	94,093	1,500 MSL	220	0	0	0	0
c	74,151	2,200 MSL	220	0	0	0	0
d	56,968	1,700 MSL	200	0	0	0	60
e	48,662	1,700 MSL	170	0	0	0	0
f	23,477	500 AGL	110	0	0	0	60
g	1,500	300 AGL	50	0	0	0	85
h	0	20 AGL	0	0	0	0	90

Flight Profile V2221RO03 Overhead Break Arrival
Based MV22B
on Runway 21R, Flight Track 21RO03 - break upwind numbers

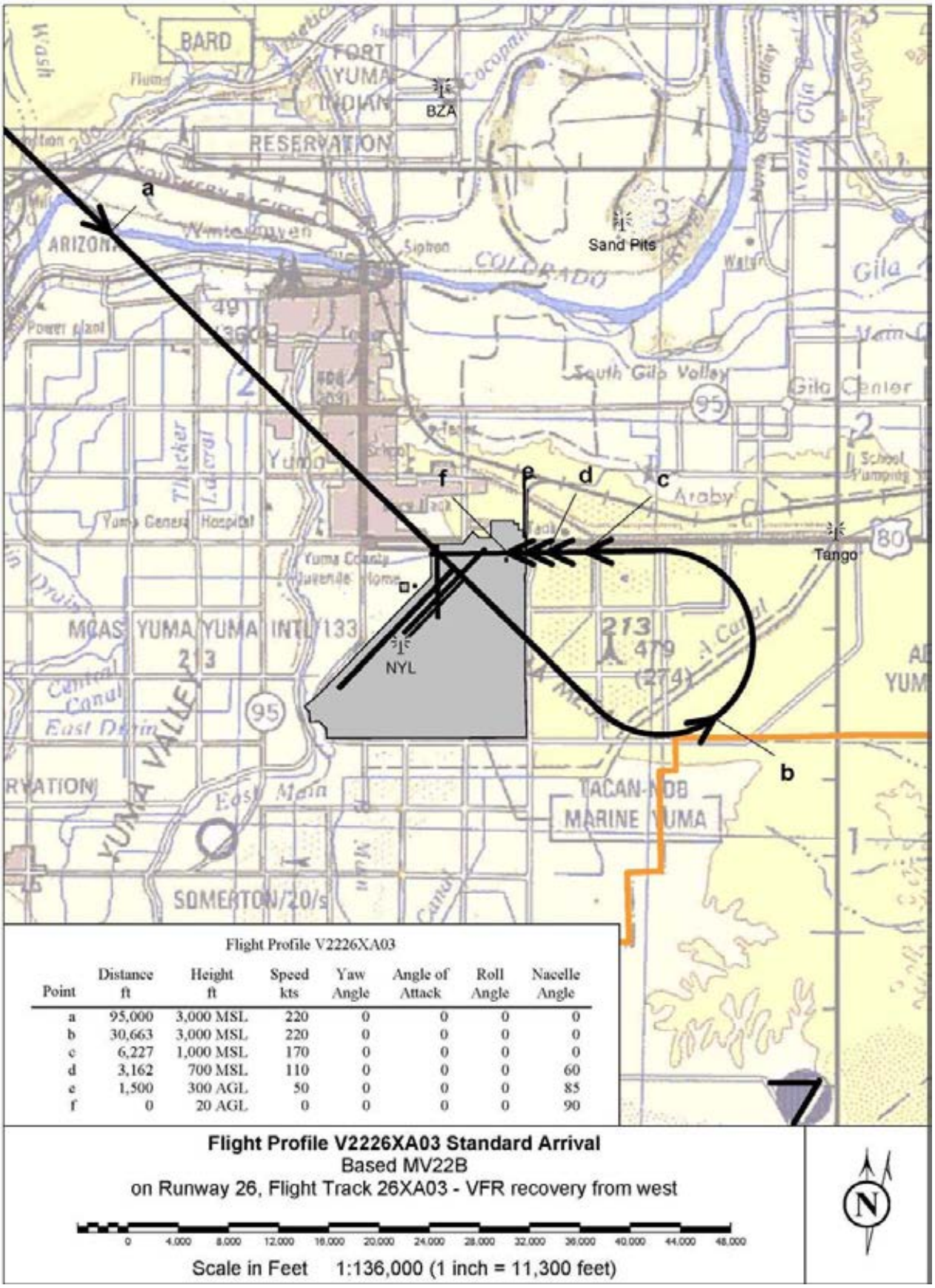
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:149,000 (1 inch = 12,400 feet)



Flight Profile V2226XA01

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	50,000	3,000 MSL	220	0	0	0	0
b	30,663	3,000 MSL	220	0	0	0	0
c	6,227	1,000 MSL	170	0	0	0	0
d	3,162	700 MSL	110	0	0	0	60
e	1,500	300 AGL	50	0	0	0	85
f	0	20 AGL	0	0	0	0	90



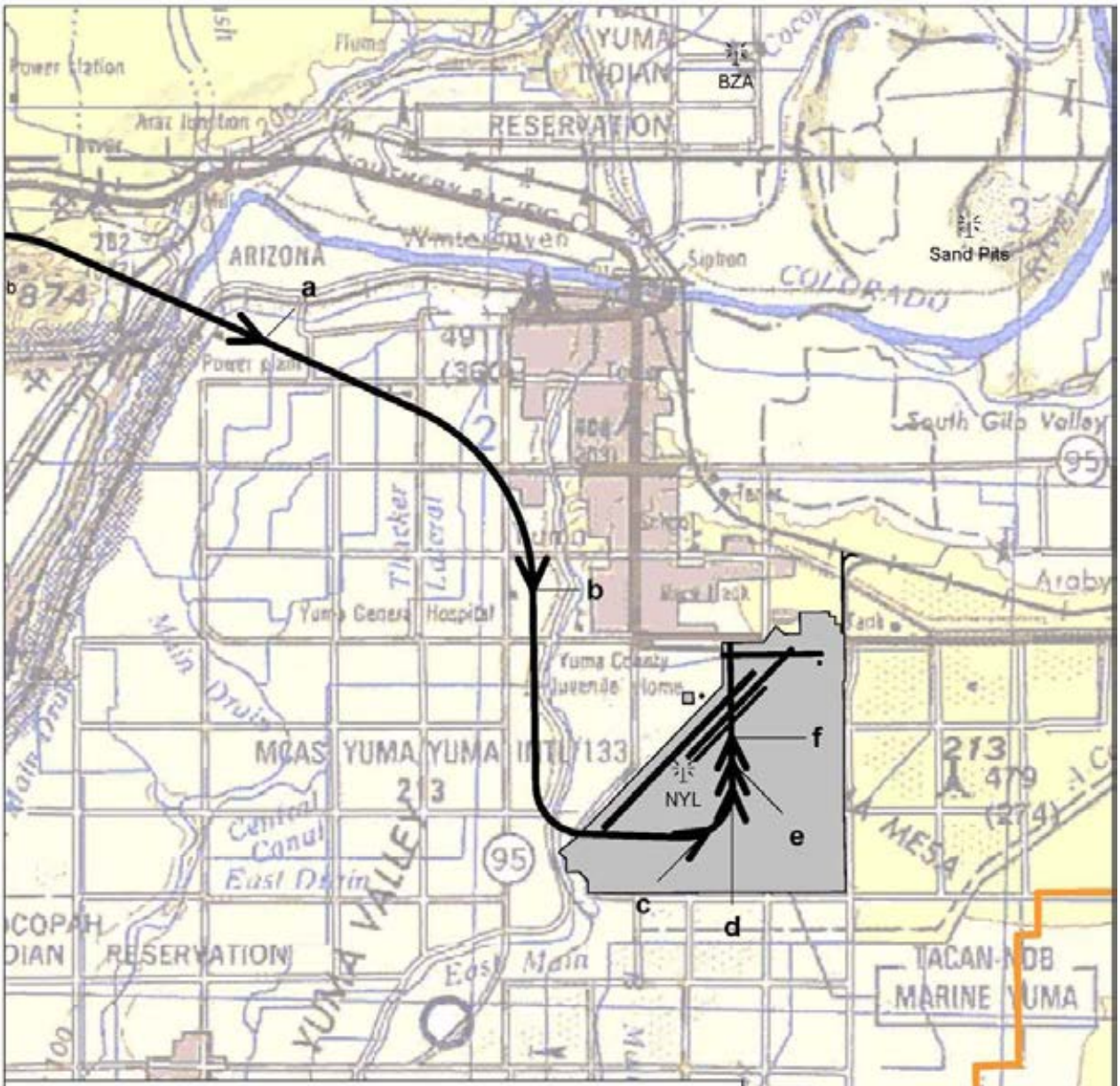
Flight Profile V2226XA03

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	95,000	3,000 MSL	220	0	0	0	0
b	30,663	3,000 MSL	220	0	0	0	0
c	6,227	1,000 MSL	170	0	0	0	0
d	3,162	700 MSL	110	0	0	0	60
e	1,500	300 AGL	50	0	0	0	85
f	0	20 AGL	0	0	0	0	90

Flight Profile V2226XA03 Standard Arrival
Based MV22B
on Runway 26, Flight Track 26XA03 - VFR recovery from west

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:136,000 (1 inch = 11,300 feet)



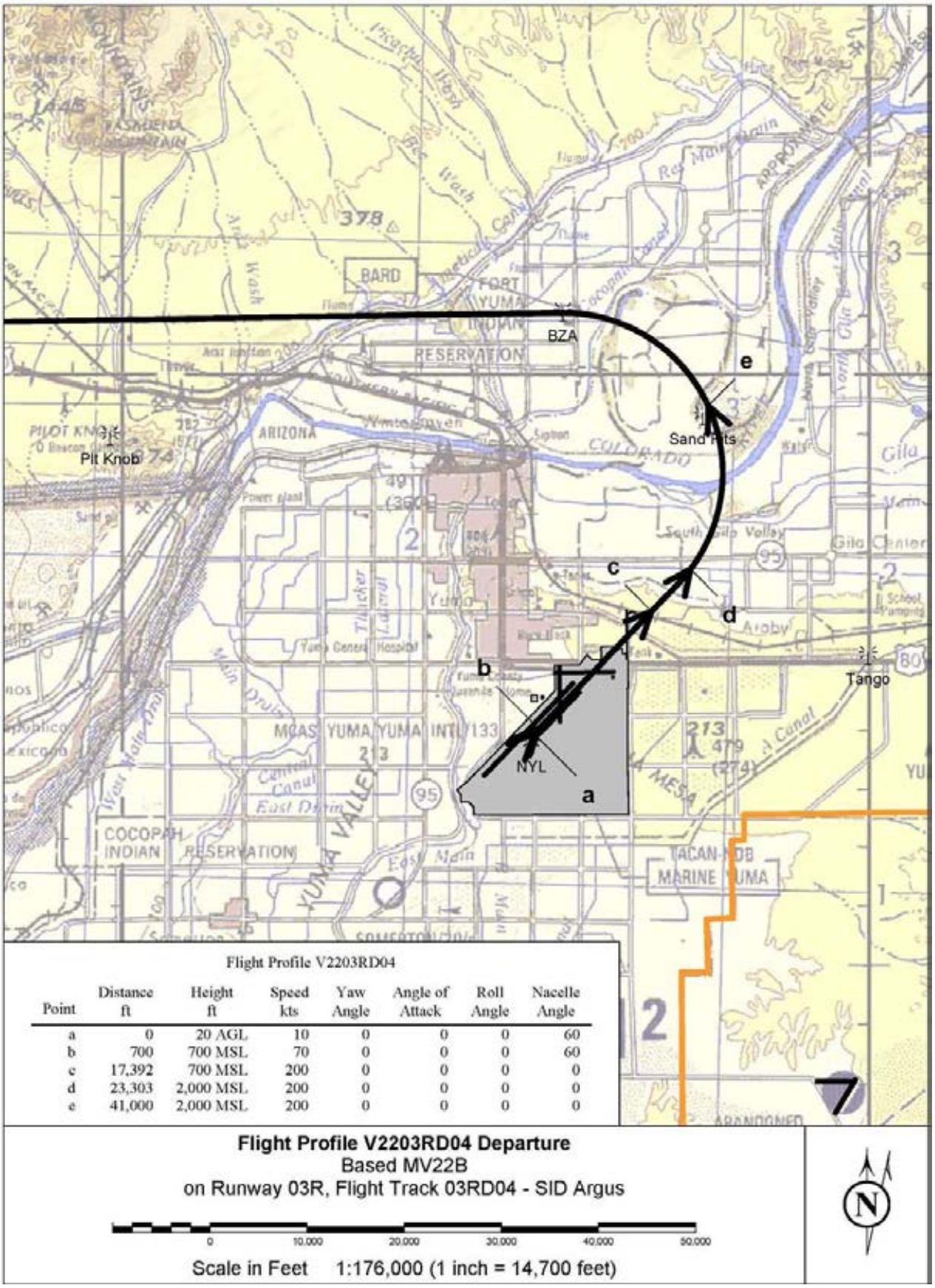
Flight Profile V2235XA02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	55,000	3,000 MSL	220	0	0	0	0
b	30,663	3,000 MSL	220	0	0	0	0
c	6,227	1,000 MSL	170	0	0	0	0
d	3,162	700 MSL	110	0	0	0	60
e	1,500	300 AGL	50	0	0	0	85
f	0	20 AGL	0	0	0	0	90

Flight Profile V2235XA02 Standard Arrival
Based MV22B
on Runway 35, Flight Track 35XA02 - VFR left traffic arrival from NW (20% of west traffic)

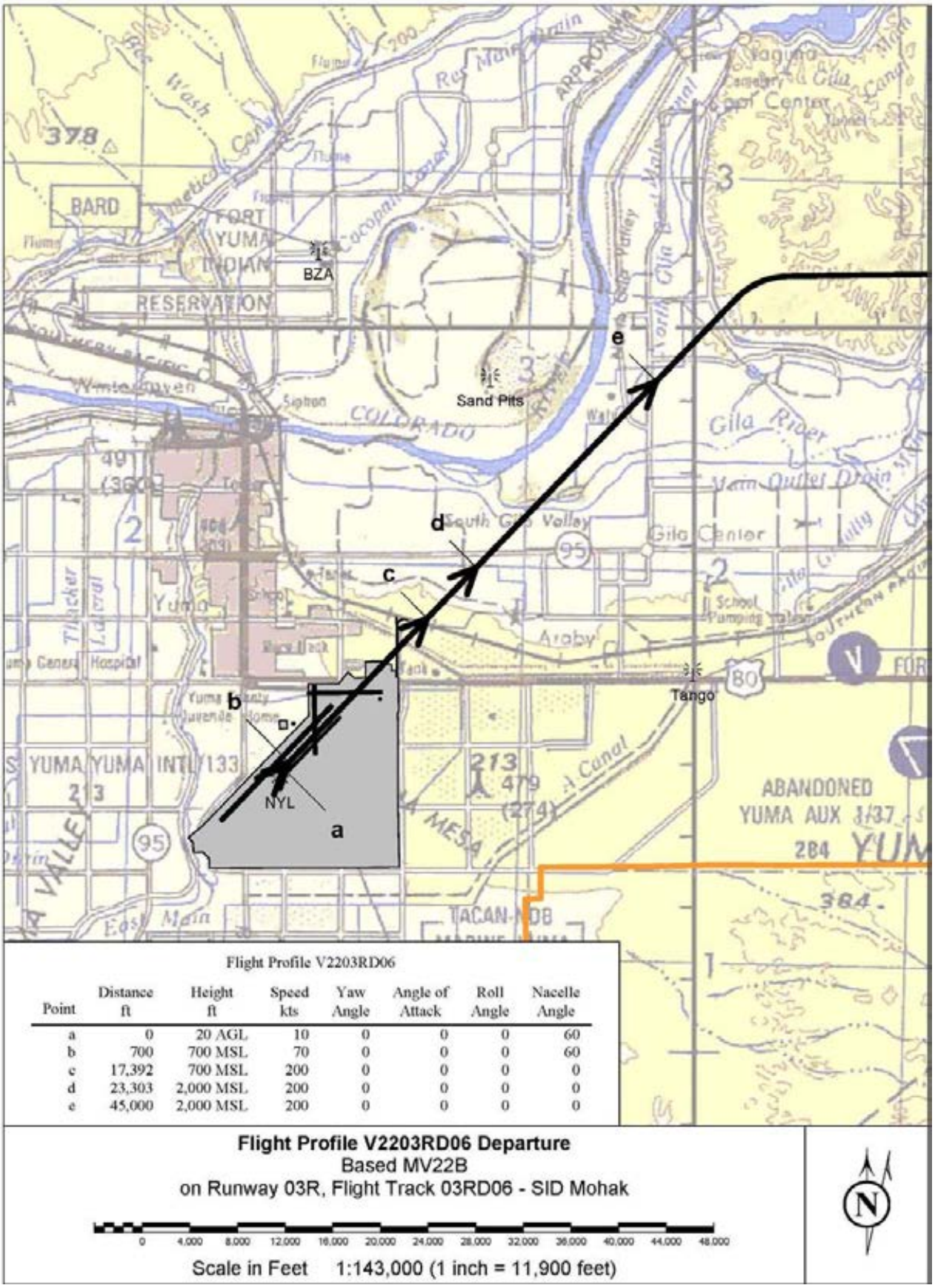
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:126,000 (1 inch = 10,500 feet)



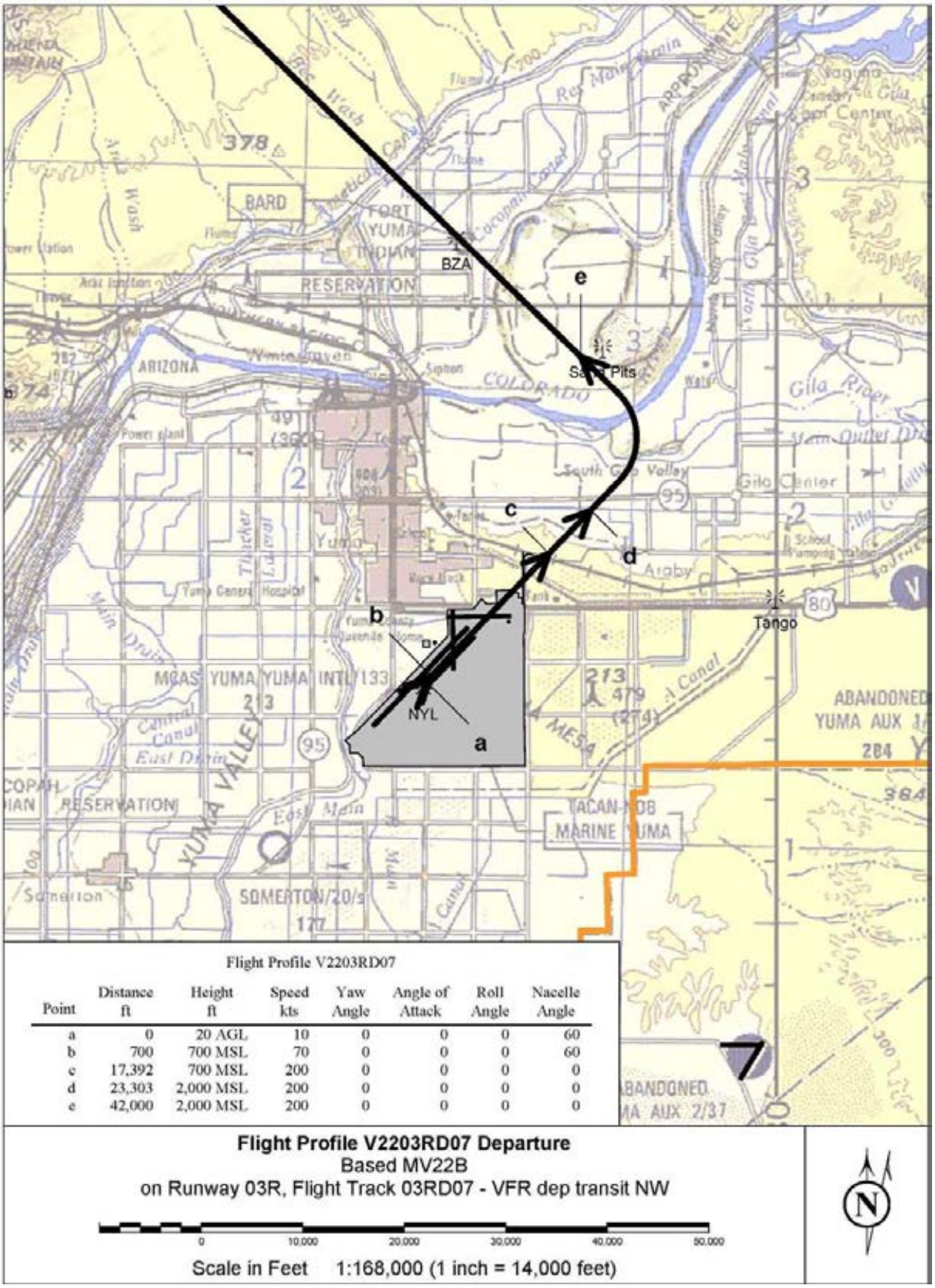
Flight Profile V2203RD04

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	41,000	2,000 MSL	200	0	0	0	0



Flight Profile V2203RD06

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	45,000	2,000 MSL	200	0	0	0	0



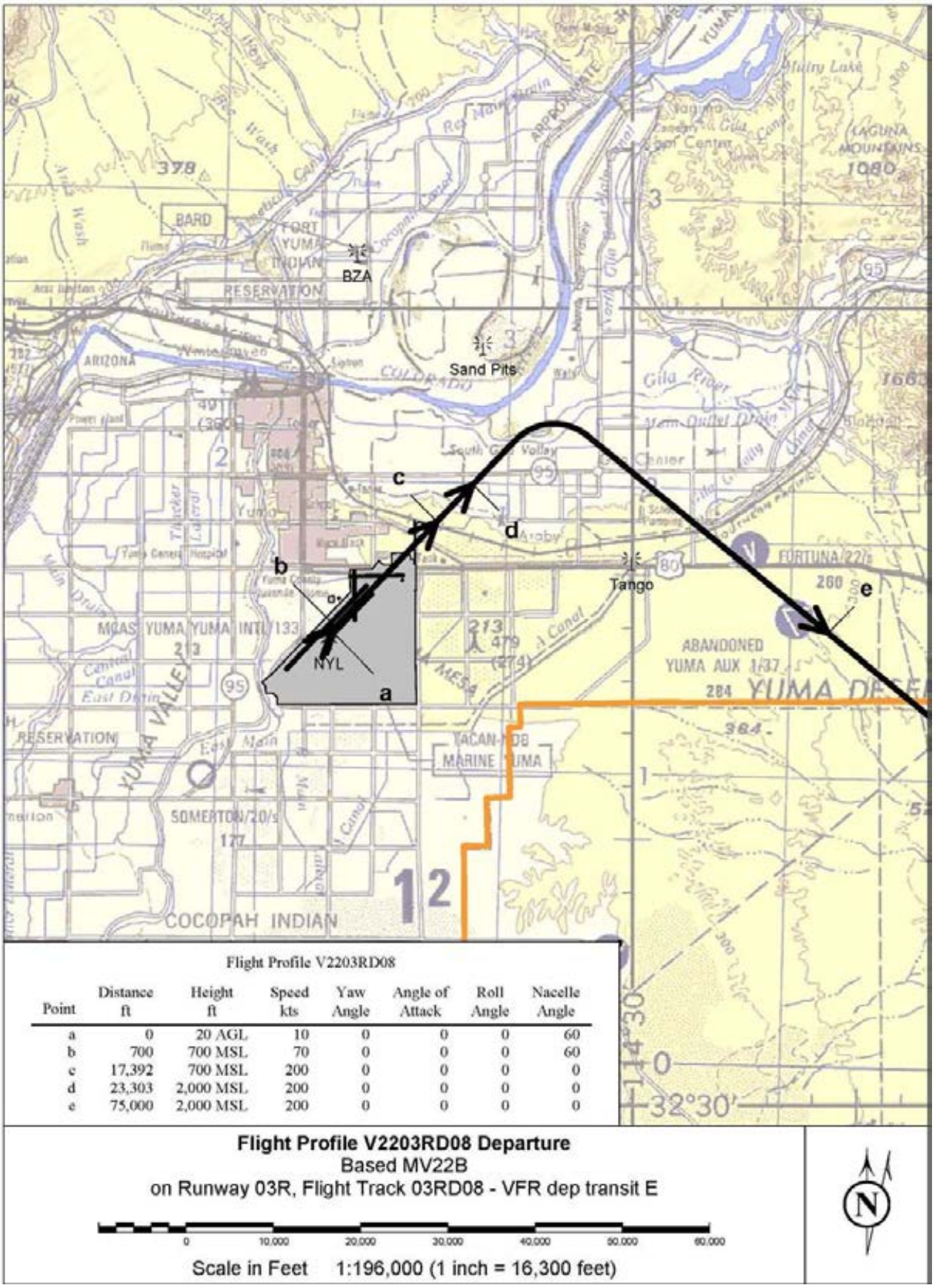
Flight Profile V2203RD07

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	42,000	2,000 MSL	200	0	0	0	0

Flight Profile V2203RD07 Departure
Based MV22B
on Runway 03R, Flight Track 03RD07 - VFR dep transit NW

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:168,000 (1 inch = 14,000 feet)



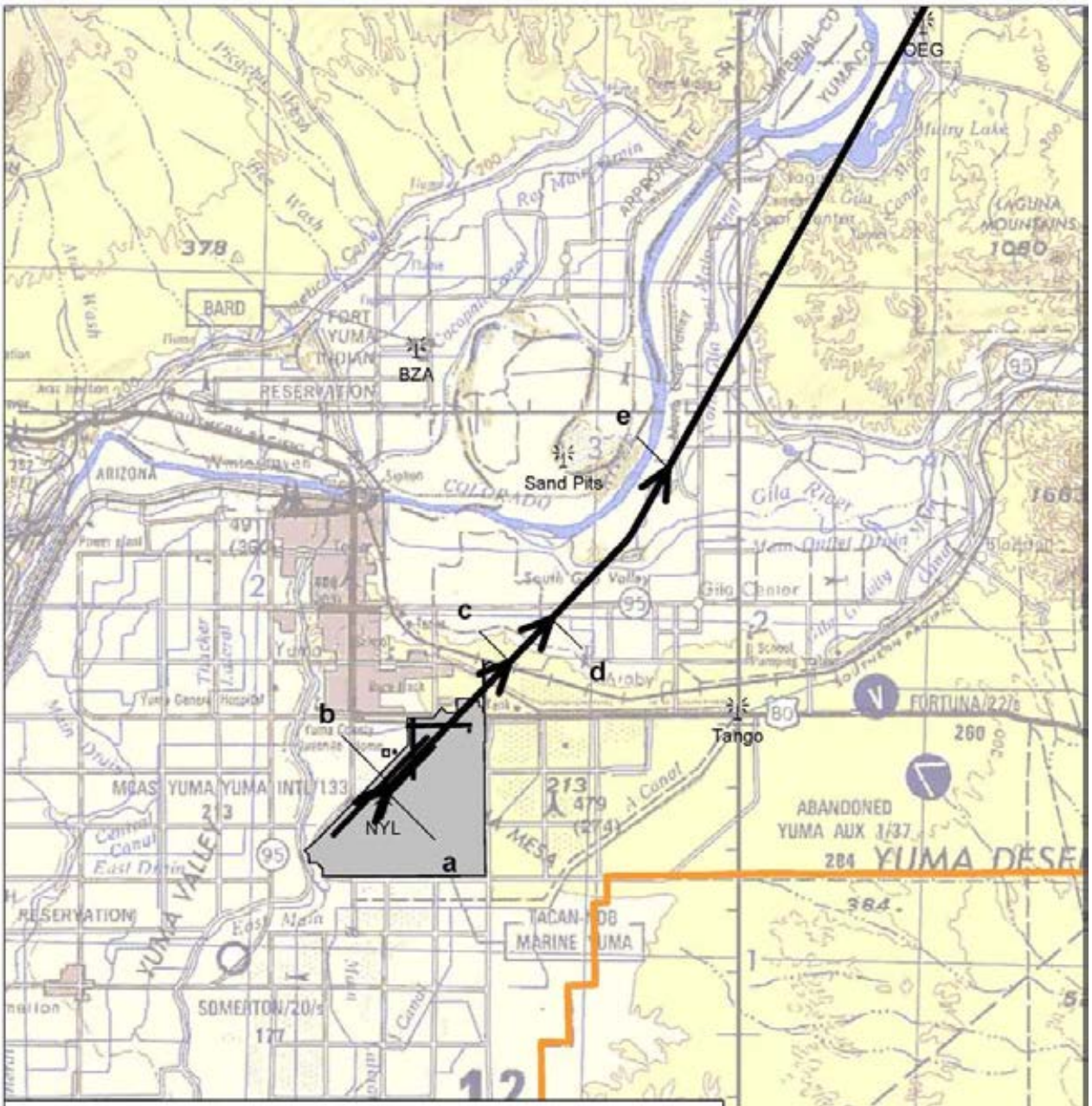
Flight Profile V2203RD08

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	75,000	2,000 MSL	200	0	0	0	0

Flight Profile V2203RD08 Departure
Based MV22B
on Runway 03R, Flight Track 03RD08 - VFR dep transit E

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:196,000 (1 inch = 16,300 feet)



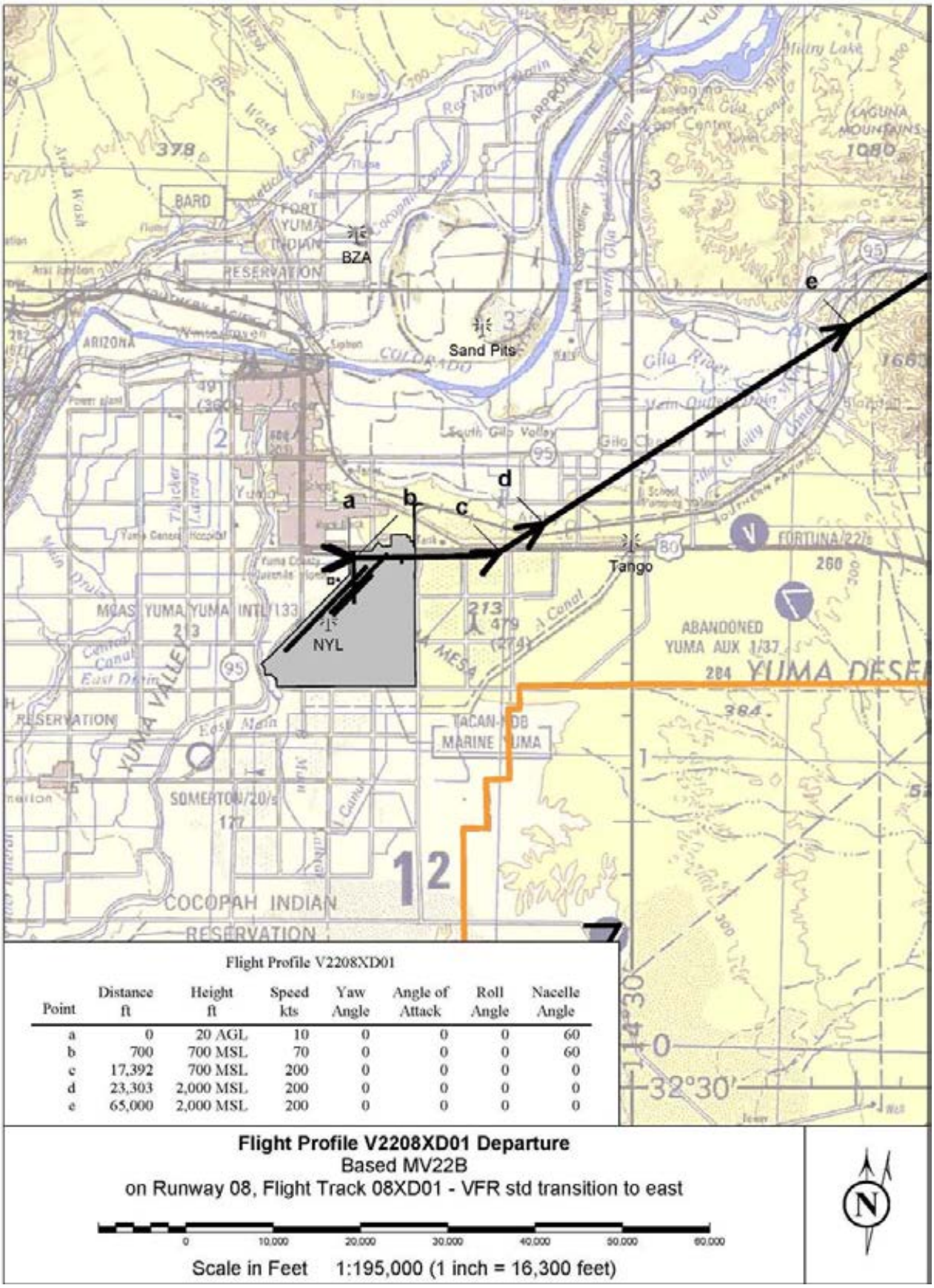
Flight Profile V2203RD09

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	42,000	2,000 MSL	200	0	0	0	0

Flight Profile V2203RD09 Departure
Based MV22B
on Runway 03R, Flight Track 03RD09 - VFR dep transit NE

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:195,000 (1 inch = 16,300 feet)



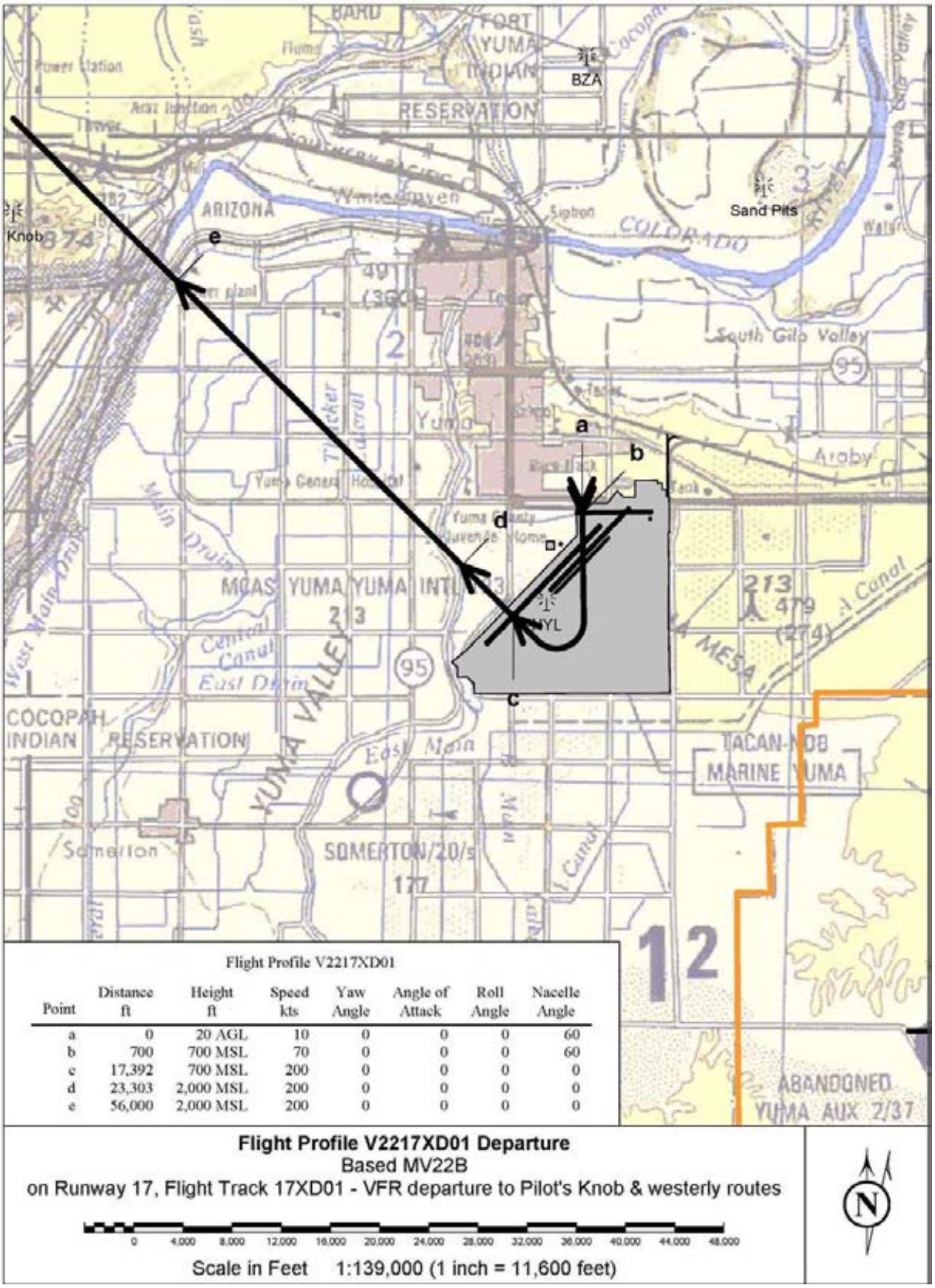
Flight Profile V2208XD01

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	65,000	2,000 MSL	200	0	0	0	0

Flight Profile V2208XD01 Departure
Based MV22B
on Runway 08, Flight Track 08XD01 - VFR std transition to east

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:195,000 (1 inch = 16,300 feet)



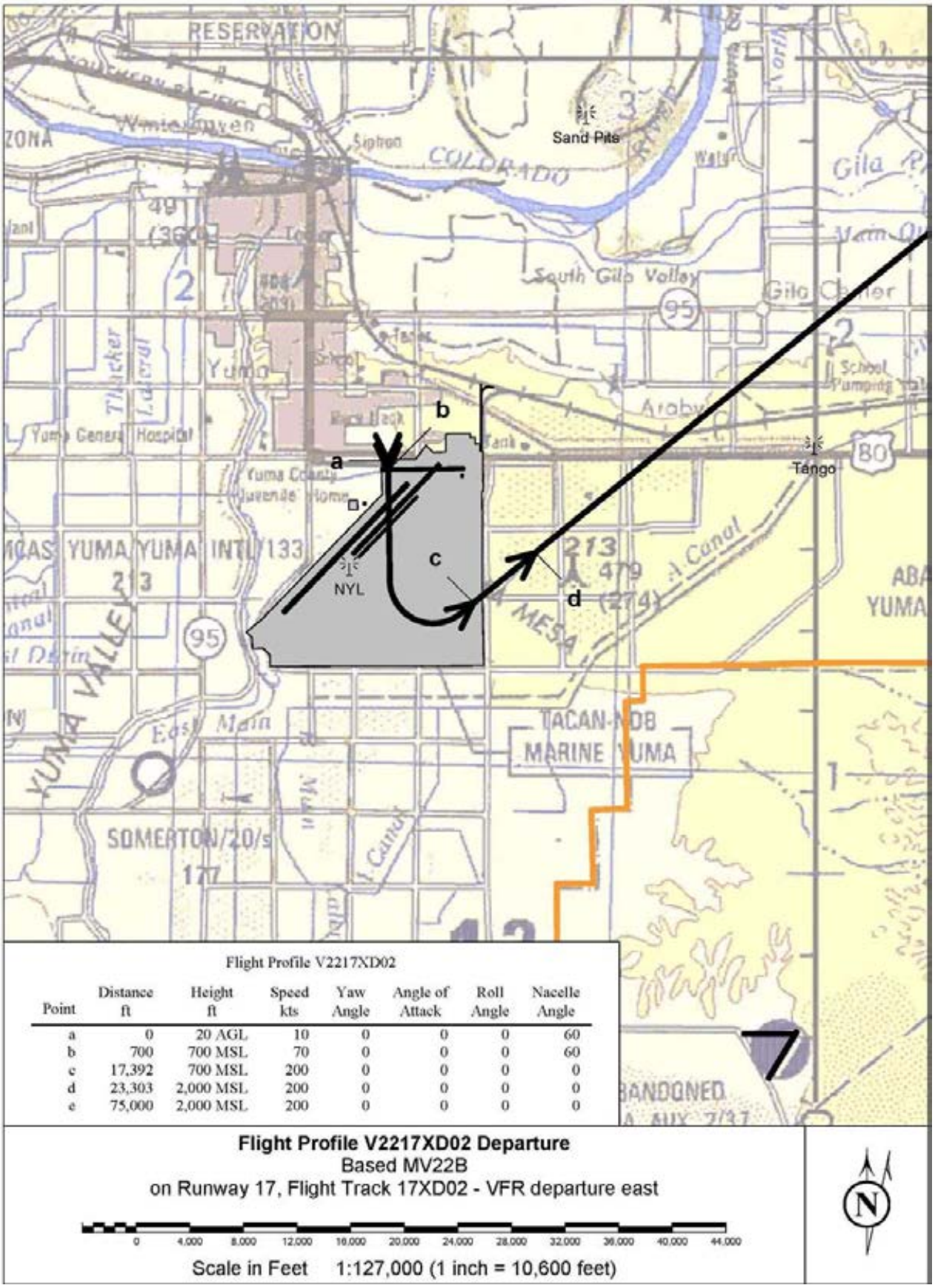
Flight Profile V2217XD01

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	56,000	2,000 MSL	200	0	0	0	0

Flight Profile V2217XD01 Departure
Based MV22B
on Runway 17, Flight Track 17XD01 - VFR departure to Pilot's Knob & westerly routes

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:139,000 (1 inch = 11,600 feet)



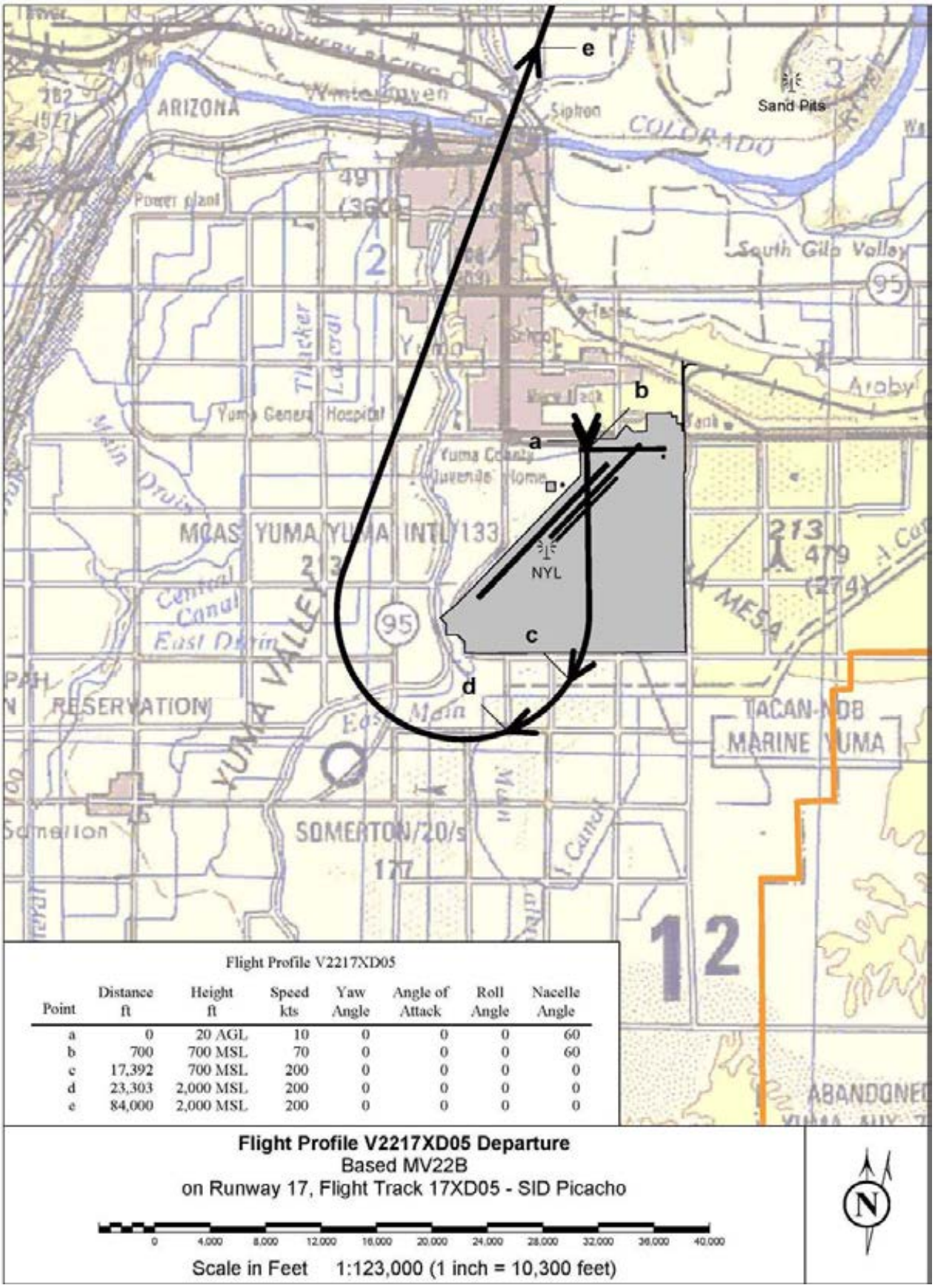
Flight Profile V2217XD02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	75,000	2,000 MSL	200	0	0	0	0

Flight Profile V2217XD02 Departure
Based MV22B
on Runway 17, Flight Track 17XD02 - VFR departure east

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:127,000 (1 inch = 10,600 feet)



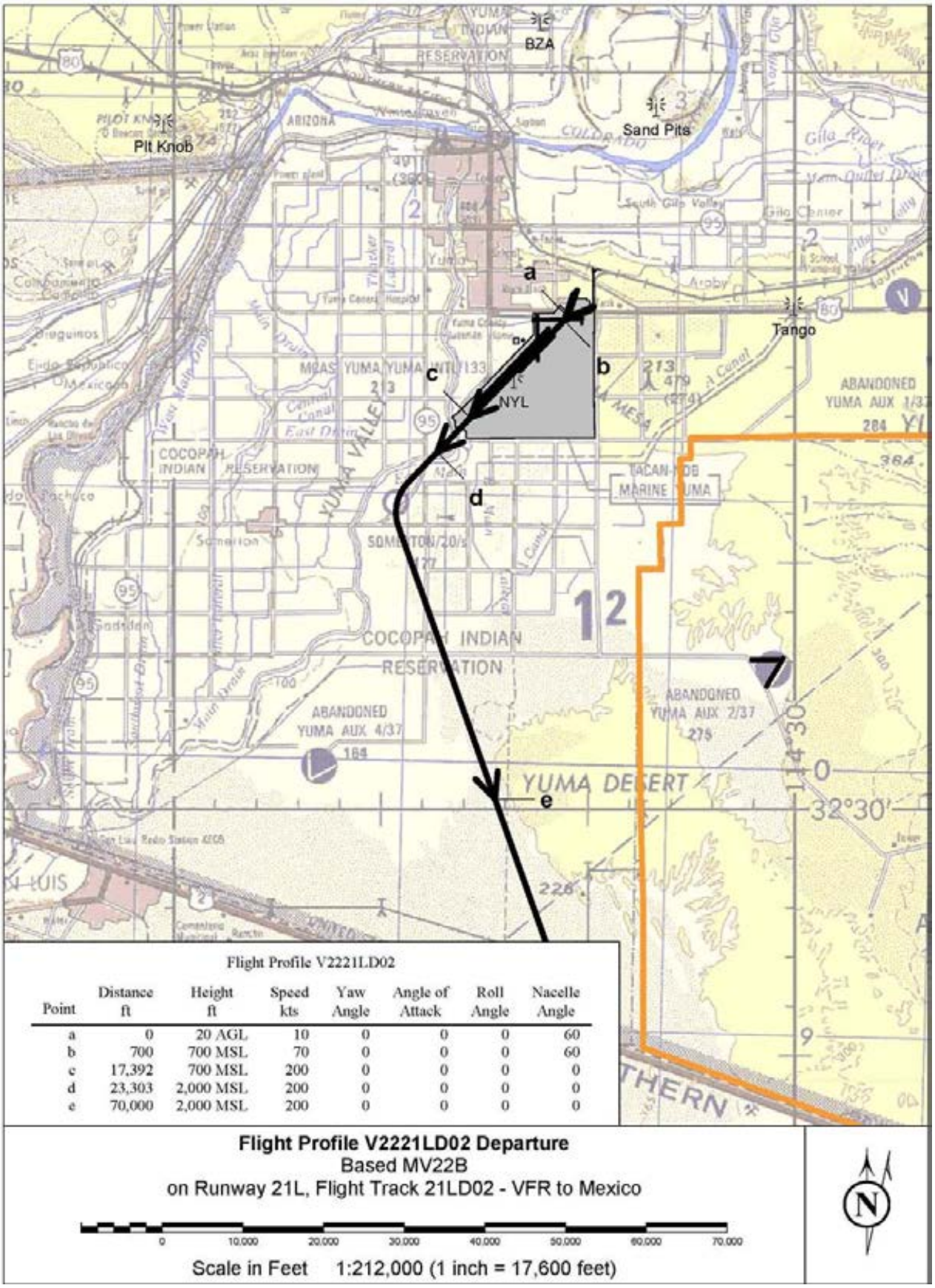
Flight Profile V2217XD05

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	84,000	2,000 MSL	200	0	0	0	0

Flight Profile V2217XD05 Departure
Based MV22B
on Runway 17, Flight Track 17XD05 - SID Picacho

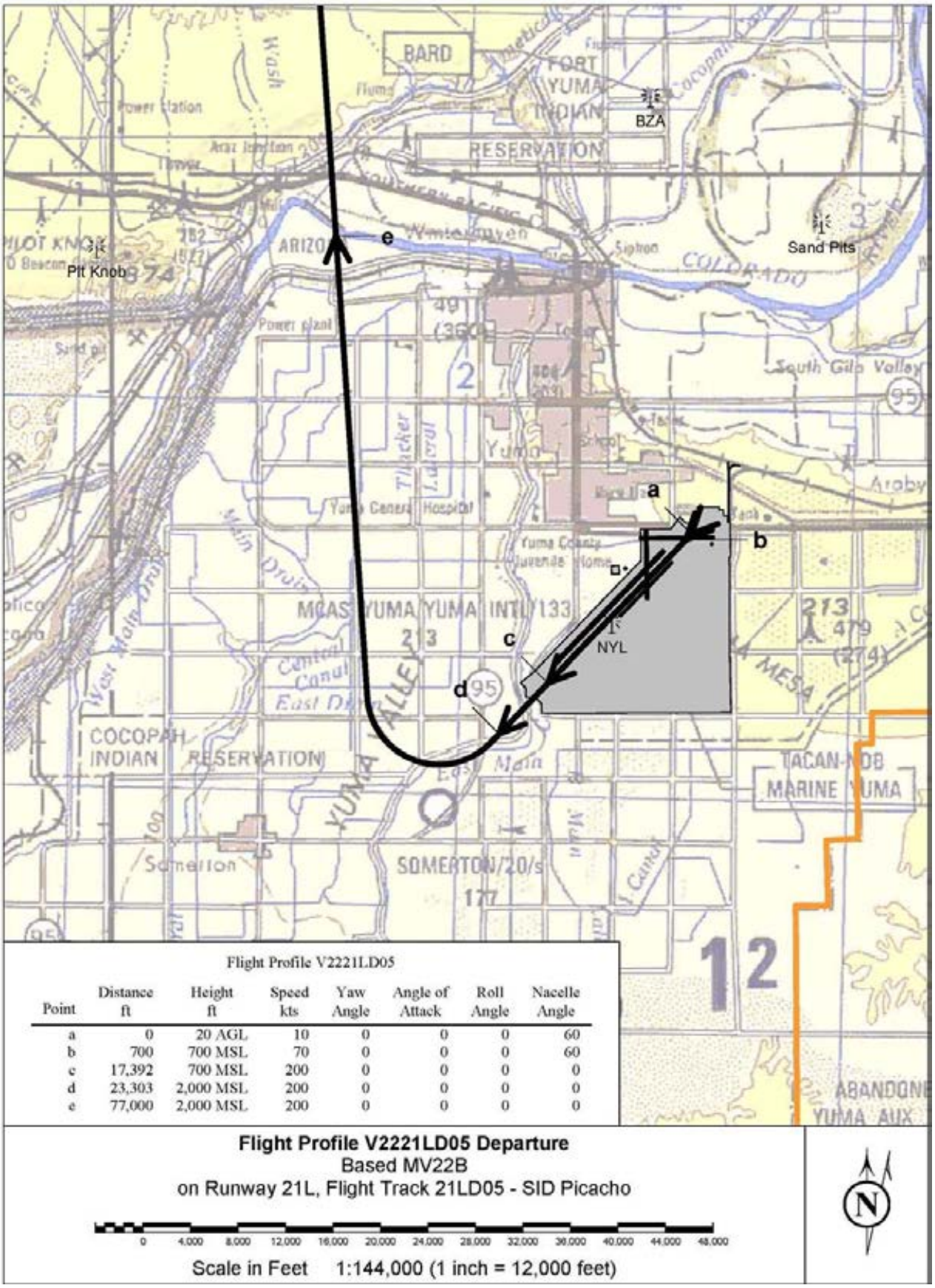
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:123,000 (1 inch = 10,300 feet)

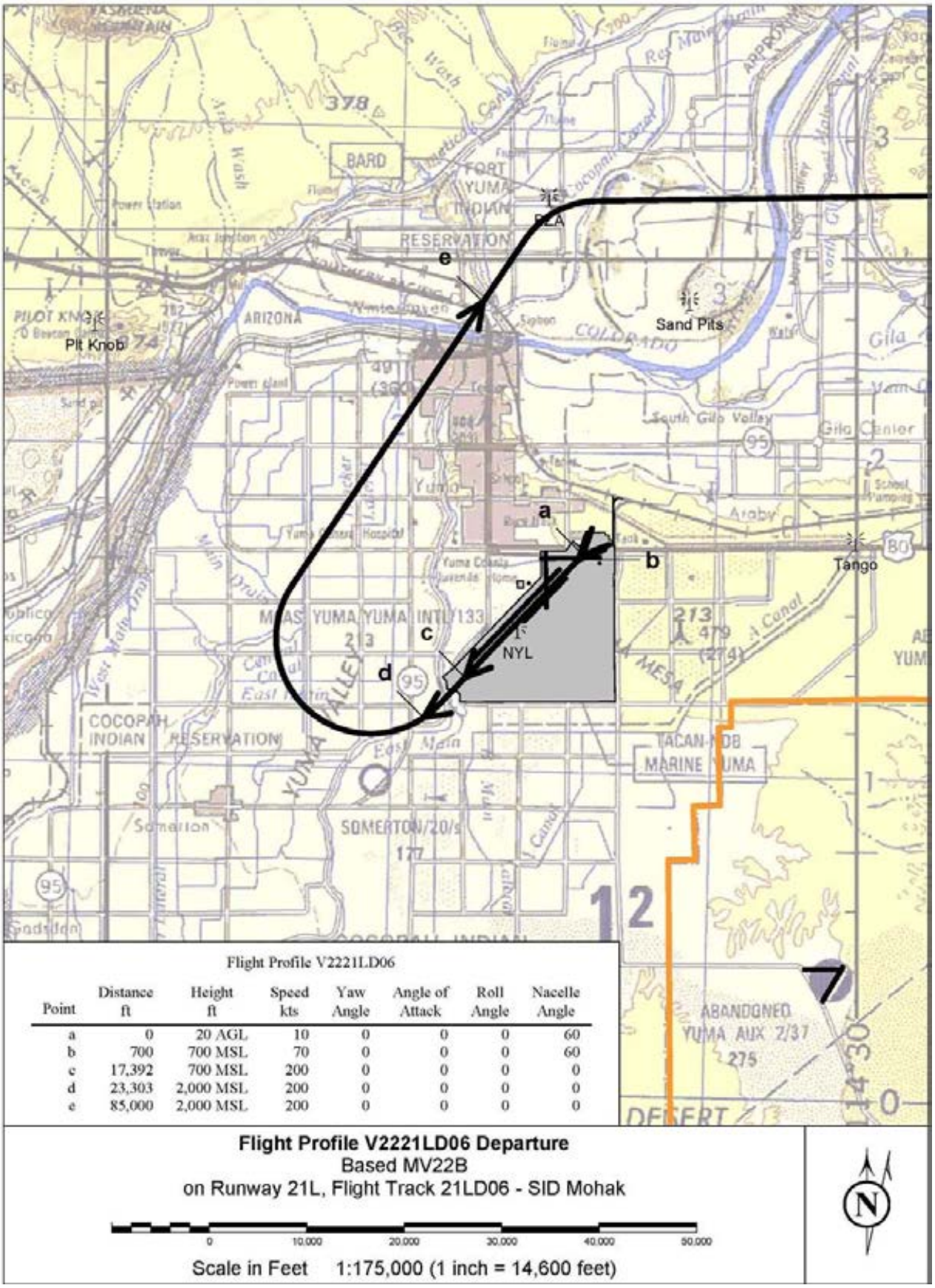


Flight Profile V2221LD02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	70,000	2,000 MSL	200	0	0	0	0



Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	77,000	2,000 MSL	200	0	0	0	0



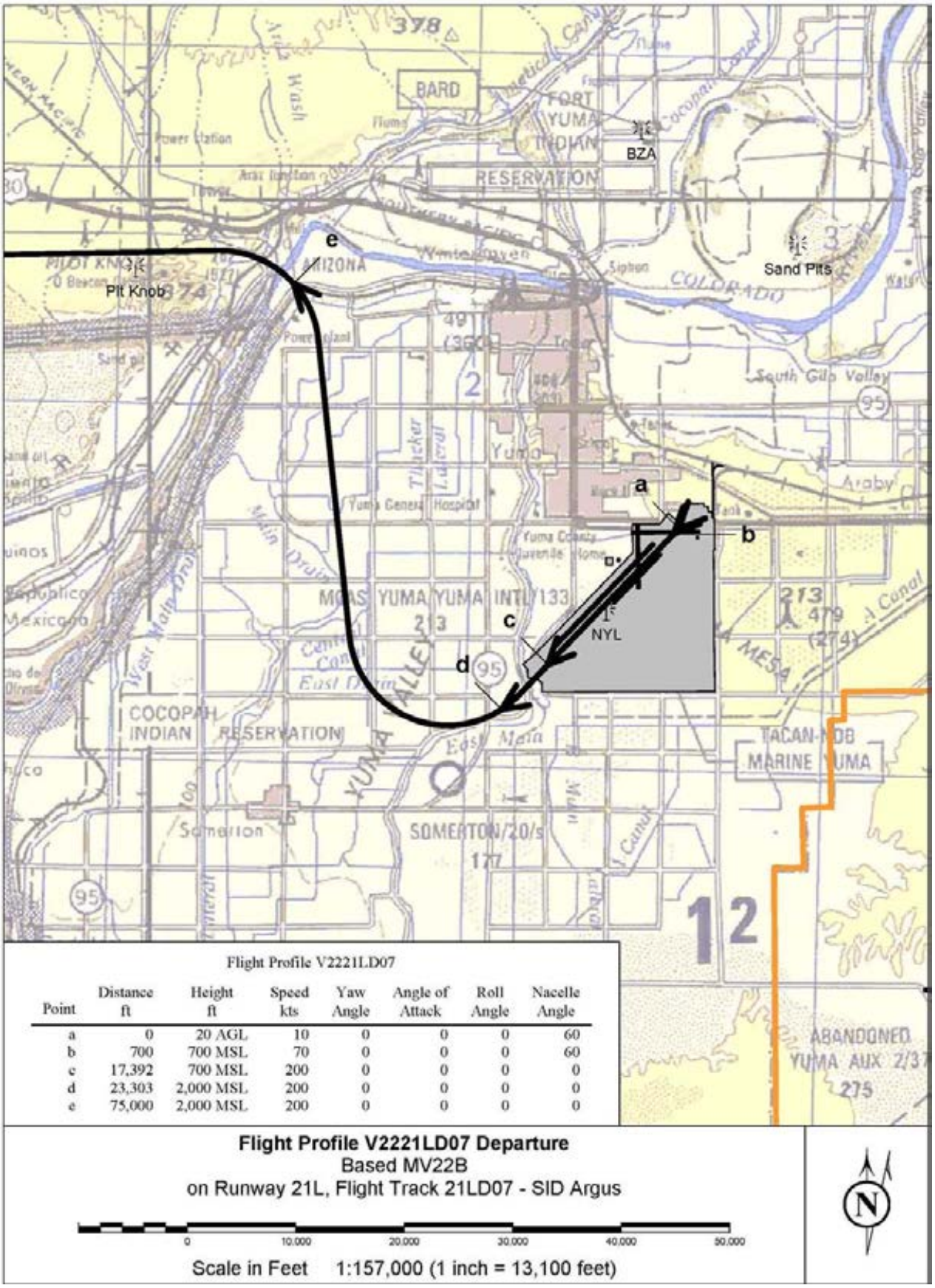
Flight Profile V2221LD06

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	85,000	2,000 MSL	200	0	0	0	0

Flight Profile V2221LD06 Departure
Based MV22B
on Runway 21L, Flight Track 21LD06 - SID Mohak

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:175,000 (1 inch = 14,600 feet)



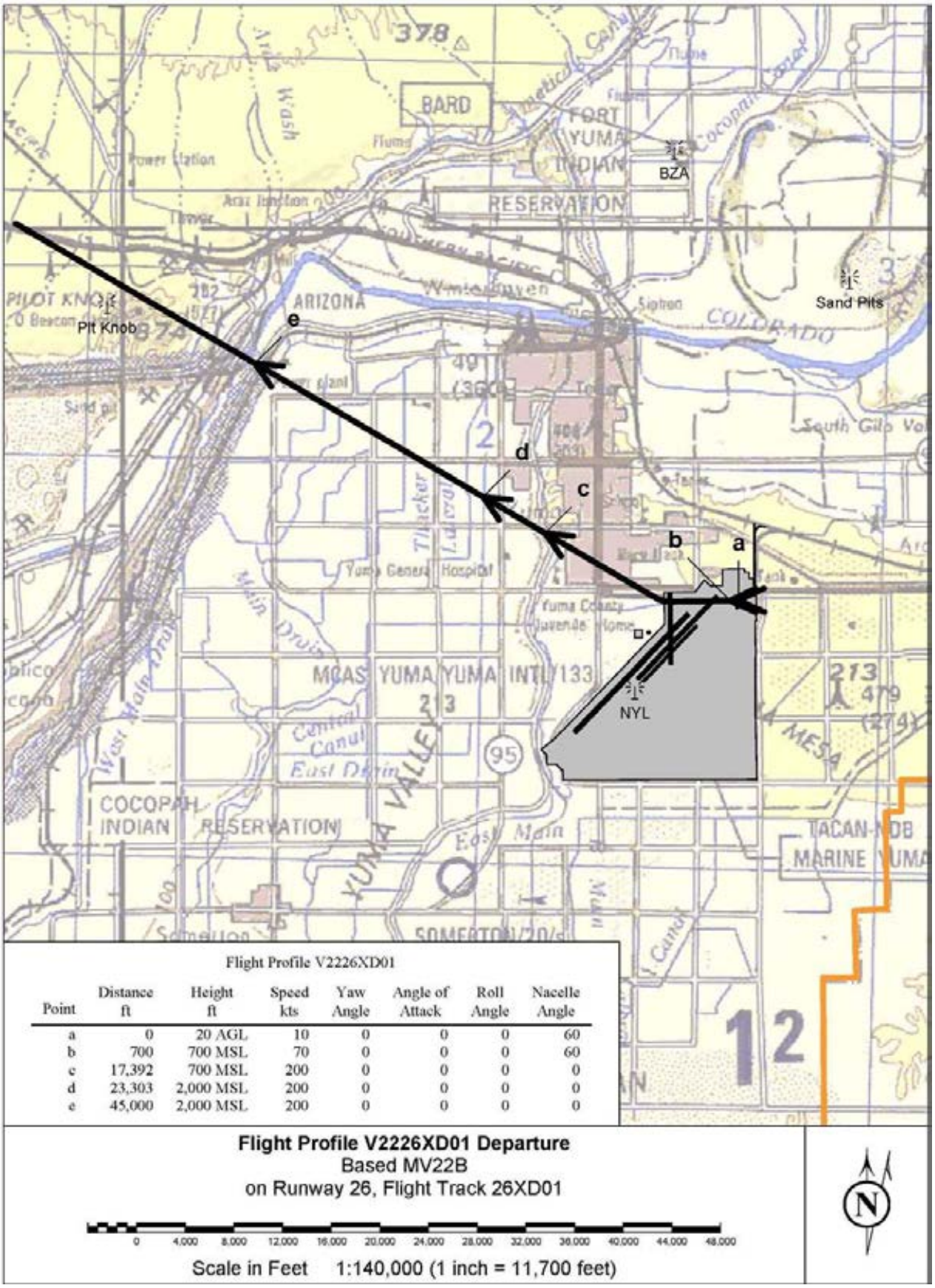
Flight Profile V2221LD07

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	75,000	2,000 MSL	200	0	0	0	0

Flight Profile V2221LD07 Departure
Based MV22B
on Runway 21L, Flight Track 21LD07 - SID Argus

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:157,000 (1 inch = 13,100 feet)



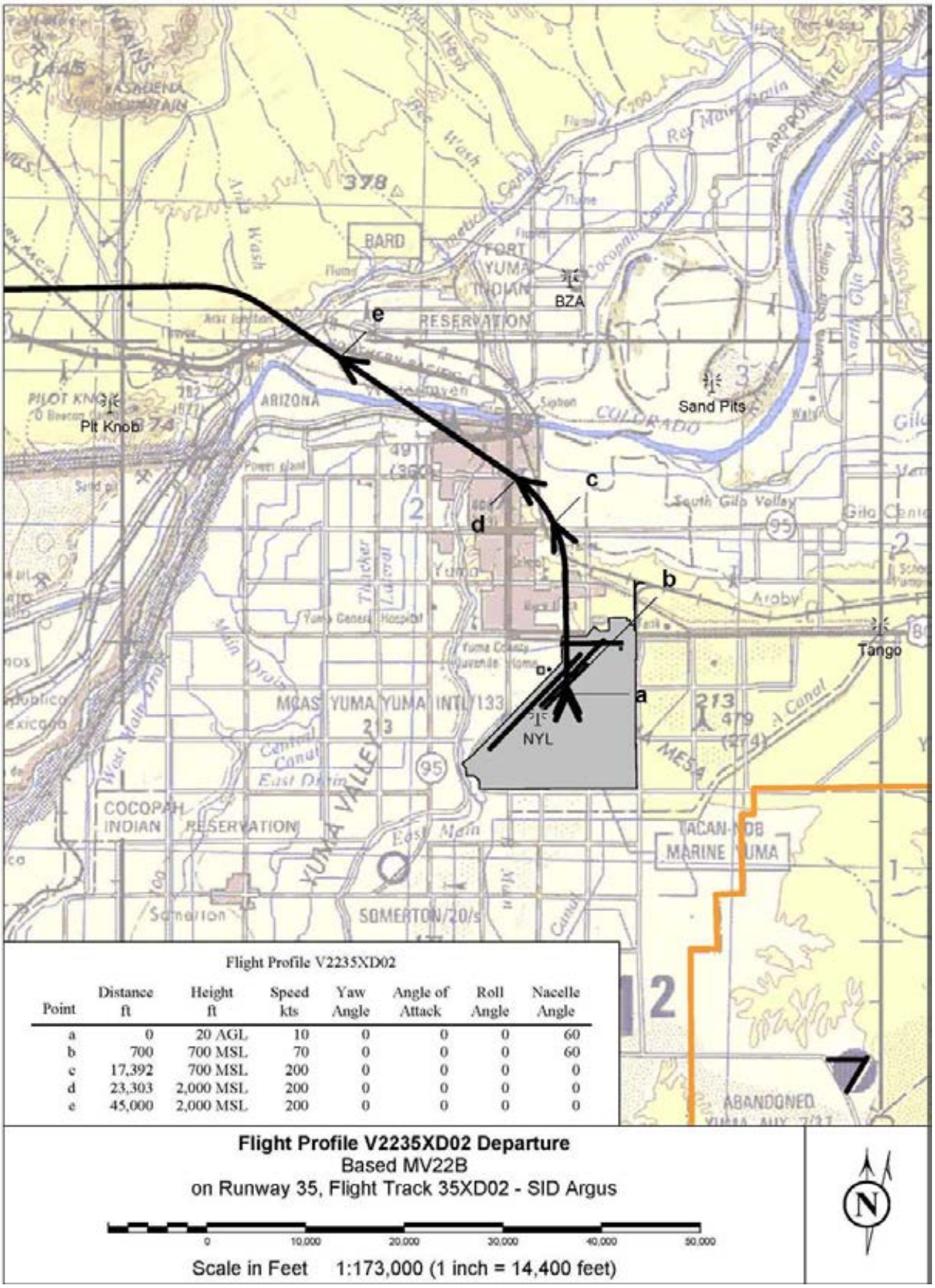
Flight Profile V2226XD01

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	45,000	2,000 MSL	200	0	0	0	0

Flight Profile V2226XD01 Departure
Based MV22B
on Runway 26, Flight Track 26XD01

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:140,000 (1 inch = 11,700 feet)



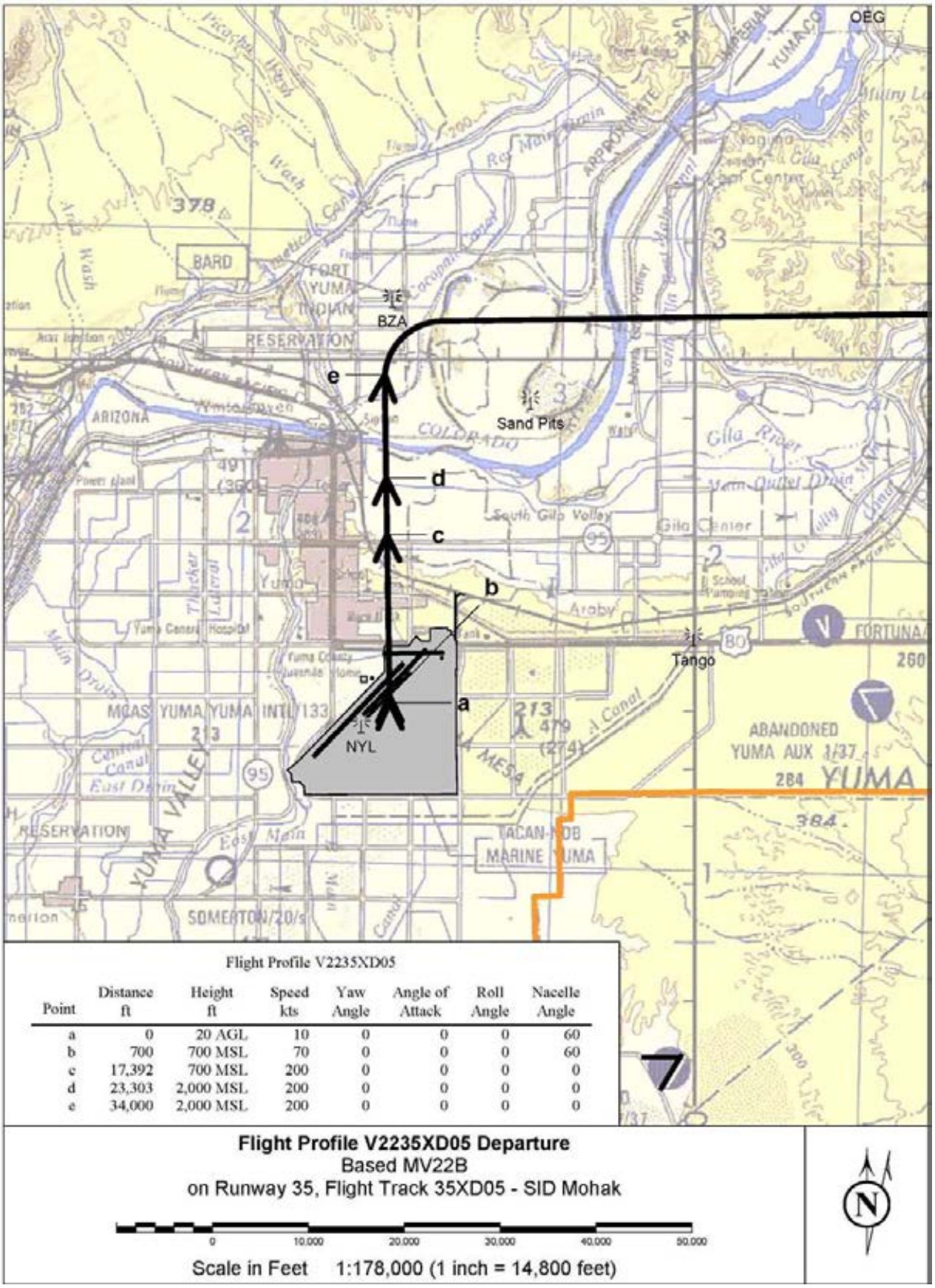
Flight Profile V2235XD02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	45,000	2,000 MSL	200	0	0	0	0

Flight Profile V2235XD02 Departure
Based MV22B
on Runway 35, Flight Track 35XD02 - SID Argus

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:173,000 (1 inch = 14,400 feet)



Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	20 AGL	10	0	0	0	60
b	700	700 MSL	70	0	0	0	60
c	17,392	700 MSL	200	0	0	0	0
d	23,303	2,000 MSL	200	0	0	0	0
e	34,000	2,000 MSL	200	0	0	0	0

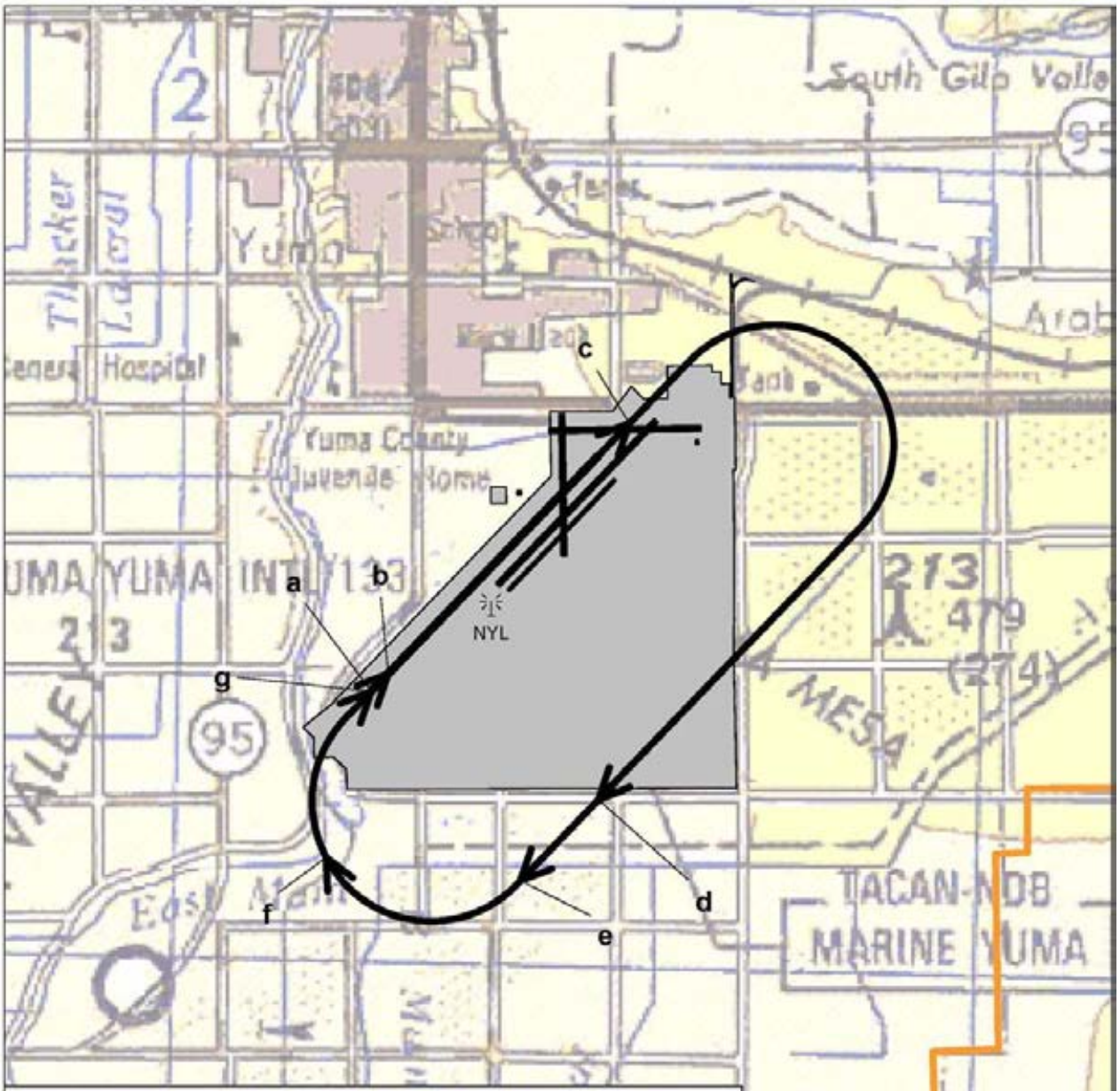
Flight Profile V2203LG02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Naceelle Angle
a	0	50 AGL	40	0	0	0	85
b	1,000	50 AGL	70	0	0	0	60
c	47,013	2,500 MSL	200	0	0	0	0
d	54,707	2,500 MSL	200	0	0	0	0
e	116,780	2,500 MSL	200	0	0	0	0
f	137,337	2,500 MSL	200	0	0	0	0
g	153,141	2,500 MSL	110	0	0	0	60
h	178,000	300 AGL	50	0	0	0	85
i	179,570	20 AGL	0	0	0	0	90

Flight Profile V2203LG02 GCA Box Pattern
Based MV22B
on Runway 03L, Flight Track 03LG02 - Left Traffic, primarily FW GCA Box

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:199,000 (1 inch = 16,600 feet)



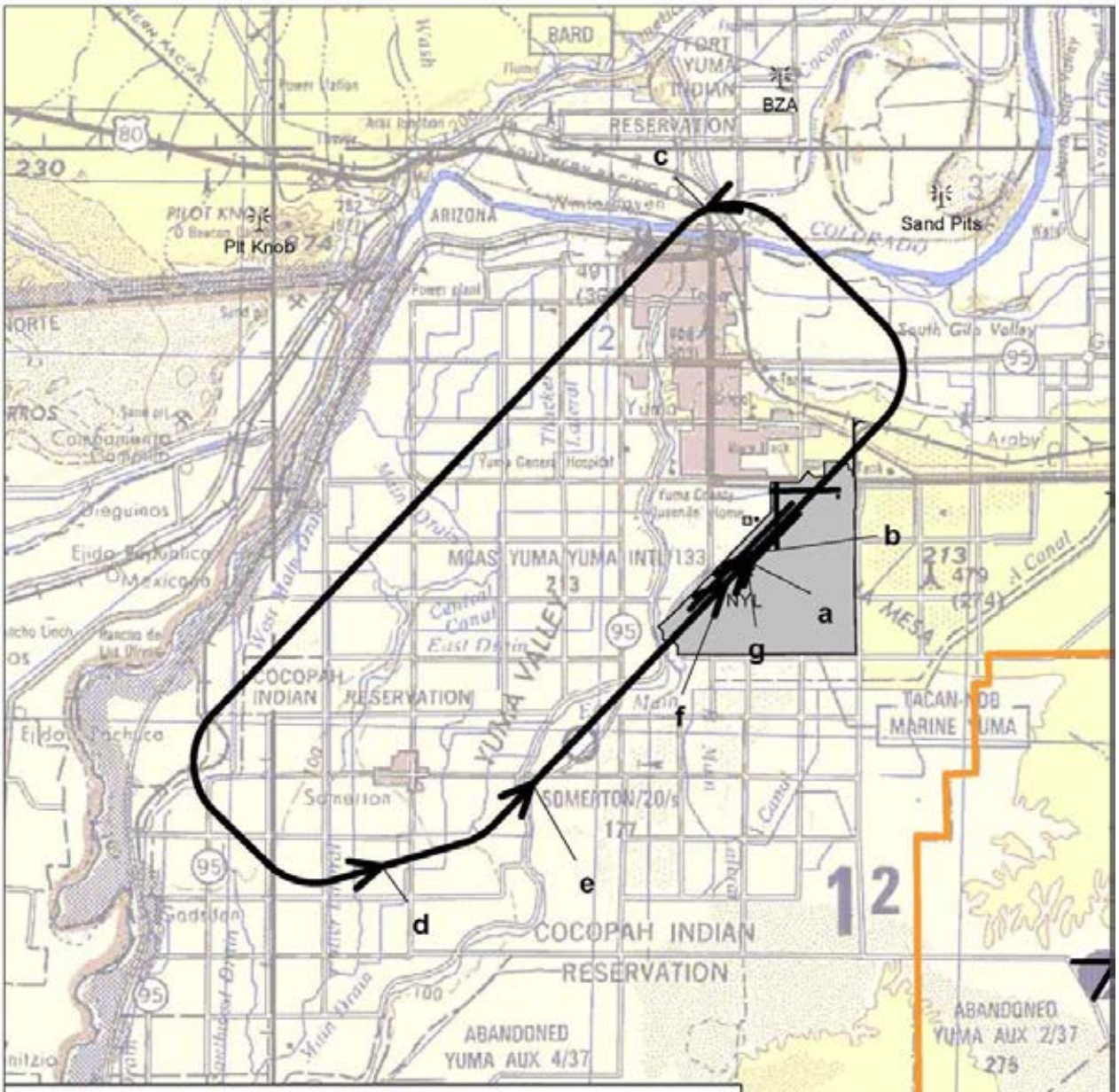
Flight Profile V2203LT01

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	54 AGL	40	0	0	0	85
b	1,000	54 AGL	70	0	0	0	60
c	15,172	1,700 MSL	170	0	0	0	0
d	49,362	1,700 MSL	170	0	0	0	0
e	53,955	500 AGL	110	0	0	0	60
f	63,362	150 AGL	50	0	0	0	85
g	70,968	20 AGL	0	0	0	0	90

Flight Profile V2203LT01 Touch and Go Pattern
Based MV22B
on Runway 03L, Flight Track 03LT01

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:83,600 (1 inch = 6,970 feet)



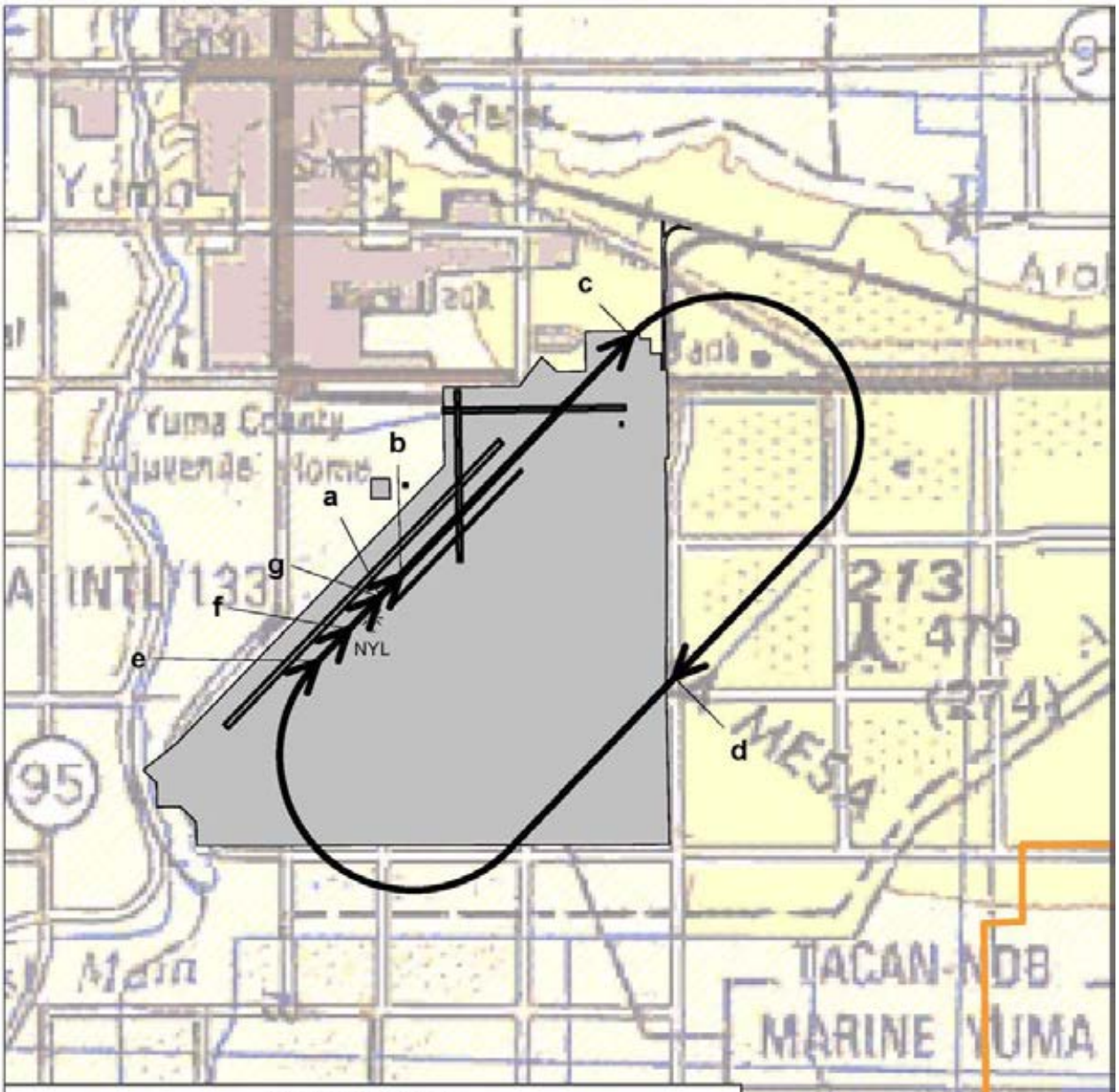
Flight Profile V2203RG02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	50 AGL	40	0	0	0	85
b	1,000	50 AGL	70	0	0	0	60
c	47,013	2,500 MSL	200	0	0	0	0
d	137,337	2,500 MSL	200	0	0	0	0
e	153,141	2,500 MSL	110	0	0	0	60
f	178,000	300 AGL	50	0	0	0	85
g	180,722	20 AGL	0	0	0	0	90

Flight Profile V2203RG02 GCA Box Pattern
Based MV22B
on Runway 03R, Flight Track 03RG02 - Left Traffic, primarily FW GCA Box

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:183,000 (1 inch = 15,200 feet)



Flight Profile V2203RT01

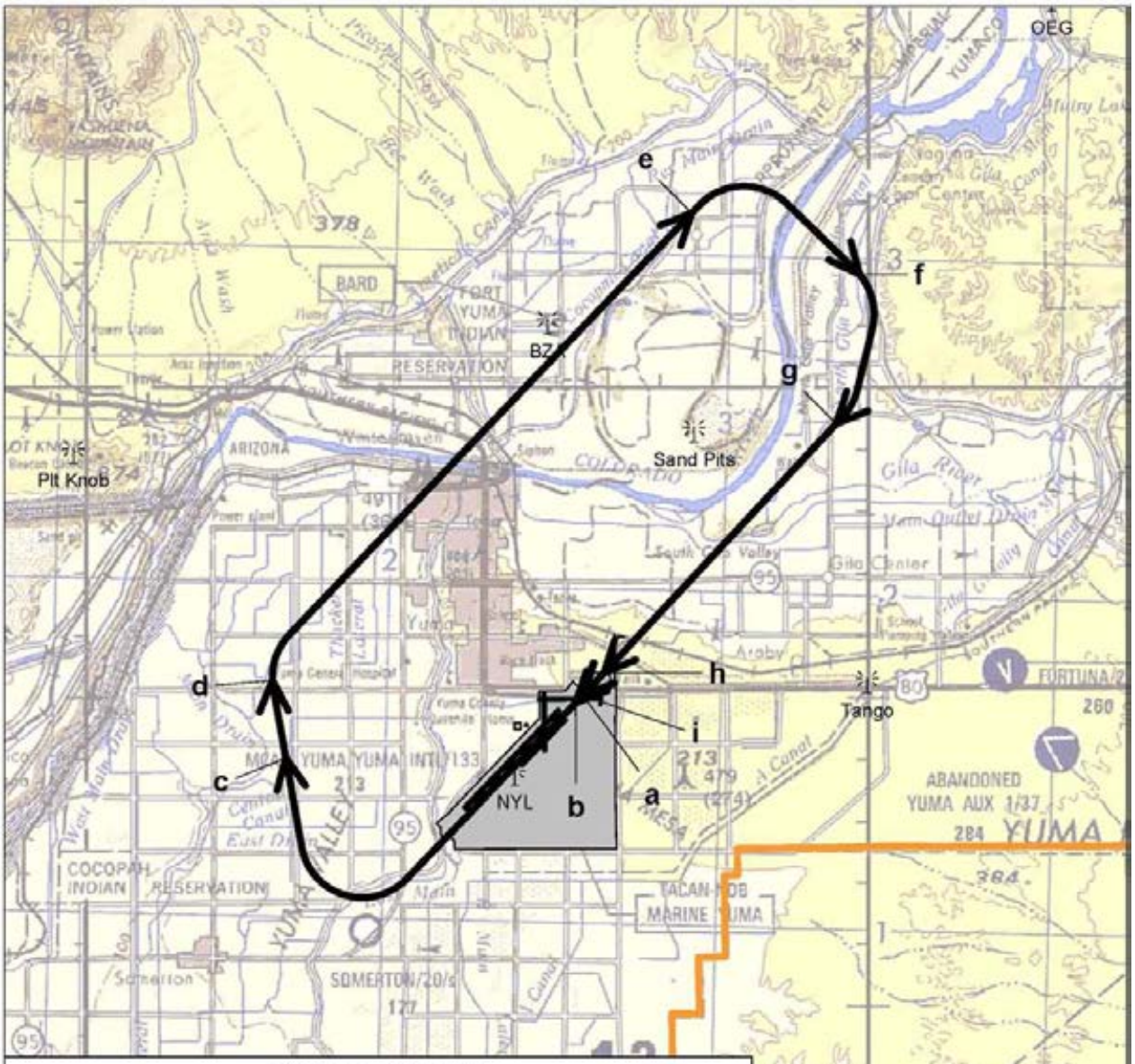
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	54 AGL	40	0	0	0	85
b	1,000	54 AGL	70	0	0	0	60
c	12,159	1,700 MSL	170	0	0	0	0
d	33,505	1,700 MSL	170	0	0	0	0
e	55,692	500 AGL	110	0	0	0	60
f	57,192	150 AGL	50	0	0	0	85
g	58,692	20 AGL	0	0	0	0	90

Flight Profile V2203RT01 Touch and Go Pattern
Based MV22B
on Runway 03R, Flight Track 03RT01

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:68,800 (1 inch = 5,740 feet)

N



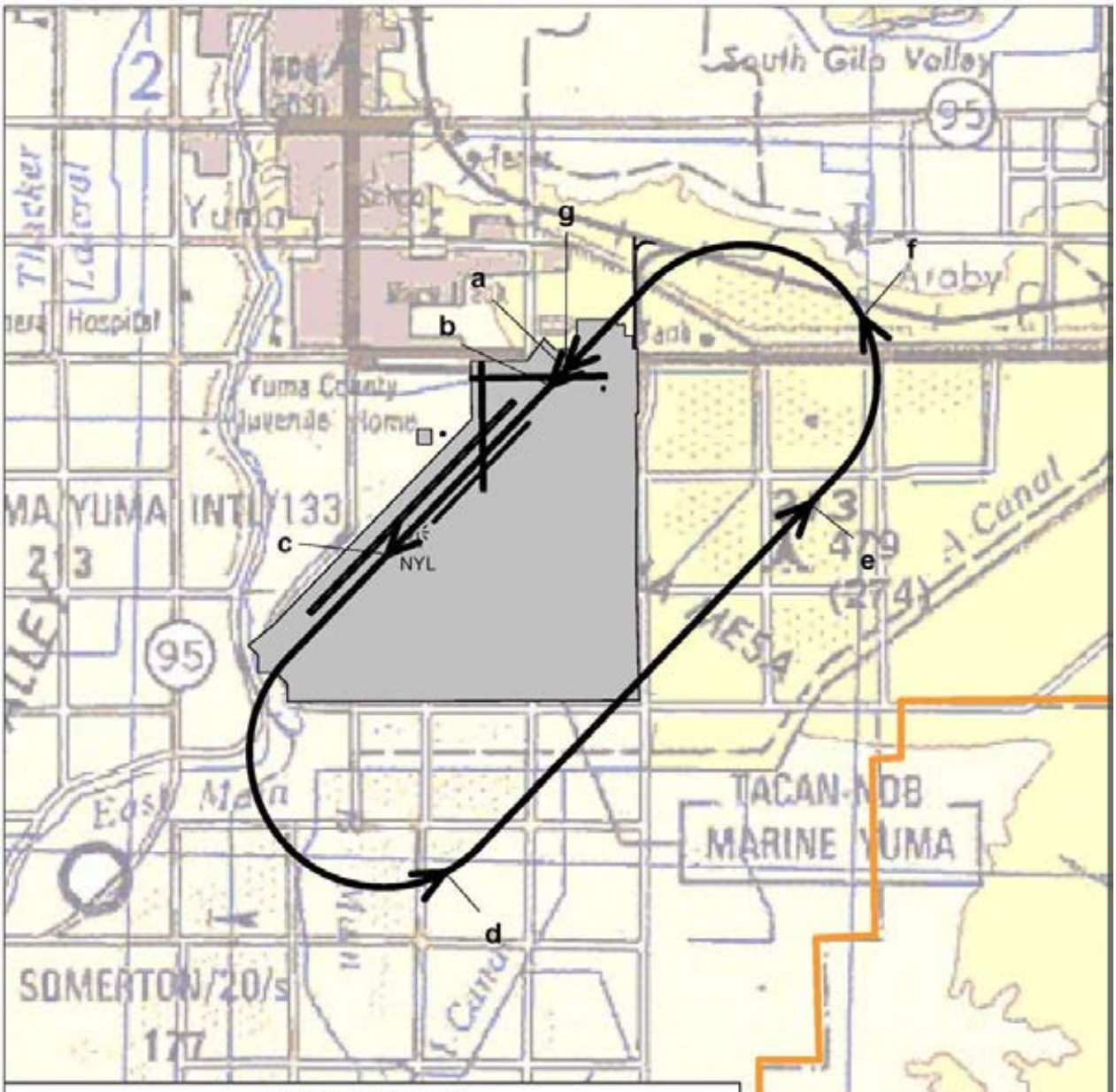
Flight Profile V2221LG02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	50 AGL	40	0	0	0	85
b	1,000	50 AGL	70	0	0	0	60
c	47,013	2,500 MSL	200	0	0	0	0
d	54,707	2,500 MSL	200	0	0	0	0
e	116,780	2,500 MSL	200	0	0	0	0
f	137,337	2,500 MSL	200	0	0	0	0
g	153,141	2,500 MSL	110	0	0	0	60
h	186,536	300 AGL	50	0	0	0	85
i	189,588	20 AGL	0	0	0	0	90

Flight Profile V2221LG02 GCA Box Pattern
Based MV22B
on Runway 21L, Flight Track 21LG02 - Right Traffic, primarily FW GCA Box

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:204,000 (1 inch = 17,000 feet)



Flight Profile V2221LT01

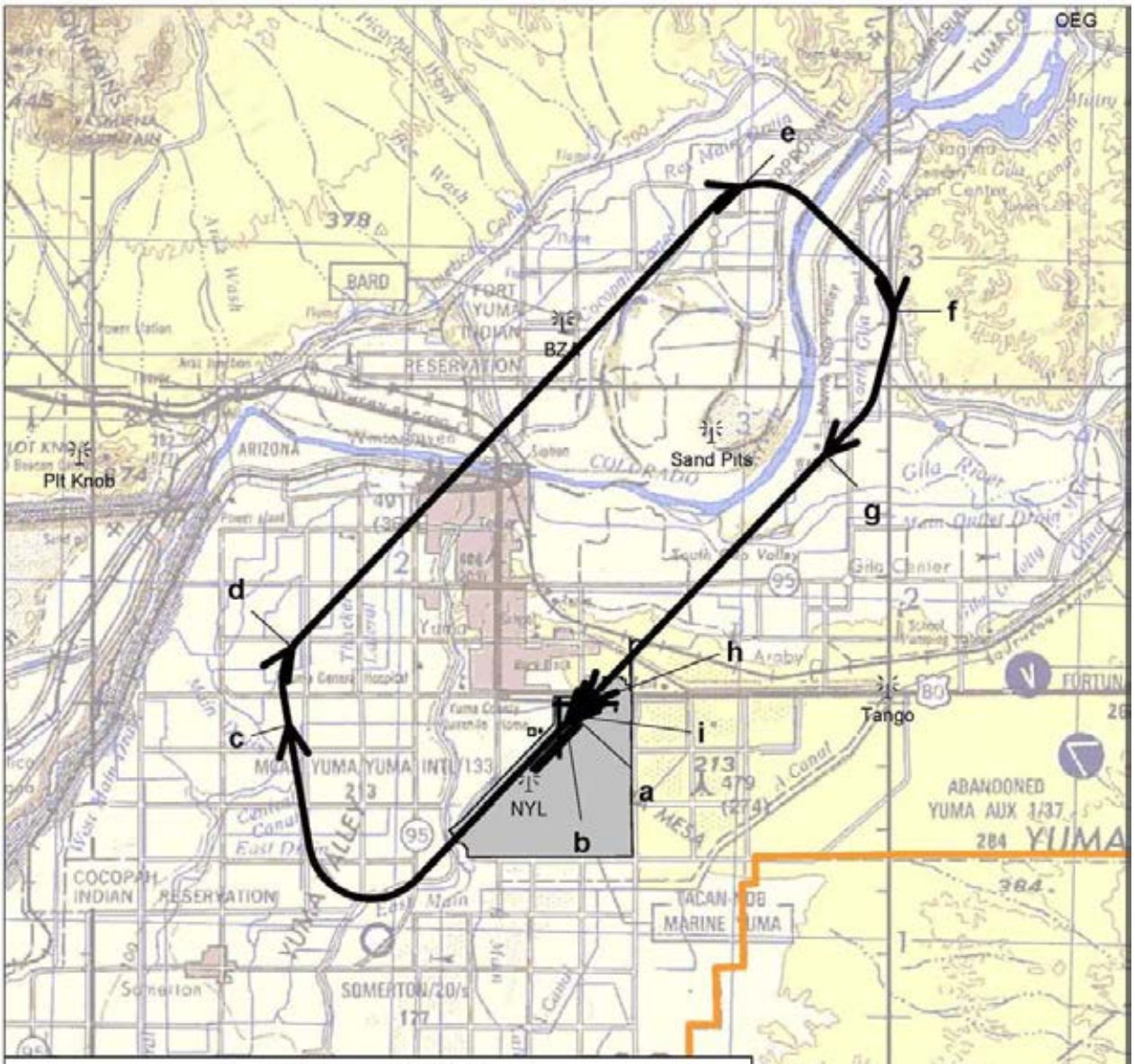
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	54 AGL	40	0	0	0	85
b	1,000	54 AGL	70	0	0	0	60
c	11,603	1,700 MSL	170	0	0	0	0
d	35,286	1,700 MSL	170	0	0	0	0
e	58,773	500 AGL	110	0	0	0	60
f	68,273	150 AGL	50	0	0	0	85
g	85,074	20 AGL	0	0	0	0	90

Flight Profile V2221LT01 Touch and Go Pattern
Based MV22B
on Runway 21L, Flight Track 21LT01 - outboard T&G

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:92,500 (1 inch = 7,710 feet)

N



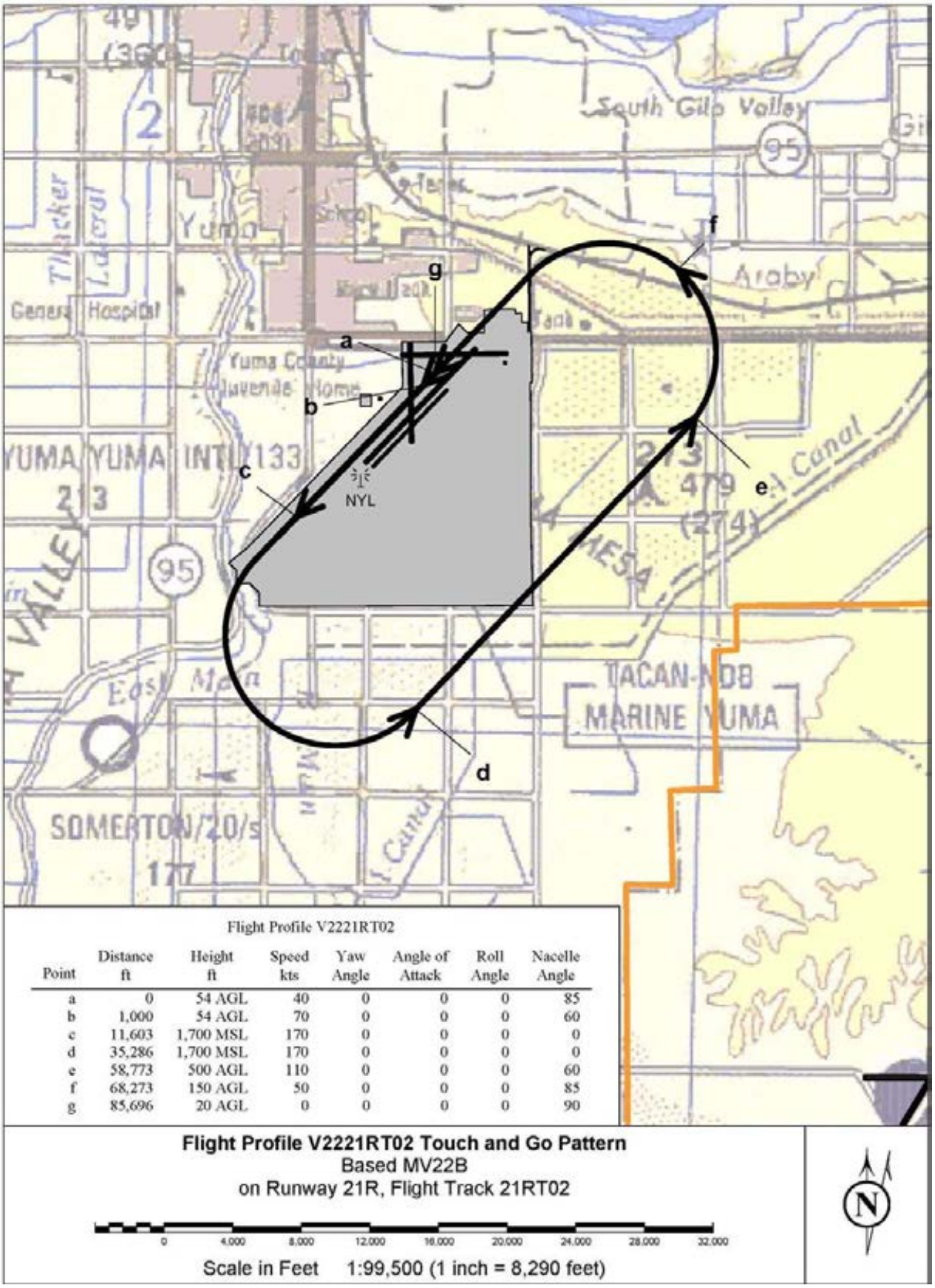
Flight Profile V2221RG02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	50 AGL	40	0	0	0	85
b	1,000	50 AGL	70	0	0	0	60
c	47,013	2,500 MSL	200	0	0	0	0
d	54,707	2,500 MSL	200	0	0	0	0
e	116,780	2,500 MSL	200	0	0	0	0
f	137,337	2,500 MSL	200	0	0	0	0
g	153,141	2,500 MSL	110	0	0	0	60
h	186,536	300 AGL	50	0	0	0	85
i	188,036	20 AGL	0	0	0	0	90

Flight Profile V2221RG02 GCA Box Pattern
Based MV22B
on Runway 21R, Flight Track 21RG02 - Right Traffic, primarily FW GCA Box

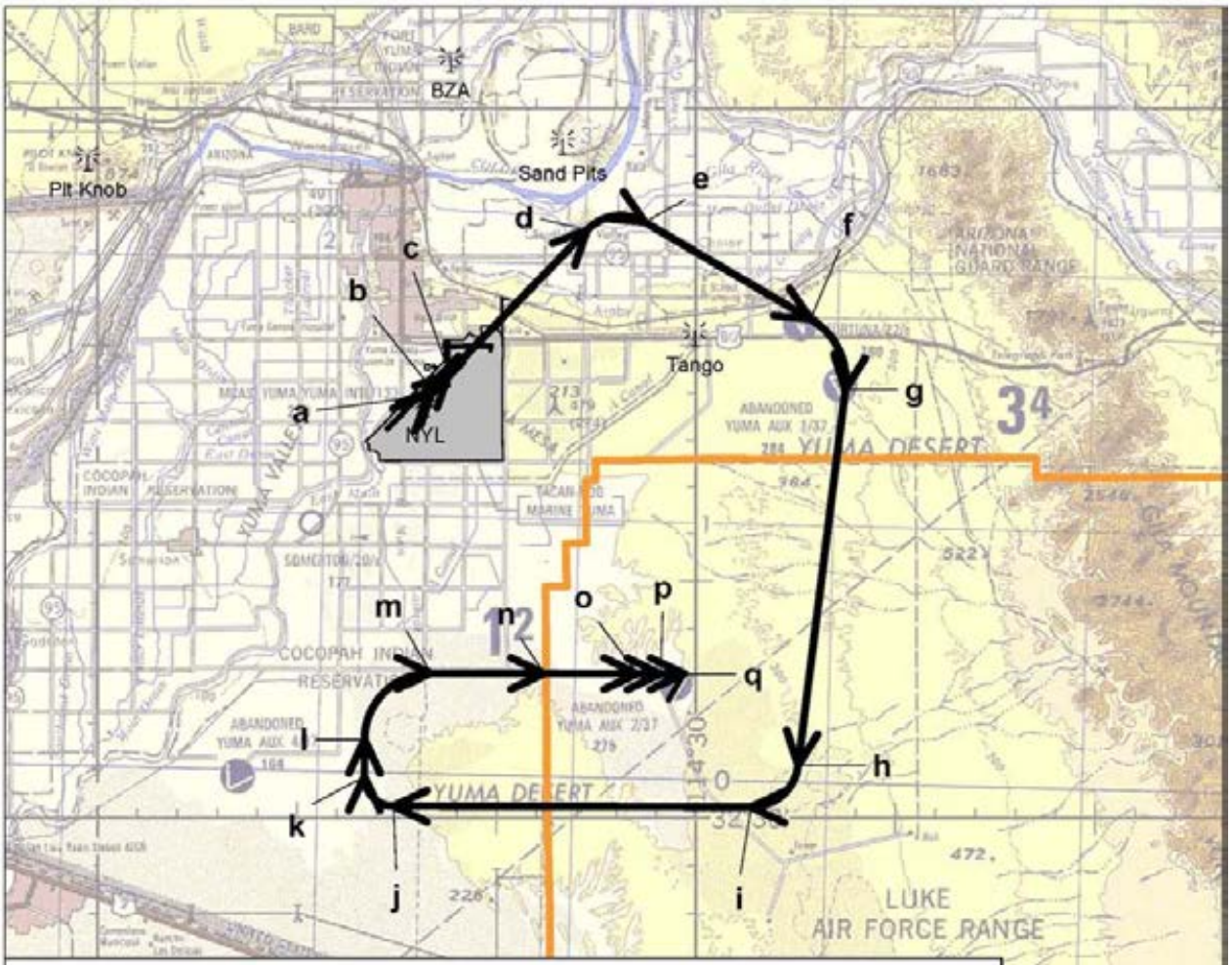
0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:200,000 (1 inch = 16,700 feet)



Flight Profile V2221RT02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	54 AGL	40	0	0	0	85
b	1,000	54 AGL	70	0	0	0	60
c	11,603	1,700 MSL	170	0	0	0	0
d	35,286	1,700 MSL	170	0	0	0	0
e	58,773	500 AGL	110	0	0	0	60
f	68,273	150 AGL	50	0	0	0	85
g	85,696	20 AGL	0	0	0	0	90



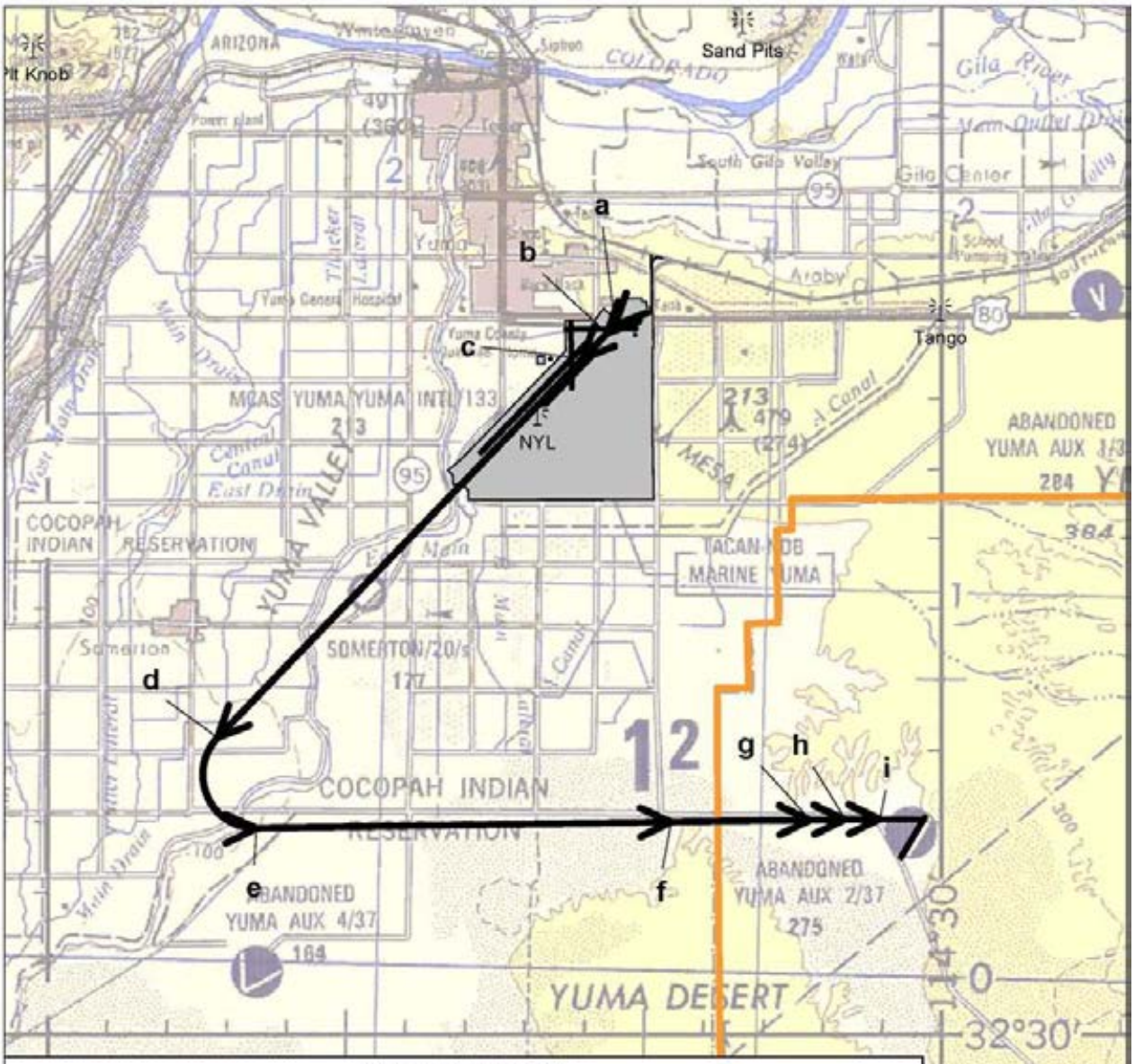
Flight Profile V2203RI09

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	0	0	0	0	90	
b	1,000	300 AGL	170	0	0	0	45	
c	4,000	700 MSL	200	0	0	0	0	
d	29,500	700 MSL	200	0	0	0	0	
e	37,560	700 MSL	200	0	0	0	0	
f	62,260	700 MSL	200	0	0	0	0	
g	72,918	700 MSL	200	0	0	0	0	
h	121,418	700 MSL	200	0	0	0	0	
i	130,220	700 MSL	200	0	0	0	0	
j	176,310	700 MSL	200	0	0	0	0	
k	182,200	700 MSL	200	0	0	0	0	
l	186,960	700 MSL	200	0	0	0	0	
m	200,312	700 MSL	200	0	0	0	0	
n	214,962	700 MSL	200	0	0	0	0	
o	226,962	700 MSL	170	0	0	0	0	
p	229,962	700 MSL	110	0	0	0	60	
q	232,962	295 MSL	0	0	0	0	90	20 ft AGL @ AUX2

Flight Profile V2203RI09 Interfacility
Based MV22B
on Runway 03R, Flight Track 03RI09

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 100,000

Scale in Feet 1:289,000 (1 inch = 24,100 feet)



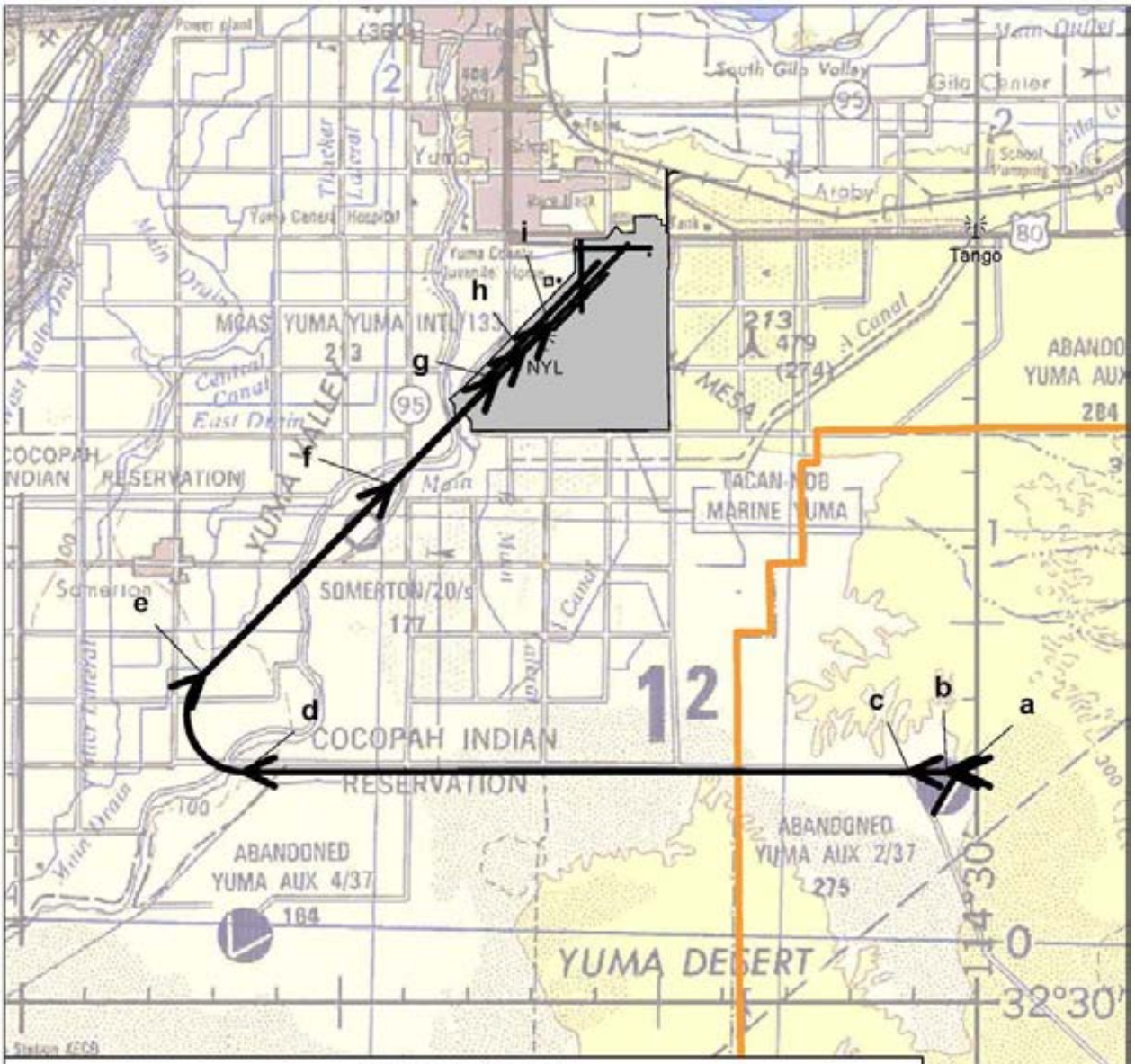
Flight Profile V2221LI09

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	0	0	0	0	90	
b	1,000	300 AGL	170	0	0	0	45	
c	4,000	700 MSL	200	0	0	0	0	
d	49,217	700 MSL	200	0	0	0	0	
e	59,954	700 MSL	200	0	0	0	0	
f	95,728	700 MSL	200	0	0	0	0	
g	107,728	700 MSL	170	0	0	0	0	
h	110,728	700 MSL	110	0	0	0	60	
i	113,728	295 MSL	0	0	0	0	90	20 ft AGL @ AUX2

Flight Profile V2221LI09 Interfacility
Based MV22B
on Runway 21L, Flight Track 21LI09

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:178,000 (1 inch = 14,900 feet)



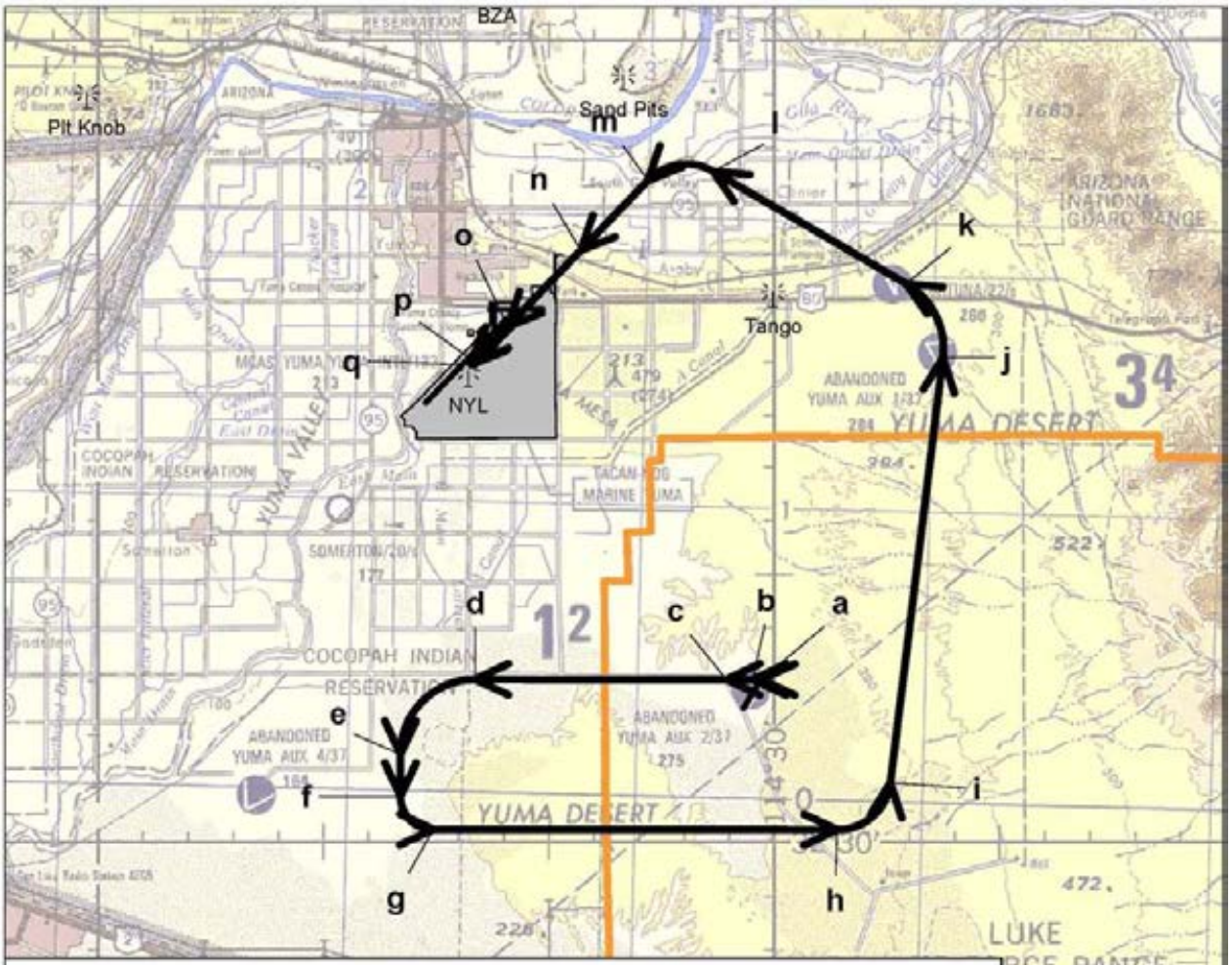
Flight Profile V2227XI03R

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	295 MSL	0	0	0	0	90	20 ft AGL @ AUX2
b	1,000	575 MSL	170	0	0	0	45	
c	4,000	700 AGL	200	0	0	0	0	
d	57,723	700 AGL	200	0	0	0	0	
e	68,453	700 AGL	200	0	0	0	0	
f	89,947	700 AGL	200	0	0	0	0	
g	101,947	700 AGL	170	0	0	0	0	
h	104,947	700 AGL	110	0	0	0	60	
i	107,947	20 AGL	0	0	0	0	90	

Flight Profile V2227XI03R Interfacility
Based MV22B
on Runway 27-AUX2, Flight Track 27XI03R

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:167,000 (1 inch = 13,900 feet)



Flight Profile V2227XI21L

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	295 MSL	0	0	0	0	90	20 ft AGL @ AUX2
b	1,000	575 MSL	170	0	0	0	45	
c	4,000	700 MSL	200	0	0	0	0	
d	32,650	700 AGL	200	0	0	0	0	
e	46,002	700 AGL	200	0	0	0	0	
f	50,762	700 AGL	200	0	0	0	0	
g	56,652	700 AGL	200	0	0	0	0	
h	102,742	700 AGL	200	0	0	0	0	
i	111,544	700 AGL	200	0	0	0	0	
j	160,044	700 AGL	200	0	0	0	0	
k	169,992	700 AGL	200	0	0	0	0	
l	195,392	700 AGL	200	0	0	0	0	
m	203,452	700 AGL	200	0	0	0	0	
n	214,452	700 AGL	200	0	0	0	0	
o	226,452	700 AGL	170	0	0	0	0	
p	231,952	700 AGL	110	0	0	0	60	
q	232,450	20 AGL	0	0	0	0	90	

Flight Profile V2227XI21L Interfacility
Based MV22B
on Runway 27-AUX2, Flight Track 27XI21L

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:256,000 (1 inch = 21,300 feet)

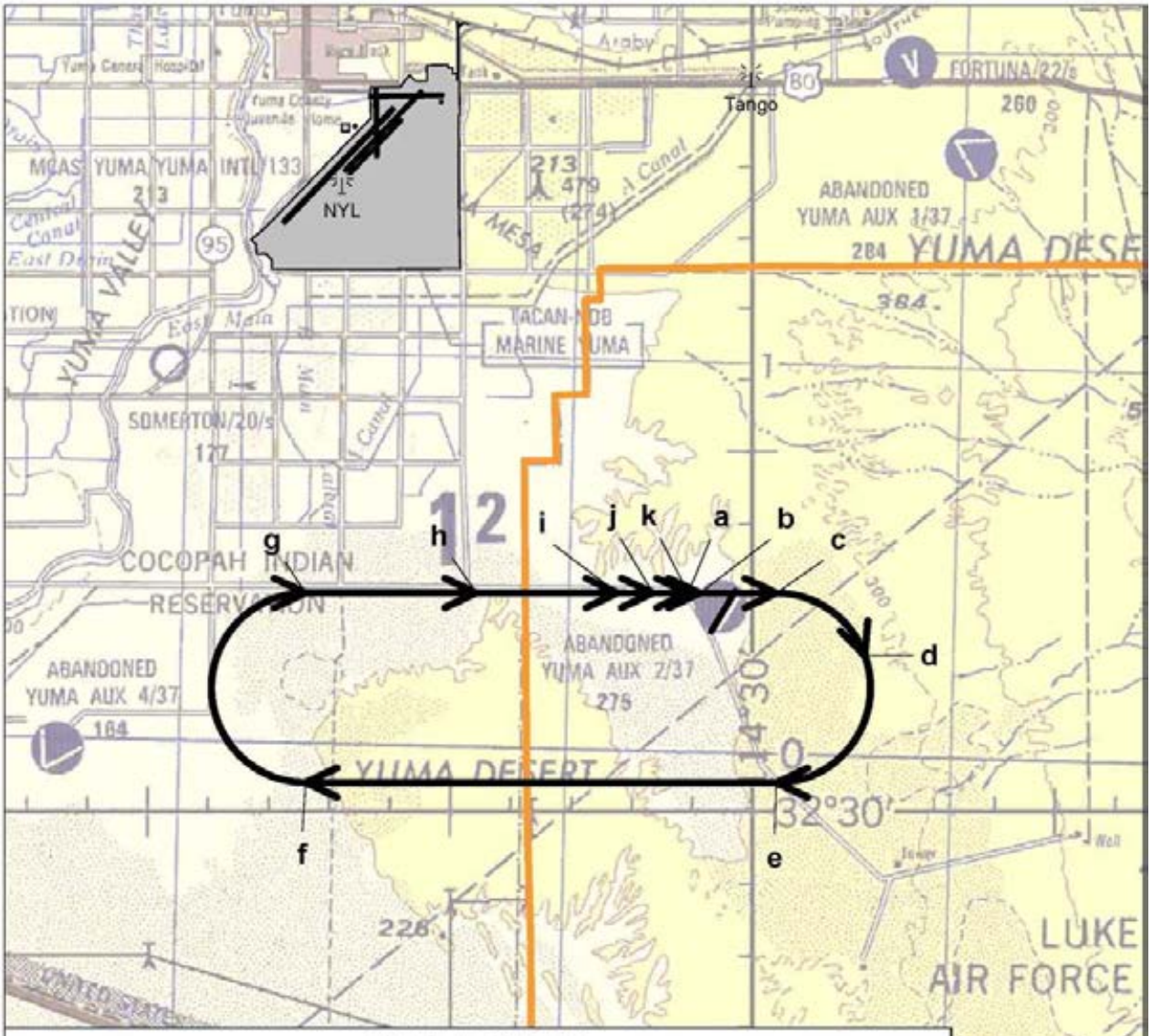
Flight Profile V2209XF01

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	325 MSL	40	0	0	0	85	50 ft AGL @ AUX2
b	1,000	325 MSL	70	0	0	0	60	50 ft AGL @ AUX2
c	7,717	893 MSL	110	0	0	0	37	Interpolated
d	17,261	1,700 MSL	170	0	0	0	0	
e	24,463	1,700 MSL	170	0	0	0	0	
f	28,016	775 MSL	110	0	0	0	60	
g	37,560	470 MSL	95	0	0	0	66	Interpolated
h	39,000	425 MSL	50	0	0	0	85	
i	40,598	295 MSL	0	0	0	0	90	20 ft AGL @ AUX2

Flight Profile V2209XF01 FCLP Pattern
Based MV22B
on Runway 09-AUX2, Flight Track 09XF01 - Aux2 FCLP - ask MAG

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000

Scale in Feet 1:47,500 (1 inch = 3,960 feet)



Flight Profile V2209XF02

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	325 MSL	40	0	0	0	85	50 ft AGL @ AUX2
b	1,000	325 MSL	70	0	0	0	60	50 ft AGL @ AUX2
c	7,500	875 MSL	108	0	0	0	38	interpolated
d	17,261	1,700 MSL	170	0	0	0	0	
e	32,623	1,700 MSL	170	0	0	0	0	
f	72,633	1,700 MSL	170	0	0	0	0	
g	97,765	1,700 MSL	170	0	0	0	0	
h	112,265	1,700 MSL	170	0	0	0	0	
i	124,265	775 MSL	110	0	0	0	60	
j	127,265	425 MSL	50	0	0	0	85	
k	130,265	295 MSL	0	0	0	0	90	20 ft AGL @ AUX2

Flight Profile V2209XF02 FCLP Pattern
Based MV22B
on Runway 09-AUX2, Flight Track 09XF02 - Aux2 FCLP - Ask MAG

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:178,000 (1 inch = 14,900 feet)

C-1.3.5 Modeled Run-Ups for MCAS Yuma

Existing Runups at MCAS Yuma

Ground Run ups

Modeled As Aircraft Type	Pad	Description	Exhaust direction	Power Setting	Duration (seconds)	Number of Engines	Percent of total departures
F4 (J79)	Runway	Ground Run ups Prior to Roll		MIL-Power	18	1	40%
				A/B	2	2	40%
F14 (TF30	Runway	Ground Run ups Prior to Roll		MIL-Power	18	1	7%
				A/B	2	2	7%
A4 (J52)	Runway	Ground Run ups Prior to Roll		MIL-Power	4	1	26%
AV8 (F402)	Runway	Ground Run ups Prior to Roll		MIL-Power	4	1	11%
A7 (TF41)	Runway	Ground Run ups Prior to Roll		MIL-Power	12.5	1	16%

High Power Pad

Modeled As Aircraft Type (& engine	Pad	Description	Exhaust Direction	Power Setting	Duration (seconds)	Duration (minutes)	Number of Engines	Daily Ops			Annual Operations		
								Day	Night	Days per Week	Day	Night	Total
F4 (J79)		High Power Turn-Up Pad	Southeast	MIL-Power	1800	30	1	2.64	0.36	6	826	113	939
				80-90% RPM	3600	60	1	2.64	0.36	6	826	113	939
A4 (J52)		High Power Turn-Up Pad	Southeast	MIL-Power	1800	30	1	2.64	0.36	6	826	113	939
				MIL-Power	1800	30	1	2.64	0.36	5	688	94	782
				80-90% RPM	1800	30	1	2.64	0.36	6	826	113	939
				80-90% RPM	900	15	1	2.64	0.36	5	688	94	782
A7 (TF41)		High Power Turn-Up Pad	Southeast	MIL-Power	1800	30	1	0.66	0.09	5	172	23	196
				80-90% RPM	1800	30	1	0.66	0.09	5	172	23	196
AV8 (F402)		High Power Turn-Up Pad	Southeast	MIL-Power	1800	30	1	0.24	0.01	5	63	3	65
				80-90% RPM	1800	30	1	0.24	0.01	5	63	3	65
DC10		High Power Turn-Up Pad	Northwest	MIL-Power	300	5	1	1	0	1	52	-	52
				80-90% RPM	1800	30	1	1	0	1	52	-	52

(2) Day = 7 am -9:59 pm; Night = 10 pm - 6:59 am

MV-22 Modeled Run-up Operations for Yuma

Modeled As Aircraft Type (& engine designation)	Pad	Description	Magnetic Heading (degrees)	Power Setting	Duration (minutes)	Number of Engines	Annual Operations			
							Day	Eve	Night	Total
CH-53E (T64-GE-416A)	HP6 - Hover Pad 6	Low Work (per full Sqn)	240	IGE Lite	7	1	10	4	0	14
	MV22FL - Hgr 4 Flight Line	In-Frame Engine Test	195	Gnd Idle	10	1	182	0	0	181.99
				Gnd Max	30	1				
				Gnd Max	30	1	5.2	0	2.8	8
				Gnd Idle	20	1	55	0	9.7	65
				Gnd Max	40	1				

(1) Run-ups modeled for a total of 87 F/A-18 aircraft
(2) Day = 7 am - 6:59 pm; Eve = 7 pm - 9:59 pm; Night = 10 pm - 6:59 am

C-1.3.6 Modeled Airspace at Barry M. Goldwater Range West — Operations and Sorties

Modeled Baseline Annual Area-type Operation/Sorties for BM Goldwater Range - BMGR-W

Aircraft Type		CW - Cactus West			Yodaville			Cactus West / Yodaville (AA, AG; AH1, UH1)									Cactus West / Yodaville		
		F9A (AA, AG; CH46)			F9B (AA, AG; CH46)			F1A			F1B			F1C			F5A (FreePlay & ACM Lo)		
		day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total
AV-8B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18E/F		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,192	12	1,204
AH-1		-	-	-	25	-	25	25	-	25	135	1	136	86	1	87	-	-	-
CH-46		31	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	1	74
UH-1		-	-	-	-	-	-	13	-	13	69	-	69	44	-	44	-	-	-
Total		31	-	31	25	-	25	38	-	38	204	1	205	130	1	131	1,265	13	1,278

Aircraft Type		TACTS HI															TACTS VALLEY		
		F2A (AG)			F2B (AG)			F6A (ACM Hi)			F6B (ACM Hi)			F6C (ACM Hi)			F9C* (ACM Lo)		
		day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total
AV-8B		238	2	240	238	2	240	348	3	351	348	3	351	348	3	351	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18E/F		-	-	-	-	-	-	2,173	22	2,195	2,173	22	2,195	2,173	22	2,195	-	-	-
F-16		-	-	-	-	-	-	668	7	675	668	7	675	668	7	675	-	-	-
F-5		-	-	-	-	-	-	1,951	20	1,971	1,951	20	1,971	1,951	20	1,971	-	-	-
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	165	2	167
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		238	2	240	238	2	240	5,140	52	5,192	5,140	52	5,192	5,140	52	5,192	165	2	167

Aircraft Type		TACTS LO																					Total		
		F4A (FreePlay)			F5B* (AA, AG, Transient)			F9C* (AA, AG, Transient			F1D* (AA, AG, Transient)			F6A			F6B			F6C					
		day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total
AV-8B		251	3	254	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,781	16	1,797
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	578	6	584	-	-	-	578	6	584
F/A-18E/F		-	-	-	-	-	-	-	-	-	-	-	-	578	6	584	-	-	-	578	6	584	7,675	78	7,753
F-16		-	-	-	-	-	-	-	-	-	-	-	-	221	2	223	221	2	223	221	2	223	2,667	27	2,694
F-5		-	-	-	-	-	-	49	1	50	-	-	-	438	4	442	438	4	442	438	4	442	8,408	85	8,493
AH-1		-	-	-	-	-	-	-	-	-	61	1	62	-	-	-	-	-	-	-	-	-	307	3	310
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	196	2	198
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-53		-	-	-	97	1	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170	2	172
UH-1		-	-	-	-	-	-	-	-	-	95	1	96	-	-	-	-	-	-	-	-	-	221	1	222
Total		251	3	254	97	1	98	49	1	50	156	2	158	1,237	12	1,249	1,237	12	1,249	1,237	12	1,249	22,003	220	22,223

Note: (1) F5B = F9C = F1D; See Figures 4-1, and 4-3 of WR 05-16 for Maps of Areas

Source: WR 05-16 modeling

Modeled Proposed Annual Area-type Operation/Sorties for BM Goldwater Range – BMGR-W

Aircraft Type	Target Passes						LAT circuits			Totals		
	Yodaville			Cactus West			F10A					
	Day	Night	Total	Day	Night	Total	Day	Night	Total	Day	Night	Total
AV-8B	3,279	3	3,282	6,320	4	6,324	392	1	393	9,991	8	9,999
F/A-18C/D	19,776	21	19,797	-	-	-	520	1	521	20,296	22	20,318
F/A-18E/F	2,197	2	2,199	-	-	-	58	-	58	2,255	2	2,257
F-16			-	4,847	11	4,858			-	4,847	11	4,858
Fixed-wing Strafe	1,007	-	1,007	1,025	-	1,025			-	2,032	-	2,032
Rotary-wing Strafe	136	-	136	51	-	51			-	187	-	187
Total	26,395	26	26,421	12,243	15	12,258	970	2	972	39,608	43	39,651

Day = 0700-2200; Night = 2200-0700

Modeled Proposed Annual Area-type Operations for BM Goldwater Range - BMGR-W

Aircraft Type		CW - Cactus West			Yodaville			Cactus West / Yodaville (AA, AG; AH1, UH1)									Cactus West / Yodaville		
		F9A (AA, AG; CH46)			F9B (AA, AG; CH46)			F1A			F1B			F1C			F5A (FreePlay & ACM Lo)		
		day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total
AV-8B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18E/F		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,192	12	1,204
AH-1		-	-	-	-	-	-	25	-	25	135	1	136	86	1	87	-	-	-
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	1	74
UH-1		-	-	-	-	-	-	13	-	13	69	-	69	44	-	44	-	-	-
Total		-	-	-	-	-	-	38	-	38	204	1	205	130	1	131	1,265	13	1,278

Aircraft Type		TACTS HI															TACTS VALLEY		
		F2A (AG)			F2B (AG)			F6A (ACM Hi)			F6B (ACM Hi)			F6C (ACM Hi)			F9C[1] (ACM Lo)		
		day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total
AV-8B		238	2	240	238	2	240	348	3	351	348	3	351	348	3	351	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18E/F		-	-	-	-	-	-	2,173	22	2,195	2,173	22	2,195	2,173	22	2,195	-	-	-
F-16		-	-	-	-	-	-	668	7	675	668	7	675	668	7	675	-	-	-
F-5		-	-	-	-	-	-	1,951	20	1,971	1,951	20	1,971	1,951	20	1,971	-	-	-
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		238	2	240	238	2	240	5,140	52	5,192	5,140	52	5,192	5,140	52	5,192	-	-	-

Aircraft Type		TACTS LO																	
		F4A (FreePlay)			F5B[1] (AA, AG, Transient)			F9C[1] (AA, AG, Transient			F1D[1] (AA, AG, Transient)			F6A			F6B		
		day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total
AV-8B		261	3	264	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	578	6	584
F/A-18E/F		-	-	-	-	-	-	-	-	-	-	-	-	578	6	584	-	-	-
F-16		-	-	-	-	-	-	-	-	-	-	-	-	221	2	223	221	2	223
F-5		-	-	-	-	-	-	49	1	50	-	-	-	438	4	442	438	4	442
AH-1		-	-	-	-	-	-	-	-	-	61	1	62	-	-	-	-	-	-
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-53		-	-	-	97	1	98	-	-	-	-	-	-	-	-	-	-	-	-
UH-1		-	-	-	-	-	-	-	-	-	95	1	96	-	-	-	-	-	-
Total		261	3	264	97	1	98	49	1	50	156	2	158	1,237	12	1,249	1,237	12	1,249

Aircraft Type		MV-22 Operating Areas															Total		
		1			2			3 (2)			4			5 (3)					
		day	night	total	day	night	total	day	night	total	day	night	total	day	night	total	day	night	total
AV-8B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,781	16	1,797
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	578	6	584
F/A-18E/F		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,675	78	7,753
F-16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,667	27	2,694
F-5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,408	85	8,493
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	307	3	310
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	1,652	104	1,756	1,652	104	1,756	1,652	104	1,756	1,652	104	1,756	1,830	203	2,033	8,438	619	9,057
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	119	5	124	119	5	124
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	135	9	144	135	9	144
H-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170	2	172
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	221	1	222
Total		1,652	104	1,756	1,652	104	1,756	1,652	104	1,756	1,652	104	1,756	2,084	217	2,301	30,499	851	31,350

Note: (1) F5B = F9C = F1D; See Figures 4-1, and 4-3 of WR 05-16 for Maps of Areas
(2) Includes MV-22 sorties to Combat Town
(3) Includes MV-22 sorties to Lonesome Dove

Source: WR 05-16 modeling

WTI Busiest Day Sorties for Baseline Condition

	Sorties per Day (1)	Number of Flying Days (1)	Busy Month Sorties Modeled
F/A-18C/D	15.2	14	213
F/A-18E/F	15.2	14	213
AV-8	13.0	21	267
OM (F-16)	2.3	8	17
F-5	0.8	3	2
CH-53	16.7	14	258
CH-46	23.3	16	407
AH-1	15.0	16	254
UH-1	10.5	12	136
MV-22	-	-	-
Total	**111.8**		**1,766**

WTI Busiest Day Sorties for Proposed Condition

	Sorties per Day (1)	Number of Flying Days (1)	Busy Month Sorties Modeled
F/A-18C/D	15.2	14	213
F/A-18E/F	15.2	14	213
AV-8	13.0	21	267
OM (F-16)	2.3	8	17
F-5	0.8	3	2
CH-53	16.7	14	258
CH-46	-	-	-
AH-1	15.0	16	254
UH-1	10.5	12	136
MV-22	4.0	4	8
Total	**92.5**		**1,367**

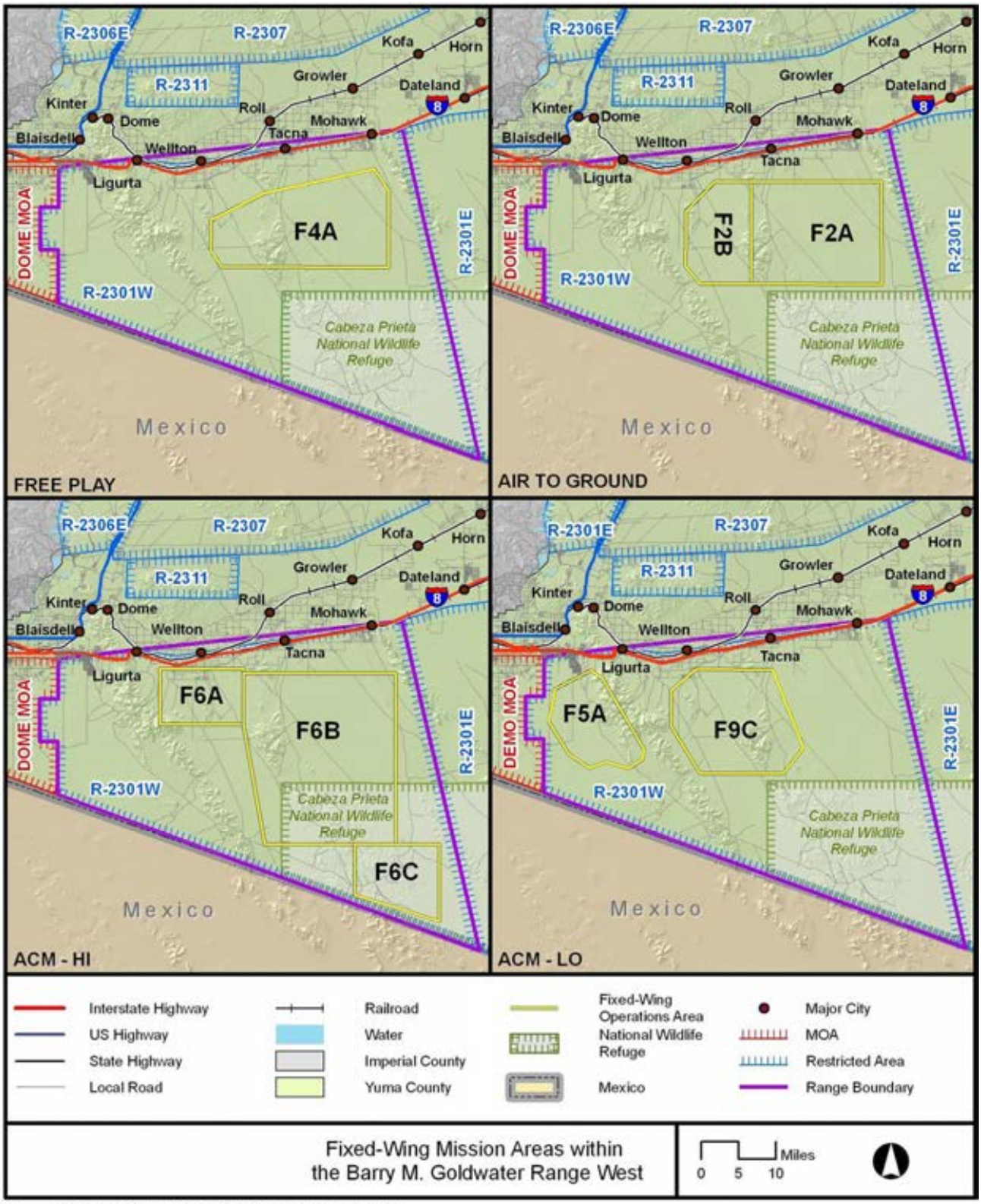
Note: (1) Average of Spring and Fall WTI Sorties

WTI Track Use

Aircraft Group	Track Name	Track Use	Temporal Split		
			Day	Night	Total
Rotary Wing (1)	Bird	50%	95%	5%	100%
	Crow	50%	95%	5%	100%
		100%			
Fixed Wing (2),(3)	Southern Trk 1	50%	95%	5%	100%
	Southern Trk 2	50%	95%	5%	100%
		100%			

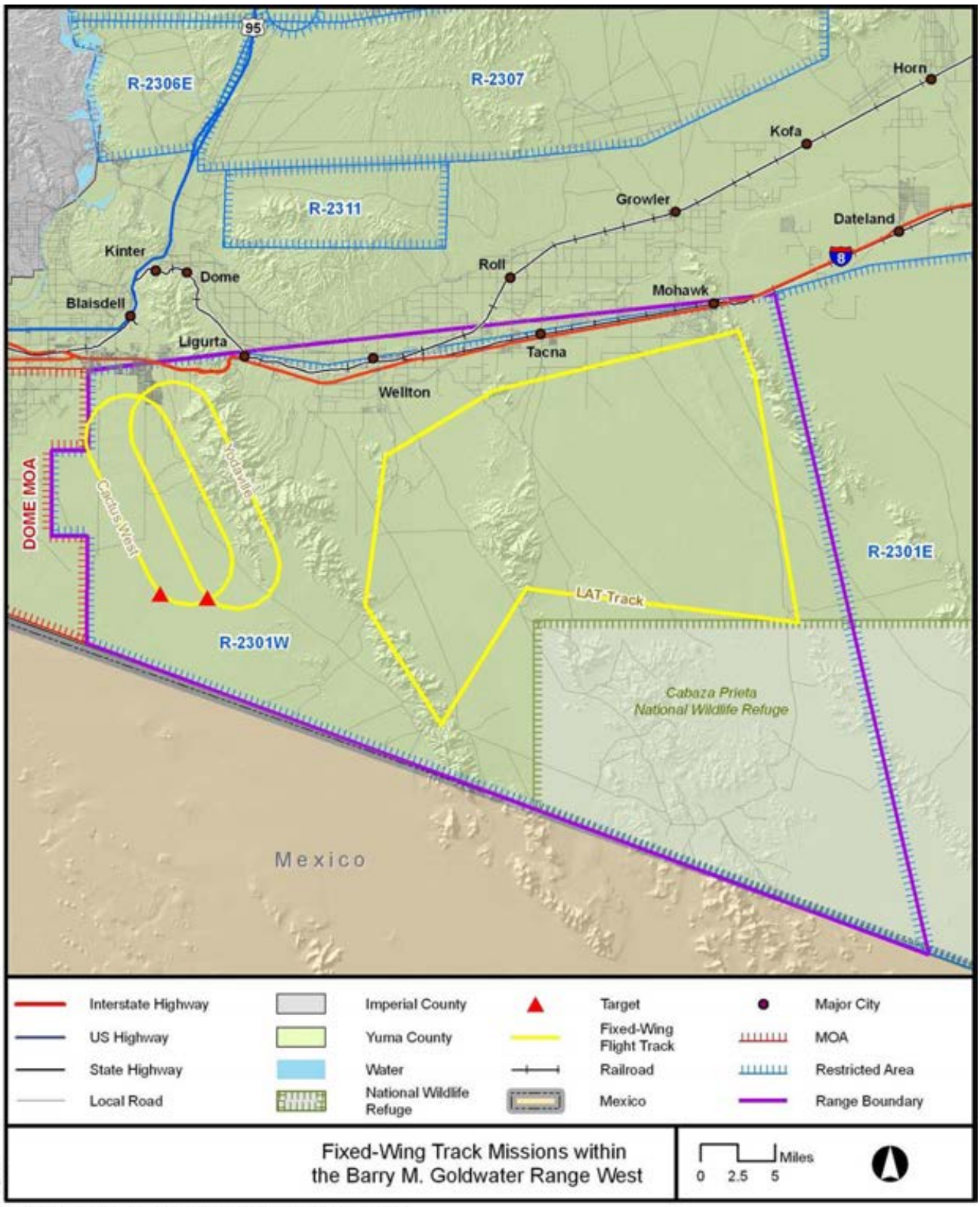
Notes:
(1) Includes AH-1W, UH-1N, CH-46, CH-53
(2) Includes F/A-18C/D, F/A-18E/F, AV-8B, OM (F-16), F-5E
(3) F-5 modeled with 100% day and 0% night ops
(4) MV22 ops spread evenly between the four tracks shown above

C-1.3.7 Modeled Airspace at Barry M. Goldwater Range West — Maps



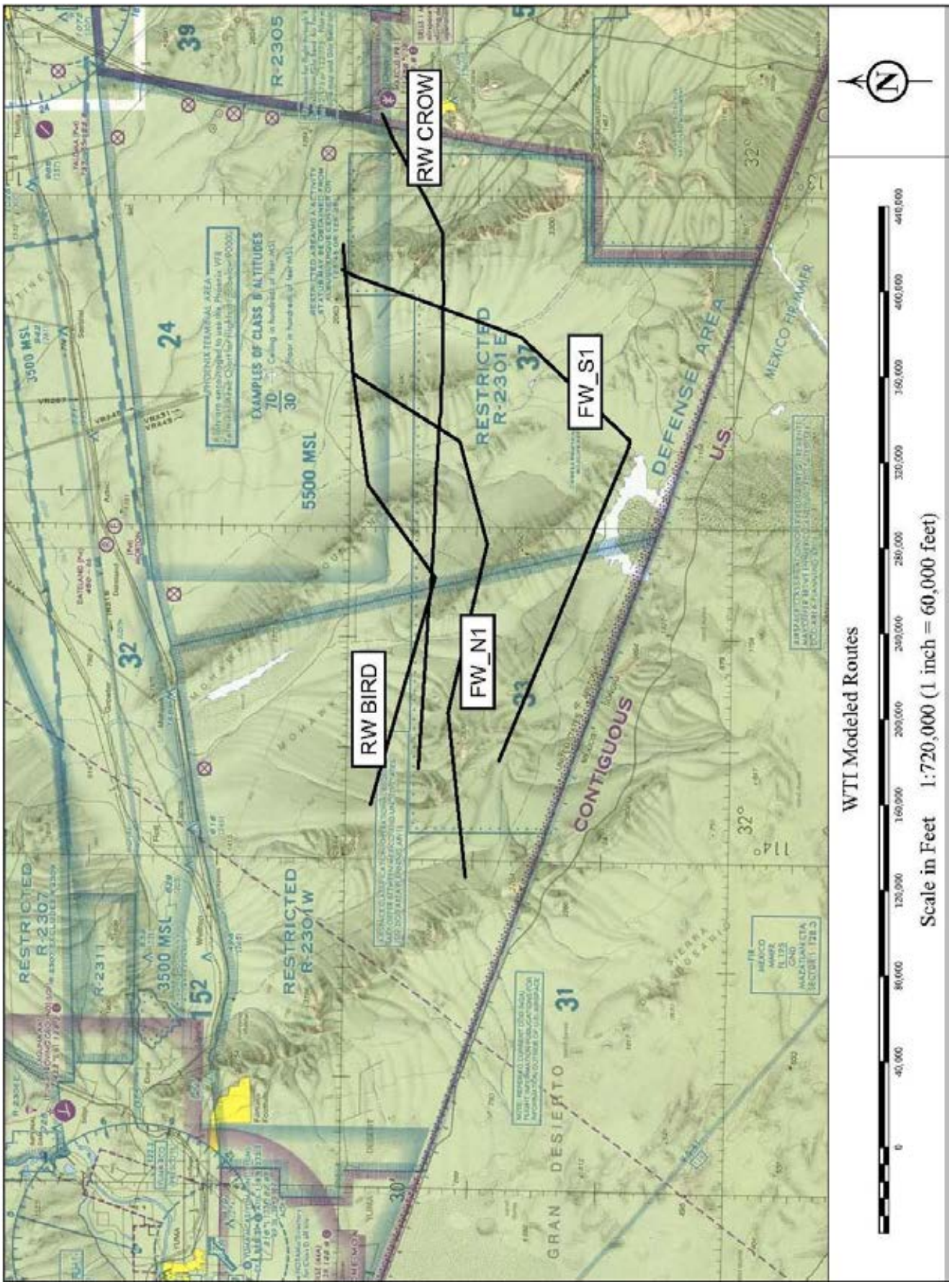
Fixed-Wing Mission Areas within the Barry M. Goldwater Range West

Source: USGS, TIGER/Line 2000, DAFIFV.507, Wyle Laboratories 2005
Geographic Reference: State Plane Coordinate Arizona West, NAD 1983, Meters



Fixed-Wing Track Missions within the Barry M. Goldwater Range West

Source: USGS, TIGER/Line 2000, DAFIFV.507, Wyle Laboratories 2005
Geographic Reference: State Plane Coordinate System Arizona West, NAD 1983, Meters


RW CROW
FW_S1
FW_N1
RW BIRD
RESTRICTED R-2301 E
RESTRICTED R-2301 W
RESTRICTED R-2307
R-2305
R-2311
5500 MSL
3500 MSL
CONTIGUOUS
DEFENSE AREA
U.S.
MEXICO
GRAN DESIERTO
WTI Modeled Routes
Scale in Feet 1:720,000 (1 inch = 60,000 feet)

C-1.3.8 Modeled Airspace at Barry M. Goldwater Range West – Flight Profiles Database

MODELED CONDITIONS										ANNUAL OPS	passes per sortie	ANNUAL SORTIES	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)						
AIRSPACE ID	MISSION ID	MISION DESC	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES				Floor*	100-1k	300-500	300-3k	400-5k	500-6k	Total
CWTRF845	MAV8BTR	45 deg dive	AV-8B	370	TRAFFIC PATTERN	90	% RPM	day	175.55	2106.6	8	263.3	100						100
CWTRF845	MAV8BTR	45 deg dive	AV-8B	370	TRAFFIC PATTERN	90	% RPM	nite	0.1	1.2	8	0.15	100						100
CWTRF830	MAV8BTR	30 deg dive	AV-8B	370	TRAFFIC PATTERN	90	% RPM	day	175.55	2106.6	8	263.3	100						100
CWTRF830	MAV8BTR	30 deg dive	AV-8B	370	TRAFFIC PATTERN	90	% RPM	nite	0.1	1.2	8	0.15	100						100
CWTRF810	MAV8BTR	10 deg dive	AV-8B	370	TRAFFIC PATTERN	90	% RPM	day	175.55	2106.6	8	263.3	100						100
CWTRF810	MAV8BTR	10 deg dive	AV-8B	370	TRAFFIC PATTERN	90	% RPM	nite	0.1	1.2	8	0.15	100						100
YDTRF7LL	MAV8BTR	Level Laydown	AV-8B	370	TRAFFIC PATTERN	90	% RPM	day	273.27	3279.24	8	409.9	100						100
YDTRF7LL	MAV8BTR	Level Laydown	AV-8B	370	TRAFFIC PATTERN	90	% RPM	nite	0.24	2.88	8	0.36	100						100
YDTRF745	MF18TR	45 deg dive	F-18E/F	449	CRUISE POWER	90	% N2	day	927.75	11133	9	1237	100						100
YDTRF745	MF18TR	45 deg dive	F-18E/F	449	CRUISE POWER	90	% N2	nite	1.12	13.44	9	1.493	100						100
YDTRF730	MF18TR	30 deg dive	F-18E/F	449	CRUISE POWER	90	% N2	day	541.95	6503.4	9	722.6	100						100
YDTRF730	MF18TR	30 deg dive	F-18E/F	449	CRUISE POWER	90	% N2	nite	0.47	5.64	9	0.627	100						100
YDTRF715	MF18TR	15 deg dive	F-18E/F	449	CRUISE POWER	90	% N2	day	361.3	4335.6	9	481.7	100						100
YDTRF715	MF18TR	15 deg dive	F-18E/F	449	CRUISE POWER	90	% N2	nite	0.31	3.72	9	0.413	100						100
CWTRF310	MF16TR	10 deg dive	F-16A	400	INTERMEDIATE POWER	92	% NC	day	80.78	969.36	9	107.7	100						100
CWTRF310	MF16TR	10 deg dive	F-16A	400	INTERMEDIATE POWER	92	% NC	nite	0.06	0.72	9	0.08	100						100
CWTRF320	MF16TR	20 deg dive	F-16A	400	INTERMEDIATE POWER	92	% NC	day	80.78	969.36	9	107.7	100						100
CWTRF320	MF16TR	20 deg dive	F-16A	400	INTERMEDIATE POWER	92	% NC	nite	0.06	0.72	9	0.08	100						100
CWTRF345	MF16TR	45 deg dive	F-16A	400	INTERMEDIATE POWER	92	% NC	day	242.35	2908.2	9	323.1	100						100
CWTRF345	MF16TR	45 deg dive	F-16A	400	INTERMEDIATE POWER	92	% NC	nite	0.78	9.36	9	1.04	100						100
F10A	MAV8F10A	LAT Ops	AV-8B	449	TRAFFIC PATTERN	100	% RPM	day	32.67	392.04	1	392				100			100
F10A	MAV8F10A	LAT Ops	AV-8B	449	TRAFFIC PATTERN	100	% RPM	nite	0.08	0.96	1	0.96				100			100
F10A	MF18F10A	LAT Ops	F-18E/F	449	CRUISE POWER	92	% N2	day	48.18	578.16	1	578.2			75			25	100
F10A	MF18F10A	LAT Ops	F-18E/F	449	CRUISE POWER	92	% N2	nite	0.07	0.84	1	0.84			75			25	100
CWSTRAF	20MMSTRA	FW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	day	85.39	1024.68	1	1025					100		100
CWSTRAF	20MMSTRA	FW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	nite	0.03	0.36	1	0.36					100		100
YDSTRAF	20MMSTRA	FW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	day	83.9	1006.8	1	1007					100		100
YDSTRAF	20MMSTRA	FW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	nite	0.01	0.12	1	0.12					100		100
CWSTRAF	20MMSTRA	RW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	day	4.21	50.52	1	50.52		100					100
CWSTRAF	20MMSTRA	RW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	nite	0.04	0.48	1	0.48		100					100
YDSTRAF	20MMSTRA	RW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	day	11.3	135.6	1	135.6		100					100
YDSTRAF	20MMSTRA	RW Strafe	20MMGU	650	CRUISE POWER	70	% RPM	nite	0.03	0.36	1	0.36		100					100

* Modeled at 1000' to 10,000' AGL

MODELED CONDITIONS									BUSY	ANNUAL	time per	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)																			
AIRSPACE ID	MISSION ID	MISION DESC	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIES	sortie (minutes)	Floor*	100-300	300-500	100-1k	200-5k	300-3k	500-1500	1k-2k	2k-3k	3k-4k	4k-5k	5k-15k	5k-25k	5k-35k	6-10k	10k-15k	10k-25k	15k-20k	20k-25k	Total
F2A	MAV8F2A	Air-Gnd	AV-8B	350	TRAFFIC PATTERN	85	% RPM	day	19.81	237.72	30													75							75
F2A	MAV8F2A	Air-Gnd	AV-8B	350	TRAFFIC PATTERN	85	% RPM	nite	0.19	2.28	30													75							75
F2B	MAV8F2B	Air-Gnd	AV-8B	400	TRAFFIC PATTERN	100	% RPM	day	19.81	237.72	10												25								25
F2B	MAV8F2B	Air-Gnd	AV-8B	400	TRAFFIC PATTERN	100	% RPM	nite	0.19	2.28	10												25								25
F4A	MAV8F4A	FreePlay	AV-8B	449	TRAFFIC PATTERN	109	% RPM	day	21.78	261.36	40						100														100
F4A	MAV8F4A	FreePlay	AV-8B	449	TRAFFIC PATTERN	109	% RPM	nite	0.22	2.64	40						100														100
F5A	MF5F5A	ACM (Lo)	F-5E	300	CRUISE POWER	95	% RPM	day	99.33	1191.96	40																		50	50	100
F5A	MF5F5A	ACM (Lo)	F-5E	300	CRUISE POWER	95	% RPM	nite	1	12	40																		50	50	100
F9C	MF5F9C	F5-vs-Helo	F-5E	449	CRUISE POWER	95	% RPM	day	4.05	48.6	40								50	50											100
F9C	MF5F9C	F5-vs-Helo	F-5E	449	CRUISE POWER	95	% RPM	nite	0.08	0.96	40								50	50											100
F6A (hi)	MAV8F6A	ACM	AV-8B	300	TRAFFIC PATTERN	90	% RPM	day	28.96	347.52	10																		100		100
F6A (hi)	MAV8F6A	ACM	AV-8B	300	TRAFFIC PATTERN	90	% RPM	nite	0.29	3.48	10																		100		100
F6A (hi)	MF18F6A	ACM	F-18E/F	300	CRUISE POWER	95	% N2	day	181.09	2173.08	10																		50	50	100
F6A (hi)	MF18F6A	ACM	F-18E/F	300	CRUISE POWER	95	% N2	nite	1.83	21.96	10																		50	50	100
F6A (low)	MF18F6A2	Air-Air	F-18E/F	300	CRUISE POWER	95	% N2	day	48.18	578.16	10					100															100
F6A (low)	MF18F6A2	Air-Air	F-18E/F	300	CRUISE POWER	95	% N2	nite	0.49	5.88	10					100															100
F6A (hi)	MF5F6A	ACM	F-18E/F	300	CRUISE POWER	95	% RPM	day	162.61	1951.32	10																		50	50	100
F6A (hi)	MF5F6A	ACM	F-18E/F	300	CRUISE POWER	95	% RPM	nite	1.64	19.68	10																		50	50	100
F6A (low)	MF5F6A2	HAT F5-vs-He	F-18E/F	350	CRUISE POWER	85	% RPM	day	36.46	437.52	10								15	25	35	25									100
F6A (low)	MF5F6A2	HAT F5-vs-He	F-18E/F	350	CRUISE POWER	85	% RPM	nite	0.37	4.44	10								15	25	35	25									100
F6A (low)	MF16F6A	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	day	18.4	220.8	10							100													100
F6A (low)	MF16F6A	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	nite	0.19	2.28	10							100													100
F6A (hi)	MF16F6A2	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	day	55.69	668.28	10														100						100
F6A (hi)	MF16F6A2	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	nite	0.56	6.72	10														100						100
F6B (hi)	MAV8F6B	ACM	F-18E/F	380	TRAFFIC PATTERN	95	% RPM	day	28.96	347.52	20																	100			100
F6B (hi)	MAV8F6B	ACM	F-18E/F	380	TRAFFIC PATTERN	95	% RPM	nite	0.29	3.48	20																	100			100
F6B (hi)	MF18F6B	ACM	F-18E/F	425	CRUISE POWER	100	% N2	day	181.09	2173.08	20	25														10	15		25	25	100
F6B (hi)	MF18F6B	ACM	F-18E/F	425	CRUISE POWER	100	% N2	nite	1.83	21.96	20	25														10	15		25	25	100
F6B (low)	MF18F6B2	Air-Air	F-18E/F	500	TRAINING ROUTE	92	% NC	day	48.18	578.16	20					100															100
F6B (low)	MF18F6B2	Air-Air	F-18E/F	500	TRAINING ROUTE	92	% NC	nite	0.49	5.88	20					100															100
F6B (hi)	MF5F6B	ACM	F-18E/F	425	CRUISE POWER	100	% RPM	day	162.61	1951.32	20	25														10	15		25	25	100
F6B (hi)	MF5F6B	ACM	F-18E/F	425	CRUISE POWER	100	% RPM	nite	1.64	19.68	20	25														10	15		25	25	100
F6B (low)	MF5F6B2	HAT F5-vs-He	F-18E/F	400	CRUISE POWER	90	% RPM	day	36.46	437.52	20								15	25	35	25									100
F6B (low)	MF5F6B2	HAT F5-vs-He	F-18E/F	400	CRUISE POWER	90	% RPM	nite	0.37	4.44	20								15	25	35	25									100
F6B (low)	MF16F6B	ACM	F-18E/F	449	LOW SPD TRAINING RT	100	% NC	day	18.4	220.8	20							100													100
F6B (low)	MF16F6B	ACM	F-18E/F	449	LOW SPD TRAINING RT	100	% NC	nite	0.19	2.28	20							100													100
F6B (hi)	MF16F6B2	ACM	F-18E/F	449	LOW SPD TRAINING RT	100	% NC	day	55.69	668.28	20														100						100
F6B (hi)	MF16F6B2	ACM	F-18E/F	449	LOW SPD TRAINING RT	100	% NC	nite	0.56	6.72	20														100						100
F6C (hi)	MAV8F6C	ACM	F-18E/F	300	TRAFFIC PATTERN	90	% RPM	day	28.96	347.52	10																		100		100
F6C (hi)	MAV8F6C	ACM	F-18E/F	300	TRAFFIC PATTERN	90	% RPM	nite	0.29	3.48	10																		100		100
F6C (hi)	MF18F6C	ACM	F-18E/F	300	CRUISE POWER	95	% N2	day	181.09	2173.08	10																		50	50	100
F6C (hi)	MF18F6C	ACM	F-18E/F	300	CRUISE POWER	95	% N2	nite	1.83	21.96	10																		50	50	100
F6C (low)	MF18F6C2	Air-Air	F-18E/F	300	CRUISE POWER	95	% N2	day	48.18	578.16	10					100															100
F6C (low)	MF18F6C2	Air-Air	F-18E/F	300	CRUISE POWER	95	% N2	nite	0.49	5.88	10					100															100
F6C (hi)	MF5F6C	ACM	F-18E/F	300	CRUISE POWER	95	% RPM	day	162.61	1951.32	10																		50	50	100
F6C (hi)	MF5F6C	ACM	F-18E/F	300	CRUISE POWER	95	% RPM	nite	1.64	19.68	10																		50	50	100
F6C (low)	MF5F6C2	HAT F5-vs-He	F-18E/F	350	CRUISE POWER	85	% RPM	day	36.46	437.52	10								15	25	35	25									100
F6C (low)	MF5F6C2	HAT F5-vs-He	F-18E/F	350	CRUISE POWER	85	% RPM	nite	0.37	4.44	10								15	25	35	25									100
F6C (low)	MF16F6C	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	day	18.4	220.8	10							100													100
F6C (low)	MF16F6C	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	nite	0.19	2.28	10							100													100
F6C (hi)	MF16F6C2	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	day	55.69	668.28	10														100						100
F6C (hi)	MF16F6C2	ACM	F-18E/F	400	LOW SPD TRAINING RT	95	% NC	nite	0.56	6.72	10														100						100
F1A	MUH1F1A	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	day	1.05	12.6	6	100																			100
F1A	MUH1F1A	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	nite	0.01	0.12	6	100																			100
F1A	MAH1F1A	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	day	2.05	24.6	6				100																100
F1A	MAH1F1A	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	nite	0.02	0.24	6				100																100
F1B	MUH1F1B	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	day	5.76	69.12	33	100																			100
F1B	MUH1F1B	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	nite	0.02	0.24	33	100																			100
F1B	MAH1F1B1	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	day	11.25	135	33				100																100
F1B	MAH1F1B1	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	nite	0.11	1.32	33				100																100
F1C	MUH1F1C	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	day	3.67	44.04	21				100																100
F1C	MUH1F1C	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	nite	0.04	0.48	21				100																100
F1C	MAH1F1C	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	day	7.16	85.92	21				100																100
F1C	MAH1F1C	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	nite	0.07	0.84	21				100																100
F1D	MUH1F1D	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	day	7.92	95.04	60				100																100
F1D	MUH1F1D	Air to Air/Gnd	F-18E/F	80	FLT AT 80 KTS	100	% RPM	nite	0.08	0.96	60				100																100
F1D	MAH1F1D	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	day	5.12	61.44	60				100																100
F1D	MAH1F1D	Air to Air/Gnd	F-18E/F	100	LFO LITE 100 KTS	100	KNOTS	nite	0.05	0.6	60				100																100
F5A	MH53F5A	FreePlay	F-18E/F	120	CRUISE POWER	68	%Q-BPA	day	6.11	73.32	60		100																		100
F5A	MH53F5A	FreePlay	F-18E/F	120	CRUISE POWER	68	%Q-BPA	nite	0.06	0.72	60		100																		100
F5B	MH53F5B	FreePlay	F-18E/F	120	CRUISE POWER	68	%Q-BPA	day	8.09	97.08	60			100																	100
F5B	MH53F5B	FreePlay	F-18E/F	120	CRUISE POWER	68	%Q-BPA	nite	0.08	0.96	60			100																	100
F9A	MH46F9A	Air to Air/Gnd	F-18E/F	110	CRUISE POWER	79	%Q-BPA	day	2.56	30.72	60		100																		100
F9A	MH46F9A	Air to Air/Gnd	F-18E/F	110	CRUISE POWER	79	%Q-BPA	nite	0.03	0.36	60		100																		100
F9B	MH46F9B	Air to Air/Gnd	F-18E/F	110	CRUISE POWER	79	%Q-BPA	day	18.73	224.76	60			100																	100
F9B	MH46F9B	Air to Air/Gnd	F-18E/F	110	CRUISE POWER	79	%Q-BPA	nite	0.19	2.28	60			100																	100
F9C (tacts valley)	MH46F9C	Transient	F-18E/F	110	CRUISE POWER	79	%Q-BPA	day	11.01	132.12	20			100																	100
F9C (tacts valley)	MH46F9C	Transient	F-18E/F	110	CRUISE POWER	79	%Q-BPA	nite	0.11	1.32	20			100																	100
F9C (tacts valley)	MH46F9C2	Flight Work	F-18E/F	110	CRUISE POWER	79	%Q-BPA	day	2.76	33.12	60		100																		100
F9C (tacts valley)	MH46F9C2	Flight Work	F-18E/F	110	CRUISE POWER	79	%Q-BPA	nite	0.03	0.36	60		100																		100

* Modeled at 1000' to 10,000' AGL

MODELED CONDITIONS						BUSY MONTH SORTIES	time per sortie (minutes)	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)							
AIRSPACE ID	MISSION ID	MISION DESC	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION			0 500	0 1000	100 300	300 500	100 1000	500 1000	2000 2001	Total
4	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
4	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
4	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
4	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
4	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
4	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
2	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
2	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
2	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
2	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
2	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
2	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
1	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
1	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
1	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
1	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
1	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
1	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
3	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
3	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
3	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
3	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
3	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
3	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
5	MV22_110	TAKEOFF PO		110	daytime	55.46	60	100							100
5	MV22_110	TAKEOFF PO		110	nighttime	6.17	60	100							100
5	MV22_220	TAKEOFF PO		220	daytime	20.79	60	100							100
5	MV22_220	TAKEOFF PO		220	nighttime	2.29	60	100							100
5	MV22_WTI	TAKEOFF PO		220	daytime	3.96	30	100							100
5	MV22_WTI	TAKEOFF PO		220	nighttime	0.21	30	100							100
5	MV22_WTI2	TAKEOFF PO		250	daytime	1.00	120							100	100
5	MV22_DT	TAKEOFF PO		110	daytime	5.62	30	100							100
5	MV22_DT	TAKEOFF PO		110	nighttime	0.38	30	100							100
4SUB	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
4SUB	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
4SUB	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
4SUB	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
4SUB	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
4SUB	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
2SUB	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
2SUB	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
2SUB	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
2SUB	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
2SUB	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
2SUB	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
1SUB	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
1SUB	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
1SUB	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
1SUB	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
1SUB	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
1SUB	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
3SUB	MV22_110	TAKEOFF PO		110	daytime	15.08	60	100							100
3SUB	MV22_110	TAKEOFF PO		110	nighttime	1.67	60	100							100
3SUB	MV22_110B	TAKEOFF PO		110	daytime	11.62	60				100				100
3SUB	MV22_220	TAKEOFF PO		220	daytime	24.12	60	100							100
3SUB	MV22_220	TAKEOFF PO		220	nighttime	2.67	60	100							100
3SUB	MV22_220B	TAKEOFF PO		220	daytime	18.00	60						100		100
5SUB	MV22_110	TAKEOFF PO		110	daytime	55.46	60	100							100
5SUB	MV22_110	TAKEOFF PO		110	nighttime	6.17	60	100							100
5SUB	MV22_220	TAKEOFF PO		220	daytime	20.79	60	100							100
5SUB	MV22_220	TAKEOFF PO		220	nighttime	2.29	60	100							100
5SUB	MV22_WTI	TAKEOFF PO		220	daytime	3.96	30	100							100
5SUB	MV22_WTI	TAKEOFF PO		220	nighttime	0.21	30	100							100
5SUB	MV22_WTI2	TAKEOFF PO		250	daytime	1.00	120							100	100
5SUB	MV22_DT	TAKEOFF PO		110	daytime	5.62	30	100							100
5SUB	MV22_DT	TAKEOFF PO		110	nighttime	0.38	30	100							100

MODELED CONDITIONS						BUSY	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)					
AIRSPACE ID	MISSION ID	MISION DESC	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	MONTH SORTIES	MIN: '0 MAX:1500	50 500	100 1000	200 500	TOTAL	Notes
RWBIRD	UH1N_80	TAKEOFF PO		80	daytime	64.50			100		100	
RWBIRD	UH1N_80	TAKEOFF PO		80	nighttime	3.42			100		100	
RWBIRD	AH1_100	TAKEOFF PO		100	daytime	120.75		100			100	
RWBIRD	AH1_75	TAKEOFF PO		75	nighttime	6.33		100			100	
RWBIRD	CH46_110	TAKEOFF PO		110	daytime	193.25		100			100	
RWBIRD	CH46_75	TAKEOFF PO		75	nighttime	10.17		100			100	
RWBIRD	CH53_120	TAKEOFF PO		120	daytime	122.58		100			100	
RWBIRD	CH53_75	TAKEOFF PO		75	nighttime	6.42		100			100	
RWBIRD	MV22_220	TAKEOFF PO		220	daytime	1.92				100	100	
RWBIRD	MV22_220	TAKEOFF PO		220	nighttime	0.08				100	100	
RWCROW	UH1N_80	TAKEOFF PO		80	daytime	64.50			100		100	
RWCROW	UH1N_80	TAKEOFF PO		80	nighttime	3.42			100		100	
RWCROW	AH1_100	TAKEOFF PO		100	daytime	120.75		100			100	
RWCROW	AH1_75	TAKEOFF PO		75	nighttime	6.33		100			100	
RWCROW	CH46_110	TAKEOFF PO		110	daytime	193.25		100			100	
RWCROW	CH46_75	TAKEOFF PO		75	nighttime	10.17		100			100	
RWCROW	CH53_120	TAKEOFF PO		120	daytime	122.58		100			100	
RWCROW	CH53_75	TAKEOFF PO		75	nighttime	6.42		100			100	
RWCROW	MV22_220	TAKEOFF PO		220	daytime	1.92				100	100	
RWCROW	MV22_220	TAKEOFF PO		220	nighttime	0.08				100	100	
FW_N1	F18AC_500	TAKEOFF PO		500	daytime	101.08	100				100	
FW_N1	F18AC_500	TAKEOFF PO		500	nighttime	5.33	100				100	
FW_N1	F18EF_500	TAKEOFF PO		500	daytime	101.08	100				100	
FW_N1	F18EF_500	TAKEOFF PO		500	nighttime	5.33	100				100	**modeled 200 ft AGL over ridgelines, 600-1500 ft AGL over valley bottoms**
FW_N1	AV8_449	TAKEOFF PO		449	daytime	126.58	100				100	
FW_N1	AV8_449	TAKEOFF PO		449	nighttime	6.67	100				100	
FW_N1	F16A_500	TAKEOFF PO		500	daytime	8.17	100				100	
FW_N1	F16A_500	TAKEOFF PO		500	nighttime	0.42	100				100	
FW_N1	F5E_449	TAKEOFF PO		449	daytime	0.92	100				100	
FW_N1	MV22_220	TAKEOFF PO		220	daytime	1.92				100	100	
FW_N1	MV22_220	TAKEOFF PO		220	nighttime	0.08				100	100	
FW_S1	F18AC_500	TAKEOFF PO		500	daytime	101.08	100				100	
FW_S1	F18AC_500	TAKEOFF PO		500	nighttime	5.33	100				100	
FW_S1	F18EF_500	TAKEOFF PO		500	daytime	101.08	100				100	
FW_S1	F18EF_500	TAKEOFF PO		500	nighttime	5.33	100				100	**modeled 200 ft AGL over ridgelines, 600-1500 ft AGL over valley bottoms**
FW_S1	AV8_449	TAKEOFF PO		449	daytime	126.58	100				100	
FW_S1	AV8_449	TAKEOFF PO		449	nighttime	6.67	100				100	
FW_S1	F16A_500	TAKEOFF PO		500	daytime	8.17	100				100	
FW_S1	F16A_500	TAKEOFF PO		500	nighttime	0.42	100				100	
FW_S1	F5E_449	TAKEOFF PO		449	daytime	0.92	100				100	
FW_S1	MV22_220	TAKEOFF PO		220	daytime	1.92				100	100	
FW_S1	MV22_220	TAKEOFF PO		220	nighttime	0.08				100	100	

C-1.3.9 Modeled Airspace Chocolate Mountain Aerial Gunnery Range – Operations and Sorties

Modeled Baseline Annual Area-type Operation/Sorties* within Restricted Area R-2507 Above the Chocolate Mountain Aerial Gunnery Range

Aircraft Type		Helicopter Close Air Support																				Helicopter Versus F-5E Air to Air									Air Combat Maneuvers								
		DEAD MAN				PUNCH BOWL				IRIS				BLUE MTN				MT BARR				S1			S2			S3			S4			S5			S6		
		day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	total	day	eve	total	day	eve	total	day	eve	total	day	eve	total	day	eve	total
AV-8B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-5E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	4	1	-	1	3	1	4	6	1	7	6	1	7	6	1	7
T-45		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-130H		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1		13	3	1	17	13	3	1	17	13	3	1	17	13	3	1	17	63	14	4	81	6	1	7	1	-	1	6	1	7	-	-	-	-	-	-	-	-	-
CH-46		-	-	-	-	-	-	-	-	22	5	1	28	22	5	1	28	175	40	11	226	5	1	6	1	-	1	5	1	6	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53		-	-	-	-	-	-	-	-	11	2	1	14	11	2	1	14	84	19	5	108	3	1	4	1	-	1	3	1	4	-	-	-	-	-	-	-	-	-
UH-1		6	1	-	7	6	1	-	7	6	1	-	7	6	1	-	7	31	7	2	40	3	1	4	1	-	1	3	1	4	-	-	-	-	-	-	-	-	-
Total		19	4	1	24	19	4	1	24	52	11	3	66	52	11	3	66	353	80	22	455	20	5	25	5	-	5	20	5	25	6	1	7	6	1	7	6	1	7

Aircraft Type		S7 - Area Reconnaissance				Fixed Wing Close Air Support with Forward Air Controller and Artillery																												LAT/AI			
						S8				S9				S10				S11				S12				S13				S14				S15			
		day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
AV-8B		1,333	306	86	1,725	127	29	8	164	127	29	8	164	127	29	8	164	64	15	4	83	254	58	16	328	254	58	16	328	64	15	4	83	190	44	12	246
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		39	9	3	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		2,044	468	132	2,644	195	45	13	253	195	45	13	253	195	45	13	253	97	22	7	126	390	89	26	505	390	89	26	505	97	22	7	126	292	67	19	378
F-5E		77	18	5	100	9	2	1	12	9	2	1	12	9	2	1	12	5	1	1	7	17	4	2	23	17	4	2	23	5	1	1	7	13	3	1	17
T-45		183	42	12	237	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-130H		9	2	1	12	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1	2	1	-	3	2	1	-	3	1	-	-	1	1	-	-	1
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		3,685	845	239	4,769	332	76	22	430	332	76	22	430	332	76	22	430	167	38	12	217	663	152	44	859	663	152	44	859	167	38	12	217	496	114	32	642

Aircraft Type		CAS Subtotal				A-A Subtotal				ACM Subtotal				AR Subtotal				LAT/AI Subtotal				Total			
		day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
AV-8B		1,017	233	64	1,314	-	-	-	-	-	-	-	-	1,333	306	86	1,725	190	44	12	246	2,540	583	162	3,285
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		-	-	-	-	-	-	-	-	-	-	-	-	39	9	3	51	-	-	-	-	39	9	3	51
F/A-18C/D		1,559	357	105	2,021	-	-	-	-	-	-	-	-	2,044	468	132	2,644	292	67	19	378	3,895	892	256	5,043
F-5E		71	16	9	96	7	2	-	9	18	3	-	21	77	18	5	100	13	3	1	17	186	42	15	243
T-45		-	-	-	-	-	-	-	-	-	-	-	-	183	42	12	237	-	-	-	-	183	42	12	237
C-130H		9	2	-	11	-	-	-	-	-	-	-	-	9	2	1	12	1	-	-	1	19	4	1	24
AH-1		115	26	8	149	13	2	-	15	-	-	-	-	-	-	-	-	-	-	-	-	128	28	8	164
CH-46		219	50	13	282	11	2	-	13	-	-	-	-	-	-	-	-	-	-	-	-	230	52	13	295
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53		106	23	7	136	7	2	-	9	-	-	-	-	-	-	-	-	-	-	-	-	113	25	7	145
UH-1		55	11	2	68	7	2	-	9	-	-	-	-	-	-	-	-	-	-	-	-	62	13	2	77
Total		3,151	718	208	4,077	45	10	-	55	18	3	-	21	3,685	845	239	4,769	496	114	32	642	7,395	1,690	479	9,564

Notes: *Rounded to the nearest operation/sortie

Source: Wyle Laboratories, 2005b (DRAFT WR 05-04, May 2005)

Baseline Annual Route-type Restricted Area R-2507 Flight Events* Above the Chocolate Mountain Aerial Gunnery Range

Aircraft Type		Helicopter Close Air Support																											
		2507N-R				*DEAD M-R*				*PUNCH B-R*				*IRIS-R*				2507S-R				*BLUE MT-R*				*MT BARR-R*			
		day	eve	night	total	*day*	*eve*	*night*	*total*	*day*	*eve*	*night*	*total*	*day*	*eve*	*night*	*total*	day	eve	night	total	*day*	*eve*	*night*	*total*	*day*	*eve*	*night*	*total*
AV-8B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-5E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T-45		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-130H		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1		76	17	5	98	*25*	*6*	*2*	*33*	*25*	*6*	*2*	*33*	*25*	*6*	*2*	*33*	151	35	10	196	*26*	*6*	*2*	*34*	*125*	*29*	*8*	*162*
CH-46		44	10	3	57	-	-	-	-	-	-	-	-	*44*	*10*	*3*	*57*	395	90	25	510	*44*	*10*	*2*	*56*	*351*	*80*	*23*	*454*
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53		21	5	1	27	-	-	-	-	-	-	-	-	*21*	*5*	*1*	*27*	191	43	13	247	*22*	*4*	*2*	*28*	*169*	*39*	*11*	*219*
UH-1		38	9	2	49	*13*	*3*	*1*	*17*	*13*	*3*	*1*	*17*	*13*	*3*	*1*	*17*	74	16	4	94	*12*	*2*	-	*14*	*62*	*14*	*4*	*80*
Total		179	41	11	231	*38*	*9*	*3*	*50*	*38*	*9*	*3*	*50*	*103*	*24*	*7*	*134*	811	184	52	1,047	*104*	*22*	*6*	*132*	*707*	*162*	*46*	*915*

Aircraft Type		Fixed-Wing High Altitude Close Air Support with Forward Air Controller and Artillery																								Totals			
		S8-T1				S8-T2				S9-T1				S9-T2				S10-T1				S10-T2							
		day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
AV-8B		127	29	8	164	127	29	8	164	127	29	8	164	127	29	8	164	127	29	8	164	127	29	8	164	762	174	48	984
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		195	45	13	253	195	45	13	253	195	45	13	253	195	45	13	253	195	45	13	253	195	45	13	253	1,170	270	78	1,518
F-5E		9	2	1	12	9	2	1	12	9	2	1	12	9	2	1	12	9	2	1	12	9	2	1	12	54	12	6	72
T-45		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-130H		1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1	6	-	-	6
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	227	52	15	294
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	439	100	28	567
MV22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	212	48	14	274
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112	25	6	143
Total		332	76	22	430	332	76	22	430	332	76	22	430	332	76	22	430	332	76	22	430	332	76	22	430	2,982	681	195	3,858

Notes: *Rounded to the nearest event
Italicized data is modeled sub-routes of 2507N-R and 2507S-R

Source: Wyle Laboratories, 2005b (DRAFT WR 05-04, May 2005)

Modeled Proposed Annual Area-type Operation/Sorties within Restricted Area R-2507 Above the Chocolate Mountain Aerial Gunnery Range

Aircraft Type		Helicopter Close Air Support																				Helicopter Versus F-5E Air to Air									Air Combat Maneuvers								
		DEAD MAN				PUNCH BOWL				IRIS				BLUE MTN				MT BARR				S1			S2(1)			S3(2)			S4			S5			S6		
		day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	total	day	eve	total	day	eve	total	day	eve	total	day	eve	total	day	eve	total
AV-8B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-5E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	4	1	-	1	3	1	4	6	1	7	6	1	7	6	1	7
T-45		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-130H		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1		13	3	1	17	13	3	1	17	13	3	1	17	13	3	1	17	63	14	4	81	6	1	7	1	-	1	6	1	7	-	-	-	-	-	-	-	-	-
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53		-	-	-	-	-	-	-	-	11	2	1	14	11	2	1	14	84	19	5	108	3	1	4	1	-	1	3	1	4	-	-	-	-	-	-	-	-	-
UH-1		6	1	-	7	6	1	-	7	6	1	-	7	6	1	-	7	31	7	2	40	3	1	4	1	-	1	3	1	4	-	-	-	-	-	-	-	-	-
Total		19	4	1	24	19	4	1	24	30	6	2	38	30	6	2	38	178	40	11	229	15	4	19	4	-	4	15	4	19	6	1	7	6	1	7	6	1	7

Aircraft Type		S7 - Area Reconnaissance				Fixed Wing Close Air Support with Forward Air Controller and Artillery																												LAT/AI			
						S8				S9				S10				S11				S12				S13				S14				S15			
		day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
AV-8B		1,333	306	86	1,725	127	29	8	164	127	29	8	164	127	29	8	164	64	15	4	83	254	58	16	328	254	58	16	328	64	15	4	83	190	44	12	246
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		39	9	3	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D		2,044	468	132	2,644	195	45	13	253	195	45	13	253	195	45	13	253	97	22	7	126	390	89	26	505	390	89	26	505	97	22	7	126	292	67	19	378
F-5E		77	18	5	100	9	2	1	12	9	2	1	12	9	2	1	12	5	1	1	7	17	4	2	23	17	4	2	23	5	1	1	7	13	3	1	17
T-45		183	42	12	237	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C-130H		9	2	1	12	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-	1	2	1	-	3	2	1	-	3	1	-	-	1	1	-	-	1
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		3,685	845	239	4,769	332	76	22	430	332	76	22	430	332	76	22	430	167	38	12	217	663	152	44	859	663	152	44	859	167	38	12	217	496	114	32	642

Notes: (1) Includes MV22 A-G and CAL sorties to Iris; sortie duration split 50% in High and 50% in Low
(2) Includes MV22 A-G and CAL sorties to Blue Mtn, Finch, EMU, and Goose; sortie duration split 50% in High and 50% in Low
(3) Includes MV22 A-G and CAL sorties to Mt Barrow, Wiss Airfield, and Star; sortie duration split 50% in High and 50% in Low

Source: Wyle Laboratories, 2005b (DRAFT WR 05-04, May 2005)

Modeled Proposed Annual Area-type Operation/Sorties within Restricted Area R-2507 Above the Chocolate Mountain Aerial Gunnery Range (continued)

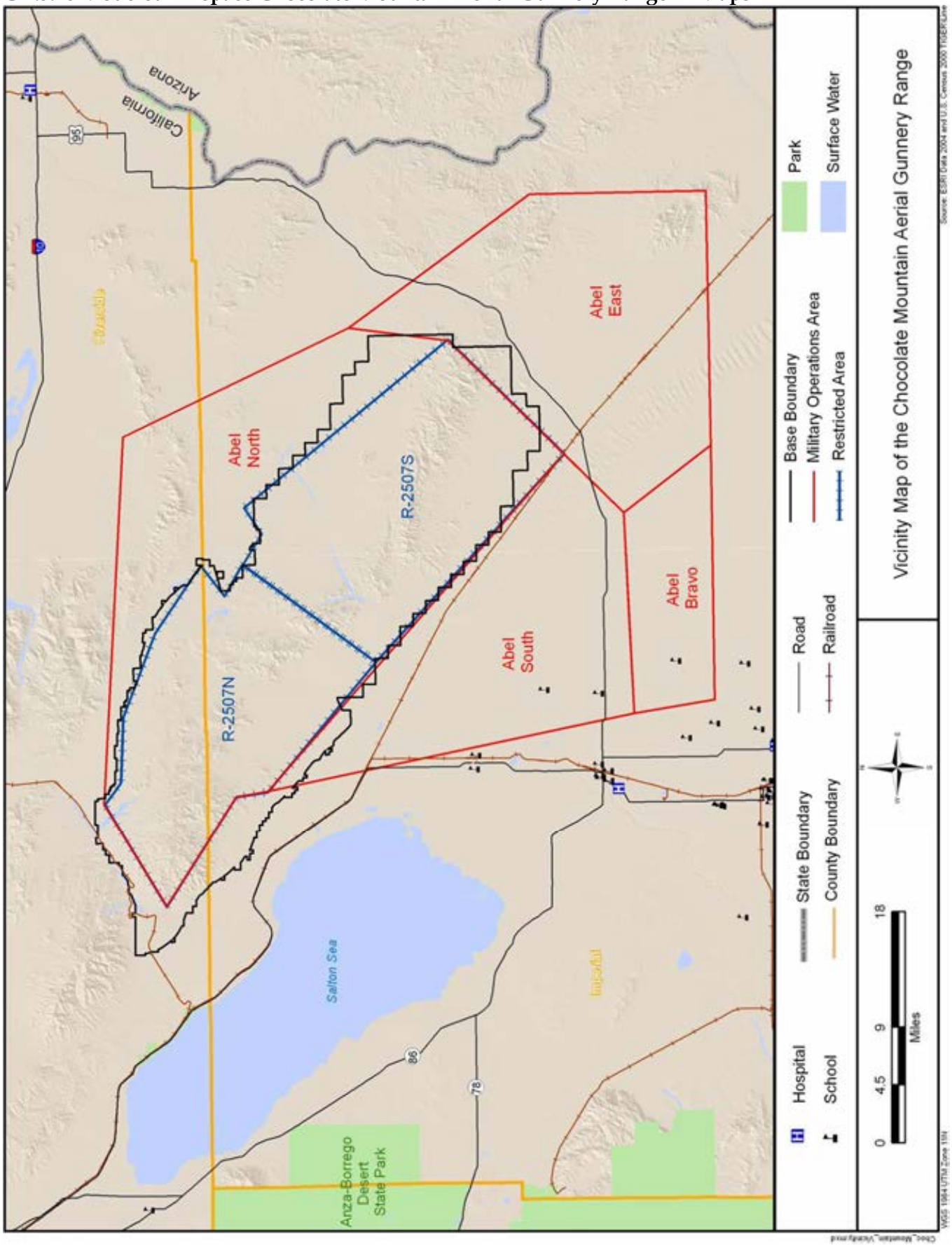
Aircraft Type		MV-22																							
		Siphon/Machen-Low[1]				*Siphon/Machen-High[1]*				Blue-Low[2]				*Blue-High[2]*				Bull-Low[3]				*Bull-High[3]*			
		day	eve	night	total	*day*	*eve*	*night*	*total*	day	eve	night	total	*day*	*eve*	*night*	*total*	day	eve	night	total	*day*	*eve*	*night*	*total*
MV-22	T&R	404	160	48	612	*576*	*375*	*92*	*1,043*	1,130	599	140	1,869	*404*	*160*	*48*	*612*	576	375	92	1,043	*1,130*	*599*	*140*	*1,869*
	WTI	-	-	-	-	*72*	-	-	*72*	64	102	10	176	-	-	-	-	72	-	-	72	*64*	*102*	*10*	*176*
	Desert Talon	-	-	-	-	*16*	-	-	*16*	96	87	9	192	-	-	-	-	16	-	-	16	*96*	*87*	*9*	*192*
Total		404	160	48	612	*664*	*375*	*92*	*1,131*	1,290	788	159	2,237	*404*	*160*	*48*	*612*	664	375	92	1,131	*1,290*	*788*	*159*	*2,237*

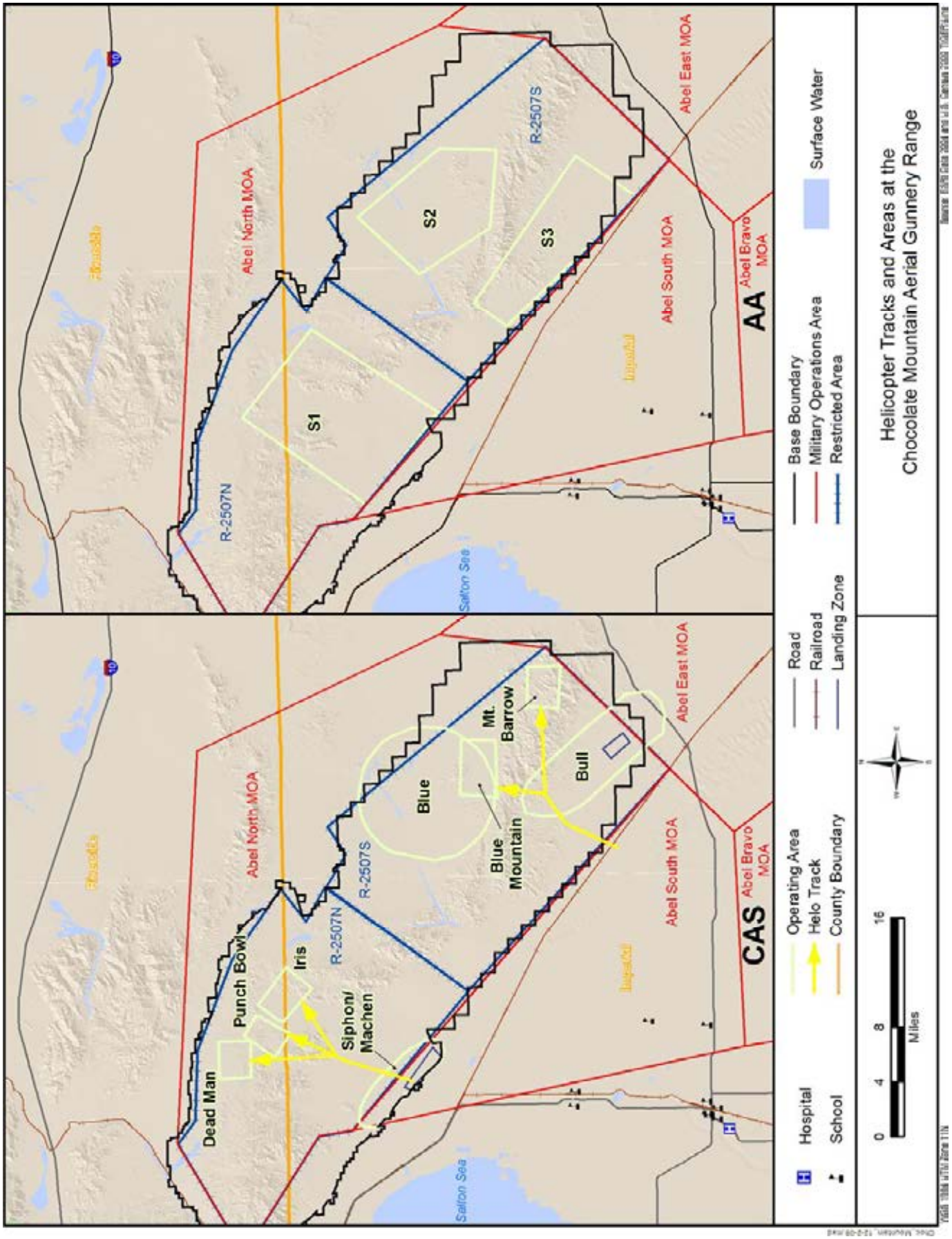
Aircraft Type		CAS Subtotal				A-A Subtotal				ACM Subtotal				AR Subtotal				LAT/AI Subtotal				MV22 Subtotal				TOTAL			
		day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
AV-8B		1,017	233	64	1,314	-	-	-	-	-	-	-	-	1,333	306	86	1,725	190	44	12	246	-	-	-	-	2,540	583	162	3,285
B-1B		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B		-	-	-	-	-	-	-	-	-	-	-	-	39	9	3	51	-	-	-	-	-	-	-	-	39	9	3	51
F/A-18C/D		1,559	357	105	2,021	-	-	-	-	-	-	-	-	2,044	468	132	2,644	292	67	19	378	-	-	-	-	3,895	892	256	5,043
F-5E		71	16	9	96	7	2	-	9	18	3	-	21	77	18	5	100	13	3	1	17	-	-	-	-	186	42	15	243
T-45		-	-	-	-	-	-	-	-	-	-	-	-	183	42	12	237	-	-	-	-	-	-	-	-	183	42	12	237
C-130H		9	2	-	11	-	-	-	-	-	-	-	-	9	2	1	12	1	-	-	1	-	-	-	-	19	4	1	24
AH-1		115	26	8	149	13	2	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	128	28	8	164
CH-46		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,110	1,134	280	3,524	2,110	1,134	280	3,524
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	136	102	10	248	136	102	10	248
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112	87	9	208	112	87	9	208
CH-53		106	23	7	136	7	2	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	113	25	7	145
UH-1		55	11	2	68	7	2	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	13	2	77
Total		2,932	668	195	3,795	34	8	-	42	18	3	-	21	3,685	845	239	4,769	496	114	32	642	2,358	1,323	299	3,980	9,523	2,961	765	13,249

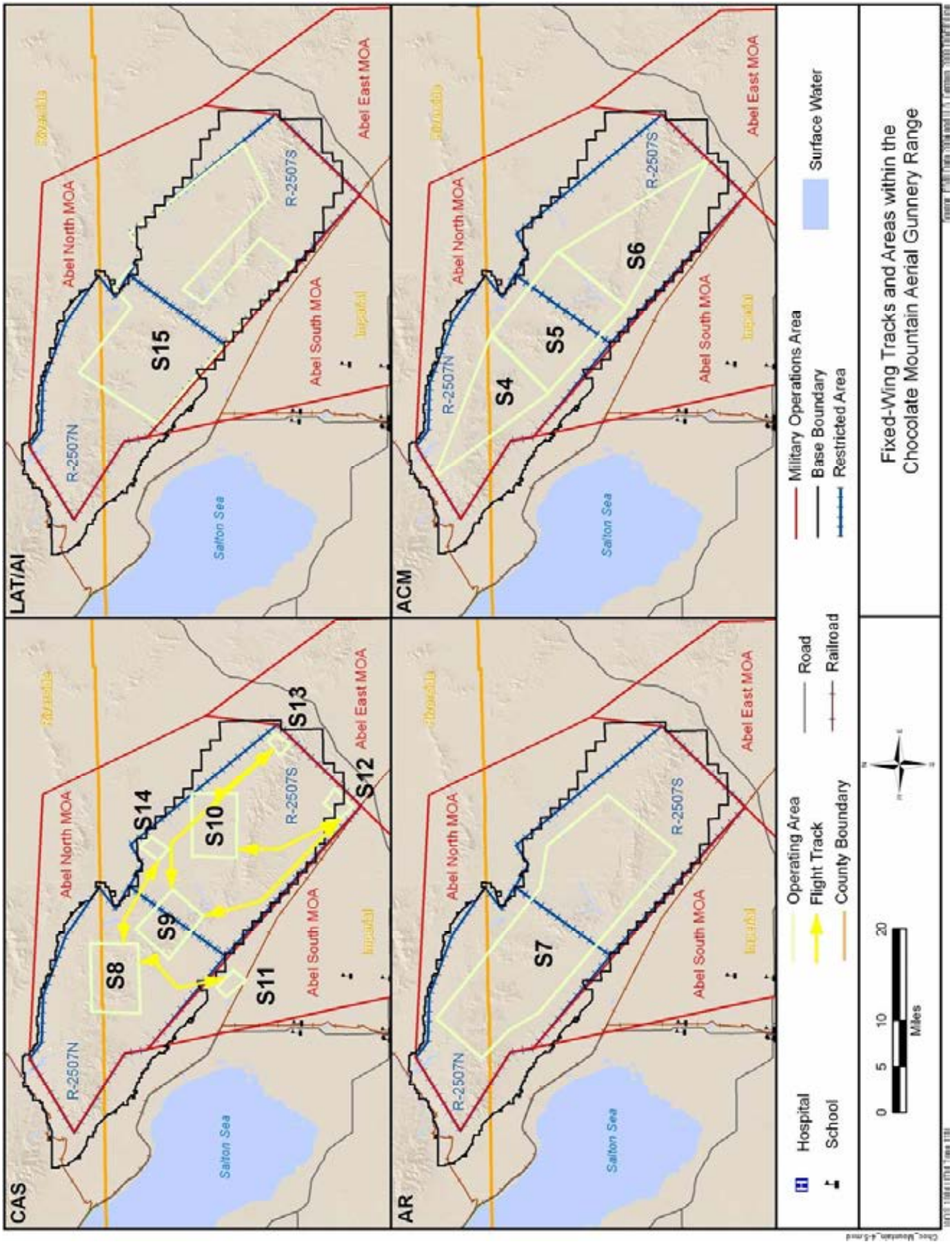
Notes: (1) Includes MV22 A-G and CAL sorties to Iris; sortie duration split 50% in High and 50% in Low
(2) Includes MV22 A-G and CAL sorties to Blue Mtn, Finch, EMU, and Goose; sortie duration split 50% in High and 50% in Low
(3) Includes MV22 A-G and CAL sorties to Mt Barrow, Wiss Airfield, and Star; sortie duration split 50% in High and 50% in Low

Source: Wyle Laboratories, 2005b (DRAFT WR 05-04, May 2005)

C-1.3.10 Modeled Airspace Chocolate Mountain Aerial Gunnery Range — Maps




Helicopter Tracks and Areas at the Chocolate Mountain Aerial Gunnery Range
AA
CAS
Abel North MOA
Abel South MOA
Abel East MOA
Abel Bravo MOA
R-2507N
R-2507S
S1
S2
S3
Dead Man
Punch Bowl
Iris
Siphon/ Machen
Blue
Blue Mountain
Mt. Barrow
Bull
Salton Sea
Imperial
Base Boundary
Military Operations Area
Restricted Area
Surface Water
Road
Railroad
Landing Zone
Operating Area
Helo Track
County Boundary
Hospital
School
0
4
8
16
Miles



Fixed-Wing Tracks and Areas within the Chocolate Mountain Aerial Gunnery Range

C-1.3.11 Modeled Airspace Chocolate Mountain Aerial Gunnery Range – Flight Profiles Database

MODELED CONDITIONS								BUSY MONTH SORTIES	TIME PER SORTIE (MINUTES)	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)	
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY			MIN: 0 MAX: 500	TOTAL
PUNCH B	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.08	150	100	100
PUNCH B	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.08	150	100	100
PUNCH B	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.5	150	100	100
DEAD M	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.08	150	100	100
DEAD M	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.08	150	100	100
DEAD M	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.5	150	100	100
BLUE MT	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.08	150	100	100
BLUE MT	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.08	150	100	100
BLUE MT	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.92	150	100	100
BLUE MT	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	0.08	150	100	100
BLUE MT	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.5	150	100	100
BLUE MT	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	1.83	150	100	100
BLUE MT	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	0.08	150	100	100
MT BARR	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	5.25	150	100	100
MT BARR	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.33	150	100	100
MT BARR	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	2.58	150	100	100
MT BARR	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.17	150	100	100
MT BARR	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	14.58	150	100	100
MT BARR	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	0.92	150	100	100
MT BARR	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	7	150	100	100
MT BARR	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	0.42	150	100	100
IRIS	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	1.08	150	100	100
IRIS	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.08	150	100	100
IRIS	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.92	150	100	100
IRIS	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	0.08	150	100	100
IRIS	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.5	150	100	100
IRIS	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	1.83	150	100	100
IRIS	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	0.08	150	100	100
S1	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.5	150	100	100
S1	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.25	150	100	100
S1	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.42	150	100	100
S1	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.25	150	100	100
S2	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.08	150	100	100
S2	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.08	150	100	100
S2	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.08	150	100	100
S2	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.08	150	100	100
S3	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	0.5	150	100	100
S3	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	0.25	150	100	100
S3	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	0.42	150	100	100
S3	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	0.25	150	100	100

MODELED CONDITIONS								BUSY MONTH SORTIES	TIME PER SORTIE (MINUTES)	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)	
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY			MIN: 0 MAX: 500	TOTAL
2507S-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	12.58		100	100
2507S-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.83		100	100
2507S-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	15.92		100	100
2507S-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	1.08		100	100
2507S-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	17.83		100	100
2507S-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	1.17		100	100
2507S-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	32.92		100	100
2507S-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	2.08		100	100
2507N-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	6.33		100	100
2507N-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.42		100	100
2507N-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	1.75		100	100
2507N-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	0.08		100	100
2507N-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	3.17		100	100
2507N-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.17		100	100
2507N-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	3.67		100	100
2507N-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	0.25		100	100
BLUE MT-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.17		100	100
BLUE MT-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.17		100	100
BLUE MT-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	1.83		100	100
BLUE MT-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	0.17		100	100
BLUE MT-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	1		100	100
BLUE MT-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	3.67		100	100
BLUE MT-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	0.25		100	100
MT BARR-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	10.42		100	100
MT BARR-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.67		100	100
MT BARR-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	14.08		100	100
MT BARR-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	0.92		100	100
MT BARR-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	5.17		100	100
MT BARR-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.33		100	100
MT BARR-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	29.25		100	100
MT BARR-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	1.92		100	100
PUNCH B-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.17		100	100
PUNCH B-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.17		100	100
PUNCH B-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	1.08		100	100
PUNCH B-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.08		100	100
IRIS-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.08		100	100
IRIS-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.17		100	100
IRIS-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	1.75		100	100
IRIS-R	CH53-CAS	CH-53E	120	CRUISE POWER	68	%Q-BPA	nighttime	0.08		100	100
IRIS-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	1.08		100	100
IRIS-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.08		100	100
IRIS-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	3.67		100	100
IRIS-R	CH46-CAS	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	0.25		100	100
DEAD M-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	2.17		100	100
DEAD M-R	AH1-CAS	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.17		100	100
DEAD M-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	1.08		100	100
DEAD M-R	UH1-CAS	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.08		100	100

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)							
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 0 MAX: 1000	300 1000	500 5000	1000 10000	5000 25000	10000 15000	10000 16000	10000 20000
S8	AV8-CAS	AV-8B	480	TAKEOFF POWER	95.00%	RPM	daytime	10.58	4		25		1			74	
S8	AV8-CAS	AV-8B	480	TAKEOFF POWER	95.00%	RPM	nighttime	0.67	4		25		1			74	
S8	F18-CAS	F-18	500	TRAINING ROUTE	92.00%	NC	daytime	16.25	7		25		1			74	
S8	F18-CAS	F-18	500	TRAINING ROUTE	92.00%	NC	nighttime	1.08	7		25		1			74	
S8	F5-CAS	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.75	7		25		1			74	
S8	F5-CAS	F-5E	350	TAKEOFF POWER	97.00%	RPM	nighttime	0.08	7		25		1			74	
S8	C130-CAS	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08	7		25		1			74	
S9	AV8-CAS	AV-8B	480	TAKEOFF POWER	95.00%	RPM	daytime	10.58	4		25		1			74	
S9	AV8-CAS	AV-8B	480	TAKEOFF POWER	95.00%	RPM	nighttime	0.67	4		25		1			74	
S9	F18-CAS	F-18	500	TRAINING ROUTE	92.00%	NC	daytime	16.25	7		25		1			74	
S9	F18-CAS	F-18	500	TRAINING ROUTE	92.00%	NC	nighttime	1.08	7		25		1			74	
S9	F5-CAS	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.75	7		25		1			74	
S9	F5-CAS	F-5E	350	TAKEOFF POWER	97.00%	RPM	nighttime	0.08	7		25		1			74	
S9	C130-CAS	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08	7		25		1			74	
S10	AV8-CAS	AV-8B	480	TAKEOFF POWER	95.00%	RPM	daytime	10.58	4		25		1			74	
S10	AV8-CAS	AV-8B	480	TAKEOFF POWER	95.00%	RPM	nighttime	0.67	4		25		1			74	
S10	F18-CAS	F-18	500	TRAINING ROUTE	92.00%	NC	daytime	16.25	7		25		1			74	
S10	F18-CAS	F-18	500	TRAINING ROUTE	92.00%	NC	nighttime	1.08	7		25		1			74	
S10	F5-CAS	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.75	7		25		1			74	
S10	F5-CAS	F-5E	350	TAKEOFF POWER	97.00%	RPM	nighttime	0.08	7		25		1			74	
S10	C130-CAS	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08	7		25		1			74	
S11	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	5.33	16							100	
S11	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.33	16							100	
S11	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	8.08	22							100	
S11	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	0.58	22							100	
S11	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.42	22							100	
S11	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08	22							100	
S11	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08	22							100	
S12	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	21.17	16							100	
S12	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	1.33	16							100	
S12	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	32.5	22							100	
S12	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	2.17	22							100	
S12	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	1.42	22							100	
S12	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.17	22							100	
S12	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.17	22							100	
S13	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	21.17	16							100	
S13	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	1.33	16							100	
S13	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	32.5	22							100	
S13	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	2.17	22							100	
S13	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	1.42	22							100	
S13	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.17	22							100	
S13	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.17	22							100	

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)								
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 0 MAX: 1000	0 5000	0 10000	500 5000	1000 10000	5000 25000	10000 15000	10000 16000	10000 20000
S14	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	5.33	16								100	
S14	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.33	16								100	
S14	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	8.08	22								100	
S14	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	0.58	22								100	
S14	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.42	22								100	
S14	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08	22								100	
S14	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08	22								100	
S15	AV8-LAT	AV-8B	480	TAKEOFF POWER	95.00%	RPM	daytime	15.83	20	70				15		15		
S15	AV8-LAT	AV-8B	480	TAKEOFF POWER	95.00%	RPM	nighttime	1	20	70				15		15		
S15	F18-LAT	F-18	500	TRAINING ROUTE	92.00%	NC	daytime	24.33	30	70				15		15		
S15	F18-LAT	F-18	500	TRAINING ROUTE	92.00%	NC	nighttime	1.58	30	70				15		15		
S15	F5-LAT	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	1.08	30	70				15		15		
S15	F5-LAT	F-5E	350	TAKEOFF POWER	97.00%	RPM	nighttime	0.08	30	70				15		15		
S15	C130-LAT	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08	30	70				15		15		
S1	F5-A2A	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.25	30				100					
S2	F5-A2A	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.08	30				100					
S3	F5-A2A	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.25	30				100					
S4	F5-ACM	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.5	11		5				95			
S5	F5-ACM	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.5	7		5				95			
S6	F5-ACM	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	0.5	11		5				95			
S7	AV8-REC	AV-8B	480	TAKEOFF POWER	95.00%	RPM	daytime	111.08	20			20						80
S7	AV8-REC	AV-8B	480	TAKEOFF POWER	95.00%	RPM	nighttime	7.17	20			20						80
S7	F18-REC	F-18	500	TRAINING ROUTE	92.00%	NC	daytime	170.33	30			20						80
S7	F18-REC	F-18	500	TRAINING ROUTE	92.00%	NC	nighttime	11	30			20						80
S7	F5-REC	F-5E	350	TAKEOFF POWER	97.00%	RPM	daytime	6.42	30			20						80
S7	F5-REC	F-5E	350	TAKEOFF POWER	97.00%	RPM	nighttime	0.42	30			20						80
S7	C130-REC	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.75	30			20						80
S7	C130-REC	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	nighttime	0.08	30			20						80
S7	EA6-REC	A-6A	250	TAKEOFF POWER	90.00%	RPM	daytime	3.25	30			20						80
S7	EA6-REC	A-6A	250	TAKEOFF POWER	90.00%	RPM	nighttime	0.25	30			20						80
S7	T45-REC	T-45	250	CRUISE POWER	85.50%	RPM	daytime	15.25	30			20						80
S7	T45-REC	T-45	250	CRUISE POWER	85.50%	RPM	nighttime	1	30			20						80

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)									
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 0 MAX: 1000	0 5000	0 10000	300 1000	500 5000	1000 10000	5000 25000	10000 15000	10000 16000	10000 20000
S8-T1	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	10.58										100	
S8-T1	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.67										100	
S8-T1	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	16.25										100	
S8-T1	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	1.08										100	
S8-T1	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.75										100	
S8-T1	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08										100	
S8-T1	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08										100	
S8-T2	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	10.58										100	
S8-T2	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.67										100	
S8-T2	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	16.25										100	
S8-T2	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	1.08										100	
S8-T2	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.75										100	
S8-T2	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08										100	
S8-T2	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08										100	
S9-T1	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	10.58										100	
S9-T1	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.67										100	
S9-T1	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	16.25										100	
S9-T1	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	1.08										100	
S9-T1	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.75										100	
S9-T1	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08										100	
S9-T1	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08										100	
S9-T2	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	10.58										100	
S9-T2	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.67										100	
S9-T2	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	16.25										100	
S9-T2	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	1.08										100	
S9-T2	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.75										100	
S9-T2	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08										100	
S9-T2	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08										100	
S10-T1	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	10.58										100	
S10-T1	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.67										100	
S10-T1	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	16.25										100	
S10-T1	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	1.08										100	
S10-T1	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.75										100	
S10-T1	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08										100	
S10-T1	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08										100	
S10-T2	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	daytime	10.58										100	
S10-T2	AV8-CASH	AV-8B	230	TAKEOFF POWER	70.00%	RPM	nighttime	0.67										100	
S10-T2	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	daytime	16.25										100	
S10-T2	F18-CASH	F-18	300	INTERMEDIATE POV	84.50%	NC	nighttime	1.08										100	
S10-T2	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	daytime	0.75										100	
S10-T2	F5-CASH	F-5E	325	CRUISE POWER	86.00%	RPM	nighttime	0.08										100	
S10-T2	C130-CASH	C-130H&N&P	220	TAKEOFF POWER	850.0 C	TIT	daytime	0.08										100	

C-1.3.12 Modeled Airspace at NAF El Centro Range Complex – Operations and Sorties

Modeled Existing Annual Area-type Operation/Sorties for R2510/12 and Kane MOAs

Aircraft Type	R-2510								R-2512				Kane MOA												Total			
	Shade Tree (101)				Loom Lobby (103)				Inkey Barley & Kitty Baggage				Kane East				Kane South				Kane West							
	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
AV-8B	58	14	6	78	38	10	4	52	60	14	6	80	-	-	-	-	-	-	-	-	-	-	-	-	156	38	16	210
A-6A	-	-	-	-	-	-	-	-	20	5	2	27	-	-	-	-	-	-	-	-	-	-	-	-	20	5	2	27
F-18	877	204	79	1,160	416	97	38	551	64	16	6	86	2,617	585	241	3,443	383	86	35	504	3,382	757	312	4,451	7,739	1,745	711	10,195
F-14A	33	8	3	44	42	10	4	56	18	4	2	24	-	-	-	-	-	-	-	-	-	-	-	-	93	22	9	124
F-5E	-	-	-	-	-	-	-	-	10	2	1	13	-	-	-	-	-	-	-	-	-	-	-	-	10	2	1	13
S-3A&B	22	6	3	31	79	19	6	104	7	3	-	10	-	-	-	-	-	-	-	-	-	-	-	-	108	28	9	145
T-2C	-	-	-	-	-	-	-	-	6	1	1	8	-	-	-	-	-	-	-	-	-	-	-	-	6	1	1	8
*T-34	243	57	22	322	252	59	23	334	6	1	1	8	-	-	-	-	-	-	-	-	-	-	-	-	501	117	46	664
T-45	48	11	4	63	41	9	4	54	6	1	1	8	-	-	-	-	-	-	-	-	-	-	-	-	95	21	9	125
C-130H&N&P	-	-	-	-	15	4	1	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	4	1	20
MV-22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-46E	-	-	-	-	8	2	1	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	1	11
CH-53E	7	2	1	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	2	1	10
OH58D	26	6	2	34	26	6	2	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	12	4	68
UH-1N	29	7	3	39	26	6	2	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	13	5	73
UH60A	17	4	2	23	19	4	2	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	8	4	48
Total	1,360	319	125	1,804	962	226	87	1,275	197	47	20	264	2,617	585	241	3,443	383	86	35	504	3,382	757	312	4,451	8,901	2,020	820	11,741

*T-34 modeled as a C-130H

**Not modeled due to retirement

Modeled Existing Annual Target Passes for R2510/12

Aircraft Type	Flight Profile	R-2510												R-2512												Total			
		Loom Lobby				Shade Tree								Inkey Barley				Kitty Baggage											
		Track 03B1				Track 01B1				Track 01B2				Track 68B1				Track 95B1				Track 95B2							
		Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
AV-8B	10 Deg. Dive	193	44	18	255	120	29	11	160	120	29	11	160	37	7	4	48	18	4	-	22	18	4	4	26	506	117	48	671
	30 Deg. Dive	95	22	11	128	58	15	4	77	58	15	4	77	18	4	-	22	7	4	-	11	7	4	-	11	243	64	19	326
	45 Deg. Dive	95	22	11	128	58	15	4	77	58	15	4	77	18	4	-	22	7	4	-	11	7	4	-	11	243	64	19	326
CH-46E	Level	-	-	-	-	-	-	-	-	-	-	-	-	26	7	4	37	11	4	-	15	11	4	-	15	48	15	4	67
MV-22	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-18A/C	F-18 BDU Delivery	2,431	562	219	3,212	1,566	361	139	2,066	1,566	361	139	2,066	234	55	22	311	117	26	11	154	113	26	7	146	6,027	1,391	537	7,955
	F-18 MK 15 Deg. Delivery	1,701	394	153	2,248	1,095	252	99	1,446	1,095	252	99	1,446	161	37	15	213	80	18	7	105	80	18	7	105	4,212	971	380	5,563
	F-18 MK 45 Deg. Delivery	726	168	66	960	467	106	44	617	471	110	44	625	66	15	7	88	33	7	4	44	33	7	4	44	1,796	413	169	2,378
OH58	Level	810	186	69	1,065	438	102	40	580	438	102	40	580	-	-	-	-	-	-	-	-	-	-	-	-	1,686	390	149	2,225
*T-34	Level	-	-	-	-	55	11	7	73	55	11	7	73	-	-	-	-	-	-	-	-	-	-	-	-	110	22	14	146
T-45	10 Deg. Dive	266	62	26	354	226	51	22	299	226	51	18	295	62	15	7	84	29	7	3	39	274	62	26	362	1,083	248	102	1,433
	30 Deg. Dive	2,405	558	215	3,178	2,022	471	183	2,676	2,022	467	183	2,672	548	128	47	723	274	62	26	362	29	7	4	40	7,300	1,693	658	9,651
UH-1N	Level	40	11	7	58	-	-	-	-	-	-	-	-	69	15	7	91	37	7	4	48	37	7	4	48	183	40	22	245
UH60A	Level	-	-	-	-	44	7	4	55	44	7	4	55	-	-	-	-	-	-	-	-	-	-	-	-	88	14	8	110
Total		8,762	2,029	795	11,586	6,149	1,420	557	8,126	6,153	1,420	553	8,126	1,239	287	113	1,639	613	143	55	811	609	143	56	808	23,525	5,442	2,129	31,096

*T-34 modeled as a C-130H

Modeled Proposed Annual Area-type Operation/Sorties for R2510/12 and Kane MOAs

Aircraft Type	R-2510								R-2512				Kane MOA												Total			
	Shade Tree (101)				Loom Lobby (103)				Inkey Barley & Kitty Baggage				Kane East				Kane South				Kane West							
	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total	day	eve	night	total
AV-8B	58	14	6	78	38	10	4	52	60	14	6	80	-	-	-	-	-	-	-	-	-	-	-	-	156	38	16	210
A-6A	-	-	-	-	-	-	-	-	20	5	2	27	-	-	-	-	-	-	-	-	-	-	-	-	20	5	2	27
F-18	877	204	79	1,160	416	97	38	551	64	16	6	86	2,617	585	241	3,443	383	86	35	504	3,382	757	312	4,451	7,739	1,745	711	10,195
F-5E	-	-	-	-	-	-	-	-	10	2	1	13	-	-	-	-	-	-	-	-	-	-	-	-	10	2	1	13
T-2C	-	-	-	-	-	-	-	-	6	1	1	8	-	-	-	-	-	-	-	-	-	-	-	-	6	1	1	8
*T-34	243	57	22	322	252	59	23	334	6	1	1	8	-	-	-	-	-	-	-	-	-	-	-	-	501	117	46	664
T-45	48	11	4	63	41	9	4	54	6	1	1	8	-	-	-	-	-	-	-	-	-	-	-	-	95	21	9	125
C-130H&N&P	-	-	-	-	15	4	1	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	4	1	20
MV-22	-	-	-	-	104	44	-	148	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	44	-	148
CH-46E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53E	7	2	1	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	2	1	10
OH58D	26	6	2	34	26	6	2	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52	12	4	68
UH-1N	29	7	3	39	26	6	2	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	13	5	73
UH60A	17	4	2	23	19	4	2	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	8	4	48
Total	1,305	305	119	1,729	937	239	76	1,252	172	40	18	230	2,617	585	241	3,443	383	86	35	504	3,382	757	312	4,451	8,796	2,012	801	11,609

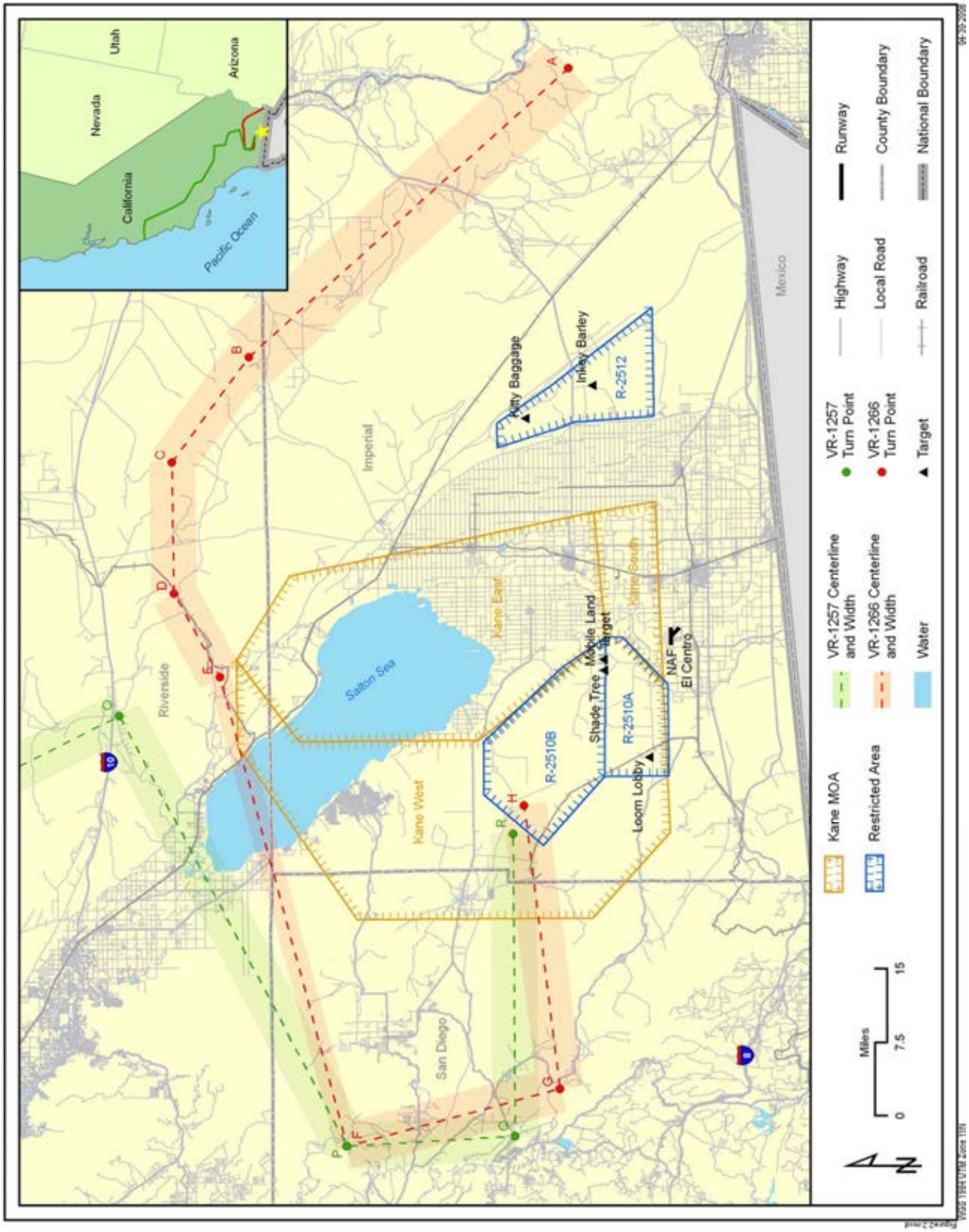
*T-34 modeled as a C-130H

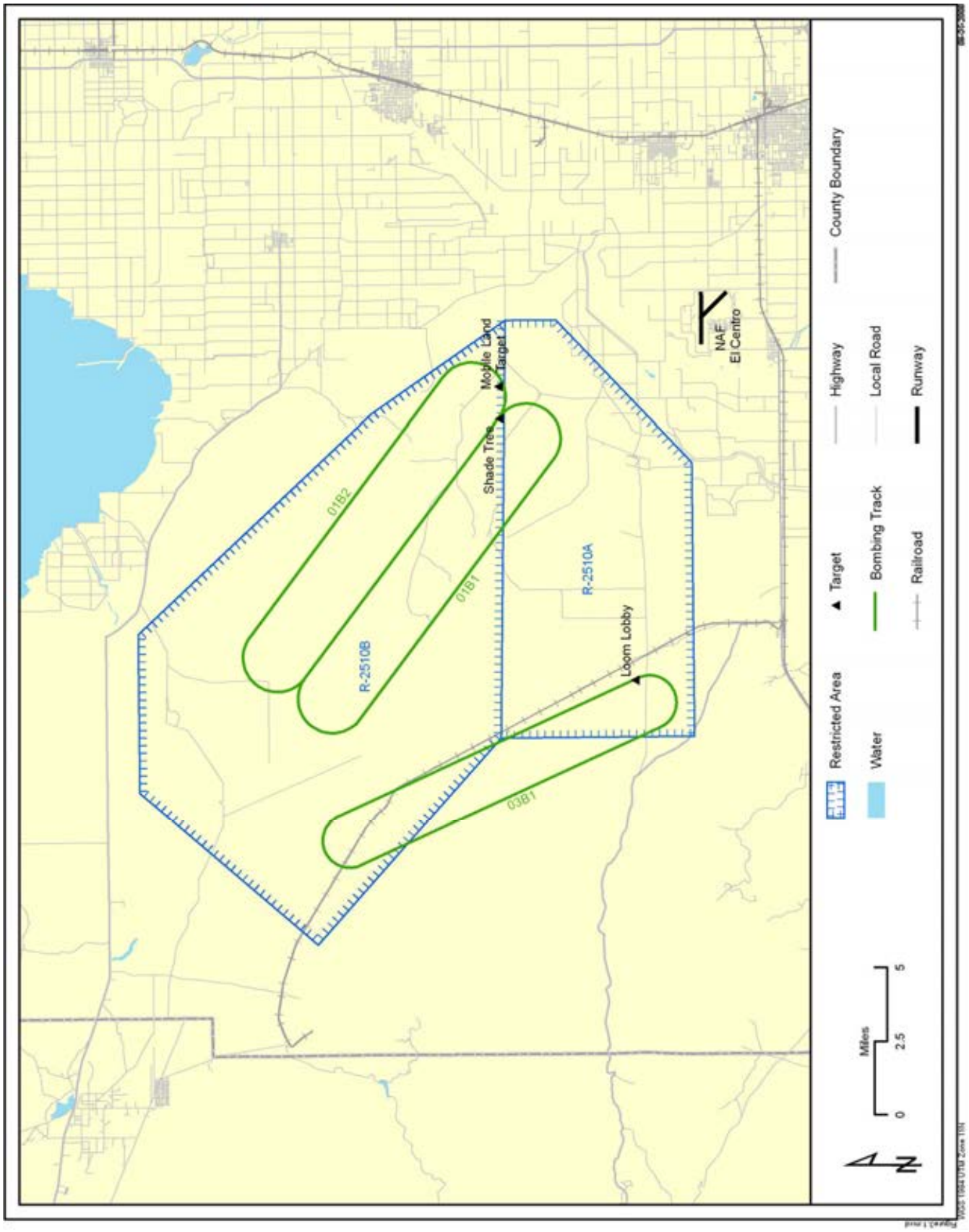
Modeled Proposed Annual Target Passes for R2510/12

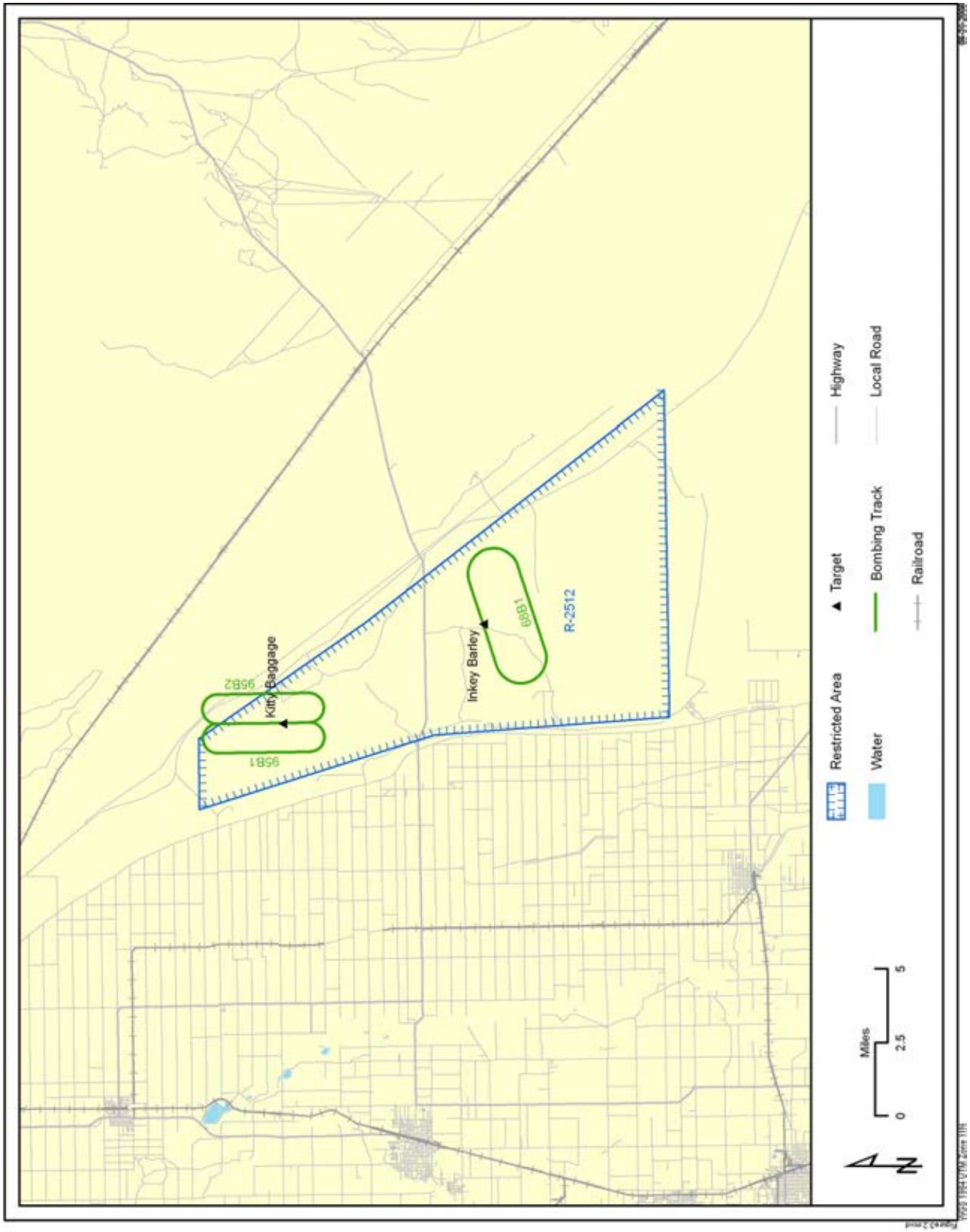
Aircraft Type	Flight Profile	R-2510												R-2512												Total			
		Loom Lobby				Shade Tree								Inkey Barley				Kitty Baggage											
		Track 03B1				Track 01B1				Track 01B2				Track 68B1				Track 95B1				Track 95B2							
		Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
AV-8B	10 Deg. Dive	193	44	18	256	120	29	11	161	120	29	11	161	37	7	4	47	18	4	-	22	18	4	4	26	507	117	47	672
	30 Deg. Dive	95	22	11	128	58	15	4	77	58	15	4	77	18	4	-	22	7	4	-	11	7	4	-	11	245	62	18	325
	45 Deg. Dive	95	22	11	128	58	15	4	77	58	15	4	77	18	4	-	22	7	4	-	11	7	4	-	11	245	62	18	325
CH-46E	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F-18A/C	F-18 BDU Delivery	2,431	562	219	3,212	1,566	361	139	2,066	1,566	361	139	2,066	234	55	22	310	117	26	11	153	113	26	7	146	6,026	1,391	537	7,953
	F-18 MK 15 Deg. Delivery	1,701	394	153	2,248	1,095	252	99	1,445	1,095	252	99	1,445	161	37	15	212	80	18	7	106	80	18	7	106	4,212	971	380	5,563
	F-18 MK 45 Deg. Delivery	726	168	66	960	467	106	44	617	471	110	44	624	66	15	7	88	33	7	4	44	33	7	4	44	1,796	412	168	2,376
OH58	Level	810	186	69	1,066	438	102	40	580	438	102	40	580	-	-	-	-	-	-	-	-	-	-	-	-	1,686	391	150	2,227
*T-34	Level	-	-	-	-	55	11	7	73	55	11	7	73	-	-	-	-	-	-	-	-	-	-	-	-	110	22	15	146
T-45	10 Deg. Dive	266	62	26	354	226	51	22	299	226	51	18	296	62	15	7	84	29	7	3	39	274	62	26	361	1,084	248	101	1,433
	30 Deg. Dive	2,405	558	215	3,179	2,022	471	183	2,675	2,022	467	183	2,672	548	128	47	723	274	62	26	361	29	7	4	40	7,300	1,694	657	9,651
UH-1N	Level	40	11	7	58	-	-	-	-	-	-	-	-	69	15	7	91	37	7	4	47	37	7	4	47	183	40	22	245
UH60A	Level	-	-	-	-	44	7	4	55	44	7	4	55	-	-	-	-	-	-	-	-	-	-	-	-	88	15	7	110
Total		8,764	2,029	796	11,589	6,150	1,420	555	8,125	6,154	1,420	551	8,125	1,212	277	110	1,599	602	139	54	795	599	139	55	792	23,480	5,424	2,120	31,024

*T-34 modeled as a C-130H

C-1.3.13 Modeled Airspace at NAF El Centro Range Complex — Maps




NAF
El Centro
Mobile Land
Target 1
Shade Tree
Loom Lobby
01B2
01B1
03B1
R-2510B
R-2510A
Restricted Area
Water
Target
Bombing Track
Railroad
Highway
Local Road
Runway
County Boundary
Miles
0
2.5
5
N


Restricted Area
Water
Target
Bombing Track
Railroad
Highway
Local Road
Miles
0
2.5
5
N
R-2512
Kitty Baggage
Inkey Barley
9581
9582
1B89

C-1.3.14 Modeled Airspace at NAF El Centro Range Complex – Flight Profiles Database

MODELED CONDITIONS									BUSY		Time per	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)															
AIRSPACE ID	MISSION ID	AIRCRAFT ID	AIRCRAFT type	SPEED (KIAS)	POWER DESC	POWER SETTING	POWER UNIT	PERIOD OF DAY	Month Sorties	ANNUAL SORTIES	Sortie (minutes)	50-500 ft AGL	500-500	500-1500	750-2300	800-3500	1100-2600	1500-4500	2k-4700	3k-8500	3100-8100	1500-10k	3k-12k	5k-14500	6k-13k	7303-7303 ft	10k-20k
R2510	101	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	daytime	51.17	614.04	30							100									
R2510	101	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	evening	11.92	143.04	30							100									
R2510	101	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	nighttime	4.58	54.96	30							100									
R2510	101	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	daytime	21.92	263.04	30												100				
R2510	101	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	evening	5.08	60.96	30												100				
R2510	101	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	nighttime	2	24	30												100				
R2510	101	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	daytime	20.25	243	30			30								5					65
R2510	101	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	evening	4.75	57	30			30								5					65
R2510	101	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	nighttime	1.83	21.96	30			30								5					65
R2510	101	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	daytime	2.42	29.04	30					100											
R2510	101	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	evening	0.58	6.96	30					100											
R2510	101	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	nighttime	0.25	3	30					100											
R2510	101	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	daytime	2.42	29.04	30														100		
R2510	101	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	evening	0.58	6.96	30														100		
R2510	101	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	nighttime	0.25	3	30														100		
R2510	101	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	daytime	3.58	42.96	30										100						
R2510	101	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	evening	0.83	9.96	30										100						
R2510	101	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	nighttime	0.33	3.96	30										100						
R2510	101	T-45L	T-45	250	TAKEOFF POWER	85 (100)	% RPM	daytime	0.42	5.04	30						100										
R2510	101	T-45L	T-45	250	TAKEOFF POWER	85 (100)	% RPM	evening	0.08	0.96	30						100										
R2510	101	OH-58	OH58D	100 (120)	LFO LITE 120 KTS	120	KNOTS	daytime	2.17	26.04	45	100															
R2510	101	OH-58	OH58D	100 (120)	LFO LITE 120 KTS	120	KNOTS	evening	0.5	6	45	100															
R2510	101	OH-58	OH58D	100 (120)	LFO LITE 120 KTS	120	KNOTS	nighttime	0.17	2.04	45	100															
R2510	101	UH-60A	UH60A	140	LFO LOAD 140 KTS	140	KNOTS	daytime	1.42	17.04	45	100															
R2510	101	UH-60A	UH60A	140	LFO LOAD 140 KTS	140	KNOTS	evening	0.33	3.96	45	100															
R2510	101	UH-60A	UH60A	140	LFO LOAD 140 KTS	140	KNOTS	nighttime	0.17	2.04	45	100															
R2510	101	UH-1N	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	2.42	29.04	45	100															
R2510	101	UH-1N	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	0.58	6.96	45	100															
R2510	101	UH-1N	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.25	3	45	100															
R2510	101	CH-53E	CH-53E	150	LEVEL FLIGHT (HPA)	90	%Q-BPA	daytime	0.58	6.96	45	100															
R2510	101	CH-53E	CH-53E	150	LEVEL FLIGHT (HPA)	90	%Q-BPA	evening	0.17	2.04	45	100															
R2510	101	CH-53E	CH-53E	150	LEVEL FLIGHT (HPA)	90	%Q-BPA	nighttime	0.08	0.96	45	100															
R2510	103	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	daytime	24.25	291	30							100									
R2510	103	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	evening	5.67	68.04	30							100									
R2510	103	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	nighttime	2.25	27	30							100									
R2510	103	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	daytime	10.42	125.04	30												100				
R2510	103	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	evening	2.42	29.04	30												100				
R2510	103	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	nighttime	0.92	11.04	30												100				
R2510	103	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	daytime	21	252	30			30								5					65
R2510	103	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	evening	4.92	59.04	30			30								5					65
R2510	103	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	nighttime	1.92	23.04	30			30								5					65
R2510	103	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	daytime	3.08	36.96	30										100						
R2510	103	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	evening	0.67	8.04	30										100						
R2510	103	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	nighttime	0.33	3.96	30										100						
R2510	103	T-45L	T-45	250	TAKEOFF POWER	85 (100)	% RPM	daytime	0.33	3.96	30						100										
R2510	103	T-45L	T-45	250	TAKEOFF POWER	85 (100)	% RPM	evening	0.08	0.96	30						100										

MODELED CONDITIONS									BUSY		Time per	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)															
AIRSPACE ID	MISSION ID	AIRCRAFT ID	AIRCRAFT type	SPEED (KIAS)	POWER DESC	POWER SETTING	POWER UNIT	PERIOD OF DAY	Month Sorties	ANNUAL SORTIES	Sortie (minutes)	50-500 ft AGL	500-500	500-1500	750-2300	800-3500	1100-2600	1500-4500	2k-4700	3k-8500	3100-8100	1500-10k	3k-12k	5k-14500	6k-13k	7303-7303 ft	10k-20k
R2510	103	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	daytime	1.58	18.96	30					100											
R2510	103	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	evening	0.42	5.04	30					100											
R2510	103	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	nighttime	0.17	2.04	30					100											
R2510	103	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	daytime	1.58	18.96	30														100		
R2510	103	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	evening	0.42	5.04	30														100		
R2510	103	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	nighttime	0.17	2.04	30														100		
R2510	103	OH-58	OH58D	100 (120)	LFO LITE 120 KTS	120	KNOTS	daytime	2.17	26.04	45	100															
R2510	103	OH-58	OH58D	100 (120)	LFO LITE 120 KTS	120	KNOTS	evening	0.5	6	45	100															
R2510	103	OH-58	OH58D	100 (120)	LFO LITE 120 KTS	120	KNOTS	nighttime	0.17	2.04	45	100															
R2510	103	UH-60A	UH60A	140	LFO LOAD 140 KTS	140	KNOTS	daytime	1.58	18.96	45	100															
R2510	103	UH-60A	UH60A	140	LFO LOAD 140 KTS	140	KNOTS	evening	0.33	3.96	45	100															
R2510	103	UH-60A	UH60A	140	LFO LOAD 140 KTS	140	KNOTS	nighttime	0.17	2.04	45	100															
R2510	103	UH-1N	UH-1N	80	FLT AT 80 KTS	100	% RPM	daytime	2.17	26.04	45	100															
R2510	103	UH-1N	UH-1N	80	FLT AT 80 KTS	100	% RPM	evening	0.5	6	45	100															
R2510	103	UH-1N	UH-1N	80	FLT AT 80 KTS	100	% RPM	nighttime	0.17	2.04	45	100															
R2510	103	CH-46E	CH-46E	150	MAX POWER	98	%Q-BPA	daytime	0.67	8.04	45	100															
R2510	103	CH-46E	CH-46E	150	MAX POWER	98	%Q-BPA	evening	0.17	2.04	45	100															
R2510	103	CH-46E	CH-46E	150	MAX POWER	98	%Q-BPA	nighttime	0.08	0.96	45	100															
R2510	103	C-130H	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	daytime	1.25	15	45			30								5					65
R2510	103	C-130H	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	evening	0.33	3.96	45			30								5					65
R2510	103	C-130H	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	nighttime	0.08	0.96	45			30								5					65
R2510	103	MV-22	MV-22	110	TAKEOFF PO	100	VC10	daytime	7.06	84.72	60						100										
R2510	103	MV-22	MV-22	110	TAKEOFF PO	100	VC10	evening	3.02	36.24	60						100										
R2512	2512	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	daytime	3.75	45	30							100									
R2512	2512	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	evening	0.92	11.04	30							100									
R2512	2512	F-18CDL	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	nighttime	0.33	3.96	30							100									
R2512	2512	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	daytime	1.58	18.96	30												100				
R2512	2512	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	evening	0.42	5.04	30												100				
R2512	2512	F-18CDH	F-18	400 (500)	TRAINING ROUTE	88 (92)	% NC	nighttime	0.17	2.04	30												100				
R2512	2512	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	daytime	2.5	30	30					100											
R2512	2512	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	evening	0.58	6.96	30					100											
R2512	2512	AV-8BL	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	nighttime	0.25	3	30					100											
R2512	2512	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	daytime	2.5	30	30														100		
R2512	2512	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	evening	0.58	6.96	30														100		
R2512	2512	AV-8BH	AV-8B	450 (550)	TAKEOFF POWER	95	% RPM	nighttime	0.25	3	30														100		
R2512	2512	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	daytime	0.42	5.04	30										100						
R2512	2512	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	evening	0.08	0.96	30										100						
R2512	2512	T-45H	T-45	250	TAKEOFF POWER	85 (100)	% RPM	nighttime	0.08	0.96	30										100						
R2512	2512	T-45L	T-45	250	TAKEOFF POWER	85 (100)	% RPM	daytime	0.08	0.96	30						100										
R2512	2512	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	daytime	0.5	6	30			30								5					65
R2512	2512	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	evening	0.08	0.96	30			30								5					65
R2512	2512	T-34	C-130H&N&P	220	TAKEOFF POWER	850	C TIT	nighttime	0.08	0.96	30			30								5					65
R2512	2512	EA-6B	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	1.67	20.04	45			30								5					65
R2512	2512	EA-6B	A-6A	250	TAKEOFF POWER	100	% RPM	evening	0.42	5.04	45			30								5					65
R2512	2512	EA-6B	A-6A	250	TAKEOFF POWER	100	% RPM	nighttime	0.17	2.04	45			30								5					65
R2512	2512	F-5	F-5E	325	CRUISE POWER	86	% RPM	daytime	0.83	9.96	30			30								5					65
R2512	2512	F-5	F-5E	325	CRUISE POWER	86	% RPM	evening	0.17	2.04	30			30								5					65
R2512	2512	F-5	F-5E	325	CRUISE POWER	86	% RPM	nighttime	0.08	0.96	30			30								5					65
R2512	2512	T-2	T-2C	250	CRUISE POWER	75	% RPM	daytime	0.5	6	45			30								5					65
R2512	2512	T-2	T-2C	250	CRUISE POWER	75	% RPM	evening	0.08	0.96	45			30								5					65
R2512	2512	T-2	T-2C	250	CRUISE POWER	75	% RPM	nighttime	0.08	0.96	45			30								5					65
Kane MOA	KANE EAS	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	daytime	218.08	2616.96	30															100	
Kane MOA	KANE EAS	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	evening	48.75	585	30															100	
Kane MOA	KANE EAS	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	nighttime	20.08	240.96	30															100	
Kane MOA	KANE SOU	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	daytime	31.92	383.04	30															100	
Kane MOA	KANE SOU	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	evening	7.17	86.04	30															100	
Kane MOA	KANE SOU	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	nighttime	2.92	35.04	30															100	
Kane MOA	KANE WE	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	daytime	281.83	3381.96	30															100	
Kane MOA	KANE WE	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	evening	63.08	756.96	30															100	
Kane MOA	KANE WE	F-18CD	F-18	500	TRAINING ROUTE	92	% NC	nighttime	26	312	30															100	

C-1.4 NOISE MODELING DATA FOR MCAGCC TWENTYNINE PALMS

C-1.4.1 Modeled MV-22 Flight Operations for MCAGCC Twentynine Palms Expeditionary Airfield

Existing Annual Flight Operations for Expeditionary Airfield at MCAGCC 29 Palms

Assumed Category	Aircraft Type		Departure				Non Break Arrival				Overhead Break				Touch and Go (1)				Camp Wilson (1)				Drop Zone Sandhill (1)				Grand Total			
			Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
Jet	F-18A/C		3	4	-	7	-	-	-	-	6	-	-	6	1	2	-	3	-	-	-	-	-	-	-	-	10	6	-	16
	F-18E/F		3	4	-	7	-	-	-	-	6	-	-	6	1	2	-	3	-	-	-	-	-	-	-	-	10	6	-	16
	AV-8B		7	9	-	16	1	1	-	2	14	-	-	14	1	2	-	3	-	-	-	-	-	-	-	-	23	12	-	35
	UC-35(3)		10	12	-	22	11	10	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	22	-	43
	C-20		10	12	-	22	11	10	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	22	-	43
	C-17		3	3	-	6	3	3	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	12
Prop	C-12		77	94	-	171	90	77	3	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167	171	3	341
	UAV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	132	-	220	88	132	-	220
	E-2/C-2		1	-	-	1	1	-	-	1	-	-	-	-	8	-	-	8	-	-	-	-	-	-	-	-	10	-	-	10
	C-130		1	2	-	3	2	1	-	3	-	-	-	-	2	2	-	4	-	-	-	-	-	-	-	-	5	5	-	10
Rotary-Wing	CH-53E		93	113	-	206	109	93	4	206	-	-	-	-	9	11	-	20	10	7	-	17	8	12	-	20	229	236	4	469
	CH-46E		144	175	-	319	173	147	7	327	-	-	-	-	6	7	-	13	16	10	-	26	8	12	-	20	347	351	7	705
	MV22B	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AH-1(4)		79	97	-	176	93	79	4	176	-	-	-	-	18	22	-	40	-	-	-	-	-	-	-	-	190	198	4	392
	UH-1		79	97	-	176	93	79	4	176	-	-	-	-	18	22	-	40	-	-	-	-	-	-	-	-	190	198	4	392
	SAR		59	72	-	131	69	59	3	131	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	128	131	3	262
	H-60		10	12	-	22	12	10	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	22	-	44
Modeled Total			431	526	-	957	494	422	19	935	26	-	-	26	54	68	-	122	26	17	-	43	16	24	-	40	1,047	1,057	19	2,123
Not Modeled Total			148	180	-	328	174	147	6	327	-	-	-	-	10	2	-	12	-	-	-	-	88	132	-	220	420	461	6	887
Grand Total			579	706	-	1,285	668	569	25	1,262	26	-	-	26	64	70	-	134	26	17	-	43	104	156	-	260	1,467	1,518	25	3,010

Notes: day = 0700-1900 local; eve = 1900-2200 local; night = 2200-0700 local
(1) Counted here as two (2) operations
(2) Modeled aircraft are shaded
(3) Modeled as Cessna-500
(4) Modeled as UH-1

Proposed Annual Flight Operations for Expeditionary Airfield at MCAGCC 29 Palms

Assumed Category	Aircraft Type		Departure				Non Break Arrival				Overhead Break				Touch and Go (1)				Camp Wilson (1)				Drop Zone Sandhill (1)				Grand Total			
			Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
Jet	F-18A/C		3	4	-	7	-	-	-	-	6	-	-	6	1	2	-	3	-	-	-	-	-	-	-	-	10	6	-	16
	F-18E/F		3	4	-	7	-	-	-	-	6	-	-	6	1	2	-	3	-	-	-	-	-	-	-	-	10	6	-	16
	AV-8B		7	9	-	16	1	1	-	2	14	-	-	14	1	2	-	3	-	-	-	-	-	-	-	-	23	12	-	35
	UC-35(3)		10	12	-	22	11	10	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	22	-	43
	C-20		10	12	-	22	11	10	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	22	-	43
	C-17		3	3	-	6	3	3	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	-	12
Prop	C-12		77	94	-	171	90	77	3	170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	167	171	3	341
	UAV		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	132	-	220	88	132	-	220
	E-2/C-2		1	-	-	1	1	-	-	1	-	-	-	-	8	-	-	8	-	-	-	-	-	-	-	-	10	-	-	10
	C-130		1	2	-	3	2	1	-	3	-	-	-	-	2	2	-	4	-	-	-	-	-	-	-	-	5	5	-	10
Rotary-Wing	CH-53E		93	113	-	206	109	93	4	206	-	-	-	-	9	11	-	20	10	7	-	17	8	12	-	20	229	236	4	469
	CH-46E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MV22B	T&R	657	395	101	1,153	125	75	19	219	532	320	82	934	368	222	56	646	-	-	-	-	90	58	18	166	1,772	1,070	276	3,118
		WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AH-1(4)		79	97	-	176	93	79	4	176	-	-	-	-	18	22	-	40	-	-	-	-	-	-	-	-	190	198	4	392
	UH-1		79	97	-	176	93	79	4	176	-	-	-	-	18	22	-	40	-	-	-	-	-	-	-	-	190	198	4	392
	SAR		59	72	-	131	69	59	3	131	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	128	131	3	262
	H-60		10	12	-	22	12	10	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	22	-	44
Modeled Total			944	746	101	1,791	446	350	31	827	558	320	82	960	416	283	56	755	10	7	-	17	98	70	18	186	2,472	1,776	288	4,536
Not Modeled Total			148	180	-	328	174	147	6	327	-	-	-	-	10	2	-	12	-	-	-	-	88	132	-	220	420	461	6	887
Grand Total			1,092	926	101	2,119	620	497	37	1,154	558	320	82	960	426	285	56	767	10	7	-	17	186	202	18	406	2,892	2,237	294	5,423

Notes: day = 0700-1900 local; eve = 1900-2200 local; night = 2200-0700 local
(1) Counted here as two (2) operations
(2) Modeled aircraft are shaded
(3) Modeled as Cessna-500
(4) Modeled as UH-1

C-1.4.2 Modeled Runway and Track Utilization for MCAGCC Twentynine Palms Expeditionary Airfield

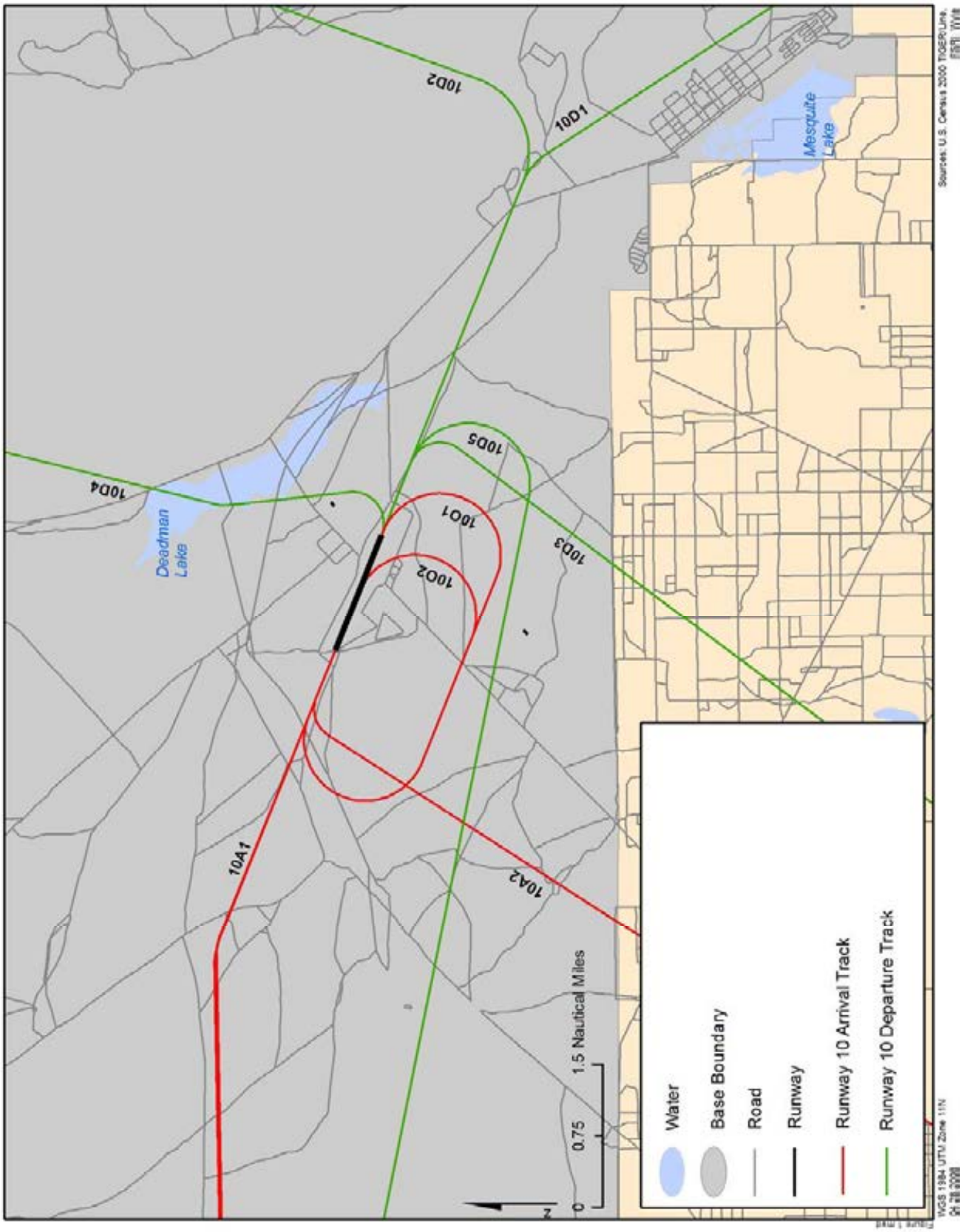
Fixed Wing Runway and Track Use at MCAGCC Twentynine Palms

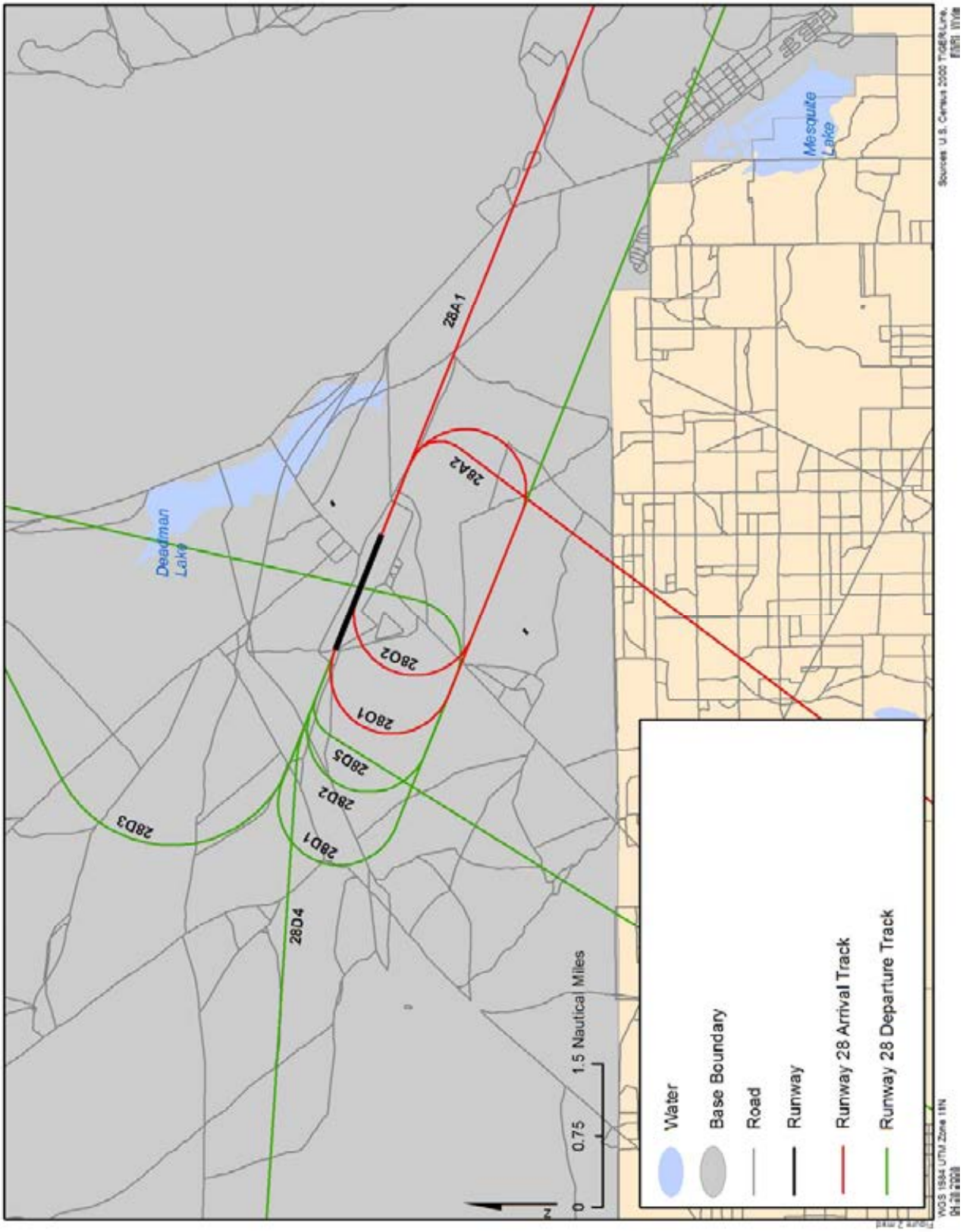
Operation Type	Runway	Runway Mix %	Flight Track ID	Flight Track %
Departures	10	25%	10D1	70%
			10D2	10%
			10D5	20%
	28	75%	28D1	10%
			28D2	40%
			28D3	40%
			28D4	10%
Straight-In Arrivals	10	25%	10A1	100%
	28	75%	28A1	100%
Overhead Arrivals	10	25%	10O1	10%
			10O2	90%
	28	75%	28O1	10%
			28O2	90%
Touch and Go	10	25%	10T1	100%
	28	75%	28T1	100%

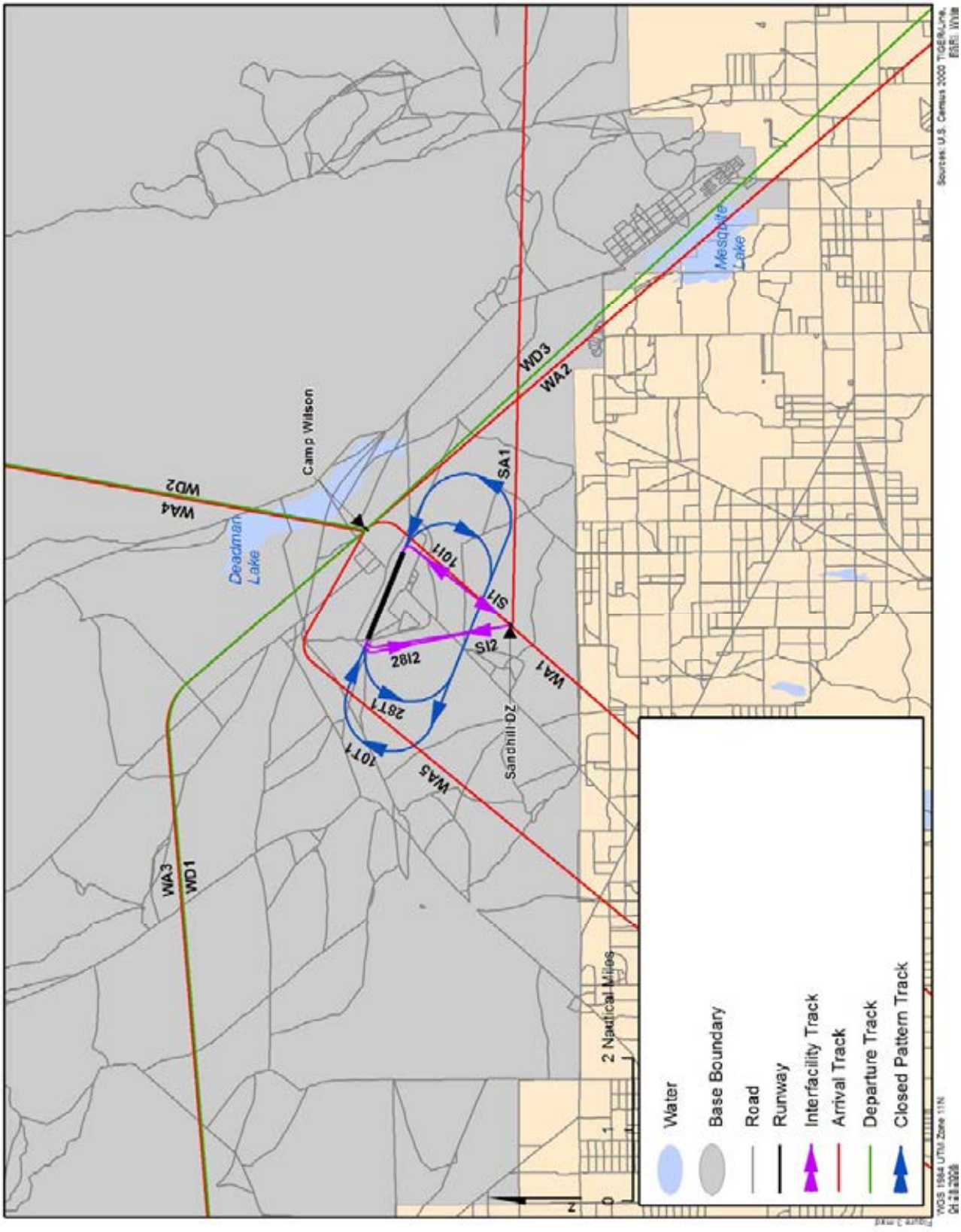
Rotary Wing Runway and Track use at MCAGCC Twentynine Palms

Operation Type	Runway	Runway Mix %	Flight Track ID	Flight Track %
Departures	10	25%	10D1	20%
			10D2	30%
			10D3	10%
			10D4	30%
			10D5	10%
	28	75%	28D1	45%
			28D4	45%
			28D5	10%
	Wilson	100%	WD1	33%
			WD2	33%
			WD3	34%
Straight-In Arrivals	10	25%	10A1	50%
			10A2	50%
	28	75%	28A1	25%
			28A2	75%
	Wilson	100%	WA1	10%
			WA2	35%
			WA3	10%
			WA4	35%
			WA5	10%
	Sandhill	100%	SA1	100%
Overhead Arrivals	10	25%	10O1	10%
			10O2	90%
	28	75%	28O1	50%
			28O2	50%
Touch and Go	10	25%	10T1	100%
	28	75%	28T1	100%
Interfacility Departures from Sandhill to Runway	Sandhill	100%	SI1	50%
	Sandhill	100%	SI2	50%

C-1.4.3 Modeled Flight Tracks for MCAGCC Twentynine Palms Expeditionary Airfield



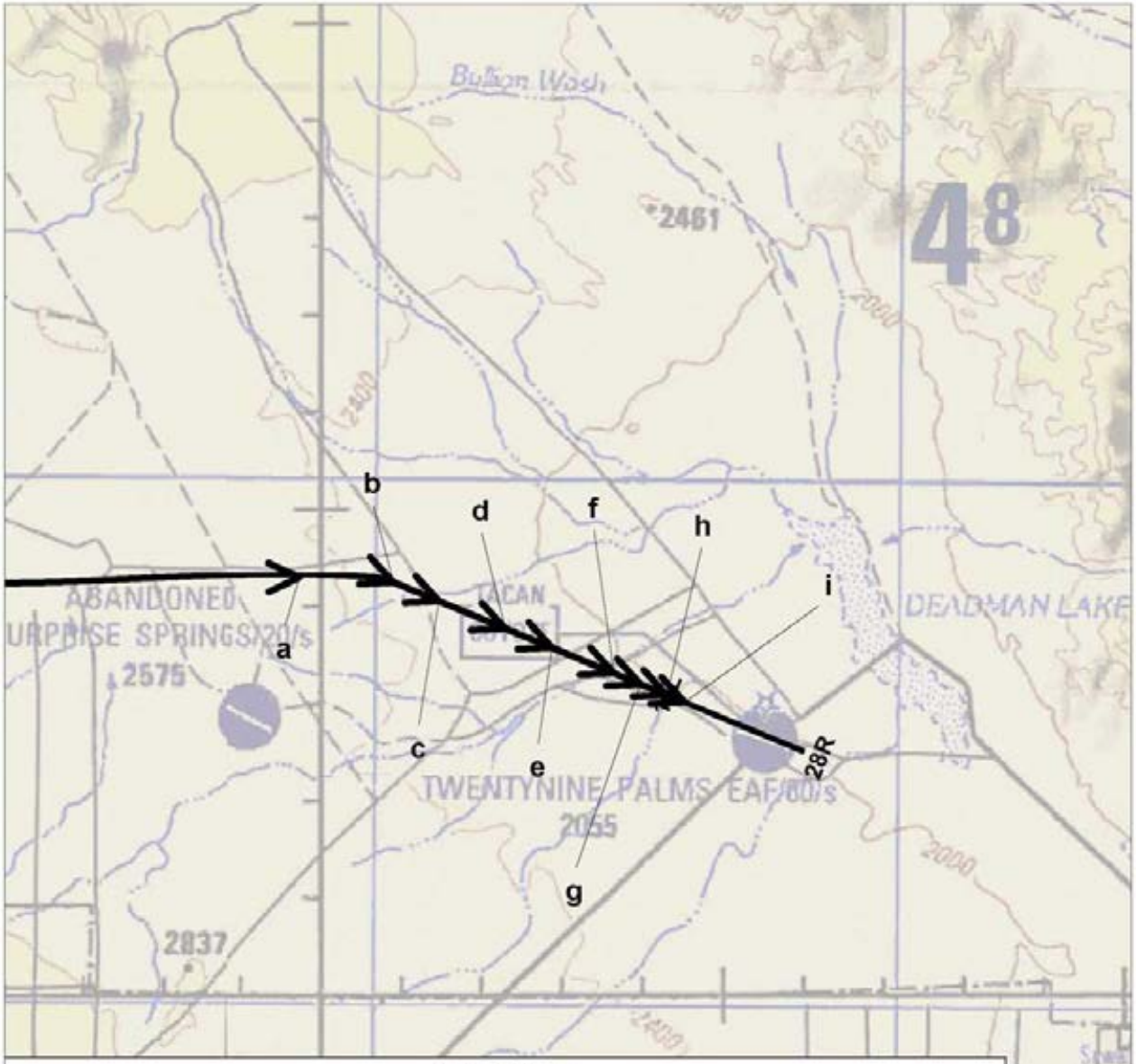

Deadman Lake
Mesquite Lake
28A1
28A2
28O2
28O1
28D5
28D2
28D1
28D3
28D4
Water
Base Boundary
Road
Runway
Runway 28 Arrival Track
Runway 28 Departure Track
0
0.75
1.5 Nautical Miles
N


Water
Base Boundary
Road
Runway
Interfacility Track
Arrival Track
Departure Track
Closed Pattern Track
2 Nautical Miles
0
1
2
Camp Wilson
Deadman Lake
Mesquite Lake
Sandhill DZ
WA1
WA2
WA3
WA4
WA5
WD1
WD2
WD3
SA1
SI1
SI2
10I1
21S
28I2
28T1
10T1

C-1.4.4 Modeled MV-22 Flight Profiles for MCAGCC Twentynine Palms Expeditionary Airfield

The flight profile information on the following pages is shown in tabular fashion, captioned on each map. The columns of the flight profile data tables are described below:

Column Heading	Description
Point	Sequence letter along flight track denoting change in flight parameters
Distance (feet)	Distance along flight track from runway threshold in feet
Height (feet)	Altitude of aircraft in feet Above Ground Level (AGL) or relative to Mean Sea Level (MSL)
Power (Appropriate Unit)* Speed (kts)	Engine power setting and Drag Configuration/Interpolation Code (defines sets of interpolation code in NOISEMAP (F for FIXED, P for PARALLEL, V for VARIABLE)) Indicated airspeed of aircraft in knots
Yaw Angle (degrees)**	Angle of the aircraft relative to its vertical axis in degrees; positive nose left
Angle of Attack (degrees)**	Angle of the aircraft, not of the wing; angle between the climb angle and the pitch angle, in degrees, positive nose up. The climb angle is the angle between the horizontal and the velocity vector (same convention). The pitch angle is the angle between the horizontal and the thrust vector (same convention)
Roll Angle (degrees)**	Angle of the aircraft relative to its longitudinal axis in degrees; positive left side down.
Nacelle Angle (degrees)***	Angle of engine nacelle pylon relative to the horizontal (airplane) mode; positive up; maximum of 90



Flight Profile 511

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	25,687	1,500 AGL	220	0	5	-15	0	+5deg aoa for level @220kts
b	19,747	1,500 AGL	220	0	-1	0	0	begin 1800 fpm desc;
c	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
d	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
f	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
g	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
h	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
i	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 511
MV22B Non-Break Arrival
on Runway 10L and Flight Track 10A1 - Fixed/Rotary Wing Arrival from W - Pt Giant

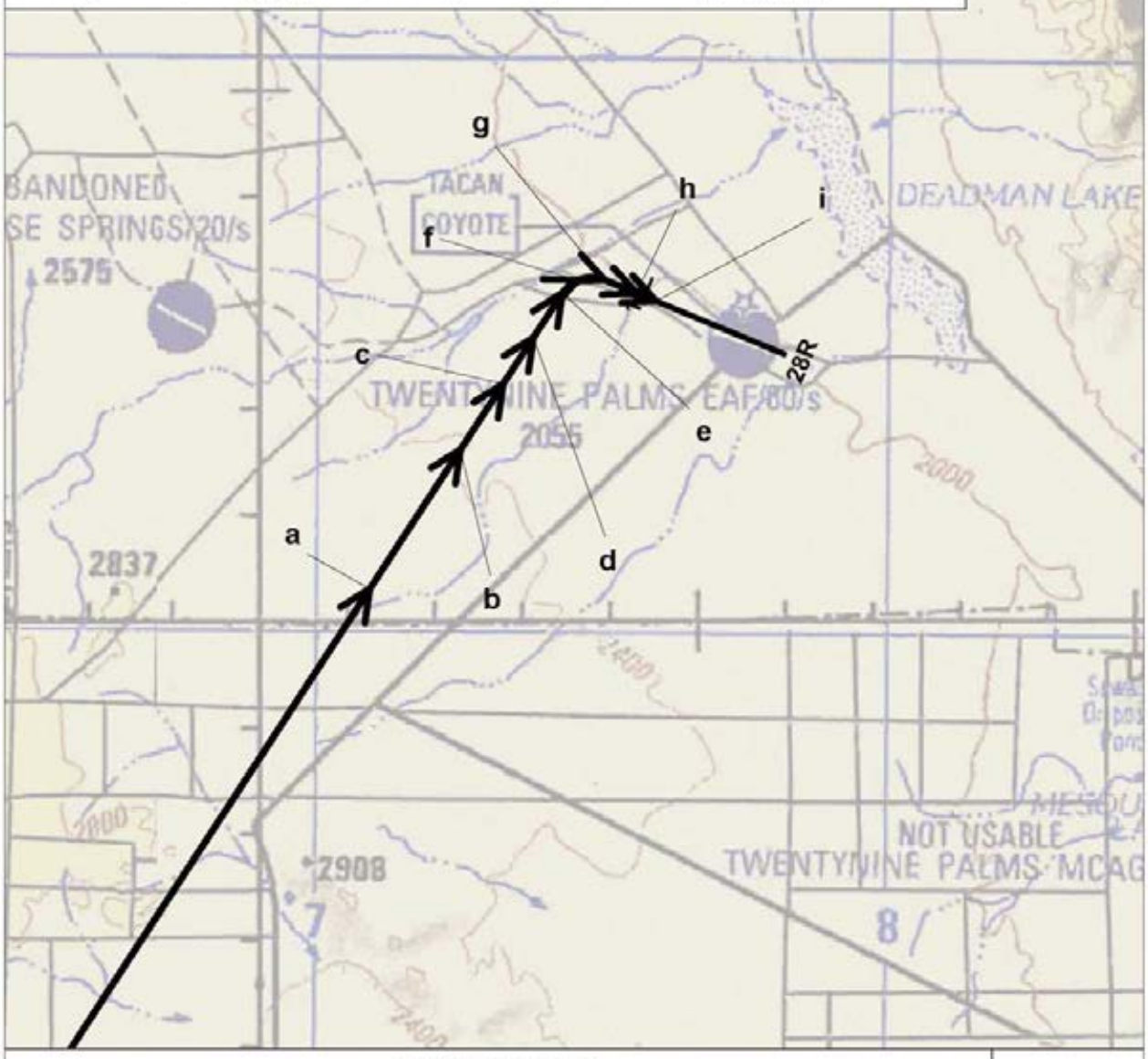
0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:130,000 (1 inch = 10,900 feet)

N

Flight Profile 512

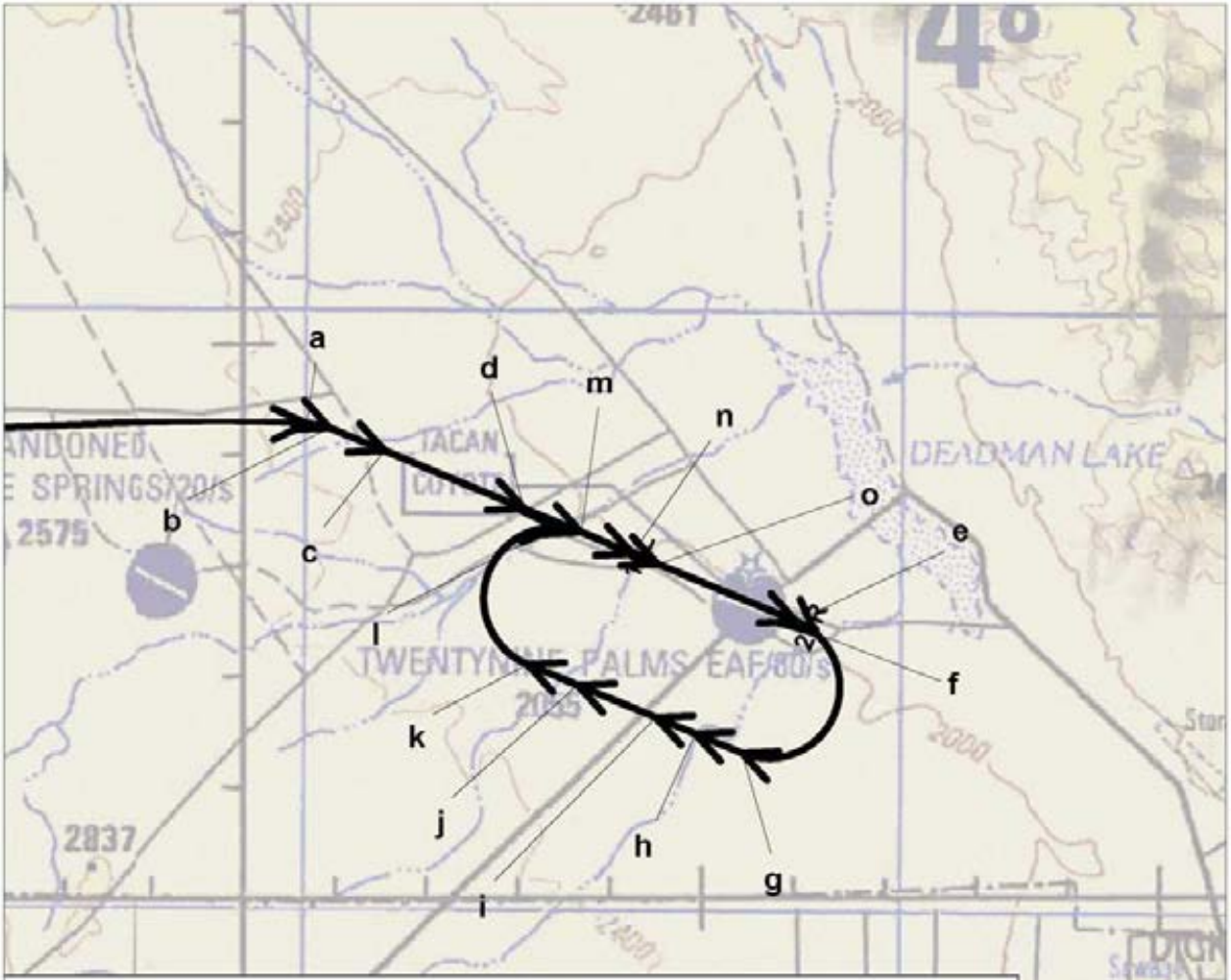
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	26,178	1,500 AGL	220	0	-1	0	0	begin 1800 fpm desc;
b	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
c	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
d	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
e	5,958	343 AGL	80	0	0	-25	80	
f	4,800	300 AGL	80	0	0	-25	80	400 fpm desc; 3deg gs
g	3,200	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
h	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
i	0	20 AGL	5	0	0	0	90	5 knot stop



Flight Profile 512
MV22B Non-Break Arrival
on Runway 10L and Flight Track 10A2 - Rotary Wing Arrival from SW - Miramar/Camp Pendleton

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:121,000 (1 inch = 10,100 feet)



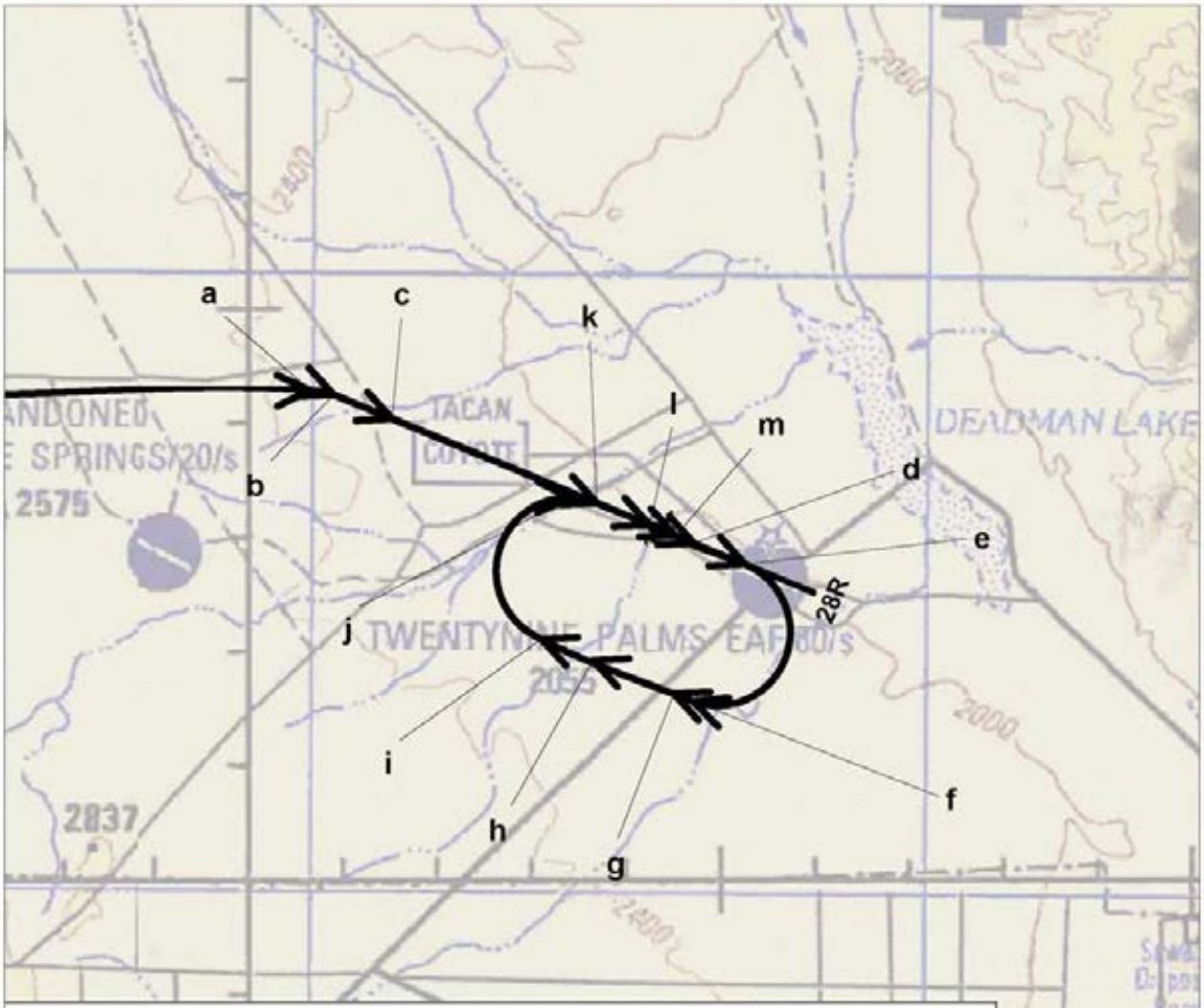
Flight Profile 521

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	70,835	1,679 AGL	205	0	0	-15	0	
b	69,551	1,582 AGL	203	0	0	0	0	
c	66,280	1,335 AGL	200	0	0	0	0	
d	57,974	1,335 AGL	170	0	0	0	0	
e	41,804	1,335 AGL	114	0	0	-25	0	
f	40,552	1,335 AGL	110	0	0	-25	60	
g	29,557	1,235 AGL	110	0	0	0	60	begin downwind leg
h	26,776	1,235 AGL	110	0	0	0	60	
i	24,443	700 AGL	110	0	0	0	60	
j	19,776	500 AGL	80	0	0	0	73	
k	16,800	468 AGL	77	0	0	-25	74	end of downwind
l	6,000	350 AGL	65	0	7	-25	79	~1nm out
m	4,550	333 AGL	60	0	8	0	81	
n	1,500	300 AGL	50	0	10	0	85	1500ft out
o	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 521
MV22B Overhead Break Arrival
on Runway 10L and Flight Track 10O1 - Fixed/Rotary Wing Overhead Arrival
End-RWY (10% of the time) - From Pt Giant

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:124,000 (1 inch = 10,300 feet)



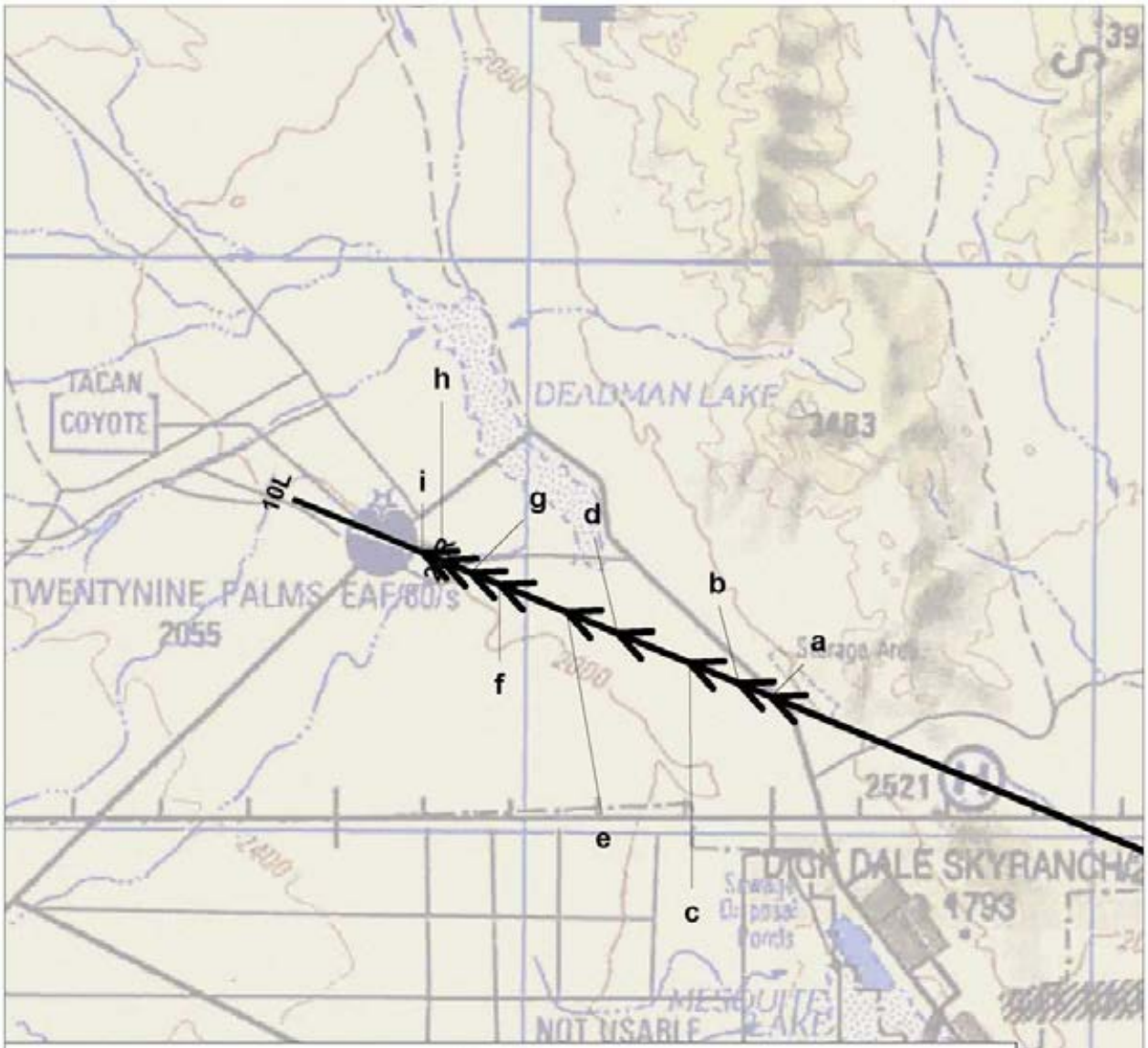
Flight Profile 522

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	62,636	1,335 AGL	187	0	0	-15	0	
b	61,351	1,335 AGL	182	0	0	0	0	
c	57,974	1,335 AGL	170	0	0	0	0	
d	40,552	1,335 AGL	110	0	0	0	0	
e	37,604	1,335 AGL	110	0	0	-25	0	
f	25,532	1,235 AGL	110	0	0	0	60	begin downwind leg
g	24,443	700 AGL	110	0	0	0	60	
h	19,776	500 AGL	80	0	0	0	73	
i	16,802	468 AGL	77	0	0	-25	74	end of downwind
j	6,000	350 AGL	65	0	7	-25	79	~1nm out
k	4,550	333 AGL	60	0	8	0	81	
l	1,500	300 AGL	50	0	10	0	85	1500ft out
m	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 522
MV22B Overhead Break Arrival
on Runway 10L and Flight Track 10O2 - Fixed/Rotary Wing Overhead Arrival
Mid-RWY (90% of the time) - From Pt Giant

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:118,000 (1 inch = 9,810 feet)



Flight Profile 513

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	21,754	1,500 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	19,747	1,500 AGL	220	0	-1	0	0	begin 1800 fpm desc;
c	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
d	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
f	4,800	300 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
g	3,000	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
h	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
i	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 513
MV22B Non-Break Arrival
on Runway 28R and Flight Track 28A1 - Fixed/Rotary Wing Straight-In Arrival - from Lake Bandini Sewage Disposal Ponds

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:121,000 (1 inch = 10,100 feet)

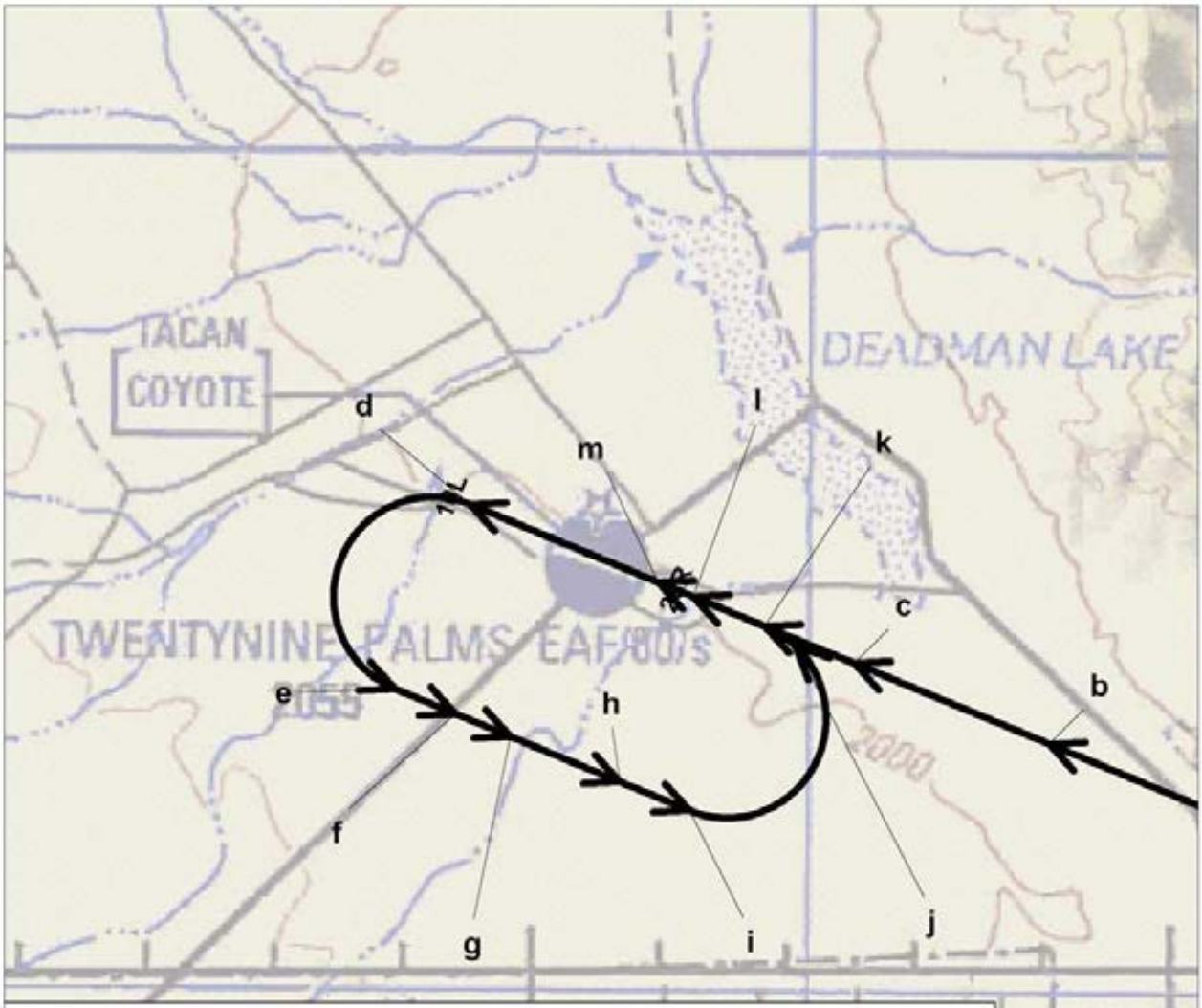
Flight Profile 514

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	20,007	1,500 AGL	220	0	-1	0	0	begin 1800 fpm desc;
b	16,667	1,200 AGL	170	0	-1	0	10	700 fpm desc
c	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
d	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
e	8,665	483 AGL	80	0	0	25	79	
f	5,958	343 AGL	80	0	0	25	80	
g	5,000	307 AGL	80	0	0	0	80	
h	3,200	200 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
i	1,200	150 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
j	0	20 AGL	5	0	0	0	90	5 knot stop

Flight Profile 514
MV22B Non-Break Arrival
on Runway 28R and Flight Track 28A2 - Rotary Wing Arrival from SW - Miramar/Camp Pendleton

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:104,000 (1 inch = 8,670 feet)



Flight Profile 523

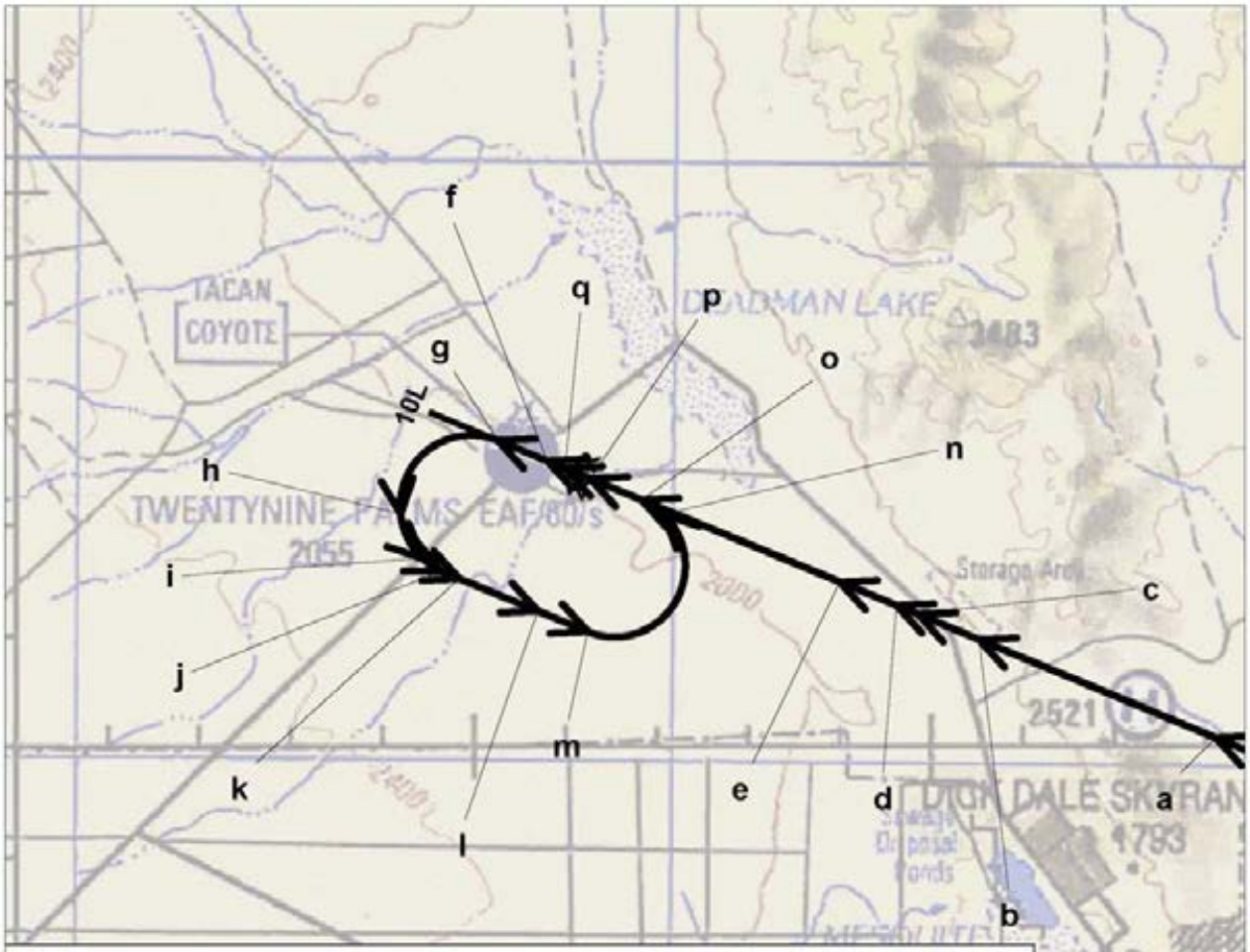
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	83,463	2,665 AGL	220	0	0	0	0	
b	66,280	1,335 AGL	200	0	0	0	0	
c	57,974	1,335 AGL	170	0	0	0	0	
d	41,604	1,335 AGL	114	0	0	25	0	Break
e	29,352	1,235 AGL	110	0	0	0	60	begin downwind leg
f	26,776	1,235 AGL	110	0	0	0	60	
g	24,443	700 AGL	110	0	0	0	60	
h	19,776	500 AGL	80	0	0	0	73	
i	16,802	468 AGL	77	0	0	25	74	end of downwind
j	6,000	350 AGL	65	0	7	25	79	~1nm out
k	4,550	333 AGL	60	0	8	0	81	
l	1,500	300 AGL	50	0	10	0	85	1500ft out
m	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 523
MV22B Overhead Break Arrival
on Runway 28R and Flight Track 28O1 - Fixed/Rotary Wing Overhead Arrival
End-RWY (10% of the time) - From Lake Bandini

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:86,700 (1 inch = 7,230 feet)

N



Flight Profile 524

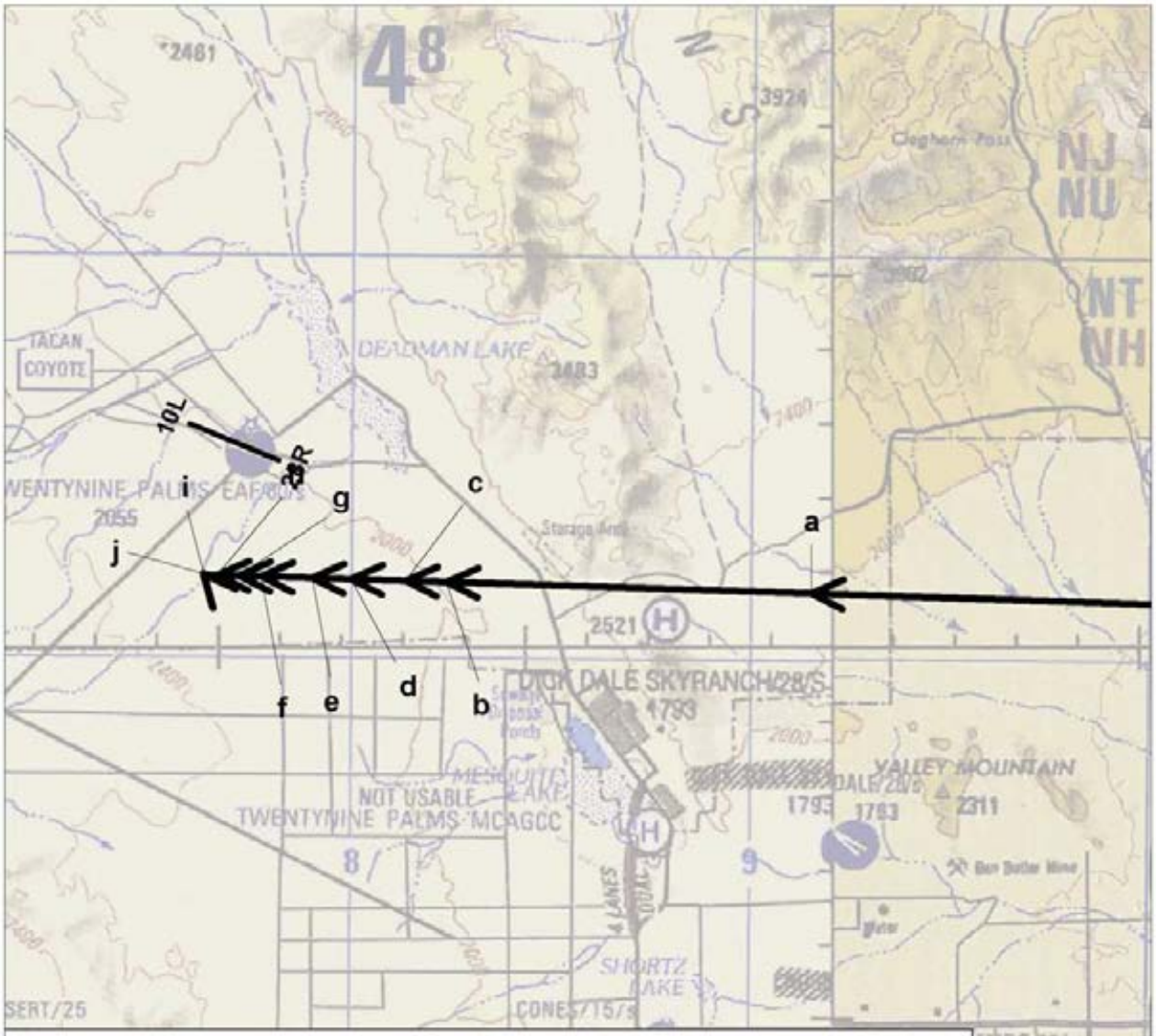
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	80,390	2,665 AGL	220	0	0	0	0	
b	66,280	1,335 AGL	200	0	0	0	0	
c	62,636	1,335 AGL	187	0	0	0	0	
d	61,351	1,335 AGL	182	0	0	0	0	
e	57,974	1,335 AGL	170	0	0	0	0	
f	40,552	1,335 AGL	110	0	0	0	0	
g	37,604	1,335 AGL	110	0	0	-25	0	Break
h	29,557	1,308 AGL	110	0	0	-25	60	
i	26,776	1,235 AGL	110	0	0	0	60	
j	25,532	950 AGL	110	0	0	0	60	begin downwind leg
k	24,443	700 AGL	110	0	0	0	60	
l	19,776	500 AGL	80	0	0	0	73	
m	16,802	468 AGL	77	0	0	-25	74	end of downwind
n	6,000	350 AGL	65	0	7	-25	79	~1nm out
o	4,550	333 AGL	60	0	8	0	81	
p	1,500	300 AGL	50	0	10	0	85	1500ft out
q	0	20 AGL	5	0	10	0	90	cross threshold

Flight Profile 524
MV22B Overhead Break Arrival
on Runway 28R and Flight Track 28O2 - Fixed/Rotary Wing Overhead Arrival
Mid-RWY (90% of the time) - From Lake Bandini

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:126,000 (1 inch = 10,500 feet)

N



Flight Profile 520

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	5,000 AGL	220	0	5	0	0	
b	20,007	1,500 AGL	220	0	5	0	0	begin 1800 fpm desc;
c	16,667	1,500 AGL	150	0	-1	0	10	700 fpm desc
d	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
f	4,800	245 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
g	2,962	130 AGL	60	0	-1	0	90	200 fpm desc; 2deg gs
h	1,200	75 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
i	100	31 AGL	9	0	0	0	90	
j	0	20 AGL	5	0	0	0	90	5 knot stop

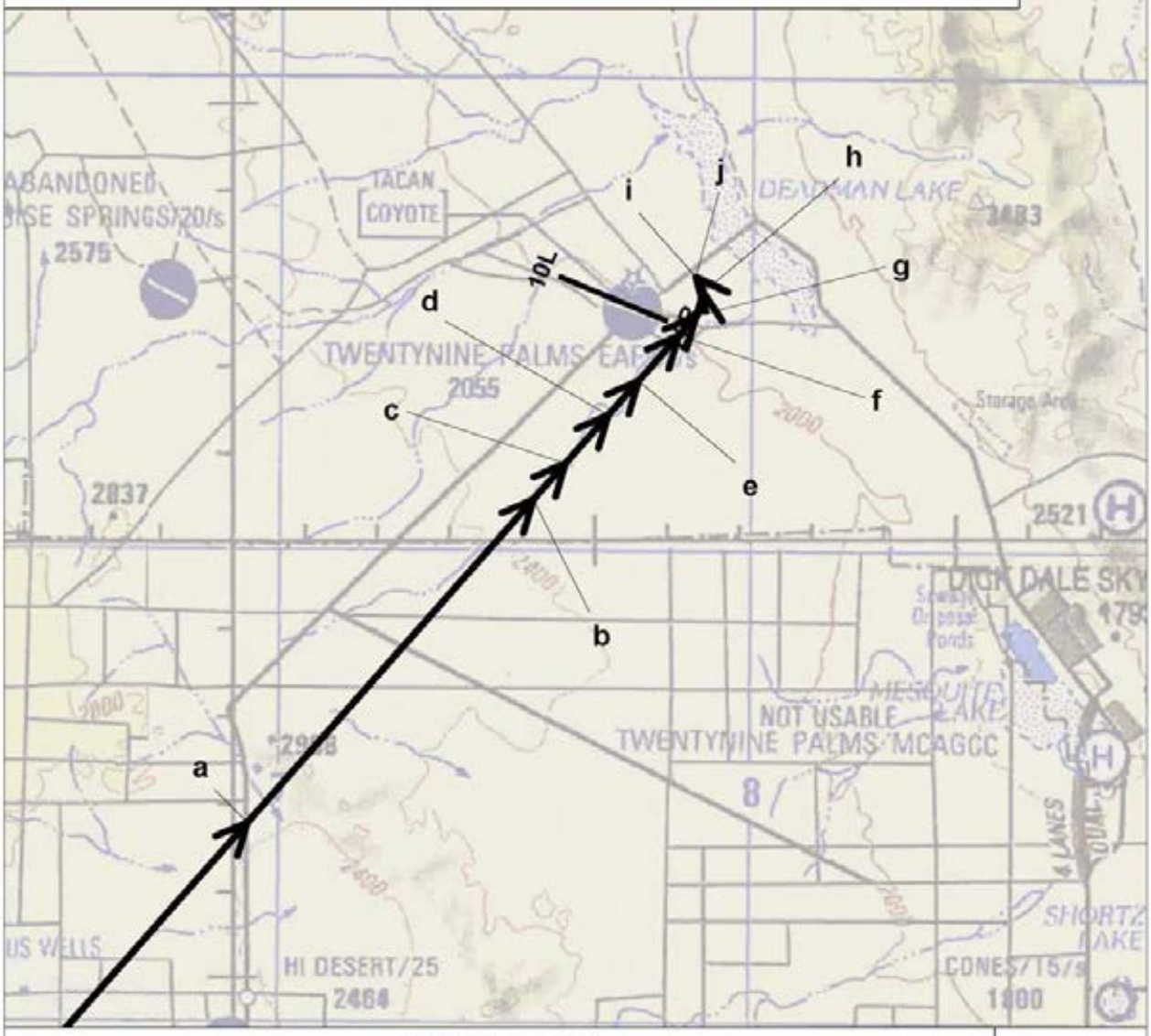
Flight Profile 520
MV22B Non-Break Arrival
on Runway SHN and Flight Track SA1 - Rotary Wing Arrival at Drop Zone Sandhill
from E

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:174,000 (1 inch = 14,500 feet)

Flight Profile 515

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	5,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	20,007	1,500 AGL	220	0	5	0	0	begin 1800 fpm desc;
c	16,667	1,500 AGL	150	0	-1	0	10	700 fpm desc
d	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
f	4,800	245 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
g	2,962	130 AGL	60	0	-1	20	87	200 fpm desc; 2deg gs
h	1,200	75 AGL	50	0	5	20	90	300 fpm desc; 6deg gs
i	100	1,931 MSL	9	0	0	0	90	
j	0	1,920 MSL	5	0	0	0	90	5 knot stop



Flight Profile 515
MV22B Non-Break Arrival
on Runway CWN and Flight Track WA1 - Rotary Wing Arrival from SW - Miramar/Camp Pendleton

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:147,000 (1 inch = 12,200 feet)

N

Flight Profile 516

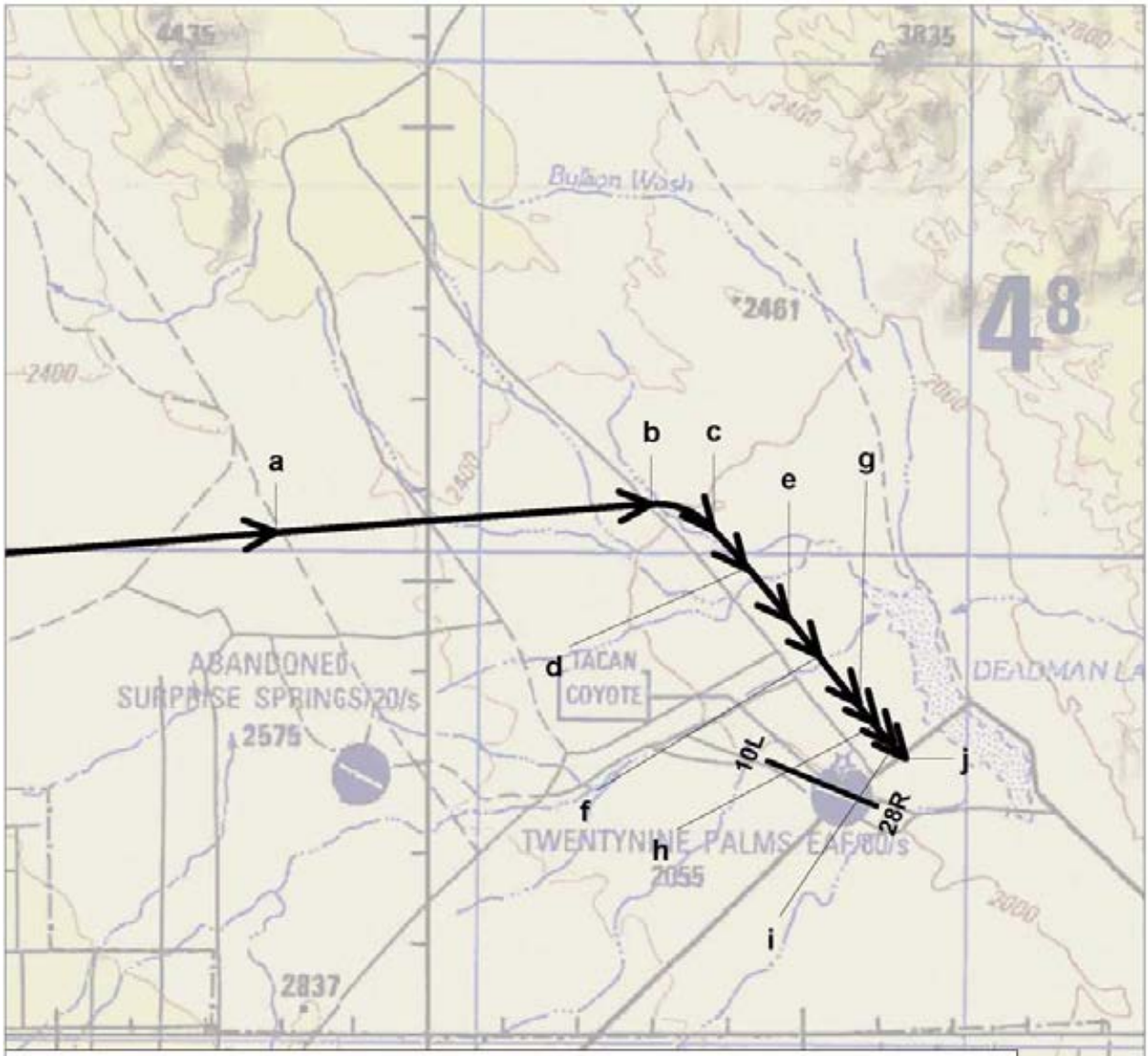
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	5,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	20,007	2,500 AGL	220	0	5	0	0	begin 1800 fpm desc;
c	16,667	1,500 AGL	150	0	-1	0	10	700 fpm desc
d	12,172	1,000 AGL	150	0	-1	0	20	1800 fpm desc
e	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
f	4,800	240 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
g	3,000	130 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
h	1,200	75 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
i	0	1,920 MSL	5	0	0	0	90	5 knot stop

Flight Profile 516
MV22B Non-Break Arrival
on Runway CWN and Flight Track WA2 - Rotary Wing Arrival from E to Wilson - Lake Bandini Sewage Disposal Ponds

0 4,000 8,000 12,000 16,000 20,000 24,000

Scale in Feet 1:79,000 (1 inch = 6,590 feet)

N



Flight Profile 517

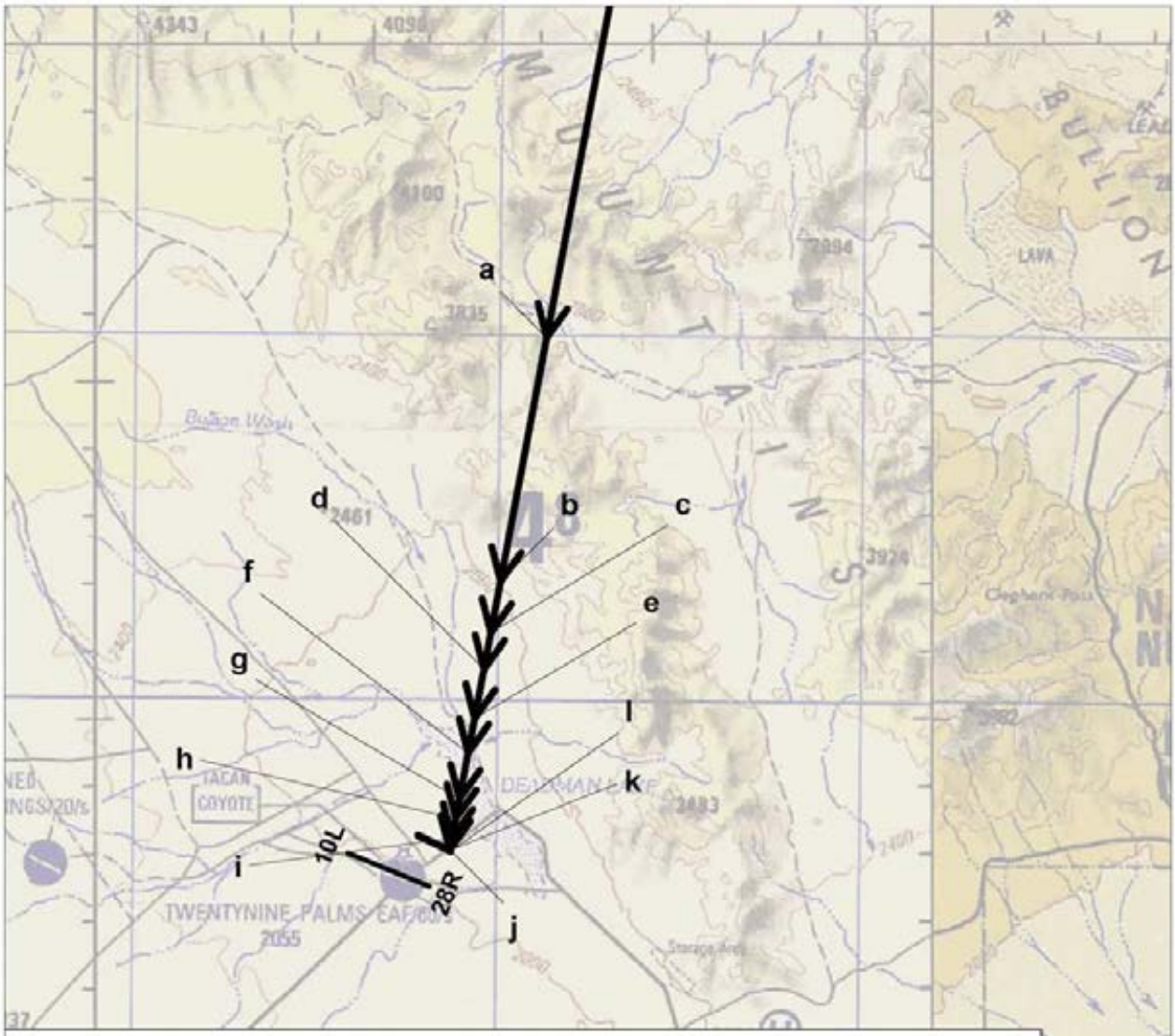
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	5,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	24,712	3,555 AGL	220	0	5	-15	0	+5deg aoa for level @220kts
c	20,000	3,555 AGL	220	0	5	0	0	begin 1800 fpm desc;
d	16,667	3,555 AGL	150	0	-1	0	10	700 fpm desc
e	12,172	3,055 AGL	150	0	-1	0	20	1800 fpm desc
f	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
g	4,800	240 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
h	3,000	125 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
i	1,200	75 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
j	0	1,920 MSL	5	0	0	0	90	5 knot stop

Flight Profile 517
MV22B Non-Break Arrival
on Runway CWS and Flight Track WA3 - Rotary Wing Arrival from W - Pt Giant

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:141,000 (1 inch = 11,800 feet)

N



Flight Profile 518

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	47,000	5,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	24,712	3,555 AGL	220	0	5	0	0	+5deg aoa for level @220kts
c	20,000	3,555 AGL	220	0	5	0	0	begin 1800 fpm desc;
d	16,667	3,555 AGL	150	0	-1	0	10	700 fpm desc
e	12,172	3,055 AGL	150	0	-1	0	20	1800 fpm desc
f	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
g	4,800	240 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
h	3,000	130 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
i	1,200	80 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
j	145	1,936 MSL	10	0	5	10	90	
k	100	1,931 MSL	9	0	5	10	90	
l	0	1,920 MSL	5	0	0	0	90	5 knot stop

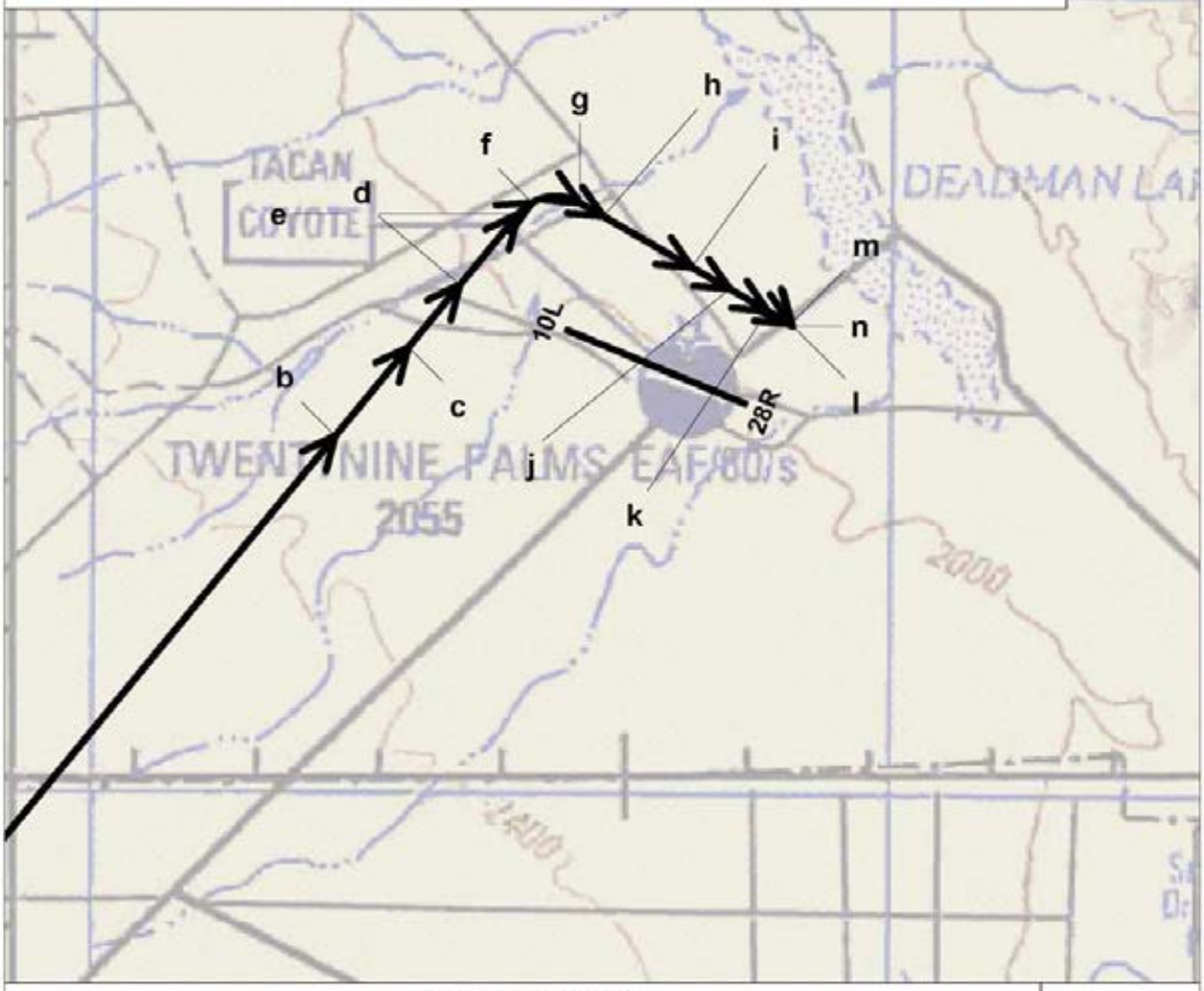
Flight Profile 518
MV22B Non-Break Arrival
on Runway CWS and Flight Track WA4 - Rotary Wing Arrival from N - Pt North

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:194,000 (1 inch = 16,200 feet)

Flight Profile 519

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	50,000	5,000 AGL	220	0	5	0	0	+5deg aoa for level @220kts
b	24,712	3,555 AGL	220	0	5	0	0	+5deg aoa for level @220kts
c	20,000	3,555 AGL	220	0	5	0	0	begin 1800 fpm desc;
d	16,667	3,555 AGL	150	0	-1	0	10	700 fpm desc
e	12,910	3,137 AGL	150	0	-1	-25	0	
f	12,172	3,055 AGL	150	0	-1	-25	20	1800 fpm desc
g	10,117	1,400 AGL	105	0	0	0	0	
h	9,000	500 AGL	80	0	0	0	79	400 fpm desc; 3deg gs
i	4,800	240 AGL	80	0	0	0	80	400 fpm desc; 3deg gs
j	3,000	130 AGL	60	0	-1	0	87	200 fpm desc; 2deg gs
k	1,200	75 AGL	50	0	5	0	90	300 fpm desc; 6deg gs
l	117	1,933 MSL	10	0	5	-5	90	
m	100	1,931 MSL	9	0	5	-5	90	
n	0	1,920 MSL	5	0	0	0	90	5 knot stop

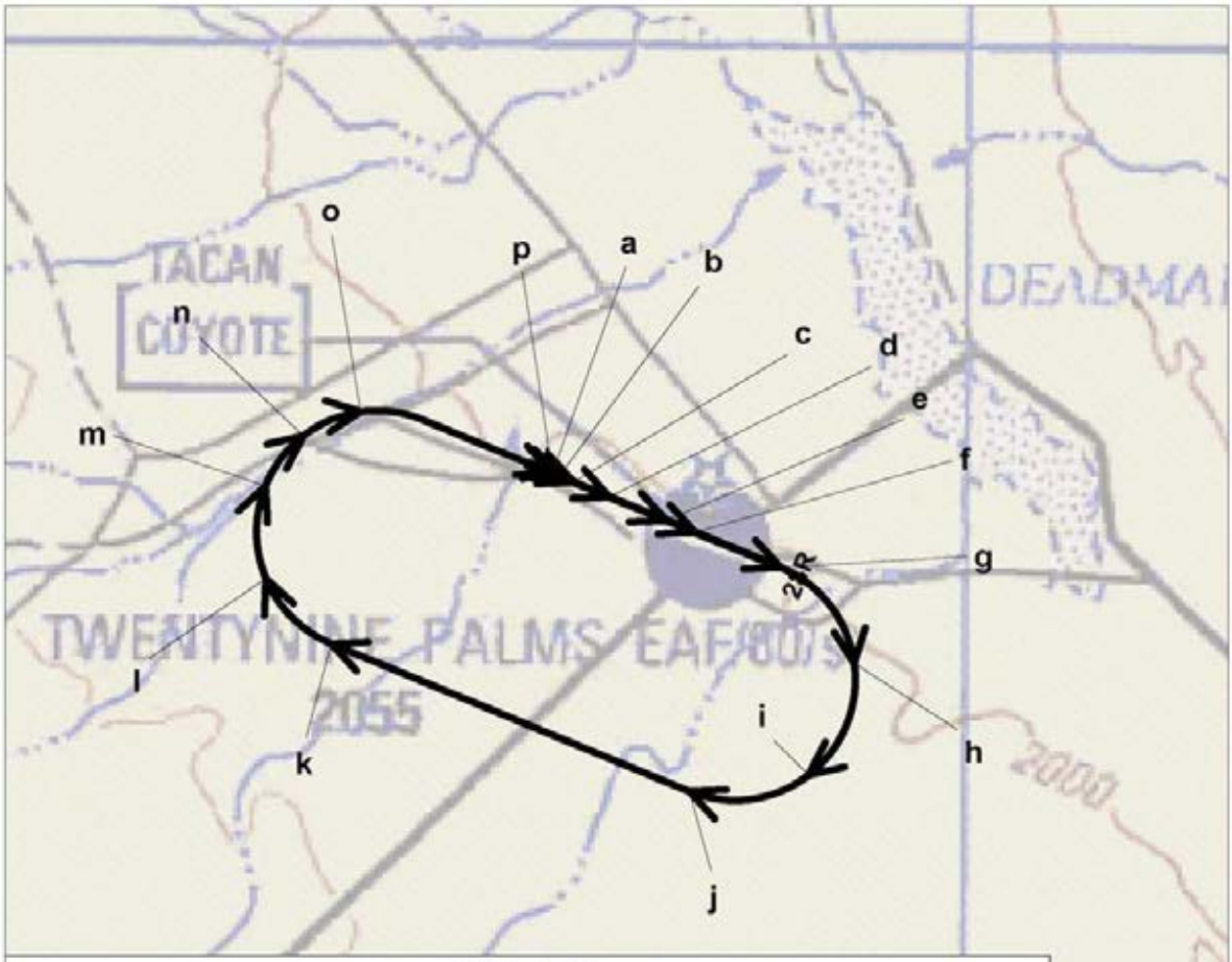


Flight Profile 519
MV22B Non-Break Arrival
on Runway CWS and Flight Track WA5 - Rotary Wing Departure to SW from Camp Wilson - Camp Pendleton

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:90,800 (1 inch = 7,570 feet)

N



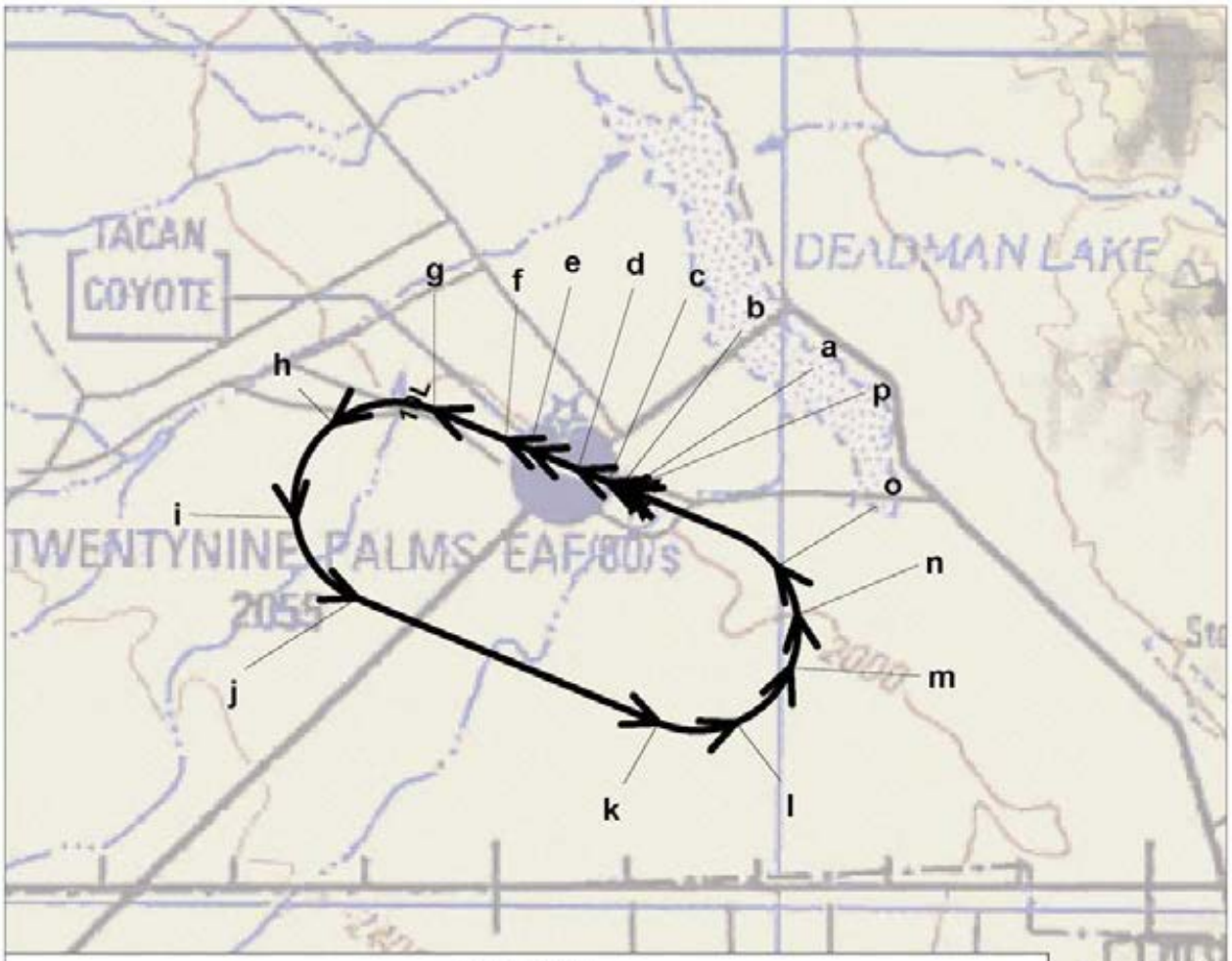
Flight Profile 525

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	800 AGL	135	0	10	0	0	
f	5,000	1,000 AGL	145	0	0	0	0	
g	8,000	1,000 AGL	170	0	7	25	0	begin turn to downwind
h	12,084	1,000 AGL	170	0	7	25	0	MOVE TO 1/3 turn
i	16,168	1,000 AGL	170	0	7	25	0	MOVE TO 2/3 turn
j	20,252	1,000 AGL	170	0	7	0	0	begin downwind
k	32,802	1,000 AGL	170	0	3	25	0	end downwind
l	35,865	750 AGL	140	0	3	25	0	1/4 thru turn
m	38,928	500 AGL	110	0	0	25	60	1/2 thru turn
n	40,974	200 AGL	60	0	0	25	87	2/3 thru turn
o	43,012	150 AGL	50	0	0	25	90	5/6 thru turn
p	49,604	20 AGL	5	0	0	0	90	

Flight Profile 525
MV22B Touch and Go
on Runway 10L and Flight Track 10T1 - Fixed/Rotary Wing Touch & Go Pattern on Rwy 10

0 4,000 8,000 12,000 16,000 20,000 24,000

Scale in Feet 1:73,100 (1 inch = 6,090 feet)



Flight Profile 526

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	5 kt start
b	250	30 AGL	45	0	-6	0	60	
c	750	150 AGL	65	0	0	0	60	
d	2,000	450 AGL	110	0	3	0	30	
e	4,000	800 AGL	135	0	10	0	0	
f	5,000	1,000 AGL	145	0	0	0	0	
g	8,000	1,000 AGL	170	0	7	25	0	begin turn to downwind
h	12,084	1,000 AGL	170	0	7	25	0	MOVE TO 1/3 turn
i	16,168	1,000 AGL	170	0	7	25	0	MOVE TO 2/3 turn
j	20,252	1,000 AGL	170	0	7	0	0	begin downwind
k	32,802	1,000 AGL	170	0	3	25	0	end downwind
l	35,865	750 AGL	140	0	3	25	0	1/4 thru turn
m	38,928	500 AGL	110	0	0	25	60	1/2 thru turn
n	40,974	200 AGL	60	0	0	25	87	2/3 thru turn
o	43,012	150 AGL	50	0	0	25	90	5/6 thru turn
p	49,604	20 AGL	5	0	0	0	90	

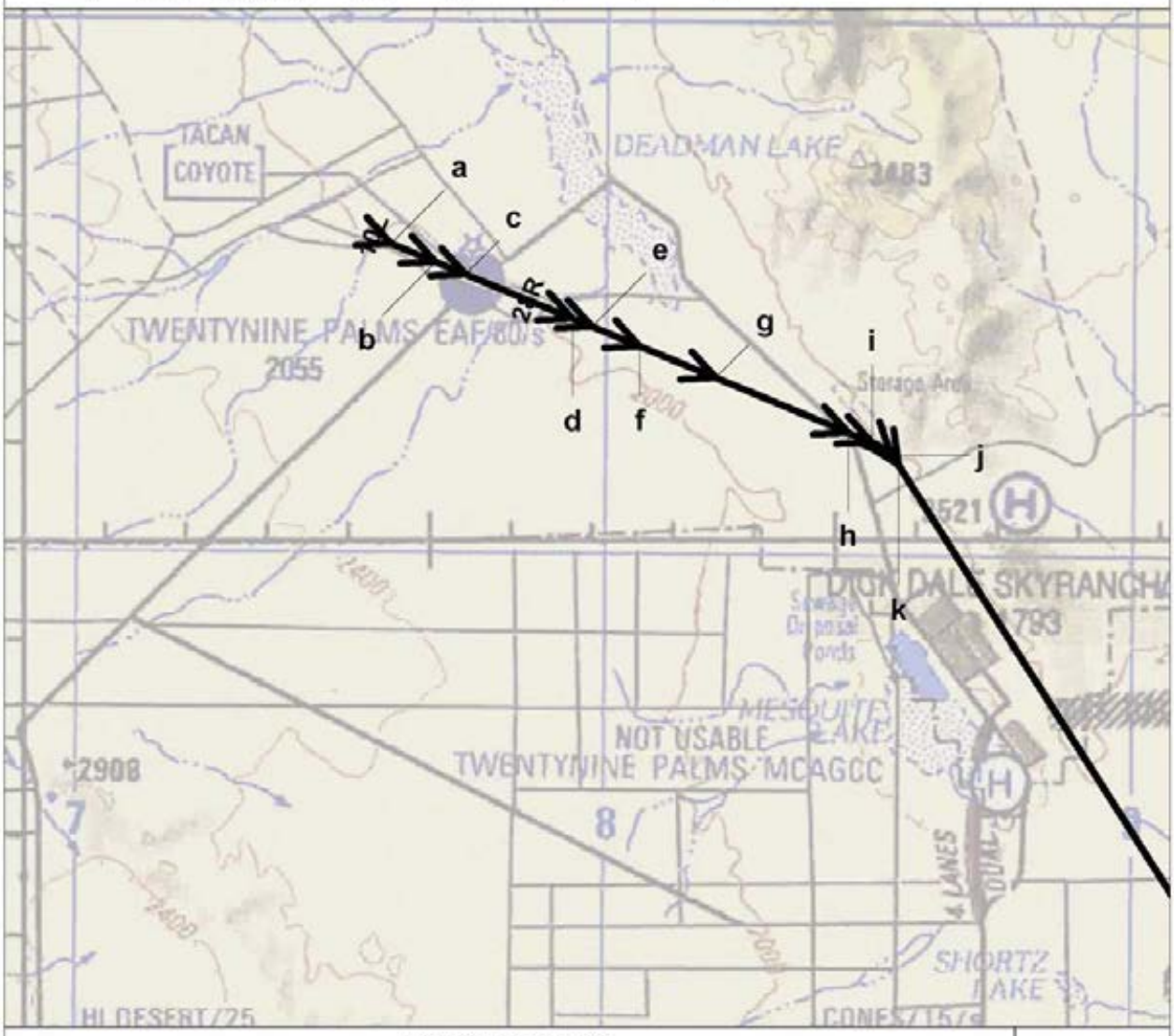
Flight Profile 526
MV22B Touch and Go
on Runway 28R and Flight Track 28T1 - Fixed/Rotary Wing Touch & Go Pattern on Rwy 28

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:86,800 (1 inch = 7,230 feet)

Flight Profile 500

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	12,189	469 AGL	162	0	0	0	11	
e	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
f	16,700	872 AGL	170	0	6	0	0	
g	21,800	1,464 AGL	170	0	6	0	0	
h	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
i	32,305	2,761 AGL	196	0	5	-10	0	
j	33,753	3,000 AGL	220	0	5	-10	0	+5deg for level cruise @ 220kts
k	34,483	3,000 AGL	220	0	5	0	0	

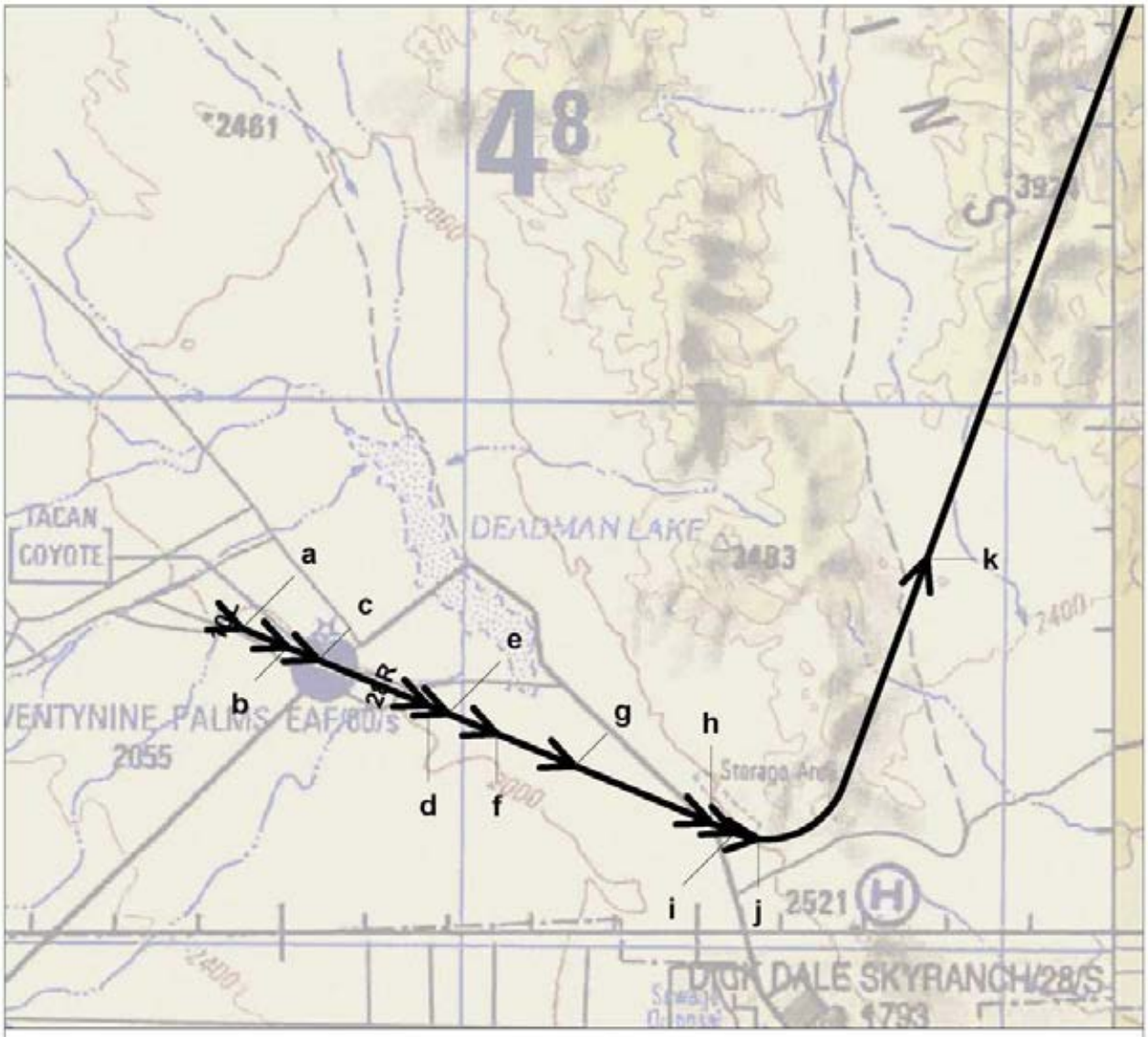


Flight Profile 500
MV22B Departure
on Runway 10L and Flight Track 10D1 - Fixed/Rotary Wing Departure to SE - Lake Bandini Sewage Disposal Ponds

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:134,000 (1 inch = 11,100 feet)

N



Flight Profile 501

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	12,189	469 AGL	162	0	0	0	11	
e	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
f	16,700	872 AGL	170	0	6	0	0	
g	21,800	1,464 AGL	170	0	6	0	0	
h	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
i	32,305	2,761 AGL	196	0	5	-15	0	
j	33,753	3,000 AGL	220	0	5	-15	0	+5deg for level cruise @ 220kts
k	54,853	3,000 AGL	220	0	5	0	0	end turn

Flight Profile 501
MV22B Departure
on Runway 10L and Flight Track 10D2 - Fixed/Rotary Wing Departure to Pt Range

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:127,000 (1 inch = 10,600 feet)

Flight Profile 502

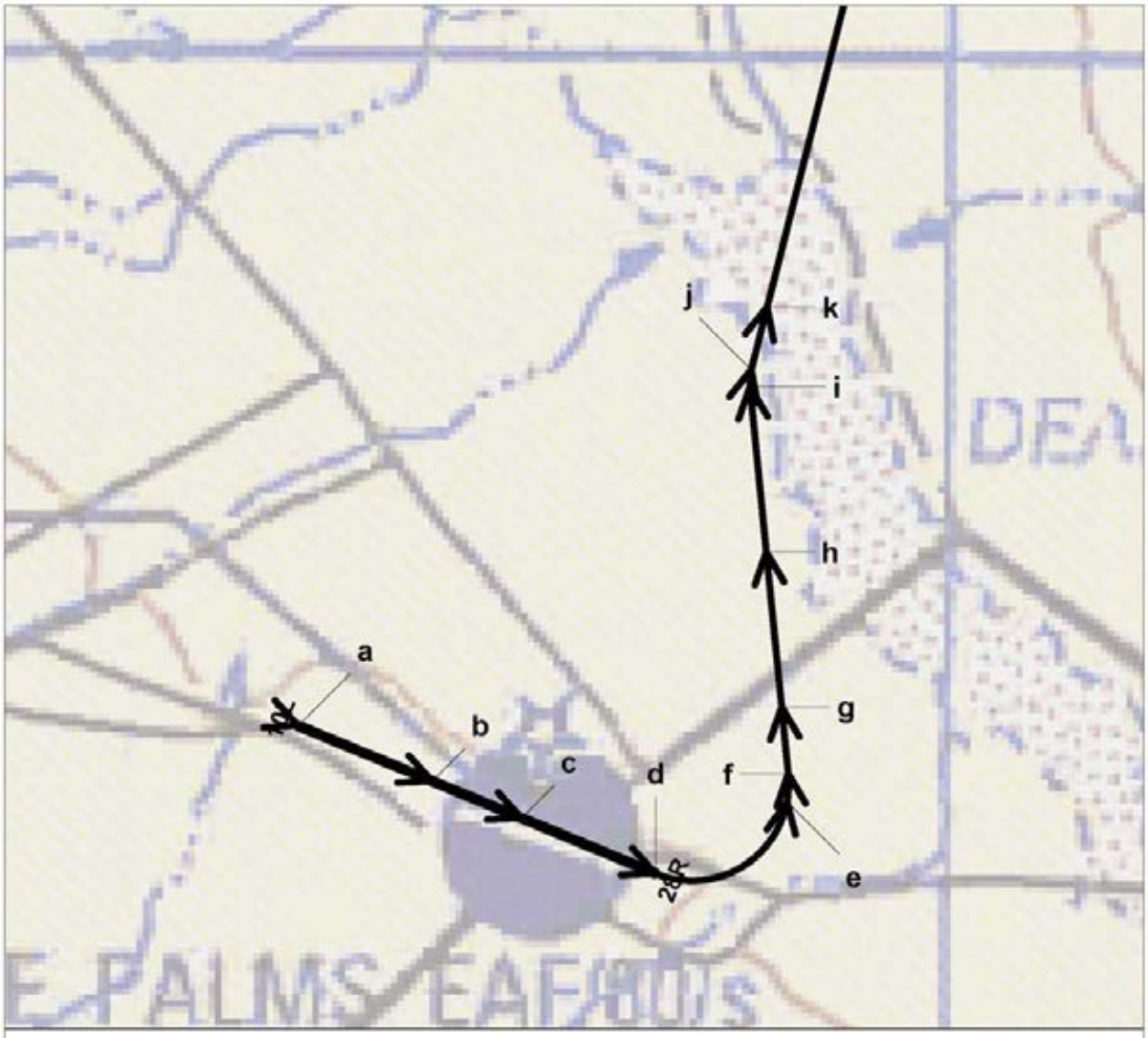
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	12,189	469 AGL	162	0	0	0	11	
e	13,000	488 AGL	167	0	6	-25	0	
f	13,500	500 AGL	170	0	6	-25	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
g	16,665	868 AGL	170	0	6	0	0	
h	21,800	1,464 AGL	170	0	6	0	0	
i	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
j	33,753	3,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile 502
MV22B Departure
on Runway 10L and Flight Track 10D3 - Rotary Wing Departure to SW - Miramar/Camp Pendleton

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:103,000 (1 inch = 8,610 feet)

N

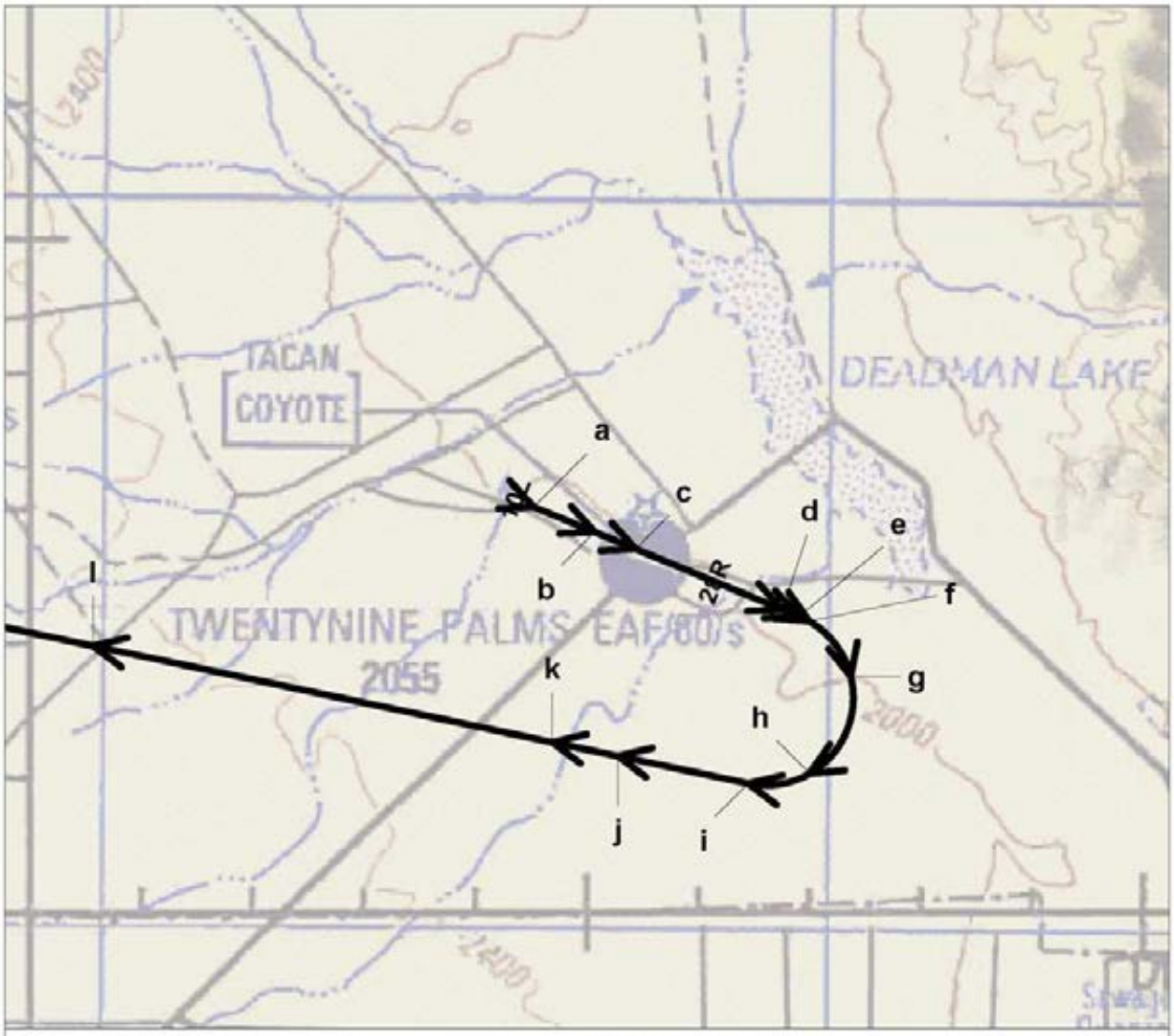


Flight Profile 503

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	8,000	349 AGL	133	0	0	25	50	
e	11,547	442 AGL	155	0	0	25	0	
f	12,119	466 AGL	159	0	5	0	0	
g	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
h	16,700	872 AGL	170	0	6	0	0	
i	20,119	1,269 AGL	170	0	6	-10	0	
j	20,468	1,309 AGL	170	0	6	0	0	
k	21,800	1,464 AGL	170	0	6	0	0	

Flight Profile 503
MV22B Departure
on Runway 10L and Flight Track 10D4 - Rotary-Wing Departure to N - Pt North

Scale in Feet 1:43,500 (1 inch = 3,630 feet)



Flight Profile 504

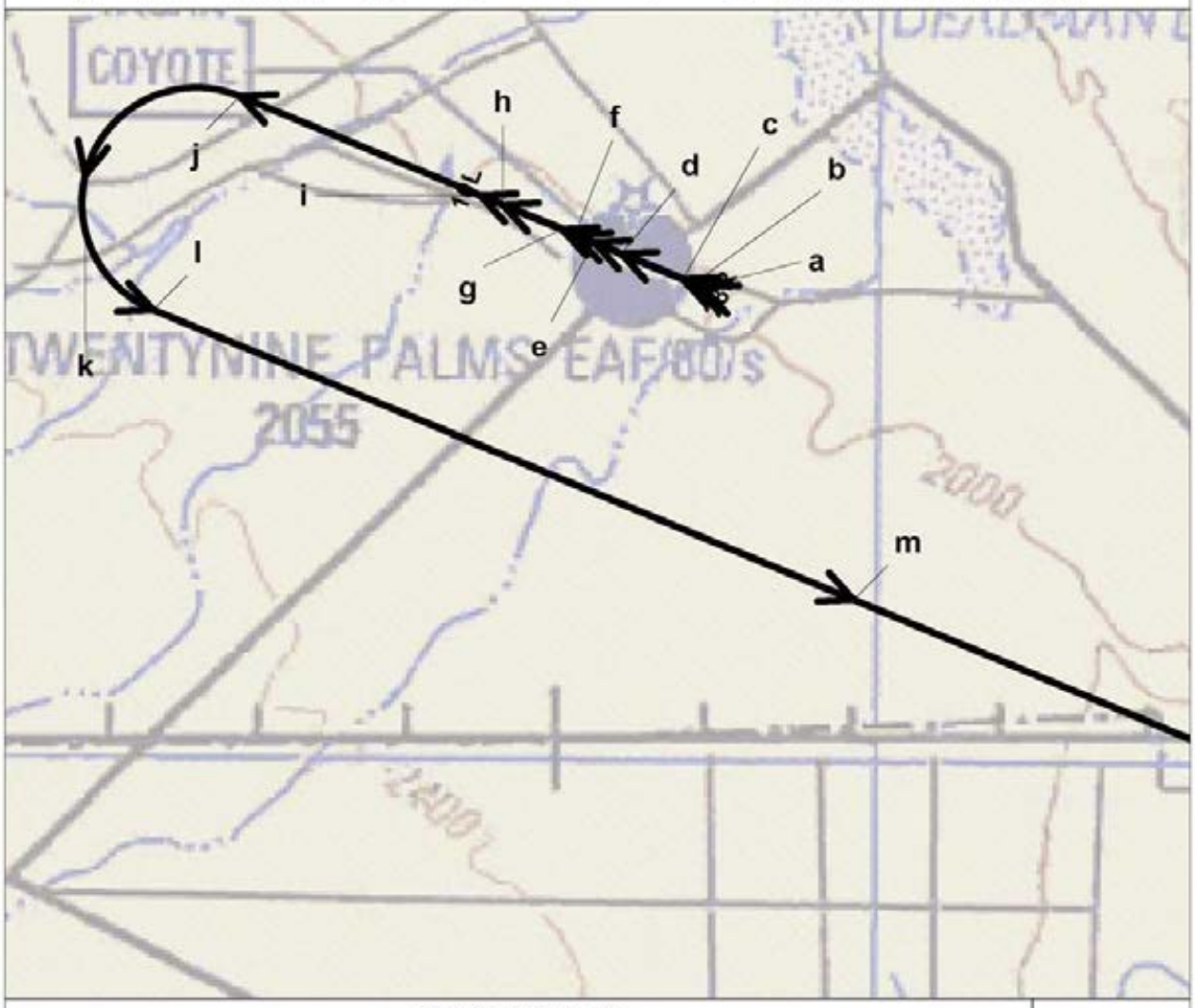
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	12,189	469 AGL	162	0	0	0	11	
e	13,000	488 AGL	167	0	5	25	0	
f	13,500	500 AGL	170	0	6	25	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
g	16,700	872 AGL	170	0	6	25	0	
h	21,800	1,464 AGL	170	0	6	25	0	
i	24,682	3,000 AGL	170	0	6	0	0	
j	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
k	33,753	3,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts
l	55,000	3,000 AGL	220	0	5	0	0	

Flight Profile 504
MV22B Departure
on Runway 10L and Flight Track 10D5 - Fixed/Rotary Wing Departure to W - Pt Giant

Scale in Feet 1:97,200 (1 inch = 8,100 feet)

Flight Profile 505

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	60	Normal 60 STO transition to APLN to 1500 ft
b	334	35 AGL	50	0	-4	0	60	
c	730	55 AGL	66	0	-2	0	60	
d	3,000	188 AGL	125	0	5	0	9	
e	4,000	500 AGL	135	0	10	0	0	
f	4,693	1,100 AGL	145	0	7	0	0	point added at beginning of turn: interpolated
g	5,175	1,500 AGL	155	0	6	0	0	
h	7,345	1,500 AGL	165	0	7	0	0	point added at end of turn: interpolated
i	8,175	1,500 AGL	170	0	7	0	0	steady state climb APLN 170kts 1500-3500 ft
j	17,000	3,500 AGL	170	0	7	25	0	straight and level, 170 kts, 7 deg pitch
k	23,710	3,500 AGL	170	0	7	25	0	straight and level, 170 kts, 7 deg pitch
l	29,252	3,500 AGL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch
m	55,000	3,500 AGL	170	0	7	0	0	straight and level, 170 kts, 7 deg pitch

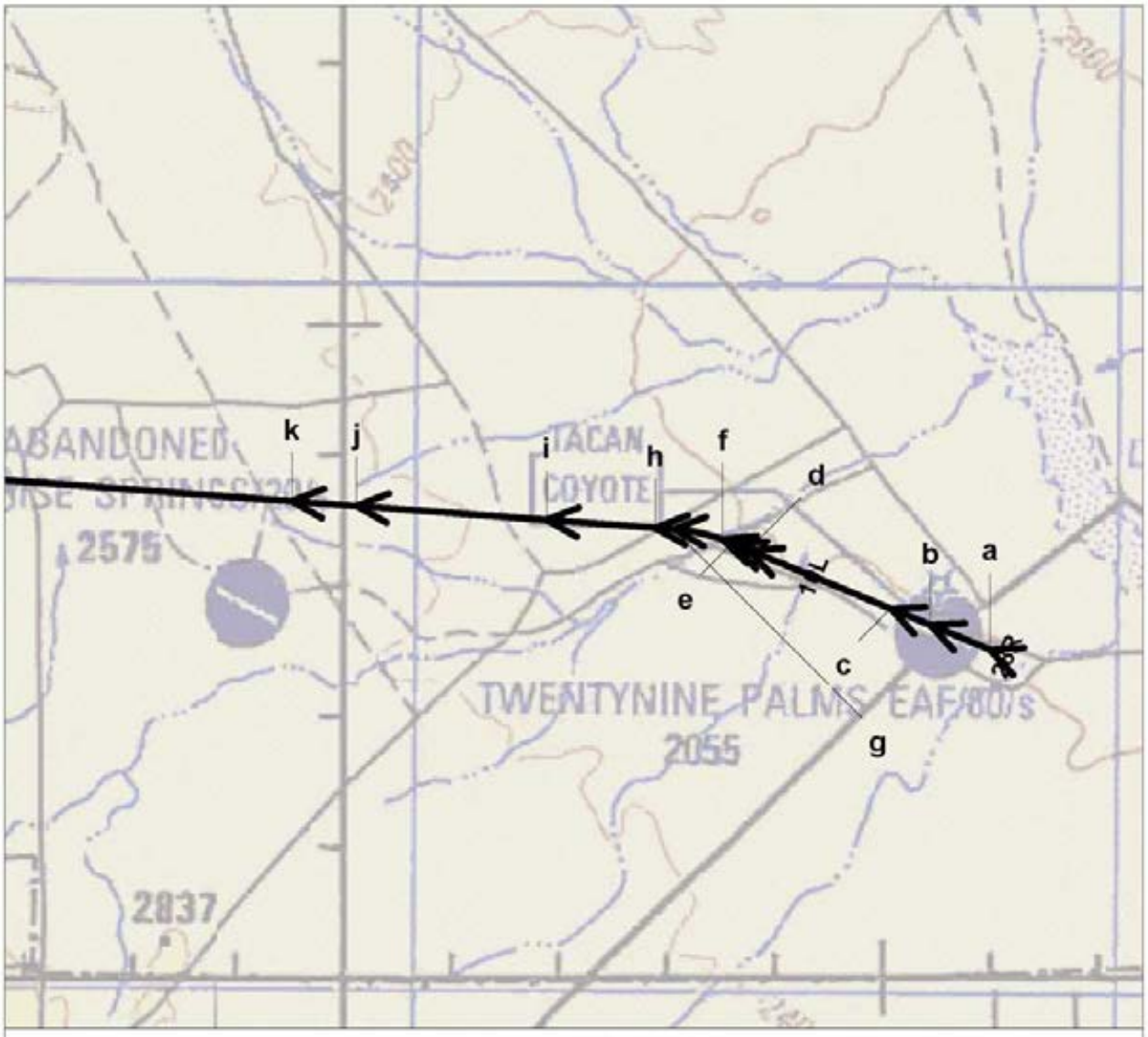


Flight Profile 505
MV22B Departure
on Runway 28R and Flight Track 28D1 - Fixed/Rotary Wing Departure to SE - Lake Bandini Sewage Disposal Ponds

0 4,000 8,000 12,000 16,000 20,000 24,000

Scale in Feet 1:74,300 (1 inch = 6,190 feet)

N



Flight Profile 506

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	115	0	0	0	70	
d	12,189	469 AGL	162	0	0	0	11	
e	13,000	488 AGL	167	0	5	10	0	
f	13,500	500 AGL	170	0	5	10	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
g	15,843	3,000 AGL	170	0	5	0	0	
h	16,700	3,100 AGL	170	0	6	0	0	
i	21,800	3,600 AGL	170	0	6	0	0	
j	30,715	4,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
k	33,753	4,800 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

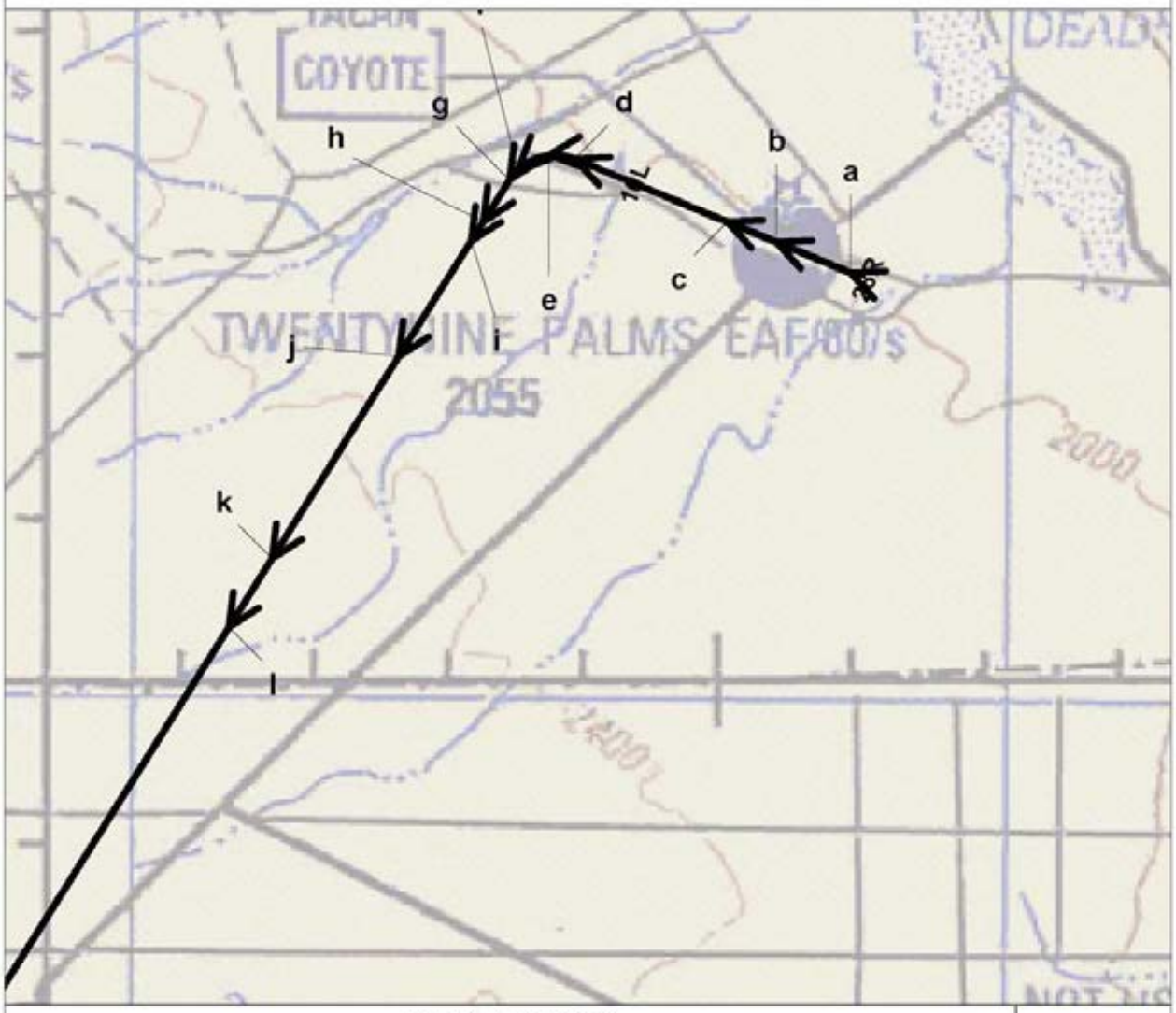
Flight Profile 506
MV22B Departure
on Runway 28R and Flight Track 28D4 - Fixed/Rotary Wing Departure to W - Pt Giant

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000

Scale in Feet 1:98,200 (1 inch = 8,180 feet)

Flight Profile 507

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	20 AGL	5	0	0	0	87	5 knot start
b	3,000	188 AGL	71	0	0	0	77	
c	5,000	300 AGL	156	0	0	0	70	
d	11,200	446 AGL	167	0	0	25	62	
e	12,189	469 AGL	162	0	0	25	11	
f	13,500	500 AGL	170	0	5	25	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
g	13,993	1,026 AGL	170	0	5	0	0	
h	15,843	3,000 AGL	170	0	5	0	0	
i	16,700	3,100 AGL	170	0	6	0	0	
j	21,800	3,600 AGL	170	0	6	0	0	
k	30,715	4,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
l	33,753	4,800 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

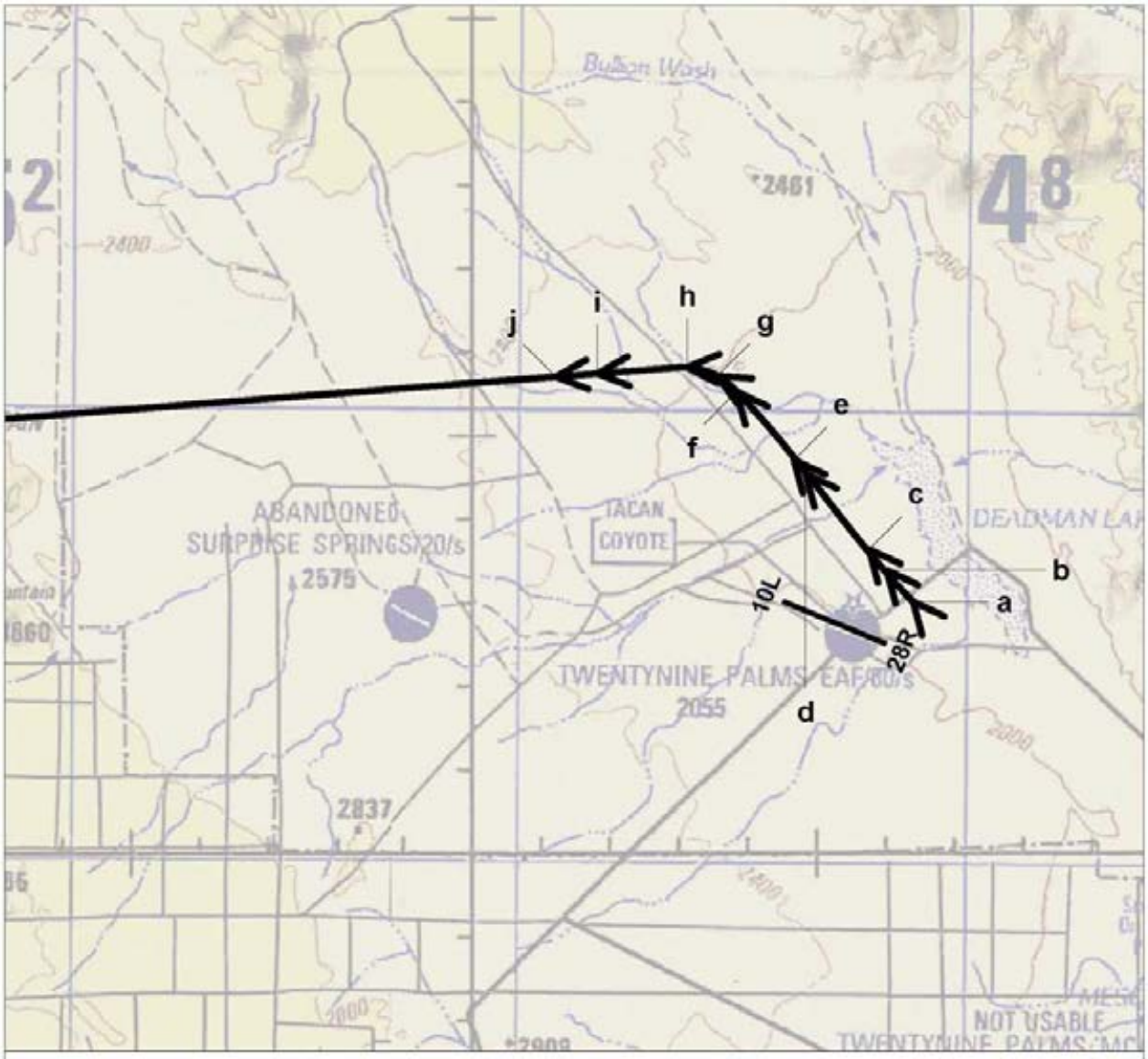


Flight Profile 507
MV22B Departure
on Runway 28R and Flight Track 28D5 - Rotary Wing Departure to SW - Miramar/Camp Pendleton

0 4,000 8,000 12,000 16,000 20,000 24,000

Scale in Feet 1:80,900 (1 inch = 6,740 feet)

N



Flight Profile 508

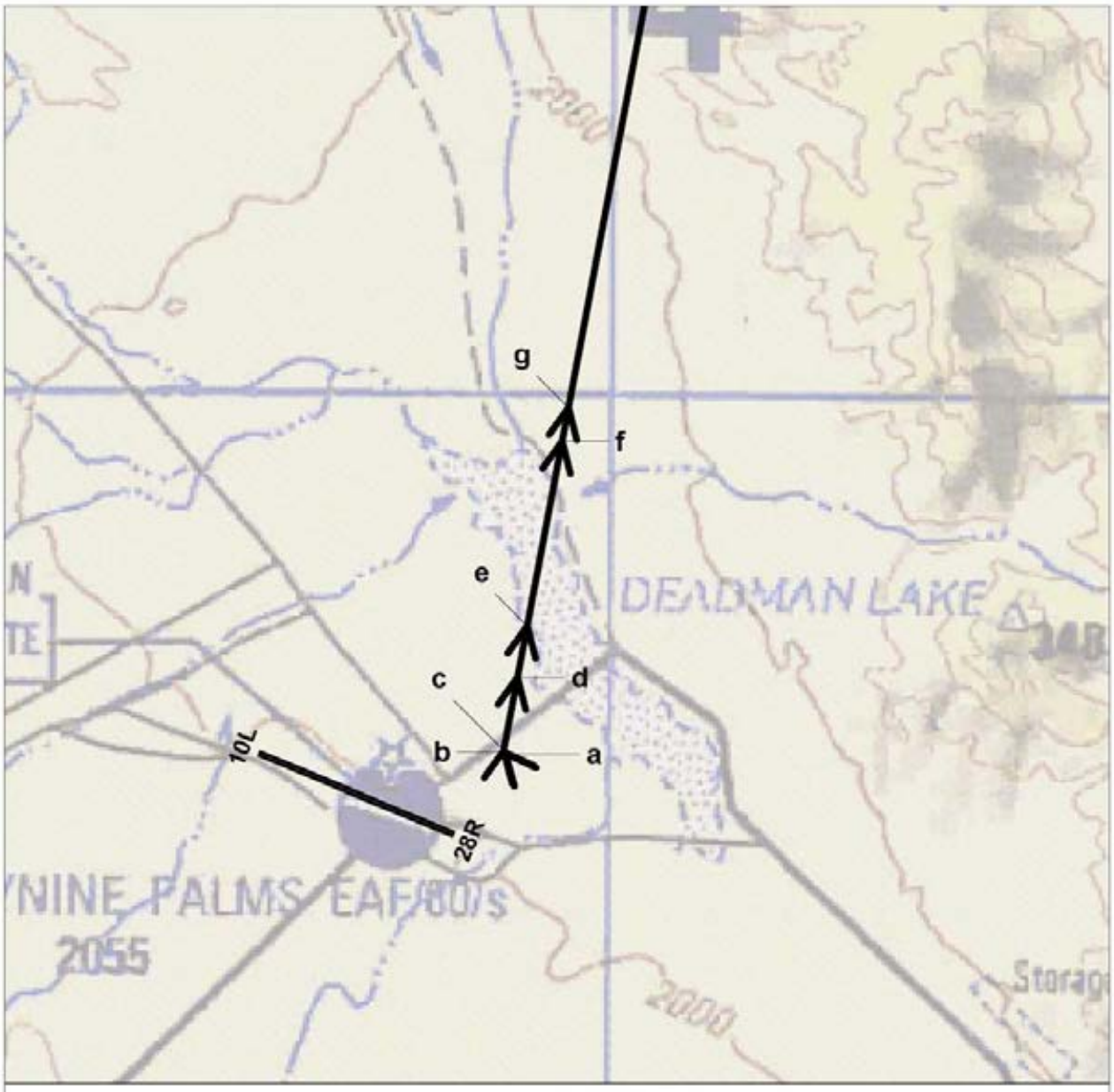
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	1,920 MSL	5	0	0	0	87	5 knot start
b	3,000	113 AGL	71	0	0	0	77	
c	5,000	225 AGL	115	0	0	0	70	
d	12,189	400 AGL	162	0	0	0	11	
e	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol
f	20,000	1,255 AGL	170	0	6	10	0	
g	21,800	1,464 AGL	170	0	6	10	0	
h	24,114	2,500 AGL	220	0	6	0	0	point added at end of turn; interpolated
i	30,715	2,500 AGL	170	0	7	0	0	accel to 220 within 0.5nm; +7deg aoa for level crui
j	33,753	3,000 AGL	220	0	5	0	0	+5deg for level cruise @ 220kts

Flight Profile 508
MV22B Departure
on Runway CWN and Flight Track WD1 - Rotary Wing Departure to W - Pt Giant

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:154,000 (1 inch = 12,800 feet)

N



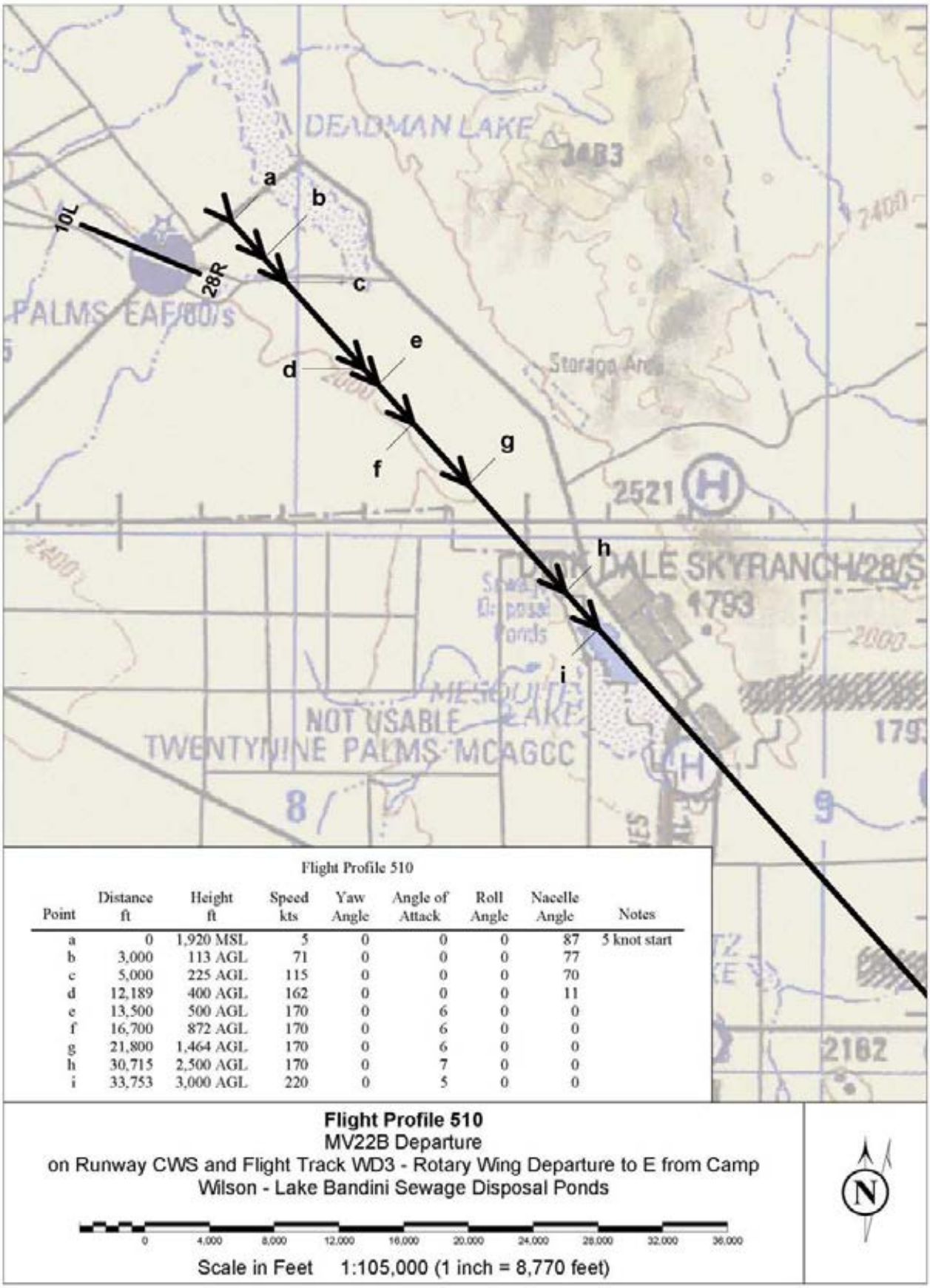
Flight Profile 509

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	1,920 MSL	5	0	0	0	87	5 knot start
b	100	1,946 MSL	7	0	0	-15	77	
c	145	1,950 MSL	8	0	0	-15	77	
d	3,000	163 AGL	71	0	0	0	77	
e	5,000	225 AGL	115	0	0	0	70	
f	12,189	400 AGL	162	0	0	0	11	
g	13,500	500 AGL	170	0	6	0	0	2000 fpm climb; +7deg aoa for 2500 fpm climb; rol

Flight Profile 509
MV22B Departure
on Runway CWN and Flight Track WD2 - Rotary Wing Departure to N - Pt North

0 4,000 8,000 12,000 16,000 20,000 24,000

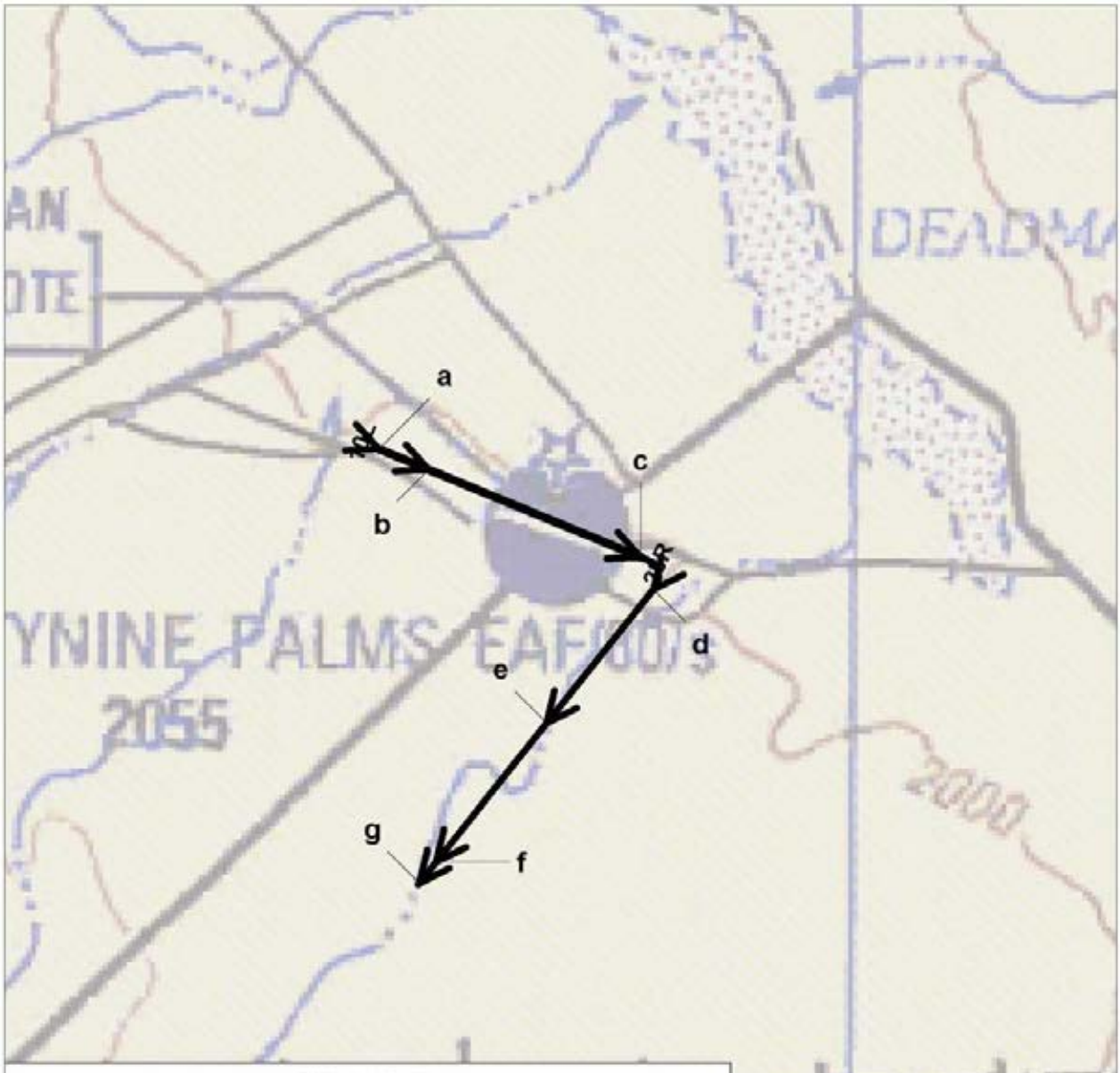
Scale in Feet 1:78,400 (1 inch = 6,530 feet)



Flight Profile 510

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle	Notes
a	0	1,920 MSL	5	0	0	0	87	5 knot start
b	3,000	113 AGL	71	0	0	0	77	
c	5,000	225 AGL	115	0	0	0	70	
d	12,189	400 AGL	162	0	0	0	11	
e	13,500	500 AGL	170	0	6	0	0	
f	16,700	872 AGL	170	0	6	0	0	
g	21,800	1,464 AGL	170	0	6	0	0	
h	30,715	2,500 AGL	170	0	7	0	0	
i	33,753	3,000 AGL	220	0	5	0	0	

Flight Profile 510
MV22B Departure
on Runway CWS and Flight Track WD3 - Rotary Wing Departure to E from Camp Wilson - Lake Bandini Sewage Disposal Ponds



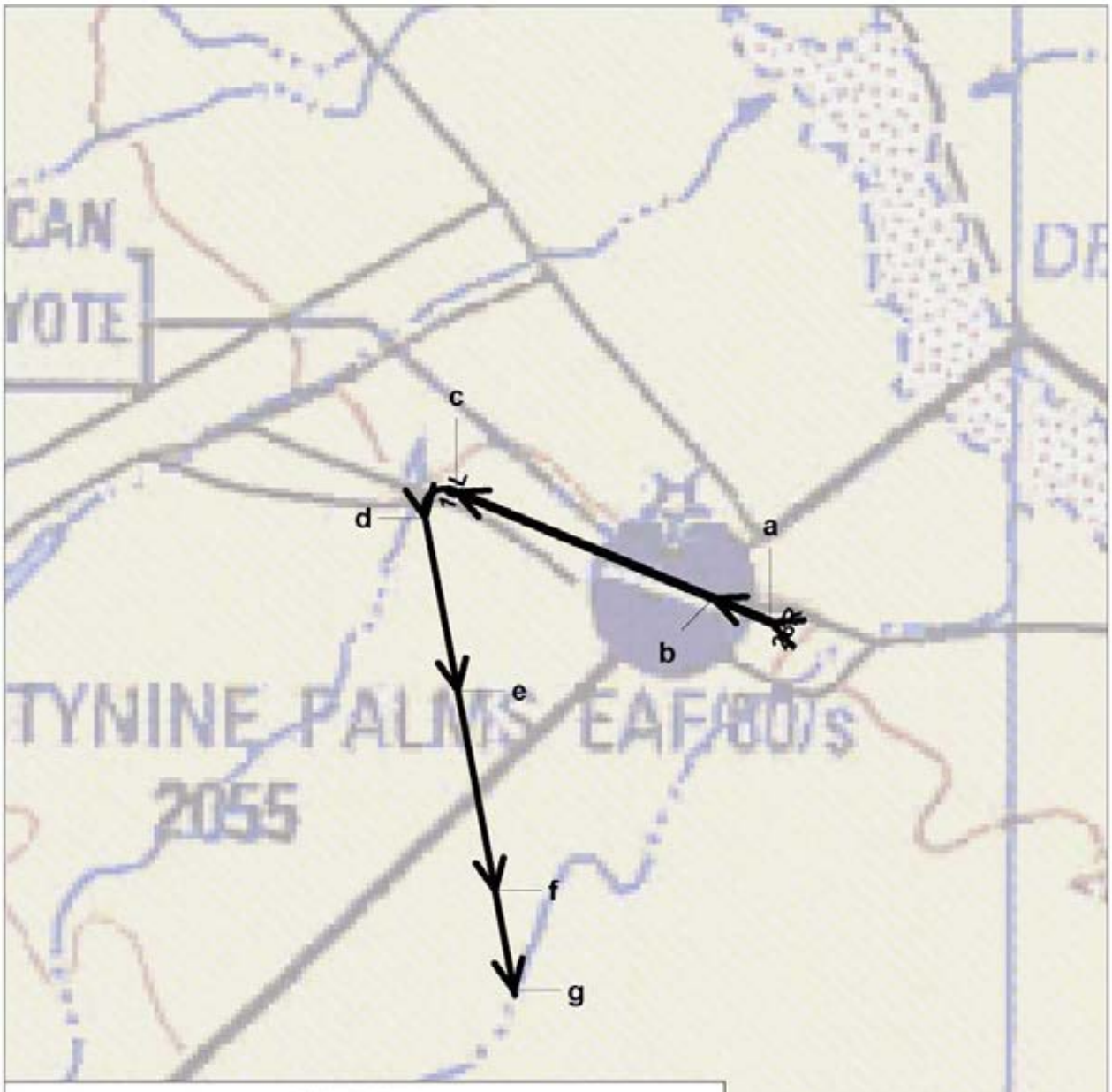
Flight Profile 530

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	10 AGL	5	0	0	0	90
b	1,519	166 AGL	70	0	0	0	76
c	7,983	500 AGL	150	0	0	-25	42
d	9,189	500 AGL	150	0	0	0	0
e	14,004	500 AGL	150	0	0	0	0
f	18,986	200 AGL	85	0	0	0	60
g	19,741	145 AGL	5	0	0	0	90

Flight Profile 530
MV22B Departure
on Runway 10L and Flight Track 10I1 - Rotary Wing Interfacility from Rwy 10 to Drop Zone Sandhill

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000 20,000

Scale in Feet 1:57,900 (1 inch = 4,820 feet)



Flight Profile 529

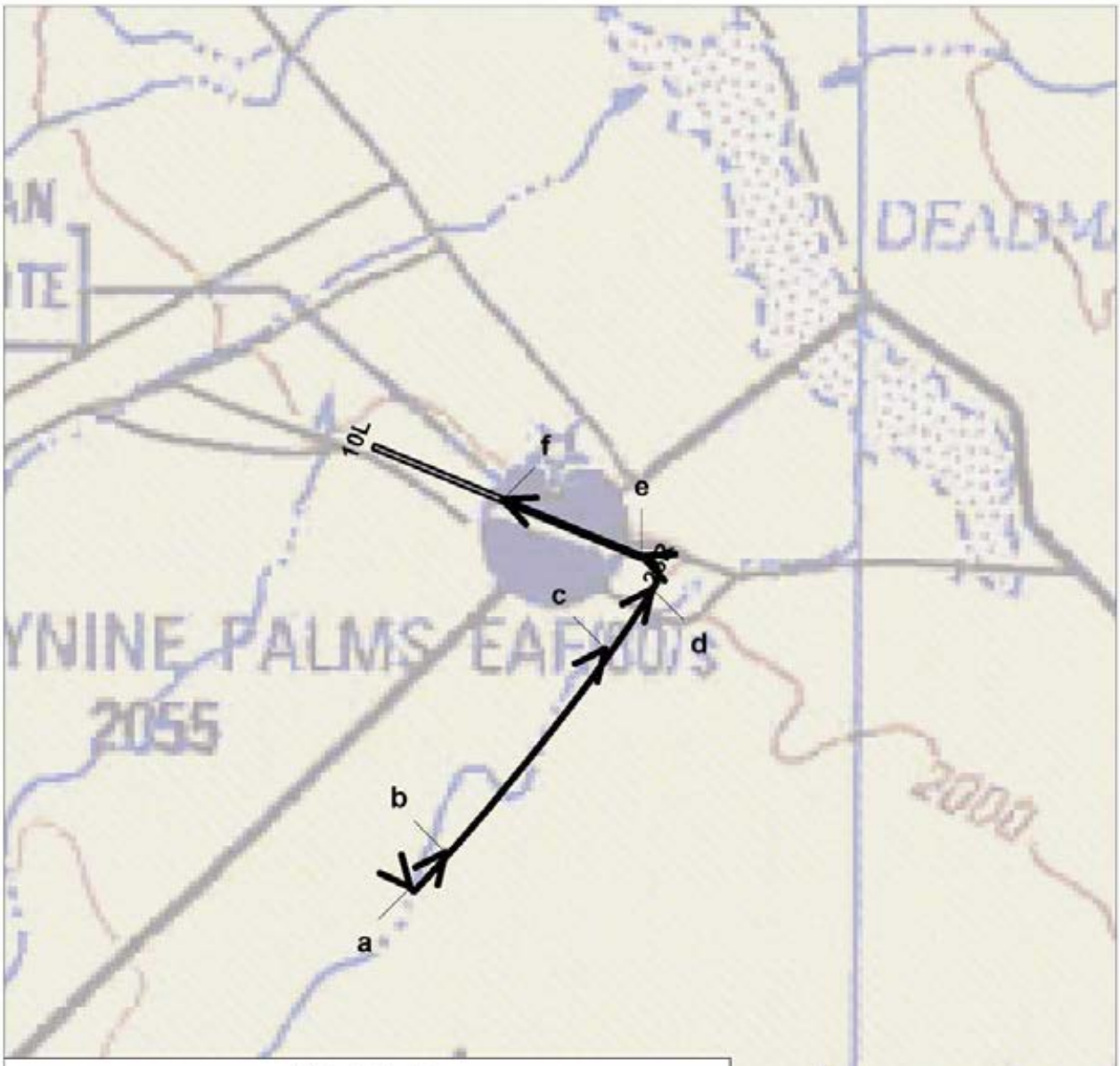
Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	10 AGL	5	0	0	0	90
b	1,519	166 AGL	110	0	0	0	60
c	8,393	500 AGL	150	0	0	25	35
d	9,692	500 AGL	150	0	0	0	0
e	14,004	500 AGL	150	0	0	0	0
f	18,986	220 AGL	110	0	0	0	35
g	21,493	145 AGL	5	0	0	0	90

Flight Profile 529
MV22B Departure
on Runway 28R and Flight Track 28I2 - Rotary Wing Interfacility to Drop Zone Sandhill

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000

Scale in Feet 1:50,200 (1 inch = 4,190 feet)

N



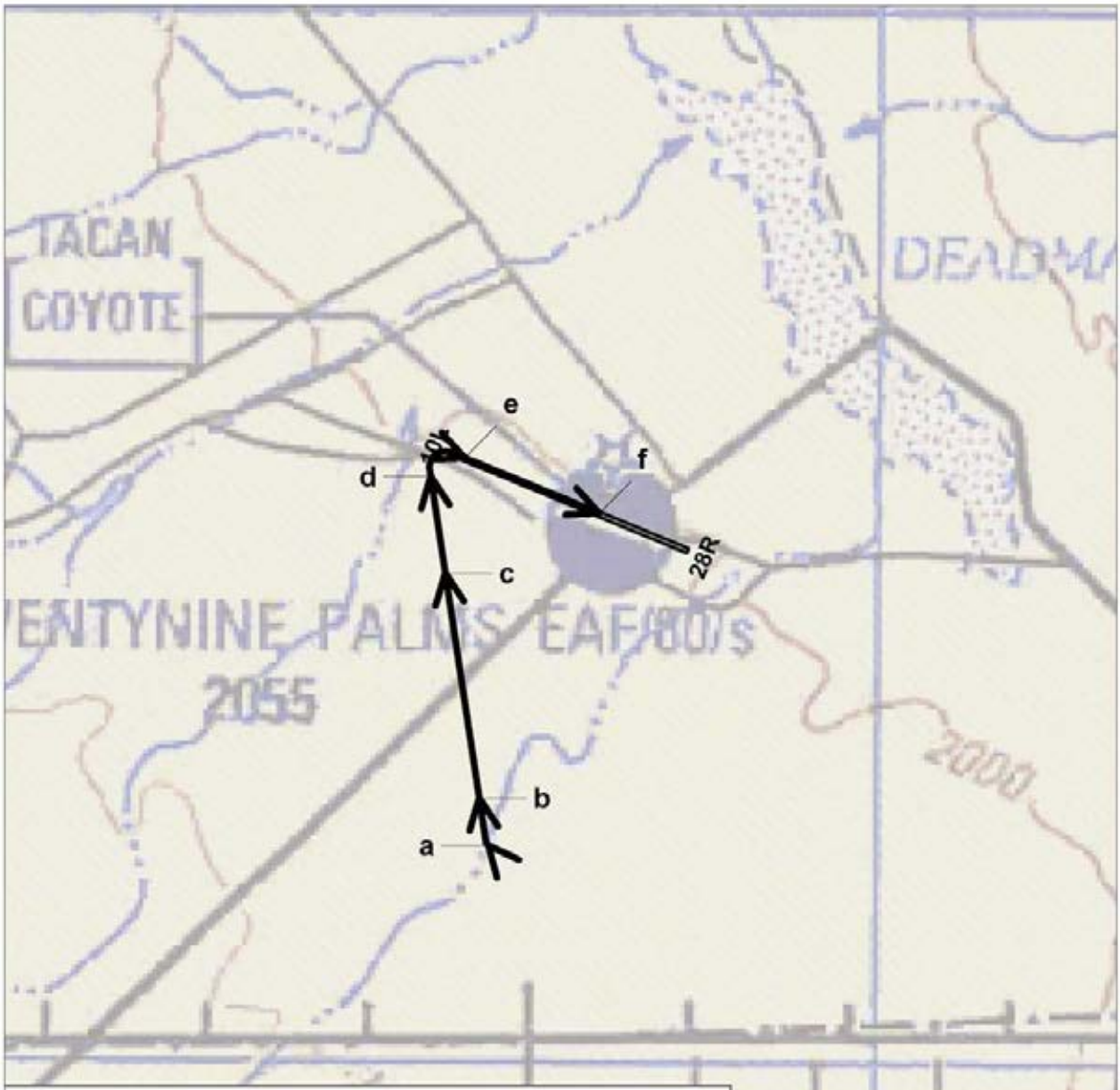
Flight Profile 527

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	145 AGL	5	0	0	0	90
b	1,519	220 AGL	110	0	0	0	60
c	8,622	500 AGL	150	0	0	0	0
d	10,714	500 AGL	150	0	0	-25	0
e	11,894	315 AGL	110	0	0	0	60
f	16,026	10 AGL	5	0	0	0	90

Flight Profile 527
Rotary Wing Interfacility from Drop Zone Sandhill to RWY 28
MV22B Departure
on Runway SHS and Flight Track SI1 - Rotary Wing Interfacility from Drop Zone Sandhill to Rwy 28

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:56,600 (1 inch = 4,720 feet)



Flight Profile 528

Point	Distance ft	Height ft	Speed kts	Yaw Angle	Angle of Attack	Roll Angle	Nacelle Angle
a	0	145 AGL	5	0	0	0	90
b	1,519	220 AGL	110	0	0	0	60
c	8,622	500 AGL	150	0	0	0	0
d	11,667	500 AGL	150	0	0	-25	0
e	13,395	500 AGL	110	0	0	0	60
f	17,959	10 AGL	200	0	0	0	90

Flight Profile 528
MV22B Departure
on Runway SHN and Flight Track SI2 - Rotary Wing Interfacility from Drop Zone Sandhill to Rwy 10

0 4,000 8,000 12,000 16,000 20,000

Scale in Feet 1:64,400 (1 inch = 5,370 feet)

N

C-1.4.5 Modeled Run-Ups for MCAGCC Twentynine Palms

No Run-Up profiles were modeled for existing or proposed scenario.

C-1.4.6 MCAGCC Twentynine Palms Modeled Airspace Operations and Sorties

Baseline Area Operation/Sorties at 29 Palms Airspace

Aircraft Type		R-2501N				R-2501S				R-2501E				R-2501W				Sundance MOA				Bristol MOA				**Totals**			
		Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
F/A-18C/D		1,075	18	-	1,093	1,371	23	-	1,394	1,062	17	-	1,079	1,016	17	-	1,033	100	2	-	102	232	5	-	237	4,856	82	-	4,938
F-5E		36	-	-	36	44	-	-	44	35	-	-	35	33	-	-	33	3	-	-	3	7	-	-	7	158	-	-	158
KC-130		340	18	-	358	433	23	-	456	335	17	-	352	322	17	-	339	32	2	-	34	75	5	-	80	1,537	82	-	1,619
AV-8B		645	250	-	895	821	319	-	1,140	636	247	-	883	611	237	-	848	60	23	-	83	140	54	-	194	2,913	1,130	-	4,043
AH-1		876	214	54	1,144	1,119	275	69	1,463	867	212	53	1,132	829	203	51	1,083	83	20	5	108	192	47	12	251	3,966	971	244	5,181
UH-1		359	-	-	359	458	-	-	458	354	-	-	354	339	-	-	339	34	-	-	34	79	-	-	79	1,623	-	-	1,623
CH-53E		537	18	-	555	684	23	-	707	530	17	-	547	508	17	-	525	50	2	-	52	116	5	-	121	2,425	82	-	2,507
CH-46E		896	161	18	1,075	1,143	206	23	1,372	884	159	17	1,060	846	152	17	1,015	84	15	2	101	195	35	5	235	4,048	728	82	4,858
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UAV(1)		161	18	107	286	206	23	137	366	159	17	106	282	152	17	101	270	15	2	10	27	35	5	23	63	728	82	484	1,294
TOTAL		4,925	697	179	5,801	6,279	892	229	7,400	4,862	686	176	5,724	4,656	660	169	5,485	461	66	17	544	1,071	156	40	1,267	22,254	3,157	810	26,221

(1) Unmanned Aerial Vehicle (Not Modeled)

Baseline Route Operations at 29 Palms Airspace

Aircraft Type		Number of Circuits												**Totals**			
		Bristol Aerial Refueling Track 19k				Bristol Aerial Refueling Track 22k				Perimeter Route							
		Day	Eve	Night	Total	Day	Evening	Night	Total	Day	Evening	Night	Total	Day	Evening	Night	Total
F/A-18C/D		98	2	-	100	98	2	-	100	-	-	-	-	196	4	-	200
F-5E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KC-130		383	25	-	408	383	25	-	408	-	-	-	-	766	50	-	816
AV-8B		63	25	-	88	63	25	-	88	-	-	-	-	126	50	-	176
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-46E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UAV(1)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		544	52	-	596	544	52	-	596	-	-	-	-	1,088	104	-	1,192

(1) Unmanned Aerial Vehicle (Not Modeled)

Proposed Airspace Operation/Sorties at 29 Palms Airspace

Aircraft Type		LAVIC LAKE				EMERSON LAKE				LEAD MTN NORTH				LEAD MOUNTAIN SOUTH				NOBLE PASS				DELTA				FASP			
		Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
MV-22	T&R	37	21	6	64	6	2	-	8	50	19	-	69	81	39	6	126	10	2	-	12	10	2	-	12	6	2	-	8
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		37	21	6	64	6	2	-	8	50	19	-	69	81	39	6	126	10	2	-	12	10	2	-	12	6	2	-	8

Aircraft Type		R-2501N				R-2501S				R-2501E				R-2501W				Sundance MOA				Bristol MOA				TOTAL			
		Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total	Day	Eve	Night	Total
F/A-18C/D		1,075	18	-	1,093	1,371	23	-	1,394	1,062	17	-	1,079	1,016	17	-	1,033	100	2	-	102	232	5	-	237	4,856	82	-	4,938
F-5E		36	-	-	36	44	-	-	44	35	-	-	35	33	-	-	33	3	-	-	3	7	-	-	7	158	-	-	158
KC-130		340	18	-	358	433	23	-	456	335	17	-	352	322	17	-	339	32	2	-	34	75	5	-	80	1,537	82	-	1,619
AV-8B		645	250	-	895	821	319	-	1,140	636	247	-	883	611	237	-	848	60	23	-	83	140	54	-	194	2,913	1,130	-	4,043
AH-1		876	214	54	1,144	1,119	275	69	1,463	867	212	53	1,132	829	203	51	1,083	83	20	5	108	192	47	12	251	3,966	971	244	5,181
UH-1		359	-	-	359	458	-	-	458	354	-	-	354	339	-	-	339	34	-	-	34	79	-	-	79	1,623	-	-	1,623
CH-53E		537	18	-	555	684	23	-	707	530	17	-	547	508	17	-	525	50	2	-	52	116	5	-	121	2,425	82	-	2,507
CH-46E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200	87	12	299
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UAV(1)		161	18	107	286	206	23	137	366	159	17	106	282	152	17	101	270	15	2	10	27	35	5	23	63	728	82	484	1,294
TOTAL		4,029	536	161	4,726	5,136	686	206	6,028	3,978	527	159	4,664	3,810	508	152	4,470	377	51	15	443	876	121	35	1,032	18,406	2,516	740	21,662

(1) Unmanned Aerial Vehicle (Not Modeled)

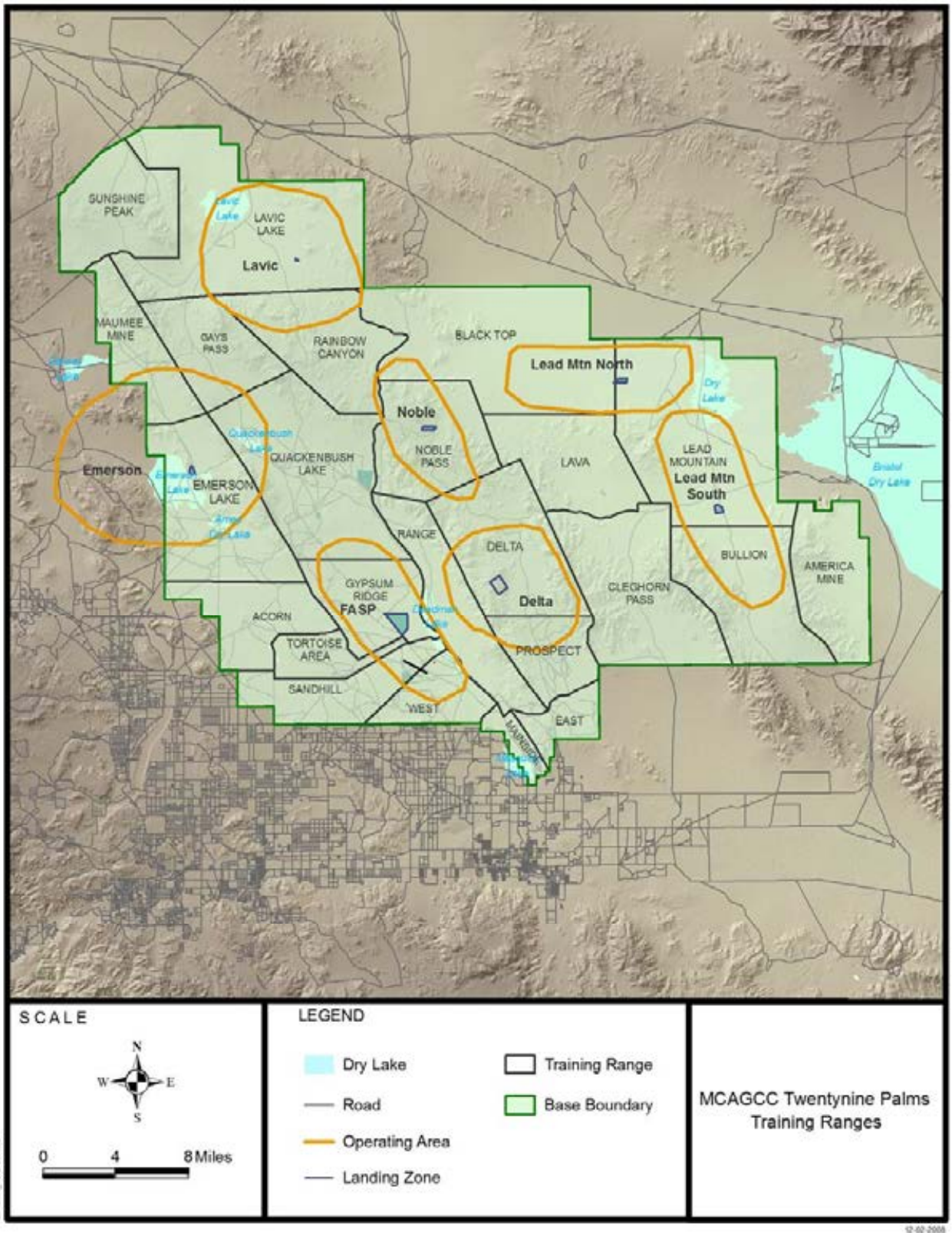
Proposed Route Operations at 29 Palms Airspace

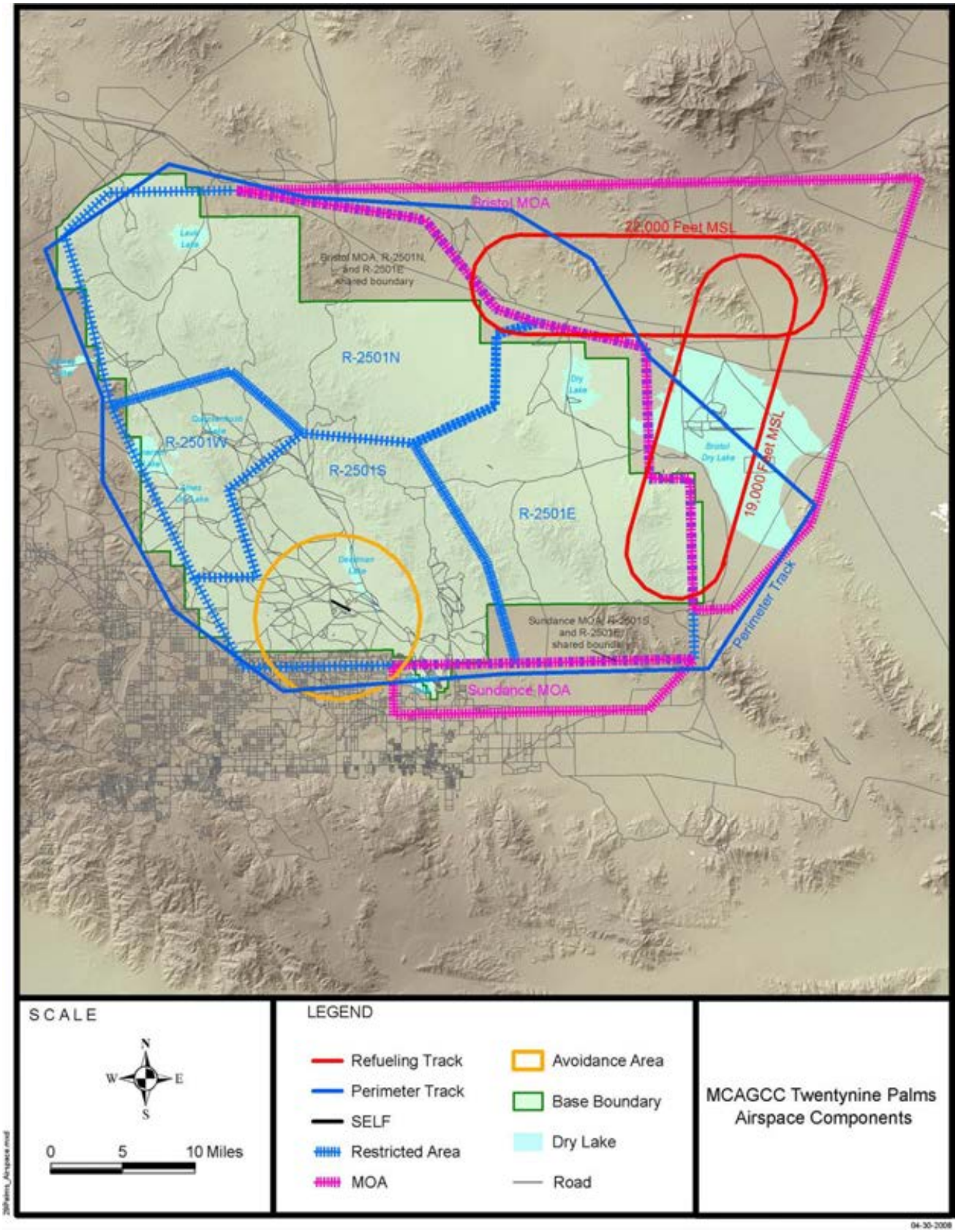
Aircraft Type		Routes (Number of Circuits)												Totals			
		Bristol Aerial Refueling Track 19k				Bristol Aerial Refueling Track 22k				Perimeter Route(2)							
		Day	Evening	Night	Total	Day	Evening	Night	Total	Day	Evening	Night	Total	Day	Evening	Night	Total
F/A-18C/D		98	2	-	100	98	2	-	100	-	-	-	-	196	4	-	200
F-5E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KC-130		383	25	-	408	383	25	-	408	-	-	-	-	766	50	-	816
AV-8B		63	25	-	88	63	25	-	88	-	-	-	-	126	50	-	176
AH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-53E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH-46E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MV-22	T&R	-	-	-	-	-	-	-	-	221	177	59	457	221	177	59	457
	WTI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Desert Talon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UAV(1)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		544	52	-	596	544	52	-	596	221	177	59	457	1,309	281	59	1,649

(1) Unmanned Aerial Vehicle (Not Modeled)

(2) Includes MV-22 High Light Level (HLL) and Low Light Level (LLL) Night Vision Goggle training and Tactics (TAC) sorties

C-1.4.7 MCAGCC Twentynine Palms Modeled Airspace - Maps




Bristol MOA
22,000 Feet MSL
Bristol MOA, R-2501N, and R-2501E shared boundary
R-2501N
R-2501W
R-2501S
R-2501E
19,000 Feet MSL
Perimeter Track
Sundance MOA, R-2501S and R-2501E shared boundary
Sundance MOA
SCALE
N
W
E
S
0
5
10 Miles
LEGEND
Refueling Track
Perimeter Track
SELF
Restricted Area
MOA
Avoidance Area
Base Boundary
Dry Lake
Road
MCAGCC Twentynine Palms
Airspace Components
04-30-2008

C-1.4.8 MCAGCC Twentynine Palms Modeled Airspace – Flight Profile Database

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)								
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 22000 MAX: 22000	0 500	0 1000	500 1000	1000 5000	1500 5000	1500 22000	19000 19000	TOTAL
BRISTOL	F-18 BRI	F-18	400	CRUISE POWER	88	% NC	daytime	19.33	5							100		100
BRISTOL	F-5 BRI	F-5E	325	CRUISE POWER	86	% RPM	daytime	0.58	15							100		100
BRISTOL	KC-130 BRI	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	6.25	120							100		100
BRISTOL	AV-8B BRI	AV-8B	300	TRAFFIC PATTERN	85	% RPM	daytime	11.67	5							100		100
BRISTOL	AH-1 BRI	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	16	30						100			100
BRISTOL	AH-1 BRI	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	1	30						100			100
BRISTOL	UH-1 BRI	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	6.58	30						100			100
BRISTOL	CH-53E BRI	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	9.67	30						100			100
2501E	F-18 RES	F-18	400	CRUISE POWER	88	% NC	daytime	88.5	9		20		40	40				100
2501E	F-5 RES	F-5E	325	CRUISE POWER	86	% RPM	daytime	2.92	9		20		40	40				100
2501E	KC-130 RES	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	27.92	9		20		40	40				100
2501E	AV-8B RES	AV-8B	300	TRAFFIC PATTERN	85	% RPM	daytime	53	9		20		40	40				100
2501E	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	72.25	18		20		40	40				100
2501E	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	4.42	18		20		40	40				100
2501E	UH-1 RES	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	29.5	18			100						100
2501E	CH-53E RES	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	44.17	18			100						100
2501E	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	73.67	18			100						100
2501E	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	1.42	18			100						100
2501N	F-18 RES	F-18	400	CRUISE POWER	88	% NC	daytime	89.58	9		20		40	40				100
2501N	F-5 RES	F-5E	325	CRUISE POWER	86	% RPM	daytime	3	9		20		40	40				100
2501N	KC-130 RES	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	28.33	9		20		40	40				100
2501N	AV-8B RES	AV-8B	300	TRAFFIC PATTERN	85	% RPM	daytime	53.75	9		20		40	40				100
2501N	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	73	18		20		40	40				100
2501N	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	4.5	18		20		40	40				100
2501N	UH-1 RES	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	29.92	18			100						100
2501N	CH-53E RES	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	44.75	18			100						100
2501N	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	74.67	18			100						100
2501N	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	1.5	18			100						100
2501S	F-18 RES	F-18	400	CRUISE POWER	88	% NC	daytime	114.25	3		20		40	40				100
2501S	F-5 RES	F-5E	325	CRUISE POWER	86	% RPM	daytime	3.67	3		20		40	40				100
2501S	KC-130 RES	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	36.08	3		20		40	40				100
2501S	AV-8B RES	AV-8B	300	TRAFFIC PATTERN	85	% RPM	daytime	68.42	3		20		40	40				100
2501S	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	93.25	6		20		40	40				100
2501S	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	5.75	6		20		40	40				100
2501S	UH-1 RES	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	38.17	6			100						100
2501S	CH-53E RES	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	57	6			100						100
2501S	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	95.25	6			100						100
2501S	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	1.92	6			100						100
2501W	F-18 RES	F-18	400	CRUISE POWER	88	% NC	daytime	84.67	9		20		40	40				100
2501W	F-5 RES	F-5E	325	CRUISE POWER	86	% RPM	daytime	2.75	9		20		40	40				100
2501W	KC-130 RES	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	26.83	9		20		40	40				100
2501W	AV-8B RES	AV-8B	300	TRAFFIC PATTERN	85	% RPM	daytime	50.92	9		20		40	40				100
2501W	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	69.08	18		20		40	40				100
2501W	AH-1 RES	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	4.25	18		20		40	40				100
2501W	UH-1 RES	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	28.25	18			100						100
2501W	CH-53E RES	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	42.33	18			100						100
2501W	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	70.5	18			100						100
2501W	CH-46E RES	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	1.42	18			100						100
SUNDANCE	F-18 SUN	F-18	400	CRUISE POWER	88	% NC	daytime	8.33	2				100					100
SUNDANCE	F-5 SUN	F-5E	325	CRUISE POWER	86	% RPM	daytime	0.25	2				100					100
SUNDANCE	KC-130 SUN	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	2.67	2				100					100
SUNDANCE	AV-8B SUN	AV-8B	300	TRAFFIC PATTERN	85	% RPM	daytime	5	2				100					100
SUNDANCE	AH-1 SUN	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	daytime	6.92	2				100					100
SUNDANCE	AH-1 SUN	AH-1G	100	LFO LITE 100 KTS	100	KNOTS	nighttime	0.42	2				100					100
SUNDANCE	UH-1 SUN	UH-1N	100	FLT AT 80 KTS	100	% RPM	daytime	2.83	2				100					100
SUNDANCE	CH-53E SUN	CH-53E	120	CRUISE POWER	68	%Q-BPA	daytime	4.17	2				100					100
SUNDANCE	CH-46E SUN	CH-46E	110	CRUISE POWER	79	%Q-BPA	daytime	7	2				100					100
SUNDANCE	CH-46E SUN	CH-46E	110	CRUISE POWER	79	%Q-BPA	nighttime	0.17	2				100					100

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)								
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 22000 MAX: 22000	0 500	0 1000	500 1000	1000 5000	1500 5000	1500 22000	19000 19000	TOTAL
LMTNN	MV22_110	TAKEOFF PO	110	110			daytime	2.08	60		100							100
LMTNN	MV22_110	TAKEOFF PO	110	110			evening	0.79	60		100							100
LMTNS	MV22_110	TAKEOFF PO	110	110			daytime	3.38	60		100							100
LMTNS	MV22_110	TAKEOFF PO	110	110			evening	1.62	60		100							100
LMTNS	MV22_110	TAKEOFF PO	110	110			nighttime	0.25	60		100							100
NOBLE	MV22_110	TAKEOFF PO	110	110			daytime	0.42	60		100							100
NOBLE	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100
DELTA	MV22_110	TAKEOFF PO	110	110			daytime	0.42	60		100							100
DELTA	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100
FASP	MV22_110	TAKEOFF PO	110	110			daytime	0.25	60		100							100
FASP	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100
EMERSON	MV22_110	TAKEOFF PO	110	110			daytime	0.25	60		100							100
EMERSON	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100
LAVIC	MV22_110	TAKEOFF PO	110	110			daytime	1.54	60		100							100
LAVIC	MV22_110	TAKEOFF PO	110	110			evening	0.88	60		100							100
LAVIC	MV22_110	TAKEOFF PO	110	110			nighttime	0.25	60		100							100
LAVICSUB	MV22_110	TAKEOFF PO	110	110			daytime	1.54	60		100							100
LAVICSUB	MV22_110	TAKEOFF PO	110	110			evening	0.88	60		100							100
LAVICSUB	MV22_110	TAKEOFF PO	110	110			nighttime	0.25	60		100							100
LMTNNSUB	MV22_110	TAKEOFF PO	110	110			daytime	2.08	60		100							100
LMTNNSUB	MV22_110	TAKEOFF PO	110	110			evening	0.79	60		100							100
NOBLESUB	MV22_110	TAKEOFF PO	110	110			daytime	0.42	60		100							100
NOBLESUB	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100
EMERSONSUB	MV22_110	TAKEOFF PO	110	110			daytime	0.25	60		100							100
EMERSONSUB	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100
LMTNSSUB	MV22_110	TAKEOFF PO	110	110			daytime	3.38	60		100							100
LMTNSSUB	MV22_110	TAKEOFF PO	110	110			evening	1.62	60		100							100
LMTNSSUB	MV22_110	TAKEOFF PO	110	110			nighttime	0.25	60		100							100
FASPSUB	MV22_110	TAKEOFF PO	110	110			daytime	0.25	60		100							100
FASPSUB	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100
DELTASUB	MV22_110	TAKEOFF PO	110	110			daytime	0.42	60		100							100
DELTASUB	MV22_110	TAKEOFF PO	110	110			evening	0.08	60		100							100

MODELED CONDITIONS								BUSY	TIME PER	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)								
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	SORTIE (MINUTES)	MIN: 22000 MAX: 22000	0 500	0 1000	500 1000	1000 5000	1500 5000	1500 22000	19000 19000	TOTAL
FLTRK22	KC130#2FTK	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	31.92		100								
FLTRK22	F18#2FLTRK	F-18	250	TRAFFIC PATTERN	82	% NC	daytime	8.12		100								
FLTRK22	AV8#2FLTRK	AV-8B	250	TRAFFIC PATTERN	70	% RPM	daytime	5.25		100								
FLTRK19	KC130#1FTK	C-130H&N&P	250	TAKEOFF POWER	850	C TIT	daytime	31.92										100
FLTRK19	F18#1FLTRK	F-18	250	TRAFFIC PATTERN	82	% NC	daytime	8.12										100
FLTRK19	AV8#1FLTRK	AV-8B	250	TRAFFIC PATTERN	70	% RPM	daytime	5.25										100
PERIMETER	MV22_220	TAKEOFF PO	110	110	VC10		daytime	26.75				100						100
PERIMETER	MV22_220	TAKEOFF PO	110	110	VC10		evening	21.25				100						100

C-1.5 NOISE MODELING DATA FOR RELEVANT MILITARY TRAINING ROUTES

C-1.5.1 Military Training Route Sorties

Existing Annual MTR Sorties

MTR	Aircraft Type	Note	Segments*	Annual Sorties			
				Day (0700-1900)	Eve (1900-2200)	Night (2200-0700)	Total
VR-1266	A-10	3	-	6	-	-	6
	AV-8B		A-F	165	-	-	165
			A-G	41	-	-	41
	C-12	3	-	1	-	-	1
	C-130H&N&P		-	13	-	-	13
	E-3	3	-	1	-	-	1
	EA-6B	4	-	229	-	-	229
	F-16A		-	6	-	-	6
	F-18	2	A-E	220	-	-	220
	F-5E		-	1	-	-	1
	T-1	3	-	1	-	-	1
	T-35	3	-	1	-	-	1
	T-38A		-	6	-	-	6
	T-45		-	140	-	-	140
	MV22-LAT		-	-	-	-	-
VR-1267	A-10	3	-	-	-	-	-
	AV-8B		-	127	-	-	127
	C-12	3	-	1	-	-	1
	C-130H&N&P		-	62	-	-	62
	EA-6B	4	-	220	-	-	220
	F-16A		-	15	-	-	15
	F-18	2	-	82	-	-	82
	T-45		-	84	-	-	84
	MV22-LAT		-	-	-	-	-
VR-1267A	A-10	3	-	1	-	-	1
	AV-8B		-	32	-	-	32
	C-12	3	-	1	-	-	1
	C-130H&N&P		-	36	-	-	36
	EA-6B	4	-	3	-	-	3
	F-18	2	-	18	-	-	18
	T-45		-	2	-	-	2
	MV22-LAT		-	-	-	-	-
VR-1268	AV-8B		-	25	-	-	25
	C-12	3	-	1	-	-	1
	A-10	3	-	3	-	-	3
	C-130H&N&P		-	1	-	-	1
	F-18		-	13	-	-	13
	T-45		-	1	-	-	1
	MV22-LAT		-	-	-	-	-
IR-216	AV-8B		-	8	-	-	8
	C-17		-	2	-	-	2
	EA-6B	4	-	95	-	-	95
	F-15A		-	1	-	-	1
	F-18	2	-	48	-	-	48
	T-45		-	16	-	-	16
	MV22-LAT		-	-	-	-	-
IR-217	AV-8B		-	6	1	1	8
	C-17		-	1	1	-	2
	EA-6B	4	-	67	20	8	95
	F-15A		-	1	-	-	1
	F-18	2	A-K	30	2	-	32
			F-I	15	1	-	16
	T-45		A-K	9	-	-	9
			F-K	7	-	-	7
	MV22-LAT		-	-	-	-	-
	MV22-HLL		-	-	-	-	-
	MV22-LLL		-	-	-	-	-
IR-218	C-130H&N&P		-	3	-	-	3
	C-17		-	1	1	-	2
	EA-6B	4	-	-	1	-	1
	F-18	2	-	12	8	1	21
	HELOS	3	-	1	-	-	1
	MV22-LAT		-	-	-	-	-
	MV22-HLL		-	-	-	-	-
	MV22-LLL		-	-	-	-	-
VR-1266				831	-	-	831
VR-1267				591	-	-	591
VR-1267A				93	-	-	93
VR-1268				44	-	-	44
IR-216				170	-	-	170
IR-217				136	25	9	170
IR-218				17	10	1	28

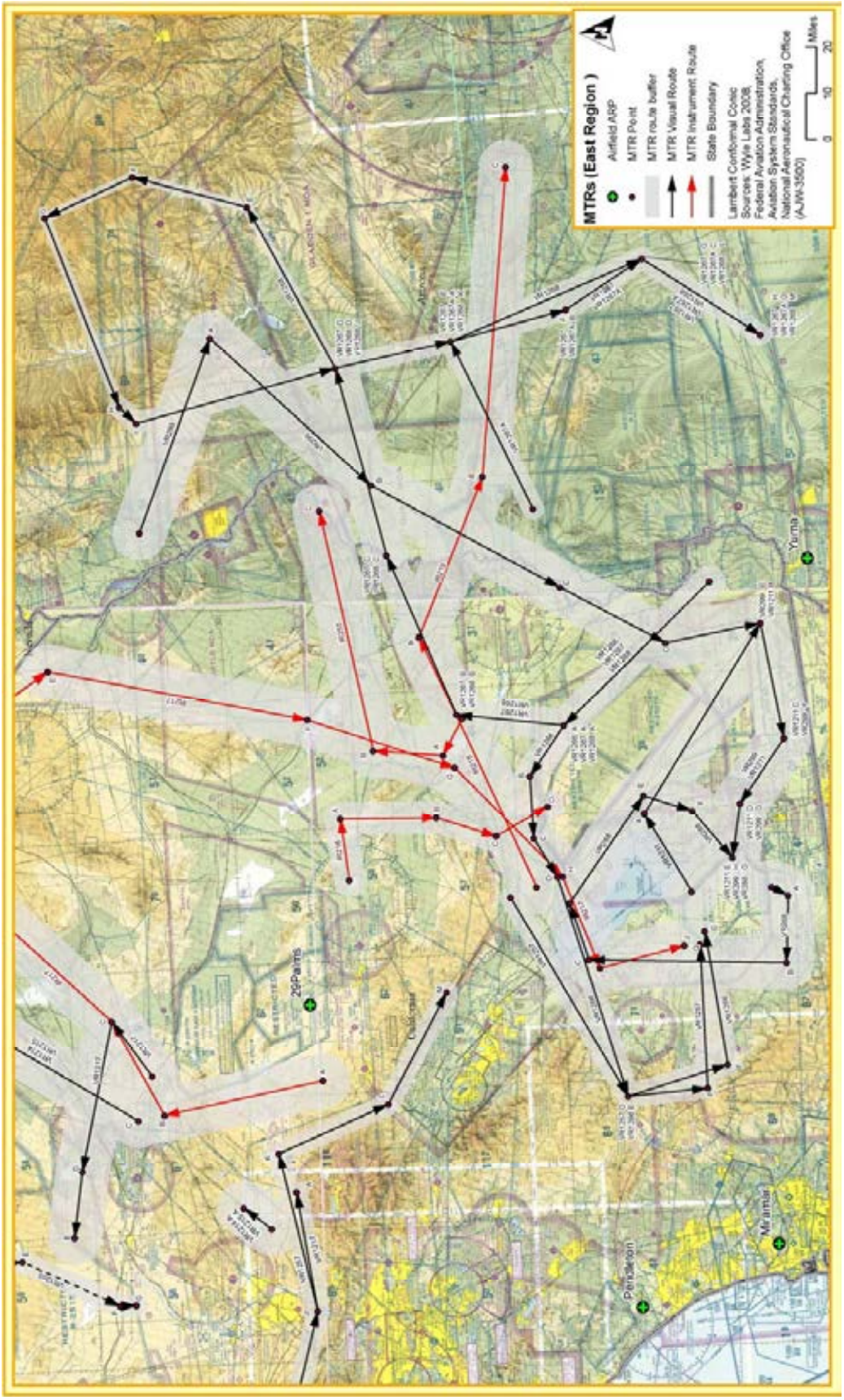
Notes:
*All aircraft fly along every segment of each MTR unless otherwise specified
2) Modeled as F/A-18C/D
3) Not modeled
4) Modeled as A-6A
5) F-14, S-3 and MV-22 not modeled for Existing conditions
6) All VR flying days and busy-month proportions derived from 4-year monthly averages for 2004 thru 2007.
(VR-1266 @ 25 days, VR-1267 @ 27 days, VR-1267A @26 days, VR-1268 @ 26 days)
7) All IR flying days and busy-month proportions derived from 2-year averages of sorties 2006 thru 2007 (Source: LtCol David C.Weir)
(IR-216 @ 21 days, IR-217 @ 21 days, IR-218 @ 9 days)

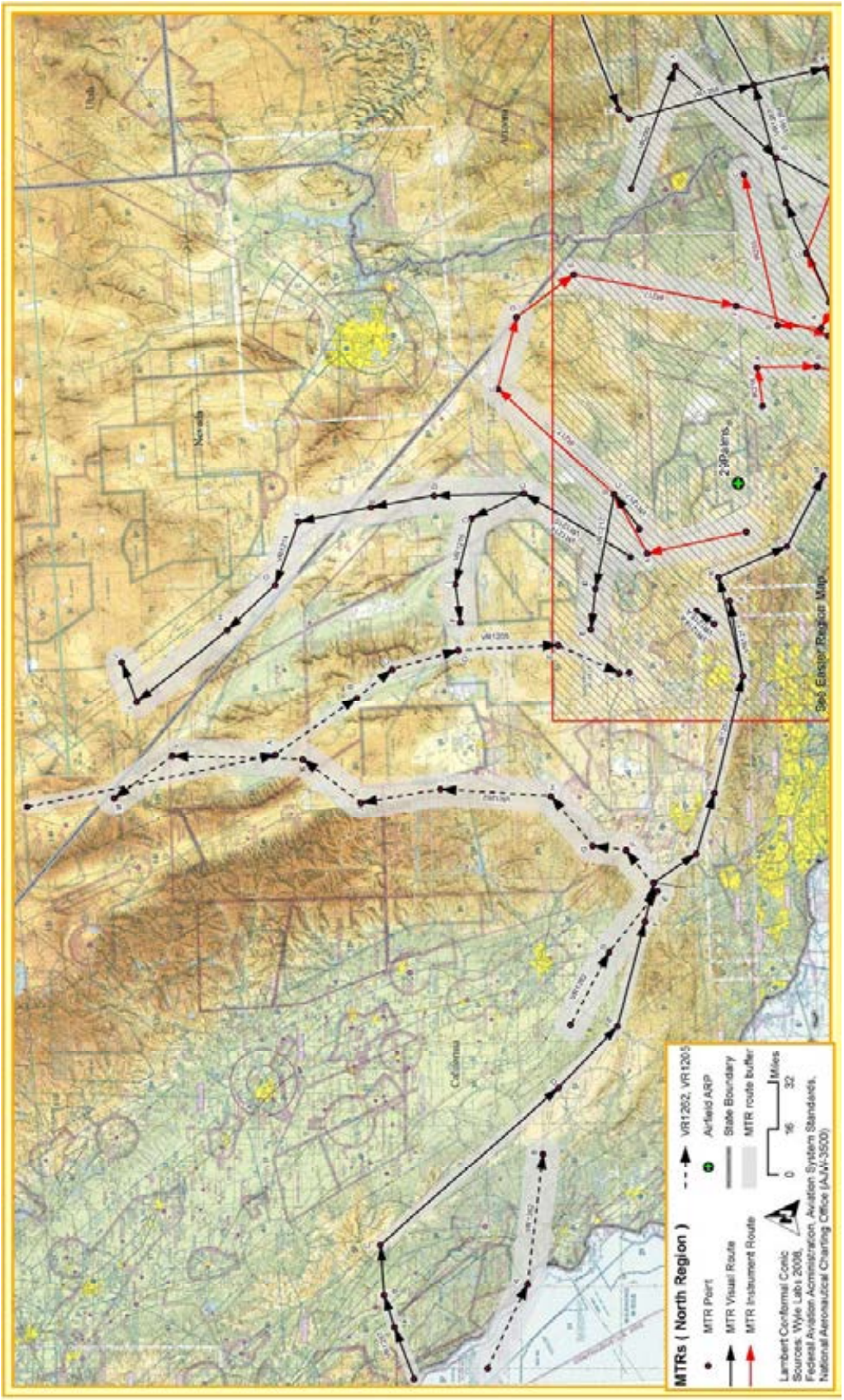
Proposed Annual MTR Sorties

MTR	Aircraft Type	Note	Segments*	Annual Sorties			
				Day (0700-1900)	Eve (1900-2200)	Night (2200-0700)	Total
VR-1266	A-10	3	-	6	-	-	6
	AV-8B		A-F	165	-	-	165
			A-G	41	-	-	41
	C-12	3	-	1	-	-	1
	C-130H&N&P		-	13	-	-	13
	E-3	3	-	1	-	-	1
	EA-6B	4	-	229	-	-	229
	F-16A		-	6	-	-	6
	F-18	2	A-E	220	-	-	220
	F-5E		-	1	-	-	1
	T-1	3	-	1	-	-	1
	T-35	3	-	1	-	-	1
	T-38A		-	6	-	-	6
	T-45		-	140	-	-	140
	MV22-LAT		-	148	-	-	148
VR-1267	A-10	3	-	-	-	-	-
	AV-8B		-	127	-	-	127
	C-12	3	-	1	-	-	1
	C-130H&N&P		-	62	-	-	62
	EA-6B	4	-	220	-	-	220
	F-16A		-	15	-	-	15
	F-18	2	-	82	-	-	82
	T-45		-	84	-	-	84
	MV22-LAT		-	148	-	-	148
VR-1267A	A-10	3	-	1	-	-	1
	AV-8B		-	32	-	-	32
	C-12	3	-	1	-	-	1
	C-130H&N&P		-	36	-	-	36
	EA-6B	4	-	3	-	-	3
	F-18	2	-	18	-	-	18
	T-45		-	2	-	-	2
	MV22-LAT		-	148	-	-	148
VR-1268	AV-8B		-	25	-	-	25
	C-12	3	-	1	-	-	1
	A-10	3	-	3	-	-	3
	C-130H&N&P		-	1	-	-	1
	F-18		-	13	-	-	13
	T-45		-	1	-	-	1
	MV22-LAT		-	148	-	-	148
IR-216	AV-8B		-	8	-	-	8
	C-17		-	2	-	-	2
	EA-6B	4	-	95	-	-	95
	F-15A		-	1	-	-	1
	F-18	2	-	48	-	-	48
	T-45		-	16	-	-	16
	MV22-LAT		-	148	-	-	148
IR-217	AV-8B		-	6	1	1	8
	C-17		-	1	1	-	2
	EA-6B	4	-	67	20	8	95
	F-15A		-	1	-	-	1
	F-18	2	A-K	30	2	-	32
			F-I	15	1	-	16
	T-45		A-K	9	-	-	9
			F-K	7	-	-	7
	MV22-LAT		-	107	159	-	266
	MV22-HLL		-	-	119	30	149
	MV22-LLL		-	-	119	30	149
IR-218	C-130H&N&P		-	3	-	-	3
	C-17		-	1	1	-	2
	EA-6B	4	-	-	1	-	1
	F-18	2	-	12	8	1	21
	HELOS	3	-	1	-	-	1
	MV22-LAT		-	148	221	-	369
	MV22-HLL		-	-	165	41	206
	MV22-LLL		-	-	165	41	206
VR-1266				979	-	-	979
VR-1267				739	-	-	739
VR-1267A				241	-	-	241
VR-1268				192	-	-	192
IR-216				318	-	-	318
IR-217				243	422	69	734
IR-218				165	561	83	809

Notes:
*All aircraft fly along every segment of each MTR unless otherwise specified
2) Modeled as F/A-18C/D
3) Not modeled
4) Modeled as A-6A
5) F-14 and S-3 not modeled for Proposed conditions
6) Aircraft from Existing condition assumed to maintain same sorties for Proposed condition

C-1.5.2 Military Training Route Maps




MTRs (North Region)
MTR Point
MTR Visual Route
MTR Instrument Route
VR1262, VR1205
Airfield ARP
State Boundary
MTR route buffer
Miles
0 16 32
Lambert Conformal Conic
Sources: Wyle Labs 2008,
Federal Aviation Administration, Aviation System Standards,
National Aeronautical Charting Office (AJW-3500)
Utah
Nevada
Arizona
California
Palms
Base Exterior Region Map

C-1.5.3 Military Training Route Flight Profiles

MODELED CONDITIONS								BUSY	TIME (% OR MINUTES) IN RANGE OF ALTITUDE (FT AGL)			
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	MIN: 0 MAX: 500	200 200	500 500	TOTAL
IR216	AV8B	AV-8B	300	TAKEOFF POWER	95	% RPM	daytime	0.67	100			100
IR216	C17	C-17	250	INTERMEDIATE POWER	92	% NC	daytime	0.17	100			100
IR216	A6A	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	7.92	100			100
IR216	F18CD	F-18	500	TRAINING ROUTE	92	% NC	daytime	4.00	100			100
IR216	T45	T-45	250	CRUISE POWER	85.5	% RPM	daytime	1.33	100			100
IR216	F15A	F-15A	450	LOW SPD TRAINING RT	77	% NC	daytime	0.08	100			100
IR216	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100			100
IR217 A-K	AV8B	AV-8B	300	TAKEOFF POWER	95	% RPM	daytime	0.50	100			100
IR217 A-K	AV8B	AV-8B	300	TAKEOFF POWER	95	% RPM	evening	0.08	100			100
IR217 A-K	AV8B	AV-8B	300	TAKEOFF POWER	95	% RPM	nighttime	0.08	100			100
IR217 A-K	C17	C-17	250	INTERMEDIATE POWER	92	% NC	daytime	0.08	100			100
IR217 A-K	C17	C-17	250	INTERMEDIATE POWER	92	% NC	evening	0.08	100			100
IR217 A-K	A6A	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	5.58	100			100
IR217 A-K	A6A	A-6A	250	TAKEOFF POWER	100	% RPM	evening	1.67	100			100
IR217 A-K	A6A	A-6A	250	TAKEOFF POWER	100	% RPM	nighttime	0.67	100			100
IR217 A-K	F18CD A-K	F-18	500	TRAINING ROUTE	92	% NC	daytime	2.52	100			100
IR217 A-K	F18CD A-K	F-18	500	TRAINING ROUTE	92	% NC	evening	0.17	100			100
IR217 A-K	T45 A-K	T-45	250	CRUISE POWER	85.5	% RPM	daytime	0.73	100			100
IR217 A-K	F15A	F-15A	450	LOW SPD TRAINING RT	77	% NC	daytime	0.08	100			100
IR217 F-I	F18CD F-I	F-18	500	TRAINING ROUTE	92	% NC	daytime	1.23	100			100
IR217 F-I	F18CD F-I	F-18	500	TRAINING ROUTE	92	% NC	evening	0.08	100			100
IR217 F-K	T45 F-K	T-45	250	CRUISE POWER	85.5	% RPM	daytime	0.60	100			100
IR217 A-K	MV22-LAT		220	TAKEOFF PO	85.5		daytime	8.92	100			100
IR217 A-K	MV22-LAT		220	TAKEOFF PO	85.5		evening	13.25	100			100
IR217 A-K	MV22-HLL		220	TAKEOFF PO	85.5		evening	9.92		100		100
IR217 A-K	MV22-HLL		220	TAKEOFF PO	85.5		nighttime	2.50		100		100
IR217 A-K	MV22-LLL		220	TAKEOFF PO	85.5		evening	9.92			100	100
IR217 A-K	MV22-LLL		220	TAKEOFF PO	85.5		nighttime	2.50			100	100
IR218	C17	C-17	250	INTERMEDIATE POWER	92	% NC	daytime	0.08	100			100
IR218	C17	C-17	250	INTERMEDIATE POWER	92	% NC	evening	0.08	100			100
IR218	C130H	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	0.25	100			100
IR218	A6A	A-6A	250	TAKEOFF POWER	100	% RPM	evening	0.08	100			100
IR218	F18CD	F-18	500	TRAINING ROUTE	92	% NC	daytime	1.00	100			100
IR218	F18CD	F-18	500	TRAINING ROUTE	92	% NC	evening	0.67	100			100
IR218	F18CD	F-18	500	TRAINING ROUTE	92	% NC	nighttime	0.08	100			100
IR218	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100			100
IR218	MV22-LAT		220	TAKEOFF PO	85.5		evening	18.42	100			100
IR218	MV22-HLL		220	TAKEOFF PO	85.5		evening	13.75		100		100
IR218	MV22-HLL		220	TAKEOFF PO	85.5		nighttime	3.42		100		100
IR218	MV22-LLL		220	TAKEOFF PO	85.5		evening	13.75			100	100
IR218	MV22-LLL		220	TAKEOFF PO	85.5		nighttime	3.42			100	100

MODELED CONDITIONS								BUSY	TIME (% OR MINUTES) IN RANGE OF				
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	Floor*	200 500	300 300	500 500	TOTAL
1266_AE	C130-1266	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	1.08	100				100
1266_AE	AV8B-1266	AV-8B	550	TAKEOFF POWER	95	% RPM	daytime	13.75			100		100
1266_AE	F18CD-1266	F-18	500	TRAINING ROUTE	92	% NC	daytime	18.33				100	100
1266_AE	T38A-1266	T-38A	299	TAKEOFF POWER	100	% RPM	daytime	0.5				100	100
1266_AE	T45-1266	T-45	250	TAKEOFF POWER	100	% RPM	daytime	11.67				100	100
1266_AE	EA6-1266	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	19.08		100			100
1266_AE	F5-1266	F-5E	325	CRUISE POWER	86	% RPM	daytime	0.08	100				100
1266_AE	F16-1266	F-16A	500	TRAINING ROUTE	84	% NC	daytime	0.5	100				100
1266_EF	C130-1266	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	1.08	100				100
1266_EF	AV8B-1266	AV-8B	550	TAKEOFF POWER	95	% RPM	daytime	13.75	100				100
1266_EF	T38A-1266	T-38A	299	TAKEOFF POWER	100	% RPM	daytime	0.5			100		100
1266_EF	T45-1266	T-45	250	TAKEOFF POWER	100	% RPM	daytime	11.67				100	100
1266_EF	EA6-1266	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	19.08				100	100
1266_EF	F5-1266	F-5E	325	CRUISE POWER	86	% RPM	daytime	0.08		100			100
1266_EF	F16-1266	F-16A	500	TRAINING ROUTE	84	% NC	daytime	0.5	100				100
1266_FG	C130-1266	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	1.08	100				100
1266_FG	AV8B-1266	AV-8B	550	TAKEOFF POWER	95	% RPM	daytime	3.44	100				100
1266_FG	T38A-1266	T-38A	299	TAKEOFF POWER	100	% RPM	daytime	0.5	100				100
1266_FG	T45-1266	T-45	250	TAKEOFF POWER	100	% RPM	daytime	11.67			100		100
1266_FG	EA6-1266	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	19.08				100	100
1266_FG	F5-1266	F-5E	325	CRUISE POWER	86	% RPM	daytime	0.08				100	100
1266_FG	F16-1266	F-16A	500	TRAINING ROUTE	84	% NC	daytime	0.5		100			100
1266_GH	C130-1266	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	1.08	100				100
1266_GH	T38A-1266	T-38A	299	TAKEOFF POWER	100	% RPM	daytime	0.5	100				100
1266_GH	T45-1266	T-45	250	TAKEOFF POWER	100	% RPM	daytime	11.67	100				100
1266_GH	EA6-1266	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	19.08	100				100
1266_GH	F5-1266	F-5E	325	CRUISE POWER	86	% RPM	daytime	0.08				100	100
1266_GH	F16-1266	F-16A	500	TRAINING ROUTE	84	% NC	daytime	0.5				100	100
1266_AE	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100				100
1266_EF	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100				100
1266_FG	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100				100
1266_GH	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100				100

MODELED CONDITIONS								BUSY	TIME (% OR MINUTES) IN RANGE OF	
AIRSPACE ID	MISSION ID	AIRCRAFT ID	SPEED (KIAS)	POWER DESCRIPTION	POWER SETTING	POWER UNIT	PERIOD OF DAY	MONTH SORTIES	Floor*	TOTAL
1267	AV8B	AV-8B	300	TAKEOFF POWER	95	% RPM	daytime	10.58	100	100
1267	C130H	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	5.17	100	100
1267	A6A	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	18.33	100	100
1267	F18CD	F-18	400	CRUISE POWER	88	% NC	daytime	6.83	100	100
1267	F16A	F-16A	300	APPROACH POWER	85	% NC	daytime	1.25	100	100
1267	T45	T-45	250	CRUISE POWER	85.5	% RPM	daytime	7	100	100
1267	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100	100
1267A	AV8B	AV-8B	300	TAKEOFF POWER	95	% RPM	daytime	2.67	100	100
1267A	C130	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	3	100	100
1267A	A6A	A-6A	250	TAKEOFF POWER	100	% RPM	daytime	0.25	100	100
1267A	F18CD	F-18	400	CRUISE POWER	88	% NC	daytime	1.5	100	100
1267A	T45	T-45	250	CRUISE POWER	85.5	% RPM	daytime	0.17	100	100
1267A	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100	100
VR-1268	AV8B	AV-8B	300	TAKEOFF POWER	95	% RPM	daytime	2.08	100	100
VR-1268	C130	C-130H&N&P	170	TAKEOFF POWER	970	C TIT	daytime	0.08	100	100
VR-1268	F18CD	F-18	400	CRUISE POWER	88	% NC	daytime	1.08	100	100
VR-1268	T45	T-45	250	CRUISE POWER	85.5	% RPM	daytime	0.08	100	100
VR-1268	MV22-LAT		220	TAKEOFF PO	85.5		daytime	12.33	100	100

* Modeled at 200' AGL

APPENDIX C-2

Sleep and Speech Analysis

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C-2.1 SLEEP & SPEECH ANALYSIS METHODOLOGY

The analysis for the potential for indoor speech interference and sleep disturbance used the following methodology. The Number of Events At or Above (NA) a selected noise threshold was computed for baseline and each alternative. The NA for outdoor sound levels was computed with prototype versions of NOISEMAP and RNM.

The dose-response relationship of percentage sentence intelligibility (SI) to steady sound level is relatively flat from 95 percent SI to 100 percent SI. The curve's slope steepens sharply for SI less than 95 percent and the curve's lower limit is 10 percent SI. Indoor speech interference was evaluated for four thresholds of percent SI – 100 percent, 95 percent, 63 percent and less than 10 percent. These thresholds of percentage SI correspond to steady indoor sound levels of 55 dBA, 65 dBA, 70 dBA and 73 dBA, respectively. As NOISEMAP and RNM cannot compute NA for a steady sound level (or Equivalent Sound Levels (L_{eq})), Maximum Sound Level (L_{Amax}) was assumed to apply. Note the analysis likely overestimates the true SI as the NA values are primarily due to flight events and the L_{Amax} of flight events only occurs for a fraction of a second for each aircraft flight event.

Both speech/sleep analyses assumed residential structures have a Noise Level Reduction (NLR) capacity of 16 dB with windows open and 26 dB with windows closed. The NLR value of 26 dB is based on in-situ measurements (Wyle 1995) and is similar to the 25 dB NLR of houses suggested by federal guidelines (FICON 1992). The 10 dB difference in NLR values for windows open compared to windows closed is also consistent with federal guidelines (FICON 1992).

Indoor sleep disturbance was evaluated for four thresholds of percentage of (long-term resident adult) awakenings – 17 percent, 15 percent, 10 percent and 5 percent. As shown in Appendix C, 17 percent is the upper limit of the data upon which sleep disturbance dose-response relationship is based. The thresholds of percentage awakenings, with windows open, correspond to outdoor SEL of 116 dBA, 110 dBA, 97 dBA and 81 dBA, respectively. The thresholds of percentage awakenings, with windows closed correspond to outdoor SEL of 126 dBA, 120 dBA, 107 dBA and 91 dBA, respectively.

C-2.2 Miramar Baseline Data

Table C.2.1 presents the estimates of indoor speech interference and sleep disturbance for each of the 17 representative noise-sensitive receptors for baseline. For closed windows, between 5 and 21 average daily events cause indoor SI less than 100% at up to 3 receptors. No events cause indoor SI less than 63%. For open windows, between 1 and 129 average daily events cause indoor SI less than 100% at up to 14 of the 17 receptors. Three receptors have indoor SI less than 95% by 5-15 average daily events. Only one receptor, A2 in the Seawolf corridor, experiences indoor SI less than 10 percent 7 times per day, on average.

Regarding sleep disturbance with closed windows, 1 average daily nighttime event at up to 3 receptors cause awakenings 5-10 percent of the time. For open windows at nighttime, between 1 and 6 average daily events at up to 8 of the 17 receptors cause awakenings 5-10 percent of the time. No events cause awakenings more than 10 percent of the time for any of the receptors.

C-2.3 Full Basing Alternative

Table C.2.2 presents the estimates of indoor speech interference and sleep disturbance for each of the 17 representative noise-sensitive receptors for the Full Basing Alternative. For closed windows, between 2 and 21 average daily events would cause indoor SI less than 100% at up to 3 receptors. No events would cause indoor SI less than 63%. For open windows, between 1 and 124 average daily events would cause indoor SI less than 100% at up to 14 of the 17 receptors. Three receptors would have indoor SI less than 95% by 7-15 average daily events. Only one receptor, A2 in the Seawolf corridor, would experience indoor SI less than 10 percent 7 times per day, on average.

Relative to baseline/No Action, the Full Basing Alternative would decrease the number of speech-interfering events by 2-5 events at up to 5 receptors. The Alternative would increase the number of speech-interfering events causing 95-99 percent SI by 9 for receptor D1 near the FCLP pattern. Overall, the Alternative would reduce the number of events causing speech interference by 7 events.

Regarding sleep disturbance with closed windows, 1 average daily nighttime event at up to 3 receptors would cause awakenings 5-10 percent of the time. For open windows at nighttime, between 1 and 6 average daily events at up to 7 of the 17 receptors would cause awakenings 5-10 percent of the time. No events would cause awakenings more than 10 percent of the time for any of the receptors.

Relative to baseline/No Action, the Full Basing Alternative would not change the number of events causing any percentage of awakenings for all but two receptors – C4 in the I-15 corridor and D1 near the FCLP pattern. For C4 and D2, the number of events causing 5-10 percent awakenings would decrease by 1 event and would increase by 1 event, respectively. Overall, the Alternative would not change the number of events causing awakenings (5-10 percent of the time with windows open).

C-2.4 Maximum Partial Basing Alternative (8 Squadrons)

Table C.2.3 presents the estimates of indoor speech interference and sleep disturbance for each of the 17 representative noise-sensitive receptors for the Maximum Partial Basing Alternative. For closed windows, between 2 and 21 average daily events would cause indoor SI less than 100% at up to 3 receptors. No events would cause indoor SI less than 63%. For open windows, between 1 and 129 average daily events would cause indoor SI less than 100% at up to 14 of the 17 receptors. Three receptors would have indoor SI less than 95% by 2-15 average daily events. Only one receptor, A2 in the Seawolf corridor, would experience indoor SI less than 10 percent 7 times per day, on average.

Relative to baseline/No Action, the Maximum Partial Basing Alternative would decrease the number of speech-interfering events by 2-3 events at up to 5 receptors. The Alternative would increase the number of speech-interfering events causing 95-99 percent SI by 7 for receptor D1 near the FCLP pattern. Overall, the Alternative would reduce the number of events causing speech interference by 9 events.

Regarding sleep disturbance with closed windows, 1 average daily nighttime event at up to 3 receptors would cause awakenings 5-10 percent of the time. For open windows at nighttime, between 1 and 6 average daily events at up to 7 of the 17 receptors would cause awakenings 5-10 percent of the time. No events would cause awakenings more than 10 percent of the time for any of the receptors.

Relative to baseline/No Action, the Maximum Partial Basing Alternative would not change the number of events causing any percentage of awakenings for all but two receptors – C4 in the I-15 corridor and

D1 near the FCLP pattern. For C4 and D2, the number of events causing 5-10 percent awakenings would decrease by 1 event and would increase by 1 event, respectively. Overall, the Alternative would not change the number of events causing awakenings (5-10 percent of the time with windows open).

C-2.5 Minimum Partial Basing Alternative (2 Squadrons)

Table C.2.4 presents the estimates of indoor speech interference and sleep disturbance for each of the 17 representative noise-sensitive receptors for the Minimum Partial Basing Alternative. For closed windows, between 2 and 21 average daily events would cause indoor SI less than 100% at up to 3 receptors. No events would cause indoor SI less than 63%. For open windows, between 1 and 129 average daily events would cause indoor SI less than 100% at up to 14 of the 17 receptors. Three receptors would have indoor SI less than 95% by 2-15 average daily events. Only one receptor, A2 in the Seawolf corridor, would experience indoor SI less than 10 percent 7 times per day, on average.

Relative to baseline/No Action, the Minimum Partial Basing Alternative would decrease the number of speech-interfering events by 2-3 events at up to 5 receptors. The Alternative would increase the number of speech-interfering events causing 95-99 percent SI by 1 for receptor D1 near the FCLP pattern. Overall, the Alternative would reduce the number of events causing speech interference by 15 events.

Regarding sleep disturbance with closed windows, 1 average daily nighttime event at up to 3 receptors would cause awakenings 5-10 percent of the time. For open windows at nighttime, between 1 and 6 average daily events at up to 7 of the 17 receptors would cause awakenings 5-10 percent of the time. No events would cause awakenings more than 10 percent of the time for any of the receptors.

Relative to baseline/No Action, the Minimum Partial Basing Alternative would not change the number of events causing any percentage of awakenings for all but one receptor – C4 in the I-15 corridor. For C4, the number of events causing 5-10 percent awakenings would decrease by 1 event. Overall, the Alternative would decrease the number of events causing awakenings (5-10 percent of the time with windows open) by 1 event.

C-2.6 No Squadron Alternative

Table C.2.5 presents the estimates of speech interference and sleep disturbance for each of the 17 representative noise-sensitive receptors for the No Squadron Alternative. For closed windows, between 2 and 21 average daily events would cause indoor SI less than 100% at up to 3 receptors. No events would cause indoor SI less than 63%. For open windows, between 1 and 129 average daily events would cause indoor SI less than 100% at up to 14 of the 17 receptors. Three receptors would have indoor SI less than 95% by 2-15 average daily events.

Only one receptor, A2 in the Seawolf corridor, would experience indoor SI less than 10 percent 7 times per day, on average.

Relative to baseline/No Action, the No Squadron Alternative would decrease the number of speech-interfering events by 2-3 events at up to 5 receptors. The number of speech-interfering events would not change for the remaining 12 receptors. Overall, the Alternative would reduce the number of events causing speech interference by 16 events.

Regarding sleep disturbance with closed windows, 1 average daily nighttime event at up to 3 receptors would cause awakenings 5-10 percent of the time. For open windows at nighttime, between 1 and 6

average daily events at up to 7 of the 17 receptors would cause awakenings 5-10 percent of the time. No events would cause awakenings more than 10 percent of the time for any of the receptors.

Relative to existing conditions, the No Squadron Alternative would not change the number of events causing any percentage of awakenings for all but one receptor – C4 in the Interstate-15 corridor. For C4, the number of events causing 5-10 percent awakenings would decrease by 1 event. Overall, the Alternative would decrease the number of events causing awakenings (5-10 percent of the time with windows open) by 1 event.

Table C.2.1
Evaluation of Indoor Speech Interference and Sleep Disturbance for the Representative Locations Near MCAS Miramar for Baseline

(a) Speech Interference

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Sum of Annual Average Daily Daytime and Evening Flights (1)							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	21	7	-	-	15	7	15	7
A3		Caminito Del Rocio	-	-	-	-	16	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	65	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	2	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	14	-	-	-	14	7	8	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	1	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	5	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	27	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	4	-	-	-
C2		Pomerado and I-15	5	-	-	-	129	5	-	-
C3		Bernardo Center and Bajada	-	-	-	-	4	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	5	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	67	-	-	-
D2		Santo and Portobello Court	-	-	-	-	61	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.1 (cont.)
Evaluation of Indoor Speech Interference and Sleep Disturbance for the Representative Locations Near MCAS Miramar for Baseline
(b) Sleep Disturbance

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Number of Annual Average Daily Nighttime Flights (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	1	-	-	-	1	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	2	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	1	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	1	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	1	-	-	-	6	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	1	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	1	-	-	-	4	-	-	-
D2		Santo and Portobello Court	-	-	-	-	4	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.2
Evaluation of Indoor Speech Interference and Sleep Disturbance for the Representative Locations Near MCAS Miramar for the Full Basing Alternative

(a) Speech Interference

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Sum of Annual Average Daily Daytime and Evening Flights (1)							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	21	7	-	-	15	7	15	7
A3		Caminito Del Rocio	-	-	-	-	16	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	65	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	2	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	14	-	-	-	14	7	8	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	1	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	2	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	27	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	2	-	-	-
C2		Pomerado and I-15	2	-	-	-	129	2	-	-
C3		Bernardo Center and Bajada	-	-	-	-	2	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	2	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	78	-	-	-
D2		Santo and Portobello Courl	-	-	-	-	61	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	**INCREASE IN Sum of Annual Average Daily Daytime and Evening Flights RE BASELINE/NO ACTION**							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	(3)	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	(2)	-	-	-
C2		Pomerado and I-15	(3)	-	-	-	-	(3)	-	-
C3		Bernardo Center and Bajada	-	-	-	-	(2)	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	(3)	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	11	-	-	-
D2		Santo and Portobello Courl	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.2 (cont.)
Evaluation of Indoor Speech Interference and Sleep Disturbance for the Representative Locations Near MCAS Miramar for the Full Basing Alternative

(b) Sleep Disturbance

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Number of Annual Average Daily Nighttime Flights (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	1	-	-	-	1	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	2	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	1	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	1	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	1	-	-	-	6	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	-	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	1	-	-	-	5	-	-	-
D2		Santo and Portobello Court	-	-	-	-	4	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	INCREASE IN Number of Annual Average Daily Nighttime Flights re BASELINE/NO ACTION (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	-	-	-	-	-	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	(1)	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	1	-	-	-
D2		Santo and Portobello Court	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.3
Evaluation of Speech Interference for the Representative Locations Near MCAS Miramar for Max Partial Basing

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Sum of Annual Average Daily Daytime and Evening Flights (1)							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	21	7	-	-	15	7	15	7
A3		Caminito Del Rocio	-	-	-	-	16	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	65	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	2	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	14	-	-	-	14	7	8	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	1	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	2	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	27	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	2	-	-	-
C2		Pomerado and I-15	2	-	-	-	129	2	-	-
C3		Bernardo Center and Bajada	-	-	-	-	2	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	2	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	75	-	-	-
D2		Santo and Portobello Court	-	-	-	-	61	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	**INCREASE IN Sum of Annual Average Daily Daytime and Evening Flights RE BASELINE/NO ACTION**							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	(3)	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	(2)	-	-	-
C2		Pomerado and I-15	(3)	-	-	-	-	(3)	-	-
C3		Bernardo Center and Bajada	-	-	-	-	(2)	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	(3)	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	8	-	-	-
D2		Santo and Portobello Court	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.3 cont. Sleep_Speech-round3 Mira Max Sleep

Table C.2.3 (cont.)
Evaluation of Indoor Speech Interference and Sleep Disturbance for the Representative Locations Near MCAS Miramar for the Maximum Partial Basing Alternative
(b) Sleep Disturbance

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Number of Annual Average Daily Nighttime Flights (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	1	-	-	-	1	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	2	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	1	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	1	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	1	-	-	-	6	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	-	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	1	-	-	-	5	-	-	-
D2		Santo and Portobello Court	-	-	-	-	4	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	INCREASE IN Number of Annual Average Daily Nighttime Flights re BASELINE/NO ACTION (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	-	-	-	-	-	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	(1)	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	1	-	-	-
D2		Santo and Portobello Court	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.4
Evaluation of Speech Interference for the Representative Locations Near MCAS Miramar for Min Partial Basing

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Sum of Annual Average Daily Daytime and Evening Flights (1)							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	21	7	-	-	15	7	15	7
A3		Caminito Del Rocio	-	-	-	-	16	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	65	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	2	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	14	-	-	-	14	7	8	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	1	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	2	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	27	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	2	-	-	-
C2		Pomerado and I-15	2	-	-	-	129	2	-	-
C3		Bernardo Center and Bajada	-	-	-	-	2	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	2	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	69	-	-	-
D2		Santo and Portobello Court	-	-	-	-	61	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	**INCREASE IN Sum of Annual Average Daily Daytime and Evening Flights RE BASELINE/NO ACTION**							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	(3)	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	(2)	-	-	-
C2		Pomerado and I-15	(3)	-	-	-	-	(3)	-	-
C3		Bernardo Center and Bajada	-	-	-	-	(2)	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	(3)	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	2	-	-	-
D2		Santo and Portobello Court	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.4 (cont.)
Evaluation of Indoor Speech Interference and Sleep Disturbance for the Representative Locations Near MCAS Miramar for the Minimum Partial Basing Alternative

(b) Sleep Disturbance

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Number of Annual Average Daily Nighttime Flights (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	1	-	-	-	1	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	2	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	1	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	1	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	1	-	-	-	6	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	-	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	1	-	-	-	4	-	-	-
D2		Santo and Portobello Court	-	-	-	-	4	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	INCREASE IN Number of Annual Average Daily Nighttime Flights re BASELINE/NO ACTION (1							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	-	-	-	-	-	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	(1)	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	-	-	-	-
D2		Santo and Portobello Court	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.5
Evaluation of Speech Interference for the Representative Locations Near MCAS Miramar for No Squadron

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Sum of Annual Average Daily Daytime and Evening Flights (1)							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	21	7	-	-	15	7	15	7
A3		Caminito Del Rocio	-	-	-	-	16	-	-	-
A4		Int'n of La Jolla Village Dr./Go	-	-	-	-	65	-	-	-
A5		Carmel Mountain Rd./El Cam	-	-	-	-	2	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	14	-	-	-	14	7	8	-
B2A		Rancho Penasquitos-Oviedo	-	-	-	-	1	-	-	-
B2B		Rancho Penasquitos-Penasq	-	-	-	-	2	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd	-	-	-	-	27	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	2	-	-	-
C2		Pomerado and I-15	2	-	-	-	129	2	-	-
C3		Bernardo Center and Bajada	-	-	-	-	2	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps	-	-	-	-	2	-	-	-
D1	FCLP	Copley Park and Hickam Fiel	-	-	-	-	67	-	-	-
D2		Santo and Portobello Court	-	-	-	-	61	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	**INCREASE IN Sum of Daytime and Evening Flights RE BASELINE/NO ACTION**							
			Windows Closed				Windows Open			
			95-99% SI	63-95% SI	10-63% SI	<10% SI	95-99% SI	63-95% SI	10-63% SI	<10% SI
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Go	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Cam	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasq	-	-	-	-	(3)	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	(2)	-	-	-
C2		Pomerado and I-15	(3)	-	-	-	-	(3)	-	-
C3		Bernardo Center and Bajada	-	-	-	-	(2)	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps	-	-	-	-	(3)	-	-	-
D1	FCLP	Copley Park and Hickam Fiel	-	-	-	-	-	-	-	-
D2		Santo and Portobello Court	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

Table C.2.5 cont. Sleep_Speech-round3 Mira No Squadron Sleep

Table C.2.5 (cont.)
Evaluation of Indoor Speech Interference and Sleep Disturbance for the Representative Locations Near MCAS Miramar for the No Squadron Alternative
(b) Sleep Disturbance

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	Number of Annual Average Daily Nighttime Flights (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	1	-	-	-	1	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	2	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	1	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	1	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	1	-	-	-	6	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	-	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	1	-	-	-	4	-	-	-
D2		Santo and Portobello Court	-	-	-	-	4	-	-	-

Representative Receptor ID	Primary Flight Corridor	Description (All Residential)	INCREASE IN Number of Annual Average Daily Nighttime Flights re BASELINE/NO ACTION (1)							
			Windows Closed				Windows Open			
			5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings	5-10% Awakenings	10-15% Awakenings	15-17% Awakenings	17% or more Awakenings
A1	Seawolf	Carmel Valley-Via Del Mar	-	-	-	-	-	-	-	-
A2		Mira Mesa-Steadman St.	-	-	-	-	-	-	-	-
A3		Caminito Del Rocio	-	-	-	-	-	-	-	-
A4		Int'n of La Jolla Village Dr./Golden Haven	-	-	-	-	-	-	-	-
A5		Carmel Mountain Rd./El Camino Real	-	-	-	-	-	-	-	-
B1	GCA Box Pattern	Mira Mesa/Glendover Ln.	-	-	-	-	-	-	-	-
B2A		Rancho Penasquitos-Oviedo Way	-	-	-	-	-	-	-	-
B2B		Rancho Penasquitos-Penasquitos Ct.	-	-	-	-	-	-	-	-
B3A		Poway-Arbolitos	-	-	-	-	-	-	-	-
B3B		Poway-Quiet Valley Ln.	-	-	-	-	-	-	-	-
B4		Scripps Ranch-Semillon Blvd./Birch Bluff Ave.	-	-	-	-	-	-	-	-
C1	I-15	Paseo Bolero Dr.	-	-	-	-	-	-	-	-
C2		Pomerado and I-15	-	-	-	-	-	-	-	-
C3		Bernardo Center and Bajada	-	-	-	-	-	-	-	-
C4		Int'n Mira Mesa Blvd/Scripps Ranch Blvd.	-	-	-	-	(1)	-	-	-
D1	FCLP	Copley Park and Hickam Field Dr.	-	-	-	-	-	-	-	-
D2		Santo and Portobello Court	-	-	-	-	-	-	-	-

Notes: (1) exclusive of upper bound for all bands

APPENDIX C-3

Discussion of Noise and Its Effect on the Environment

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C-3.1 BASICS OF SOUND

Noise is unwanted sound. Sound is all around us; sound becomes noise when it interferes with normal activities, such as sleep or conversation.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jackhammers) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound.

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration. First, intensity is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic of sound is frequency, which is the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches. The third important characteristic of sound is duration or the length of time the sound can be detected.

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. Because of this vast range, using a linear scale to represent the intensity of sound becomes very unwieldy. As a result, a logarithmic unit known as the decibel (abbreviated dB) is used to represent the intensity of a sound. Such a representation is called a sound level. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB; sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 to 140 dB are felt as pain (Berglund and Lindvall 1995).

Because of the logarithmic nature of the decibel unit, sound levels cannot be arithmetically added or subtracted and are somewhat cumbersome to handle mathematically. However, some simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example:

$$60 \text{ dB} + 60 \text{ dB} = 63 \text{ dB, and}$$

$$80 \text{ dB} + 80 \text{ dB} = 83 \text{ dB.}$$

Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

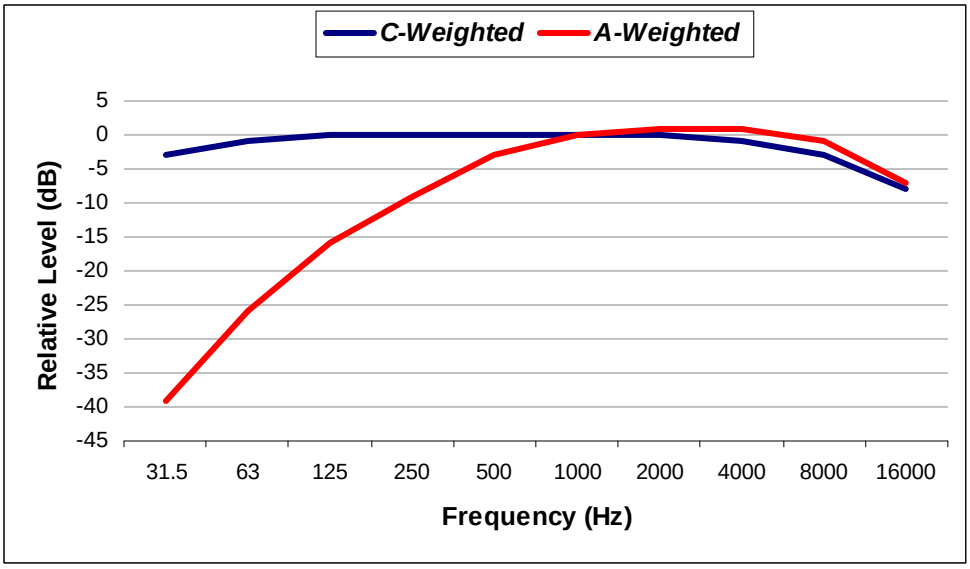
$$60.0 \text{ dB} + 70.0 \text{ dB} = 70.4 \text{ dB.}$$

Because the addition of sound levels is different than that of ordinary numbers, such addition is often referred to as "decibel addition" or "energy addition." The latter term arises from the fact that what we are really doing when we add decibel values is first converting each decibel value to its corresponding acoustic energy, then adding the energies using the normal rules of addition, and finally converting the total energy back to its decibel equivalent.

The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness, and this relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB

actually represents a 90% decrease in sound intensity but only a 50% decrease in perceived loudness because of the nonlinear response of the human ear (similar to most human senses).

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), which is the standard unit for cps. The normal human ear can detect sounds that range in frequency from about 20 Hz to about 15,000 Hz. All sounds in this wide range of frequencies, however, are not heard equally by the human ear, which is most sensitive to frequencies in the 1,000 to 4,000 Hz range. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. A-weighting accounts for frequency dependence by adjusting the very high and very low frequencies (below approximately 500 Hz and above approximately 10,000 Hz) to approximate the human ear's lower sensitivities to those frequencies. C-weighting is nearly flat throughout the range of audible frequencies, hardly de-emphasizing the low frequency sound while approximating the human ear's sensitivity to higher intensity sounds. The two curves shown in Figure C3-1 are also the most adequate to quantify environmental noises.



Source: ANSI S1.4 -1983 "Specification of Sound Level Meters"

Figure C3-1. Frequency Response Characteristics of A and C Weighting Networks

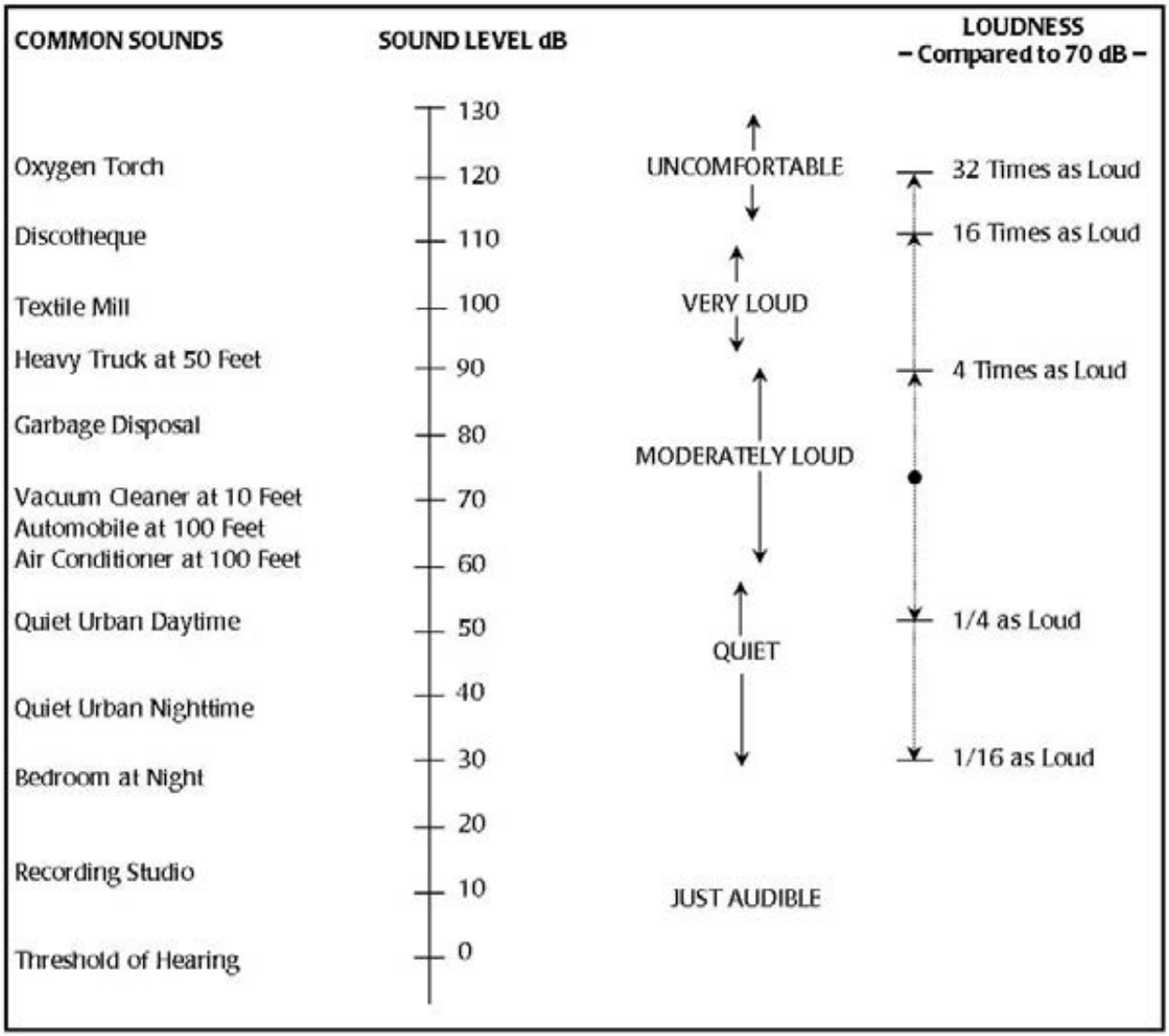
C-3.1 A-weighted Sound Level

Sound levels that are measured using A-weighting, called A-weighted sound levels, are often denoted by the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the adjective "A-weighted" is often omitted and the measurements are expressed as dB. In this report (as in most environmental impact documents), dB units refer to A-weighted sound levels.

Noise potentially becomes an issue when its intensity exceeds the ambient or background sound pressures. Ambient background noise in metropolitan, urbanized areas typically varies from 60 to 70 B and can be as high as 80 dB or greater; quiet suburban neighborhoods experience ambient noise levels of approximately 45-50 dB (U.S. Environmental Protection Agency 1978).

Figure C3-2 is a chart of A-weighted sound levels from typical sounds. Some noise sources (air conditioner, vacuum cleaner) are continuous sounds which levels are constant for some time. Some (automobile, heavy truck) are the maximum sound during a vehicle pass-by. Some (urban daytime, urban nighttime) are

averages over extended periods. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.



Source: *Handbook of Noise Control*, C.M. Harris, Editor, McGraw-Hill Book Co., 1979, and FICAN 1992.

Figure C3-2. Typical A-weighted Sound Levels of Common Sounds

Aircraft noise consists of two major types of sound events: aircraft takeoffs and landings, and engine maintenance operations. The former can be described as intermittent sounds and the latter as continuous. Noise levels from flight operations exceeding background noise typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contribution drops to lower levels, often becoming indistinguishable from the background.

C-3.1.1 C-weighted Sound Level

Sound levels measured using a C-weighting are most appropriately called C-weighted sound levels (and denoted dBC). C-weighting is nearly flat throughout the audible frequency range, hardly de-mphasizing the low frequency. This weighting scale is generally used to describe impulsive sounds. Sounds that are

characterized as impulsive generally contain low frequencies. Impulsive sounds may induce secondary effects, such as shaking of a structure, rattling of windows, inducing vibrations. These secondary effects can cause additional annoyance and complaints.

The following definitions in the American National Standard Institute (ANSI) Report S12.9, Part 4 provide general concepts helpful in understanding impulsive sounds (American National Standards Institute 1996).

Impulsive Sound: Sound characterized by brief excursions of sound pressure (acoustic impulses) that significantly exceeds the ambient environmental sound pressure. The duration of a single impulsive sound is usually less than one second (American National Standards Institute 1996).

Highly Impulsive Sound: Sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting.

High-energy Impulsive Sound: Sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams.

C-3.2 NOISE METRICS

As used in environmental noise analyses, a metric refers to the unit or quantity that quantitatively measures the effect of noise on the environment. To quantify these effects, the Department of Defense and the Federal Aviation Administration use three noise-measuring techniques, or metrics: first, a measure of the highest sound level occurring during an individual aircraft overflight (single event); second, a combination of the maximum level of that single event with its duration; and third, a description of the noise environment based on the cumulative flight and engine maintenance activity. Single noise events can be described with Sound Exposure Level or Maximum Sound Level. Another measure of instantaneous level is the Peak Sound Pressure Level. The cumulative energy noise metric used is the Day/Night Average Sound Level. Metrics related to DNL include the Onset-Rate Adjusted Day/Night Average Sound Level, and the Equivalent Sound Level. In the state of California, it is mandated that average noise be described in terms of Community Noise Equivalent Level (State of California 1990). CNEL represents the Day/Evening/Night average noise exposure, calculated over a 24-hour period. Metrics and their uses are described below.

C-3.2.1 Maximum Sound Level (L_{max})

The highest A-weighted integrated sound level measured during a single event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or maximum sound level.

During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. The maximum sound level indicates the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second, and is denoted as "fast" response (American National Standards Institute 1988). Slowly varying or steady sounds are generally measured over a period of one second, denoted "slow" response. The maximum sound level is important in judging the interference caused by a noise

event with conversation, TV or radio listening, sleep, or other common activities. Although it provides some measure of the intrusiveness of the event, it does not completely describe the total event, because it does not include the period of time that the sound is heard.

C-3.2.2 Peak Sound Pressure Level (L_{pk})

The peak sound pressure level, is the highest instantaneous level obtained by a sound level measurement device. The peak sound pressure level is typically measured using a 20 microseconds or faster sampling rate, and is typically based on unweighted or linear response of the meter.

C-3.2.3 Sound Exposure Level (SEL)

Sound exposure level is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of the net impact of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL would include both the maximum noise level and the lower noise levels produced during onset and recess periods of the overflight.

SEL is a logarithmic measure of the total acoustic energy transmitted to the listener during the event. Mathematically, it represents the sound level of a constant sound that would, in one second, generate the same acoustic energy as the actual time-varying noise event. For sound from aircraft overflights, which typically lasts more than one second, the SEL is usually greater than the L_{max} because an individual overflight takes seconds and the maximum sound level (L_{max}) occurs instantaneously. SEL represents the best metric to compare noise levels from overflights.

C-3.2.4 Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level and Community Noise Equivalent Level are composite metrics that account for SEL of all noise events in a 24-hour period. In order to account for increased human sensitivity to noise at night, a 10 dB penalty is applied to nighttime events (10:00 p.m. to 7:00 a.m. time period). A variant of the DNL, the CNEL level includes a 5-decibel penalty on noise during the 7:00 p.m. to 10:00 p.m. time period, and a 10-decibel penalty on noise during the 10:00 p.m. to 7:00 a.m. time period.

The above-described metrics are average quantities, mathematically representing the continuous A-weighted or C-weighted sound level that would be present if all of the variations in sound level that occur over a 24-hour period were smoothed out so as to contain the same total sound energy. These composite metrics account for the maximum noise levels, the duration of the events (sorties or operations), and the number of events that occur over a 24-hour period. Like SEL, neither DNL nor CNEL represent the sound level heard at any particular time, but quantifies the total sound energy received. While it is normalized as an average, it represents all of the sound energy, and is therefore a cumulative measure.

The penalties added to both the DNL and CNEL metrics account for the added intrusiveness of sounds that occur during normal sleeping hours, both because of the increased sensitivity to noise during those hours and because ambient sound levels during nighttime are typically about 10 dB lower than during daytime hours.

The inclusion of daytime and nighttime periods in the computation of the DNL and CNEL reflects their basic 24-hour definition. It can, however, be applied over periods of multiple days. For application to civil airports, where operations are consistent from day to day, DNL and CNEL are usually applied as an annual average. For some military airbases, where operations are not necessarily consistent from day to

day, a common practice is to compute a 24-hour DNL or CNEL based on an average busy day, so that the calculated noise is not diluted by periods of low activity.

Although DNL and CNEL provide a single measure of overall noise impact, they do not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. For example, a daily average sound level of 65 dB could result from a very few noisy events or a large number of quieter events.

Daily average sound levels are typically used for the evaluation of community noise effects (i.e., long-term annoyance), and particularly aircraft noise effects. In general, scientific studies and social surveys have found a high correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (U.S. Environmental Protection Agency 1978 and Schultz 1978). The correlation from Schultz's original 1978 study is shown in Figure C3-3. It represents the results of a large number of social surveys relating community responses to various types of noises, measured in day-night average sound level.

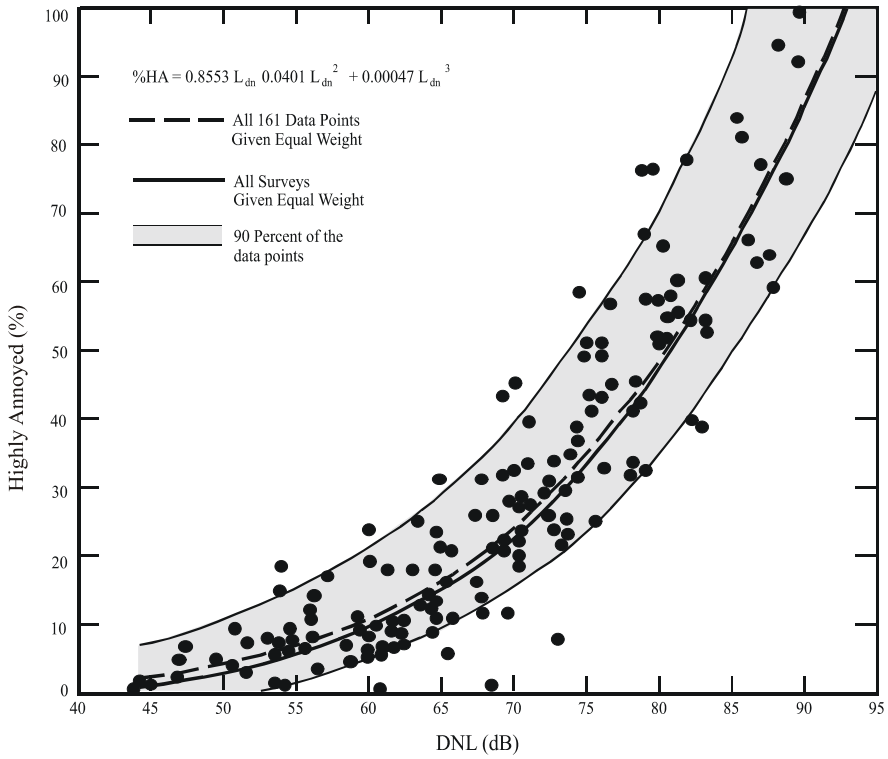


Figure C3-3. Community Surveys of Noise Annoyance

A more recent study has reaffirmed this relationship (Fidell, et al. 1991). Figure C3-4 (Federal Interagency Committee On Noise 1992) shows an updated form of the curve fit (Finegold, et al. 1994) in comparison with the original. The updated fit, which does not differ substantially from the original, is the current preferred form. In general, correlation coefficients of 0.85 to 0.95 are found between the percentages of groups of people highly annoyed and the level of average noise exposure. The correlation coefficients for the annoyance of individuals are relatively low, however, on the order of 0.5 or less. This is not surprising, considering the varying personal factors that influence the manner in which individuals react to noise. However, for the evaluation of community noise impacts, the scientific community has endorsed the use of DNL (American National Standards Institute 1980; American National Standards Institute 1988; U.S. Environmental Protection Agency 1974; Federal Interagency Committee On Urban Noise 1980 and Federal Interagency Committee On Noise 1992).

The use of DNL (CNEL in California) has been criticized as not accurately representing community annoyance and land-use compatibility with aircraft noise. Much of that criticism stems from a lack of understanding of the basis for the measurement or calculation of DNL. One frequent criticism is based on the inherent feeling that people react more to single noise events and not as much to "meaningless" time-average sound levels.

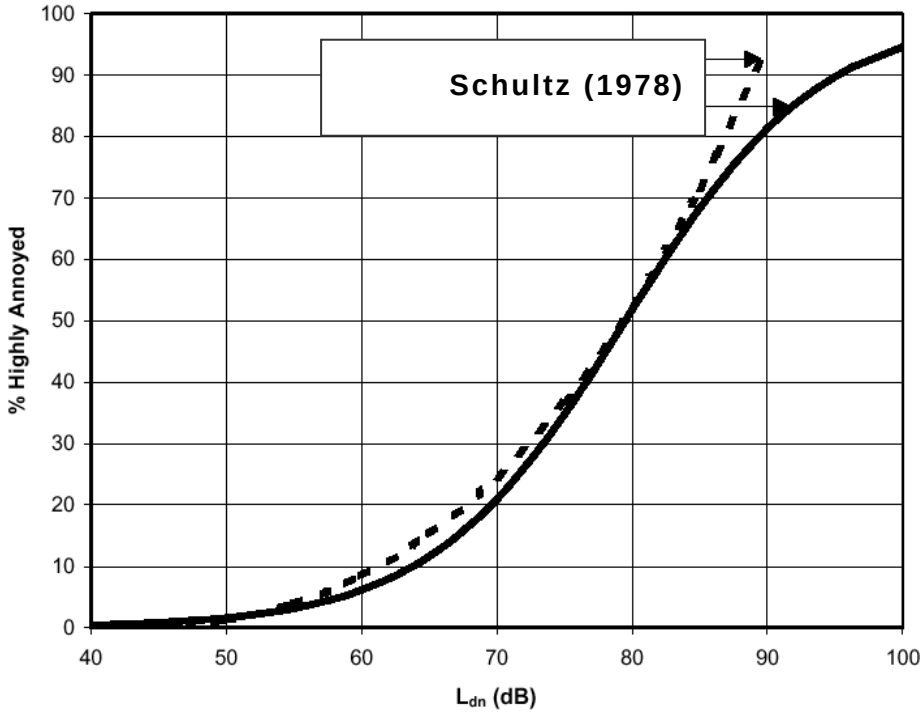


Figure C3-4. Response of Communities to Noise; Comparison of Original (Schultz, 1978) and Current (Finegold, et al. 1994) Curve Fits

In fact, a time-average noise metric, such as DNL and CNEL, takes into account both the noise levels of all individual events that occur during a 24-hour period and the number of times those events occur. The logarithmic nature of the decibel unit causes the noise levels of the loudest events to control the 24-hour average.

As a simple example of this characteristic, consider a case in which only one aircraft overflight occurs during the daytime over a 24-hour period, creating a sound level of 100 dB for 30 seconds. During the remaining 23 hours, 59 minutes, and 30 seconds of the day, the ambient sound level is 50 dB. The day-night average sound level for this 24-hour period is 65.9 dB. Assume, as a second example, that 10 such 30-second overflights occur during daytime hours during the next 24-hour period, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes of the day. The day-night average sound level for this 24-hour period is 75.5 dB. Clearly, the averaging of noise over a 24-hour period does not ignore the louder single events and tends to emphasize both the sound levels and number of those events.

C-3.2.5 Equivalent Sound Level (L_{eq})

Another cumulative noise metric that is useful in describing noise is the equivalent sound level. L_{eq} is calculated to determine the steady-state noise level over a specified time period. The L_{eq} metric can provide

a more accurate quantification of noise exposure for a specific period, particularly for daytime periods when the nighttime penalty under the DNL metric is inappropriate.

Just as SEL has proven to be a good measure of the noise impact of a single event, L_{eq} has been established to be a good measure of the impact of a series of events during a given time period. Also, while L_{eq} is defined as an average, it is effectively a sum over that time period and is, thus, a measure of the cumulative impact of noise. For example, the sum of all noise-generating events during the period of 7 a.m. to 4 p.m. could provide the relative impact of noise generating events for a school day.

C-3.2.6 Rate Adjusted Day-Night Average Sound Level (L_{dnr})

Military aircraft flying on Military Training Routes (MTRs) and in Restricted Areas/Ranges generate a noise environment that is somewhat different from that associated with airfield operations. As opposed to patterned or continuous noise environments associated with airfields, overflights along MTRs are highly sporadic, ranging from 10 per hour to less than one per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset, exhibiting a rate of increase in sound level (onset rate) of up to 150 dB per second.

To represent these differences, the conventional SEL metric is adjusted to account for the "surprise" effect of the sudden onset of aircraft noise events on humans with an adjustment ranging up to 11 dB above the normal Sound Exposure Level (Stusnick, et al. 1992). Onset rates between 15 to 150 dB per second require an adjustment of 0 to 11 dB, while onset rates below 15 dB per second require no adjustment. The adjusted SEL is designated as the onset-rate adjusted sound exposure level (SEL_r).

Because of the sporadic, often seasonal, occurrences of aircraft overflights along MTRs and in Restricted Areas/Ranges, the number of daily operations is determined from the number of flying days in the calendar month with the highest number of operations in the affected airspace or MTR. This avoids dilution of the exposure from periods of low activity, much the way that the average busy day is used around military airbases. The cumulative exposure to noise in these areas is computed by DNL over the busy month, but using SEL_r instead of SEL. This monthly average is denoted L_{dnmr}. If onset rate adjusted DNL is computed over a period other than a month, it would be designated L_{dnr} and the period must be specified. In the state of California, a variant of the L_{dnmr} includes a penalty for evening operations (7 p.m. to 10 p.m) and is denoted $CNEL_{mr}$.

C-3.3 NOISE EFFECTS

C-3.3.1 Annoyance

The primary effect of aircraft noise on exposed communities is one of long-term annoyance. Noise annoyance is defined by the EPA as any negative subjective reaction on the part of an individual or group (U.S. Environmental Protection Agency 1974). As noted in the discussion of DNL above, community annoyance is best measured by that metric.

The results of attitudinal surveys, conducted to find percentages of people who express various degrees of annoyance when exposed to different levels of DNL, are very consistent. The most useful metric for assessing people's responses to noise impacts is the percentage of the exposed population expected to be "highly annoyed." A wide variety of responses have been used to determine intrusiveness of noise and disturbances of speech, sleep, television or radio listening, and outdoor living. The concept of "percent highly annoyed" has provided the most consistent response of a community to a particular noise

environment. The response is remarkably complex, and when considered on an individual basis, widely varies for any given noise level (Federal Interagency Committee On Noise 1992).

A number of nonacoustic factors have been identified that may influence the annoyance response of an individual. Newman and Beattie (1985) divided these factors into emotional and physical variables:

Emotional Variables

- Feelings about the necessity or preventability of the noise;
- Judgment of the importance and value of the activity that is producing the noise;
- Activity at the time an individual hears the noise;
- Attitude about the environment;
- General sensitivity to noise;
- Belief about the effect of noise on health; and
- Feeling of fear associated with the noise.

Physical Variables

- Type of neighborhood;
- Time of day;
- Season;
- Predictability of noise;
- Control over the noise source; and
- Length of time an individual is exposed to a noise.

C-3.3.2 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. The disruption of routine activities such as radio or television listening, telephone use, or family conversation gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Speech is an acoustic signal characterized by rapid fluctuations in sound level and frequency pattern. It is essential for optimum speech intelligibility to recognize these continually shifting sound patterns. Not only does noise diminish the ability to perceive the auditory signal, but it also reduces a listener's ability to follow the pattern of signal fluctuation. In general, interference with speech communication occurs when intrusive noise exceeds about 60 dB (Federal Interagency Committee On Noise 1992).

Indoor speech interference can be expressed as a percentage of sentence intelligibility among two people speaking in relaxed conversation approximately 3 feet apart in a typical living room or bedroom (U.S. Environmental Protection Agency 1974). The percentage of sentence intelligibility is a non-linear function of the (steady) indoor background A-weighted sound level. Such a curve-fit yields 100 percent sentence intelligibility for background levels below 57 dB and yields less than 10 percent intelligibility for background levels above 73 dB. The function is especially sensitive to changes in sound level between 65 dB and 75 dB. As an example of the sensitivity, a 1 dB increase in background sound level from 70 dB to 71 dB yields a 14 percent decrease in sentence intelligibility. The sensitivity of speech interference to noise at

65 dB and above is consistent with the criterion of DNL 65 dB generally taken from the Schultz curve. This is consistent with the observation that speech interference is the primary cause of annoyance.

C-3.3.3 Sleep Interference

Sleep interference is another source of annoyance and potential health concern associated with aircraft noise. Because of the intermittent nature and content of aircraft noise, it is more disturbing than continuous noise of equal energy. Given that quality sleep is requisite for good health, repeated occurrences of sleep interference could have an effect on overall health.

Sleep interference may be measured in either of two ways. "Arousal" represents actual awakening from sleep, while a change in "sleep stage" represents a shift from one of four sleep stages to another stage of lighter sleep without actual awakening. In general, arousal requires a somewhat higher noise level than does a change in sleep stage.

Sleep is not a continuous, uniform condition but a complex series of states through which the brain progresses in a cyclical pattern. Arousal from sleep is a function of a number of factors that include age, sex, sleep stage, noise level, frequency of noise occurrences, noise quality, and pre-sleep activity. Because individuals differ in their physiology, behavior, habitation, and ability to adapt to noise, few studies have attempted to establish noise criterion levels for sleep disturbance.

Lukas (1978) concluded the following with regard to human sleep response to noise:

- Children 5 to 8 years of age are generally unaffected by noise during sleep.
- Older people are more sensitive to sleep disturbance than younger people.
- Women are more sensitive to noise than men, in general.
- There is a wide variation in the sensitivity of individuals to noise even within the same age group.
- Sleep arousal is directly proportional to the sound intensity of aircraft flyover. While there have been several studies conducted to assess the effect of aircraft noise on sleep, none have produced quantitative dose-response relationships in terms of noise exposure level, DNL, and sleep disturbance. Noise-sleep disturbance relationships have been developed based on single-event noise exposure.

An analysis sponsored by the U.S. Air Force summarized 21 published studies concerning the effects of noise on sleep (Pearsons, et al. 1989). The analysis concluded that a lack of reliable studies in homes, combined with large differences among the results from the various laboratory studies, did not permit development of an acceptably accurate assessment procedure. The noise events used in the laboratory studies and in contrived in-home studies were presented at much higher rates of occurrence than would normally be experienced in the home. None of the laboratory studies were of sufficiently long duration to determine any effects of habituation, such as that which would occur under normal community conditions.

A study of the effects of nighttime noise exposure on the in-home sleep of residents near one military airbase, near one civil airport, and in several households with negligible nighttime aircraft noise exposure, revealed SEL as the best noise metric predicting noise-related awakenings. It also determined that out of 930 subject nights, the average spontaneous (not noise-related) awakenings per night was 2.07 compared to the average number of noise-related awakenings per night of 0.24 (Fidell, et al. 1994). Additionally, a 1995 analysis of sleep disturbance studies conducted both in the laboratory environment and in the field (in the sleeping quarters of homes) showed that when measuring awakening to noise, a 10 dB increase in SEL was associated with only an 8 percent increase in the probability of awakening in the laboratory studies, but

only a 1 percent increase in the field (Pearsons, et al. 1995). Pearsons, et al. (1995), reported that even SEL values as high as 85 dB produced no awakenings or arousals in at least one study. This observation suggests a strong influence of habituation on susceptibility to noise-induced sleep disturbance. A 1984 study (Kryter 1984) indicates that an indoor SEL of 65 dB or lower should awaken less than 5 percent of exposed individuals.

Nevertheless, some guidance is available in judging sleep interference. The EPA identified an indoor DNL of 45 dB as necessary to protect against sleep interference (U.S. Environmental Protection Agency 1978). Assuming a very conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds to an outdoor day-night average sound level of 65 dB to minimize sleep interference.

In 1997, the Federal Interagency Committee on Aviation Noise (FICAN) adopted an interim guideline for sleep awakening prediction. The new curve, based on studies in England (Ollerhead, et al. 1992) and at two U.S. airports (Los Angeles International and Denver International), concluded that the incidence of sleep awakening from aircraft noise was less than identified in a 1992 study (Federal Interagency Committee On Noise 1992). Using indoor single-event noise levels represented by SEL, potential sleep awakening can be predicted using the curve presented in Figure C3-5. Typically, homes in the United States provide 15 dB of sound attenuation with windows open and 25 dB with windows closed and air conditioning operating. Hence, the outdoor SEL of 107 dB would be 92 dB indoors with windows open and 82 dB indoors with windows closed and air conditioning operating.

Using Figure C3-5, the potential sleep awakening would be 15% with windows open and 10% with windows closed in the above example.

The new FICAN curve does not address habituation over time by sleeping subjects and is applicable only to adult populations. Nevertheless, this curve provides a reasonable guideline for assessing sleep awakening. It is conservative, representing the upper envelope of field study results.

The FICAN curve shown in Figure C3-5 represents awakenings from single events. To date, no exact quantitative dose-response relationship exists for noise-related sleep interference from multiple events; yet, based on studies conducted to date and the USEPA guideline of a 45 DNL to protect sleep interference, useful ways to assess sleep interference have emerged. If homes are conservatively estimated to have a 20-dB noise insulation, an average of 65 DNL would produce an indoor level of 45 DNL and would form a reasonable guideline for evaluating sleep interference. This also corresponds well to the general guideline for assessing speech interference. Annoyance that may result from sleep disturbance is accounted for in the calculation of DNL, which includes a 10-dB penalty for each sortie occurring after 10 pm or before 7 am.

C-3.3.4 Hearing Loss

Considerable data on hearing loss have been collected and analyzed. It has been well established that continuous exposure to high noise levels will damage human hearing (U.S. Environmental Protection Agency 1978). People are normally capable of hearing up to 120 dB over a wide frequency range. Hearing loss is generally interpreted as the shifting of a higher sound level of the ear's sensitivity or acuity to perceive sound. This change can either be temporary, called a temporary threshold shift (TTS), or permanent, called a permanent threshold shift (PTS) (Berger, et al. 1995).

The EPA has established 75 dB for an 8-hour exposure and 70 dB for a 24-hour exposure as the average noise level standard requisite to protect 96% of the population from greater than a 5 dB PTS (U.S. Environmental Protection Agency 1978). Similarly, the National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) identified 75 dB as the minimum level at which hearing loss may occur (Committee on Hearing, Bioacoustics, and Biomechanics 1977). However, it is

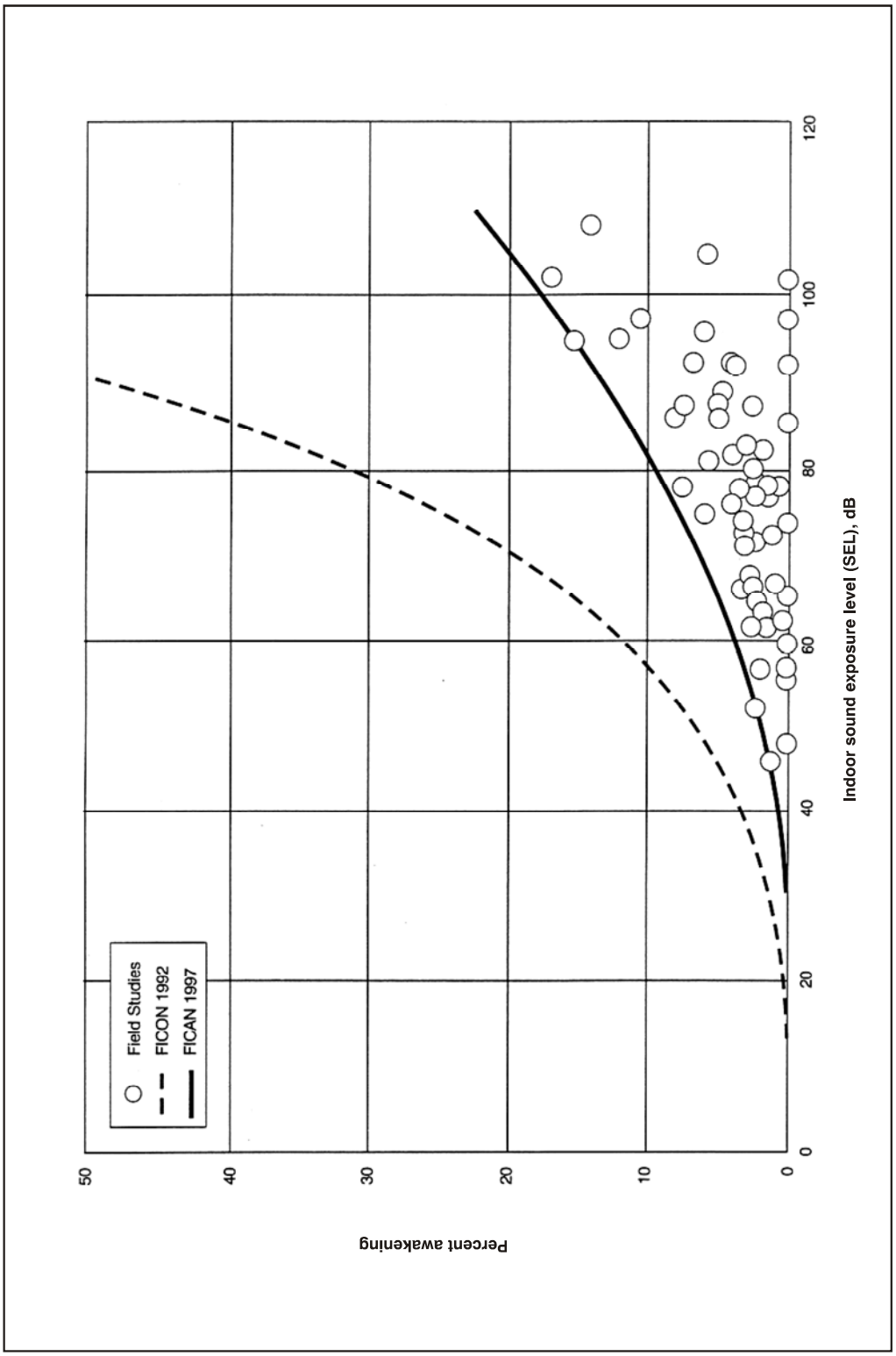


Figure C3-5. Recommended Sleep Disturbance Dose-Response Relationship

important to note that continuous, long-term (40 years) exposure is assumed by both EPA and CHABA before hearing loss may occur.

Federal workplace standards for protection from hearing loss allow a time-average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period. Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4,000 Hz, after a 40-year exposure) is a time-average sound level of 70 dB over a 24-hour period.

Studies on community hearing loss from exposure to aircraft flyovers near airports showed that there is no danger, under normal circumstances, of hearing loss due to aircraft noise (Newman and Beattie 1985).

A laboratory study measured changes in human hearing from noise representative of low-flying aircraft on MTRs. (Nixon, et al. 1993). In this study, participants were first subjected to four overflight noise exposures at A-weighted levels of 115 dB to 130 dB. One-half of the subjects showed no change in hearing levels, one-fourth had a temporary 5-dB increase in sensitivity (the people could hear a 5-dB wider range of sound than before exposure), and one-fourth had a temporary 5-dB decrease in sensitivity (the people could hear a 5-dB narrower range of sound than before exposure). In the next phase, participants were subjected to a single overflight at a maximum level of 130 dB for eight successive exposures, separated by 90 seconds or until a temporary shift in hearing was observed. The temporary hearing threshold shifts resulted in the participants hearing a wider range of sound, but within 10 dB of their original range.

In another study of 115 test subjects between 18 and 50 years old, temporary threshold shifts were measured after laboratory exposure to military low-altitude flight (MLAF) noise (Ising, et al. 1999). According to the authors, the results indicate that repeated exposure to MLAF noise with L_{max} greater than 114 dB, especially if the noise level increases rapidly, may have the potential to cause noise induced hearing loss in humans.

Because it is unlikely that airport neighbors will remain outside their homes 24 hours per day for extended periods of time, there is little possibility of hearing loss below a day-night average sound level of 75 dB, and this level is extremely conservative.

C-3.3.5 Nonauditory Health Effects

Studies have been conducted to determine whether correlations exist between noise exposure and cardiovascular problems, birth weight, and mortality rates. The nonauditory effect of noise on humans is not as easily substantiated as the effect on hearing. The results of studies conducted in the United States, primarily concentrating on cardiovascular response to noise, have been contradictory (Cantrell 1974). Cantrell (1974) concluded that the results of human and animal experiments show that average or intrusive noise can act as a stress-provoking stimulus. Prolonged stress is known to be a contributor to a number of health disorders. Kryter and Poza (1980) state, "It is more likely that noise-related general ill-health effects are due to the psychological annoyance from the noise interfering with normal everyday behavior, than it is from the noise eliciting, because of its intensity, reflexive response in the autonomic or other physiological systems of the body." Psychological stresses may cause a physiological stress reaction that could result in impaired health.

The National Institute for Occupational Safety and Health and EPA commissioned CHABA in 1981 to study whether established noise standards are adequate to protect against health disorders other than hearing defects. CHABA's conclusion was that:

Evidence from available research reports is suggestive, but it does not provide definitive answers to the question of health effects, other than to the auditory system, of long-term exposure to noise. It seems

prudent, therefore, in the absence of adequate knowledge as to whether or not noise can produce effects upon health other than damage to auditory system, either directly or mediated through stress, that insofar as feasible, an attempt should be made to obtain more critical evidence.

Since the CHABA report, there have been more recent studies that suggest that noise exposure may cause hypertension and other stress-related effects in adults. Near an airport in Stockholm, Sweden, the prevalence of hypertension was reportedly greater among nearby residents who were exposed to energy averaged noise levels exceeding 55 dB and maximum noise levels exceeding 72 dB, particularly older subjects and those not reporting impaired hearing ability (Rosenlund, et al. 2001). A study of elderly volunteers who were exposed to simulated military low-altitude flight noise reported that blood pressure was raised by L_{max} of 112 dB and high speed level increase (Michalak, et al. 1990). Yet another study of subjects exposed to varying levels of military aircraft or road noise found no significant relationship between noise level and blood pressure (Pulles, et al. 1990).

The U.S. Department of the Navy prepared a programmatic Environmental Assessment (EA) for the continued use of non-explosive ordnance on the Vieques Inner Range. Following the preparation of the EA, it was learned that research conducted by the University of Puerto Rico, Ponce School of Medicine, suggested that Vieques fishermen and their families were experiencing symptoms associated with vibroacoustic disease (VAD) (U.S. Department of the Navy 2002). The study alleged that exposure to noise and sound waves of large pressure amplitudes within lower frequency bands, associated with Navy training activities—specifically, air-to-ground bombing or naval fire support—was related to a larger prevalence of heart anomalies within the Vieques fishermen and their families. The Ponce School of Medicine study compared the Vieques group with a group from Ponce Playa. A 1999 study conducted on Portuguese aircraft-manufacturing workers from a single factory reported effects of jet aircraft noise exposure that involved a wide range of symptoms and disorders, including the cardiac issues on which the Ponce School of Medicine study focused. The 1999 study identified these effects as VAD.

Johns Hopkins University (JHU) conducted an independent review of the Ponce School of Medicine study, as well as the Portuguese aircraft workers study and other relevant scientific literature. Their findings concluded that VAD should not be accepted as a syndrome, given that exhaustive research across a number of populations has not yet been conducted. JHU also pointed out that the evidence supporting the existence of VAD comes largely from one group of investigators and that similar results would have to be replicated by other investigators. In short, JHU concluded that it had not been established that noise was the causal agent for the symptoms reported and no inference can be made as to the role of noise from naval gunfire in producing echocardiographic abnormalities (U.S. Department of the Navy 2002).

Most studies of nonauditory health effects of long-term noise exposure have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. One of the best scientific summaries of these findings is contained in the lead paper at the National Institutes of Health Conference on Noise and Hearing Loss, held on 22 to 24 January 1990 in Washington, D.C.:

> "The nonauditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an 8-hour day). At the recent (1988) International Congress on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss, and even above these criteria, results regarding such health effects were ambiguous. Consequently, one comes to the conclusion that establishing and enforcing exposure levels

protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem, but also any potential nonauditory health effects in the work place" (von Gierke 1990).

Although these findings were specifically directed at noise effects in the workplace, they are equally applicable to aircraft noise effects in the community environment. Research studies regarding the nonauditory health effects of aircraft noise are ambiguous, at best, and often contradictory. Yet, even those studies that purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, two UCLA researchers apparently found a relationship between aircraft noise levels under the approach path to Los Angeles International Airport (LAX) and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the "noise-exposed" population (Meacham and Shaw 1979). Nevertheless, three other UCLA professors analyzed those same data and found no relationship between noise exposure and mortality rates (Frerichs, et al. 1980).

As a second example, two other UCLA researchers used this same population near LAX to show a higher rate of birth defects for 1970 to 1972 when compared with a control group residing away from the airport (Jones and Tauscher 1978). Based on this report, a separate group at the Center for Disease Control performed a more thorough study of populations near Atlanta's Hartsfield International Airport (ATL) for 1970 to 1972 and found no relationship in their study of 17 identified categories of birth defects to aircraft noise levels above 65 dB (Edmonds, et al. 1979).

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft time-average sound levels below 75 dB.

The potential for noise to affect physiological health, such as the cardiovascular system, has been speculated; however, no unequivocal evidence exists to support such claims (Harris 1997). Conclusions drawn from a review of health effect studies involving military low-altitude flight noise with its unusually high maximum levels and rapid rise in sound level have shown no increase in cardiovascular disease (Schwartze and Thompson 1993). Additional claims that are unsupported include flyover noise producing increased mortality rates and increases in cardiovascular death, aggravation of post-traumatic stress syndrome, increased stress, increase in admissions to mental hospitals, and adverse affects on pregnant women and the unborn fetus (Harris 1997).

C-3.3.6 Performance Effects

The effect of noise on the performance of activities or tasks has been the subject of many studies. Some of these studies have established links between continuous high noise levels and performance loss. Noise-induced performance losses are most frequently reported in studies employing noise levels in excess of 85 dB. Little change has been found in low-noise cases. It has been cited that moderate noise levels appear to act as a stressor for more sensitive individuals performing a difficult psychomotor task.

While the results of research on the general effect of periodic aircraft noise on performance have yet to yield definitive criteria, several general trends have been noted including:

- A periodic intermittent noise is more likely to disrupt performance than a steady-state continuous noise of the same level. Flyover noise, due to its intermittent nature, might be more likely to disrupt performance than a steady-state noise of equal level.
- Noise is more inclined to affect the quality than the quantity of work.
- Noise is more likely to impair the performance of tasks that place extreme demands on the worker.

C-3.3.7 Noise Effects on Children

In response to noise-specific and other environmental studies, Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (1997), requires federal agencies to ensure that policies, programs, and activities address environmental health and safety risks to identify any disproportionate risks to children.

A review of the scientific literature indicates that there has not been a tremendous amount of research in the area of aircraft noise effects on children. The research reviewed does suggest that environments with sustained high background noise can have variable effects, including noise effects on learning and cognitive abilities, and reports of various noise-related physiological changes.

C-3.3.7.1 Effects on Learning and Cognitive Abilities

In 2002 release of the "Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools," the American National Standards Institute refers to studies that suggest that loud and frequent background noise can affect the learning patterns of young children. ANSI provides discussion on the relationships between noise and learning, and stipulates design requirements and acoustical performance criteria for outdoor-to-indoor noise isolation. School design is directed to be cognizant of, and responsive to, surrounding land uses and the shielding of outdoor noise from the indoor environment. ANSI has approved a new standard for acoustical performance criteria in schools. The new criteria include the requirement that the one-hour-average background noise level shall not exceed 35 dBA in core learning spaces smaller than 20,000 cubic-feet and 40 dBA in core learning spaces with enclosed volumes exceeding 20,000 cubic-feet. This would require schools be constructed such that, in quiet neighborhoods indoor noise levels are lowered by 15 to 20 dBA relative to outdoor levels. In schools near airports, indoor noise levels would have to be lowered by 35 to 45 dBA relative to outdoor levels (American National Standards Institute 2002).

The studies referenced by ANSI to support the new standard are not specific to jet aircraft noise and the potential effects on children. However, there are references to studies that have shown that children in noisier classrooms scored lower on a variety of tests. Excessive background noise or reverberation within schools causes interferences of communication and can therefore create an acoustical barrier to learning (American National Standards Institute 2002). Studies have been performed that contribute to the body of evidence emphasizing the importance of communication by way of the spoken language to the development of cognitive skills. The ability to read, write, comprehend, and maintain attentiveness, are, in part, based upon whether teacher communication is consistently intelligible (American National Standards Institute 2002).

Numerous studies have shown varying degrees of effects of noise on the reading comprehension, attentiveness, puzzle-solving, and memory/recall ability of children. It is generally accepted that young children are more susceptible than adults to the effects of background noise. Because of the developmental status of young children (linguistic, cognitive, and proficiency), barriers to hearing can cause interferences or disruptions in developmental evolution.

Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of schoolchildren. Although many factors could contribute to learning deficits in school-aged children (e.g., socioeconomic level, home environment, diet, sleep patterns), evidence exists that suggests that chronic exposure to high aircraft noise levels can impair learning.

Specifically, elementary school children attending schools near New York City's two airports demonstrated lower reading scores than children living farther away from the flight paths (Green, et al. 1982). Researchers have found that tasks involving central processing and language comprehension (such as reading, attention, problem solving, and memory) appear to be the most affected by noise (Evans and Lepore 1993; Hygge 1994; and Evans, et al. 1998). It has been demonstrated that chronic exposure of first- and second-grade children to aircraft noise can result in reading deficits and impaired speech perception (i.e., the ability to hear common, low-frequency [vowel] sounds but not high frequencies [consonants] in speech) (Evans and Maxwell 1997).

The Evans and Maxwell (1997) study found that chronic exposure to aircraft noise resulted in reading deficits and impaired speech perception for first- and second-grade children. Other studies found that children residing near the Los Angeles International Airport had more difficulty solving cognitive problems and did not perform as well as children from quieter schools in puzzle-solving and attentiveness (Bronzaft 1997; Cohen, et al. 1980). Children attending elementary schools in high aircraft noise areas near London's Heathrow Airport demonstrated poorer reading comprehension and selective cognitive impairments (Haines, et al. 2001a, and 2001b). Similarly, a study conducted by Hygge (1994) found that students exposed to aircraft noise (76 dBA) scored 20% lower on recall ability tests than students exposed to ambient noise (42-44 dBA). Similar studies involving the testing of attention, memory, and reading comprehension of schoolchildren located near airports showed that their tests exhibited reduced performance results compared to those of similar groups of children who were located in quieter environments (Evans, et al. 1998; Haines, et al. 1998). The Haines and Stansfeld study indicated that there may be some long-term effects associated with exposure, as one-year follow-up testing still demonstrated lowered scores for children in higher noise schools (Haines, et al. 2001a, and 2001b). In contrast, a study conducted by Hygge, et al. (2002) found that although children living near the old Munich airport scored lower in standardized reading and long-term memory tests than a control group, their performance on the same tests was equal to that of the control group once the airport was closed.

Finally, although it is recognized that there are many factors that could contribute to learning deficits in school-aged children, there is increasing awareness that chronic exposure to high aircraft noise levels may impair learning. This awareness has led the World Health Organization and a North Atlantic Treaty Organization working group to conclude that daycare centers and schools should not be located near major sources of noise, such as highways, airports, and industrial sites (World Health Organization 2000; North Atlantic Treaty Organization 2000).

C-3.3.7.2 Health Effects

Physiological effects in children exposed to aircraft noise and the potential for health effects have also been the focus of limited investigation. Studies in the literature include examination of blood pressure levels, hormonal secretions, and hearing loss.

As a measure of stress response to aircraft noise, authors have looked at blood pressure readings to monitor children's health. Children who were chronically exposed to aircraft noise from a new airport near Munich, Germany, had modest (although significant) increases in blood pressure, significant increases in stress hormones, and a decline in quality of life (Evans, et al. 1998). Children attending noisy schools had statistically significant average systolic and diastolic blood pressure ($p<0.03$). Systolic blood pressure means were 89.68 mm for children attending schools located in noisier environments compared to 86.77 mm for a control group. Similarly, diastolic blood pressure means for the noisier environment group were 47.84 mm and 45.16 for the control group (Cohen, et al. 1980).

Although the literature appears limited, relatively recent studies focused on the wide range of potential effects of aircraft noise on school children have also investigated hormonal levels between groups of

children exposed to aircraft noise compared to those in a control group. Specifically, Haines, et al. (2001b and 2001c) analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise. In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

Other studies have reported hearing losses from exposure to aircraft noise. Noise-induced hearing loss was reportedly higher in children who attended a school located under a flight path near a Taiwan airport, as compared to children at another school far away (Chen, et al. 1997). Another study reported that hearing ability was reduced significantly in individuals who lived near an airport and were frequently exposed to aircraft noise (Chen and Chen 1993). In that study, noise exposure near the airport was reportedly uniform, with DNL greater than 75 dB and maximum noise levels of about 87 dB during overflights. Conversely, several other studies that were reviewed reported no difference in hearing ability between children exposed to high levels of airport noise and children located in quieter areas (Fisch 1977; Andrus, et al. 1975; Wu, et al. 1995).

C-3.3.8 Effects on Domestic Animals and Wildlife

Hearing is critical to an animal's ability to react, compete, reproduce, hunt, forage, and survive in its environment. While the existing literature does include studies on possible effects of jet aircraft noise and sonic booms on wildlife, there appears to have been little concerted effort in developing quantitative comparisons of aircraft noise effects on normal auditory characteristics. Behavioral effects have been relatively well described, but the larger ecological context issues, and the potential for drawing conclusions regarding effects on populations, has not been well developed.

The relationships between potential auditory/physiological effects and species interactions with their environments are not well understood. Manci, et al. (1988), assert that the consequences that physiological effects may have on behavioral patterns is vital to understanding the long-term effects of noise on wildlife. Questions regarding the effects (if any) on predator-prey interactions, reproductive success, and intra-inter specific behavior patterns remain.

The following discussion provides an overview of the existing literature on noise effects (particularly jet aircraft noise) on animal species. The literature reviewed here involves those studies that have focused on the observations of the behavioral effects that jet aircraft and sonic booms have on animals.

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on the public and the potential for adverse ecological impacts. These studies were largely completed in response to the increase in air travel and as a result of the introduction of supersonic jet aircraft. According to Manci, et al. (1988), the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes.

The abilities to hear sounds and noise and to communicate assist wildlife in maintaining group cohesiveness and survivorship. Social species communicate by transmitting calls of warning, introduction, and other types that are subsequently related to an individual's or group's responsiveness.

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or could interfere with behavioral patterns (Manci, et al. 1988). Although the effects are likely temporal, aircraft noise may

cause masking of auditory signals within exposed faunal communities. Animals rely on hearing to avoid predators, obtain food, and communicate with, and attract, other members of their species. Aircraft noise may mask or interfere with these functions. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights. Secondary effects may include non-auditory effects such as stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects, and include population decline and habitat loss. Most of the effects of noise are mild enough that they may never be detectable as variables of change in population size or population growth against the background of normal variation (Bowles 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects, and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith, et al. 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci, et al. 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife "flight" due to noise. Apparently, animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed wing versus rotor-wing [helicopter]) and type of flight mission may also produce different levels of disturbance, with varying animal responses (Smith, et al. 1988). Consequently, it is difficult to generalize animal responses to noise disturbances across species.

One result of the 1988 Manci, et al., literature review was the conclusion that, while behavioral observation studies were relatively limited, a general behavioral reaction in animals from exposure to aircraft noise is the startle response. The intensity and duration of the startle response appears to be dependent on which species is exposed, whether there is a group or an individual, and whether there have been some previous exposures. Responses range from flight, trampling, stampeding, jumping, or running, to movement of the head in the apparent direction of the noise source. Manci, et al. (1988), reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals.

C-3.3.8.1 Domestic Animals

Although some studies report that the effects of aircraft noise on domestic animals is inconclusive, a majority of the literature reviewed indicates that domestic animals exhibit some behavioral responses to military overflights but generally seem to habituate to the disturbances over a period of time. Mammals in particular appear to react to noise at sound levels higher than 90 dB, with responses including the startle response, freezing (i.e., becoming temporarily stationary), and fleeing from the sound source. Many studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Manci, et al. 1988). Some studies have reported such primary and secondary effects as reduced milk production and rate of milk release, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate, and a reduction in thyroid activity. These latter effects appear to represent a small percentage of the findings occurring in the existing literature.

Some reviewers have indicated that earlier studies, and claims by farmers linking adverse effects of aircraft noise on livestock, did not necessarily provide clear-cut evidence of cause and effect (Cottereau 1978). In contrast, many studies conclude that there is no evidence that aircraft overflights affect feed intake, growth, or production rates in domestic animals.

Cattle

In response to concerns about overflight effects on pregnant cattle, milk production, and cattle safety, the U.S. Air Force prepared a handbook for environmental protection that summarizes the literature on the impacts of low-altitude flights on livestock (and poultry) and includes specific case studies conducted in numerous airspaces across the country. Adverse effects have been found in a few studies but have not been reproduced in other similar studies. One such study, conducted in 1983, suggested that 2 of 10 cows in late pregnancy aborted after showing rising estrogen and falling progesterone levels. These increased hormonal levels were reported as being linked to 59 aircraft overflights. The remaining eight cows showed no changes in their blood concentrations and calved normally (U.S. Air Force 1994b). A similar study reported abortions occurred in three out of five pregnant cattle after exposing them to flyovers by six different aircraft (U.S.Air Force 1994b). Another study suggested that feedlot cattle could stampede and injure themselves when exposed to low-level overflights (U.S. Air Force 1994b).

A majority of the studies reviewed suggests that there is little or no effect of aircraft noise on cattle. Studies presenting adverse effects to domestic animals have been limited. A number of studies (Parker and Bayley 1960; Casady and Lehmann 1967; Kovalcik and Sottnik 1971) investigated the effects of jet aircraft noise and sonic booms on the milk production of dairy cows. Through the compilation and examination of milk production data from areas exposed to jet aircraft noise and sonic boom events, it was determined that milk yields were not affected. This was particularly evident in those cows that had been previously exposed to jet aircraft noise.

A study examined the causes of 1,763 abortions in Wisconsin dairy cattle over a one-year time period and none were associated with aircraft disturbances (U.S.Air Force 1993). In 1987, Anderson contacted seven livestock operators for production data, and no effects of low-altitude and supersonic flights were noted. Three out of 43 cattle previously exposed to low-altitude flights showed a startle response to an F/A-18 aircraft flying overhead at 500 feet above ground level and 400 knots by running less than 10 meters. They resumed normal activity within one minute (U.S.Air Force 1994b). Beyer (1983) found that helicopters caused more reaction than other low-aircraft overflights, and that the helicopters at 30 to 60 feet overhead did not affect milk production and pregnancies of 44 cows and heifers in a 1964 study (U.S. Air Force 1994b).

Additionally, Beyer reported that five pregnant dairy cows in a pasture did not exhibit fright-flight tendencies or disturb their pregnancies after being overflown by 79 low-altitude helicopter flights and 4 low-altitude, subsonic jet aircraft flights (U.S. Air Force 1994b). A 1956 study found that the reactions of dairy and beef cattle to noise from low-altitude, subsonic aircraft were similar to those caused by paper blowing about, strange persons, or other moving objects (U.S. Air Force 1994b).

In a report to Congress, the U. S. Forest Service concluded that "evidence both from field studies of wild ungulates and laboratory studies of domestic stock indicate that the risks of damage are small (from aircraft approaches of 50 to 100 meters), as animals take care not to damage themselves (U.S. Forest Service 1992). If animals are overflown by aircraft at altitudes of 50 to 100 meters, there is no evidence that mothers and young are separated, that animals collide with obstructions (unless confined) or that they traverse dangerous ground at too high a rate." These varied study results suggest that, although the confining of cattle could magnify animal response to aircraft overflight, there is no proven cause-and-effect link between startling cattle from aircraft overflights and abortion rates or lower milk production.

Horses

Horses have also been observed to react to overflights of jet aircraft. Several of the studies reviewed reported a varied response of horses to low-altitude aircraft overflights. Observations made in 1966 and

1968 noted that horses galloped in response to jet flyovers (U.S. Air Force 1993). Bowles (1995) cites Kruger and Erath as observing horses exhibiting intensive flight reactions, random movements, and biting/kicking behavior. However, no injuries or abortions occurred, and there was evidence that the mares adapted somewhat to the flyovers over the course of a month (U.S. Air Force 1994b). Although horses were observed noticing the overflights, it did not appear to affect either survivability or reproductive success. There was also some indication that habituation to these types of disturbances was occurring.

LeBlanc, et al. (1991), studied the effects of F-14 jet aircraft noise on pregnant mares. They specifically focused on any changes in pregnancy success, behavior, cardiac function, hormonal production, and rate of habituation. Their findings reported observations of "flight-fright" reactions, which caused increases in heart rates and serum cortisol concentrations. The mares, however, did habituate to the noise. Levels of anxiety and mass body movements were the highest after initial exposure, with intensities of responses decreasing thereafter. There were no differences in pregnancy success when compared to a control group.

Swine

Generally, the literature findings for swine appear to be similar to those reported for cows and horses. While there are some effects from aircraft noise reported in the literature, these effects are minor. Studies of continuous noise exposure (i.e., 6 hours, 72 hours of constant exposure) reported influences on short-term hormonal production and release. Additional constant exposure studies indicated the observation of stress reactions, hypertension, and electrolyte imbalances (Dufour 1980). A study by Bond, et al. (1963), demonstrated no adverse effects on the feeding efficiency, weight gain, ear physiology, or thyroid and adrenal gland condition of pigs subjected to observed aircraft noise. Observations of heart rate increase were recorded, noting that cessation of the noise resulted in the return to normal heart rates. Conception rates and offspring survivorship did not appear to be influenced by exposure to aircraft noise.

Similarly, simulated aircraft noise at levels of 100 dB to 135 dB had only minor effects on the rate of feed utilization, weight gain, food intake, or reproduction rates of boars and sows exposed, and there were no injuries or inner ear changes observed (Manci, et al. 1988; Gladwin, et al. 1988).

Domestic Fowl

According to a 1994 position paper by the U.S. Air Force on effects of low-altitude overflights (below 1,000 ft) on domestic fowl, overflight activity has negligible effects (U.S. Air Force 1994a). The paper did recognize that given certain circumstances, adverse effects can be serious. Some of the effects can be panic reactions, reduced productivity, and effects on marketability (e.g., bruising of the meat caused during "pile-up" situations).

The typical reaction of domestic fowl after exposure to sudden, intense noise is a short-term startle response. The reaction ceases as soon as the stimulus is ended, and within a few minutes all activity returns to normal. More severe responses are possible depending on the number of birds, the frequency of exposure, and environmental conditions. Large crowds of birds, and birds not previously exposed, are more likely to pile up in response to a noise stimulus (U.S. Air Force 1994a). According to studies and interviews with growers, it is typically the previously unexposed birds that incite panic crowding, and the tendency to do so is markedly reduced within five exposures to the stimulus (U.S. Air Force 1994a). This suggests that the birds habituate relatively quickly. Egg productivity was not adversely affected by infrequent noise bursts, even at exposure levels as high as 120 to 130 dBA.

Between 1956 and 1988, there were 100 recorded claims against the Navy for alleged damage to domestic fowl. The number of claims averaged three per year, with peak numbers of claims following publications of studies on the topic in the early 1960s (U.S. Air Force 1994a). Many of the claims were disproved or did not

have sufficient supporting evidence. The claims were filed for the following alleged damages: 55% for panic reactions, 31% for decreased production, 6% for reduced hatchability, 6% for weight loss, and less than 1% for reduced fertility (U.S. Air Force 1994a).

Turkeys

The review of the existing literature suggests that there has not been a concerted or widespread effort to study the effects of aircraft noise on commercial turkeys. One study involving turkeys examined the differences between simulated versus actual overflight aircraft noise, turkey responses to the noise, weight gain, and evidence of habituation (Bowles, et al. 1990a). Findings from the study suggested that turkeys habituated to jet aircraft noise quickly, that there were no growth rate differences between the experimental and control groups, and that there were some behavioral differences that increased the difficulty in handling individuals within the experimental group.

Low-altitude overflights were shown to cause turkey flocks that were kept inside turkey houses to occasionally pile up and experience high mortality rates due to the aircraft noise and a variety of disturbances unrelated to aircraft (U.S. Air Force 1994a).

C-3.3.8.2 Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock (Manci, et al. 1988). This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci, et al. 1988).

C-3.3.8.2.1 Mammals

Terrestrial Mammals

Studies of terrestrial mammals have shown that noise levels of 120 dBA can damage mammals' ears, and levels at 95 dBA can cause temporary loss of hearing acuity. Noise from aircraft has affected other large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior. One study recommended that aircraft not be allowed to fly at altitudes below 2,000 feet above ground level over important grizzly and polar bear habitat (Dufour 1980). Wolves have been frightened by low-altitude flights that were 25 to 1,000 feet off the ground. However, wolves have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980).

Wild ungulates (American bison, caribou, bighorn sheep) appear to be much more sensitive to noise disturbance than domestic livestock (Weisenberger, et al. 1996). Behavioral reactions may be related to the past history of disturbances by such things as humans and aircraft. Common reactions of reindeer kept in an enclosure exposed to aircraft noise disturbance were a slight startle response, raising of the head, pricking ears, and scenting of the air. Panic reactions and extensive changes in behavior of individual animals were not observed. Observations of caribou in Alaska exposed to fixed-wing aircraft and helicopters showed running and panic reactions occurred when overflights were at an altitude of 200 feet or less. The reactions decreased with increased altitude of overflights, and, with more than 500 feet in altitude, the panic reactions stopped. Also, smaller groups reacted less strongly than larger groups. One negative effect of the running and avoidance behavior is increased expenditure of energy. For a 90-kg

animal, the calculated expenditure due to aircraft harassment is 64 kilocalories per minute when running and 20 kilocalories per minute when walking. When conditions are favorable, this expenditure can be counteracted with increased feeding; however, during harsh winter conditions, this may not be possible. Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters in the northern regions suggested that wolves are less disturbed than wild ungulates, while grizzly bears showed the greatest response of any animal species observed.

It has been proven that low-altitude overflights do induce stress in animals. Increased heart rates, an indicator of excitement or stress, have been found in pronghorn antelope, elk, and bighorn sheep. As such reactions occur naturally as a response to predation, infrequent overflights may not, in and of themselves, be detrimental. However, flights at high frequencies over a long period of time may cause harmful effects. The consequences of this disturbance, while cumulative, is not additive. It may be that aircraft disturbance may not cause obvious and serious health effects, but coupled with a harsh winter, it may have an adverse impact. Research has shown that stress induced by other types of disturbances produces long-term decreases in metabolism and hormone balances in wild ungulates.

Behavioral responses can range from mild to severe. Mild responses include head raising, body shifting, or turning to orient toward the aircraft. Moderate disturbance may be nervous behaviors, such as trotting a short distance. Escape is the typical severe response.

Marine Mammals

The physiological composition of the ear in aquatic and marine mammals exhibits adaptation to the aqueous environment. These differences (relative to terrestrial species) manifest themselves in the auricle and middle ear (Manci, et al. 1988). Some mammals use echolocation to perceive objects in their surroundings and to determine the directions and locations of sound sources (Simmons 1983 in Manci, et al. 1988).

In 1980, the Acoustical Society of America held a workshop to assess the potential hazard of manmade noise associated with proposed Alaska Arctic (North Slope-Outer Continental Shelf) petroleum operations on marine wildlife and to prepare a research plan to secure the knowledge necessary for proper assessment of noise impacts (Acoustical Society of America, 1980). Since 1980 it appears that research on responses of aquatic mammals to aircraft noise and sonic booms has been limited. Research conducted on northern fur seals, sea lions, and ringed seals indicated that there are some differences in how various animal groups receive frequencies of sound. It was observed that these species exhibited varying intensities of a startle response to airborne noise, which was habituated over time. The rates of habituation appeared to vary with species, populations, and demographics (age, sex). Time of day of exposure was also a factor (Muyberg 1978 in Manci, et al. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 dBA caused a greater intensity of startle reactions than lower-intensity booms at 72 to 79 dBA. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980 in Manci, et al. 1988).

Jehl and Cooper (1980) indicated that low-flying helicopters, loud boat noises, and humans were the most disturbing to pinnipeds. According to the research, while the space launch and associated operational activity noises have not had a measurable effect on the pinniped population, it also suggests that there was a greater "disturbance level" exhibited during launch activities. There was a recommendation to continue observations for behavioral effects and to perform long-term population monitoring (Jehl and Cooper 1980).

The continued presence of single or multiple noise sources could cause marine mammals to leave a preferred habitat. However, it does not appear likely that overflights could cause migration from suitable habitats as aircraft noise over water is mobile and would not persist over any particular area. Aircraft noise, including supersonic noise, currently occurs in the overwater airspace of Eglin, Tyndall, and Langley AFBs from sorties predominantly involving jet aircraft. Survey results reported in Davis, et al. (2000), indicate that cetaceans (i.e., dolphins) occur under all of the Eglin and Tyndall marine airspace. The continuing presence of dolphins indicates that aircraft noise does not discourage use of the area and apparently does not harm the locally occurring population.

In a summary by the National Parks Service (1994) on the effects of noise on marine mammals, it was determined that gray whales and harbor porpoises showed no outward behavioral response to aircraft noise or overflights. Bottlenose dolphins showed no obvious reaction in a study involving helicopter overflights at 1,200 to 1,800 feet above the water. Neither did they show any reaction to survey aircraft unless the shadow of the aircraft passed over them, at which point there was some observed tendency to dive (Richardson, et al. 1995). Other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise (U.S. Air Force 2000). The noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna along the coast of California have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc. 1997).

Manatees appear relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats [although their hearing is actually similar to that of pinnipeds (Bullock, et al. 1980)]. Little is known about the importance of acoustic communication to manatees, although they are known to produce at least ten different types of sounds and are thought to have sensitive hearing (Richardson, et al. 1995). Manatees continue to occupy canals near Miami International Airport, which suggests that they have become habituated to human disturbance and noise (Metro-Dade County 1995). Since manatees spend most of their time below the surface and do not startle readily, no effect of aircraft overflights on manatees would be expected (Bowles, et al. 1991b).

C-3.3.8.2.2 Birds

Auditory research conducted on birds indicates that they fall between the reptiles and the mammals relative to hearing sensitivity. According to Dooling (1978), within the range of 1 to 5 kHz, birds show a level of hearing sensitivity similar to that of the more sensitive mammals. In contrast to mammals, bird sensitivity falls off at a greater rate to increasing and decreasing frequencies. Passive observations and studies examining aircraft bird strikes indicate that birds nest and forage near airports. Aircraft noise in the vicinity of commercial airports apparently does not inhibit bird presence and use.

High-noise events (like a low-altitude aircraft overflight) may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests (Ellis, et al. 1991). These activities impose an energy cost on the birds that, over the long term, may affect survival or growth. In addition, the birds may spend less time engaged in necessary activities like feeding, preening, or caring for their young because they spend time in noise-avoidance activity. However, the long-term significance of noise-related impacts is less clear. Several studies on nesting raptors have indicated that birds become habituated to aircraft overflights and that long-term reproductive success is not affected (Grubb and King 1991; Ellis, et al. 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant (Branta bernicla nigricans) (Ward and Stehn 1990) to 85 dB for crested tern (Sterna bergii) (Brown 1990).

Songbirds were observed to become silent prior to the onset of a sonic boom event (F-111 jets), followed by "raucous discordant cries." There was a return to normal singing within 10 seconds after the boom

(Higgins 1974 in Manci, et al. 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Manci, et al. (1988), reported a reduction in reproductive success in some small territorial passerines (i.e., perching birds or songbirds) after exposure to low-altitude overflights. However, it has been observed that passerines are not driven any great distance from a favored food source by a nonspecific disturbance, such as aircraft overflights (U.S. Forest Service 1992). Further study may be warranted.

A recent study, conducted cooperatively between the DoD and the USFWS, assessed the response of the red-cockaded woodpecker to a range of military training noise events, including artillery, small arms, helicopter, and maneuver noise (Pater, et al. 1999). The project findings show that the red-cockaded woodpecker successfully acclimates to military noise events. Depending on the noise level that ranged from innocuous to very loud, the birds responded by flushing from their nest cavities. When the noise source was closer and the noise level was higher, the number of flushes increased proportionately. In all cases, however, the birds returned to their nests within a relatively short period of time (usually within 12 minutes). Additionally, the noise exposure did not result in any mortality or statistically detectable changes in reproductive success (Pater, et al. 1999). Red-cockaded woodpeckers did not flush when artillery simulators were more than 122 meters away and SEL noise levels were 70 dBA.

Lynch and Speake (1978) studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey (Meleagris gallopavo silvestris) in Alabama. Hens at four nest sites were subjected to between 8 and 11 combined real and simulated sonic booms. All tests elicited similar responses, including quick lifting of the head and apparent alertness for between 10 and 20 seconds. No apparent nest failure occurred as a result of the sonic booms.

Twenty-one brood groups were also subjected to simulated sonic booms. Reactions varied slightly between groups, but the largest percentage of groups reacted by standing motionless after the initial blast. Upon the sound of the boom, the hens and poults fled until reaching the edge of the woods (approximately 4 to 8 meters). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15 to 20 seconds). In no instances were poults abandoned, nor did they scatter and become lost. Every observation group returned to normal activities within a maximum of 30 seconds after a blast.

C-3.3.8.2.2.1 Raptors

In a literature review of raptor responses to aircraft noise, Manci, et al. (1988), found that most raptors did not show a negative response to overflights. When negative responses were observed they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest.

Ellis, et al. (1991), performed a study to estimate the effects of low-level military jet aircraft and mid- to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black-hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, bald eagle). They observed responses to test stimuli, determined nest success for the year of the testing, and evaluated site occupancy the following year. Both long- and short-term effects were noted in the study. The results reported the successful fledging of young in 34 of 38 nest sites (all eight species) subjected to low-level flight and/or simulated sonic booms. Twenty-two of the test sites were revisited in the following year, and observations of pairs or lone birds were made at all but one nest. Nesting attempts were underway at 19 of 20 sites that were observed long enough to be certain of breeding activity. Reoccupancy and productivity rates were within or above expected values for self-sustaining populations.

Short-term behavior responses were also noted. Overflights at a distance of 150 m or less produced few significant responses and no severe responses. Typical responses consisted of crouching or, very rarely, flushing from the perch site. Significant responses were most evident before egg laying and after young were "well grown." Incubating or brooding adults never burst from the nest, thus preventing egg breaking or knocking chicks out of the nest. Jet passes and sonic booms often caused noticeable alarm; however, significant negative responses were rare and did not appear to limit productivity or reoccupancy. Due to the locations of some of the nests, some birds may have been habituated to aircraft noise. There were some test sites located at distances far from zones of frequent military aircraft usage, and the test stimuli were often closer, louder, and more frequent than would be likely for a normal training situation.

Manci, et al. (1988), noted that a female northern harrier was observed hunting on a bombing range in Mississippi during bombing exercises. The harrier was apparently unfazed by the exercises, even when a bomb exploded within 200 feet. In a similar case of habituation/non-disturbance, a study on the Florida snail-kite stated the greatest reaction to overflights (approximately 98 dBA) was "watching the aircraft fly by." No detrimental impacts to distribution, breeding success, or behavior were noted.

Bald Eagle

A study by Grubb and King (1991) on the reactions of the bald eagle to human disturbances showed that terrestrial disturbances elicited the greatest response, followed by aquatic (i.e., boats) and aerial disturbances. The disturbance regime of the area where the study occurred was predominantly characterized by aircraft noise. The study found that pedestrians consistently caused responses that were greater in both frequency and duration. Helicopters elicited the highest level of aircraft-related responses. Aircraft disturbances, although the most common form of disturbance, resulted in the lowest levels of response. This low response level may have been due to habituation; however, flights less than 170 meters away caused reactions similar to other disturbance types. Ellis, et al. (1991), showed that eagles typically respond to the proximity of a disturbance, such as a pedestrian or aircraft within 100 meters, rather than the noise level. Fleischner and Weisberg (1986) stated that reactions of bald eagles to commercial jet flights, although minor (e.g., looking), were twice as likely to occur when the jets passed at a distance of 0.5 mile or less. They also noted that helicopters were four times more likely to cause a reaction than a commercial jet and 20 times more likely to cause a reaction than a propeller plane.

The USFWS advised Cannon AFB that flights at or below 2,000 feet AGL from October 1 through March 1 could result in adverse impacts to wintering bald eagles (U.S. Fish and Wildlife Serice 1998). However, Fraser, et al. (1985), suggested that raptors habituate to overflights rapidly, sometimes tolerating aircraft approaches of 65 feet or less.

Osprey

A study by Trimper, et al. (1998), in Goose Bay, Labrador, Canada, focused on the reactions of nesting osprey to military overflights by CF-18 Hornets. Reactions varied from increased alertness and focused observation of planes to adjustments in incubation posture. No overt reactions (e.g., startle response, rapid nest departure) were observed as a result of an overflight. Young nestlings crouched as a result of any disturbance until they grew to 1 to 2 weeks prior to fledging. Helicopters, human presence, float planes, and other ospreys elicited the strongest reactions from nesting ospreys. These responses included flushing, agitation, and aggressive displays. Adult osprey showed high nest occupancy rates during incubation regardless of external influences.

The osprey observed occasionally stared in the direction of the flight before it was audible to the observers. The birds may have been habituated to the noise of the flights; however, overflights were strictly controlled

during the experimental period. Strong reactions to float planes and helicopter may have been due to the slower flight and therefore longer duration of visual stimuli rather than noise-related stimuli.

Red-tailed Hawk

Anderson, et al. (1989), conducted a study that investigated the effects of low-level helicopter overflights on 35 red-tailed hawk nests. Some of the nests had not been flown over prior to the study. The hawks that were naïve (i.e., not previously exposed) to helicopter flights exhibited stronger avoidance behavior (nine of 17 birds flushed from their nests) than those that had experienced prior overflights. The overflights did not appear to affect nesting success in either study group. These findings were consistent with the belief that red-tailed hawks habituate to low-level air traffic, even during the nesting period.

C-3.3.8.2.2.2 Migratory Waterfowl

A study of caged American black ducks was conducted by Fleming, et al. in 1996. It was determined that noise had negligible energetic and physiologic effects on adult waterfowl. Measurements included body weight, behavior, heart rate, and enzymatic activity. Experiments also showed that adult ducks exposed to high noise events acclimated rapidly and showed no effects.

The study also investigated the reproductive success of captive ducks, which indicated that duckling growth and survival rates at Piney Island, North Carolina, were lower than those at a background location. In contrast, observations of several other reproductive indices (i.e., pair formation, nesting, egg production, and hatching success) showed no difference between Piney Island and the background location. Potential effects on wild duck populations may vary, as wild ducks at Piney Island have presumably acclimated to aircraft overflights. It was not demonstrated that noise was the cause of adverse impacts. A variety of other factors, such as weather conditions, drinking water and food availability and variability, disease, and natural variability in reproduction, could explain the observed effects. Fleming noted that drinking water conditions (particularly at Piney Island) deteriorated during the study, which could have affected the growth of young ducks. Further research would be necessary to determine the cause of any reproductive effects.

Another study by Conomy, et al. (1998) exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dBA. It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38 percent to 6 percent in 17 days and remained stable at 5.8 percent thereafter. In the same study, the wood duck did not appear to habituate to aircraft disturbance. This supports the notion that animal response to aircraft noise is species-specific. Because a startle response to aircraft noise can result in flushing from nests, migrants and animals living in areas with high concentrations of predators would be the most vulnerable to experiencing effects of lowered birth rates and recruitment over time. Species that are subjected to infrequent overflights do not appear to habituate to overflight disturbance as readily.

Black brant studied in the Alaska Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65% of all the disturbances. Humans, eagles, and boats caused a greater percentage of brant to take flight. There was markedly greater reaction to Bell-206-B helicopter flights than fixed wing, single-engine aircraft (Ward, et al. 1986).

The presence of humans and low-flying helicopters in the Mackenzie Valley North Slope area did not appear to affect the population density of Lapland longspurs, but the experimental group was shown to have reduced hatching and fledging success and higher nest abandonment. Human presence appeared to have a greater impact on the incubating behavior of the black brant, common eider, and Arctic tern than fixed-wing aircraft (Gunn and Livingston 1974).

Gunn and Livingston (1974) found that waterfowl and seabirds in the Mackenzie Valley and North Slope of Alaska and Canada became acclimated to float plane disturbance over the course of three days. Additionally, it was observed that potential predators (bald eagle) caused a number of birds to leave their nests. Non-breeding birds were observed to be more reactive than breeding birds. Waterfowl were affected by helicopter flights, while snow geese were disturbed by Cessna 185 flights. The geese flushed when the planes were under 1,000 feet, compared to higher flight elevations. An overall reduction in flock sizes was observed. It was recommended that aircraft flights be reduced in the vicinity of premigratory staging areas.

Manci, et al. 1988 reported that waterfowl were particularly disturbed by aircraft noise. The most sensitive appeared to be snow geese. Canada geese and snow geese were thought to be more sensitive than other animals such as turkey vultures, coyotes, and raptors (Edwards, et al. 1979).

C-3.3.8.2.2.3 Wading and Shore Birds

Black, et al. (1984), studied the effects of low-altitude (less than 500 feet AGL) military training flights with sound levels from 55 to 100 dBA on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity--including nest success, nestling survival, and nestling chronology--was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology. Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 to 390 feet, there was no reaction in nearly 75% of the 220 observations. Ninety percent displayed no reaction or merely looked toward the direction of the noise source. Another 6 percent stood up, 3 percent walked from the nest, and 2 percent flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). Apparently, non-nesting wading birds had a slightly higher incidence of reacting to overflights than nesting birds. Seagulls observed roosting near a colony of wading birds in another study remained at their roosts when subsonic aircraft flew overhead (Burger 1981). Colony distribution appeared to be most directly correlated to available wetland community types and was found to be distributed randomly with respect to military training routes. These results suggest that wading bird species presence was most closely linked to habitat availability and that they were not affected by low-level military overflights (U.S. Air Force 2000).

Burger (1986) studied the response of migrating shorebirds to human disturbance and found that shorebirds did not fly in response to aircraft overflights, but did flush in response to more localized intrusions (i.e., humans and dogs on the beach). Burger (1981) studied the effects of noise from JFK Airport in New York on herring gulls that nested less than 1 kilometer from the airport. Noise levels over the nesting colony were 85 to 100 dBA on approach and 94 to 105 dBA on takeoff. Generally, there did not appear to be any prominent adverse effects of subsonic aircraft on nesting, although some birds flushed when the concorde flew overhead and, when they returned, engaged in aggressive behavior. Groups of gulls tended to loaf in the area of the nesting colony, and these birds remained at the roost when the concorde flew overhead. Up to 208 of the loafing gulls flew when supersonic aircraft flew overhead. These birds would circle around and immediately land in the loafing flock (U.S. Air Force 2000).

In 1970, sonic booms were potentially linked to a mass hatch failure of Sooty Terns on the Dry Tortugas (Austin, et al. 1970). The cause of the failure was not certain, but it was conjectured that sonic booms from military aircraft or an overgrowth of vegetation were factors. In the previous season, Sooties were observed to react to sonic booms by rising in a "panic flight," circling over the island, then usually settling down on their eggs again. Hatching that year was normal. Following the 1969 hatch failure, excess vegetation was cleared and measures were taken to reduce supersonic activity. The 1970 hatch appeared to proceed

normally. A colony of Noddies on the same island hatched successfully in 1969, the year of the Sooty hatch failure.

Subsequent laboratory tests of exposure of eggs to sonic booms and other impulsive noises (Bowles, et al. 1991a; Bowles, et al. 1994; Cottereau 1972; Cogger and Zegarra 1980) failed to show adverse effects on hatching of eggs. A structural analysis (Ting, et al. 2002) showed that, even under extraordinary circumstances, sonic booms would not damage an avian egg.

Burger (1981) observed no effects of subsonic aircraft on herring gulls in the vicinity of JFK International Airport. The concorde aircraft did cause more nesting gulls to leave their nests (especially in areas of higher density of nests), causing the breakage of eggs and the scavenging of eggs by intruder prey. Clutch sizes were observed to be smaller in areas of higher-density nesting (presumably due to the greater tendency for panic flight) than in areas where there were fewer nests.

C-3.3.8.3 Fish, Reptiles, and Amphibians

The effects of overflight noise on fish, reptiles, and amphibians have been poorly studied, but conclusions regarding their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin, et al. 1988). Although fish do startle in response to low-flying aircraft noise, and probably to the shadows of aircraft, they have been found to habituate to the sound and overflights. Reptiles and amphibians that respond to low frequencies and those that respond to ground vibration, such as spadefoots (genus Scaphiopus), may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour (1980) and Manci, et al. (1988), summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American Alligator and the Spectacled Caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including DNLs of 85 dB.

C-3.3.8.4 Summary

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects.

The relationships between physiological effects and how species interact with their environments have not been thoroughly studied. Therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.

Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance, wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese in one study. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the "startle" or "fright" response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response

decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation/nesting phase.

C-3.3.9 Property Values

Property within a noise zone (or Accident Potential Zone) may be affected by the availability of federally guaranteed loans. According to U.S. Department of Housing and Urban Development (HUD), Federal Housing Administration (FHA), and Veterans Administration (VA) guidance, sites are acceptable for program assistance, subsidy, or insurance for housing in noise zones of less than 65 DNL, and sites are conditionally acceptable with special approvals and noise attenuation in the 65 to 75 DNL noise zone and the greater than 75 DNL noise zone. HUD's position is that noise is not the only determining factor for site acceptability, and properties should not be rejected only because of airport influences if there is evidence of acceptability within the market and if use of the dwelling is expected to continue. Similar to the Navy's and Air Force's Air Installation Compatible Use Zone Program, HUD, FHA, and VA recommend sound attenuation for housing in the higher noise zones and written disclosures to all prospective buyers or lessees of property within a noise zone (or Accident Potential Zone).

Newman and Beattie (1985) reviewed the literature to assess the effect of aircraft noise on property values. One paper by Nelson (1978), reviewed by Newman and Beattie, suggested a 1.8 to 2.3 percent decrease in property value per decibel at three separate airports, while at another period of time, they found only a 0.8 percent devaluation per decibel change in DNL. However, Nelson also noted a decline in noise depreciation over time which he theorized could be due to either noise sensitive people being replaced by less sensitive people or the increase in commerical value of the property near airports; both ideas were supported by Crowley (1978). Ultimately, Newman and Beattie summarized that while an effect of noise was observed, noise is only one of the many factors that is part of a decision to move close to, or away from, an airport, but which is sometimes considered an advantage due to increased opportunities for employment or ready access to the airport itself. With all the issues associated with determining property values, their reviews found that decreases in property values usually range from 0.5 to 2 percent per decibel increase of cumulative noise exposure.

More recently Fidell, et al. (1996) studied the influences of aircraft noise on actual sale prices of residential properties in the vicinity of two military facilities and found that equations developed for one area to predict residential sale prices in areas unaffected by aircraft noise worked equally well when applied to predicting sale prices of homes in areas with aircraft noise in excess of LDN 65dB. Thus, the model worked equally well in predicting sale prices in areas with and without aircraft noise exposure. This indicates that aircraft noise had no meaningful effect on residential property values. In some cases, the average sale prices of noise exposed properties were somewhat higher than those elsewhere in the same area. In the vicinity of Davis-Monthan AFB/Tucson, AZ, Fidell found the homes near the airbase were much older, smaller and in poorer condition than homes elsewhere. These factors caused the equations developed for

predicting sale prices in areas further away from the base to be inapplicable with those nearer the base. However, again Fidell found that, similar to other researchers, differences in sale prices between homes with and without aircraft noise were frequently due to factors other than noise itself.

C-3.3.10 Noise Effects on Structures

Normally, the most sensitive components of a structure to airborne noise are the windows and, infrequently, the plastered walls and ceilings. An evaluation of the peak sound pressures impinging on the structure is normally used to determine the possibility of damage. In general, with peak sound levels above 130 dB, there is the possibility of the excitation of structural component resonances. While certain frequencies (such as 30 hertz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than one second above a sound level of 130 dB are potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or rattling of objects within the dwelling such as hanging pictures, dishes, plaques, and bric-a-brac. Window panes may also vibrate noticeably when exposed to high levels of airborne noise. In general, such noise-induced vibrations occur at peak sound levels of 110 dB or greater. Thus, assessments of noise exposure levels for compatible land use should also be protective of noise-induced secondary vibrations.

C-3.3.11 Noise Effects on Terrain

It has been suggested that noise levels associated with low-flying aircraft may affect the terrain under the flight path by disturbing fragile soil or snow, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such effects, and it is considered improbable that such effects would result from routine, subsonic aircraft operations.

C-3.3.12 Noise Effects on Historical and Archaeological Sites

Because of the potential for increased fragility of structural components of historical buildings and other historical sites, aircraft noise may affect such sites more severely than newer, modern structures. Particularly in older structures, seemingly insignificant surface cracks initiated by vibrations from aircraft noise may lead to greater damage from natural forces (Hanson, et al. 1991). There are few scientific studies of such effects to provide guidance for their assessment.

One study involved the measurements of sound levels and structural vibration levels in a superbly restored plantation house, originally built in 1795, and now situated approximately 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. These measurements were made in connection with the proposed scheduled operation of the supersonic Concorde airplane at Dulles (Wesler 1977). There was special concern for the building's windows, since roughly half of the 324 panes were original. No instances of structural damage were found. Interestingly, despite the high levels of noise during Concorde takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning.

As noted above for the noise effects of noise-induced vibrations of conventional structures, assessments of noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites.

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APPENDIX D

Ground Traffic and Transportation Cumulative Impacts

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APPENDIX D

GROUND TRAFFIC AND TRANSPORTATION CUMULATIVE IMPACTS FOR MCAS MIRAMAR, MCAS CAMP PENDLETON, AND MCAS YUMA

A quantitative cumulative traffic and transportation analysis was conducted for MCAS Miramar, MCAS Camp Pendleton, and MCAS Yuma. This analysis is presented in sections 3.0, 4.0, and 5.0, respectively.

1.0 MCAS MIRAMAR

Cumulative analysis was anticipated to occur primarily between FY 2010 and FY 2020. Estimated traffic volumes for 2010 and 2020 were obtained from San Diego Association of Governments (SANDAG 2007a; SANDAG 2007b); the estimates do not take into account potential traffic changes related to the proposed action. The cumulative analysis for the construction-related traffic volumes and for the various alternatives on local streets were added to the SANDAG estimated 2010 and 2020 traffic volumes. It should be noted that the SANDAG FY 2010 and FY 2020 model forecast includes all pending developments that are consistent with the adopted general plan. The individual cumulative projects provided in section 8.2 are only a small portion of the pending development within San Diego County, therefore, the SANDAG traffic forecasts provide a better projection of the traffic that will exist in the year 2010 and 2020 than the list of cumulative project methodology.

The DoN evaluated significance of cumulative impacts in light of thresholds outlined in the City of San Diego Traffic Impact Manual (City of San Diego 1998). The level of significance varies from an allowable increase of ten percent or less for LOS A to an allowable increase of two percent or less for LOS D and E, and an allowable increase of one percent or less for LOS F. It should be noted that LOS D is considered to be an acceptable LOS; therefore, the thresholds of significance were only applied to LOS E and LOS F. If the project causes a change greater than that outlined in the City's thresholds, this is considered a significant cumulative impact.

Full Basing Alternative

Construction of New Facilities and Potential Impact on Local Streets

Construction activities are anticipated to occur primarily between FY 2010 and FY 2014. Estimated traffic volumes for 2010 were obtained from San Diego Association of Governments (SANDAG 2007a); these estimates do not take into account potential traffic changes related to the proposed action. For this cumulative analysis, the construction-related traffic volumes for this alternative were added to the SANDAG estimated 2010 traffic volumes. Table 1.1 illustrates this "2010 plus project" (construction traffic) Full Basing Alternative roadway segment daily LOS.

Based on this analysis, construction-related traffic associated with this alternative may create significant cumulative impacts on the following segment: Miramar Way between Kearny Villa Road and Interstate-15 (I-15) southbound ramp. Construction traffic impacts to this segment can be mitigated to a less than significant by conducting construction activities during off-peak hours.

Table 1.1. 2010 + Project (Construction Traffic)
MCAS Miramar Full Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2010**			*2010 + Project*			*Impact?*		
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	Δ *ADT*(3)	Δ *V/C*(4)	*Impact?*(5)
Interstate-15 (I-15)										
Mira Mesa Blvd to Miramar Rd	(1)	**326,000**	**1.420**	**F(2)**	**326,070**	**1.420**	**F(2)**	**70**	**0.000**	**None**
Miramar Rd to Miramar Wy	(1)	**321,000**	**1.530**	**F(2)**	**351,070**	**1.530**	**F(2)**	**70**	**0.000**	**None**
South of Miramar Wy	(1)	**358,000**	**1.560**	**F(2)**	**358,106**	**1.560**	**F(2)**	**106**	**0.000**	**None**
Miramar Way										
Kearny Villa Rd to I-15 SB Ramp	15,000(2)	**15,000**	**1.000**	**F**	**15,176**	**1.012**	**F**	**176**	**0.012**	**Significant**

Notes:

ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; SB = southbound; Δ = Change In;

(1) The levels of service for I-15 were determined based on the Caltrans District 11 procedures (Caltrans 2002).

(2) Capacity is based on the upper limit of LOS E per the City of San Diego (City of San Diego 1998).

(3) The incremental change in conditions associated with the proposed project (i.e. the difference between 2010 w/ project and 2010 without project conditions).

(4) Using City of San Diego guidelines as the reference point for significance, LOS E has a thresholds of 0.02 and LOS F has a threshold hold of 0.01 (City of San Diego 2007).

(5) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.

Operations at the Airfield and Potential Impact on Local Streets

Transition from the helicopters to the MV-22 is scheduled to be completed by 2020. Estimated traffic volumes for 2020 were obtained from San Diego Association of Governments (SANDAG 2007b); these estimates do not take into account potential traffic changes related to the proposed action. For the cumulative analysis, the operations-related traffic volumes for this alternative were added to the SANDAG estimated 2020 traffic volumes. Table 1.2 illustrates this "2020 plus project" Full Basing Alternative roadway segment daily LOS.

Based on this analysis, operations-related traffic associated with this alternative may create significant cumulative impacts for the following segments:

- I-15 between Mira Mesa Boulevard and south of Miramar Way;
- Miramar Road between Clayton Drive and Kearny Villa Drive;
- Miramar Road between Kearny Mesa Road and I-15 southbound ramp; and
- Miramar Way between Kearny Villa Road and I-15 southbound ramp.

In addition, cumulative projects, such as JSF and Grow the Force that would substantially increase the number of personnel at MCAS Miramar, would exacerbate significant operations-related cumulative impacts to traffic from the Full Basing Alternative.

Mitigation Measures

Construction-related traffic impacts to this segment can be mitigated to a less than significant by conducting construction activities during off-peak hours. Significant operations-related traffic impacts cannot be mitigated because the DON is legally prohibited from funding roadway improvements outside the installation.

Maximum Partial Basing Alternative (8 Squadrons)

Construction of New Facilities and Potential Impact on Local Streets

Table 1.3 illustrates the "2010 plus project" (construction traffic) Maximum Partial Basing Alternative roadway segment daily LOS, using the same methodology as described above. Based on this analysis, construction-related traffic volumes for the Maximum Basing Partial Alternative would continue to operate at an unacceptable LOS F with the addition of the Maximum Partial Basing Alternative. The addition of the construction-related traffic volumes for the Maximum Partial Basing Alternative would not create significant cumulative impacts on the roadway system.

Operations at the Airfield and Potential Impact on Local Streets

Table 1.4 illustrates the "2020 plus project" Maximum Partial Basing Alternative roadway segment daily level of services, using the same methodology as described above. Based on this analysis, operations-related traffic associated with this alternative may create a significant cumulative impact of the following segments:

- I-15 south of Miramar Way;
- Miramar Road between Kearny Mesa Road and I-15 southbound ramps; and
- Miramar Way between Kearny Villa Road and I-15 southbound ramps.

Table 1.2. 2020 + Project (Operations Traffic)
MCAS Miramar Full Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*[2]	**2020**			*2020 + Project*			*Impact?*		
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	*Δ ADT*[3]	*Δ V/C*[4]	*Impact?*[5]
Interstate-15 (I-15)										
Mira Mesa Blvd to Miramar Rd	(1)	**357,000**	**1.550**	**F(2)**	**357,831**	**1.560**	**F(2)**	**831**	**0.010**	**Significant**
Miramar Rd to Miramar Wy	(1)	**379,000**	**1.650**	**F(2)**	**379,831**	**1.660**	**F(2)**	**831**	**0.010**	**Significant**
South of Miramar Wy	(1)	**385,000**	**1.670**	**F(2)**	**386,246**	**1.680**	**F(2)**	**831**	**0.010**	**Significant**
Interstate-805 (I-805)										
Mira Mesa Blvd to Miramar Rd	(1)	**226,000**	**1.19**	**F(0)**	**226,183**	**1.190**	**F(0)**	**183**	**0.000**	**None**
South of Miramar Rd	(1)	**267,000**	**1.40**	**F(2)**	**267,184**	**1.400**	**F(2)**	**184**	**0.000**	**None**
Miramar Road										
I-805 to Nobel Dr	60,000	40,000	0.667	C	40,367	0.673	C	367	0.006	N/A
Nobel Dr to Eastgate Mall	60,000	**72,000**	**1.200**	**F**	72,367	**1.206**	**F**	**367**	**0.006**	**None**
Miramar Pl to Camino Santa Fe	50,000	**84,000**	**1.680**	**F**	84,367	**1.687**	**F**	**367**	**0.007**	**None**
Camino Santa Fe to Distribution	60,000	43,000	0.717	C	43,367	0.723	C	367	0.006	N/A
Distribution to Miramar Wy	60,000	48,000	0.800	C	48,367	0.806	C	367	0.006	N/A
Miramar Wy to Carroll Rd	60,000	43,000	0.717	C	43,000	0.717	C	0	0.000	N/A
Carroll Rd to Camino Ruiz	60,000	42,000	0.700	C	42,000	0.700	C	0	0.000	N/A
Camino Ruiz to Clayton Dr	60,000	**61,000**	**1.017**	**F**	61,000	**1.017**	**F**	**0**	**0.000**	**None**
Clayton Dr to Kearny Villa Rd	60,000	**65,000**	**1.083**	**F**	65,831	**1.097**	**F**	**831**	**0.014**	**Significant**
Kearny Villa Rd to Kearny Mesa Rd	60,000	**58,000**	**0.967**	**E**	58,831	**0.981**	**E**	**831**	**0.014**	**None**
Kearny Mesa Rd to I-15 SB Ramps	40,000	**62,000**	**1.550**	**F**	62,831	**1.571**	**F**	**831**	**0.021**	**Significant**
Pomerado Road										
East of I-15 NB Ramp	15,000	**33,000**	**2.200**	**F**	**33,000**	**2.200**	**F**	**0**	**0.000**	**None**
Miramar Way										
Kearny Villa Rd to I-15 SB Ramp	15,000	**13,000**	**0.867**	**E**	**14,246**	**0.950**	**E**	**1,246**	**0.083**	**Significant**
Kearny Villa Road										
Miramar Rd to Miramar Wy	40,000	**36,000**	**0.900**	**E**	**36,000**	**0.900**	**E**	**0**	**0.000**	**None**
Miramar Wy to SR-163	40,000	31,000	0.775	D	31,000	0.775	D	0	0.000	N/A

Notes:

ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; SB = southbound; NB = northbound; N/A = Not Applicable; Δ = Change In;

(1) The levels of service for I-15 and I-805 were determined based on the Caltrans District 11 procedures (Caltrans 2002).

(2) Capacity is based on the upper limit of LOS E per the City of San Diego (City of San Diego 1998).

(3) The incremental change in conditions associated with the proposed project (i.e. the difference between 2020 w/ project and 2020 without project conditions).

(4) Using City of San Diego guidelines as the reference point for significance, LOS E has a thresholds of 0.02 and LOS F has a threshold hold of 0.01 (City of San Diego 2007).

(5) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.

Table 1.3. 2010 + Project (Construction Traffic)
MCAS Miramar Maximum Partial Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2010**			*2010 + Project*			*Impact?*		
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	Δ *ADT*(3)	Δ *V/C*(4)	*Impact?*(5)
Interstate-15 (I-15)										
Mira Mesa Blvd to Miramar Rd	(1)	**326,000**	**1.420**	**F(2)**	**326,042**	**1.420**	**F(2)**	**42**	**0.000**	**None**
Miramar Rd to Miramar Wy	(1)	**321,000**	**1.530**	**F(2)**	**321,042**	**1.530**	**F(2)**	**42**	**0.000**	**None**
South of Miramar Wy	(1)	**358,000**	**1.560**	**F(2)**	**358,062**	**1.560**	**F(2)**	**62**	**0.000**	**None**
Miramar Way										
Kearny Villa Rd to I-15 SB Ramp	15,000(2)	**15,000**	**1.000**	**F**	**15,104**	**1.007**	**F**	**104**	**0.007**	**None**

Notes:

ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; SB = southbound; Δ = Change In;

(1) The levels of service for I-15 were determined based on the Caltrans District 11 procedures (Caltrans 2002).

(2) Capacity is based on the upper limit of LOS E per the City of San Diego (City of San Diego 1998).

(3) The incremental change in conditions associated with the proposed project (i.e. the difference between 2010 w/ project and 2010 without project conditions).

(4) Using City of San Diego guidelines as the reference point for significance, LOS E has a thresholds of 0.02 and LOS F has a threshold hold of 0.01 (City of San Diego 2007).

(5) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.

Table 1.4. 2020 + Project (Operations Traffic)
MCAS Miramar Maximum Partial Basing Alternative (8 Squadrons) Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*[2]	**2020**			*2020 + Project*			*Impact?*		
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	*Δ ADT*[3]	*Δ V/C*[4]	*Impact?*[5]
Interstate-15 (I-15)										
Mira Mesa Blvd to Miramar Rd	(1)	**357,000**	**1.550**	**F(2)**	**357,543**	**1.550**	**F(2)**	**543**	**0.000**	**None**
Miramar Rd to Miramar Wy	(1)	**379,000**	**1.650**	**F(2)**	**379,543**	**1.650**	**F(2)**	**543**	**0.000**	**None**
South of Miramar Wy	(1)	**385,000**	**1.670**	**F(2)**	**385,814**	**1.680**	**F(2)**	**814**	**0.010**	**Significant**
Interstate-805 (I-805)										
Mira Mesa Blvd to Miramar Rd	(1)	**226,000**	**1.190**	**F(0)**	**226,119**	**1.190**	**F(0)**	**119**	**0.000**	**None**
South of Miramar Rd	(1)	**267,000**	**1.400**	**F(2)**	**267,120**	**1.400**	**F(2)**	**120**	**0.000**	**None**
Miramar Road										
I-805 to Nobel Dr	60,000	40,000	0.667	C	40,239	0.671	C	239	0.004	N/A
Nobel Dr to Eastgate Mall	60,000	**72,000**	**1.200**	**F**	72,239	**1.204**	**F**	**239**	**0.004**	**None**
Miramar Pl to Camino Santa Fe	50,000	**84,000**	**1.680**	**F**	84,239	**1.685**	**F**	**239**	**0.005**	**None**
Camino Santa Fe to Distribution	60,000	43,000	0.717	C	43,239	0.721	C	239	0.004	N/A
Distribution to Miramar Wy	60,000	48,000	0.800	C	48,239	0.804	C	239	0.004	N/A
Miramar Wy to Carroll Rd	60,000	43,000	0.717	C	43,000	0.717	C	0	0.000	N/A
Carroll Rd to Camino Ruiz	60,000	42,000	0.700	C	42,000	0.700	C	0	0.000	N/A
Camino Ruiz to Clayton Dr	60,000	**61,000**	**1.017**	**F**	61,000	**1.017**	**F**	**0**	**0.000**	**None**
Clayton Dr to Kearny Villa Rd	60,000	**65,000**	**1.083**	**F**	65,543	**1.092**	**F**	**543**	**0.009**	**None**
Kearny Villa Rd to Kearny Mesa Rd	60,000	**58,000**	**0.967**	**E**	58,543	**0.976**	**E**	**543**	**0.009**	**None**
Kearny Mesa Rd to I-15 SB Ramps	40,000	**62,000**	**1.550**	**F**	62,543	**1.564**	**F**	**543**	**0.014**	**Significant**
Pomerado Road										
East of I-15 NB Ramp	15,000	**33,000**	**2.200**	**F**	**33,000**	**2.200**	**F**	**0**	**0.000**	**None**
Miramar Way										
Kearny Villa Rd to I-15 SB Ramp	15,000	**13,000**	**0.867**	**E**	**13,814**	**0.921**	**E**	**814**	**0.054**	**Significant**
Kearny Villa Road										
Miramar Rd to Miramar Wy	40,000	**36,000**	**0.900**	**E**	**36,000**	**0.900**	**E**	**0**	**0.000**	**None**
Miramar Wy to SR-163	40,000	31,000	0.775	D	31,000	0.775	D	0	0.000	N/A

Notes:

ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; SB = southbound; NB = northbound; N/A = Not Applicable; Δ = Change In;

(1) The levels of service for I-15 and I-805 were determined based on the Caltrans District 11 procedures (Caltrans 2002).

(2) Capacity is based on the upper limit of LOS E per the City of San Diego (City of San Diego 1998).

(3) The incremental change in conditions associated with the proposed project (i.e. the difference between 2020 w/ project and 2020 without project conditions).

(4) Using City of San Diego guidelines as the reference point for significance, LOS E has a thresholds of 0.02 and LOS F has a threshold hold of 0.01 (City o f San Diego 2007).

(5) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.

In addition, cumulative projects, such as JSF and Grow the Force that would substantially increase the number of personnel at MCAS Miramar, would exacerbate significant operations-related cumulative impacts to traffic from the Maximum Partial Basing Alternative.

Mitigation Measures

Significant operations-related traffic impacts cannot be mitigated because the DoN is legally prohibited, per 31 USC §1301(a), from funding roadway improvements outside the installation.

Minimum Partial Basing Alternative (2 Squadrons)

Construction of New Facilities and Potential Impact on Local Streets

Table 1.5 illustrates the "2010 plus project" (construction traffic) Minimum Partial Basing Alternative roadway segment daily LOS, using the same methodology as described above. Based on this analysis, construction-related traffic volumes for the Minimum Partial Basing Alternative would continue to operate at an unacceptable LOS F or worse with the addition of the Minimum Partial Basing Alternative. However, the addition of the construction-related traffic for the Minimum Partial Basing Alternative would not exceed the allowable thresholds for significance, thus no significant cumulative impacts would occur on the traveled roadway system.

Operations at the Airfield and Potential Impact on Local Streets

The Minimum Partial Basing Alternative would reduce the traffic on the roadways by 1,192 trips per day after the construction phase is completed. Thus there would be a decrease in traffic associated with this alternative, and no significant cumulative impacts would occur on the traveled roadway system.

Mitigation Measures

Because there would be no significant cumulative impacts on ground traffic and transportation, no mitigation measures are proposed.

Non-MCAS Miramar Basing Alternatives

Construction of New Facilities and Potential Impact on Local Streets

Under this alternative, the MV-22 would not be based at MCAS Miramar. No construction would occur at MCAS Miramar under this alternative; therefore, no significant cumulative impacts would occur on the traveled roadway system on or within the vicinity of MCAS Miramar.

Operations at the Airfield and Potential Impact on Local Streets

If no MV-22 squadrons are based at MCAS Miramar, there would be a reduction in traffic on the roadways by 2,084 trips per day due to the removal of the existing squadrons of CH-46E at MCAS Miramar. Thus there would be a decrease in traffic associated with this alternative, and no significant cumulative impacts would occur on the traveled roadway system on or within the vicinity of MCAS Miramar.

Table 1.5. 2010 + Project (Construction Traffic)
MCAS Miramar Minimum Partial Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2010**			*2010 + Project*			*Impact?*		
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	*Δ ADT(3)*	*Δ V/C(4)*	*Impact?(5)*
Interstate-15 (I-15)										
Mira Mesa Blvd to Miramar Rd	(1)	**326,000**	**1.420**	**F(2)**	**326,023**	**1.420**	**F(2)**	**23**	**0.000**	**None**
Miramar Rd to Miramar Wy	(1)	**321,000**	**1.530**	**F(2)**	**321,023**	**1.530**	**F(2)**	**23**	**0.000**	**None**
South of Miramar Wy	(1)	**358,000**	**1.560**	**F(2)**	**358,035**	**1.560**	**F(2)**	**35**	**0.000**	**None**
Miramar Way										
Kearny Villa Rd to I-15 SB Ramp	15,000(2)	**15,000**	**1.000**	**F**	**15,058**	**1.004**	**F**	**58**	**0.004**	**None**

Notes:

ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; SB = southbound; Δ = Change In;

(1) The levels of service for I-15 were determined based on the Caltrans District 11 procedures (Caltrans 2002).

(2) Capacity is based on the upper limit of LOS E per the City of San Diego (City of San Diego 1998).

(3) The incremental change in conditions associated with the proposed project (i.e. the difference between 2010 w/ project and 2010 without project conditions).

(4) Using City of San Diego guidelines as the reference point for significance, LOS E has a thresholds of 0.02 and LOS F has a threshold hold of 0.01 (City of San Diego 2007).

(5) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.

Mitigation Measures

Because there would be no significant cumulative impact on ground traffic and transportation, no mitigation measures are proposed.

No Action Alternative

No construction would occur under this alternative, and ground traffic and transportation would operate as described above under the existing conditions. Therefore, there would not be an increase or decrease in traffic associated with the project, and no cumulative impacts would occur on the traveled roadway system.

2.0 MCAS CAMP PENDLETON

Cumulative analysis was anticipated to occur primarily between FY 2010 and FY 2020. Estimated traffic volumes for 2010 and 2020 were obtained from San Diego Association of Governments (SANDAG 2007a; SANDAG 2007b); the estimates do not take into account potential traffic changes related to the proposed actions. The cumulative analysis for the construction-related traffic volumes and for the various alternatives on local streets were added to the SANDAG estimated 2010 and 2020 traffic volumes. It should be noted that the SANDAG FY 2010 and FY 2020 model forecast includes all pending developments that are consistent with the adopted general plan. The individual cumulative projects provided in section 8.2 are only a small portion of the pending development within San Diego County, therefore, the SANDAG traffic forecasts provide a better projection of the traffic that will exist in the year 2010 and 2020 than the list of cumulative project methodology.

The DoN evaluated significance of cumulative impacts in light of thresholds outlined in the City of San Diego's Traffic Impact Manual (City of San Diego 1998). The level of significance varies from an allowable increase of ten percent or less for LOS A to an allowable increase of two percent or less for LOS D and E, and an allowable increase of one percent or less for LOS F. It should be noted that LOS D is considered to be an acceptable LOS; therefore, the thresholds of significance were only applied to LOS E and LOS F. If the project causes a change greater than that outlined in the City's thresholds, this is considered a significant cumulative impact.

Partial Basing Alternative (2 Squadrons)

Construction of New Facilities and Potential Impact on Local Streets

Construction activities are anticipated to occur primarily between FY 2010 and FY 2014. Estimated traffic volumes for 2010 were obtained from San Diego Association of Governments (SANDAG 2007a); these estimates do not take into account potential traffic changes related to the proposed action. For this cumulative analysis, the construction-related traffic volumes for this alternative were added to the SANDAG estimated 2010 traffic volumes. Table 2.1 illustrates this "2010 plus project" (construction traffic) Partial Basing Alternative roadway segment daily LOS. Based on this analysis, construction-related traffic volumes for the Partial Basing Alternative would operate at an acceptable LOS C with the addition of the Partial Basing Alternative. Thus no significant cumulative impacts would occur on the traveled roadway system.

Table 2.1. 2010 + Project (Construction Traffic)
MCAS Camp Pendleton Partial Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2010**			*2010 + Project*			*Impact?*		
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	Δ *ADT*(3)	Δ *V/C*(4)	*Impact?*(5)
Interstate-5 (I-5)										
Cristianitos Rd to Basilone Rd	(1)	128,000	0.800	C	128,008	0.800	C	8	0.000	None
Basilone Rd to Las Pulgas Rd	(1)	142,000	0.800	C	142,030	0.800	C	30	0.000	None
Las Pulgas Rd to Harbor Dr	(1)	146,000	0.720	C	146,030	0.720	C	30	0.000	None
South of Harbor Dr	(1)	154,000	0.750	C	154,030	0.750	C	30	0.000	None

Notes:

ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; Δ = Change In;

(1) The levels of service for I-5 were determined based on the Caltrans District 11 procedures (Caltrans 2002).

(2) Capacity is based on the upper limit of LOS E per the City of San Diego (City of San Diego 1998).

(3) The incremental change in conditions associated with the proposed project (i.e. the difference between 2010 w/ project and 2010 without project conditions).

(4) Using City of San Diego guidelines as the reference point for significance, LOS E has a thresholds of 0.02 and LOS F has a threshold hold of 0.01 (City of San Diego 2007).

(5) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.

Operations at the Airfield and Potential Impact on Local Streets

The Partial Basing Alternative would reduce the traffic on the roadways by 550 trips per day after the construction phase is completed. Thus there would be a decrease in traffic associated with this alternative, and no significant cumulative impacts would occur on the traveled roadway system.

Mitigation Measures

Because there would be no significant cumulative impacts on ground traffic and transportation, no mitigation measures are proposed.

Non-MCAS Camp Pendleton Basing Alternatives

Construction of New Facilities and Potential Impact on Local Streets

Under these alternatives, the MV-22 would be based at MCAS Miramar or would be split between MCAS Miramar and MCAS Yuma, but not at MCAS Camp Pendleton. No construction would occur at MCAS Camp Pendleton under these alternatives; therefore, no significant cumulative impacts would occur on the traveled roadway system on or within the vicinity of MCAS Camp Pendleton.

Operations at the Airfield and Potential Impact on Local Streets

If no MV-22 squadrons are based at MCAS Camp Pendleton, there would be a reduction in traffic on the roadways by 1,442 trips per day due to the removal of the existing squadrons of CH-46E at MCAS Camp Pendleton. Thus there would be a decrease in traffic associated with these alternatives, and no significant cumulative impacts would occur on the traveled roadway system on or within the vicinity of MCAS Camp Pendleton.

Mitigation Measures

Because there would be no significant cumulative impact on ground traffic and transportation, no mitigation measures are proposed.

3.0 MCAS YUMA

Cumulative analysis was anticipated to occur primarily between FY 2010 and FY 2020. Estimated traffic volumes for 2010 and 2020 were obtained from a growth rate calculated with the Yuma Metropolitan Planning Organization (YMPO) 2006-2029 Regional Transportation Plan Final Report (YMPO 2007a); the estimates do not take into account potential traffic changes related to the proposed actions. The cumulative analysis for the construction-related traffic volumes and for the various alternatives on local streets were added to the YMPO estimated 2010 and 2020 traffic volumes. It is assumed that the YMPO includes all pending developments that are consistent with the adopted general plan. The individual cumulative projects provided in section 8.2 are only a small portion of the pending development within Yuma County, therefore, the YMPO traffic forecasts provide a better projection of the traffic that will exist in the year 2010 and 2020 than the list of cumulative project methodology.

Maximum Partial Basing Alternative (8 Squadrons)

Construction of New Facilities and Potential Impact on Local Streets

Construction activities are anticipated to occur primarily between FY 2010 and FY 2014. Estimated traffic volumes for 2010 were obtained using a growth rate from the YMPO 2006-2029 estimated traffic volumes; these estimates do not take into account potential traffic changes related to the proposed action. For this cumulative analysis, the construction-related traffic volumes for this alternative were added to the estimated 2010 traffic volumes. Table 3.1 illustrates this "2010 plus project" (construction traffic) Maximum Partial Basing Alternative (8 Squadrons) roadway segment daily LOS.

This alternative would add 82 daily trips to the average daily traffic of 24,400 on Avenue 3E between Interstate 8 and Business 8, which is at LOS F. This increase of 0.3 percent is considered a significant portion of the total cumulative traffic volume and may create a significant cumulative impact.

Table 3.1. 2010 + Project (Construction Traffic)
MCAS Yuma Maximum Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2010**			*2010 + Project*			*Impact?*	
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	*Δ ADT(1)*	*Impact?(2)*
Interstate-8 (I-8)(a)									
Co 9th St to Avenue 3E	80,000	42,300	0.529	B	42,341	0.528	B	41	None
Avenue 3E to Araby Rd	80,000	44,200	0.553	B	44,241	0.553	B	41	None
Avenue 3E(b)									
Interstate 8 to Business 8	13,120	**24,400**	**1.860**	**F**	**24,482**	**1.866**	**F**	**82**	**Significant**
Business 8 to 40th St	32,400	23,300	0.719	C	23,382	0.722	D	82	None

Notes:
ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; N/A = Not Applicable;
Δ = Change In;
(1) The incremental change in conditions associated with the proposed project (i.e. the difference between 2010 w/ project and 2010 without project conditions).
(2) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.
(a) ADOT criteria (i.e., a change in LOS) was used as a reference point for significant for the interstate.
(b) City of Yuma Traffic Impact Study Guidelines (i.e., a roadway segment operates at worse than LOS D) was used as a reference point for significance.

Operations at the Airfield and Potential Impact on Local Streets

Transition from the helicopters to the MV-22 is scheduled to be completed by 2020. Estimated traffic volumes for 2020 were obtained using a growth rate from the YMPO 2006-2029 estimated traffic volumes; these estimates do not take into account potential traffic changes related to the proposed action. For this cumulative analysis, the construction-related traffic volumes for this alternative were added to the estimated 2020 traffic volumes. Table 3.2 illustrates this "2020 plus project" Maximum Partial Basing Alternative roadway segment daily LOS.

Based on this analysis, operations-related traffic associated with this alternative may create a significant cumulative impact on the following segments:

- Avenue 3E between Interstate 8 and Business 8;

- Avenue 3E between Business 8 and 40th Street; and
- Avenue 3E between 40th Street and Co 14th Street.

In addition, cumulative projects, such as JSF and Grow the Force that would substantially increase the number of personnel at MCAS Yuma, would exacerbate significant operations-related cumulative impacts to traffic from the Maximum Partial Basing Alternative.

Table 3.2. 2020 + Project (Operations Traffic)
MCAS Yuma Maximum Partial Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2020**			*2020 + Project*			*Impact?*	
		ADT	**V/C**	**LOS**	**ADT**	**V/C**	**LOS**	*Δ ADT(1)*	*Impact?(2)*
Interstate-8 (I-8)(a)									
Co 9th St to Avenue 3E	80,000	53,300	0.666	C	55,413	0.693	C	2,113	None
Avenue 3E to Araby Rd	80,000	58,800	0.735	D	60,913	0.761	D	2,113	None
Business 8(b)									None
West of Avenue 3E	54,000	35,600	0.659	C	36,509	0.676	C	909	None
East of Avenue 3E	36,000	28,900	0.803	D	29,809	0.828	D	909	None
County 14th Street(b)									
West of Avenue 3E	13,120	**16,400**	**1.250**	**F**	**16,400**	**1.250**	**F**	**0**	None
Avenue 3E(b)									
Interstate 8 to Business 8	13,120	**33,100**	**2.523**	**F**	**37,326**	**2.845**	**F**	**4,226**	**Significant**
Business 8 to 40th St	32,400	**31,000**	**0.957**	**E**	**35,312**	**1.090**	**F**	**4,312**	**Significant**
40th St to Co 14th St	13,120	**19,300**	**1.471**	**F**	**19,386**	**1.478**	**F**	**86**	**Significant**
Co 14th St to Co 15th St	13,120	**12,800**	**0.976**	**E**	**12,800**	**0.976**	**E**	**0**	None

Notes:
ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; N/A = Not Applicable; Δ = Change In;
(1) The incremental change in conditions associated with the proposed project (i.e. the difference between 2020 w/ project and 2020 without project conditions).
(2) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.
(a) ADOT criteria (i.e., a change in LOS) was used as a reference point for significant for the interstate.
(b) City of Yuma Traffic Impact Study Guidelines (i.e., a roadway segment operates at worse than LOS D) was used as a reference point for significance.

Mitigation Measures

Construction-related traffic impacts to this segment can be mitigated to a less than significant by conducting construction activities during off-peak hours. Significant operations-related traffic impacts cannot be mitigated because the DoN is legally prohibited, per 31 USC §1301(a), from funding roadway improvements outside the installation.

Minimum Partial Basing Alternative (2 Squadrons)

Construction of New Facilities and Potential Impact on Local Streets

Table 3.3 illustrates the "2010 plus project" (construction traffic) Minimum Partial Basing Alternative roadway segment daily LOS, using the same methodology as described above. Based on this analysis, construction-related traffic volumes for the Minimum Partial Basing Alternative would continue to operate at an unacceptable LOS F or worse with the addition of the Minimum Partial Basing Alternative.

This alternative would add 38 daily trips to the average daily traffic of 24,400 on Avenue 3E between Interstate 9 and Business, which is at Los F. This increase of 0.2 percent is not a considerable portion of the traffic, and is not a significant impact.

Table 3.3. 2010 + Project (Construction Traffic)
MCAS Yuma Minimum Partial Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2010**			*2010 + Project*			*Impact?*	
		ADT	**V/C**	**LOS**	***ADT***	**V/C**	*LOS*	*Δ ADT(1)*	*Impact?(2)*
Interstate-8 (I-8)									
Co 9th St to Avenue 3E	80,000	42,300	0.529	B	42,319	0.529	B	19	None
Avenue 3E to Araby Rd	80,000	44,200	0.553	B	44,219	0.553	B	19	None
Avenue 3E									
Interstate 8 to Business 8	13,120	24,400	1.860	F	24,438	1.863	F	38	None
Business 8 to 40th St	32,400	23,300	0.719	C	23,338	0.720	D	38	None

Notes:
ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; N/A = Not Applicable; Δ = Change In;
(1) The incremental change in conditions associated with the proposed project (i.e. the difference between 2010 w/ project and 2010 without project conditions).
(2) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.

Operations at the Airfield and Potential Impact on Local Streets

Transition from the helicopters to the MV-22 is scheduled to be completed by 2020. Estimated traffic volumes for 2020 were obtained using a growth rate from the YMPO 2006-2029 estimated traffic volumes; these estimates do not take into account potential traffic changes related to the proposed action. For this cumulative analysis, the construction-related traffic volumes for this alternative were added to the estimated 2020 traffic volumes. Table 3.4 illustrates this "2020 plus project" Minimum Partial Basing Alternative roadway segment daily LOS.

Based on this analysis, operations-related traffic associated with this alternative is considered to be a significant portion of the total cumulative traffic volumes for the following segments:

- Avenue 3E between Interstate 8 and Business 8;
- Avenue 3E between Business 8 and 40th Street; and
- Avenue 3E between 40th Street and Co 14th Street.

In addition, cumulative projects, such as JSF and Grow the Force that would substantially increase the number of personnel at MCAS Yuma, would exacerbate significant operations-related cumulative impacts to traffic from the Minimum Partial Basing Alternative.

Table 3.4. 2020 + Project (Operations Traffic)
MCAS Yuma Minimum Partial Basing Alternative Roadway Segment Daily Level of Service

Roadway Segment	*Capacity*	**2020**			*2020 + Project*			*Impact?*	
		ADT	**V/C**	**LOS**	**ADT**	**V/C**	**LOS**	*Δ ADT*[(1)]	*Impact?*[(2)]
Interstate-8 (I-8)[(a)]									
Co 9th St to Avenue 3E	80,000	53,300	0.666	C	54,032	0.675	C	732	None
Avenue 3E to Araby Rd	80,000	58,800	0.735	D	59,532	0.744	D	732	None
Business 8[(b)]									None
West of Avenue 3E	54,000	35,600	0.659	C	35,951	0.666	C	351	None
East of Avenue 3E	36,000	28,900	0.803	D	29,251	0.813	D	351	None
County 14th Street[(b)]									
West of Avenue 3E	13,120	**16,400**	**1.250**	**F**	**16,400**	**1.250**	**F**	**0**	**None**
Avenue 3E[(b)]									
Interstate 8 to Business 8	13,120	**33,100**	**2.523**	**F**	**34,564**	**2.634**	**F**	**1,464**	**Significant**
Business 8 to 40th St	32,400	**31,000**	**0.957**	**E**	**32,494**	**1.003**	**F**	**1,494**	**Significant**
40th St to Co 14th St	13,120	**19,300**	**1.471**	**F**	**19,330**	**1.473**	**F**	**30**	**Significant**
Co 14th St to Co 15th St	13,120	**12,800**	**0.976**	**E**	**12,800**	**0.976**	**E**	**0**	**None**

Notes:
ADT = Average Daily Traffic; LOS = Level of Service; v/c = volume-to-capacity; N/A = Not Applicable; Δ = Change In;
(1) The incremental change in conditions associated with the proposed project (i.e. the difference between 2020 w/ project and 2020 without project conditions).
(2) Significant Impacts access whether the project traffic itself is a considerable portion of the total cumulative impacts.
(a) ADOT criteria (i.e., a change in LOS) was used as a reference point for significant for the interstate.
(b) City of Yuma Traffic Impact Study Guidelines (i.e., a roadway segment operates at worse than LOS D) was used as a reference point for significance.

Mitigation Measures

Construction-related traffic impacts to this segment can be mitigated to a less than significant by conducting construction activities during off-peak hours. Significant operations-related traffic impacts cannot be mitigated because the DoN is legally prohibited, per 31 USC §1301(a), from funding roadway improvements outside of the installation.

Non-MCAS Yuma Alternatives

Under these alternatives, the MV-22 would be based at MCAS Miramar or would be split between MCAS Miramar and MCAS Camp Pendleton, but not at MCAS Yuma. No construction would occur at MCAS Yuma under these alternatives, and ground traffic and transportation would operate as described above under the existing conditions. Therefore, there would not be an increase or decrease in traffic at MCAS Yuma, and no cumulative impacts would occur on the traveled roadway system on or within the vicinity of MCAS Yuma.

No Action Alternative

No construction would occur under this alternative, and ground traffic and transportation would operate as described above under the existing conditions. Therefore, there would not be an increase or decrease in traffic associated with the project, and no cumulative impacts would occur on the traveled roadway system.

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APPENDIX E

Non-Federal Cumulative Projects

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Non-Federal Past, Present, and Reasonably Foreseeable Future Projects by General Vicinity		
Project Name	**Project Description**	**Anticipated Timeframe**
SOUTHERN CALIFORNIA		
Stonebridge Estates (formerly Rancho Encantada), Scripps Miramar Ranch	Approved 2,658-total-acre (1,076 hectare) development with 828 single-family dwelling units, 106 multi-family dwelling units, 26 acres (11 hectares) school/park sites, and 5 acres (2 hectares) institutional areas.	Anticipated to be built out by 2007.
Versante, Scripps Miramar Ranch	Approved 26 single-family dwelling units.	Constructed.
Castlerock, East Elliot	Proposed 192 (78 hectares) 376 single-family dwelling units and 122 multi-family dwelling units.	2010
Fanita Ranch, Santee	Proposed 2,550 acres (1,032 hectares), up to 1,300 dwelling units and luxury office and supporting commercial.	2010
Sycamore Landfill, East Elliott	35-acre (14-hectare) expansion, 21 acres (9 hectares) for ancillary uses, including fill Little Sycamore Canyon, then build up about 250 to 300 feet (76 to 91 meters) in height.	30-year life expectancy.
Twin Oaks 4, San Diego County	Construction of four single-family residences along Twin Oaks Valley Road within the Bonsall Community planning area in the unincorporated area of San Diego County.	A mitigated negative declaration was submitted to the County of San Diego Planning Division in August 2005.
Pala Mesa Resort, San Diego County	Development of 78 condo/hotel units, a spa with approximately 30 hotel suites, improvements to existing lodge with resort commercial amenities and capacity for ~54 hotel rooms, 148 townhomes, and improvements to the driving range and golf course. The project is located within the Fallbrook Subregional Planning area within the unincorporated portion of San Diego County.	A Notice of Preparation was submitted by the County of San Diego Planning Division in August 2007.

Non-Federal Past, Present, and Reasonably Foreseeable Future Projects by General Vicinity		
Project Name	**Project Description**	**Anticipated Timeframe**
TTM 16480 (PLN 05-329) Grewe Subdivision, City of San Clemente	Request to subdivide an existing 2.87 acre site into 9 individual lots for 9 single family residential units within the City of San Clemente.	The Negative Declaration was submitted by the City of San Clemente in July 2007.
Pacific Golf and Residential Project, City of San Clemente	Development of 381 residential units on approximately 77.6 acres of the 248 acre project site. The remaining site will consist of a reconfigured 18-hole golf course, the existing 27,000 square foot clubhouse and a new fitness and pool facility.	A draft EIR was submitted in April 2006 and the City of San Clemente submitted a Notice of Determination in June 2007.
Miramar Plaza, City of Carlsbad	The proposed project would develop Miramar Plaza, a mixed-use building that would include a range of uses including residential units, timeshare units, a restaurant with associated bar, office, and commercial uses. The existing Miramar Theater and bowling alley that is currently on the project site would be demolished in order to construct the proposed project.	A Notice of Preparation was submitted by the City of Carlsbad in July 2006.
State Route 76 Melrose to South Mission Highway Improvements, San Diego County	Widening and realignment of State Route 76 in northern San Diego County from Melrose Drive in Oceanside to South Mission Road in Bosnall.	A NOP was submitted by the Cities of Oceanside and Fallbrook in October 2005 and an EIR was submitted in October 2007.
Ocean Street Residences CT 05-12/CP 05-11/HDP 05-07/CDP 05-28, City of Carlsbad	The 3.05-acre site is currently developed with 50 apartment units. The proposed project includes the demolition of the existing apartments and construction of a new 35-unit airspace condominium project with underground parking.	A mitigated negative declaration was submitted by the City of Carlsbad in November 2007.

Non-Federal Past, Present, and Reasonably Foreseeable Future Projects by General Vicinity		
Project Name	**Project Description**	**Anticipated Timeframe**
Palomar Community College-North Education Center, Facilities Master Plan	Development of a new Community College center to serve the Northern San Diego County area. The project site is approx. 85 acres of undeveloped land located east of I-15, between Pala Road/State Route 76 and Pala Mesa Heights Drive, in the community of Fallbrook.	An EIR was submitted by the Palomar Community College District in September 2007.
Mariners Cove, City of Carlsbad	Development of 40 townhome condominiums. Onsite improvements include swimming pool, passive recreation area, a public nature trail, and public parking.	An EIR was submitted by the City of Carlsbad in September 2007.
Robertson Ranch Master Plan EIR, City of Carlsbad	Request for approval of a Site Development Plan (SDP) to allow for the construction of an affordable housing project consisting of 78 units and one leasing office within Planning Area 15 of the Robertson Ranch Master Plan. The project was described in the Program EIR for the Robertson Ranch Master Plan and the proposed activities will have no effects beyond those analyzed in the Program EIR.	A Notice of Determination was submitted by the City of Carlsbad in March 2007.
City of Carlsbad North Aqua Hedionada Interceptor (NAHI) Western Segment Realignment Project	The project involves relocating an existing sewer line, located along the north shore of the Agua Hedionda Lagoon, further inland. The new sewer line will be installed by utilizing 1,821 linear feet of micro-tunneling techniques and approximately 436 linear feet of conventional open trench construction with eleven new access holes and rehabilitation of four existing access holes.	A mitigated negative declaration was submitted by the City of Carlsbad in June 2007.
La Costa Town Square, City of Carlsbad	The proposed La Costa Town Center involves the construction and operation of a mixed-use project that includes 393,100 square feet of retail uses, a 9.7 acre Multi-Family development site, and 64 single-family detached residential units.	A Notice of Preparation was submitted by the City of Carlsbad in July 2007.
Robertson's Oceanside Ready Mix Concrete, City of Oceanside	Development of a concrete manufacturing plant that will produce "ready mix" concrete for use in construction. The manufacturing plant is proposed to process a maximum of 1,200 cubic yards of concrete per day. The project includes an aggregate storage building, a batch plant, an office building, and a 12,000 gallon above ground fuel storage tank. The remainder of the site would consist of two detention basins, parking, and landscaping.	The City of Oceanside submitted a Negative Declaration in September 2007.

Non-Federal Past, Present, and Reasonably Foreseeable Future Projects by General Vicinity		
Project Name	**Project Description**	**Anticipated Timeframe**
CityMark Development Project, City of Oceanside	Development of ~ 231 residential units, 124 hotel unites, 49,000 sf of commercial parking space, 70,000 sf of public open space and associated parking areas on the five City blocks in downtown Oceanside.	An EIR was submitted by the City of Oceanside in October 2007.
Oceanside Beach Resort, City of Oceanside	The proposed project would develop a total of approximately 420,000 square feet of hotel/timeshare, visitor-serving commercial, and supporting uses on the two blocks totaling 2.76 acres, including the South Block (Block 16, 1.38 acres) and the North Block (Block 17, 1.38 acres). The North Block of the project would consist of up to 120 resort keys, including a combination of hotel rooms and fractional/timeshare units, along with a restaurant and shops, and the South Block would include up to 293 hotel rooms. Each block would contain an eight-story building with two levels of subterranean parking. The total number of units combined for the two blocks would be a maximum of 413 resort keys with a minimum of 285 hotel guestrooms. Approximately 18,000 square feet of visitor-serving commercial uses would also be developed. An existing historic residence (the Graves House located at 102 North Pacific Street) would be relocated from its current location on the South Block to a new location on the North Block and be incorporated into the public plaza. The residence would undergo restoration and adaptive rehabilitation for re-use, such as a coffee house, restaurant, or other visitor serving use compatible with the character of the structure.	An EIR was submitted by the City of Oceanside in August 2007.
Rancho Vista Amendment Project, City of Oceanside	Implement remedial grading necessary to provide slope stability to allow the construction of a previously approved 29-unit single-family detached Seniors-Age-Restricted residential community on the site. The remediation would involve the construction of a 60-foot wide.	The City of Oceanside submitted an EIR in July 2007.
Loma Alta Creek Ultraviolet Treatment Facility, City of Oceanside	The proposed project is to construct an ultraviolet treatment facility to remove pollutants in Loma Alta Creek and the Pacific Ocean.	A Notice of Determination was submitted by the City of Oceanside in July 2007.
Boardwalk Development Project, City of Oceanside	The project involves construction of an 82-room hotel, 4,180 square foot restaurant and 4 residential condominiums.	A NOD was submitted by the City of Oceanside in March 2007.

Non-Federal Past, Present, and Reasonably Foreseeable Future Projects by General Vicinity		
Project Name	**Project Description**	**Anticipated Timeframe**
Jeffries Ranch Project, City of Oceanside	Subdivision of 82.5 acres into 44 single-family detached lots and deletion of Circulation Element Road.	An EIR was submitted by the City of Oceanside Planning Department in May of 2006.
Oceanpointe Project, City of Oceanside	Development of 198 condominium units clustered within three conceptual villages, with associated recreation areas, parking, and private access roads.	The City of Oceanside submitted an EIR in February 2006.
Sycamore Creek Estates Specific Plan, City of Vista	Development of 59 single-family residences on 13.4 acres.	The City of Vista submitted an EIR in December 2006.
ARIZONA		
Arizona State Parks Arizona Trails 2000 Plan	This statewide plan provides information and recommendations to agencies for their management of motorized and non-motorized trails. The plan guides the expenditures from the Arizona Off-highway Vehicle Recreation Fund, Arizona Heritage Fund Trails Component, and Federal Recreational Trails Program.	2000
Residential and Community Growth	The Yuma and Yuma Foothills areas continue to experience rapid growth in residential, commercial, agricultural, and light industrial development. Continued growth is expected.	On-going.
Yuma Area Service Highway	The highway has been proposed by the Yuma Metropolitan Planning Organization to connect Interstate-8 east of Yuma to U.S. – Mexico border at San Luis. A portion of the highway is proposed within the northwestern-most edge of the Barry M. Goldwater Range (West).	Estimated 2005.

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APPENDIX F

Biological Resources

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APPENDIX F-1

Non-Listed Vertebrate Species on MCAS Camp Pendleton 2002 – 2008

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Non-Listed Vertebrate Species on MCAS Camp Pendleton 2002-2008

The existing habitat on MCAS Camp Pendleton supports a diversity of terrestrial vertebrate species shown in Tables 1-5. These tables list (in descending phylogenetic order) vertebrate species known to occupy or move through MCAS Camp Pendleton indicating their 1) occurrence status (Resident breeding population or Transient individuals), and 2) relative abundance based upon number of observations per year. Excluded are three Endangered Species Act listed species: the 1) least Bell's vireo (*Vireo pusillus bellii*), 2) southwestern willow flycatcher (*Empidonax extimus trailii*), and 3) arroyo toad (*Anaxyrus [Bufo] californicus*).

Table 1. Native Mammals (17 species)

Common Name	***Scientific Name***	***Occurrence*** ***Resident / Transient***	***Abundance*** ***Common / Uncommon / Rare***
Desert shrew	*Notiosorex crawfordi*	Resident	Uncommon
Ornate shrew	*Sorex ornatus*	Resident	Common
Broad-footed mole	*Scapanus latimanus*	Resident	Rare
California vole	*Microtus californicus*	Resident	Common
Pocket gopher	*Thomomys bottae*	Resident	Common
Deer mouse	*Peromyscus maniculatus*	Resident	Common
Western harvest mouse	*Reithrodontomys megalotis*	Resident	Common
Dusky-footed woodrat	*Neotoma fuscipes*	Resident	Uncommon
California ground squirrel	*Spermophilis beecheyi*	Resident	Common
Desert cottontail	*Sylvilagus auduboni*	Resident	Common
Longtail weasel	*Mustela frenata*	Resident	Rare
Raccoon	*Procyon lotor*	Transient	Common
Grey fox	*Urocyon cinereoargenteus*	Transient	Uncommon
Coyote	*Canis latrans*	Transient	Uncommon
Black-tailed deer	*Odocoileus hemonius*	Transient	Uncommon
Bobcat	*Felis rufus*	Transient	Uncommon
Mountain lion	*Puma concolor*	Transient	Rare
Notes: Common = > 20 observations / year Uncommon = > 5-20 observations / year Rare = 0-5 observations / year			

Table 2. Native Birds (53 species)

Common Name	***Scientific Name***	***Occurrence*** ***Resident / Transient***	***Abundance*** ***Common / Uncommon / Rare***
Red-tailed hawk	*Buteo jamaicensis*	Transient	Common
Red-shouldered hawk	*Buteo lineatus*	Resident	Common
Ferruginous hawk	*Buteo regalis*	Transient	Rare
Cooper's hawk	*Accipiter cooperi*	Resident	Common
Sharp-shined hawk	*Accipiter striatus*	Transient	Uncommon
Merlin	*Falco columbarius*	Transient	Uncommon
American kestrel	*Falco sparverius*	Resident	Common
Black-shouldered kite	*Elanus caeruleus*	Resident	Common
Northern harrier	*Circus cyaneus*	Transient	Uncommon
Barn owl	*Tyto alba*	Resident	Common
Great horned owl	*Bubo virginianus*	Transient	Uncommon
Turkey vulture	*Cathartes aura*	Transient	Common
Mourning dove	*Zenaida macroura*	Resident	Common
Roadrunner	*Geococcyx californianus*	Transient	Uncommon

Table 2. Native Birds (53 species)

Common Name	***Scientific Name***	***Occurrence*** ***Resident / Transient***	***Abundance*** ***Common / Uncommon / Rare***
American crow	*Corvus brachyrhynchos*	Resident	Common
Raven	*Corvus corax*	Transient	Common
Anna's hummingbird	*Calypte anna*	Resident	Common
Black-chinned hummingbird	*Archilochus alexandri*	Resident	Uncommon
Northern flicker	*Colaptes auratus*	Transient	Uncommon
Western kingbird	*Tyrranus verticalis*	Transient	Common
Cassin's kingbird	*Tyrannus vociferans*	Transient	Common
Black phoebe	*Sayornis nigricans*	Resident	Common
Scrub jay	*Aphelocoma coerulescens*	Transient	Uncommon
California quail	*Callipela californica*	Resident	Common
Violet-green swallow	*Tachycineta thalissina*	Transient	Common
Cliff swallow	*Hirundo pyrrhonota*	Transient	Common
Barn swallow	*Hirundo rustica*	Resident	Common
Rough-winged swallow	*Stelgidopteryx serripennis*	Transient	Common
Marsh wren	*Cistothorus palustris*	Resident	Rare
White-crowned sparrow	*Zonotrichia leucophrys*	Resident	Common
California towhee	*Piplio crissalis*	Resident	Common
Horned lark	*Eremophila alpestris*	Resident	Common
Meadow lark	*Sternella neglecta*	Resident	Common
Cedar waxwing	*Bombycilla cedorum*	Transient	Rare
Yellow-rumped warbler	*Dendroica coronata*	Resident	Common
Yellow warbler	*Dendroica petechia*	Resident	Common
Common yellowthroat	*Geothlypis trichas*	Resident	Uncommon
Brewer's blackbird	*Euphagus cyanocephalus*	Resident	Common
Red-winged blackbird	*Agelaius phoeniceus*	Resident	Common
Dark-eyed junco	*Junco hymenalis*	Transient	Uncommon
Brown-headed cowbird	*Molothrus ater*	Resident	Uncommon
Lesser goldfinch	*Carduelis psaltria*	Resident	Common
Western tanager	*Pitanga ludoviciana*	Transient	Uncommon
Western bluebird	*Sialia mexicana*	Transient	Uncommon
Mallard	*Anas platyrhynchos*	Transient	Common
American coot	*Fulica americana*	Transient	Common
Great blue heron	*Ardea herodia*	Transient	Common
Green-backed heron	*Buteorides striatus*	Resident	Uncommon
Black-crowned night heron	*Nycticorax nycticorax*	Transient	Common
Great egret	*Casmerodius albus*	Transient	Common
Snowy egret	*Egretta thula*	Transient	Common
Killdeer	*Charadria vociferus*	Resident	Common
White-faced ibis	*Plegaides chihi*	Transient	Rare

Notes:
Common = > 20 observations / year
Uncommon = > 5-20 observations / year
Rare = 0-5 observations / year

Table 3. Native Reptiles (12 species)

Common Name	***Scientific Name***	***Occurrence*** ***Resident / Transient***	***Abundance*** ***Common / Uncommon / Rare***
Western fence lizard	*Sceloporus occidentalis*	Resident	Common
Side-blotched lizard	*Uta stansburiana*	Resident	Common
Southern alligator lizard	*Elgaria multicarinata*	Resident	Common
Western skink	*Eumeces skiltonianaus*	Resident	Common
Ringneck snake	*Diadophis punctatus*	Resident	Uncommon
Two-striped garter snake	*Thamnophis hammondii*	Resident	Uncommon
South coast garter snake	*Thamnophis sirtalis*	Transient	Rare
Western coachwhip	*Masticophis flagellum*	Resident	Common
Striped whipsnake	*Masticophis lateralis*	Transient	Rare
Common kingsnake	*Lampropeltis getula*	Resident	Common
Pacific rattlesnake	*Crotalus helleri*	Resident	Common
Red-diamond rattlesnake	*Crotalus exsul*	Transient	Rare
Speckled rattlesnake	*Crotalus mitchelli*	Transient	Rare
Notes: Common = > 20 observations / year Uncommon = > 5-20 observations / year Rare = 0-5 observations / year			

Table 4. Native Amphibians (4 species)

Common Name	***Scientific Name***	***Occurrence*** ***Resident / Transient***	***Abundance*** ***Common / Uncommon / Rare***
Western toad	*Anaxyrus boreas*	Resident	Uncommon
Western spadefoot	*Spea hammondii*	Resident	Uncommon
Pacific treefrog	*Pseudacris regilla*	Resident	Common
Slender salamander	*Batrachoceps pacificus*	Resident	Rare
Notes: Common = > 20 observations / year Uncommon = > 5-20 observations / year Rare = 0-5 observations / year			

Table 5. Non-Native / Exotic Species (7 species inclusive)

Common Name	***Scientific Name***	***Occurrence*** ***Resident / Transient***	***Abundance*** ***Common / Uncommon / Rare***
Virginia opossum	*Didelphis viginiana*	Transient	Uncommon
House mouse	*Mus musculus*	Resident	Uncommon
Ring-necked pheasant	*Phasianus colchius*	Transient	Rare
Cattle egret	*Bubulcus ibis*	Resident	Uncommon
European Starling	*Sturnus vulgaris*	Resident	Uncommon
House sparrow	*Passer domesticus*	Resident	Common
American bullfrog	*Lithobates catesbianus*	Transient	Rare
Notes: Common = > 20 observations / year Uncommon = > 5-20 observations / year Rare = 0-5 observations / year			

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APPENDIX F-2

Bird MOU

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OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

RECEIVED
APR 18 2006
BY:
APR 03 2007

MEMORANDUM FOR DEPUTY ASSISTANT SECRETARY OF THE ARMY (ENVIRONMENT, SAFETY AND OCCUPATIONAL HEALTH)
DEPUTY ASSISTANT SECRETARY OF THE NAVY (ENVIRONMENT)
DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE (ENVIRONMENT, SAFETY AND OCCUPATIONAL HEALTH)
DIRECTOR, DEFENSE LOGISTICS AGENCY

SUBJECT Guidance to Implement the Memorandum of Understanding to Promote the Conservation of Migratory Birds

On July 31, 2006, the Department of Defense (DoD) and the U.S. Fish and Wildlife Service (FWS) entered into a Memorandum of Understanding (MOU) to Promote the Conservation of Migratory Birds, in accordance with Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds." This MOU describes specific actions that should be taken by DoD to advance migratory bird conservation; avoid or minimize the take of migratory birds; and ensure DoD operations—other than military readiness activities—are consistent with the Migratory Bird Treaty Act. The MOU also describes how the FWS and DoD will work together cooperatively to achieve these ends. The MOU does not authorize the take of migratory birds; the FWS, however, may develop incidental take authorization for federal agencies that complete an Executive Order MOU.

I strongly encourage all DoD personnel to work cooperatively with the FWS to implement the actions described in the MOU and to take steps to further migratory bird conservation. This MOU specifically pertains to the following categories of DoD activities:

Natural resource management activities, including, but not limited to, habitat management, erosion control, forestry activities, agricultural outleasing, conservation law enforcement, invasive weed management, and prescribed burning;

(2) Installation support functions, including but not limited to, the maintenance, construction or operation of administrative offices, military exchanges, road

construction, commissaries, water treatment facilities, storage facilities, schools, housing, motor pools, non-tactical equipment, laundries, morale, welfare, and recreation activities, shops, landscaping, and mess halls;

(3) Operation of industrial activities

(4) Construction or demolition of facilities relating to these routine operations; and

(5) Hazardous waste cleanup.

This MOU does not address incidental take during military readiness activities, which was addressed in a rulemaking in accordance with section 315 of the National Defense Authorization Act for Fiscal Year 2003. The final rule, Migratory Bird Permits: Take of Migratory Birds by the Armed Force, was published as 50 CFR Part 21 in the February 28, 2007 Federal Register, pages 8931-8950.

Successful implementation of the MOU will require early planning and coordination between individual military bases and local FWS offices for particular projects that may affect migratory birds. A variety of useful tools are available to assist DoD natural resource managers in integrating bird conservation measures with DoD activities, as described in the attachment. If you have any questions, please contact Mr. Peter Boice at (703) 604-0524.

Alex A. Beehler

Alex A. Beehler
Assistant Deputy Under Secretary of Defense
(Environment, Safety and Occupational Health)

Attachments:
As stated

MEMORANDUM OF UNDERSTANDING
BETWEEN THE
U.S. DEPARTMENT OF DEFENSE
AND THE
U.S. FISH AND WILDLIFE SERVICE
TO PROMOTE THE CONSERVATION OF MIGRATORY BIRDS

This Memorandum of Understanding (MOU) is entered into between the U.S Department of Defense (DoD) and the U.S. Fish and Wildlife Service (FWS) (hereinafter "the Parties").

A <u>Purpose and Scope</u>

Pursuant to Executive Order 13186 (January 17, 2001), Responsibilities of Federal Agencies to Protect Migratory Birds, this MOU outlines a collaborative approach to promote the conservation of migratory bird populations.

This MOU does not address incidental take during military readiness activities, which is being addressed in a rulemaking in accordance with section 315 of the National Defense Authorization Act for Fiscal Year 2003 (Pub. L. 107-314, 116 Stat. 2458).

This MOU specifically pertains to the following categories of DoD activities

Natural resource management activities, including, but not limited to, habitat management, erosion control, forestry activities, agricultural outleasing, conservation law enforcement, invasive weed management, and prescribed burning;

(2) Installation support functions, including but not limited to, the maintenance, construction or operation of administrative offices, military exchanges, road construction, commissaries, water treatment facilities, storage facilities, schools, housing, motor pools, non-tactical equipment, laundries, morale, welfare, and recreation activities, shops, landscaping, and mess halls;

(3) Operation of industrial activities;

(4 Construction or demolition of facilities relating to these routine operations and

Hazardous waste cleanup

This MOU identifies specific activities where cooperation between the Parties will contribute substantially to the conservation of migratory birds and their habitats. This MOU does not authorize the take of migratory birds.

B. Authorities

The Parties' responsibilities under the MOU are authorized by provisions of the following laws:

Alaska National Interest Lands Conservation Act of 1980 (16 USC 410hh-3233)
Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. 668-668d)
Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.)
Fish and Wildlife Act of 1956 (16 U.S.C. 742 et seq.)
Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901-2911)
Fish and Wildlife Coordination Act (16 U.S.C. 661-667)
Migratory Bird Conservation Act (16 U.S.C. 715-715d, 715e, 715f-715r)
Migratory Bird Treaty Act (16 U.S.C. 703-711)
National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347)
Sikes Act Improvement Act of 1997 (16 USC 670a-670o)
Agreements to limit encroachments and other constraints on military training, testing, and operations (10 U.S.C. § 2684a)

C. Background

The Parties have a common interest in the conservation and management of America's natural resources. The Parties agree that migratory birds are important components of biological diversity and that the conservation of migratory birds will both help sustain ecological systems and help meet the public demand for conservation education and outdoor recreation, such as wildlife viewing and hunting opportunities. The Parties also agree that it is important to: 1) focus on bird populations; 2) focus on habitat restoration and enhancement where actions can benefit specific ecosystems and migratory birds dependent upon them; and 3) recognize that actions taken to benefit some migratory bird populations may adversely affect other migratory bird populations.

The DoD mission is to provide for the Nation's defense. DoD's conservation program works to ensure continued access to land, air, and water resources for realistic military training and testing while ensuring that the natural and cultural resources entrusted to DoD's care are sustained in a healthy condition.

The DoD is an active participant in international bird conservation partnerships including Partners in Flight (PIF) and the North American Bird Conservation Initiative (NABCI). Military lands frequently provide some of the best remaining habitat for migratory bird species of concern, and DoD plans to continue its leadership role in bird conservation partnerships.

Through the PIF initiative, DoD works in partnership with numerous Federal and State agencies and nongovernmental organizations for the conservation of migratory and resident birds and to enhance migratory bird survival. Through DoD PIF, a list of species of concern (see Definitions) has been developed for each Bird Conservation Region where DoD facilities occur, thus improving DoD's ability to evaluate any migratory bird conservation concerns on respective DoD lands.

Integrated Natural Resources Management Plans (INRMPs) offer a coordinated approach for incorporating habitat conservation efforts into installation management

INRMPs are a significant source of baseline conservation information and conservation initiatives used when preparing National Environmental Policy Act (NEPA) documents for all DoD management activities. This linkage helps to ensure that appropriate conservation and mitigation measures are identified in NEPA documents and committed to, when appropriate, in final decision documents.

The DoD PIF program provides a framework for incorporating landbird, shorebird and waterbird habitat management efforts into INRMPs. DoD's strategy focuses on inventorying and long-term monitoring to determine changes in migratory bird populations on DoD installations. Effective on-the-ground management may then be applied to those areas identified as having the highest conservation value. DoD's PIF goal is to support the military's training and testing mission while being a vital and supportive partner in regional, national, and international bird conservation initiatives. DoD strives to implement cooperative projects and programs on military lands to benefit the health and well-being of birds and their habitats, whenever possible. The Department of Defense implements bird inventories and monitoring programs in numerous ways including Monitoring Avian Productivity and Survivorship (MAPS) and Next Generation Radar (NEXRAD) for studying bird movements in the atmosphere. DoD also maintains an integrated pest management (IPM) program designed to reduce the use of pesticides to the minimum necessary.

The mission of the FWS is to work with others to conserve, protect, manage, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The FWS is legally mandated to implement the provisions of the Migratory Bird Treaty Act (MBTA), which include responsibilities for population management (e.g., monitoring), habitat protection (e.g., acquisition, enhancement, and modification), international coordination, and regulation development and enforcement The FWS also promotes migratory bird conservation through its coordination and consultation efforts with other entities.

Many FWS programs are involved in bird conservation activities, including

The Division of Migratory Bird Management and Regional Migratory Birds and Habitat Programs serve as focal points in the United States for policy development and strategic planning, developing and implementing monitoring and management initiatives that help maintain healthy populations of migratory birds and their habitat, and providing continued opportunities for citizens to enjoy bird-related recreation.

2. The Division of Bird Habitat Conservation is instrumental in supporting habitat conservation partnerships through the administration of bird conservation grant programs and development of Joint Ventures that serve as major vehicles for implementing the various bird conservation plans across the country.

3. Ecological Services Field Offices across the country serve as the primary contacts for environmental reviews that include, when requested, projects developed by local military installations and DoD regional offices involving migratory bird issues. The Field Offices coordinate with the Regional Migratory Bird Offices, as necessary, during these reviews regarding permits

and overall migratory bird conservation coordination for DoD activities.

4. The Office of Law Enforcement is the principal FWS program that enforces the legal provisions of the MBTA.

The Parties agree this MOU shall be implemented to the extent permitted by law and in harmony with agency missions, subject to the availability of appropriations and budgetary limits.

D. Responsibilities

Each Party shall:

a. Emphasize an interdisciplinary, collaborative approach to migratory bird conservation in cooperation with other governments, State and Federal agencies, and non-federal partners within the geographic framework of the NABCI Bird Conservation Regions.

b. Strive to protect, restore, enhance, and manage habitat of migratory birds, and prevent or minimize the loss or degradation of habitats on DoD-managed lands, by:

(1) Identifying and avoiding management actions that have the potential to adversely affect migratory bird populations, including breeding, migration, or wintering habitats; and by developing and implementing, as appropriate, conservation measures that would avoid or minimize the take of migratory birds or enhance the quality of the habitat used by migratory birds.;

(2) Working with partners to identify, conserve, and manage Important Bird Areas, Western Hemisphere Shorebird Reserve Network sites, and other significant bird conservation sites that occur on DoD-managed lands;

(3) Preventing or abating the pollution or detrimental alteration of the habitats used by migratory birds;

(4) Developing and integrating information on migratory birds and their habitats into outreach and education materials and activities; and

(5) Controlling the introduction, establishment, and spread of non-native plants or animals that may be harmful to migratory bird populations, as required by Executive Order 13112 on Invasive Species.

c. Work with willing landowners to prevent or minimize the loss or degradation of migratory bird habitats on lands adjacent or near military installation boundaries. This cooperative conservation may include:

Participating in efforts to identify, protect, and conserve

important migratory bird habitats or other significant bird conservation sites and ecological conditions that occur in landscapes or watersheds that may be affected by activities on DoD lands;

(2) Developing and integrating information on migratory bird resources found on DoD lands into other partners' outreach and education materials and activities; and

(3) Using available authorities to enter into agreements with other Federal agencies, States, other governmental entities, and private conservation organizations to conserve and enhance habitat in a compatible manner so military operations are not restricted.

d. Promote collaborative projects such as

(1) Developing or using existing inventory and monitoring programs, at appropriate scales, with national or regional standardized protocols, to assess the status and trends of bird populations and habitats, including migrating, breeding, and wintering birds;

(2) Designing management studies and research projects using national or regional standardized protocols and programs, such as MAPS, to identify the habitat conditions needed by applicable species of concern, to understand interrelationships of co-existing species, and to evaluate the effects of management activities on habitats and populations of migratory birds;

(3) Sharing inventory, monitoring, research, and study data for breeding, migrating, and wintering bird populations and habitats in a timely fashion with national data repositories such as Breeding Bird Research and Monitoring Database (BBIRD), National Point Count Database, National Biological Information Infrastructure, and MAPS;

(4) Working in conjunction with each other and other Federal and State agencies to develop reasonable and effective conservation measures for actions that affect migratory birds and their natural habitats;

(5) Participating in or promoting the implementation of existing regional or national inventory and monitoring programs such as Breeding Bird Survey (BBS), BBIRD, Christmas Bird Counts, bird atlas projects, or game bird surveys (e.g., mid-winter waterfowl surveys) on DoD lands where practicable and feasible.

(6) Using existing partnerships and exploring opportunities for expanding and creating new partnerships to facilitate combined funding for inventory, monitoring, management studies, and research

e. Provide training opportunities to DoD natural resources personnel on migratory bird issues, to include bird population and habitat inventorying,

monitoring methods, and management practices that avert detrimental effects and promote beneficial approaches to migratory bird conservation.

f. Participate in the Interagency Council for the Conservation of Migratory Birds to evaluate implementation of this MOU.

g. Promote migratory bird conservation internationally, as it relates to wintering, breeding and migration habitats of birds that breed on DoD lands.

h. Promote and undertake ecologically sound actions to curb the introduction in the wild of exotic or invasive species harmful to migratory birds.

2 The Department of Defense Shall

a. Follow all migratory bird permitting requirements for non-military readiness activities that are subject to 50 CFR Parts 21.22 (banding or marking), 21.23 (scientific collecting), 21.26 (special Canada goose permit), 21.27 (special purposes), or 21.41 (depredation). No permit is required to take birds in accordance with Parts 21.43 - 21.47 (depredation orders).

b. Encourage incorporation of comprehensive migratory bird management objectives in the preparation of DoD planning documents, including Integrated Natural Resource Management Plans, Pest Management Plans, Installation Master Plans, NEPA analyses, and non-military readiness elements of Bird Aircraft Strike Hazard documents. Comprehensive planning efforts for migratory birds include PIF Bird Conservation Plans, the North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, and North American Waterbird Conservation Plan and associated regional plans where available.

c. Incorporate conservation measures addressed in Regional or State Bird Conservation Plans in INRMPs.

d. Consistent with imperatives of safety and security, allow the FWS and other partners reasonable access to military lands for conducting sampling or survey programs such as MAPS, BBS, BBIRD, International Shorebird Survey, and breeding bird atlases.

e. Prior to starting any activity that is likely to affect populations of migratory birds:

(1) Identify the migratory bird species likely to occur in the area of the proposed action and determine if any species of concern could be affected by the activity;

(2) Assess and document, through the project planning process, using NEPA when applicable, the effect of the proposed action on species of concern. Use best available demographic, population, or habitat

association data in the assessment of effects upon species of concern;

(3) Engage in early planning and scoping with the FWS relative to potential impacts of a proposed action, to proactively address migratory bird conservation, and to initiate appropriate actions to avoid or minimize the take of migratory birds.

f. Manage military lands and activities other than military readiness in a manner that supports migratory bird conservation, giving consideration to the following factors:

(1) Habitat protection, restoration, and enhancement. Military lands contain many important habitats for migratory birds. Some unique, sensitive, endangered and/or declining habitat types that may require special management attention include:

(a) Grasslands. Many native grassland communities require intensive management to maintain and restore vigor and species diversity and to provide habitat for migratory birds and other wildlife dependent on native grasslands. Grassland management and restoration tools include controlled burning, mowing, grazing, native species planting, and exotic plant removal. Many grasslands have evolved with a natural fire regime, and the management activities often emulate this fire regime.

(b) Riparian and wetland habitats. Military lands contain riparian and wetland habitats that may be critical for migratory birds. DoD will strive to prevent the destruction or degradation of wetlands and riparian vegetation, and also restore those habitats, when feasible, where they have been degraded.

(c) Coastal beach, salt marsh, and dune habitats. Military lands support some of the best remaining undisturbed coastal habitats. DoD will strive to protect, restore and prevent the destruction of coastal and island habitats that are important to breeding, migrating and wintering shorebirds, salt marsh land birds and colonial water birds.

(d) Longleaf pine ecosystem. Some of the best remaining examples of the longleaf pine ecosystem occur on military lands. Such habitats benefit from prescribed fire and other management measures which DoD regularly implements on thousands of acres in the Southeast. The DoD manages and will continue to manage this ecosystem to benefit and promote migratory bird conservation.

(2) Fire and fuels management practices. Fire plays an important role in shaping plant and animal communities and is a valuable tool in restoring habitats altered by decades of fire suppression. Fire management may include fire suppression, but also involves fire

prevention and fuels treatment, including prescribed burning and monitoring, to protect communities and provide for healthy ecosystems. Fire management planning efforts will consider the effects of fire management strategies on the conservation of migratory bird populations.

(3) Invasive Species and Aquatic Nuisance Species management practices. Invasive Species and Aquatic Nuisance Species are a threat to native habitats and wildlife species throughout the United States, including military lands. Efforts to control/contain these species must take into account both the impacts from invasive species and the effects of the control efforts on migratory bird populations. Invasive Species and Aquatic Nuisance Species that can threaten migratory birds and their habitats include, but are not limited to, exotic grasses, trees and weeds, terrestrial and aquatic insects and organisms, non-native birds, and stray and feral cats.

(4) Communications towers, utilities and energy development. Increased communications demands, changes in technology and the development of alternative energy sources result in impacts on migratory birds. DoD will review wind turbine and powerline guidelines published by FWS and the Avian Power Line Interaction Committee, respectively, and consult with FWS as needed, in considering potential effects on migratory birds of proposals for locating communications towers, powerlines or wind turbines on military lands. Construction of new utility and energy systems and associated infrastructure should be designed to avoid and minimize impacts on migratory bird populations. Existing utilities may also be considered for retrofitting to reduce impacts.

(5) Recreation and public use. The demand for outdoor recreational opportunities on public lands is increasing. Impacts on migratory birds may occur both through direct and indirect disturbances by visitors and through agency activities associated with providing recreational opportunities to visitors and installation personnel and morale facilities (e.g., facilities construction). DoD provides access to military lands for recreation and other public use, such as Watchable Wildlife and bird watching, where such access does not compromise security and safety concerns or impact migratory birds, other species, or their habitats.

Many conservation measures have been developed to benefit a variety of migratory bird species and their associated habitats. Some of these conservation measures may be directly applicable to DoD activities other than military readiness related activities; however, the appropriateness and practicality of implementing any specific conservation measure may have to be determined on a case-by-case basis. The FWS will work cooperatively with DoD in providing existing conservation measures and developing new ones as needed. Examples of some conservation measures may be found at

http://www.partnersinflight.org/pubs/BMPs.htm for landbird species.

g. Develop and implement new and/or existing inventory and monitoring programs, at appropriate scales, using national standardized protocols, to evaluate the effectiveness of conservation measures to minimize or mitigate take of migratory birds, with emphasis on those actions that have the potential to significantly impact species of concern.

h. Advise the public of the availability of this MOU through a notice published in the Federal Register.

i. In accordance with DoD INRMP guidance, promote timely and effective review of INRMPs with respect to migratory bird issues with the FWS and respective state agencies. During the INRMP review process, evaluate and coordinate with FWS on any potential revisions to migratory bird conservation measures taken to avoid or minimize take of migratory birds.

3 **The Fish and Wildlife Service Shall:**

a. Work with DoD by providing recommendations to minimize adverse effects upon migratory birds from DoD actions.

b. Through the Division of Migratory Bird Management, maintain a Web page on permits that provides links to all offices responsible for issuing permits and permit application forms for take of migratory birds.

c. Provide essential background information to the DoD when requested to ensure sound management decisions. This may include migratory bird distributions, status, key habitats, conservation guidelines, and risk factors within each BCR. This includes updating the FWS publication of *Birds of Conservation Concern* at regular intervals so it can be reliably referenced.

d. Work to identify special migratory bird habitats (i.e., migration corridors, stop-over habitats, ecological conditions important in nesting habitats) to aid in collaborative planning.

e. Through the Ecological Service Field Offices, provide to DoD, upon request, technical assistance on migratory bird species and their habitats.

f. In accordance with FWS Guidelines for Coordination with DoD and Implementation of the 1997 Sikes Act (2005), work cooperatively with DoD in the development, review and revision of INRMPs.

g. Review and comment on NEPA documents and other planning documents forwarded by military installations.

E. It is Mutually Agreed and Understood That:

This MOU will not change or alter requirements associated with the MBTA, Endangered Species Act, NEPA, Sikes Act or other statutes or

legal authority

2 The responsibilities established by this MOU may be incorporated into existing DoD actions; however, DoD may not be able to implement some responsibilities identified in the MOU until DoD has successfully included them in formal planning processes. This MOU is intended to be implemented when new actions are initiated as well as during the initiation of new, or revisions to, INRMPs, Pest Management Plans, and activities other than military readiness of addressed within Bird Aircraft Strike Hazard plans. It does not apply to ongoing DoD actions for which a NEPA decision document was finalized prior to, or within 180 days of the date this MOU is signed.

3 This MOU in no way restricts either Party from participating in similar activities with other public or private agencies, governments, organizations, or individuals.

4. An elevation process to resolve any dispute between the Parties regarding a particular practice or activity is in place and consists of first attempting to resolve the dispute with the DoD military installation and the responsible Ecological Services Field Office. If there is no resolution at this level, either Party may elevate the issue to the appropriate officials at the applicable Military Service's Chain of Command and FWS Regional Offices. In the event that there is no resolution by these offices, the dispute may be elevated by either Party to the headquarters office of each agency.

5 This MOU is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement, contribution of funds, or transfer of anything of value between the Parties will be handled in accordance with applicable laws, regulations, and procedures, including those for government procurement and printing. Such endeavors will be outlined in separate agreements that shall be made in writing by representatives of the Parties and shall be independently authorized by appropriate statutory authority.

6. The Parties shall schedule periodic meetings to review progress and identify opportunities for advancing the principles of this MOU.

7 This MOU is intended to improve the internal management of the executive branch and does not create any right or benefit, substantive or procedural, separately enforceable at law or equity by a party against the United States, its agencies or instrumentalities, its officers or employees, or any other person.

8 Modifications to the scope of this MOU shall be made by mutual consent of the Parties, through issuance of a written modification, signed and dated by both Parties, prior to any changes.

9 Either Party may terminate this instrument, in whole or in part, at any time before the date of expiration by providing the other Party with a written

statement to that effect.

The principal contacts for this instrument are as follows:

Brian Millsap, Chief Division of Migratory Bird Management US Fish and Wildlife Service 4401 N. Fairfax Drive MS4107 Arlington, VA 22203	L. Peter Boice, Conservation Team Leader Office of the Secretary of Defense 1225 S. Clark St. Suite 1500 Arlington, VA 22202-4336

This MOU is executed as of the last date signed below and expires no later than five (5) years thereafter, at which time it is subject to review and renewal, or expiration.

F. Definitions

Action – a program, activity, project, official policy, rule, regulation or formal plan directly carried out by DoD, but not a military readiness activity.

Breeding Biology Research and Monitoring Database (BBIRD) - national, cooperative program that uses standardized field methodologies for studies of nesting success and habitat requirements of breeding birds (http://pica.wru.umt.edu/BBIRD/).

Breeding Bird Survey (BBS) – a standardized international survey that provides information on population trends of breeding birds, through volunteer observations located along randomly selected roadside routes in the United States, Canada and Mexico (http://www.mbr-pwrc.usgs.gov/bbs/bbs.html).

Bird Conservation Region - a geographic unit used to facilitate bird conservation actions under the North American Bird Conservation Initiative (http://www.manomet.org/USSCP/bcrmaps.html).

Birds of Conservation Concern - published by the FWS Division of Migratory Bird Management, refers to the list of migratory and non-migratory birds of the United States and its territories that are of conservation concern. The current version of the list Birds of Conservation Concern 2002 is available at (http://migratorybirds.fws.gov/reports/bcc2002.pdf).

Comprehensive Planning Efforts for Migratory Birds – includes Partners in Flight, North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, Western Hemisphere Shorebird Reserve Network, North American Waterbird Conservation Plan, and other planning efforts integrated through the North American Bird Conservation Initiative.

Conservation Measure – an action undertaken to improve the conservation status of one or more species of migratory birds. Examples include surveys and inventories, monitoring, status assessments, land acquisition or protection, habitat restoration, population manipulation, research, and outreach.

Conservation Planning – strategic and tactical planning of agency activities for the long-term conservation of migratory birds and their habitats.

Council for the Conservation of Migratory Birds – an interagency council established by the Secretary of the Interior to oversee the implementation of Executive Order 13186.

Ecological Condition – the composition, structure, and processes of ecosystems over time and space. This includes the diversity of plant and animal communities, the productive capacity of ecological systems and species diversity, ecosystem diversity, disturbance processes, soil productivity, water quality and quantity, and air quality. Often referred to in terms of ecosystem health, which is the degree to which ecological factors and their interactions are reasonably complete and functioning for continued resilience, productivity, and renewal of the ecosystem.

Effect (adverse or beneficial) – "effects" and "impacts," as used in this MOU are synonymous. Effects may be direct, indirect, or cumulative, and refer to effects from management actions or categories of management actions on migratory bird populations, habitats, ecological conditions and/or significant bird conservation sites.

Important Bird Areas (IBAs) – a network of sites that provide essential habitat for the long-term conservation of birds. In the United States, the IBA network is administered by the American Bird Conservancy and the National Audubon Society. (http://www.audubon.org/nird/iba/)

Integrated Natural Resources Management Plan (INRMP) – an integrated plan based, to the maximum extent practicable, on ecosystem management that shows the interrelationships of individual components of natural resources management (e.g., fish and wildlife, forestry, land management, outdoor recreation) to military mission requirements and other land use activities affecting an installation's natural resources. INRMPs are required for all DoD installations with significant natural resources, pursuant to the Sikes Act Improvement Act.

International Shorebird Survey – a monitoring program started in 1974 to survey shorebirds (sandpipers, plovers, etc.) across the Western Hemisphere. (http://www.manomet.org/programs/shorebirds).

Management Action – an activity by a government agency that could cause a positive or negative impact on migratory bird populations or habitats. Conservation measures to mitigate potential negative effects of actions may be required.

Migratory Bird – any bird listed in 50 CFR §10.13, Code of Federal Regulations

Military Readiness Activity – all training and operations of the Armed Forces that relate to combat, including but not limited to the adequate and realistic testing of military equipment, vehicles, weapons and sensors for proper operation and suitability for combat use.

Monitoring Avian Productivity and Survivorship (MAPS) – a program that uses the banding of birds during the breeding season to track the changes and patterns in the

number of young produced and the survivorship of adults and young (http://www.birdpop.org/maps.htm).

National Environmental Policy Act (NEPA) – a Federal statute that requires Federal agencies to prepare a detailed analysis of the environmental impacts of a proposed action and alternatives, and to include public involvement in the decision making process for major Federal actions significantly affecting the quality of the human environment 42 U.S.C. §4321, et. seq.

North American Bird Conservation Initiative (NABCI) – an initiative to align the avian conservation community to implement bird conservation through regionally-based, biologically driven, landscape-oriented partnerships across the North American continent. NABCI includes Federal agencies of Canada, Mexico and the United States, as well as most landbird, shorebird, waterbird, and waterfowl conservation initiatives (http://www.nabci-us.org).

North American Waterbird Conservation Plan – a partnership of Federal and State government agencies, non-governmental organizations, and private interests focusing on the conservation of waterbirds, primarily including marshbirds and inland, coastal, and pelagic colonial waterbirds (www.nacwcp.org/pubs/). The vision of the partnership is that the distribution, diversity and abundance of populations and breeding, migratory, and nonbreeding waterbirds are sustained throughout the lands and waters of North America, Central America, and the Caribbean.

North American Waterfowl Management Plan –a partnership of Federal and State agencies, non-governmental organizations, and private interests focusing on the restoration of waterfowl populations through habitat restoration, protection, and enhancement (http://birdhabitat.fws.gov/NAWMP/nawmphp.htm).

Partners in Flight (PIF) – a cooperative partnership program of more than 300 partners including Federal and State government agencies, non-governmental organizations, conservation groups, foundations, universities and industry focusing on the conservation of landbirds. DoD was an original signatory to the PIF Federal Agencies' MOA. (http://www.partnersinflight.org and http://www.dodpif.org).

Species of Concern – refers to those species listed in the periodic report *Birds of Conservation Concern*; priority migratory bird species documented in the comprehensive bird conservation plans (North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, Partners in Flight Bird Conservation Plans); species or populations of waterfowl identified as high, or moderately high, continental priority in the North American Waterfowl Management Plan; listed threatened and endangered bird species in 50 CFR. 17.11; and MBTA listed game birds below desired population sizes

Take – as defined in 50 C.F.R. 10.12, to include pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect.

U.S. Shorebird Conservation Plan – an effort undertaken by a partnership of Federal and State government agencies, as well as non-governmental and private organizations

to ensure that stable and self-sustaining populations of all shorebird species are restored and protected (http://www.fws.gov/shorebird).

The Parties hereto have executed this agreement as of the date shown below.

Director
US Fish and Wildlife Service

Signature 7/7/06 Date

Assistant Deputy Under Secretary of Defense (Environment, Safety and Occupational Health)
US Department of Defense

Signature 7/31/06 Date

USEFUL TOOLS IN IMPLEMENTING MIGRATORY BIRD CONSERVATION BY THE DOD

The following is not an exhaustive list of tools available to help address migratory bird conservation but are excellent sources to start.

Partners in Flight (http://www.partnersinflight.org)
Partners in Flight is an umbrella network of which the DoD bird conservation program is a vital part. Partners in Flight was launched in 1990 in response to growing concerns about declines in the populations of many landbirds, and to address the conservation of birds not covered by existing conservation initiatives.

The PIF web site provides helpful information including links to regional plans that discuss bird conservation goals and objectives for individual species in a specific physiographic region.

DoD Partners in Flight (http://www.dodpif.org/)
The Management Strategy for DoD PIF is to promote and support a partnership role in the protection and conservation of birds and their habitats by protecting vital DoD lands and ecosystems, enhancing biodiversity, and maintaining healthy and productive natural systems consistent with the military mission. The DoD PIF web site provides a number of useful resources for addressing or learning more about migratory bird conservation, including fact sheets and a database of installation-specific information.

Installation Bird Checklist (http://www.dodpif.org/)
This is an ongoing effort to providing a list of birds known to occur on or in the vicinity of individual military bases in addition to seasonal occurrence records.

Species of Concern (http://www.dodpif.org/)
Although migratory bird conservation should address all migratory birds, the MOU places a priority on addressing the conservation of species of concern as resources are limited to effectively address all birds. Species of concern refers to those species listed in the periodic report FWS *Birds of Conservation Concern;* priority migratory bird species documented in the comprehensive bird conservation plans (North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, Partners in Flight Bird Conservation Plans); species or populations of waterfowl identified as high, or moderately high, continental priority in the North American Waterfowl Management Plan; listed threatened and endangered bird species in 50 CFR. 17.11; and Migratory Bird Treat Act listed game birds below desired population sizes. To assist DoD staff in determining what species may be impacted by activities on military bases, DoD PIF is in the process of developing a list of species of concern for each military base in the continental U.S. Until these individual base lists are finalized, list of species of concern are available at the larger Bird Conservation Region (BCR) scale. BCRs are ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues.

The DoD Bird Conservation Database (Database) (http://www.dodpif.org/projects/)
This database was created to document, consolidate, and disseminate bird conservation efforts on or involving military lands and civil works projects and make that information available as a resource for planners, land managers and other professionals involved in bird conservation.

This database can provide a valuable resource for biologists to share natural resource management information on their base including species accounts, research and monitoring, bird surveys, etc. Base biologists are encouraged to insert abstracts on their natural resource projects into the database.

Conservation Measures (http://www.partnersinflight.org/pubs/BMPs.htm)
There is currently a lack of a single resource database that provides easy reference to migratory bird conservation measures that may be implemented for a diversity of species or habitat types. However, several efforts are underway and will be available in the future. One resource that is currently underdevelopment but readily available are Best Management Practices on the Partners in Flight web site.

DoD PIF-L List Serve (http://www.dodpif.org/).
This Listserve supports the natural resource managers at DoD sites to more effectively address migratory and resident bird issues, and incorporate bird habitat conservation plans into the INRMP process. The list should be used for items that will benefit natural resource managers with bird conservation issues, including as requests for information or assistance. See the web site for how to subscribe to the list.

US Shorebird Conservation Plan (http://www.fws.gov/shorebirdplan/) is an effort undertaken by a partnership of Federal and State government agencies, as well as non-governmental and private organizations to ensure that stable and self-sustaining populations of all shorebird species are restored and protected. Both the U.S. Plan and regional step down plans provide useful information regarding population goals and objectives for individual priority shorebird species.

North American Waterbird Conservation Plan
(http://www.waterbirdconservation.org/)
This partnership of Federal and State government agencies, non-governmental organizations, and private interests focuses on the conservation of waterbirds, primarily including marshbirds and inland, coastal, and pelagic colonial waterbirds). As with the Partners in Flight and Shorebird initiatives, waterbird conservation plans are available at both the continental and regional scale. These include population and habitat objectives for individual waterbird species and management recommendations.

FWS Course for DoD Natural Resource Managers: Migratory Bird Conservation – A Trust Responsibility
The FWS periodically offers a MBTA course specifically modified for DoD participants. FWS hopes to offer the course approximately once a year.

DoD Conservation Page (http://www.denix.osd.mil/Conservation/)
The Conservation Web page on DENIX offers a wide variety of bird conservation reports and other products. Of particular note are the sections on "Wildlife" and "Endangered Species."

DoD Legacy Resource Management Program (http://www.dodlegacy.org)
The Legacy program funds efforts that preserve our nation's natural and cultural heritage on DoD lands. Three principles guide the Legacy Program: *stewardship*, *leadership*, and *partnership*. Stewardship initiatives assist DoD in safeguarding its irreplaceable resources for future generations. By embracing a leadership role as part of the program, DoD serves as a model for respectful use of natural and cultural resources. Through partnerships, Legacy strives to access the knowledge and talents of individuals outside of DoD. The Legacy Web site describes proposal submittal guidelines, lists previously funded projects, and provides links to many products. Bird conservation is one of Legacy's eleven areas of interest.

Strategic Environmental Research and Development Program (http://www.serdp.org)
SERDP is DoD's environmental science and technology program, planned and executed in full partnership with the Department of Energy and the Environmental Protection Agency, with participation by numerous other federal and non-federal organizations. To address the highest priority issues confronting the Army, Navy, Air Force, and Marines, SERDP focuses on cross-service requirements and pursues high-risk/high-payoff solutions to the Department's most intractable environmental problems. The development and application of innovative environmental technologies support the long-term sustainability of DoD's training and testing ranges as well as significantly reduce current and future environmental liabilities. SERDP offers funding in the following four focus areas: Environmental Restoration, Munitions Management, Sustainable Infrastructure, and Weapons Systems and Platforms. Sustainable Infrastructure (SI) encompasses the technologies required to sustain training and testing ranges, as well as the installation infrastructure that supports those ranges and the deployed forces. SI is subdivided into natural resources, facilities, and cultural resources.

Environmental Security Technology Certification Program (http://www.estcp.org)
ESTCP is DoD's environmental technology demonstration and validation program. The goal of ESTCP is to identify, demonstrate, and transfer technologies that address DoD's highest priority environmental requirements. The Program promotes innovative, cost-effective environmental technologies through demonstrations at DoD facilities and sites. These technologies provide a return on investment through improved efficiency, reduced liability, and direct cost savings. ESTCP's strategy is to select lab-proven technologies with broad DoD application and aggressively move them to the field for rigorous trials documenting their cost, performance, and market potential. ESTCP offers funding in the following four focus areas: Environmental Restoration, Munitions Management, Sustainable Infrastructure, and Weapons Systems and Platforms. Sustainable Infrastructure (SI) encompasses the technologies required to sustain training and testing ranges, as well as the installation infrastructure that supports those ranges and the deployed forces. SI is subdivided into natural resources, facilities, and cultural resources

North American Bird Conservation Initiative (NABCI)
The U.S. NABCI Committee is a forum of government agencies, non-profit organizations, and initiatives dedicated to advancing integrated bird conservation in North America. Its strategy is to foster coordination and collaboration among the bird conservation community on key issues of concern. Through annual work plans, NABCI focuses its efforts on advancing bird monitoring, conservation design, international conservation, and institutional support in state and federal agencies for bird habitat conservation.

DoD Coordinated Bird Monitoring Plan
A Coordinated Bird Monitoring (CBM) approach now is being followed in the United State and Canada by many public and private agencies. The CBM approach stresses clear specification of management issues that bird monitoring can help address, careful attention to quantitative issues, and coordination among the different bird initiatives and between these groups and managers who will use the information. DoD is undertaking a three-year project that will develop four products to help improve bird monitoring programs on DoD land -- a review of existing monitoring programs, guidelines for selected surveys, a plan for monitoring species of special concern on DoD land, and recommendations for DoD's role in continental bird monitoring programs.

APPENDIX F-3

Biology Sensitive Species Tables

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PLANT SPECIES ON MCB CAMP PENDLETON

All species are listed by taxonomic family. The primary resources used to develop this table were the Camp Pendleton Plant Database, California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California (Skinner & Pavlik 1994), the CalFlora (2000) database, and The Jepson Manual (Hickman 1993). The latter two references were used as the main sources for scientific naming and taxonomy. Species indicated as on record in the herbarium were collected on Base and are archived at San Diego State University. Note: the following list does not include exotic ornamental plants used in landscaping, nor have all species listed been confirmed in sightings or survey reports on Base (all are within range distributions for the area).

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
ACERACEAE					
Acer macrophyllum	big-leaf maple	NPT	No	FAC	
AGAVACEAE					
Yucca whipplei	our lord's candle	NPS			
AIZOACEAE					
Carpobrotus chilensis	sea fig	EPH	No		
Carpobrotus edulis	hottentot fig	EPH	Yes		EPPC A-1
Mesembryanthemum crystallinum	crystal ice plant	EAH	Yes		EPPC B
Mesembryanthemum nodiflorum	little ice plant	EAH	Yes		
Sesuvium verrucosum	western sea purslane	NPH	Yes	FACW	
Tetragonia tetragonioides	New Zealand spinach	EAPH	No		
ALISMATACEAE					
Alisma triviale	northern water-plantain	NPH			
AMARANTHACEAE					
Amaranthus albus	white tumbleweed	EAH	No	FACU	
Amaranthus blitoides	prostrate amaranth	NAH	No	FACW	
Amaranthus californicus	California amaranth	NAH	No	FACW	
ANACARDIACEAE					
Malosma laurina	laurel sumac	NPST	Yes		
Rhus integrifolia	lemonade berry	NPS	Yes		
Rhus ovata	sugar bush	NPS	Yes		
Rhus trilobata	basketbush, skunkbush	NPS	Yes	N	
Rhus trilobata var. *pilosissima*	squawbush	NPS			
Schinus molle	Peruvian pepper tree	EPT	Yes		EPPC B
Toxicodendron diversilobum	western poison oak	NPSV	Yes		
APIACEAE					
Apiastrum angustifolium	mock parsley	NAH	Yes	NI	
Apium graveolens	common celery	EABH	No	FACW*	
Berula erecta	cut-leaf water parsnip	NPH	Yes		
Bowlesia incana	American Bowlesia	NAH	No		
Conium maculatum	common poison hemlock	EPH	Yes	FACW	EPPC B
Daucus carota	Queen Anne's lace, wild carrot	EPH	Yes		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating [2]	Species Status [3]
APIACEAE *(Cont'd)*					
Daucus pusillus	rattlesnake weed	NAH	Yes		
Daucus pusillus	rattlesnake weed	NAH	Yes		
Eryngium aristulatum var. *parishii*	San Diego button celery	NAPH	No	OBL	CNPS 1B, CE, FE
Eryngium pendletonensis	Camp Pendleton button celery	NPH			
Eryngium vaseyi	Vasey's button celery	NPH		FACW	
Foeniculum vulgare	sweet fennel	EPH	Yes	FACU	EPPC A-1
Lomatium dasycarpum ssp. *dasycarpum*	woolly-fruit lomatium	NPH	Yes		
Lomatium utriculatum	common lomatium	NPH	No		
Osomorhiza brachypoda	California sweet cicely	NPH	Yes		
Sanicula arguta	sharp-tooth sanicle	NPH	Yes		
Sanicula crassicaulis	Pacific sanicle	NPH	Yes		
Sanicula tuberosa	turkey-pea sanicle	NPH	Yes		
Tauschia arguta	southern tauschia	NPH	Yes		
APOCYNACEAE					
Vinca major	Blue periwinkle	EPH	Yes		EPPC B
ARECACEAE					
Phoenix canariensis	Canary Island date palm	EPT			
ASCLEPIADACEAE					
Asclepias californica	California milkweed	NPH	No		
Asclepias fascicularis	narrow leaf milkweed	NPH	Yes	FAC	
Sarcostemma cynanchoides ssp. *hartwegii*	Hartweg's milkvine	NPHV	Yes		
Funastrum cynanachoides ssp. *heterophyllum*	Hartweg's milkvine	NPHV			
ASTERACEAE					
Achillea millefolium	yarrow	NPH	Yes		
Achillea millefolium ssp. *californica*	California yarrow	NPH			
Acourtia microcephala	sacapellote	NPH	Yes		
Agoseris grandiflora	large-flower agoseris	NPH	Yes		
Amblyopappus pusillus	pineapple weed	NAH	Yes	FACW-	
Ambrosia acanthicarpa	annual bur weed	NAH	No		
Ambrosia chamissonis	beach bur	NPH	Yes		
Ambrosia confertiflora	weak-leaf burbush	NPH	No		
Ambrosia psilostachya	western ragweed	NPH	Yes	FAC	
Ambrosia psilostachya ssp. *californica*	western ragweed	NAPH			
Artemisia californica	coastal sagebrush	NPS	Yes		
Artemisia douglasiana	douglas mugwort	NPH	Yes	FACW	
Artemisia dracunculus	tarragon, dragon sagewort	NPH	Yes		
Artemisia pycnocephala	coastal sagewort	NPH			
Artemisia tridentata ssp. *tridentata*	Great Basin sagebrush	NPS	No		
Aster subulatus var. *ligulatus*	slim aster	NAH	Yes		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
ASTERACEAE *(Cont'd)*					
Baccharis douglasii	saltmarsh baccharis, Douglas' baccharis	NPH		OBL	
Baccharis emoryi	Emory's baccharis	NPS	Yes	FACW	
Baccharis pilularis	coyote bush	NPS	Yes		
Baccharis salicifolia	mule fat or seep willow	NPS	Yes	FACW	
Baccharis sarothroides	broom baccharis	NPS	No		
Bebbia juncea	rush sweetbush	NPS			
Bebbia juncea var. *aspera*	rush sweetbush	NPS	Yes		
Brickellia californica	California brickellbush	NPS	Yes		
Carduus pycnocephalus	Italian thistle	EAH	Yes		
Centaurea melitensis	tocalote	EAH	Yes		EPPC B
Chaenactis artemisiifolia	artemisia pincushion	NAH	Yes		
Chaenactis glabriuscula var. *glabriuscula*	yellow pincusion	NAH	Yes		
Chamomilla suaveolens	common pineapple weed	EAH	Yes	FACU	
Chrysanthemum coronarium	garland chrysanthemum	EAH	Yes		
Cirsium occidentale var. *californicum*	cobweb thistle	NPH	Yes		
Cirsium vulgare	bull thistle	EAH	No	FACU	EPPC B
Cnicus benedictus	blessed thistle	EAH	No		
Conyza bonariensis	flax-leaf fleabane	EAH	No		
Conyza canadensis	common horseweed	NAH	Yes		
Coreopsis maritima	San Diego sea dahlia	NPH	Yes		CNPS 2,
Corethrogyne filaginifolia	common sand aster	NPH	Yes		
Corethrogyne filaginifolia ssp. *filaginifolia*	common sand aster	NPH	Yes		
Corethrogyne filaginifolia ssp. *incana*	San Diego sand aster	NPH			CNPS 1B
Corethrogyne filaginifolia ssp. *virgata*	virgate sand aster	NPH	Yes		
Cotula australis	Australian brass buttons	EAH	No		
Cotula coronopifolia	African brass buttons	EPH	Yes	FACW+	
Cynara cardunculus	globe artichoke, cardoon	EPH	No		EPPC A-1
Eclipta prostrata	false daisy	EAH	No		
Encelia californica	California encelia	NPS	Yes		
Encelia farinosa	incienso, desert encelia	NPS	Yes		
Erigeron foliosus	leafy fleabane	NPH	Yes		
Erigeron foliosus var. *foliosus*	leafy daisy	NPHS	Yes		
Eriophyllum confertiflorum var.*confertiflorumum*	long stem golden yarrow	NPS	Yes		
Euthamia occidentalis	western goldenrod	NPH	Yes	OBL	
Filago californica	California filago	NAH	Yes		
Filago gallica	narrow-leaf filago	EAH	No		
Gnaphalium bicolor	bicolor cudweed	NPH	Yes		
Gnaphalium californicum	California everlasting	NAH	Yes		
Gnaphalium canescens ssp. *beneolens*	fragrant everlasting	NPH	Yes		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
ASTERACEAE *(Cont'd)*					
Gnaphalium canescens ssp. *microcephalum*	everlasting	NPH	Yes		
Gnaphalium leucocephalum	white-head cudweed	NPH	Yes		
Gnaphalium luteo-album	everlasting	EAH	Yes		
Gnaphalium palustre	lowland cudweed	NAH	Yes	FACW	
Gnaphalium ramosissimum	pink everlasting	NPH	No		
Gnaphalium stramineum	cotton-batting plant	NAPH	No		
Grindelia camporum	big gumplant	NPH	Yes		
Grindelia camporum var. *camporum*	great valley gumweed	NPH	Yes	FACU	
Gutierrezia sarothrae	San Joaquin matchweed	NPS	No		
Hazardia squarrosa var. *grindelioides*	sawtooth goldenbush	NPS	Yes		
Hazardia squarrosa var. *squarrosa*	sawtooth goldenbush	NPS			
Hedypnois cretica	crete hedypnois	EAH	Yes		
Helianthus annuus	westen sunflower	NAH	Yes	FAC-	
Helianthus annuus ssp. *lenticularis*	common western sunflower	NAH	Yes		
Helianthus gracilentus	slender sunflower	NPH	Yes		
Hemizonia fasciculata	fascicled tarweed	NAH	Yes		
Hemizonia paniculata	San Diego tarweed	NAH	Yes	FACU*	
Heterotheca grandiflora	telegraph weed	NAPH	Yes		
Holocarpha virgata ssp. *elongata*	curving tarweed	NAH	No		
Hypochoeris glabra	smooth cat's ear	EAH	Yes		
Isocoma menziesii var. *decumbens*	spreading goldenbush	NPS		FAC+	
Isocoma menziesii var. *menziesii*	spreading golden bush	NPS	Yes		
Isocoma menziesii var. *vernonioides*	coastal goldenbush	NPS	Yes	FAC+	
Jaumea carnosa	salty Susan	NPH	Yes	OBL	
Lactuca serriola	wild lettuce	EAH	Yes	FAC	
Lagophylla ramosissima	common hareleaf	NAH	Yes		
Lasthenia californica	common goldfields	NAH	Yes		
Lepidospartum squamatum	scale broom	NPS	Yes		
Lessingia filaginifolia var. *filaginifolia* [4]	cudweed aster	NPH	Yes		
Logfia gallica [4]	narrow leaf cottonrose	EAH	No		
Madia elegans	common madia	NAH			
Madia gracilis ssp. *gracilis*	slender madia	NAH	No		
Madia sativa	coast madia	NAH	Yes		
Malacothrix saxatilis var. *tenuifolia*	cliff aster	NPH	Yes		
Microseris elegans	elegant microseris	NAH	Yes		
Osmadenia tenella	osmadenia	NAH	Yes		
Pentachaeta aurea	golden daisy	NAH	No		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
ASTERACEAE *(Cont'd)*					
Picris echioides	bristly ox tongue	EAPH	Yes	FAC*	
Pluchea odorata var. *odorata*	salt marsh fleabane	NAPH	No	OBL	
Pluchea sericea	arrowweed	NPS	Yes	FACW	
Porophyllum gracile	odora	NPH	Yes		
Psilocarphus brevissimus	woolly marbles	NAH	Yes	OBL	
Psilocarphus tenellus	slender wooly heads	NAH	Yes	FAC	
Rafinesquia californica	California chicory	NAH	Yes		
Senecio aphanactis	California groundsel	NAH	Yes		
Senecio californicus	California butterweed	NAH	Yes		
Senecio flaccidus var. *douglasii*	sand-wash butterweed	NPS	Yes		
Senecio milkanioides	German ivy	EPH			EPPC A-1
Senecio vulgaris	common groundsel	EAH	Yes	NI*	
Silybum marianum	milk thistle	EAPH	No		
Solidago californica	California goldenrod	NPH	Yes		
Sonchus asper [4]	spiney-leaf sow thistle	EAH	Yes	FAC	
Sonchus oleraceus	common sow thistle	EAH	Yes	NI*	
Stebbinsoseris heterocarpa	derived microseris	NAH	No		
Stephanomeria diegensis	San Diego wreath plant	NAPH	Yes		
Stephanomeria exigua ssp. *deanei*	Deane's wreath plant	NAH	Yes		
Stephanomeria virgata	virgate wreath plant	NAH	Yes		
Stylocline gnaphaloides	everlasting nest straw	NAH	Yes		
Symphyotrichum divaricatum [4]	saltmarsh aster	NAH		FACW	
Uropappus lindleyi	silver puffs	NAH	Yes		
Venegasia carpesioides	jesuit flower	NPH	Yes		
Viguiera laciniata	San Diego sunflower	NPS	Yes		CNPS 4
Viguiera purissimae	no common name	NPS			
Xanthium spinosum	spiny cocklebur	NAH	No	FAC+	
Xanthium strumarium	cocklebur	NAH	Yes	FAC+	
Xanthium strumarium var. *canadense* [4]	Canada cocklebur	NAH	Yes	FAC+	
AZOLLACEAE					
Azolla filiculoides	Pacific mosquitofern	NPF	No		
BETULACEAE					
Alnus rhombifolia	white alder	NPT	Yes	FACW	
BLECHNACEAE					
Woodwardi fimbriata	giant chain ferry	NPF	Yes		
BORAGINACEAE					
Amsinckia intermedia	common fiddleneck	NAH			
Amsinckia menziesii	rancher's fiddleneck	NAH	Yes		
Cryptantha clevelandii var. *florosa* [4]	Cleveland's large cryptantha	NAH	Yes		
Cryptantha intermedia	Nievita's cryptantha	NAH	Yes		
Cryptantha micromeres	minute-flower cryptantha	NAH	Yes		
Cryptantha microstachys	tejon cryptantha	NAH	Yes		
Cryptantha muricata	prickly cryptantha	NAH	Yes		
Cryptantha muricata var. *jonesii* [4]	Jones' pointed cryptantha	NAH	Yes		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating [2]	Species Status [3]
BORAGINACEAE *(Cont'd)*					
Cryptantha muricata var. *muricata* [4]	pointed cryptantha	NAH	Yes		
Harpagonella palmeri	Palmer's grappling-hook	NAH	No		CNPS 2
Harpagonella palmeri var. *palmeri* [4]	Palmer's grappling hook	NAH	No		
Heliotropium curvassavicum	salt heliotrope	NPH		OBL	
Heliotropium curvassavicum var. *oculatum* [4]	salt heliotrope	NAPH	Yes		
Pectocarya linearis ssp. *ferocula*	slender pectocarya	NAH	Yes		
Pectocarya pencillata	winged pectocarya	NAH	Yes		
Plagiobothrys acanthocarpus	adobe popcornflower	NAH	Yes	OBL	
Plagiobothrys collinus var. *californicus*	California popcornflower	NAH	Yes		
Plagiobothrys nothofulvus	rusty popcornflower	NAH	Yes	FAC	
BRASSICACEAE					
Brassica nigra	black mustard	EAH	No	FAC	EPPC B
Brassica rapa	field mustard	EAH	Yes		
Cakile maritima	sea rocket	EAH	No		
Capsella bursa-pastoris	shepherd's purse	EAH	Yes		
Cardamine californica	milkmaids	NPH	Yes		
Cardaria draba	hoary cress, whitetop	EPH			EPPC A-2
Caulanthus simulans	Payson's caulanthus	NAH	Yes		
Descurainea sophia	fine-leaf tansy mustard	EAH	No		
Draba cuneifolia	whitlow	NAH	No		
Erysimum ammophilum	coast wallflower	NPH	Yes		CNPS 1B
Guillenia lasiophyllum	California mustard	NAH	No		
Hirshfeldia incana	shortpod mustard	EPH	Yes	UPL	
Lepidium densiflorum var. *pubecarpum*	peppergrass	NAH	No	FAC	
Lepidium lasiocarpum [4]	sand peppergrass	NAH	Yes		
Lepidium latifolium	perennial pepperweed	EPH		FACW	EPPC A-1
Lepidium latipes	dwarf peppergrass	NAH	Yes	OBL	
Lepidium latipes var. *latipes*	San Diego pepperweed	NAH		OBL	CNPS 1B
Lepidium nitidum	shining peppergrass	NAH	No		
Lobularia maritima	sweet alyssum	EPH	Yes		
Raphanus raphanistrum	wild radish	EAPH			
Raphanus sativus	wild radish	EAPH	Yes		
Rorripa nasturium-aquaticum	white watercress	NPH	Yes	OBL	
Sibara virginica	Virginia rockcress	NAPH	Yes		
Sinapis arvensis	field charlock	EAH	No		
Sisymbrium irio	London rocket	EAH	No		
Sisymbrium officinale	hedge mustard	EAH	Yes		
Sisymbrium orientale	hare's ear cabbage	EAH	No		
Thysanocarpus curvipes var. *elegans* [4, 5]	hairy lacepod	NAH			

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Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
CACTACEAE					
Mammillaria dioica	fish-hook cactus	NPS[S]	No		
Opuntia bigelovii	teddy bear cholla	NPS[S]	No		
Opuntia californica var. *pakeri* [4]	brown spined prickly pear	NPS[S]	No		
Opuntia ficus-indica	tuna cactus	EPS[S]			
Opuntia littoralis	coastal prickly pear	NPS[S]	No		
Opuntia oricola	prickly pear	NPS[S]	No		
Opuntia parryi	valley cholla	NPS[S]	No		
Opuntia phaeacantha	tulip prickly pear	NPS[S]			
Opuntia prolifera	coastal cholla	NPS[S]	No		
Opuntia X demissa [4]	hybrid ficus indica	NPS[S]			
CALLITRICHACEAE					
Callitriche longipedunculata [4]	long stalk water starwort	NAH		OBL	
Callitriche marginata	long stalk water starwort	NAH	Yes	OBL	
CAMPANULACEAE					
Nemacladus pinnatifidus	comb-leaf threadplant	NAH	No		
Triodanis perfoliata	Venus looking glass	NAPH		FAC	
CAPPARACEAE					
Isomeris arborea	bladderpod	NPS	No		
Cleome isomeris [4]	bladderpod spiderflower	NPS			
CAPRIFOLIACEAE					
Lonicera subspicata var *denudata*	southern honeysuckle	NPVS	Yes		
Sambucus mexicana	desert elderberry	NPST	Yes		
Sambucus nigra var. *canadensis* [4]	common elderberry	NPST		FACU	
Symphoricarpos mollis	spreading snowberry	NPS	No		
CARYOPHYLLACEAE					
Cardionema ramosissima	tread lightly or beach sand mat	NPH	Yes		
Cerastium glomeratum	mouse-eared chickweed	EAH	No		
Polycarpon depressum	California polycarp	NAH	Yes		
Polycarpon tetraphyllum	fourleaved allseed	EAH			
Silene antirrhina	snapdragon catchfly	NAH	Yes		
Silene gallica	common catchfly	EAH	Yes		
Silene laciniata [4]	cardinal catchfly	NPH			
Silene laciniata ssp. *major*	southern pink	NPH	Yes		
Spergularia arvensis	corn spurry	EAH	No		
Spergularia bocconii	Baccone's sand spurry	EAH	Yes		
Spergularia macrotheca var. *macrotheca*	sticky sand spurry	NPH	Yes	FAC+	
Spergularia marina	salt marsh sand spurry	NAH	No		
Spergularia rubra	ruby sand spurry	EAPH	No	FAC-	
Spergularia salina [4]	salt sandspurry	NAPH	No		
Spergularia villosa	villous sand spurry	EPH	Yes		
Stellaria media	common chickweed	EAH	Yes	FACU	

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Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
CHENOPODIACEAE					
Allenrolfea occidentalis	Iodine-bush	NPS			
Arthrocnemum subterminale [4]	Parish's glasswort	NPH	No	OBL	
Atriplex californica	California saltbush	NPH	Yes	FAC	
Atriplex canescens	shad scale	NPS		FACU	
Atriplex canescens ssp. *canescens*	shad scale	NPS	No		
Atriplex coulteri	Coulter's saltbush	NPH	No		
Atriplex lentiformis ssp. *Breweri* [4]	Brewer's saltbush	NPS	No	FAC	
Atriplex leucophylla	seascale, beach saltbush	NPH	Yes	FAC*	
Atriplex prostrata [4]	triangle oracle, spear scale	NAH			
Atriplex rosea	redscale, red saltbush	EAH	No	FACU	
Atriplex semibaccata	Australian saltbush	EPH	Yes	FAC	EPPC A-2
Atriplex triangularis	spear oracle	NAH	Yes		
Atriplex watsonii	Watson's saltbush	NPH	Yes	FACW+	
Bassia hyssopifolia	five-hook bassia	EAH	Yes	FAC	EPPC B
Beta vulgaris	garden beet	EPH	Yes	FACU	
Chenopodium album	lamb's quaters	EAH	No	FAC	
Chenopodium ambrosioides	Mexican tea	EAPH	No	FAC	
Chenopodium californicum	California goosefoot	NPH	Yes		
Chenopodium murale	nettle leaf goosefoot	EAH	Yes		
Salicornia bigelovii	dwarf saltwort	NAH			
Salicornia subterminalis	Parish's glasswort	NPH	No		
Salicornia virginica	woody glasswort	NPH	Yes	OBL	
Salsola kali [4]	Russian thistle	EAH		FACU+	
Salsola tragus	Russian Thistle	EAH	Yes		
Suaeda moquinii	Torrey's Sea-blite	NPH	No		
Suaeda taxifolia	woolly sea-blite	NPS	No		
CISTACEAE					
Helianthemum scoparium	peak rush rose	NPS	Yes		
CONVOLVULACEAE					
Calystegia macrostegia ssp.	morning glory	NPHV	Yes		
Calystegia macrostegia	island morning glory	NPHV			
Calystegia macrostegia ssp.	narrow-leaf morning glory	NPHV	Yes		
Calystegia purpurata	smooth western morning glory	NPH			
Calystegia soldanella	beach morning glory	NPH	No		
Convolvulus arvensis	common bindweed	EPHV	Yes		
Cressa truxillensis	spreading alkali weed	NPH		FACW	
Cressa truxillensis var. *vallicola* [4, 6]	alkali weed	NPH	Yes		
Dichondra occidentalis	western ponyfoot	NPH[R]	Yes		CNPS 4

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Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating [2]	Species Status [3]
CRASSULACEAE					
Crassula aquatica	crassula	NAH	Yes	OBL	
Crassula connata	pygmy weed	NAH	Yes		
Dudleya blochmaniae ssp. *blochmaniae*	Blochman's dudleya	NPH	Yes		CNPS 1B
Dudleya edulis	lady's fingers	NPH	Yes		
Dudleya lanceolata	coastal dudleya	NPH	Yes		
Dudleya multicaulis	many-stemmed dudleya	NPH	Yes		CNPS 1B
Dudleya pulverulenta	chalk lettuce	NPH	Yes		
Dudleya viscida	sticky dudleya	NPH	Yes		CNPS 1B
CUCURBITACEAE					
Cucurbita foetidissima	calabazilla	NHV	No		
Marah macrocarpus	Cucamonga manroot,	NPHV	Yes		
CUSCUTACEAE					
Cuscuta californica	witch's hair	NAHV[P]	Yes		
Cuscuta ceanothi	canyon dodder	NAHV[P]	No		
Cuscuta salina	salty dodder	NAHV[P]	No		
Cuscuta subinclusa	canyon dodder	NAHV[P]	No		
CYPERACEA					
Carex alma	sturdy sedge	NPH[G]	Yes	FACW*	
Carex lanuginosa	wooly sedge	NPH[G]	No		
Carex pellita [4]	wooly sedge	NPH[G]	No	OBL	
Carex spissa	San Diego sedge	NPH[G]	Yes	FAC	
Carex triquetra	triangular fruit sedge	NPH[G]	Yes		
Cyperus eragrostis	tall flatsedge	NPH[G]	Yes	FACW	
Cyperus erythrorhizos	red-root flatsedge	NAH[G]	No	OBL	
Cyperus esculentus	chufa flatsedge, nutsedge	NPH[G]	No	FACW	
Cyperus involucratus	umbrella plant	EPH[G]	No		
Cyperus niger	nutsedge	NPH[G]	No		
Cyperus odoratus	fragrant flatsedge	NAH[G]	No	FACW	
Eleocharis macrostachya	pale spike sedge	NPH[G]	Yes		
Eleocharis montevidensis	sand spike rush	NPH[G]	Yes	FACW	
Eleocharis palustris [4]	common spikerush	NPH[G]		OBL	
Schoenoplectus actus var.	common tule	NPH[G]	No	OBL	
Schoenoplectus americanus [4]	chairmaker's bulrush	NPH[G]	Yes	OBL	
Schoenoplectus californicu [4]	California bulrush	NPH[G]	Yes	OBL	
Scirpus acutus [4, 7]	viscid bulrush	NPH[G]	No		
Scirpus americanus	Olney's bulrush	NPH[G]	Yes		
Scirpus californicus	California bulrush	NPH[G]	Yes		
Scripus microcarpus	mountain bog bulrush, small fruit bulrush	NPH[G]	Yes		
Scripus robustus	big bulrush, big tule	NPH[G]	Yes		
DATISCACEAE					
Datisca glomerata	durango root	NPH	Yes	FACW	

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DRYOPTERIDACEAE					
Dryopteris arguta	coastal woodfern	NPF			
ELATINACEAE					
Elatine brachysperma	yerba fango	NAPH	No	FACW	
Elatine chilensis	elatine	NAPH	No	OBL	
EQUISETACEAE					
Equisetum arvense	common horsetail	NPF	Yes	FAC	
Equisetum laevigatum	smooth scouringrush	NPF	Yes	FACW	
ERICACEAE					
Arctostaphylos glandulosa	eastwood manzanita	NPS			
Arctostaphylos glandulosa ssp. *adamsii*	eastwood manzanita	NPS	Yes		
Arctostaphylos glandulosa ssp. *glandulosa*	eastwood manzanita	NPS	No		
Arctostaphylos glauca	big berry manzanita	NPST	Yes		
Arctostaphylos peninsularis [4]	peninsular manzanita	NPS			
Arctostaphylos rainbowensis	rainbow manzanita	NPS	Yes		CNPS 1B,
Comarostaphylis diversifolia ssp. *diversifolia*	summer holly	NPS	Yes		CNPS 1B
Comarostaphylis diversifolia ssp. *planifolia*	summer holly	NPS	Yes		
Xylococcus bicolor	mission manzanita	NPS	No		
EUPHORBIACEAE					
Chamaesyce micromera	Sonora sand mat	NAH	No		
Chamaesyce nutans	large spurge	EAH	Yes		
Chamaesyce polycarpa	small seed sandmat, small seeded spurge	NPH			
Chamaesyce polycarpa ssp. *polycarpa*	small-seed sandmat	NPH	Yes		
Croton californicus	California croton	NPH	Yes		
Croton californicus var. *californicus* [4]	California croton	NPH	Yes		
Croton californicus var. *tenuis* [4]	California croton	NPH	Yes		
Eremocarpus setigerus	doveweed	NAH	Yes		
Euphorbia myrsinites [4]	gopher spurge	EPH	Yes		
Euphorbia spathulata	reticulate-seed spurge	NAH	No		
Ricinus communis	castor bean	EPS	No	FACU	EPPC B
Stillingia linearifolia	linear-leaf stillingia	NPH	Yes		
FABACEAE					
Amorpha fruticosa var. *occidentalis* [4, 8]	false indigo	NPS	Yes	FAC*	
Astragalus gambelianus	Gambel's locoweed	NAH	Yes		
Astragalus pomonensis	Pomona locoweed	NPH	No		
Astragalus tener var. *titi* [9]	coastal dunes milk-vetch	NAH	No	FACW	CNPS 1B, CE, FE
Astragalus trichopodus var. *leucopsis*	ocean locoweed	NPH	Yes		

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Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
FABACEAE *(Cont'd)*					
Cytisus multiflorus	sweet white Spanish broom	EPS	No		
Hoita macrostachya	leather root	NPH	Yes		
Lathyrus laetiflorus var. *barbarae* [4, 10]	Santa Barbara sweetpea	NPH			
Lathyrus vestilus var. *alefeldii*	San Diego sweetpea	NPH	Yes		
Lathyrus vestilus var. *vestilus*	San Diego sweetpea	NPH	Yes		
Lotus argophyllus var. *argophyllus*	silver leaf lotus	NPH	Yes		
Lotus corniculatus	birdfoot trefoil	EPH	No	FAC	
Lotus hamatus	grab lotus	NAH	No		
Lotus heermannii	wooly lotus	NPH	Yes		
Lotus nuttallianus	prostrate lotus	NAH	Yes		CNPS 1B
Lotus purshianus [4, 11]	Spanish clover	NAH	Yes		
Lotus salsuginous var. *salsuginous*	alkali lotus	NAH	No		
Lotus scoparius var. *scoparius*	coastal deer weed	NPH	Yes		
Lotus strigosus [4]	strigose lotus	NAH	Yes		
Lotus strigosus var. *strigosus* [4]	strigose bird's foot trefoil, strigose lotus	NAH	Yes		
Lotus wrangelianus	calf lotus	NAH	Yes		
Lupinus albifrons	lupine	NPS			
Lupinus albifrons var. *albifrons*	lupine	NPH	Yes		
Lupinus arboreus	yellow bush lupine	NPS	No		
Lupinus bicolor var. *microphyllus* [4]	miniature lupine	NAPH	No		
Lupinus concinnus var. *agardhianus*	Agardh's lupine	NAH	No		
Lupinus excubitus var. *hallii*	grape soda lupine	NPS	No		
Lupinus hirsutissimus	stinging lupine	NAH	Yes		
Lupinus longifolius	Pauma lupine	NPS	Yes		
Lupinus polycarpus [4]	small flower lupine	NAH	Yes		
Lupinus sparsiflorus	Coulter's lupine	NAH	Yes		
Lupinus succulentus	arroyo lupine	NAH	Yes		
Lupinus truncatus	collar lupine	NAH	Yes		
Medicago polymorpha	bur clover	EAH	No		
Medicago sativa	alfalfa	EPH	No		
Melilotus alba	white sweet clover	EABH	No	FACU+	
Melilotus indica	Indian sweet clover	EAH	Yes	FAC	
Pickeringia montana var. *tomentosa*	chaparral pea	NPS	Yes		
Senna didymobotrya	senna	EPS	Yes		
Spartium junceum	Spanish broom	EPS	No		
Trifolium ciliolatum	tree clover	NAH	No		
Trifolium depauperatum var. *amplectans*	pale bladder clover	NAH	No	FAC-	
Trifolium gracilentum	pin point clover	NAH	No		
Trifolium macrocephalum	maiden clover	NPH	Yes	FACU*	
Trifolium tridentatum [4, 13]	valley clover	NAH			
Trifolium willdenovii	valley clover	NAH	Yes		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
FABACEAE *(Cont'd)*					
Vicia americana [4]	American vetch	NPHV	No	NI	
Vicia ludoviciana var. *ludoviciana*	deerpea vetch	NAH	No	NI	
Vicia villosa ssp. *varia*	winter vetch	EAHV	Yes		
FAGACEAE					
Quercus agrifolia var. *agrifolia*	coast live oak, encina	NPT	Yes		
Quercus berberidifolia	scrub oak	NPT	Yes		
Quercus dumosa	scrub oak	NPS	Yes		CNPS 1B
Quercus engelmannii	mesa blue oak or engelmann oak	NPT	Yes		
FRANKENIACEAE					
Frankenia salina	alkali heath	NPH	Yes	FACW+	
GENTIANACEAE					
Centaurium venustum	canchalagua	NAH	Yes		
GERANIACEAE					
Erodium botrys	long beake filaree	EAH	Yes		
Erodium cicutarium	red-stem filaree	EAH	Yes		
Erodium moschatum	white-stem filaree	EAH	Yes		
Geranium carolinianum	Carolina geranium	EPH	No		
Pelargonium zonale	zonal geranium	EPHS	Yes		
GROSSULARIACEAE					
Ribes indecorum	white flower current	NPS	Yes		
Ribes malvaceum	chaparral current	NPS	Yes		
Ribes malvaceum var. *viridifolium*	chaparral current	NPS	Yes		
Ribes speciosum	fuchsia-flower gooseberry	NPS	Yes		
Ribes roezlii	Sierra gooseberry	NPS	No		
HIPPOCASTANACEAE					
Aesculus californica	California buckeye	NPT	No		
HYDROPHYLLACEAE					
Emmenanthe penduliflora	whispering bells	NAH	Yes		
Eriodictyon crassifolium	coastal yerba santa	NPS	Yes		
Eucrypta chrysanthemifolia var. *chrysan themifolia*	eucrypta	NAH	Yes		
Lamium amplexicaule [4]	dead nettle	EAH	No		
Nemophila menziesii	baby blue eyes	NAH	No		
Phacelia cicutaria var. *hispida*	caterpillar phacelia	NAH	No		
Phacelia distans	wild heliotrope	NAH	No		
Phacelia grandiflora	phacelia	NAH	No		
Phacelia imbricata ssp. *imbricata*	phacelia	NPH	Yes		
Phacelia minor	wild canterbury bell	NAH	Yes		
Phacelia parryi	Parry's phacelia	NAH	Yes		
Phacelia ramosissima var. *austrolitoralis*	phacelia	NPH	No		
Phacelia ramosissima var. *latifolia*	phacelia	NPH	No		
Phacelia stellaris	phacelia	NAH			CNPS 1B

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Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
HYDROPHYLLACEAE *(Cont'd)*					
Phacelia tanacetifolia	phacelia	NAH	Yes		
Pholistoma auritum	fiesta flower	NAH	Yes		
IRIDACEAE					
Sisyrinchium bellum	western blue-eyed grass	NPH[G]	Yes		
ISOETACEAE					
Isoetes orcuttii	Orcutt's quillwort	NPF	No	OBL	
JUNCACEAE					
Juncus acutus var. *leopoldii*	southwestern spiny rush	NPH[GR]	Yes	FACW	CNPS 4
Juncus balticus	baltic rush	NPH[G]	No	OBL	
Juncus bufonius	toad rush	NAH[G]	Yes	FACW+	
Juncus dubius	dubis rush	NPH[G]	No	FACW*	
Juncus effusus var. *pacificus*	pacific rush	NPH[G]	No	FACW+	
Juncus macrophyllus	long-leaf rush	NPH[G]	No	FACW*	
Juncus mexicanus	mexican rush	NPH[G]	Yes	FACW	
Juncus rugulosus	wrinkled rush	NPH[G]	Yes	OBL	
Juncus textiles	basket rush	NPH[G]	Yes	OBL	
Juncus xiphiodes	iris-leaved rush	NPH[G]	Yes	OBL	
LAMIACEAE					
Marrubium vulgare	horehound	EPH	Yes	FAC	
Mentha arvensis	tule mint	NPH	No	FACW	
Mentha spicata [4]	spearmint	EPH	No	OBL	
Monardella hypoleuca	thick-leaved monardella	NPH	Yes		
Monardella hypoleuca ssp. *hypoleuca*	monardella	NPH	Yes		
Monardella hypoleuca ssp. *lanata*	felt-leaved rock monardella	NPH[R]			CNPS 1B
Salvia apiana	white sage	NPS	Yes		
Salvia clevelandii	fragrant sage	NPS	Yes		
Salvia columbariae	chia	NAH	Yes		
Salvia mellifera	black sage	NPS	Yes		
Salvia spathacea	pitcher sage	NPH	Yes		
Satureja chandleri	San Miguel savory	NPH			CNPS 4
Scutellaria tuberosa	Danny's skullcap	NPH	No		
Stachys ajugoides var. *rigida*	hedge nettle	NAH	Yes	OBL	
Stachys bullata	hedge nettle	NPH	Yes		
Stachys rigida var. *quercetorum* [4]	rough hedge nettle	NPH	Yes		
Stachys rigida var. *rigida* [4]	rough hedge nettle	NPH		FACW+	
Trichostema lanceolatum	vinegar weed, wooly blue curls	NAH	No		
LAURACEAE					
Umbellularia californica	California bay	NPT	No	FAC	
LEMNACEAE					
Lemna minor	common duckweed	NPH	No	OBL	

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
LILIACEAE					
Agave americana [4]	American century plant	NPS	No		
Allium haematochiton	redskin onion	NPH	Yes		
Allium peninsulare	Mexicali onion	NPH	Yes		
Allium peninsulare var. *peninsulare*	peninsula onion	NPH			
Allium praecox	early onion	NPH	No		
Asparagus asparagoides	African asparagus fern	EPV	No		
Asparagus officinalis [4]	garden asparagus	EPH	No	FACU	
Bloomeria crocea	common goldenstar	NPH			
Bloomeria crocea var. *crocea*	common goldenstar	NPH	Yes		
Brodiaea filifolia	thread-leaved brodiaea	NPH		FAC*	CNPS 1B, CE, FE
Brodiaea jolonensis	chaparral brodiaea	NPH	Yes		
Calochortus albus	white fairy lantern	NPH	Yes		
Calochortus albus var. *albus*	white fairy lantern	NPH	Yes		
Calochortus splendens	splended mariposa lily	NPH	Yes		
Calochortus weedii	Weed's mariposa lily	NPH	Yes		
Calochortus weedii var. *weedii*	Weed's mariposa	NPH	Yes		
Chlorogalum parviflorum	small flower soap root	NPH	Yes		
Chlorogalum pomeridianum	waxy leaf soap plant	NPH	Yes		
Dichelostemma capitatum	bluedicks	NPH	Yes		
Dichelostemma capitatum ssp. *capitatum*	bluedicks	NPH	Yes		
Dichelostemma capitatum ssp. *pauciflorum*	bluedicks	NPH			
Fritillaria biflora	chocolate lily	NPH	Yes		
Lilium humboldtii ssp. *ocellatum*	Humboldt's lily	NPH	Yes		CNPS 4
Muilla maritime	common muilla	NPH	Yes		
Yucca schidigera	Mohave yucca	NPT	No		
Yucca whiipplei	chaparral yucca	NPS	Yes		
Zigadenus fremontii	Fremont's death camus	NPH	Yes		
LOASACEAE					
Mentzelia micrantha	small flowered stick-leaf	NAH	Yes		
LYTHRACEAE					
Lythrum hyssopifolia	grass poly	EAPH	Yes	FACW	
MALVACEAE					
Malacothamnus densiflorus	many-flowered mallow	NPS	No		
Malacothamnus fasciculatus	chaparral mallow	NPS	Yes		
Malva parviflora [4]	cheeseweed	EAH	Yes		
Malvella leprosa [4]	alkali mallow	NPH	Yes	FAC*	
Sidalcea malvaeflora ssp. *sparsifolia*	checker-bloom	NPH	Yes		
Sphaeralcea ambigua	apricot mallow	NPH	No		
MARSILEACEAE					
Pilularia americana	American pilwort	NPF	Yes	OBL	
MOLLUGINACEAE					
Glinus lotoides	glinus	EAH	Yes	OBL	

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
MYOPORACEAE					
Myoporum laetum	myoporum	EPTS	Yes		EPPC A-2
NYCTAGINACEAE					
Abronia maritima	red sand verbena	NPH	Yes		CNPS 4
Abronia umbellata	beach sand verbena	NPH	Yes		
Abronia villosa	desert sand verbena	NAH	Yes		
Abronia villosa var. *aurita*	chaparral sand verbena	NAH	Yes		
Mirabilis californica	wishbone bush	NPH	Yes		
Fraxinus velutina	velvet ash	NPT		FACW	
Fraxinus velutina var. *coriacea* [4, 14]	velvet ash	NPT	Yes		
Olea europea	olive	EPST	No		EPPC B
ONAGRACEAE					
Camissonia bistorta	southern sun cup	NAH	Yes		
Camissonia californica	false mustard	NAH	Yes		
Camissonia cheiranthifolia ssp. *suffruticosa*	beach evening primrose	NPH	Yes		
Camissonia hirtella	field sun cup	NAH	No		
ONAGRACEAE *(Cont'd)*					
Camissonia intermedia	sun cup	NAH	No		
Camissonia lewisii	sun cup	NAH	Yes		
Camissonia strigulosa	sun cup	NAH	Yes		
Clarkia bottae	punchbowl clarkia	NAH	Yes		
Clarkia delicata	campo clarkia	NAH			
Clarkia epilobioides	canyon godetia	NAH	Yes		
Clarkia purpurea ssp. *quadrivulnera*	four-spot clarkia	NAH	Yes		
Clarkia purpurea ssp. *viminea*	large clarkia	NAH	Yes		
Epilobium canum	California fuchsia	NPH			
Epilobium canum ssp. *angustifolium* [4]	California fuchsia	NPH			
Epilobium canum ssp. *canum*	California fuchsia	NPH	Yes		
Epilobium canum ssp. *latifolium*	California fuchsia	NPH	Yes		
Epilobium ciliatum ssp. *ciliatum*	willow herb	NPH	No	FACW	
Epilobium densiflorum	dense boisduvalia	NAH			
Epilobium pygmaeum	smooth boisduvalia	NAH	No		
Ludwigia peploides ssp. *peploides*	willow water weed	NPH	No	OBL	
Oenothera californica	evening primrose	NPH	Yes		
Oenothera californica ssp. *Glabrata* [4, 15]	evening primrose	NAPH			
Oenothera elata ssp. *hirsutissima*	Great Marsh evening primrose	NPH	Yes	FACW	
OXALIDACEAE					
Oxalis albicans ssp. *californica*	California wood sorrel	NPH	Yes		
Oxalis corniculata	yellow sorrel	EPH	Yes	FACU	
Oxalis pes-caprae	Bermuda buttercup	EPH	No		

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PAEONIACEAE					
Paeonia californica	California peony	NPH	No		
PAPAVERACEAE					
Dicentra chrysantha	golden ear drops	NPH	Yes		
Eschscholzia californica	California poppy	NAPH	Yes		
Eschscholzia californica var. *peninsularis* [4, 16]	California poppy	NAPH			
Papaver californicum	fire poppy	NAH	Yes		
Platystemon californicus	cream cups	NAH	No		
Romneya coulteri	canyon matilija poppy	NPH	Yes		CNPS 4
Romneya coulteri var. *trichocalyx* [4, 17]	bristly matilija poppy	NPH			
Romneya trichocalyx	coastal matilija poppy	NPH	Yes		
PINACEAE					
Pseudotsuga macrocarpa	bigcone douglas	NPT	No		
PLANTAGINACEAE					
Plantago bigelovii	long-leaf plantain	NAH		OBL	
Plantago coronopus	cut-leaf plantain	EAH	No	FAC	
Plantago elongata	vernal pool plantain	NAH	Yes	FACW*	
Plantago erecta	dot-seed plantain	NAH	Yes		
Plantago lanceolata	English plantain	EPH	Yes	FAC-	
Plantago major	common plantain	EPH	Yes	FACW-	
Plantago ovata	woolly plantain	NAH	Yes		
PLATANACEAE					
Platanus racemosa	California sycamore	NPT	Yes	FACW	
PLUMBAGINACEAE					
Limonium californicum var. *mexicanum* [4, 18]	San Diego rosemary	NPH	No	OBL	
Limonium sinuatum	notchleaf marsh rosemary	EPH	Yes	FACW	
POACEAE					
Achnatherum coronatum	giant stipa	NPH[G]	Yes		
Agrostis exarata	spike bentgrass	NPH[G]	Yes		
Agrostis exarata var. *minor* [4, 19]	spike bentgrass	NPH[G]	Yes		
Agrostis pallens	seashore bentgrass	NPH[G]			
Aristida adscensionis	sixweeks three-awn	NAH[G]	Yes		
Aristida purpurea var. *purpurea*	purple three-awn	NPH[G]	Yes		
Aristida ternipes var. *gentilis* [4]	spidergrass	NPH[G]	Yes		
Arundo donax	giant reed	EPH[G]	Yes	FACW	EPPC A-1
Avena barbata	slender oat	EAPH[G]	Yes		
Avena fatua	wild oat	EAH[G]	No		
Bothriochloa barbinodis	cane beardgrass	NPH[G]	Yes		
Bouteloua aristidoides var. *aristidoides* [4]	needlegrama	NAH[G]			
Brachypodium distachyon	purplefalse brome	EAPH[G]			
Bromus carinatus	California brome	NAH[G]	No		
Bromus diandrus	ripgut grass	EAH[G]	Yes		
Bromus grandis	tall brome	NPH[G]	No		

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POACEAE *Cont'd)*					
Bromus hordeaceus	soft brome	EAH[G]	Yes	FACU-	
Bromus madritensis ssp. *rubens*	red brome	EAH[G]		NI	EPPC A-2
Bromus mollis [4, 20]	soft cheese brome	EAH[G]		FACU-	
Bromus rubens [4]	red brome	EAH[G]		NI	
Bromus tectorum	cheatgrass	EAH[G]	No	FACW	EPPC A-1
Cortaderia jubata	purple pampas grass	EPH[G]			EPPC A-1
Cortaderia selloana	pampas grass	EPH[G]			EPPC A-1
Crypsis schoenoides	swamp grass	EAH[G]	Yes	OBL	
Cynodon dactylon	bermuda grass	EPH[G]	Yes	FAC	
Deschampsia danthonioides	annual hairgrass	NAH[G]	No	FACW	
Deschampsia elongata	slender hairgrass	NPH[G]	Yes	FACW	
Distichlis spicata	inland saltgrass	NPH[G]		FACW*	
Echinochloa crus-pavonis	gulf cockspur grass	EAH[G]	No	OBL	
Elymus elymoides ssp. *elymoides*	squirreltail	NPH[G]	Yes		
Elymus glaucus ssp. *glaucus*	blue wild rye	NPH[G]	No	FACU	
Elymus glaucus ssp. *virescens*	Pacific wild rye	NPH[G]	No	FACU	
Elymus multisetus	big squirreltail	NPH[G]	Yes		
Gastridium ventricosum	nit grass	EAH[G]	No	FACU	
Hordeum brachyantherum	meadow barley	NPH[G]	No	FACW	
Hordeum intercedens	vernal barley	NAH[G]	Yes		
Hordeum murinum	wild barley	EAH[G]	Yes		
Hordeum marinum ssp. *gussoneanum*	Mediterranean barley	EAH[G]	No		
Hordeum murinum ssp. *glaucum*	smooth barley	EAH[G]	No		
Hordeum murinum ssp. *leporinum*	hair barley	EAH[G]	No		
Hordeum murinum ssp. glaucum	smooth barley	EAH[G]			
Hordeum pusillum [4]	little barley	NAH[G]		FACU	
Hordeum vulgare [4]	common barley	EAH(G)	Yes		
Koeleria macrantha	junegrass	NPH[G]	Yes		
Koeleria pyramidata [4, 21]	junegrass	NPH[G]			
Lamarckia aurea	goldentop	EAH[G]	Yes		
Leptochloa fusca var. *uninervia* [4]	Mexican sprangletop	NAPH[G]	Yes	FACW	
Leymus condensatus	giant wild rye	NPH[G]		FACU	
Leymus triticoides	creeping wild ryegrass	NPH[G]		FAC+	
Lolium arundinaceaum [4]	tall fescue	EPH[G]	No	FAC-	
Lolium multiflorum	Italian ryegrass	EABH[G]	Yes		
Lolium perenne	English ryegrass	EPH[G]	Yes	FAC*	
Melica frutescens	tall melic	NPH[G]			
Melica imperfecta	small-flowered melica	NPH[G]	Yes		
Monanthocloe littoralis	shoregrass, keygrass	NPH[G]		OBL	
Muhlenbergia microsperma	littleseed muhly	NAH[G]	Yes		
Muhlenbergia rigens	California deergrass	NPH[G]	Yes	FACW	

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POACEAE *Cont'd)*					
Nasella cernua	nodding needlegrass	NPH[G]			
Nasella lepida	smallflower needlegrass	NPH[G]			
Nasella pulchra	purple needlegrass	NPH[G]			
Panicum capillare	capillare witchgrass	NAH[G]			
Parapholis incurva	sickle grass	EAH[G]	Yes	OBL	
Paspalum dilatalum	dallis grass	EPH[G]	Yes	FAC	
Paspalum distichum	knot grass	NPH[G]		OBL	
Pennisetum setaceum	Crimson fountaingrass, fountaingrass	EPH[G]	Yes		EPPC A-1
Phalaris lemmonii	Lemmon's canary grass	NAH[G]	No	FACW-	
Piptatherum miliaceum	smilograss	EPH[G]	No		
Poa annua	annual bluegrass	EAH[G]	No	FACW-	
Poa pratensis	Kentucky bluegrass	EPH[G]	No	FACU	
Poa secunda	sandberg bluegrass	NPH[G]	No		
Polypogon monspeliensis	annual rabbitsfoot grass	NAH[G]	Yes	FACW+	
Rhynchelytrum repens	natal grass	EPH[G]	No		
Schismus barbatus	mediterranean grass	EAH[G]	Yes		
Sorghum halepense	johnsongrass	EPH[G]	No	FACU	
Vulpia bromoides	brome fescue	EAH[G]	Yes	FACW	
Vulpia myuros	rattail fescue	EAH[G]	Yes	FACU*	
Vulpia myuros var. *hirsuta*	foxtail fescue	EAH[G]	Yes		
Vulpia myuros var. *myuros*	rattail fescue	EAH[G]	Yes		
Vulpia octoflora var. *hirtella*	tufted fescue	NAH[G]	Yes		
Vulpia octoflora var. *octoflora*	slender fescue	NAH[G]	Yes		
POLEMONIACEAE					
Allophyllum giliodes ssp. *violaceum*	violet false gilia	NAH	No		
Allophyllum glutinosum	blue false gilia	NAH	Yes		
Eriastrum sapphirinum	sapphire wooly-star	NAH	Yes		
Eriastrum sapphirinum ssp. *dasyanthum* [4]	sapphire wooly-star	NAH			
Gilia angelensis	grassland gilia	NAH	Yes		
Gilia capitata	bluefield gilia, ball gilia	NAH	Yes		
Gilia capitata ssp. *abrotanifolia*	ball gilia	NAH	Yes		
Linanthus dianthiflorus	ground pink	NAH	Yes		
POLEMONIACEAE *(Cont'd)*					
Linanthus liniflorus ssp. *pharnaceoides* [4]	Great Basin linanthus	NAH	Yes		
Linanthus parviflorus	coast baby-star	NAH	Yes		
Navarretia atractyloides	hollyleaf pincusion plant, skunkwell	NAH			
Navarretia fossalis	Moran's skunkweed	NAH	Yes	OBL	CNPS 1B, FT
Navarretia hamata	skunkweed	NAH	Yes		
POLYGALACEAE					
Polygala cornuta var. fishiae	Fishe's Milkwort	NAS	Yes		CNPS 4

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POLYGONACEAE					
Chorizanthe fimbriata	fringed spineflower	NAH	Yes		
Chorizanthe procumbens	prostrate spineflower	NAH	Yes		CNPS 4
Chorizanthe procumbens var. *albiflora* [4, 22]	palaspine flower	NAH			CNPS 4
Chorizanthe staticoides	Turkish rugging	NAH	Yes		
Chorizanthe staticoides ssp. *chrysacantha* [4, 23]	Turkish rugging	NAH			
Eriogonum elongatum [4]	tall buckwheat	NPH	Yes		
Eriogonum fasciculatum var. *fasciculatum*	flat-top buckwheat	NPS	Yes		
Eriogonum parvifolium	bluff buckwheat	NPS	Yes		
Eriogonum thurberi	Thurber's buckwheat	NAH	No		
Lastarriaea coriacea	lastarriaea	NAH	Yes		
Nemacaulis denudata var. *denudata*	coast wooly heads	NAH	Yes		
Polygonum arenastrum	yard knotweed	EAPH	Yes		
Polygonum argyrocoleon	Persian wireweed	EAH	Yes	FAC+	
Polygonum lapathifolium	willow smartweed	NAH	No	OBL	
Polypodium californicum [4]	California polypody	NPH			
Pterostegia drymarioides	granny's hairnet	NAH	Yes		
Rumex conglomeratus	whorled dock	EPH	No	FACW	
Rumex crispus	curly dock	EPH	No	FACW-	
Rumex hymenosepalus	canaigre, wild rhubarb	NPH	Yes		
Rumex maritimus	golden dock	NAPH	No		
Rumex salicifolius var. *salicifolius*	willow dock	NPH	Yes	OBL	
POLYPODIACEAE					
Polypodium californicum	California polypody	NPF	Yes		
PORTULACACEAE					
Calandrinia breweri	Brewer's calandrinia	NAH	No		CNPS 4
Calandrinia cilliata var. *menziesii* [4, 24]	red maids	NAH	Yes	FACU*	
Calandrinia maritima	seaside calandrinia	NAH	No		CNPS 4
Claytonia perfoliata	miner’s lettuce	NAH	Yes	FAC	
Claytonia perfoliata ssp. *perfoliata*	miner's lettuce	NAH	Yes		
Portulaca oleracea	common purslane	EAH	No	FAC	
POTAMOGETONACEAE					
Stuckenia pectinatus [4]	fennel-leaf pondweed	NPH	Yes		
PRIMULACEAE					
Anagallis arvensis	scarlet pimpernel	EAH	Yes	FAC	
Anagallis minima	chaffweed	NAH			
Centunculus minimus	common chaffweed	NAH	Yes		
Dodecatheon clevelandii ssp. *clevelandii*	Padre's shooting star	NPH	Yes		
Samolus parviflorus	water pimpernel	NPH	Yes	OBL	

Plant Species on MCB Camp Pendleton

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PTERIDACEAE					
Adiantum capillus-veneris	southern maiden hair	NPF	Yes	FACW	
Adiantum jordanii	California maiden hair	NPF	Yes		
Aspidotis californica	California lacefern	NPF	Yes		
Cheilanthes newberryi	California cottonfern	NPF	Yes		
Pellaea andromedifolia	coffee cliffbrake	NPF	Yes		
Pellaea mucronata	bird's foot cliffbrake	NPF	Yes		
Pentagramma triangularis	pityrogramma	NPF	Yes		
Pentagramma triangularis ssp. *triangularis*	California gold-back fern	NPF	Yes		
Pentagramma triangularis ssp. *viscosa*	silverback fern, sticky gold-back fern	NPF	No		
Pteridium aquilinium var. *pubescens* [4]	hairy bracken fern	NPF	Yes	FACU	
RANUNCULACEAE					
Clematis lasiantha	pipestem virgin's bower	NPHV	No		
Clematis ligusticifolia	yerba de chivato	NPHV	No	FAC	
Clematis pauciflora	small-leaf virgin's bower	NPHV	Yes		
Delphinium cardinale	scarlet larkspur	NPH	Yes		
Delphinium parryi	Parry's larkspur	NPH	Yes		
Myosurus minimus ssp. *apus*	mouse-tail	NAH	Yes	OBL	CNPS 3
Ranunculus aquatilis var. *capillaceus*	hairleaf water buttercup	NPH	Yes	FAC	
Ranunculus californicus	California buttercup	NPH	Yes	FAC	
Ranunculus trichophyllus var. *trichophyllus* [4, 25]	threadleaf crowfoot	NPH	Yes	OBL	
Thalictrum fendleri var. *polycarpum*	common meadow rue	NPH	Yes	FACU	
RHAMNACEAE					
Adolphia californica	California spinebush	NPS	No		
Ceanothus crassifolius	thick-leaf wild lilac	NPS	Yes		
Ceanothus leucodermis	whitebark lilac	NPS	No		
Ceanothus oliganthus	hairy ceanothus	NPS	Yes		
Ceanothus spinosus	greenbark lilac	NPST	Yes		
Ceanothus tomentosus	Ramona lilac	NPS	No		
Frangula californica var. *californica* [4]	California coffeeberry	NPST	Yes		
Frangula californica var. *tomentalla* [4]	California coffeeberry	NPST	Yes		
Rhamnus californica ssp. *californica*	California coffeeberry	NPS	Yes		
Rhamnus crocea	spiny redberry	NPS	Yes		
Rhamnus ilicifolia	holly-leaf redberry	NPS	Yes		
Rhamnus tomentella	chaparral coffeeberry	NPS	Yes		

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ROSACEAE					
Adenostoma fasciculatum	chamise	NPT	Yes		
Aphanes occidentalis	western lady's mantle	NAPH	No		
Cercocarpus betuloides var. *betuloides*	interior mountain-mahogany	NPST	No		
Cercocarpus minutiflorus	San Diego mountain-mahogany	NPS	Yes		
Cercocarpus montanus var. *glaber* [4,26]	birchleaf mountain-mahogany	NPST	No		
Cercocarpus montanus var. *minutiflorus* [4,27]	smooth mountain-mahogany	NPS	Yes		
Chamaebatia australis	southern mountain misery	NPS	No		CNPS 4
Heteromeles arbutifolia	christmas berry, toyon	NPS	Yes		
Horkelia cuneata ssp. *cuneata*	wedgeleaf horkelia	NPH	Yes		CNPS 1B
Horkelia cuneata ssp. *puberula*	mesa horkelia	NPH	Yes		
Horkelia truncata	Ramona Horkelia	NPH	Yes		CNPS 1B
Potentilla glandulosa	sticky cinquefoil	NPH	Yes		
Potentilla glandulosa ssp. *glandulosa*	sticky cinquefoil	NPH	Yes		
Prunus ilicifolia	holly-leaf cherry	NPST	Yes		
Rosa californica	California rose	NPS	Yes	FAC+	
Rubus ursinus	California blackberry	NPSV	Yes		
RUBIACEAE					
Galium angustifolium	narrow-leaf bedstraw	NPH	Yes		
Galium angustifolium ssp. *angustifolium*	narrow-leaf bedstraw	NPH	Yes		
Galium aparine	common bedstraw	EAH	Yes	FACU	
Galium nuttallii	climbing bedstraw, San Diego bedstraw	NPH	Yes		
Galium nuttallii ssp. *nuttallii*	Nuttall's bedstraw	NPH	Yes		
RUTACEAE					
Cneoridium dumosum	coast spice bush	NPS	Yes		
SALICACEAE					
Populus balsamifera ssp. *trichocarpa*	black cottonwood	NPT	Yes	FACW	
Populus fremontii ssp. *fremontii*	Fremont's cottonwood	NPT	No	FAC+*	
Salix exigua	sand bar willow	NPST	No	OBL	
Salix gooddingii	southwestern willow	NPT	Yes	OBL	
Salix laevigata	red willow	NPT	No	FACW+	
Salix lasiolepis var. *lasiolepis* [4]	arroyo willow	NPT	No	FACW	
Salix lucida ssp. *lasiandra*	shining willow	NPT	Yes	NI	
SAURURACEAE					
Anemopsis californica	yerba mansa	NPH	Yes	OBL	
SAXIFRAGACEAE					
Jepsonia parryi	coast jepsonia	NPH	No		
Lithophragma affine	woodland-star	NPH	Yes		
Lithophragma affine var. *affine* [4]	coast paint brush	NPH	Yes		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
SCROPHULARIACEAE					
Antirrhinum coulterianum	snapdragon	NAH	No		
Antirrhinum kelloggii	climbing snapdragon	NAH	No		
Antirrhinum nuttallianum	Nuttall's snapdragon	NAPH	Yes		
Castilleja affinis	Indian paintbrush	NPH	Yes		
Castilleja affinis ssp. *affinis*	coast paint-brush	NPH	Yes		
Castilleja exserta	red owl's clover	NAH	Yes		
Castilleja foliolosa	felt paint-brush	NPH	Yes		
Castilleja minor	California thread-torch	NAH	No	OBL	
Collinsia heterophylla	purple Chinese houses	NAH	Yes		
Cordylanthus maritimus	saltmarsh bird’s beak	NAH	Yes	OBL	CNPS 1B
Cordylanthus maritimus ssp. *maritmus*	bird's beak	NAH[HP]	No		
Cordylanthus rigidus	stiffbranch bird’s beak	NAH			
Cordylanthus rigidus ssp. *brevibracteatus*	dark-tip bird's beak	NAH	No		
Cordylanthus rigidus ssp. *rigidus*	stiffbranch bird’s beak	NAH			
Cordylanthus rigidus ssp. *setigerus*	dark-tip bird's beak	NAH	Yes		
Diplacus aurantiacus [4]	orange bush monkey flower	NPH			
Keckiella antirrhinoides [4]	yellow bush penstemon	NPS	No		
Keckiella cordifolia	climbing bush penstemon	NPS	Yes		
Linaria canadensis var. *texana*	blue toadflax	NAPH	Yes		
Linaria maroccana	toadflax	EAH	Yes		
Mimulus aurantiacus	bush monkey flower	NPS	Yes		
Mimulus brevipes	slope semiphore	NAH	Yes		
Mimulus cardinalis	scarlet monkey flower	NPH	Yes	OBL	
Mimulus guttatus	seep monkey flower	NAPH[R]	No	OBL	
Mimulus puniceus	red bush monkey flower	NPS			
Neogaerrhinum strictum [4]	Kellogg’s snapdragon	NAVH	No		
Pedicularis densiflora	Indian warrior	NPH	Yes		
Penstemon centranthifollius	scarlet bugler	NPH	Yes		
Penstemon heterophyllus var. *australis*	chaparral penstemon	NPH	Yes		
Penstemon spectabilis	showy penstemon	NPH	Yes		
Sairocarpus coulterianus [4]	snapdragon	NAVH	No		
Sairocarpus nuttallianus [4]	Nuttall’s snapdragon	NABH	Yes		
Scrophularia californica	California fig wort	NPH	Yes	FAC	
Scrophularia californica ssp. *floribunda*	California bee plant	NPH	Yes	FAC	
Verbascum thapsus	common mullein	EPH	No		
Veronica anagallis-aquatica [4]	water speedwell	EBPH	No	OBL	
Veronica peregrina [4]	neckweed, Mexican speedwell	NAH	Yes	OBL	
Veronica peregrina ssp. *xalapensis* [4]	Mexican speedwell	NAH	Yes		

Plant Species on MCB Camp Pendleton

Family - Genus species	Common Name	Form [1]	Herbarium	Wetland Indicator Rating[2]	Species Status [3]
SELAGINELLACEAE					
Selaginella bigelovii	Bigelow's mossfern	NPF	No		
Selaginella cinerascens	ashy spike moss	NPF[R]	Yes		CNPS 4
SIMAROUBACEAE					
Ailantus altissima	tree of heaven	EPT		FACU	EPPC A-2
SOLANACEAE					
Datura stramonium	Jimsonweed	EAH			
Datura wrightii	Jimsonweed	NPH	Yes	FAC	
Lycium californicum	California desert thorn	NPS	No		
Nicotiana attenuata	coyote tobacco	NAH	No	FAC	
Nicotiana clevelandii	Cleveland's tobacco	NAH	Yes		
Nicotiana glauca	tree tobacco	EPST	Yes	FAC	
Physalis crassifolia	Greene's ground cherry	NAPH	Yes		
Physalis crassifolia var. *crassifolia* [4]	yellow nightshade groundcherry	NAPH	Yes		
Physalis lancifolia	lance-leaf ground cherry	EAH	No		
Solanum americanum	common nightshade	NAPH			
Solanum douglasii	Douglas' nightshade	NPH	Yes	FAC	
Solanum nigrum	black nightshade	EAH	Yes	FACU	
Solanum parishii	Parish's nightshade	NPS	Yes		
Solanum xanti	chaparral nightshade	NPHS	Yes		
Solanum xanti var. *intermedium* [4]	chaparral nightshade	NPHS	Yes		
STYRACACEAE					
Styrax officinalis var. *fulvescens* [4, 28]	snowdrop bush	NPS	Yes		
Styrax officinalis var. *redivivus*	snowdrop bush	NPS	Yes		
TAMARICACEAE					
Tamarix parviflora	Tamarisk	EPST	No	FAC	EPPC A-1
TYPHACACEAE					
Typha domingensis	southern cattail	NPH	Yes	OBL	
Typha latifolia	broad-leaf cattail	NPH	No	OBL	
URTICACEAE					
Hesperocnide tenella	western nettle	NAH	Yes		
Parietaria hespera var. *californica*	western pellitory	NAH	No		
Urtica dioica ssp. *holosericea*	hoary nettle	NPH	No	FACW	
Urtica urens	dwarf nettle	EAH	No		
VERBENACEAE					
Verbena bracteata	bract vervain	NAPH	Yes	FACW	
Verbena lasiostachys	western vervain	NPH	Yes	FAC-	
VIOLACEAE					
Viola pedunculata	Johnny jump-up	NPH	Yes		
VISCACEAE					
Phoradendron macrophyllum	big-leaf mistletoe	NPS[P]	No		
Phoradendron villosum	oak mistletoe	NPS[P]	No		
VITACEAE					
Vitis girdiana	desert grape	NPVS	Yes		

1 Form: (N) Native, (E) Exotic, (P) Perennial, (B) Biennial, (A) Annual, ([G]) Grass, (H) Herb, (V) Vine, (F) Fern, (S) Shrub, (T) Tree, ([P]) Parasitic, ([HP]) Hemiparasitic, ([R]) Rhizomatic, ([S]) Succulent.

2 Wetland Indicator Rating: (OBL) Obligate Wetland, occur almost always (estimated >99%) under natural conditions in wetlands; (FACW) Facultative Wetland, usually occur in wetlands (estimated probability 67-99%), but occasionally found in nonwetlands; (FAC) Facultative, equally likely to occur in wetlands or nonwetlands (estimated probability 43-66%); (FACU) Facultative Upland, usually occur in nonwetlands (estimated probability 67-99%), but occasionally found in wetlands (estimated probability (1-33%); (UPL) Obligate Upland, occur in wetlands in another region, but occur almost always (estimated probability >99%) under natural conditions in nonwetlands in the region specified (California). If a species does not occur in welands in any region, it is not on the National List. The three facultative categories are subdivided by positive (+) and negative (-) modifiers to more specifically define the regional frequency of occurrence in wetlands; (+) indicates more frequently and (-) indicates less frequently found in wetlands. An asterisk (*) identifies tentative assignments based on limited information from which to determine the indicator status. “No indicator” (NI) is recorded for those species for whic (NI) is recorded for those species for which insufficient information was available to determine an indicator status or that were not considered by the Regional Interagency Review Panel. For additional information and most current plant list see the USFWS National Wetland Inventory Center website (http://www.nwi.fws.gov).

3 Species Status: The following codes indicate whether a species has been included on a federal, state (California), and/or California Native Plant Society (CNPS) list as rare, candidate, etc. If a species does not appear on any of the lists, the Species Status field is left blank.

- For federal candidate and listed plants: (FE) federally listed, endangered; (FT) federally listed, threatened; (FC) federally listed, candidate; (FPE) federally proposed, endangered; (FPT) federally proposed, threatened.
- For state listed plants: (CE) state listed, endangered; (CR) state listed, rare; (CT) state listed, threatened.
- For CNPS list codes: (1A) species presumed extinct; (1B) species rare, threatened, or endangered in California and elsewhere; (2) species rare, threatened, or endangered in California but which are more common elsewhere; (3) species for which more information is needed; (4) a watch list of species of limited distribution.
- For exotic pest plant council (EPPC); (EPPC A) Most inasive Wildland pest plants; documented as aggressive invaders that displace natives and disrupt natural habitats. Includes tow sub-lists: (EPPC A-1) Wide spread pests that are invasive in more than 3 Jepson regions; (EPPC A-2) Regional pests invasive in 3 or fewer Jepson regions; (EPPC A-2) Regional pests invasive in 3 or fewer Jepson regions; (EPPC B): Wildland pest plants of lesser invasiveness; invasive pest plants that spread less rapidly and cause a lesser degree of habitat disruption; may be wide-spread or regional. For additional information and most current California exotic pest plant list see the California Exotic Pest Plant Council website (http://www.caleppc.org/info/plantlist.html).

4 Source (USDA, NRCS 2001)

5 Thysanocarpus curvipes var. elegans syn. for Thysanocarpus curvipes

6 Cressa truxillensis var. vallicola syn. for Cressa truxillensis

7 Scirpus acutus syn. for Schoenoplectus acutus var. acutus

8 Amorpha fruticosa var. occidentalis syn. for Amorpha fruticosa

9 Historically present, but not found in recent (> 20 years ago) surveys

10 Lathyrus laetiflorus var. barbarae syn. for Lathyrus vestitus var. alefeldii

11 Lotus purshianus syn. for Lotus unifoliotatus var. unifoliotatus

12 Lupinus concinnus var. agardhianus syn. for Lupinus agardhianus

13 Trifolium tridentatum syn. for Trifolium willdenowii

14 Fraxinus velutina var. coriacea syn. for Fraxinus velutina

15 Oenothera californica ssp. glabrata syn. for Oenothera californica var. californica

16 Eschscholzia californica var. peninsularis syn. for Eschscholzia californica var. californica

17 Romneya coulteri var. trichocalyx syn. for Romneya trichocalyx

18 Limonium californicum var. mexicanum syn for Limonium californicum

19 Agrostis exarata var. minor syn. Agrostis exarata

20 Bromus mollis syn. for Bromus hordeaceus var. hordeaceus

21 Koeleria pyramidata syn. for Koleria macrantha

22 Chorizanthe procumbens var. albiflora syn. for Chorizanthe procumbens

23 Chorizanthe staticoides ssp. chrysacantha syn. for Chorizanthe staticoides

24 Calandrinia cilliata var. menziesii syn. for Calandrinia cilliata

25 Ranunculus trichophyllus var. trichophyllus syn. for Ranunculus aquatilis capillaceus

26 Cercocarpus montanus var. glaber syn. for Cercocarpus betuloides

27 Cercocarpus montanus var. minutiflorus syn. for Cercocarpus minutiflorus

28 Styrax officinalis var. fulvescens syn. for Styrax rediviva

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APPENDIX F
WILDLIFE SPECIES ON CAMP PENDLETON

All species are listed by taxanomic class. For amphibians, birds, mammals, and reptiles, the scientific and common names, families, and species status were confirmed using the California Wildlife Habitat Relationships System (CDFG 1999), the California Natural Diversity Database (CDFG 2005) and Nature Serve Explorer 2006. Information on the remaining classes was confirmed using various resources including the Camp Pendleton Wildlife Database (June 2000). The wildlife species listed have been included in sightings or surveys on Base, however, their occurrence may require confirmation. This list is not expected to be comprehensive.

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Amphibia				
Arboreal Salamander	Plethodontidae	*Aneides lugubris*	Native	
Pacific Slender Salamander	Plethodontidae	*Batrachoseps pacificus major*	Native	CSSC
Garden Slender Salamander	Plethodontidae	*Batrachoseps major*	Native	
Western (California) Toad	Bufonidae	*Bufo boreas halophilus*	Native	
Arroyo Toad	Bufonidae	*Bufo californicus*	Native	FE, CP, CSSC
Monterey Salamander	Plethodontidae	*Ensatina eschscholtzii eschscholtzii*	Native	
California Treefrog		*Pseudacris cadaverina*	Native	
Pacific Chorus Frog	Hylidae	*Pseudacris regilla*	Native	
California Red-legged Frog [2]	Ranidae	*Rana aurora draytonii*	Native	FT, CP, CSSC, USFS
Bullfrog	Ranidae	*Rana catesbeiana*	Exotic	H
Western Spadefoot toad	Pelobatidae	*Spea hammondi*	Native	CP, CSSC
Coast Range Newt	Salamandridae	*Taricha torosa torosa*	Native	CSSC
Class Anopla				
Ribbon worm	Lineidae	*Cerebratulus sp.*	Native	
Class Arachnida				
Hunting Spider	Agelenidae	*Agelenopsis aperta*	Native	
Funnel Web Spider	Agelenidae	*Blabomma sancta*	Native	
Web Spinning Spider	Agelenidae	*Blabomma sp.*	Native	
Hunting Spider	Agelenidae	*Calilena gosoga*	Native	
Hunting Spider	Agelenidae	*Calilena stylophora*	Native	
Hunting Spider	Agelenidae	*Calymmaria monicae*	Native	
Hunting Spider	Agelenidae	*Circurina utahana*	Native	
Hunting Spider	Agelenidae	*Hololena dana*	Native	
Hunting Spider	Agelenidae	*Rualena balboae*	Native	
Hunting Spider	Agelenidae	*Yorima angelica*	Native	
Hackled Band Weaver Spider	Amaurobiidae	*Metaltella simoni*	Native	
Running Spider	Anyphaenidae	*Aysha incursa*	Native	
Running Spider	Anyphaenidae	*Teudis mordax*	Native	
Orb Weaver	Araneidae	*Araneus andrewsi*	Native	
Ariel Web Spider	Araneidae	*Araneus bispinosus*	Native	
Orb Weaver	Araneidae	*Araneus detrimentosus*	Native	
Garden Spider	Araneidae	*Araneus pegnia*	Native	
Garden Spider	Araneidae	*Argiope argentata*	Native	
Orb Weaver	Araneidae	*Argiope blanda*	Native	
Orb Weaver	Araneidae	*Argiope trifasciata*	Native	
Orb Weaver	Araneidae	*Corinna bajula*	Native	
Garden Spider	Araneidae	*Cyclosa turbinata*	Native	
Garden Spider	Araneidae	*Eustala californiensis*	Native	
Orb Weaver	Araneidae	*Eustala conshlea*	Native	
Orb Weaver	Araneidae	*Gea heptagon*	Native	
Garden Spider	Araneidae	*Hypsosingafunebris*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Arachnida *cont.*				
Orb Weaver	Araneidae	*Larina directa*	Native	
Orb Weaver	Araneidae	*Meriola decepta*	Native	
Labyrinth Spider	Araneidae	*Metepeira crussipes*	Native	
Running Spider	Clubionidae	*Agroeca trivittata*	Native	
Running Spider	Clubionidae	*Anachemmis sp.*	Native	
Running Spider	Clubionidae	*Castianeira occidens*	Native	
Running Spider	Clubionidae	*Castianeira thalia*	Native	
Running Spider	Clubionidae	*Cheiracastrium inclusum*	Native	
Running Spider	Clubionidae	*Cyspira eclectica*	Native	
Running Spider	Clubionidae	*Drassinella gertschi*	Native	
Running Spider	Clubionidae	*Liocranoides dolichopus*	Native	
Running Spider	Clubionidae	*Phrurotimpus borealis*	Native	
Running Spider	Clubionidae	*Scotinella kastoni*	Native	
Running Spider	Clubionidae	*Syspira tigrina*	Native	
Running Spider	Clubionidae	*Trachelas sp.*	Native	
Funnel Web Spider	Cybaeidae	*Cybeaus sp.*	Native	
Trap-door Spider	Cytaucheniidae	*Aptosticus sp.*	Native	
Orb Weaver Spider	Dictynidae	*Dictyna abundans*	Native	
Orb Weaver Spider	Dictynidae	*Dictyna agressa*	Native	
Orb Weaver Spider	Dictynidae	*Dictyna cholla*	Native	
Orb Weaver Spider	Dictynidae	*Dictyna completa*	Native	
Orb Weaver Spider	Dictynidae	*Dictyna serena*	Native	
Hackled Band Weaver Spider	Dictynidae	*Emblyna consulta*	Native	
Hackled Band Weaver Spider	Dictynidae	*Emblyna hoya*	Native	
Hackled Band Weaver Spider	Dictynidae	*Emblyna serena*	Native	
Orb Weaver Spider	Dictynidae	*Tricholathys jacinto*	Native	
Orb Weaver Spider	Dictynidae	*Tricholathys monterea*	Native	
Tube Weaver Spider	Diguetidae	*Diguetia canities*	Native	
Primative Hunter Spider	Dysteridae	*Dystera crocata*	Native	
Filistatids Spider	Filistatidae	*Filistatinellas sp.*	Native	
Filistatids Spider	Filistatidae	*Kukulcania sp.*	Native	
Running Spider	Gnanphosidae	*Micaria jeanae*	Native	
Running Spider	Gnanphosidae	*Sergiolus montanus*	Native	
Running Spider	Gnaphosidae	*Callilipes eremella*	Native	
Running Spider	Gnaphosidae	*Callilipes gosoga*	Native	
Running Spider	Gnaphosidae	*Cesonia trivittata*	Native	
Running Spider	Gnaphosidae	*Drassyllus conformans*	Native	
Running Spider	Gnaphosidae	*Drassyllus fractus*	Native	
Running Spider	Gnaphosidae	*Drassyllus insularis*	Native	
Running Spider	Gnaphosidae	*Drassyllus lamprus*	Native	
Running Spider	Gnaphosidae	*Drassylus salton*	Native	
Running Spider	Gnaphosidae	*Gnaphosa californica*	Native	
Running Spider	Gnaphosidae	*Haplodrussus maculatus*	Native	
Parson Spider	Gnaphosidae	*Herpyllus gertschi*	Native	
Running Spider	Gnaphosidae	*Micaria deserticola*	Native	
Running Spider	Gnaphosidae	*Micaria icenogglei*	Native	
Running Spider	Gnaphosidae	*Micaria utahana*	Native	
Running Spider	Gnaphosidae	*Nodocion sp.*	Native	
Running Spider	Gnaphosidae	*Sergiolus angustus*	Native	
Running Spider	Gnaphosidae	*Sergiolus gertschi*	Native	
Running Spider	Gnaphosidae	*Trachyzelotes lyonetti*	Native	
Running Spider	Gnaphosidae	*Urozelotes rusticus*	Native	
Running Spider	Gnaphosidae	*Zelotes gabriel*	Native	
Running Spider	Gnaphosidae	*Zelotes gynethus*	Native	
Running Spider	Gnaphosidae	*Zelotes monachus*	Native	
Running Spider	Gnaphosidae	*Zelotes nilicola*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Arachnida *cont.*				
Hunting Spider	Hahniidae	*Neoantistea santana*	Native	
Crab Spider	Heteropodidae	*Olios schistus*	Native	
Sheet-web Weaver	Linyphiidae	*Ceraticelus phylax*	Native	
Sheet-web Spider	Linyphiidae	*Ceraticelus sp.*	Native	
Sheet-web Spider	Linyphiidae	*Erigone dentosa*	Native	
Sheet-web Spider	Linyphiidae	*Frontinella pyramitela*	Native	
Sheet-web Spider	Linyphiidae	*Idionella nesiotes*	Native	
Sheet-web Weaver	Linyphiidae	*Idionella sclerata*	Native	
Sheet-web Weaver	Linyphiidae	*Linyphantes aliso*	Native	
Sheet-web Spider	Linyphiidae	*Meioneta sp.*	Native	
Sheet-web Weaver	Linyphiidae	*Microlinyphia mandibulata punctata*	Native	
Sheet-web Spider	Linyphiidae	*Spirembolus erratus*	Native	
Sheet-web Spider	Linyphiidae	*Spirembolus monicus*	Native	
Sheet-web Spider	Linyphiidae	*Spirembolus monticolens*	Native	
Sheet-web Weaver	Linyphiidae	*Spirembolus pusillus*	Native	
Sheet-web Weaver	Linyphiidae	*Spirembolus tortuosus*	Native	
Running Spider	Liocranidae	*Phrurotimpus mateonus*	Native	
Wolf Spider	Lycosidae	*Alopecosa kochii*	Native	
Wolf Spider	Lycosidae	*Pardosa californica*	Native	
Wolf Spider	Lycosidae	*Pardosa hyperborea*	Native	
Wolf Spider	Lycosidae	*Pardosa sierra*	Native	
Wolf Spider	Lycosidae	*Pardosa sternatis*	Native	
Wolf Spider	Lycosidae	*Schizocosa mccooki*	Native	
Atypical Tarantula	Mecicobothriidae	*Megahexura fulva*	Native	
Atypical Tarantula	Micicobothriidae	*Hexurella rupicola*	Native	
Sheet-Web Weaver	Mimetidae	*Mimetus hesperus*	Native	
Aerial Web Spider	Mimetidae	*Mimetus sp.*	Native	
Running Spider	Miturgidae	*Syspira synthetica*	Native	
Hackled Band Weaver Spider	Oecobiidae	*Oecobius annulipes*	Native	
Primitive Weaver Spider	Oonopidae	*Opopaea bandidina*	Native	
Primitive Weaver Spider	Oonopidae	*Orchestina sp.*	Native	
Primitive Weaver Spider	Oonopidae	*Scaphiella hesperus*	Native	
Lynx Spider	Oxyopidae	*Oxyopes salticus*	Native	
Lynx Spider	Oxyopidae	*Oxyopes scalaris*	Native	
Lynx Spider	Oxyopidae	*Oxyopes tridens*	Native	
Lynx Spider	Oxyopidae	*Peucetia viridans*	Native	
Crab Spider	Philodromidae	*Apollophanes texanus*	Native	
Crab Spider	Philodromidae	*Ebo mexicanus*	Native	
Crab Spider	Philodromidae	*Philodromus chamisis*	Native	
Crab Spider	Philodromidae	*Philodromus gertschi gertschi*	Native	
Crab Spider	Philodromidae	*Philodromus quercicola*	Native	
Crab Spider	Philodromidae	*Tibellus chamberlini*	Native	
Primitive Weaver Spider	Pholicidae	*Pholcophora americana*	Native	
Primitive Weaver Spider	Pholicidae	*Psilochorus sp.*	Native	
Primitive Weaver Spider	Plectreuridae	*Plectreueys conifera*	Native	
Jumping Spider	Salticidae	*Eris sp.*	Native	
Jumping Spider	Salticidae	*Habronattus californicus*	Native	
Jumping Spider	Salticidae	*Habronattus elegans*	Native	
Jumping Spider	Salticidae	*Habronattus hirsutus*	Native	
Jumping Spider	Salticidae	*Habronattus oregonensis*	Native	
Jumping Spider	Salticidae	*Habronattus tarsalis*	Native	
Jumping Spider	Salticidae	*Habronattus tranquillus*	Native	
Jumping Spider	Salticidae	*Metacyrba taeniola*	Native	
Metaphid Jumping Spider	Salticidae	*Metaphidippus diplacis*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Arachnida *cont.*				
Metaphid Jumping Spider	Salticidae	*Metaphidippus mannii*	Native	
Metaphid Jumping Spider	Salticidae	*Metaphidippus taeniola*	Native	
Metaphid Jumping Spider	Salticidae	*Metaphidippus vitis*	Native	
Jumping Spider	Salticidae	*Peckhamia americana*	Native	
Jumping Spider	Salticidae	*Phidippus coccineus*	Native	
Jumping Spider	Salticidae	*Phidippus johnsoni*	Native	
Jumping Spider	Salticidae	*Salticus palpalis*	Native	
Jumping Spider	Salticidae	*Sarinda cutleri*	Native	
Jumping Spider	Salticidae	*Sassacus papenhoei*	Native	
Jumping Spider	Salticidae	*Sitticus dorsatus*	Native	
Jumping Spider	Salticidae	*Synageles occidentalis*	Native	
Jumping Spider	Salticidae	*Talavera minuta*	Native	
Jumping Spider	Salticidae	*Thiodina sp.*	Native	
Whip Scorpion	Schizomidae	*Trithyreus sp.*	Native	
Primative Hunting Spider	Scytodidae	*Scytodes sp.*	Native	
Comb-Footed Spider	Therdiidae	*Theridion intervallatum*	Native	
Comb-Footed Spider	Therdiidae	*Theridion llano*	Native	
Comb-Footed Spider	Therdiidae	*Theridion murarium*	Native	
Comb-Footed Spider	Therdiidae	*Theridion punctipes*	Native	
Comb-footed Spider	Theridiidae	*Achaearanea sp.*	Native	
Comb-Footed Spider	Theridiidae	*Argyodes fictilium*	Native	
Comb-footed Spider	Theridiidae	*Crustulina sticta*	Native	
Comb-Footed Spider	Theridiidae	*Dipoena abdita*	Native	
Comb-Footed Spider	Theridiidae	*Dipoena atopa*	Native	
Comb-footed Spider	Theridiidae	*Dipoena prona*	Native	
Comb-footed Spider	Theridiidae	*Enoplognatha selma*	Native	
Comb-Footed Spider	Theridiidae	*Euryopis californica*	Native	
Comb-Footed Spider	Theridiidae	*Euryopis spinigera*	Native	
Comb-Footed Spider	Theridiidae	*Latrodectus hesperus*	Native	
Comb-Footed Spider	Theridiidae	*Steassa marmorata*	Native	
Crab Spider	Theridiidae	*Steatoda washona*	Native	
Comb-Footed Spider	Theridiidae	*Theridion goodnightorum*	Native	
Comb-Footed Spider	Theridiidae	*Theridion kawea*	Native	
Comb-Footed Spider	Theridiidae	*Theridion rabuni*	Native	
Comb-Footed Spider	Theridiidae	*Thymoites expulsus*	Native	
Comb-Footed Spider	Theridiidae	*Tidarren sisyphoides*	Native	
Crab Spider	Thomisidae	*Coriaeaechne utahensis*	Native	
Crab Spider	Thomisidae	*Misumenops aikoae*	Native	
Crab Spider	Thomisidae	*Misumenops californicus*	Native	
Crab Spider	Thomisidae	*Misumenops formosipes*	Native	
Crab Spider	Thomisidae	*Misumenops importunus belkini*	Native	
Crab Spider	Thomisidae	*Misumenops lepidus*	Native	
Crab Spider	Thomisidae	*Misumenops rothi*	Native	
Crab Spider	Thomisidae	*Misumenops sp.*	Native	
Longsighted Hunter Spider	Thomisidae	*Pellenes levii*	Native	
Crab Spider	Thomisidae	*Philodroma rufus pacificus*	Native	
Crab Spider	Thomisidae	*Steatoda grossa*	Native	
Crab Spider	Thomisidae	*Steatoda triangulosa*	Native	
Crab Spider	Thomisidae	*Tmarus sp.*	Native	
Crab Spider	Thomisidae	*Xysticus calfornicus*	Native	
Crab Spider	Thomisidae	*Xysticus gulosus*	Native	
Crab Spider	Thomisidae	*Xysticus iviei iviei*	Native	
Crab Spider	Thomisidae	*Xysticus pretiosus*	Native	
Mites			Native	
Ticks			Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Aves				
Cooper's Hawk	Accipitridae	*Accipiter cooperii*	Native	CSSC, MBTA
Sharp-shinned Hawk	Accipitridae	*Accipiter striatus*	Native	CSSC, MBTA
Golden Eagle	Accipitridae	*Aquila chrysaetos*	Native	CFP, CSSC, CDF, MBTA
Zone-tailed Hawk	Accipitridae	*Buteo albonotatus*	Native	MBTA
Red-tailed Hawk	Accipitridae	*Buteo jamaicensis*	Native	MBTA
Rough-legged Hawk	Accipitridae	*Buteo lagopus*	Native	MBTA
Red-shouldered Hawk	Accipitridae	*Buteo lineatus*	Native	MBTA
Ferruginous Hawk	Accipitridae	*Buteo regalis*	Native	CSSC, MBTA
Swainson's Hawk	Accipitridae	*Buteo swainsoni*	Native	CT, MBTA
Northern Harrier	Accipitridae	*Circus cyaneus*	Native	CSSC, MBTA
White-tailed Kite	Accipitridae	*Elanus leucurus*	Native	CFP, MBTA
Bald Eagle	Accipitridae	*Haliaeetus leucocephalus*	Native	CT, CFP, CDF, FT, MBTA
Osprey	Accipitridae	*Pandion haliaetus*	Native	CSSC, CDF, MBTA
Bushtit	Aegithalidae	*Psaltriparus minimus*	Native	MBTA
California Horned Lark	Alaudidae	*Eremophila alpestris actia*	Native	CSSC, MBTA
Belted Kingfisher	Alcedinidae	*Ceryle alcyon*	Native	MBTA
Rhinoceros Auklet	Alcidae	*Cerorhinca monocerata*	Native	MBTA
Common Murre	Alcidae	*Uria aalge*	Native	MBTA
Wood Duck	Anatidae	*Aix sponsa*	Native	H, MBTA
Northern Pintail	Anatidae	*Anas acuta*	Native	H, MBTA
American Wigeon	Anatidae	*Anas americana*	Native	H, MBTA
Northern Shoveler	Anatidae	*Anas clypeata*	Native	H, MBTA
Green-winged Teal	Anatidae	*Anas crecca*	Native	H, MBTA
Cinnamon Teal	Anatidae	*Anas cyanoptera*	Native	H, MBTA
Blue-winged Teal	Anatidae	*Anas discors*	Native	H, MBTA
Eurasian Wigeon	Anatidae	*Anas penelope*	Native	MBTA
Mallard	Anatidae	*Anas platyrhynchos*	Native	H, MBTA
Gadwall	Anatidae	*Anas strepera*	Native	H, MBTA
Greater White-fronted Goose	Anatidae	*Anser albifrons*	Native	H, MBTA
Lesser Scaup	Anatidae	*Aythya affinis*	Native	H, MBTA
Redhead	Anatidae	*Aythya americana*	Native	H, MBTA
Ring-necked Duck	Anatidae	*Aythya collaris*	Native	H, MBTA
Greater Scaup	Anatidae	*Aythya marila*	Native	H, MBTA
Canvasback	Anatidae	*Aythya valisineria*	Native	H, MBTA
Brant	Anatidae	*Branta bernicla nigricans*	Native	H, MBTA
Canada Goose	Anatidae	*Branta canadensis*	Native	H, MBTA
Bufflehead	Anatidae	*Bucephala albeola*	Native	H, MBTA
Common Goldeneye	Anatidae	*Bucephala clangula*	Native	H, MBTA
Snow Goose	Anatidae	*Chen caerulescens*	Native	H, MBTA
Ross's Goose	Anatidae	*Chen rossii*	Native	H, MBTA
Oldsquaw	Anatidae	*Clangula hyemalis*	Native	H, MBTA
Tundra Swan	Anatidae	*Cygnus columbianus*	Native	MBTA
White-winged Scoter	Anatidae	*Melanitta fusca*	Native	H, MBTA
Black Scoter	Anatidae	*Melanitta nigra*	Native	H, MBTA
Surf Scoter	Anatidae	*Melanitta perspicillata*	Native	H, MBTA
Common Merganser	Anatidae	*Mergus merganser*	Native	H, MBTA
Red-breasted Merganser	Anatidae	*Mergus serrator*	Native	H, MBTA
Ruddy Duck	Anatidae	*Oxyura jamaicensis*	Native	H, MBTA
White-throated Swift	Apodidae	*Aeronautes saxatalis*	Native	MBTA
Chimney Swift	Apodidae	*Chaetura pelagica*	Native	MBTA
Vaux's Swift	Apodidae	*Chaetura vauxi*	Native	CSSC, MBTA
Great Egret	Ardeidae	*Ardea alba*	Native	CDF, MBTA
Great Blue Heron	Ardeidae	*Ardea herodias*	Native	CDF, MBTA
American Bittern	Ardeidae	*Botaurus lentiginosus*	Native	MBTA

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Aves *cont.*				
Cattle Egret	Ardeidae	*Bubulcus ibis*	Native	MBTA
Green Heron	Ardeidae	*Butorides virescens*	Native	MBTA
Little Blue Heron	Ardeidae	*Egretta caerulea*	Native	MBTA
Reddish Egret	Ardeidae	*Egretta rufescens*	Native	MBTA
Snowy Egret	Ardeidae	*Egretta thula*	Native	MBTA
Tricolored Heron	Ardeidae	*Egretta tricolor*	Native	MBTA
Least Bittern	Ardeidae	*Ixobrychus exilis*	Native	CSSC, MBTA
Yellow-crowned Night Heron	Ardeidae	*Nyctanassa violacea*	Native	MBTA
Black-crowned Night Heron	Ardeidae	*Nycticorax nycticorax*	Native	MBTA
Cedar Waxwing	Bombycillidae	*Bombycilla cedrorum*	Native	MBTA
Lesser Nighthawk	Caprimulgidae	*Chordeiles acutipennis*	Native	MBTA
Common Poorwill	Caprimulgidae	*Phalaenoptilus nuttallii*	Native	MBTA
Blue Grosbeak	Emberizidae	*Guiraca caerulea*	Native	MBTA
Black-headed Grosbeak	Cardinalidae	*Pheucticus melanocephalus*	Native	MBTA
Turkey Vulture	Cathartidae	*Cathartes aura*	Native	MBTA
Western Snowy Plover	Charadriidae	*Charadrius alexandrinus nivosus*	Native	FT, CSSC, MBTA
Semipalmated Plover	Charadriidae	*Charadrius semipalmatus*	Native	MBTA
Killdeer	Charadriidae	*Charadrius vociferus*	Native	MBTA
Lesser Golden Plover	Charadriidae	*Pluvialis dominica*	Native	MBTA
Black-bellied Plover	Charadriidae	*Pluvialis squatarola*	Native	MBTA
Wood Stork	Ciconiidae	*Mycteria americana*	Native	FE, CSSC, MBTA
Band-tailed Pigeon	Columbidae	*Columba fasciata*	Native	H, MBTA
Rock Dove	Columbidae	*Columba livia*	Exotic	
Common Ground-Dove	Columbidae	*Columbina passerina*	Native	MBTA
White-winged Dove	Columbidae	*Zenaida asiatica*	Native	H, MBTA
Mourning Dove	Columbidae	*Zenaida macroura*	Native	H, MBTA
Western Scrub Jay	Corvidae	*Aphelocoma californica*	Native	MBTA
American Crow	Corvidae	*Corvus brachyrhynchus*	Native	H, MBTA
Common Raven	Corvidae	*Corvus corax*	Native	MBTA
Steller's Jay	Corvidae	*Cyanocitta stelleri*	Native	MBTA
Western Yellow-billed Cuckoo	Cuculidae	*Coccyzus americanus occidentalis*	Native	CE, USFS, MBTA
Greater Roadrunner	Cuculidae	*Geococcyx californianus*	Native	MBTA
Southern California Rufous-crowned Sparrow	Emberizidae	*Aimophila ruficeps canescens*	Native	CSSC, MBTA
Grasshopper Sparrow	Emberizidae	*Ammodramus savannarum*	Native	MBTA
Bell's Sage Sparrow	Emberizidae	*Amphispiza belli belli*	Native	CSSC, MBTA
Lark Bunting	Emberizidae	*Calamospiza melanocorys*	Native	MBTA
Chestnut-collared Longspur	Emberizidae	*Calcarius ornatus*	Native	MBTA
Lark Sparrow	Emberizidae	*Chondestes grammacus*	Native	MBTA
Dark-eyed Junco	Emberizidae	*Junco hyemalis*	Native	MBTA
Swamp Sparrow	Emberizidae	*Melospiza georgiana*	Native	MBTA
Lincoln's Sparrow	Emberizidae	*Melospiza lincolnii*	Native	MBTA
Song Sparrow	Emberizidae	*Melospiza melodia*	Native	MBTA
Brown-headed cowbird	Emberizidae	*Molothrus ater*	Exotic	MBTA
Belding's Savannah Spar-row	Emberizidae	*Passerculus sandwichensis beldingi*	Native	CE, CSSC, MBTA
Fox Sparrow	Emberizidae	*Passerella iliaca*	Native	MBTA
Lazuli Bunting	Emberizidae	*Passerina amoena*	Native	MBTA
Green-tailed Towhee	Emberizidae	*Pipilo chlorurus*	Native	MBTA
California Towhee	Emberizidae	*Pipilo crissalis*	Native	MBTA
Canyon Towhee	Emberizidae	*Pipilo fuscus*	Native	MBTA
Spotted Towhee	Emberizidae	*Pipilo maculatus*	Native	MBTA
Vesper Sparrow	Emberizidae	*Pooecetes gramineus*	Native	MBTA
Dickcissel	Emberizidae	*Spiza americana*	Native	MBTA

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Aves *cont.*				
Black Chinned Sparrow	Emberizidae	*Spizella atrogularis*	Native	MBTA
Brewer's Sparrow	Emberizidae	*Spizella breweri*	Native	MBTA
Chipping Sparrow	Emberizidae	*Spizella passerina*	Native	MBTA
White-throated Sparrow	Emberizidae	*Zonotrichia albicollis*	Native	MBTA
Golden-crowned Sparrow	Emberizidae	*Zonotrichia atricapilla*	Native	MBTA
White-crowned Sparrow	Emberizidae	*Zonotrichia leucophrys*	Native	MBTA
Merlin	Falconidae	*Falco columbarius*	Native	CSSC, MBTA
Prarie Falcon	Falconidae	*Falco mexicanus*	Native	CSSC, MBTA
Peregrine Falcon	Falconidae	*Falco peregrinus anatum*	Native	CE, CFP, CDF, MBTA
American Kestrel	Falconidae	*Falco sparverius*	Native	MBTA
Magnificent Frigatebird	Fregatidae	*Fregata magnificens*	Native	MBTA
Lawrence's Goldfinch	Fringillidae	*Carduelis lawrencei*	Native	MBTA
Pine Siskin	Fringillidae	*Carduelis pinus*	Native	MBTA
Lesser Goldfinch	Fringillidae	*Carduelis psaltria*	Native	MBTA
American Goldfinch	Fringillidae	*Carduelis tristis*	Native	MBTA
House Finch	Fringillidae	*Carpodacus mexicanus*	Native	MBTA
Purple Finch	Fringillidae	*Carpodacus purpureus*	Native	MBTA
Arctic Loon	Gaviidae	*Gavia arctica*	Native	MBTA
Common Loon	Gaviidae	*Gavia immer*	Native	CSSC, MBTA
Pacific Loon	Gaviidae	*Gavia pacifica*	Native	MBTA
Red-throated Loon	Gaviidae	*Gavia stellata*	Native	MBTA
Barn Swallow	Hirundinidae	*Hirundo rustica*	Native	MBTA
Cliff Swalllow	Hirundinidae	*Petrochelidon pyrrhonota*	Native	MBTA
Purple Martin	Hirundinidae	*Progne subis*	Native	CSSC, MBTA
Bank Swallow	Hirundinidae	*Riparia riparia*	Native	CT, MBTA
Northern Rough-winged Swallow	Hirundinidae	*Stelgidopteryx serripennis*	Native	MBTA
Tree Swallow	Hirundinidae	*Tachycineta bicolor*	Native	MBTA
Violet-green Swallow	Hirundinidae	*Tachycineta thalassina*	Native	MBTA
Red-winged Blackbird	Icteridae	*Agelaius phoeniceus*	Native	MBTA
Tricolored Blackbird	Icteridae	*Agelaius tricolor*	Native	CSSC, MBTA
Brewer's Blackbird	Icteridae	*Euphagus cyanocephalus*	Native	MBTA
Hooded Oriole	Icteridae	*Icterus cucullatus*	Native	CSSC, MBTA
Northern Oriole	Icteridae	*Icterus glabula*	Native	MBTA
Scott's Oriole	Icteridae	*Icterus parisorum*	Native	MBTA
Great-tailed Grackle	Icteridae	*Quiscalus mexicanus*	Native	MBTA
Western Meadowlark	Icteridae	*Sturnella neglecta*	Native	MBTA
Yellow-headed Blackbird	Icteridae	*Xanthocephalus xanthocephalus*	Native	MBTA
Loggerhead Shrike	Laniidae	*Lanius ludovicianus*	Native	MBTA
Black Tern	Laridae	*Chlidonias niger*	Native	CSSC, MBTA
Herring Gull	Laridae	*Larus argentatus*	Native	MBTA
California Gull	Laridae	*Larus californicus*	Native	CSSC, MBTA
Mew Gull	Laridae	*Larus canus*	Native	MBTA
Ring-billed Gull	Laridae	*Larus delawarensis*	Native	MBTA
Glaucous-winged Gull	Laridae	*Larus glaucescens*	Native	MBTA
Heermann's Gull	Laridae	*Larus heermanni*	Native	MBTA
Yellow-footed Gull	Laridae	*Larus livens*	Native	MBTA
Little Gull	Laridae	*Larus minutus*	Native	MBTA
Western Gull	Laridae	*Larus occidentalis*	Native	MBTA
Bonaparte's Gull	Laridae	*Larus philidelphia*	Native	MBTA
Thayer's Gull	Laridae	*Larus thayeri*	Native	MBTA
Black-legged Kittiwake	Laridae	*Rissa tridactyla*	Native	MBTA
Black skimmer	Laridae	*Rynchops nigra*	Native	CSSC, MBTA
Parasitic Jaeger	Laridae	*Stercorarius parasiticus*	Native	MBTA
California Least Tern	Laridae	*Sterna antillarum browni*	Native	FE, CE, CFP, MBTA
Caspian Tern	Laridae	*Sterna caspia*	Native	MBTA

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Aves *cont.*				
Elegant Tern	Laridae	*Sterna elegans*	Native	CSSC, MBTA
Forster's Tern	Laridae	*Sterna forsteri*	Native	MBTA
Common Tern	Laridae	*Sterna hirundo*	Native	MBTA
Royal Tern	Laridae	*Sterna maxima*	Native	MBTA
Arctic Tern	Laridae	*Sterna paradisaea*	Native	MBTA
Northern Mockingbird	Mimidae	*Mimus polyglottos*	Native	MBTA
Sage Thrasher	Mimidae	*Oreoscoptes montanus*	Native	MBTA
California Thrasher	Mimidae	*Toxostoma redivivum*	Native	MBTA
American Pipit	Motacillidae	*Anthus rubescens*	Native	MBTA
Oak Titmouse	Paridae	*Baeolophus inornatus (old name Parus inornatus)*	Native	MBTA
Mountain Chickadee	Paridae	*Parus gambeli*	Native	MBTA
Yellow-rumped Warbler	Emberizidae	*Dendroica coronata*	Native	MBTA
Black-throated Gray Warbler	Emberizidae	*Dendroica nigrescens*	Native	MBTA
Hermit Warbler	Emberizidae	*Dendroica occidentalis*	Native	MBTA
Palm Warbler	Emberizidae	*Dendroica palmarum*	Native	MBTA
Chestnut-sided Warbler	Emberizidae	*Dendroica pensylvanica*	Native	MBTA
Yellow Warbler	Emberizidae	*Dendroica petechia*	Native	CSSC, MBTA
Blackpoll Warbler	Emberizidae	*Dendroica striata*	Native	MBTA
Townsend's Warbler	Emberizidae	*Dendroica townsendi*	Native	MBTA
Common Yellowthroat	Emberizidae	*Geothlypis trichas*	Native	MBTA
Yellow-breasted Chat	Emberizidae	*Icteria virens*	Native	MBTA
Black-and-White Warbler	Emberizidae	*Dendroica varia*	Native	MBTA
MacGillivray's Warbler	Emberizidae	*Oporornis tolmiei*	Native	MBTA
Northern Waterthrush	Emberizidae	*Seiurus noveboracensis*	Native	MBTA
American Redstart	Emberizidae	*Setophaga ruticilla*	Native	MBTA
Orange-crowned Warbler	Emberizidae	*Vermivora celata*	Native	MBTA
Lucy's Warbler	Emberizidae	*Vermivora luciae*	Native	MBTA
Tennessee Warbler	Emberizidae	*Vermivora perigrina*	Native	MBTA
Nashville Warbler	Emberizidae	*Vermivora ruficapilla*	Native	MBTA
Wilson's Warbler	Emberizidae	*Wilsonia pusilla*	Native	MBTA
House Sparrow	Passeridae	*Passer domesticus*	Exotic	
American White Pelican	Pelicanidae	*Pelecanus erythrorhynchos*	Native	CSSC MBTA
Brown Pelican	Pelicanidae	*Pelecanus occidentalis californicus*	Native	FE, CE, CFP, MBTA
Double-crested Cormorant	Phalacrocoracidae	*Phalacrocorax auritus*	Native	CSSC, MBTA
Pelagic Cormorant	Phalacrocoracidae	*Phalacrocorax pelagicus*	Native	MBTA
Brant's Cormorant	Phalacrocoracidae	*Phalacrocorax penicillatus*	Native	MBTA
Chukar	Phasianidae	*Alectoris chukar*	Exotic	H
California Quail	Phasianidae	*Callipepla californica*	Native	H
Wild Turkey	Phasianidae	*Meleagris gallopavo*	Exotic	H
Mountain Quail	Phasianidae	*Oreortyx pictus*	Native	H
Ring-necked Pheasant	Phasianidae	*Phasianus colchicus*	Exotic	H
Northern Flicker	Picidae	*Colaptes auratus*	Native	MBTA
Acorn Woodpecker	Picidae	*Melanerpes formicivorus*	Native	MBTA
Lewis' Woodpecker	Picidae	*Melanerpes lewis*	Native	MBTA
Nuttall's Woodpecker	Picidae	*Picoides nuttallii*	Native	MBTA
Downy Woodpecker	Picidae	*Picoides pubescens*	Native	MBTA
Hairy Woodpecker	Picidae	*Picoides villosus*	Native	MBTA
Red-naped Sapsucker	Picidae	*Sphyrapicus nuchalis*	Native	MBTA
Red-breasted Sapsucker	Picidae	*Sphyrapicus ruber*	Native	MBTA
Clark's Grebe	Podicipedidae	*Aechmophorus clarkii*	Native	MBTA
Western Grebe	Podicipedidae	*Aechmophorus occidentalis*	Native	MBTA
Horned Grebe	Podicipedidae	*Podiceps auritus*	Native	MBTA
Eared Grebe	Podicipedidae	*Podiceps nigricollis*	Native	MBTA
Pied-billed Grebe	Podicipedidae	*Podilymbus podiceps*	Native	MBTA

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Aves *cont.*				
Northern Fulmar	Procellariidae	*Fulmaris glacialis*	Native	MBTA
Black Storm-petrel	Hydrobatidae	*Oceanodroma melania*	Native	MBTA
Sooty Shearwater	Procellariidae	*Puffinus griseus*	Native	MBTA
Black-vented Shearwater	Procellariidae	*Puffinus opisthomelas*	Native	MBTA
Phainopepla	Ptilogonatidae	*Phainopepla nitens*	Native	MBTA
American Coot	Rallidae	*Fulica americana*	Native	H MBTA
Common Moorhen	Rallidae	*Gallinula chloropus*	Native	H, MBTA
Sora Rail	Rallidae	*Porzana carolina*	Native	MBTA
Virginia Rail	Rallidae	*Rallus limicola*	Native	MBTA
Light-footed Clapper Rail [4]	Rallidae	*Rallus longirostris levipes*	Native	FE, CE, CFP, MBTA
Black-necked Stilt	Recurvirostridae	*Himantopus mexicanus*	Native	MBTA
American Avocet	Recurvirostridae	*Recurvirostra americana*	Native	MBTA
Ruby-crowned Kinglet	Muscicapidae	*Regulus calendula*	Native	MBTA
Golden-crowned Kinglet	Muscicapidae	*Regulus satrapa*	Native	MBTA
Spotted Sandpiper	Scolopacidae	*Actitis macularia*	Native	MBTA
Surfbird	Scolopacidae	*Aphriza virgata*	Native	MBTA
Ruddy Turnstone	Scolopacidae	*Arenaria interpres*	Native	MBTA
Black Turnstone	Scolopacidae	*Arenaria melanocephala*	Native	MBTA
Sanderling	Scolopacidae	*Calidris alba*	Native	MBTA
Dunlin	Scolopacidae	*Calidris alpina*	Native	MBTA
Baird's Sandpiper	Scolopacidae	*Calidris bairdii*	Native	CSSC, MBTA
Red Knot	Scolopacidae	*Calidris canutus*	Native	MBTA
Stilt Sandpiper	Scolopacidae	*Calidris himantopus*	Native	MBTA
Western Sandpiper	Scolopacidae	*Calidris mauri*	Native	MBTA
Pectoral Sandpiper	Scolopacidae	*Calidris melanotos*	Native	MBTA
Least Sandpiper	Scolopacidae	*Calidris minutilla*	Native	MBTA
Semipalmated Sandpiper	Scolopacidae	*Calidris pusilla*	Native	MBTA
Willet	Scolopacidae	*Catoptrophorus semipalmatus*	Native	MBTA
Common Snipe	Scolopacidae	*Gallinago gallinago*	Native	H, MBTA
Wandering Tattler	Scolopacidae	*Heteroscelus incanus*	Native	MBTA
Short-billed Dowitcher	Scolopacidae	*Limnodromus griseus*	Native	MBTA
Long-billed Dowitcher	Scolopacidae	*Limnodromus scolopaceus*	Native	MBTA
Marbled Godwit	Scolopacidae	*Limosa fedoa*	Native	MBTA
Long-billed Curlew	Scolopacidae	*Numenius americanus*	Native	CSSC, MBTA
Whimbrel	Scolopacidae	*Numenius phaeopus*	Native	MBTA
Red Phalarope	Scolopacidae	*Phalaropus fulicaria*	Native	MBTA
Red-necked Phalarope	Scolopacidae	*Phalaropus lobatus*	Native	MBTA
Wilson's Phalarope	Scolopacidae	*Phalaropus tricolor*	Native	MBTA
Spotted Redshank	Scolopacidae	*Tringa erythropus*	Native	MBTA
Lesser Yellowlegs	Scolopacidae	*Tringa flavipes*	Native	MBTA
Greater Yellowlegs	Scolopacidae	*Tringa melanoleuca*	Native	MBTA
Red-breasted Nuthatch	Sittidae	*Sitta canadensis*	Native	MBTA
White-breasted Nuthatch	Sittidae	*Sitta carolinensis*	Native	MBTA
Short-eared Owl	Strigidae	*Asio flammeus*	Native	CSSC, MBTA
Long-eared Owl	Strigidae	*Asio otus*	Native	CSSC, MBTA
Burrowing Owl	Strigidae	*Athene cunicularia*	Native	CSSC, MBTA
Great Horned Owl	Strigidae	*Bubo virginianus*	Native	MBTA
Western Screech Owl	Strigidae	*Otus kennicottii*	Native	MBTA
Spotted Owl	Strigidae	*Strix occidentalis occidentalis*	Native	CSSC, USFS, MBTA
European Starling	Sturnidae	*Sturnus vulgaris*	Exotic	
Blue-gray Gnatcatcher	Muscicapidae	*Polioptila caerulea*	Native	MBTA
Coastal California Gnat-catcher	Muscicapidae	*Polioptila californica californica*	Native	FT, CSSC, MBTA
Black-tailed Gnatcatcher	Muscicapidae	*Polioptila melanura*	Native	MBTA

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Aves *cont.*				
Western Tanager	Emberizidae	*Piranga ludoviciana*	Native	MBTA
Summer Tanager	Emberizidae	*Piranga rubra*	Native	MBTA
Roseate Spoonbill	Threskiornithidae	*Ajaia ajaja*	Native	MBTA
White-faced Ibis	Threskiornithidae	*Plegadis chihi*	Native	CSSC, MBTA
Wrentit	Timaliidae	*Chamaea fasciata*	Native	
Black-chinned Hummingbird	Trochilidae	*Archilocus alexandri*	Native	MBTA
Anna's Hummingbird	Trochilidae	*Calypte anna*	Native	MBTA
Costa's Hummingbird	Trochilidae	*Calypte costae*	Native	MBTA
Broad-billed Hummingbird	Trochilidae	*Cynanthus latirostris*	Native	MBTA
Rufous Hummingbird	Trochilidae	*Selasphorus rufus*	Native	MBTA
Allen's Hummingbird	Trochilidae	*Selasphorus sasin*	Native	MBTA
Cactus Wren	Troglodytidae	*Campylorhynchus brunneicapillus sandiegoense*	Native	CSSC, USFS, MBTA
Canyon Wren	Troglodytidae	*Catherpes mexicanus*	Native	MBTA
Marsh Wren	Troglodytidae	*Cistothorus palustris*	Native	MBTA
Rock Wren	Troglodytidae	*Salpinctes obsoletus*	Native	MBTA
Bewick's Wren	Troglodytidae	*Thryomanes bewickii*	Native	MBTA
House Wren	Troglodytidae	*Troglodytes aedon*	Native	MBTA
Winter Wren	Troglodytidae	*Troglodytes troglodytes*	Native	MBTA
Hermit Thrush	Muscicapidae	*Catharus guttatus*	Native	MBTA
Swainson's Thrush	Muscicapidae	*Catharus ustulatus*	Native	MBTA
Varied Thrush	Muscicapidae	*Ixoreus naevius*	Native	MBTA
Western Bluebird	Muscicapidae	*Sialia mexicana*	Native	MBTA
American Robin	Muscicapidae	*Turdus migratorius*	Native	MBTA
Olive-sided Flycatcher	Tyrannidae	*Contopus cooperi*	Native	MBTA
Western Wood-Peewee	Tyrannidae	*Contopus sordidulus*	Native	MBTA
Pacific-slope Flycatcher	Tyrannidae	*Empidonax difficilis*	Native	MBTA
Hammond's Flycatcher	Tyrannidae	*Empidonax hammondii*	Native	MBTA
Dusky Flycatcher	Tyrannidae	*Empidonax oberholseri*	Native	MBTA
Southwestern Willow Flycatcher	Tyrannidae	*Empidonax traillii extimus*	Native	FE, CE, USFS, MBTA
Gray Flycatcher	Tyrannidae	*Empidonax wrightii*	Native	MBTA
Ash-throated Flycatcher	Tyrannidae	*Myiarchus cinerascens*	Native	MBTA
Rose-throated Becard	Tyrannidae	*Pachyramphus aglaiae*	Native	MBTA
Vermillion Flycatcher	Tyrannidae	*Pyrocephalus rubinus*	Native	MBTA
Black Phoebe	Tyrannidae	*Sayornis nigricans*	Native	MBTA
Eastern Phoebe	Tyrannidae	*Sayornis phoebe*	Native	MBTA
Say's Phoebe	Tyrannidae	*Sayornis saya*	Native	MBTA
Western Kingbird	Tyrannidae	*Tyrannus verticalis*	Native	MBTA
Cassin's Kingbird	Tyrannidae	*Tyrannus vociferans*	Native	MBTA
Barn Owl	Tytonidae	*Tyto alba*	Native	MBTA
Least Bell's Vireo	Vireonidae	*Vireo bellii pusillus*	Native	FE, CE, MBTA
Cassin's Vireo (formerly Solitary vireo)	Vireonidae	*Vireo cassinii*	Native	MBTA
Warbling Vireo	Vireonidae	*Vireo gilvus*	Native	MBTA
White-eyed Vireo	Vireonidae	*Vireo griseus*	Native	MBTA
Hutton's Vireo	Vireonidae	*Vireo huttoni*	Native	MBTA
Gray Vireo	Vireonidae	*Vireo vicinior*	Native	MBTA
Class Bivalvia				
Asiatic Clam	Corbiculidae	*Corbicula fluminea*	Exotic	
Class Chilopoda				
Centipede			Native	
Class Crustacea				
Brine shrimp	Artemiidae	*Artemia salina*	Native	
Red Swamp Crayfish	Astacidae	*Procambarus clarkii*	Exotic	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Crustacea *con't*.				
Lindahl's fairy shrimp	Branchinectidae	*Branchinecta lindahli*	Native	
San Diego fairy shrimp	Branchinectidae	*Branchinecta sandiegoensis*	Native	FE
Red ghost shrimp	Callianassidae	*Callianassa californiensis*	Native	
Rock crab	Cancridae	*Cancer antennarius*	Native	
Yellow shore-crab	Grapsidae	*Hemigrapsus oregonensis*	Native	
Striped shore-crab	Grapsidae	*Pachygrapsus crassipes*	Native	
Kelp crab	Majidae	*Pugettia producta*	Native	
Fiddler crab	Ocypodidae	*Uca crenulata*	Native	
Broken-back/Grass Shrimp	Palaemonidae	*Palaemon macrodactylus*	Exotic	
Riverside fairy shrimp	Streptocephalidae	*Streptocephalus woottoni*	Native	FE
Sowbug			Native	
Class Diplopoda				
Millipede				
Class Gastropoda				
Striped sea hare	Aglajidae	*Navanax inermis*	Native	
Cloudy bubble snail	Bullidae	*Bulla gouldiana*	Native	
California horn snail	Certhideidae	*Cerithidea californica*	Native	
Festive rock shell	Muricidae	*Pteropurpura festivus*	Native	
Purple Olive	Olividae	*Olivella biplicata*	Native	
Class Insecta				
Achilid planthopper	Achilidae		Native	
Darner	Aeshnidae	*Aeshna sp.*	Native	
Leaf miner fly	Agromyzidae		Native	
Scale insect	Aleyroddidae	*Trialeurodes vaporariorum*	Native	
Comb-clawed beetle	Alleculidae		Native	
Broad-headed bug	Alydidae		Native	
Stonefly	Amphinemuridae	*Malenka sp.*	Native	
Andrenid bee	Andrenidae		Native	
Drugstore beetle	Anobiidae		Native	
Antlike flower beetle	Anthicidae		Native	
Minute pirate bugs	Anthocoridae		Native	
Anthomyiid fly	Anthomidae		Native	
Aphelinid	Aphelinidae		Native	
Aphid	Aphididae		Native	
Bumble bee	Apidae	*Bombus spp.*	Native	
Common (European) Honeybee	Apidae	*Apis mellifera*	Exotic	
Robber fly	Asilidae		Native	
Small mayfly	Baetidae		Native	
Mayfly	Baetidae	*Callibaetis sp.*	Native	
Giant water bug	Belostomatidae		Native	
Stilt bug	Berytidae	*Acanthophysa echinata*	Native	
Stilt bug	Berytidae	*Jalysus wickhami*	Native	
Stilt bug	Berytidae	*Pronotacantha annulata*	Native	
Bethylid	Bethylidae		Native	
March fly	Bibionidae		Native	
Cockroach	Blatellidae		Native	
Bee fly	Bombyliidae		Native	
Powder post beetle	Bostrichidae		Native	
Braconid	Braconidae		Native	
Seed beetle	Bruchidae		Native	
Metallic wood-boring beetle	Buprestidae		Native	
Small mayfly	Caenidae		Native	
Blow fly	Calliphoridae		Native	
Broad-winged damselfly	Calopterygidae		Native	
Soldier beetle	Cantharidae		Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Insecta *cont.*				
Ground beetle	Carabidae		Native	
Gall gnats	Cecidomyiidae		Native	
Longhorn beetle	Ceramycidae	*Ipochus fasciatus*	Native	
Ceraphronid	Ceraphronidae		Native	
Biting midge	Ceratopogonidae		Native	
Scale insect	Cercopodae		Native	
Midge	Chironomidae		Native	
Fruit fly	Chloropidae		Native	
Leaf beetle	Chrysomelidae	*Chlamisus sp.*	Native	
Leaf beetle	Chrysomelidae	*Cryptocephalus sanguinecollis*	Native	
Leaf beetle	Chrysomelidae	*Trirhabda sp.*	Native	
Brown lacewing	Chrysopidae	*Chrysoperla carnea*	Native	
Green lacewing	Chrysopidae	*Hremochrysa sp.*	Native	
Cicada	Cicadellidae	*Aceratagallia obscura*	Native	
Cicada	Cicadellidae	*Ballana sera*	Native	
Cicada	Cicadellidae	*Ballana simplex*	Native	
Cicada	Cicadellidae	*Cochlorhinus unispinosus*	Native	
Cicada	Cicadellidae	*Colladonus montanus*	Native	
Cicada	Cicadellidae	*Cuerna gladiola*	Native	
Cicada	Cicadellidae	*Deltacephalus sonorus*	Native	
Cicada	Cicadellidae	*Empoasoa decora*	Native	
Cicada	Cicadellidae	*Exitianus exitiosus*	Native	
Cicada	Cicadellidae	*Gyponana sp.*	Native	
Cicada	Cicadellidae	*Idiocerus sp.*	Native	
Cicada, Vanduzee's	Cicadellidae	*Okanagana vanduzeei*	Native	
Cicada	Cicadellidae	*Phlepsius ovatus*	Native	
Cicada	Cicadellidae	*Scaphytopius elegans*	Native	
Cicada	Cicadellidae	*Scaphytopius loricatas*	Native	
Cicada	Cicadellidae	*Tiaga sp.*	Native	
Cicada	Cicadellidae	*Twiningia permista*	Native	
Cicada	Cicadellidae	*Xerophloea peltata*	Native	
Fly	Cicidomyiidae		Native	
Tiger beetle	Cincindelidae		Native	
Scale insect	Cixiidae	*Oliaris sp.*	Native	
Scale Insect	Clastopteridae	*Clastoptera lineatocollis*	Native	
Checked Beetle	Cleridae		Native	
Wax Scales	Coccidae		Native	
Ladybird Beetle	Coccinellidae	*Cycloneda sanguinea*	Native	
Lacewing	Coenagrionidae		Native	
Narrow-winged Damselflies	Coenagrionidae		Native	
Forktail	Coenagrionidae	*Ischnura cervula*	Native	
Lacewing	Coniopterygidae		Native	
Leaf-footed Bugs	Coreidae	*Anasa sp.*	Native	
Water Boatmen	Corixidae		Native	
Common water boatman	Corixidae	*Corisella inscripta*	Native	
Large water boatman	Corixidae	*Hesperocorixa laevigata*	Native	
Water boatman	Corixidae	*Trichocorixa sp.*	Native	
Dobsonflies	Corydalidae	*Neohermes californicus*	Native	
Flat Bark Beetle	Cucujidae		Native	
Mosquito	Culicidae	*Culex sp.*	Native	
Mosquito	Culicidae	*Culiseta sp.*	Native	
Snout Beetle	Curculionidae	*Anthonomus*	Native	
Snout Beetle	Curculionidae	*Anthonomus decipiens*	Native	
Snout Beetle	Curculionidae	*Anthonomus inermis*	Native	
Snout Beetle	Curculionidae	*Anthonomus ornatulus*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Insecta *cont.*				
Potato Stalk Borer	Curculionidae	*Trichobaris*	Native	
Burrower Bugs	Cydnidae		Native	
Cynipids	Cynipidae		Native	
Delphacid Planthoppers	Delphacidae		Native	
Tooth-necked Fungus Beetle	Derdontidae		Native	
Earwigs	Dermestidae		Native	
Diapriids	Diapriidae		Native	
Dictyopharid Planthoppers	Dictyopharidae	*Scolops sp.*	Native	
Dictyopharid Planthoppers	Dictyopharidae	*Ticida sp.*	Native	
Long-legged Flies	Dolichopodidae		Native	
Pomace Flies	Drosophilidae		Native	
Dryinids	Dryinidae		Native	
Long-toed Water Beetle	Dryopidae		Native	
River beetle	Dytiscidae	*Agabus disintegratus*	Native	
Predaceous Diving Beetles	Dytiscidae	*Cybister sp.*	Native	
	Dytiscidae	*Deronectes striatellus*	Native	
Giant green water beetle	Dytiscidae	*Dytiscus marginicollis*	Native	
	Dytiscidae	*Hygrotus sp.*	Native	
Predaceous Diving Beetle	Dytiscidae	*Laccophilus mexicanus atristernalis*	Native	
Predaceous Diving Beetle	Dytiscidae	*Merragata hebroides*	Native	
Predaceous Diving Beetle	Dytiscidae	*Rhantus gutticollis*	Native	
Click Beetle	Elateridae		Native	
Riffle Beetles	Elmidae		Native	
Dance Flies	Empilidae		Native	
Encyrtids	Encyrtidae		Native	
Shore Flies	Ephydridae		Native	
Eulophids	Eulophidae		Native	
Eupelmids	Eupelmidae		Native	
Eurytomids	Eurytomidae		Native	
Figitids	Figitidae		Native	
Flatid Planthoppers	Flatidae	*Metcalfa pruinosa*	Native	
Ants	Formicidae		Native	
Argentine ants	Formicidae	*Iridiomyrmex humilis*	Exotic	
Gasteruptiids	Gasteruptiidae		Native	
Geometer Moths	Geometridae		Native	
Water strider	Gerridae	*Gerris incognitus*	Native	
Common water strider	Gerridae	*Gerris remigis*	Native	
Clubtails	Gomphidae		Native	
Grasshoppers	Gryllacrididae		Native	
Lacewing	Gryllidae		Native	
Whirligig Beetles	Gyrinidae		Native	
Halictid Bees	Halictidae		Native	
Crawling Water Beetles	Haliplidae		Native	
Water Striders	Haliplidae		Native	
Crawling Water Beetle	Haliplidae	*Peltodytes simplex*	Native	
Helomyzid Flies	Helomyzidae		Native	
Brown Lacewings	Hemerobiidae	*Micromus subantious*	Native	
Brown Lacewings	Hemerobiidae	*Micromus variolosus*	Native	
Brown Lacewings	Hemerobiidae	*Sympherobius californicus*	Native	
Brown Lacewings	Hemerobiidae	*Sympherobius killingtoni*	Native	
Fiery Skipper	Hesperiidae	*Hylephila phyleus*	Native	
Woodland Skipper	Hesperiidae	*Ochlodes agricola*	Native	
Checkered Skipper	Hesperiidae	*Pyrgus albescens*	Native	
Hister Beetles	Histeridae		Native	
Water Scavenger Beetle	Hydrophilidae	*Berosus striatus*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Insecta *cont.*				
Water Scavenger Beetle	Hydrophilidae	*Enochrus sp.*	Native	
Water Scavenger Beetle	Hydrophilidae	*Helophorus sp.*	Native	
Common scavenger water beetle	Hydrophilidae	*Tropisternus lateralis*	Native	
Net-spinning Caddisflies	Hydropsychidea	*Hydropsyche oslari*	Native	
Micro-caddisflies	Hydroptilidae		Native	
Ichneumons	Ichneumonidae	*Ophion sp.*	Native	
Issid Planthoppers	Issidae	*Danepteryx manca*	Native	
Issid Planthoppers	Issidae	*Dictyssa mutata*	Native	
Issid Planthoppers	Issidae	*Dictyssaobliqua*	Native	
Issid Planthoppers	Issidae	*Neaethus sp.*	Native	
Red Bug or Stainer	Largidae		Native	
Minute Brown Scavenger Beetle	Lathrididae	*Corticarina sp.*	Native	
Round Fungus Beetle	Leiodidae	*Leiodessus sp.*	Native	
Lepidostomids	Lepidostomtidea	*Lepidostoma sp.*	Native	
Mayflies	Leptophlebidae		Native	
Common Skimmer	Libellulidae		Native	
Pastel skimmer	Libellulidae	*Sympetrum corruptum*	Native	
Western Pygmy Blue	Lycaenidae	*Brephidium exile*	Native	
Bernardino Blue	Lycaenidae	*Euphilotes battoides bernardino*	Native	
Marine Blue	Lycaenidae	*Leptotes marina*	Native	
Acmon Blue	Lycaenidae	*Plebeius acmon*	Native	
Common Hairstreak	Lycaenidae	*Strymon melinus*	Native	
Seed Bugs	Lygaeidae	*Corius sp.*	Native	
Seed Bugs	Lygaeidae	*Geocoris sp.*	Native	
Seed Bugs	Lygaeidae	*Lygaceua sp.*	Native	
Jumping Bristletails	Machilidae		Native	
Leafcutting Bees	Megaspilidae		Native	
Soft-Winged Flower Beetle	Melyridae		Native	
Treehoppers	Membracidae	*Paranthronae hispida*	Native	
Treehoppers	Membracidae	*Philya californensis*	Native	
Treehoppers	Membracidae	*Spissistilus festunis*	Native	
Treehoppers	Membracidae	*Stictocephala sp.*	Native	
Treehoppers	Membracidae	*Thelamonanthe sp.*	Native	
Plant Bugs	Miridae	*Daracela sp.*	Native	
Plant Bugs	Miridae	*Lopidea confraterna*	Native	
Plant Bugs	Miridae	*Phytocoris babiequiro*	Native	
Plant Bugs	Miridae	*Phytocoris borrego*	Native	
Plant Bugs	Miridae	*Phytocoris californica*	Native	
Plant Bugs	Miridae	*Phytocoris canecens*	Native	
Plant Bugs	Miridae	*Phytocoris rosens*	Native	
Tumbling Flower beetles	Mordellidae	*Mordellis tena*	Native	
Muscid Flies	Muscidae		Native	
Velvet Ants	Mutillidae		Native	
Fungus Gnats	Myctophilidae		Native	
Fairyflies	Mymaridae		Native	
Damsel Bugs	Nabidae		Native	
Creeping Water Bugs	Naucoridae		Native	
Spring Stoneflies	Nemouridae		Native	
Alfalfa Looper	Noctuiidae	*Autograha californica*	Native	
Noctuid Moths	Noctuiidae	*Hemieuxoa rudens*	Native	
Noctuid Moths	Noctuiidae	*Leucania multilinea*	Native	
Noctuid Moths	Noctuiidae	*Orthodes rufula*	Native	
Variegated Cutworm	Noctuiidae	*Peridroma saucia*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Insecta *cont.*				
Armyworm	Noctuiidae	*Pseudaletia unipuneta*	Native	
Cabbage Looper	Noctuiidae	*Trichoplusia ni*	Native	
Early Spring Miller	Noctuiidae	*Xylomyges curialis*	Native	
Small backswimmer	Notonectidae	*Buenoa margaritacea*	Native	
Scimitar Backswimmer	Notonectidae	*Buenoa scimitra*	Native	
Large backswimmer	Notonectidae	*Notonecta undulata*	Native	
Single-banded backswimmer	Notonectidae	*Notonecta uniufaciata*	Native	
Queen	Nymphalidae	*Danaus gilippus*	Native	
Monarch butterfly	Nymphalidae	*Danaus plexippus*	Native	
Chalcedon Checkerspot	Nymphalidae	*Euphydryas chalcedona*	Native	
Buckeye	Nymphalidae	*Junonia coenia*	Native	
Lorquin's Admiral	Nymphalidae	*Liminitis lorquini lorquini*	Native	
Mourning Cloak	Nymphalidae	*Nymphalis antiopa*	Native	
West Coast Lady	Nymphalidae	*Vanessa annabella*	Native	
Painted Lady	Nymphalidae	*Vanessa cardui*	Native	
Virginia Lady	Nymphalidae	*Vanessa virginiensis*	Native	
Bot Flies	Oestridae		Native	
Pale Swallowtail	Papilionidae	*Papilio eurymedon*	Native	
Western Tiger Swallowtail	Papilionidae	*Papilio rutulus*	Native	
Anise Swallowtail	Papilionidae	*Papilio zelicaon*	Native	
Wasp	Pemphredonidae		Native	
Stink Bugs	Pentatomidae	*Cosmopepla intergressus*	Native	
Stink Bugs	Pentatomidae	*Euchistus conspersus*	Native	
Stink Bugs	Pentatomidae	*Murgantia histrionica*	Native	
Stink Bugs	Pentatomidae	*Thyanta pallidovirens*	Native	
Perlodid Stoneflies	Perlodidae	*Isoperta sp.*	Native	
Lacewing	Phasmatidae		Native	
Caddisflies	Philimyiidae		Native	
Finger-net Caddisflies	Philopotamidae		Native	
Humpbacked Flies	Phoridae		Native	
Phylloxeran	Phylloxeridae		Native	
Ambush Bugs	Phymatidae		Native	
Sara Orange-tip	Pieridae	*Anthocharis sara*	Native	
Alfalfa Butterfly	Pieridae	*Colias eurytheme*	Native	
Cloudless Sulfur	Pieridae	*Phoebis sennae*	Native	
Cabbage White Butterfly	Pieridae	*Pieris rapae*	Exotic	
Checkered White	Pieridae	*Pontia protodice*	Native	
Skipper Flies	Piophilidae		Native	
Big-headed Flies	Pipunculidae		Native	
platygasterids	Platygastridae	*Inosternma sp.*	Native	
Trumpet-net Caddisflies	Polycentropoidae		Native	
Spider Wasps	Pompilidae		Native	
Ambush Bugs	Prostemminae		Native	
Water-penny Beetles	Psephenidae	*Psephenus sp.*	Native	
Sand Flies	Psychodidae		Native	
Tube-making Caddisflies	Psychomiidae		Native	
Psyllids	Psyllidae		Native	
Pyeromalids	Pteromalidae		Native	
Plume Moths	Pterophoridae		Native	
Pyralid Moths	Pyralidae		Native	
Snakeflies	Raphidiidae	*Agulla sp.*	Native	
Assassin Bugs	Reduvidae	*Zelus tetracanthus*	Native	
Snipe Fly	Rhagionidae		Native	
Scentless Plant Bugs	Rhopalidae	*Arhyssus lateralis*	Native	
Primative Caddisflies	Rhyacophilidae		Native	
Behr's Metalmark	Riodinidae	*Apodemia mormo virgulti*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Insecta *cont.*				
Fatal Metalmark	Riodinidae	*Caliphelis nemesis*	Native	
Shore Bugs	Saldidae		Native	
Nymph Butterflies	Satyridae	*Coenonympha tullia*	Native	
California Ringlet	Nymphalidae	*Coenonympha tullia californica*	Native	
Shining Fungus Beetle	Scarabaeidae	*Dichelonyx sp.*	Native	
Anthomyiid Flies	Scatophagidae		Native	
Minute Black Scavenger Flies	Scatopsidae		Native	
Scelionids	Scelionidae		Native	
Window Flies	Scenopinidae		Native	
Dark-Winged Fungus Gnats	Sciaridae		Native	
March Flies	Sciomyzidae		Native	
Engraver Beetle	Scolytidae		Native	
Shield-backed Bugs	Scutelleridae	*Homaemus aneifrons*	Native	
Shield-backed Bugs	Scutelleridae	*Honaemus variegatus*	Native	
Antlike Stone Beetle	Scydmaenidae		Native	
Seelionid	Seelionidae		Native	
Carrion Beetle	Silphidae		Native	
Black Flies	Simuliidae	*Simulium vittatum*	Native	
Mayflies	Siphlonuridae		Native	
Small Dung Flies	Sphaeoceridae		Native	
Wasp	Sphecidae		Native	
Rove Beetle	Staphylinidae		Native	
Soldier Flies	Stratiomyidae		Native	
Syrphid Flies	Syrphidae		Native	
Fruit Flies	Tachinidae		Native	
Darkling Beetle	Tenebrionidae		Native	
Fruit Flies	Tephritidae	*Aciurina thoracion*	Native	
Fruit Flies	Tephritidae	*Dioxyna sororcula*	Native	
Fruit Flies	Tephritidae	*Tephritis arizonensis*	Native	
Fruit Flies	Tephritidae	*Tephritis baccharis*	Native	
Fruit Flies	Tephritidae	*Trupanea wheeleri*	Native	
Common Sawflies	Tetracampidae		Native	
Lacewing	Tettigoniidae		Native	
Stiletto Flies	Therividae		Native	
Negro Bugs	Thyreocoridae		Native	
Lace Bugs	Tingidae	*Corythuchu spinosa*	Native	
Crane Flies	Tipulidae	*Tipula sp.*	Native	
Torymids	Torimidae	*Monodontomerinae*	Native	
Tortricid Moths	Tortricidae		Native	
Mammal Chewing Lice	Trichodectidae		Native	
Trichogrammatids	Trichogrammatidae		Native	
Trixoscelidid Flies	Trixoscelidae		Native	
Skin Beetle	Trogidae		Native	
Diplurans			Native	
Webspinners			Native	
Termites			Native	
Fleas			Native	
Springtails			Native	
Class Mammalia				
Bison	Bovidae	*Bos bison*	Exotic	
Coyote	Canidae	*Canis latrans*	Native	H
Gray Fox	Canidae	*Urocyon cinereoargenteus*	Native	H
Beaver	Castoridae	*Castor canadensis*	Exotic	H
Southern Mule Deer	Cervidae	*Odocoileus hemionus fuliginatus*	Native	H

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Mammalia *cont.*				
Bottle-nosed Dolphin	Delphinidae	*Tursiops truncatus*	Native	
Opossum	Didelphiidae	*Didelphis virginiana*	Native	H
Gray Whale	Eschrichtiidae	*Eschrichtius robustus*	Native	
Feral Cat	Felidae	*Felis catus*	Exotic	
Mountain Lion	Felidae	*Puma concolor*	Native	
Bobcat	Felidae	*Puma rufus*	Native	H
Botta's Pocket Gopher	Geomyidae	*Thomomys bottae*	Native	
Dulzura (California) Pocket Mouse	Heteromyidae	*Chaetodipus californicus femoralis*	Native	CSSC
San Diego Pocket Mouse	Heteromyidae	*Chaetodipus fallax*	Native	CSSC
Dulzura Kangaroo Rat		*Dipodomys simulans*		
Pacific Kangaroo Rat	Heteromyidae	*Dipodomys agilis*	Native	
Stephen's Kangaroo Rat	Heteromyidae	*Dipodomys stephensi*	Native	FE, CT
Pacific Pocket Mouse	Heteromyidae	*Perognathus longimembris pacificus*	Native	FE
San Diego Black-tailed Jackrabbit	Leporidae	*Lepus californicus bennetti*	Native	CSSC
Desert Cottontail	Leporidae	*Sylvilagus audubonii*	Native	H
Brush Rabbit	Leporidae	*Sylvilagus bachmani*	Native	H
Striped Skunk	Mephitidae	*Mephitis mephitis*	Native	H
Western Mastiff Bat	Molossidae	*Eumops perotis californicus*	Native	CSSC
Pocketed Free-tailed Bat	Molossidae	*Nyctinomops femorrosaccus*	Native	CSSC
Brazilian Free-tailed Bat	Molossidae	*Tadarida brasiliensis*	Native	
California Vole	Muridae	*Microtus californicus*	Native	
House Mouse	Muridae	*Mus musculus*	Exotic	
Dusky-footed Woodrat	Muridae	*Neotoma fuscipes*	Native	
San Diego Woodrat	Muridae	*Neotoma lepida intermedia*	Native	CSSC
Southern Grasshopper Mouse	Muridae	*Onychomys torridus ramona*	Native	CSSC
Brush Mouse	Muridae	*Peromyscus boylii*	Native	
California Mouse	Muridae	*Peromyscus californicus*	Native	
Cactus Mouse	Muridae	*Peromyscus eremicus*	Native	
Deer Mouse	Muridae	*Peromyscus maniculatus*	Native	
Pinon Mouse	Muridae	*Peromyscus truei*	Native	
Norway Rat	Muridae	*Rattus norvegicus*	Exotic	
Black Rat	Muridae	*Rattus rattus*	Exotic	
Western Harvest Mouse	Muridae	*Reithrodontomys megalotis*	Native	
Long-tailed Weasel	Mustelidae	*Mustela frenata*	Native	H
Western Spotted Skunk	Mustelidae	*Spilogale gracilis*	Native	H
Badger	Mustelidae	*Taxidea taxus*	Native	H
California Sea Lion	Otariidae	*Zalophus californianus*	Native	CP
Northern Elephant Seal	Phocidae	*Mirounga angustirostris*	Native	CP, CFP
Ringtail	Procyonidae	*Bassariscus astutus*	Native	CFP
Raccoon	Procyonidae	*Procyon lotor*	Native	H
California Ground Squirrel	Sciuridae	*Spermophilus beecheyi*	Native	
Desert Shrew	Soricidae	*Notiosorex crawfordi*	Native	
Ornate Shrew	Soricidae	*Sorex ornatus*	Native	
Broad-footed Mole	Talpidae	*Scapanus latimanus*	Native	
Pallid Bat	Vespertilionidae	*Antrozous pallidus*	Native	CSSC, USFS
Big Brown Bat	Vespertilionidae	*Eptesicus fuscus*	Native	
Yuma Myotis	Vespertilionidae	*Myotis yumanensis*	Native	CSSC
Western Pipistrelle	Vespertilionidae	*Pipistrellus hesperus*	Native	
Class Osteichthyes				
Topsmelt	Atherinidae	*Atherinops affinis*	Native	
Jacksmelt	Atherinidae	*Atherinopsis californiensis*	Native	
California Grunion	Atherinidae	*Leuresthes tenuis*	Native	
Pacific Sanddab	Bothidae	*Citharichthys sordidus*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Osteichthyes *cont.*				
Speckled Sanddab	Bothidae	*Citharichthys stigmaeus*	Native	
Longfin Sanddab	Bothidae	*Citharichthys xanthostigma*	Native	
California Halibut	Bothidae	*Paralichthys californicus*	Native	
Gray Smoothhound	Carcharhinidae	*Mustelus californicus*	Native	
Green Sunfish	Centrarchidae	*Lepomis cyanellus*	Exotic	
Bluegill	Centrarchidae	*Lepomis macrochirus*	Exotic	
Redear Sunfish	Centrarchidae	*Lepomis microlophus*	Exotic	
Redeye Bass	Centrarchidae	*Micropterus coosae*	Exotic	
Largemouth Bass	Centrarchidae	*Micropterus salmonides*	Exotic	
Smallmouth bass		*Micropterus dolomieu*	Exotic	
Spotted Sand Bass	Centrarchidae	*Paralabrax clathratus*	Native	
Black Crappie	Centrarchidae	*Pomoxis nigromaculatus*	Exotic	
Giant Sea Bass	Centrarchidae	*Stereolepis gigas*	Native	
Bay Blenny	Clinidae	*Hypsoblennius gentilis*	Native	
Staghorn Sculpin	Cottidae	*Leptocottus armatus*	Native	
California Tonguefish	Cynoglossidae	*Symphurus atricauda*	Native	
Carp	Cyprinidae	*Cyprinus carpio*	Exotic	
Arroyo Chub	Cyprinidae	*Gila orcutti*	Native	
Golden Shiner	Cyprinidae	*Notemigonus crysoleucas*	Exotic	
Flathead Minnow	Cyprinidae	*Pimphales promelas*	Exotic	
California Killifish	Cyprinodontidae	*Fundulus parvipinnis*	Native	
Barred Surfperch	Embiotocidae	*Amphistichus argenteus*	Native	
Shiner Surfperch	Embiotocidae	*Cymatogaster aggregata*	Native	
Dwarf Surfperch	Embiotocidae	*Micrometrus minimus*	Native	
Deepbody Anchovy	Engraulididae	*Anchoa compressa*	Native	
Bay Anchovy	Engraulididae	*Anchoa delicatissima*	Native	
Northern anchovy		*Engraulis mordax*	Native	
Threespine Stickleback	Gasterosteidae	*Gasterosteus aculeatus*	Native	
Opaleye	Girellidae	*Girella nigricans*	Native	
Arrow Goby	Gobiidae	*Clevlandia ios*	Native	
Longtail Goby	Gobiidae	*Ctenogobius sagitulla*	Native	
Tidewater Goby	Gobiidae	*Eucyclogobius newberryi*	Native	FE
Longjaw Mudsucker	Gobiidae	*Gillichthys mirabilis*	Native	
Cheekspot Goby	Gobiidae	*Ilypnus gilberti*	Native	
Shadow Goby	Gobiidae	*Quietula y-cauda*	Native	
Black Bullhead	Ictaluridae	*Ameiurus melas*	Exotic	
Yellow Bullead	Ictaluridae	*Ameiurus natalis*	Exotic	
Brown Bullhead	Ictaluridae	*Ictalurus nebulosus*	Exotic	
Channel Catfish	Ictaluridae	*Ictalurus punctatus*	Exotic	
Striped Mullet	Mugilidae	*Mugil cephalus*	Native	
Butterfly Ray	Myliobatididae	*Gymnura marmorata*	Native	
Bat Ray	Myliobatididae	*Myliobatis californica*	Native	
Round Stingray	Myliobatididae	*Urolophus halleri*	Native	
Yellowfin Goby	Percidae	*Acanthogobius flavimanus*	Exotic	
Diamond Turbot	Pleuronectidae	*Hypsopsetta guttulata*	Native	
Starry Flounder	Pleuronectidae	*Platyichthys stellatus*	Native	
Mosquitofish	Poeciliidae	*Gambusia affinis*	Exotic	
Silver Salmon	Salmonidae	*Oncorhynchus kisutch*	Native	
Southern Steelhead	Salmonidae	*Oncorhynchus mykiss*	Native	FE
White Seabass	Sciaenidae	*Cynoscion nobilis*	Native	
California Corbina	Sciaenidae	*Menticirrhus undulatus*	Native	
Spotfin Croaker	Sciaenidae	*Roncador sternsii*	Native	
Queenfish	Sciaenidae	*Seriphus politus*	Native	
Yellowfin Croaker	Sciaenidae	*Umbrina roncador*	Native	
Pacific Bonito	Scombridae	*Sarda chiliensis*	Native	
Pacific Mackerel	Scombridae	*Scomber japonicus*	Native	

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Osteichthyes *cont.*				
Albacore	Scombridae	*Thunnus alalunga*	Native	
Striped Bass	Serranidae	*Morone saxatilis*	Exotic	
Kelp Bass	Serranidae	*Paralabrax clathratus*	Native	
Spotted Sand Bass	Serranidae	*Paralabrax maculatofasciatus*	Native	
Barred Sand Bass	Serranidae	*Paralabrax nebulifer*	Native	
Giant Sea Bass	Serranidae	*Stereolepis gigas*	Native	
California Sheephead	Sphyraenidae	*Pimelometopon pulchrum*	Native	
California Barracuda	Sphyraenidae	*Sphyraena argentea*	Native	
Bay Pipefish	Syngnathidae	*Syngnathus auliscus*	Native	
Pipefish	Syngnathidae	*Syngnathus leptorhynchus*	Native	
Class Phalangida				
Harvestmen			Native	
Class Reptilia				
Southern Alligator Lizard	Anguidae	*Elgaria multicarinata webbii*	Native	
Coastal Rosy Boa	Boidae	*Charina trivirgata roseofusca*	Native	USFS
Pacific Loggerhead Turtle [5]	Cheloniidae	*Caretta caretta*	Native	FT
Pacific Green Sea Turtle	Cheloniidae	*Chelonia mydas agassizii*	Native	FT
Common Snapping Turtle	Chelydridae	*Chelydra serpentina*	Exotic	
Pacific (olive) Ridley Turtle	Cheloniidae	*Lepidochelys olivacea*	Native	FT
California Glossy Snake	Colubridae	*Arizona elegans occidentallis*	Native	
Western Yellow-bellied Racer	Colubridae	*Coluber constrictor mormon*	Native	
San Diego Ringneck Snake	Colubridae	*Diadophis punctatus similus*	Native	USFS
Night Snake	Colubridae	*Hypsiglena torquata*	Native	
California Kingsnake	Colubridae	*Lampropeltis getulus californiae*	Native	
Red Racer (Coachwhip)	Colubridae	*Masticophis flagellum piceus*	Native	
Striped Racer	Colubridae	*Masticophis lateralis*	Native	
San Diego Gopher Snake	Colubridae	*Pituophis melanoleucus annectens*	Native	
Longnose Snake	Colubridae	*Rhinoceilus lecontei*	Native	
Coast Patch-nosed Snake	Colubridae	*Salvadora hexalepis virgultea*	Native	CSSC
California Black-head Snake	Colubridae	*Tantilla planiceps eiseni*	Native	
Two-striped Garter Snake	Colubridae	*Thamnophis hammondi*	Native	CP, CSSC, USFS
South Coast Garter Snake	Colubridae	*Thamnophis sirtalis ssp.*	Native	CSSC
California Lyre Snake	Colubridae	*Trimorphodon biscutatus vandenburghi*	Native	
Pacific Leatherback Turtle	Dermochelyidae	*Dermochelys coriacea*	Native	FT
Painted Turtle [6]	Emydidae	*Chrysemys picta*	Exotic	
Southwestern Pond Turtle	Emydidae	*Clemmys marmorata pallida*	Native	CP, CSSC, USFS
Florida Red-bellied Turtle [6]	Emydidae	*Pseudemys nelsoni*	Exotic	
Red-eared Slider	Emydidae	*Trachmys scripta elegans*	Exotic	
San Diego Banded Gecko [7]	Eublepharidae	*Coleonyx variegatus abbottii*	Native	
Western Blind Snake	Leptotyphlopidae	*Leptotyphlops humilis*	Native	
Coast Horned Lizard	Phrynosomatidae	*Phrynosoma coronatum (blainvillii)*	Native	CP, CSSC, USFS
Western Fence Lizard	Phrynosomatidae	*Sceloporus occidentalis*	Native	
Granite Spiny Lizard	Phrynosomatidae	*Sceloporus orcutti*	Native	
Side-blotched Lizard	Phrynosomatidae	*Uta stansburiana*	Native	
Gilbert's Skink	Scincidae	*Eumeces gilberti*	Native	
Western Skink	Scincidae	*Eumeces skiltonianus*	Native	CSSC
Orange-throated Whiptail	Teiidae	*Aspidoscelis hyperythra beldingi*	Native	CP, CSSC

Table F-2. Wildlife Species on MCB Camp Pendleton

Common Name	Family	Species	Origin	Species Status [1]
Class Reptilia *cont.*				
Western Whiptail	Teiidae	*Cnemidophorus tigris multiscutatus*	Native	
Coastal Whiptail	Teiidae	*Aspidoscelis tigris stejnegeri*	Native	
Speckled Rattlesnake	Viperidae	*Crotalus mitchelli pyrrhus*	Native	
Red Diamond Rattlesnake	Viperidae	*Crotalus ruber*	Native	CSSC
Southern Pacific Rattlesnake	Viperidae	*Crotalus viridis helleri*	Native	

1 Species Status. Abbreviations for the legal status of the species are as follows (see CDFG 1999 for full descriptions): (FE) federally listed, endangered; (FT) federally listed, threatened; (CE) state (California) listed, endangered; (CT) state listed, threatened; (CFP) California fully protected; (CP) California protected; (CSSC) California Species of Special Concern; (H) Harvested; (USFS) U.S. Forest Service sensitive species; (CDF) California Department of Forestry and Fire Protection sensitive species; (BLM) Bureau of Land Management sensitive species; and (MTBA) included in 50 CFR 10.13 list of migratory birds.

2 Red-legged frogs were historically present on Camp Pendleton, but not located during survey efforts of all drainages from 1995 to 1997 (Holland & Goodman 1998a, 1998b).

3 The wood stork is listed as a vagrant on the Camp Pendleton's "Checklist of Birds" having been observed only twice on Base, 23 December 1983 and 20 February 1984.

4 Only unpaired (possibly transient) light-footed clapper rails have been observed on Camp Pendleton since 1988 (Zembal & Hoffman 2000). The most recent unpaired sighting of a light-footed clapper rail on Camp Pendleton was in 1997 (Zembal & Hoffman 2000).

5 Uncommon in the San Diego area, only a single record of a Pacific loggerhead turtle exists on Camp Pendleton (Holland & Goodman 1998a, 1998b).

6 Likely an "accidental"/captive release.

7 The San Diego banded gecko was not found on Camp Pendleton during the Holland and Goodman (1998a, 1998b) study despite intensive survey efforts; however, a single museum record exists fro De Luz (from 1945) and it is assumed that this species does occur on Base.

References

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Table F-3 Federally Listed, Proposed, or Designated Candidate Endangered or Threatened Species Identified for Counties under the Bob Stump Training Range Complex Airspace						
***Scientific Name* and Common Name**	*COUNTY OF OCCURRENCE BY STATE1*		**STATUS** *(FEDERAL AND STATE)2*			***General Habitat Associations ****
	Arizona	***California***	***Fed***	***AZ***	***CA***	
Allium munzii *Munz' onion*		*Riverside*	*E*	-	*T*	Grows in heavy clay soils in open and gray areas of chaparral, coastal scrub, cismontane woodland, pinyon-juniper woodland, and valley and foothill grassland.
Ambrosia pumila *San Diego ambrosia*		*Riverside*	*E*	-	-	Grows in sandy loam or clay soils in chaparral, coastal scrub, and valley and foothill grassland. Can persist in areas of superficial disturbance.
Ambystoma californiense California tiger salamander		*Riverside*	*T*	-	-	Need underground refuges, especially ground squirrel burrows & vernal pools or other seasonal water sources for breeding.
Antilocapra americana sonoriensis Sonoran pronghorn	*Yuma*		*E*	-	-	Typically, bajadas are used as fawning areas and sandy dune areas provide food seasonally. Historical range was probably larger than exists today. This subspecies also occurs in Mexico
Arenaria paludicola Marsh sandwort		*Riverside*	*E*	-	*E*	Grows up through dense mats of reeds and cattails in freshwater marshes and swamps.
Astragalus lentiginosus var. *coachellae* Coachella Valley milk-vetch		*Riverside*	*E*	-	-	Sand flats washes, outwash fans, sometimes on dunes in Sonoran desert scrub.
Astragalus magdalenae var. *peirsonii* Peirson's milk-vetch		*Imperial*	*T*	-	*E*	Slopes and hollows in mobile desert dunes, usually to the lee of the prevailing winds.
Astragalus tricarinatus Triple-ribbed milk-vetch		*Riverside*	*E*	-	-	Hot, rocky slopes in canyons and along edge of boulder-strewn desert washes in Joshua tree woodland, and Sonoran desert scrub.
Atriplex coronata var. *notatior* San Jacinto Valley crownscale		*Riverside*	*E*	-	-	Playas, chenopod scrub, valley and foothill grassland and vernal pools of the San Jacinto River Valley
Batrachoseps major aridus Desert slender salamander		*Riverside*	*E*	-	*E*	Occurs under limestone sheets, rocks, & talus, usually at the base of damp, shaded, north & west-facing walls. Known only from hidden palm canyon & Guadalupe Creek, Riverside County, in barren areas, palm oasis, desert wash, and desert scrub.

Table F-3 Federally Listed, Proposed, or Designated Candidate Endangered or Threatened Species Identified for Counties under the Bob Stump Training Range Complex Airspace						
***Scientific Name* and Common Name**	*COUNTY OF OCCURRENCE BY STATE1*		**STATUS** *(FEDERAL AND STATE)2*			***General Habitat Associations ****
	Arizona	***California***	***Fed***	***AZ***	***CA***	
Berberis nevinii Nevin's barberry		*Riverside*	*E*	-	*E*	On steep, north-facing slopes or in low grade sandy washes in chaparral, cismontane woodland, coastal scrub, and riparian scrub.
Branchinecta lynchi Vernal pool fairy shrimp		*Riverside*	*T*	-	-	Inhabits small, clear-water sandstone-depression pools and grassed swale, earth slump, or basalt-flow depression pools.
Brodiaea filifolia Thread-leaved brodiaea		*Riverside*	*T*	-	*E*	Usually associated with clay soils in annual grassland and vernal pools; often surrounded by shrubland habitats in cismontane woodland, coastal scrub, playas, valley and foothill grassland, and vernal pools.
Bufo californicus Arroyo toad		*Riverside*	*E*	-	-	Semi-arid regions near washes or intermittent streams, including valley-foothill and desert riparian and desert wash.
Catostomus santaanae Santa Ana sucker		*Riverside*	*T*	-	-	Habitat generalists, but prefer sand-rubble-boulder bottoms, cool, clear water, & algae. Endemic to Los Angeles basin south coastal streams.
Ceanothus ophiochilus Vail Lake ceanothus		*Riverside*	*T*	-	*E*	Grows in Gabbro seams on north-facing ridges on the eastern sides of mountains in chaparral.
Charadrius alexandrinus nivosus Western snowy plover		*Riverside*	*T*	*WSC*	-	Sandy beaches, salt pond levees and shores of large alkali lakes. Needs sandy, gravelly or friable soils for nesting.
Coccyzus americanus occidentalis Western yellow-billed cuckoo	*Yuma*	*Imperial, Riverside*	*C*	*WSC*	*E*	Nests in riparian jungles of willow, often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape along the broad, lower flood-bottoms of larger river systems.
Cordylanthus maritimus ssp. *maritimus* Salt marsh bird's-beak		*Riverside*	*E*	-	*E*	Limited to the higher zones of the coastal salt marsh habitat and in coastal dunes.
Cyprinodon macularius Desert pupfish		*Riverside, Imperial*	*E*	*WSC*	*E*	Desert ponds, springs, marshes and streams in southern California.

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***Scientific Name* and Common Name**	*COUNTY OF OCCURRENCE BY STATE1*		**STATUS** *(FEDERAL AND STATE)2*			***General Habitat Associations ****
	Arizona	***California***	***Fed***	***AZ***	***CA***	
Dinacoma caseyi Casey's June Beetle		*Riverside*	*C*	-	-	Found only in two populations in a small area of southern palm springs. Occurs in sandy soils; the females live underground and only come to the ground surface to mate.
Dipodomys merriami parvus San Bernardino kangaroo rat		*Riverside*	*E*	-	-	Alluvial scrub vegetation on sandy loam substrates characteristic of alluvial fans and flood plains.
Dipodomys stephensi Stephens' kangaroo rat		*Riverside*	*E*	-	*T*	Primarily annual & perennial grasslands, but also occurs in coastal scrub & sagebrush with sparse canopy cover. Prefers buckwheat, chamise, brome grass & filaree. Will burrow into firm soil.
Dodecahema leptoceras Slender-horned spineflower		*Riverside*	*E*	-	*E*	Flood deposited terraces and washes supporting chaparral and alluvial fan sage scrub.
Empidonax traillii extimus Southwestern willow flycatcher	*Yuma*	*Riverside, Imperial*	*E*	*WSC*	*E*	Riparian woodlands in southern California.
Eriastrum densifolium ssp. *sanctorum* Santa Ana River woollystar		*Riverside*	*E*	-	*E*	In sandy soils on river floodplains or terraced fluvial deposits in coastal scrub and chaparral.
Erigeron parishii Parish's daisy		*Riverside*	*T*	-	-	Often on carbonate; limestone mountain slopes; typically associated with drainages in Mojavean desert scrub, pinyon-juniper woodland, Joshua tree woodland.
Eryngium aristulatum var. *parishii* San Diego button-celery		*Riverside, Imperial*	*E*	-	*E*	San Diego mesa hardpan & claypan vernal pools & southern interior basalt flow vernal pools; usually surrounding by scrub.
Euphydryas editha quino Quino checkerspot butterfly		*Riverside*	*E*	-	-	Sunny openings within chaparral and coastal sage shrublands in parts of Riverside & San Diego counties. Hills and mesas near the coast. Need high densities of food plants *Plantago erecta*, *P. insularis*, *Orthocarpus purpurescens*

Table F-3 Federally Listed, Proposed, or Designated Candidate Endangered or Threatened Species Identified for Counties under the Bob Stump Training Range Complex Airspace						
***Scientific Name* and Common Name**	*COUNTY OF OCCURRENCE BY STATE1*		**STATUS** *(FEDERAL AND STATE)2*			***General Habitat Associations ****
	Arizona	***California***	***Fed***	***AZ***	***CA***	
Gopherus agassizii Desert tortoise		*Riverside, Imperial*	*T*	*WSC*	*T*	Most common in desert scrub, desert wash, and Joshua tree habitats; occurs in almost every desert habitat. Require friable soil for burrow and nest construction. Creosote bush habitat with large annual wildflower blooms preferred.
Navarretia fossalis Spreading navarretia		*Riverside*	*T*	-	-	San Diego hardpan & San Diego claypan vernal pools; in swales & vernal pools, often surrounded by other habitat types.
Oncorhynchus mykiss irideus Southern steelhead - southern California ESU		*Riverside*	*E*	-	-	Federal listing refers to populations from Santa Maria River south to southern extent of range (San Mateo creek in San Diego co.)
Orcuttia californica California Orcutt grass		*Riverside*	*E*	-	*E*	Vernal pools.
Ovis canadensis nelsoni dps Peninsular bighorn sheep		*Riverside*	*E*	-	*T*	Open desert slopes below 4,000 ft elevation from San Gorgonio pass south into Mexico. Optimal habitat includes steep walled canyons and ridges bisected by rocky or sandy washes, with available water.
Pelecanus occidentalis californicus California brown pelican	*Yuma*		*E*	-	-	Subspecies is found on Pacific Coast and is endangered due to pesticides. It is an uncommon transient in Arizona on many Arizona lakes and rivers. Individuals wander up from Mexico in summer and fall. No breeding records in Arizona.
Phrynosoma mcallii Flat-tailed horned Lizard	*Yuma*	*Riverside, Imperial*	*CA*	*WSC*	-	Conservation Agreement revised in 2003. Species also found in portions of San Diego County, central Riverside County, and Imperial County, California; also Sonora and Baja California, Mexico.
Polioptila californica californica Coastal California gnatcatcher		*Riverside*	*T*	-	-	Obligate, permanent resident of coastal sage scrub below 2500 ft in southern California. Low, coastal sage scrub in arid washes, on mesas & slopes. Not all areas classified as coastal sage scrub are occupied.

Table F-3 Federally Listed, Proposed, or Designated Candidate Endangered or Threatened Species Identified for Counties under the Bob Stump Training Range Complex Airspace						
***Scientific Name* and Common Name**	*COUNTY OF OCCURRENCE BY STATE1*		**STATUS** *(FEDERAL AND STATE)2*			***General Habitat Associations ****
	Arizona	***California***	***Fed***	***AZ***	***CA***	
Ptychocheilus lucius Colorado squawfish		*Imperial*	*E*	-	*E*	Was native to the Colorado river bordering California. Adults found in deep pools in the main river channel, smaller fish are found in shallow & quiet waters.
Rallus longirostris yumanensis Yuma clapper rail	*Yuma*	*Riverside, Imperial*	*E*	*WSC*	*T*	Nests in fresh-water marshes along the Colorado river and along the south and east ends of the Salton Sea. Prefers stands of cattails and tules dissected by narrow channels of flowing water; principle food is crayfish.
Rana aurora draytonii California red-legged frog		*Riverside*	*T*	-	-	Lowlands & foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation. Requires 11-20 weeks of permanent water for larval development. Must have access to estivation habitat.
Rana muscosa Mountain yellow-legged frog		*Riverside*	*E*	-	-	Federal listing refers to populations in the San Gabriel, San Jacinto & San Bernardino mountains only. Always encountered within a few feet of water. Tadpoles may require 2 - 4 yrs to complete their aquatic development.
Rhaphiomidas terminatus abdominalis Delhi Sands flower-loving fly		*Riverside*	*E*	-	-	Found only in areas of the Delhi sands formation in southwestern San Bernardino & northwestern Riverside Counties. Requires fine, sandy soils, often with wholly or partly consolidated dunes & sparse vegetation. Oviposition requires shade.
Spermophilus tereticaudus chlorus Palm Springs round-tailed ground squirrel		*Riverside*	*C*	-	-	Restricted to the Coachella Valley. Prefers desert succulent scrub, desert wash, desert scrub, alkali scrub, & levees. Prefers open, flat, grassy areas in fine-textured, sandy soil. Density correlated with winter rainfall.

Table F-3 Federally Listed, Proposed, or Designated Candidate Endangered or Threatened Species Identified for Counties under the Bob Stump Training Range Complex Airspace

***Scientific Name* and Common Name**	*COUNTY OF OCCURRENCE BY STATE1*		**STATUS** *(FEDERAL AND STATE)2*			***General Habitat Associations ****
	Arizona	***California***	***Fed***	***AZ***	***CA***	
Streptocephalus woottoni Riverside fairy shrimp		*Riverside*	*E*	-	-	Endemic to western Riverside, Orange, and San Diego Counties in areas of tectonic swales/earth slump basins in grassland & coastal sage scrub. Inhabit seasonally astatic pools filled by winter/spring rains. Hatch in warm water later in the season.
Trichostema austromontanum ssp. *compactum* Hidden Lake bluecurls		*Riverside*	*T*	-	-	Occurs in seasonally submerged lake margins, decomposed granite in Upper montane coniferous forest.
Uma inornata Coachella Valley fringe-toed lizard		*Riverside*	*T*	-	*E*	Limited to sandy areas in the Coachella Valley, Riverside County. Requires fine, loose, windblown sand (for burrowing), interspersed with hardpan and widely spaced desert shrubs.
Vireo bellii pusillus Least Bell's vireo		*Riverside, Imperial*	*E*	*WSC*	*E*	Summer resident of southern California in low riparian in vicinity of water or in dry river bottoms. Nests placed along margins of bushes or on twigs projecting into pathways, usually willow, coyote brush, or mesquite.
Xyrauchen texanus Razorback sucker	*Yuma*	*Riverside, Imperial*	*E*	*WSC*	*E*	Found in the Colorado River bordering California. Adapted for swimming in swift currents but also need quiet waters. Spawn in areas of sand/gravel/rocks in shallow water.

*General Habitat Association Information from: CNDDB 2007, USFWS 2007

Federal ESA
E: Federally Listed as Endangered
T: Federally Listed as Threatened
C: Federal Special Concern Species
-: No listing

Arizona Game and Fish Department
WSC: Wildlife of Special Concern
-: No listing

California Department of Fish and Game
WSC: Wildlife of Special Concern
-: No listing

Table F-4. Special Status Fauna at MCAGCC Twentynine Palms

Common Name	Scientific Name	Federal Status	State Status (priority)
Birds			
LeConte's Thrasher	*Toxostoma lecontei*	None	CSSC (3)
Loggerhead Shrike	*Lanius ludovicianus*	None	CSSC (n/a)
Prairie Falcon	*Falco mexicanus*	None	Endangered (3)
Northern Harrier	*Circus cyaneus*	None	CSSC (2)
Burrowing Owl	*Athene cunicularia*	None	CSSC (2)
Long-eared Owl	*Asio otus*	None	CSSC (2)
Golden Eagle	*Aquila chrysaetos*	Bald / Golden Eagle Protection Act	CSSC (3) FP3511
Sharp-shinned Hawk	*Accipiter striatus*	None	CSSC (3)
Cooper's Hawk	*Accipiter cooperi*	None	CSSC (3)
Willow Flycatcher #	*Empidonax trailii*	Endangered	Endangered
Black Tern	*Chlidonias niger*	None	CSSC (2)
Short-eared owl	*Asio flammeus*	None	CSSC (3)
Vaux's Swift	*Chaetura vauxi*	None	CSSC (2)
Yellow Warbler	*Dendroica petechia brewsteri*	None	CSSC (2)
Brown Pelican	*Pelecanus occidentalis*	Endangered	Endangered
American White Pelican	*Pelecanus erythrorhynchos*	None	CSSC (1)
Bell's Vireo	*Vireo bellii pusillus*	Endangered	Endangered
Snowy Plover	*Charadrius alexandrinus*	Threatened	CSSC (3)
Peregrine Falcon	*Falco peregrinus anatum*	none	Endangered
Gilded Flicker	*Colaptes auratus chrysoides*	none	Endangered
All raptors		none	FP 3503
Mammals			
Townsend's Western Big-eared Bat (= Townsend's Big-eared Bat)	*Corynorhinus townsendii* (= *Plecotus townsendii*)	None	CSSC (2)
California Leaf-nosed Bat	*Macrotus californicus*	none	CSSC (2)
Western (= California) Mastiff Bat	*Eumops perotis californicus*	none	CSSC (2)
Pallid San Diego Pocket Mouse	*Chaetodipus* (= *Perognathus*) *fallax pallidus*	none	CSSC (n/a)
Pallid Bat	*Antrozous pallidus*	none	CSSC (n/a)
Reptiles			
Mojave Fringe-toed Lizard	*Uma scoparia*	none	CSSC (n/a)
Desert Tortoise	*Gopherus agassizii*	Threatened	Threatened

Notes:
Not able to determine subspecies on MAGTFTC MCAGCC.
* Definitions:
Federal. Federal categories per the Endangered Species Act, administrated by the USFWS.
FE Endangered - any species officially listed by the USFWS that is in danger of extinction throughout all or a significant portion of its range.
FT Threatened - any species officially listed by the USFWS that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
BGEPA Bald and Golden Eagle Protection Act of 1940.
State State categories per the 1984 California Endangered Species Act
SE Endangered - any species officially listed by the California Fish and Game Commission that is in danger of extinction throughout all or a significant portion of its range.
ST Threatened - any species officially listed by the California Fish and Game Commission that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
CSSC California Special Concern Species.
FP 3511 Fully protected in accordance with Section 3511 of the California Fish and Game Code.
FP 3503 Fully protected in accordance with Section 3503.5 of the California Fish and Game Code, which prohibits the take of any birds, nests or eggs of bird in the orders Falconiformes and Strigiformes

F-5. Military Training Routes						
Common Name and Scientific Name	**COUNTY OF OCCURRENCE BY STATE[1]**		**STATUS (FEDERAL AND STATE)[2]**			***General Habitat Associations***
	California	*Arizona*	*Fed*	*CA*	*AZ*	
AMPHIBIANS						
Arroyo toad, *Bufo microscaphus californicus*	Riverside, San Bernardino, San Diego		E	SC		For breeding, adults require overflow pools adjacent to the inflow channel of streams that are free of predatory fishes Strongly favor shallow, exposed pools with a low current velocity.
California red-legged frog, *Rana aurora draytonii*	Riverside, San Bernardino		T	SC		Prefer dense, shrubby riparian vegetation associated with deep, still or slow-moving water
California tiger salamander, *Ambystoma californiense*	Riverside		T	SC		Habitat includes grasslands and foothill regions. Breed in permanent, lowland aquatic sites.
Chiricahua Leopard Frog, *Rana chiricahuensis*		Yavapai			WSC	Found in ephemeral pools and unpredictable waters
Desert slender salamander, *Batrachoseps major aridus*	Riverside		E	E		Found in crevices between limestone sheets and under limestone slabs and other rocks along the base of cliffs where continuous water seepage occurs.
Sierra Madre yellow-legged frog, *Rana muscosa*	Riverside, San Bernardino, San Diego		E	SC		Found in ponds, dams, lakes, and streams at moderate to high elevations appears. Prefers open stream and lake margins that gently slope up.
BIRDS						
American peregrine falcon, *Falco peregrinus anatum*	San Diego	La Paz	DE	E	WSC	Range includes most of California, except in deserts. Nesting and wintering habitats are varied, including wetlands, woodlands, other forested habitats, cities, agricultural areas and coastal habitats
Bald eagle (wintering pop.)/Sonoran bald eagle population *Haliaeetus leucocephalus*		Mohave, Yavapai, Yuma	T (PDL)	E	WSC	Wintering habitat includes perches in a variety of species of trees, in close proximity to a food source (fish, waterfowl, seabirds). Communal roosts are often located in close proximity to a rich food source and most often in forests with an old-growth constituent. (USFWS 1986)

F-5. Military Training Routes						
Common Name and Scientific Name	**COUNTY OF OCCURRENCE BY STATE[1]**		**STATUS (FEDERAL AND STATE)[2]**			***General Habitat Associations***
	California	*Arizona*	*Fed*	*CA*	*AZ*	
BIRDS						
Belding's Savanna Sparrow *Passerculus sandwichensis beldingi*	San Diego			E		Occurs primarily in grassland, saline emergent wetland, and wet meadow habitats. At Salton Sea, winters uncommonly in desert riparian habitat, primarily in saltcedar scrub at river mouths. East of Sierra Nevada, winters locally north through Owens Valley. Belding's savannah sparrow, P. s. beldingi, lives year-round in scattered southern coastal wetlands. (CDFG 2009)
California brown pelican, *Pelecanus occidentalis californicus*	San Diego	Yuma	E	E		A Southern California population breeds on islands off the coast of Southern California and in Mexico. Between breeding seasons, pelicans gather in communal roosts along the Pacific Coast and at the Salton Sea in Imperial County, California. Major roosts are found on man-made structures (piers, jetties, offshore rocks) and on beaches. (CDFG 2000)
California least tern, *Sternula antillarum browni*	San Diego		E	E		Nests in colonies on bare, gravelly, or sparsely vegetated coastal beaches, coastal wetlands, and riverine sandbars. Nest at sites near sources of water where small fish are abundant. (CDFG 2000)
Coastal California gnatcatcher, *Polioptila californica californica*	Riverside, San Bernardino, San Diego		T	SC		Typically occurs in or near sage scrub habitat. Will also use chaparral, grassland, and riparian habitats where they occur in proximity to sage scrub for dispersal and foraging. Avoid nesting on very steep slopes (greater than 40 percent).
Least Bell's vireo, *Vireo bellii pusillus*	Imperial, Riverside, San Bernardino, San Diego		E	E		Breeds in cottonwood-willow forests, oak woodlands, shrubby thickets, and dry washes with willow thickets at the edges. Large breeding populations in Riverside and San Diego counties.
Light-footed clapper rail, *Rallus longirostris levipes*	San Diego		E	E		Inhabits cordgrass-pickleweed salt marsh year-round, feeding primarily on intertidal invertebrates. (CDFG 2000)
Mexican Spotted Owl, *Strix occidentalis lucida*		Yavapai	T		WSC	Nest or roost in closed canopy forests or rocky canyons. The majority of nests are found in trees. Favors old growth mixed-conifer forests.

F-5. Military Training Routes						
Common Name and Scientific Name	**COUNTY OF OCCURRENCE BY STATE[1]**		**STATUS (FEDERAL AND STATE)[2]**			***General Habitat Associations***
	California	*Arizona*	*Fed*	*CA*	*AZ*	
BIRDS						
Southwestern willow flycatcher, *Empidonax traillii extimus*	Imperial, Riverside, San Bernardino, San Diego	Mohave, Yavapai, Yuma	E	E	WSC	Breeds in patchy to dense riparian habitats along streams and other wetlands. (USFWS 2002)
Western snowy plover, *Charadrius alexandrines nivosus*	Riverside, San Bernardino, San Diego		T	SC		Nest on sand spits, dune-backed beaches, beaches along creeks and river mouths, lagoons, and estuaries along the pacific coast from Baja California to Washington. (USFWS 2001)
Western yellow-billed cuckoo, *Coccyzus americanus occidentalis*	Imperial, Riverside, San Bernardino, San Diego	Mohave, Yavapai, Yuma	C	E	WSC	Nests in riparian habitats, primarily woodlands with willows and cottonwoods or mesquite thickets.
Yuma clapper rail, *Rallus longirostris yumanensis*	Imperial, Riverside, San Bernardino	Mohave, Yavapai, Yuma	E	T	WSC	Inhabits dense stands of cattails and bulrushes along the lower Colorado River from California and Arizona south into Mexico year-round. The rail is also found at the Salton Sea in Imperial County, California. (CDFG 2000)
FISH						
Bonytail, *Gila elegans*		La Paz			WSC	Prefers pools and eddies of warm, often heavily silted, swift moving rivers. Also occur in reservoir habitats. Still found in Lake Mojave and Lake Havasu
Colorado Pikeminnow, *Ptychocheilus lucius*	Imperial, San Bernardino	Yavapai	E	E	WSC	Found in major tributaries in slow, deep water. Currently extirpated from California waters
Desert pupfish, *Cyprinodon macularius*	Imperial, San Bernardino, San Diego	La Pax, Mohave, Yavapai	E	E		Will tolerate waters with salinities from freshwater to nearly twice that of seawater, with water temperatures ranging from 36 F to 113 F, and oxygen levels down to 0.1 ppm
Gila Chub, *Gila intermedia*		Yavapai	E		WSC	Found in smaller headwater streams, cienegas and springs or marshes of the Gila River basin. Utilize diverse habitat types based on season and age. Adults have been collected from deep pools with heavily vegetated margins and undercut banks. Juveniles have been collected from riffles, pools and undercut banks of runs. In larger stream systems they utilize heavily vegetated backwaters for cover and feeding.

F-5. Military Training Routes						
Common Name and Scientific Name	**COUNTY OF OCCURRENCE BY STATE[1]**		**STATUS (FEDERAL AND STATE)[2]**			***General Habitat Associations***
	California	*Arizona*	*Fed*	*CA*	*AZ*	
FISH						
Gila Topminnow, *Poeciliopsis occidentalis occidentalis*		La Paz, Yavapai	E		WSC	Occupy headwater springs and vegetated margins and backwater areas of intermittent and perennial streams and rivers. Prefers shallow warm water in a moderate current with dense aquatic vegetation and algae mats. Can live in a fairly wide range of water temperatures and chemistries.
Humpback Chub, *Gila cypha*		Mohave	E		WSC	Found in riverine habitats, especially canyon areas with fast current,deep pools, and boulder habitat. Generally found in habitats below 1,219 m (4,000 ft) in elevation.
Razorback Sucker, *Xyrauchen texanus*		La Paz, Mohave, Yavapai, Yuma	E		WSC	Prefers shallow swift waters of mid-channel sandbars (less than 12ft deep) during the summer months, and slow runs, slack waters and eddies (2.0 to 4.6ft) in the winter. Found in Lake Mojave
Southern steelhead, *Oncorhynchus mykiss irideus*	San Diego		E	SC		In Southern Califonia, in higher-elevation headwaters,
Spikedace, *Meda fulgida*		Yavapai	T		WSC	Found in moderate to large perennial streams, where it inhabits shallow riffles with sand, gravel, and rubble substrates, and moderate to swift currents and swift pools over sand or gravel substrates
Tidewater goby, *Eucyclogobius newberryi*	San Diego		E	SC		Found in shallow lagoons and lower stream reaches where the water is brackish to fresh and slow-moving or fairly still, but not stagnant
Unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni*	San Bernardino		E	E		This fish is currently restricted to the upper Santa Clara River drainage in Los Angeles and Ventura counties, San Antonio Creek on Vandenburg Air Force Base, San Luis Obispo County, and an isolated population in San Felipe Creek in San Diego County.
Virgin River Chub, *Gila seminuda*		Mohave	E		WSC	Found in deeper areas where waters are swift, but not turbulent, and is generally associated with boulders or other cover
Woundfin, *Plagopterus argentissimus*		Mohave	E		WSC	Occupies swift parts of silty streams, seemingly avoiding clear waters and very seldom found in quieter pools. Occupies main channel of seasonally swift, highly turbid, and extremely warm streams, with sandy, constantly shifting bottoms

F-5. Military Training Routes						
Common Name and Scientific Name	**COUNTY OF OCCURRENCE BY STATE[1]**		**STATUS (FEDERAL AND STATE)[2]**			***General Habitat Associations***
	California	*Arizona*	*Fed*	*CA*	*AZ*	
REPTILES						
Desert Tortoise, *Gopherus agassizii*	Imperial, Riverside, San Bernardino	La Paz, Mohave, Yavapai, Yuma	T	T	WSC	Inhabits river washes, rocky hillsides, and flat desert having sandy or gravelly soil. Creosote bush, burrobush, saltbush, Joshua tree, Mojave yucca and cacti are often present in the habitat along with other shrubs, grasses, and wildflowers
MAMMALS						
Bighorn sheep, *Ovis canadensis*	Riverside, San Bernardino, San Diego		E	T		Inhabit mountainous terrain, alluvial fans and washes, and areas of flat terrain, such as valley floors, which serve as linkages between mountain ranges and allow for access to resources such as food and water.
Hualapai Mexican Vole, *Microtus mexicanus hualpaiensis*		Yavapai	E		WSC	Inhabits burrows in washes with abundant grass or sedge cover and a riparian or ponderosa pine overstory. Active year round. (USFWS 1991)
Lesser Long-nosed Bat, *Leptonycteris curasoae yerbabuenae*		Yuma	E		WSC	Roosts in caves and mines during the day. Night roosts include caves, mines, rock crevices, trees, shrubs, and occasionally abandoned buildings. (USFWS 1995)
Sonoran pronghorn, *Antilocapra Americana sonoriensis*		Yuma	E		WSC	Located in the Sonoran Desert in broad alluvial valleys separated by block-faulted mountains. Ephemeral washes are important during summer for thermal protection. (USFWS 1998)

Notes: 1. Counties of occurrence determined through review of county lists provided on California Natural Diversity Database (2008) and Arizona Game and Fish Department, Heritage Data Management System (Feb 2008)

2. Status:

Federal Status (determined by U.S. Fish and Wildlife Service)

- E Federally listed as Endangered.
- T Federally listed as Threatened.
- C Federally listed as Candidate (has not yet been proposed for listing)

California State Status (determined by California Department of Fish and Game):

- E State listed as Endangered
- T State listed as Threatened
- CSC State listed as California Species of Special Concern

Arizona State Status (determined by Arizona Game and Fish Department)

- WSC State listed as Wildlife of Special Concern

References

California Natural Diversity Database (CNDDB). 2007. Sacramento: California Department of Fish and Game.

United States Fish and Wildlife Service (USFWS). 2007. Public Website with information about federally listed and proposed species that occur in Yuma County, Arizona: http://www.fws.gov/southwest/es/arizona/Documents/CountyLists/Yuma.pdf, Accessed November 28, 2007.

The following tables include the list of sensitive plant species known, or having the potential to, occur on the MCAGCC, as provided in the MCAGCC Integrated Natural Resources Management Plan (Fiscal Years 2007-2011):

Table F-6 Sensitive Plants Known				
Scientific name	**Common Name**	**Federal Status***	**State Status***	**CNPS Status***
Allium parishii	Parish's onion	None	None	4
Castela emoryi	crucifixion thorn	None	None	2
Cryptantha holoptera	winged cryptantha	None	None	
Cynanchum utahense	Utah swallow-wort	None	None	4
Escobaria vivipara var. *alversonii[=Coryphantha v.* var.*a.]*	foxtail cactus	R	None	1B
Ferocactus cylindraceus var. *cylindraceus [=F. acanthodes* var.*a.]*	California barrel cactus	R	None	4
Galium angustifolium ssp.*gracillimum*	narrowleaf bedstraw	None	None	
Muilla coronata	crowned muilla	R	None	4
Penstemon albomarginatus	whitemargin beardtongue	None	None	1B
Wislizenia refracta ssp. *refracta*	spectacle fruit	None	None	4

Table F-7 Sensitive Plants potentially present				
Scientific name	**Common Name**	**Federal Status***	**State Status***	**CNPS Status***
Camissonia boothii spp. *Boothii*	Booth's evening primrose	None	None	
Chorizanthe spinosa	Mojave spineflower	None	None	
Chorizanthe xanti var. *leucotheca*	Riverside spineflower	None	None	
Cryptantha costata	Ribbed cryptantha	None	None	
Dudleya saxosa ssp. *saxosa*	Panamint liveforever	None	None	
Eriophyllum mohavense	Mojave woolly sunflower	R	None	2
Gilia aliquanta spp. *Aliquanta*	puffcalyx gilia	None	None	3
Lasthenia glabrata ssp. *Coulteri*	Coulter's goldfields	None	None	1B
Matelea parvifolia	spearleaf	None	None	2
Monardella robisonii	Robison's monardella	R	None	1B
Penstemon thurberi	Thurber's penstemon	None	None	
Quincula lobata	Chinese lantern	None	None	2
Portulaca halimoides (P. mundula)	silkcotton purslane	None	None	2
Sclerocactus polyancistrus	redspined fishhook cactus	None	None	4
Sidalcea neomexicana	salt spring checkerbloom	None	None	2

F-5. Military Training Routes						
Common Name and Scientific Name	**COUNTY OF OCCURRENCE BY STATE[1]**		**STATUS (FEDERAL AND STATE)[2]**			***General Habitat Associations***
	California	*Arizona*	*Fed*	*CA*	*AZ*	
						but not stagnant
Unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni*	San Bernardino		E	E		This fish is currently restricted to the upper Santa Clara River drainage in Los Angeles and Ventura counties, San Antonio Creek on Vandenburg Air Force Base, San Luis Obispo County, and an isolated population in San Felipe Creek in San Diego County.
Virgin River Chub, *Gila seminuda*		Mohave	E		WSC	Found in deeper areas where waters are swift, but not turbulent, and is generally associated with boulders or other cover
Woundfin, *Plagopterus argentissimus*		Mohave	E		WSC	Occupies swift parts of silty streams, seemingly avoiding clear waters and very seldom found in quieter pools. Occupies main channel of seasonally swift, highly turbid, and extremely warm streams, with sandy, constantly shifting bottoms
REPTILES						
Desert Tortoise, *Gopherus agassizii*	Imperial, Riverside, San Bernardino	La Paz, Mohave, Yavapai, Yuma	T	T	WSC	Inhabits river washes, rocky hillsides, and flat desert having sandy or gravelly soil. Creosote bush, burrobush, saltbush, Joshua tree, Mojave yucca and cacti are often present in the habitat along with other shrubs, grasses, and wildflowers
MAMMALS						
Bighorn sheep, *Ovis canadensis*	Riverside, San Bernardino,		E	T		Inhabit mountainous terrain, alluvial fans and washes, and areas of flat terrain, such as valley floors, which serve as linkages between mountain ranges and allow for access to

F-5. Military Training Routes

Common Name and Scientific Name	COUNTY OF OCCURRENCE BY STATE[1]		STATUS (FEDERAL AND STATE)[2]			*General Habitat Associations*
	California	*Arizona*	*Fed*	*CA*	*AZ*	
	San Diego					resources such as food and water.
Hualapai Mexican Vole, *Microtus mexicanus hualpaiensis*		Yavapai	E		WSC	Inhabits burrows in washes with abundant grass or sedge cover and a riparian or ponderosa pine overstory. Active year round. (USFWS 1991)
Lesser Long-nosed Bat, *Leptonycteris curasoae yerbabuenae*		Yuma	E		WSC	Roosts in caves and mines during the day. Night roosts include caves, mines, rock crevices, trees, shrubs, and occasionally abandoned buildings. (USFWS 1995)
Sonoran pronghorn, *Antilocapra Americana sonoriensis*		Yuma	E		WSC	Located in the Sonoran Desert in broad alluvial valleys separated by block-faulted mountains. Ephemeral washes are important during summer for thermal protection. (USFWS 1998)

Notes: 1. Counties of occurrence determined through review of county lists provided on California Natural Diversity Database (2008) and Arizona Game and Fish Department, Heritage Data Management System (Feb 2008)

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- CSC State listed as California Species of Special Concern

Arizona State Status (determined by Arizona Game and Fish Department)

F-5. Military Training Routes						
Common Name and Scientific Name	**COUNTY OF OCCURRENCE BY STATE[1]**		**STATUS (FEDERAL AND STATE)[2]**			***General Habitat Associations***
	California	*Arizona*	*Fed*	*CA*	*AZ*	
WSC State listed as Wildlife of Special Concern						

References

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Castela emoryi	crucifixion thorn	None	None	2
Cryptantha holoptera	winged cryptantha	None	None	
Cynanchum utahense	Utah swallow-wort	None	None	4
Escobaria vivipara var. *alversonii[=Coryphantha v.* var.*a.]*	foxtail cactus	R	None	1B
Ferocactus cylindraceus var. *cylindraceus [=F. acanthodes* var.*a.]*	California barrel cactus	R	None	4
Galium angustifolium ssp.*gracillimum*	narrowleaf bedstraw	None	None	
Muilla coronata	crowned muilla	R	None	4
Penstemon albomarginatus	whitemargin beardtongue	None	None	1B
Wislizenia refracta ssp. *refracta*	spectacle fruit	None	None	4

Table F-7 Sensitive Plants potentially present				
Scientific name	**Common Name**	**Federal Status***	**State Status***	**CNPS Status***
Camissonia boothii spp. *Boothii*	Booth's evening primrose	None	None	
Chorizanthe spinosa	Mojave spineflower	None	None	
Chorizanthe xanti var. *leucotheca*	Riverside spineflower	None	None	
Cryptantha costata	Ribbed cryptantha	None	None	
Dudleya saxosa ssp. *saxosa*	Panamint liveforever	None	None	
Eriophyllum mohavense	Mojave woolly sunflower	R	None	2
Gilia aliquanta spp. *Aliquanta*	puffcalyx gilia	None	None	3
Lasthenia glabrata ssp. *Coulteri*	Coulter's goldfields	None	None	1B
Matelea parvifolia	spearleaf	None	None	2
Monardella robisonii	Robison's monardella	R	None	1B
Penstemon thurberi	Thurber's penstemon	None	None	
Quincula lobata	Chinese lantern	None	None	2
Portulaca halimoides (P. mundula)	silkcotton purslane	None	None	2
Sclerocactus polyancistrus	redspined fishhook cactus	None	None	4
Sidalcea neomexicana	salt spring checkerbloom	None	None	2

Table F-8. Plant Species Known to Occur at MCAS Miramar

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Lycophyta (Fern-allies)			
Isoetaceae – Quill Family			
Isoetes howellii	Howell's Quillwort	ACOE vernal pool indicator	4, 7
Isoetes orcuttii	Orcutt's Quillwort	ACOE vernal pool indicator	4, 5, 6, 7, 16
Selaginellaceae – Spike Moss Family			
Selaginella bigelovii	Bigelow's Spike-Moss	Native	13, 17, 19
Selaginella cinerascens	Mesa Spike-Moss	Native	9, 10, 13, 17, 19
Pterophyta (Ferns)			
Marsileaceae – Pepperwort Family			
Marsilea vestita	Hairy Pepperwort	ACOE vernal pool indicator	4, 20
Pilularia americana	American Pillwort	ACOE vernal pool indicator	4, 5, 6, 7, 10, 16, 20
Ophilglossaceae – Adder's-Tongue Fern Family			
Ophioglossum californicum	California Adder's-Tongue Fern	Native	13, 19
Polypodiaceae – Polypody Family			
Polypodium californicum	California Polypody	Native	11
Pteridaceae – Brake Family			
Adiantum jordanii	California Maidenhair	Native	11, 13
Pentagramma triangularis ssp. *viscosa*	Silverback Fern	Native	11, 13
Pellaea andromedifolia	Coffee Fern	Native	12
Pellaea mucronata	Bird's-foot Cliff-Brake	Native	13, 17
Anthophyta (Dicotyledones)			
Aizoaceae – Fig-marigold Family			
Mesembryanthemum crystalliumum	Iceplant	Invasive	Station Natural Resources Division (NRD) Staff
Mesembryanthemum nodiflorum	Iceplant	Invasive	2
Carpobrotus species	Iceplant	Invasive	1, 9
Amaranthaceae – Amaranth Family			
Amaranthus albus	Tumbling Pigweed	Non-native	21
Anacardiaceae – Sumac Family			
Malosma laurina	Laurel Sumac	Native	2, 9, 11, 13, 17
Rhus integrifolia	Lemonadeberry	Native	9, 11, 13, 17
Rhus ovata	Sugar Bush		11
Schinus molle	Peruvian Pepper Tree	Non-native	11
Toxicodendron	Western Poison Oak	Native	9, 13, 17

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
diversilobum			
Apiaceae – Carrot Family			
Apiastrum angustifolium	Wild Celery	Non-native	11, 12, 13
Apium graveolens	Common Celery	Non-native	13
Daucus pusillus	American Wild Carrot	Native	11, 12, 13, 17
Eryngium aristulatum var. *parishii*	San Diego Button Celery	FE, ACOE vernal pool indicator	2, 3, 4, 5, 6, 7, 14, 16, 20
Foeniculum vulgare	Fennel	Invasive	1
Lomatium dasycarpum	Woolly Lomatium	Native	11
Sanicula arguta	Snakeroot	Native	11, 13
Sanicula crassicaulis	Pacific Sanicle	Native	13
Asclepiadaceae – Milkweed Family			
Asclepias fascicularis	Narrow-leaf Milkweed	Native	11, 13, 17
Asteraceae – Sunflower Family			
Acourtia microcephala	Perezia	Native	11, 13
Ambrosia psilostachya	Western Ragweed	Native	11, 13, 17
Anthemis cotula	Mayweed	Non-native	21
Artemisia californica	California Sagebrush	Native	2, 9, 11, 12, 13, 17
Artemisia palmeri	Palmer's Sagewort	CNPS4	8, 13
Baccharis pilularis	Coyote Bush	Native	10, 11
Baccharis salicifolia	Mulefat	Native	9, 11, 13, 17, 18
Baccharis sarothroides	Broom Baccharis	Native	9, 10, 11, 12, 13, 17
Brickellia californica	California Brickellbush	Native	17
Carduus pycnocephalus	Italian Thistle	Invasive	19
Centaurea melitensis	Tocalote	Invasive	2, 10, 12, 13, 16, 17
Chaenactis artemisiifolia	Artemisia Pinchushion	Native	11
Chaenactis glabriuscula var. *tenuifolia*	Yellow Pincushion	Native	11
Chamomila suaveolens	Pineapple Weed	Non-native	21
Chrysanthemum coronarium	Garland Daisy	Non-native	21
Cirsium occidentale	California Thistle	Native	13
Conyza bonariensis	Flax-leaf Fleabane	Non-native	13
Conyza canadensis	Horseweed	Non-native	11, 12
Conyza coulteri	Coulter's Horseweed	Non-native	
Corethrogyne filaginifolia	California-aster	Native	9, 11, 12, 13, 17
Cotula australis	Australian Brass-Buttons	Non-native	11
Cotula coronopifolia	Common Brass-Buttons	Non-native	2, 3, 5, 6, 10, 13, 16, 21
Cynara cardunculus	Artichoke Thistle	Invasive	1
Deinandra fasciculata	Slender Tarweed	Native	2, 3, 7, 10, 11, 12, 13, 16, 17
Dittrichia graveolens	Stinkywort	Invasive	NRD Staff
Encelia californica	Bush Sunflower	Native	11
Encelia farinosa	Brittlebrush	Native	NRD Staff
Erigeron foliosus var. *foliosus*	Fleabane Aster	Native	11, 17
Eriophyllum	Golden Yarrow	Native	11, 12, 18

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
confertiflorum			
Filago californica	California Filago	Native	13, 16
Filago gallica	Narrow-leaf Filago	Non-native	10, 11, 12, 13, 16, 17, 18
Gazania rigens	Gazania	Non-native	NRD Staff
Gnaphalium bicolor	Two-toned Everlasting	Native	11
Gnaphalium californicum	California Everlasting	Native	11, 13, 17
Gnaphalium canescens	Fragrant Everlasting	Native	13, 17
Gnaphalium luteo-album	Cudweed	Non-native	13
Gnaphalium stramineum	Cotton-batting Plant	Native	13
Harzardia squarrosa var. *grindelioides*	Saw-toothed Goldenbush	Native	13
Hedypnois cretica	Crete Weed	Non-native	10, 11, 13, 17
Helianthus annuus	Common Sunflower	Non-native	13, 21
Helianthus gracilentus	Slender Sunflower	Native	NRD Staff
Heterotheca grandiflora	Telegraph Weed	Native	11, 13
Holocarpha virgata	Sticky Tarweed	Native	7, 10, 11, 13, 16
Hypochaeris glabra	Smooth Cat's-Ear	Non-native	3, 7, 10, 11, 12, 13, 16, 17
Isocoma menziesii	Coast Goldenbush	Native	2, 9, 11, 13, 17
Lactuca serriola	Prickly Lettuce	Non-native	10, 13
Lasthenia californica	California Goldfields	Native	11, 12, 13
Layia platyglossa	Tidy-tips	Native	NRD Staff
Micropus californicus	Slender Cottonweed	Native	19
Osmadenia tenella	Rosin Weed	Native	10, 11, 12
Pentachaeta aurea	Golden-rayed Pentachaeta	Native	11
Picris echioides	Bristly Oxtongue	Non-native	13
Pluchea odorata	Marsh Fleabane	Native	NRD Staff
Porophyllum gracile	Odora	Native	11, 13
Psilocarphus brevissimus	Woolly-Marbles	ACOE vernal pool indicator	3, 4, 5, 6, 7, 10, 12, 16 20
Psilocarphus tenellus	Slender Woolly-Marbles	Native	4, 7, 10, 16, 20
Rafinesquia californica	California Chicory	Native	13, 21
Senecio vulgaris	Common Groundsel	Non-native	11
Silybum marianum	Milk Thistle	Invasive	11, 13
Sonchus asper	Prickly Sow Thistle	Non-native	10, 11, 13
Sonchus oleraceus	Common Sow Thistle	Non-native	10, 11, 12, 13, 16
Stebbinsoseris heterocarpa	Grassland Stebbinsoseris	Native	12
Stephanomeria virgata	Twiggy Wreath Plant	Native	11, 12, 13, 17
Stylocline gnaphaloides	Everlasting Nest-Straw	Native	11, 13, 17
Uropappus lindleyi	Silver Puffs	Native	11, 13
Viguiera laciniata	San Diego Sunflower	Native	9, 11, 15
Xanthium strumarium	Cocklebur	Non-native	13, 21
Boraginaceae – Borage Family			
Amsinckia menziesii	Common Fiddleneck	Native	11
Cryptantha clevelandii	White Forget-Me-Not	Native	21

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Cryptantha intermedia	Common Forget-Me-Not	Native	13, 21
Cryptantha muricata	Prickly Cryptantha	Native	9
Harpagonella palmeri	Palmer's Grappling Hook	CNPS 4	11, 15, 18
Heliotropium curassavicum	Wild Heliotrope	Native	NRD Staff
Pectocarya linearis	Slender Pectocarya	Native	11
Plagiobothrys acanthocarpus	Adobe Popcornflower	ACOE vernal pool indicator	5, 20, 21
Plagiobothrys bracteatus	Bracted Popcornflower	ACOE vernal pool indicator	5
Plagiobothrys collinus	Popcornflower	Native	11
Plagiobothrys leptocladus	Alkali Plagiobothrys	ACOE vernal pool indicator	10
Plagiiobothrys nothofulvus	Popcornflower	Native	12, 21
Brassicaceae – Mustard Family			
Athysanus pusillus	Dwarf Athysanus	Native	
Brassica nigra	Black Mustard	Non-native	7, 9, 10, 13, 17, 21
Capsella bursa-pastoris	Shepherd's Purse	Non-native	11
Cardamine californica	Milk Maids	Native	NRD Staff
Caulanthus heterophyllus	San Diego Jewelflower	Native	11, 12, 17
Coronopus didymus	Wart Cress	Non-native	21
Hirschfeldia incana	Perennial Mustard	Non-native	9, 11
Lepidium nitidum	Shining Peppergrass	Native	12, 13, 21
Lepidium virginicum var. *robinsonii*	Robinson's Peppergrass	Native	8
Lobularia maritima	Sweet Alyssum	Non-native	13
Raphanus sativus	Wild radish	Non-native	13, 21
Rapistrum rugosum	Wild Turnip	Non-native	NRD Staff
Rorippa nasturtium-aquaticum	Watercress	Native	NRD Staff
Thysanocarpus spp.	Lace Pod	Native	11
Cactaceae – Cactus Family			
Cylindropuntia californica	Cane Cholla	Native	11
Cylindropuntia prolifera	Coast Cholla	Native	9, 2002 SDNHM specimen
Ferocactus viridescens	San Diego Barrel Cactus	CNPS 2	8, 9, 11, 13, 17, 18, 19
Opuntia littoralis	Coastal Prickly-Pear	Native	9, 11, 13, 17, 19
Opuntia oricola	Pancake Prickly-Pear	Native	2002 SDNHM specimen, 19
Callitrichaceae – Water Starwort Family			
Callitriche marginata	Long-stem Water Starwort	ACOE vernal pool indicator	4, 5, 6, 7, 10, 16, 19, 20
Campanulaceae – Bellflower Family			
Downingia cuspidata	Toothed Downingia	ACOE vernal pool indicator	2, 3, 4, 5, 6, 7, 10, 16, 20

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Capparaceae – Caper Family			
Isomeris arborea	Bladderpod	Native	11
Caprifoliaceae – Honeysuckle Family			
Lonicera subspicata var. *denudata*	Honeysuckle	Native	11, 13, 17
Sambucus mexicana	Mexican Elderberry	Native	9, 13, 21
Caryophyllaceae – Pink Family			
Cardionema ramosissimum	Sandmat	Native	11, 17
Cerastium fontanum	Chickweed	Non-native	13
Cerastium glomeratum	Mouse-ear Chickweed	Non-native	11, 13, 19
Silene antirrhina	Snapdragon Catchfly	Native	13
Silene gallica	Common Catchfly	Non-native	11, 12, 13, 17, 19
Silene laciniata ssp. *major*	Southern Indian Pink	Native	11, 17, 19
Spergula arvensis	Spurry	Non-native	10, 11, 12, 17
Spergularia bocconii	Biccone's Sand-spurrey	Non-native	11, 13, 16
Stellaria media	Common Chickweed	Non-native	11, 19
Chenopodiaceae – Goosefoot Family			
Atriplex semibaccata	Australian Saltbush	Non-native	21
Chenopodium album	Lamb's Quarters	Non-native	13
Chenopodium californicum	California Goosefoot	Native	13, 19
Salsola tragus	Russian-thistle	Invasive	2, 11, 16, 19
Cistaceae – Rock-rose Family			
Cistus creticus	Rock-rose	Non-native	NRD Staff
Helianthemum scoparium	Peak Rush-rose	Native	9, 11, 12, 13, 17
Convolvulaceae – Morning-glory Family			
Calystegia macrostegia	Western Bindweed	Native	9, 13, 17, 19
Convolvulus arvensis	Common Bindweed	Non-native	11
Cressa truxillensis	Alkali Weed	Native	11
Dichondra occidentalis	Western Dichondra	Native	11, 13, 15
Crassulaceae – Stonecrop Family			
Crassula aquatica	Water Pygmy-weed	ACOE vernal pool indicator	4, 5, 6, 7, 10, 16, 20
Crassula connata	Pygmy-weed	Native	10, 11, 12, 13, 19
Dudleya edulis	Ladies' Fingers	Native	11
Dudleya lanceolata	Lance-leaved Dudleya	Native	11, 19
Dudleya pulverulenta	Chalk Dudleya	Native	11, 17, 18, 19
Dudleya variegata	Variegated Dudleya	CNPS 1B	15, 18
Cucurbitaceae – Gourd Family			
Marah macrocarpus	Wild Cucumber	Native	11, 12, 13, 17, 19
Cuscutaceae – Dodder Family			
Cuscuta californica	Dodder	Native	11, 13, 19
Datiscaceae – Datisca Family			
Datisca glomerata	Durango Root	Native	NRD Staff
Dipsacaceae – Teasel Family			
Dipsacus sativus	Teasel	Non-native	13

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Elatinaceae – Elatine Family			
Elatine brachysperma	Short-seed Waterwort	Native	5, 6, 7, 10, 16, 20
Elatine californica	California Waterwort	ACOE vernal pool indicator	4, 7, 21
Ericaceae – Heath Family			
Arctostaphylos glandulosa ssp. *crassifolia*	Del Mar Manzanita	FE	11, 15, 18, 19
Arctostaphylos glandulosa ssp. *zacaensis*	Eastwood Manzanita	Native	15, 18, 19
Comarostaphylis diversifolia var. *diversifolia*	Summer-holly	Native	8, 11
Xylococcus bicolor	Mission Manzanita	Native	9, 11, 12, 13, 17, 18, 19
Euphorbiaceae – Spurge Family			
Chamaesyce albomarginata	Rattlesnake Weed	Native	17
Chamaesyce polycarpa	Small-seeded Sandmat	Native	11, 13, 16
Croton californicus	California Croton	Native	21
Eremocarpus setigerus	Dove Weed	Native	2, 3, 7, 10, 11, 13, 16, 17, 19
Euphorbia peplus	Petty Spurge	Non-native	13, 21
Ricinus communis	Castor Bean	Invasive	11, 19
Fabaceae – Pea Family			
Acacia melanoxylon	Black Wattle	Invasive	11, 19
Lathyrus vestitus	San Diego Sweet-pea	Native	11, 19
Lotus corniculatus	Birdfoot Trefoil	Non-native	13
Lotus hamatus	San Diego Lotus	Native	19
Lotus micranthus	Small-flowered Lotus	Native	19
Lotus purshianus	Spanish Clover	Native	13, 16, 19
Lotus scoparius	Deerweed	Native	7, 9, 11, 12, 13, 16, 17, 19
Lotus strigosus	Strigose Lotus	Native	12, 13, 17, 19
Lupinus bicolor	Miniature Lupine	Native	10, 11, 13, 19
Lupinus concinnus	Bajada Lupine	Native	13
Lupinus hirsutissimus	Stinging Lupine	Native	11
Lupinus succulentus	Arroyo Lupine	Native	11
Lupinus truncatus	Collar Lupine	Native	11, 19
Medicago polymorpha	California Burclover	Non-native	11, 13, 19
Melilotus alba	White Sweetclover	Non-native	13, 19
Melilotus indica	Sourclover	Non-native	11, 13
Melilotus officinalis	Yellow Sweetclover	Non-native	19
Trifolium depauperatum	Pale Sack Clover	Native	7, 13
Trifolium fragiferum	Strawberry Clover	Non-native	21
Trifolium hirtum	Rose Clover	Non-native	19
Trifolium microcephalum	Maiden Clover	Native	13
Vicia americana	American Vetch	Native	19
Vicia sativa ssp. *sativa*	Common Vetch	Non-native	19

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Vicia villosa	Hairy Vetch	Non-native	11, 13
Fagaceae – Beech Family			
Quercus agrifolia	Coast Live Oak	Native	9, 13, 15, 17, 18
Quercus berberidifolia	Scrub Oak	Native	9, 11, 12, 13, 17, 19
Quercus dumosa	Nuttall's Scrub Oak	CNPS 1B	2, 8, 13, 19
Quercus engelmannii	Engelmann Oak	Native	NRD Staff
Gentianaceae – Gentian Family			
Centaurium venustum	Canchalagua	Native	10, 11, 13, 16, 19
Geraniaceae – Geranium Family			
Erodium botrys	Long-beaked Filaree	Non-native	2, 3, 7, 9, 10, 11, 12, 13, 16, 17, 18, 19
Erodium cicutarium	Red-stem Filaree	Non-native	7, 10, 11, 13, 16, 18, 19
Erodium moschatum	White-stem Filaree	Non-native	16
Geranium californicum	California Geranium	Native	19
Geranium carolinianum	Carolina Geranium	Native	11, 13, 19
Geranium molle	Dove-foot Geranium	Non-native	16
Grossulariaceae – Gooseberry Family			
Ribes indecorum	White-flowering Currant	Native	11, 17
Ribes speciosum	Fuchsia-flowered Gooseberry	Native	11, 13, 21
Hydrophyllaceae – Waterleaf Family			
Emmenanthe penduliflora	Whispering Bells	Native	19
Erodictyon crassifolium	Yerba Santa	Native	9, 11, 17, 19
Eucrypta chrysanthemifolia	Eucrypta	Native	11, 13, 19
Phacelia cicutaria var. *hispida*	Caterpillar Phacelia	Native	11
Phacelia grandiflora	Giant-flowered Phacelia	Native	NRD Staff
Phacelia parryi	Parry's Phacelia	Native	19
Phacelia ramosissima var. *latifolia*	Shrubby Phacelia	Native	11
Pholistoma auritum ssp. *auritum*	Fiesta Flower	Native	11
Pholistoma racemosum	San Diego Fiesta Flower	Native	11, 13
Turricula parryi	Poodle-dog Bush	Native	11
Hypericaceae – St. John's Wort Family			
Hypericum canariense	Canary Island St. John's Wort	Non-native	1
Lamiaceae – Mint Family			
Marrubium vulgare	Horehound	Non-native	11, 19
Monardella viminea (formerly known as *M. linoides* ssp. *viminea*)	Willowy Monardella	FE	8, 9, 17, 18, 19
Pogogyne abramsii	San Diego Mesa Mint	FE, ACOE vernal pool indicator	2, 3, 4, 5, 6, 7, 10, 14, 16, 18, 19, 20
Salvia apiana	White Sage	Native	9, 11, 13, 17, 19
Salvia columbariae	Chia	Native	11, 12, 13, 17, 19
Salvia mellifera	Black Sage	Native	2, 9, 12, 13, 15, 17, 18

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Scutellaria tuberosa	Danny's Skullcap	Native	11, 19
Stachys ajugoides	Hedgenettle	Native	13, 19
Trichostema lanatum	Woolly Bluecurls	Native	11, 19
Lythraceae – Loosestrife Family			
Lythrum hyssopifolium	Grass Poly	Non-native	3, 4, 5, 6, 7, 10, 11, 13, 16, 19, 20
Malvaceae – Mallow Family			
Malacothamnus densiflorus	Many-flower Bushmallow	Native	19
Malacothamnus fasciculatus	Chaparral Mallow	Native	9, 11, 13, 17, 19
Malva parviflora	Cheeseweed	Non-native	11, 13, 19
Sidalcea malvaeflora	Checker Mallow	Native	9, 11, 13
Molluginaceae – Carpet-weed Family			
Glinus lotoides	Carpet-weed	Non-native	16
Myrtaceae – Myrtle Family			
Eucalyptus globulus	Blue Gum	Non-native	21
Eucalyptus sideroxylon	Red Ironbark	Non-native	21
Nyctaginaceae – Four O'Clock Family			
Mirabilis californica	Wishbone Bush	Native	11, 12, 13, 19
Oleaceae – Olive Family			
Olea europa	Mission Olive	Non-native	NRD Staff
Onagraceae – Evening-primrose Family			
Camissonia bistorta	California Sun Cup	Native	11, 19
Camissonia cheiranthifolia	Beach Evening Primrose	Native	19
Camissonia micrantha	Small Primrose	Native	19
Clarkia delicata	Campo Clarkia	Native	11
Clarkia purpurea ssp. *quadrivulnera*	Four-spot Clarkia	Native	11, 13, 17, 19
Epilobium canum	California Fuchsia	Native	9, 13, 17, 19
Epilobium pygmaeum	Smooth Boisduvalia	Native	20
Oxalidaceae – Wood-sorrel Family			
Oxalis albicans ssp. *californica*	California Wood Sorrel	Native	11, 13, 17, 19
Oxalis pes-caprae	Bermuda Buttercup	Invasive	11, 12, 13, 16, 19
Papaveraceae – Poppy Family			
Dicentra chrysantha	Golden Ear-drops	Native	13
Eschscholzia california	California Poppy	Native	9, 11, 18, 19
Plantaginaceae – Plantain Family			
Plantago coronopus	Cut-leaf Plantain	Non-native	10
Plantago erecta	California Plantain	Native	7, 10, 12, 13, 16, 19
Plantago elongata	Vernal Pool Plantain	ACOE vernal pool indicator	6, 5, 7, 10, 16, 20
Plantago lanceolata	English Plantain	Non-native	21
Platanaceae – Sycamore Family			
Platanus racemosa	California Sycamore	Native	9, 13, 17, 19
Plumbaginaceae – Leadwort Family			
Limonium sinuatum	Sea-Lavender	Non-native	9

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Polemoniaceae – Phlox Family			
Gilia angelensis	Grassland Gilia	Native	11
Linanthus dianthiflorus	Ground Pink	Native	11, 12, 13, 19
Navarretia atractyloides	Holly-leaf Skunkweed	Native	21
Navarretia fossalis	Spreading Navarretia	FT, ACOE vernal pool indicator	4, 7, 20
Navarretia hamata	Hooked Skunkweed	Native	7, 10, 11, 12, 13, 16, 19
Polygonaceae – Buckwheat Family			
Chorizanthe fimbriata	Fringed Spineflower	Native	11, 17, 19
Chorizanthe polygonoides var. *longispina*	Long-spined Spineflower	CNPS 1B	8, 11, 13, 16, 18, 19
Chorizanthe procumbens	Prostrate Spineflower	CNPS 4	11, 15, 19
Eriogonum fasciculatum	Flat-topped Buckwheat	Native	2, 9, 12, 13, 15, 17, 18
Eriogonum gracile	Slender Buckwheat	Native	21
Eriogonum wrightii	Foothill Buckwheat	Native	17
Polygonum arenastrum	Common Knotweed	Non-native	19
Pterostegia drymarioides	Granny's Hairnet	Native	11, 13, 19
Rumex crispus	Curly Dock	Non-native	2, 5, 6, 9, 10, 13, 16, 17, 19
Rumex salicifolius	Willow Dock	Native	9, 13
Portulacaceae – Purslane Family			
Calandrinia ciliata	Red Maids	Native	11, 12, 13, 19
Calyptridium monandrum	Common Calyptridium	Native	13
Claytonia perfoliata	Miner's Lettuce	Native	11, 13, 19
Primulaceae – Primrose Family			
Anagallis arvensis	Scarlet Pimpernel	Non-native	9, 10, 11, 13, 16, 19
Centunculus minimus	Chaffweed	ACOE vernal pool indicator	4, 5, 6, 7, 10, 16, 20, 21
Dodecatheon clevelandii	Padre's Shooting Star	Native	11, 13, 19
Ranunculaceae – Buttercup Family			
Clematis lasiantha	Pipestems	Native	19
Clematis pauciflora	Ropevine	Native	13, 17, 21
Delphinium parryi	Parry's Larkspur	Native	17
Myosurus minimus	Mousetail	ACOE vernal pool indicator	4, 5, 6
Thalictrum fendleri	Common Meadow-rue	Native	11, 13
Resedaceae – Mignonette Family			
Reseda luteola	Mignonette	Non-native	21
Rhamnaceae – Buckthorn Family			
Ceanothus tomentosus	Ramona-lilac	Native	11, 12, 13, 17, 18, 19
Ceanothus verrucosus	Wart-stemmed Ceanothus	CNPS 2	15
Rhamnus crocea	Spiny Redberry	Native	9, 11, 13, 17, 19
Rhamnus ilicifolia	Hollyleaf Redberry	Native	18, 19
Rosaceae – Rose Family			
Adenostoma	Chamise	Native	2, 9, 11, 12, 13, 17, 18

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
fasciculatum			
Cercocarpus minutiflorus	San Diego Mountain-mahogany	Native	11, 13, 15, 17, 18, 19
Heteromeles arbutifolia	Toyon	Native	9, 11, 13, 17
Prunus ilicifolia	Holly-leaf Cherry	Native	9, 11, 13, 15, 17, 18
Prunus virginiana var. *demissa*	Western Choke-cherry	Native	11
Rubiaceae – Madder Family			
Galium angustifolium ssp. *angustifolium*	Narrow-leaved Bedstraw	Native	11, 12, 13, 19
Galium aparine	Goose Grass	Native	11, 13, 19
Galium nuttallii	San Diego Bedstraw	Native	13
Galium stellatum	Star-flowered Bedstraw	Native	13
Rutaceae – Rue Family			
Cneoridium dumosum	Bushrue	Native	9, 11, 12, 13, 19
Salicaceae – Willow Family			
Populus fremontii	Fremont Cottonwood	Native	21
Salix exigua	Narrow-leaved Willow	Native	19
Salix laevigata	Red Willow	Native	19
Salix gooddingii	Goodding's Black Willow	Native	9
Salix lasiolepis	Arroyo Willow	Native	9, 13, 19
Saururaceae			
Anemopsis californica	Yerba Mansa	Native	13
Saxifragaceae – Saxifrage Family			
Jepsonia parryi	Mesa Saxifrage	Native	11, 13, 19
Scrophulariaceae – Figwort Family			
Antirrhinum coulterianum	Coulter's Snapdragon	Native	21
Antirrhinum kelloggii	Climbing Snapdragon	Native	19
Antirrhinum nuttallianum	Nuttall's Snapdragon	Native	11, 12, 13, 19
Castilleja densiflora ssp. *gracilis*	Parish's Owl's-clover	Native	13
Castilleja exserta	Purple Owl's-clover	Native	7, 10, 11, 12, 13, 19
Collinsia heterophylla	Chinese Houses	Native	11, 19
Cordylanthus rigidus ssp. *setigerus*	Dark-tip Bird's Beak	Native	11, 19
Linaria canadensis	Blue Toadflax	Native	13, 19
Mimulus aurantiacus	Coast Monkeyflower	Native	9, 11, 13, 17, 19
Mimulus brevipes	Slope Semiphore	Native	11, 19
Mimulus guttatus	Seep Monkeyflower	Native	11, 13, 17
Mimulus pilosus	Downy Monkeyflower	Native	19
Pedicularis densiflora	Indian Warrior	Native	11, 19
Penstemon centranthifolius	Scarlet Bugler	Native	21
Scrophularia californica	California Figwort	Native	19
Veronica anagallis-aquatica	Water Speedwell	Non-native	21

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Veronica peregrina	Purslane Speedwell	Native	4, 6, 10
Solanaceae – Nightshade Family			
Datura wrightii	Thorn-apple	Non-native	13, 21
Nicotiana glauca	Tree Tobacco	Invasive	1
Solanum americanum	White Nightshade	Non-native	12
Solanum douglasii	Douglas's Nightshade	Native	13
Solanum parishii	Parish's Nightshade	Native	13, 17, 19
Solanum xanti	Purple Nightshade	Native	9, 11
Tamaricaceae – Tamarisk Family			
Tamarix species	Tamerisk, Salt Cedar	Invasive	1, 13
Urticaceae – Nettle Family			
Hesperocnide tenella	Western Nettle	Native	13
Parietaria hespera	Western Pellitory	Native	13
Verbenaceae – Vervain Family			
Verbena lasiostachys	Western Verbena	Native	21
Verbena menthifolia	Mint-leaf Vervain	Native	21
Violaceae – Violet Family			
Viola pedunculata	Johnny Jump-up	Native	11, 13, 19
Anthophyta (Monocotyledones)			
Alismataceae – Water-Plantain Family			
Alisma plantago-aquatica	Water plantain	Native	NRD Staff
Arecaceae – Palm Family			
Washingtonia filifera	Fan palm	Native	1
Cyperaceae – Sedge Family			
Carex triquetra	Triangular-fruit Sedge	Native	11, 13
Cyperus involucratus	African Umbrella Plant	Non-native	10, 13, 16
Eleocharis acicularis	Needle Spike-sedge	Native	5, 6, 16
Eleocharis macrostachya	Pale Spike-sedge	Native	3, 4, 5, 6, 7, 9, 10, 13, 16, 20
Eleocharis parishii	Parish's Spike-sedge	Native	19
Scripus californicus	California Tulle	Native	13
Iridaceae – Iris Family			
Sisyrinchium bellum	Blue-eyed Grass	Native	9, 11, 13, 19
Juncaceae – Rush Family			
Juncus bufonius	Toad Rush	Native	5, 6, 7, 10, 11, 16, 19, 20
Juncus dubius	Mariposa Rush	Native	4, 5, 6, 7, 9, 10, 11, 13, 16, 19
Juncus mexicanus	Mexican Rush	Native	10, 21
Juncus phaeocephalus	Brown-head Rush	Native	21
Liliaceae – Lily Family			
Allium haematochiton	Red-skin Onion	Native	19
Allium praecox	Early Onion	Native	13, 19
Asphodelus fistulosus	Hollow-stem Asphodelus	Non-native	21
Bloomeria crocea	Common Goldenstar	Native	11
Brodiaea jolonensis	Dwarf Brodiaea	Native	7, 10, 11
Brodiaea orcuttii	Orcutt's Brodiaea	Native	3, 5, 6, 7, 8, 10, 11, 16,

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
			18, 19
Calochortus splendens	Splendid Mariposa Lily	Native	11, 13, 19
Calochortus weedii var. *weedii*	Weed's Mariposa Lily	Native	11, 19
Chlorogalum parviflorum	Small-flowered Soap Plant	Native	11, 12, 13, 19
Chlorogalum pomeridianum var. *pomeridianum*	Wavyleaf Soap Plant	Native	11
Dichelostemma capitatum	Blue Dicks	Native	9, 11, 12, 13, 19
Fritillaria bilflora	Chocolate Lily	Native	NRD Staff
Muilla clevelandii	San Diego Goldenstar	CNPS 1B	8, 9, 10, 11, 13, 15, 18, 19
Muilla maritima	Common Goldenstar	Native	10, 11, 13, 19
Yucca schidigera	Mohave Yucca	Native	9, 11, 19
Yucca whipplei ssp. *whipplei*	Our Lord's Candle	Native	11, 13, 17, 19
Zigadenus fremontii	Fremont's Camas	Native	11, 19
Juncaginaceae – Arrow-grass Family			
Lilaea scilloides	Flowering-quillwort	Native	4, 5, 6, 7, 10, 16, 20, 21
Orchidaceae – Orchid Family			
Piperia unalascensis	Slenderspire Piperia	Native	21
Poaceae – Grass Family			
Achnatherum coronatum	Giant Stipa	Native	17, 21
Agrostis avenacea	Redtop	Invasive	2, 3, 4, 5, 6, 7, 10, 11, 16
Agrostis microphylla	Small-leaf Bent	Native	5, 6, 16
Agrostis pallens	Bent Grass	Native	9, 19
Agrostis viridis	Water Bent	Non-native	13
Arundo donax	Giant Reed	Invasive	21
Avena barbata	Slender Wild Oat	Invasive	2, 3, 7, 10, 11, 12, 13, 16, 17, 19
Avena fatua	Wild Oat	Invasive	11, 17, 19
Bothriochloa barbinodis	Cane Bluestem	Native	11
Brachypodium distachyon	Purple Falsebrome	Non-native	13, 17
Briza minor	Quaking Grass	Non-native	13
Bromus carinatus	California Brome	Native	11
Bromus diandrus	Ripgut Brome	Non-native	7, 11, 12, 13, 16, 17, 18, 19
Bromus hordeaceus	Soft Chess	Non-native	2, 3, 7, 10, 11, 12, 16, 17, 19
Bromus madritensis ssp. *rubens*	Foxtail Chess	Non-native	2, 3, 7, 9, 10, 11, 12, 13, 16, 17, 18, 19
Cortaderia selloana	Pampas Grass	Invasive	1, 13, 21
Cynodon dactylon	Bermuda Grass	Non-native	11, 13
Deschampsia danthonioides	Annual Hairgrass	ACOE vernal pool indicator	3, 4, 5, 6, 7, 10, 11, 16, 19
Distichlis spicata	Saltgrass	Native	7

Marine Corps Air Station Miramar – Observed Flora			
Scientific Name	**Common Name+**	**Status***	**Reference ****
Elymus glaucus	Blue Wildrye	Native	13
Gastridium ventricosum	Nit Grass	Non-native	5, 6, 7, 10, 11, 12, 13, 16, 17, 19
Hordeum murinum ssp. *leporinum*	Hare Barley	Non-native	13
Hordeum vulgare	Common Barley	Non-native	7
Lamarckia aurea	Goldentop	Non-native	10, 11, 12, 16, 17, 19
Leymus condensatus	Giant Wild Rye	Native	11, 13
Lolium multiflorum	Italian Ryegrass	Non-native	11, 13, 17, 19
Lolium perenne	Perennial Ryegrass	Non-native	2, 10, 21
Melica imperfecta	Coast Range Melic	Native	13, 17, 21
Muhlenbergia microsperma	Littleseed Muhly	Native	11, 19
Muhlenbergia rigens	Deergrass	Native	11, 13, 19
Nassella cernua	Nodding Needlegrass	Native	12
Nassella lepida	Foothill Needlegrass	Native	11, 13, 19
Nassella pulchra	Purple Needlegrass	Native	4, 7, 9, 10, 11, 13, 17, 18, 19
Orcuttia californica	California Orcutt Grass	FE, ACOE vernal pool indicator	4, 21
Paspalum dilatatum	Dallis Grass	Non-native	NRD Staff
Pennisetum setaceum	Fountain Grass	Non-native	11, 19
Phalaris caroliana	Carolina Canary Grass	Non-native	13
Phalaris lemmonii	Lemon's Canary Grass	Native	3, 5, 6, 10, 16
Phalaris minor	Littleseed Canary Grass	Non-native	11, 19
Poa annua	Annual Bluegrass	Non-native	21
Poa secunda	One-sided Bluegrass	Native	19
Polypogon monspeliensis	Annual Beard Grass	Non-native	2, 3, 5, 6, 7, 10, 11, 13, 16, 19
Rhynchelytrum repens	Natal Grass	Non-native	NRD Staff
Vulpia bromoides	Six-weeks Fescue	Non-native	19
Vulpia myuros	Rat-tail Fescue	Non-native	3, 7, 10, 12, 13, 16, 19
Vulpia octoflora	Tufted Fescue	Native	12, 13
Typhaceae – Cattail Family			
Typha domingensis	Southern Cattail	Native	13
Typha latifolia	Broad-leaved Cattail	Native	11, 19

*Definitions:

Federal Federal categories per the Endangered Species Act, administered by the USFWS

FE Endangered - any species officially listed by the USFWS that is in danger of extinction throughout all or a significant portion of its range

FT Threatened - any species officially listed by the USFWS that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FC Candidate - species for which there is sufficient information to support a proposal for listing under the Endangered Species Act.

State California-listed per California Endangered Species Act of 1984, administered by the CDFG:

CE Endangered. Taxa which are in serious danger of becoming extinct throughout all, or a significant portion, of their range due to one or more causes including loss of habitat, change in habitat, over exploitation, predation, competition, or disease (Section 2062 of the Fish and Game Code).

CT Threatened. Taxa which, although not presently threatened with extinction, are likely to become endangered species in the foreseeable future (Section 2067 of the Fish and Game Code).

CR Rare. Taxa which, although not presently threatened with extinction, are present in such small numbers throughout their range that they may become endangered if the present environment worsens (Section 1901 of the Fish and Game Code).

CC Candidate. Taxa which the Fish and Game Commission has formally noticed as being under review by the Department in addition to the list of threatened and endangered species.

California Native Plant Society Per the CNPS publication, *Inventory of Rare and Endangered Vascular Plants of California*:

1B Rare, threatened, or endangered in California and elsewhere

2 Rare, threatened, or endangered in California, but more common elsewhere

3 Need more information (a review list)

4 Plants of limited distribution (a watch list)

ACOE vernal pool indicator Per Army Corps of Engineers Special Public Notice, Regional General Conditions to the Nationwide Permits, Regional General Condition #1 – Vernal Pool Notification, *Indicator Species for Vernal Pools* List, Los Angeles District, Regulatory Branch, November 1997.

Native Per California Invasive Plant Council publication *Invasive Plants of California's Wildlands:* Plant species growing within their natural range and dispersal potential.

Non-native Per California Invasive Plant Council publication *Invasive Plants of California's Wildlands:* Plant species growing beyond their natural range or natural zone of potential dispersal, including all domesticated and feral species and all hybrids involving at least one non-native parent species.

Invasive Per California Invasive Plant Council publication *Invasive Plants of California's Wildlands:* Plant species that spread into areas where they are not native, or that displace natives or bring about changes in species composition, community structure, or ecosystem function.

+Common Name follows The Jepson Manual, San Diego Natural History Museum, or California Native Plant Society terminology respectively.

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Table F-9. Animal Species Known to Occur or Potentially Occurring at MCAS Miramar

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Amphibians			
Order Caudata			
Family Plethodontidae			
Aneides lugubris	Arboreal salamander		2001 Reptile/Amphibian Survey
Batrachoceps pacificus major	Garden slender salamander		2001 Reptile/Amphibian Survey
Order Anura			
Family Pipidae			
Xenopus laevis	African clawed frog	Non-native	2001 Reptile/Amphibian Survey
Family Pelobatidae			
Bufo boreas halophilus	California toad		2001 Reptile/Amphibian Survey
Spea hammondii	Western spadefoot toad	FSC/CSC	2001 Reptile/Amphibian Survey
Family Hylidae			
Pseudacris regilla	Pacific chorus frog		2000 Vertebrate Survey
Family Ranidae			
Rana catesbeiana	Bullfrog	Non-native	2001 Reptile/Amphibian Survey
Reptiles			
Order Tesudines			
Family Emydidae			
Clemmys marmorata pallida	Southwestern pond turtle	FSC/CSC	2000 Vertebrate Survey; Not Verified by 2001 Reptile/Amphibian Survey
Trachemys scripta elegans	Northern red-eared slider	Non-native	2001 Reptile/Amphibian Survey
Order Squamata			
Family *Phrynosomatidae*			
Phrynosoma coronatum blainvillii	San Diego horned lizard	CSC	2001 Reptile/Amphibian Survey
Sceloporus occidentalis biseriatus	San Joaquin fence lizard		2001 Reptile/Amphibian Survey
Sceloporus occidentalis	Western fence lizard		
Sceloporus orcutti	Granite spiny lizard		2001 Reptile/Amphibian Survey
Uta stansburiana elegans	California side-blotched lizard		2001 Reptile/Amphibian Survey
Family Xantusiidae			
Xantusia henshawi	Granite night lizard		2000 Vertebrate Survey
Family *Scincidae*			
Eumeces skiltonianus interparietalis	Coronado Island skink	CSC	2001 Reptile/Amphibian Survey
Family *Teiidae*			
Cnemidophorus hyperythrus beldingi	Belding's orange-throated whiptail	CSC	2001 Reptile/Amphibian Survey
Cnemidophorus tigris	Coastal whiptail		2001 Reptile/Amphibian Survey

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
multiscutatus			
Family *Anguidae*			
Elgaria multicarinaas webbii	San Diego alligator lizard		2001 Reptile/Amphibian Survey
Family *Anniellidae*			
Anniella pulchra pulchra	Silvery legless lizard	FSC/CSC	2001 Reptile/Amphibian Survey
Family *Leptotyphlopidae*			
Leptotyphlops humilis humilis	Western blind snake		2001 Reptile/Amphibian Survey
Family *Boidae*			
Lichanura trivirgata roseofusca	Coastal rosy boa	FSC	2001 Reptile/Amphibian Survey
Family *Colubridae*			
Arizona occidentalis occidentalis	California glossy snake		Potential (Not Recorded in Recent Surveys)
Coluber constrictor mormon	Western yellow-bellied racer		2001 Reptile/Amphibian Survey
Diadophis punctatus similis	San Diego ringneck snake		2001 Reptile/Amphibian Survey
Hypsiglena torquata nuchalata	California night snake		2001 Reptile/Amphibian Survey
Lampropeltis getula californiae	California kingsnake		2001 Reptile/Amphibian Survey
Masticophis flagellum piceus	Red coachwhip		2001 Reptile/Amphibian Survey
Masticophis lateralis lateralis	California stripped racer		2001 Reptile/Amphibian Survey
Pituophis melanoleucus annectens	San Diego gopher snake		2001 Reptile/Amphibian Survey
Rhinocheilus lecontei lecontei	Western long-nose snake		2001 Reptile/Amphibian Survey
Salvadora hexalepis virgultea	Coastal patch-nosed snake	CSC	2001 Reptile/Amphibian Survey
Thamnophis hammondii hammondi	Hammond two-striped garter snake	CSC	2001 Reptile/Amphibian Survey
Tantilla planiceps	Western black-headed snake		2001 Reptile/Amphibian Survey
Trimorphodon biscutatus lyrophanes	Baha California lyre snake		2001 Reptile/Amphibian Survey
Family *Viperidae*			
Crotalus exsul	Red diamond rattlesnake	CSC	2001 Reptile/Amphibian Survey
Crotalus mitchellii	Southern speckled rattlesnake		2001 Reptile/Amphibian Survey
Crotalus viridis helleri	Southern pacific rattlesnake		2001 Reptile/Amphibian Survey
Birds			
Order Podicipediformes			
Family *Podicipedidae*			
Aechmorphorus clarkii	Clark's Grebe		2000 Vertebrate Survey
Aechmophorus occidentalis	Western Grebe	BSC	2000 Vertebrate Survey
Podiceps nigricollis	Eared Grebe	BSC	2000 Vertebrate Survey
Podilymbus podiceps	Pied-billed Grebe		2001 Reptile/Amphibian Survey

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Order Pelecaniformes			
Family *Pelecanidae*			
Pelecanus erythrorhynchos	American White Pelican	BSC	2001 Reptile/Amphibian Survey
Pelecanus occidentalis	Brown Pelican		Potential (Not Recorded in Recent Surveys)
Family *Phalacrocoracidae*			
Phalacrocorax auritus	Double-crested Cormorant		2001 Reptile/Amphibian Survey
Order Ciconiiformes			
Family *Ardeidae*			
Ardea alba	Great Egret		2001 Reptile/Amphibian Survey
Ardea herodias	Great Blue Heron		2001 Reptile/Amphibian Survey
Bubulcus ibis	Cattle Egret		2000 Vertebrate Survey
Butorides striatus	Green-backed Heron		Potential (Not Recorded in Recent Surveys)
Butorides virescens	Green Heron		2000 Vertebrate Survey
Egretta caerulea	Little Blue Heron	BSC	2000 Vertebrate Survey
Egretta thula	Snowy Egret	BSC	2001 Reptile/Amphibian Survey
Ixobrychus exilis	Least Bittern		2001 Reptile/Amphibian Survey
Nycticorax nycticorax	Black-crowned Night Heron	BSC	2001 Reptile/Amphibian Survey
Family *Threskiornithidae*			
Plegadis chihi	White-faced Ibis		2000 Vertebrate Survey
Family *Cathartidae*			
Cathartes aura	Turkey Vulture		2001 Reptile/Amphibian Survey
Order Anseriformes			
Family *Anserinae*			
Branta canadensis	Canada Goose	BSC	2000 Vertebrate Survey
Chen caerulescens	Snow Goose	BSC	2000 Vertebrate Survey
Family *Anatidae*			
Aix sponsa	Wood Duck	BSC	2001 Reptile/Amphibian Survey
Anas crecca	Green-winged Teal	BSC	2001 Reptile/Amphibian Survey
Anas platyrhynchos	Mallard	BSC	2001 Reptile/Amphibian Survey
Anas acuta	Northern Pintail	BSC	2001 Reptile/Amphibian Survey
Anas discors	Blue-winged Teal	BSC	2001 Reptile/Amphibian Survey
Anas cyanoptera	Cinnamon Teal	BSC	2001 Reptile/Amphibian Survey
Anas clypeata	Northern Shoveler	BSC	2001 Reptile/Amphibian Survey
Anas strepera	Gadwall	BSC	2001 Reptile/Amphibian Survey
Anas americana	American Widgeon	BSC	2001 Reptile/Amphibian Survey
Aythya valisineria	Canvasback	BSC	Potential (Not Recorded in Recent Surveys)
Aythya americana	Redhead	BSC	2000 Vertebrate Survey
Aythya collaris	Ring-necked Duck	BSC	2001 Reptile/Amphibian Survey
Aythya affinis	Lesser Scaup	BSC	2001 Reptile/Amphibian Survey
Bucephala clangula	Common Goldeneye		Potential
Bucephala albeola	Bufflehead	BSC	2001 Reptile/Amphibian Survey
Lophodytes cucullatus	Hooded Merganser		2001 Reptile/Amphibian Survey
Oxyura jamaicensis	Ruddy Duck	BSC	2001 Reptile/Amphibian Survey
Order Falconiformes			
Family *Accipitridae*			

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Subfamily *Pandioninae*			
Pandion haliaetus	Osprey	BSC/CSC	2001 Reptile/Amphibian Survey
Subfamily *Accipitrinae*			
Accipiter cooperii	Cooper's Hawk	BSC/CSC	2001 Reptile/Amphibian Survey
Accipiter striatus	Sharp-shinned Hawk	CSC	2001 Reptile/Amphibian Survey
Aquila chrysaetos	Golden Eagle	BGEPA	2001 Reptile/Amphibian Survey
Buteo lineatus	Red-shouldered Hawk		2001 Reptile/Amphibian Survey
Buteo jamaicensis	Red-tailed Hawk		2001 Reptile/Amphibian Survey
Buteo regalis	Ferruginous Hawk	FSC/BSC/CSC	2001 Reptile/Amphibian Survey
Circus cyaneus	Norther Harrier	BSC/CSC	2001 Reptile/Amphibian Survey
Elanus leucrus	White-tailed Kite	BSC	2001 Reptile & Amphib.Survey
Family *Falconidae*			
Falco columbarius	Merlin	CSC	2001 Reptile/Amphibian Survey
Falco mexicanus	Prairie Falcon	BSC/CSC	2001 Reptile/Amphibian Survey
Falco peregrinus	Peregrine Falcon	BSC/CE	2001 Reptile/Amphibian Survey
Falco sparverius	American Kestrel	BSC	2001 Reptile/Amphibian Survey
Order Galliformes			
Family *Odontophoridae*			
Callipepla californica	California Quail	BSC	2001 Reptile/Amphibian Survey
Order Gruiformes			
Family *Rallidae*			
Fulica americana	American Coot		2001 Reptile/Amphibian Survey
Gallinula chloropus	Common Moorhen		2001 Reptile/Amphibian Survey
Porzana carolina	Sora		2001 Reptile/Amphibian Survey
Rallus limicola	Virginia Rail		2001 Reptile/Amphibian Survey
Order Charadriiformes			
Family *Charadriidae*			
Charadrius semipalmatus	Semipalmated Plover		2000 Vertebrate Survey
Charadrius vociferus	Killdeer	BSC	2001 Reptile/Amphibian Survey
Pluvialis squatarola	Black-bellied Plover	BSC	2001 Reptile/Amphibian Survey
Family *Recurvirostridae*			
Himantopus mexicanus	Black-necked Stilt		2001 Reptile/Amphibian Survey
Recurvirostra americana	American Avocet	BSC	
Family *Scolopacidae*			
Actitis macularia	Spotted Sandpiper		2001 Reptile/Amphibian Survey
Calidris alpina	Dunlin	BSC	2000 Vertebrate Survey
Calidris bairdii	Baird's Sandpiper		2000 Vertebrate Survey
Calidris canutus	Red Knot	BSC	2001 Reptile/Amphibian Survey
Calidris mauri	Western Sandpiper	BSC	2001 Reptile/Amphibian Survey
Calidris melanotos	Pectoral Sandpiper		2001 Reptile/Amphibian Survey
Calidris minutilla	Least Sandpiper	BSC	2001 Reptile/Amphibian Survey
Catoptrophorus semipalmatus	Willet	BSC	Potential (Not Recorded in Recent Surveys)
Gallinago gallinago	Common Snipe	BSC	2001 Reptile/Amphibian Survey
Limosa fedoa	Marbled Godwit	BSC	Potential (Not Recorded in Recent Surveys)
Limnodromus griseus	Short-billed Dowitcher	BSC	Potential (Not Recorded in Recent Surveys)
Limnodromus scolopaceus	Long-billed		2001 Reptile/Amphibian Survey

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
	Dowitcher		
Numenius americanus	Long-billed Curlew	BSC	2001 Reptile/Amphibian Survey
Numenius phaeopus	Whimbrel	BSC	1999 LTEM Monitoring Project
Phalaropus fulicaria	Red Phalarope		2000 Vertebrate Survey
Phalaropus lobatus	Red-necked Phalarope		2001 Reptile/Amphibian Survey
Phalaropus tricolor	Willon's Phalarope	BSC	Potential (Not Recorded in Recent Surveys)
Tringa flavipes	Lesser Yellowlegs	BSC	2000 Vertebrate Survey
Tringa melanoleuca	Greater Yellowlegs	BSC	2001 Reptile/Amphibian Survey
Tringa solitaria	Solitary Sandpiper		2001 Reptile/Amphibian Survey
Family *Laridae*			
Subfamily *Larinae*			
Larus argentatus	Herring Gull		2000 Vertebrate Survey
Larus californicus	California Gull	BSC	2000 Vertebrate Survey
Larus canus	Mew Gull		Potential (Not Recorded in Recent Surveys)
Larus delawarensis	Ring-billed Gull		2000 Vertebrate Survey
Larus occidentalis	Western Gull	BSC	2001 Reptile/Amphibian Survey
Larus philadelphia	Bonaparte's Gull	BSC	2001 Reptile/Amphibian Survey
Subfamily *Sterninae*			
Sterna caspia	Caspian Tern	BSC	2001 Reptile/Amphibian Survey
Sterna forsteri	Forster's Tern	BSC	2001 Reptile/Amphibian Survey
Order Columbiformes			
Family *Columbidae*			
Columba livia	Rock Dove	Non-Native	2001 Reptile/Amphibian Survey
Columba fasciata	Band-tailed Pigeon	BSC	2000 Vertebrate Survey
Columbina passerina	Common Ground-dove	BSC	Potential (Not Recorded in Recent Surveys)
Zenaida asiatica	White-winged Dove		2001 Reptile/Amphibian Survey
Zenaida macroura	Mourning Dove	BSC	2001 Reptile/Amphibian Survey
Order Cuculiformes			
Family *Cuculidae*			
Subfamily *Neomorphinae*			
Geococcyx californianus	Greater Roadrunner		2001 Reptile/Amphibian Survey
Order Strigiformes			
Family *Tyonidae*			
Tyto alba	Barn Owl	BSC	2001 Reptile/Amphibian Survey
Family *Strigidae*			
Asio flammeus	Short-eared Owl	BSC	2001 Reptile/Amphibian Survey
Asio otus	Long-eared Owl	CSC	2001 Reptile/Amphibian Survey
Athene cunicularia	Burrowing Owl	FSC/BSC/CSC	2001 Reptile/Amphibian Survey
Bubo virginianus	Great Horned Owl		2001 Reptile/Amphibian Survey
Otus kennicottii	Western Screech-owl		2001 Reptile/Amphibian Survey
Order Caprimulgiformes			
Family *Caprimulgidae*			
Subfamily *Chordeilinae*			
Chordeiles acutipennis	Lesser Nighthawk		2001 Reptile/Amphibian Survey
Subfamily *Caprimulginae*			
Phalaenoptilus nuttallii	Common Poor-will		2001 Reptile/Amphibian Survey
Order Apodiformes			

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Family *Apodidae*			
Subfamily *Chaeturinae*			
Chaetura pelagica	Chimney Swift		2001 Reptile/Amphibian Survey
Chaetura vauxi	Vaux's Swift	FSC/CSC	2001 Reptile/Amphibian Survey
Subfamily C*ypseloidinae*			
Cypseloides niger	Black Swift	FEC/BSC/CSC	2001 Reptile/Amphibian Survey
Subfamily *Aponinae*			
Aeronautes saxatalis	White-throated Swift		2001 Reptile/Amphibian Survey
Family *Trochillidae*			
Subfamily *Trochilinae*			
Archilochus alexandri	Black-chinned Hummingbird	BSC	2001 Reptile/Amphibian Survey
Calypte anna	Anna's Hummingbird	BSC	2001 Reptile/Amphibian Survey
Calypte costae	Costa's Hummingbird	FSC/BSC	2001 Reptile/Amphibian Survey
Selasphorus rufus	Rufous Hummingbird	FSC/BSC	2001 Reptile/Amphibian Survey
Selasphorus sasin	Allen's Hummingbird	FSC/BSC	2001 Reptile/Amphibian Survey
Order Coraciiformes			
Family *Alcedinidae*			
Subfamily *Cerylinae*			
Ceryle alcyon	Belted Kingfisher		2001 Reptile/Amphibian Survey
Order Piciformes			
Family *Picidae*			
Subfamily *Picinae*			
Colaptes auratus	Northern Flicker		2001 Reptile/Amphibian Survey
Melanerpes formicivorus	Acorn Woodpecker	BSC	2001 Reptile/Amphibian Survey
Melanerpes lewis	Lewis's Woodpecker	BSC	2000 Vertebrate Survey
Picoides nuttallii	Nuttall's Woodpecker	FSC/BSC	2001 Reptile/Amphibian Survey
Picoides pubescens	Downy Woodpecker		2001 Reptile/Amphibian Survey
Sphyrapicus nuchalis	Red-naped Sapsucker		2001 Reptile/Amphibian Survey
Sphyrapicus ruber	Red-breasted Sapsucker	BSC	2000 Vertebrate Survey
Sphyrapicus varius	Yellow-bellied Sapsucker		2000 Vertebrate Survey
Order Passeriformes			
Family *Tyrannidae*			
Subfamily *Fluvicolinae*			
Contopus cooperi	Olive-sided Flycatcher	FSC/BSC	2001 Reptile/Amphibian Survey
Contopus sordidulus	Western-wood Pewee	BSC	2001 Reptile/Amphibian Survey
Empidonax difficilis	Pacific-slope Flycatcher		2000 Vertebrate Survey
Empidonax difficilis	Western Flycatcher		2001 Reptile/Amphibian Survey

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Empidonax hammondii	Hammond's Flycatcher		2001 Reptile/Amphibian Survey
Empidonax traillii	Willow Flycatcher	CE	2001 Reptile/Amphibian Survey
Empidonax traillii extimus	Southwestern Willow Flycatcher	FE	2000 Vertebrate Survey (Has not been verified to subspecies)
Sayornis nigricans	Black Phoebe	BSC	2001 Reptile/Amphibian Survey
Sayornis saya	Say's Phoebe		2001 Reptile/Amphibian Survey
Subfamily *Tyranninae*			
Myiarchus cinerascens	Ash-throated Flycatcher	BSC	2001 Reptile/Amphibian Survey
Tyrannus melancholicus	Tropical Kingbird		Potential (Not Recorded in Recent Surveys)
Tyrannus verticalis	Western Kngbird		2001 Reptile/Amphibian Survey
Tyrannus vociferans	Cassin's Kingbird	BSC	2001 Reptile/Amphibian Survey
Family *Laniidae*			
Lanius ludovicianus	Loggerhead Shrike	FSC/BSC/CSC	2001 Reptile/Amphibian Survey
Family *Vireonidae*			
Vireo bellii bellii	Least Bell's Vireo	FE	2001 Reptile/Amphibian Survey
Vireo cassinii	Cassin's Vireo	BSC	2001 Reptile/Amphibian Survey
Vireo gilvus	Warbling Vireo	BSC	2001 Reptile/Amphibian Survey
Vireo huttoni	Hutton's Vireo	BSC	2001 Reptile/Amphibian Survey
Vireo solitarius plumbeox	Solitary Vireo		Potential (Not Recorded in Recent Surveys)
Family *Corvidae*			
Aphelocoma californica	Western Scrub-jay	BSC	2001 Reptile/Amphibian Survey
Corvus brachyrhynchos	American Crow		2001 Reptile/Amphibian Survey
Corvus corax	Common Raven		2001 Reptile/Amphibian Survey
Family *Alaudidae*			
Eremophila alpestris	California Horned Lark		2001 Reptile/Amphibian Survey
Family *Hirundinidae*			
Subfamily *Hirundinianae*			
Hirundo rustica	Barn Swallow	FSC/CT	2001 Reptile/Amphibian Survey
Petrochelidon pyrrhonota	Cliff Swallow		2001 Reptile/Amphibian Survey
Progne subis	Purple Martin		2000 Vertebrate Survey
Riparia riparia	Bank Swallow		Potential (Not Recorded in Recent Surveys)
Stelgidopteryx serripennis	Northern Rough-winged Swallow	BSC	2001 Reptile/Amphibian Survey
Tachycineta bicolor	Tree Swallow		2001 Reptile/Amphibian Survey
Tachycineta thalassina	Violet-green Swallow	BSC	2001 Reptile/Amphibian Survey
Family *Paridae*			
Baeolophus inornatus	Oak Titmouse	BSC	2001 Reptile/Amphibian Survey
Poecile gambeli	Mountain Chickadee		2001 Reptile/Amphibian Survey
Family *Aegithalidae*			
Psaltriparus minimus	Bushtit	BSC	2001 Reptile/Amphibian Survey
Family T*roglodytidae*			
Campylorhynchus brunneicapillus	Cactus Wren	BSC/CSC	2001 Reptile/Amphibian Survey
Cistothorus palustris	Marsh Wren	BSC	2001 Reptile/Amphibian Survey

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Salpinctes obsoletus	Rock Wren		2001 Reptile/Amphibian Survey
Thryomanes bewickii	Bewick's Wren		2001 Reptile/Amphibian Survey
Troglodytes aedon	House Wren		2001 Reptile/Amphibian Survey
Family *Regulidae*			
Regulus calendula	Ruby-crowned Kinglet		2001 Reptile/Amphibian Survey
Family *Sylviidae*			
Subfamily *Polioptilinae*			
Polioptila caerulea	Blue-gray Gnatcatcher		2001 Reptile/Amphibian Survey
Polioptila californica californica	Coastal California Gnatcatcher	FT/BSC	2001 Reptile/Amphibian Survey
Family *Turdidae*			
Catharus guttatus	Hermit Thrush		2001 Reptile/Amphibian Survey
Catharus ustulatus	Swainson's Thrush		2001 Reptile/Amphibian Survey
Sialia currucoides	Mountain Bluebird		2001 Reptile/Amphibian Survey
Sialia mexicana	Western Bluebird	BSC	2001 Reptile/Amphibian Survey
Turdus migratorius	American Robin		2001 Reptile/Amphibian Survey
Family *Timaliidae*			
Chamaea fasciata	Wrentit	BSC	2001 Reptile/Amphibian Survey
Family *Mimidae*			
Mimus polyglottos	Northern Mockingbird		2001 Reptile/Amphibian Survey
Oreoscoptes montanus	Sage Thrasher		2000 Vertebrate Survey
Toxostoma redivivum	California Thrasher	FSC/BSC	2001 Reptile/Amphibian Survey
Family *Sturnidae*			
Sturnus vulgaris	European Starling	Non-native	2001 Reptile/Amphibian Survey
Family *Motacillidae*			
Anthus rubescens	American Pipit	BSC	2001 Reptile/Amphibian Survey
Family *Bombycillidae*			
Bombycilla cedrorum	Cedar Waxwing		2001 Reptile/Amphibian Survey
Family *Passeridae*			
Passer domesticus	House Sparrow	Non-native	2001 Reptile/Amphibian Survey
Family *Ptilogonatidae*			
Phainopepla nitens	Phainopepla	BSC	2001 Reptile/Amphibian Survey
Family *Fringillidae*			
Subfamily *Carduelinae*			
Carduelis lawrencei	Lawrence's Goldfinch	FSC/BSC	2001 Reptile/Amphibian Survey
Carduelis pinus	Pine Siskin		2001 Reptile/Amphibian Survey
Carduelis psaltria	Lesser Goldfinch	BSC	2001 Reptile/Amphibian Survey
Carduelis tristis	American Goldfinch		2001 Reptile/Amphibian Survey
Carpodacus cassinii	House Finch	BSC	2000 Vertebrate Survey
Carpodacus purpureus	Purple Finch		2000 Vertebrate Survey
Family *Parulidae*			
Dendroica coronata	Yellow-rumped Warbler		2001 Reptile/Amphibian Survey
Dendroica nigrescens	Black-throated Gray Warbler	BSC	2001 Reptile/Amphibian Survey
Dendroica occidentalis	Hermit Warbler	BSC	2000 Vertebrate Survey

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Dendroica palmarum	Palm Warbler		2000 Vertebrate Survey
Dendroica petechia	Yellow Warbler	CSC	2001 Reptile/Amphibian Survey
Dendroica townsendi	Townsend's Warbler	BSC	2001 Reptile/Amphibian Survey
Geothlypis trichas	Common Yellowthroat	BSC	2001 Reptile/Amphibian Survey
Oporornis tolmiei	Macgillivray's Warbler		2001 Reptile/Amphibian Survey
Vermivora celata	Orange-crowned Warbler		2001 Reptile/Amphibian Survey
Vermivora ruficapilla	Nashville Warbler		2001 Reptile/Amphibian Survey
Wilsonia citrina	Hooded Warbler		
Wilsonia pusilla	Wilson's Warbler		2001 Reptile/Amphibian Survey
Icteria virens	Yellow-breasted Chat	CSC	2001 Reptile/Amphibian Survey
Family *Thraupidae*			
Piranga ludoviciana	Western Tanager		2001 Reptile/Amphibian Survey
Piranga rubra	Summer Tanager	CSC	2000 Vertebrate Survey
Family *Emberizidae*			
Aimophila ruficeps	Rufous-crowned Sparrow	CSC	2001 Reptile/Amphibian Survey
Ammodramus savannarum	Grasshopper Sparrow		2001 Reptile/Amphibian Survey
Amphispiza belli	Sage Sparrow	FSC/BSC/CSC	2001 Reptile/Amphibian Survey
Chondestes grammacus	Lark Sparrow	FSC/BSC	2001 Reptile/Amphibian Survey
Junco hyemalis	Dark-eyed Junco		2001 Reptile/Amphibian Survey
Melospiza lincolnii	Lincoln's Sparrow		2001 Reptile/Amphibian Survey
Melospiza melodia	Song Sparrow	BSC	2001 Reptile/Amphibian Survey
Passerculus sandwichensis	Savannah Sparrow		2001 Reptile/Amphibian Survey
Passerella iliaca	Fox Sparrow		2001 Reptile/Amphibian Survey
Pipilo chlorurus	Green-tailed Towhee		2001 Reptile/Amphibian Survey
Pipilo crissalis	California Towhee	BSC	2001 Reptile/Amphibian Survey
Pipilo maculatus	Spotted Towhee	BSC	2001 Reptile/Amphibian Survey
Pooecetes gramineus	Vesper Sparrow		2001 Reptile/Amphibian Survey
Spezilla atrogularis	Black-chinned Sparrow	BSC	2001 Reptile/Amphibian Survey
Spizella passerina	Chipping Sparrow		2001 Reptile/Amphibian Survey
Sturnella neglecta	Western Meadowlark	BSC	2001 Reptile/Amphibian Survey
Zonotrichia atricapilla	Golden-crowned Sparrow	BSC	2001 Reptile/Amphibian Survey
Zonotrichia leucophrys	White-crowned Sparrow		2001 Reptile/Amphibian Survey
Family *Cardinalidae*			
Guiraca caerulea	Blue Grosbeak		2001 Reptile/Amphibian Survey
Passerina amoena	Lazuli Bunting	BSC	2001 Reptile/Amphibian Survey
Passerina cyanea	Indigo Bunting		2000 Vertebrate Survey
Pheucticus ludovicianus	Rose-breasted Grosbeak		2001 Reptile/Amphibian Survey
Pheucticus melanocephalus	Black-headed Grosbeak	BSC	2001 Reptile/Amphibian Survey
Family *Icteridae*			

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Agelaius phoeniceus	Red-winged Blackbird		2001 Reptile/Amphibian Survey
Agelaius tricolor	Tricolored Blackbird	FSC/BSC/CSC	2001 Reptile/Amphibian Survey
Cassidix mexicanus	Great-tailed Grackle		2001 Reptile/Amphibian Survey
Euphagus cyanocephalus	Brewer's Blackbird	BSC	2001 Reptile/Amphibian Survey
Icterus bullockii	Bullock's Oriole	BSC	2001 Reptile/Amphibian Survey
Icterus cucullatus	Hooded Oriole	BSC	2001 Reptile/Amphibian Survey
Molothrus ater	Brown-headed Cowbird		2001 Reptile/Amphibian Survey
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Potential
Mammals			
Order Didelphidae			
Family *Didelphiidae*			
Didelphis virginiana	Opossum		2000 Vertebrate Survey
Order Insectivora			
Family *Soricidae*			
Notiosorex crawfordi crawfordi	Desert gray shrew		2000 Vertebrate Survey
Sorex ornatus ornatus	Ornate shrew		2000 Vertebrate Survey
Order Chiroptera			
Family *Vespertilionidae*			
Eptesicus fuscus	Big brown bat		2000 Vertebrate Survey
Lasiurus borealis	Red bat		2000 Vertebrate Survey
Myotis yumanensis sociabilis	Yuma myotis	FSC	2000 Vertebrate Survey
Pipistrellus hesperus	Western pipistrel		2000 Vertebrate Survey
Family *Molossidae*			
Eumops perotis	Western mastiff bat		2000 Vertebrate Survey
Nyctinomops femorasaccus	Pocketed free-tailed bat	CSC	2000 Vertebrate Survey
Tadarida brasiliensis	Mexican free-tailed bat		2000 Vertebrate Survey
Order Lagomorpha			
Family L*eporidae*			
Lepus californicus bennittii	Black-tailed jackrabbit		2000 Vertebrate Survey
Sylvilagus audubonii sanctidiegi	Desert cottontail		2000 Vertebrate Survey
Sylvilagus bachmani	Brush rabbit		2000 Vertebrate Survey
Order Rodentia			
Family *Sciuridae*			
Spermophilus beecheyi nudipes	California ground squirrel		2000 Vertebrate Survey
Family *Geomyidae*			
Thomomys bottae sanctidiegi	Southern pocket gopher		2000 Vertebrate Survey
Family *Heteromyidae*			
Chaetodipus californicus femoralis	California (dulzura) pocket mouse		
Chaetodipus fallax fallax	San Diego pocket mouse		2000 Vertebrate Survey

Marine Corps Air Station Miramar – Known Fauna			
Scientific Name	**Common Name**	**Status**	**Most Recent Reference**
Dipodomys agilis	Agile kangaroo rat		2000 Vertebrate Survey
Dipodomys simulans	Dulzura kangaroo rat		2000 Vertebrate Survey
Family *Muridae*			
Microtus californicus sanctidiegi	California vole		2000 Vertebrate Survey
Mus musculus	House mouse	Non-native	2000 Vertebrate Survey
Neotoma fuscipes macrotis	Dusky-footed woodrat		2000 Vertebrate Survey
Neotoma lepida intermedia	San Diego desert woodrat		2000 Vertebrate Survey
Onychomys torridus ramona	Southern grasshopper mouse		2000 Vertebrate Survey
Peromyscus boylii rowleyi	Brush mouse		2000 Vertebrate Survey
Peromyscus califronicus insignis	California mouse		2000 Vertebrate Survey
Peromyscus eremicus fraterculus	Cactus mouse		2000 Vertebrate Survey
Peromyscus maniculatus gambellii	Deer mouse		2000 Vertebrate Survey
Rattus rattus	Black rat	Non-native	2000 Vertebrate Survey
Reithrodontomys megalotis longicaudus	Western harvest mouse		2000 Vertebrate Survey
Order Carnivora			
Family *Canidae*			
Canis latrans clepticus	Coyote		2000 Vertebrate Survey
Urocyon cinereoargenteus californicus	Gray fox		2000 Vertebrate Survey
Family *Procyonidae*			
Bassariscus astutus	Ringtailed cat		Potential (Not Recorded in Recent Surveys)
Procyon lotor	Common raccoon		2000 Vertebrate Survey
Family *Mustelidae*			
Mustela frenata	Long-tailed weasel		2000 Vertebrate Survey
Mephitis mephitis holtzneri	Striped skunk		2000 Vertebrate Survey
Spilogale putorius microrhina	Western spotted skunk		Potential (Not Recorded in Recent Surveys)
Family *Felidae*			
Felis concolor californicus	Mountain lion		2000 Vertebrate Survey
Lynx rufus californicus	Bobcat		2000 Vertebrate Survey
Order Artiodactyla			
Family *Cervidae*			
Odocoileus hemionus fuliginata	Mule deer		2000 Vertebrate Survey

*Definitions:

Federal Federal categories per the Endangered Species Act, administered by the USFWS

FE Endangered - any species officially listed by the USFWS that is in danger of extinction throughout all or a significant portion of its range

FT Threatened - any species officially listed by the USFWS that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FSC Federal Species of Special Concern (Animal or Plant).

BGEPA Bald and Golden Eagle Protection Act of 1940

BSC Bird Species of Concern includes species that are of concern because of (a) documented or apparent population declines,

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APPENDIX G

V-22 Exhaust and Downwash Memos

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APPENDIX G-1

V-22 Exhaust Memo

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DEPARTMENT OF THE NAVY
PROGRAM EXECUTIVE OFFICER
AIR ASW ASSAULT AND SPECIAL MISSION PROGRAMS
47123 BUSE ROAD, BLDG 2272, Suite 149
PATUXENT RIVER, MD 20670-1547

IN REPLY REFER TO

Ser PMA-275/V22/357

JUL 21 2008

From: PMA-275 Program Manager
To: Headquarters, Marine Corps,
Department of Aviation, Aviation Logistics Support Branch
3000 Marine Corps, Pentagon Rm 5E518
Washington DC 20350-3000

Subj: RISK OF FIRE FROM V-22 EXHAUST

Ref: (a) Bell Boeing Test Report 901-993-356, Appendix E
(b) NAVAIR Safety Action Record (SAR) 22-02, Grass Fire Due to hot Exhaust

Encl: (1) Excerpt from A1-V22AB-NFM-000 MV-22B NATOPS Flight Manual
(2) U.S. Air Force JOPREP JIFFY report DTG 302000Z MAY 2007
(3) Excerpt from NSWCCD-65-TR-2006/12 March 2006, Structural Evaluation of an LHD-Class Amphibious Ship Flight Deck
Subjected to Exhaust Gas Heat from a MV-22 Osprey Aircraft
(4) Excerpt from National Institute for Standards and Technology (NIST) Technical Note 1481, Ignition of Cellulosic Fuels by Heated and Radiative Surfaces, March 2007

1. To support the transition of the MV-22B Osprey aircraft to the west coast, the program office has been requested to provide information concerning the risk of a grass fire due to the exhaust temperature of the V-22. This letter summarizes the V-22 program office's assessment of that risk.

2. The tiltrotor configuration of the V-22 necessitates that the engine exhaust be directed down with the nacelles in the vertical position. This places the engine exhaust exit 4ft 4in above the ground. To reduce heating of the ground and aircraft components, the V-22 incorporates an exhaust deflector system which directs the exhaust gasses outward, away from the aircraft and the ground. The exhaust deflector system is activated at low power settings with Weight on Wheels, but can be de-selected by the pilot. A temperature profile of V-22 exhaust with the coanda system off is illustrated in enclosure (1). With exhaust deflectors off, the V-22 exhaust temperature at the exit plane is 515 deg F above the ambient temperature decreasing to 150 deg F above ambient temperature at a distance of 4ft 4in below the bottom of the nacelle IR suppressor.

3. To date, there has been one documented grass fire attributed to V-22 exhaust. The fire occurred approximately 10 miles southwest of Troy, Alabama. Enclosure (2) contains the U.S. Air Force JOPREP JIFFY report, similar to a U.S. Marine Corps flash report, detailing the incident. The probable cause of the fire was attributed to an interruption of the exhaust deflector operation. With the exhaust deflector inoperative, the exhaust was directed straight down, increasing the temperature directly below the nacelle to a temperature high enough to support combustion of grass.

4. Testing to measure the effectiveness of the coanda exhaust deflection was performed in 1997. The maximum ground temperature achieved during this testing was 422 deg F (reference a). To quantify the flight deck heating characteristics of V-22 exhaust, with the exhaust defection system operating, testing was conducted aboard USS Wasp in 2005. An instrumented flight deck was constructed to measure deck temperatures for a V-22 with exhaust deflectors operating, at varied engine power settings. A graph of flight deck temperature (in deg F) versus time is presented in enclosure (3). These results show that the flight deck temperature reached 300 deg F approximately 10 minutes after engine start, attained a maximum temperature of 380 deg F 30 minutes after engine start, and remained at 380 deg F for as long as 90 minutes after engine start.

5. Information concerning the combustion temperatures of various plant based materials may be found in NIST Technical Note 1481, Ignition of Cellulosic Fuels by Heated and Radiative Surfaces. This testing was conducted to characterize the ignition behavior of typical outdoor fuels by heated mufflers and catalytic converters found on outdoor power equipment. The fuels tested included shredded newsprint, tall fescue, cheat grass, fine Florida grass, and pine needles. A summary of the test results is presented in enclosure (4), showing time to glowing ignition (in seconds) versus temperature (in deg C) for both no wind and high wind conditions. The figures show glowing ignition is reached at temperatures as low as 572 deg F (300 deg C). This is 150 to 192 deg F above the maximum ground temperatures achieved with exhaust deflectors operating during the 1997 coanda and the 2005 USS Wasp flight deck heating tests.

6. The Naval Air Systems Command (NAVAIR) system safety has also conducted a safety assessment of the risk of a grass fire caused by hot exhaust (reference b). This safety assessment took into account all the information presented above as well as extenuating circumstances such as rigid vegetation extending higher into the exhaust stream and leaking fuel or hydraulic fluid after an extended period with the engines shut down. After taking all of the data and possible circumstances into account, NAVAIR system safety assessed the risk of a grass fire as a remote frequency (> 1 event per million flight hours).

7. The available data indicates, under normal operations, with exhaust deflectors operating, the exhaust of the V-22 should not heat ground to a temperature high enough to support combustion of plant based materials. This conclusion is also consistent with V-22 operational experience. After 44,000 V-22 flight hours and operations to numerous unprepared landing zones at bases and ranges including sites in Alabama, Arizona, California, Florida, Maryland, Nevada, New Mexico, North Carolina, and Virginia, there has been one documented fire with exhaust deflectors inoperative and no documented fires with exhaust deflectors operating.

8. Based on the information available, it is the assessment of PMA-275, that operations to unprepared surfaces can be safely accomplished provided exhaust deflectors are operable. Additional operational mitigations such as avoiding placing rigid vegetation such as bushes and brush directly beneath the nacelle and limiting time the aircraft is on deck in unprepared landing zones will further mitigate this already remote risk.

M.D. MULHERN
COL USMC

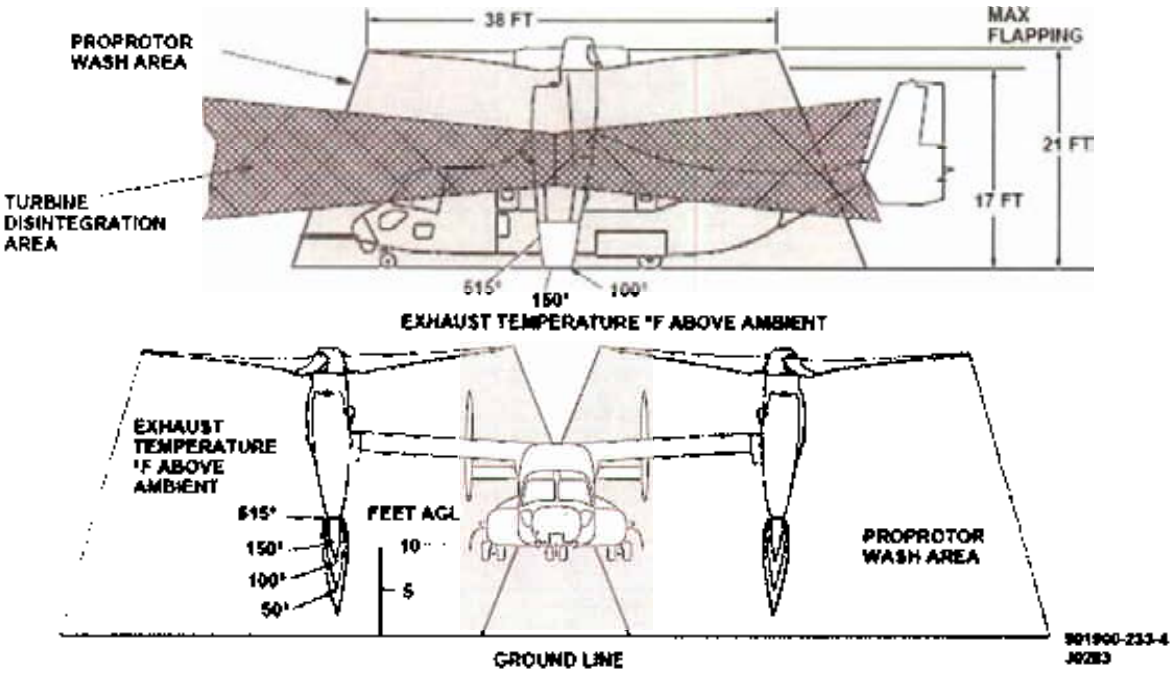

Figure 3-13. Danger Areas
A1-V22AB-NFM-000
NATOPS Flight Manual Navy Model MV-22B Tiltrotor, 1 October 2006

UNCLAS

DTG: 302000Z MAY 2007

FM 1 SOW HURLBURT FIELD FL//CP//

UNCLAS JOPREP JIFFY

MSGID/OPREP-3H/1 SOW/052/MAY//
REF/A/DESC: INITIAL VOICE OPREP-3H REPORT/1 SOW/301951ZMAY2007/052//
FLAGWORD/HOMELINE/-// TIMELOC/300305ZMAY2007/TROY, AL/FINAL//
GENTEXT/INCIDENT IDENTIFICATION AND DETAILS/THE COMMAND POST WAS NOTIFIED AT 300646Z MAY 2007 AND THE COMMANDER APPROVED THE VOICE REPORT AT 301932Z MAY 2007. THE INFORMATION WAS VERIFIED BY THE 8TH SPECIAL OPERATIONS SQUADRON AT 300646Z MAY 2007. A CV-22B, CALL SIGN RAVEN 47, TAIL NUMBER 04-0029 WAS ON A TRAINING MISSION AT A LANDING ZONE (RT392, N31.49.584/W086.10.996) 10NM SOUTHWEST OF TROY, ALABAMA. AT 300305Z MAY 2007, A GRASS FIRE ERRUPTED UNDER THE RIGHT ENGINE EXHAUST SUPRESSOR; THE PROBABLE CAUSE OF THE FIRE WAS DUE TO A MISSION COMPUTER FAILURE INTERRUPTING THE ENGINE EXHAUST DEFLECTOR SYSTEM. THE AIRCREW IMMEDIATELY TOOK OFF AND DETERMINED THAT THE FIRE WAS ONLY ON THE GROUND. RAVEN 47 COORDINATED A WITH LOCAL AIRSPACE CONTROLLING AGENCY FOR A FIRE RESPONSE CREW. ONCE THE FIREFIGHTERS WERE ON SCENE, THE AIRCRAFT RETURNED TO HOME STATION AT 300435Z MAY 2007. RULE 8.8 APPLIES. NO FURTHER INFORMATION AVAILABLE. THIS IS A COMMAND POST FINAL REPORT.//

UNCLAS

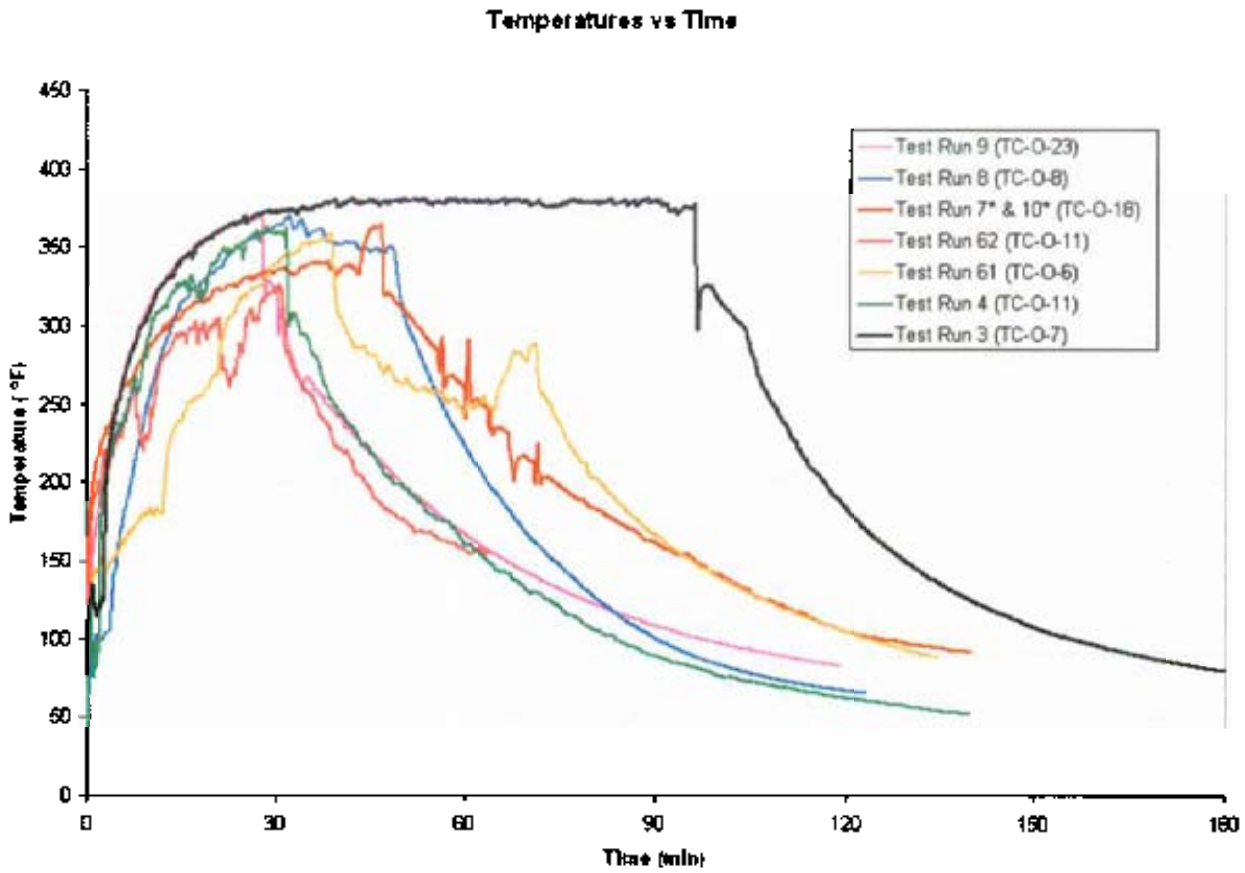

Figure 11. Measured Maximum Temperatures vs. Time (All Tests)

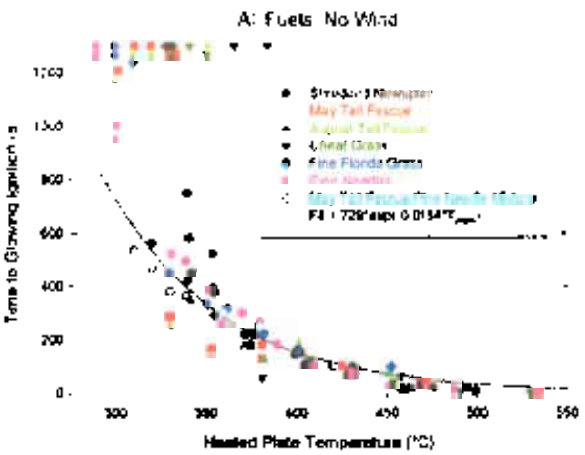

Figure 73. Data for time to glowing ignition with no applied wind are plotted as a function of heated plate temperature for seven fuels. Data near the upper temperature axis represent experiments for which ignition did not take place. The solid curve is the result of a least squares fit assuming an exponential dependence on heated plate temperature for all data where ignition was observed.

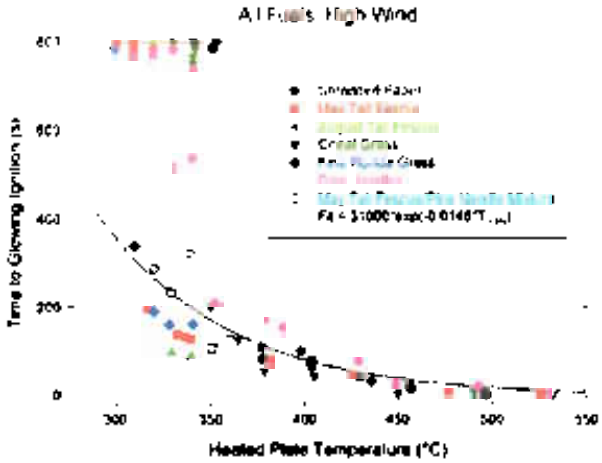

Figure 74. Data for time to glowing ignition with a high applied wind are plotted as a function of heated plate temperature for seven fuels. Data near the upper temperature axis represent experiments for which ignition did not take place. The solid curve is the result of a least squares fit assuming an exponential dependence on heated plate temperature for all data where ignition was observed.

NIST Technical Note 1481

Ignition of Cellulosic Fuels by Heated and Radiative Surfaces

William M. Pitts

NIST National Institute of Standards and Technology • Technology Administration • U.S. Department of Commerce

NIST Technical Note 1481

Ignition of Cellulosic Fuels by Heated and Radiative Surfaces

William M. Pitts
Building and Fire Research Laboratory

March 2007

U.S. Department of Commerce
Carlos M. Gutierrez, Secretary

Technology Administration
Robert Cresanti, Under Secretary of Commerce for Technology

National Institute of Standards and Technology
William Jeffrey, Director

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National Institute of Standards and Technology Technical Note 1481
Natl. Inst. Stand. Technol. Tech. Note. 1481, 106 pages (March 2007)
CODEN: NSPUE2

Abstract

Experiments designed to characterize the ignition behavior of typical outdoor fuels by heated mufflers and catalytic converters found on outdoor power equipment are described. Ignition by direct contact with a heated surface and by radiation from a heated surface were considered. For the first scenario the fuel was placed in contact with an electrically heated surface, and the times required for ignition measured as a function of surface temperature. The effects of a wind on heated plate ignition were studied by passing air flows of 1.1 m/s and 2.5 m/s over the fuel bed. Fuels tested included shredded newsprint, four types of grass, pine needles, a grass/pine needle mixture and three types of dry leaves. Both glowing combustion and flaming were observed. The transition to flaming required glowing combustion to be present. Ignition times generally increased with decreasing surface temperature until a temperature was reached where ignition was no longer observed. Ignition times for given applied wind and surface temperature conditions and transition to flaming behavior were fuel dependent. An applied wind generally reduced the time required for ignition, with the reduction being greater for the higher velocity. A commercially available cone calorimeter operated in the non piloted ignition mode was used to impose known radiative heat fluxes on the fuel surface, and ignition times were measured as a function of applied heat flux. Shredded newsprint, two types of grass, pine needles, and non fire-retarded flexible polyurethane foam were studied. Ignition times for radiative heating increased with decreasing applied heat flux until levels were reached where ignition did not occur. The polyurethane foam had a distinctly different behavior than the cellulosic fuels. Comparison of the heated plate and radiative heating experiments suggests that they can be related using the black body temperature corresponding to the applied radiative heat flux.

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Executive Summary

Recently implemented and proposed regulations for outdoor power equipment require reductions in hydrocarbon and nitrogen oxides to levels that require the use of catalytic converters. Concerns have been raised that catalytic converters can result in increased temperatures for exhaust gases and surfaces that could increase the risk of fires. In response to this concern, The International Consortium for Fire Safety, Health, and the Environment (ICFSHE), with funding provided by the Outdoor Power Equipment Institute, awarded a contract to the SP Swedish National Testing and Research Institute (SP) for a "Scientific Evaluation of the Risk Associated with Heightened Environmental Requirements on Outdoor Power Equipment." As part of this study ICFSHE requested that the Building and Fire Research Laboratory of the National Institute of Standards and Technology (BFRL/NIST) provide experimental support to SP. A work statement was adopted that involved characterizing the ignition of typical outdoor fuels by ignition sources representative of those expected for outdoor power equipment exhaust systems.

This report summarizes the findings of the BFRL/NIST investigation. One series of experiments was designed to simulate the ignition behaviors of fuels that come into direct contact with a heated surface. A series of experiments was run in which porous fuel beds were brought into contact with a 10.2 cm × 10.2 cm heated copper plate held at a constant temperature. The plate faced upward. A constant mass of the material to be tested was placed in a stainless steel wire screen cage to a depth of 2.5 cm, placed over the heated plate, and then exposed to the surface by removing a metal shutter from the bottom of the cage. The primary experimental measurements were whether or not glowing and/or flaming developed and, if so, the heating times required. Observations were made visually and by video recording of the experiments. Secondary observations included smoke behaviors, locations of initial burning, and the appearance of the fuel bed following an experiment. The effect of a wind on ignition behavior was investigated by running experiments with no wind and in the presence of low (1.0 m/s) and high winds (2.5 m/s). Heated plate temperatures were varied from temperatures in excess of 500 °C where ignition periods were short (a few seconds) down to temperatures where ignition of the fuels was not observed after many minutes.

A second series of experiments was designed to characterize ignition of porous fuel beds by radiative heating. Such heating occurs when fuel is located near, but not in direct contact with, a heated surface. The experiments were made with a cone calorimeter, a standard instrument designed primarily for heat release rate measurements with an applied radiative heat flux. Cone calorimeter measurements usually utilize an electrical spark as an ignition source, but these experiments were non piloted, and the spark was not used. Exposed fuel bed surfaces had the same dimensions as for the heated plate experiments, but samples were placed in sample holders with solid walls and were irradiated from above by a radiant source that was shielded from the fuel by a cooled shutter until the start of an experiment. Glowing and flaming ignition times were determined for a range of applied heat fluxes, from levels sufficient to induce ignition within a few seconds down to levels where ignition was not observed after many minutes. The only air flow was that around the sample induced by the experimental system. Useful secondary measurements included the heat release rate and mass for the sample holder and fuel as functions of time.

Heated plate ignition experiments were done for shredded newsprint, four grasses (two samples of tall fescue collected from the same location at NIST in May and August, cheat grass from California, and a sample of fine grass from Florida provided by a manufacturer of outdoor power equipment that was intended to simulate debris from the top of a mower housing), pine needles, and a mixture of May tall fescue, and pine needles. A limited number of tests were also run for boxwood, American elm, and pin oak leaves. Cone calorimeter tests were done for shredded newsprint, May tall fescue, cheat grass and pine needles. Samples of a non fire-retarded flexible polyurethane foam, representing a common plastic, were also tested in the cone calorimeter.

Some general observations from the heated plate experiments include the release of smoke, most likely a combination of condensed water and organic pyrolyzate as fuels are heated. The smoke distribution for experiments without a wind indicated that circular buoyant plumes were formed within the porous fuel beds by the flows rising from the heated plate and oxidizing fuel surfaces. With a wind applied to the fuel bed, smoke escaped along a band extending across the fuel bed perpendicular to the wind direction. This smoke distribution resulted from the interaction of the wind entering the fuel bed, which was slowed by interaction with the fuel, and the buoyancy driven flow. Qualitative observation indicated that the amount of pyrolysis occurring within a fuel bed was related to the amount of smoke observed. Smoke levels were generally heavy immediately prior to glowing or flaming ignition.

For heated plate temperatures around 550 °C all of the fuels ignited within a few seconds. As the plate temperature was reduced, the ignition times at first slowly increased until temperatures reached about 450 °C. Further reductions in temperature resulted in ignition times that increased more rapidly as the plate temperature was reduced. The dependence on temperature was shown to be captured well by fitting with exponential curves. Eventually, as the plate temperature was lowered, a point was reached for which a given type of fuel bed no longer ignited.

The ignition described above includes both glowing combustion and flaming. There were conditions for which glowing was observed but flaming was not and fewer examples of flaming without observed glowing. Even though glowing was not observed in all experiments in which flames were seen, in most experiments it appeared earlier. Video recordings of the transition to flaming showed that flames ignited within regions surrounded by intense glowing. A blue flame would suddenly appear and then spread rapidly before yellow flames appeared. These observations suggest that the transition to flaming requires the presence of high temperature glowing areas to supply the ignition energy and premixed volumes of gaseous fuel pyrolyzate and air having concentrations within the flammability limits for the mixture.

The general heated plate ignition temperature dependence discussed above was observed for the three wind conditions tested, but ignition times and fuel dependent transition to flaming behaviors depended strongly on wind condition. When a low wind was applied the ignition times were reduced from those for the same fuel without a wind, assuming ignition occurred for both conditions. Similar reductions in ignition times were observed when results for low and high winds were compared. For the lowest plate temperatures, the reductions in ignition times on going from no wind to high wind were on the order of a factor of two. Transition from glowing combustion to flaming was observed whenever glowing developed for shredded newsprint and pine needles. With a few isolated exceptions, none of the grass samples that

developed glowing in the absence of wind transitioned to flaming, while the August tall fescue, cheat grass, and fine Florida grass did transition to flaming when low and high winds were present. For most cases, glowing May tall fescue failed to transition to flaming with wind present. Note that the difference between the May tall fescue and August tall fescue implies seasonal differences for grass samples taken from the same location. The May tall fescue/pine needle mixture displayed flaming behaviors intermediate between those for the individual fuels, transitioning from glowing to flaming in over half of the experiments without wind and in all cases when wind was present.

Ignition times for the individual fuels displayed similar dependencies on heated plate temperature and wind as described above. By fitting the combined results for each wind condition to an exponential, it was possible to demonstrate that systematic effects of fuel were present that introduced ignition time variations that were larger than those observed for a given individual fuel. For a specified heated plate temperature and wind condition, the longest ignition times were found for the shredded newsprint and pine needles, while the grasses tended to have the shortest ignition times. The May tall fescue/pine needle mixture gave intermediate ignition times.

Minimum heated plate temperatures required for a given fuel and wind condition can be estimated from the experimental measurements. Values ranged from 290 °C to 380 °C and had complicated dependencies on fuel type and wind condition. These dependencies are described in detail in the full manuscript. In general, when a wind was not present the grasses tended to have higher minimum heated plate ignition temperatures than the shredded paper and pine needles. When wind was introduced the minimum temperatures for the grasses decreased while those for the shredded paper and pine needles increased such that the lowest minimum temperatures with wind tended to be those for the grasses. Inspection of the grass fuel beds following experiments at temperatures lower than required for ignition with no wind provided insight into the reason for this behavior. It was found that non glowing smoldering took place in the absence of a wind down to temperatures on the order of 300 °C. Presumably, when a wind was applied more oxygen was available at the fuel surface and sufficient heat was generated for the non glowing combustion to transition to glowing. Similar non glowing smoldering was not observed for shredded paper and pine needles. It is likely that for these fuels the applied wind cooled the samples and resulted in the higher minimum ignition temperatures. The May tall fescue/pine needle mixture without wind yielded the lowest observed minimum ignition temperature of 290 °C. This suggests that the May tall fescue component of the mixture was able to begin non glowing smoldering at this temperature and that the heat generated was sufficient to ignite glowing combustion on the pine needle fraction. Transition to flaming was observed in this particular experiment.

Limited experiments with a heated plate temperature of 380 °C indicated that leaves are likely to have similar ignition behaviors to those observed for the cellulosic fuels investigated more fully.

The cone calorimeter radiative ignition (glowing and flaming) experiments were run without a lateral air flow. Applied heat fluxes were varied from a high of 50 kW/m^2 down to values where ignition was not observed. Plots of ignition time versus applied heat flux had similar appearances to the plots of ignition time versus heated plate temperature discussed above. For

the highest heat fluxes ignition times were on the order of a few seconds. As the applied heat flux was reduced to lower values, the ignition times increased slowly at first. Eventually, with further reductions, applied heat fluxes reached values where ignition times began to increase rapidly at rates that increased with decreasing flux. Ignition times of hundreds of seconds were observed before further reductions in applied heat flux resulted in no ignition. As for the heated plate experiments, the dependencies of ignition times on applied heat flux were well described by exponential curve fits.

Results for three of the fuels, shredded paper, May tall fescue, and cheat grass, fell on very similar curves, with the rapid increases in ignition beginning around 20 kW/m^2 and minimum applied heat fluxes required for ignition of approximately 10 kW/m^2. The ignition time for the pine needles was slightly different, with the rapid rise starting around 30 kW/m^2 and a slower rate of increase with decreasing heat flux than found for the three other fuels. A minimum applied heat flux for ignition was not determined for the pine needles.

Even though the ignition times as a function of applied heat flux were similar for the four fuels, transition to flaming behaviors were very different. Flaming was observed for all of the fuels with applied heat fluxes of 40 kW/m^2 and higher, and maximum observed heat release rates were similar. However, as the applied heat flux was reduced below 40 kW/m^2 only glowing combustion developed for the two grasses, while the shredded newsprint and pine needles continued to transition to flaming. These ignition behaviors were observed over applied heat fluxes in the 10 kW/m^2 to 40 kW/m^2 range. Observed time behaviors for heat release rate and mass loss were consistent with these observations. The highest heat release rates and mass loss rates were observed during flaming, while the values were much reduced during smoldering. The measurements for the glowing grass indicated that there were two distinct types of smoldering having different effective heats of combustion. There seemed to be an initial oxidation that converted a part of the grass to a high energy char, which then smoldered slowly with much slower mass loss but a comparable heat release rate.

The cone calorimeter results are in good agreement with the heated plate results with regard to flaming behavior for the grasses. They indicate that with no wind present it is very difficult to generate flaming, consistent with the absence of flaming in the heated plate experiments. The shredded newsprint and pine needles transitioned to flaming in all cases where glowing developed, again consistent with the heated plate experiments. Measurements of ignition times, heat release rates, and mass loss were similar for the May tall fescue and cheat grass. Recall that these two grasses had different behaviors with regard to transition to flaming in the presence of a wind. The similarity of the results suggests that the cone calorimeter is not able to distinguish fuels that have different flaming behaviors in the presence of wind.

Radiative ignition experiments were performed for polyurethane foam. The ignition time behavior was very different from those observed for the cellulosic fuels, and the minimum ignition applied heat flux was 23 kW/m^2. Heat release rate curves had two peaks corresponding to initial burning of the foam that generated a liquid component, which then burned as a pool fire. At the lowest applied heat fluxes the foam formed the liquid without oxidation, and if flaming ignited, it was only for the liquid fraction.

In order to determine if the response of a fuel to a radiative heat flux could be related to its response on a heated plate, black body temperatures corresponding to given applied heat fluxes were calculated. Comparisons of heated plate temperatures and the corresponding black body temperatures from the cone calorimeter results indicated that values for minimum ignition temperature and the temperature where the sharp increases in ignition times began were slightly higher for the black body temperatures, but were close enough to justify the approach. This is particularly true when it is noted that the application of heat to the bottom of the fuel beds and open walls of the fuel holder for the heated plate experiments should result in slightly lower ignition temperatures than the radiative heating experiments where heat is applied to the top of fuel beds enclosed on the sides.

A review of the literature identified very few experiments that could be compared directly to the current findings. Limited numbers of measurements of ignition times versus surface temperature were consistent for similar fuel beds. A review of experiments that identified minimum ignition temperatures yielded a wide range of values that were of little use for comparison. No experiments were identified that investigated non piloted radiative ignition of these types of fuels.

The experimental results are subject to uncertainties associated with such parameters as temperature measurement, identification of ignition time, and stochastic variations of fuel behavior and packing. Due to the limited number of measurements possible, it was not feasible to determine probability curves for such variables as ignition temperature as a function of heated plate temperature or applied heat flux. In spite of these uncertainties the results demonstrate that smoldering and flaming ignition of cellulosic fuel beds exposed to conditions chosen to be representative of those generated on heated exhausts of outdoor power equipment vary with surface temperature or applied heat flux, fuel type, wind, and season. In addition to these parameters, there are a number of others that would be expected to affect ignition behavior but were not varied in this study. These include fuel moisture, fuel bed exposed surface area, fuel bed thickness, fuel bed porosity, spatial orientation of the heat source and the fuel bed, and the accessibility of the interior of a fuel bed to an applied wind.

Keeping in mind the experimental uncertainties and additional parameters that could affect ignition behavior, it is possible to provide some general guidance with regard to expected ignition behaviors of cellulosic fuels when subjected to contact with a heated surface or exposure to thermal radiation. Curve fits to exponentials based on data for multiple fuels have been made that provide reasonable approximations for the observed variations in ignition times with heated plate temperature and applied heat flux. For the heated surface, these fits are available for three wind conditions. While clearly not representative of worst case conditions, these curves should be useful for assessing the likelihood of ignition and the time required for a generic cellulosic fuel subjected to conditions similar to those investigated here.

It is common to introduce safety factors when making engineering estimates having safety implications. For the ignition of cellulosic fuels by contact with a heated surface the following assumptions are appropriate: 1) ignition is possible for temperatures of 290 °C and higher, 2) any ignition that takes place will result in flaming, and 3) ignition times estimated from the exponential curve fits should be divided by a factor of two. The available experimental data

cover a range of winds from 0 m/s to 2.5 m/s, and the fits can be used to estimate ignition times over this range. Caution should be exercised when extending the estimates to higher wind cases.

An exponential curve fit of ignition times versus applied heat flux has been determined from the radiative heating experiments. Similar assumptions to those above would allow this curve to be utilized for estimating ignition times for cellulosic fuel beds exposed to a given level of heat flux. However, based on the similar ignition time dependencies observed between heated plate temperatures and black body temperatures derived from the applied heat fluxes, it is recommended that black body temperatures based on the applied heat fluxes be used in conjunction with the exponential curves derived from the heated plate experiments to estimate ignition times for radiative heating. This has the advantage of providing estimates for ignition by radiative heating in the presence of a wind.

Suggestions are provided for improvements to the experimental system and for additional experiments.

1. Introduction

Concerns about the levels of hydrocarbons and nitrogen oxides released from the exhausts of outdoor power equipment (OPE) led the California Air Resources Board to approve regulations in September, 2003 requiring reductions in these species to levels which require the use of exhaust catalytic converters. Having received a required US Environmental Protections Agency (EPA) waiver, these regulations went into effect in 2007. The EPA is currently considering extending a similar regulation to the entire country. [1]

Exhaust catalysts operate by lowering the temperatures required to oxidize pollutant species. Since oxidation reactions are exothermic, heat is generated, and there is the potential for exhaust gas temperatures to increase when a catalyst is present. The use of a catalyst may raise the temperatures of the gases exhausted by the engine as well as the temperatures of exposed surfaces that form the exhaust system.

It is known that the temperatures generated by existing exhaust systems on OPE are high enough to be potential fire ignition sources for typical organic fuels. Several groups, including the Outdoor Power Equipment Institute (OPEI) and the National Association of State Fire Marshals (NASFM), questioned whether higher temperatures associated with the use of catalytic converters on OPE might result in an increased risk of unwanted fire.

In response to these concerns and at the request of NASFM, The International Consortium for Fire Safety, Health, and the Environment (ICFSHE), with funding provided by OPEI, awarded a contract to the SP Swedish National Testing and Research Institute (now renamed SP Technical Research Institute of Sweden, referred to as "SP") for a "Scientific Evaluation of the Risk Associated with Heightened Environmental Requirements on Outdoor Power Equipment." Phase I of this investigation included a literature review and development of an experimental research plan for studying this problem. The findings of the Phase I study are available. [2]

ICFSHE requested that the Building and Fire Research Laboratory of the National Institute of Standards and Technology (BFRL/NIST) provide experimental support to SP as part of the Phase II effort. A work statement entitled "Ignition of Fuels by Conductive, Radiative, and Conductive Heating" was prepared and submitted to ICFSHE and SP for consideration. The work statement proposed to experimentally characterize the ignition behaviors of a variety of natural and man made organic fuels when exposed to heat sources believed to be representative of those generated by the exhausts of OPE. This work statement was accepted and research funding was provided to BFRL/NIST by ICFSHE with technical management and oversight provided by SP.

The original work statement included ignition studies using three types of heat sources—heated plate (conductive), heated flow (convective), and radiative. A variety of materials were to be investigated including a grass, pine needles, leaves, sawdust, oil, and gasoline. Tests were proposed to characterize the effects of spatial orientation, an imposed wind, and an uneven heat distribution on the heated plate.

Initial testing showed the ignition of grasses was dependent on the type of grass and the presence or absence of a wind played a dominant role in ignition behavior. Based on these observations and with the agreement of SP, the test matrix was modified to focus more attention on the effects of grass type and wind condition. It was decided that characterizing ignition by a heated plate and by radiation was more important than characterizing ignition due to a convective heat flow, and this heat source was dropped from the investigation. Ultimately, ignitions studies on a variable-temperature heated plate were carried out for shredded newsprint, four different grass samples, pine needles, and a grass/pine needle mixture. Three wind conditions—no wind and two imposed wind velocities of 1.1 m/s and 2.5 m/s—were used. A limited number of tests were done with three types of leaves. Radiative ignition studies were performed as a function of applied heat flux for shredded newsprint, two types of grass, pine needles, and non fire-retarded flexible polyurethane foam.

The following section, Section 2, provides an overview of relevant past studies and introduces some concepts useful for the later discussion. The experimental systems and procedures are discussed in Section 3. Section 4 presents the experimental findings for the investigation. The final section, Section 5, summarizes the findings along with the implications for possible ignition by heated plates or radiative surfaces.

2. Important Concepts and Literature Review

The focus of this experimental program is the characterization of ignition for various fuels by heat sources deemed to be representative of those expected for exhaust systems on OPE such as lawn mowers. Two potential scenarios are emphasized. In the first it is assumed the fuel comes into direct contact with a heated surface. Since exhaust temperatures can vary over a wide range, the response of the fuel will be investigated as a function of surface temperature. In the second scenario the fuel is located close to, but sufficiently far from, a heated surface that heating of the fuel is dominated by radiative heat transfer. In this case the important experimental parameter is the radiative heat flux (kW/m^2) impinging on the fuel surface. Since the heat flux depends on the radiating surface temperature to the fourth power, the fuel response to a range of heat fluxes is considered.

Since by definition OPE is operated outdoors, ignition of natural fuels such as grasses, pine needles, and leaves are considered to be particularly important. It is also possible that heated exhaust surfaces will come in contact with a variety of man-made fuels during storage. As a result there is a nearly infinite number of potential fuels that could be considered relevant to this problem. For this study the ignition behaviors of shredded newsprint, four types of grass (May tall fescue, August tall fescue, cheat, and fine Florida), pine needles, various types of leaves, a May tall fescue/pine needle mixture, and polyurethane foam were investigated. While chosen to be representative of possible fuels, care should be exercised in extrapolating the findings to additional fuels.

The focus of this investigation is ultimately fire safety. From this standpoint, “flaming combustion” in which gasified fuel molecules undergo a self sustaining reaction with oxygen in the air to release heat and light is considered to represent the most dangerous type of combustion.

The natural fuels chosen for study as well as the shredded newsprint contain high concentrations of cellulose along with other natural polymers such as hemicellulose, and lignin. Materials containing these polymers are known to be susceptible to a type of surface combustion known as smoldering. In his review, Ohlemiller defines smoldering as “a slow, low-temperature, flameless form of combustion, sustained by heat evolved when oxygen directly attacks the surface of a condensed-phase fuel.” [3]

Smoldering usually involves both endothermic and exothermic processes. Moisture removal from the fuel and gasification of low molecular weight fuel molecules (known as pyrolysis) generally require energy input. As described by Ohlemiller, fuel pyrolysis often leads to the formation of a poorly characterized carbon-enriched material referred to as char. Oxidative surface reactions with char are exothermic and provide the heat necessary to sustain smoldering. [3] Note that fuel pyrolysis is possible without oxidation. Local surface oxidation can also occur near a heated surface without the development of self-sustaining smoldering.

Once initiated, in most cases the smoldering reaction rate is limited by the amount of oxygen available at the fuel surface. Therefore smoldering behavior is generally sensitive to parameters that affect the amount of oxygen reaching the surface. An example of such a parameter is the

porosity of a smoldering fuel bed. The more open the fuel bed, the more easily oxygen will be able reach a given fuel surface and support smoldering. The presence of an imposed or natural (buoyancy-driven) flow strongly influences the amount of oxygen reaching a smoldering fuel surface. Everyone is familiar with the increase in intensity that occurs when one blows on a piece of paper or wood with visible smoldering. The fuel surface-to-volume ratio is also an important parameter controlling smoldering behavior with high ratios favoring smoldering.

Most studies of smoldering consider such properties as the spread rate in a fuel bed. The study of Palmer, who investigated smoldering spread through a variety of materials and configurations, is a classic example. [4] Studies that consider ignition of smoldering are much rarer. In his comprehensive review on ignition, Babrauskas includes a section on smoldering in general and smoldering ignition in particular. [5] Many of the studies he summarizes involve determination of the minimum energy necessary to ignite smoldering. Of direct relevance to this study, Ohlemiller showed that the lowest temperature of a heated surface capable of igniting smoldering in a bed of cellulosic insulation varied with the size of the heater. [6,7] For a 0.48 cm diameter wire a minimum temperature of 380 °C to 385 °C was required, while the limit dropped to 255 °C to 260 °C for a 200 cm × 200 cm plate. Times required for ignition with these low temperatures were on the order of hours. Babraukas also discusses a limited number of studies in which the time to ignition was determined as a function of applied heat flux. Materials studied included cotton fabrics and polyurethane foam. [5]

A number of parameters have been identified as important in controlling smoldering behavior in porous fuel beds such as those considered in this study. [3,5] The fuel must be capable of forming a rigid char during pyrolysis. Char formation varies widely in solid fuels. Charring and char oxidation rates in cellulosic fuels are known to be sensitive to the concentration of various inorganic salts, metals, and metal hydroxides. The amount of moisture absorbed in the fuel is a very important parameter. Physical properties of the fuel beds such as size, thickness, and porosity also play roles.

Babrauskas notes that there are two smoldering modes that are characterized by whether or not oxidizing surface temperatures are high enough to emit visible light. [5] The type of smoldering in which light is emitted is often referred to as “glowing combustion.” Drysdale includes a short discussion of glowing combustion as part of a discussion of smoldering in his book. [8] In the current work smoldering in which there is no visible light produced will be referred to as “non glowing combustion.” It appears that little previous research has considered the conditions necessary for the development of glowing combustion or its general behavior.

It is well known in the fire community that under certain conditions smoldering will spontaneously transition to flaming combustion. [5,8] While the general requirements for ignition in the gas phase are known, there is little practical understanding of the transition to flaming from smoldering solids. At a minimum, it is necessary that a solid fuel pyrolyze with a sufficient rate to generate a premixed fuel/air mixture that lies between the lean and rich flammability limits. Such a mixture can ignite in two well defined ways—piloted and non-piloted. In “piloted ignition” a source of heat and free radicals, such as a flame or spark, are used to initiate the combustion reactions, which then become self sustaining. In non-piloted ignition the flammable fuel/air mixture must be heated to a point where free radicals are generated within

the mixture, and rapid chain branching chemical reactions lead to sustained combustion. Typically, higher temperatures must be present for non piloted ignition than for piloted ignition.

In the current work a cone calorimeter will be used for the radiative ignition studies. Babrauskas and Parker have described the use of the instrument for this purpose. [9] Most ignition experiments that have been done in the cone utilized an electric discharge as a pilot for the flame. It is possible to operate the system without a spark in order to study non piloted ignition.

A primary focus of this work is the ignition behavior of cellulosic fuels. Babrauskas included a review of ignition of forest materials, vegetation, and hay in his comprehensive monograph on ignition. [10] His general comments concerning such measurements are relevant. He points out that there are numerous measurements of ignition temperatures in the literature, but that the results vary widely. Potential sources of these variations include fuel composition and moisture content, but Babrauskas argues that variations due to such factors should be much less than observed, and he attributes much of the variability to experimental protocols and operator inexperience.

Many of the ignition studies cited by Babrauskas involve determining a lower temperature limit for combustion. A variety of heating approaches were employed with the most prevalent being immersion in air held at a constant temperature in an oven. Minimum ignition temperatures reported for a variety of natural fuels ranged from 166 °C to as high as 675 °C. There is no indication of the times required for ignition or the type of combustion observed.

In a number of studies relatively large heated bodies were deposited on various types of porous natural fuel beds. Ignition temperature tended to be somewhat higher than reported for other ignition sources, with minimum values ranging between 450 °C and 650 °C.

More recently, several studies of radiant ignition of forest fuels have appeared. Most of these tests have utilized either the ISO 5657 [11] or cone calorimeter [12,13,14] tests. ISO 5657 and the cone calorimeter are similar tests, but differ in the sample size and configuration and in the type of igniter used in piloted ignition studies. Most of these tests were designed to measure the flammability of natural fuels and usually utilized piloted ignition. Some findings are summarized by Babruaskas, but it is difficult to draw conclusions relevant to the current investigation. [10]

In a book on the investigation of wildfires, Ford includes a useful summary of selected studies on wildland fuel ignition. [15] He discusses similar large variations in minimum ignition temperatures to those cited by Babrauskas, but notes wildland physicists have settled on a temperature of 320 °C as an arbitrary average. Ford summarizes the results of an extensive investigation of ignition by heated surfaces carried out at the Oregon State Engineering Research Station in 1949. Lower ignition temperatures for a wide range of woods and papers fell in a range of 220 °C to 300 °C.

There is an extensive literature available concerning the pyrolysis and burning behavior of cellulose and cellulosic fuels. The observed behaviors are quite complex and a detailed discussion is not appropriate for the purposes of this investigation. However, it is possible to

provide some guidance for the general effects of fuel composition on burning behavior. The recent review of Plucinski is useful for this purpose. [16] Quoting this author, "Plant tissue is approximately 50 % carbon, 44 % oxygen and 5 % hydrogen by mass and varies between 41-53 % cellulose, 16-33 % hemicellulose, and 16 – 33 % lignin. Cellulose tends to burn by flaming combustion and lignin by glowing combustion."

In the following, several investigations are briefly summarized because they used experimental approaches similar to those of this study or considered similar fuels.

In a study primarily concerned with the temperatures generated by automobile exhaust systems, Harrison reported ignition times for a dry annual grass and dry pine needles as functions of the temperature of a heated barbeque charcoal igniter placed on top of piles of the fuels. [17] For both fuels the ignition times increased with decreasing temperature, with the times becoming longer as the temperature was lowered. For the grass the minimum ignition temperature was 400 °C and for the pine needles the corresponding temperature was 350 °C. Both fuels required about 4 min for ignition at these minimum temperatures. Ignitions at lower temperatures were not observed in experiments lasting six minutes. A 0.9 m/s (2 mph) wind had a noticeable effect on grass ignition time, reducing the ignition time for a 400 °C surface to 1.3 min.

In a particularly relevant investigation, Kaminski simulated the ignition of punky (decayed, crumbly, and dry) wood, cheat grass, saw dust, and tree moss by a chain saw muffler by attaching a wire heater to an actual muffler. [18] It was found that punky wood would smoke and glow at temperatures as low as 270 °C. The presence of a low wind reduced the time required for ignition and increased the intensity of the glowing combustion. Glowing for cheat grass was observed at 330 °C, but sawdust only browned under these conditions. The tree moss was reported to have a behavior similar to the punky wood.

In a series of reports Stockstad reported on non piloted and piloted ignition studies of rotten wood [19], cheat grass [20], and pine needles [21] in which minimum heat flux intensities for ignition, time to ignition, and temperatures at times of ignition were given. Small individual pieces of the samples were heated by immersion in a furnace. A variety of rotten woods were tested. Minimum temperatures for ignition were on the order of 270 °C to 300 °C. Times required for glowing combustion were on the order of 1 min. For cheat grass the minimum temperature for which non piloted ignition was observed was 450 °C with ignition times on the order of 20 s. Ignition of pine needles occurred for temperature as low as 365 °C, with glowing appearing after roughly 60 s.

Recently, Manzello et al. have investigated the ignition of shredded paper, pine needle, grass, and hardwood mulch fuel beds by glowing and flaming firebrands deposited on top of the beds. [22,23] Experiments were done with single and groups of four firebrands of two sizes (diameters of 25 mm and 50 mm). Imposed air flows of 0.5 m/s and 1.0 m/s were used. The effect of moisture level was tested by using 0 % and 11 % fuel moisture levels. Ignition by glowing brands is most relevant to the current study, and these findings can be summarized as follows. The only fuel that was readily ignited by a single firebrand was the shredded paper. Only glowing combustion was observed. When 4 brands were used the pine needle fuel beds ignited only with the 50 mm-diameter brands in the presence of the 1 m/s wind. In this case

smoldering ignition with transition to flaming was observed for both fuel moistures. The larger firebrands induced smoldering in the dried hardwood mulch with both airflows, with the smoldering transitioning to flaming for the higher air flow. Grass only ignited when dry and exposed to four brands and the higher air flow. Combustion began as smoldering and transitioned to flaming.

White and coworkers have described on an effort to develop an approach for flammability measurements of vegetation using a cone calorimeter. [24,25,26] Measurements have been typically made with applied heat fluxes of 25 kW/m^2 or 50 kW/m^2 and piloted ignition. Changes in flammability due to seasonal variations for several species of ornamental vegetation [25] and for cheat grass grown in the presence of varying CO_2 concentrations [26] have been reported.

3. Experimental Systems and Procedures

3.1. Ignition by Thermal Conduction from a Heated Surface

Ignition of cellulosic fuels as the result of thermal conduction from a heated surface was investigated by placing loosely packed samples of the material to be tested in contact with a uniformly heated surface. The surface was oriented facing upward. The response of the sample to heating was observed while maintaining a constant surface temperature. The dependence of a given fuel response on surface temperature was determined by repeating the experiment for a range of surface temperatures. Experiments were done with and without a lateral air flow applied to the fuel bed.

3.1.1. Experimental System

3.1.1.1. Heated Plate

The heated plate was fabricated by inserting four Watlow* 300 W cartridge heaters (Model number E4A30) into a 10.2 cm × 10.2 cm square plate having a thickness of 1.9 cm. Machinable copper was used for the plate due to its high thermal conductivity, which minimized temperature gradients within the plate. Each heater was 10.2 cm long and had a diameter of 0.63 cm. The four heaters were inserted into four parallel 0.64 cm-diameter holes, drilled horizontally through the plate at the vertical center, and positioned 0.95 cm, 3.5 cm, 6.7 cm, and 9.2 cm from the perpendicular edge of the plate. The heaters were equipped with male National Pipe Thread (NPT) fittings and were inserted firmly into machined female NPT fittings in the copper plate. A schematic of the plate showing planar and side views is shown in Figure 1.

Two power supplies were utilized to provide electric current for the heaters. One of the sources was a Kepco Model ATE 100-2.5M capable of supplying up to 2.5 A at a maximum of 100 V DC. The second power supply was a Kepco Model ATE 150-7M that could provide up to 7 A with a maximum voltage of 150 V DC. One of the center cartridge heaters was connected to the smaller power supply, while the three remaining heaters were wired in parallel to the larger supply. Assuming that the four cartridge heaters are operated at the same current, this arrangement could provide a maximum current of 2.33 A to each heater.

The temperature of the plate was monitored using three Type K thermocouples†, which were press fit into 0.16 cm-diamter holes drilled from the back side of the plate to within 0.32 cm of

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* Certain commercial equipment, instruments, or materials are identified in this document. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the products identified are necessarily the best available for the purpose.

† As explained in Section 5, the estimation of standard uncertainties (for time to glowing or flaming ignition and for maximum observed heat release rate) requires a greater number of experiments than could be performed within the scope of this project. In the absence of such data a qualitative approach was adopted in which the degree of collapse of experimental data onto well-defined curves was adopted as a qualitative basis fro assessing uncertainty; therefore, this report does not provide estimates of standard uncertainties, and graphs do not display error bars.

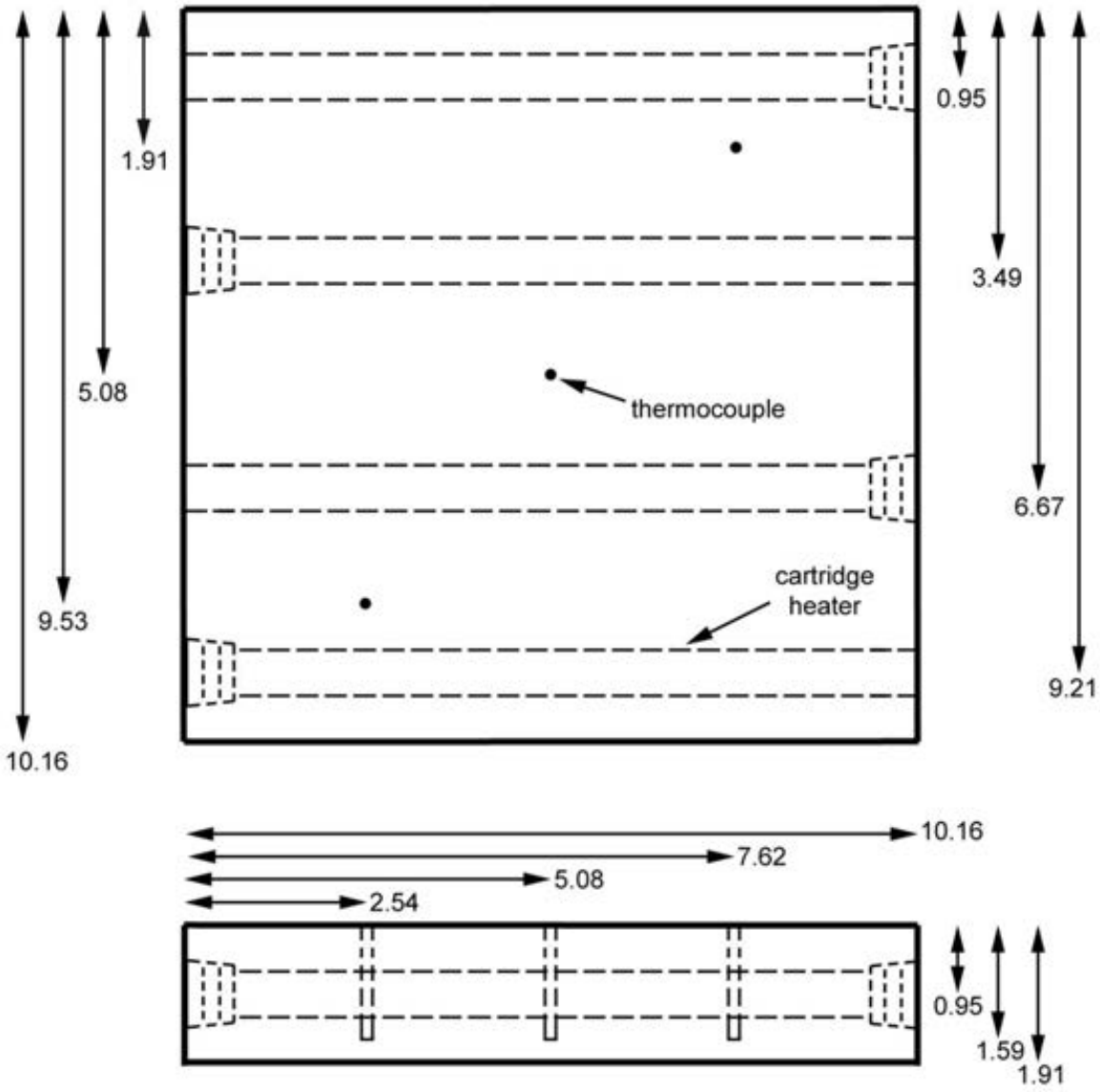

Figure 1. Schematic plan and side views are shown for the heated copper plate used for the ignition studies. All dimensions are in cm.

the top heated surface. Two of the mounting holes were located on opposite corners of the plate at distances of 1.91 cm from the edges parallel to the heaters and 2.54 cm from the edges perpendicular to the heaters. The third thermocouple was located at the center of the plate. The thermocouple leads were connected to Omega DP41-TC thermocouple readers that provided visual readouts of the temperatures at the three locations.

The heated plate was placed on a ring stand. Figure 2 shows a photograph of the plate with the heaters and thermocouples in place. Initial testing of the heated plate in ambient air showed that setting the two power supplies to the same voltage resulted in a current flow for the larger supply

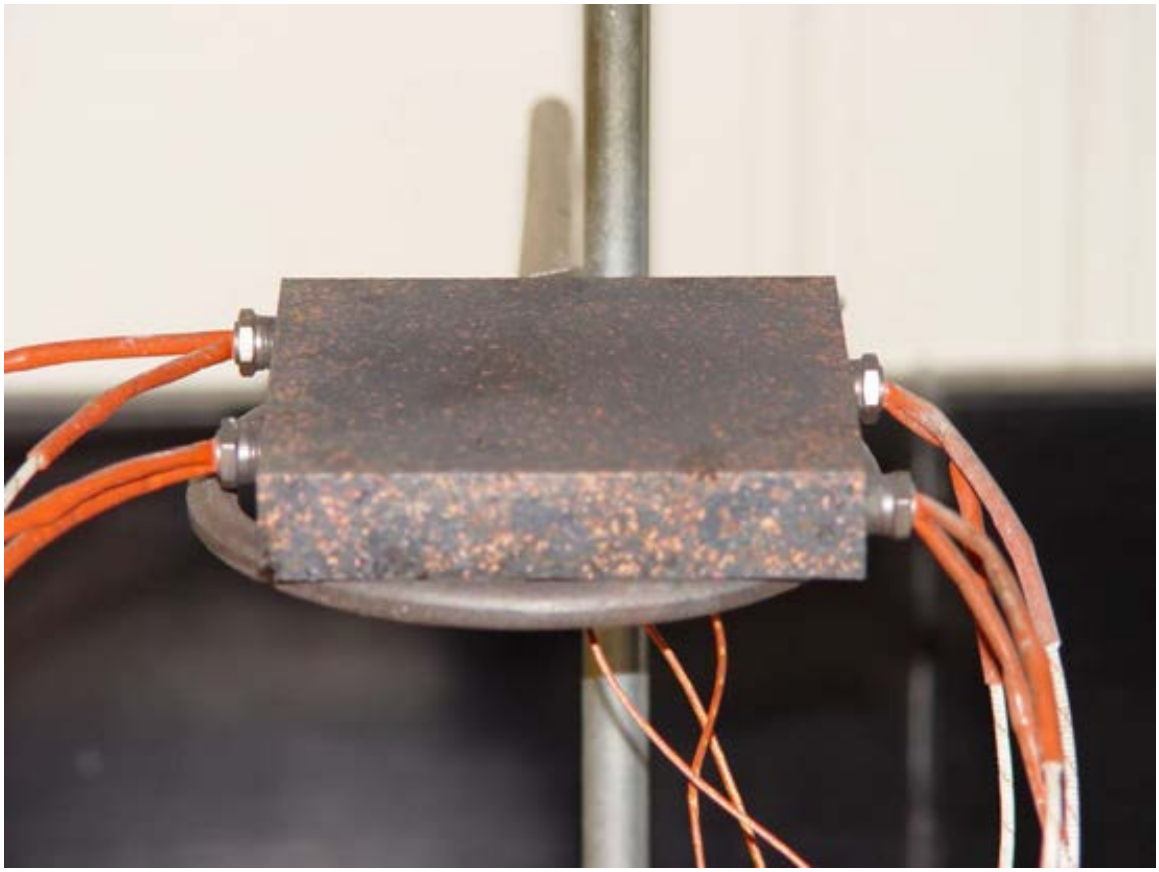

Figure 2. This photograph shows the heated copper plate used for ignition measurements of cellulosic fuels in place on a ring stand. The ends of the four cartridge heaters and their leads can be seen on the two edges of the plate. The leads for three thermocouples imbedded in the plate are visible below.

that was three times larger than recorded for the smaller. This is the expected behavior if the four cartridge heaters have the same resistance values. As the temperature of the plate was increased, the three thermocouple outputs provided temperature readings that agreed within 1 °C, indicating good uniformity of the temperature field within the plate. For recording purposes, the temperature of the thermocouple at the center of the plate was used.

Figure 3 shows the plate temperature recorded as a function of the current applied to each of the cartridge heaters as solid circles from an initial calibration. The result of a quadratic least squares curve fit is shown as a solid line for comparison purposes only. Over the course of the experiments small variations in temperature for a given current were observed that were most likely due to changes in the emissivity of the copper surface. Some changes in the physical appearance of the plate were apparent when the operating temperatures were varied.

3.1.1.2. Air Flows

Experiments were performed with and without air flows over the heated plate. Air flows were generated using a Dayton Model 4C443A blower delivering a nominal volumetric flow rate of

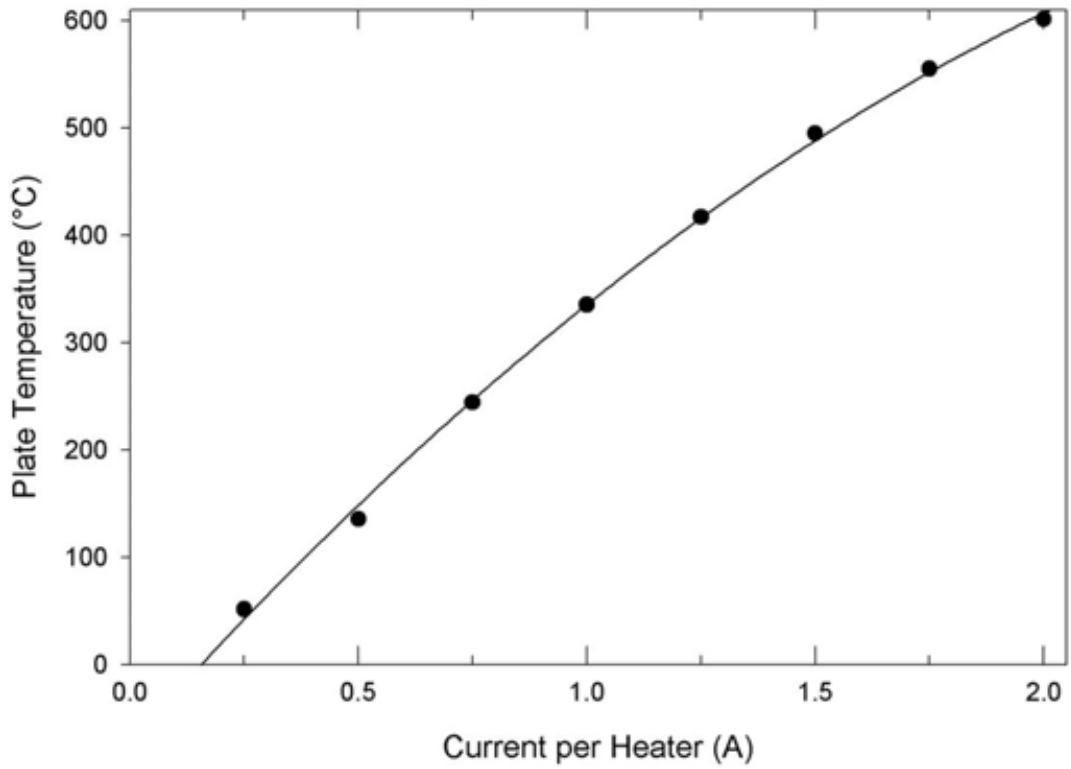

Figure 3. The temperature measured at the center of the heated copper plate is plotted as a function of the current applied to the four cartridge heaters embedded within the plate. Filled circles are the experimental measurements and the solid curve is the result of a quadratic least squares curve fit to the data.

219 L/s. The output of the blower was mounted at the same height as the heated plate and directed towards the plate from a distance of 134 cm. The air velocity at the plate was characterized by recording the output from an Applied Technologies, Inc. Model SPAS/24 sonic anemometer with a portable computer. The anemometer measures wind velocity in two dimensions. The probe was placed 1.2 cm above the plate such that one of the velocity components was aligned along the primary direction of the flow generated by the blower, as shown in Figure 4.

Figure 5 shows an example of the wind speed recorded by the sonic anemometer. Initially the blower was off. When the blower was turned on the air speed increased rapidly to values on the order of 2.5 m/s. Rapid fluctuations in speed are evident during the just over 300 s the fan was on. When the fan was turned off the speed dropped rapidly to that characteristic of the quiescent laboratory.

Averaging the data plotted in Figure 5 yielded means and root mean square (rms) values of 0.09 m/s ± 0.04 m/s and 2.5 m/s ± 0.3 m/s for the wind speeds with the fan turned off and on, respectively. The low wind speed recorded with the fan off is reasonable since the plate was located under an open exhaust hood. The mean wind speed recorded with the fan turned on should be indicative of the applied wind speed, but it likely that the fluctuations are underestimated due to the averaging inherent in recording over the 15 cm path length between

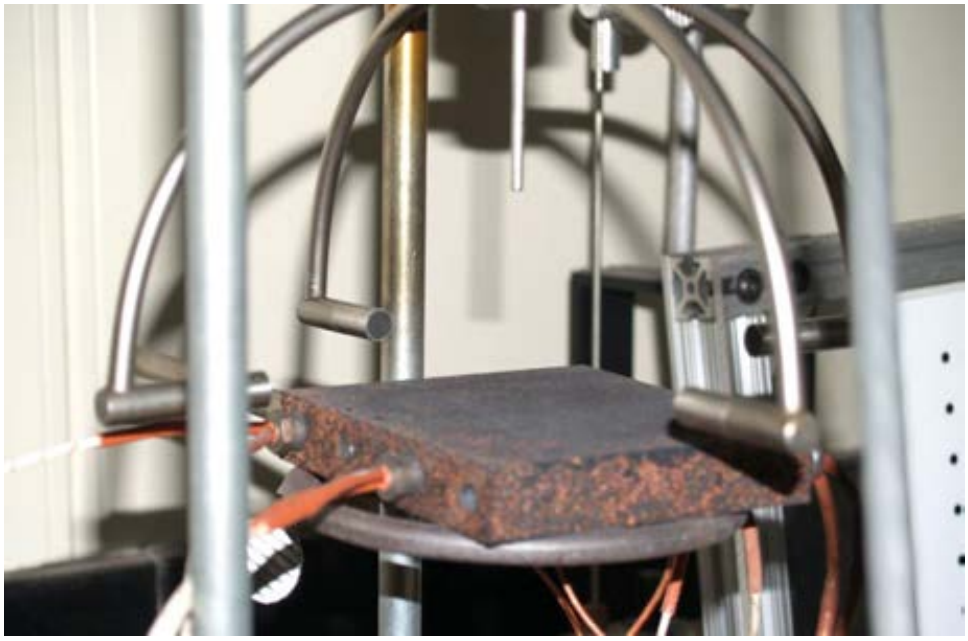

Figure 4. Photograph showing the sonic anemometer probe used to characterize the applied wind velocity in place 1.2 cm above the unheated copper plate.

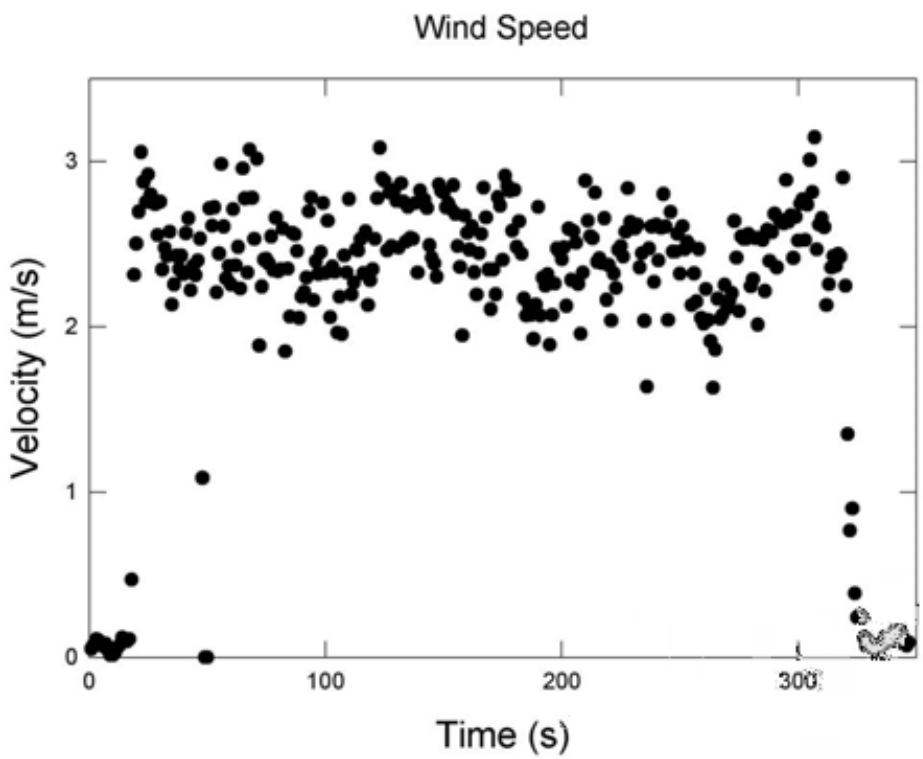

Figure 5. The wind speed above the copper plate along the primary flow direction of the blower recorded as a function of time is shown with the blower turned on and off.

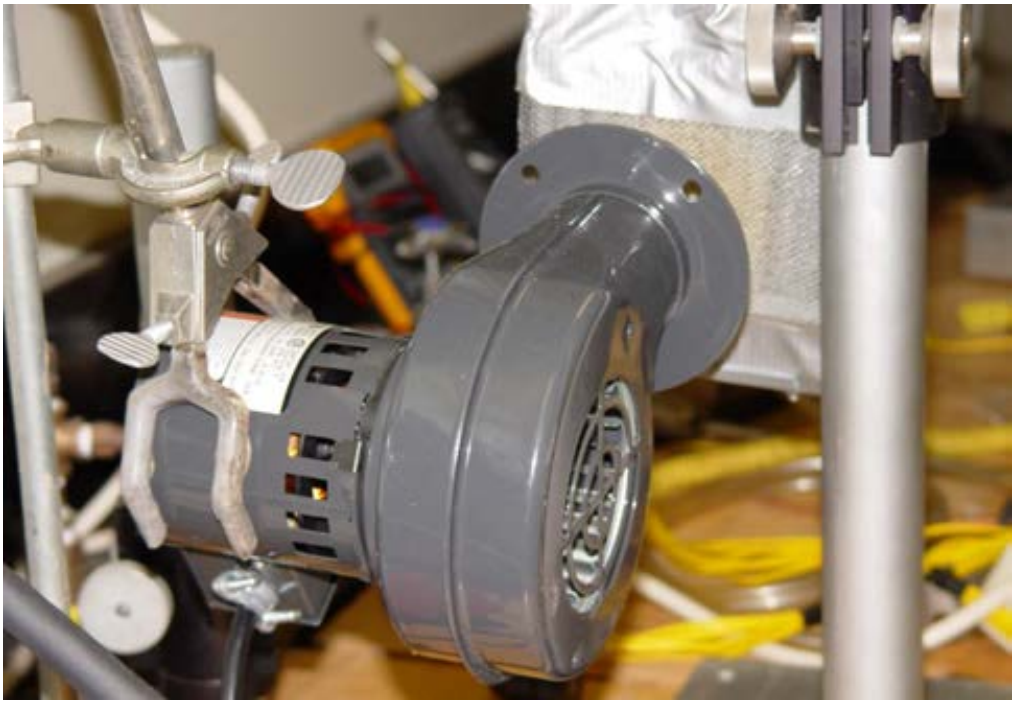

Figure 6. The blower with screens in place used to generate the “low” velocity air flow is shown.

the sonic transmitter and receiver. A more accurate value for the rms would have required measurements with much higher spatial resolution, which were not done.

Velocity measurements such as those shown in Figure 5 were repeated six times over a two month period. The average of the six mean measurements with the fan turned on was 2.53 m/s with individual standard deviations comparable to that for the data in Figure 5. The measured ratios of rms to the average varied from roughly 8 % to 11 %.

A wind speed of 2.5 m/s corresponds to 5.6 mph. It became clear early in the project that lower wind speeds affected the ignition behaviors of fuels placed on the heated plate when compared to cases without wind, and that it was desirable to apply a wind with a lower speed. Instead of generating the lower velocity by controlling the blower output, the velocity was reduced by leaving the flow unchanged and placing a series of four screens with an open aperture of roughly 5.3 cm × 11.4 cm in the flow path. The screens were placed on a holder that could be easily placed into and removed from the blower stream in a repeatable manner by attachment with a clamp to a horizontal rod supported by a vertical mount. Figure 6 shows a photograph of the blower with the screens in place.

The wind speed with the screens in place was measured in the same way described above. Four measurements yielded an average value of 1.1 m/s. The rms values for individual measurements varied from 13 % to 20 %, somewhat higher than observed for the higher speed flow. As discussed above, it is likely that the measurements underestimate the actual fluctuations.

In this report experiments with an applied wind of roughly 2.5 m/s will be referred to as “high wind” cases, while those using 1.1 m/s will be denoted as “low wind” cases. Note that these designations simply refer to the relative magnitudes of the flows used in this study and have no relevance to potential magnitudes of outdoor winds.

3.1.1.3. Wire-Screen Cage

The purpose of these experiments is to characterize the ignition behavior of typical outdoor cellulosic fuels when placed in contact with a heated surface. Common outdoor fuels such as grasses and pine needles consist of small pieces that form porous fuel beds. These materials had to be contained in some manner in order to create fuel beds that could be reproducibly brought in contact with the heated plate. It was viewed as desirable to allow the fuel beds to have free access to air from the sides and top. As a compromise for these competing requirements, the fuels were contained within a cage fabricated from stainless steel wire screen. The screen was formed from wires with a diameter of 0.71 cm and a wire spacing of 0.32 cm.

The wire-screen cage was designed so that the fuel beds would have nominal dimensions of 10.2 cm × 10.2 cm × 2.5 cm when the cage was placed over the heated plate. An open-bottom wire-screen cage was formed by starting with a 10.2 cm-square section of the wire screen that served as the top of the cage and attaching four wire-screen sidewalls with fine wire. Three of the sidewalls had widths of 10.2 cm and depths of 4.2 cm. Two slots that lined up with the threaded heater mounts visible in Figure 2 were cut in each of the two opposed sidewalls. These slots were wide enough to just allow the cage to slide down pass the mounts while the slot depths of 1.1 cm provided an open height above the plate of 2.7 cm when the cage rested on the mounts. The fourth side wall of the cage was formed from a 10.2 cm wide length of screen with a depth of 2.5 cm. When placed on the cage there was a narrow open gap of approximately 0.013 cm between the bottom of the short side wall and the top of the plate.

In order to apply the fuel within the wire-screen cage to the heated plate it was necessary to provide a bottom of the cage that could be removed. The bottom section that served this purpose is shown in place on the inverted wire-screen cage in Figure 7. This section was cut from a 0.008 cm-thick steel plate. The rectangular portion of the plate has dimensions of 10.2 cm ×10.8 cm and was designed to slide between the two deep sidewalls on opposite sides of the cage. The 2.54 cm × 1.27 cm tab on the right side of the bottom section in Figure 7 slides through a slot cut 2.5 cm from the top of the third deep sidewall and rests on top of the short sidewall on the opposite side of the cage. The narrow section on the left side served as a handle that allowed the bottom plate to be slid along the top of the plate and removed to expose the fuel to the plate.

The fuel to be tested was placed in the upside down wire screen cage to a depth of 2.5 cm. The bottom plate was then inserted into the slot as shown in Figure 7. By grasping the handle, the wire-screen cage was carefully inverted and place over the heated plate. The bottom was then rapidly removed by sliding it away from the cage. Note that the bottom plate insulated the fuel from the heated plate until it was rapidly removed, thus providing a well defined time of fuel application.

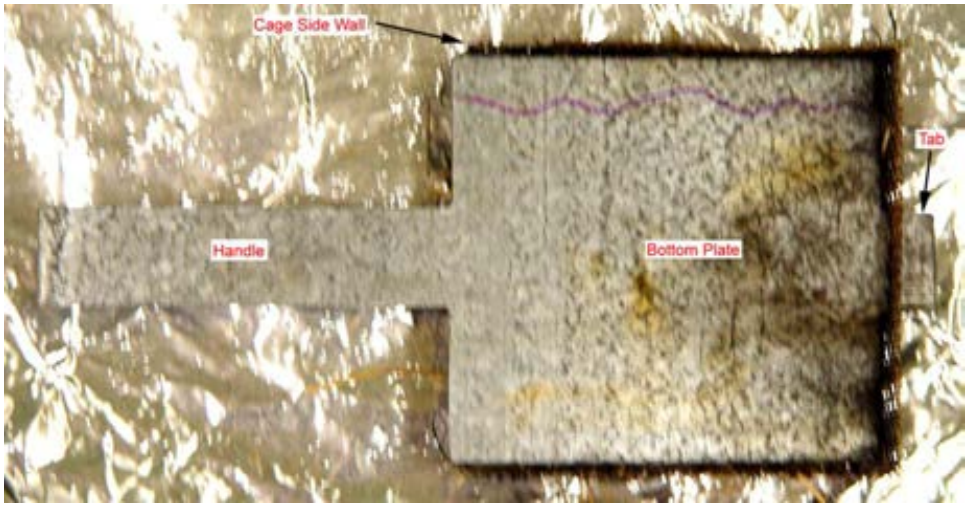

Figure 7. The wire cage with its removable steel-plate bottom in place is shown looking down from above.

It should be noted that the wire-screen cage provided resistance to the air flow into the fuel bed that varied with the velocity passing through the screen. A test with a single flat section of the screen placed upstream of the test plate indicated that the high wind flow velocity was reduced by 32 % by passing through the screen.

3.1.2. Visual Recordings of Ignition Experiments

The principle experimental diagnostic used for the heated plate ignition experiments was videography. Each ignition experiment was recorded using a Sony Model DCR-PC100 mini-DV video camera. The taped results were subsequently analyzed to determine the time when the fuel was placed on the plate and the times when glowing combustion and flaming were observed. Other behaviors such as the location and amount of smoke released could also be tracked. The temperature of the plate was monitored by reading the temperature recorded by the center thermocouple in the plate out loud so that it was recorded on the audio track of the video. Subsequent analysis of the video tape allowed the temperature to be determined as a function of time. Other visual observations were also recorded in this way.

3.1.3. Experimental Procedure

The various fuels investigated during the study are described below. For each fuel the mass of material required to fill the approximately 262 cm^3 volume of the wire-screen cage was determined, and this mass was used for all experiments with that fuel. In filling the cage no attempt was made to order or compress the fuel. The resulting fuel beds were typically loosely packed and porous. The density of the fuel bed was calculated by dividing the fuel mass by the nominal fuel bed volume.

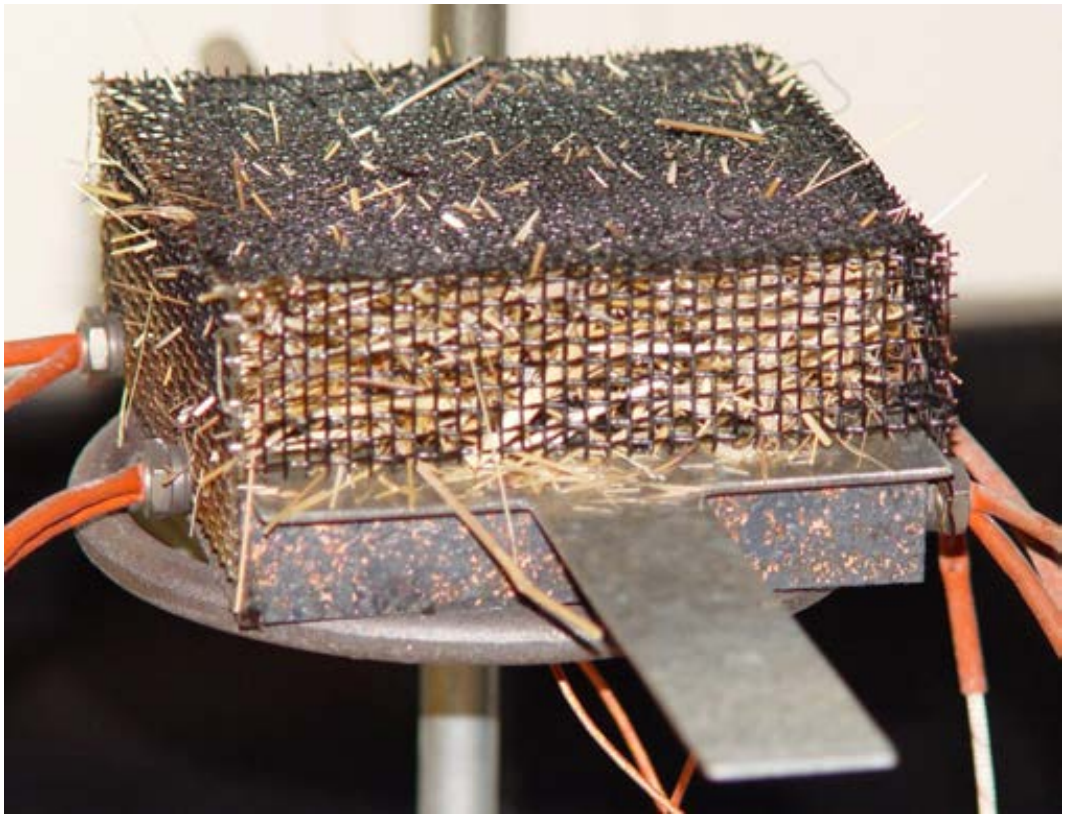

Figure 8. This photograph shows the wire-screen sample cage with its steel-plate bottom in place on top of the heated plate. The cage is filled with cheat grass. The fuel is placed on the plate by withdrawing the bottom of the cage using the handle visible in the photograph.

The pre-determined mass of fuel was then loosely evenly distributed into the inverted wire-screen cage through the open bottom. Once the fuel was distributed, the tab on the plate that formed the bottom of the cage was inserted into the slot in the wire-screen side wall and allowed to rest on the opposite side wall.

The first step in an experiment was to heat the plate to the desired temperature by adjusting the equal currents supplied to each heater by the two power supplies. When an experiment was to be run the camera was first started and identifying information such as the date and test conditions were recorded audibly. The wire-screen cage was then carefully inverted and placed over the heated plate as shown in Figure 8. Within a few seconds the plate was extracted from the bottom of the cage, and the fuel was applied to the plate. If a wind was to be applied, the fan was turned on immediately prior to or just after the application of the fuel.

The application of the fuel and wind changed the heat losses from the plate and adjustments to the currents were required to maintain a constant temperature. For instance, applying the fuel in the absence of the wind typically caused the temperature to increase, indicating that heat transfer to the fuel was more than offset by reduced heat losses from the plate. In this case the currents to the heaters needed to be reduced in order to maintain a constant temperature. On the other hand, applying a wind without adding the fuel caused the temperature to drop due to increased

convective heat transfer to the air from the plate surfaces, and it was necessary to increase the currents to maintain a constant temperature.

By trial and error the amount of current change required to maintain a nearly constant temperature for a given fuel and wind condition was determined. As soon as the fuel was applied and the wind (if applicable) was turned on, the current would be manually adjusted to the appropriate level. During the remainder of the experiment the plate temperature would be monitored and small current adjustments would be made as necessary to hold the temperature variation within a small range. The actual current changes were not recorded, but it was noted that there was a correlation between the required current and the behavior of the fuels. For instance, when glowing combustion was observed, it was typical to have to reduce the current slightly in order to maintain the temperature.

Experiments showed that it was normally necessary to reduce the currents substantially when fuels were applied without a wind, relatively small changes in current were required when experiments were done with a low wind, and increased currents were needed when a high wind was used. The changes in temperature were relatively slow, and it was generally possible to hold the recorded temperatures within ± 2 °C. Occasionally larger excursions were observed, but variations were always much smaller than the smallest step size (typically 10 °C) used for plate temperature settings. Figure 9 shows a plot of representative temperature histories recorded for a range of temperature settings and wind condition (none, low, high). Times are generally shorter at higher temperatures since an experiment was halted when flaming was observed or visual observation (e.g., smoke no longer visible) suggested no additional reaction was taking place.

At the conclusion of an experiment the video camera was shut off. At a later time the video tape was replayed in order to record the plate temperature readings as a function of time, ignition times for glowing and flaming combustion, and other experimental observations such as smoke behavior.

3.2. Ignition by Thermal Radiation

Ignition of cellulosic fuels as the result of exposure to thermal radiation was investigated by placing loosely packed samples of the material to be tested in a cone calorimeter operated in a non piloted ignition mode. The exposed surface of the fuel bed was oriented facing upward. The response of the sample to an imposed heat flux was observed while maintaining a constant heat flux. The time required to ignite the fuel was recorded. The dependence of the ignition time on heat flux level for a given fuel was determined by repeating the experiment for a range of imposed heat fluxes. Other parameters available from the experiments, in addition to time to ignition, included time behaviors of heat release rate, mass, and smoke optical density.

3.2.1. Cone Calorimeter

The cone calorimeter is a widely available standard instrument used primarily to measure the heat release rate of small samples when subjected to a uniform radiative heat flux. Heat release rate is measured using the oxygen depletion approach. The cone calorimeter has been adopted

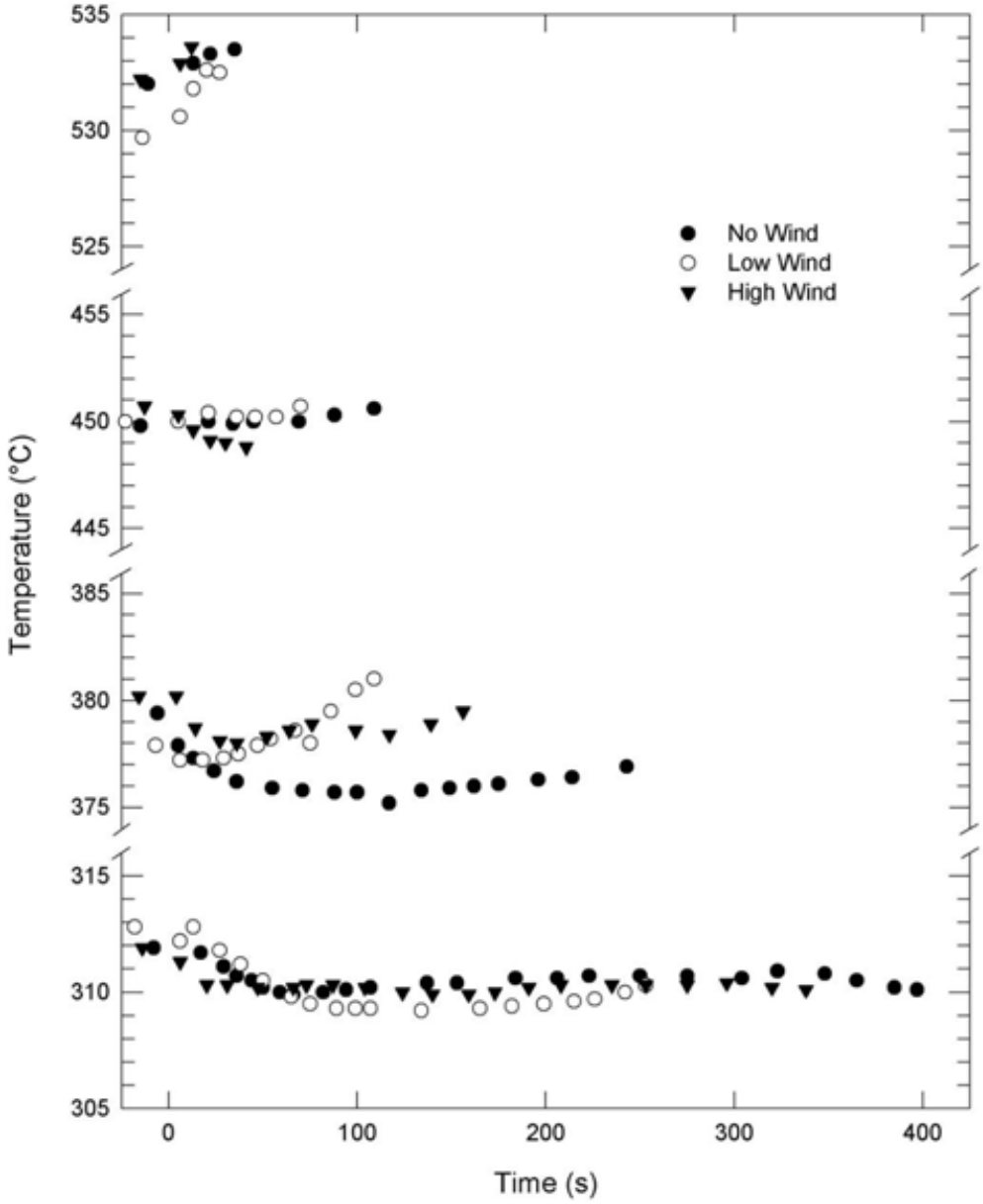

Figure 9. Temperatures recorded during experiments in which cellulosic fuels were place on a heated plate are plotted as a function of time. Zero time is defined as the time when the fuel was exposed to the surface.

as a standard method by ASTM International (ASTM E-1354) [12], the International Organization for Standardization (ISO 5660) [13], and the National Fire Protection Association (NFPA 264A) [14].

While primarily designed for heat release rate measurements, the cone calorimeter can be used to study radiative ignition since it provides a nearly uniform and easily varied source of radiative

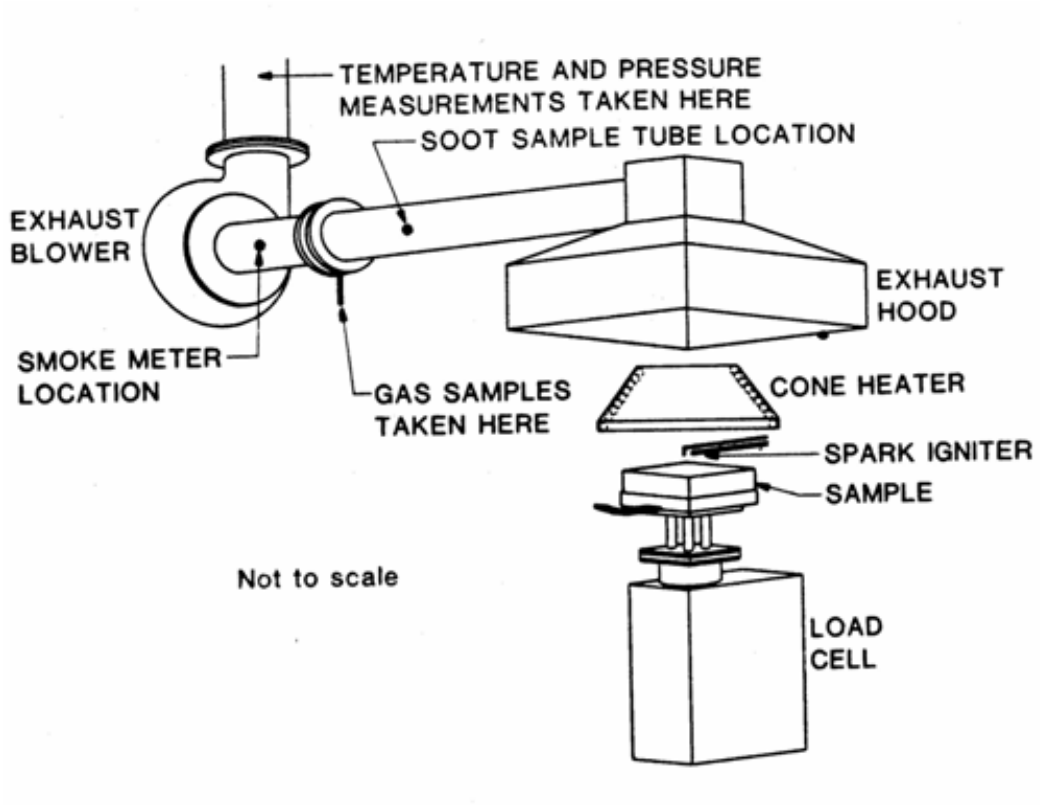

Figure 10. This schematic shows the principal components of the cone calorimeter used to investigate the ignition behavior of cellulosic fuels and polyurethane foam.

heat flux at the sample surface. Babrauskas and Parker describe the use of the cone calorimeter for ignition studies. [9]

Figure 10 shows a schematic diagram of a cone calorimeter. The principal components are a conical resistance heater wound in the form of a truncated cone with temperature control achieved using 3 type K thermocouples as inputs for a controller that automatically adjusts the current supply, cooled shutter to protect the sample before the start of a test, a specimen holder placed on top of a load cell for mass measurement, a spark igniter used for piloted ignition of fuel vapors, a hood and blower driven exhaust system equipped with an orifice plate for velocity measurements, a gas sampling port used to extract gases for oxygen (paramagnetic analyzer) and other molecular species concentration measurement, and a laser system for monitoring smoke obscuration.

The cone calorimeter used for these experiments was manufactured by Atlas Combustion Analysis Systems. It was subsequently modified by replacing the original software for controlling the experiment and performing analysis with software developed by Fire Testing Technology Ltd. The results of measurements include observed ignition times and heat release rate per unit area, sample and sample holder mass, and smoke optical density as a function of time, along with such derived properties as maximum heat release rate, time to maximum heat release rate, total mass loss, effective heat of combustion, etc. The experimental results were imported into spreadsheet files and displayed using a standard plotting software package.

Figure 11. A sample holder used during the radiative ignition experiments is shown filled with fuel.

3.2.2. Experimental Procedure

The experiments were performed while generally following the standard cone calorimeter protocols. Sample sizes were 10.2 cm ×10.2 cm × 2.54 cm and were contained within a sample holder formed from a double-layer of aluminum foil, which was open at the top. Note that unlike the experiments on heated surface ignition, the sides of the sample holder were closed. The sample holders for the plate heating and cone calorimeter experiments were the same size, and the mass of a particular fuel used was also the same. Figure 11 shows one of the sample holders filled with fuel. No external wind was imposed during these measurements, and the only air flow was that induced by the cone calorimeter blower and natural convection from the samples. The separation between the top of the fuel bed and base of the cone was 2.5 cm.

Prior to an experiment the radiative heat flux at the location of the sample was set by adjusting the current to the cone heater until the desired level was measured with a calibrated gauge. At this point the water-cooled shutter was positioned between the cone and the sample area to limit preheating of the sample. After the sample holder and fuel were placed in position and background measurements were completed, the shutter was rapidly removed to expose the sample to the imposed heat flux. This defines time zero. Cone experiments often incorporate a spark igniter above the sample to provide a pilot for the flammable gases that are generated from the fuel. Since the purpose of these experiments was to investigate non piloted ignition, the igniter was withdrawn from above the sample and was not activated during these measurements.

Ignition times were determined visually by noting the appearance of either glowing combustion or flaming. In practice, the measured heat release behaviors also provided good indications for ignition times. An experiment was allowed to continue until obvious changes in fuel appearance were no longer apparent and the time rates of change for mass and heat release rate were small.

3.3. Fuels Investigated

A variety of cellulosic fuels including shredded newsprint, four grasses, and pine needles were investigated. In addition, limited measurements were carried out on three types of dried leaves. The ignition behavior of a common plastic fuel, non fire-retarded flexible polyurethane foam, was investigated in the cone calorimeter.

Free moisture absorbed in the fuel is known to be an important parameter for the ignition and burning behavior of cellulosic fuels. No attempts were made to control free moisture, defined as the percentage mass of water relative to the dry material, in this study beyond allowing the fuels to come into equilibrium with the surrounding laboratories, which had nominal temperatures of 20 °C with variable relative humidity that did not exceed 50 %. Free moisture in the fuels was measured using the procedure described by Manzello et al. [22,23] in which the material to be tested is placed in an oven held at 105 °C for three hours and the amount of mass loss quantified. These authors showed that no further changes in mass occurred after 3 hours for these thin fuels.

Several grams of the material were placed in a small tared aluminum pan and weighed to ± 0.0001 g. The pan and grass were then placed in the oven. After three hours the pan was removed from the oven and allowed to cool in a desiccator. The cooled fuel sample and pan was quickly reweighed after removal from the desiccator in order to limit the uptake of moisture by the dried sample. The free moisture percentage was calculated using the following equation,

$$\frac{m_{f,m} - m_{f,d}}{m_{f,d} - m_p} \times 100, \qquad (1)$$

where $m_{f,m}$ is the measured mass of the pan and fuel with moisture, $m_{f,d}$ is the mass of the pan and dried fuel, and m_p is the mass of the empty pan.

3.3.1. Shredded Newsprint

Commercial newsprint was obtained from a local publisher as remnants of large 61.0 cm wide rolls. Measurements with a micrometer at several locations on a small area of the newsprint yielded a thickness of 6.4×10^{-3} cm. Sections of the newsprint were run through a shredder that generated strips that were roughly 0.4 cm wide by 4 cm long. There were substantial variations in the lengths of individual pieces.

Fuel beds were created by loosely packing 6.9 g ± 0.1 g of the shredded newsprint into the wire-screen cage sample holder. Figure 12 shows a photograph of the shredded newsprint in the wire-screen cage.

The free moisture percentage of the shredded newsprint was measured well after ignition testing was completed. Two independent measurements yielded values of 6.2 % and 6.4 %.

Figure 12. Photograph of shredded newsprint in wire-screen cage.

Figure 13. Photograph of May tall fescue in wire-screen cage.

3.3.2. May Tall Fescue Grass

A sample of tall fescue grass (*Festuca arundinacea*) was collected on the NIST campus (GPS location of 39.08.082 N, 77.12.709 W) on May 25, 2006. The site was the outfield of a softball field that was planted in tall fescue about six years ago. The grass had been cut within the past two days. Clippings that had been cut and expelled from the mower and were resting on top of the growing grass were collected. The grass clippings felt dry and light to the touch. The weather over the previous few days had been nearly ideal for drying with no rain, a temperature range of roughly 7 °C to 21 °C, and dew point temperatures on the order of 4 °C.

Spring is a time of rapid grass growth in this region. Significant rain had fallen within the past two weeks. The uncut grass was thick and dark green. As a result of the conditions, the grass had been fairly long when cut, with the clippings having a range of lengths varying from 8 cm to 15 cm. A small amount of the grass was topped with seeds. Even after drying the grass clippings retained a light greenish color. Much of the collected grass consisted of thin blades.

After several weeks of storage in a general purpose laboratory, three independent measurements of free moisture percentage taken over several days yielded values of 12.8 %, 11.9 %, and 13.6 %. These values are typical of those expected when the moisture in the grass has come into equilibrium with air in the surrounding laboratory.

As collected, the tall fescue did not pack well in the sample holders due to its length. Scissors were used to cut bunches of the grass into lengths of 2.5 cm to 5 cm, which were used to form the fuel beds. A mass of 9.0 g of material was found to be adequate for forming a 2.5 cm deep bed when lightly packed into the sample holders. Figure 13 shows a sample of tall fescue grass in the wire-screen cage used for the heated plate experiments. For the remainder of the report these samples will be referred to as “May tall fescue.”

Figure 14. Photograph of August tall fescue in wire-screen cage.

Figure 15. Photograph of cheat grass in cone calorimeter aluminum pan.

3.3.3. August Tall Fescue Grass

A second sample of recently cut tall fescue grass was collected from the same location as the May tall fescue on August 29, 2006. Samples of this grass will be referred to as August tall fescue. Once again, clippings created by mowing were collected from above the uncut grass.

August in this region is typically hot and often dry. Weather records indicate that over the four prior weeks daytime high temperatures ranged from about 27 °C to 38 °C, with lows ranging from 13 °C to 27 °C. The last significant rain had fallen on August 7th.

This grass had a very different appearance than that collected in May. It was tan colored and appeared to consist primarily of stalks as opposed to blades. Its length varied from about 2.5 cm to 7.5 cm, and it could be packed into fuel beds without cutting.

Figure 14 shows a fuel bed formed from 7.0 g of August tall fescue.

The grass felt dry to the touch when collected. A measurement of its free moisture percentage after two days in the laboratory yielded a value of 13.1 %.

3.3.4. Cheat Grass

Figure 15 shows one of the samples of cheat grass in an aluminum pan. Cheat grass (*Bromus tectorum*) is an invasive plant introduced into the United States in the 1890s. It has subsequently spread widely across the western United States. Cheat grass is a winter grass, growing rapidly in late winter and spring. In summer it dies off, leaving a dried grass that is widely regarded as highly flammable and a major contributor to wildland fires.

Figure 16. A photograph showing an uncut sample of cheat grass

The cheat grass for this investigation was provided by researchers from the United Stated Department of Agriculture, Agricultural Research Service Laboratory in Reno, NV. The grass was collected in the Honey Lake Valley of northeastern California (GPS coordinates 40.08.291 N, 120.04.672 W) on July 19, 2006 and shipped to Gaithersburg, MD. During the week prior to collection high temperatures were around 38 °C with relative humidity below 10 %.

Figure 16 shows a portion of the cheat grass as received. The grass was cut near its base and had heights on the order of 45 cm. The grass felt dry to the touch and was golden in color. It consisted of very slender stalks topped with branching seed structures known as panicles. The free moisture percentage of a sample of the grass was measured to be 11.2 %.

As received, the grass could not easily be packed into the fuel beds. The grass was cut into lengths of 2.5 cm to 5 cm using scissors. No special care was taken to isolate the stalks and panicles, and both were present in the fuel beds. A mass of 8.0 g was sufficient to fill the sample holders.

3.3.5. Fine Florida Grass

A grass sample collected at a lawn mower manufacturer's test site near Tampa, FL was provided for the study. The grass had been removed from the tops of mower decks and was intended for testing the debris that collects on mowers. The sample had been collected at least a year earlier and was stored in bags under dry conditions. The grassy material was cut finely and felt fluffy when unpacked, having a consistency similar to sawdust. The material was brown in color. No additional information was available, including the type of grass that had been cut or weather conditions. This material will be referred to as fine Florida grass.

An 8.0 g sample of the fine Florida grass just filled the wire-screen cage. Figure 17 shows a photograph of the cage filled with fire Florida grass. Two measurements of fuel moisture percentage recorded well after the ignition experiments were completed yielded values of 10.1 % and 9.6 %.

Figure 17. Photograph of fine Florida grass in wire-screen cage.

Figure 18. Photograph of pine needles in wire-screen cage.

3.3.6. Pine Needles

Pine needles were obtained from a commercial operation (Florida Pine Straw Company of Mayo, FL) that distributes pine needles for use as mulch. These needles come from loblolly pine trees (*Pinus taeda*). They are collected by machines that sweep up pine needles that have fallen to the ground. They were delivered in bales that were opened and left exposed to the laboratory.

The pine needles were dark brown and dry to the touch. The fuel moisture was measured to be 13.7 %. They had lengths that generally varied from 15 cm to 23 cm with rectangular cross sections having rough dimensions of 0.5 mm × 1.4 mm (dimensions were highly variable). Individual needles were brittle and easily broken. Often two or three pine needles were connected together at their base by a needle sheath, forming a fascicle. Since the needles were typically too long for the sample holders, they were cut into lengths between 2.5 cm and 5 cm using scissors for testing purposes. No attempt was made to separate the sheaths from the needles. Small debris, most often small pieces of pine wood, was removed when encountered.

The cut pine needles formed a dense bed, with 16.0 g used to fill the sample holders. Figure 18 shows a photograph of a bed of pine needles in the wire-screen cage.

3.3.7. May Tall Fescue/Pine Needle Mixture

A mixture of May tall fescue grass and pine needles was tested using materials processed as described above. The masses required to fill the cage for the grass (9 g) and pine needles (16 g) were quite different. The masses of each required for the mixture were calculated for a 50 %/50 % mixture by mass assuming the volumes of each component would be independent of mixing. The result was 5.8 g for a total mass of 11.6 g, with grass making up 64 % of the volume and the pine needles 36 %. The two materials were weighed independently and then mixed by hand until

Figure 19. Photograph of the May tall fescue/pine needle mixture in the wire-screen cage.

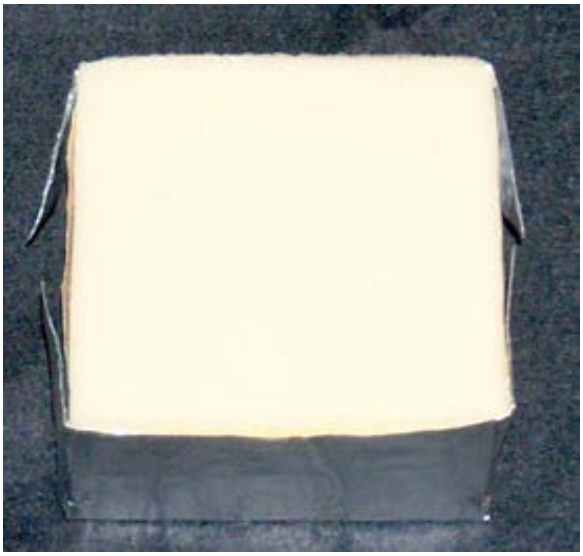

Figure 20. Photograph of polyurethane in a cone calorimeter sample holder.

they appeared to be evenly distributed. The mixture was then placed in the wire-screen cage. Figure 19 shows a photograph of the resulting mixture.

3.3.8. Preliminary Tests with Leaves

A limited number of heated-plate experiments were done using leaves collected locally. These included leaves from boxwood (*Buxus*), American elm (*Ulmaceae Ulmus Americana*) and pin oak (*Quercus palustris*).

3.3.9. Polyurethane Foam

Flexible polyurethane foam was tested in the cone calorimeter. The samples were obtained from a commercial supplier and were not fire retarded. The exact composition of the material is not known. The sample thickness was 5.1 cm. Sample masses varied over a range of 11 g to 12 g. Figure 20 shows a photograph of a sample of the polyurethane surrounded by the aluminum foil used as the holder for the cone experiments.

3.3.10. Fuels Summary

Table 1 includes the mass used, nominal density, and measured moisture content for all of the fuels used during the current investigation. Missing data represent cases for which the amount of fuel available was limited or measurements were not made.

Table 1. Summary of Fuels, Sample Mass Used, Nominal Fuel Bed Densities, and Measured Fuel Moisture

Fuel	**Sample Mass (g)**	**Nominal Density (g/cm^2)**	**Fuel Moisture (%)**
Shredded Newsprint	6.9	0.026	6.2 6.4
May Tall Fescue	9.0	0.034	12.8 11.9 13.6
August Tall Fescue	7.0	0.027	13.1
Cheat Grass	8.0	0.031	11.2
Fine Florida Grass	8.0	0.031	10.1 9.6
Pine Needles	16.0	0.061	13.7
May Tall Fescue/Pine Needle Mixture	11.6	0.044	--
Boxwood Leaves	8.0	--	--
American Elm Leaves	5.5, 5.5	--	--
Pin Oak Leaves	6.0, 9.4	--	--
Polyurethane Foam (5.1 cm thickness)	11 to 12	0.042 to 0.046	--

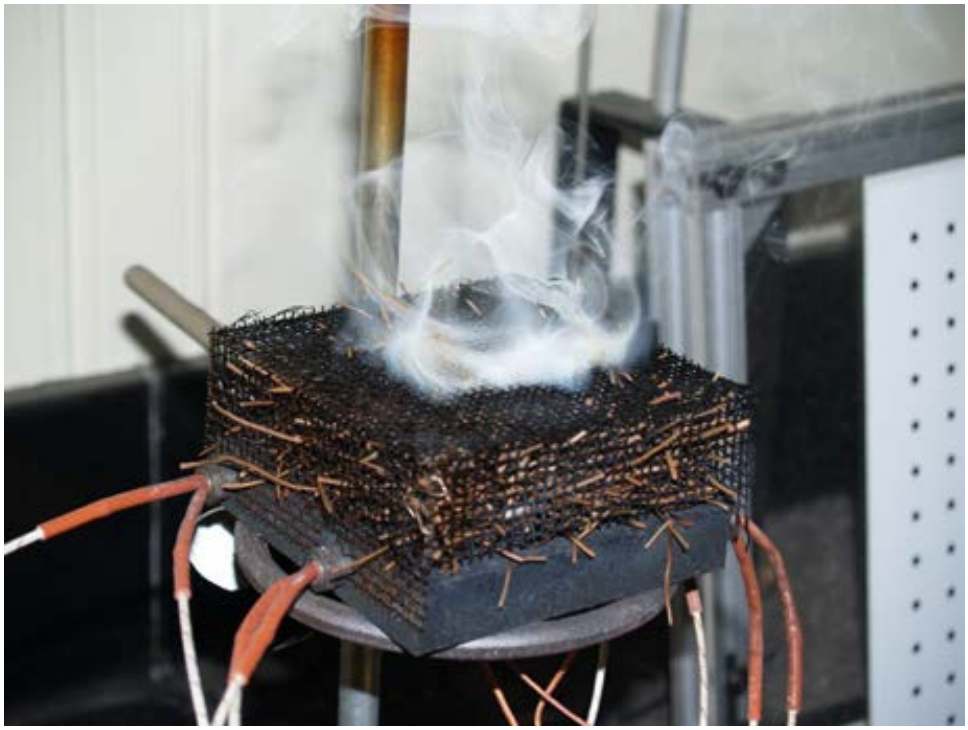

Figure 21. The smoke plume rising from a pine needle fuel bed in contact with the heated plate held at a temperature of 380 °C is shown 213 s after application.

4. Results

4.1. Some General Observations from Heated Plate Ignition Studies

A variety of qualitative observations provide insight into the characteristics and response of the porous fuel beds when placed on a heated plate. First, cases without an applied wind will be discussed. This will be followed by observations when low and high winds were used.

When the temperature of the heated plate was high enough, all of the fuels tested generated a white "smoke" that would flow from the top of the fuel bed. The composition of the smoke is unknown, but it is likely that it contained varying proportions of condensed water vapor and organic pyrolyzate. At times, particularly after it first appeared, the smoke would rise from localized sections of the fuel bed surface. More commonly, the smoke would appear over a large fraction of the surface area. In the latter case, the smoke immediately above the fuel bed typically assumed a circular shape such that there was a smoke-free area around the perimeter of the square fuel surface. Above the surface, the smoke would rise and its area would decrease so that the smoke near the surface adopted a conical shape. As the smoke moved further away from the plate it would develop the fluctuating shape characteristic of a buoyancy-dominated fluctuating flow. Figure 21 shows an example of this type of smoke flow for a bed of pine needles placed on the plate held at 380 °C.

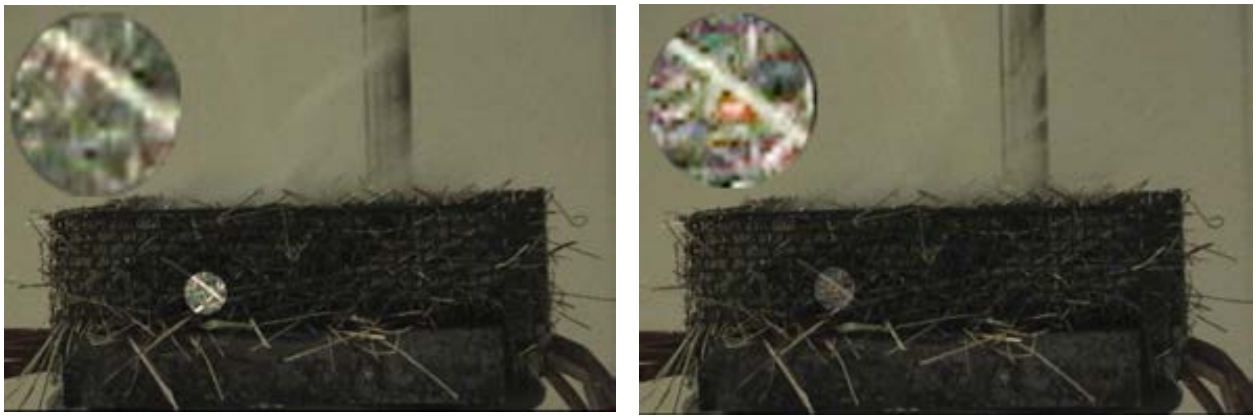

Figure 22 Two frames taken one second apart from a video of a hot surface ignition experiment with May tall fescue are shown. A small area of glowing combustion had appeared during the one second period (compare the blown up areas prior to (left) and after (right) ignition).

The appearance of smoke at the top surface of a fuel bed indicates that the bed is porous to the buoyant flow of heated gases generated within the bed by contact with the heated plate and any heat release taking place within the fuel bed. The characteristic shape of the smoke at the fuel surface suggests that the buoyant flow within the bed acts much like a buoyant plume in open air, entraining air radially inward that has passed through the sides of the fuel bed.

The amount of smoke released from a fuel bed (qualitative description, estimated visually) varied widely with time, the fuel tested, and plate temperature. The level of smoke observed ranged from just barely visible to quite heavy as seen in Figure 21. It was clear the smoke density was related to the amount of fuel pyrolysis that was taking place. Particularly for the lower plate temperatures where relatively long periods were required for glowing combustion and/or flaming to appear, the smoke would tend to increase with time, becoming quite heavy before glowing or flaming appeared.

During the experiments, the times for the appearance of glowing combustion and flame were noted visually and recorded audibly on the video tape. The times were determined a second time based on a visual review of the video tape. The video camera used for the investigation responds to light in the near infrared, and was particularly useful for detecting the onset of glowing combustion as long as it is not hidden from view within the fuel bed. For experiments without an applied wind, glowing combustion was usually observed on the video tape before it was seen visually. The sensitivity possible using the video camera is demonstrated in Figure 22, which compares two frames taken one second apart from a video of an ignition experiment for May tall fescue with a plate temperature of 381 °C and no wind applied. The appearance of the glowing combustion is easily identified by comparing the two enlarged areas. Glowing combustion would generally appear at a small single point in the fuel bed and then spread to cover larger areas.

The glowing combustion was not generally hidden within the fuel bed for cases without an applied wind because there was a high likelihood that it would appear on the side of the fuel bed facing the camera. The most likely reason for this side to be favored was the narrow open slit

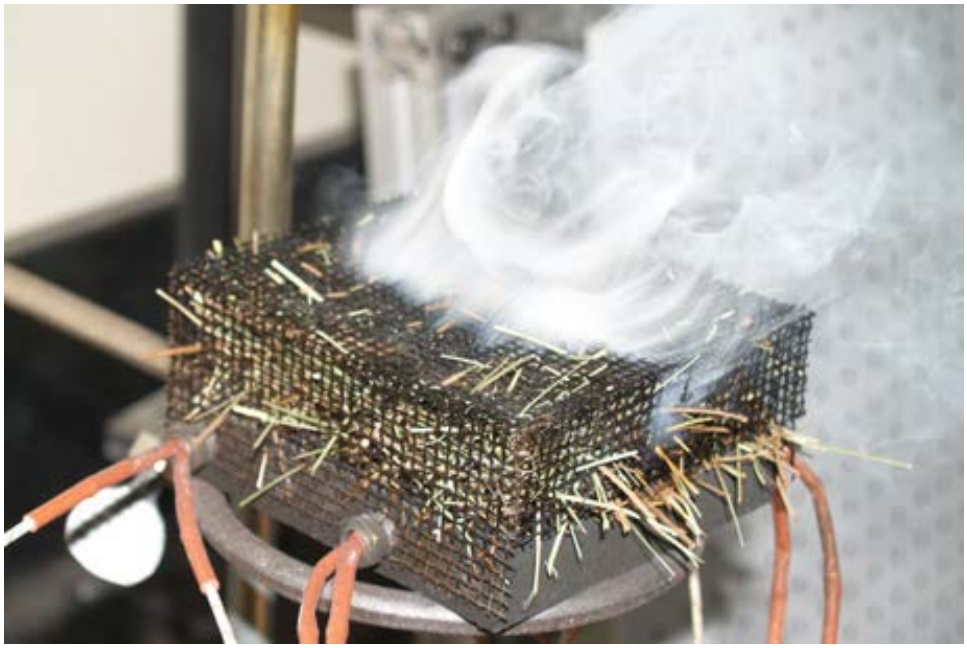

Figure 23. The smoke generated by a mixture of May tall fescue and pine needles applied to the heated plate at 380 °C in the presence of a low wind is shown 175 s after application.

between the heated plate and the base of the wire-screen sidewall. As discussed earlier, smoldering development is very dependent on the amount of oxygen reaching the fuel surface. Apparently, the small slit allowed more air to enter the cage from this side than passed through the screens on the other three sides, with the result that the initial surface heating required to ignite glowing combustion was more likely near the slit. The practical effect of this preference is likely a short decrease in the time required for glowing combustion to develop compared to that which would have been observed if the screen wall extended below the heated plate.

The observations changed substantially when a wind was applied. For both low and high wind cases, smoke that came from the top of the fuel bed tended to lie along a narrow band oriented perpendicular to the flow direction. Figure 23 shows an example of this behavior for the May tall fescue/pine needle mixture with a plate temperature of 380 °C and a low wind applied. This photograph was taken 175 s after the fuel was placed on the plate. Note that the band of smoke across the top of the fuel bed also extends down the side of the cage.

While the amount of smoke generated varied with fuel type, surface temperature, and time after fuel application, the formation of a smoke band was normally observed with an applied wind. The location of the smoke band relative to the upstream edge would often shift somewhat during an experiment. It was also observed that for a given fuel type, the band would be located further downwind for the higher wind case. The upstream edge of the band tended to appear anywhere from upstream of the center of the fuel bed to locations reaching at least 4/5 of the way across from the upstream side.

As the wind passed through the upstream side of the wire-screen cage, it was certainly attenuated in the manner shown experimentally above. The porous fuel bed would slow down the air flow further. It is the interaction of this attenuated wind with the buoyant flow rising from the heated plate and fuel that leads to the formation of the smoke band. The higher velocity flow is able to penetrate further, thus explaining the downstream shift observed for the higher wind velocities.

The presence of an air flow also affected observed ignition behaviors. The wind causes two competing effects that can affect surface ignition. On one hand, the flow convectively cools the fuel and reduces fuel surface reaction rates. On the other hand, it substantially increases the amount of oxygen reaching the fuel surface, which enhances surface reaction rates. For most of the experiments described below, the latter effect was dominant since both glowing and flaming combustion appeared at locations towards the upstream sides of the fuel beds.

One result of applying a wind was to slightly increase uncertainties associated with measurements of glowing ignition time. Unlike for no-wind cases, glowing ignition was often observed at locations well away from the fuel bed side facing the camera. This is another indication that wind is enhancing surface reactions, since it suggests it is overwhelming the effect of increased air flow through the narrow gap in the wires-screen cage on the camera side. The nascent ignitions with a wind were often hidden from the camera by the fuel bed, and it was common for the earliest observation of glowing combustion to be made visually by the observer. This effect is likely exacerbated when the ignition is location further within the fuel bed away from the observer. It is difficult to estimate how much earlier glowing combustion may have been present before it was detected, but it is likely to have involved relatively short periods since glowing combustion tended to spread rapidly in the presence of a wind, making it more apparent to both the observer and the video camera.

Once glowing combustion appeared, it tended to spread more rapidly and become more intense than in the absence of wind. Generally, the glowing would move downstream away from the location where it was first observed. Often a band of unburned fuel was observed along the upstream edge of the bed. Strong temporal oscillations in glowing intensity with periods on the order of a few seconds were frequently observed. It was unclear if these oscillations were due to variations in the wind velocity or some instability associated with the combustion behavior.

Some qualitative observations concerning the development and behavior of glowing combustion and the transition to flaming both with and without wind are relevant. Glowing combustion tended to appear at isolated small areas, here referred to as pinpoints, similar to those visible in Figure 22. In the absence of a wind the glowing pinpoints could usually be observed moving slowly over individual pieces of fuel. This seems to imply that glowing combustion is a distinct process from non glowing combustion that is self sustaining. As noted above, glowing is generally believed to be due to surface oxidation of char that had been formed by earlier fuel pyrolysis.

In the presence of a wind, the intensity of glowing was enhanced substantially and at times would appear to be more wide spread than the pinpoints typically observed without wind, with glowing over longer lengths of individual fuel elements.

A glowing fuel element appeared to be capable of inducing glowing in nearby fuel elements. As a result glowing combustion usually spread away from locations where it was initially noted. In this way volumes of glowing combustion would develop. Since the number of glowing fuel elements was increasing, the amount of heat release associated with glowing would increase during these glowing periods.

In numerous experiments the transition to flaming was captured on video. A blue flame would appear over a small volume within the fuel bed and then spread rapidly to other locations. At times, these flames moved with speeds on the order of tens of cm/s. The location where the initial flame appeared was always surrounded by an area of extensive glowing. Within a short period of time yellow flames would appear, and the flaming became self sustaining.

The observations concerning transition to flaming suggest that gaseous combustion developed in regions within the fuel beds where a flammable premixed gaseous fuel/air mixture had accumulated and eventually ignited. A rapidly spreading blue flame is characteristic of a premixed flame. The gaseous fuel was generated by pyrolysis of the solid fuel and mixed with air diffusing or flowing into the fuel bed. The initial rapid spread of the flames indicates that flammable mixtures were present over extensive volumes. Heat and/or free radicals are necessary to ignite a premixed fuel/air mixture. The fact that ignitions were observed in areas of intense glowing suggests that sufficient heat was present to ignite the locally flammable gas mixture. While not conclusive, the observation that transition to flaming occurred in areas of intense glowing suggests that glowing is required to ignite flaming in these pyrolyzing fuel beds.

Once a premixed flame developed, the increased heat release rate rapidly pyrolyzed additional fuel, which then burned as a diffusion flame. The appearance of yellow flames, due to soot formation and subsequent irradiance from within the flame, is indicative of diffusional flame burning.

4.2. Shredded Newsprint

Both heated plate and cone calorimeter ignition experiments were done for this fuel.

4.2.1. Heated Surface Ignition Results

Figure 24 shows heated-plate results for the times required for the onset of glowing combustion and flaming as functions of surface temperature and wind condition for shredded newsprint. The symbols and protocols used in this figure will be used throughout the remainder of the report. The wind condition is indicated by both symbol and color as follows: no wind—red circle, low wind—green square, and high wind—blue triangle. Filled symbols represent results for glowing combustion, while open symbols are used for the onset of flaming. As the temperature was lowered, temperatures were eventually reached where neither glowing combustion nor flaming were observed after long periods. These experiments were allowed to proceed until it became clear (no indication of additional reaction) that ignition was unlikely. Instead of showing the actual experimental times, these results are indicated by plotting the appropriate filled symbol near the upper temperature axis.

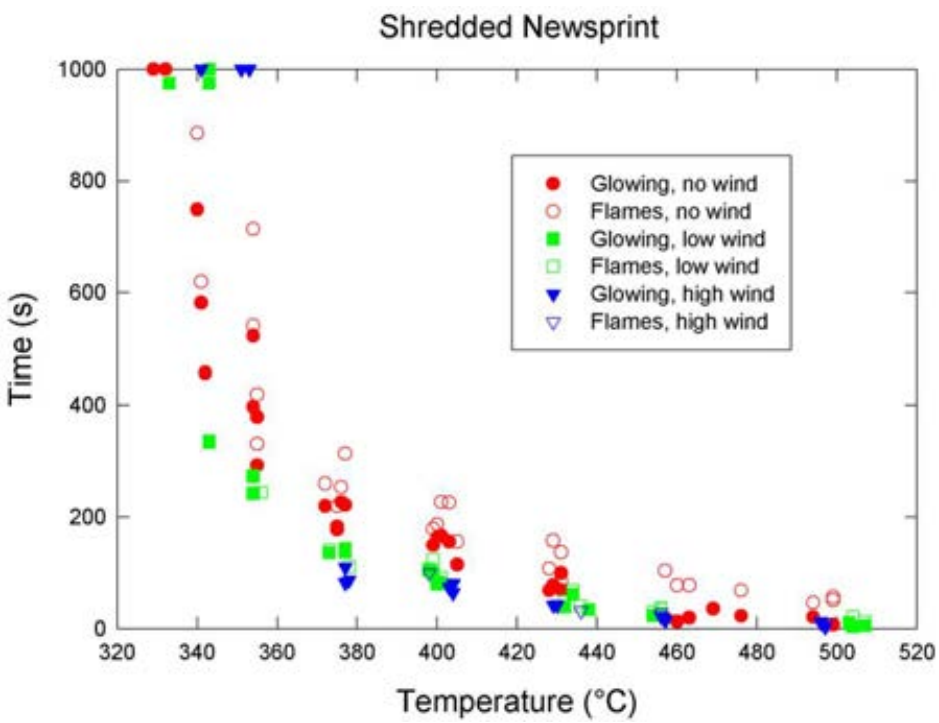

Figure 24. Ignition times for glowing combustion and flaming are shown as a function of temperature for shredded newsprint fuel beds applied to a heated plate. Results are included for no wind, low wind, and high wind cases.

While there is some scatter in results, clear trends emerge from the measurements shown in Figure 24. As expected, the times required for the appearance of glowing combustion and flaming increased as the plate temperature decreased, with data for all of the conditions falling on well defined curves. For temperatures around 500 °C glowing ignition appeared within a few seconds. With a wind applied the glowing combustion rapidly transitioned to flaming, while periods ranging from 26 s to 50 s were required when no wind was present. The time required for the appearance of glowing combustion increased to more than 400 s at temperatures around 340 °C. One of the three tests around this temperature did not transition to flaming, but the other two did, requiring 38 s and 137 s after glowing first appeared. A review of the data shows that for the 30 experiments where glowing was observed without an applied wind, only four failed to transition to flaming. These four had heated plate temperatures of 342 °C , 375 °C, 429 °C, and 469 °C. The wide temperature range suggests that the failure to transition was somehow dependent on a property of the fuel and not directly related to the surface temperature.

For temperatures between 380 °C and 500 °C the effect of applying a wind was to reduce the times required for glowing ignition to appear as compared to cases without wind. These reductions approached 50 % for the lower part of this temperature range. The reductions were greater with a high wind than with a low, though the reductions were smaller than those between the no-wind and low-wind cases.

The time required for transition to flaming was much shorter with wind applied than for the no-wind cases. In all cases with an applied wind, if the shredded newsprint began to glow, it transitioned to flaming in a short period of time.

When the heated plate temperature was lowered to around 350 °C glowing combustion was no longer observed in the presence of the high wind, but ignition still occurred for the low wind and no wind conditions. Even though glowing combustion did not develop, there were indications that some pyrolysis of the fuel did occur. Smoke was observed rising from the fuel bed within a few seconds of being placed on the plate. However, after a short period of time the smoke died off, and there was no additional indication of reaction.

As a test, when it was apparent that no further visual signs of reaction were present, the wind was turned off with the fuel bed still on the plate during one of the tests around 350 °C. The fuel began to smoke immediately, and flames appeared quickly when the wind was turned back on after two minutes. These observations indicate that for plate temperatures around 350 °C the high wind within the fuel bed convectively cooled the fuel to a point where it could not sustain glowing combustion.

As the plate temperature was lowered from around 350 °C to around 340 °C, a similar behavior was seen with low wind flows, with only one of the three tests igniting at the lower plate temperature. As for the high-wind cases around 350 °C, the fuel bed began to smoke again when the wind was turned off. In one case, glowing combustion was observed when the wind was turned back on after a couple of minutes.

Shredded newsprint placed on the heated plate at 333 °C and exposed to the low wind also failed to develop glowing combustion, but light smoke did appear shortly after the fuel was applied and then dissipated and died off. Figure 25 shows photographs of the bottom and top of this fuel bed after removal from the plate. Inspection shows that the shredded newsprint was heavily blackened on the downwind side of fuel bed base and that there was a light brown band evident across the top of the fuel bed perpendicular to the wind flow about ¾ of the way across the bed from the upstream edge. The absence of blackening on the upstream portion of the fuel bed base provides additional support that the air flow cooled the fuel sufficiently that pyrolysis could not take place, while further downstream the cooling prevented the development of smoldering from the pyrolysis region in immediate contact with the heated plate. The brown band on the top is located at the location where smoke was observed coming from the fuel bed. It may be due to either deposited smoke coming from below or light pyrolysis of the fuel by the heated wind-driven plume passing through the fuel bed.

At temperatures around 340 °C glowing combustion was observed for all three experiments run without an applied wind. There was considerable scatter in the times required for glowing to appear. When the temperature was lowered an additional 10 °C glowing combustion did not develop, even though some smoke was released and blackening of the fuel bed base occurred. This blackening is evident in Figure 26, which shows the bottom and top of the shredded newsprint after removal from the plate held at 332 °C. The blackened newsprint extends across the bottom of the fuel bed except for the outer edges. On the top there is a roughly circular area that is browned. The degree of darkening and the diameter of the circle were found to increase

Figure 25. Bottom (left) and top (right) views of a shredded newsprint fuel bed are shown after the fuel was removed from the heated plate held at 333 °C with a low wind applied. Glowing combustion was not observed.

Figure 26. Bottom (left) and top (right) views of a shredded newsprint fuel bed are shown after the fuel was removed from the heated plate held at 332 °C with no wind applied. Glowing combustion was not observed.

with fuel depth. Similar to the low wind case, this behavior suggests that the browning resulted from soot deposition from or light pyrolysis due to the thermal plume within the porous fuel bed. These images reveal that even though the plate surface temperature was high enough to cause some pyrolysis of the fuel in immediate contact, it was insufficient to allow self-sustained smoldering to develop and did not provide sufficient heat to ignite glowing combustion.

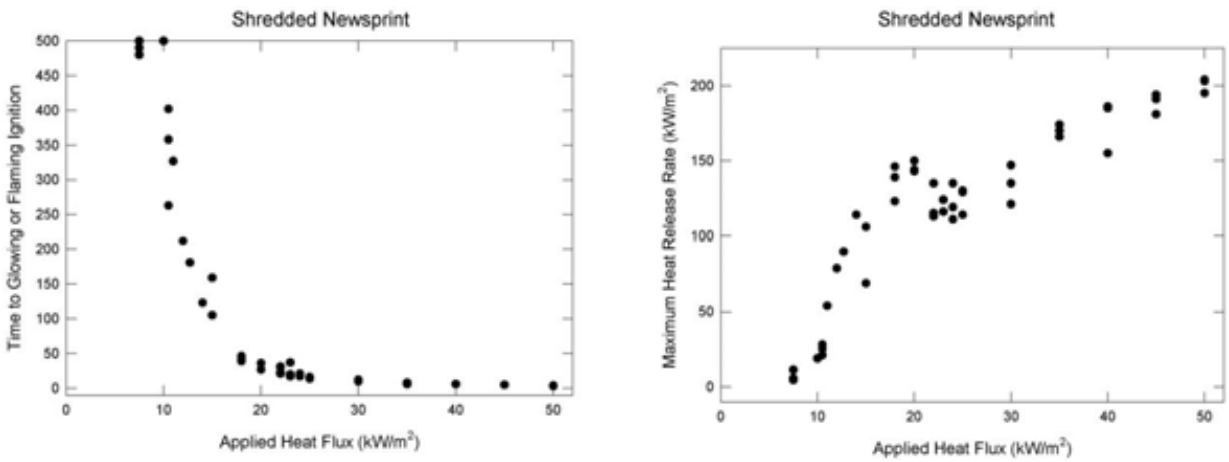

Figure 27. Values of time to glowing or flaming ignition and maximum observed heat release rate are plotted as functions of applied heat flux for shredded newsprint fuel beds.

4.2.2. Radiative Heating Ignition Results

The ignition behaviors of shredded newsprint fuel beds subjected to various applied heat flux (AHF) levels of thermal radiation were characterized using the cone calorimeter. The most direct indicator of ignition behavior dependence on AHF is the time required for flaming ignition. Figure 27 summarizes the time to glowing or flaming observations for shredded newsprint. Neither glowing nor flames appeared with very low AHFs. These experiments are indicated by the values plotted near the upper AHF axis, actual experimental times were usually longer. The heat release rate (HRR) behavior is widely considered the most important fuel flammability parameter. Maximum observed HRRs are plotted as a function of AHF in Figure 27.

For AHFs ranging from 20 kW/m^2 to 50 kW/m^2 times to ignition decreased slowly from about 20 s to around 4 s with increasing AHF. For AHFs below 20 kW/m^2 ignition times began to rise rapidly with decreasing AHF, approaching 350 s for 11 kW/m^2. Flaming ignition did not occur for AHFs around 10 kW/m^2, but glowing ignition was observed, requiring between 250 s and 400 s. Glowing combustion was not observed when the AHF was decreased to 7.5 kW/m^2.

Maximum HRRs showed a comparable dependence on AHF. For AHFs between 20 kW/m^2 and 50 kW/m^2 maximum HRRs increased slowly with increasing AHF. This is the expected behavior and is commonly observed in cone calorimeter experiments since the rate of fuel pyrolysis is expected to decrease at lower AHFs. For AHFs below 20 kW/m^2 the maximum HRRs dropped faster, approaching the noise floor of the experiment for an AHF of 7.5 kW/m^2.

Additional details concerning the response of shredded newsprint to a radiative heat flux can be obtained by considering the time behaviors of the HRR and mass loss behavior. Figure 28 shows plots of these variables as a function of time for three experiments with AHFs of 50 kW/m^2. The results show that the HRRs began to increase immediately, reaching maximum values in 16 s, while the samples mass loss began with the application of the heat flux. These observations are

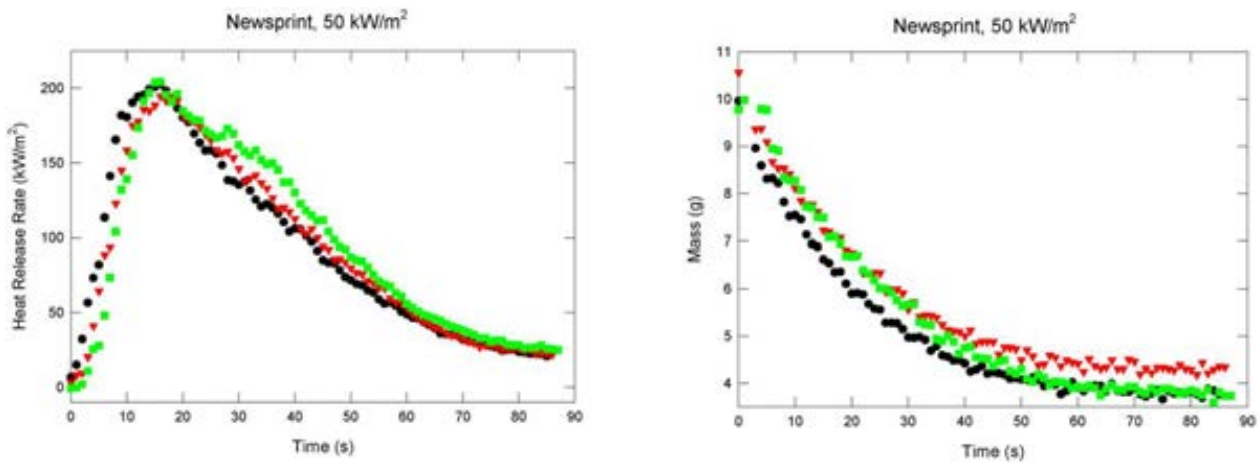

Figure 28. Heat release rates and sample masses are plotted as a function of time for three experiments with a 50 kW/m^2 heat flux applied to shredded newsprint fuel beds.

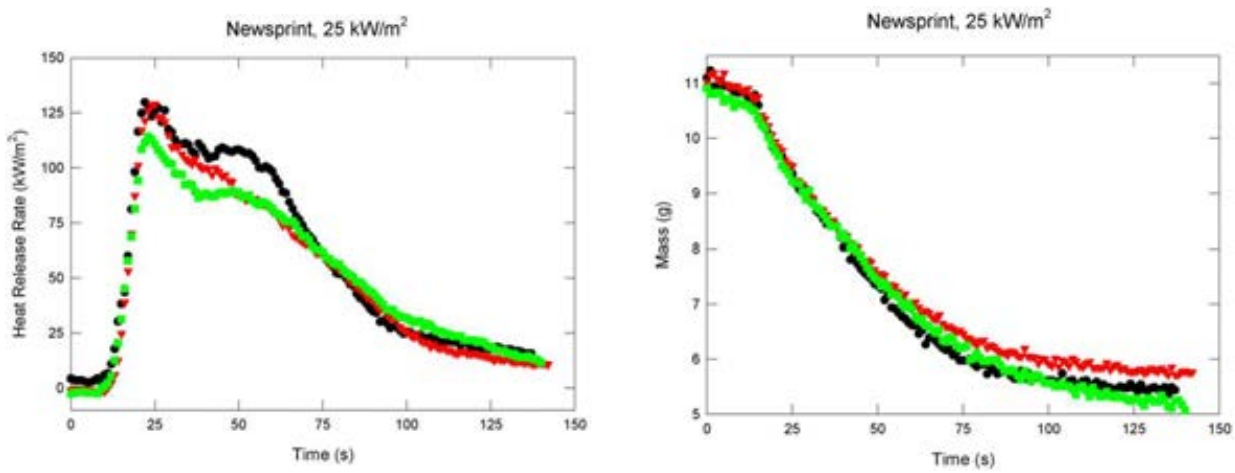

Figure 29. Heat release rates and sample masses are plotted as a function of time for three experiments with a 25 kW/m^2 heat flux applied to shredded newsprint fuel beds.

consistent with rapid flaming observed with this AHF. Most of the samples HRR and mass loss were complete after 90 s.

Three similar plots are shown in Figure 29 for an AHF of 25 kW/m^2. The major difference between Figure 28 and Figure 29 is the presence of substantial induction periods lasting approximately 11 s for the 25 kW/m^2 AHF cases during which there were low mass loss rates and extremely low HRRs. The absence of a measurable HRR during the induction periods indicates that oxidation and heat generation were not occurring even though fuel moisture removal or slow non oxidative pyrolysis, indicated by the mass loss, was taking place. Once oxidation and heat release began, as evidenced by a measurable HRR, the HRR grew rapidly, and flaming was observed within a short period of time, similar to the behavior observed with the 50 kW/m^2 AHFs. This suggests that once smoldering, and likely glowing combustion, developed there was a rapid transition to flaming.

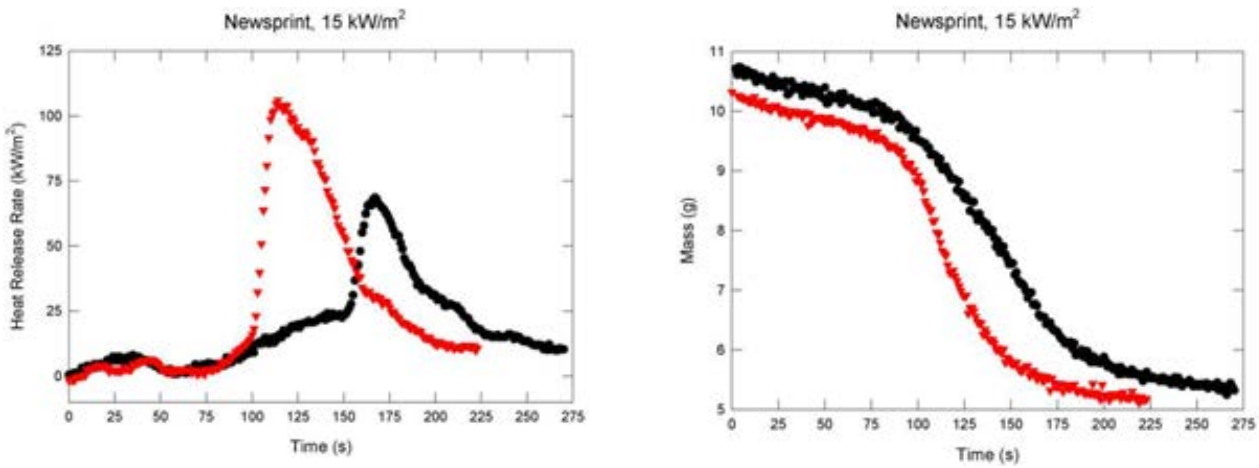

Figure 30. Heat release rates and sample masses are plotted as a function of time for two experiments in which a 15 kW/m^2 heat flux was applied to shredded newsprint.

Figure 30 shows similar plots of HRRs and sample masses for two experiments with an AHF of 15 kW/m^2. The observed data differ markedly from those with higher AHF values described above. As for an AHF of 25 kW/m^2, there is an induction period following the application of the heat flux during which mass loss is observed, but there is no measurable HRR. For 15 kW/m^2 this period lasted about 75 s. After this time the HRR began to increase slowly for both experiments, and there is a marked increase in the mass loss rate. The relatively small values and initial slow growth of the HRRs suggest that smoldering had developed and was spreading within the fuel beds.

The two experiments had different behaviors once smoldering developed. For one, the HRR seemed to grow more quickly, and there was a distinct transition to flaming roughly 25 s after smoldering developed that resulted in a sudden large increase in HRR by nearly 100 kW/m^2, with a substantial increase in the mass loss rate at the same time. For the second experiment the smoldering phase lasted much longer (roughly 75 s), and the HRR due to smoldering was much higher. When flaming did develop around 150 s, the HRR increase and overall peak values were considerably reduced compared to the other case. Apparently, the longer smoldering time resulted in a reduction in the rate of fuel pyrolysis during flaming as well as the fuel available to support flaming. The mass loss behavior also reflects this difference, and the mass loss rate was lower during flaming for the second experiment.

For AHFs as low as 11 kW/m^2 the HRR and mass behaviors were similar to those in Figure 30. For 11 kW/m^2 there was an induction period that lasted roughly 200 s, followed by a period of smoldering during which the HRR and mass loss slowly increased with time, followed by a short flaming period that appeared roughly 125 s after smoldering first started. It is the sum of the induction period followed by the smoldering period that combine to give the observed flaming ignition times.

As seen in Figure 27, flaming ignition was not observed for AHFs of 10.5 kW/m^2 or less. HRR measurements with AHF around 10 kW/m^2 did show that there was still an induction period during which mass loss took place, but there was no measurable HRR. The induction period was

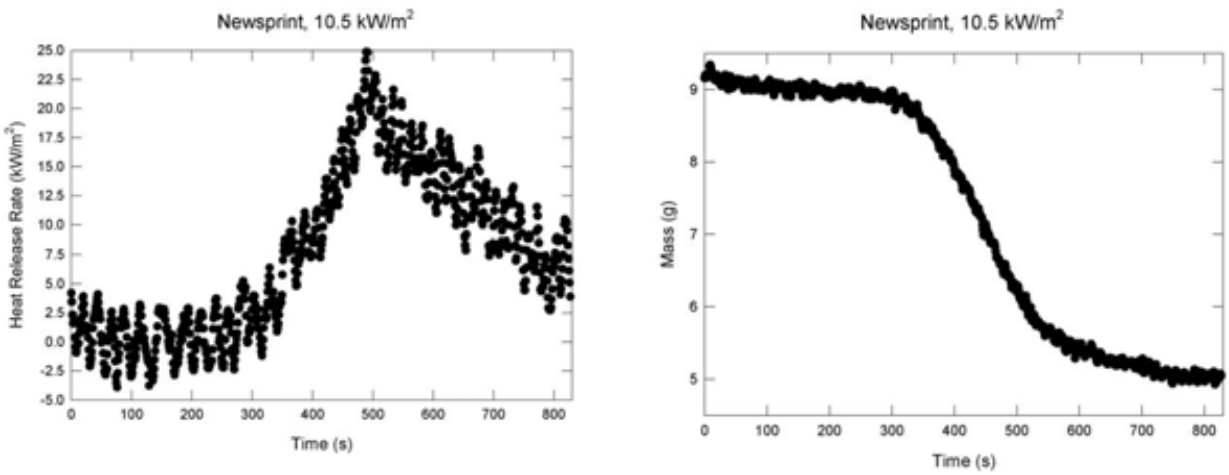

Figure 31. Heat release rates and sample masses are plotted as a function of time for an experiment in which a 10.5 kW/m^2 heat flux was applied to shredded newsprint.

followed by a period during which smoldering developed and was marked by an initially increasing HRR and accelerated mass loss rate. Figure 31 shows an example of this behavior with an AHF of 10.5 kW/m^2. Note that nearly 300 s was required for smoldering to develop.

When an AHF of 7.5 kW/m^2 was used there was a very small amount of mass loss immediately following the application of the heat flux. After this, the mass no longer changed. The HRR remained very close to zero over a 600 s period.

Figure 32 shows the appearance of a newsprint fuel bed after applying 7.5 kW/m^2 for several minutes. There is some light browning on the top of the bed, but no indication of a self-sustained reaction. The non uniform browning may be associated with small spatial variations in the heat flux from the cone heater or to variations in cooling associated with natural flow from the heated fuel surface.

4.3. May Tall Fescue

Both heated plate and cone ignition experiments were done for this fuel.

4.3.1. Heated Surface Ignition Results

Figure 33 summarizes the temperature dependence of the times required for glowing combustion and flaming following the application of May tall fescue fuel beds to the heated plate. The most striking feature of the data is the nearly complete absence of flaming combustion. For the 28 cases in which glowing combustion was observed, only three resulted in flaming. It should be noted that even though a transition to flaming did not occur, the glowing combustion could be quite intense, particularly with an applied wind. When flaming did appear, it was weak and short lived. There is no apparent temperature dependence for whether flaming occurred or not. The flaming behavior for May tall fescue contrasts with that found for shredded newsprint, where

Figure 32. Photograph of the top surface of a shredded newsprint fuel bed following application of a 7.5 kW/m^2 heat flux.

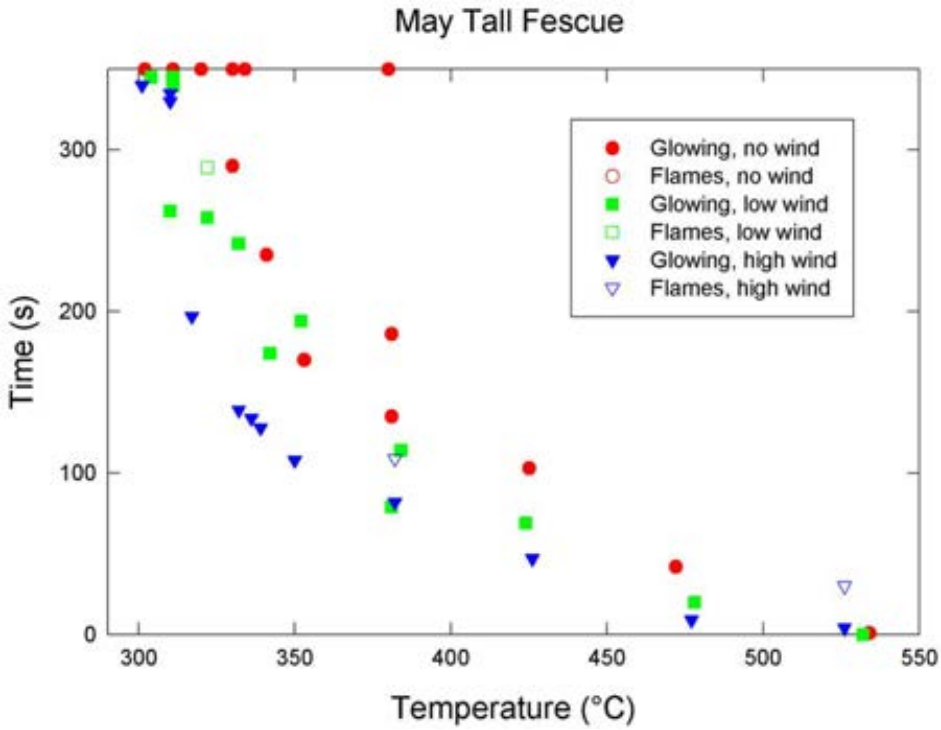

Figure 33. Ignition times for glowing combustion and flaming are shown as a function of temperature for May tall fescue grass fuel beds applied to a heated plate. Results are included for no wind, low wind, and high wind cases.

flaming combustion took place in nearly every experiment in which glowing combustion was observed.

Even though there is scatter in the glowing combustion data, it is clear that the times required for ignition fall on three distinct bands corresponding to no wind, low wind, and high wind conditions. The times required for ignition increased from near zero around 525 °C to periods approaching 300 s for temperatures around 325 °C. Similar to observations for the shredded newsprint, the ignition times for a given temperature decreased with increasing wind. Unlike for the shredded newsprint, the largest reductions occurred on going from low wind cases to high wind cases.

The proportional change in going from no wind to low wind seems smaller than for the shredded newsprint. At the lower temperatures the reduction in ignition times on going from no wind to high wind appears to be greater than a factor of two for the grass.

There are other differences between the May tall fescue and shredded newsprint results. Even though the shredded newsprint transitions to flaming much more readily than the grass, the May tall fescue seems to smolder more easily. This can be seen by comparing times required for glowing combustion at a given temperature, which are generally lower for the grass, and noting that glowing combustion develops for lower plate temperatures (as low as 310 °C) than for the shredded newsprint (as low as 340 °C).

Another difference between the shredded newsprint and May tall fescue concerns the lowest temperatures for which smoldering or flaming was observed for the three wind conditions. For newsprint, combustion appeared at lower plate temperatures as the wind was decreased, with the lowest temperatures capable of igniting the newsprint being observed for the no-wind condition. The opposite is true for the data shown in Figure 33, with the lowest ignition temperatures observed with wind present. This observation suggests that for the low temperature end of the surface ignition curve the development of glowing combustion for May tall fescue is more sensitive to the amount of air supplied to the fuel surface than is shredded newsprint, since the additional air effectively counteracts the additional cooling resulting from the air flow.

The appearance of the fuel beds following an experiment provides additional insights into the importance of air flow on the reaction behavior of the May tall fescue fuel beds. Figure 34 shows bottom and top views of a fuel bed that had developed glowing combustion after being placed on the heated plate held at 341 °C without an applied wind. It is clear that the smoldering spread through the entire bed. There is a narrow region of unburned fuel around the three edges of the fuel bed with wire-screen extending below the plate. No unburned fuel is evident on the side of the cage with the narrow open slit at the base of the wire-screen side wall. In fact, the remaining fuel at this location seemed to be grayer, suggesting more complete combustion. These observations agree with the earlier discussion that the air inflows on the cage side wall with the open slit differs from that through the sides with full wire-screen sidewalls.

Figure 35 shows photographs of the bottom and top of a fuel bed following removal from the heated plate held at 336 °C with a high wind applied. Glowing combustion was observed at

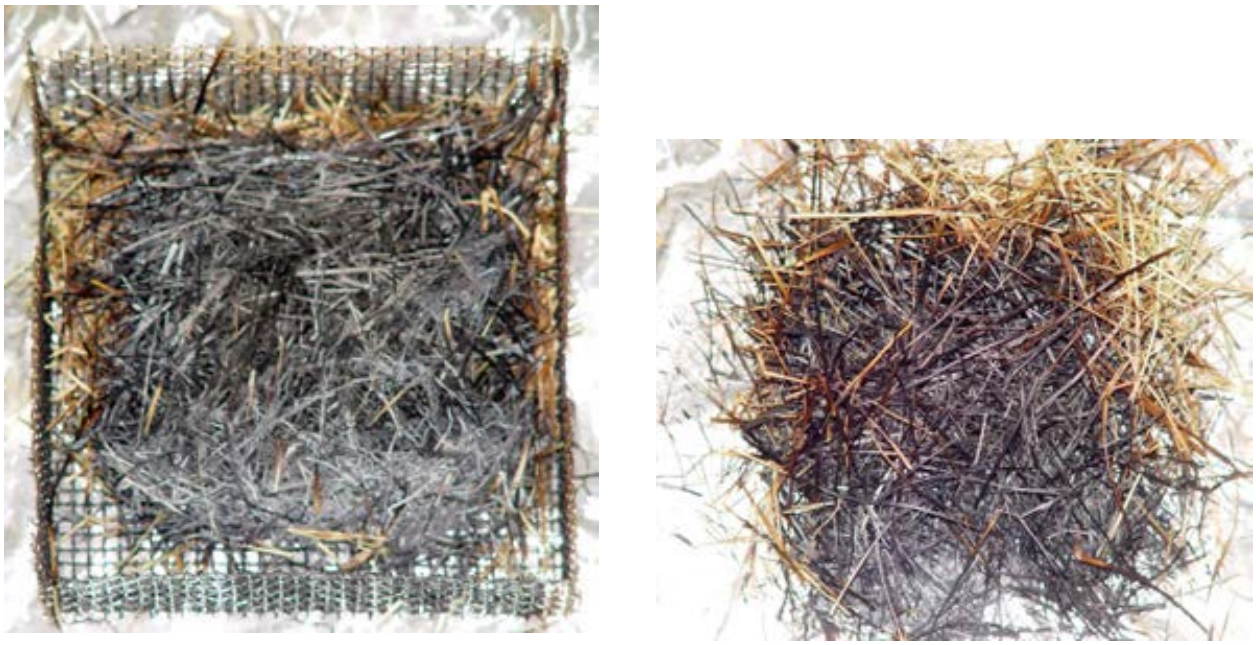

Figure 34. Bottom (left) and top (right) views of a May tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 341 °C with no wind applied. Glowing combustion was observed after 235 s.

Figure 35. Bottom (left) and top (right) views of a May tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 336 °C with a high wind applied. Glowing combustion was observed after 134 s.

134 s following application to the plate and was allowed to proceed for a period of time. The effects of the air flow are marked. The fuel bed has three distinct bands that run perpendicular to

Figure 36. Bottom (left) and top (right) views of a May tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 311 °C with no wind applied. Glowing combustion was not observed.

the wind direction and extend from the top to the bottom of the bed. There is an area of unburned grass on the upstream side of the bed. Apparently, cooling associated with the air flow was sufficient to prevent propagation of the glowing combustion into this area. Near the center there is a grayish area indicating more complete combustion. This is likely the result of more intense reaction due to a greater availability of air. On the downstream side of the fuel bed the tall fescue is simply blackened, suggesting incomplete reaction of the fuel. This type of burning pattern is typical of those observed with an applied wind, but with the low wind the unburned upstream portion was narrower, and the gray band was located closer to the upstream edge.

It was noted above that glowing combustion for the May tall fescue was not observed below 340 °C in the absence of a wind. However, the appearance of the fuel beds following exposure to the heated plate at lower temperatures indicates that non glowing smoldering was still taking place at much lower plate temperatures. Figure 36 shows the bottom and top of a fuel bed that was held at 311 °C without an applied wind. The bottom of the fuel bed is heavily blackened across its entire extent. On the top there is circle of similar blackened material surrounded by a band of unburned grass. Such blackening is not expected in the absence of fuel surface oxidation. These observations indicate that a non glowing smolder wave started near the heated plate and passed upward to the top surface of the fuel bed. The most likely reason for the area of unburned grass around the outside of the top surface is that this grass was cooled by air being entrained in the thermal plume rising from the heated surface and smoldering fuel.

For the lowest plate temperature tested without an applied wind, 302 °C, the fuel bed had a similar appearance to that seen in Figure 36.

Figure 37. Bottom (left) and top (right) views of a May tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 311 °C with a low wind applied. Glowing combustion was not observed.

Figure 37 shows similar photographs for a fuel bed held at the same surface temperature, 311 °C, as in Figure 36, but with a low wind applied. Most of the bottom is blackened with the exception of a narrow band along the upwind (right hand side in photograph) edge. On the top surface of the fuel bed there is a brown band that extends across the bed perpendicular to the wind direction and just downstream of the center. Deeper within the bed the band is much darker. Clearly there had been some pyrolysis of the fuel in contact with the plate and in the vicinity of the line plume formed by heated gases rising within the fuel bed. Smoldering does not seem to have occurred, since there is no indication that areas of pyrolysis moved away from the heated areas.

Tests with low and high winds with plate temperatures near 300 °C showed partial blackening of the bottoms of the fuel bed, but there were larger areas of unblackened fuels along the upstream edges. For the high wind case, this area extended nearly half way across the bed. For both low and high wind cases there were light brown bands across the tops of the fuel bed, with the band for the high wind case located further downstream.

4.3.2. Radiative Heating Ignition Results

The heated plate experiments for May tall fescue showed that these fuel beds were unlikely to transition to flaming, even when glowing combustion was present. With one exception, flaming was only observed in the radiative ignition experiments for AHFs equal to or greater than 40 kW/m^2. On the other hand, glowing combustion was observed with much lower AHFs. Figure 38 shows the times required for glowing or flaming combustion to appear following application of the radiative heat flux as a function of the AHF. Similar to the results for shredded newsprint (see Figure 27), the ignition times increased very slowly as the AHF was reduced from

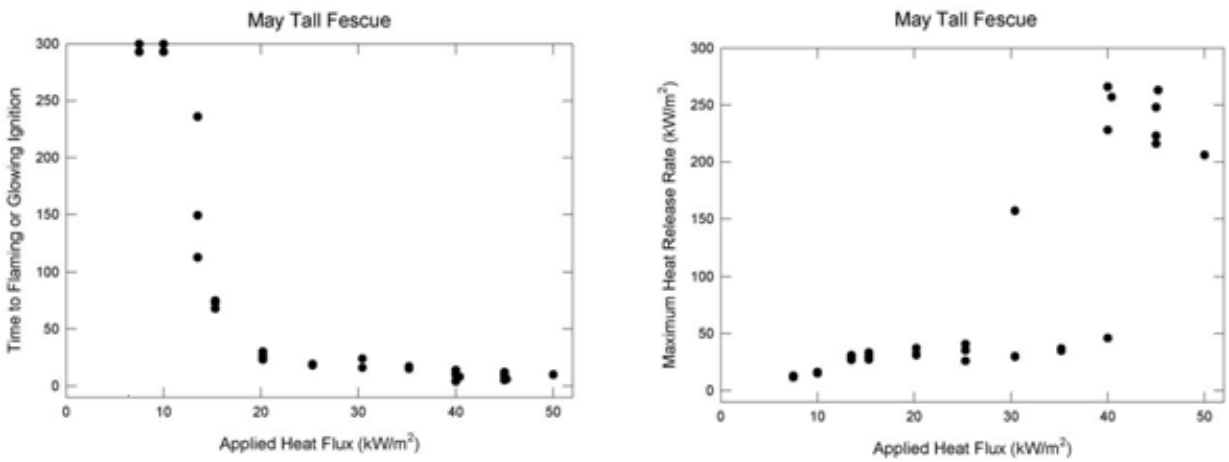

Figure 38. Values of time to flaming or glowing ignition and maximum observed heat release rate are plotted as functions of applied heat flux for May tall fescue fuel beds.

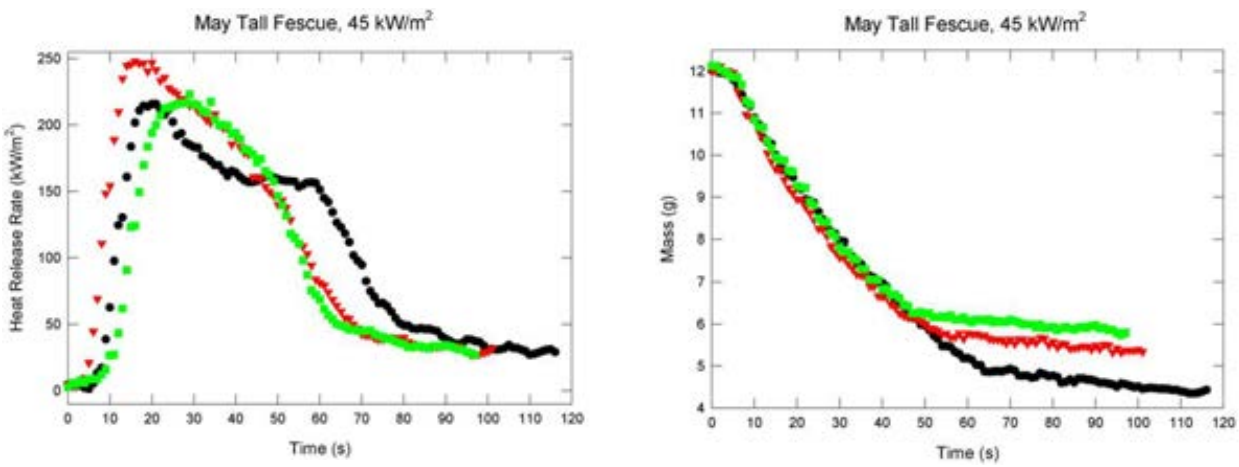

Figure 39. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 45 kW/m^2 heat flux was applied to May tall fescue.

50 kW/m^2 to 20 kW/m^2. For still lower AHFs the ignition times began to increase rapidly with decreasing AHF before ignition was no longer observed with AHFs near 10 kW/m^2 and lower.

Even though the ignition time plots for shredded newsprint and May tall fescue have similar appearances, distinct differences in burning behavior appear in the plots of maximum HRR versus AHF. Maximum HRRs for the shredded newsprint remained high for AHF as low as 11 kW/m^2, while maximum HRRs for the May tall fescue dropped to low values for AHFs lower than 40 kW/m^2. The abrupt drop in HRR for the May tall fescue around an AHF of 40 kW/m^2 is due to the absence of flaming combustion at lower AHFs.

Plots of HRR and fuel mass versus time provide additional insights into the ignition behaviors of the May tall fescue fuel beds. Figure 39 shows three sets of results for an AHF of 45 kW/m^2. After a brief period during which there was a relatively slow loss of fuel mass and low HRR, both the HRRs and mass loss rates increased rapidly, reflecting the onset of flaming. Flaming

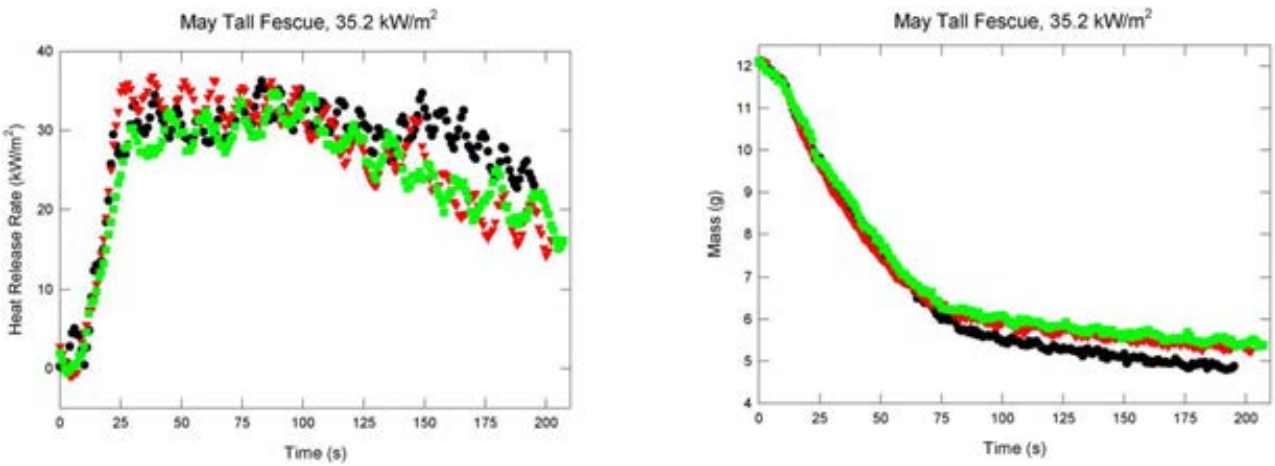

Figure 40. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 35.2 kW/m^2 heat flux was applied to May tall fescue.

lasted for about 50 s to 60 s before dying down. Apparently, smoldering combustion continued after the flaming period since measurable HRRs and low mass lost rates were still present.

Flaming was not observed when an AHF of 35.2 kW/m^2 was applied to the May tall fescue. Figure 40 shows HRRs and masses for three experiments. Similar to Figure 39, there is a brief induction period lasting about 10 s during which there is little HRR, but mass loss is taking place. After this time, the HRRs began to increase rapidly, rising to values on the order of 32 kW/m^2. HRR values remained nearly constant for about 50 s before beginning to fall slowly. The fuel mass loss rate abruptly accelerated at the same time the HRR first begins to rise. This is near the time when glowing combustion first appeared, suggesting that glowing combustion spreading over the fuel bed is responsible for the increased HRR and mass loss rate. At roughly the same time that the HRR began to drop slowly there was a distinct change in the slope of the mass loss, with the mass loss rate decreasing abruptly.

When the effective heat of combustion (EHC) is defined as the HRR divided by the mass loss rate, it is clear that the EHC abruptly increased at the time when the mass loss rate drops. These observations suggest that at least two types of fuel surface oxidation reactions were taking place. The first has a relatively low EHC and likely corresponds to oxidative surface reaction of easily pyrolysed fuel components. Initial pyrolyis of cellulosic fuels is known to form an enriched-carbon char that has a higher EHC that reacts more slowly. The oxidation of the char formed during the initial more rapid oxidative pyrolysis of the grass is most likely responsible for the period of relatively high HRR with relatively low mass loss rate.

In Figure 39 it is evident that the HRR and mass loss behavior following the flaming periods are similar to those observed at the longest times in Figure 40. This suggests that the flaming observed for the May tall fescue with the highest AHFs also formed a high energy containing char that then oxidized more slowly.

Comparison of the HRR and mass loss behaviors observed for AHFs over the range of 20 kW/m^2 to 35 kW/m^2 showed that they were similar to those in Figure 40 with some variation in slopes

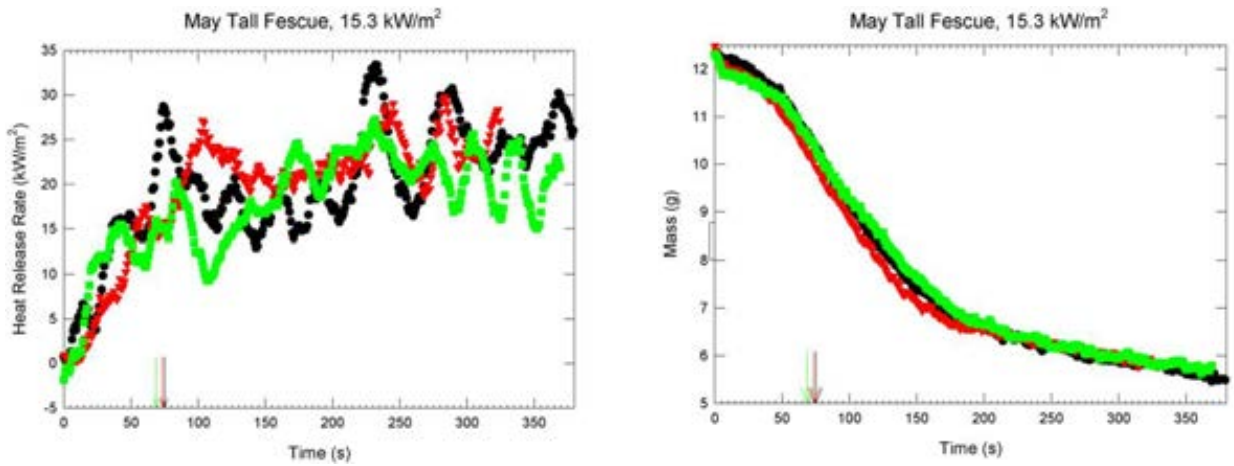

Figure 41. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 15.3 kW/m^2 heat flux was applied to May tall fescue. The arrows indicate the times when glowing combustion appeared.

and transition times. The relatively short times required for glowing combustion to develop for these AHFs (see Figure 38) suggest that glowing combustion rapidly developed and spread over the fuel bed, leading to the formation of chars that then oxidized more slowly.

For AHFs less than 20 kW/m^2 the time required for glowing combustion to develop rapidly increased. Figure 41 shows three sets of measured HRRs and masses as a function of time for an AHF of 15.3 kW/m^2. Color-coded arrows have been added to the plots indicating the times when glowing combustion was observed. The data show that low HRRs developed shortly after the fuel was exposed to the AHF. Relatively slow mass loss rates appeared around the same time. Around 50 s after exposure there was a clear shift in the mass behavior, with the mass loss rate increasing. This change is most likely associated with the development of sustained smoldering. Interestingly, glowing combustion did not appear until about 20 s after smoldering developed. This suggests that the initial smoldering is non glowing and that transition to glowing required a short period of time. These conclusions are consistent with findings from the heated plate experiments that showed that non glowing smoldering occurred at lower temperatures.

The observation of nearly constant HRRs while there is a distinct reduction in the mass loss rate around 175 s indicates that two distinct EHCs occurred for this lower AHF. This behavior is similar to that observed with AHFs covering the 20 kW/m^2 to 35 kW/m^2 AHF range.

Figure 42 shows similar plots for three experiments with an AHF of 13.5 kW/m^2. For each there was a short induction period at the start of the heating during which the HRR remained close to zero but during which there was a slow mass loss. After the induction period the HRR began to rise, but the increases were much slower than when 15.3 kW/m^2 was used. At roughly 75 s there was a distinct increase in the mass loss rate suggesting that smoldering had developed. Glowing combustion was not observed until much later when a significant fraction of the more rapid mass change had already occurred. The sustained HRR and reduced mass loss rate at longer times again indicates that an initial pyrolysis produced a char that then oxidized with a higher effective

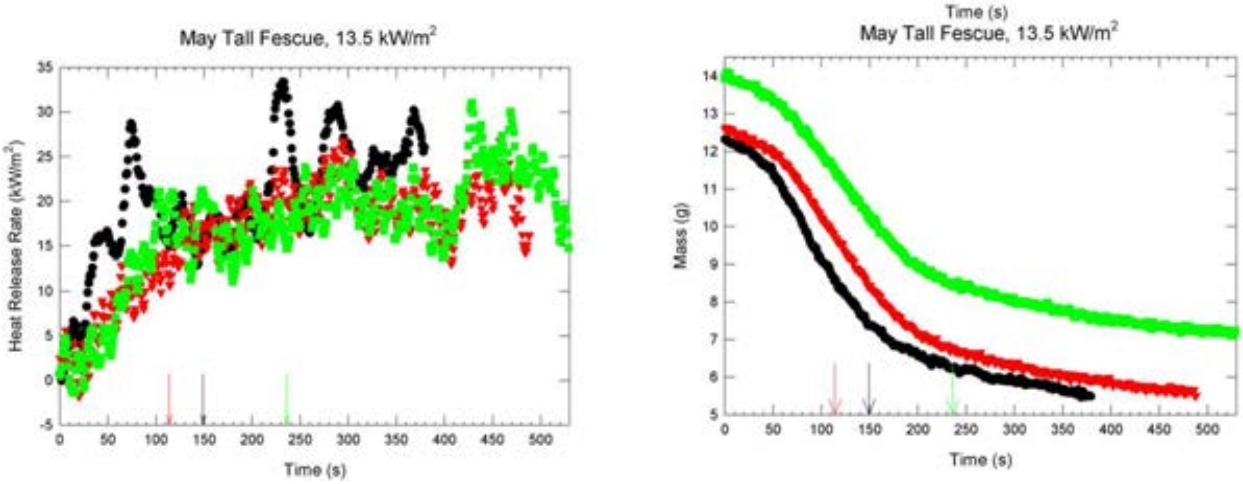

Figure 42. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 13.5 kW/m^2 heat flux was applied to May tall fescue. The arrows indicate the times when glowing combustion appeared.

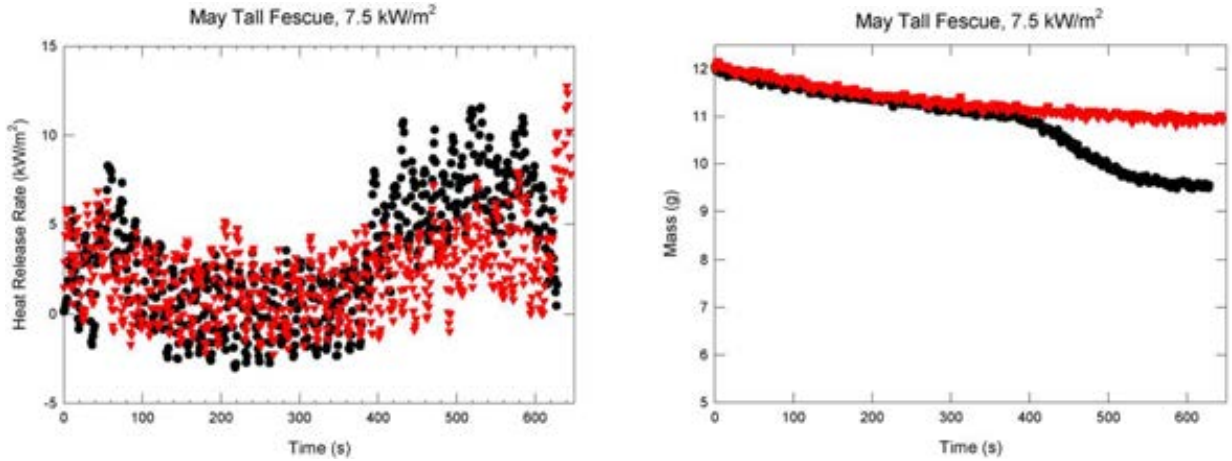

Figure 43. Heat release rates and sample masses are plotted as a function of time for two experiments in which a 7.5 kW/m^2 heat flux was applied to May tall fescue.

heat of combustion. The much longer periods required for each of these stages as compared to cases with AHFs of 15.3 kW/m^2 requires a strong dependence on AHF.

Glowing combustion was not observed for experiments with AHFs of 10 kW/m^2 and 7.5 kW/m^2. Figure 43 shows plots of HRR and mass as functions of time for two experiments with an AHF of 7.5 kW/m^2. After the heat fluxes were applied there were long periods lasting several hundred seconds during which a very slow mass loss occured without significant HRR. The mass lost could be due to non oxidative pyrolysis or moisture removal. During one of the experiments the mass loss rate accelerated around 400 s. There seems to have been a very small increase in the measured HRR at the same time, suggesting limited oxidation was taking place. Interestingly, both the HRR and mass loss rate seemed to decrease back to the lower levels after about 100 s, a time when a large fraction of the original mass remained. This suggests that even though some

Figure 44. This slightly out of focus photograph shows the top surface of a May tall fescue fuel bed following application of an applied radiative heat flux that was insufficient to induce glowing combustion.

non glowing oxidation took place, there was no sustained smoldering. There is a hint that the HRR for the second run may have started to increase after 600 s, just as the experiment ended.

Results with AHFs of 10 kW/m^2 were similar to those for 7.5 kW/m^2 with a nearly linear mass change over the first 200 s followed by an increased mass loss rate lasting about 100 s. There seemed to be a very small HRR that only developed at roughly the same time as the change in mass lost rate. After 600 s about 20 % of the original mass remained.

Some blackening of the grass was observed at the lower AHFs. Figure 44 shows an example of a fuel bed at the conclusion of an experiment in which glowing combustion did not occur. Some blackening of the surface is evident. The blackening is not uniform, but has a distribution over the top of the fuel bed that is similar to that seen for the shredded newsprint in Figure 32. As before, this distribution could be due to the air flow distribution or small variations the cone thermal radiation distribution.

4.4. August Tall Fescue

Only heated plate ignition experiments were performed for August tall fescue. Figure 45 shows the measured ignition times for glowing combustion and flaming as a function of the heated plate temperature. The results will be compared with the corresponding results for May tall fescue shown in Figure 33.

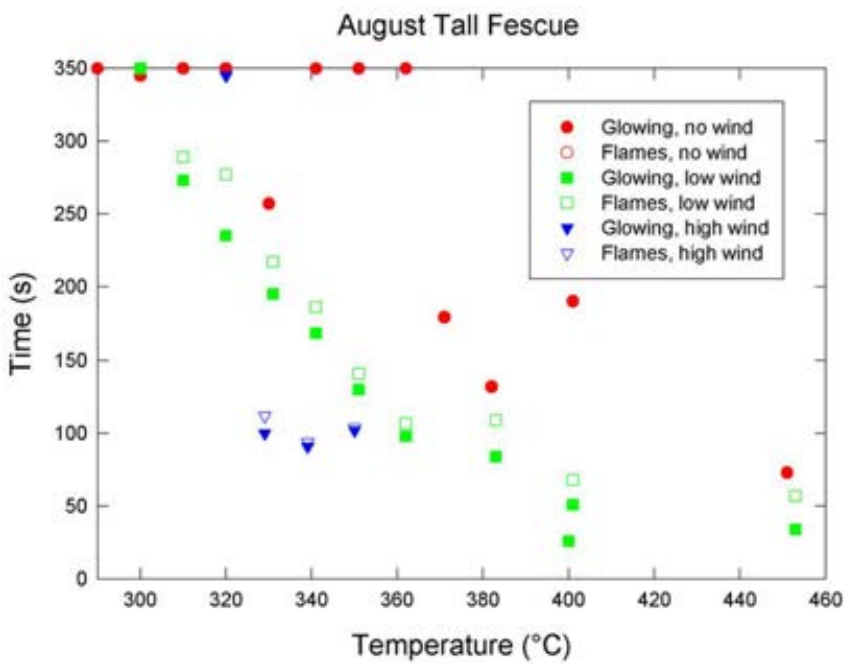

Figure 45. Ignition times for glowing combustion and flaming are shown as a function of temperature for August tall fescue grass fuel beds applied to a heated plate. Results are included for no wind, low wind, and high wind cases.

The most dramatic difference between the two fuels is that the August tall fescue was much more likely to transition to flaming in the presence of a wind. Only three such transitions with limited flaming times were observed with the May tall fescue, while all of the August tall fescue samples exposed to the wind transitioned to flaming. These flames were robust and lasted for many seconds. Figure 46 shows an example of the flames for an experiment with the heated plate held at 310 °C in the presence of the low wind. Flames were observed 289 s after the fuel was applied to the plate and the photograph was taken 5 s later. The strong glowing that tended to develop along the upstream edge with an applied wind is also visible in this image.

The transition to flaming for August tall fescue required the presence of a wind. Flames were not observed for the five experiments without wind in which glowing combustion developed.

Even though flaming was more likely for August tall fescue than for May tall fescue, the August tall fescue required higher heated plate temperatures to induce glowing combustion in the absence of wind. With the one exception of a measurement with the plate temperature held at 380 °C, glowing combustion for the May tall fescue was observed for plate temperatures at or above 340 °C and was absent for plate temperatures around 320 °C. Both responses were observed with the plate temperature held near 330 °C. For the August tall fescue, again with the exception of one experiment, the glowing combustion was observed for temperatures of 370 °C and higher, while it was absent for temperatures of 360 °C and lower, suggesting a 30 °C difference between the two grass samples for the lowest temperatures required to induce glowing combustion when wind was absent.

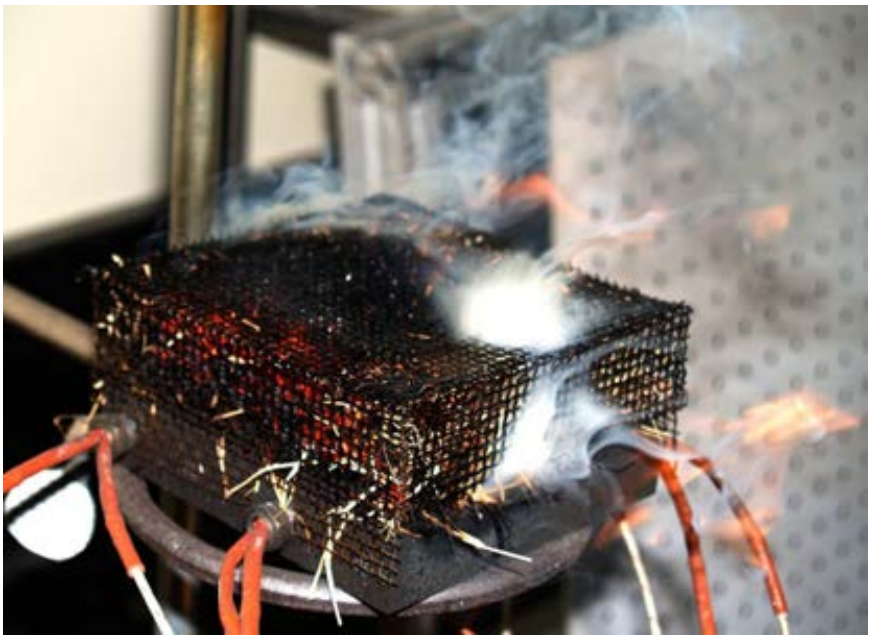

Figure 46. Photograph showing flaming from an August tall fescue fuel bed on the heated plate held at 310 °C in the presence of a low wind. Flames appeared 289 s after the fuel was placed on the plate, and the photograph was taken 5 s later. Strong glowing combustion is present along the upstream edge of the fuel bed.

Despite the fact that the transition to flaming behaviors for the two grasses were very different in the presence of a wind, the dependencies of glowing combustion ignition times on the plate temperature were similar. For both the lowest plate temperature for which glowing combustion developed in the presence of a low wind was around 310 °C, and the times required for ignition were similar, with roughly 275 s being required around 310 °C. The data for the August tall fescue indicate that the glowing combustion ignition times in the presence of a low wind are reduced from those in the absence of the wind, in a manner similar to those for the May tall fescue. Recall that the effect of the low wind was somewhat less than observed for the shredded newsprint.

The high wind results for August tall fescue are limited. However, similar to the May tall fescue, the times required for glowing combustion ignition fall somewhat below those with a low wind. For the May tall fescue glowing combustion, ignition was observed for plate temperatures as low as 317 °C, while the lowest ignition temperature for August tall fescue was 329 °C. Due to the limited measurements, it is not possible to determine if this difference is statistically significant.

The appearance of the fuel beds following experiments in which ignition was not observed provides additional insight in the smoldering of August tall fescue. Even though glowing combustion was not generally observed for temperatures below 360 °C without a wind, images indicate that non glowing smoldering developed and spread partially through the fuel beds with temperatures as low as 300 °C. Figure 47 shows the bottom and top of a fuel bed after being placed on the heated plate at 300 °C. The bottom of the fuel bed is blackened over a large fraction of its area. Three narrow bands of unblackened fuel are visible along the edges. The top

Figure 47. Bottom (left) and top (right) views of an August tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 300 °C with no wind applied. No glowing combustion was observed.

of the fuel bed is also blackened, indicating that smoldering had passed upward through the bed even though the smoldering seems to have progressed upward primarily on the right side of the fuel bed and on the side facing the camera where the open slit was present in the wire-screen cage. At higher plate temperatures where glowing combustion was not observed, the fuel beds had similar appearances, but the fractions of the bottom and top surfaces blackened were larger.

Figure 48 shows the appearance of the bottom and top of an August tall fescue fuel bed after removal from the heated plate held at 290 °C without a wind applied. A blackened area covers much of the bottom of the fuel bed, but on the top the only indication of the heating is a small circular brownish area near the center. As discussed earlier, this browning may be due to the deposit of smoke in the thermal plume coming from below or to light heating of the fuel by the thermal plume. In either case, it is clear that smoldering did not propagate upward to the top of the fuel bed from below. While sufficient to cause pyrolysis of the fuel in direct contact with the heated plate, this plate temperature was too low to generate sustained smoldering.

A fuel bed that was placed on the heated plate held at 310 °C with a low wind applied is shown in Figure 49. This is the same fuel bed shown in Figure 46. Both glowing combustion and flaming were observed. Much of the fuel bed is blackened, but there is an area of unburned grass on the downstream edge of the bed. This suggests that air entrained into the burning fuel bed was able to cool the fuel sufficiently to limit glowing combustion and flame spread. In the image showing the bottom of the fuel bed there is a small gray area on the upwind edge (right side of photograph) indicating that some ash formation had occurred. This suggests that complete oxidation of the char formed by the initial fuel pyrolysis was aided by the presence of the wind.

Figure 48. Bottom (left) and top (right) views of an August tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 290 °C with no wind applied. No glowing combustion was observed.

Figure 49. Bottom (left) and top (right) views of an August tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 310 °C with a low wind applied. Glowing combustion and flaming were observed.

The appearance of fuel beds that did not develop glowing combustion in the presence of a wind provides evidence for the important role that convective cooling played in hindering the development of smoldering at low plate temperatures. Figure 50 shows the bottom and top of the fuel bed following application to the heated plate held at 320 °C in the presence of a high wind. On the bottom there is a band of blackened fuel perpendicular to the wind direction that

Figure 50. Bottom (left) and top (right) views of an August tall fescue fuel bed are shown after the fuel was removed from the heated plate held at 320 °C with a high wind applied. No glowing combustion was observed.

covers about ¼ of the bed width on the downstream side starting near the center of the bed. This distribution suggests that the wind passing through the upstream side of the cage as well as the air entrained into the resulting thermal plume from the downstream side were effective in cooling the fuel to a level where significant pyrolysis could not take place. The top of the fuel bed shows only a very narrow band of browning due either to smoke deposition or light pyrolysis. These photographs show that significant smoldering did not develop within the fuel bed.

The fuel beds for the cases with low wind for which glowing combustion was not observed had similar appearances to those for the high wind case shown in Figure 50. The area subject to blackening on the bottoms of the fuel surfaces and the degree of browning at the top varied with the heated plate temperature.

4.5. Cheat Grass

Both heated plate and cone calorimeter ignition experiments were done for this fuel.

4.5.1. Heated Surface Ignition Results

Figure 51 shows a plot of times to glowing combustion and flaming as a function of heated plate temperature for cheat grass fuel beds. As observed for the other fuels discussed thus far, even though there is scatter in the experimental results, the data fall on three broad bands corresponding to no wind, low wind, and high wind cases, with the ignition times increasing as the plate temperature decreases. Considering the results for glowing combustion, when ignition occurs for a given plate temperature, the data for no wind lies at longer times, followed by the low-wind results, with the shortest times required for the high-wind cases.

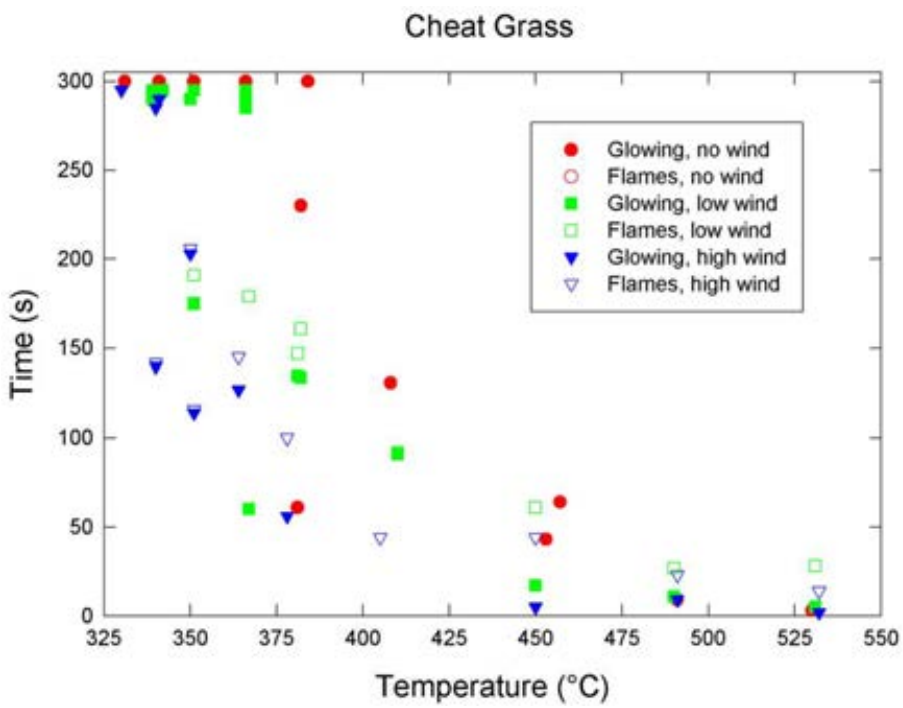

Figure 51. Ignition times for glowing combustion and flaming are shown as a function of temperature for cheat grass fuel beds applied to a heated plate. Results are included for no wind, low wind, and high wind cases.

The general behavior of the cheat grass with regard to transition to flaming was the same as observed for the August tall fescue. Flaming was not observed when a wind was not applied to the fuel bed, and transition to flaming occurred for all experiments in which glowing combustion developed in the presence of low or high wind.

More detailed comparison with the results for August tall fescue suggests that cheat grass may have a slightly reduced tendency to develop glowing combustion. For both fuels the results suggest that glowing combustion no longer developed when the plate temperature was reduced from around 380 °C to around 360 °C. However, the lowest temperatures for which glowing combustion were observed for the cheat grass were around 340 °C and 350 °C for low and high winds cases, respectively. The corresponding values for August tall fescue were 310 °C and 330 °C. Recall that these temperatures for the August tall fescue were already higher than observed for the May tall fescue, suggesting the tendency for cheat grass to develop glowing combustion is considerably lower than for the May tall fescue.

The appearance of cheat grass fuel beds for which glowing combustion did not develop in the absence of a wind provides additional evidence that the tendency for the cheat grass fuel beds to smolder (either non glowing or glowing) was reduced compared to the August tall fescue. Figure 52 shows photographs for a fuel bed that did not develop glowing combustion when placed on the heated plate held at 341 °C. The bottom of the fuel bed is heavily blackened indicating significant pyrolysis took place. On the top of the fuel there is a darkened circular area near the center that indicates that non glowing smoldering spread upward through the fuel bed. This darkened area is surrounded by fuel that is not discolored and the darkened area is not

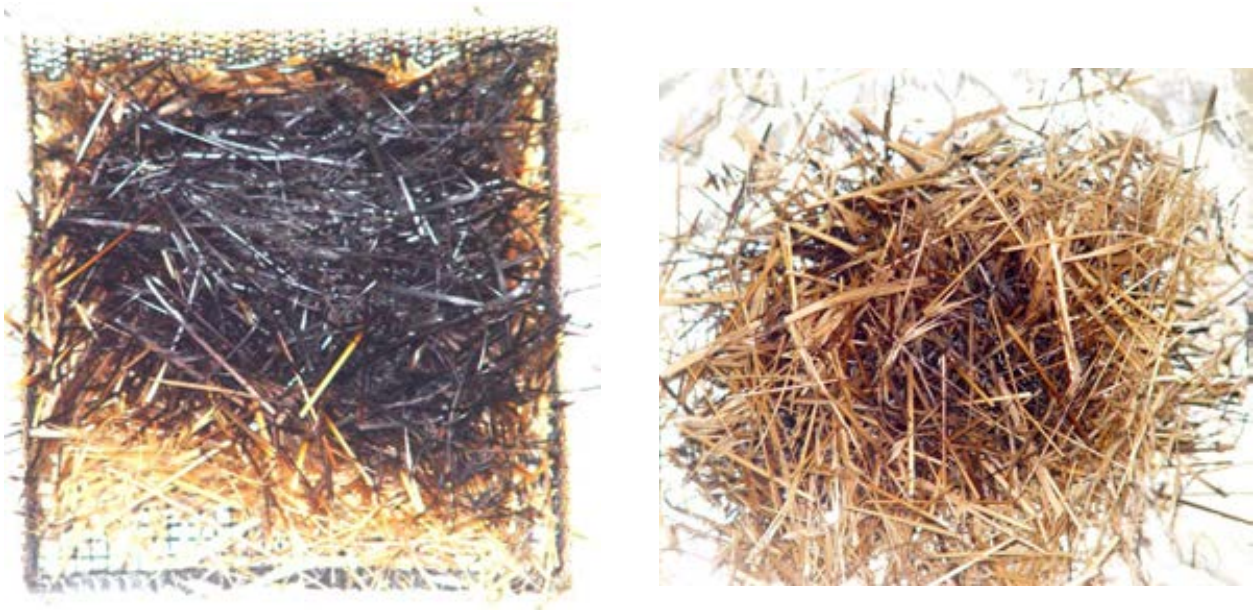

Figure 52. Bottom (left) and top (right) views of cheat grass fuel bed are shown after the fuel was removed from the heated plate held at 341 °C with no wind applied. No glowing combustion was observed.

as blackened as the bottom of the fuel bed, suggesting that smoldering was barely sustained. Similar fuel bed photographs for the heated plate held at 331 °C show that even though the fuel was pyrolyzed on the bottom, smoldering did not reach the top surface, which was barely browned near the center. For August tall fescue, non glowing smoldering was observed for plate temperatures down to 300 °C, but not for 290 °C.

The appearance of the cheat grass fuel beds that did not develop glowing combustion in the presence of low and high winds was similar to those already described for other fuels, with blackening on the bottom primarily on the downstream side and a narrow brown band across the top perpendicular to the wind flow direction. Figure 53 shows an example of this for a heated plate temperature of 350 °C in the presence of a low wind. Once again the cooling effect of an applied wind has been shown to be important for the fuel reaction behavior at low heated plate temperatures.

4.5.2. Radiative Heating Ignition Results

Figure 54 shows plots of the times required for glowing or flaming ignition and maximum HRRs as functions of AHF for the cheat grass. Similar to the results for May tall fescue (see Figure 38), flaming was only observed for the highest AHFs used, but glowing combustion was seen for AHFs extending down to approximately 10 kW/m^2. The maximum values of HRR measured for flaming cheat grass were roughly 80 % of those measured for the May tall fescue, even though the initial mass of cheat grass was only 11 % less (8.0 g versus 9.0 g). Quantitative comparison shows that slightly more heat was released by the smoldering May tall fescue for given AHFs in the 10 kW/m^2 and 35 kW/m^2 range.

Figure 53. Bottom (left) and top (right) views of a cheat grass fuel bed are shown after the fuel was removed from the heated plate held at 350 °C with a low wind applied. No glowing combustion was observed.

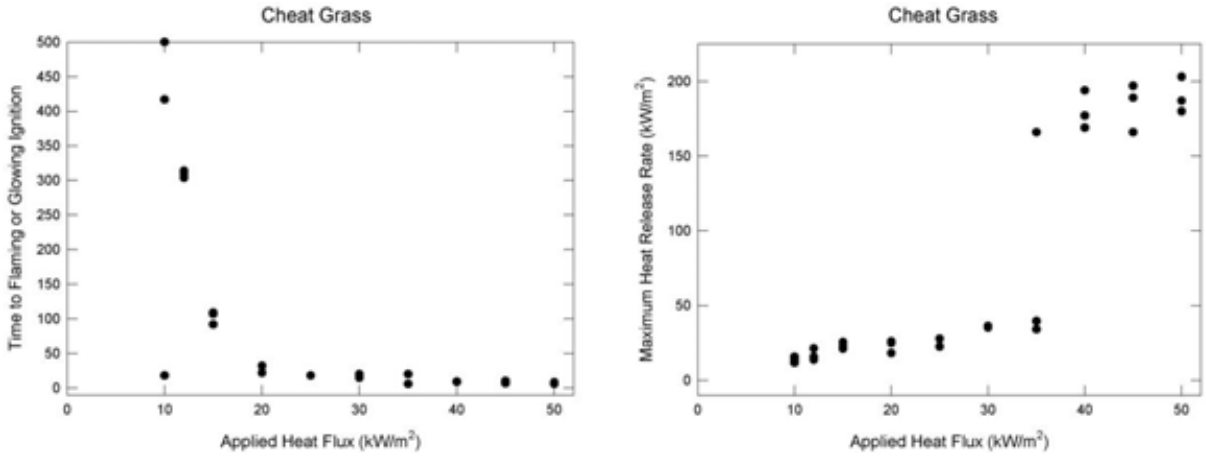

Figure 54. Values of time to flaming ignition and maximum observed heat release rate are plotted as functions of applied heat flux for cheat grass.

The heated plate ignition experiments indicated that cheat grass and May tall fescue had similar behaviors when no wind was applied, but that the grasses displayed very different transition to flaming behaviors when wind was present. Since the cone calorimeter results are similar for the two fuels, it seems likely that radiative heating experiments are not sensitive to fuel behaviors that depend strongly on the presence of wind.

Figure 55 shows the time dependencies of HRR and sample mass measured for an AHF of 45 kW/m^2. Figure 39 shows corresponding results for May tall fescue. The general behaviors are quite similar for the two grasses.

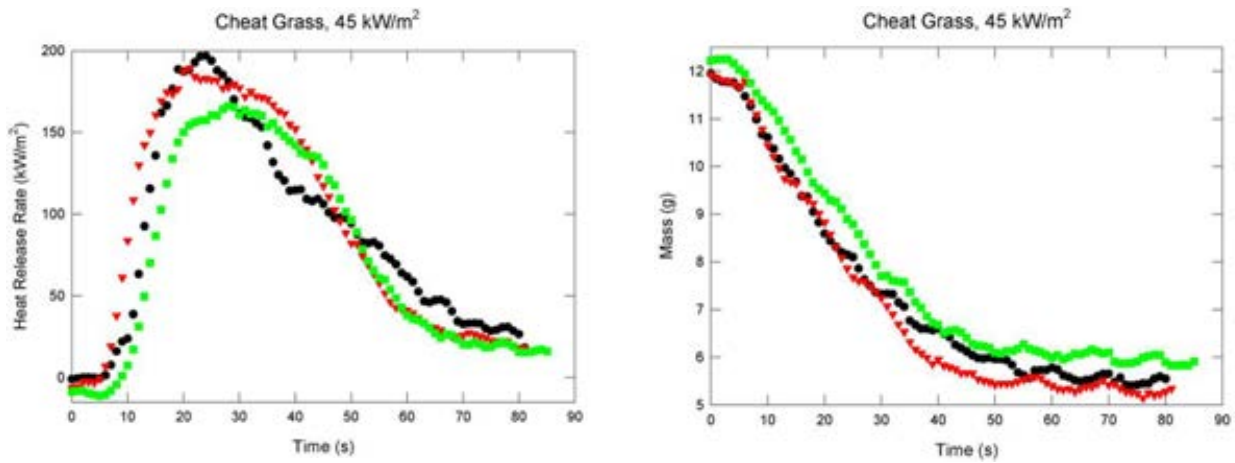

Figure 55. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 45 kW/m^2 heat flux was applied to cheat grass.

Results for HRR and mass loss versus time for experiments with glowing cheat grass had similar time dependences to those for the May tall fescue shown in Figure 40 to Figure 42. Note that this indicates that smoldering cheat grass also has two distinct effective heats of combustion, implying that high energy char was formed and then slowly oxidized.

Glowing combustion was observed for only one of three cheat grass samples run with the AHF set to 10 kW/m^2. All three had HRRs and fuel variations with time similar to those observed for the May tall fescue with an AHF of 7.5 kW/m^2 shown in Figure 43. There were long induction periods lasting about 200 s during which the mass decreased but no heat was released. This was followed by periods during which the mass loss rate was noticeably faster and the HRR rose to about 10 kW/m^2. These observations suggest that non glowing smoldering was taking place at these times. Glowing combustion was observed for one sample at 417 s. By this time the mass loss rate had decreased, indicating that the char formed earlier was being oxidized.

4.6. Fine Florida Grass

Only heated plate ignition experiments were performed for the fine Florida grass. Figure 56 shows the times required for glowing combustion and flaming to appear as functions of heated plate temperature for no, low, and high wind conditions. The results for the different wind cases fall on three distinct curves, with the no wind cases requiring longer times and the high wind cases the shortest times. The reduction in ignition times was largest between the no wind and low wind conditions.

With one exception, flaming was not observed in the absence of wind. In contrast, flaming occurred in each experiment with a low or high wind during which an ignition was noted. In Figure 56 many of the measurements with wind only show the times when flames appeared. For most of these experiments glowing combustion was observed prior to the appearance of flames, but the time differences were too small to be resolved on the plot. The dependence of the transition from glowing combustion to flaming on wind condition is similar to those for August

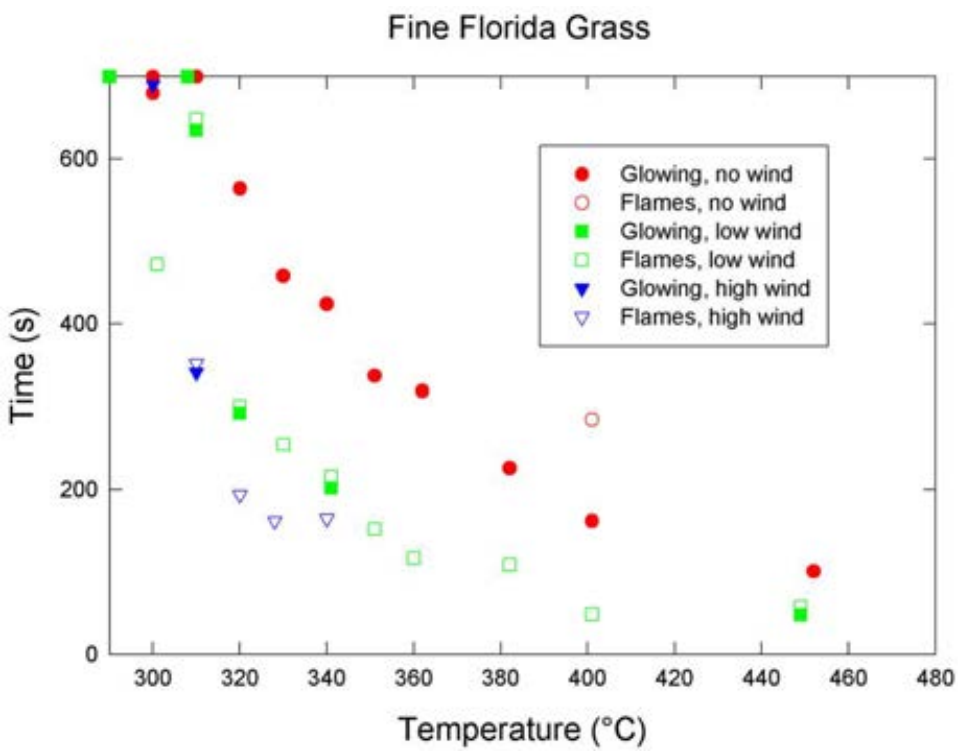

Figure 56. Ignition times for glowing combustion and flaming are shown as a function of temperature for fine Florida grass fuel beds applied to a heated plate. Results are included for no wind, low wind, and high wind cases.

tall fescue (Figure 45) and cheat grass (Figure 51), but the times required for transition are generally shorter. These three types of grass all differ from May tall fescue, since it tended to not flame for any of the wind conditions.

Even though the dependence of ignition behavior on wind condition for the fine Florida grass is the same as observed for August tall fescue and cheat grass, the lowest plate temperatures required for glowing combustion ignition are considerably lower. Ignitions were observed for plate temperatures as low as 321 °C, 301 °C, and 310 °C for the no, low, and high wind cases, respectively. Corresponding values for August tall fescue and cheat grass were 371 °C, 310 °C, and 331 °C and 381 °C, 351 °C, and 340 °C. On the other hand, the lower heated plate temperature ignition limits for May tall fescue (330 °C, 310 °C, and 317 °C, respectively), which had a different transition-to-flaming behavior, are similar to those for the fine Florida grass.

Even though May tall fescue and fine Florida grass have similar lower plate temperature limits for the development of glowing combustion in the absence of wind, comparison of Figure 33 and Figure 56 shows that much longer periods were required for the appearance of glowing at a given plate temperature for the fine Florida grass. This observation, along with the earlier findings that non glowing smoldering developed for August tall fescue and cheat grass for plate temperatures well below those for which glowing combustion occurred, suggests that each of these grasses is capable of non glowing smoldering and that the lower plate temperature limit for glowing

Figure 57. Bottom (left) and top (right) views of a fine Florida grass fuel bed are shown after the fuel was removed from the heated plate held at 321 °C with no wind applied. Glowing combustion was observed.

combustion depends on the ease with which non glowing smoldering transitions to glowing combustion.

Figure 57 shows bottom and top views of a fine Florida grass fuel bed after it was removed from the heated plate held at 321 °C. A large fraction of the fuel bed is blackened on the bottom showing that the grass in contact with the heated plate was pyrolyzed. Two areas at opposite corners of the fuel are blackened on the top. This indicates that smoldering passed from the bottom to the top of the fuel bed at these locations. The absence of blackening at other locations on the top surface suggests that the fuel bed was barely able to support smoldering at this heated plate temperature. Even so, glowing combustion was observed during this experiment.

The corresponding photographs for a fuel bed placed on the heated plate at 310 °C are shown in Figure 58. The blackening on the bottom shows that the fuel in contact with the plate was pyrolyzed. Unlike for the higher plate temperature cases shown in Figure 57, the top of fuel bed is only lightly browned in the center showing that smoldering for this fuel bed did not progress to the top from the bottom surface. The light brown area is either due to deposited smoke or limited pyrolysis due to the thermal plume that developed within the fuel bed.

The observations above suggest that if non glowing smoldering developed in these fine Florida grass fuel beds, it would transition to glowing combustion. This was not the case at the lower heated plate temperatures for the other grasses discussed above, for which non glowing combustion was observed without transition to glowing combustion.

The tops and bottoms of fuel beds for which glowing combustion was not observed in the presence of a wind had similar appearances. Figure 59 shows an example for the heated plate

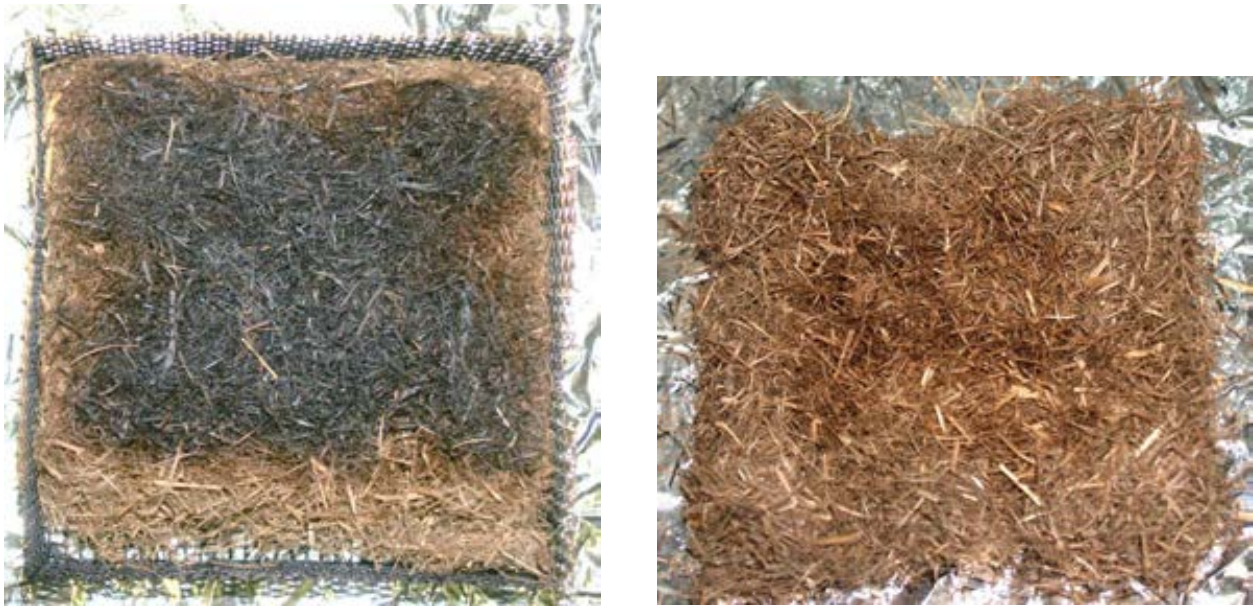

Figure 58. Bottom (left) and top (right) views of a fine Florida grass fuel bed are shown after the fuel was removed from the heated plate held at 310 °C with no wind applied. Glowing combustion was not observed.

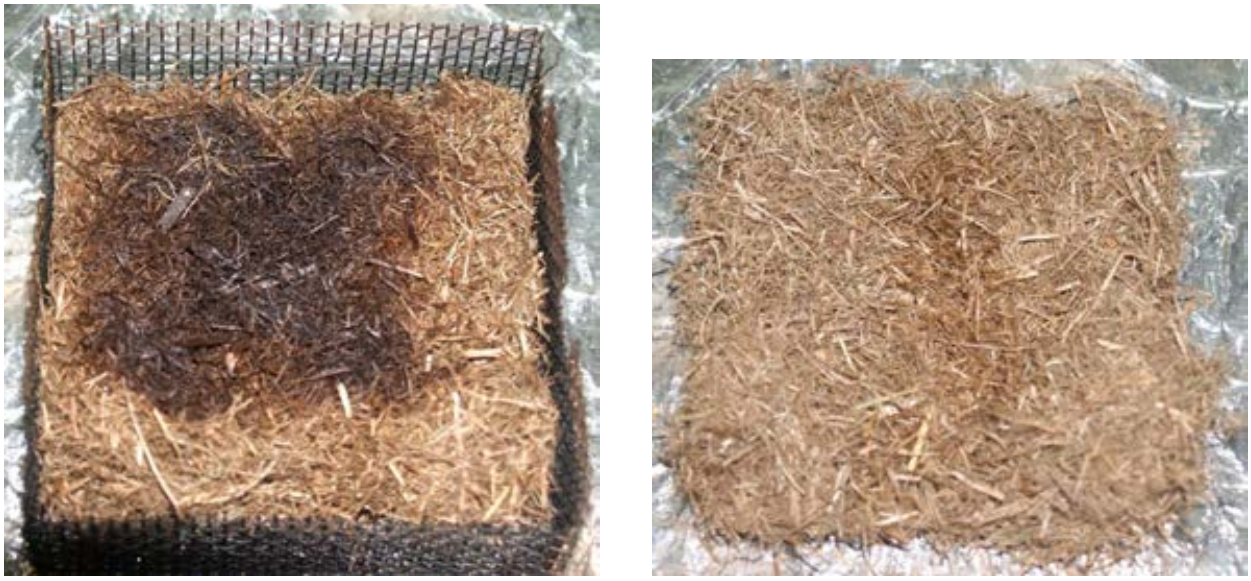

Figure 59. Bottom (left) and top (right) views of a fine Florida grass fuel bed are shown after the fuel was removed from the heated plate held at 290 °C with a low wind applied. Glowing combustion was not observed.

held at 290 °C with a low wind. A rectangular area of the bottom fuel surface is blackened, with unblackened bands visible along the upstream (wider band on right side of image) and the downstream edges. As discussed earlier, convective cooling due to wind flow over the fuel and the thermal plume formed by the rising heated gases seemed to cool the fuel and limit reaction at

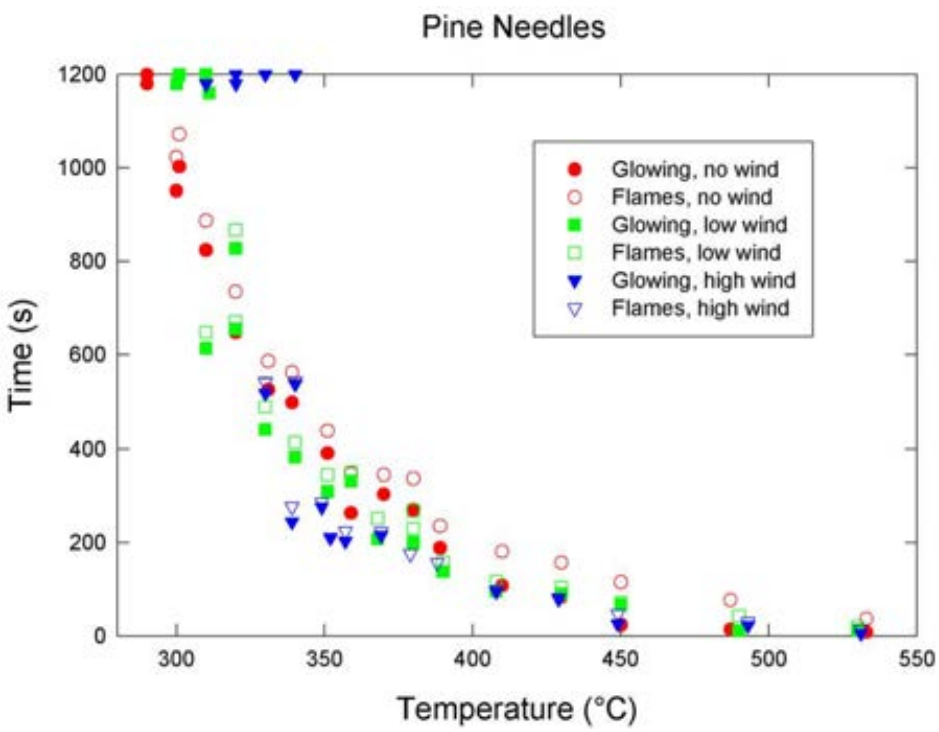

Figure 60. Ignition times for glowing combustion and flaming are shown as a function of temperature for pine needle fuel beds applied to a heated plate. Results are included for no wind, low wind, and high wind cases.

the upstream and downstream edges. The top of the fuel bed appears to be completely unaffected by the heating except for a narrow light brown band running perpendicular to the wind flow direction just downstream of the center. This band is either due to deposited smoke or light pyrolysis by the thermal plume.

4.7. Pine Needles

Both heated plate and cone ignition experiments were done for this fuel.

4.7.1. Heated Surface Ignition Results

The times required for the appearance of glowing combustion and flaming are plotted as a function of heated plate temperature for pine needle fuel beds exposed to no wind, low wind, and high wind in Figure 60. Results for the three wind conditions fall on well defined curves with the data with no wind requiring longer times for a given plate temperature and the measurements with a high wind requiring the shortest periods. The relative separations of the curves are somewhat less than observed for the grasses discussed above, but similar to those for shredded newsprint (see Figure 24).

Figure 61. Bottom (left) and top (right) views of a pine needle fuel bed are shown after the fuel was removed from the heated plate held at 290 °C with no wind applied. No glowing combustion was observed.

There are several differences between the pine needle results and those for the grass samples discussed earlier. Perhaps the most important is that the transition from glowing combustion to flaming was observed for all samples that developed glowing combustion, irrespective of wind condition. All of the grasses were unlikely to flame without an applied wind, and the May tall fescue resisted flaming even in the presence of a wind. Interestingly, the shredded newsprint flaming behavior was similar to that for pine needles.

In contrast to the grass findings where the fuel beds developed glowing combustion at lower plate temperatures when a wind was present, the high wind condition resulted in the highest plate temperatures for which the pine needles did not begin glowing. Glowing combustion for the pine needle fuel beds no longer occurred in the presence of a high wind for plate temperatures between 330 °C and 340 °C. Glowing ignition in the presence of a low wind was not observed below temperatures of about 310 °C, while plate temperatures had to fall below 300 °C before glowing combustion did not develop when no wind was present. Shredded newsprint is the only other fuel that showed a similar dependence on wind, but the range of temperatures over which the transition from glowing to non glowing occurred for the three wind conditions was somewhat smaller, taking place from about 350 °C to 330 °C.

Another difference between the shredded newsprint and pine needle fuel beds and the grass fuel beds is the time required for glowing combustion to develop at the low ends of the heated plate temperature ranges. For the grasses these times ranged between 200 s and 600 s, with the Florida fine grass responsible for the longest times. For the shredded newsprint and pine needles the maximum periods observed approached 1000 s.

Figure 61 shows photographs of the bottom and top of one of the pine needle fuel beds after removal from the heated plate held at a temperature of 290 °C in the absence of wind. The

Figure 62. Bottom (left) and top (right) views of a pine needle fuel bed are shown after the fuel was removed from the heated plate held at 340 °C with no wind applied. No glowing combustion was observed.

bottom of the fuel bed is blackened, indicating that some pyrolysis of pine needles in contact with the heated plate took place. Smoldering clearly did not spread from the bottom to the top of the fuel bed since there is little, if any, discoloration of the fuel on the top surface. Since fuel beds placed on the heated plate held at temperatures only 10 °C higher developed glowing combustion and flaming, this suggests that if non glowing smoldering did start in these fuel beds, it always transitioned to glowing combustion and ultimately flaming.

Figure 62 shows the bottom and top of a fuel bed that did not develop glowing combustion when placed on the heated plate held at 340 °C with the high wind. A narrow band on the bottom of the fuel bed is blackened on the downstream side. There is little indication of pyrolysis on the upstream side. This is an indication that convective cooling of the fuel has limited reaction at these locations despite an increased air supply. Smoldering clearly did not develop within the fuel bed since the top of the fuel bed shows only a hint of discoloration at the downstream edge. Photographs for other low and high wind cases where glowing combustion did not occur have similar appearances, even though in some the bands of discoloration on the tops of the fuel beds were more pronouced. These observations are consistent with those discussed earlier for other fuel beds that did not smolder in the presence of wind.

4.7.2. Radiative Heating Ignition Results

Plots of time to flaming ignition and maximum HRR as functions of AHF are included in Figure 63 from cone calorimeter measurements with pine needles. The data span a range of AHFs from 15 kW/m^2 to 50 kW/m^2. Flaming ignition was observed over this entire range of AHF. Unfortunately, measurements are not available for lower AHFs.

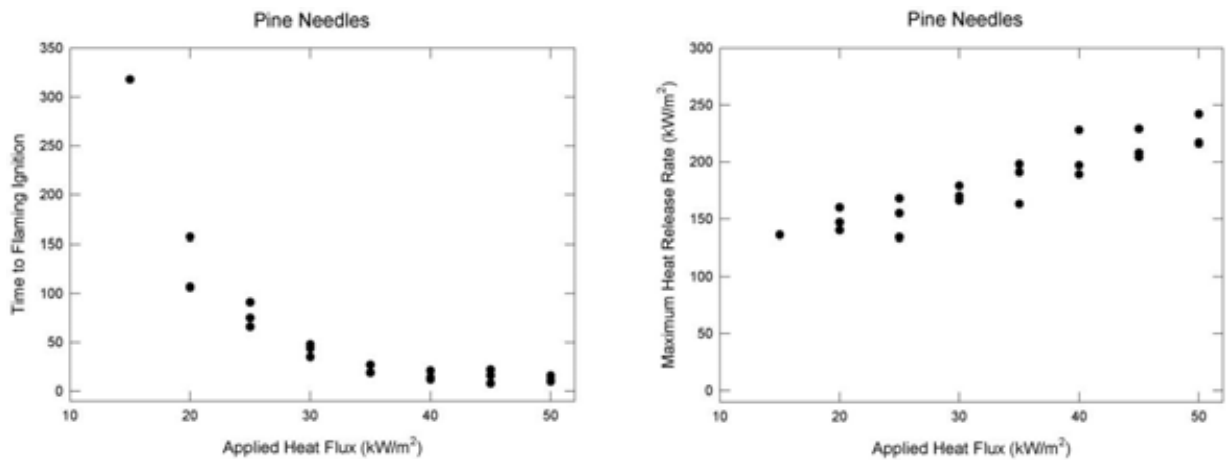

Figure 63. Values of time to flaming ignition and maximum observed heat release rate are plotted as functions of applied heat flux for pine needles.

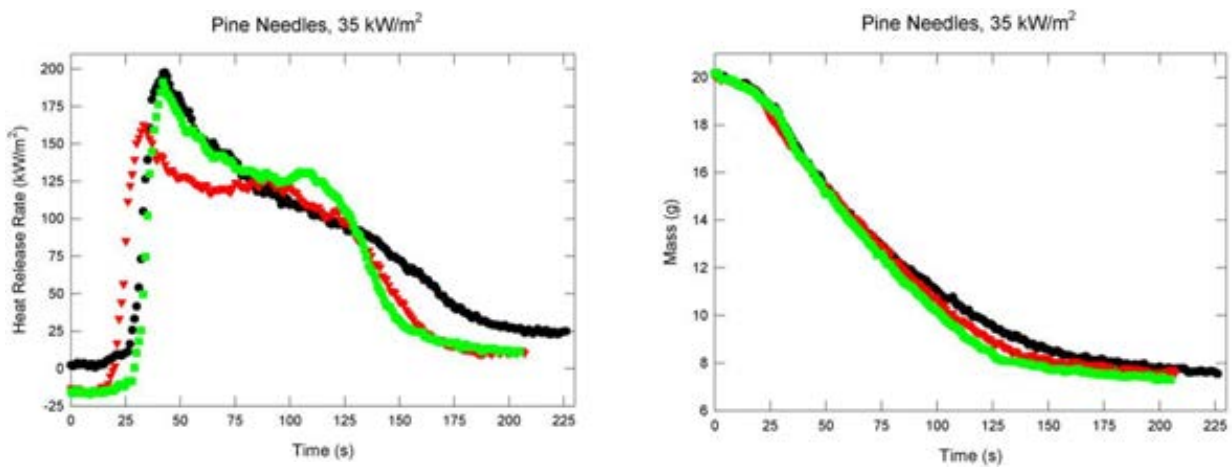

Figure 64. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 35 kW/m^2 heat flux was applied to pine needles.

Less than 30 s was required for ignition with AHFs equal to or greater than 35 kW/m^2, and the ignition times varied little with AHF over this range. For AHFs around 30 kW/m^2 the ignition times began to increase more rapidly with decreasing AHF. The general dependence of ignition times on AHF is similar to those observed for shredded newsprint, May tall fescue, and cheat grass, but for these fuels the rapid increases in ignition times began when the AHF was on the order of 20 kW/m^2, and the rates of increase with decreasing AHF were higher.

Even though the dependence of the ignition times on AHF is highly non linear, the values of maximum HRR appear to have a nearly linear dependence, falling with decreasing AHF over the entire AHF range. This behavior is expected for fuels where the pyrolysis rate during flaming combustion is proportional to the AHF.

Additional insight into the ignition behavior of pine needles is provided by considering the time behaviors of the HRR and mass loss. Figure 64 shows results for three experiments with an AHF

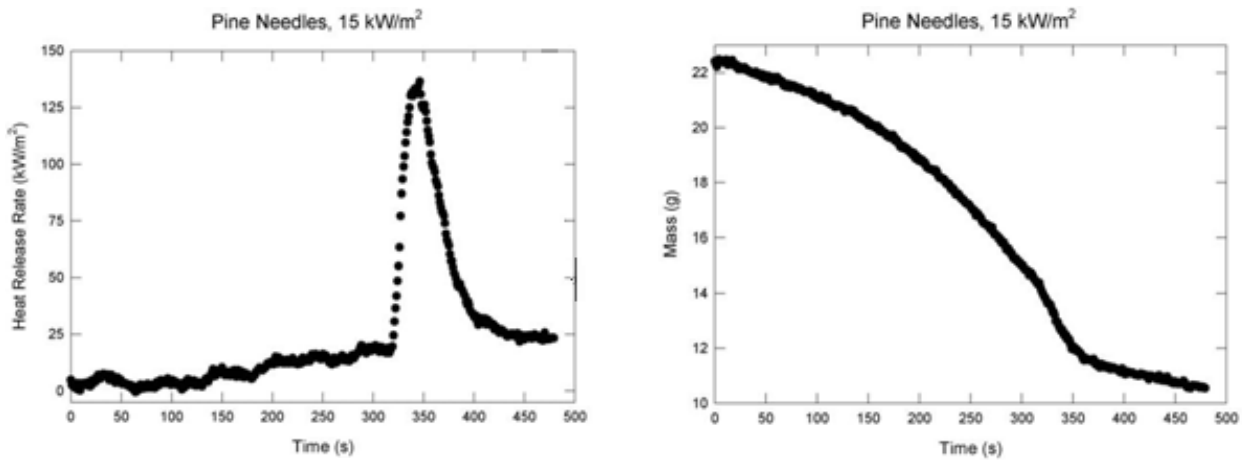

Figure 65. Heat release rates and sample masses are plotted as a function of time for an experiment in which a 15 kW/m^2 heat flux was applied to pine needles.

of 35 kW/m^2. Short induction periods were present at the beginning during which there were relatively low mass loss rates and very little heat release. After the induction period, there were abrupt increases in the rates of mass loss and the HRRs rose very rapidly to their maximum values. Flaming combustion lasted roughly 125 s, before the HRRs and mass loss rates decreased rapidly to levels expected for smoldering and then decreased slowly.

Time plots for an AHF of 30 kW/m^2 have a similar appearance to those in Figure 64, with the exception that the induction periods increased substantially, varying from about 35 s to 50 s, and the HRRs increased slowly to values on the order of 20 kW/m^2 before the rapid increase associated with the transition to flaming. As the AHFs were reduced further the induction periods continued to increase.

Figure 65 shows the HRR and mass loss curves for an experiment with an AHF of 15 kW/m^2. There was a period of roughly 125 s at the start during which the HRR was very close to zero and mass was being loss relatively slowly. After the induction period the HRR began to increase slowly and the slope of the mass loss curve also increased slowly. After about 200 s the HRR had increased to roughly 20 kW/m^2, and there was a sudden transition to flaming.

These data reveal that for low AHFs there are at least three distinct processes involved in the ignition of pine needles. The first is a period during which the fuel mass decreases, but there is little if any heat release. The mass loss is likely due to drying of the fuel and non oxidative fuel pyrolysis. During the second phase the fuel surface begins to oxidize and surface temperatures rise slowly. The increasing surface temperatures lead to more intense pyrolysis since the mass loss rates increase and smoldering spreads. It is unclear if glowing combustion developed in the cone experiments, but observations from the heated plate experiments suggest that non glowing smoldering is not likely to play an important role for this fuel. For these fuel beds, transition to flaming seems to take place when the measured HRRs reach a value of approximately 20 kW/m^2.

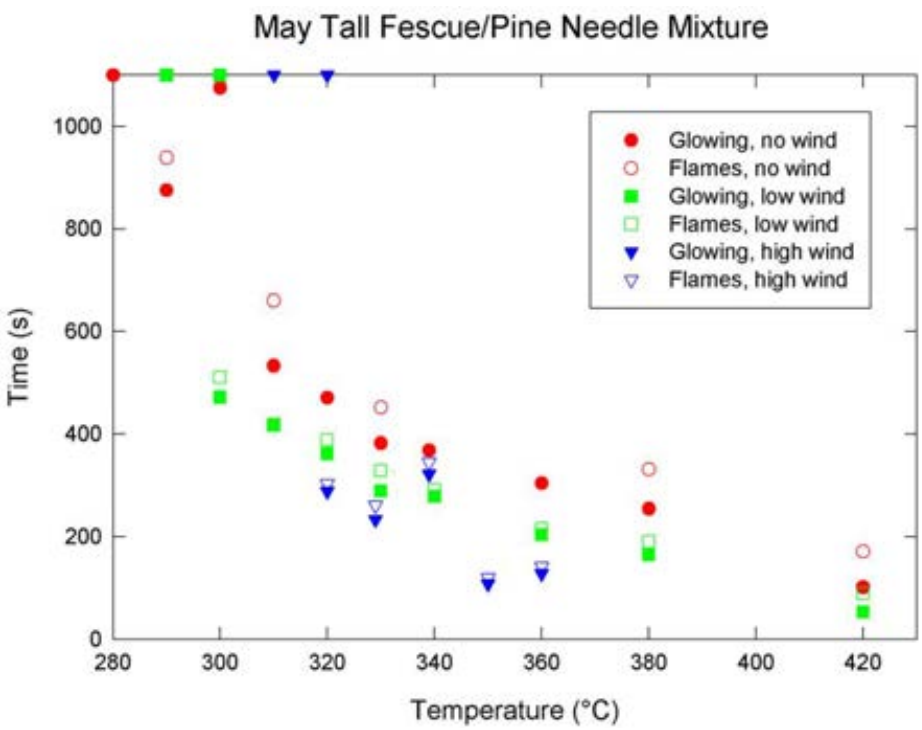

Figure 66. Ignition times for glowing combustion and flaming are shown as a function of temperature for May tall fescue/pine needle mixture fuel beds applied to a heated plate. Results are included for no wind, low wind, and high wind cases.

4.8. May Tall Fescue/Pine Needle Mixture

Only heated plate ignition experiments were performed for the May tall fescue/pine needle mixture. Figure 66 shows the times required for the development of glowing combustion and flaming plotted as a function of plate temperature for no, low, and high wind cases. The results for the different wind conditions fall on well defined curves with ignition times that increase as the plate temperature decreases. Generally, for a given plate temperature, the longest ignition times were observed for no wind cases and the shortest are for high wind cases.

The two fuels in the mixture were chosen because they represented two extremes in the ignition behaviors observed for the natural fuels considered in this study. May tall fescue (see Figure 33) had a low tendency to flame when placed on a heated plate for any of the wind conditions tested, while the pine needles (see Figure 60) transitioned to flaming whenever glowing combustion developed. The application of a wind resulted in larger reductions in glowing combustion ignition times with a given plate temperature for the May tall fescue. In the presence of a wind the development of glowing combustion in the May tall fescue was observed for lower plate temperatures than when a wind was not present. The opposite was true for pine needles. The times required for the appearance of glowing combustion at a given plate temperature were typically much longer for the pine needles as compared to the May tall fescue.

Comparison of Figure 66 with Figure 33 and Figure 60 suggests that a 50 %/50 % mixture by mass of May tall fescue and pine needles resulted in fuel beds with ignition behaviors that were intermediate between those for the individual fuels, but which also had some properties that might be considered less desirable than those for the individual fuels alone.

The results in Figure 66 show that the fuel mixture was much more likely to flame than the May tall fescue. Transition from glowing combustion to flaming was observed in all cases with an applied wind and in just over half of the cases without wind. It is noteworthy that the tendency for the mixture to flame is greater than for all of the grasses tested. For the experiments without an applied wind, there is no clear correlation of the appearance of flames with plate temperature, suggesting that the probability of transition to flaming for this fuel mixture is related to the flammability of the gases generated by pyrolysis and not to the specific local ignition conditions.

For the lower plate temperatures where both of the indivual fuels developed glowing combustion, the ignition times for the mixture tended to lie between those observed for the individual fuels, but to fall somewhat closer to those for the May tall fescue. As an example, consider the low-wind experiments with plate temperatures around 310 °C. Glowing combustion required over 600 s to develop for the pine needles, while the comparable time for the May tall fescue was between 250 s and 275 s. The ignition time for the mixture was just over 400 s. This behavior suggests that the May tall fescue first develops non glowing smoldering with the heat generated by the surface oxidation being transferred to both non smoldering May tall fescue and pine needles. Eventually surface temperatures on a portion of the mixed fuel reach a point where transition to glowing combustion occurs. This glowing combustion spreads and increases the heat release until it is sufficient to ignite the pyrolysis gases generated by the smoldering, and transition to flaming takes place.

For the pine needles the lowest plate temperature where glowing and flaming ignition was observed was 300 °C without a wind present, and roughly 1000 s was required for glowing combustion to develop. For the same plate temperature the May tall fescue/pine needle mixture with a low wind required just under 500 s to begin glowing and rapidly transition to flaming. The lowest plate temperature that produced a glowing and/or flaming ignition for all of the fuels studied during this study was the 290 °C ignition of the fuel mixture in the absence of the wind. As discussed earlier, non glowing smoldering was observed for the May tall fescue for the lowest plate temperature, 302 °C, run without an applied wind. It is likely that non glowing smoldering of the May tall fescue within the fuel mixture generated the initial heat necessary to ignite glowing combustion in the fuel mixture.

The conclusion that non glowing combustion of the May tall fescue component is responsible for the initial heat release in the fuel mixture is supported by the photographs of the bottom and top of the fuel bed shown in Figure 67 for an experiment with the heated plate held at 280 °C and no applied wind. No glowing combustion was observed in this experiment. The bottom of the fuel bed is blackened, indicating significant fuel pyrolysis had occurred. On the top there is a circular dark brown area indicating that some pyrolysis of the fuel mixture took place here as well. Given the low plate temperature, pyrolysis on the top of the bed would not have been expected unless a non glowing smolder front had passed upward through the fuel bed. It has been shown that smoldering in the pine needle beds studies here always involved glowing combustion.

Figure 67. Bottom (left) and top (right) views of a May tall fescue/pine needle mixed fuel bed are shown after the fuel was removed from the heated plate held at 280 °C with no wind applied. No glowing combustion was observed.

At lower plate temperatures the effect of applying a wind to the fuel mixture was to decrease the likelihood of ignition since glowing combustion was observed for lower plate temperatures in the absence of a wind than with wind present. This dependence on wind is the same as observed for pine needles and suggests this component of the fuel mixture dominated this particular behavior.

The importance of convective cooling of the mixed fuel by an applied wind on the ignition behavior is demonstrated by the images shown in Figure 68 for a fuel bed removed from the heated plate held at 320 °C in the presence of a high wind. On the bottom of the fuel bed there is a small blackened area on the downstream half of the bed. Fuel pyrolysis has clearly occurred here. There is some discoloration of the fuel bed along a narrow band lying perpendicular to the wind direction near the downstream edge suggested smoke deposition from or some light pyrolysis by the thermal plume passing through the fuel bed. Similar observations for other fuels have been attributed to convective cooling of the fuel near the heated plate.

4.9. Preliminary Tests with Leaves

A limited number of ignition experiments were carried out on the heated plate using three types of dried leaves. All of these tests were run with heated plate temperatures of 381 °C. This temperature was chosen because the experiments discussed above indicated that this temperature is high enough to ensure that glowing combustion will develop in a reasonably short period of time.

A single experiment was done for 8 g of boxwood leaves placed on the heated plate without a wind. Glowing combustion was observed 90 s after the leaves were applied, but transition to

Figure 68. Bottom (left) and top (right) views of a May tall fescue/pine needle mixed fuel bed are shown after the fuel was removed from the heated plate held at 320 °C with a high wind applied. No glowing combustion was observed.

flaming did not occur. Photographs of the fuel bed showed blackening on the bottom, a circular blackened area on the top, and an area of unreacted fuel around the outside edge of the bed.

Two experiments were run with 5.5 g of elm leaves. When a low wind was used, glowing combustion and flaming appeared nearly simultaneously after 93 s. Smoke was observed coming from the fuel bed along a line perpendicular to the wind flow direction located about 2/3 of the way across the bed from the upstream edge. Photographs show that most of the fuel was blackened. For the second experiment no wind was applied. Glowing combustion developed 253 s after fuel application, but no transition to flaming was observed. The glowing combustion spread quickly to cover most of the fuel bed.

Two repeats of an experiment with the oak leaves in the presence of a low wind were done. For the first test 6.0 g of leaves were used. Neither glowing combustion nor flaming were observed, but heavy smoke was observed along a line perpendicular to the wind flow direction, indicating that pyrolysis was occurring. Photographs after the experiment showed that the bottom was heavily blackened, but the top appeared to be unaffected. This suggests that sustained smoldering did not occur. For the second experiment the mass of oak leaves was increased to 9.4 g. Glowing combustion was observed after 216 s, and flames appeared 11 s later. Both ignitions occurred near the surface of the heated plate. The fuel bed was completely blackened, and there was some ash formation.

The experiments with leaves are too few in number to draw many definite conclusions, but it is clear that leaves can ignite and flame for plate temperatures around 380 °C. The results also

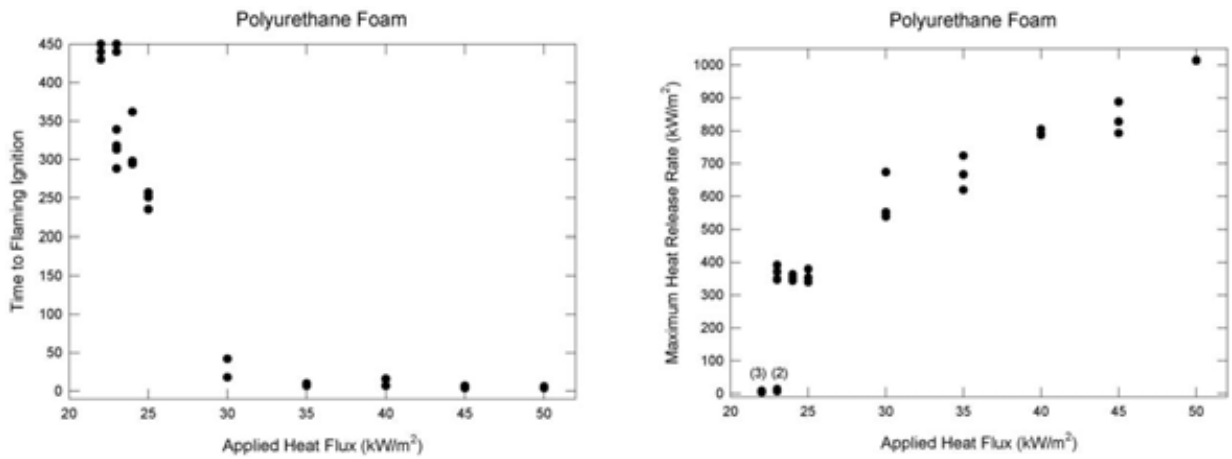

Figure 69. Values of time to flaming ignition and maximum observed heat release rate are plotted as functions of applied heat flux for polyurethane foam. Numbers in parentheses refer to the number of repeated measurements.

suggest that the application of a wind will have similar effects in enhancing ignition to those for the fuels discussed earlier.

4.10. Radiative Ignition of Non Fire-Retarded Flexible Polyurethane Foam

Non fire-retarded flexible polyurethane was included in the study as an example of a plastic material that might be found in an area where outdoor power equipment is stored. Experiments were done only in the cone calorimeter.

Figure 69 shows measured times to flaming ignition and maximum HRRs as a function of AHF. For AHFs between 30 kW/m^2 and 50 kW/m^2 the times required for flaming ignition increased slowly as the AHF decreased. When the AHF was decreased to 25 kW/m^2 the ignition times suddenly jumped to values on the order of 250 s. When the AHF was reduced to 24 kW/m^2 the ignition times increased by about another 50 s. Flaming was observed in only 4 of 6 tests with a further reduction of 1 kW/m^2 in AHF. Maximum ignition times for the cases that flamed were roughly 325 s. When the AHF was set to 22 kW/m^2 no flaming ignitions were observed for three tests.

Despite the highly non linear dependence of the ignition times on AHF, there was a nearly linear decrease in the maximum HRRs, with values dropping from about 1000 kW/m^2 for an AHF of 50 kW/m^2 to around 350 kW/m^2 for the lowest AHFs where ignition occurred.

Time resolved measurements of HRR and fuel mass reveal that the ignition and burning behaviors of the polyurethane foam were different from those observed for the other fuels. Figure 70 shows plots for an AHF of 50 kW/m^2. Following a brief induction period during which the HRR grew slowly and the mass loss rate was low, the HRR and mass loss rate grew

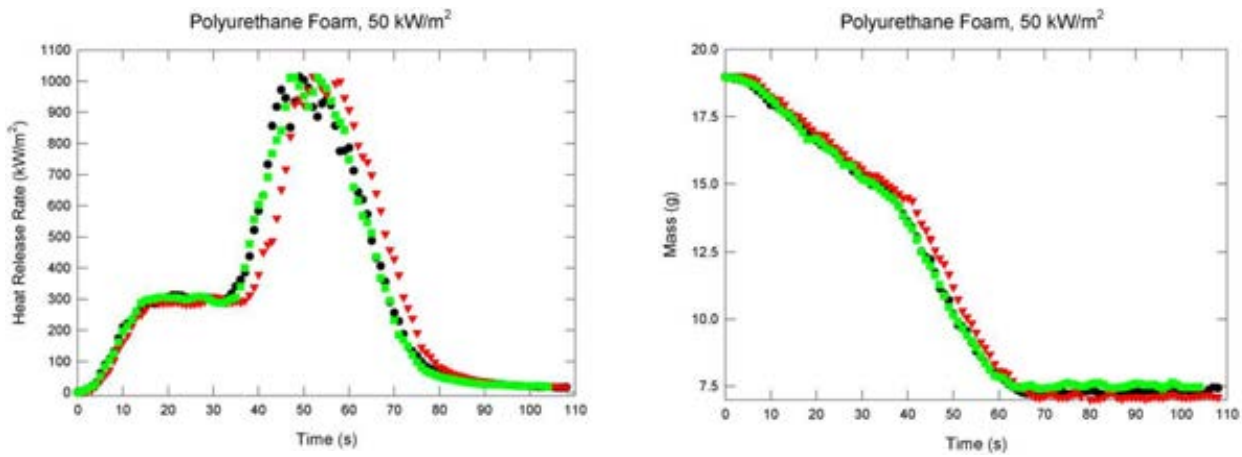

Figure 70. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 50 kW/m^2 heat flux was applied to polyurethane foam.

rapidly to much higher plateau values that lasted about 25 s. About 40 s after exposing the sample to the AHF the HRR rate began to increase again, rising from about 300 kW/m^2 to a peak of around 1000 kW/m^2. The mass loss rate during this second burning phase was much higher than during the first. Following the second burning period the HRR fell rapidly to values close to zero, and the mass did not change appreciably.

Visual observations of flames spreading across a similar polyurethane foam provide a plausible explanation for the observed HRR behavior. As the flames spread onto unburned foam, the foam first darkened and began to shrink. As the foam continued to burn and shrink it generated a brown liquid that began to collect. Once the foam had fully collapsed, the liquid remained as a pool, which then burned as a pool fire. The first heat release peak in Figure 70 is likely associated with burning of the expanded foam. As the foam burned it was forming a liquid pool in the bottom of the sample pan, which eventually ignited and resulted in the second HRR peak.

The HRR and fuel mass time behaviors for tests with AHFs between 30 kW/m^2 and 50 kW/m^2 had similar appearances to those in Figure 70. As the AHF was reduced the induction period tended to increase. For an AHF of 30 kW/m^2 the induction times began to vary significantly, ranging from 15 s to 35 s.

Figure 71 includes plots showing HRR and fuel mass as a function of time for three experiments with an AHF of 25 kW/m^2. These curves have a very different appearance from those with an AHF of 50 kW/m^2 shown in Figure 70. There is a very long induction period during which a large fraction of the fuel mass is loss without significant heat release. This suggests that non oxidative pyrolysis of the foam was taking place. After periods ranging from 230 s to 250 s, the HRR began to rise quickly and flaming was present for a short period of time. During flaming the mass loss rates increased substantially, having slopes comparable to those present during the second burning phase with an AHF of 50 kW/m^2. Taken together, these observations suggest that the pyrolyzate generated directly from the foam was not ignited when a AHF of 25 kW/m^2 was used, but that the liquid pool that was generated by this pyrolysis did eventually ignite.

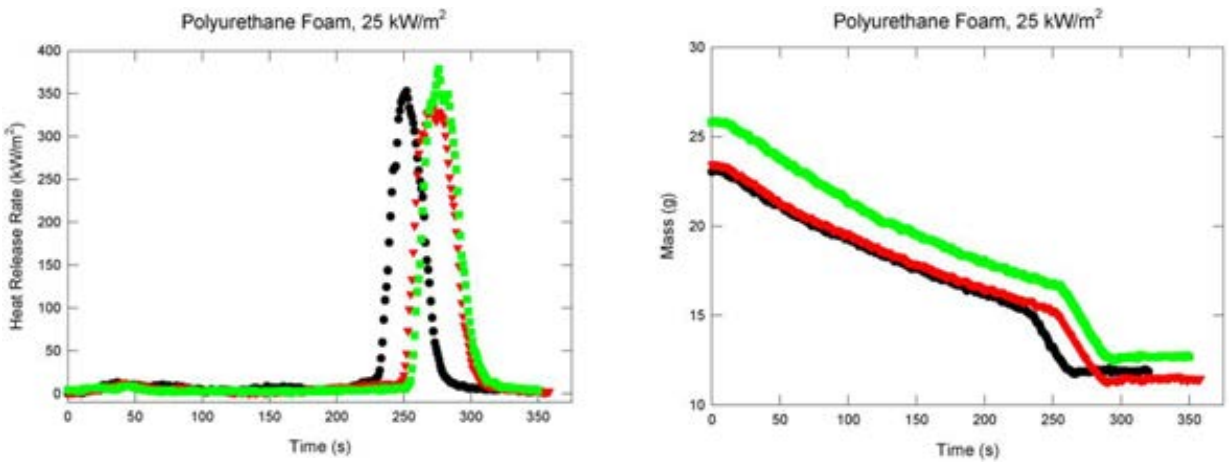

Figure 71. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 25 kW/m^2 heat flux was applied to polyurethane foam.

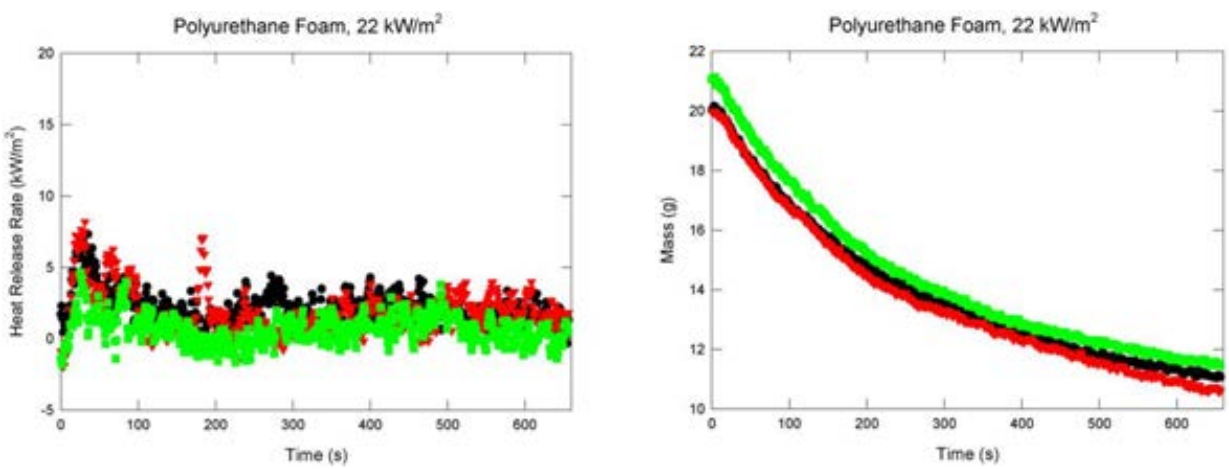

Figure 72. Heat release rates and sample masses are plotted as a function of time for three experiments in which a 22 kW/m^2 heat flux was applied to polyurethane foam.

During these experiments there was concern that the ignition of the foam might be due to the presence of the cone heater acting as a pilot for the pyrolysis gases being generated. This possibility was checked by making a video recording of the ignition. It was clear from analysis of this video that ignition occurred within the sample holder and then spread rapidly upwards.

Plots (not shown) of HRRs and fuel mass as functions of time for the three experiments with an AHF of 24 kW/m^2 and the four experiments that ignited with an AHF of 23 kW/m^2 are similar to those shown in Figure 71 with induction times that determine the times to ignition shown in Figure 69.

Figure 72 shows similar plots for an AHF of 22 kW/m^2 for which ignitions were not observed. The HRR plots suggest that there were brief periods during which some oxidation was occurring, but overall the HRRs were close to zero over the entire periods. On the other hand, a large fraction of the fuel mass was loss. This indicates that non oxidative pyrolysis was taking place in

cases where no ignition was observed. At the end of these experiments the inside of the sample holder was covered with a thin layer of solid black material. This was likely the remnants of the liquid material that formed during the pyrolysis of the polyurethane foam.

Due to the complex reaction behavior of the foam that led to the formation of a liquid and that left a hard-to-remove residue, the decision was made to not risk testing this material on the heated plate.

5. Summary and Discussion

The purpose of this investigation was to provide experimental findings that can be used to better estimate the potential for ignition associated with the heated exhaust surfaces present during the operation of OPE. Due to the application, emphasis was placed on natural fuels often found in the outdoor environment. Scenarios involving direct contact of fuel with a heated surface and radiative heating of fuel placed near a heated surface have been considered. A number of important parameters have been identified and varied during the investigation, including fuel type, heated surface temperature and intensity of applied radiative heat flux, and the absence or present of an imposed wind.

An important characteristic of most of the fuels considered is the ability to smolder. The primary source of information on smoldering behavior of the fuels used in this investigation is derived from the heated plate experiments. While for a limited number of experiments non glowing smoldering without a transition to glowing was observed (based on blackening of the fuel), it was far more common for glowing combustion to develop. As discussed earlier, the development of glowing appears to be a requirement for the ignition of flames in these fuel beds. The times required for the appearances of glowing and flaming are the primary data for the experiments reported here.

As for all experiments, there are uncertainties associated with the measurements that need to be assessed. As discussed in Section 4.1, some uncertainty in ignition times was introduced during visual observation of glowing combustion. In some cases the initial glowing was hidden within the fuel bed and glowing was not observed until a later time. It is believed in these cases that the time periods between initial glowing and the detection of combustion (either glowing or flaming) were relatively short and have little or no effect on the general conclusions drawn from the experiments.

Due to the stochastic nature of the fuel beds and the natural variation in the tendency of individual fuel elements to ignite, uncertainties in measured ignition times for a given heated plate temperature or radiative heat flux are inevitable. The only effective way to quantitatively characterize these variations would be to perform sufficient experiments to allow statistical analysis. It was not possible to perform the large number of experiments required within the scope of the current effort. In the absence of such data, a qualitative approach was adopted in which the degree of collapse of experimental data onto well defined curves is used as a qualitative basis for assessing uncertainty.

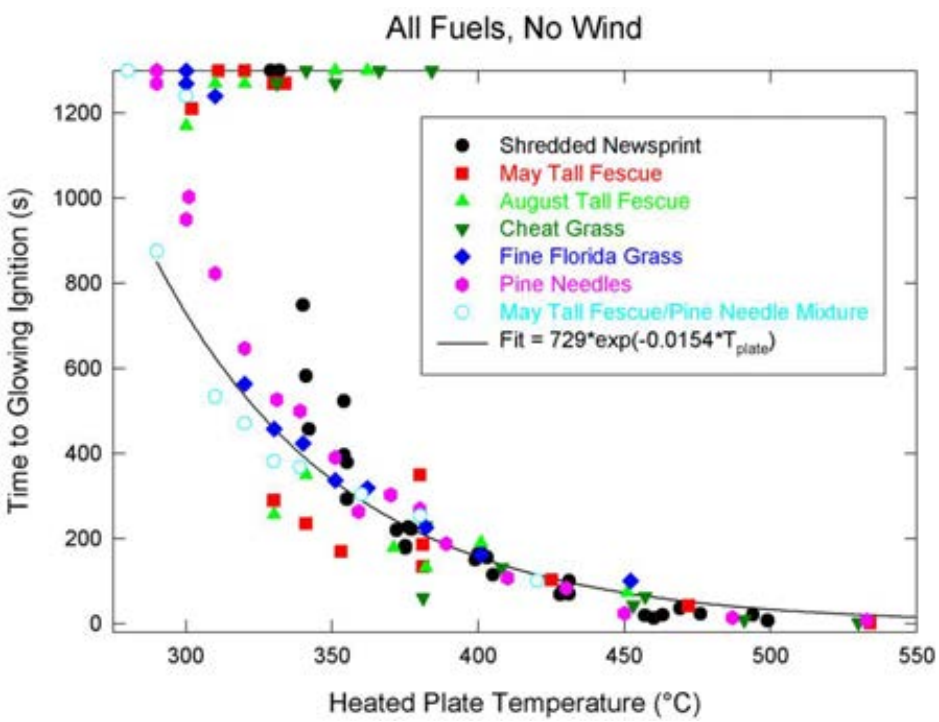

Figure 73. Data for time to glowing ignition with no applied wind are plotted as a function of heated plate temperature for seven fuels. Data near the upper temperature axis represent experiments for which ignition did not take place. The solid curve is the result of a least squares fit assuming an exponential dependence on heated plate temperature for all data where ignition was observed.

Similar considerations apply to determinations of the minimum heated plate temperatures or radiative heat fluxes required to ignite a given type of fuel bed. A detailed study would be expected to reveal an ignition probability curve in which the probability of ignition would increase from near zero to near one as temperature was increased over some range. Mapping out such a probability curve would have required far too many experiments. For this work an approach was adopted in which heated plate temperatures or radiative heat fluxes were reduced in discrete steps. Usually, but not in all cases, the step sizes were such that well defined demarcations between experiments with and without ignition were identified. Lower temperature ignition limits can be identified from these experiments, but due to the stochastic nature of the processes it is prudent to assign an uncertainty of at least one step size to the results.

Results for individual fuels have been discussed in Section 4. In order to assess the roles of fuel type, heated plate temperature, and wind for the surface ignition experiments, ignition time data (the shorter of glowing or flaming) for all of the fuels tested have been plotted together on a single plot. Figure 73 shows the result for experiments without an applied wind. For comparison purposes, a least squares curve fit assuming the fall off of ignition times with increasing plate temperature has an exponential dependence was fit to all of the data for which ignition was observed. The result of the fit,

$$t_{glowing,fit,none} = 729 \times e^{-0.0154 T_{heated\ plate}}, \qquad \textbf{(2)}$$

where $t_{glowing,fit,none}$ is the calculated time to ignition and $T_{heated\ \mathrm{plate}}$ is the heated plate temperature is shown as a solid curve in Figure 73 . The experimental data fall on a wide band on either side of the curve fit.

Data for each fuel shows a similar dependence on plate temperature, with the ignition time increasing with decreasing plate temperature and the rate of increase accelerating. Comparison with the exponential curve fit included in Figure 73 shows that an exponential dependence on plate temperature provides a good approximation for the temperature dependence.

Closer inspection of Figure 73 shows that data for individual fuels lie on well defined curves that show much smaller variations than the consolidated data. These relatively small variations show that variations in measurements for individual fuels are much smaller than those due to variations between fuels. Interestingly, data for all of the fuels seem to lie close together for plate temperatures above 400 °C, with larger relative differences between fuels appearing for lower heated plate temperatures.

Results for the May and August tall fescue grasses fall close together and lie well below the curve fit, data for fine Florida grass and the May tall fescue/pine needle mixture fall close to the curve fit, and the shredded newsprint and pine needle data appear well above the curve. It is difficult to assess the behavior of cheat grass because it did not ignite for temperatures below 380 °C. Recall that transition to flaming in the absence of a wind was unlikely for May tall fescue, August tall fescue, and cheat grass, while the May tall fescue/pine needle mixture transitioned to flaming in over half of the tests, and the pine needles and shredded newsprint were likely to flame for all wind conditions. The probability of transition to flaming in the absence of wind seems partially correlated with the time-to-ignition variations observed between fuels, with a shorter time to ignition correlating with a lowered probability of transition to flaming.

The data at the top of the plot in Figure 73 represents experiments for which glowing or flaming ignition was not observed. Minimum ignition temperatures show distinct fuel-type dependencies. The highest minimum ignition temperature (380 °C) was for cheat grass. This was followed by the August tall fescue (371 °C) and May tall fescue (340 °C). Recall that even though glowing combustion was not observed just below the transition temperature for these two grasses, non glowing smoldering was observed down to temperatures around 300 °C. The minimum heated plate ignition temperature (340 °C) for shredded newsprint was similar to that for May tall fescue. Next was the fine Florida grass with a minimum ignition temperature of around 320 °C. The minimum ignition temperatures were 300 °C for pine needles and 290 °C for the May tall fescue/ pine needle mixture. In general, the four grasses seem to have the highest minimum ignition temperatures, but there is no clear correlation between the minimum ignition temperatures and the relative ordering of the ignition time curves.

Results of the heated plate ignition experiments with a low wind for the seven fuels are plotted in Figure 74. The data fall within a band and have a similar temperature dependence to those for the no wind case shown in Figure 73. A least squares curve fit to an exponential gave

$$t_{glowing,\,fit,low} = 106{,}000 \times e^{-0.0176 T_{heated\ plate}}, \qquad (3)$$

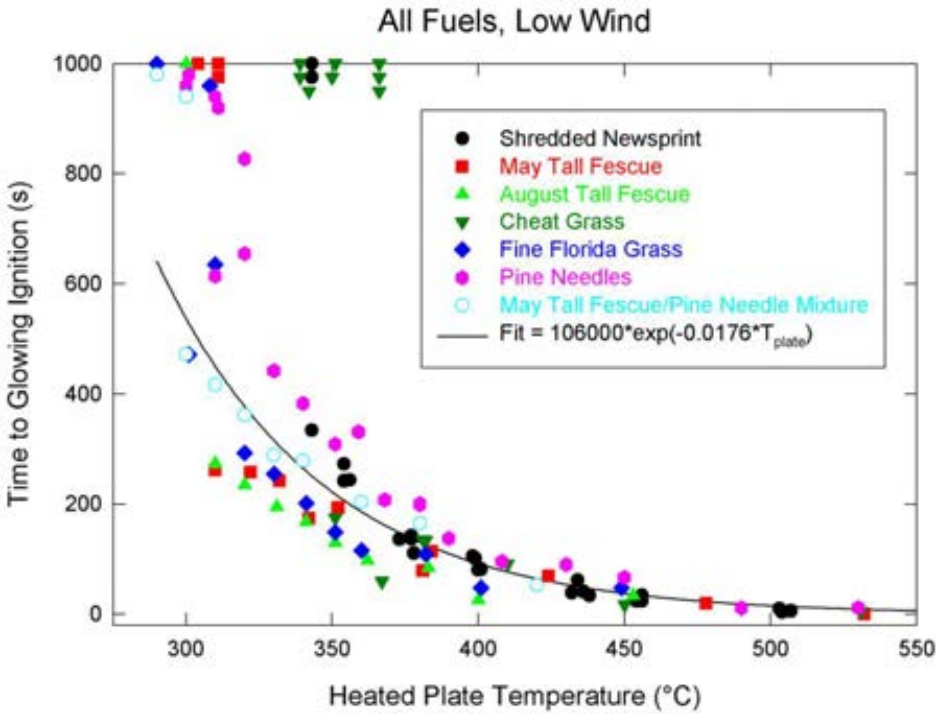

Figure 74. Data for time to glowing ignition with a low applied wind are plotted as a function of heated plate temperature for seven fuels. Data near the upper temperature axis represent experiments for which ignition did not take place. The solid curve is the result of a least squares fit assuming an exponential dependence on heated plate temperature for all data where ignition was observed.

and is shown as a solid curve in Figure 74. Similar to the no wind case, the data for individual fuels fall on bands with fluctuations that are smaller than the differences between the fuels.

As for the no wind case, the data lie fairly close together for heated plate temperatures greater than 400 °C and begin to diverge at lower temperatures. The data for May tall fescue, August tall fescue, and fine Florida grass are close together and lie below the curve fit. The results for the May tall fescue/pine needle mixture lie close to the calculated curve, while those for shredded newsprint and pine needles fall above. As for the no wind case, it is difficult to assess cheat grass because it did not ignite below 380 °C. The locations of the curves for the different fuels relative to the curve fit are similar to those for the no wind experiments, with the exception that the data for fine Florida grass lies somewhat closer to those for May tall fescue and August tall fescue.

Minimum heated plate ignition temperatures for cheat grass (380 °C), shredded newsprint (340 °C) pine needles (310 °C), and the May tall fescue/pine needle mixture (300 °C) were similar to those observed without an applied wind. May tall fescue, August tall fescue, and fine Florida grass each ignited for plate temperatures as low as 310 °C. For all three grasses this value is lower than observed without a wind present.

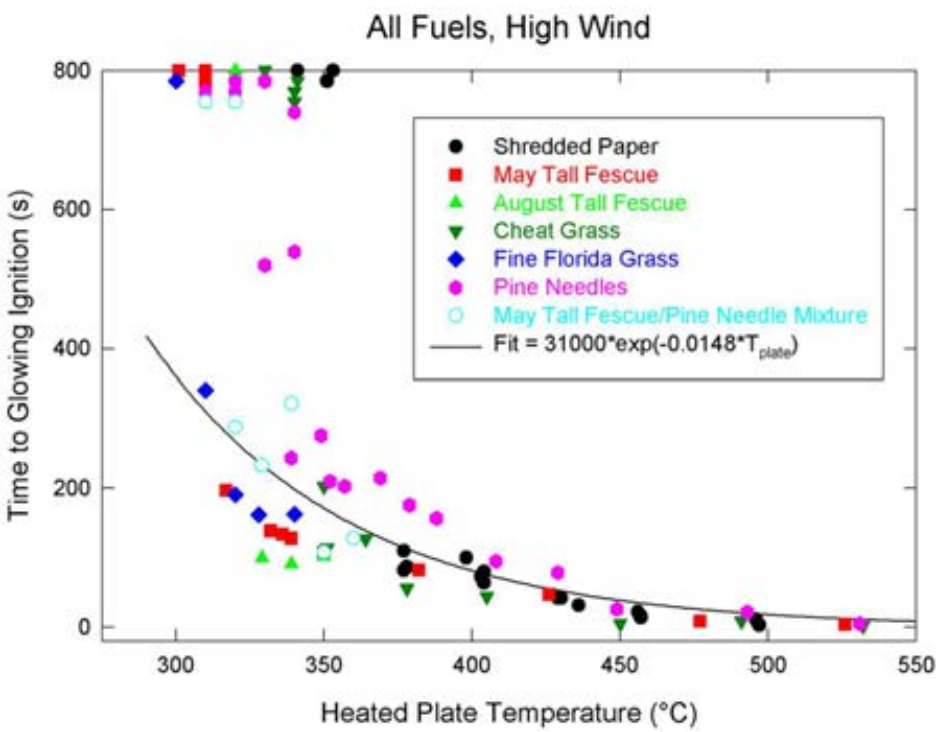

Figure 75. Data for time to glowing ignition with a high applied wind are plotted as a function of heated plate temperature for seven fuels. Data near the upper temperature axis represent experiments for which ignition did not take place. The solid curve is the result of a least squares fit assuming an exponential dependence on heated plate temperature for all data where ignition was observed.

A similar plot of ignition times versus heated plate temperature is shown in Figure 75 for experiments with a high wind. For some of the fuels fewer measurements were done than for the no and low wind cases, but the results follow similar trends. The variations with plate temperature are similar, and a least squares curve fit to an exponential for all of the data with ignition yields

$$t_{glowing,fit,high} = 310{,}000 \times e^{-0.0148 T_{heated\ plate}}, \tag{4}$$

which is shown in the figure as the solid curve.

As for the no wind and low wind cases, the data for individual fuels fall on well defined curves having smaller fluctuations than the variations between different fuels. The results for May tall fescue, August tall fescue, and fine Florida grass fall close together and lie below the curve. Unlike earlier experiments where the cheat grass did not ignite with a plate temperature below 380 °C, the lowest ignition temperature with a high wind was 350 °C. The data for the cheat grass fall close to the curve fit for all of the data, as do the measurements for the May tall fescue/pine needle mixture. As observed for the other two wind cases, longer ignition times were required for pine needles than indicated by the curve fit. It is not possible to assess the behavior of the shredded newsprint due to the gap of 30 °C between the lowest plate temperature where ignition was observed at 380 °C and the plate temperature where ignition did not occur.

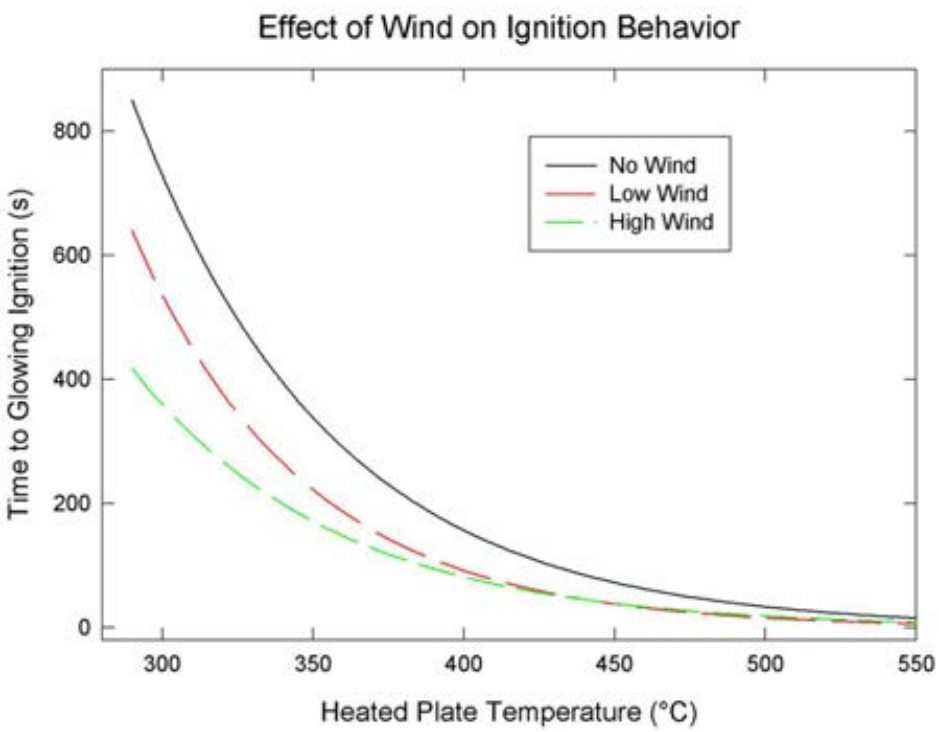

Figure 76. Results of exponential least squares curve fits of experimental ignition times as a function of heated plate temperature for seven fuels are shown for no wind, low wind, and high wind cases.

The highest value of minimum heated plate ignition temperature for these fuels was found for the shredded newsprint, lying between 380 °C and 360 °C. The next was the cheat grass with a minimum ignition temperature of 350 °C, which is about 30 °C lower than observed for this fuel with the other two wind conditions. The minimum ignition temperature for pine needles was 340 °C, but note that this material failed to ignite for some experiments at both 340 °C and 350 °C. The lowest minimum ignition temperatures for the three remaining grasses and the May tall fescue/pine needle mixture fell between 310 °C and 330 °C, with the fine Florida grass having the lowest value.

The data plotted in Figure 73 to Figure 75 show how ignition behaviors depend on the heated plate temperature and fuel for the porous beds studied here. Additional insights into the effects of wind are obtained by plotting the curve fits given by Equation (2) to Equation (4) on a common plot, as shown in Figure 76. It should be kept in mind that these curve fits are for seven fuels and that there were systematic variations in the data with fuel. Nonetheless, given the similarities in the spreads of data and the similar effects of fuel for the three wind cases, it seems appropirate to use these fits to characterize the effects of wind on surface ignition.

The feature that stands out in Figure 76 is the substantial reduction in ignition times with increasing wind speed for a given heated plate temperature. This effect is particularly pronounced over the lower portions of the temperature range. The dependence on wind is monotonic for the three conditions tested, suggesting that further reductions in ignition times would be likely at higher wind speeds. It should be noted that the two wind velocities used,

1.1 m/s and 2.5 m/s, correspond to 2.5 mph and 5.6 mph. These velocities are comparable to speeds at which OPE operate, and could be induced by equipment motion in still air. Outdoor winds are frequently considerably higher than these levels, so substantial additional reductions in ignition times might be possible for conditions typically encountered in outdoor environments.

The reductions in ignition time with increasing wind as well as qualitative observations concerning the ignition behavior such as initial ignition location and glowing intensity indicate that the primary effect of wind is to increase the amount of oxygen reaching the fuel surface. Since surface oxidation rates for temperatures high enough to generate meaningful reaction rates are generally limited by the rate at which oxygen reaches the surface, the effect is to accelerate the surface reaction rate and decrease the ignition times for both glowing and flaming ignition.

A wind effect that is not revealed by the results plotted in Figure 76 is the potential to convectively cool the fuel and thus slow or prevent ignition. Observed changes in the minimum plate temperatures required for ignition with wind speed and the distributions of blackening on the bottom of fuel beds that did not ignite in the presence of a wind provide evidence that convective cooling affected the surface reaction behavior of the porous fuel beds studied here. Presumably, the observed ignition behavior is determined by a balance of the competing effects of increased oxygen availability and convective cooling. The need to consider these competing effects should be kept in mind when extending the results of this study to wind conditions that were not investigated.

The non piloted thermal radiation ignition behaviors for four of the seven fuels investigated in detail using the heated plate were also studied with the cone calorimeter. Figure 77 shows plots of glowing or flaming ignition time versus AHF for shredded newsprint, May tall fescue, cheat grass, and pine needles. The data plotted near the upper axis represent experiments for which ignition was not observed.

The data for the different fuels fall on well defined curves which have a similar dependence on AHF to the ignition time variations observed with heated plated temperature (see Figure 73 to Figure 76). For the highest AHFs ignition occurs within a few seconds. As the AHF is reduced from the highest values there is a range where the ignition times increase slowly with decreasing AHF. With further reductions in AHF, a point is reached where the measured ignition times begin to rise rapidly. For pine needles the rapid rise begins around 30 kW/m^2 and for the remaining three fuels around 20 kW/m^2. The rate of increase with decreasing AHF is much higher for the three remaining fuels than for pine needles.

The data for the shredded newsprint, May tall fescue, and cheat grass fall close together. These three sets of data were combined, and a least squares fit to an exponential was obtained. The result,

$$t_{ignition,\,fit} = 5540 \times e^{-0.260\,AHF}\,, \tag{5}$$

is shown in Figure 77 as a solid line. The measurements for the three fuels fall close to the calculated curve.

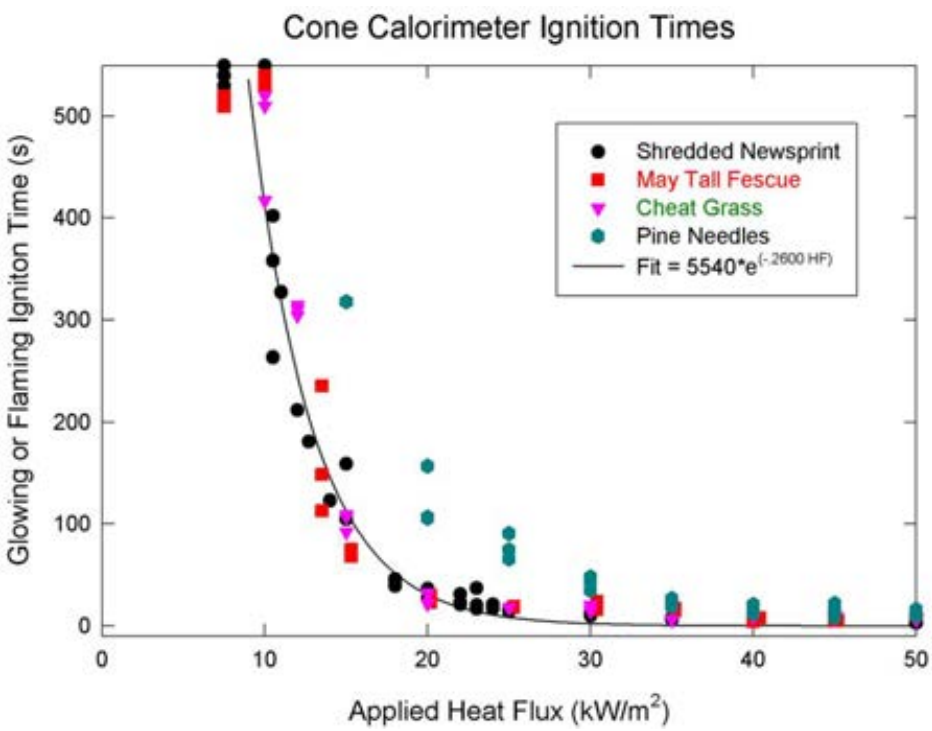

Figure 77. Ignition times due to non piloted radiative heating in the cone calorimeter are plotted as a function of applied heat flux for the four fuels indicated. The solid line shows the results of a least squares exponential curve fit to the combined data for shredded newsprint, May tall fescue, and cheat grass.

Due to the similarities in the response curves, it is worthwhile to consider whether the radiative ignition results can be related to those for the heated plate in some way. One approach is to compare effective temperatures for the radiant heat flux, determined by assuming the thermal radiation is generated by a black body, with corresponding heated plate temperatures. The radiative heat flux (RHF) from an ideal black body is given by

$$RHF = 5.67 \times 10^{-13} * T_{BB}^{4}, \tag{6}$$

where the *RHF* has units of kW/m^2 and T_{BB} is the black body temperature in K. Values of temperature derived from Equation (6) are plotted as a function of RHF in Figure 78.

The results in Figure 77 indicate that ignition did not occur for AHFs of 7.5 kW/m^2 and that the minimum AHF required to ignite smoldering was around 10 kW/m^2 for shredded newsprint, May tall fescue, and cheat grass. The corresponding black body temperatures for these AHFs are 330 °C and 375 °C. The minimum observed heated plate ignition temperatures for these fuels with no applied wind were 340 °C, 340 °C, and 380 °C. The close agreement between the minimum heated plate ignition temperatures and the black body temperature range over which radiative ignition no longer occurred suggests that the processes determining the minimum ignition conditions are similar for the two types of heating and that the fuel surfaces are being heated to comparable temperatures.

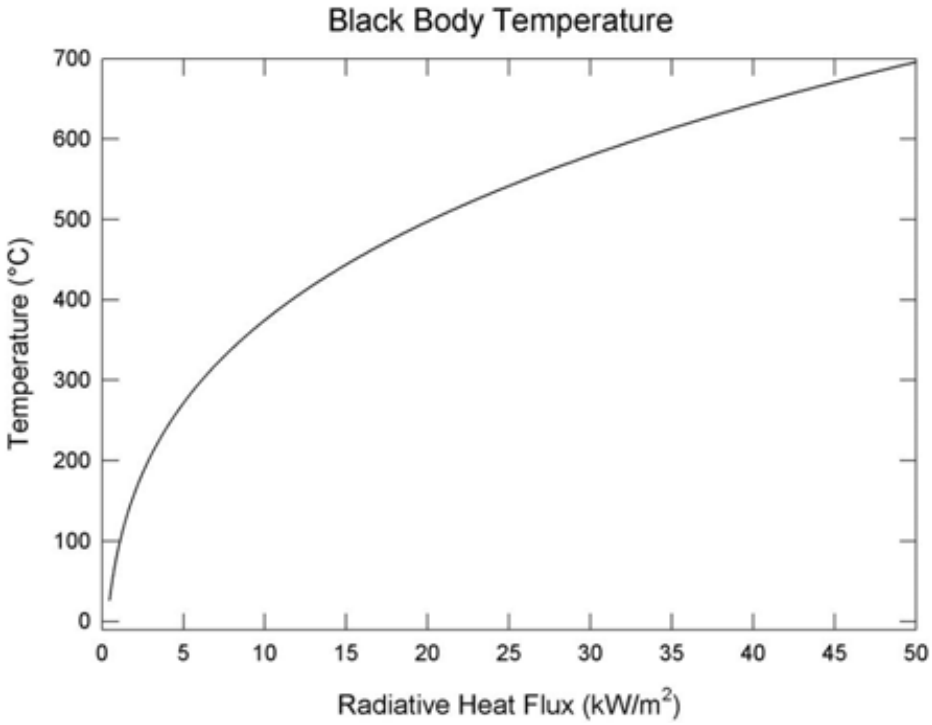

Figure 78. Temperatures are plotted as a function of radiative heat flux assuming that the flux is generated by an ideal black body.

The results in Figure 73 show that ignition times increased slowly with decreasing plate temperature between 550 °C and 450 °C and then began to increase more rapidly with an increasing slope as heated plate temperatures were lowered further. A similar change in slope occurs around 20 kW/m^2 for the time to ignition data in Figure 77. The black body temperature for 20 kW/m^2 is 498 °C. This temperature is somewhat higher than the 450 °C estimate from the heated plate experiments, but is close enough to support the conclusion that the response of these fuels to the two heating types is similar. This is particularly so when it is noted that differences in response should be expected based on configurational differences between the two experiments. The heated plate applied heat at the bottom of the fuel bed, and a buoyant plume, which entrained air through the sides of the fuel bed, was generated. This plume both heats fuel above the plate and provides additional oxygen for surface oxidation. On the other hand, in the cone calorimeter experiment the radiative heating was applied to the top of a fuel bed that was closed on the sides. In this case buoyancy-induced flow by heating near the top surface of the bed is expected to remove heat from the fuel bed, and the absence of air flow into the fuel bed from the sides results in a reduced surface oxidation rate compared to the heated plate experiments. Both of these effects are expected to lengthen ignition times.

The above discussion refers to the ignition behaviors of shredded newsprint, May tall fescue, and cheat grass. The agreement between experiments with the two types of heating is not as good when pine needles are considered. The radiative ignition times for this fuel began to increase around 30 kW/m^2. This corresponds to a black body temperature of 580 °C. Corresponding increases in ignition times for heated plate ignition did not appear until the plate temperature was reduced to around 450 °C. It has not been possible to provide an explanation for this difference.

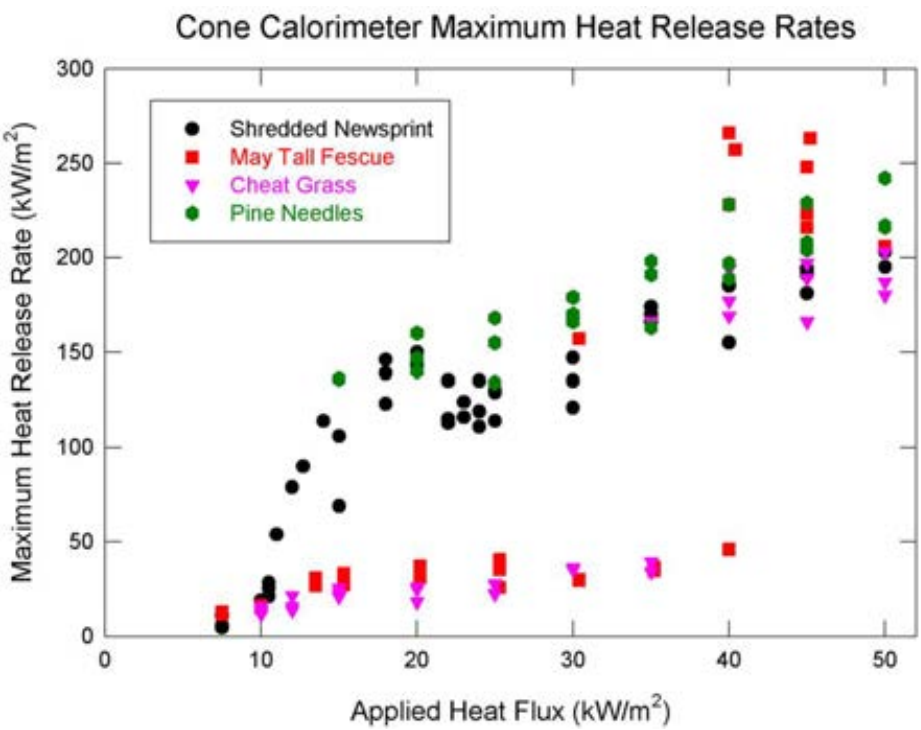

Figure 79. Values of maximum heat release rate are plotted as a function of applied heat flux for the four fuels indicated.

The behavior of maximum HRRs determined in the cone calorimeter experiments provide additional information concerning ignition behavior, particularly with respect to transition to flaming. Figure 79 shows combined plots of maximum HRRs versus AHF for shredded newsprint, May tall fescue, cheat grass, and pine needles. The high maximum HRRs indicate that flaming was ignited for all of these fuels with AHFs of 40 kW/m^2 and higher. At these high AHFs the maximum HRRs were around 200 kW/m^2 for each of the fuels.

As the AHF was reduced below 40 kW/m^2 the two grasses no longer flamed, and the observed HRRs dropped precipitously to values characteristic of smoldering. The corresponding black body temperature for an AHF of 40 kW/m^2 is 643 °C. This temperature is much higher than the highest heated plate temperatures used, thus the cone calorimeter results are consistent with the fact that transition to flaming was not observed on the heated plate for these two grasses when no wind was applied. Since smoldering was present at lower temperatures for both grasses, these results suggest that flammable mixtures of pyrolysis gases for these grasses are only generated when the fuels are subjected to high heating fluxes and/or high fuel surface temperatures.

In contrast to the grass behavior, transition to flaming was observed for the shredded newsprint and pine needles for AHFs as low 10 kW/m^2. This is consistent with the observations for the heated plate experiments, which showed that these two fuels transitioned to flaming in the absence of a wind whenever glowing was observed.

The transition to flaming behaviors of May tall fescue and cheat grass were very different in the presence of a wind, with transition observed for the cheat grass and not for the May tall fescue.

The cone calorimeter results provide no indication of this difference since the observed ignition behaviors and maximum HRRs were similar for both. This suggests that while radiative heat flux measurements can provide insights into smoldering and flaming behaviors for fuels placed on a heated surface when no wind is present, they do not differentiate ignition differences that appear due to the presence of a wind.

It is significant that similar differences in transition to flaming behavior were observed for the May tall fescue (did not flame) and August tall fescue (flamed) with wind present. These two samples were collected from the same location and likely consisted of the same type of grass (there is a possibility that more than one type of grass was present and grew at different rates, depending on conditions). Even so, the results indicate that ignition characteristics for grass samples from a given location can vary with seasonal changes.

The fact that flaming is observed for the May tall fescue and cheat grass with similar AHFs in the cone calorimeter does provide a clue as to the reason for their different flaming behaviors when placed on the heated plate in the presence of wind. The observations suggest that the temperatures developed on the fuel surfaces as a result of oxidation are higher for the cheat grass than for the May tall fescue.

The cone calorimeter results for polyurethane foam were different from those observed for the cellulosic fuels. No smoldering was observed, and the material either flamed or did not ignite. For AHFs of 30 kW/m^2 or greater the ignition times were less than 50 s, increasing to several hundred seconds for AHFs between 23 kW/m^2 and 25 kW/m^2. No ignition was observed with APHs of 22 kW/m^2. This value is much higher than the minimum AHFs that ignited smoldering in the cellulosic fuels. Two distinct burning periods with different HRR behaviors were observed in the HRR time histories for the polyurethane foam that were not characteristic of the other fuels. This was attributed to the formation of a liquid component during the foam burning followed by pool burning. The higher AHFs required for ignition and the burning behavior suggest that polyurethane foam placed in contact with or near a heated surface may not ignite as easily as shredded newsprint or the natural fuels that can smolder at lower temperatures.

As discussed in Section 2, only limited information is available in the literature for comparison with the results of this investigation. The most similar studies were those of Harrison [17] and Kaminski [18], who reported limited measurements of ignition times for natural fuels when placed in contact with variable temperature heated surfaces. Harrison reported that pine needles and grass ignited in about four minutes with surface temperatures of 400 °C and 350 °C, respectively. The effect of a light wind was to reduce the ignition time. With the exception of punky wood, which ignited in several hundred seconds for a surface temperature of 270 °C, Kaminski found that most of the fuels he investigated would ignite with surface temperatures between 300 °C and 330 °C. These results are comparable to those reported here. Cheat grass was reported as requiring 120 s for ignition at 330 °C. The current measurements (see Figure 51) indicated that cheat grass did not ignite at temperatures below 380 °C when a wind was not present.

Stockstad has reported the ignition behavior of small pieces of cheat grass [20], pine needles [21], and rotten wood [19] when exposed to heated air in an oven. Cheat grass ignition was

observed to require 7 s for a temperature of 380 °C, while pine needles required about 15 s for temperatures as low as 300 °C. These minimum ignition temperatures are in good agreement with values for the same fuels determined in the current study, but the observed ignition times are much shorter than those measured with the heated plate.

No previous experiments were identified in the literature with which the radiative heating results could be directly compared. White and coworkers have employed the cone calorimeter to investigate piloted ignition for a variety of natural fuels including cheat grass, but measurements have been made using only one or two AHFs. [24,25,26]

Manzello et al. investigated the ignition behavior of similar fuel beds, including shredded newsprint, grass, and pine needles, in the presence of light winds due to contact with one or more glowing fire brands placed on the top surface. [22,23] Their results indicated that shredded newsprint developed smoldering, grass did not smolder or flame, and pine needles developed smoldering and transitioned to flaming only with four large glowing brands applied and with the highest wind (1 m/s) used. These results suggest that glowing fire brands placed on top of a fuel bed are less likely to ignite smoldering or flaming than when similar fuels are placed on top of a heated plate. This is the case even though heated plate temperatures were likely much lower than the surface of a glowing fire brand.

The ignition behaviors of the cellulosic fuels investigated can be classified into two broad groups: pine needles and shredded newsprint which developed smoldering and transitioned to flaming when no wind was present and the grass samples which developed smoldering, but did not transition to flaming without an imposed wind. Note that the May tall fescue/pine needle mixture had ignition behaviors intermediate between these two extremes. It is not possible to definitely identify the reasons for these differences without careful characterization of the fuels and their response to heating. However, it is possible to provide a plausible explanation. Newsprint is known to consist primarily of cellulose, while the natural fuels contain varying proportions of cellulose and lignin (see the discussion in Section 2). As discussed earlier, fuels with high percentages of cellulose are more likely to flame, while fuels with higher percentages of lignin tend to smolder. This suggests that the shredded newsprint and pine needles investigated here tend to flame because they contain higher percentages of cellulose relative to lignin than the grasses that were studied.

It is possible that the different ignition behaviors of May tall fescue (limited transition to flaming) and August tall fescue (transitioned to flaming) in the presence of a wind are due to differences in the cellulose/lignin ratios for the two grasses, with a higher ratio of lignin in the rapidly growing spring grass, or to some other type of seasonal compositional difference.

The results of this investigation have demonstrated that smoldering and flaming ignition of cellulosic fuel beds exposed to conditions chosen to be representative of those generated on OPE heated exhausts vary with surface temperature, fuel type, wind, and season. In addition to these parameters, there are a number of others that would be expected to affect ignition behavior but were not varied in this study. One of these parameters is fuel moisture. The grasses and pine needles used in this investigation had measured fuel moisture percentages ranging from 10 % to 14 %. This narrow range is consistent with the expected values for these types of dry fuels

stored in a general purpose laboratory maintained near 20 °C. Such small variations are not expected to significantly affect ignition behavior. Much wider variations in fuel moisture are observed in nature, with higher values often present in living and recently cut vegetation and lower values found for dried vegetation located in higher temperature or low-humidity environments.

Babrauskas provides good reviews of the effects of moisture content on ignition behavior in general and for outdoor fuels in particular. [5] The primary effect of moisture content on cellulosic fuels is expected to be a lengthening of ignition times since a fraction of the heat applied to the fuel will be used to remove fuel moisture at the expense of heating the fuel. Once the fuel moisture has been removed, the fuel will begin to heat and eventually surface oxidation can become self sustaining.

Other important parameters not varied in the current investigation include fuel bed exposed surface area, fuel bed thickness, fuel bed porosity, spatial orientation of the heat source and the fuel bed, and the accessibility of the interior of a fuel bed to an applied wind. The potential for changes in ignition behavior due to these fuel bed properties must be kept in mind when using the findings of this investigation to assess the potential for ignition of fuels by heated surfaces.

Even though the findings of this investigation are subject to the limitations discussed above, it is possible to derive some guidance with regard to ignition behaviors expected for heated exhaust surfaces of OPE. The results indicate that ignition of natural fuels can occur for heated surface temperatures as low as 290 °C. All of the cellulosic fuels studied had lower limit ignition temperatures for some wind conditions that were within 50 °C of this value. In general, these lower limits are in good agreement with the value of 320 °C recommended by Ford as being representative of the lower ignition temperature for natural fuels. [15]

The temperature-ignition time curves observed in this study are likely to be important when considering potential scenarios involving ignition of fuels by contact with or radiation from heated surfaces. Several minutes were required for ignition (either glowing or flaming) near the lower limit temperatures for all of the fuels investigated. However, when temperatures were increased by 100 °C or AHFs by 10 kW/m^2, these times dropped to tens of seconds and became very short when heated plate temperatures or AHFs were increased further.

While clearly not representative of the worst possible cases, the ignition time curve fits to heated plate temperatures given by Equation (2) to Equation (4) should be useful for estimating times to ignition for general cellulosic porous fuel beds brought into contact with heated surfaces having a temperature range of 290 °C to 550 °C. In order to provide a safety factor, the calculated ignition times for a given surface temperature could be reduced by a factor of 2. It would also be appropriate to consider the calculated ignition times to be the periods required for flaming to develop, even though in many cases only glowing combustion would occur. Additional reductions in calculated ignition times would be prudent if winds higher than 2.5 m/s are considered likely.

The experimental findings suggest there is a correlation between the temperature dependence of ignition on the heated plate and black body temperatures corresponding to AHFs used for the

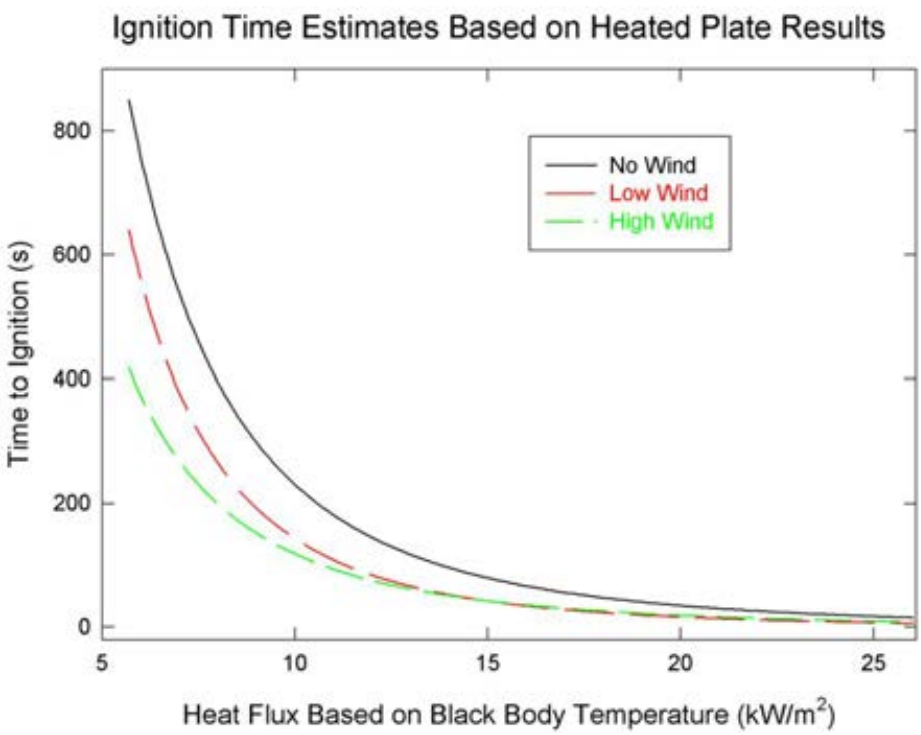

Figure 80. The curve fit times to ignition for no wind, low wind, and high wind shown in Figure 76 are plotted as a function of the AHF calculated for the radiative heat flux from a black body held at the heated plate temperature.

radiative ignition experiments. For the fuel beds and heating configurations studied, the calculated black body temperatures were slightly higher for the lowest ignition temperature and the locations of the knees in plots of ignition time versus heated plate temperature and AHF. As noted, these differences are in the direction expected based on the different fuel bed holders and directions of heat application for the two experiments.

A reasonable approach for estimating ignition times for cellulosic fuels subjected to a radiative heat flux is to use the time/temperature curves for heated surface ignition, and convert the heated plate temperatures to AHFs assuming black body thermal radiation. Figure 80 shows the results. The curve for the no wind case has a similar appearance to those determined in the radiative ignition experiments. There are no experimental data for the effects of wind on the ignition of radiatively heated fuel beds. However, given the similarities of the no wind cases, it is reasonable to expect that the effects of applying winds are captured correctly.

The determination of the ignition time/temperature and ignition time/applied heat flux relationships for cellulosic fuels was time consuming due to the large number of measurements required. It should be possible to learn a great deal concerning fuel effects with many less experiments at a single temperature. Based on the results of the experiments reported here, an appropriate plate temperatures for such tests would be 380 °C, with experiments run with and without an applied wind. Such experiments would provide relative indications for the propensity of fuels to smolder and flame in the absence of a wind along with an indication of the effects of wind on these ignition behaviors.

The experimental systems developed for this investigation have proven useful for the purpose of characterizing the ignition of cellulosic fuels. There are a number of improvements that could be made to the heated plate system. Perhaps the most important would be the use of a computer controlled system for maintaining a constant plate temperature while automatically recording the plate temperature. It would also be possible to record the currents required to maintain a constant temperature. Qualitative observations indicate that this measurement would provide insights into whether or not endothermic or exothermic processes were taking place as well as an indication for the amounts of heat generated during surface oxidation. The development of such a system should be straight forward and would alleviate the need to carefully review video tapes in order to record the temperatures.

The current findings show that HRRs from the cone calorimeter provide information concerning smoldering and flaming of these fuels when subjected to radiative heat fluxes. The time behavior of the HRR provides a good indication for when ignition occurs. Due to the configuration, it is difficult to visually observe when glowing combustion develops within the fuel bed. It would be useful to modify the cone calorimeter in a way that would allow improved detection of the onset of glowing combustion.

In order to provide higher confidence in the findings of this investigation it would be useful to make similar measurements for a wider variety of fuels. In particular it would be useful to consider a wider variety of grasses and to include various types of leaves. It would also be important to characterize the role of such parameters as fuel moisture and fuel bed density, porosity, and thickness that were not varied.

The types of studies reported here could serve as the basis for a much improved understanding of the ignition behaviors of cellulosic fuels. It should be possible to correlate fuel composition (e.g., cellulose to lignin ratio) with ignition behavior. It would be also worthwhile to examine the possibility that small scale heating experiments such as differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA), which record the response of small samples to heating, correlate with the fuel bed ignition behaviors since surface reactions appear to play such large roles.

6. Acknowledgements

Many people contributed to the success of this effort. Funding was provided by The International Consortium for Fire Safety, Health, and the Environment (ICFSHE) with financial oversight by Karen Suhr. Technical oversight was provided by Petra Andersson and Margaret Simonson of SP Technical Research Institute of Sweden.

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The heated plate was designed and assembled at BFRL/NIST. Bill Grosshandler provided the design and Mike Selepak, Michael Smith, and Ed Hnetkovsky ordered parts, did required machining, and assembled the plate.

All experiments in the cone calorimeter were performed at BFRL/NIST by Michael Smith, who did an excellent job.

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APPENDIX G-2

V-22 Downwash Memo

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BELL BOEING

THE TILTROTOR TEAM

INTEROFFICE MEMO

9 December 2008
IOM 81:ATC:atc:3770

To: R. Slaughter
Copies to: BHTI: R. Bryson, J. Narramore, B. Roberts, T. Trept
BH: J. Liu

From: A. Cummings

Re: Hover Outwash Profile Comparison of V-22, CH-46A, CH-53E

References: (1) NAWCADPAX--98-88-RTR "V-22 ROTOR DOWNWASH SURVEY" R. E. Lake and W. J. Clark.
(2) Boeing-Vertol Memo 8-7442-1-103 Rev A"Horizontal Component of Downwash from a CH46A Helicopter in Hover" D.L. Bierly, 23 Jan 1968.
(3) V-22 NATOPS Manual.

A request from NAVFAC was received from the ILS Group at Bell Helicopter regarding downwash and outwash from the rotor of the V-22 in hover. This request supports an environmental impact trade study of deploying the V-22 to the California area. Temperature information was provided by D. Loe in the Propulsions group. This memo borrows information from several sources and compares several other aircraft outwash profiles.

An example of NATOPS data is shown below in Figure 1. The data is primarily focused on a 45,000 lb aircraft hovering at 20 ft AGL. Data collected in 1998 on the V-22 by NAVAIR is plotted in detail in the 98-88 report. The focus of this report concerned impact to personnel near the aircraft. The V-22 data was compared to the CH-53K. The plots are shown below Figure 2.

Historical data of the CH-46A is presented in Memo 8-7442-1-103 for a 19,000 lb aircraft hovering at 40 ft AGL. This data was scaled according to the plots in the memo from 40 ft AGL to 20 ft AGL based on momentum theory. The nose and tail dynamic pressure at 20 ft AGL is 80% of the value of the dynamic pressure at the nose and tail at 40 ft AGL. The complete map of dynamic pressure at 40 ft AGL was scaled by 80% in order to compare to the V-22. The resultant velocity comparison for the V-22 and the CH-46A is shown below in Figure 3. The V-22 contours were traced from figures in the 98-88 report.

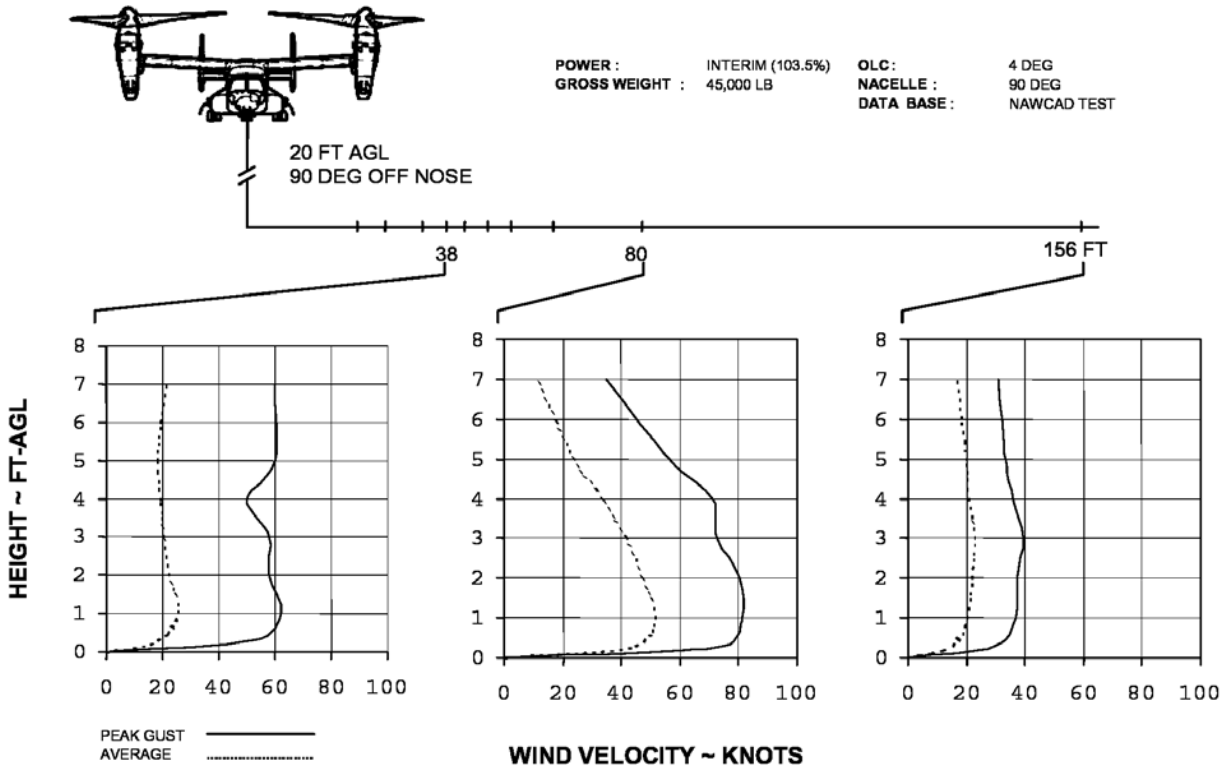


Figure 1. A selection of data from Figure 11-6 in the MV-22 NATOPS manual for downwash profile.

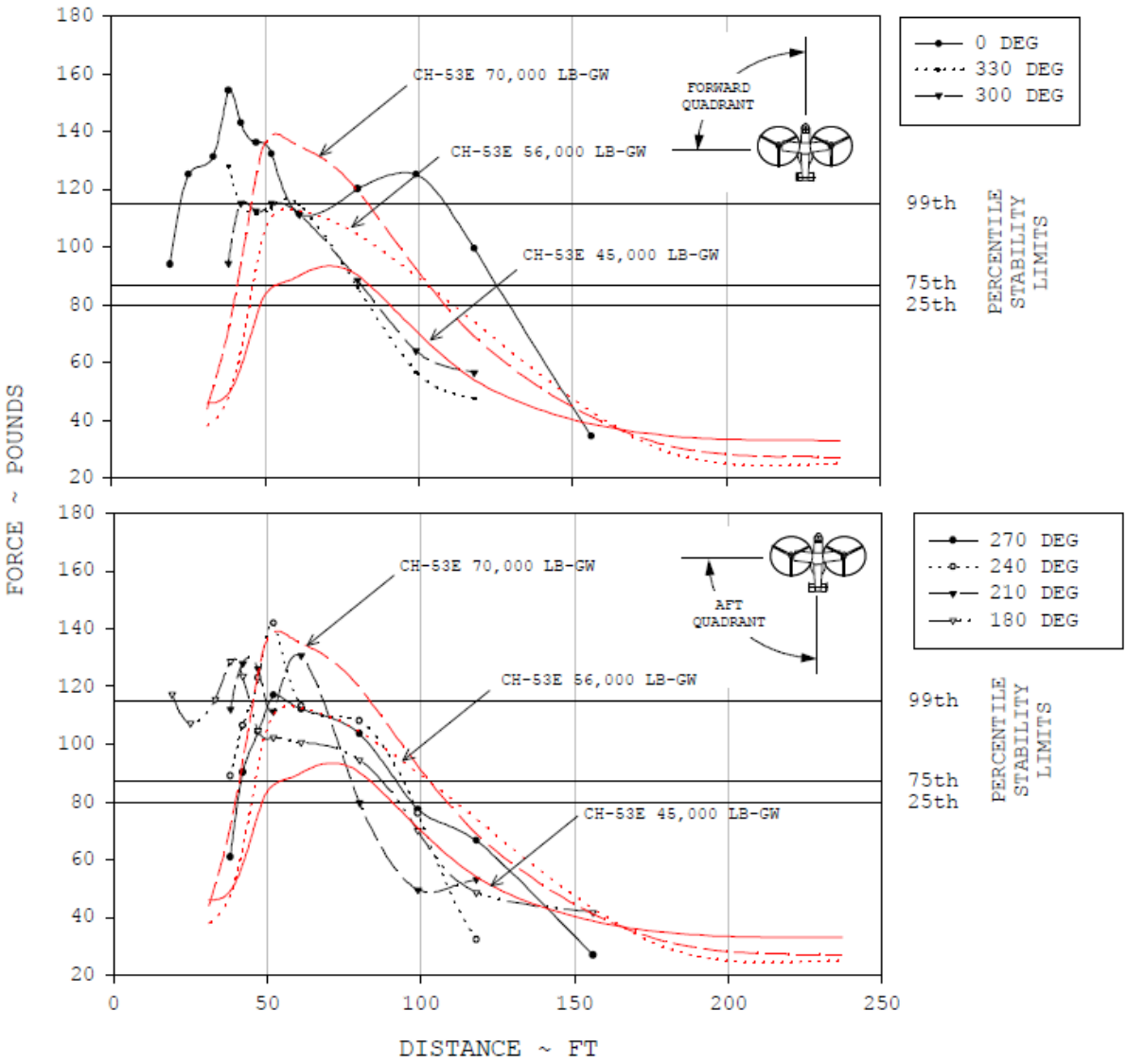


Figure 2. Comparison of CH-53E helicopter and the V-22 tiltrotor aircraft peak downwash wind forces plotted as a function of distance.

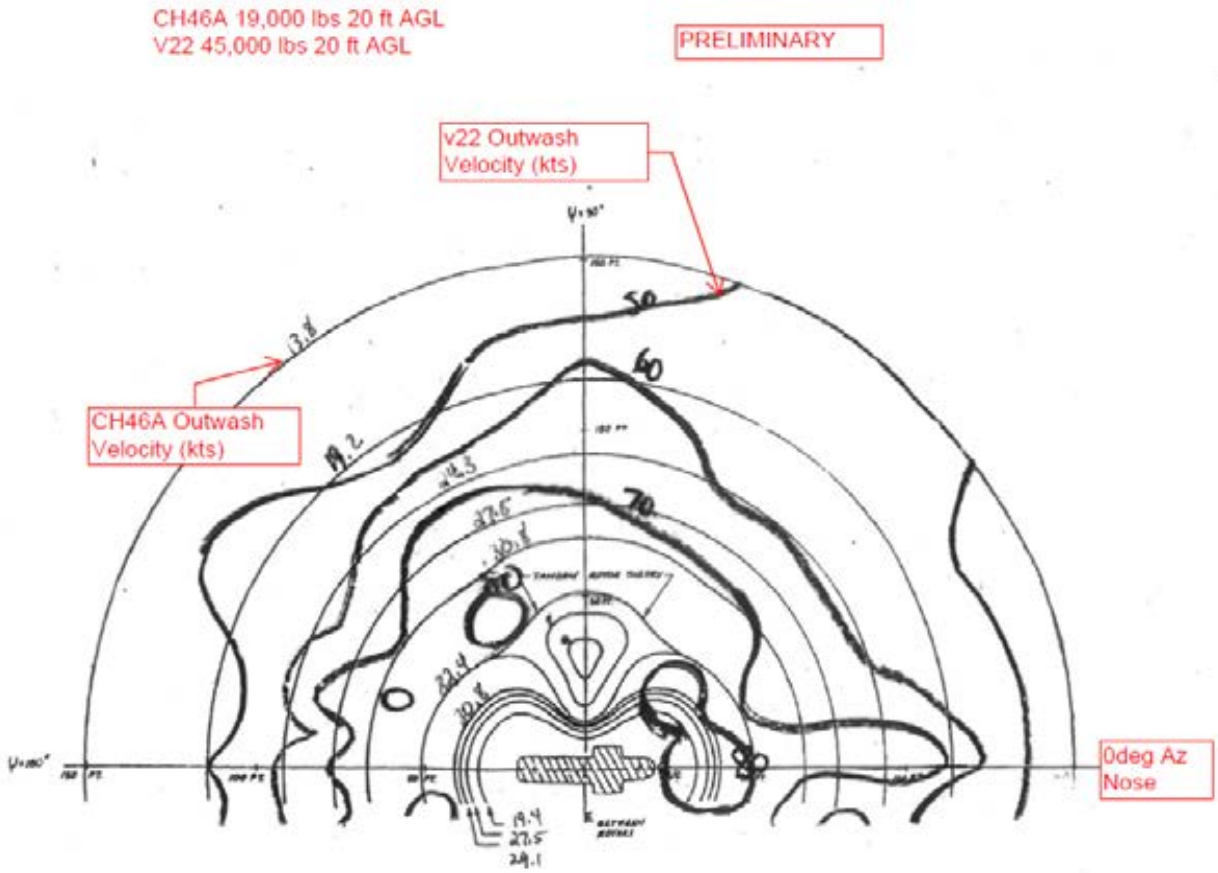


Figure 3. Outwash velocity comparison for scaled CH-46A and V-22 at 20 ft AGL.

Please direct any questions to the undersigned.

Antonette T. Cummings
V-22 Aerodynamics
817-280-8397
Bell Helicopter, Ft Worth

BOEING-VERTOL INTER-OFFICE MEMORANDUM

REVISED: 23 January 1968
Date: ~~10 May 1967~~
Ref: 8-7442-1-103
From: C. E. Kolesar
REVISION A - From: D. L. Bierly

To: D. Brandt P32-76

DOWNWASH

Subject: Horizontal Component of Downwash From a CH-46A Helicopter in Hover.

Reference: (a) Hiller Aircraft Corporation Report #60-15

(b) Dynasciences TRECOM Report No. DCR-39, dated August 1964.

Enclosures: (1) CH-46A Hovering Downwash Dynamic Pressure Map.

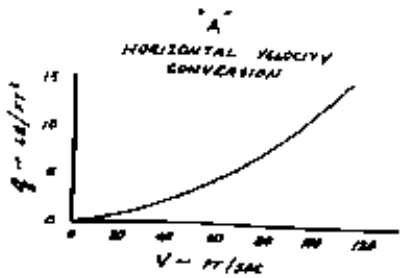
(2) CH-46A Downwash Distribution (wheel height = 20 ft.)

(3) CH-46A Downwash Distribution (wheel height = 40 ft.)

(4) CH-46A Downwash Distribution (wheel height = 87 ft.)

Enclosure 1 presents the horizontal component of downwash dynamic pressure, "q", for a CH-46A helicopter, gross weight = 19000 lbs. in a hover at 40 foot wheel height. The dynamic pressure shown is the maximum; i.e. at one foot above the ground. At 5 feet above the ground, the dynamic pressure is approximately 50% of the values shown. The conversion from "q", pounds per square foot, to V, horizontal velocity in feet per second, is found in Curve "A". A correction factor to be applied to the "q" values on the contour plot when operating at gross weights other than 19000 lbs. is found in Curve "B". The shape and position of the contours remain the same for different gross weights, only the value of "q" changes.

Enclosures 2, 3 and 4 present the horizontal component of downwash dynamic pressure for azimuth positions of $\Psi = 0°$, 90°, 180° and 270° for wheel heights of 20, 40 and 50 feet respectively. The random rotor theory portion of each curve was derived from test data [illegible] in reference [illegible] single rotor theory is valid for downwash [illegible]

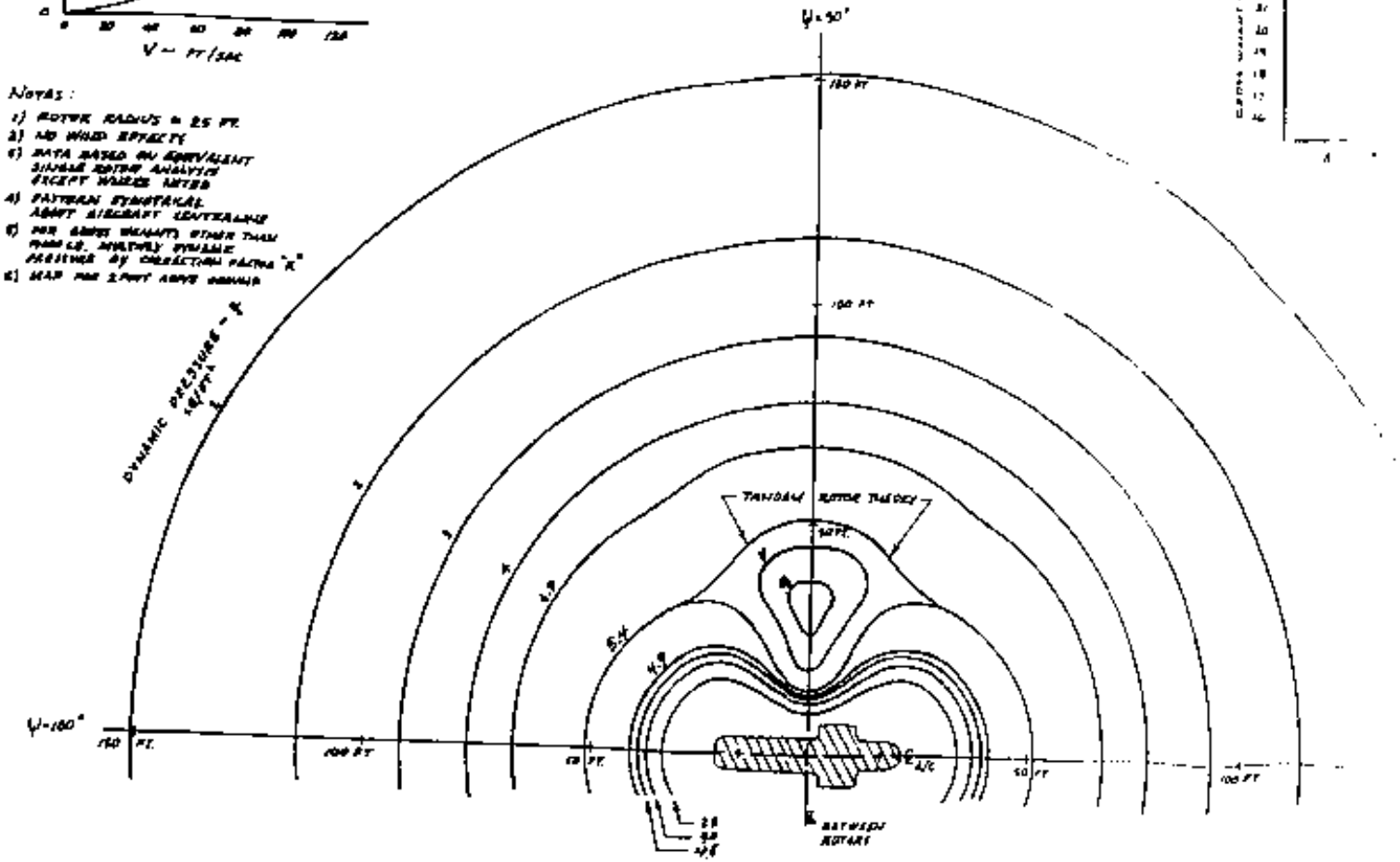


Notes:

1) ROTOR RADIUS = 25 FT.
2) NO WIND EFFECTS
3) DATA BASED ON EQUIVALENT SINGLE ROTOR ANALYSIS EXCEPT WAKES MERGED
4) PATTERN SYMMETRICAL ABOUT AIRCRAFT CENTERLINE
5) FOR GROSS WEIGHTS OTHER THAN 19000 LB, MULTIPLY DYNAMIC PRESSURE BY CORRECTION FACTOR "K"
6) MAP FOR 2 FOOT ABOVE GROUND

CH-46A HOVERING DOWNWASH DYNAMIC PRESSURE MAP

HOVER GROSS WEIGHT ~ 19000 LB
40 FT WHEEL HEIGHT



R. Stanislau 5/8/67

and consists of replacing the tandem rotor with an equivalent single rotor with the same disc loading and area. For $\psi = 90°$ and 270° a transition region exists between tandem and single rotor theory. To date, this region is relatively undefined and at best can only be approximately as shown. The dynamic pressures shown are for 1 foot above the ground. At 5 feet above the ground, the values of "q" are about 50% of those shown. Curves "A" and "B" of enclosure 1 also apply to enclosures 2, 3 and 4.

C. E. Kolesar
Prod. Aero. Unit Chief
X 2252

R.A.S./bvd

NOTE:

The enclosures contained herein are intended to give approximate values of the maximum dynamic pressure, and as such are not to be used for the placement of either personnel or equipment.

D. L. Bierly
CH-46 '107 Projects Aerodynamics
[illegible]

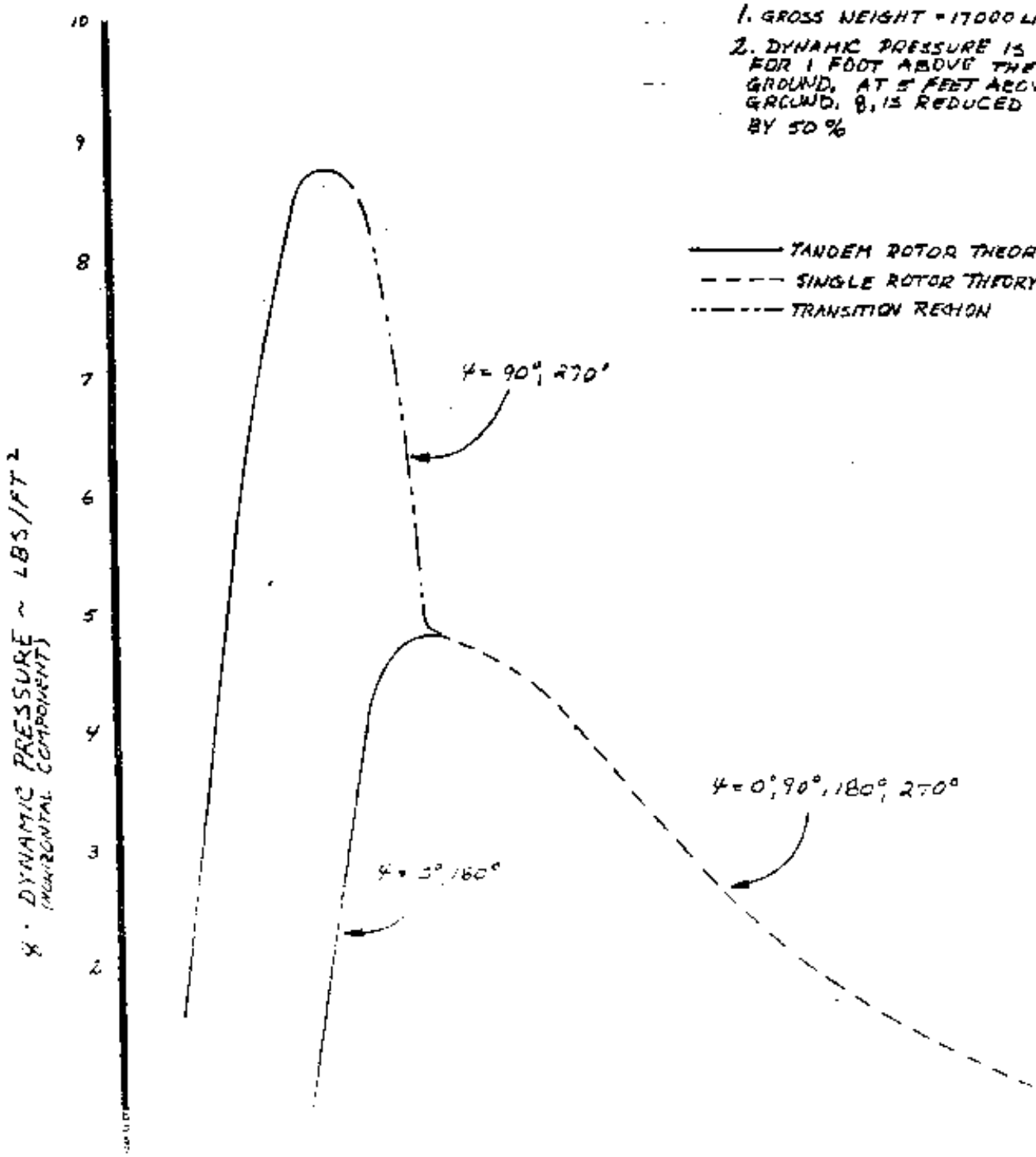
CH-47LA DOWNWASH DISTRIBUTION

ENCLOSURE 2

WHEEL HEIGHT = 20 FEET

NOTES:

1. GROSS WEIGHT = 17000 LBS.
2. DYNAMIC PRESSURE IS FOR 1 FOOT ABOVE THE GROUND. AT 5 FEET ABOVE GROUND, q_1 IS REDUCED BY 50%



Z. BIRELY 1-23-68

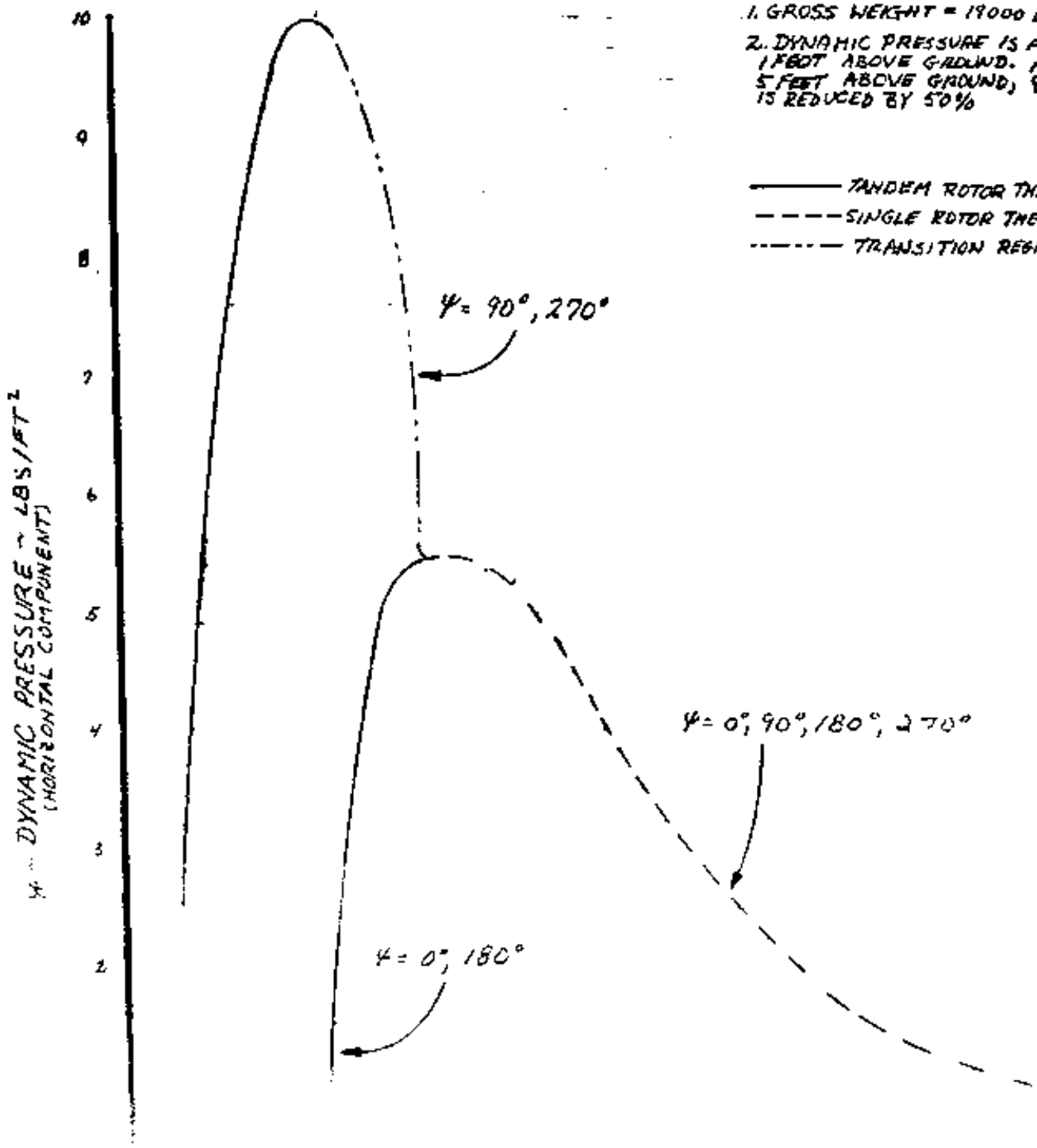
CH-46A DOWNWASH DISTRIBUTION

ENCLOSURE 3

WHEEL HEIGHT = 40 FEET

NOTES:

1. GROSS WEIGHT = 19000 LBS.
2. DYNAMIC PRESSURE IS FOR 1 FOOT ABOVE GROUND. AT 5 FEET ABOVE GROUND, Q IS REDUCED BY 50%



D Bierly 1-23-68

FEET

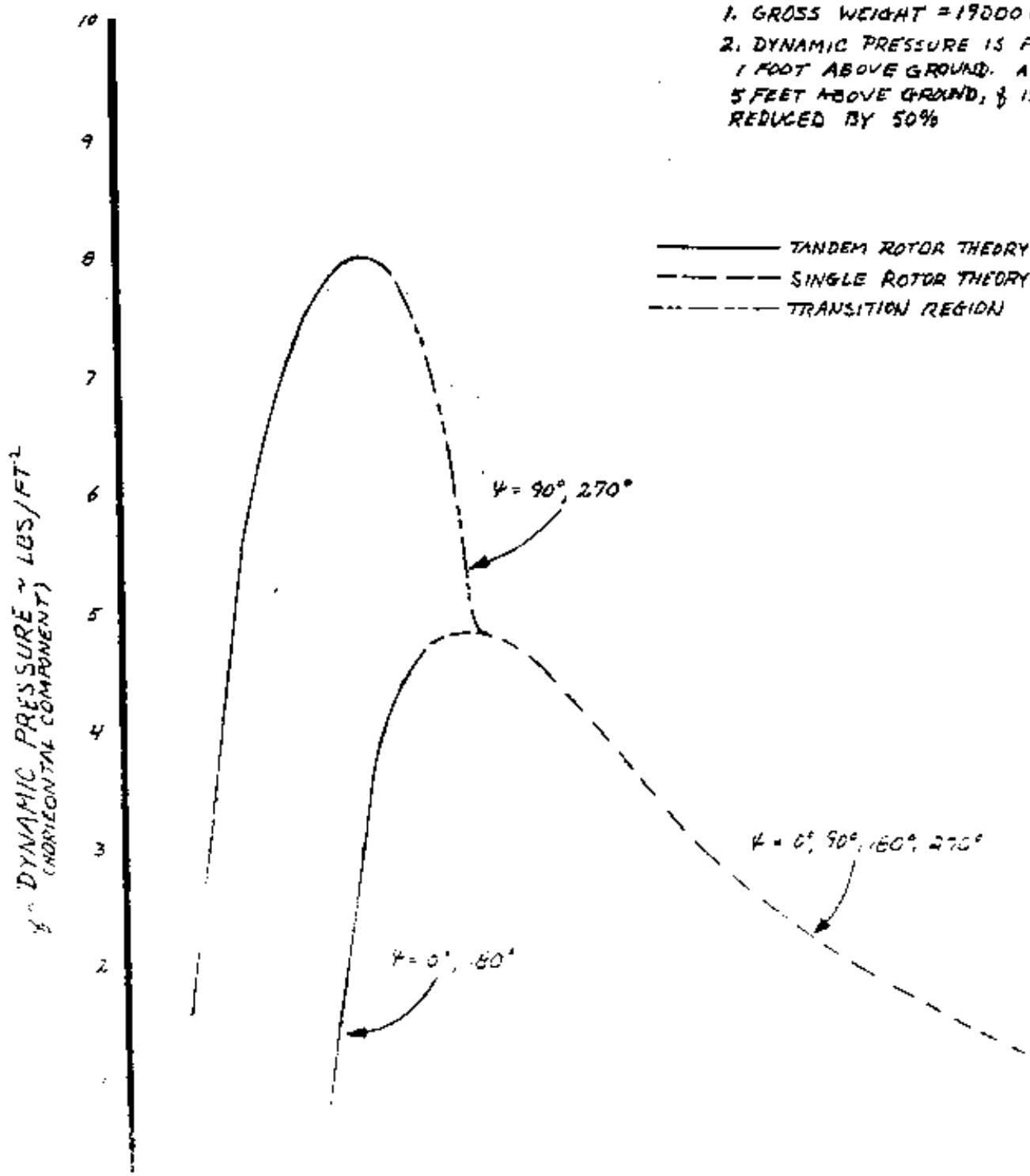
CH-46A DOWNWASH DISTRIBUTION

ENCLOSURE 4

WHEEL HEIGHT = 87 FEET

NOTES:

1. GROSS WEIGHT = 19000 LBS
2. DYNAMIC PRESSURE IS FOR 1 FOOT ABOVE GROUND. AT 5 FEET ABOVE GROUND, $\bar{q}$ IS REDUCED BY 50%



D. BIERLY 1-23-68

APPENDIX H

Agency Correspondence

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APPENDIX H-1

United States Fish and Wildlife Service

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UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS WEST
BOX 555200
CAMP PENDLETON, CALIFORNIA 92055 5200

IN REPLY REFER TO
5090
ENVSEC
October 2, 2008

Dr. Benjamin Tuggle
Regional Director
Southwest Regional Office
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, NM 87103-1306

HAS BEEN SENT
OCT 7 2008

Dear Dr. Tuggle:

SUBJECT: CONSULTATION IN SUPPORT OF THE MV-22 HOMEBASING ENVIRONMENTAL IMPACT STATEMENT FOR THE U.S. MARINE CORPS

Marine Corps Installations West (MCIWEST) is preparing for formal consultation with the U.S. Fish and Wildlife Service (USFWS) for the MV-22 Osprey (aircraft) Homebasing project, pursuant to Section 7 of the Endangered Species Act, as amended. The consultation is necessary to support fielding of the MV-22 and the development of an Environmental Impact Statement being prepared in compliance with the National Environmental Policy Act. The proposed action involves MV-22 basing and operations on MCIWEST installations and live-fire ranges located in California and Arizona (Figure 1). Therefore, MCIWEST seeks early coordination with your office and your Region 8 counterpart to identify the most efficient and effective means to accomplish the upcoming formal consultation. Early coordination goals include identifying a USFWS lead office and point of contact and establishing a regional USFWS consultation team.

The MV-22 is the replacement for the less-capable, 1960s-vintage CH-46 medium-lift helicopter. The MV-22 utilizes tilt rotor technology to provide the maneuverability and lift of a helicopter and, in the fixed-wing mode, has the ability to fly twice as fast, four times as far, and carry twice the combat load of the CH-46. The purpose of the project is to determine the basing location(s) for MV-22 squadrons providing medium-lift support for Marine Corps active duty and reserve requirements on the West Coast. The Marine Corps seeks to base the MV-22 where it can best support the military training mission while making use of existing facilities to the greatest extent practicable. The proposed action will base up to ten MV-22 Osprey squadrons on the West Coast replacing eight CH-46 medium-lift helicopter squadrons and one CH-53 heavy-lift helicopter squadron. The MV-22 will conduct training, readiness, and special exercise operations within controlled airspace and on training ranges used historically by the aircraft being replaced.

The proposed MV-22 squadrons may be based at a single installation or split between two aviation facilities. Basing installations under consideration are Marine Corps Air Station (MCAS) Miramar, MCAS Camp Pendleton, and MCAS Yuma (Figure 1). Facility requirements necessitate the construction or renovation of airfield facilities, including appropriate hangar space, aircraft apron parking, and other related facilities (e.g., aircraft wash racks, fuel storage).

Additionally, the MV-22 will operate at Marine Corps Base (MCB) Camp Pendleton, Chocolate Mountain Aerial Bombing and Gunnery Range, Barry M. Goldwater Range (West), R-2510 (airspace), R-2512 (airspace), and Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms (Figure 1). The MV-22 will use existing landing sites at the four installations and no new construction is proposed other than those facility requirements mentioned above.

A Biological Assessment is being prepared to support the consultation on the potential effects to the 24 federally threatened or endangered species that are known to inhabit MCIWEST installations and ranges and that may be affected by MV-22 operations (Table 1).

TABLE 1. FEDERALLY-LISTED THREATENED AND ENDANGERED SPECIES (BY INSTALLATION)

Species Common Name	MCAS Miramar	MCAS Yuma[2]	MCB Camp Pendleton[1]	MCAGCC 29 Palms
1. San Diego Mesa Mint	X			
2. San Diego Button Celery	X		X	
3. Spreading Navarretia	X		X	
4. California Orcutt's Grass	X			
5. Del Mar Manzanita	X			
6. Willowy Monardella	X			
7. San Diego Fairy Shrimp	X		X	
8. Riverside Fairy Shrimp	X		X	
9. California Gnatcatcher	X		X	
10. Least Bell's Vireo	X		X	
11. California Brown Pelican			X	
12. California Least Tern			X	
13. Light-footed Clapper Rail			X	
14. Southwestern Willow Flycatcher			X	
15. Western Snowy Plover			X	
16. Bald Eagle (desert DPS)			X	
17. Pacific Pocket Mouse			X	
18. Stephens' Kangaroo Rat			X	
19. Southern Steelhead Trout			X	
20. Tidewater Goby			X	
21. Arroyo Toad			X	
22. Thread-leaved Brodiaea			X	
23. Desert Tortoise		X		X
24. Sonoran Pronghorn Antelope		X		
25. Lesser Long-nosed Bat		X		

[1]- Includes all listed species that occur on MCAS Camp Pendleton.
[2]- Includes all listed species that occur on Chocolate Mountain Aerial Bombing and Gunnery Range and Barry M. Goldwater Range.

5090
ENVSEC
October 2, 2008

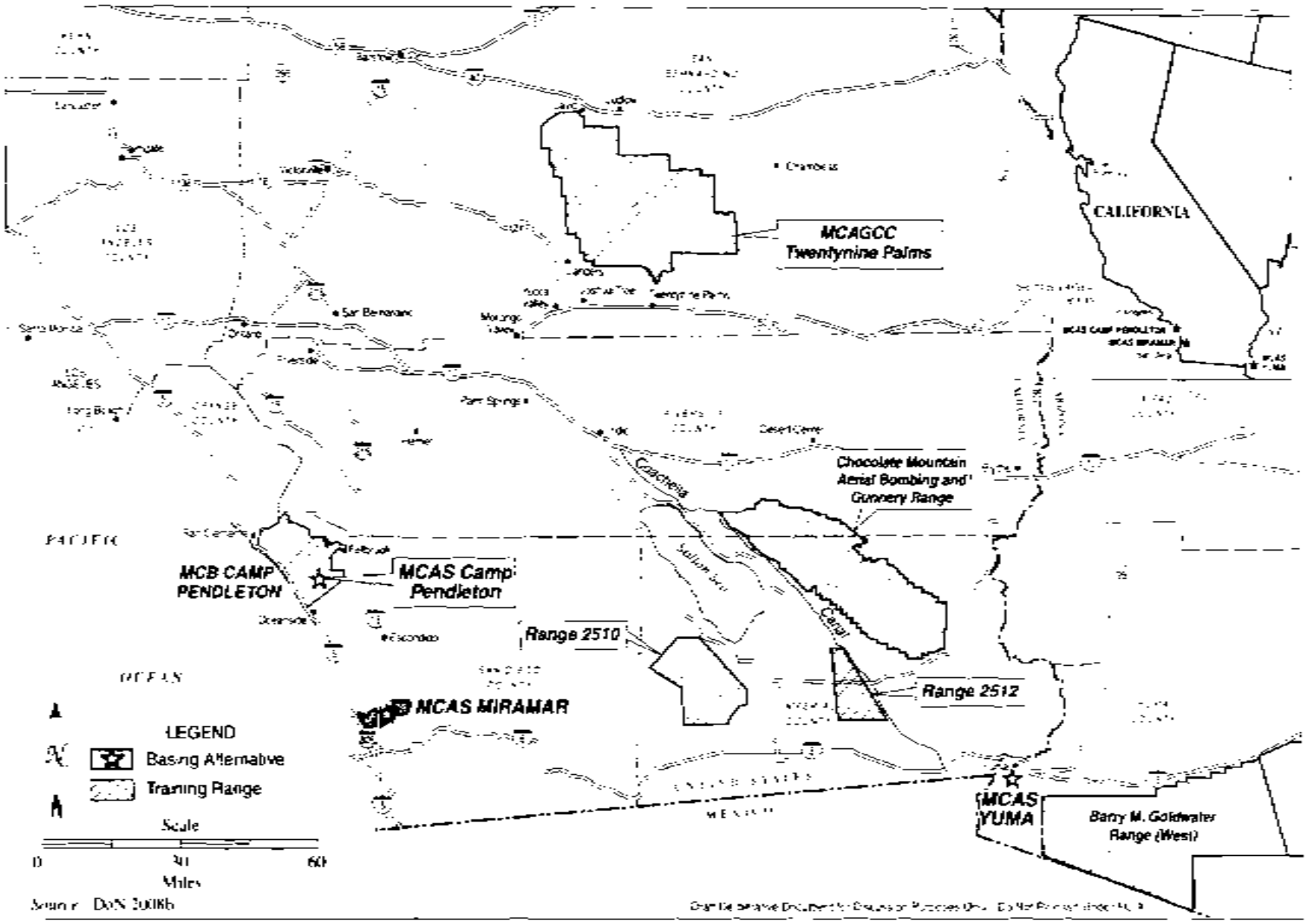
As stated above, we request designation of a lead office to coordinate the preparation of the relevant Biological Opinion and associated consultation dialogue. We solicit and welcome any suggestions that will facilitate an efficient and cooperative approach to this regional consultation. Thank you for your attention to this matter. If you have any questions concerning this project please do not hesitate to contact me at (760) 725-3561, or my project lead Mr. Zak Likins; he can be reached at (760) 763-6976 or zachery.likins@usmc.mil.

Sincerely,

L. E. ARMAS
Head, MCIWEST Environmental Security Branch
By direction of the Commanding General

Enclosure: 1. Figure 1

Copy to:
CMC (LFL), Attn: Ms. Mary Hassell
Regional Director, Region 8, USFWS, Sacramento
Field Supervisor, Carlsbad Field Office
Field Supervisor, Ventura Field Office
Field Supervisor, Phoenix Field Office



Source: DoN 2008b

Location of Basing Alternatives and Proposed Training Ranges for the MV-22

FIGURE

1

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS WEST
BOX 555200
CAMP PENDLETON, CALIFORNIA 92055-5200

IN REPLY REFER TO
5090
ENVSEC
October 2, 2008

BEEN SENT

OCT 07 2008

Mr. Ren Lohoefener
Regional Director
Region 8
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W-206
Sacramento, CA 95825

Attention: Ms. Vicki L. Campbell, Deputy Division Chief, Section 7, HC
EC and Forest Resources, Ecological Services

Dear Mr. Lohoefener:

SUBJECT: CONSULTATION IN SUPPORT OF THE MV-22 HOMEBASING ENVIRONMENTAL IMPACT STATEMENT FOR THE U.S. MARINE CORPS

Marine Corps Installations West (MCIWEST) is preparing for formal consultation with the U.S. Fish and Wildlife Service (USFWS) for the MV-22 Osprey (aircraft) Homebasing project, pursuant to Section 7 of the Endangered Species Act, as amended. The consultation is necessary to support fielding of the MV-22 and the development of an Environmental Impact Statement being prepared in compliance with the National Environmental Policy Act. The proposed action involves MV-22 basing and operations on MCIWEST installations and live-fire ranges located in California and Arizona (Figure 1). Because these sites fall within the areas of responsibility for two USFWS regions and three field offices, MCIWEST seeks early coordination with your office and your Southwest Regional Office counterpart to identify the most efficient and effective means to accomplish the upcoming formal consultation. Early coordination goals include identifying a USFWS lead office and point of contact and establishing a regional USFWS consultation team.

The MV-22 is the replacement for the less-capable, 1960s-vintage CH-46 medium-lift helicopter. The MV-22 utilizes tilt rotor technology to provide the maneuverability and lift of a helicopter and, in the fixed-wing mode, has the ability to fly twice as fast, four times as far, and carry twice the combat load of the CH-46. The purpose of the project is to determine the basing location(s) for MV-22 squadrons providing medium-lift support for Marine Corps active duty and reserve requirements on the West Coast. The Marine Corps seeks to base the MV-22 where it can best support the military training mission while making use of existing facilities to the greatest extent practicable. The proposed action will base up to ten MV-22 Osprey squadrons on the West Coast replacing eight CH-46 medium-lift helicopter squadrons and one CH-53 heavy-lift helicopter squadron. The MV-22 will conduct training, readiness, and special exercise operations within controlled airspace and on training ranges used historically by the aircraft being replaced.

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A Biological Assessment is being prepared to support the consultation on the potential effects to the 24 federally threatened or endangered species that are known to inhabit MCIWEST installations and ranges and that may be affected by MV-22 operations (Table 1).

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7. San Diego Fairy Shrimp	X		X	
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9. California Gnatcatcher	X		X	
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11. California Brown Pelican			X	
12. California Least Tern			X	
13. Light-footed Clapper Rail			X	
14. Southwestern Willow Flycatcher			X	
15. Western Snowy Plover			X	
16. Bald Eagle (desert DPS)			X	
17. Pacific Pocket Mouse			X	
18. Stephens' Kangaroo Rat			X	
19. Southern Steelhead Trout			X	
20. Tidewater Goby			X	
21. Arroyo Toad			X	
22. Thread-leaved Brodiaea			X	
23. Desert Tortoise		X		X

Species Common Name	MCAS Miramar	MCAS Yuma[2]	MCB Camp Pendleton[1]	MCAGCC 29 Palms
24. Sonoran Pronghorn Antelope		X		
25. Lesser Long-nosed Bat		X		

[1]- Includes all listed species that occur on MCAS Camp Pendleton.
[2]- Includes all listed species that occur on Chocolate Mountain Aerial Bombing and Gunnery Range and Barry M. Goldwater Range.

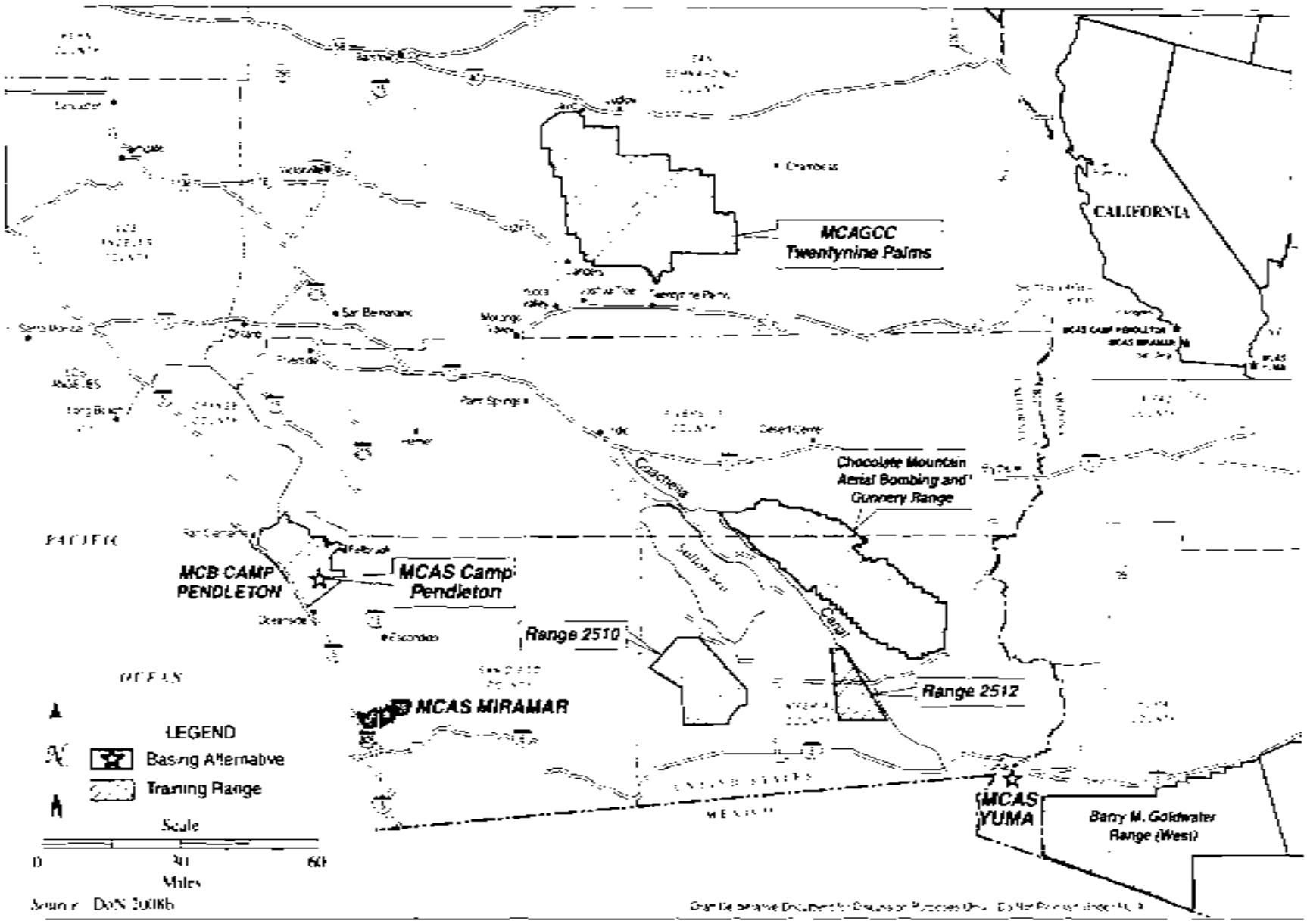
As stated above, we request designation of a lead office to coordinate the preparation of the relevant Biological Opinion and associated consultation dialogue. We solicit and welcome any suggestions that will facilitate an efficient and cooperative approach to this regional consultation. Thank you for your attention to this matter. If you have any questions concerning this project please do not hesitate to contact me at (760) 725-3561, or my project lead Mr. Zak Likins; he can be reached at (760) 763-6976 or zachery.likins@usmc.mil.

Sincerely,

L. E. ARMAS
Head, MCIWEST Environmental Security Branch
By direction of the Commanding General

Enclosure: 1. Figure 1

Copy to:
CMC (LFL), Attn: Ms. Mary Hassell
Regional Director, Southwest Region, USFWS, Albuquerque
Field Supervisor, Carlsbad Field Office
Field Supervisor, Ventura Field Office
Field Supervisor, Phoenix Field Office



Source: DoN 2008b

Location of Basing Alternatives and Proposed Training Ranges for the MV-22

FIGURE

1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, California 92011

In Reply Refer To:
FWS-MCBCP-08B0678-09TA0859

JUL 30 2009

Mr. S. W. Norquist
Marine Corps Installations West
United States Marine Corps
Box 555200
Camp Pendleton, California 92055-5200

Subject: Initiation of Formal Section 7 Consultation for the West Coast Basing of the MV-22 and Training Project, Marine Corps Base Camp Pendleton and Marine Corps Air Stations Pendleton and Miramar, San Diego County, California; Marine Corps Air Ground Combat Center, San Bernardino County, California; and the Bob Stump Training Range Complex, Riverside and Imperial Counties, California, and Yuma County, Arizona

Dear Mr. Norquist:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) receipt of your letter (5090 ENVSEC) on June 1, 2009, requesting initiation of formal consultation pursuant to section 7 of the Endangered Species Act of 1973 (Act), as amended, regarding the proposed project (Project); West Coast Basing of the MV-22, including training, readiness, and special exercises operations as identified below. A final biological assessment (BA) describing the Project and its potential effects on federally listed species was also received on June 1, 2009. Basing and training activities are proposed to occur at Marine Corps Base Camp Pendleton (MCBCP) and Marine Corps Air Stations (MCAS) Pendleton and Miramar, San Diego County, California; Marine Corps Air Ground Combat Center (MCAGCC), San Bernardino County, California; the Bob Stump Training Range Complex, which includes Ranges 2510 and 2512 and the Chocolate Mountain Aerial Bombing and Gunnery Range in Riverside and Imperial Counties, California, and the Barry M. Goldwater Range (BMGR) in Yuma County, Arizona; as well as various Military Training Routes (MTRs) between these locations. We have assigned project number FWS-MCBCP-08B0678 to this consultation. Please refer to this number in any future correspondence on this consultation.

TAKE PRIDE IN AMERICA

Species subject to formal consultation

Your letter indicated that the Project is likely to adversely affect the federally endangered San Diego fairy shrimp (*Branchinecta sandiegonensis*) through direct impacts associated with Project construction at MCAS Miramar. The BA also concluded that the Project may adversely affect the federally endangered Riverside fairy shrimp (*Streptocephalus woottoni*) at MCBCP and the Sonoran pronghorn (*Antilocapra americana sonoriensis*) at BMGR.

The BA further concluded that the project was not likely to adversely affect the federally threatened coastal California gnatcatcher (*Polioptila californica californica*) or the federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*), least Bell's vireo (*Vireo bellii pusillus*), and the lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*). However, based on our preliminary analysis and discussions between our respective staff, we agreed to proceed with formal consultation to address potential adverse effects associated with noise and rotorwash to these species at MCBCP and BMGR.

For Sonoran pronghorn and lesser long-nosed bat, our consultation will address consistency with the Marine Corps' existing Ongoing Activities by the Marine Corps Air Station –Yuma Biological Opinion (22410-1995-F-0114-R005) and will be processed as a reinitiation of that BO from the Service's Tucson field office. For vireo and flycatcher, consultation will address consistency of the proposed project with the MCBCP's existing Riparian and Estuarine/Beach Ecosystems Biological Opinion (1-6-95-F-02, "Riparian BO").

Species for which potential effects have been fully addressed through previous consultations

The BA concluded that the Project will not adversely affect a variety of coastal bird species including the federally endangered California brown pelican (*Pelecanus occidentalis*), light-footed clapper rail (*Rallus longirostris levipes*), and California least tern (*Sternula antillarum browni*), and the federally threatened western snowy plover (*Charadrius alexandrinus nivosus*). Although we believe that these bird species may be adversely affected by the noise and sight of MV-22 aircraft flying over their foraging and nesting sites, these effects have been fully addressed under the Riparian BO. The same avoidance and minimization measures will apply to MV-22 aircraft flying over coastal areas as apply to existing aircraft, and the disturbance associated with use of the MV-22 aircraft is anticipated to be similar or less than disturbance associated with use of existing aircraft, including the CH-46 helicopter, which the MV-22 will be replacing. Furthermore, proposed landing zones are at least 300 meters from identified nesting sites for these species. Therefore, no further consultation regarding these federally listed coastal bird species is necessary unless new information becomes available or the project description changes.

The federally threatened desert tortoise (*Gopherus agassizii*) occurs within the Chocolate Mountains and at MCAGCC. The final BA indicated that the MV-22 training may affect the species due to habitat degradation from downwash or fire, and as a result of noise; however, the Marine Corps has determined that the potential for adverse effects to the desert tortoise are so

low as to be insignificant and discountable, and therefore the proposed action may affect but is not likely to adversely affect the desert tortoise. The Service's Ventura field office concurs with this determination for MCAGCC. In addition, training activities on MCAGCC already occur, and their effects on the desert tortoise have been addressed through formal consultation (see biological opinions 1-8-99-F-41 and 1-8-05-F-31). These consultations led to the implementation of avoidance and minimization measures that will be implemented in association with use of the MV-22 aircraft and will further reduce the potential for adverse effects on the desert tortoise from the MV-22 activities at MCAGCC. This rationale also applies to activities potentially affecting desert tortoise in the Chocolate Mountains (see biological opinion 1-6-95-F-40).

Species not likely to be adversely affected

Based on information in the final BA, we concur that the Project will not adversely affect the following plant species: the federally endangered San Diego button celery (*Eryngium aristulatum* var. *parishii*), willowy monardella (*Monardella viminea*), and the federally threatened thread-leaved brodiaea (*Brodiaea filifolia*) and spreading navarretia (*Navarretia fossalis*). These plants are either not present within the Project area, or Project impacts would not result in plant mortality. In addition, you concluded that the project will not affect California Orcutt grass (*Orcuttia californica*) and San Diego mesa mint (*Pogogyne abramsii*).

Further, we concur that with implementation of the avoidance and minimization measures proposed in the BA, the Project may affect, but is not likely to adversely affect, the following animal species: federally endangered tidewater goby (*Eucyclogobiurs newberryi*), arroyo toad (*Bufo californicus*), Stephens' kangaroo rat (*Dipodomys stephensii*), and Pacific pocket mouse (*Perognathus longimembris pacificus*).

The BA concludes that the project is not likely to adversely affect the federally endangered peninsular bighorn sheep (*Ovis Canadensis nelsoni*, "sheep") or its designated critical habitat. While designated critical habitat for sheep exists in Range 2510, this project does not include any land use of this area and only proposes flights over the range. Because no physical modification of the habitat would occur as part of the action and because sheep have not been observed in this area, we concur that this project is not likely to adversely affect the sheep or adversely modify designated critical habitat.

The Service's Ventura field office concurs that the bird species addressed in the BA that occur at MCAGCC (western snowy plover, California brown pelican, southwestern willow flycatcher, and least Bell's vireo) are not likely to be adversely affected at MCAGCC.

Additional guidance

The BA concludes that the federally endangered southern steelhead (*Oncorhynchus mykiss*) is not likely to be adversely affected. Please contact the National Marine Fisheries Service to consult on potential effects of the Project on southern steelhead.

Summary

In summary, the Carlsbad Fish and Wildlife Office will proceed with consultation for Riverside and San Diego fairy shrimp, coastal California gnatcatcher, least Bell's vireo, and southwestern willow flycatcher. The Tucson Fish and Wildlife Office will proceed with consultation for the Sonoran pronghorn and lesser long-nosed bat. There are no species that are anticipated to be adversely affected within the jurisdiction of the Ventura Fish and Wildlife Office.

Please note that our concurrence that the project is not likely to adversely affect many of the species identified above is dependent on information provided in the BA that the MV-22 is highly unlikely to start fires. If use of the MV-22 results in any fires in the areas addressed by this consultation, we recommend that the Marine Corps reinitiate consultation to address potential effects of fire on federally listed species resulting from use of the MV-22.

Section 7 allows the Service up to 90 calendar days to conclude formal consultation with your agency and an additional 45 calendar days to prepare our biological opinion (unless we mutually agree to an extension). Therefore, we expect to provide you with our biological opinion no later than October 14, 2009. We look forward to working with you and the Ventura and Tucson field offices during the consultation process to ensure that impacts to listed species are avoided and minimized to the maximum extent practicable through project design and an effective monitoring program.

As a reminder, the Act requires that after initiation of formal consultation, the Federal action agency make no irreversible or irretrievable commitment of resources that limits future options. This practice insures that agency actions do not preclude the formulation or implementation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

If you have any questions regarding this letter, please contact Marci Koski from the Carlsbad Fish and Wildlife Office at (760) 431-9440 extension 304, Rick Farris from the Ventura Fish and Wildlife Office at (805) 644-1766 extension 316, or Erin Fernandez from the Tucson Fish and Wildlife Office at (520) 670-6150.

Sincerely,

for Karen A. Goebel
Assistant Field Supervisor

cc:
Ms. Erin Fernandez, Arizona Ecological Services Field Office
Mr. Rick Farris, Ventura Field Office

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, California 92011

In Reply Refer To:
FWS-MCBCP-08B0678-09F0860

October 7, 2009

Mr. S. W. Norquist
Marine Corps Installations West
United States Marine Corps
Box 555200
Camp Pendleton, California 92055-5200

Attention: Mr. Zachery Likins

Subject: **DRAFT** Formal Section 7 Consultation for the West Coast Basing of the MV-22 and Training Project in Southern California and Southwestern Arizona

Dear Mr. Norquist:

This document transmits our draft biological opinion based on our review of the proposed West Coast Basing of the MV-22 Osprey tilt-rotor aircraft (MV-22) and its use in training on Marine Corps Base Camp Pendleton (MCBCP), Marine Corps Air Station Camp Pendleton (MCASCP) and Marine Corps Air Station Miramar (Miramar), San Diego County, California; Marine Corps Air Ground Combat Center (MCAGCC), San Bernardino County, California; and the Bob Stump Training Range Complex (BSTRC), Riverside and Imperial Counties, California, and Yuma County, Arizona, and its effects on the federally endangered San Diego fairy shrimp (*Branchinecta sandiegonensis*, "SDFS") and Riverside fairy shrimp (*Streptocephalus woottoni*, "RFS") and the federally threatened coastal California gnatcatcher (*Polioptila californica californica*, "gnatcatcher") in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*). Potential effects to the federally endangered least Bell's vireo (*Vireo bellii pusillus*, "vireo") and southwestern willow flycatcher (*Empidonax traillii extimus*, "flycatcher") are addressed through a consistency analysis with *Biological Opinion for Programmatic Activities and Conservation Plans in Riparian and Estuarine/Beach Ecosystems on Marine Corps Base, Camp Pendleton* ("Riparian BO"; 1-6-95-F-02), as described below. Potential effects to the federally endangered Sonoran pronghorn (*Antilocapra americana sonoriensis*, "pronghorn") and lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*, "bat") are being addressed by the Tucson Fish and Wildlife Office, which is currently analyzing the project's consistency with the existing programmatic biological opinion addressing training activities at the Barry M. Goldwater Range (BMGR; part of the BSTRC) in Yuma County, Arizona. If the project is determined to be consistent with the Tucson Fish and Wildlife Office's existing programmatic biological opinion, the consistency analysis will be attached as an appendix to the final version of this biological opinion.

TAKE PRIDE IN AMERICA

This biological opinion is based on information provided in the *Final Biological Assessment, West Coast Basing of the MV-22* (BA) included with your letter requesting initiation of formal consultation on this project (5090 ENVSEC, received June 1, 2009), site visits on August 27 and September 15, 2009, and correspondence, notes and information compiled during the course of our consultation with the U.S. Marine Corps (USMC) on the subject project. This information and other references cited in this biological opinion constitute the best available scientific information on the status and biology of the species considered. The complete project file for this consultation is maintained at the Carlsbad Fish and Wildlife Office (CFWO).

Consultation History

We received your letter to initiate formal consultation and the associated BA on June 1, 2009. The BA analyzed effects of the proposed action on 24 federally listed species (BA, Table V-9) occurring on five USMC installations in California and Arizona. In the BA you determined that the proposed project is likely to adversely affect SDFS, RFS and the pronghorn, but is not likely to adversely affect the other 21 species analyzed. In our June 30, 2009, response (FWS-MCBCP-08B0678-09TA0859) to your letter, we concurred with your determination that the proposed action is likely to adversely affect SDFS, RFS, and pronghorn. Based on discussions between our respective staffs, we agreed that the proposed action is also likely to adversely affect the gnatcatcher, the vireo, the flycatcher, and bat. Furthermore, our letter stated that the effects of the proposed action on the remaining 17 species are either addressed through previous consultations, or are not likely to adversely affect those species.

As described in our June 30, 2009, letter adverse affects to SDFS are likely to occur on both MCBCP and Miramar; adverse affects to RFS, gnatcatchers, vireos and flycatchers are likely to be limited to MCBCP; and adverse affects to pronghorns and bats will be limited to the BMGR in Yuma County, Arizona. This biological opinion addresses the effects of the proposed action on SDFS, RFS, gnatcatchers, vireos, and flycatchers on MCBCP and Miramar. Potential effects to the pronghorn and bat are being addressed by the Tucson Fish and Wildlife Office, which is currently analyzing the project's consistency with the existing programmatic biological opinion addressing training activities at the Barry M. Goldwater Range (BMGR; part of the BSTRC) in Yuma County, Arizona. If the project is determined to be consistent with the Tucson Fish and Wildlife Office's existing programmatic biological opinion, the consistency analysis will be attached as an appendix to the final version of this biological opinion.

Details of the consultation prior to your June 1 initiation letter are described in the BA (Section I.3). Our respective staff exchanged electronic correspondence and conducted phone conversations between June 1, 2009, and October 7, 2009, and conducted site visits on August 27 and September 15, 2009, to clarify specific details of the proposed action.

Consistency with the MCBCP Programmatic Biological Opinion.

The Riparian BO (1-6-95-F-02) evaluated the effects of routine helicopter operations on both vireos and flycatchers on MCBCP. Although the use of the MV-22 on MCBCP was not evaluated in the Riparian BO, the MV-22 is intended to replace an existing helicopter (the CH-46E) that was addressed by the Riparian BO. As part of this consultation, the USMC has stated that all programmatic instructions (i.e., avoidance and minimization measures) within the Riparian BO that are applicable to helicopter operations will be applicable to operation of the MV-22.

The noise generated by the MV-22 is generally similar to the CH-46E that it will replace (BA, Table V-1), except that it will generate slightly less noise while cruising and slightly more noise while landing and taking off. Overall, there is likely to be little difference in the effects of MV-22 noise on vireos and flycatchers from the effects of CH-46E noise, which were analyzed under the Riparian BO.

Outwash (i.e., horizontal wind velocity) generated by the MV-22 on landings and takeoffs will be substantially greater than that generated by the CH-46E (BA, p. V-4), but outwash is likely to attenuate rapidly with decreasing distance from the landing site; the difference in outwash generated by the two vehicles is likely to be negligible beyond 90 meters (m) (300 feet [ft]) from the landing point (BA, Appendix A-2). Despite the potential for the MV-22 to disturb vireos, flycatchers, or their nests in the vicinity of the landing area, only seven of the proposed landing sites (Cal Sites 1, 4, and 23; LZ 62; PAD 2; DZ Papa 3 and DZ Tank Park) are within 90 m (300 ft) of areas occupied by vireos and flycatchers. Additionally, these seven sites will experience a net reduction of 96 percent in annual operations (i.e., to 72 annual MV-22 operations versus 2112 annual CH-46E operations) under the proposed action. Therefore, these sites will experience slightly greater disturbance from MV-22 outwash, but dramatically less frequently than experienced during past CH-46E operations. Due to the dramatically lowered frequency of MV-22 operations near vireo and flycatchers, it is likely that the effects of the proposed action are lower than that anticipated for the CH-46E under the Riparian BO.

The USMC has evaluated the potential for MV-22 operations to ignite wildfires and has determined that the MV-22 is unlikely to increase the number of wildfires started on MCBCP (BA, section V.3.2). Therefore, we will not further evaluate the potential for the MV-22 to ignite wildfires. If operation of the MV-22 is found to cause wildfires in the future, the USMC has stated that it will reinitiate consultation with the Service to evaluate the effects of those fires on vireos, flycatchers, and other federally listed species that may be affected.

Based on the information provided and the analysis above, we have determined that the effects on vireos and flycatchers due to MV-22 training at MCBCP will be no greater than those evaluated for helicopter training within the Riparian BO. Therefore, we have determined that the

proposed action is consistent with the Riparian BO and does not require further analysis within this biological opinion regarding its effects on the vireo and flycatcher.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The MV-22 is the replacement for the current fleet of 1960s-era CH-46E medium-lift helicopters. The MV-22 aircraft utilizes tilt-rotor technology to provide the maneuverability and lift of a helicopter and, in fixed wing mode, has the ability to fly twice as fast, four times as far, and carry twice the combat load of the CH-46E. The proposed action will base up to ten MV-22 squadrons (120 MV-22s) on the West Coast. Eight active duty squadrons (96 MV-22s) will be based at Miramar, and two reserve squadrons (24 MV-22s) will be based at MCASCP. The new MV-22 squadrons will replace seven CH-46E active duty squadrons (90 aircraft), one reserve CH-46E squadron (13 aircraft), and one reserve CH-53E squadron (11 aircraft). Training operations involving the MV-22 will originate from Miramar and MCASCP and occur on and above MCBCP, MCAGCC, the various components of BSTRC, and within intervening airspace (Military Training Routes) between these installations. Because training activities outside MCBCP and Miramar will either not adversely affect listed species or are being addressed by the Tucson Fish and Wildlife Office through a review of the project's consistency with the programmatic biological opinion addressing training activities at BMGR, this biological opinion will address only those portions of the project that pertain to construction of infrastructure on Miramar and training operations on MCBCP.

Transition from the existing CH-46E helicopters to the MV-22 is scheduled to occur between fiscal year (FY) 2010 and FY 2020, with about one squadron transitioned each year. Construction activities will occur primarily between FY 2010 and FY 2014. MV-22 training exercises and operations will begin with the arrival of the first MV-22 aircraft in FY 2010.

Project Description on Miramar

Basing of eight MV-22 squadrons at Miramar will lead to an increase of 48 aircraft and 746 military personnel at Miramar. The proposed action will require construction and/or renovation of airfield facilities to accommodate the MV-22 squadrons. New support facilities at Miramar will include up to three new hangar modules, parking apron, new fueling pits, and five new wash racks (BA section II.a.4.1). Up to 28 MV-22 aircraft will be housed in hangars, and the rest will be housed on the aircraft parking apron. A majority of the new facilities on Miramar will be built in existing developed areas, with the exception of the new fueling pits and a small portion of the eastern most parking apron expansion. The project footprint at Miramar includes a buffer zone of up to 15 m (50 ft) around proposed new facilities, which will be permanently impacted. No new facilities will be constructed within the 15 m (50 ft) buffer zone, but it will be recontoured to prevent water ponding and subsequent potential establishment of vernal pool habitat. Following

project construction, the buffer zone will be reseeded with native herbaceous species that will withstand frequent disturbance, as identified in Miramar's INRMP (USMC 2006).

Implementation of the proposed action will result in an increase of approximately 22,246 airfield operations per year at Miramar, which is a 20 percent increase in operations over existing conditions. The proposed increase, however, falls within historic use of the airfield, which has fluctuated between approximately 90,000 and 167,000 annual flight operations for all aircraft between 1996 and 2003 (USMC 2006). No new flight tracks will be established.

Project Description on MCBCP

Established "Special Use Airspace" on MCBCP will not be expanded or modified with implementation of the proposed training operations. No new landing sites will be established on MCBCP in association with this action, nor will any existing landing sites be modified. The USMC estimates that the MV-22 will be involved in 17,008 operations[1] per year on MCBCP with about 11,665 of those being operations at 47 previously designated landing sites (e.g., Landing Zones [LZs], Drop Zones [DZs], or Confined Area Landing [CAL] sites) that have been in use for many years prior to this action. All 47 landing sites are illustrated in Figures A-0 through A-47 of a map book provided by the USMC ("map book" USMC 2009a) that shows detailed maps of the landing sites relative to listed species and their habitat. The introduction of up to ten MV-22 squadrons to the Marine Corps fleet, any subsequent use of the training environment within MCBCP and the reduction of CH-46E operations will result in an increase of about 1,895 operations per year, representing a three percent increase in operations compared to existing conditions (i.e., operations including the CH-46E and other helicopters operating on MCBCP). This increase is primarily due to a significant increase in use of the Helicopter Outlying Landing Field (HOLF) to conduct MV-22 Field Carrier Landing Practice (FCLP) operations. However, most landing areas will see a reduction in use compared to existing conditions. Of the 47 landing sites on MCBCP listed in the BA, two sites will experience a significant increase (greater than 200 operations), 7 sites will experience a slight increase (10 or less operations), 9 sites will experience a slight decrease (10 or less operations), and the remaining 29 sites will experience a moderate (10-100 operations) to significant decrease (100 or more operations) in the number of landing operations each year. The two sites experiencing significant increases in landing operations (i.e., the HOLF with 7,118 additional operations and the HLZ with 238 additional operations) are paved or prepared surface areas. The remaining 45 landing sites are a mixture of hard-surface sites (12 sites) and bare dirt/grass areas (33 sites). Eleven of the sites (5 hard surface; 6 bare dirt/grass) are within or adjacent to developed cantonment areas with limited native habitat nearby.

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[1] "Operations" may involve one of many different activities involving a helicopter: (1) a single event that occurs at the air station, such as a departure, arrival, or touch-down; (2) typical activities at defined training sites (e.g., Landing Zone, Drop Zone, or Confined Area Landing sites) such as hovering, landing, loading/unloading, and taking off; or (3) ingress or egress to/from those training sites noted above with each one-way trip representing an operation.

The MV-22 will operate in association with other types of USMC training activities, including foot traffic training, vehicle training, and other aircraft training, as the MV-22 is transitioned into the USMC fleet. These other training activities are extensive and diverse in nature, and are currently being evaluated in the ongoing programmatic consultation regarding USMC activities in upland habitats on MCBCP. Because these associated activities are already undergoing consultation, they will not be evaluated in this biological opinion; this opinion will only address the impacts of operation of the MV-22 itself.

Measures on Miramar

The USMC will incorporate the following avoidance, minimization, and conservation measures into the proposed actions on Miramar:

1. A qualified biological resource monitor (construction monitor)[2], with technical expertise and understanding of SDFS and its habitat, will monitor project construction and will be responsible for ensuring compliance with the conservation measures identified herein, and to ensure unanticipated impacts to SDFS are avoided. Monitoring activities will include, but not be limited to, assisting in identifying work areas, directly monitoring construction activities, and providing guidance/education to construction personnel to ensure avoidance and minimization of impacts to SDFS and its habitat.

2. Proposed construction activities will not begin until a qualified biologist has been designated as the construction monitor, in cooperation with the Service. The USMCwill provide the monitor with a copy of this biological opinion, the water quality management plan described below, and contact information for the Service.

3. The biological monitor will be onsite at all times during clearing and grubbing of vegetation, initial site grading, and use of heavy equipment that occurs within 30 m (100 ft) of the known watersheds of vernal pools and seasonally ponded features occupied by SDFS. The biological monitor will notify installation environmental security staff and the construction supervisor immediately should any construction-related activities conflict with this biological opinion or the associated water quality management plan. All inadvertent, unanticipated impacts to vernal pools will be reported to the Service within 72 hours or 3 business days, whichever is soonest.

[2] A qualified biologist or biological monitor for vernal pool habitat will have (1) a bachelor's degree with an emphasis in ecology, natural resource management, or related science; (2) five years or more of demonstrated local experience with and understanding of the ecology of vernal pools; and, (3) previous experience with applying the terms and conditions of a biological opinion.

4. The project footprint surrounding the fuel pits area will be clearly marked with flagging, fencing, and/or signposts to minimize the likelihood of unanticipated impacts to SDFS and its habitat in the surrounding environment. The construction fencing, flagging, and/or signposts will be monitored and maintained throughout the construction period. All project-related activities will occur within the project boundary.

5. The USMC will implement a water quality monitoring and management plan to minimize project-related sedimentation and pollution impacts to adjacent SDFS habitat and ensure that the project has not compromised the hydrology of adjacent vernal pools. The plan will be prepared and submitted to the Service for review and approval at least 30 days prior to project construction at Miramar. The plan will include the type, placement, and monitoring of erosion and pollution control measures; criteria for minimizing blading and grading of construction work areas in vernal pool watersheds; post-construction water quality monitoring; SDFS sampling; monitoring of surface area and duration of ponding at affected vernal pool locations[3]; and seasonal construction restrictions in vernal pool watersheds (vegetation clearing or grading activities will be conducted when soils are dry enough to reduce the potential for ground surface erosion and minimize impacts to vernal pool basins and watersheds adjacent to the construction area). Post-construction monitoring will be conducted for a period of five normal or greater wet seasons, as measured by local weather stations (e.g., Lindbergh Field).

6. Consistent with Miramar's INRMP, the USMC will restore vernal pools to offset impacts to SDFS and its habitat. Based on estimated impacts, the USMC will restore a total of 0.076 ha (0.189 ac) of vernal pools on Miramar. Inoculum will be collected during the dry season from basins supporting endangered species prior to the start of construction.

7. Prior to initiating the project on Miramar, the USMC will prepare a vernal pool restoration/enhancement plan for Service review and concurrence. The plan will include restoration/enhancement locations, restoration/enhancement components, monitoring requirements and time periods, success criteria, and follow-up measures as appropriate.

Measures on MCBCP

The USMC will incorporate the following avoidance, minimization, and conservation measures into the proposed actions on MCBCP:

1. The USMC will conduct MV-22 operations in a manner designed to reduce the potential to ignite training-related wildfires, including the following:

[3] These locations include vernal pools and seasonally ponded features within the action area that are occupied by SDFS.

a. Exhaust deflectors on the MV-22 will be employed by operators as needed to maintain aircraft, passenger and operator safety and minimize the likelihood of ignitions at unprepared, undeveloped or vegetated landing sites to the greatest degree possible during landings, takeoffs, hovering, or while on the ground with engines running.

b. Operators will minimize the time on the ground with engines running on unprepared sites and follow all recommendations in the Naval Air Training and Operating Procedures Standardization (NATOPS) manual. Additionally, operators will use developed sites and prepared surfaces during training scenarios, to the maximum degree possible.

c. For training within DZs, operators will touch down only on improved or disturbed, unvegetated surfaces where the potential for fire is lowest and landings have been approved, such as paved LZs, fire breaks, and/or training roads.

2. The USMC will adhere to the Fire Danger Rating System restrictions when conducting MV-22 operations to minimize the risk of igniting wildfires. The USMC will conduct MV-22 operations during extreme fire hazard days as follows:

a. In accordance with the MCBCP Fire Danger Rating System, training and use of the MV-22 will be limited to developed or improved landing sites, to the maximum extent possible, under a Red (extreme hazard) Fire Danger Rating. This restriction does not include emergency actions or selected training scenarios considered essential to completing training required for pending deployment, as approved by the MCBCP Fire Department. For any approved training at undeveloped, vegetated sites under Orange (high) Fire Danger Rating days or higher, operators and trainers will exercise extreme caution during landings, takeoffs, hovering, or while on the ground with engines running, to minimize the risk of fire, particularly during the transition period and until such time as sufficient experience with the aircraft has been gained and its use demonstrates the risk of fire is low, as identified by the USMC. Exemptions allowing use of any landing areas on MCBCP under Red (extreme) or Orange (high) Fire Danger Rating days will be approved by the MCBCP Fire Department, who will also provide pre-positioned fire equipment as a precautionary measure.

b. As a precautionary measure, until more experience has been gained with MV-22 training at MCBCP, fire incident reviews associated with the initial deployment period of the MV-22 will be conducted by USMC (MCBCP or MCIWEST) Environmental Security (ES) staff following any report of a wildfire ignition related to the MV-22 operations, with results of the fire review transmitted to CFWO within three working days of completion of the review. This measure may be modified by the USMC in the future, in coordination with MCIWEST and MCBCP ES staff and the MCBCP Fire Department, as fire incident information is collected and analyzed, and sufficient experience with the MV-22 is gained to ensure the risk of fires being started is minimized to maximum

extend possible. MCIWEST and MCBCP ES staff will notify CFWO of any changes to these restrictions.

3. The USMC will review and update the MCBCP Range and Training Regulations (RTRs) and Wing Standard Operating Procedures (SOPs) to reflect the potential for accidental wildfire associated with MV-22 training, and will incorporate the requirements of the measures listed above, as appropriate. MCIWEST and MCBCP ES staff will be responsible for ensuring that SOPs reflect restrictions and measures identified as a result of this and other pertinent consultations with the Service. Updates to the RTRs and Wing SOPs will be published prior to use of unprepared, undeveloped, or vegetated landing sites, as identified in the BA and the map book.

4. Within five years of initiating the proposed project, the USMC will prepare a report describing and quantifying MV-22 training incidents that result in wildfire ignitions for all West Coast operations. The report will include an assessment of the conditions under which the fire started, such as relative humidity, fuel moisture, ambient temperature, and vegetation type, as well as a description of the project area and other factors which may further the understanding of fire potential. The USMC will distribute the report to the MCIWEST G-3 (Aviation Operations), MCBCP Fire Department, MCBCP ES, MCBCP Training and Range Management Division (TRMD) and CFWO. The report will be used to inform and guide decisions regarding adaptive fire management strategies, including but not limited to, adopting additional training restrictions on the MV-22, if needed. Future revisions to the MCBCP Integrated Natural Resources Management Plan (INRMP) will evaluate the best available data on fires associated with the MV-22, and incorporate appropriate guidelines and updates to the existing fire management program.

5. Prior to completion of the report described above, the USMC will immediately report (within 72 hours) to CFWO any wildfires ignited by MV-22s during operations on MCBCP. If the MV-22 is found to significantly increase the frequency of wildfires ignited during training operations, the USMC will reinitiate consultation with the Service to evaluate the effects of those fires on federally listed species.

6. Unless specifically authorized by and coordinated with MCBCP ES staff, acting in cooperation with the MCBCP Fire Department and TRMD, the USMC will conduct MV-22 operations on MCBCP during the transition phase (2010-2020) according to the following restrictions:

   a. MV-22 operators will exercise extreme caution during landings, takeoffs, hovering, or while on the ground with engines running, to minimize the risk of fire. MV-22 operators will avoid training in areas with a high risk of igniting fires, especially adjacent to riparian corridors as described in the Riparian BO. To the maximum extent feasible, MV-22 operators will also exercise extreme caution when operating over sage scrub

communities and vernal pools habitats, particularly between 15 February and 31 August, to ensure fire risk is minimized.

b. All MV-22 training activities will comply with terms and conditions of the existing Riparian BO, as referenced above.

c. Troops associated with MV-22 training activities will deploy away from riparian corridors, vernal pools, and other sensitive habitats to the maximum extent possible, and follow all restrictions identified on the Environmental Operations Map, the RTRs, and will avoid all areas posted as off-limit.

d. The MV-22 will land only at locations designated in the BA. When training within DZs, operators will touch down only on improved or disturbed, unvegetated surfaces where the potential for fire is lowest and landings have been approved, such as paved LZs, fire breaks, and training roads. MV-22 operators will make every effort possible to touch down only at locations greater than 200 m (650 ft) from riparian corridors and sage scrub communities to minimize fire potential and noise producing activities within habitat occupied by federally listed species.

e. In known vernal pool areas (e.g., DZ Tank Park), the MV-22 will land on existing roads and will avoid landing in occupied vernal pools to the maximum extend possible. Equipment and vehicles associated with MV-22 operations will be kept on existing roads and will avoid operating in occupied vernal pools and areas posted as off-limits.

Action Area

According to 50 CFR § 402.02 pursuant to section 7 of the Act, the "action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. Subsequent analyses of the environmental baseline, effects of the action, and levels of incidental take are based upon the action area.

Action Area on Miramar

The action area on Miramar includes the project footprint and surrounding area within about 150 m (500 ft). SDFS in the action area will be directly impacted by habitat destruction and may be indirectly affected by factors such as altered runoff patterns, increased sedimentation, and increased oil-based contamination in the water. Although MV-22 will operate over much of Miramar, day-to-day operation of the airfield has already been addressed through formal consultation (Service 1996), and the MV-22 is not anticipated to significantly alter the number of operations or noise profile relative to historical conditions. Therefore, the action area at Miramar is restricted to the project footprint and adjacent habitat, and the effects analysis on Miramar is restricted to potential effects to SDFS.

Action Area on MCBCP

Although the MV-22 will only land at the 47 specified landing sites on MCBCP, the MV-22 can operate anywhere within the airspace above MCBCP. Operation of the MV-22 within MCBCP airspace will expose all of MCBCP to potential noise-related effects of the MV-22. Therefore, we consider all of MCBCP to be the action area for this project.

STATUS OF THE SPECIES

San Diego fairy shrimp

Listing Status

The Service listed the SDFS as an endangered species on February 3, 1997 (62 FR 4925), because of habitat destruction, fragmentation, and degradation from agriculture practices, urban development, alterations of wetland hydrology, off-road vehicle activity, and grazing. A recovery plan for SDFS was completed in September 1998 (Service 1998). The Service published a final rule designating critical habitat for the SDFS on October 23, 2000 (65 FR 63438). The Service re-proposed critical habitat for the SDFS on April 22, 2003 (68 FR 19888); the final rule designating SDFS critical habitat was published on December 12, 2007 (72 FR 70648).

Species Description

The SDFS is a small aquatic crustacean in the family Branchinectidae (Order: Anostraca) that is restricted to vernal pools, originally described by Fugate (1993) from samples collected on Del Mar Mesa, San Diego County. Mature individuals lack a carapace and have a delicate elongate body, large stalked compound eyes, and 11 pairs of swimming legs (Service 2000a). Adult male SDFS range in size from 9 to 16 millimeters (mm) (0.35 to 0.63 inches [in]); adult females are 8 to 14 mm (0.31 to 0.55 in) long. The second pair of antennae in males is greatly enlarged and specialized for clasping the females during copulation, while the second pair of antennae in the females is cylindrical and elongate.

Habitat affinities

SDFS is among a number of other aquatic invertebrate and indigenous plant species that have evolved to occupy the extreme environmental conditions found in vernal pool habitats (Stone 1990). Vernal pools are a specialized form of seasonal wetlands that occur in a geographical area extending from southern Oregon through California into northern Baja California, Mexico. Vernal pools form in regions with Mediterranean climates where shallow depressions fill with water during fall and winter rains and then evaporate in the spring (Collie and Lathrop 1976;

Holland 1976, 1978; Holland and Jain 1977, 1988; Thorne 1984). Downward percolation of water within the pools is prevented by the presence of an impervious subsurface layer, like claypan, hardpan, or volcanic stratum (Holland 1976, 1988). Seasonal inundation makes vernal pools too wet for adjacent upland plant species adapted to drier soil conditions, while rapid drying during late spring makes pool basins unsuitable for typical marsh or aquatic species that require a more permanent source of water.

Vernal pool systems are often characterized by different landscape features including mima mound micro-topography, varied pool basin size and depth, and vernal swales. Due to local topography and geology, the pools are usually clustered into pool complexes (Holland and Jain 1988). Pools within a complex typically are separated by distances on the order of meters and may form dense, interconnected mosaics of small pools or a sparse scattering of larger pools. Pool complexes are often interconnected by a shared watershed, generally ensuring that some between-pool water flow continues.

Road ruts, man-made ponds, minor impoundments on drainages, and abandoned borrow sites are generally not considered vernal pools. However, pools that support vernal pool species and that appear to be anthropogenic in origin are often historical vernal pools that have been degraded as a consequence of previous land uses (Service 1998).

The SDFS is a habitat specialist restricted primarily to vernal pools, although it will occur in other ephemeral basins. Fairy shrimp are ecologically dependent on seasonal fluctuations in their habitat such as absence or presence of water during specific times of the year, duration of inundation, and other environmental factors that likely include specific salinity, conductivity, dissolved solids, and pH levels. Water chemistry is one of the most important factors in determining the distribution of this species (Gonzalez et al. 1996). SDFS inhabit shallow, small pools that are less than 25 centimeters (cm) (9.8 in) deep with relatively low ion concentrations, a moderate pH, and water temperatures ranging from degrees 10 to 26 Celsius (°C) (50 to 79 degrees Fahrenheit [°F]).

Life history

Freshwater crustaceans, including SDFS, have a two-stage life cycle and spend the majority of their life cycle in the cyst stage (Templeton and Levin 1979, Schaal and Leverich 1981, Herzig 1985, Venable 1989). "Resting eggs" or "cysts" are capable of withstanding temperature extremes and prolonged drying. Fairy shrimp egg banks in the soil may be composed of the eggs from several years of breeding (Donald 1983, Simovich and Hathaway 1997). Vernal pools and ephemeral wetlands may hatch only a fraction of the total cysts in any given year, thereby allowing for reproductive success over several seasons (Simovich and Hathaway 1997). The cysts will hatch in 3 to 9 days when water temperatures are between 5 and 20 °C (41 and 68 °F), although hatching times are quickest (3 days) when temperature is constant at 15 °C (59 °F) (Hathaway and Simovich 1996). The inability to hatch at higher temperatures protects SDFS

from infrequent summer storms that might otherwise be sufficient to stimulate development, but inadequate for SDFS to complete their life cycle (Service 1998). Eggs that do hatch mature within seven days to two weeks depending on water temperature, with adult SDFS typically observed from January to March. Females carry eggs in an elongate ventral brood sac that are either dropped to the pool bottom or remain in the brood sac until the female dies and sinks (Eriksen and Belk 1999).

Status and Distribution

SDFS occur from southern Orange County and northern San Diego County (MCBCP, San Marcos and Ramona) south to Otay Mesa and at Valle de las Palmas in northwestern Baja California, Mexico. All known localities are below 700 m (2,300 ft) of elevation and within 65 kilometers (km) (40 miles [mi]) of the Pacific Ocean.

Loss of vernal pool habitat in San Diego County is estimated at around 95 to 97 percent because of intensive cultivation and urbanization (Bauder and McMillan 1998). Similar to San Diego County, vernal pool habitat was once extensive on the coastal plain of Los Angeles and Orange counties, but there has been a near total loss of vernal pool habitat in these areas (Keeler-Wolf et al. 1998). The majority of the vernal pools within the range of the SDFS were lost prior to 1990 (Service 1998), and therefore, many populations of SDFS have likely been extirpated or have experienced drastic declines due to the substantial loss of habitat in southern California.

Population Dynamics and Estimates

Viable resting SDFS eggs within vernal pool soils constitute "cyst banks," with only a portion of these eggs hatching with any one pool hydration (Simovich and Hathaway 1997, Service 1998). Depending on the prevailing precipitation patterns, this may lead to adult populations within given pools that vary by several orders of magnitude between years. Individual pools can support thousands of adult SDFS during appropriate conditions, but dispersal ability is limited and most reproductive effort remains within the same pool (Davies et al. 1997). Therefore, the appropriate unit for assessing SDFS populations is the number of pools, or pool complexes, occupied by SDFS based on multiple years of observation.

The two-stage life cycle of SDFS in combination with the inter-annual variability of suitable breeding conditions make estimating SDFS population size difficult, and no estimates of range-wide population size are available for this species. Approximately 8,100 hectares (ha) (20,015 acres [ac]) distributed across Orange and San Diego counties have been determined to be essential to the conservation of SDFS, and this acreage encompasses all pools occupied by SDFS and their associated watersheds (Service 2003a). Approximately 1,247 ha (3,082 ac) have been designated as critical habitat (Service 2007a).

Threats and Conservation Needs

Threats to vernal pools can be divided into three major categories: 1) direct destruction of vernal pools such as construction, vehicle traffic, domestic animal grazing, dumping, and deep plowing; 2) indirect threats which degrade or destroy the vernal pool over time such as altered hydrology (*e.g.*, damming, draining), invasion of alien species, habitat fragmentation, and associated deleterious effects resulting from adjoining urban land uses; and 3) potentially catastrophic long-term threats including the effect of isolation on genetic diversity and locally adapted genotypes, air and water pollution, drastic climatic variations, and changes in nutrient availability (Bauder 1986).

Since the listing of SDFS, the Service has worked with project proponents to minimize and offset the loss of occupied SDFS pools caused by development projects. This has been achieved through conservation, enhancement, and/or restoration of suitable vernal pool habitat on or near project sites, as agreed to during interagency consultation or the habitat conservation planning (HCP) process.

Through the HCP process, large-scale development planning has been used to conserve SDFS and vernal pools on private lands throughout large portions of their range. In 1996, the Service issued a permit for the Central and Coastal Subregion Natural Community Conservation Plan and Habitat Conservation Plan for Orange County. In 1997 and 1998, the Service issued permits to the city of San Diego and San Diego County, respectively, for Multiple Species Conservation Plans. In 2007, the Service issued a permit for the Orange County Southern Subregion Habitat Conservation Program. The Service has determined that these plans will provide long-term protection to core populations of SDFS in Orange and San Diego counties (Service 2003a, 2007a).

Recovery Planning

The Recovery Plan divides southern California vernal pools into eight management units, five of which contain SDFS. The units with SDFS are Los Angeles-Orange, North Coastal San Diego (which includes MCBCP), Central Coastal San Diego (which includes Miramar), South Coastal San Diego, and Inland Valleys San Diego. According to the Recovery Plan, there are 90 complexes (associated groups of vernal pools) with SDFS that should be "secured from further loss and degradation in a configuration that maintains habitat function and species viability" to stabilize the current status of SDFS (Service 1998). In general, the complexes identified as necessary to stabilize the current status of SDFS were believed to be the most important for recovery of the species. The Recovery Plan identified an additional 21 complexes that should be "secured" for the SDFS to be reclassified from "endangered" to "threatened." Since the Recovery Plan was completed, additional complexes have been discovered, and there are currently a total of 131 complexes known to be occupied by SDFS. These complexes are scattered throughout the management units, but are particularly concentrated in Central Coastal

San Diego and South Coastal San Diego. Of the 111 complexes listed in the Recovery Plan as necessary to stabilize or reclassify the population of SD fairy shrimp, 64 (or 58%) are currently conserved, identified as a conservation priority (on military land), proposed for conservation, or partially conserved and restored; 45 (or 41%) are not conserved, have been developed, are proposed for development, or are impacted. The status of the remaining complexes is unknown at this time.

Status on Miramar

Vernal pool habitat on Miramar is one of the largest and most contiguous in southern California, supporting one of the most important assemblages of endangered and sensitive species dependent on vernal pool habitat in the region (Bauder and Wier 1991). The vernal pools on Miramar are defined as San Diego Mesa Hardpan type by Holland (1986), consisting of the Redding groups of shallow, cobbly, or gravelly loams that range from 2 to 50 percent slopes. While the usual vegetation is chaparral or coastal sage scrub, past grazing and other development has disturbed many areas and converted the vegetation to non-native grasslands (Miramar 2006).

Based on 2007 GIS data for Miramar that incorporates survey efforts since 1993[4], there are approximately 45 complexes occurring on the Base totaling approximately 157 acres of vernal pool basin area. Of the 27 complexes listed in the Recovery Plan as necessary to stabilize the population of SD fairy shrimp, 20 (or 74%) are currently conserved or have been identified as a conservation priority (Appendix B, Status of Vernal Pool Complexes Identified in the Recovery Plan).

The primary threat to SDFS on Miramar is destruction and degradation of habitat through construction of new facilities and expansion of infrastructure. Past development actions on Miramar have resulted in the total or partial loss of five complexes (GG1+, GG2+, HH4+, W4, and Z11+), one of which was identified as necessary to stabilize the population of SD fairy shrimp (HH4+). However, restoration techniques including decompaction, sculpting/recontouring, reseeding, re-establishment, and invasive species removal have been used, and when necessary modified, to restore impacted or lost pools on Miramar during the past 14 years, as indicated by the following examples (USMC 2006).

- In 1997, 2.3 acres (79 pools) were restored within AA4-7, F (north), F16, U15, and U19 pool groups (Black 2000a, 2003a).
- In 1997, 2.3 acres (75 pools) were restored within Management Unit 2, X1-4, Z1-3, EE1, and HH3+ pool groups (Black 2000b, 2003b).
- In 1998-1999, 0.85 acre (69 pools) was restored within A4, AA8, AA9, and AA10 pool groups (KEA Environmental, Inc. 1999; EDAW, Inc. 2005).

[4] Vernal pool resources were mapped at various times using varying types of mapping technology and therefore contain varying accuracies. Further, only the most recently mapped data contains a presence/absence survey for SD fairy shrimp.

- In 1999-2000 Miramar re-established/restored about 3.9 acres of vernal pool basin area in the Miramar Mounds National Natural Landmark Vernal Pool Group U (north) (Tomsovic and Macaller 2003, 2004a, and 2004b).

Overall, there has been a net benefit to the vernal pool resource on Miramar because of increased habitat (either through restoration or enhancement) and active or passive management. For example, in the 1991 Bauder and Weir survey, a total of 60 pools were identified for the EE1 complex. Current mapping efforts indicate a total of 927 pools in this complex (USMC 2007). Additionally, past impacts have been offset by preserving approximately 3.16 vernal pool basin acres in complexes identified as either necessary to stabilize or reclassify the population of SD fairy shrimp (AA4-7, F16-17, U-15, U-19). Finally, management objectives defined in detail in Chapter 7 of Miramar's INRMP (USMC 2006) reflect the priorities for vernal pool conservation and management, which will continue to benefit SDFS and other co-occurring vernal pool species.

The action area includes part of the HH1-4 vernal pool complexes. These complexes occur adjacent to the flightline and include 420 pools, totaling about 4.5 ha (11.2 ac) of vernal pool habitat, comprised of both naturally occurring and human-made depressions (e.g., ruts, ditches). Of the 420 pools, 166 are occupied by SDFS, totaling about 3.5 ha (8.6 ac) of occupied vernal pool habitat. The eastern edge of these complexes has been disturbed by past development, including paving, fill, and blading within the pools and their watersheds (Bauder and Weir 1991).

Past project impacts to the HH complexes include Base Closure and Realignment Act (BRAC) activities (1-6-95-F-33), which impacted approximately 1.2 ha (3 ac) of vernal pool basin area, and the flightline perimeter road repair and bore sight range demolition (1-6-99-F-64), which impacted 0.21 ha (0.53 ac) of vernal pool habitat. Restoration activities for these projects included re-establishment and/or restoration of vernal pool basin acreage throughout Miramar, these restoration projects have been largely successful, as stated above. Recent unauthorized impacts occurred in complex HH 1 in December 2008 and February 2009, which impacted 0.016 ha (0.04 ac) and 0.024 ha (0.06 ac) of basin area, respectively. Partial restoration of these pools has occurred and these pools appear to be functioning similar to nearby control pools (Kassebaum 2009).

Status on MCBCP

Base-wide surveys during the 1997-1998 and 1998-1999 wet seasons detected a total of 1,477 vernal pools on MCBCP that can be grouped into eight primary areas, with 219 of these pools occupied by SDFS (RECON 2001b). The most recent study on MCBCP (RECON 2007) has increased the estimated number of vernal pools on MCBCP to 2,403. Only 1,448 of those pools have been surveyed for fairy shrimp (60 percent), of which 273 pools are occupied by SDFS (RECON 2007). Considering that not all pools have been surveyed for fairy shrimp, and it is likely that not all vernal pools on MCBCP have been identified, the number of pools RECON

(2007) reported occupied by SDFS is probably a conservative estimate of the actual number of pools occupied by this species on MCBCP.

The Recovery Plan defined eight vernal pool complexes on MCBCP, which are synonymous with the eight areas described by RECON (2001b). Of these eight complexes, six (Cockleburr, Las Pulgas, San Mateo, the State Park Lease Area, Stuart Mesa, and Wire Mountain) were identified in the Recovery Plan as essential for stabilizing the species, and one (O'Neill) was identified as essential for downlisting.

The USMC currently uses a categorical classification system to evaluate the quality of vernal pools on MCBCP (RECON 2001a), with the extremes being Class IV pools that have a high level of disturbance and low vernal pool plant diversity and Class I pools have little or no disturbance and high species diversity; Classes II and III are intermediate. Although this classification system is subjective and has not been peer-reviewed, it provides a framework for discussions about the state of vernal pools on MCBCP, ongoing or projected impacts to those pools, and proposals for restoration. The majority of the pools on MCBCP (78 percent; RECON 2001a) appear to be moderately to highly degraded (i.e., Class III and IV).

Although many pools at MCBCP are degraded and may appear to be anthropogenic in origin, areas that support vernal pool species are often historical vernal pools that have been modified and degraded as a consequence of previous land uses (FWS-MCBCP-1-6-00-F-40). Historic (e.g., ranching and agriculture) and recent (e.g., military training) land uses on MCBCP are likely to have degraded many areas to the point where it is impossible to determine whether specific sites historically contained vernal pools appropriate for SDFS. Although many of the ephemeral pools on MCBCP do not fit the classical description of southern California vernal pools, they function as such in their ability to support SDFS.

Ongoing and potential threats to the SDFS populations on MCBCP include pool destruction and degradation from project construction, military training activities (especially off-road vehicle exercises), and infrastructure maintenance (Service 1997, 1998, 2000a).

Since the listing of the SDFS, up to 19 pools assumed or known to be occupied by SDFS have been permanently impacted or degraded in association with housing or infrastructure construction projects on MCBCP. Through the formal consultation process, the USMC has attempted to avoid and minimize impacts to pools near proposed projects, and has implemented restoration and/or additional protections of some vernal pools containing fairy shrimp to offset unavoidable impacts.

No studies have been conducted to determine how ongoing military training affects SDFS. Training may be compatible with SDFS to some extent, but training, particularly by vehicles, may also negatively affect fairy shrimp by disrupting pool hydrology and chemistry, crushing cysts, displacing adults or cysts to unsuitable locations, or promoting exotic invasive plants that

degrade pool habitat (Service 1998). A more recent threat identified may be the incidental dispersal of the unlisted and widespread *B. lindahli* through training activities, which may compete or hybridize with *B. sandiegonensis* (FWS-MCBCP-4412.4). Although range regulations require vehicles to remain on dirt roads and avoid vernal pools (USMC 2002), it is acknowledged that vehicles leave roads occasionally during training exercises and have on occasion done extensive damage to occupied fairy shrimp pools (Service 2005a). The military has proposed that vehicle training may promote the spread of listed fairy shrimp on MCBCP by compacting soils and creating depressions that hold water (ephemeral "road pools") and that these pools may be subsequently inoculated with listed fairy shrimp cysts transported by vehicles (U. S. Navy 2001, 2002). This potentially beneficial cyst dispersal may be outweighed by the negative effects of an equal or greater tendency to disperse *B. lindahli*. In addition, SDFS are typically found in pools on MCBCP that appear to be less degraded (Moeur 1998, RECON 2001b), which runs contrary to the belief that off-road vehicle training benefits SDFS populations. Due to the uncertainty regarding the effects of military training on SDFS, the Service has evaluated the effects of military training conservatively within past biological opinions and determined that military vehicle training is generally detrimental to SDFS and the pools they occupy. In an attempt to resolve some of the uncertainty regarding the impact of vehicle training on listed fairy shrimp, the USMC is in the process of studying the impact of tracked vehicle training on fairy shrimp in association with the fielding of recently developed tracked vehicle, the AAAV/EFV (FWS-MCBCP-3223.3).

Utility companies (San Diego Gas & Electric [SDG&E], Southern California Edison [SCE]) with transmission and distribution lines on MCBCP maintain some dirt roads on MCBCP to provide access for maintenance of power lines, power poles and towers, and other structures. SDG&E currently conducts road and facility maintenance actions according to a HCP that specifies that SDG&E will generally avoid impacts to occupied SDFS pools. Incidental take of SDFS within their plan area is authorized for unavoidable impacts. SDG&E coordinates with the USMC and the Service to avoid and minimize impacts to occupied SDFS pools to the maximum extent practicable. It is likely that SDG&E's routine maintenance results in some mortality of SDFS and pool degradation on an occasional basis. SCE does not currently have incidental take authorization for maintenance of their facilities, although SCE has informed the Service that they are developing avoidance and minimization protocols for activities near listed species and their habitats.

Riverside fairy shrimp

Listing Status

The Service listed RFS as an endangered species on August 3, 1993 (58 FR 41391), because of habitat loss and degradation due to urban and agricultural development, off-road vehicle use, trampling, and other factors. A recovery plan for RFS was completed in September 1998 (Service 1998). Critical habitat for RFS was designated on May 30, 2001 (66 FR 29384), but

was vacated by court order on October 30, 2002, and remanded for re-designation. Critical habitat for RFS was re-designated on April 12, 2005 (70 FR 19154).

Species Description

The RFS is a small freshwater crustacean in the family Streptocephalidae (Order: Anostraca) that is restricted to vernal pools and other ephemeral basins. The species was first collected in 1979 by Dr. Clyde Erickson and formally described as a new species in 1990 (Eng et al. 1990). The RFS is distinguished from similar species by its red-colored cercopods (anterior appendages), which occur on all of the ninth and 30 to 40 percent of the eighth abdominal segments (Eng et al. 1990). Adult fairy shrimp may grow to a length of 13 to 25 mm (0.5 to 1.0 in) (Eng et al. 1990). Like other fairy shrimp species, RFS swim upside down throughout their life cycle.

Habitat Affinities

Like SDFS, RFS is among a number of other indigenous plant and aquatic invertebrate species that have evolved to occupy the extreme environmental conditions found in vernal pool habitats (Stone 1990).

RFS are found in relatively deep (> 30 cm [>12 in]), cool water vernal pools that are inundated for at least 2 months. RFS are also found in disturbed vernal pool habitats where basins have been compacted or artificially deepened and, therefore, hold water for longer periods of time. Although basins supporting populations often appear to be artificially created or enhanced, such basins are located within soils that are capable of seasonal ponding and are often surrounded by naturally occurring pool complexes. These "artificial basins" function in the same manner as naturally occurring vernal pools by filling with late fall, winter and/or spring rains that gradually dry up during the spring and/or summer.

Water within pools supporting RFS may be clear, but more commonly it is moderately turbid (Eriksen and Belk 1999). Typically, pools supporting RFS have low total dissolved solids and alkalinity (means of 77 and 65 parts per million, respectively), corroborated by pH at neutral or just below (7.1-6.4) (Eng et al. 1990, Gonzalez et al. 1996, Eriksen and Belk 1999).

Life History

Freshwater crustaceans, including the RFS, have a two-stage life cycle and spend the majority of their life cycle in the cyst stage (Templeton and Levin 1979, Schaal and Leverich 1981, Herzig 1985, Venable 1989). After hatching, RFS require 48 to 56 days to reach sexual maturity in contrast with other fairy shrimp that can reach maturity in less than 2 weeks (Hathaway and Simovich 1996). Fairy shrimp mate upon reaching maturity, and female RFS produce between 17 and 427 cysts (eggs) over their lifetime (Simovich and Hathaway 1997). The cysts are either dropped by the females to settle into the mud at the bottom of the pool, or they remain in the

brood sac until the female dies and sinks to the bottom (Eriksen and Belk 1999). Fairy shrimp cysts may persist in the soil for several years until conditions are favorable for successful reproduction (Service 2001). The cysts will hatch in 7 to 24 days when water temperatures are between 41 and 77 degrees Fahrenheit, although hatching times are quickest (7 days) when temperatures fluctuate between 15 and 25 °C (59 and 77 °F) (Hathaway and Simovich 1996). The inability to hatch at higher temperatures protects RFS from infrequent summer storms that might otherwise be sufficient to stimulate development, but inadequate for RFS to complete their life cycle (Service 1998). Furthermore, not all cysts are likely to hatch during the individual winter storms, thus providing a mechanism for survival if the inundation period is too short in a given year (Simovich and Hathaway 1997).

RFS are non-selective filter-feeders that filter suspended solids from the water column (Eriksen and Belk 1999). Detritus, bacteria, algal cells, and other items between 1.3 to 76 microns (μ) (1×10^{-5} to 4×10^{-3} in) may be filtered and ingested (Eriksen and Belk 1999). RFS are preyed upon by a wide variety of wildlife, including beetles, dragonfly larvae, other arthropods, frogs, salamanders, toad tadpoles, shorebirds, ducks and other migratory birds, and even other fairy shrimp.

Status and Distribution

RFS are found in a limited number of disjunct, isolated locations in cismontane southern California from Ventura, Los Angeles, Orange, Riverside, and San Diego counties in the United States to northern Baja California, Mexico, north of Ensenada (Service 1998, 2001, 2004a; Brown et al. 1993). The Service (2004a) has identified four core populations and seven isolated RFS populations remaining. Core population areas are defined by multiple pools or pool complexes containing RFS that are within close proximity (about 8 km [5 mi]) of other occupied pools and pool complexes. Isolated populations are defined by single pools or pool complexes known to contain RFS that are separated from other known locations by greater than 16 km (10 mi). The core RFS population areas are located in the Orange County Foothills, Western Riverside County, the southern coastal portion of Camp Pendleton in San Diego County, and Otay Mesa in San Diego County (Service 2004a).

Loss of historic vernal pool habitat in San Diego County is estimated at around 95 to 97 percent because of intensive cultivation and urbanization (Bauder and McMillan 1998). Similar to San Diego County, vernal pool habitat was once extensive on the coastal plain of Los Angeles and Orange counties, but there has been a near total loss of vernal pool habitat in these areas (Keeler-Wolf et al. 1998). The majority of the vernal pools within the range of the RFS were lost prior to 1990 (Service 1998), and therefore, many populations of RFS have likely been extirpated or have experienced drastic declines due to the substantial loss of habitat in southern California.

Population Dynamics and Estimates

Viable resting RFS eggs within vernal pool soils constitute "cyst banks," with only a portion of these eggs hatching with any one pool hydration (Simovich and Hathaway 1997, Service 1998). Depending on the prevailing precipitation patterns, this may lead to adult populations within given pools that vary by several orders of magnitude between years. Individual pools can support thousands of adult fairy shrimp during appropriate conditions, but dispersal ability is limited and most reproductive effort remains within the same pool (Davies et al. 1997). Therefore, the appropriate unit for assessing RFS populations is the number of pools, or pool complexes, occupied by RFS based on multiple years of observation.

The two-stage life cycle of RFS in combination with the inter-annual variability of suitable breeding conditions make estimating RFS population size difficult, and no estimates of range-wide population size are available for this species. Approximately 7,620 ha (18,830 ac) distributed across Ventura, Los Angeles, Orange, Riverside, and San Diego counties have been determined to be essential to the conservation of RFS, and this acreage encompasses all pools occupied by RFS and their associated watersheds (Service 2004a). Approximately 124 ha (306 ac) have been designated as critical habitat (Service 2005b).

Threats and Conservation Needs

Threats to vernal pools can be divided into three major categories: 1) direct destruction of vernal pools by construction, vehicle traffic, domestic animal grazing, dumping, and deep plowing; 2) indirect threats which degrade or destroy the vernal pool over time via altered hydrology (*e.g.*, damming, draining), invasion of alien species, habitat fragmentation, and associated deleterious effects resulting from adjoining urban land uses; and 3) potentially catastrophic long-term threats including the effect of isolation on genetic diversity and locally adapted genotypes, air and water pollution, drastic climatic variations, and changes in nutrient availability (Bauder 1986; Service 1993a, 2004a).

Since the listing of RFS, the Service has worked with project proponents to minimize and offset the loss of occupied RFS pools caused by development projects. This has been achieved through conservation, enhancement, and/or restoration of suitable vernal pool habitat on or near project sites, as agreed to during interagency consultation or the HCP process.

Through the HCP process, large-scale development planning has been used to conserve RFS and vernal pools on private lands throughout large portions of their range. In 1996, the Service issued a permit for the Central and Coastal Subregion Natural Community Conservation Plan and Habitat Conservation Plan for Orange County. In 1997 and 1998, the Service issued permits to the city of San Diego and San Diego County, respectively, for Multiple Species Conservation Plans. In 2004, the Service issued a permit for the Western Riverside County Multiple Species Habitat Conservation Plan. The Service has determined that these plans will provide long-term

protection to core populations of RFS in Orange, Riverside, and San Diego counties (Service 2005b).

Recovery Planning

The Recovery Plan divides southern California vernal pools into eight management units, five of which contain RFS. The units with RFS are Transverse, Los Angeles-Orange, North Coastal San Diego (which includes MCBCP), Central Coastal San Diego (which includes Miramar), and South Coastal San Diego. Pool complexes with RFS are scattered throughout the management areas, with the majority of occupied RFS complexes occurring in North Coastal San Diego and Los Angeles-Orange. According to the Recovery Plan, all of the complexes, except for the O'Neill complex on MCBCP, should be "secured from further loss and degradation in a configuration that maintains habitat function and species viability" to stabilize the current status of RFS (Service 1998); according to the Recovery Plan the O'Neill complex should be "secured" for the RFS to be reclassified from "endangered" to "threatened."

Status on MCBCP

Base-wide surveys during the 1997-1999 wet seasons detected a total of 88 vernal pools on MCBCP occupied by RFS (RECON 2001b). RECON (2001b) identified eight vernal pool complexes on MCBCP, six of which contain RFS. The most recent study on MCBCP (RECON 2007) found 110 pools occupied by RFS (RECON 2007). Based on reasons already provided, the number of pools RECON (2007) reported occupied by RFS is probably a conservative estimate of the actual number of pools occupied by this species on MCBCP. Although many of the ephemeral pools on MCBCP do not fit the classical description of southern California vernal pools (see previous discussion for SDFS), they function as such in their ability to support RFS.

The Recovery Plan defined eight vernal pool complexes on MCBCP, which are synonymous with the eight complexes described by RECON (2001b); six of these complexes contain RFS. Five of the RFS-occupied complexes (Cocklebur, Las Pulgas, San Mateo, the State Park Lease Area, Stuart Mesa, and Wire Mountain) were identified in the Recovery Plan as essential for stabilizing the species, and one (O'Neill) was identified as essential for downlisting.

Ongoing and potential threats to the RFS populations on MCBCP include pool destruction and degradation from project construction, military training activities (especially off-road vehicle exercises), and infrastructure maintenance (Service 1993a, 1998, 2001).

Since the listing RFS, up to eight pools assumed or known to be occupied by RFS have been permanently impacted or degraded in association with housing or infrastructure construction project on MCBCP. Through the formal consultation process, the USMC has attempted to avoid and minimize impacts to pools near proposed projects, and has implemented restoration and/or

additional protections of some vernal pools containing fairy shrimp to offset unavoidable impacts.

As stated previously for SDFS, the actual long-term effects of military training on RFS have not been clearly resolved. Training may be compatible with RFS to some extent; but training, particularly by vehicles, may also negatively affect fairy shrimp by disrupting pool hydrology and chemistry, crushing cysts, displacing adults or cysts to unsuitable locations, or promoting exotic invasive plants that degrade pool habitat (Service 1998). In an attempt to resolve some of the uncertainty regarding the impact of vehicle training on listed fairy shrimp, the USMC will study and evaluate the impact of tracked vehicle training on fairy shrimp in association with the fielding of the AAAV/EFV (FWS-MCBCP-3223.3).

Camp Pendleton's Facilities Maintenance Department (FMD) maintains most roads on MCBCP, except for those roads that are regularly maintained by right-of-way holders (such as the utilities mentioned below) or lessees (such as agriculture lessees). In addition, FMD maintains firebreaks and mowed fuelbreaks. Maintenance of infrastructure near vernal pools requires approval from the Assistant Chief of Staff, Environmental Security (AC/S, ES). AC/S, ES requires that FMD follow practices that avoid and minimize impacts to occupied vernal pools, but there have been unauthorized impacts in the past. Six pools, four of which were known to support RFS, were filled and disced near the Wire Mountain housing area in 1998 and 1999 during firebreak maintenance activities (USMC 1998a, 1999). The USMC has implemented restoration efforts in this area to offset these unauthorized impacts (RECON 2004). As stated previously for SDFS, ongoing maintenance activities by utility companies (SDG&E and SCE) are likely to occasionally result in some mortality of listed fairy shrimp and pool degradation.

Coastal California gnatcatcher

Listing Status

The Service listed the coastal California gnatcatcher as threatened on March 30, 1993 (58 FR 16742). Habitat loss and fragmentation resulting from urban and agricultural development as well as fire, invasive plants, and predation all contributed to the listing decision. Additionally, the Service issued a special rule, in conjunction with the listing decision pursuant to section 4(d) of the Act, defining the conditions under which take of the gnatcatcher would not be a violation of section 9 (58 FR 65088). This special rule recognized the California's Natural Community Conservation Planning (NCCP) Program, and several local governments' ongoing multi-species conservation planning efforts (e.g., the San Diego MSCP) that intend to apply the Act standards to activities affecting the gnatcatcher. A final revised critical habitat designation for the gnatcatcher was published on December 19, 2007.

Species Description

The gnatcatcher is a small (length: 11 cm (4.33 in); weight: 6 grams (g) (0.28 ounces [oz])), long-tailed member of the family Sylviidae that is endemic to cismontane southern California and northwestern Baja California, Mexico (Atwood 1980, 1988, 1990, 1991; AOU 1983, 1989, 1998). Its body plumage is dark blue-gray above and grayish-white below, while the tail is mostly black above and below. The male has a distinctive black cap that is absent during the winter and both sexes have a distinctive white eye-ring. Vocalizations of this species include a call consisting of a rising and falling series of three kitten-like mew notes. The gnatcatcher is distinguished from the black-tailed gnatcatcher (*Polioptila melanura*) by its darker body plumage, less extensive white on tail feathers (rectrices 5 and 6), and longer tail.

Habitat Affinities

The gnatcatcher typically occurs in or near coastal sage scrub (CSS), which is composed of relatively low-growing, dry-season deciduous, and succulent plants. Characteristic plants of these communities include California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), laurel sumac (*Malosma laurina*), lemonadeberry (*Rhus integrifolia*), bush penstemon (*Keckiella antirrhinoides*), *Salvia* spp., *Encelia* spp., and *Opuntia* spp. (Atwood 1990, Beyers and Wirtz 1997, Braden et al. 1997a, Weaver 1998).

CSS has been estimated to have historically covered nearly 1 million ha (2.5 million ac) of coastal California (Barbour and Major 1977), although anthropogenic development and land conversion have substantially depleted this habitat (Kirkpatrick and Hutchinson 1977, Axelrod 1978, Klopatek et al. 1979, Westman 1987, O'Leary 1990), with potentially less than 15 percent of the original acreage of CSS remaining (Westman 1981a, 1981b). In addition to agricultural use and urbanization, increased fire frequency and the introduction of exotic plants have had an adverse impact on CSS habitat (O'Leary 1990).

CSS is patchily distributed throughout the range of the gnatcatcher, and gnatcatchers are not uniformly distributed within the structurally and floristically variable CSS. Gnatcatchers occur most frequently within California sagebrush-dominated stands of CSS (Atwood 1990; Atwood et al. 1998a, 1999; Beyers and Wirtz 1997), and Weaver (1998) found that gnatcatcher densities in northern San Diego County are highest in areas where California buckwheat or California encelia (*Encelia californica*) are co-dominant with sagebrush. Despite these general habitat preferences, all shrub species within CSS are used by gnatcatchers. Gnatcatchers are typically found in stands of CSS that have moderate shrub canopy cover (40-80 percent) (Atwood 1980, 1988; Beyers and Wirtz 1997). The relative density of shrub cover influences gnatcatcher territory sizes, with territory sizes increasing as shrub cover decreases, probably due to limited resource availability. Gnatcatchers will use sparsely vegetated CSS as long as perennial shrubs are available, although there appears to be a minimum cover threshold below which the habitat becomes unsuitable (Beyers and Wirtz 1997). Braden et al. (1997a) found that gnatcatcher

fitness is positively correlated with the structural complexity of vegetation within territories; however, structural complexity does not necessarily equate to canopy cover or habitat maturity (G. Braden, San Bernardino County Museum, pers. comm. to C. Collier, Service, 2000).

Gnatcatchers also use chaparral, grassland, and riparian plant communities where they occur adjacent to, or intermix with, CSS (Campbell et al. 1998). The use of these atypical habitats appears to be most frequent during late summer, autumn, and winter, with smaller numbers of birds using non-CSS areas during the breeding season. However, breeding territories have been documented in non-CSS (e.g., chaparral, grassland, ruderal habitats).

Life History

The gnatcatcher is primarily insectivorous, non-migratory, and exhibits strong site tenacity (Atwood 1990). Fecal sample analyses reveal a diet composed predominantly of leaf- and plant-hoppers and spiders (Burger et al. 1999). True bugs, wasps, bees, and ants are minor components of the diet (Burger et al. 1999). Gnatcatcher adults selected prey to feed their young that is larger than expected given the distribution of arthropods available in their environment. Both adults and young consume more sessile than active prey items (Burger et al. 1999).

Gnatcatcher pairs strongly defend territories during the breeding season against other gnatcatchers and predators, while some gnatcatcher pairs will also defend territories throughout the year (Preston et al. 1998). Breeding season territories range in size from less than 1 ha to greater than 10 ha (2.5 ac to 25 ac) (Atwood et al. 1998b, Preston et al. 1998), with mean territory size generally being greater for inland populations than coastal populations. In the non-breeding season, the area used by individual gnatcatchers may be almost twice as large as that used during the breeding season (Preston et al. 1998).

Most gnatcatchers first breed at 1 year of age (Atwood and Bontrager 2001). The gnatcatcher breeding season extends from late-February through early-August with the peak of nesting attempts occurring from mid-March through mid-May (Grishaver et al. 1998, Atwood and Bontrager 2001). Nests are constructed over a 4-10 day period and are most often placed in perennial species of CSS about 1.2 m (3.9 ft) above the ground (Atwood 1990). Gnatcatchers do not show any significant preference or avoidance of any CSS species for use in the placement of nests (Grishaver et al. 1998). Gnatcatchers typically lay clutches of 3 to 5 eggs (Atwood 1990, Galvin 1998, Grishaver et al. 1998), and clutch sizes may be influenced by the amount of precipitation immediately preceding nest initiation (Patten and Rotenberry 1999). The egg incubation period is 14 days, and the nestling period is 10 to 15 days (Grishaver et al. 1998). Both sexes participate in all phases of the nesting cycle, and gnatcatcher pairs may produce more than one brood in one nesting season (Atwood 1990, Grishaver et al. 1998). Predation is the most common cause of nest failure, accounting for up to 66 percent of nest failures in some areas (Braden et al. 1997b, Grishaver et al. 1998). Over 30 percent of all nests may be parasitized by cowbirds in the absence of cowbird control, but because many parasitized nests are eventually

depredated, the negative effects of parasitism may be outweighed by the much larger effects of predation (Braden et al. 1997b).

Juveniles stay within their natal territories up to 5 weeks after fledging from the nest (Grishaver et al. 1998), with juveniles subsequently dispersing to find their own foraging and nesting territories. Juveniles have been observed to disperse up to 10.0 km (6.2 mi) from their natal territory (Atwood and Bontrager 2001), but they generally disperse less than 3.0 km (1.9 mi) on average (Bailey and Mock 1998, Galvin 1998, Atwood and Bontrager 2001). Dispersing gnatcatchers are apparently able to traverse highly human-modified landscapes for at least short distances (Bailey and Mock 1998).

Similar to other passerine species, gnatcatcher mortality is highest for the youngest age class, with much of this attributable to predation of young in nests (Atwood 1990, Braden et al. 1997b) and high mortality rates among dispersing juveniles, as indicated by low re-sighting of banded birds (Bailey and Mock 1998, Galvin 1998). Sources of mortality for gnatcatchers have not been well-studied, although physiological stress during cold, wet winter months when food availability may be low is probably the main source of mortality among adults and dispersing juveniles (Atwood 1990, Atwood and Bontrager 2001). Mean average survivorship of gnatcatchers during their first year is estimated to be 29 percent, with annual survivorship for adults 57 percent, although there is probably a high annual variation within and between populations (Atwood and Bontrager 2001). The oldest documented individual was a female at least 8 years old (Atwood and Bontrager 2001).

Status and Distribution

The gnatcatcher is found on the coastal slopes of southern California, from southern Ventura southward through Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties into Baja California, Mexico to about 30 degrees North latitude near El Rosario (AOU 1957; Atwood 1980, 1990; Service 2000b, 2003b). Today, about 94 percent of the gnatcatchers in the United States are found in Orange, western Riverside, and San Diego counties (Atwood and Bontrager 2001). Small, extremely isolated populations remain in portions of its former range in Los Angeles, San Bernardino, and Ventura counties; however, wildland fires within recent years may have adversely affected the status of gnatcatchers in some of these areas.

Population Dynamics and Estimates

The abundance of gnatcatchers at a given locale can fluctuate extensively on an annual basis (Atwood et al. 1998a, Erickson and Miner 1998, Preston et al. 1998); population declines or increases of greater than 50 percent between successive years have been reported regularly. Population fluctuations appear to be influenced by precipitation (Atwood et al. 1998a, Erickson and Miner 1998, Patten and Rotenberry 1999), with over-winter survivorship being negatively affected and subsequent productivity being positively affected by high winter precipitation. This

dynamic relationship between winter precipitation, survivorship and productivity has been noted for other resident bird species in coastal southern California (Kus and Beck 2001) and the Pacific coast (Nott et al. 2002). The stability of gnatcatcher populations may also be negatively affected by increasing fragmentation (Atwood and Bontrager 2001), with populations in small, isolated fragments more susceptible to extirpation from stochastic (i.e., drought) or catastrophic (i.e., wildfire) events.

In 1993, the Service estimated that about 2,562 pairs of gnatcatchers remained in the United States. Of these, 30 pairs (1.2 percent) occurred in Los Angeles County, 757 pairs (29.5 percent) occurred in Orange County, 261 pairs (10.2 percent) occurred in Riverside County, and 1,514 pairs (59.1 percent) occurred in San Diego County. Using four different estimation methods, the Service (2005c) estimated between 1,324 and 3,009 gnatcatcher pairs occupied Orange and San Diego counties in 2002. Assuming that the proportion of the gnatcatchers among all counties (including those not surveyed in 2002) remained consistent between 1993 and 2002, the overall gnatcatcher population in 2002 was comparable in magnitude to that estimated in 1993.

The population estimates described above were calculated prior to catastrophic fires in San Diego County in 2003 and San Diego and Orange Counties in 2007. These fires are assumed to have temporarily reduced the overall gnatcatcher population because of the temporary loss of gnatcatcher occupied habitat. In the 2007 firestorm, about 11,401 ha (28,173) ac of CSS burned in Orange County and about 34,076 ha (84,202 ac) of CSS burned in San Diego County in several separate locations, including MCBCP. MCBCP had additional large wildfire in 2008 that impacted extensive acreage of CSS occupied by gnatcatchers.

Threats and Conservation Needs

Gnatcatchers were considered locally common in the mid-1940s, but they had declined substantially in the United States by the 1960s (Atwood 1980). Although observed declines in numbers and distribution of the gnatcatcher resulted from numerous factors, habitat destruction, fragmentation, and degradation are the principal reasons for the Federal listing of the gnatcatcher as threatened in 1993 (58 FR 16742).

Urban development projects are currently the primary source of gnatcatcher habitat loss and fragmentation. Since the listing of the gnatcatcher, the Service has worked with project proponents to offset the loss of occupied or potential gnatcatcher habitat caused by development projects. This has been achieved through conservation, enhancement, and/or restoration of CSS on or near project sites, as agreed to during interagency consultation or the habitat conservation planning (HCP) process. Gnatcatcher habitat conservation, enhancement, and restoration since the listing of the gnatcatcher are likely to have offset CSS loss to some degree and buffered any decline in the gnatcatcher population caused by habitat destruction. Restored habitat has the potential to support gnatcatchers when there is a source population nearby that can access the

restored site (O'Connell and Erickson 1998, Miner et al. 1998). When combined with conserved CSS, enhanced and restored CSS has the potential to support a stable gnatcatcher population.

A consequence of urbanization that is contributing to the loss, degradation, and fragmentation of CSS is an increase in wildfire frequency (Keeley et al. 1999, Keeley and Fotheringham 2001, Keeley 2005). High fire frequencies and the lag period associated with recovery of the vegetation may significantly reduce the viability of affected gnatcatcher subpopulations (Dudek 2000). Although fire is a natural component of CSS ecology (Holland and Keil 1995), frequent fires may alter species composition of the community by breaking the reproductive cycles of some species, like California sagebrush and California buckwheat (Zedler et al. 1983, Malanson and Westman 1985, Holland and Keil 1995). Frequent fires may lead to the conversion of CSS into grasslands (Callaway and Davis 1993, Keeley et al. 2005). Due to loss of shrub cover, recently burned areas are used infrequently by gnatcatchers, and 4 to 5 years may be the minimum period of vegetation recovery necessary before gnatcatchers establish territories within completely burned areas (Wirtz et al. 1997, Atwood and Bontrager 2001). The period of habitat recovery necessary before gnatcatchers reoccupy burned areas depends on fire intensity, existence of unburned refugia within or adjacent to the burn perimeter, seasonal timing of the burn, soil type, post-fire rainfall patterns, topography, and pre-fire habitat conditions (Atwood et al. 2000).

The October 2003 wildfires throughout southern California affected 4 percent of known gnatcatcher occurrences, 16 percent of designated critical habitat acreage, and 28 percent of the Service's modeled habitat for the gnatcatcher (Bond and Bradley 2004). In October of 2007, severe wildfires burned about 36 percent of high quality habitat and 25 percent of very high quality gnatcatcher habitat in San Diego County. Of the areas burned in 2007, about 9.5 percent of high and very high quality habitat areas were previously burned in the 2003 fires. Due to the scope and intensity of the recent southern California fires, the areas affected are expected to take several years to fully recover; therefore, any remaining gnatcatcher source populations, and remaining gnatcatcher habitat, are important to the survival and recovery of the species. Furthermore, invasive plants tend to replace native CSS vegetation after fires in CSS (Keeley et al. 2005). Invasive plants (primarily non-native grass and annual forbs) are also more likely to dry out earlier in the summer and contribute to increased wildfire frequencies (Bunn et al. 2007). Fire frequency and burn size should be kept low where these exotic plants are well-established and where irreversible conversion of shrublands to grasslands is likely.

Although fire continues to be a threat, the several large regional HCPs in southern California mentioned above have addressed many other effects of urban development on this species. These plans are expected to provide long-term protection of occurrences of gnatcatchers and gnatcatcher habitat in western Riverside, Orange, and San Diego counties. For example, for the San Diego MSCP, Central/Coastal Orange County HCP, and Western Riverside MSHCP, between 42 and 80 percent of gnatcatcher locations are expected to be conserved; also for these plans, 52 to 76 percent of gnatcatcher habitat acres are expected to be conserved. The Orange

County Southern Subregion HCP anticipates conservation of 86 percent of locations and 88 percent of suitable habitat. Additional management and restoration of CSS on public and private lands as part of HCPs or through other conservation efforts will improve dispersal linkages and breeding habitat and will further aid the persistence and recovery of the species.

Status on MCBCP

The first surveys for gnatcatchers on MCBCP were conducted in 1989 (Tutton 1991) and detected 169 gnatcatcher territories, excluding the State Park lease area. A subsequent study in 1994 (Griffiths Wildlife Biology [GWB] 1997) detected 479 territories, also excluding the State Park lease area. Surveys for gnatcatchers in 1998 (Atwood et al. 1999) identified 620 territories, including the State Park lease area. Surveys in 2003 identified 316 gnatcatcher territories on MCBCP (GWB 2004), while preliminary information for surveys in 2006 identified 668 gnatcatcher territories on MCBCP (GWB 2008). The observed fluctuations in the gnatcatcher population on MCBCP are probably mostly influenced by environmental factors (e.g., precipitation, winter low temperatures, etc.), although it is likely that wildfires are also a significant additional anthropogenic influence on population change.

The USMC has estimated 19,106 ha (47,211 ac) of CSS suitable for gnatcatchers exists on MCBCP (USMC 2004). The current distribution of higher quality CSS and gnatcatchers on the perimeter of MCBCP (GWB 2004, 2008) probably reflects all past land uses, including agriculture and ranching practiced prior to the acquisition of MCBCP by the USMC (Baumgartner 1989, Zedler et al.1997). Since acquisition by the USMC, the most intense military training (i.e., live-fire training) has been focused towards the center of MCBCP, away from the communities adjacent to the perimeter of the installation. Although military training is likely to have continued to degrade CSS in the center of MCBCP, CSS has probably improved on the perimeter of MCBCP with the removal of most historic ranching and agricultural activities.

Ongoing and potential threats to gnatcatcher populations and gnatcatcher critical habitat on MCBCP since the listing include project construction, military training activities, cowbird parasitism, predation, habitat degradation, and fire (Service 1993b, GWB 1997).

Since the listing of the gnatcatcher, the USMC has formally consulted on project-related impacts to approximately 43.9 ha (108.6) ac of CSS on MCBCP considered to have been occupied by gnatcatchers (Service 2009). Including consultations where the USMC did not act as the lead agency during formal consultation (e.g., some highway, railroad and other projects), since the listing of the gnatcatcher, 58.9 ha (145.5 ac) of CSS has been impacted on MCBCP by various projects and has been offset by 89.8 ha (221.9 ac) of CSS conservation, enhancement, and restoration, leading to a potential net gain in CSS available to gnatcatchers on MCBCP and other areas within their range. Enhancement and restoration sites on MCBCP are not set aside as habitat preserves and therefore may be subject to subsequent training-related impacts over time.

Prior to the listing of the gnatcatcher, training on MCBCP was likely to have caused regular mortality of adult gnatcatchers, nest destruction, and incremental habitat degradation and destruction. Since the listing of the gnatcatcher, the USMC has instituted Range and Training Regulations that restrict ground disturbing activities, habitat removal, and training activities within occupied gnatcatcher habitat. These restrictions are likely to have reduced the incidence of gnatcatcher mortality, nest destruction, and habitat degradation and destruction caused by training activities.

Cowbird trapping on MCBCP intended to protect and conserve vireo and flycatcher populations has virtually eliminated nest-parasitism of these annually-monitored riparian species (GWB 2001; Kus 2001; USGS 2006, 2007), and cowbird parasitism of gnatcatcher nests has probably also been greatly reduced as a consequence of this program (GWB 1997).

The single biggest consequence of training that leads to the mortality of gnatcatchers and CSS degradation and destruction is probably human-caused wildfires, which can lead to catastrophic loss of CSS occupied by gnatcatchers. Gnatcatchers and their habitat on MCBCP have historically been exposed to wildfire on a periodic basis, either through natural ignitions or from anthropogenic sources prior to European settlement (Lewis 1973, Minnich 1983, Zedler et al.1997, Mensing et al. 1999). Despite this, current training activities on MCBCP lead to an artificially high return rate of wildfires (Minnich 1983, Zedler et al.1997, USMC 1998b). Over time, repeated wildfires have converted most of the shrublands in the center of MCBCP to a higher proportion of grasslands, savannahs, and sparse shrublands (Zedler et al. 1997).

In contrast, areas on the perimeter of MCBCP removed from the traditional live-fire areas generally contain mature shrublands and major gnatcatcher population centers and carry higher fuel loads. Wildfires caused by live-fire training have occasionally carried into these peripheral areas with higher fuel loading, causing extensive damage to high quality CSS and other shrublands; this usually occurs during hot, dry weather when high offshore winds ("Santa Ana conditions") develop in autumn and winter. When the conditions are right, these perimeter shrublands on MCBCP are susceptible to catastrophic wildfire. A significant amount of CSS (6,917 ha [17,092 ac]) on MCBCP burned during recent Santa Ana-driven fires in 2007 and 2008 (USMC 2009b); these wildfires burned CSS encompassing at least 205 gnatcatcher territories identified in 2006. Although the majority of the gnatcatcher-occupied habitat which occurs on the perimeter of MCBCP remains intact, it is likely that gnatcatchers occupying burned areas were either directly killed or displaced, with potentially high mortality of gnatcatchers occurring.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all

proposed Federal projects in the action area that have undergone section 7 consultation and the impacts of State and private actions that are contemporaneous with the consultation in progress.

Status within the Action Area

San Diego fairy shrimp – Miramar

The proposed action would occur within the Main Station area on a level mesa that is bordered by Rose Canyon on the north and San Clemente Canyon on the south. Surveys for SDFS and associated with vernal pools and other seasonally ponded habitats in the vicinity of the project area were comprehensively surveyed and mapped between 2001 and 2005 (USMC 2008).

The action area on Miramar, defined as all areas within 150 m (500 ft) of the project footprint, contains vernal pools and seasonally ponded features that support SDFS. The action area covers the east end of the HH vernal pool complexes described in the Recovery Plan. A more complete description of the HH complex is provided in the *Status of the Species – San Diego Fairy Shrimp* (*Status on Miramar*) section above.

There are a total of 21 pools (15 vernal pools and 6 seasonally ponded features) within the action area, including 13 pools occupied by SDFS. The total surface area of vernal pools within the action area is 0.088 ha (0.219 ac) (including 0.083 ha [0.204 ac] that is occupied by SDFS) and 0.114 ha (0.281) ac of seasonally ponded basin occupied by SDFS.

San Diego fairy shrimp and Riverside fairy shrimp – MCBCP

As stated previously, there are at least 273 pools occupied by SDFS and 110 pools occupied by RFS on MCBCP (RECON 2007). The following description of the environmental baseline for SDFS and RFS addresses only those pools likely to be affected by MV-22 operations on MCBCP. The two areas that may be affected are the DZ Tank Park and CAL 23 landing sites.

At least 26 pools occupied by SDFS and 13 pools occupied by RFS occur within the defined DZ Tank Park area (map book, Figure A-45), which is within the Las Pulgas complex defined in the Recovery Plan. All of these pools are moderately to highly degraded (i.e., Class III to IV pools per RECON 2001b). All vernal pools in this area are subject to ongoing degradation and loss of SDFS and RFS by military vehicle training, particularly fairy shrimp cysts that are crushed or displaced by military vehicles (FWS-MCBCP-3223.3). According to the BA, the USMC conducts about 133 CH-46E helicopter operations per year in the DZ Tank Park Area.

The BA (pp. IV-12 and IV-14) states that CAL Site 23 contains occupied SDFS and RFS pools, but figures within both the BA (Figure IV-12) and the map book (Figure A-19) show that there are no occupied pools within or immediately adjacent to the designated CAL Site 23. This disagreement is most likely due to repeated instances within the recent past where helicopters

landed at a distance from the actual CAL Site 23, in an area about 230 m (750 ft) to the east that does contain occupied SDFS and RFS pools (i.e., pool group 68 [RECON 2001b]). The USMC has stated that the occupied area to the east is not part of CAL Site 23 and that the MV-22 will not land in that vernal pool habitat (Z. Likins, USMC, pers. comm. to P. Beck, Service, September 30, 2009); therefore, we do not consider the CAL Site 23 to be occupied by SDFS or RFS.

Coastal California gnatcatcher – MCBCP

As stated previously, there were at least 668 gnatcatcher territories on MCBCP in 2006 (GWB 2008). All gnatcatchers on MCBCP are likely to be exposed to MV-22 noise, either during landing operations or operations where the MV-22 is transitioning between landing sites.

Gnatcatchers at the 47 landing sites may also be exposed to rotor outwash during landing operations. Two DZs (DZ Tank Park and DZ Basilone) have gnatcatchers mapped within their boundaries, while five other landing sites (STOL 101, CAL Site 20, LZ Viewpoint, VTOL 2, and LZ 27) have mapped gnatcatcher territories within 90 m (300 ft).

The BA and the map book show at least 13 gnatcatcher locations within DZ Tank Park and 4 gnatcatcher locations a within DZ Basilone. A review of GWB (2008) indicates that there were probably only 6 gnatcatcher locations within DZ Tank Park and 2 gnatcatcher locations a within DZ Basilone during the most recent Base-wide gnatcatcher survey in 2006; the distribution of gnatcatchers shown in the BA and map book is actually a composite of multiple years of survey data (Z. Likins, USMC, pers. com. to P. Beck, Service, September 29, 2009). Although the distribution of mapped gnatcatcher locations shown in the BA/map book are helpful in illustrating the areas used by gnatcatchers around various landing sites over an extended timeframe, we consider GWB (2008) to be a more accurate depiction of the likely number of territories within or near each these two locations.

The BA and map book show two landing sites (STOL 101 and CAL Site 20) with two or more gnatcatcher locations within 30 m (100 ft); two landing sites (LZ Viewpoint and VTOL 2) with two or more gnatcatcher locations within 60 m (200 ft); and one additional site (LZ 27) with at least one gnatcatcher location within 90 m (300 ft). All five of these sites with gnatcatcher locations mapped within 90 m (300 ft) have hard landing surfaces surrounded by CSS. Twelve additional sites have gnatcatcher locations mapped 150 m (500 ft) or more from the landing site. Due to the difference in mapping scale and the lack of comparable reference features between the BA/book versus GWB (2008), it is not possible to estimate the number gnatcatchers near each site based on GWB (2008). Although we consider the number of gnatcatcher locations depicted in the BA/map book to be an overestimate of the probable number of gnatcatchers within a given distance from each site, it is a reasonable indicator of the maximum number of gnatcatchers that are likely to occur near each landing site.

EFFECTS OF THE ACTION

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action that will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the proposed action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time but are still reasonably certain to occur.

Miramar (San Diego Fairy Shrimp)

Habitat Loss and Destruction of Cysts

Construction of the fuel pits will directly impact 12 pools (8 vernal pools and 4 seasonally ponded features[5]), 5 of which are occupied by SDFS. About 0.014 ha (0.035 ac) of vernal pool basin area (includes both occupied and unoccupied vernal pools) will be removed during construction of the fuel pits area. Of this, 0.002 ha (0.006 ac) supports SDFS and 0.012 ha (0.029 ac) do not. Additionally, 0.038 ha (0.094 ac) of seasonally ponded features that support SDFS will also be impacted. These acreage impacts include a 15 m (50 ft) buffer around the fuel pits construction footprint; the buffer area will be regraded and re-vegetated to discourage the future ponding within this buffer zone. Direct impacts will be in the form of destruction of cysts in the soil and loss of habitat by removal and excavation of vernal pool soils and upland plant communities that support vernal pool formation.

Vernal pool soils, including SDFS cysts, will be salvaged from the directly-impacted pools for use in subsequent restoration efforts. It is likely that some of the salvaged cysts will survive if they are used to "seed" newly created or restored pools, but for the purposes of this analysis, all cysts removed from the pools are assumed to be lost as it is possible that the salvaged cysts may not be used in the restoration, and many of the cysts will be destroyed during their salvage, storage, and re-introduction to restored habitat.

The loss of 0.052 ha (0.129 ac) of vernal pool habitat comprises about 1 percent of the mapped vernal pool habitat in the HH complex series. These pools were identified in the Recovery Plan as necessary to stabilize or reclassify the population of SDFS. However, because only a small amount of vernal pool habitat will be lost, implementation of the proposed project is not likely to compromise the unique combination of factors (e.g., hydrology, upland habitat) that currently exists within the HH complex series, which are necessary to support the formation and persistence of vernal pools.

[5] Seasonally ponded features are defined as ditches, road ruts, and impoundments.

The loss of SDFS habitat will be offset through development and implementation of a detailed restoration plan for restoration/re-establishment of 0.076 ha (0.189 ac) of high-quality SDFS habitat on Miramar.

Changes to Hydrology and Water Quality

Vernal pools and seasonally ponded features that are within the action area but outside the project footprint may be exposed to indirect effects associated with construction and operation of the fuel pits. There are a total 9 pools (7 vernal pools and 2 seasonally ponded features) within the action area but outside the project footprint. Of these pools, 8 are occupied by SDFS. About 0.074 ha (0.184 ac) of vernal pool basin area, including 0.071 ha (0.175 ac) that supports SDFS, and 0.076 ha (0.187 ac) of seasonally ponded features that support SDFS are within the action area but outside the project footprint. Potential indirect effects to these pools include alteration of existing hydrology and watershed area; reduction of water quality; and fragmentation of vernal pool habitat in the action area.

Excavating and grading the fuel pit area has the potential to alter natural hydrological regimes that support the SDFS and its habitat. The complex hydrology of vernal pools is supported by both surface flows within a pool's topographic watershed (i.e., the surface area in which water drains into a vernal pool) and subsurface flows that may extend beyond the surface watershed. Surface and subsurface lateral flows between vernal pools and the surrounding uplands influence the onset and level of inundation, and the seasonal drying of vernal pools (Hanes and Stromberg 1998). The project footprint includes small portions of the watersheds of three pools with SDFS. In each case, the project will likely result in small changes to the amount of surface flow entering the pool. However, because only a small portion of the watershed will be directly impacted, changes to surface flows entering these pools are not anticipated to be substantial.

In addition to affecting surface flows, the project has the potential to affect subsurface flows. For example, grading cuts near pools can accelerate the flow of water out of the subsoil (Bauder 1987). As such, graded slope cuts adjacent to the watersheds of vernal pools may result in 'leakage' of water out of the watersheds (City 2003). Conversely, trapping all subsurface flows of water within the surface watershed of the vernal pools via putting in retaining walls, or other developed features, may alter the hydrology of the pools by changing the onset or duration of ponding. Modifications to the hydrology of vernal pools can also alter the distribution of other vernal pool flora and fauna that are influenced by the length and frequency of water inundation (Bauder 1987, 2000). For instance, exotic plant species can become more prevalent in disturbed vernal pools when the periods of water inundation are reduced, while freshwater marsh species can expand into disturbed vernal pools when the periods of inundation are increased. Nevertheless, construction activities similar to those associated with the proposed project have been conducted in the surrounding environment, and the pools in the action area have continued to persist and to support SDFS. Therefore, although the project may have a minor effect on

subsurface flows for pools in the action area, changes to the hydrology of pools in the action area but outside the project footprint are not anticipated to be substantial.

Runoff from the fuel pit area could lead to a reduction in vernal pool water quality in adjacent ponds, potentially affecting SDFS survival and reproduction. SDFS are "osmoregulators" that maintain constant internal chemical concentrations, but cannot tolerate wide extremes in sodium or bicarbonate concentrations; therefore, they are vulnerable to contaminants in runoff waters and watershed quality that alter levels of salts and alkalinity (Service 1998). If the project results in runoff with high levels of pollutants, it could alter the specific water chemistry required by SDFS, thus negatively affecting their ability to mature and reproduce (Gonzalez et al. 1996; Holtz 2003). In addition, increased siltation from project-related construction could enter nearby pools, decreasing habitat quality and reducing survival of existing cysts. However, implementation of the water quality monitoring and management plan is anticipated to effectively minimize project-related sedimentation and pollution in nearby ponds.

In summary, we anticipate that the project may result in minor changes to water quality and hydrology in nearby vernal pools, but these changes will not be substantial and will not interfere with the ability of SDFS to survive and reproduce in these ponds. The USMC will implement a water quality and SDFS monitoring program to ensure that the above assessments regarding potential indirect effects to SDFS pools are correct. If data from this program reveal substantial differences in level and duration of ponding, pollutants, and/or loss of SDFS in vernal pools within the action area, as measured against nearby control pools, the USMC has stated that it will reinitiate consultation to address these effects.

Isolation

Construction of the fuel pit area will lead to increased isolation of three pools with SDFS, which lie to the east and south of the new development. Past studies of SDFS have shown that without human interference, SDFS pools generally have very low levels of genetic exchange (Fugate 1993, Davies 1996). Therefore, increased isolation *per se* is likely to have little effect on SDFS populations over the short term. Over the long term, decreased gene flow could increase susceptibility to extinction and reduced fitness (Soule 1986, Bohonak 2005), but, in general, gene flow is substantially higher in areas with high levels of human activity than in pristine areas (Bohonak 2005).

The project is located near the east edge of the HH complexes, so although a few pools will be isolated following project completion, the project is not anticipated to substantially interfere with the ecological functions within the HH complexes, such as hydrology, gene flow, and associated plant and animal communities, that link the vernal pools to one another and the surrounding uplands.

Human Encroachment

Development projects in close proximity to pools with SDFS have the potential to negatively affect nearby pools by increasing human access, which can lead to the trampling of cysts, habitat degradation, and introduction of non-native plant and animal species (Service 2004b). However, the pools in the action area are already in close proximity to USMC facilities, so the new development is not anticipated to substantially increase access to these pools. In addition, the project includes a 15 m (50 ft) vegetated buffer adjacent to the development area, which should minimize unauthorized encroachment into nearby vernal pools.

Restoration

As described above, restoration proposed in association with this project will likely use cysts salvaged from the impacted pools. However, for the purposes of this analysis, all salvaged cysts are assumed to be lost, as it is possible that the salvaged cysts may not be used in the restoration, and many of the cysts will be destroyed during their salvage, storage, and re-introduction to restored habitat. In addition, restoration activities may result in the destruction of a low number of cysts during habitat restoration activities, such as re-contouring of ponds, removal of non-native invasive plant species, and monitoring activities. However, the benefits to SDFS associated with restoration are anticipated to be substantially greater than the destruction of a low number of cysts. We anticipate that the vernal pool restoration plan for this project will include specific measures to minimize potential impacts to SDFS during restoration activities.

MCBCP

San Diego fairy shrimp and Riverside fairy shrimp

The only location where MV-22 landing and training operations are likely to affect SDFS and RFS is in the DZ Tank Park area, which is within the Las Pulgas complex described in the Recovery Plan. The USMC has stated that it will avoid vernal pools to the maximum extent feasible during MV-22 training operations. Additionally, due to the limited nature of suitable conditions necessary to land a MV-22 (i.e., a relatively flat, dry surface), it is unlikely that MV-22s will attempt to land in or near the DZ Tank Park pools when these pools are filled with water. Since SDFS and RFS require pooled water to hatch and mature, it is unlikely that MV-22 operations will directly affect adult SDFS or RFS.

MV-22 landing operations in or near the DZ Tank Park pools may infrequently impact occupied pools when they are dry, as these landing operations may lead to the crushing of fairy shrimp cysts under the MV-22's landing wheels, or displacement (and probable mortality of) of cysts that are blown out of the pools by rotor wash. According to the BA, only 4 MV-22 operations per year are expected in the DZ Tank Park area, which represents a decrease of about 129 helicopter operations per year (i.e., a 97 percent decrease) in this area. Therefore, the potential to

land directly in occupied vernal pools even during the dry season is very limited, but still possible. As a consequence of these infrequent landings in occupied vernal pools, we anticipate mortality of SDFS and RFS cysts associated with MV-22 operations is likely to occur on rare occasions.

Because the vernal pools in the DZ Tank Park area are already highly degraded and have been exposed to a high level of helicopter and vehicle training, it is unlikely that the MV-22 operations in and of themselves will lead to substantial further degradation of these pools such that either SDFS or RFS are extirpated from these pools. Furthermore, since we do not anticipate extirpation of SDFS or RFS from any of these pools due to MV-22 operations, we do not anticipate that MV-22 operations will substantially affect the status of SDFS or RFS within the Las Pulgas complex described in the Recovery Plan or preclude recovery of these species.

Coastal California gnatcatcher

Based on GWB (2008), there are likely to be at least 6 gnatcatcher territories that overlap the DZ Tank Park area to some extent and at least 2 gnatcatcher territories that overlap the DZ Basilone area. Although the USMC has stated that it will generally avoid CSS during MV-22 operations, it remains possible that some landing operations may occur near CSS or other habitats occupied by gnatcatchers. It is unlikely that any adult gnatcatcher will be directly injured or killed by MV-22 landing operations because adult gnatcatchers are likely to flee the immediate area if an MV-22 approaches the area they are occupying. Additionally, it is unlikely that an MV-22 will land directly on a gnatcatcher nest, due to the need for MV-22s to land on relatively flat ground devoid of anything other than low herbaceous vegetation.

It is possible that MV-22s will occasionally land adjacent to or hover above CSS that has an active gnatcatcher nest; powerful rotor outwash generated by the MV-22 has the potential to damage or destroy gnatcatcher nests in this situation. The three-dimensional spread of outwash will lead to its asymptotical decline (BA, Appendix A-2); due to friction with the ground and vegetation, it is likely that outwash will decline fairly rapidly as function of the distance from the source. Based on information provided in the BA, Appendix A-2, we anticipate that the biological effects of outwash will have dissipated to point of being biologically insignificant at distances of 90 m (300 ft) from the source. Of the 47 landing sites, only seven are likely to have gnatcatchers close enough to be affected by rotor outwash: two DZs (DZ Tank Park and DZ Basilone) have gnatcatchers within their boundaries, while five other landing sites (STOL 101, CAL Site 20, LZ Viewpoint, VTOL 2, and LZ 27) have gnatcatchers within 90 m (300 ft) of the landing area.

MV-22s landing at or hovering above the seven sites listed above may generate powerful rotor outwash that has the potential to damage or destroy gnatcatcher nests at or adjacent to these sites. Only 4 MV-22 operations per year will be conducted separately in each DZ Tank Park and DZ Basilone, a substantial decline from the number of operations currently conducted by CH-46E

helicopters (i.e., 133 operations in DZ Tank Park and 31 operations in DZ Basilone). CAL Site 20, LZ 27, LZ Viewpoint, STOL 101, and VTOL 2 are expected to receive only 40 MV-22 operations per year across all five sites combined, which is a 95 percent reduction from the current 820 annual CH-46E operations. Due to this dramatic reduction in annual operations and the limited potential for a nest at or near one of these landing sites, there is only a low probability that a gnatcatcher nest will be damaged or destroyed in any one year. Despite this reduction, there remains the potential that gnatcatcher nests may occasionally be damaged or destroyed in association with MV-22 operations at these areas.

Although the combined number of gnatcatcher nests that may be impacted at the seven sites considered above is hard to estimate, we anticipate that less than one percent of nests initiated by gnatcatchers within 90 m (300 ft) of these landing areas will be affected, due to the low likelihood of MV-22 operations near an active gnatcatcher nest. Since there are at least ten gnatcatcher territories that have been observed in and around these landing sites, this probability of one percent or less would lead to the destruction or damage of one gnatcatcher nest or less every ten years from MV-22 outwash.

All gnatcatchers on MCBCP may be subjected to MV-22 noise, either at landing sites or during over-flights. Noise decreases asymptotically with distance from the noise source (Larkin 1994); therefore, at some point noise originating from the project will diminish to the point that it is biologically insignificant. Forman and Deblinger (2000) estimated the maximum distance of direct ecological effects, including noise, from a suburban highway averaged just over 300 m (1000 ft), but noted a high degree of variability in that average. Due to the high degree of variability noted by Forman and Deblinger (2000), it is unlikely that noise will adversely affect gnatcatchers at distances beyond 150 m (500 ft) from the source.

The noise generated by the MV-22 is generally similar to the CH-46E that it will replace (BA, Table V-1), except that it will generate slightly less noise while cruising and slightly more noise while landing and taking off. Since most gnatcatchers on MCBCP are not adjacent to proposed landing sites and will be exposed only to over-flights, the lower cruising noise level indicates that most gnatcatchers will be exposed to less noise from the MV-22 as compared to the CH-46E. This lowered noise exposure indicates that it is unlikely that these gnatcatchers will be adversely affected by noise generated by MV-22 over-flights, as gnatcatchers on MCBCP are likely to be mostly habituated to current over-flight noise.

Although the higher landing noise levels may disturb gnatcatchers at or near landing sites to some extent, the physical impact of MV-22 rotor outwash is likely to have a more significant immediate effect on gnatcatchers and is likely to overshadow the effects of noise. Although there is potential for the combined effects of the greater rotor outwash and noise generated by the MV-22 to cause some gnatcatchers to be disturbed to the point that they shift their territories away from the designated landing sites, this will be offset by the substantial reduction in the number of landings at the five landing sites and two DZ sites listed above. Since the seven sites are

projected to have a combined total of only 48 annual operations, the higher noise generated by the MV-22 will be experienced less frequently and is, therefore, unlikely to cause displacement of any gnatcatchers from their current territories.

Although a few gnatcatcher nests may be damaged or destroyed on an infrequent basis, it is unlikely that this loss will lead to a measurable decline in gnatcatcher population on MCBCP, and we do not anticipate that MV-22 operations will negatively affect recovery of this species.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. We are unaware of any non-Federal actions in the area of the proposed project that may affect the species considered in this biological opinion.

CONCLUSION

After reviewing the current status of the San Diego fairy shrimp, the Riverside fairy shrimp, and the coastal California gnatcatcher, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of these species. Our conclusion is based on the following:

a. The loss of 0.052 ha (0.129 ac) of SDFS habitat (which includes 0.040 ha [0.10 ac] of occupied and 0.012 ha [0.029 ac] of unoccupied habitat) represents less than one percent of habitat in the HH vernal pool complexes identified in the Recovery Plan and a fraction of the available habitat on Miramar; in addition, the loss will not substantially limit the important ecological functions that link the vernal pool complexes to one another and the surrounding unaffected uplands in this area.

b. The project will result in a net increase in higher quality vernal pool habitat and flora and fauna diversity upon project completion and is thus consistent with the goals addressed in the Recovery Plan for the SDFS.

c. Although SDFS and RFS cysts may be crushed by MV-22 training operations at MCBCP on a rare basis, these impacts are not likely to substantially impact any of the affected populations. In addition, MV-22 training operations are not likely to substantially degrade SDFS habitat on MCBCP.

d. MV-22 training operations at MCBCP are unlikely to injure, kill, or displace any adult gnatcatchers. Gnatcatcher nests may be damaged or destroyed on a very infrequent basis by MV-22 training operations, but this impact is anticipated to have a negligible effect on the gnatcatcher population on MCBCP and is not anticipated to interfere with the species' recovery.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. Harm is further defined by us to include significant habitat modification or degradation that actually kills or injures a listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by us as an action that creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2) of the Act, such incidental take is not considered a prohibited taking under the Act, provided that such taking is in compliance with this incidental take statement.

AMOUNT OR EXTENT OF TAKE

We anticipate that the following take could occur as a result of the proposed actions listed below:

1. It is not possible to determine the number of SDFS that will be impacted by the proposed project. The exact population size of SDFS is difficult to estimate due to the dynamic conditions associated with their habitat. The reproductive success of SDFS is dependent on seasonal fluctuations in their habitat, such as presence or absence of water during specific times of the year, duration of inundation, and other environmental factors that likely include specific salinity, conductivity, dissolved solids, and pH levels. Therefore, the population of SDFS in any given pool varies dramatically. Nevertheless, we anticipate that all SDFS and/or cysts within the vernal pool habitat located within the project footprint and 15 m (50 ft) buffer area (i.e., 12 pools or 0.052 ha [0.129 ac] of SDFS habitat) will be taken in the form of direct mortality (i.e., harm) by grading, excavating, and filling the basins they occupy. Cysts will be salvaged from impacted pools, but for the purposes of this analysis, all cysts are assumed to be "taken."

   The take threshold for SDFS at Miramar is the loss or substantial degradation (i.e, project-related indirect effects to hydrology, sedimentation, or pollution that preclude SDFS survival and reproduction) of more than the 12 pools within the project footprint covering an estimated 0.052 ha (0.129 ac).

2. A low but unquantifiable number of SDFS cysts will be crushed or displaced during habitat restoration and enhancement activities conducted consistent with the vernal pool habitat restoration plan for this project.

3. A low but unquantifiable number of SDFS and RFS cysts will be crushed within or displaced from vernal pools in the DZ Tank Park area as a result of MV-22 operations. No injury or mortality of SDFS or RFS cysts or adults is anticipated or authorized as a result of MV-22 operations at other sites.

4. No more than one active gnatcatcher nest will be destroyed once every ten years by MV-22 rotor outwash during operations at the 47 designated landing sites.

EFFECT OF TAKE

In the accompanying biological opinion, we determined that this level of anticipated take is not likely to result in jeopardy to the San Diego fairy shrimp, the Riverside fairy shrimp, or the coastal California gnatcatcher.

REASONABLE AND PRUDENT MEASURES

We have not identified any additional reasonable and prudent measures, beyond the conservation measures described in the project description of this biological opinion, that are necessary or appropriate to further minimize the incidental take of the San Diego fairy shrimp, the Riverside fairy shrimp, or the coastal California gnatcatcher during project implementation.

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the Act, the USMC must comply with terms and conditions which implement the reasonable and prudent measures described above. Since no further reasonable and prudent measures are identified, no terms and conditions are necessary.

DISPOSITION OF SICK, INJURED, OR DEAD SPECIMENS

Upon locating dead, injured, or sick individuals of threatened or endangered species, initial notification must be made to our Division of Law Enforcement in either San Diego, California, at (619) 557-5063 or in Torrance, California, at (310) 328-6307 within 3 working days. Notification should also be sent by telephone and writing to this office in Carlsbad, California, at 6010 Hidden Valley Road, Suite 101, Carlsbad, California 92011, (760) 431-9440. Written notification must be made within 5 calendar days and include the collection date and time, the location of the animal, and any other pertinent information. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to

preserve biological material in the best possible state. The remains of intact specimens shall be placed with educational or research institutions holding the appropriate State and Federal permits. Remains shall be placed with the San Diego Natural History Museum, San Diego. Arrangements regarding proper disposition of potential museum specimens shall be made with the institution by the authorized biologist prior to implementation of the action.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's responsibility for this species, pursuant to section 7(a)(1) of the Act. There are no conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the West Coast Basing of the MV-22 and Training Project as outlined in materials submitted to us. As provided in 50 CFR §402.16 reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; and (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

In addition to the general circumstances described above, we have identified two specific circumstances under which the USMC should reinitiate consultation to address unanticipated impacts to federally listed species: 1) If the project is found to cause wildfires resulting in potential adverse effects to federally listed species; and 2) if the project results in substantial degradation (i.e, project-related indirect effects to hydrology, sedimentation, or pollution that preclude or significantly impair SDFS survival or reproduction) of pools that are in the action area but outside the project footprint at Miramar. The USMC has committed to implement monitoring programs developed in coordination with the Service to evaluate whether either of these potential effects occurs.

If you have any questions regarding this letter, please contact Fish and Wildlife Biologist Peter Beck at (760) 431-9440 extension 213.

Sincerely,

Jim A. Bartel
Field Supervisor

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Appendix B. Status of Miramar Vernal Pool Complexes Identified in the Recovery Plan

Complexes necessary for Stabilization of SD Fairy Shrimp (R1)		Current Status	Occupied	No. of Basins
1.	A4, Tierrasanta	Conservation Priority	Y	103
2.	AA1 east	Conservation Priority	N	26
3.	AA1 south	Conservation Priority/Mitigation Site	Y	55
4.	AA1 west	Conservation Priority	Y	45
5.	AA10	Conservation Priority	Y	417
6.	AA11	Conservation Priority	Y	85
7.	AA12	Conservation Priority	Y	23
8.	AA12 north+	Impacted	Y	83
9.	AA12 south	Conservation Priority	N	12
10.	AA13	Conservation Priority	Y	882
11.	AA4	Unknown	Y	15
12.	AA4-7	Conservation/Mitigation Site	Y	171
13.	AA9	Conservation Priority	Y	176
14.	EE1	Conservation Priority	Y	927
15.	EE2	Conservation Priority/Restoration (Partial)	Y	407
16.	EE6-17	Conservation/Mitigation Site	Y	44
17.	EE1-2	Enhancement/Development (Partial)	Y	8
18.	HH1+	Conservation Priority/Restoration (Partial)	Y	291
19.	HH2+	Conservation Priority	Y	95
20.	HH3+	Enhancement/Development (Partial)	Y	16
21.	HH4+	Developed (Partial)	N	8
22.	RR1	Conservation Priority	Y	91
23.	RR2	Conservation Priority	Y	26
24.	U1-13 (North)	Conservation Priority/Restoration (Partial)	Y	1656
25.	Z10	Enhancement/Development (Partial)	Y	37
26.	Z1-5	Conservation Priority	Y	125
27.	Z6-7	Enhancement/Development (Partial)	Y	107
Complexes necessary for Reclassification of SD Fairy Shrimp (R2)		**Current Status**	**Occupied**	**No. of Basins**
1.	AA8	Conservation Priority	Y	50
2.	F north (F28)	Conservation Priority/Restoration (Partial)	Y	337
3.	U15	Conservation/Mitigation Site	Y	47
4.	U19	Conservation/Mitigation Site	Y	9

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APPENDIX H-2

State Historic Preservation Office

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UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS WEST
BOX 555230
CAMP PENDLETON, CALIFORNIA 92055-5230

IN REPLY REFER TO
5090.xx
ENVSEC/zhl

Mr. James Garrison
State Historic Preservation Officer
Arizona State Parks
1300 W. Washington
Phoenix, AZ 85007

Subj: INITIATION OF SECTION 106 NATIONAL HISTORIC PRESERVATION ACT CONSULTATION – WEST COAST BASING OF THE MV-22 AIRCRAFT, CALIFORNIA AND ARIZONA

Dear Mr. Garrison,

The Marine Corps Installations West (MCIWEST) is initiating consultation in accordance with 36 CFR 800.3 for a project that will introduce the MV-22 Osprey tilt-rotor (MV-22) aircraft to the Western United States (U.S.). The proposed undertaking includes: 1) basing up to 10 MV-22 squadrons; 2) construction and/or renovation of airfield facilities; and 3) conducting MV-22 operations.

The proposed undertaking will base up to ten MV-22 squadrons (120 aircraft) on the West Coast, and will replace eight (8) CH-46E helicopter squadrons (103 aircraft) and one (1) CH-53E helicopter squadron (11 aircraft) currently based on the West Coast. The proposed MV-22 squadrons will be located at a single installation or will be split between a maximum of two aviation facilities. Installations under consideration include Marine Corps Air Station (MCAS) Miramar, MCAS Camp Pendleton, and MCAS Yuma (Figure 1). Facility requirements that may necessitate the construction and/or renovation of airfield facilities include appropriate hangar space, aircraft apron parking, and other related facilities (e.g., aircraft wash racks, fuel storage).

The MV-22 will conduct training and readiness operations and special exercise operations within Marine Corps controlled airspace and training ranges located on the West Coast. This includes operations at Marine Corps Base (MCB) Camp Pendleton, the Bob Stump Training Range Complex (Chocolate Mountain Aerial Bombing and Gunnery Range, Barry M. Goldwater Range [West], R-2510 and R-2512), and Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms (Figure 1). No construction is associated with proposed operations, but the MV-22 will utilize landing zones within these training ranges.

The Marine Corps is developing a determination of the area of potential effects (APE), per 36 CFR 800.4(a)(1). We are also in the process of completing record and literature searches and background research to identify historic properties within the APE as outlined in 36 CFR

800.4(a)(2)&(3) and 800.4(b)&(c). The results of these studies will be the subject of future consultations.

In accordance with 36 CFR 800.3, the Marine Corps requests initiation of consultation with the California and Arizona SHPOs. Since this is a multi-state undertaking, the Marine Corps requests that the California and Arizona SHPOs determine how they would like to proceed with consultation. For example, per 36 CFR 800.3(c)(2), if more than one state is involved in an undertaking, the involved SHPOs may agree to designate a lead SHPO to act on their behalf in the Section 106 process.

In proceeding with the planning of this undertaking, we plan to coordinate our Section 106 NHPA consultation with the development of an Environmental Impact Statement (EIS) to meet our National Environmental Policy Act (NEPA) requirements pursuant to 36 CFR 800.8. Our plan to involve the public will follow our established procedures for completing the NEPA process as well as fulfill our responsibilities under 36 CFR 800.3(e). Please provide any concerns you have regarding this approach so that we many incorporate them in our process.

Shortly after sending this letter, we will be initiating consultation with federally recognized Indian tribes affiliated with lands currently under Marine Corps jurisdiction. Similarly, we will also be notifying non-federally recognized Indian tribes subject to 36 CFR 800.3 (f). The purpose, pursuant to 36 CFR 800.3 (f) (2), is to determine if they (the Tribes) have any religious or cultural interest in the APEs involved. Please provide any comments you have regarding our efforts to identify all potential consulting parties and gather information as outlined in 36 CFR 800.3(f) and 800.4(a)(4).

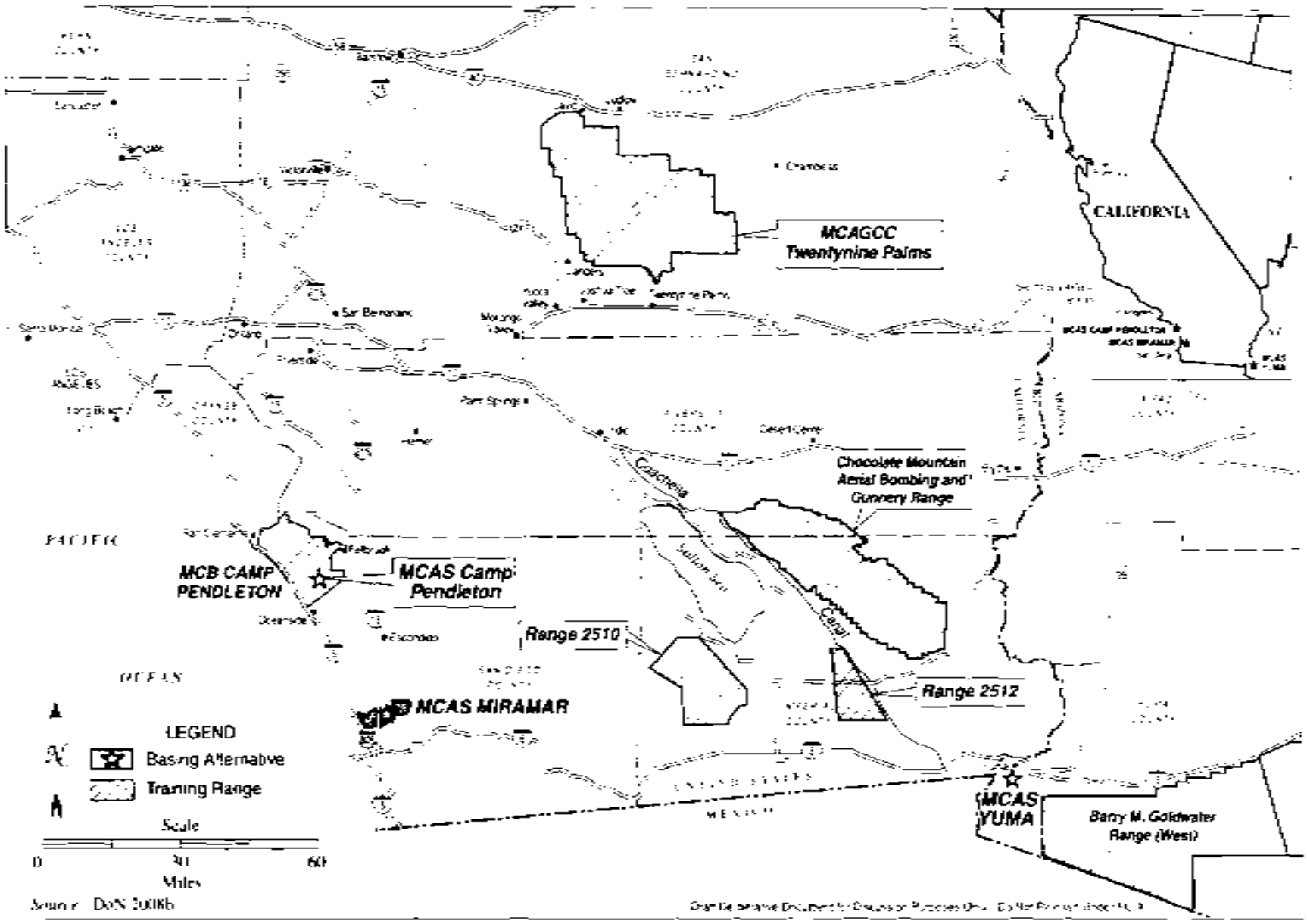
If you have any questions regarding this initial consultation, please contact Mr. Zak Likins at (760) 763-6976.

Sincerely,

Lupe E. Armas
By Direction of the Commanding General

Enclosures: Figure 1 - Location Map

cc: Mr. Milford Wayne Donaldson, SHPO/California State Park



Source: DoN 2008b

Location of Basing Alternatives and Proposed Training Ranges for the MV-22

FIGURE

1

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS WEST
BOX 555293
CAMP PENDLETON, CALIFORNIA 92055-5293

IN REPLY REFER TO
5090.xx
ENVSEC/zbl

Mr. Milford Wayne Donaldson
State Historic Preservation Officer
California Department of Parks and Recreation
1416 9th Street, Room 1442-7
Sacramento, CA 95814

Subj: INITIATION OF SECTION 106 NATIONAL HISTORIC PRESERVATION ACT CONSULTATION – WEST COAST BASING OF THE MV-22 AIRCRAFT, CALIFORNIA AND ARIZONA

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800.4(a)(2)&(3) and 800.4(b)&(c). The results of these studies will be the subject of future consultations.

In accordance with 36 CFR 800.3, the Marine Corps requests initiation of consultation with the California and Arizona SHPOs. Since this is a multi-state undertaking, the Marine Corps requests that the California and Arizona SHPOs determine how they would like to proceed with consultation. For example, per 36 CFR 800.3(c)(2), if more than one state is involved in an undertaking, the involved SHPOs may agree to designate a lead SHPO to act on their behalf in the Section 106 process.

In proceeding with the planning of this undertaking, we plan to coordinate our Section 106 NHPA consultation with the development of an Environmental Impact Statement (EIS) to meet our National Environmental Policy Act (NEPA) requirements pursuant to 36 CFR 800.8. Our plan to involve the public will follow our established procedures for completing the NEPA process as well as fulfill our responsibilities under 36 CFR 800.3(e). Please provide any concerns you have regarding this approach so that we many incorporate them in our process.

Shortly after sending this letter, we will be initiating consultation with federally recognized Indian tribes affiliated with lands currently under Marine Corps jurisdiction. Similarly, we will also be notifying non-federally recognized Indian tribes subject to 36 CFR 800.3 (f). The purpose, pursuant to 36 CFR 800.3 (f) (2), is to determine if they (the Tribes) have any religious or cultural interest in the APEs involved. Please provide any comments you have regarding our efforts to identify all potential consulting parties and gather information as outlined in 36 CFR 800.3(f) and 800.4(a)(4).

If you have any questions regarding this initial consultation, please contact Mr. Zak Likins at (760) 763-6976.

Sincerely,

Lupe E. Armas
By Direction of the Commanding General

Enclosures: Figure 1 - Location Map

cc: James Garrison, SHPO/Arizona State Park

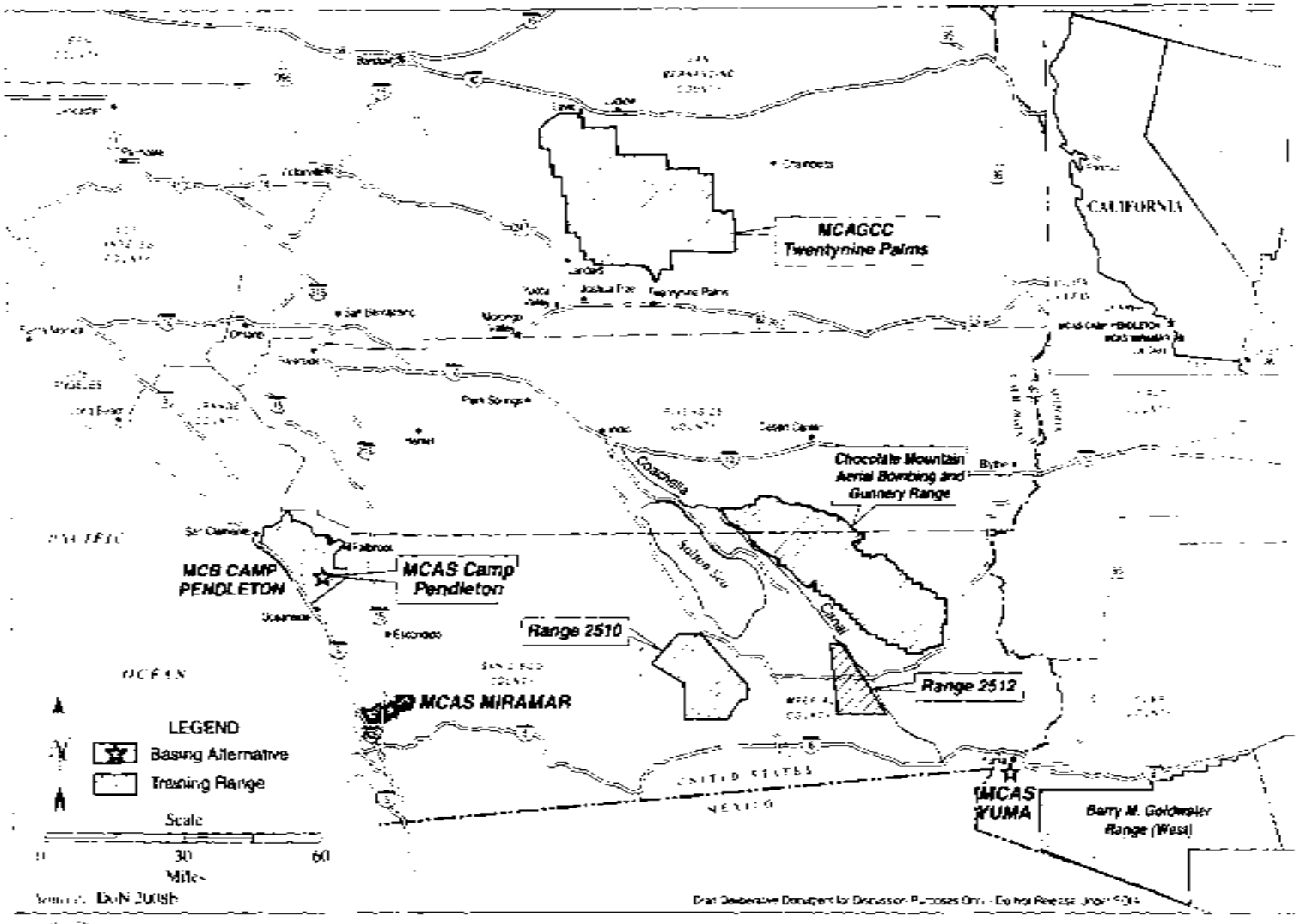


FIGURE 1

Location of Basing Alternatives and Proposed Training Ranges for the MV-22

5090/NHPA/106
MCIWEST/ENVSEC

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS WEST
BOX 555200
CAMP PENDLETON, CALIFORNIA 92055-5200

IN REPLY REFER TO

5090/NHPA
MCIWEST/ENVSEC
AUG 0 3 2009

Ms. Caroline Hall
Office of Federal Agency Programs
Advisory Council on Historic Preservation
1100 Pennsylvania Avenue NW, Suite 8035
Washington, DC 20004

Re: Notification of potential effects to cultural resources and development of a Programmatic Agreement for the West Coast Basing of the Marine Corps' MV22 Osprey aircraft.

Dear Ms. Hall,

Marine Corps Installations West (MCIWEST), acting as the project sponsor for the U.S. Marine Corps (lead federal agency) in transitioning the MV-22 aircraft (Osprey) to the West Coast, invites the Advisory Council on Historic Preservation (ACHP), per 36 C.F.R. § 800.14(b)(1)(ii), to enter into a Programmatic Agreement with the U.S. Marine Corps regarding the avoidance, minimization and mitigation of potential effects that may occur as a result of implementation of the above federal action. Since this federal action would take place in southern California and western Arizona, the development of this programmatic agreement has and will continue to involve consultations with the State Historic Preservation Officers (SHPOs) of both of these states. (Figure ES-1 and Figure 6.4.2-1)

Purpose and Need for the Undertaking

The purpose of the Undertaking is to determine the basing location(s) for MV-22 squadrons that would provide medium lift capability to support the First Marine Expeditionary Force (I MEF) and meet West Coast requirements for reserve component medium lift capability, and provide for efficient training through ready access to ranges, training areas and airspace. The MV-22 is the replacement for the current fleet of less-capable, 1960s-era CH-46 medium lift helicopters. The Third Marine Aircraft Wing (3D MAW) currently operates seven active duty squadrons of CH-46Es in support of the West Coast-based I MEF. The 4th MAW currently operates a reserve squadron of CH-46Es and, until recently, operated a reserve squadron of CH-53Es that was used in a medium lift capacity from Edwards Air Force Base (AFB) to meet West Coast reserve component medium lift requirements.

The need for the proposed action is to base the USMC's new medium lift aircraft where it can best support the I MEF and 4th MAW missions, while making use of existing facilities to the greatest extent practicable and preventing impacts to combat capability and mission readiness during the transition to meet current and future operational requirements of the USMC. In addition, increasing maintenance requirements limit the use of the aging aircraft (CH-46E) on the emerging battlefield. The MV-22 aircraft utilize tilt-rotor technology to provide the maneuverability and lift of a helicopter and, in fixed wing mode, have the ability to fly twice as fast, four times as far, and carry twice the combat load of the CH-46E (DoN 2008a). Thus,

replacement of CH-46E helicopters with MV-22 aircraft will modernize the USMC medium lift fleet and improve the operational capabilities of the 3D and 4th MAW squadrons.

DESCRIPTION OF THE PROPOSED

In general, the Undertaking is the introduction of the MV-22 aircraft to the Western U.S., as part of a USMC-wide process of replacing its aging fleet of medium lift helicopters with more advanced, operationally-capable aircraft. The replacement of CH-46E helicopters with MV-22 aircraft will modernize the USMC medium lift fleet and improve the operational capabilities of the 3D and 4th MAW squadrons. The would base up to ten MV-22 squadrons consisting of eight active duty squadrons and two reserve squadrons with a combined total of 120 aircraft on the West Coast.

The new MV-22 would replace seven CH-46E active duty squadrons (90 aircraft), one reserve CH-46E squadron (13 aircraft), and one reserve CH-53E squadron (11 aircraft) currently operated by the 3D and 4th MAWs (Table 1 below). Of the seven CH-46E active duty squadrons, three are associated with Marine Aircraft Group-39 (MAG-39) at Marine Corps Air Station (MCAS) Camp Pendleton, and four are associated with MAG-16 currently stationed at MCAS Miramar. Currently, the two Marine Corps reserve squadrons are associated with MAG-46 and located at Edwards AFB.

The MV-22 tilt-rotor aircraft is a new type of aircraft for the USMC, with new and different capabilities as compared to the CH-46 helicopter it is replacing. As a result, the USMC has made reasonable assumptions about the number and types of proposed MV-22 training, readiness and special exercise operations, based on operations currently being performed by medium lift helicopter squadrons, while accounting for differences in the aircraft (e.g., greater speed, range and combat payload capabilities) that would permit tactical training in ways not currently possible using conventional helicopters. Such assumptions are based on the MV-22 Training and Readiness Manual (USMC 2008c), which provides the best information available regarding proposed MV-22 operations.

The Marine Corps expects to continue updating the MV-22 Training and Readiness manual and training plans to reflect lessons learned from training evolutions and deployment experience. Due to the evolving nature of these MV-22 training requirements, additional training areas and air space, on or off Department of Defense (DoD)-owned lands, likely will emerge as necessary or useful for applying the aircraft's capabilities to ever-changing missions. The environmental impacts associated with new training requirements will be evaluated under the National Environmental Policy Act (NEPA), and will include consultation pursuant to the National Historic Preservation Act, where applicable. Toward that end, the U.S. Marine Corps (USMC) is seeking programmatic agreements with State Historic Preservation Officers to set forth procedures for evaluating future proposed landing zones.

The Marine Corps has selected the following basing option as the Preferred Alternative: eight squadrons at MCAS Miramar (Maximum Partial Basing Alternative at MCAS Miramar) and two reserve squadrons at MCAS Camp Pendleton (Partial Basing Alternative at MCAS Camp Pendleton). This basing option is presented hereinafter as the proposed action or , which includes the following: 1) basing up to eight MV-22 squadrons for employment by the 3D MAW to provide medium lift capability to the I MEF located at Marine Corps Base (MCB) Camp Pendleton; 2) basing of up to two 4th MAW MV-22 squadrons to provide a West Coast reserve component medium lift capability; 3) construction and/or renovation of airfield facilities necessary to accommodate and maintain the MV-22 squadrons; and 4) conducting MV-22 training, readiness and special exercise operations to attain and maintain proficiency in the operational employment of the MV-22.

Basing Operations, including Proposed Construction, Demolition and/or Renovation

Proposed MV-22 operations at established airfields include the following actions: Departures, Arrivals (Straight-In/Full-Stop), Overhead Break Arrivals, Touch-and-Go, Field Carrier Landing Practice, Ground-Controlled Approach Box, and Low Work. (see Attachment 1 for definitions of these terms)

Facility requirements that necessitate the construction and/or renovation of airfield facilities include appropriate hangar space, aircraft apron parking, and other related facilities (e.g., aircraft wash racks, fuel storage) along the flightlines of MCAS Miramar and MCAS Camp Pendleton. Enclosures A (MCAS Miramar) and B (MCAS Camp Pendleton) of this letter describe the proposed construction in greater detail.

At MCAS Miramar, due to current space constraints north of the existing runway, a maximum of eight squadrons of MV-22 aircraft (Table 1) would be stationed (based). Figure ES-4 and Table 5 (taken from the Environmental Impact Statement (EIS) and attached herein) provide the details regarding proposed new construction and necessary demolition of existing facilities. Basing eight squadrons of MV-22 aircraft at MCAS Miramar would entail up to 28 MV-22 aircraft housed in hangars and the rest on the aircraft parking apron (hangar and apron space planning accounts for at least 12 aircraft being deployed at all times). New support facilities would include three new hangar modules, parking apron, four new fueling pits, and five new wash racks. Figure 2.3-3 also shows an optional Hangar 7, which would be in lieu of the hangar module on the east side of Hangar 3 and the hangar module on the west side of Hangar 4. Although the Optional Hangar 7 currently overlaps with some aircraft parking space, parking for the affected aircraft could be moved adjacent to the Marine Expeditionary Unit (MEU) parking shown in purple. The apron expansion on the eastern side of the flightline would interfere with an existing flightline access road; flightline traffic would be rerouted to another existing road further east. The existing fueling octagon and the compass rose facilities would have to be relocated to provide enough parking apron for both the MV-22s and the existing CH-53Es. This Undertaking requires construction north of the runway to accommodate 84 aircraft, but no construction would occur in the undeveloped area south of the runway. A dedicated construction staging/lay-down area has been identified, located north of Hangar 6 (Figure ES-4, vertical cross-hatching).

Table 1. Proposed Change in Aircraft and Personnel at MCAS Miramar

	Aircraft	Officers	Enlisted	Total Military Personnel
EXISTING AIRCRAFT/PERSONNEL TO BE REPLACED BY THE MV-22				
MCAS Miramar (four CH-46E active duty squadrons)	48	192	1,077	1,269
PROPOSED MV-22 AIRCRAFT/PERSONNEL				
Proposed Action (the) = Maximum Partial Basing (8-Squadron) Alternative	96	323	1,692	2,015
NET CHANGE IN AIRCRAFT/PERSONNEL				
Proposed Action (the) = Maximum Partial Basing (8-Squadron) Alternative	+48	+131	+615	+746

(NOTE: tables 2-4 are located at the back of this correspondence letter, following the three map figures).

Table 5. Summary of Proposed Construction and Demolition at MCAS Miramar

	Preferred Alternative (): 8-Squadrons
CONSTRUCTION	
Building Facilities (square feet)	230,562
Airfield Facilities (square yards)	400,651
DEMOLITION	
Building Facilities (square feet)	43,633
Airfield Facilities (square yards)	144,061

Source: DoN 2008b

At MCAS Camp Pendleton, due to the limited amount of developable land along the flightline, the maximum number of MV-22 aircraft possible is two squadrons. Up to eight MV-22 aircraft would be housed in hangars, and the rest on the aircraft parking apron (Table 6). New support facilities, including a new hangar module, modifications (renovations) to an existing hangar, new wash rack, and new parking apron would be as shown in Figure ES-6 and Table 7. New facilities may require the demolition and relocation of an existing Explosive Ordnance Disposal (EOD) operations building, either as an addition to the proposed new hangar or as a standalone facility (Figure ES-6). The fuel farm would also be upgraded. MCAS Camp Pendleton has a designated construction staging/lay-down area in a parking lot outside of the flightline that has been used in the past for construction-related equipment and materials; this area would be used for the same purpose for this .

Table 6. Proposed Change in Aircraft and Personnel at MCAS Camp Pendleton

	Aircraft	Officers	Enlisted	Total Military Personnel
EXISTING AIRCRAFT/PERSONNEL TO BE REPLACED BY THE MV-22				
MCAS Camp Pendleton (three CH-46E active duty squadrons)	42	124	845	969
PROPOSED MV-22 AIRCRAFT/PERSONNEL				
Proposed Action (the) = Partial Basing (2-Squadron) Alternative	24	100	612	712
NET CHANGE IN AIRCRAFT/PERSONNEL				
Proposed Action (the) = Partial Basing (2-Squadron) Alternative	-18	-24	-233	-257

Table 7. Summary of Proposed Construction and Demolition at MCAS Camp Pendleton

	Preferred Alternative (): 2-Squadrons
CONSTRUCTION	
Building Facilities (square feet)	80,106
Airfield Facilities (square yards)	76,171
DEMOLITION	
Building Facilities (square feet)	1,344
Airfield Facilities (square yards)	0

Source: DoN 2008b

Airfield Use

Airfield use at MCAS Miramar would be dependent upon the number of squadrons based at the station. Table 8 below provides an approximate number of annual MV-22 airfield operations expected at MCAS Miramar. An airfield flight operation is defined here as a single event that occurs at the air station, such as departure, arrival, or touch down. For example, one aircraft departing and returning would represent two airfield flight operations. The Undertaking includes eight active duty squadrons representing the maximum number of airfield operations under a partial basing scenario. The proposed MV-22 airfield operations would replace approximately 17,000 annual airfield operations at MCAS Miramar currently being conducted by the CH-46E aircraft that the MV-22 is replacing.

Table 8. Proposed Annual MV-22 Airfield Flight Operations at MCAS Miramar

Operation Type	Preferred Alternative (): 8-Squadrons
Departure	16,327
Arrival (no break)	1,635
Overhead Break Arrival	14,696
Touch-and-Go	3,015
GCA Box	3,769
Low Work	126
Total	39,568

Notes: GCA = Ground-Controlled Approach. Touch-and-Go, GCA Box, and Low Work are counted as two operations each. The 8-Squadron Alternative includes eight active duty squadrons.

At MCAS Camp Pendleton, Table 9 below provides an approximate number of annual MV-22 airfield operations expected for the Undertaking. As indicated above, an airfield flight operation is defined here as a single event that occurs at the air station, such as a departure, arrival, or touch down. The Undertaking (Partial Basing Alternative) includes two active duty squadrons representing the maximum possible airfield operations proposed for MCAS Camp Pendleton. The proposed MV-22 airfield operations would replace approximately 18,000 annual airfield operations at MCAS Camp Pendleton currently being conducted by the CH-46E aircraft that the MV-22 is replacing.

Table 9. Proposed Annual MV-22 Airfield Flight Operations at MCAS Camp Pendleton

Operation Type	Preferred Alternative (): 2-Squadrons
Departure	5,005
Arrival (no break)	5,005
Touch-and-Go	928
GCA Box	1,159
Total	12,097

Notes: GCA = Ground-Controlled Approach. Touch and Go and GCA Box are counted as two operations each. The 2 Squadron Alternative includes two active duty squadrons. The proposed MV-22 FCLPs would occur at MCB Camp Pendleton (on the Helicopter Outlying Landing Field or "HOLF") instead of the airfield

Proposed Training, Readiness and Special Exercise Operations

In addition to basing and related construction and demolition activities along the flightlines of MCAS Miramar and MCAS Camp Pendleton, MV-22 training, readiness and special exercise operations will be conducted within existing DOD-controlled airspace and training ranges located on the West Coast. This includes operations at MCB Camp Pendleton (San Diego County, California), the Bob Stump Training Range Complex (Barry M. Goldwater Range – West [BMGR-West] (Yuma County, Arizona), Chocolate Mountain Aerial Gunnery Range [CMAGR] (Imperial and Riverside counties, California), and Ranges -2510 and -2512 (Imperial County, California)), as well as at Marine Corps Air-Ground Combat Center (MCAGCC) at Twentynine Palms (San Bernardino County, California), and various Military Training Routes (MTRs) located in San Diego, San Bernardino, Riverside, and Imperial counties in California and in Yuma, La Paz, Pima, Pinal, Maricopa, Yavapai, and Mohave counties in Arizona)(Figure 6.4.2-1).

Proposed operations would fall into three broad categories: initial or familiarization training designed to instruct new pilots or acquaint pilots of other aircraft with the operation of the MV-22; tactical training designed to teach MV-22 aircrew the tactical employment of the aircraft; and integrated training designed to teach aircrew how to combine MV-22 operations with other Marine or joint air and ground assets.

Operations for new or transition pilots would include working through the MV-22 Training and Readiness Manual (USMC 2008c), and would involve the use of the aircraft's machine gun at existing targets. Course elements include the following:

- Familiarization profiles (night and day);
- Formations (night and day);
- Nuclear, biological, and chemical equipment training (night and day);
- Tactics;
- Confined area landings;
- Combined arms exercises;
- Night vision goggle training;
- Terrain-following exercises; and
- Training in urban environment exercises.

Examples of proposed MV-22 integrated training include special exercises, such as the Weapons Tactics Instructors (WTI) course and Desert Talon. WTI and Desert Talon are staged from MCAS Yuma, Arizona, and each occurs twice a year for about three to four weeks, a large portion of which occurs in the classroom. The purpose of the WTI course is to hone the skills of USMC aviation units in weapons delivery, tactics, command and control, and integration of joint forces. The exercise is focused on the six major functions of Marine Aviation: offensive air support, anti-air warfare, assault support, aerial reconnaissance, electronic warfare, and control of missiles and aircraft. The purpose of Desert Talon is to prepare aviation and aviation support units for the Operation Iraqi Freedom rotation in a realistic desert environment. The training events are designed to expose participants to missions that would likely be implemented while deployed, with emphasis on integration, coordination, and tactical execution. No construction or other types of site modifications are associated with proposed training, readiness and special exercise operations.

Approximately 46,000 total MV-22 annual operations are expected to occur at the training ranges and MTRs (Table 10). This would replace approximately 27,000 annual operations currently being conducted by the CH-46E aircraft that the MV-22 is replacing. This change in number of annual operations takes into account that the MV-22 is a new type of aircraft and that every pilot will need to complete all training based on the MV-22 Training and Readiness Manual. This includes initial or familiarization training designed to instruct new pilots or acquaint pilots of other aircraft with the operation of the MV-22. As the pool of experienced MV-22 pilots increases over time, it is expected that the number of annual training operations will decrease.

Chapter 6 describes each training range and the MTRs in more detail and provides an analysis of impacts related to operations at these locations.

Table 10. Proposed Change in Annual Airspace/Range Operations

Location	Addition of MV-22 Operations	Reduction of CH-46 Operations	Change in Operations over Existing Conditions
MCB Camp Pendleton	17,008	-15,113	1,895
BMGR-West	17,942	-5,652	12,290
CMAGR	5,111	-862	4,249
R-2510 and R-2512	148	-78	70
MCAGCC	3,874	-5,563	-1,689
MTRs	2,085	-	2,085
Total	46,168	-27,268	18,900

Note: Includes operations at the Helicopter Outlying Landing Field (HOLF) at MCB Camp Pendleton, the outlying auxiliary airfield (AUX-2) at Barry M. Goldwater Range, and the Expeditionary Airfield (EAF) at MCAGCC. For MTRs, each one-way trip represents an operation

Transit and Military Training Routes (MTRs)

The MV-22 would also use seven MTRs located within southern California and western Arizona as part of their training operations (Figure 6.4.2-1). These include IR-216, IR-217, IR-218, VR-1266, VR-1267, VR-1267A, and VR-1268. These MTRs are sufficient to accommodate proposed operations associated with the MV-22 Training and Readiness Manual. Although the MV-22 may fly at a range of altitudes and speeds along these routes, for the purposes of air quality and noise modeling, it was estimated that the MV-22 would fly at 200 knots and at the minimum altitude allowable, which in most cases was between 200 feet (60 meters) and 500 feet (152 meters) above ground level. Note that some segments of the MTRs have higher minimum altitudes to protect recreational or biological resources. For example, aircraft must stay over 3,000 feet (915 meters) over the Imperial National Wildlife Refuge when flying VR-1266 and VR-1267. The MV-22 operators would abide by these regulations.

Typical routes for access to and from airfields, ranges, and MTRs throughout the southern California and Arizona regions, would occur at over 3,000 feet (914 meters) above ground level. The only exceptions are major Ingress and Egress routes to and from airfields, ranges, and MTRs that fall within the restricted airspace adjacent to the proposed basing locations or training locations. Note that MV-22 will be transitioning from the ground level to 3,000 feet above ground level within these Ingress and Egress routes.

AREA OF POTENTIAL EFFECT

In accordance with 36 C.F.R. § 800.4(a)(1), MCIWEST has established the Area of Potential Effect (APE) for the proposed .

For construction, renovation and demolition at MCAS Miramar and MCAS Camp Pendleton, the APE consists of all areas of ground disturbance associated with proposed construction activities, construction vehicle parking, staging activities, and, in the case of MCAS Miramar, habitat restoration areas. For historic architectural resources, the APE includes any buildings/structures that will be altered, renovated or demolished. For Native American resources, the APE includes all areas of ground disturbance of any traditional cultural resources that could be affected by construction. Enclosures A (MCAS Miramar) and B (MCAS Camp Pendleton) of this letter describe the APE for the two installations and provide detailed maps of the APE.

For proposed training, readiness and special exercise operations, the APE includes all areas of potential ground disturbance from hovering and/or landing the MV-22 within the training ranges. Downdraft and outwash occur from moving rotors (collectively known as rotorwash). Rotorwash forces are relative to the engine power settings and the aircraft's proximity to the ground. Rotorwash from the MV-22 would be greater than from the CH-46 (the aircraft it is replacing) at a given height above the ground. Outwash from the MV-22 would reach 50 knots at a distance of 150 feet from the aircraft when hovering at 20 feet above ground level, which is three to four times greater than that associated with the CH-46. The outwash velocities would rapidly diminish very near the ground surface.

Rotorwash from an MV-22 aircraft during landing, take-offs, and hovering immediately above the ground may disturb archaeological sites in the immediate vicinity of the hovering aircraft, although the extent of this disturbance would depend on local soil characteristics, presence of vegetation, and size/weight of artifacts. To account for this rotorwash, the APE includes a 350-foot buffer area around the point of landing. The 350-foot buffer area was based on the Navy Program Office's review of existing rotorwash information for the MV-22. Enclosures C (MCB Camp Pendleton), D (Bob Stump Training Range Complex), and E (MCAGCC) of this letter describe the APE for the training ranges and provide detailed maps of the APE.

STEPS TAKEN TO IDENTIFY HISTORIC PROPERTIES

Per 36 C.F.R. § 800.4(a)(2)&(3) and § 800.4(b)&(c), MCIWEST has completed a review of available records regarding the presence of historic properties within the APE. This includes an extensive review of previous survey efforts in the vicinity of each landing area APE, identifying any data gaps, and reviewing available information on all recorded archaeological sites or historic building/structures (e.g., site records, testing reports, SHPO correspondence) to identify previous eligibility recommendations.

In the case of MCAS Miramar and BMGR-West, two archaeological field surveys were conducted specifically for this Undertaking, one at each installation (SAIC 2008, 2009); no other field investigations were conducted as part of this project.

Based on our analysis, 95 recorded archaeological sites are within the APE. There also is the possibility of unrecorded archaeological sites within unsurveyed portions of the APE. Table 11 below provides a summary of recorded archaeological sites within the APE, broken down by installation and National Register of Historic Places (National Register) status. Those resources, coded as "DE" or "CE" in Table 11, are considered historic properties. Those resources coded "NEV" have not been evaluated. No historic buildings or structures will be affected by the Undertaking. The enclosures provide the details regarding all identified archaeological sites at each installation. Additional survey data (the identification phase of the) will be collected at all identified landing areas lacking 100% survey coverage, as described below, including sites at MCB Camp Pendleton, BMGR-W and CMAGR, and MCAGCC (see Enclosures C, D(a) , D(b) and E, respectively).

The identification phase of this to determine the presence of historic properties within the APE is incomplete, which has lead MCIWEST to make its' "may affect" Finding. As described below, there is: 1) the need for additional archaeological surveys for areas that lack adequate survey coverage: 2) the need for additional site testing of non-evaluated sites that cannot be avoided; and 3) continued consultation with Indian tribes (on-going) and may lead to the identification of additional cultural resources and/or traditional use areas.

Table 11. Recorded Archaeological Sites within the APE

Installation	DI	DE	CI	CE	NEV	Total
MCAS Miramar	4	-	3	-	-	7
MCAS Camp Pendleton	-	1	-	-	1	2
MCB Camp Pendleton	-	-	9	4	18	31
BMGR-West (Arizona)	6	-	9	4	4	23
CMAGR	-	-	22	3	1	26
MCAGCC	-	-	-	1	5	6
Total	10	1	43	12	2	95

National Register Status: DI = determined ineligible for inclusion on the National Register with SHPO agreement; DE = determined eligible for inclusion on the National Register with SHPO agreement; CI = considered ineligible for inclusion on the National Register (pending SHPO agreement); CE = considered eligible for inclusion on the National Register (pending SHPO agreement); NEV = not evaluated for National Register eligibility.

FINDING OF EFFECT

Proposed Construction and Habitat Restoration. Based on the analysis conducted to identify historic properties within the APE, MCIWEST has found that the proposed would have no effect on recorded historic properties within the MCAS Miramar APE (see Enclosure A). For MCAS Camp Pendleton, the recorded site boundaries of CA-SDI-10156/12599/H, a historic property, is within the APE. Previous excavations within or immediately adjacent to the APE have been negative, which suggest the likelihood of encountering intact archaeological deposits within the APE is low, but this possibility cannot be dismissed completely. MCIWEST has identified conditions to the proposed Undertaking, including construction monitoring, preconstruction meetings, and procedures regarding the discovery of unexpected archaeological materials to minimize the potential adverse effect (see Enclosure B).

Proposed Training, Readiness and Special Exercise Operations. Based on the analysis conducted to identify historic properties within the MCB Camp Pendleton, Bob Stump Training Range Complex, and MCAGCC APE, it was determined that portions of the APE lack adequate survey coverage and may contain as yet unidentified historic properties. MCIWEST has identified conditions to the proposed Undertaking that will either 1) add operational protocols to ensure avoidance of areas lacking survey coverage, or 2) require surveys before MV-22 operations take place for those areas that cannot be avoided. If an archaeological site is identified based on a subsequent survey, MCIWEST will follow the procedures outlined in the Final Programmatic Agreement regarding identification and evaluation, once approved and signed.

Our analysis of existing data also demonstrated the presence of archaeological sites eligible for listing on the National Register, as well as those that have not been previously evaluated within the APEs. MV-22 landing operations may affect the integrity of a historic property due to aircraft rotorwash if the property is located within 350 feet of the landing site. MCIWEST has identified conditions to the proposed Undertaking that will either 1) add operational protocols to ensure avoidance of eligible sites and non-evaluated sites, 2) require testing of non-evaluated sites to determine if the resource is eligible or ineligible for listing on the National Register, and/or 3) require treatment of an eligible site that cannot be avoided. If additional archaeological sites are recommended as eligible for listing on the National Register based on subsequent site testing, MCIWEST will follow the procedures outlined in the Final Programmatic Agreement regarding mitigation and treatment, once approved and signed.

Tables 2 and 3 provide a summary of proposed conditions, as needed, for each of the 126 landing areas proposed for use by the MV-22 (see "Proposed Conditions" column). These conditions will be incorporated into the Final Programmatic Agreements for both California and Arizona SHPOs once approved and signed.

CONSULTATION

Indian Tribe Consultation. MCIWEST initiated consultation with federally recognized Indian tribes subject to 36 C.F.R. § 800.3(f)(2) and non-federally recognized Indian tribes affiliated with lands currently under Marine Corps jurisdiction and involved in this . The purpose was to determine if they (the Tribes) have any religious or cultural interest in the APEs involved with the Undertaking.

Archaeologists from each installation identified the tribal governments whom they typically consult with on their respective activities (those within their geographic reach and/or known to have tribal lands and/or traditional use areas as part of their respective installation lands). A total of 71 consultation initiation letters were sent to approximately 50 tribal governments, with follow-up phones call and e-mails to each Tribe thereafter to ensure these tribal governments had received the initiation letter, and if so, determine if they had specific questions, comments and/or concerns. Table 4 identifies approximately 50 tribal governments initially contacted by mail and provides information on relevant discussions with each tribal representative.

Of the 71 initiation letters sent out, approximately 15 tribal government responses were received. These included written comments returned using a response form, e-mails and/or tribal representatives discussed their respective concerns over the phone. In addition, face-to-face meetings were held at selected installations (MCAS CPEN, MCB CPEN and MCAGCC), as indicated in Table 4. These included meetings at: MCB Camp Pendleton (January 22, 2009); MCAS Camp Pendleton (March 13, 2009); and MCAGCC at Twentynine Palms (January 8 and 22, 2009).

At the meetings, the proposed Undertaking was discussed and tribal representatives provided either written or verbal comments directly to the Marine Corps representatives. In some instances, individual face-to face meetings were held with selected tribal representatives who had responded in writing and had requested to be contacted. These included the Quechan and Cocopah Nations, to date. Additional individual follow-up face-to-face meetings are anticipated over the next two (2) months to ensure all comments and concerns are identified, captured and incorporated into the formal project record. Future group meetings are currently planned at MCAS Yuma, MCAGCC and MCB Camp Pendleton sometime in late August and early September 2009. All additional, relevant tribal input received in the future will be recorded and provided to SHPO and made part of the formal administrative record for this project.

Public Outreach per the National Environmental Policy Act. The Marine Corps, with support from DON, prepared an EIS regarding this Undertaking. Public scoping meetings were held in October and November 2000, in six southern California communities and in Yuma, Arizona. The Draft EIS was circulated for review and comment to government agencies, local organizations, Native American tribes, and interested private citizens for 45 days between 17 February 2009 and 30 March 2009. Public meetings were conducted during the review period in two southern California communities (one near MCAS Camp Pendleton in the City of San Clemente [25 March 09], and one near MCAS Miramar in the City of San Diego [24 March 09]), as well as in Yuma, Arizona [near MCAS Yuma] on 26 March 09). The Final EIS will be circulated for a 30-day review period (expected release date is approximately October 2009).

Please provide any comments you have regarding our efforts to identify all potential consulting parties and gather information as outlined in 36 C.F.R. §§ 800.3(f) and 800.4(a)(4).

RECOMMENDED ACTIONS TO AVOID, MINIMIZE OR MITIGATE ADVERSE EFFECTS

In accordance with 800.6(a)(1)(i)(C) and 800.14(b)(1)(ii), MCIWEST has determined that effects on historic properties cannot be fully determined prior to approval of this Undertaking, and proposes to enter into a Programmatic Agreement with the SHPO, the Advisory Council of Historic Preservation, and other

consulting parties to resolve adverse effects. Potential effects, if any, vary by installation, training area and range, as indicated in the enclosures (Attachment 2, Enclosures A-E). As a result, MCIWEST is notifying the ACHP of its actions and requesting ACHP participation in the section 106 consultation process, including development of Programmatic Agreement(s) (PA) with California and Arizona SHPOs and other interested parties, to resolve all potential effects of the Undertaking.

Development of the PA will ensure the following: (1) MV-22 aircraft will train within only those landing sites previously surveyed where no Historic Properties would be adversely affected; and (2) for those landing sites yet to be fully surveyed, cultural resource surveys will be conducted to provide 100% coverage within the APE and evaluations completed, with SHPO agreement before use by these aircraft. If archaeological resources are identified within the APEs, precise landing sites would be located away from any eligible resources to avoid impacts altogether. If precise landing sites cannot be identified that avoid the impact, a mitigation plan would be implemented per the PA to minimize the effect to any eligible cultural resource site to the maximum extent practicable. Further, any remaining sites with potential resource impacts would be mitigated according to the steps identified within the PA, as mutually agreed to by and between all parties (e.g., treatment, data recovery, etc.) before any use by MV-22 aircraft. (see Enclosures A - E).

If you have any questions, please contact Mr. Zachery H. Likins at (760) 763-7948.

Sincerely,

S. W. Norquist
Environmental Security Manager
Marine Corps Installations / WEST
Box 555200, Bldg. B22165
Camp Pendleton, CA 92055-5200

Attachments:
1 – Definitions
2 – Enclosures A-E
A – MCAS Miramar
B – MCAS Camp Pendleton
C – MCB Camp Pendleton
D – Bob Stump Training Range Complex
E – MCAGCC
3 – Draft Programmatic Agreement

cc: James W. Garrison, SHPO/Arizona
M. Wayne Donaldson, SHPO/California

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS WEST
BOX 555200
CAMP PENDLETON, CALIFORNIA 92055-5200

IN REPLY REFER TO:
ENVSEC/MCIWEST
MV22-NHPA/106
JUL 17 2009

Mr. James W. Garrison
State Historic Preservation Officer
Chief of the Historic Preservation Section
State Historic Preservation Office
Arizona State Parks
1300 W. Washington
Phoenix, AZ 85007

ATTN: Ann Valdo Howard
Public Archaeology Programs Manager and
Archaeological Compliance Specialist

Subj: SECTION 106 NATIONAL HISTORIC PRESERVATION ACT (NHPA) CONSULTATION – USE OF THE BARRY M. GOLDWATER RANGE – WEST IN ARIZONA TO CONDUCT TRAINING, READINESS AND SPECIAL EXERCISE OPERATIONS WITH THE MV-22 AIRCRAFT

Dear Ms. Howard,

Marine Corps Installations West (MCIWEST) is continuing consultation in accordance with 36 CFR 800 for a project that will introduce the MV-22 tilt-rotor Osprey (MV-22) aircraft to the Western United States. That portion of the proposed Undertaking (e.g., West Coast Basing of the MV22) occurring in Arizona relates only to MV-22 training, readiness and special exercise operations at the Barry M. Goldwater Range-West (BMGR-West), which is part of the Bob Stump Training Range Complex that is controlled and managed by the USMC, in general, with operational control exercised by MCAS Yuma (see Final Legislative EIS, March 2006).

Thirty-two existing Ground Support Areas (GSA) and one established landing zone (LZ Lonesome Dove) within the BMGR-West would will be used during training operations, including as landing zones for the MV22 aircraft as identified in Table 1, which provides a summary of each landing area. More detailed information on these landing areas is provided in Enclosure D. The remaining components of the overall Undertaking take place in California and are therefore not discussed further in this letter.

As described below and detailed in Enclosure D , MCIWEST has found that effects on historic properties cannot be fully determined prior to approval of the Undertaking, and proposes to enter into a Programmatic Agreement (with the State Historic Preservation Office (SHPO), the Advisory Council of Historic Preservation, and other consulting parties to resolve adverse effects. A draft Programmatic Agreement (Enclosure A) is enclosed for your review and comment.

Description of the Proposed Undertaking

That portion of the proposed Undertaking occurring in Arizona includes only training, readiness and special exercise operations conducted by MV-22 squadrons based on the West Coast in San Diego, California. The proposed Undertaking will base up to ten MV-22 squadrons (120 aircraft) in southern California and will replace nine helicopter squadrons (114 aircraft) currently authorized for basing on the West Coast. No construction activities are proposed for the BMGR-West at this time, and none are anticipated.

In Arizona, MV-22 squadrons will conduct training, readiness and special exercise operations within existing, Federal Aviation Administration-approved, Marine Corps controlled airspace and on existing training ranges, including routine landing operations at MCAS Yuma, use of the Bob Stump Training Range Complex (e.g., BMGR-West) and use of various Military Training Routes (MTRs) and transit routes between installations located in Arizona and California. No construction or other types of site modifications or ground disturbing activities are associated with proposed training operations at the BMGR-West. The MV-22 squadrons will use only existing, historically-used landing zones and training areas (e.g., GSAs) that are already subject to military training activities. Many of these training locations have been in use since the 1960's, with some range use areas dating back to World War II (see Final Legislative EIS, March 2006; Ch. 2, sect 2.3, pg 22 – "BMGR History").

The Marine Corps expects to continue updating the MV-22 Training and Readiness manual and training plans to reflect lessons learned from training evolutions and deployment experience. Due to the evolving nature of these MV-22 training requirements, additional training areas and air space, on or off Department of Defense (DoD)-owned lands, likely will emerge as necessary or useful for applying the aircraft's capabilities to ever-changing missions. The environmental impacts associated with new training requirements will be evaluated under the National Environmental Policy Act (NEPA), and will include consultation pursuant to the National Historic Preservation Act, where applicable. Toward that end, the U.S. Marine Corps (USMC) is seeking programmatic agreement(s) with State Historic Preservation Officers to set forth procedures for evaluating future proposed landing zones.

Area of Potential Effects

In accordance with 36 CFR 800.4(a)(1), MCIWEST has established the Area of Potential Effects (APE) for the proposed Undertaking at BMGR-West. For proposed training, readiness and special exercise operations, the APE includes all areas of potential ground disturbance from hovering and/or landing the MV-22 within the training ranges. As stated above, 33 specific landing areas were identified for the BMGR-West as part of the proposed Undertaking occurring in Arizona. Although no new construction or improvements are proposed, ground disturbance from hovering and/or landing of the MV22 aircraft could occur at these locations due to dust and debris being scattered and/or becoming airborne from aircraft rotorwash. Downdraft and outwash occur from moving rotors (collectively known as rotorwash). Rotorwash forces are relative to the engine power settings and the aircraft's proximity to the ground. Rotorwash from the MV-22 would be greater than from the CH-46 (the aircraft it is replacing) at a given height above the ground. Outwash from the MV-22 would reach 50 knots at a distance of 150 feet from the aircraft when hovering at 20 feet above ground level, which is three to four times greater than that associated with the CH-46. The outwash velocities would rapidly diminish very near the ground surface. As a result, rotorwash from the aircraft during landing, take-offs, and hovering immediately

above the ground could temporarily affect vegetation and soils in the immediate vicinity of the hovering aircraft.

Rotorwash from an MV-22 aircraft during landing, take-offs, and hovering immediately above the ground may also disturb artifacts lying on the surface in the immediate vicinity of the hovering aircraft, although the extent of this disturbance would depend on local soil characteristics, presence of vegetation, and size/weight of artifacts. To account for this rotorwash, the APE includes a 350-foot buffer area around the point of landing. The 350-foot buffer area was based on the Navy Program Office's review of existing rotorwash information for the MV-22. For Native American resources, the APE includes the area of potential ground disturbance from aircraft rotorwash. Enclosure D (Bob Stump Training Range Complex; Barry M. Goldwater Range - West) of this letter provides additional information about describe the APE, including detailed maps of the APE. MCIWEST requests SHPO agreement on our identification of the APE.

Identification of Historic Properties within the APE

In accordance with 36 CFR 800.4(a)(2)&(3) and 800.4(b)&(c), MCIWEST has completed a review of available records regarding the presence of historic properties within the APE. This includes an extensive review of previous survey efforts in the vicinity of each landing zone (LZ) and/or GSA and associated APE, identifying any survey gaps, and reviewing available information on all recorded archaeological sites or historic building/structures (e.g., site records, testing reports, SHPO correspondence) to identify previous eligibility recommendations. In the case of BMGR-West, one archaeological field survey was conducted specifically for this Undertaking (SAIC 2009); no other field investigations were conducted in Arizona as part of this Undertaking. The enclosure to this letter provides additional information regarding the level of effort undertaken to identify historic properties for the BMGR-West APE.

Based on this analysis, 23 recorded archaeological sites were identified within the APE at BMGR-West. Due to a lack of survey information, unrecorded archaeological sites within unsurveyed portions of the APE may exist. Table 2 provides a summary of recorded archaeological sites within the APE at BMGR-West, broken down by National Register of Historic Places (National Register) status. Those resources, coded as "DE" or "CE" in Table 2, are considered historic properties. Those resources coded "NEV" have not been evaluated. No historic buildings or structures will be affected by the Undertaking. Enclosure D provide the details regarding all identified archaeological sites at BMGR-West. This submittal package also includes a DVD containing electronic copies of all primary references (e.g., site records, reports, SHPO correspondence) reviewed for this project.

MCIWEST requests Arizona SHPO agreement on the recommendations regarding sites within Arizona that are considered eligible (four [4] sites) or ineligible (nine [9] sites) for listing on the National Register, as noted on Table 2 and in Enclosure D.

Table 2. Recorded Archaeological Sites within the APE

Installation	DI	DE	CI	CE	NEV	Total
BMGR-West (Arizona)	6	-	9	4	4	23

National Register Status: DI = determined ineligible for inclusion on the National Register with SHPO agreement; DE = determined eligible for inclusion on the National Register with SHPO agreement; CI = considered ineligible for inclusion on the National Register (pending SHPO agreement); CE = considered eligible for inclusion on the National Register (pending SHPO agreement), NEV = not evaluated for National Register eligibility

The identification phase of that portion of the Undertaking in Arizona to determine the presence of historic properties within the APE is incomplete. As described below, there is 1) the need for additional archaeological surveys for areas that lack adequate survey coverage; 2) the need for site testing of non-evaluated sites that cannot be avoided; and 3) consultation with Indian tribes is on-going and may lead to the identification of additional traditional cultural resources. We solicit any comments you have regarding these efforts to seek information and identify historic properties within the APE.

Finding of Effect

Proposed Training and Readiness Operations. Based on the analysis conducted to identify historic properties within the APE at BMGR-West, MCIWEST determined that the proposed Undertaking lacks adequate survey coverage and that GSAs may contain as yet unidentified historic properties. MCIWEST has identified conditions to the proposed Undertaking that will either 1) add operational protocols to ensure avoidance of areas lacking survey coverage, or 2) require surveys prior to MV-22 operations for those areas that cannot be avoided. If an archaeological site is identified based on a subsequent survey, MCIWEST will follow the procedures outlined on the enclosed Draft Programmatic Agreement regarding post-review discoveries, per 36 CFR 800.13.

The identification analysis also demonstrated the presence of archaeological sites considered eligible for listing on the National Register (historic properties) as well as those that have not been previously evaluated within the APE. MV-22 landing operations may affect the integrity of a historic property due to aircraft rotorwash if the property is located within 350 feet of the landing site. MCIWEST has identified conditions to the proposed Undertaking that will either 1) add operational protocols to ensure avoidance of eligible sites and non-evaluated sites, 2) require testing of non-evaluated sites to evaluate if the resource is eligible or ineligible for listing on the National Register, and/or 3) require site capping to an eligible site that cannot be avoided. If additional archaeological sites are recommended as eligible for listing on the National Register based on subsequent site testing, MCIWEST will follow the procedures outlined on the enclosed Draft Programmatic Agreement regarding post-review discoveries, per 36 CFR 800.13.

Table 1 provides a summary of proposed conditions for each of the 33 landing areas (or GSAs and LZs) proposed for use by the MV-22 (see "Proposed Conditions" column). These conditions have been incorporated into the enclosed Draft Programmatic Agreement.

Finding of Effect. The identification phase of this Undertaking to determine the presence of historic properties within the APE is incomplete. There is the need for additional archaeological survey and site testing, and consultation with Indian tribes is on-going. In accordance with 800.6(a)(1)(i)(C) and 800.14(b)(1)(ii), MCIWEST has found that effects on historic properties cannot be fully determined prior to approval of this Undertaking, and proposes to enter into a Programmatic Agreement with the SHPO, the Advisory Council of Historic Preservation, and other consulting parties to resolve adverse effects.

Consultation

Indian Tribe Consultation. MCIWEST initiated consultation with non-federally recognized Indian tribes subject to 36 CFR 800.3(f) (consulting parties) and federally recognized Indian tribes affiliated with lands currently under Marine Corps jurisdiction and involved in this

Undertaking. The purpose, pursuant to 36 CFR 800.3(f)(2), was to determine if they (the Tribes) have any religious or cultural interest in the APEs involved.

Archaeologists from each installation identified the Tribal governments that they historically have consulted with on their respective projects (those within some geographic reach or those known to have traditional use areas or Tribal lands within or near the installation). Approximately 50 Tribal Nations (both federal and non-federal recognized tribes) were contacted, 12 of which are located in Arizona. These Tribes were notified by mail, with follow-up phones call made to each nation, thereafter, to confirm that the initial letter had been received and if Tribal representatives had specific questions or wanted to comment formally regarding concerns they had about the proposed Undertaking. Table 3 identifies the 12 Tribes in Arizona contacted via letter, phone and/or e-mail about the proposed Undertaking and provides information on relevant discussions with Tribal representatives.

Of the 12 Tribal Nations contacted, approximately seven have responded to date with written comments by returning an enclosed response form, or in other written correspondence (see Enclosure B, Tribal response letters). Several of the responding Tribes indicated they would be deferring commenting on that portion of the proposed Undertaking occurring in Arizona at BMGR-West to the Tohono O'odham Nation. To date, face-to-face meetings have taken place with selected Tribal representatives, including the: Chemehuevi Tribe; Colorado River Indian Tribes; Quechan Tribe, and; Cocopah Tribe. Additional follow-up face-to-face group meetings are anticipated at MCAS Yuma, as are individual meetings with selected Tribal representatives, depending on the level of interest. These group and individual face-to-face meetings are also planned over the next two months to ensure all comments and concerns are captured and issues discussed with Tribal representatives. Such interactions will include the Hopi Tribe, as well as the Gila River Nation, as appropriate. The result of MCIWEST Tribal consultation efforts to date, including all phone calls, letters, e-mails, meetings, and any written responses received are provided in Table 3, with Tribal response letters provided herein as Enclosure C. Any additional, relevant Tribal input in the future will be recorded and provided to SHPO for their files.

Public Outreach per the National Environmental Policy Act. The U.S Marine Corps, with assistance from the Department of the Navy (DoN), has prepared an Environmental Impact Statement (EIS) with regards to this Undertaking. Public scoping meetings were held in October and November 2000, in six southern California communities and in Yuma, Arizona. The Draft EIS was circulated for review and comment to government agencies, local organizations, Tribal Nations, and interested private citizens for 45 days between 17 February 2009 and 3 April 2009. A public meeting was conducted during the review period in Yuma, Arizona (near MCAS Yuma) at the local high school. The Final EIS, upon completion, will be circulated for a 30-day review period, with an expected release date of approximately 1 October 2009.

Please provide any comments you have regarding our efforts to identify all potential consulting parties and gather information as outlined in 36 CFR 800.3(f) and 800.4(a)(4).

Organization of this SHPO Consultation Package

Enclosure D provides the details regarding the establishment of the APE, identification of historic properties, and finding of effect for the BMGR-West. Additionally, copies of primary references for BMGR-West have been organized for easy access and are provided in electronic format on the enclosed DVD. Given the large volume of material related to this Undertaking, the goal of this effort was to make it as easy as possible for the SHPO to complete their review.

If you have any questions, please contact Mr. Zachery H. Likins at (760) 763-7948.

Sincerely,

S. W. NORQUIST
Environmental Security Manager
Marine Corps Installations West
Box 555200, Bldg. B22165
Camp Pendleton, CA 92055-5200

Enclosures:
A - Draft Programmatic Agreement(s)
B – Tribal Response Letters
C – DVD with electronic copies of the primary references
D – Bob Stump Training Range Complex; Barry M. Goldwater Range - West

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS WEST
BOX 555200
CAMP PENDLETON, CALIFORNIA 92055-5200

IN REPLY REFER TO
ENVSEC/MCIWEST
MV22-NHPA/106
JUL 17 2009

Mr. M. Wayne Donaldson
State Historic Preservation Officer
California Department of Parks and Recreation
1416 9th Street, Room 1442-7
Sacramento, CA 95814

Subj: SECTION 106 NATIONAL HISTORIC PRESERVATION ACT (NHPA) CONSULTATION – WEST COAST BASING OF THE MV-22 AIRCRAFT IN CALIFORNIA

Dear Mr. Donaldson,

The Marine Corps Installations/WEST (MCIWEST) is continuing consultation in accordance with 36 CFR 800 for a project that will introduce the MV-22 tilt-rotor Osprey (MV-22) aircraft to the Western United States (U.S.) (the proposed Undertaking).

That portion of the proposed Undertaking occurring in California relates to MV-22 basing actions at Marine Corps Air Station (MCAS) Miramar and MCAS Camp Pendleton, as well as training operations at the Marine Corps Air-Ground Combat Center located at Twentynine Palms (MCAGCC), Marine Corps Base (MCB) Camp Pendleton, and the Chocolate Mountain Aerial Gunnery Range (CMAGR) within the Bob Stump Training Range Complex. A summary of proposed conditions for each landing area in California is provided in Table 3. The detailed information on the California landing areas is provided in Enclosures A-C, D(b) and E. The remaining components of the proposed Undertaking take place in Arizona at the Barry M. Goldwater Range-West (BMGR-W), although they are also discussed in this submittal for reference.

As described below, MCIWEST has found that effects on historic properties cannot be fully determined prior to approval of this Undertaking, and proposes to enter into a Programmatic Agreement with the State Historic Preservation Office (SHPO), the Advisory Council of Historic Preservation, and other consulting parties to resolve adverse effects. A draft Programmatic Agreement is enclosed for your review and comment.

Description of the Proposed Undertaking

The proposed Undertaking will base up to ten MV-22 squadrons (120 aircraft) on the West Coast, and will replace eight (8) CH-46E helicopter squadrons (103 aircraft) and one (1) CH-53E helicopter squadron (11 aircraft) currently based on the West Coast. Under the proposed Undertaking, eight (8) active duty MV-22 squadrons will be based at MCAS Miramar and two reserve MV-22 squadrons will be based at MCAS Camp Pendleton. Facility requirements that

necessitate the construction and/or renovation of airfield facilities include appropriate hangar space, aircraft apron parking, and other related facilities (e.g., aircraft wash racks, fuel storage). Enclosures A (MCAS Miramar) and B (MCAS Camp Pendleton) of this letter describe the proposed construction in greater detail. No other construction activities are proposed at either of these two installations, and none are anticipated elsewhere at existing Marine Corps training ranges, as described below.

MV-22 squadrons will conduct training and readiness operations and special exercise operations within existing, Federal Aviation Administration-approved, Marine Corps controlled airspace and on existing training ranges located on the West Coast. This includes landing operations at MCB Camp Pendleton, the Bob Stump Training Range Complex (CMAGR, BMGR-West), and MCAGCC. No construction or other types of site modifications are associated with proposed training operations beyond those mentioned above for the flightlines at MCAS Miramar and MCAS Camp Pendleton. The MV-22 squadrons will use only existing landing zones and training areas that are already subject to military training activities. Many of these training locations have been in use since the 1960's, and some may date back even earlier.

MV-22 flight operations will also occur over other areas of the Bob Stump Training Range Complex (e.g., R-2510 located near Naval Air Facility El Centro), the Cabeza Prieta National Wildlife Refuge, as well as along various Military Training Routes (MTRs) and transit routes between installations. However, these operations will not include low hovering, landing, or take-offs and will not result in any type of ground disturbance. Therefore, these types of airspace operations are not discussed further.

Area of Potential Effects

In accordance with 36 CFR 800.4(a)(1), MCIWEST has established the Area of Potential Effects (APE) for the proposed Undertaking. The APE for MCAS Miramar and MCAS Camp Pendleton consists of all areas of ground disturbance associated with proposed construction activities, construction vehicle parking, staging activities, and, in the case of MCAS Miramar, habitat restoration areas. For historic architectural resources, the APE includes any buildings/structures that will be altered or demolished, as well as any viewsheds of historic buildings that may be affected by construction. For Native American resources, the APE includes all areas of ground disturbance and the viewsheds of any traditional cultural resources that could be affected by construction. Enclosures A (MCAS Miramar) and B (MCAS Camp Pendleton) of this letter describe the APE for the two installations and provide detailed maps of the APE.

For the proposed training and readiness operations, the APE includes all areas of potential ground disturbance from hovering and/or landing the MV-22 within the training ranges. Specific landing sites were identified for MCB Camp Pendleton, the Bob Stump Training Range Complex, and MCAGCC as part of the proposed Undertaking. Although no new construction or improvements are proposed, ground disturbance from hovering and/or landing of the MV22 aircraft could occur at these locations due to dust and debris being scattered and/or becoming airborne from aircraft rotorwash. Downdraft and outwash occur from moving rotors (collectively known as rotorwash). Rotorwash forces are relative to the engine power settings and the aircraft's proximity to the ground. Rotorwash from the MV-22 would be greater than from the CH-46 (the aircraft it is replacing) at a given height above the ground. Outwash from the MV-22 would reach 50 knots at a distance of 150 feet from the aircraft when hovering at 20 feet above ground level, which is three to four times greater than that associated with the CH-46.

The outwash velocities would rapidly diminish very near the ground surface. As a result, rotorwash from the aircraft during landing, take-offs, and hovering immediately above the ground could temporarily affect vegetation and soils in the immediate vicinity of the hovering aircraft.

Rotorwash from an MV-22 aircraft during landing, take-offs, and hovering immediately above the ground may disturb artifacts lying on the surface in the immediate vicinity of the hovering aircraft, although the extent of this disturbance would depend on local soil characteristics, presence of vegetation, and size/weight of artifacts. To account for this rotorwash, the APE includes a 350-foot buffer area around the point of landing. The 350-foot buffer area was based on the Navy Program Office's review of existing rotorwash information for the MV-22. For Native American resources, the APE is the same as described above (i.e., areas of potential ground disturbance from aircraft rotorwash). Enclosures C (MCB Camp Pendleton), D (Bob Stump Training Range Complex), and E (MCAGCC) of this letter describe the APE for the training ranges and provide detailed maps of the APE.

MCIWEST requests SHPO agreement on our identification of the APE.

Identification of Historic Properties within the APE

In accordance with 36 CFR 800.4(a)(2)&(3) and 800.4(b)&(c), MCIWEST has completed a review of available records regarding the presence of historic properties within the APE. This includes an extensive review of previous survey efforts in the vicinity of each LZ and associated APE, identifying any survey gaps, and reviewing available information on all recorded archaeological sites or historic building/structures (e.g., site records, testing reports, SHPO correspondence) to identify previous eligibility recommendations. In the case of MCAS Miramar and BMGR-West, two archaeological field surveys were conducted specifically for this Undertaking, one at each installation (SAIC 2008, 2009); no other field investigations were conducted as part of this Undertaking. The enclosures to this letter describe the level of effort undertaken for each installation.

Based on this analysis, 95 recorded archaeological sites were identified within the APE. There also is the possibility of unrecorded archaeological sites within unsurveyed portions of the APE. Table 1 provides a summary of recorded archaeological sites within the APE, broken down by installation and National Register of Historic Places (National Register) status. Those resources, coded as "DE" or "CE" in Table 1, are considered historic properties. Those resources coded "NEV" have not been evaluated. No historic buildings or structures will be affected by the Undertaking. Enclosures A through E provide the details regarding all identified archaeological sites at each installation. This submittal package also includes a DVD containing electronic copies of all primary references (e.g., site records, reports, SHPO correspondence) reviewed for this project.

MCIWEST requests California SHPO agreement on the recommendations regarding sites within California that are considered eligible (eight [8] sites) or ineligible (thirty-four [34 sites) for listing on the National Register, as noted on Tables 2, A-2, C-3, D-3b, and E-3..

Table 1. Recorded Archaeological Sites within the APE

Installation	DI	DE	CI	CE	NEV	Total
MCAS Miramar	4	-	3	-	-	7
MCAS Camp Pendleton		1			1	2
MCB Camp Pendleton	-	-	9	4	18	31
BMGR-West (Arizona)	6	-	9	4	4	23
CMAGR	-		22	3	1	26
MCAGCC	-	-	-	1	5	6
Total	10	1	43	12	2	95

National Register Status: DI = determined ineligible for inclusion on the National Register with SHPO agreement; DE = determined eligible for inclusion on the National Register with SHPO agreement; CI = considered ineligible for inclusion on the National Register (pending SHPO agreement); CE = considered eligible for inclusion on the National Register (pending SHPO agreement); NEV = not evaluated for National Register eligibility

The identification phase of this Undertaking to determine the presence of historic properties within the APE is incomplete. As described below, there is 1) the need for additional archaeological surveys for areas that lack adequate survey coverage; 2) the need for additional site testing of non-evaluated sites that cannot be avoided; and 3) consultation with Indian tribes is on-going and may lead to the identification of additional traditional cultural resources. We solicit any comments you have regarding these efforts to seek information and identify historic properties within the APE.

Finding of Effect

Proposed Construction and Habitat Restoration. Based on the analysis conducted to identify historic properties within the APE, MCIWEST has found that the proposed Undertaking would have no effect on recorded historic properties within the MCAS Miramar APE (see Enclosure A for details). For MCAS Camp Pendleton, the recorded site boundaries of CA-SDI-10156/12599/H (Topamai), a historic property, fall within the APE. Previous excavations within or immediately adjacent to the APE have been negative, which suggest the likelihood of encountering intact archaeological deposits within the APE is low, but this possibility cannot be dismissed completely. MCIWEST has identified conditions to the proposed Undertaking, including construction monitoring, preconstruction meetings, and procedures regarding the discovery of unexpected archaeological materials to minimize the potential adverse effect (see Enclosure B).

Proposed Training and Readiness Operations. Based on the analysis conducted to identify historic properties within the MCB Camp Pendleton, Bob Stump Training Range Complex, and MCAGCC APE, it was determined that portions of the APE lack adequate survey coverage and may contain as yet unidentified historic properties. MCIWEST has identified conditions to the proposed Undertaking that will either 1) add operational protocols to ensure avoidance of areas lacking survey coverage, or 2) require surveys prior to MV-22 operations for those areas that cannot be avoided. If an archaeological site is identified based on a subsequent survey, MCIWEST will follow the procedures outlined on the enclosed Programmatic Agreement regarding post-review discoveries, per 36 CFR 800.13.

The identification analysis also demonstrated the presence of archaeological sites eligible for listing on the National Register (historic properties) as well as those that have not been previously evaluated within the APE. MV-22 landing operations may affect the integrity of a historic property due to aircraft rotorwash if the property is located within 350 feet of the landing site. MCIWEST has identified conditions to the proposed Undertaking that will either 1) add operational protocols to ensure avoidance of eligible sites and non-evaluated sites, 2) require

testing of non-evaluated sites to evaluate if the resource is eligible or ineligible for listing on the National Register, and/or 3) require site capping to an eligible site that cannot be avoided. If additional archaeological sites are recommended as eligible for listing on the National Register based on subsequent site testing, MCIWEST will follow the procedures outlined on the enclosed Programmatic Agreement regarding post-review discoveries, per 36 CFR 800.13.

Tables 2 and 3 provide a summary of proposed conditions, as needed, for each of the 126 landing areas proposed for use by the MV-22 (see "Proposed Conditions" column). These conditions have been incorporated into the enclosed Programmatic Agreement.

Finding of Effect. The identification phase of this Undertaking to determine the presence of historic properties within the APE is incomplete. There is the need for additional archaeological survey and site testing, and consultation with Indian tribes is on-going. In accordance with 800.6(a)(1)(i)(C) and 800.14(b)(1)(ii), MCIWEST has found that effects on historic properties cannot be fully determined prior to approval of this Undertaking, and proposes to enter into a Programmatic Agreement with the SHPO, the Advisory Council of Historic Preservation, and other consulting parties to resolve adverse effects.

Consultation

Indian Tribe Consultation. MCIWEST initiated consultation with non-federally recognized Indian tribes subject to 36 CFR 800.3(f) (consulting parties) and federally recognized Indian tribes affiliated with lands currently under Marine Corps jurisdiction and involved in this Undertaking. The purpose, pursuant to 36 CFR 800.3(f)(2), was to determine if they (the Tribes) have any religious or cultural interest in the APEs involved.

Archaeologists from each installation identified the tribal governments that they historically have consulted with on their respective projects (those within some geographic reach or those known to have traditional use areas or tribal lands within or near the installation). Seventy-one total tribal Nations (both federal and non-federal recognized tribes), 30 of which are located in California, were notified by mail, with follow-up phones call made to each nation thereafter to determine if these Nations had received the initial letter and if they had specific questions or would like to comment formally regarding their concerns about the proposed Undertaking. Table 4 identifies the 71 tribal Nations contacted via letter initially, and then by phone and/or email thereafter, as appropriate, and provides information on relevant discussions with tribal representatives.

Of the 71 Nations contacted, approximately 13 responded with written comments by returning an enclosed response form. In addition, tribal representatives were invited to attend a meeting (briefing) on the proposed Undertaking to allow them to ask questions, discuss any concerns they had and provide their comments directly to the Marine Corps representatives. These meetings were held with tribal representatives at selected installations (MCAS Camp Pendleton, MCB Camp Pendleton and MCAGCC) (see Table 4). Future meetings are also planned, including at one at MCAS Yuma, and another one at MCB Camp Pendleton in late July. In some instances, face-to face individual meetings were held with selected tribal representatives. These included the Quechan and Cocopah Nations in Arizona, to date. Additional follow-up, individual face-to-face meetings are also planned over the next two months to ensure all comments and concerns are captured and discussed with tribal representatives. The result of MCIWEST efforts to date, including all phone calls, letters, emails, meetings, and any written responses received are provided in Table 4. Any additional, relevant tribal input in the future will be recorded and provided to SHPO for their files.

Public Outreach per the National Environmental Policy Act. The Department of the Navy (DoN) has prepared an Environmental Impact Statement (EIS) with regards to this Undertaking. Public scoping meetings were held in October and November 2000, in six southern California communities and in Yuma, Arizona. The Draft EIS was circulated for review and comment to government agencies, local organizations, tribal Nations, and interested private citizens for 45 days between 17 February 2009 and 3 April 2009. Public meetings were conducted during the review period in two southern California communities (one near MCAS Camp Pendleton and one near MCAS Miramar) as well as in Yuma, Arizona (near MCAS Yuma). The Final EIS will be circulated for a 30-day review period (expected release date October 2009).

Please provide any comments you have regarding our efforts to identify all potential consulting parties and gather information as outlined in 36 CFR 800.3(f) and 800.4(a)(4).

Organization of this SHPO Consultation Package

Enclosures have been provided for each installation (MCAS Miramar, MCAS Camp Pendleton, MCB Camp Pendleton, Bob Stump Training Range Complex, MCAGCC) that provide details regarding the establishment of the APE, identification of historic properties, and finding of effect for each installation. Additionally, copies of primary references have been organized for easy access and are provided in electronic format on the enclosed DVD. Given the large volume of material related to this Undertaking, the goal of this effort was to make it as easy as possible for the SHPO to complete their review.

If you have any questions, please contact Mr. Zachery H. Likins at (760) 763-7948.

Sincerely,

Stan Norquist
Environmental Security Manager
Marine Corps Installations / WEST
Box 555200, Bldg. B22165
Camp Pendleton, CA 92055-5200

Enclosures:
A – MCAS Miramar
B – MCAS Camp Pendleton
C – MCB Camp Pendleton
D – Bob Stump Training Range Complex
E – MCAGCC
F – Draft Programmatic Agreement(s)
DVD with electronic copies of the primary references

cc: James Garrison, SHPO/Arizona State Park

John L. Nau, III
Chairman

Susan S. Barnes
Vice Chairman

John M. Fowler
Executive Director

Preserving America's Heritage

August 17, 2009

The Honorable Ray Mabus
Secretary of the Navy
Office of the Secretary of the Navy
2000 Navy Pentagon
Washington, DC 20350-2000

Dear Secretary Mabus:

In response to a notification by the United States Marine Corps (USMC), the Advisory Council on Historic Preservation (ACHP) will participate in consultation to develop a programmatic agreement for the proposed MV22 Osprey Aircraft, West Coast Basing in Arizona and California. Our decision to participate in this consultation is based on the *Criteria for Council Involvement in Reviewing Individual Section 106 Cases*, contained within our regulations. The criteria are met for this proposed undertaking because the undertaking has substantial impacts on important historic properties and presents issues of concern to Indian tribes.

Section 800.6(a)(1)(iii) of our regulations requires that we notify you, as the head of the agency, of our decision to participate in consultation. By copy of this letter, we are also notifying S. W. Norquist, the Environmental Security Manager for Marine Corps Installations in Camp Pendleton, California, of this decision.

Our participation in this consultation will be handled by Louise Dunford Brodnitz who can be reached at 202-606-8527 or lbrodnitz@achp.gov. We look forward to working with your agency and other consulting parties to consider alternatives to this undertaking that could avoid, minimize, or mitigate potential adverse effects on historic properties and to reach a programmatic agreement.

Sincerely,

John Fowler

John M. Fowler
Executive Director

ADVISORY COUNCIL ON HISTORIC PRESERVATION

1100 Pennsylvania Avenue NW, Suite 803 • Washington, DC 20004
Phone: 202-606-8503 • Fax: 202-606-8647 • achp@achp.gov • www.achp.gov

Arizona State Parks

"Managing and conserving Arizona's natural, cultural and recreational resources"

MIR

August 21, 2009

S. W. Norquist, Environmental Security Manager
Marine Corps Installation West
P.O. Box 555200, Building B22165
Camp Pendleton, CA 92055-5200

Re: West Coast Basing of the MV-22 in Arizona on the Marine Corps Air Station; DOD-MCAS; SHPO-2008-1626(40529)

Dear Mr. Norquist:

Janice K. Brewer
Governor

State Parks Board Members

Chair
Reese Woodling
Tucson

Tracey Westerhausen
Phoenix

Larry Landry
Phoenix

Walter D. Armer, Jr.
Vail

Arlan Colton
Tucson

William C. Scalzo
Phoenix

Maria Baier
State Land Commissioner

Renée E. Bahl
Executive Director

Arizona State Parks
1300 W. Washington
Phoenix, AZ 85007

Tel & TTY: 602.542.4174
AZStateParks.com

800.285.3703 from (520 & 928) area codes

General Fax: 602.542.4180

Director's Office Fax: 602.542.4188

Thank you for consulting with us on the above proposed undertaking. Mr. Likins of your staff has been keeping us well informed and updated on this important project, and we appreciate his efforts and attention to detail with regard to the Section 106 consultation process. Pursuant to 36 CFR Part 800, we have reviewed your cover letter and your Enclosure D on the Arizona portion of this undertaking; our review of your draft Programmatic Agreement dated 8/17/2009 will be sent to you in a separate review letter. We offer the following comments and advice:

1) We note that this enclosure includes information on the locations of the Ground Support Areas (GSA) and landing zones (LZ) that are proposed for the Barry M. Goldwater Range-West (BMGR-W) on the Marine Corps Air Station in Arizona. We note that no construction activities are proposed for this area at this time or in the future. Thus, the disturbances from the landing of these aircraft will consist primarily of surface impacts resulting from downdrafts and outwash from rotorwash forces. We are pleased that the Agency has designated a 350-foot buffer zone around the point of landing for these aircraft and that this buffer zone will be considered in all evaluations of impacts to cultural resources.

2) We understand that the Agency conducted a Class I overview for these locations within the BMGR-W, the results of which are presented in tables in Enclosure D. We note that majority of the 32 GSAs on the BMGR-W have not been surveyed by professional archaeologists. In addition, we are concerned that most of the existing/previous surveys are over ten years old. In 2004, our office produced guidance on the use of old survey (i.e., surveys older than 10 years in age) data. This SHPO Guidance Point #5 is available for downloading at www.azstateparks.com/SHPO/review.html. Given that the vast majority (10 out of 14) of the surveys conducted on the BMGR-W, and referenced on page D (a) – 7, for this undertaking are over 10 years old, we remain concerned about the adequacy and accuracy of relying on the data from these surveys. Our Guidance Point recommends that all old surveys be evaluated for their continued accuracy using a suite of criteria provided in our guidance. Thus, we are requesting that an addendum to Enclosure D be generated that provides this assessment for the 10 surveys that are cited in the Enclosure. Once this evaluation has been provided, we will be better able to assess the need for additional survey at the GSAs.

3) On page 3 of your cover letter, you ask the AZSHPO to concur on the "recommendations" (should be "determinations") of eligibility for 13 known sites on the BMGR-W. Unfortunately, we are unable to provide you with our consensus on your determinations of eligibility at this time as we do not have any information on these sites. Please provide us with site descriptions, site sketch maps, photographs, and integrity information for these sites.

4) Your cover letter (page 4) mentions that "site capping" will be used to avoid eligible sites. As I mentioned in discussions with Mr. Likins, burial-in-place is not an adequate mitigation measure in Arizona. As per our Guidance Point #4 (2004), this treatment is usually reserved for rare situations that do not appear to be met for this undertaking. Thus, we request that this mitigation measure not be considered for the eligible sites on the BMGR-W and that data recovery be conducted prior to the disturbance of eligible sites from MV-22 rotorwash.

5) On page 5 of your cover letter, you state that Enclosure D presents various items for consideration, including a finding of effect for the BMGR-W portion of the project. Please note that there should be only one finding of effect for the whole undertaking.

6) On page D (a)-1, it is stated that the Agency wishes to defer a determination of eligibility (DOE) for the historic AUX-2 airfield since it will not be modified for use by the MV-22 aircraft. We recommend that the Agency and our office go ahead and consult on a consensus DOE for this site just in case future maintenance is needed as a result of the increased number of annual light operations. Please provide us with an eligibility determination for this site, as well as the site descriptive information, photographs, etc. upon which to evaluate your DOE.

7) As discussed with Mr. Likins, our office would appreciate an analysis of potential auditory impacts from the operation of the MV-22 aircraft to Traditional Cultural Properties (TCPs), if present, and/or other types of sensitive cultural resources. The cover letter and Enclosure D do not currently include any discussion of potential auditory impacts.

8) In addition to the 23 known archaeological sites, we agree that the potential exists for additional, unrecorded archaeological sites to be located within the BMGR-W Area of Potential Effects (APE) for this undertaking.

9) Your "Finding of Effect" section on page D (a)-4 does not mention the process of consultation and review for the new survey reports that will be generated for the GSAs in Arizona. These reports need to be submitted to the SHPO, Tribes and other consulting parties for review and comment prior to the utilization of these GSAs by the MV-22 aircraft. The PA for this undertaking will also need to clearly specify this review process and timeline.

10) Again, please be aware that we are unable to agree with your assessment that additional surveys are <u>only</u> needed in the 12 GSAs specified on page D(a)-4, last paragraph. Until the Agency analyzes the adequacy and accuracy of the old surveys that were conducted in the BMGR-W APE, we cannot agree that these surveys form an adequate basis for determining the current level of need for surveys in and around

the GSAs. We recommend that your assessment of the need for additional survey within each GSA should include, at a minimum, the following evaluations: 1) are there known sites in or near the area?, 2) what is the age of any previous surveys conducted in the GSA and is the survey data still accurate?, 3) what percentage of the GSA has already been surveyed?, 4) are there isolated artifacts and/or features (non-site phenomena) in the GSA, and 5) is the geomorphological setting of the GSA conducive to site location? I would be happy to discuss these factors in detail with Mr. Likins, as this issue is extremely critical to the AZSHPO.

11) Since it is our understanding that tribal consultations are still ongoing, and in fact some Tribes have only just recently been contacted for the first time, the statement on page D(a) -5 that "There are no identified traditional cultural resources within the BMGR-West APE" should be qualified with "*To date*, there are no identified..." (emphasis added). We look forward to learning the results of your tribal consultation efforts.

12) Part of the mitigation for this undertaking needs to be the implementation of a long-term monitoring program that looks for, and assesses, potential impacts from the repeated use of these aircraft to historic properties in and around the GSAs. This important component needs to be discussed in the PA, as well as in the recommendations that result from the additional surveys that will be accomplished prior to the use of these aircraft on the BMGR-West APE.

13) Finally, we encourage the Agency to hire a replacement archaeologist for the MCAS in Arizona as soon as possible. We believe that this position is critical to the successful operation of the MV-22 aircraft on the BMGR-W and to avoiding and/or minimizing adverse effects to historic properties on the Range. Thank you.

We appreciate your continued cooperation with this office in complying with the historic preservation requirements for federal undertakings. Again, thank you for the competent assistance of Mr. Likins of your staff; we are confident that the issues and questions that we have raised in this letter can be worked out to the satisfaction of all parties. If you have any questions or concerns, please feel free to contact me at 602/542-7138, or e-mail me at ahoward@azstateparks.gov.

Sincerely,

Ann V. Howard

Ann Valdo Howard
Public Archaeology Programs Manager/Archaeologist
State Historic Preservation Office

"Managing and conserving Arizona's natural, cultural and recreational resources"

MIR

Arizona State Parks

August 21, 2009

S. W. Norquist, Environmental Security Manager
Marine Corps Installation West
P.O. Box 555200, Building B22165
Camp Pendleton, CA 92055-5200

Re: West Coast Basing of the MV-22 in Arizona on the Marine Corps Air Station – Draft Programmatic Agreement Review; DOD-MCAS; SHPO-2008-1626(40529)

Dear Mr. Norquist:

Janice K. Brewer
Governor

State Parks Board Members

Chair
Reese Woodling
Tucson

Tracey Westerhausen
Phoenix

Larry Landry
Phoenix

Walter D. Armer, Jr.
Vail

Arlan Colton
Tucson

William C. Scalzo
Phoenix

Maria Baier
State Land Commissioner

Renée E. Bahl
Executive Director

Arizona State Parks
1300 W. Washington
Phoenix, AZ 85007

Tel & TTY: 602.542.4174
AZStateParks.com

800.285.3703 from (520 & 928) area codes

General Fax: 602.542.4180

Director's Office Fax: 602.542.4188

Thank you for providing us with a draft Programmatic Agreement (PA) for the above proposed undertaking. Pursuant to 36 CFR Part 800, we have reviewed the draft PA (version dated 8/17/2009) and offer the following comments:

1) Stipulation II.A.: Please delete "planning" after "mitigation" in the first sentence. It is mitigation, not mitigation planning, that needs to be conducted or overseen by a professional that meets the federal standards and qualifications.

2) Stipulation IV.C.: Please delete the first paragraph under this general stipulation as it is redundant with Stipulation IV.B.

3) Stipulation IV.C.2.: In the sentence dealing with the scope of the identification efforts that will be undertaken in the future, please add "age of previous surveys" to the list of criteria that will be considered in determining the level of survey effort needed at a given GSA or LZ. Also, please add "determinations of eligibility" to the list of critical steps in the identification process at the end of this stipulation.

4) Stipulation IV.C.3.: This stipulation states that the Marine Corps will not consult with SHPO before a sample survey is undertaken. Please note that the AZSHPO requests consultation on the level of effort proposed in sample surveys. Generally, we request 100% (intensive) surveys; therefore, non-intensive survey efforts require consultation on sample design (i.e., size and rationale).

5) Stipulation IV.C.3.c.: If a Tribal representative participates in a survey by helping to conduct the archaeological survey and they are not a professional archaeologist, then they must be under the supervision of a professional archaeologist. Please clarify this stipulation.

6) Stipulation IV.C.4: This appears to be specific to California. If this stipulation is going to be retained, then a similar stipulation that discusses site recordation processes for Arizona and the Arizona State Museum (ASM) also needs to be included in this PA.

7) Stipulation IV.C.6: Same comment as above - make this stipulation satisfy both states, or include an additional stipulation for Arizona.

8) Stipulation IV.C.7.b: Same comment as above if you are going to add specifics on California's processes, please add the Arizona SHPO's 1999 "Administrative Procedure for Documentation Submitted for Review in Compliance with Historic Preservation Laws," as well as the ASM's requirements and guidelines on site designation, recordation and reporting (see www.statemuseum.arizona.edu/crservices/index.shtml).

9) Stipulation IV.C. lacks a process for the submittal of survey reports to SHPOs, tribes and other consulting parties. Please add this review and comment process, along with the relevant timelines, to this stipulation.

10) Stipulation IV.C.8: Please note that the Arizona SHPO does not want ASM site cards included within a survey report (SR). Instead, the SR should include (within the text) individual site description summaries and site sketch maps, along with integrity assessments, evaluation of potential impacts from MV-22 rotorwash, and recommendations of site eligibility.

11) Stipulation IV.C.: Please include a stipulation that surface collection during survey will not be conducted (at least not in Arizona). This practice, if conducted on an eligible site would result in data recovery and thus would be constitute an adverse effect to the site.

12) Stipulation IV.C.10.a.: This stipulation is unclear – please spell out what 36 CFR 60.4 states and how it negates the need for consultation with the SHPO.

13) Stipulation V.A.: Once again, this stipulation appears to be specific to California. Please include the ASM in a like and appropriate manner.

14) Stipulation VI.B.: It appears that this stipulation is referring to historic buildings or structures only, not archaeological sites; please make this clear. In the unnumbered paragraph following this stipulation, please change the reference to Stipulation "V.B." to "VI.B."

15) Stipulation VII: We believe that this whole stipulation would fit better under "Stipulation IX: Mitigation Measures" since Stipulation VII seems to be discussing treatment (i.e., testing, data recovery, etc.) of impacts to historic properties.

16) Stipulation VII.A.1. It appears that the Marine Corps is discussing subsurface testing within a known site, but this is not clear as it is proceeded by the statement that the area has not been previously surveyed. If the area has not been previously surveyed, it should be surveyed first rather than tested. Please clarify.

17) Stipulation VII.A.3.: The AZSHPO would prefer to review data recovery plans even if such a plan is "comparable in scope involving similar resources affected in a similar way." We believe that such an evaluation on the part of the Agency is subjective; we would be happy to expedite our review in these instances with a 15 day timeline.

18) Stipulation VII.A.5.: Please add an "S" before "HPO" in the second to last sentence, and the word "may" before "request" in the last sentence.

19) Stipulation VII.A.6.: See my point #16 above.

20) Stipulation VIII.A.: This stipulation references a "Stipulation V.B." but there is not currently a Stipulation V.B. in this PA. Please correct this reference so that we can better understand the intent of this stipulation.

21) Stipulation VIII.B.: Please add ASM and the AZSITE statewide database to this stipulation which currently only discusses California's system. Also, this stipulation states that "All reports…shall be provided to the CA and AZ SHPOs as specified below…" – where below? If this information is contained within a subsequent stipulation, then the specific stipulation needs to be cited here. Please clarify.

22) Stipulation VIII.C.: This stipulation needs to be elaborated. If a tribal TCP is also an archaeological site or a cultural site that is over 50 years old, SHPO needs to be consulted on eligibility and treatment. Thus, please add "after consultation with SHPO" at the end of the stipulation.

23) Stipulation IX.A.: "Stipulation V" in the last sentence should be Stipulation "VII," I believe.

24) Stipulation IX.A.1.: This stipulation is unclear. "Standard Resource Protection Measures" need to be defined. Also, if a historic property has been "affected" then it needs treatment, not monitoring. Please elaborate and clarify this stipulation.

25) Stipulation IX.A.2.: How is this stipulation different from IX.A.1? Please clarify and reduce redundancy as appropriate.

26) Stipulation IX.A.3.: If a historic property is impacted (i.e., "the prescribed protection measures have not been followed"), then the SHPOs should be notified immediately, not in a report that comes out twice a year.

27) Stipulation IX.A.4.: If the CRM decides that a historic property cannot be avoided and that monitoring is needed, they need to consult with SHPO prior to implementation to seek concurrence that monitoring is an adequate treatment (as opposed to the need for testing, data recovery, etc.). Thus, please add "after consultation with SHPO." to the end of the last sentence.

28) Stipulation IX.B.1.: How is this stipulation different from IX.A.3? It appears to be redundant and should be deleted? If not, then our comment #24 above thus pertains to this stipulation as well.

29) Stipulation IX.B.2.: Ditto with comment #25 above.

30) Stipulation IX.B.3.: Given the AZSHPO's policy on site burial-in-place, this stipulation either needs to be deleted or changed to reference California only.

31) Stipulation IX.C.: SHPO needs to be consulted at the time the decision is made, not in the semi-annual report.

32) Stipulation X.A.: Add "Arizona SHPO" to the first sentence and make "SHPO" plural so that it does not read just the California SHPO.

33) Stipulation X.B.: It is unclear which stipulations are being discussed in the first sentence – please reference them specifically. This first sentence is unclear, but hopefully accurate reference to the appropriate stipulations will clarify its intent. It appears that this stipulation is referring to a damage assessment report; if so, please call it by that name.

34) Stipulation XI.B.2.: Please add "As a result of the NEPA scoping process," to the beginning of the first sentence. Also, what does "CPEN" mean – please define this acronym. The stipulation cited in the last sentence is incorrect as there is not stipulation III.D. Please clarify.

35) Stipulation XII: This stipulation needs to be titled "Review of the PA" so that it is distinguished from report reviews, etc.

36) Stipulation XV ("Anti-deficiency Act"): This stipulation should be numbered "XVI" as Stipulation XV proceeded it ("Duration of the PA"). In other words, you currently have two stipulations numbered "XV."

37) EXECUTION clause: Please delete "and implementation" immediately after the word "EXECUTION" as SHPOs and the Council do not implement the PA, the Agency does.

38) Signatory lines: Please refer to our office as the "Arizona State Historic Preservation Office."

39) Tribal signature lines: Please add the Hopi Tribe to the list of federally recognized tribes as we know that you are consulting with them.

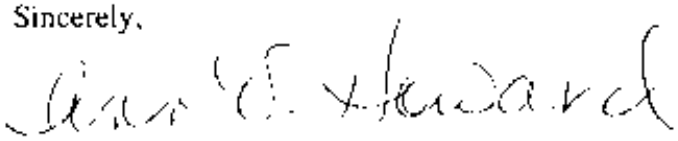
40) Attachment B: Stipulation I.E.: Both stipulation numbers cited in this stipulation are incorrect. Please clarify.

41) As mentioned in our letter reviewing Enclosure D, the PA needs to include a stipulation that delineates a program of long-term monitoring for those GSAs and LZs that have historic properties located within or near them. This

monitoring program will ensure that any unforeseen impacts to these properties are identified and then treated.

We look forward to reviewing a revised PA that addresses our comments and concerns. As always, we appreciate your continued cooperation with this office in complying with the historic preservation requirements for federal undertakings. If you have any questions or concerns, please feel free to contact me at 602/542-7138, or e-mail me at ahoward@azstateparks.gov.

Sincerely,



Ann Valdo Howard
Public Archaeology Programs Manager/Archaeologist
State Historic Preservation Office

STATE OF CALIFORNIA – THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, *Governor*

OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
P.O. BOX 942896
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calshpo@ohp.parks.ca.gov
www.ohp.parks.ca.gov

7 October 2009

Reply In Reference To: USMC080926A

Stan Norquist
Director, Environmental Security
Marine Corps Installations / WEST
Box 55200, Bldg. B22165
Camp Pendleton, CA 92055-5200

RE: Section 106 Consultation, West Coast Basing of the MV-22 Aircraft in California, SHPO Comments on Draft Programmatic Agreement

Dear Mr. Norquist:

My office has received your 17 July 2009 letter regarding the proposed basing of the MV-22 Aircraft in California. With that letter, you initiated consultation with me regarding this undertaking in order to comply with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f), as amended, and its implementing regulation at 36 CFR Part 800. Along with your consultation letter, you also enclosed reports for each of the facilities involved in this undertaking and a draft of the proposed Programmatic Agreement (PA), which will address the potential effects related to the basing and operations of the MV-22 Osprey.

In accordance with the above-mentioned regulations, my staff has reviewed the consultation letter and supporting documentation. On 1 October 2009, I sent a letter to you with my comments on the draft PA. As the consultation proceeds, my staff and I will continue to work with you and your staff on this project and agreement document. The Marine Corps has been responsive to our requests for additional information and clarifications to support our analyses. To date, there have been no significant issues identified that would preclude finalization of a PA that will satisfy the USMC's Section 106 responsibilities and support the subject undertaking.

Thank you for seeking my comments and considering historic properties as part of your project planning. I look forward to continuing consultation on this undertaking and to completing it through the execution of the PA. If you have any questions or concerns, please contact Mark Beason, at (916) 653-8902 or mbeason@parks.ca.gov.

Sincerely,

Milford Wayne Donaldson, FAIA
State Historic Preservation Officer

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APPENDIX H-3

Edwards Air Force Base

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE OHIO

26 APR 2007

MEMORANDUM FOR HQ USAF/A7

FROM: HQ AFMC/A8
4375 Chidlaw Road, Bldg 262, Room B205
Wright-Patterson AFB OH 45433-5006

SUBJECT: USMC MV-22 Basing Consideration at Edwards AFB, California

1. In a 3 Aug 00 memo (Tab 3), SAF/MII agreed to a Navy request (Tab 2) that Edwards AFB be considered as a potential beddown location for the initial cadre of Marine Corps MV-22 aircraft. The V-22 program office at Patuxent River MD is now in the planning window for beddown actions in support of this program. As part of this planning we were asked to reevaluate the initial request for MV-22 basing at Air Force Flight Test Center (AFFTC) Edwards AFB.

2. The attached AFFTC/CC memo of 21 Mar 07 (Tab 1) is our response to this follow-up request. The AFFTC response indicates that changes in their mission, the lack of air emission credit availability, and current and projected test and evaluation workload impacts to airspace, range and airfield capabilities require them to withdraw from consideration as a potential MV-22 beddown location. We concur with their evaluation.

3. If you have any questions, our action officer is Ms. Charlene Holmes, HQ AFMC/A8X; (937) 257-4679, DSN 787-4679. Email: charlene.holmes2@wpafb.af.mil.

JOHN H. FOLKERTS
Major General, USAF
Director, Strategic Plans and Programs

Attachments:

1. AFFTC/CC Memo, 21 Mar 07
2. Navy Memo, 15 Jun 00
3. SAF/MII Memo, 3 Aug 00

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE FLIGHT TEST CENTER (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA

MEMORANDUM FOR AFMC/A8X

MAR 2 . 2007

FROM: AFFTC/CC

SUBJECT: USMC MV-22 Basing Consideration

1. We have been analyzing the potential basing of USMC MV-22 aircraft at Edwards AFB since early 2006. Our mission has evolved over the last 6 years, and so has the Concept of Operations for the MV-22. As a result, I have determined that USMC MV-22 basing consideration is not compatible with the current and future Test & Evaluation (T&E) mission at the Air Force Flight Test Center (AFFTC).

2. The two most significant issues impacting my decision are:

a. Airspace, range, and airfield impacts. Based on the projected number of MV-22s, plus the current and projected T&E workload, I am concerned our airspace, range, and airfield risk saturation if this mission were to base at the AFFTC.

b. Air emission credit availability. Currently, we share air emission credits with China Lake and have a small growth projection built into our air credit budget for T&E growth. The MV-22 mission would absorb 100% of our credits. This would significantly impact our ability to undertake additional T&E missions.

3. For these reasons, I have decided to remove AFFTC from further consideration for the MV-22 basing. I appreciate your team's patience and understanding while we have analyzed this important issue. If you need any additional information, my Action Officer for this project is Mr. Dwight Deakin (dwight.deakin@edwards.af.mil) at DSN 527-2412.

Curtis M. Bedke

CURTIS M. BEDKE
Major General, USAF
Commander

DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(INSTALLATIONS AND ENVIRONMENT)
1000 NAVY PENTAGON
WASHINGTON, D.C. 20350-1000

JUN 15 2000

MEMORANDUM FOR THE DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS)

Subj: REQUEST FOR PARTICIPATION AS A COOPERATING AGENCY IN PREPARING THE ENVIRONMENTAL IMPACT STATEMENT FOR FIELDING THE MV-22 AIRCRAFT IN THE 3RD AND 4TH MARINE AIRCRAFT WINGS

The Department of the Navy is in the initial stages of preparing the Environmental Impact Statement (EIS) in support of fielding the MV-22 in the 3rd and 4th Marine Aircraft Wings (MAWs). The general physical area of consideration is the Southwest, within 200 NM of Marine Corps Base, Camp Pendleton, California. At this early stage, the apparent preferred alternative will be formed around Marine Corps Air Station (MCAS) Miramar and MCAS Camp Pendleton. Our recent experience in regional basing decisions, however, indicates that a range of alternatives beyond the Department of the Navy should be considered. To that end, we would like to include Edwards Air Force Base and March Air Force Reserve Base in the alternatives studied. The other sites to be initially considered are MCAS Yuma and Naval Air Facility El Centro.

Request your approval to include the two Air Force installations, as well as your participation as a cooperating agency pursuant to 40 CFR 1501.6. The Air Force's cooperation in the development and initial procurement of the V-22 aircraft was a significant contribution to the success of the program. Your further cooperation in the Department of the Navy's fielding of the aircraft will add value to our efforts and help ensure a comprehensive approach to this EIS effort.

Our points of contact for this project are Mr. Brad Chittenden of the Marine Corps Aviation Department [703-614-1835] and Major Eric Steidl of the Marine Corps Installations and Logistics Department [703-695-8202]. They are available to address any detailed questions you or your staff may have.

Duncan Holaday
Deputy Assistant Secretary
(Installations and Facilities)

DEPARTMENT OF THE AIR FORCE
WASHINGTON, DC

Office of The Assistant Secretary

03 AUG 2000

MEMORANDUM FOR DEPUTY ASSISTANT SECRETARY OF THE NAVY (INSTALLATIONS AND FACILITIES)

FROM: SAF/MII
1660 Air Force Pentagon
Washington, DC 20330-1660

SUBJECT: Request for Participation as a Cooperating Agency in Preparing the MV-22 Environmental Impact Statement (EIS) in the 3rd and 4th Marine Aircraft Wings

Thank you for your 15 Jun 00 letter requesting the Air Force participate as a cooperating agency in the preparation of the EIS for the proposed basing of MV-22 aircraft in the 3rd and 4th Marine Aircraft Wings. The Air Force agrees to serve as a cooperating agency. Our understanding is that this proposed beddown EIS entails approximately 108 MV-22 aircraft and 5,000 personnel, including dependents.

Edwards Air Force Base (AFB) is considered a major range and test facility base. The primary mission of the installation is to test new aircraft for the Air Force. We concur with Edwards being considered as an alternative in the EIS for the basing of the MV-22. Presently, Edwards hosts two Marine Corps Reserve Helicopter Squadrons without significant impact on the installation's primary mission. After completion of the environmental and Clean Air Act conformity analysis, replacement of these squadrons with limited MV-22 aircraft may be compatible with the installation's mission. We, therefore, concur with Edwards AFB being considered as alternative in the EIS.

We also concur with March Air Reserve Base (ARB) being considered as a limited beddown alternative for Reserve MV-22 operations. The ability of Edwards AFB and March ARB to expand or accommodate new missions will need to be explored in the EIS as factors in the environmental and conformity analysis.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ▶ 2

To Paul Hubbell	From Rich Anderson
Dept./Agency	Phone # 588-6690
Fax # 695-7453	Fax # 588-0202

APPENDIX H-4

Tribal Governments and Other Interested Parties

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MARINE CORPS INSTALLATIONS WEST
BOX 555200
CAMP PENDLETON, CALIFORNIA 92055-5200

IN REPLY REFER TO
5090
ENVSEC
DEC 0 3 2008

Mr. Steve Banegas
Spokesperson
Kumeyaay Cultural Repatriation Committee
1095 Barona Road
Lakeside, California 92040-1541

Dear Mr. Banegas:

SUBJECT: INITIATION OF CONSULTATION – WEST COAST BASING OF THE MV-22 AIRCRAFT, CALIFORNIA AND ARIZONA

The Marine Corps Installations West (MCIWEST) is initiating consultation for a project that will introduce the MV-22 Osprey tilt-rotor aircraft to the western United States. This project includes: (1) basing up to ten MV-22 squadrons; (2) construction or renovation of airfield facilities; and (3) conducting MV-22 operations within existing military lands and along existing Department of Defense-controlled Military Training Routes (MTRs).

The project will base up to ten MV-22 squadrons (120 aircraft) on the West Coast and will replace nine helicopter squadrons (114 aircraft) currently based on the West Coast. The proposed MV-22 squadrons will be located at a single installation or will be split between a maximum of two aviation facilities. Installations under consideration include Marine Corps Air Station (MCAS) Miramar, MCAS Camp Pendleton, and MCAS Yuma (Figure 1).

Basing aircraft at these installations will require construction or renovation of the airfield facilities to provide appropriate hangar space, aircraft apron parking, and other related facilities (e.g., aircraft wash racks, refueling stations). All construction and associated ground disturbance will occur on existing airfields.

The MV-22 will conduct training and readiness operations within Department of Defense-controlled airspace and training ranges located on the West Coast. This includes operations at Marine Corps Base (MCB) Camp Pendleton; the Bob Stump Training Range Complex, which includes the Chocolate Mountain Aerial Bombing and Gunnery Range, the Barry M. Goldwater Range (West), R-2510, and R-2512; and the Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms (Figure 1). No construction is associated with proposed operations, but the MV-22 will use landing zones within these training ranges.

In addition, the MV-22 will use seven existing MTRs, which are corridors of airspace used by the military, usually for conducting low-altitude, high-speed training. The seven MTRs are located within southern California and western Arizona (Figure 2). Although altitudes and speeds along these routes may vary, in most cases the minimum altitude allowable is 200 feet (60 meters) above ground level. Some segments of the MTRs have higher minimum altitudes to

protect recreational use or biological resources. For example, aircraft must stay above 3,000 feet (915 meters) over the Imperial National Wildlife Refuge. Unlike the Marine Corps training ranges noted above, aircraft cannot land along these MTRs.

While this project covers MV-22 operations within military lands and along seven MTRs, there may be a subsequent project analyzing potential MV-22 operations on non-military lands (e.g., Bureau of Land Management, Forest Service, and both state and private lands). These MV-22 operations may be included under a separate consultation effort, as needed, once decisions have been made about where these operations would be desired.

MCIWEST is very interested in hearing your questions or concerns about the project. Attached is a response form to express any initial concerns and to let us know if you would like to be included in an upcoming face-to-face meeting. We appreciate your input on this important project.

In addition to contacting your office, MCIWEST is contacting all other appropriate federally and non-federally recognized tribal governments. We are also contacting the public at relevant regional Archaeological Society offices both through the National Environmental Policy Act (NEPA) process and through Section 106 of the National Historic Preservation Act (NHPA). All comments we receive, and any concerns expressed to MCIWEST, will be taken into consideration while planning for this undertaking.

If you have any questions regarding this initial consultation, please contact Mr. Zak Likins at (760) 763-6976.

Sincerely,

S. W. NORQUIST
By direction of the Commanding General

Enclosures: 1. Figures 1 and 2
2. Response Form

Copy to: Commanding Officer, MCAS Yuma

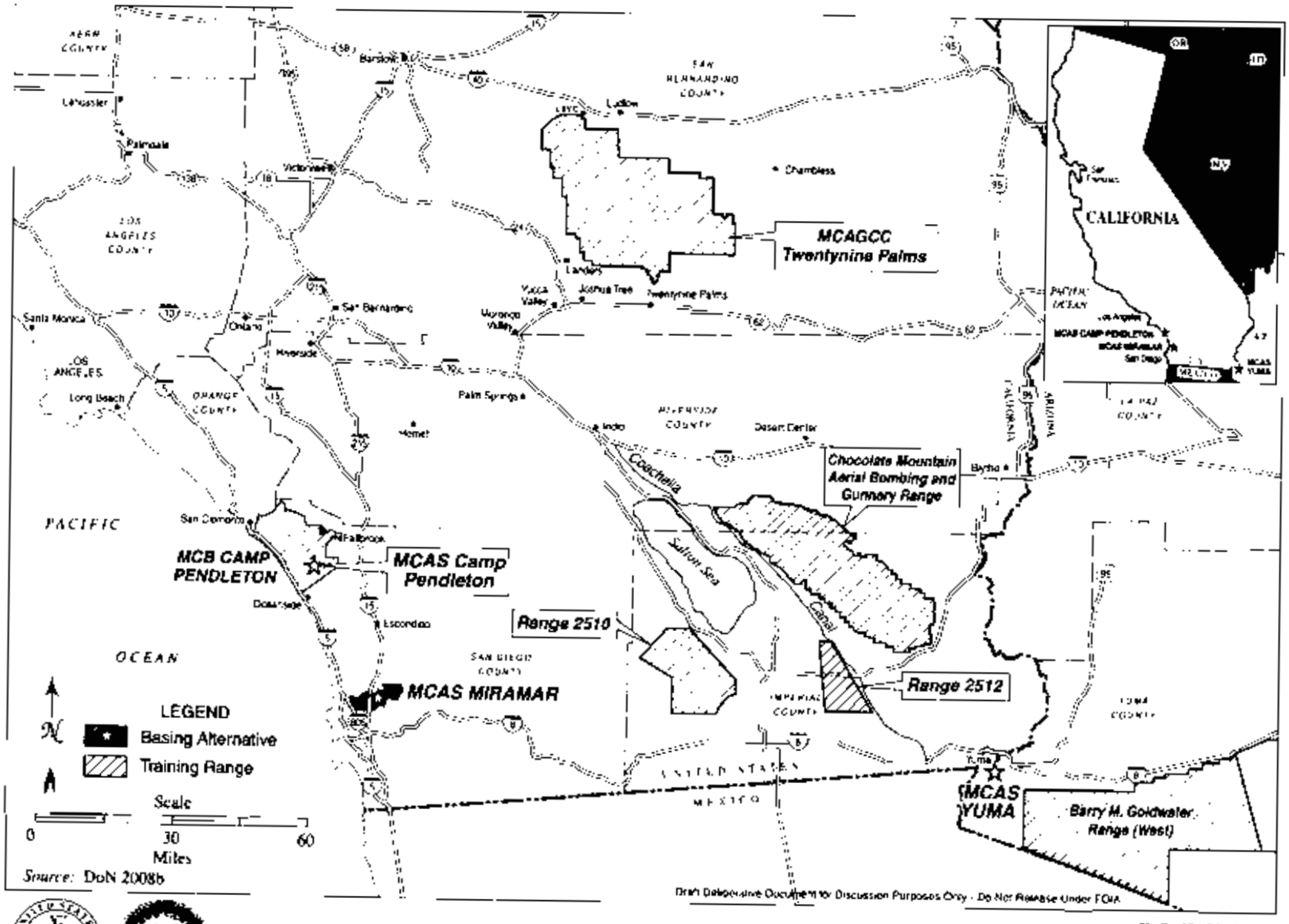
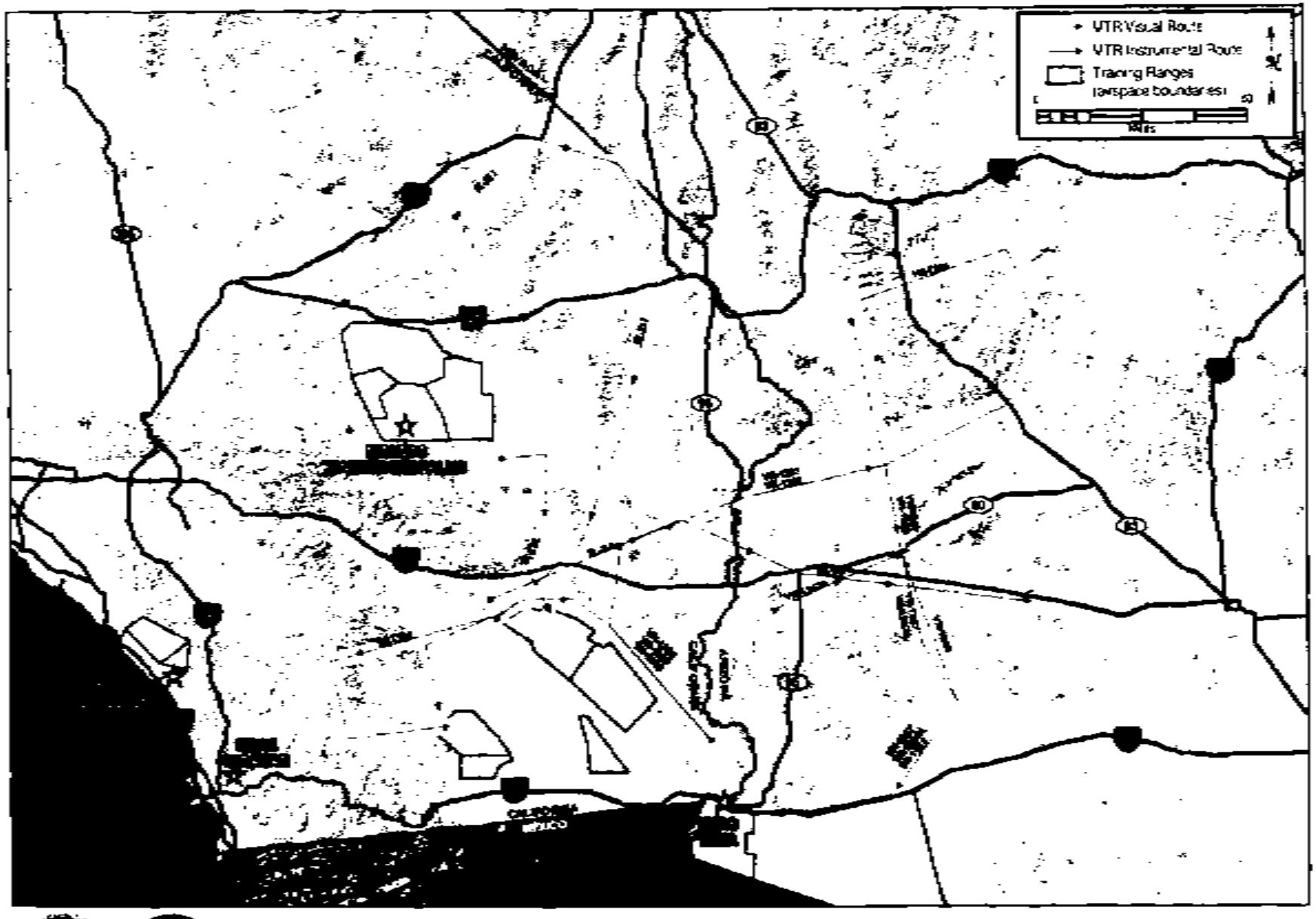


FIGURE 1

Location of Basing Alternatives and Proposed Training Ranges for the MV-22



Military Training Routes Proposed for Use by the MV-22

FIGURE

2

RESPONSE FORM
WEST COAST BASING OF THE MV-22 AIRCRAFT
MARINE CORPS INSTALLATIONS WEST (MCIWEST)

_____ I/We do not have concerns.

_____ I/We have concerns and would like to be contacted. You may contact me at the following: _____

_____ I/We have concerns. They are outlined below:

_____

_____ I/We would like to be included in the distribution of the Environmental Impact Statement related to this project.

_____ I/We would like to be included in a face-to-face meeting, and are available during the following time periods: _____

CONTACT LETTER MAILED TO:

NAME AND ADDRESS (if different):

Signature Date Signature Date

Please Return Completed form to:

S. W. Norquist
Deputy - Environmental Security Branch
Marine Corps Installations West
Attn: Zachery H. Likins
Box 555200, Bldg. 22165
Camp Pendleton, CA 92055-5200

PHONE: (760) 763-6976
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