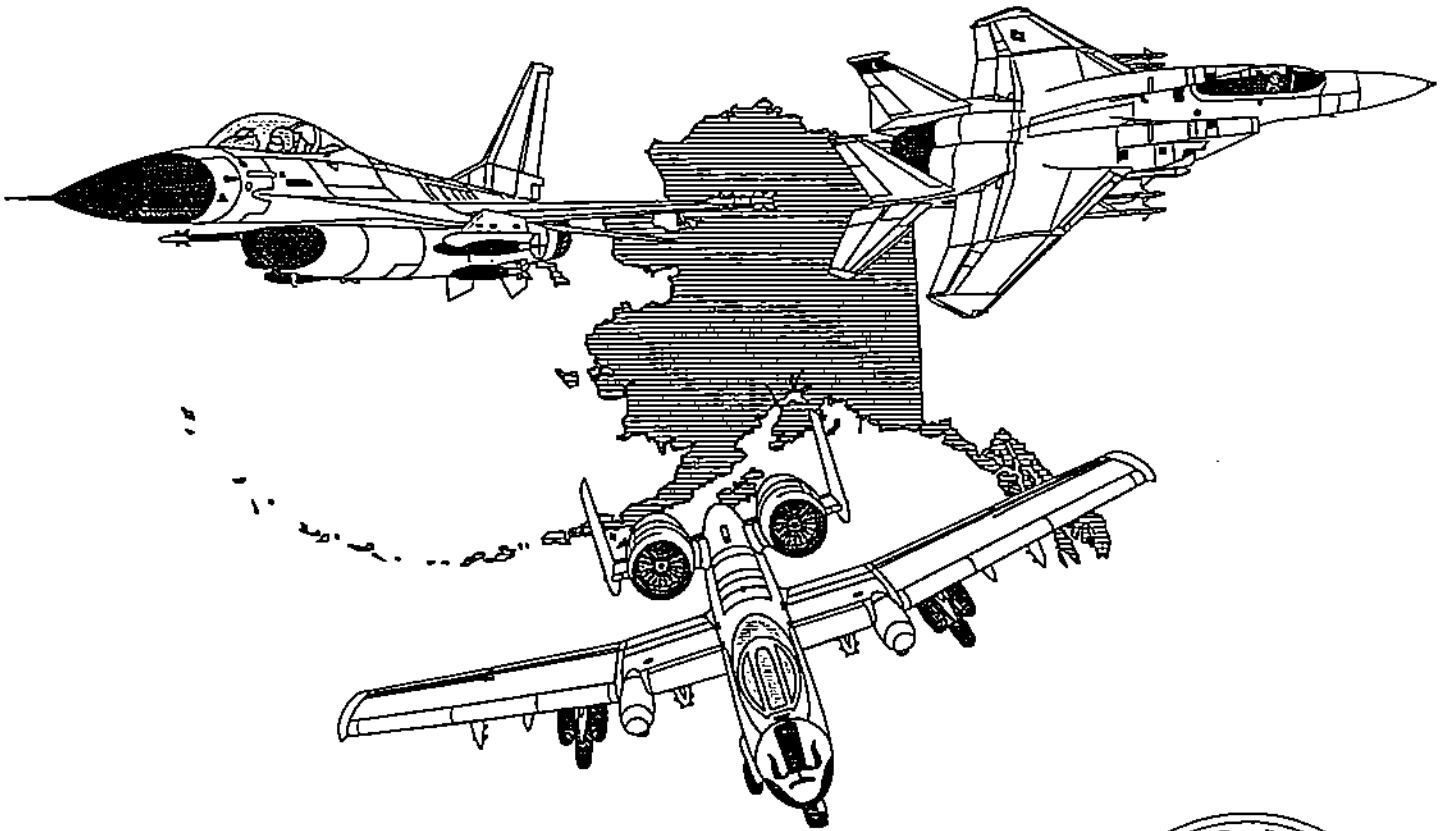


FINAL

Environmental Impact Statement **ALASKA MILITARY OPERATIONS AREAS**

VOLUME II

- *Environmental Consequences*
- *Bibliography*
- *Persons and Agencies Contacted*
- *Preparers and Reviewers*
- *Distribution List*
- *Index*



August 1995
Department of the Air Force
11th Air Force
Elmendorf AFB, Alaska



Volume II

Figure 4-1	Northern Interior Region - Proposed Action	4-5
Figure 4-4	Southern Interior Region--Proposed Action	4-15
Figure 4-7	Southcentral Region--Proposed Action	4-23
Figure 4-10	Western Region--Proposed Action	4-31
Figure 4-13	Southern Interior Region--Alternative A	4-39
Figure 4-14	Northern Interior Region - Alternative B	4-43
Figure 4-15	Southcentral Region--Alternative B	4-47
Figure 4-18	Northern Interior Region - Alternative A—Modified	4-55
Figure 4-19	Southern Interior Region - Alternative A—Modified	4-59
Figure 4-23	Southcentral Region - Alternative A—Modified	4-65
Figure 4-24	Western Region - Alternative A—Modified	4-69

Table of Contents

LIST OF FIGURES	v
LIST OF TABLES	vi
ENVIRONMENTAL CONSEQUENCES	
4.1 Introduction	4-1
4.2 Airspace Management, Aircraft Operations, and Aviation Safety	4-3
4.2.1 Issues/Concerns	4-3
4.2.1.1 Impact Assessment Approach (Methodology)	4-3
4.2.2 Proposed Action	4-3
4.2.2.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-3
4.2.2.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-13
4.2.2.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety	4-21
4.2.2.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety	4-29
4.2.3 Alternative A	4-37
4.2.3.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-37
4.2.3.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-37
4.2.3.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety	4-41
4.2.3.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety	4-41
4.2.4 Alternative B	4-41
4.2.4.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-41
4.2.4.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-45
4.2.4.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety	4-46
4.2.4.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety	4-53
4.2.5 No Action Alternative	4-53
4.2.5.1 All Regions: Airspace Management, Aircraft Operations, and Aviation Safety	4-53
4.2.6 Alternative A—Modified	4-53
4.2.6.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-53
4.2.6.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety	4-58
4.2.6.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety	4-64
4.2.6.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety	4-67
4.2.7 Accident Potential	4-71

4.3	Noise	4-73
4.3.1	Issues/Concerns	4-73
4.3.1.1	Impact Assessment Approach (Methodology)	4-73
4.3.2	Proposed Action	4-84
4.3.2.1	Northern Interior Region	4-84
4.3.2.2	Southern Interior Region	4-89
4.3.2.3	Southcentral Region	4-90
4.3.2.4	Western Region	4-95
4.3.3	Alternative A	4-97
4.3.3.1	Northern Interior Region	4-97
4.3.3.2	Southern Interior Region	4-97
4.3.3.3	Southcentral Region	4-97
4.3.3.4	Western Region	4-97
4.3.4	Alternative B	4-97
4.3.4.1	Northern Interior Region	4-97
4.3.4.2	Southern Interior Region	4-98
4.3.4.3	Southcentral Region	4-98
4.3.4.4	Western Region	4-98
4.3.5	No Action Alternative	4-98
4.3.5.1	All Regions	4-98
4.3.6	Alternative A—Modified	4-98
4.3.6.1	Northern Interior Region	4-98
4.3.6.2	Southern Interior Region	4-99
4.3.6.3	Southcentral Region	4-99
4.3.6.4	Western Region	4-99
4.4	Chaff and Flares/Hazardous Operations	4-101
4.4.1	Issues/Concerns	4-101
4.4.2	Proposed Action	4-101
4.4.2.1	Chaff and Flares	4-101
4.4.2.2	Laser Use	4-105
4.4.2.3	Munitions Use and Handling	4-105
4.4.2.4	Emergency Response Procedures	4-105
4.4.3	Alternative A	4-106
4.4.4	Alternative B	4-106
4.4.5	No Action Alternative	4-106
4.4.6	Alternative A—Modified	4-106
4.5	Biological Resources	4-107
4.5.1	Issues and Concerns	4-107
4.5.1.1	Impact Assessment Approach	4-107
4.5.1.2	Summary and Critique of Existing Information	4-108
4.5.1.3	Potential Biological Effects	4-109
4.5.1.4	Impacts Considered in Comparison of Alternatives and Mitigation Recommendations	4-118
4.5.2	Comparison of Alternatives	4-120
4.5.2.1	Effects on Biodiversity	4-120
4.5.2.2	Effects on Protected Species	4-120
4.5.2.3	Habitat-Specific Effects	4-120
4.5.2.4	Impact Levels	4-123
4.6	Recreation	4-127
4.6.1	Background	4-127
4.6.2	Methodology and Assumptions	4-128
4.6.3	Impacts Common to All Alternatives	4-130

	4.6.4 Area-Specific Effects	4-130
	4.6.4.1 Northern Interior Region	4-130
	4.6.4.2 Southcentral Region	4-131
	4.6.5 Commercial Recreation	4-135
4.7	Subsistence	4-137
	4.7.1 Background	4-137
	4.7.2 Methodology and Assumptions	4-137
	4.7.3 Impacts Common to All Alternatives	4-138
	4.7.4 Northern Interior Region	4-139
	4.7.4.1 Proposed Action	4-140
	4.7.4.2 No Action Alternative	4-140
	4.7.4.3 Alternative A	4-141
	4.7.4.4 Alternative B	4-141
	4.7.4.5 Alternative A—Modified	4-141
	4.7.5 Southern Interior Region	4-142
	4.7.5.1 Proposed Action	4-142
	4.7.5.2 No Action Alternative	4-142
	4.7.5.3 Alternative A	4-143
	4.7.5.4 Alternative B	4-143
	4.7.5.5 Alternative A—Modified	4-143
	4.7.6 Southcentral Region	4-143
	4.7.6.1 Proposed Action	4-143
	4.7.6.2 No Action Alternative	4-144
	4.7.6.3 Alternative A	4-144
	4.7.6.4 Alternative B	4-144
	4.7.6.5 Alternative A—Modified	4-144
	4.7.7 Western Region	4-144
	4.7.7.1 Proposed Action	4-145
	4.7.7.2 No Action Alternative	4-145
	4.7.7.3 Alternative A	4-146
	4.7.7.4 Alternative B	4-146
	4.7.7.5 Alternative A—Modified	4-146
4.8	Land Use	4-147
	4.8.1 Background	4-147
	4.8.1.1 General Methods and Assumptions	4-147
	4.8.1.2 Methodology and Assumptions	4-149
	4.8.2 Environmental Consequences (All MOAs)	4-150
	4.8.2.1 Proposed Action	4-150
	4.8.2.2 No Action Alternative	4-150
	4.8.2.3 Alternative A	4-150
	4.8.2.4 Alternative B	4-150
	4.8.2.5 Alternative A—Modified	4-151
	4.8.3 Environmental Consequences: Eielson and Elmendorf AFBs	4-151
	4.8.3.1 Eielson Air Force Base	4-151
	4.8.3.2 Elmendorf Air Force Base	4-154
4.9	Air Quality	4-159
	4.9.1 Issues/Concerns	4-159
	4.9.1.1 Impact Assessment Methodology	4-159

4.9.2	Proposed Action	4-159
4.9.2.1	Northern Interior Region	4-159
4.9.2.2	Southern Interior Region	4-160
4.9.2.3	Southcentral Region	4-161
4.9.2.4	Western Region	4-161
4.9.3	Alternative A	4-162
4.9.4	Alternative B	4-162
4.9.5	No Action Alternative	4-162
4.9.6	Alternative A—Modified	4-162
4.10	Socioeconomics	4-163
4.10.1	Eielson Air Force Base	4-163
4.10.2	Elmendorf Air Force Base	4-163
4.10.3	Galena Airport and King Salmon Airport	4-164
4.10.4	Military Operations Areas	4-164
4.11	Other Environmental Consequences	4-165
4.11.1	Cumulative Impacts	4-165
4.11.1.1	Airspace Management, Aircraft Operations, and Aviation Safety	4-165
4.11.1.2	Noise	4-166
4.11.1.3	Chaff and Flares/Hazardous Operations	4-167
4.11.1.4	Biological Resources	4-167
4.11.1.5	Recreation Resources	4-168
4.11.1.6	Subsistence Resources	4-169
4.11.1.7	Land Use	4-169
4.11.1.8	Air Quality	4-169
4.11.1.9	Socioeconomics	4-170
4.11.2	Unavoidable Adverse Impacts	4-170
4.11.2.1	Airspace Management, Aircraft Operations, and Aviation Safety	4-170
4.11.2.2	Noise	4-170
4.11.2.3	Chaff and Flares/Hazardous Operations	4-170
4.11.2.4	Biological Resources	4-170
4.11.2.5	Recreation Resources	4-170
4.11.2.6	Subsistence Resources	4-170
4.11.2.7	Land Use	4-171
4.11.2.8	Air Quality	4-171
4.11.2.9	Socioeconomics	4-171
4.11.3	Relationship between Short-Term Uses and Long-Term Productivity	4-171
4.11.4	Irreversible and Irrecoverable Commitments of Resources	4-171
4.12	Mitigation	4-173
BIBLIOGRAPHY		5-1
PERSONS AND AGENCIES CONTACTED		6-1
PREPARERS AND REVIEWERS		7-1
FINAL EIS DISTRIBUTION LIST		8-1
INDEX		9-1

LIST OF FIGURES

Figure 4-1	Northern Interior Region - Proposed Action	4-5
Figure 4-2	Northern Interior Region--Proposed Action--Federal Airways	4-7
Figure 4-3	Northern Interior Region--Military Training Routes	4-9
Figure 4-4	Southern Interior Region--Proposed Action	4-15
Figure 4-5	Southern Interior Region--Proposed Action--Federal Airways	4-17
Figure 4-6	Southern Interior Region--Military Training Routes	4-18
Figure 4-7	Southcentral Region--Proposed Action	4-23
Figure 4-8	Southcentral Region--Proposed Action--Federal Airways	4-25
Figure 4-9	Southcentral Region--Military Training Routes	4-26
Figure 4-10	Western Region--Proposed Action	4-31
Figure 4-11	Western Region--Proposed Action--Federal Airways	4-33
Figure 4-12	Western Region--Military Training Routes	4-34
Figure 4-13	Southern Interior Region--Alternative A	4-39
Figure 4-14	Northern Interior Region - Alternative B	4-43
Figure 4-15	Southcentral Region--Alternative B	4-47
Figure 4-16	Southcentral Region--Alternative B--Military Training Routes	4-49
Figure 4-17	Southcentral Region--Alternative B--Federal Airways	4-51
Figure 4-18	Northern Interior Region - Alternative A--Modified	4-55
Figure 4-19	Southern Interior Region - Alternative A--Modified	4-59
Figure 4-20	BUFFALO MOA Civilian Flight Corridors	4-61
Figure 4-21	Example Civil Flight Corridors Through the BUFFALO MOA along the Alaska Highway	4-62
Figure 4-22	Example Civil Flight Corridors Through the BUFFALO MOA along the Alaska Highway	4-63
Figure 4-23	Southcentral Region - Alternative A--Modified	4-65
Figure 4-24	Western Region - Alternative A--Modified	4-69
Figure 4-25	Northern Interior Region: Predicted Sonic Boom L_{cdn} Contours for Routine Air-to-Air Training Under the Proposed Action	4-86
Figure 4-26	Northern Interior Region: Predicted Sonic Boom L_{cdn} Contours for Routine and Major Flying Exercise Air-to-Air Training Under the Proposed Action	4-88
Figure 4-27	Southcentral Region: Predicted Sonic Boom L_{cdn} Contours for Routine Air-to-Air Training Under the Proposed Action	4-92
Figure 4-28	Southcentral Region: Predicted Sonic Boom L_{cdn} Contours for Routine and Major Flying Exercise Air-to-Air Training Under the Proposed Action	4-94
Figure 4-29	Western Region: Predicted Sonic Boom L_{cdn} Contours for Routine Air-to-Air Training Under the Proposed Action	4-96
Figure 4-30	DNL Contours for Proposed Action Operations at Eielson AFB - Routine Daily Training Plus Six MFEs per Year	4-153
Figure 4-31	DNL Contours for Proposed Action Operations at Elmendorf AFB - Routine Daily Training Plus Six MFEs per Year	4-157

LIST OF TABLES

Table 4-1	Estimated Number of Monthly Routine Sorties Potentially Associated with Supersonic Activity in the Northern Interior Region	4-11
Table 4-2	Predicted Class A Mishap Rates and Summary of Class A Mishaps for Aircraft Flying in Alaska (Proposed Action and Alternatives A, B, and A—Modified)	4-72
Table 4-3	Summary of Maximum Sound Levels for Selected Altitudes Above Ground Level	4-79
Table 4-4	Summary of Sound Exposure Levels for Selected Altitudes Above Ground Level	4-80
Table 4-5	Maximum C-weighted, Day-Night Average Sound Levels and Average Number of Sonic Booms per Month Resulting from Supersonic Operations	4-85
Table 4-6	Predicted Monthly Air-to-Air Operations, C-weighted, Day-Night Average Sound Levels, and Average Number of Sonic Booms per Month as a Result of MFE Activities During an MFE Flying Month	4-87
Table 4-7	Comparison of Alternatives on the Basis of Affected Habitat and Other Quantifiable Variables	4-122
Table 4-8	Comparison of Alternatives on the Basis of Potential Significant Adverse (Level III) Impacts	4-126
Table 4-9	Comparison of Alternatives on the Basis of Potential Adverse (Level II and III) Impacts to Recreation Resources	4-133
Table 4-10	Land Use Compatibility with Yearly Day-Night Average A-Weighted Sound Levels (DNL)	4-149
Table 4-11	On-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Eielson AFB Proposed Operations - Routine Daily Training plus Six MFEs per Year	4-154
Table 4-12	Off-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Eielson AFB Proposed Operations - Routine Daily Training Plus Six MFEs per Year	4-154
Table 4-13	On-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Elmendorf AFB Proposed Operations - Routine Daily Training plus Six MFEs per Year	4-158
Table 4-14	Off-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Elmendorf AFB Proposed Operations - Routine Daily Training Plus Six MFEs per Year	4-158
Table 4-15	Aircraft Air Pollutant Emissions Estimates for the YUKON 1 MOA: Proposed Action	4-160
Table 4-16	Aircraft Air Pollutant Emissions Estimates for Eielson AFB, Alaska: Proposed Action	4-160
Table 4-17	Aircraft Air Pollutant Emissions Estimates for Elmendorf AFB, Alaska: Proposed Action	4-161
Table 4-18	Potential Mitigation Measures	4-175

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This chapter discusses the potential consequences or impacts of each of the alternatives described in Chapter 2. The intent of this chapter is to provide the scientific and analytical basis for comparing the alternatives.

In accordance with guidelines found in the CEQ regulations (*40 CFR 1502.22*), the EIS notes where information relevant to determining reasonably foreseeable significant adverse impacts is incomplete or unavailable, indicates the relevance of any incomplete or unavailable information to assessing potential environmental consequences, and summarizes existing credible scientific evidence relevant to determining impacts. CEQ requires an EIS to evaluate potential impacts based on theoretical approaches or research methods generally accepted in the scientific community. All potential impacts, including those with little probability of occurrence, must be analyzed provided that the analysis is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. In keeping with the goals of NEPA and the directives of the CEQ, this EIS uses methodologies that have been documented in the scientific literature and are generally accepted by the scientific community, and employs quantifiable variables to assess what, in many cases, are subjective effects.

This Page Intentionally Left Blank

4.2 Airspace Management, Aircraft Operations, and Aviation Safety

4.2.1 Issues/Concerns

Issues and concerns pertaining to airspace management and aircraft operations resulting from the Proposed Action or Alternatives include:

- The effect of converting previously utilized Temporary Military Operations Areas (TMOAs) to permanent MOAs and creating new permanent MOAs on regional airspace.
- The effect of airspace modifications on non-participating civil and military aircraft operations.
- The effect of airspace modification on public use airports that underlie or are adjacent to a MOA.
- The effect on the regional airports of increased aircraft operations at Eielson and Elmendorf Air Force Bases (AFBs) during Major Flying Exercises (MFEs).
- The effect of the redistribution of where aircraft would operate during routine training and an increase in the number of annual MFE participants and sorties, despite the fact that no overall change in the number of routine aircraft operations would occur.
- The effect of changes to the structure and utilization of the MOAs and the increased potential for aircraft mishaps and bird strikes.

4.2.1.1 Impact Assessment Approach (Methodology)

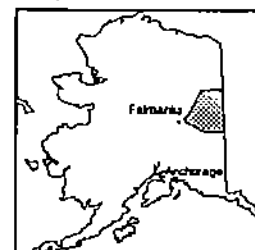
Impacts to airspace management, aircraft operations, and aviation safety are predicated on the extent to which the Proposed or Alternative Actions would affect the navigable airspace in a terminal or enroute airspace environment. Impacts could occur if an Alternative negatively affected: (1) movement of other air traffic in the area; (2) air traffic control systems or facilities; (3) airspace already designated and used for other purposes (i.e., MOAs, RAs, MTRs) or (4) an increase in midair collision potential between military and non-participating civil operations.

Potential impacts were assessed through a general evaluation to determine the extent to which the Proposed or Alternative Airspace modifications would change existing relationships with federal airways, uncharted visual flight routes, transition areas, and airport related air traffic operations; and the effect of the modifications on IFR and VFR air traffic.

4.2.2 Proposed Action

4.2.2.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety

The MOAs proposed for the Northern Interior Region are depicted in Figure 2-1 and Figure 4-1, and described in detail in sections 2.4.2 through 2.4.6 and Table 2-2. As is the case today, one federal airway, V-481 (see Figure 4-2), would continue to cross through the western third of YUKON 1 and 2 MOAs.



This Page Intentionally Left Blank

Figure 4-1
Northern Interior Region
Proposed Action &
Alternative A

Legend:

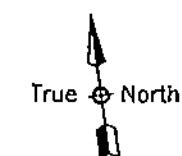
Airspace:

- MOA/RA Boundary
- - - Adjacent MOA/RA Boundary
- ▨ Military Exclusion Area

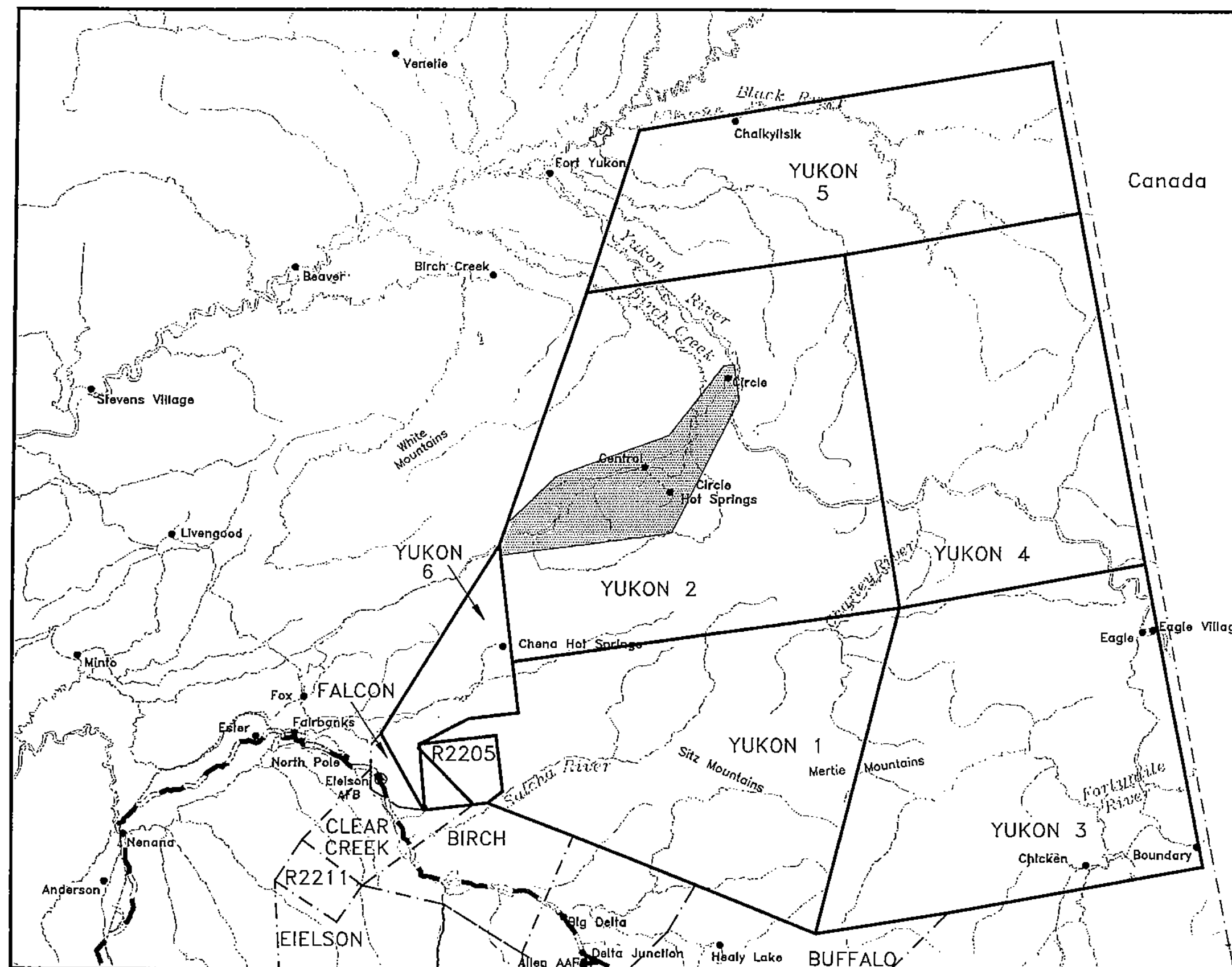
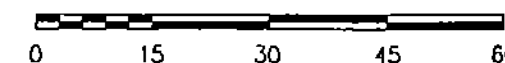
Sources:

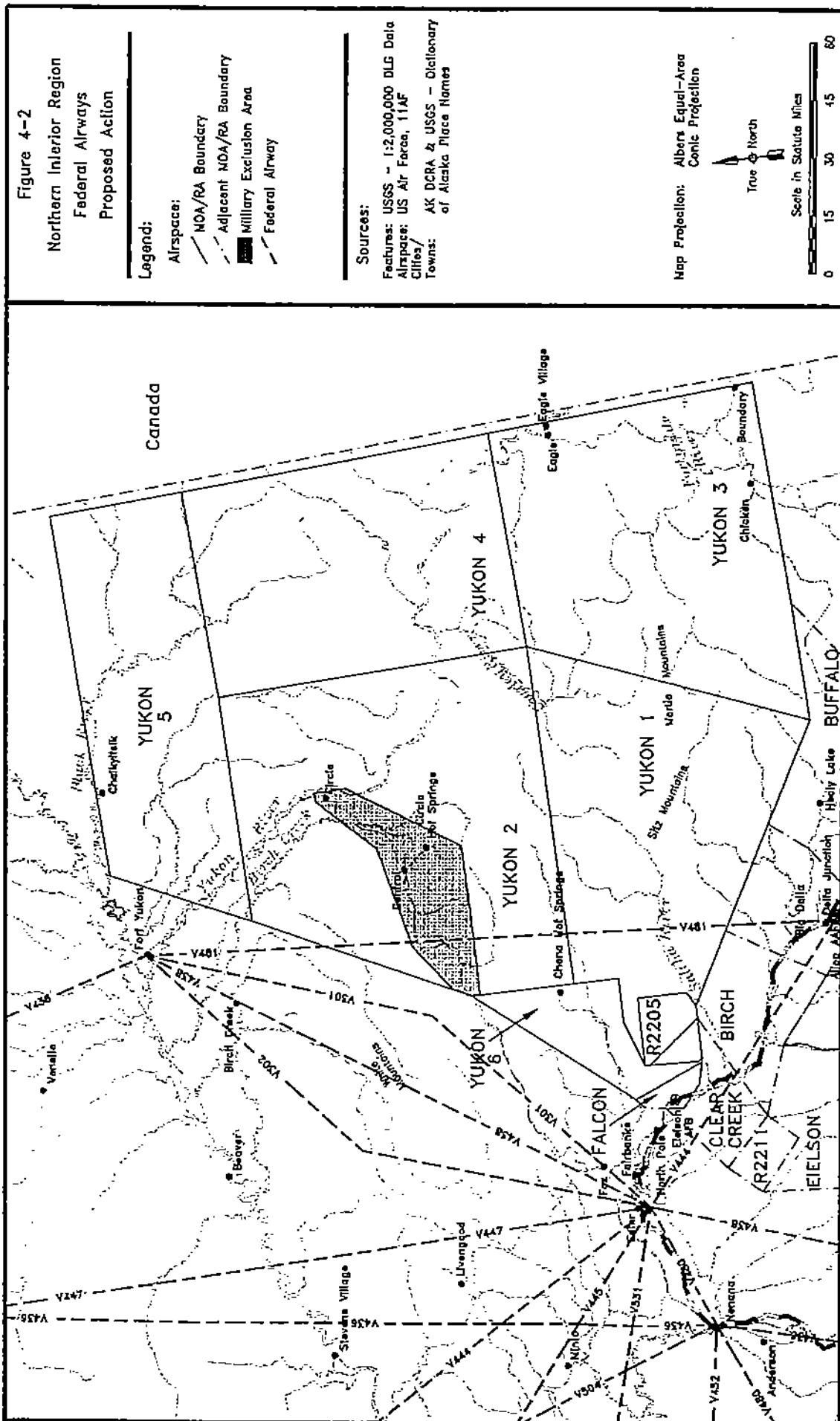
Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, 11AF
Cities/
Towns: AK DCRA & USGS - Dictionary
of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection



Scale in Statute Miles





Under the Proposed Action, 21,000 square miles of low-altitude airspace (YUKON 1, 2, 3, 4, and 6 MOAs) below 2,000 feet AGL and 3,570 square miles (YUKON 5 MOA) at a floor of 3,000 feet AGL would be available daily for routine training and for up to 60 days per year of MFEs in the region. The proposed Northern Interior Region would also overlie the MTR structure previously assessed (USAF 1992a). MTRs in the region that have various route segments coincident within the YUKON 1, 2, 3, 4, and 6 MOAs include MTR 935, 940, 954, and 1909. These MTRs in relation to the proposed MOAs are depicted in Figure 4-3. Airspace scheduling and management of both the proposed MOAs and the MTRs coincident with this proposed structure would remain the joint responsibility of the 354 FW at Eielson AFB and the 3 WG at Elmendorf AFB.

The proposed YUKON 3 MOA would overlie three public use airports at Chicken, Eagle, and Boundary; and the proposed YUKON 4 MOA would overlie one public use airport at Ben Creek. To avoid adverse impacts on the VFR traffic utilizing these airports, FAA airspace policy as outlined in FAA Handbook 7400.2, *Procedures for Handling Airspace Matters*, provides that a MOA should exclude the airspace below 1,500 feet AGL and within a 3 nautical mile (NM) radius of airports available for public use. These required exclusion areas would become part of the MOA description when charted by the FAA.

Since VFR aircraft operations are not denied access to MOAs, continued VFR use of the airspace would not be precluded. However, the introduction of low-altitude military tactical aircraft training on a daily basis as opposed to the previous limited uses of the TMOAs (with their higher floors) may create collision hazards that do not currently exist. Compliance with aircraft right-of-way regulations contained in the *Federal Aviation Regulation (FAR) 91* and *Air Force Instruction (AFI) 11-206* (formerly *AFR 60-16*) would require a high degree of attention on the part of both military and civil pilots, and would require that civil pilots familiarize themselves with all information that would be available on the revised aeronautical charts, through the flight service agencies in Northway and Fairbanks, via local Notices to Airmen (NOTAMs), and from the Air Force directly on the use of the MOAs. Similarly, military pilots would need to become familiar with existing civil, non-participating activity throughout the areas with particular attention on the VFR flyways and landing locations in the southern half of YUKON 4 and throughout the entirety of YUKON 3 MOAs.

While these MOAs represent a block of airspace designed to accomplish air-to-ground and air-to-air training, the area is not entirely uncontrolled. Use of these blocks of airspace for military training must be scheduled through the 354 FW, and access, entry, and exit from the airspace is controlled by an air traffic control agency or by direct VFR flight from Eielson AFB (routine training only). Although the MOAs would be opened for extended hours of operation throughout the day, they would not be in continuous use on a daily basis. Policy for joint use of these airspaces is based on the "see-and-avoid" concept. This concept is enhanced by the F-15 and F-16 airborne radar's ability to detect small (Cessna- and Piper-sized) targets moving at slow rates of speed at ranges of 10 to 20 miles. The proposed MOA boundaries define airspace within which non-participating VFR aircraft are expected to operate with greater caution (see-and-avoid). The Air Force's Special Use Airspace Information System, as described in section 3.2.2, provides an increased level of situational awareness for all pilots flying within the coverage area of the system. However, low-altitude radar coverage is extremely limited in the YUKON 3 MOA and non-existent in YUKON 4 MOA (see Figure 3-7 and Figure 3-8).

4.2.2.1.1 Northern Interior Region Routine and Joint/Combined Training

Under the Proposed Action, YUKON 1 through 5 MOAs (the primary MOAs in the region) are anticipated to support approximately 45 percent of the routine daily training by Alaska-based units and deployed aircraft. This is only slightly higher than the routine daily training currently being accomplished in YUKON 1 and YUKON 2 MOAs. Under this alternative, routine daily training operations in YUKON 1 and YUKON 2 are expected to decrease approximately 19 percent over current levels with those sorties being distributed primarily to the proposed YUKON 3 and YUKON 4 MOAs, with a very small portion to the YUKON 5 MOA. The low potential utilization in YUKON 3 and 4 MOAs when compared to the 5-hour block (10:00 a.m. to 3:00 p.m.) of MOA availability would appear excessive. It is anticipated that operations in YUKON 3 and 4 MOAs would actually require approximately 3 hours per day. The 5-hour block proposed for YUKON 3 and 4 MOAs would provide scheduling flexibility to handle changing weather conditions in the Interior or possible maintenance/operations delays. Table 2-7 presents the estimated daily usage of the YUKON MOAs, and activities for the Stuart Creek air-to-ground weapons range (R-2205) are presented in Table 2-8 for the Proposed Action. The proposed YUKON 6 MOA would be used as a transition MOA along the west side of YUKON 1 and YUKON 2 MOAs, and would provide connections between YUKON 2 and the Stuart Creek range (R-2205). Training sorties would not be expected to use YUKON 6 exclusively, but in addition to other activities in YUKON 1 or 2 MOAs/R-2205.

Under the Proposed Action, the 354 FW at Eielson AFB would continue to be the primary user of the MOAs in the Northern Interior Region. Eielson-based aircraft (or deployed aircraft flying from Eielson AFB) are anticipated to account for approximately 72 percent (a 5 percent decrease under current usage) of the routine daily use of the proposed airspace. Elmendorf-based aircraft would account for the remainder of the operations in the region. Operations would continue to be associated with the F-16C/D, F-15C/D, F-15E, and OA-10A aircraft training in both air-to-air and air-to-ground tactics, and it is anticipated that the percentage of these types of training would not be expected to change from what was described in Chapter 3. Further, the percentage of an individual sortie's duration at various altitudes in the proposed MOAs is not expected to change from current practices. Low-altitude air-to-ground training sorties would be expected to be flown through the YUKON 1 MOA, throughout the YUKON 2 MOA south and east of the exclusion area along the Steese Highway Corridor, primarily in the southern half of YUKON 4 MOA, throughout the YUKON 3 MOA, and transiting through YUKON 6 MOA. Air-to-air training is expected to continue to occur primarily in the YUKON 1 and YUKON 2 MOAs with secondary activities in YUKON 3, YUKON 4, and when needed YUKON 5 MOAs. The use of the Stuart Creek range would continue to account for approximately 38 percent of the total routine range operations.

Under the Proposed Action, approximately 23,870 square miles (YUKON 1, 2, 3, 4, and 5 MOAs) of airspace in the region would be authorized, down to a floor of 5,000 feet AGL for routine air-to-air training that could result in supersonic activity and a sonic boom propagating to the ground. Table 4-1 depicts the average number of monthly routine aircraft sorties (and their locations) expected to be conducting training that could potentially result in a supersonic occurrence.

Table 4-1 Estimated Number of Monthly Routine Sorties Potentially Associated with Supersonic Activity in the Northern Interior Region

MOA	Monthly Routine Air-to-Air Sorties
YUKON 1	54
YUKON 2	55
YUKON 3	42
YUKON 4	15
YUKON 5	8
Total	174

4.2.2.1.2 Northern Interior Region Major Flying Exercises

Under the Proposed Action, the 11th Air Force would continue to conduct MFEs up to 60 days per year in the Northern Interior Region. MFEs could include up to 200 MFE aircraft sorties per day and could last for up to 15 flying days. During an MFE, all MOAs in the region could potentially be utilized. Similar to today's MFEs, the YUKON 1, 2, and 6 MOAs would be expected to take the heaviest traffic due to their central location within the region, their size, and their location relative to the Stuart Creek and Oklahoma air-to-ground weapons ranges. It is expected that during an MFE day, up to 95 percent of the total MFE sorties would pass through YUKON 1 and/or 2 MOA sometime during the exercise period. YUKON 3, 4, and 5 MOAs could experience up to 85 percent of the total MFE sorties passing through those respective areas. Generally operations in these outlying MOAs would be of a less intensive nature than those in YUKON 1 and 2 MOAs.

MFE air-to-air training, which could include some supersonic operations, could occur in the YUKON 3, 4, and 5 MOAs (in addition to the YUKON 1 and 2 MOAs). These training operations, some of which could create a sonic boom that could propagate to the ground, could occur throughout YUKON 1-5 MOAs. Supersonic operations would be authorized down to a minimum altitude of 5,000 feet AGL throughout these MOAs. Although the geographic areas covered by the proposed YUKON 3, 4, and 5 MOAs have been used for MFE training in the past (as TMOAs), they are not currently authorized for supersonic operations below 30,000 feet MSL. Supersonic occurrences are generally associated with air-to-air training and could occur in a manner similar to routine training. It is estimated that up to 63 air-to-air sorties could be conducting such training during an MFE flying day.

Operations on the Stuart Creek range and through R-2205 would include about 50 percent of the air-to-ground attack aircraft flying in the MFE. It is expected that range attack procedures would continue to be practiced as they are today (see section 3.2.2.2) except that there could be up to a 33 percent increase in air-to-ground MFE sorties using the range daily. Though an increased number of sorties would be expected under through the range, no increase in total munitions expenditures (live or inert) is expected under the Proposed Action.

4.2.2.1.3 Civilian Aircraft Operations

It is anticipated that the nature of civilian aircraft operations in the Northern Interior Region will change over the next several years. As aircraft navigation equipment (in particular the Global Positioning System [GPS]) becomes more affordable and widely available to smaller civil operators, there would be an anticipated desire for more direct civil routings between Fairbanks and communities along the Steese Highway underlying YUKON 2,

between Fairbanks and the communities under the southern/eastern portions of YUKON 3, and between the communities under YUKON 2 and YUKON 3. The increase in low-altitude military training airspace available on a continuous basis (as opposed to the higher altitude temporary airspace used on a limited basis) could lead to adverse impacts in the YUKON 3 MOA and the southern half of the YUKON 4 MOA between military flight training and civil access to these communities. Routine training, being of a lower intensity compared to MFE training, would be the least invasive, and low-altitude operations during an MFE would have the most impact on these two MOAs. However, due to the timing of MFEs in 2-hour periods, their infrequency, and the Air Force program to make information available to concerned aviators, the potential temporary schedule disruption to non-participating aviation should not create a significant adverse impact.

4.2.2.1.4 Northern Interior Region Aviation Safety

The Proposed Action would increase the permanent airspace available for low-altitude military aircraft operations in areas with known low-altitude civil aviation. Establishing the YUKON 3 and 4 MOAs with floors of 100 feet AGL would add approximately 9,460 square miles of low-altitude airspace over portions of the Yukon-Charley Rivers National Preserve, and the Charley and Fortymile National Wild and Scenic Rivers. Though specific use numbers are not available, these areas are frequented (by air) by various outfitters, guides, air taxis, and private hunters/fishermen. Flights into the areas are more frequent in the summer, and numerous uncharted landing areas have been established in the areas for these purposes. Proposed operations are expected throughout the year (as compared to up to 60 days per year today), and operations would be at lower altitudes than currently experienced in the YUKON 3 TMOA. As was discussed in section 3.2.6.2, Air Force records indicate there have been no midair collisions between military and civil aircraft in the State of Alaska, and the only near miss reports filed since 1991 have been in the vicinity of Eielson and Elmendorf AFBs. The proposed low-altitude use of this airspace would increase the need for vigilance on the part of both military and civil aviation operating in the proposed YUKON 3 and 4 MOAs to minimize the increased potential of a midair collision hazard. Further, strict adherence to a policy of "getting the word out" through NOTAMs and other forums on planned high-intensity activity and using the capabilities of the Special Use Airspace Information System throughout its area of coverage should reduce potential impacts.

4.2.2.1.5 Bird Aircraft Strike Hazard

The Bird Strike Hazard Evaluations for the proposed Alaska MOAs are designed to minimize the risk of a damaging bird strike (refer to Appendix H). Operational recommendations are based on the severity of the bird strike hazard at a particular time of day, month, and segment of a low-altitude route or low-altitude MOA operation, and are intended for use by airspace planners and pilots.

BASH evaluations that identify specific hazards and provide recommendations for each MOA are included in Appendix H. Local hazards for Elmendorf AFB and Eielson AFB are best identified by on-site surveys. The Air Force BASH Team has visited these bases, and the reports have been incorporated into the base BASH plans. These plans should be referred to by mission planners to obtain the best local BASH reduction information.

Migratory and breeding waterfowl, raptors, and cranes may present severe hazards to aircraft operations, especially along the Alaska river systems. The bird strike hazard potential can be significantly reduced by implementing the avoidance recommendations. However, these recommendations are general in nature since specific flight paths within the MOAs have not been addressed. As a result, avoidance recommendations necessary to avoid hazards within the large areas and wide altitude ranges may be too restrictive to meet training objectives. Enough data are available to develop a risk algorithm and construct a bird avoidance model (BAM) that would provide a more refined flight risk. Bird/aircraft strike hazards would be minimized with implementation of the BASH recommendations in Appendix H.

4.2.2.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety

The MOAs proposed for the Southern Interior Region are depicted in Figure 2-1 and Figure 4-4, and described in detail in sections 2.4.2 through 2.4.6 and Table 2-3.



Under the Proposed Action, approximately 4,050 square miles of transition airspace below 2,000 feet AGL and 400 square miles (CLEAR CREEK MOA) at a floor of 3,000 feet Mean Sea Level (MSL) would be available daily for routine training and for up to 60 days per year of MFEs in the region. Four of the five proposed MOAs in the region of influence would lie under three federal airways in the region. A major southeast/northwest artery, V-444 (see Figure 4-5), runs from the Northway area to the northwest over the proposed BUFFALO MOA at a minimum enroute altitude of 8,000 feet MSL, to Delta Junction, over the proposed BIRCH MOA with a minimum enroute altitude of 5,000 feet MSL, through the top of the proposed CLEAR CREEK MOA at 5,000 feet MSL, and on to Fairbanks. Also V-481 and V-515 proceed south out of Delta Junction with minimum enroute altitudes of 12,000 feet MSL. With V-444 and CLEAR CREEK MOA having the coincident altitudes at 5,000 feet MSL, the minimum enroute altitude on V-444 that could be assigned when CLEAR CREEK was active would be 6,000 feet MSL. The FAA has also noted that the altitude structure proposed for the CLEAR CREEK MOA would interfere with IFR traffic vector patterns currently used by Fairbanks Approach Control. IFR and VFR aircraft executing approaches to runway 31 at Eielson AFB are vectored southeast of the airport at 3,000 to 4,000 feet MSL to access the final approach course. These altitudes are selected to ensure adequate terrain clearance and radar coverage. The activation of the CLEAR CREEK MOA would restrict the ability of air traffic control to run traffic to Eielson arriving runway 31 or departing runway 13. However, since CLEAR CREEK MOA would only be used occasionally, activated by NOTAM, it is anticipated that the proposed MOAs in this region would not create significant adverse impacts on IFR and VFR operations.

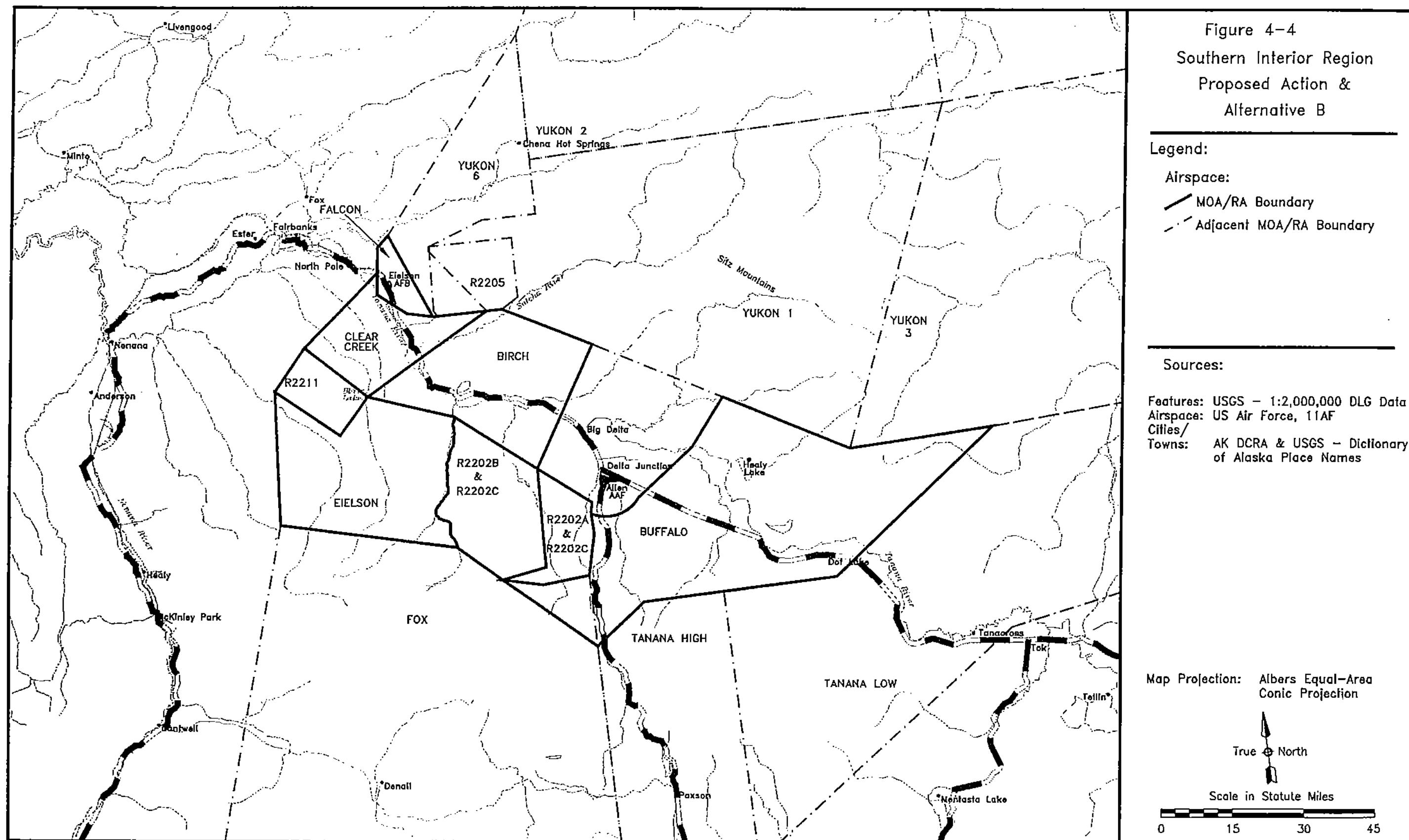
The airspace within the proposed FALCON MOA also encompasses the Class D airspace surrounding the Eielson AFB. MOA operations in the FALCON MOA would exceed 200 KIAS and be in conflict with the speed restrictions imposed in the Class D airspace surrounding Eielson AFB. Activation of the FALCON MOA would require discontinuing flight operations at Eielson AFB (the Class D airspace would not be active) until the MOA airspace is released. Activation of the MOA would only be by NOTAM and when coordinated with the air traffic control facility at Eielson AFB. To preclude unnecessary delays should the airfield be required to reopen unexpectedly, procedures would have to be established between operations, air traffic control personnel, and/or the FAA regional facility at Fairbanks for termination of MOA operations and release of the airspace to the Eielson air traffic control function during these unplanned conditions. Such an agreement should be clearly detailed to avoid any adverse impacts to the ability of the Eielson AFB tower to reopen the airfield on very short notice when operations are occurring in the proposed FALCON MOA.

The proposed Southern Interior Region would also overlies the MTR structure previously assessed (USAF 1992a). MTRs in the region that have various route segments coincident within the BIRCH, EIELSON, and BUFFALO MOAs include MTR 928, 935, 937, 1900, and 1926. These MTRs in relation to the proposed MOAs are depicted in Figure 4-6. Airspace scheduling and management of both the proposed MOAs and the MTRs coincident with this proposed structure would remain the joint responsibility of the 354 FW at Eielson AFB and the 3 WG at Elmendorf AFB.

The proposed MOAs would not overlies any public use airports, but would effectively surround the Allen Army Airfield south of Delta Junction and the Delta Junction Airport along the Richardson Highway north of Delta Junction. The western boundaries of the proposed BUFFALO MOA have been adjusted to provide sufficient procedural airspace for air traffic control at the Allen Army Airfield, but the location of these airfields relative to the MOAs of the Southern and Northern Interior Regions could result in adverse impacts due their isolation.

Since VFR aircraft operations are not denied access to MOAs, continued VFR use of the airspace would not be precluded. However, the introduction of low-altitude military tactical aircraft training on a daily basis (approximately 45 sorties per day) as opposed to the previous limited uses of the TMOAs (with the higher floors in BUFFALO) and an increased number of daily MFE sorties would increase the potential collision hazards over existing conditions and create an adverse impact. Compliance with aircraft right-of-way regulations contained in *FAR 91* and *AFI 11-206* (formerly *AFR 60-16*) would require a high degree of attention on the part of both military and civil pilots, and would require that civil pilots familiarize themselves with all information that would be available on the revised aeronautical charts, through the flight service agencies in Northway and Fairbanks, via local NOTAMs, through the Air Force's Special Use Airspace Information System, and from the Air Force directly on the use of the MOAs. Likewise, military aircrews must maintain a constant vigilance for low-altitude helicopter operations in the vicinity of the pipeline and for other non-participating aviation that in most cases would be traveling along the highways and across military flight routes through the region.

While these MOAs represent a block of airspace designed to accomplish air-to-ground training, the area is not entirely uncontrolled. Use of these MOAs for military training must be scheduled through the 354 FW. Access, entry, and exit from the airspace may be controlled by an air traffic control agency if Air Force operations are occurring on an IFR flight plan. Air Force aircraft conducting routine training may choose to enter the areas (under VFR) without obtaining a clearance from an air traffic control agency. Though the MOAs are opened for extended hours of operations throughout the day, they are not in continuous use on a daily basis. Policy for joint use of these airspaces is based on the "see-and-avoid" concept. 11th Air Force flying operations in these areas further enhances this concept with the ability of the F-15 and F-16 airborne radar's ability to detect small (Cessna and Piper-sized) targets moving at slow rates of speed at ranges of 10 to 20 miles. The proposed MOA boundaries define airspace within which non-participating VFR aircraft are expected to operate with greater caution (see and avoid). The Air Force's Special Use Airspace Information System, as described in section 3.2.2, provides an increased level of situational awareness for all pilots flying within the coverage area of the system. Low-altitude radar coverage would be provided for all proposed MOAs in the region except for the eastern half of BUFFALO MOA. Potential adverse impacts are expected from operations in the BUFFALO, EIELSON, and BIRCH MOAs at low-altitudes.



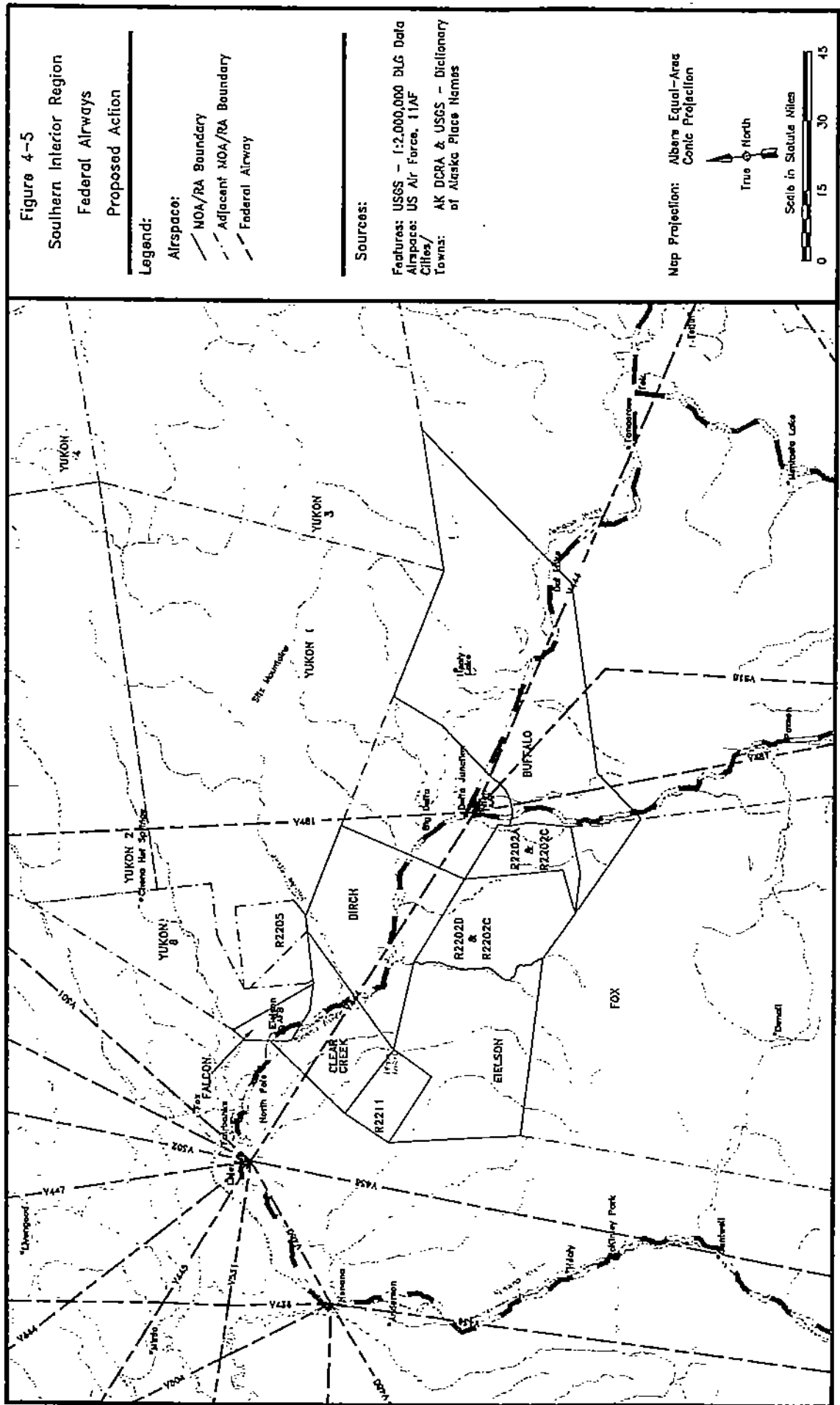


Figure 4-6

Southern Interior Region
Military Training Routes
Proposed Action

Legend:

Airspace:

- MOA/RA Boundary
- Adjacent MOA/RA Boundary
- Military Training Route

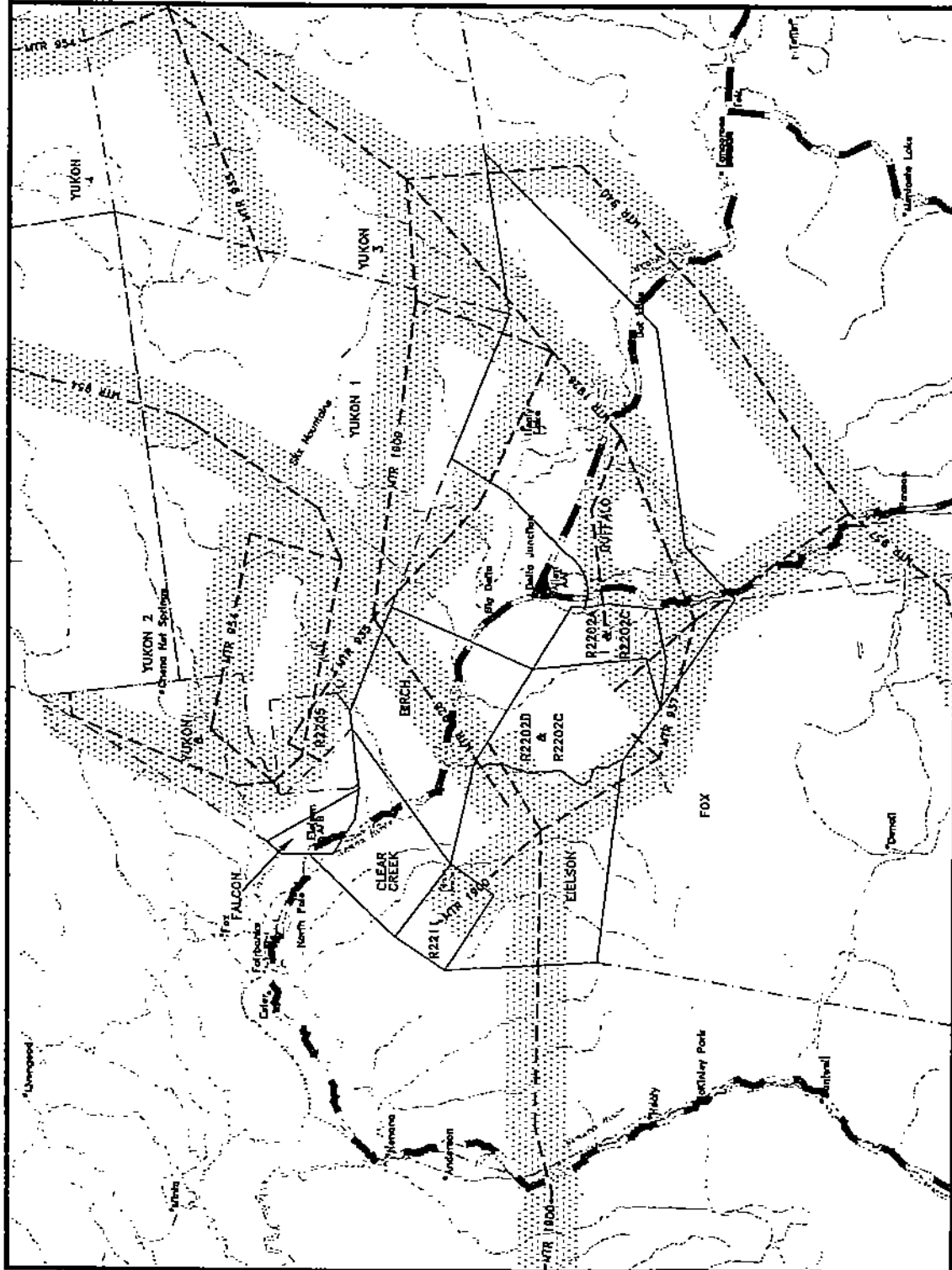
Sources:

Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, 11AF
Cities/Towns: AK DCRA & USGS - Dictionary of Alaska Place Names

Map Projection: Albers Equal-Area Conic Projection

True North

Scale in Statute Miles



4.2.2.2.1 Southern Interior Region Routine and Joint/Combined Training

Under the Proposed Action, all the MOAs in the region except FALCON MOA, would be used for transition activity between the YUKON 1, YUKON 3, and R-2205 areas in the Northern Interior Region to the R-2202 and R-2211 areas surrounding the ranges at Oklahoma and Blair Lakes, and even down to the FOX MOA in the Southcentral Region. The proposed BIRCH, EIELSON, and BUFFALO MOAs are also of sufficient size to provide areas for close air support training between the F-16Cs and OA-10As at Eielson AFB, and the BUFFALO MOA could also support low-altitude air-to-air training (LOWAT). However, due to the orientation of the BIRCH and BUFFALO MOAs along the Richardson and Alaska Highways, use of these MOAs for other than transition airspace to and from the ranges/MOAs could create a significant adverse impact. Their uses as defined by this Proposed Action limit the potential impact.

Under the Proposed Action, the 354 FW at Eielson AFB would continue to be the primary user of the MOAs in the Southern Interior Region. Eielson-based aircraft (or deployed aircraft flying from Eielson AFB) are anticipated to account for approximately 70 percent of the routine daily use of the proposed airspace. It is anticipated that the F-15Es based at Elmendorf AFB would make up the remaining 30 percent of the use of the proposed airspace. Table 2-7 presents the estimated daily usage of the proposed MOAs and Table 2-8 presents the same information for the RAs (R-2202 and R-2211) in the region.

The percentage of an individual sortie's duration at various altitudes in the proposed MOAs is not expected to change from current practices for low-altitude training in other regions, especially with the low ceilings of 4,000 feet MSL and 7,000 feet MSL in BIRCH and BUFFALO respectively. Low-altitude air-to-ground training sorties would be expected to be flown through the BIRCH, EIELSON, and BUFFALO MOAs in either direction to or from the ranges. FALCON MOA would be used only sparingly (anticipated for up to two periods per day each, up to 30 minutes per period) when airfield attack scenarios were being practiced. CLEAR CREEK MOA would be used strictly as a transition area, without tactical maneuvering, where aircraft could proceed between FALCON MOA, YUKON 1 MOA, R-2205, and R-2211.

Under the Proposed Action, no supersonic operations below 30,000 feet MSL would be permitted in conjunction with training activities in any of the MOAs in the Southern Interior Region.

The use of the Oklahoma and Blair Lakes air-to-ground weapons ranges would continue to account for approximately 62 percent of the total routine range operations. There has been a slight shift away from use of the Blair Lakes range for routine training; however, it is anticipated that no changes in routine operations or procedures on the range would result from implementation of the Proposed Action.

Under the Proposed Action, routine daily operations at Eielson AFB would continue to average approximately 62 aircraft sorties per day. Operations could be interrupted as discussed previously, during periods when the FALCON MOA was activated. Table 2-6 depicts the daily sorties flown from Eielson AFB during periods of normal routine training and during an MFE under the Proposed Action.

4.2.2.2.2 Southern Interior Region Major Flying Exercises

Under the Proposed Action, the 11th Air Force would continue to conduct MFEs up to 60 days per year in the Southern Interior Region. MFEs could include up to 200 MFE aircraft sorties per day and could last for up to 15 flying days. During an MFE, all MOAs in the region could potentially be utilized. The BUFFALO, BIRCH, and EIELSON MOAs would be expected to take the heaviest traffic due to their location within the region, their size, and their location relative to the Stuart Creek and Oklahoma ranges. It is expected that during an MFE day, up to 66 percent of the total MFE sorties would pass through BIRCH MOA; approximately 45 percent of the sorties through BUFFALO MOA; and about 38 percent of the sorties through EIELSON MOA, sometime during the exercise period. FALCON MOA would only be activated when an airfield attack scenario was part of the

exercise, and then would only see about 6 percent of the total exercise sorties. Use of CLEAR CREEK would be restricted to aircraft transitioning to the R-2211 airspace and holding for return to Eielson AFB.

Under the Proposed Action and during an MFE, operations at Eielson AFB could average up to 170 sorties per day versus approximately 142 sorties per day at current MFE levels. These increases in base loading during an MFE under the Proposed Action would not produce any adverse impacts to Eielson AFB air traffic operations.

4.2.2.2.3 Civilian Aircraft Operations

Under the Proposed Action, it is anticipated that civilian aircraft operations along the Northway to Fairbanks corridor would be adversely impacted when the MOAs were active. Though avenues exist for transit over the MOAs (BUFFALO and BIRCH), the FAA has noted that general aviation rarely climbs to such altitudes. Additionally, the need for regular, daily pipeline inspection flights below 500 feet AGL would continue concurrent with Air Force operations. It is expected that the greatest risk of an increased potential for aircraft interactions in the region would occur during weather conditions where a low ceiling (2,000 feet AGL) precludes civil aviators from flying at higher altitudes through or over the MOAs. In this case, it is highly possible that both military and civil non-participating aircraft could simultaneously transit these areas under the weather, but confined to a relatively small block of airspace due to the low ceiling conditions. This would create the potential for adverse impacts.

4.2.2.2.4 Southern Interior Region Aviation Safety

Under the Proposed Action, the creation of the BIRCH MOA with a 100 foot AGL floor and the BUFFALO MOA with a 300 foot AGL floor would add approximately 1,760 square miles of permanent low-altitude airspace available on a daily basis across a major low-altitude VFR flyway. These areas lie over an area of frequent VFR flights along the Alaska and Richardson Highways, and daily low-altitude maintenance/inspection flights along the Alaska Pipeline. Proposed operations in these MOAs would be at lower altitudes than presently authorized (in the BUFLO TMOA) and would be expected to occur on a daily basis as opposed to the current limit of 60 days per year during an MFE. Increased risks for midair collisions could exist along these flyways in the vicinity of the proposed BIRCH and BUFFALO MOAs, requiring a significantly heightened awareness on the part of both military and general aviation in this congested area to minimize these potential midair collision hazards. As was discussed in section 3.2.6.2. Air Force records indicate there have been no midair collisions between military and civil aircraft in the State of Alaska and the only near miss reports filed since 1991 have been in the vicinity of Eielson and Elmendorf AFBs. Further, strict adherence to a policy of "getting the word out" through NOTAMs and other forums on planned high-intensity activity in these airspaces, along with a real-time flight information system such as the Air Force's Special Use Airspace Information System would minimize the potential impacts.

4.2.2.2.5 Bird Aircraft Strike Hazard

The Bird Strike Hazard Evaluations for the proposed Alaska MOAs are designed to minimize the risk of a damaging bird strike (refer to Appendix H). Operational recommendations are based on the severity of the bird strike hazard at a particular time of day, month, and segment of a low-altitude route or low-altitude MOA operation, and are intended for use by airspace planners and pilots.

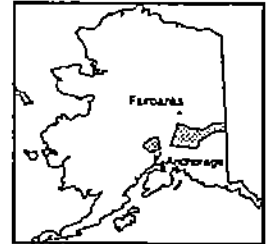
BASH evaluations that identify specific hazards and provide associated recommendations for each MOA are included in Appendix H. Local hazards for Elmendorf AFB and Eielson AFB are best identified by on-site surveys. The Air Force BASH Team has visited these bases, and the reports have been incorporated into the base BASH plans. These plans should be referred to by mission planners to obtain the best local BASH reduction information.

Migratory and breeding waterfowl, raptors, and cranes may present severe hazards to aircraft operations, especially along the Alaska river systems. The bird strike hazard potential can be significantly reduced by

implementing the avoidance recommendations (refer to Appendix H). However, these recommendations are general in nature since specific flight paths within the MOAs have not been addressed. As a result, avoidance recommendations necessary to avoid hazards within the large areas and wide altitude ranges, may be too restrictive to meet training objectives. Enough data are available to develop a risk algorithm and construct a BAM that would provide a more refined flight risk. Bird/aircraft strike hazards would be minimized with implementation of the BASH recommendations in Appendix H.

4.2.2.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety

The MOAs proposed for the Southcentral Region are depicted in Figure 2-1 and Figure 4-7, and described in detail in sections 2.4.2 through 2.4.6 and Table 2-4. Approximately 7,460 square miles of airspace (the FOX MOA) would be available for routine as well as MFE training. The FOX MOA would have a floor of 3,000 feet AGL.¹ No changes are proposed for the SUSITNA MOA.



No federal airways would pass through any of the MOAs in the Southcentral Region (see Figure 4-8). However, the area west of the FOX MOA and east of the SUSITNA MOA is a heavily used IFR corridor into and out of Anchorage. It is possible that simultaneous activation of both the SUSITNA and FOX MOAs could jeopardize the FAA's ability to provide adequate procedural separation along the north-south air routes between the two MOAs.

The proposed FOX MOA would overlie MTR 937 (see Figure 4-9) (USAF 1992a). However, the 3,000 foot AGL floor of the FOX MOA would put it at the ceiling of the MTR 937, and potential conflicts would require coordinated scheduling between the 3 WG and the 354 FW.

The proposed FOX MOA would overlie one public use airport at Susitna Lodge, but the 3,000 foot AGL floor of the MOA would preclude any significant impact on VFR traffic using the airport. Access to the areas under the MOA would not be impeded. No significant adverse impact on access to hunting and fishing areas or other VFR traffic transitioning through the MOA is predicted.

4.2.2.3.1 Southcentral Region Routine and Joint/Combined Training

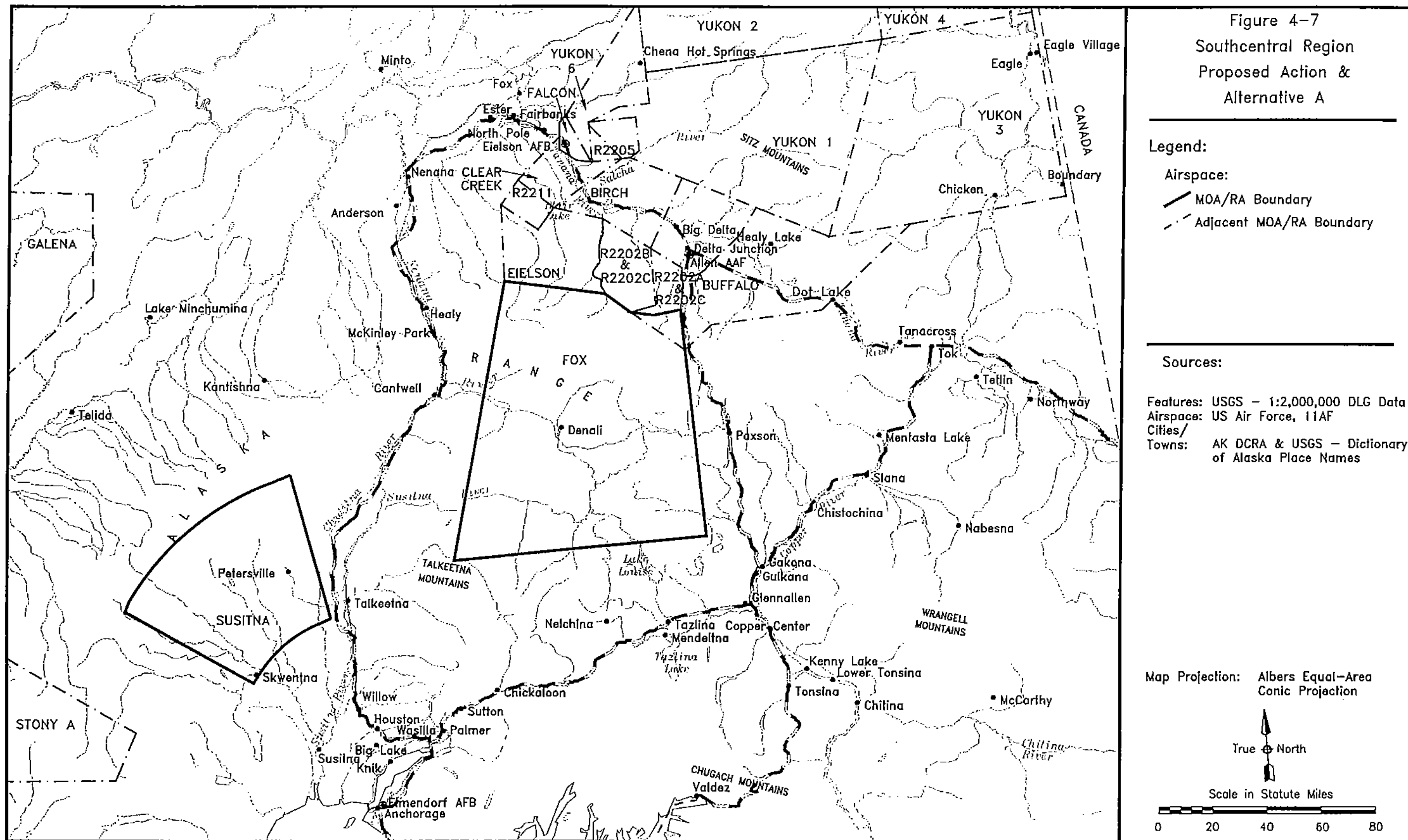
Under the Proposed Action, the FOX MOA is anticipated to support up to 17 percent of the routine daily training by Alaska-based units and deployed aircraft. With the use of FOX, it is expected that operations in SUSITNA could decline slightly, with FOX being a more suitable area for air-to-air training. Table 2-7 presents the estimated daily usage of the southcentral MOAs under the Proposed Action. Under this action F-16s from Eielson and F-15s from Elmendorf would be the main users of the MOAs in the region for conducting air-to-air training. The proposed FOX MOA would provide the first suitable airspace in the region for aircraft from both Eielson and Elmendorf to engage in dissimilar air combat training. The majority of this training is expected to occur in the southern two-thirds of the MOA due to the high terrain in the northern third.

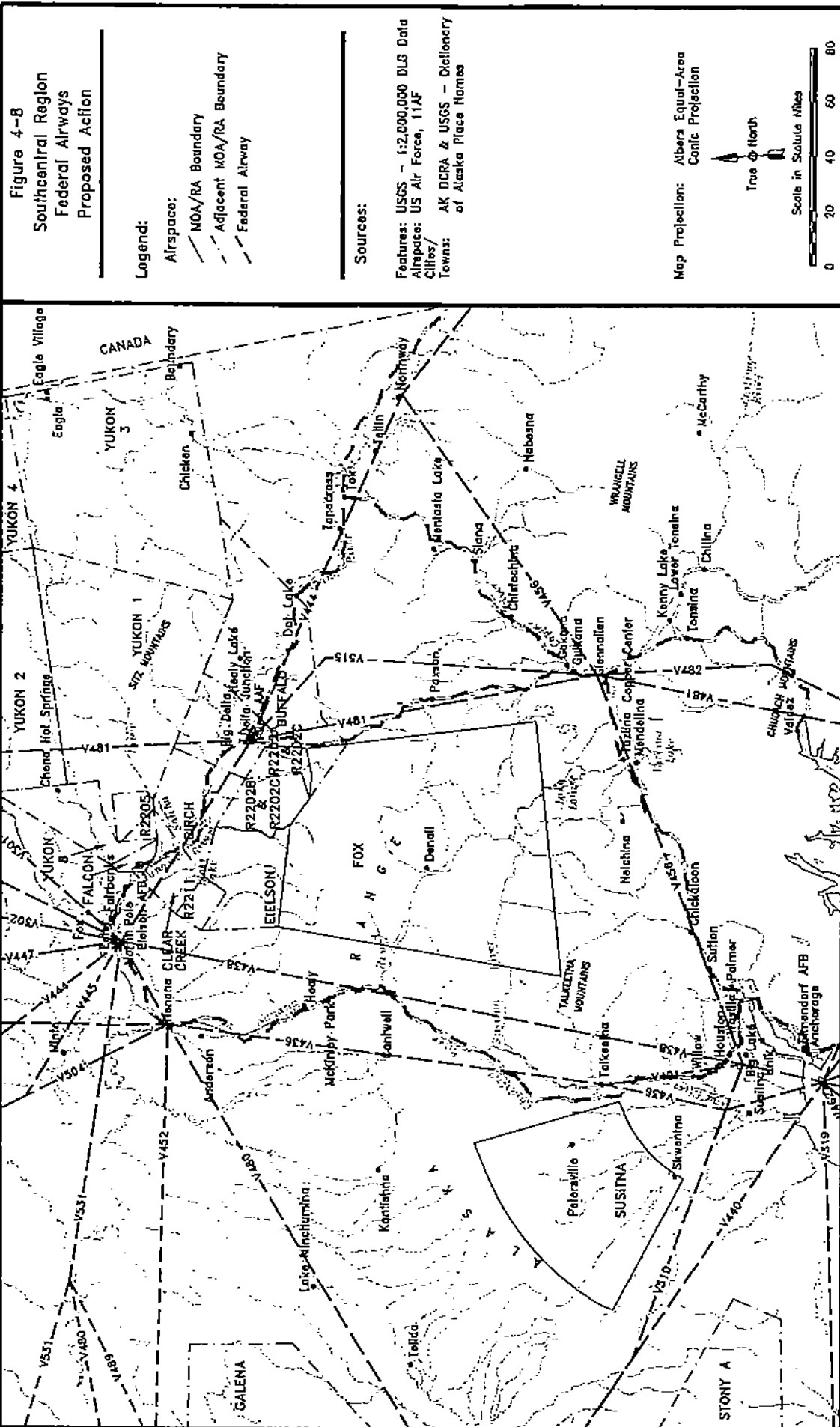
Under the Proposed Action, routine air-to-air training that could result in supersonic activity and a sonic boom propagating to the ground could be conducted in the FOX MOA down to a floor of 5,000 feet AGL. Supersonic activities would continue unchanged in the SUSITNA MOA. Supersonic occurrences are generally associated with air-to-air training activities and occur during closure for intercepts or during escape and evasive maneuvers. Since all the training planned for the FOX and SUSITNA MOAs would be air-to-air training, an average of 16

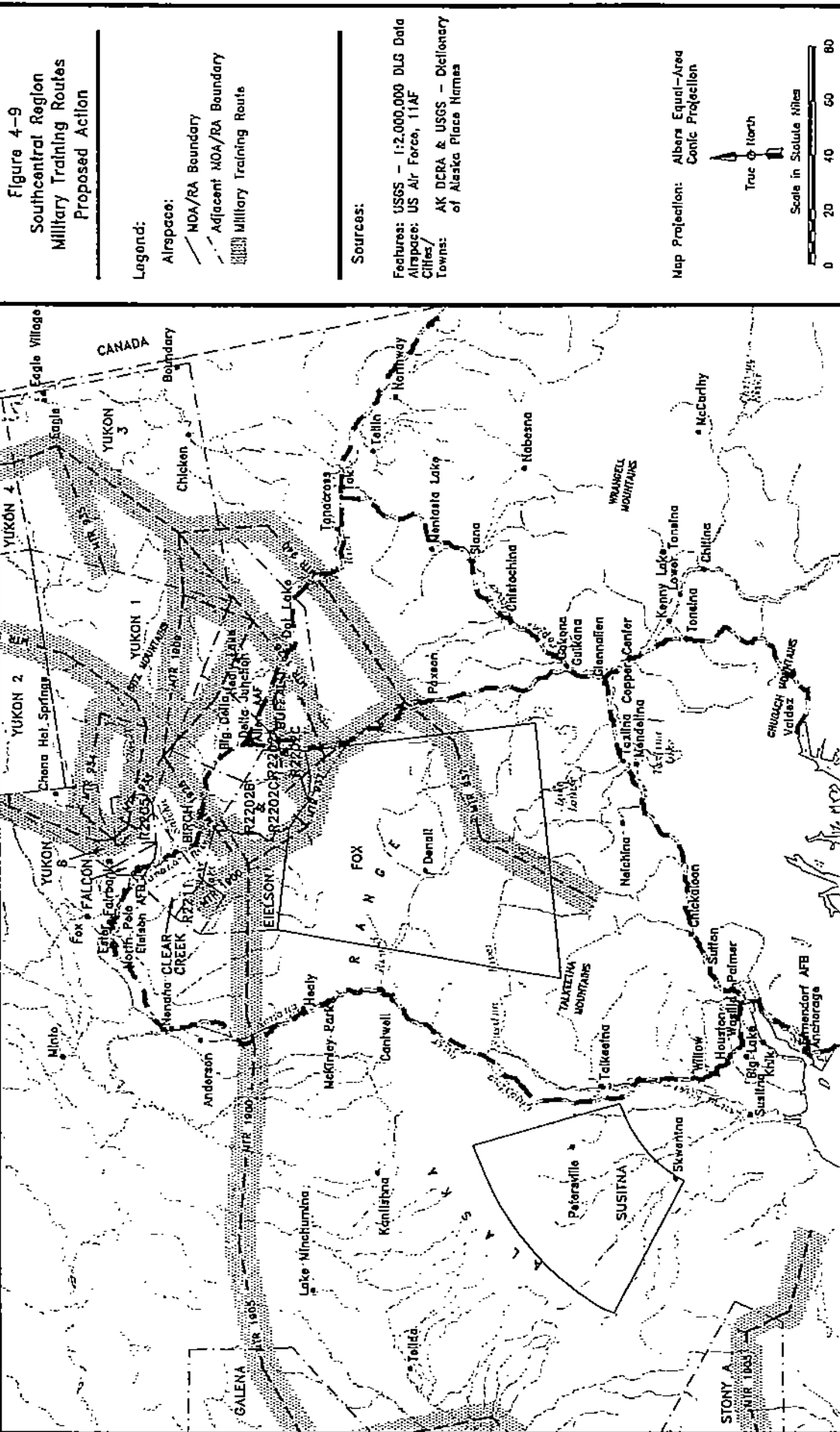
¹The very northeast corner of the FOX MOA (FOX B) overlapping the BUFFALO MOA would have a floor of 7,000 feet MSL.

sorties per day in FOX and 3 per day in SUSITNA would be conducting training that could result in a supersonic occurrence.

Under the Proposed Action, routine daily operations at Elmendorf AFB would continue to average approximately 84 total aircraft sorties per day. Table 2-6, depicts the daily sorties flown from Elmendorf AFB during periods of normal routine training and during an MFE under the Proposed Action.







4.2.2.3.2 Southcentral Region Major Flying Exercises

Under the Proposed Action, the 11th Air Force could use the FOX MOA during an MFE. MFEs could be conducted for up to 60 days per year, include up to 200 MFE aircraft sorties per day, and could last for up to 15 flying days. During an MFE, the FOX MOA would be used for air combat and marshalling of air combat defensive forces. The SUSITNA MOA would not be used for MFEs; however, routine training could be going on in SUSITNA simultaneously with MFE flying training in other parts of the region.

Under the Proposed Action, the FOX MOA would be authorized for supersonic activity down to 5,000 feet AGL. Supersonic activities would continue unchanged in the SUSITNA MOA. Supersonic occurrences are generally associated with air-to-air training activities and occur during closure for intercepts or during escape and evasive maneuvers. Nearly all the activities planned for the FOX MOA during an MFE would be air-to-air training. Up to 63 air-to-air sorties could use the FOX MOA daily during a 15-day MFE flying period and be expected to be conducting training that could potentially result in a supersonic occurrence.

During an MFE, operations at Elmendorf AFB could average up to 164 sorties per day versus approximately 132 sorties per day at current MFE levels. These increases are not expected to adversely impact to Elmendorf AFB air traffic operations nor general air traffic operations in the Anchorage, Alaska Terminal Area.

4.2.2.3.3 Civilian Aircraft Operations

It is not anticipated that civilian aircraft operations in the Southcentral Region would be impacted by the Proposed Action due to the high floors of the SUSITNA MOA. The FOX MOA with its 3,000 foot AGL floor also provides access below the MOA but not to the extent of the higher SUSITNA MOA. With the advent of GPS navigation equipment and the possibility of more direct routings from the Delta Junction area into the Matanuska-Susitna Valley, the floor as proposed for the FOX MOA may not provide adequate, unobstructed clearance for these direct flights, especially under IFR conditions.

4.2.2.3.4 Southcentral Region Aviation Safety

Under the Proposed Action, the creation of the FOX MOA would add approximately 7,460 square miles of permanent airspace down to a floor of 3,000 feet AGL. The proposed MOA would lie over areas such as the Gulkana and Delta National Wild and Scenic Rivers, the Denali Highway, and the very northern portion of the Nelchina Public Use Area. However, its floor, established at 3,000 feet AGL, should provide adequate access by air to the areas.

4.2.2.3.5 Bird Aircraft Strike Hazard

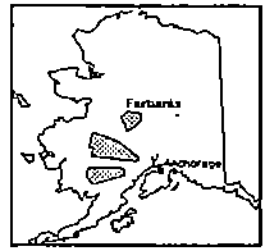
The Bird Strike Hazard Evaluations for the proposed Alaska MOAs are designed to minimize the risk of a damaging bird strike (refer to Appendix H). Operational recommendations are based on the severity of the bird strike hazard at a particular time of day, month, and segment of a low-altitude route or low-altitude MOA operation, and are intended for use by airspace planners and pilots.

BASH evaluations that identify specific hazards and provide associated recommendations for each MOA are included in Appendix H. Local hazards for Elmendorf AFB and Eielson AFB are best identified by on-site surveys. The Air Force BASH Team has visited these bases, and the reports have been incorporated into the base BASH plans. These plans should be referred to by mission planners to obtain the best local BASH reduction information.

Migratory and breeding waterfowl, raptors, and cranes may present severe hazards to aircraft operations, especially along the Alaska river systems. The bird strike hazard potential can be significantly reduced by implementing the avoidance recommendations (refer to Appendix H). However, these recommendations are

general in nature since specific flight paths within the MOAs have not been addressed. As a result, avoidance recommendations necessary to avoid hazards within the large areas and wide altitude ranges may be too restrictive to meet training objectives. Enough data are available to develop a risk algorithm and construct a BAM that would provide a more refined flight risk. Bird/aircraft strike hazards would be minimized with implementation of the BASH recommendations in Appendix H.

4.2.2.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety



The MOAs proposed for the Western Region are depicted in Figure 2-1 and Figure 4-10, and described in detail in sections 2.4.2 through 2.4.6 and Table 2-5. Approximately 3,150 square miles of low-altitude airspace in STONY B MOA would be available for routine training and for local air-to-air surge exercises in the region. No other airspace floors in the Western Region would be modified. The airspace within the Western Region would continue to be used for routine daily training and limited air-to-air surge exercises conducted by the 3 WG at Elmendorf AFB.

No federal airways pass through any of the MOAs in the Western Region (see Figure 4-11).

All of the MOAs in the region overlie some of the MTRs (see Figure 4-12) (USAF 1992a). The ceilings of portions of MTRs 931 and 933 are at 3,000 feet AGL, the floor of the NAKNEK 1 and 2 MOAs; MTRs 933 and 1905 pass through the STONY A and STONY B MOAs; and MTR 1905 passes through the GALENA MOA. Airspace scheduling and management of both the proposed MOAs and the MTRs would remain the joint responsibility of the 354 FW at Eielson AFB and the 3 WG at Elmendorf AFB.

The proposed STONY B MOA (with a 100-foot AGL floor) would overlie public use airports at Crooked Creek, Red Devil, Sleetmute, and Stony River No 2. To avoid adverse impacts on VFR traffic using these airports, FAA airspace policy as outlined in FAA Handbook 7400.2, *Procedures for Handling Airspace Matters*, provides that a MOA should exclude the airspace 1,500 feet AGL and below within a 3 NM radius of airports available for public use. These required exclusion areas would become part of the MOA description when charted by the FAA.

Since VFR aircraft operations are not denied access to MOAs, the lowering of the floor in STONY B MOA would not preclude continued VFR use. However, the introduction of low-altitude military tactical aircraft training on a daily basis as opposed to the previous use of the STONY B MOA (with its higher floor) may result in a potential collision hazard. Compliance with aircraft right-of-way regulations contained in *FAR 91* and *AFI 11-206* would require a high degree of attention on the part of both military and civil pilots, and would require that civil pilots familiarize themselves with all information that would be available on the revised aeronautical charts, through the flight service agencies, via local NOTAMs, and from the Air Force directly on the use of the MOAs. Similarly, military pilots would need to become familiar with existing civil, non-participating activity throughout the STONY B MOA with particular attention to the VFR flights and landing locations along the rivers in the region.

This Page Intentionally Left Blank



Figure 4-10

Western Region

Proposed Action,
Alternative A, and
Alternative B

Legend:

Airspace:

MOA Boundary

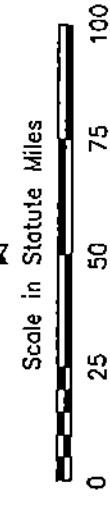
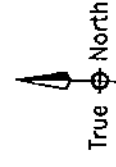
Adjacent MOA Boundary

Sources:

Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, 11AF
Cities/
Towns:

AK DCRA & USGS - Dictionary
of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection



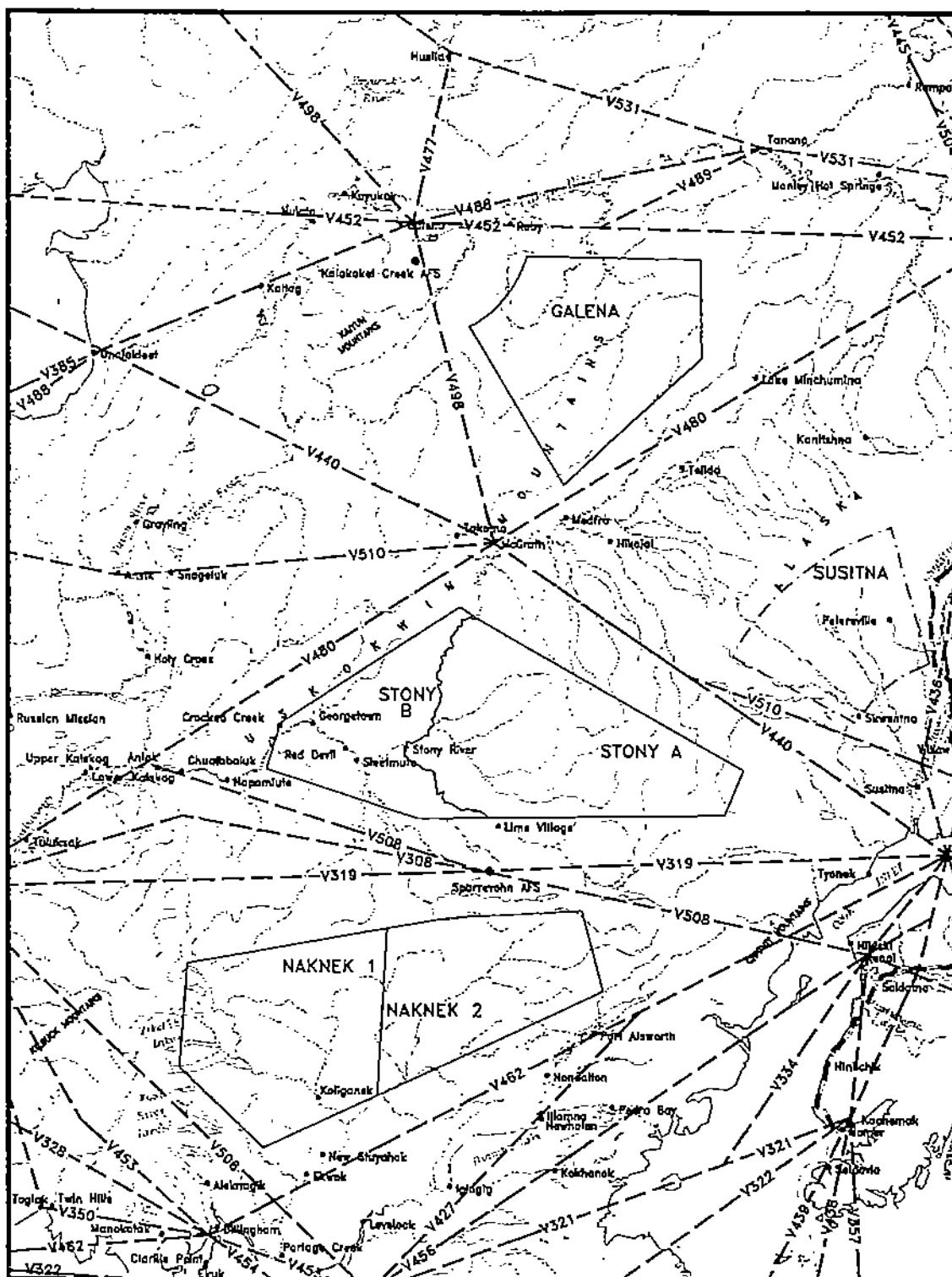


Figure 4-11
Western Region
Federal Airways
Proposed Action

Legend:

Airspace:

- MOA Boundary
- - - Adjacent MOA Boundary
- - - Federal Airway

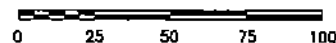
Sources:

Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, 11AF
Cities/
Towns: AK DCRA & USGS - Dictionary
of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection



Scale in Statute Miles



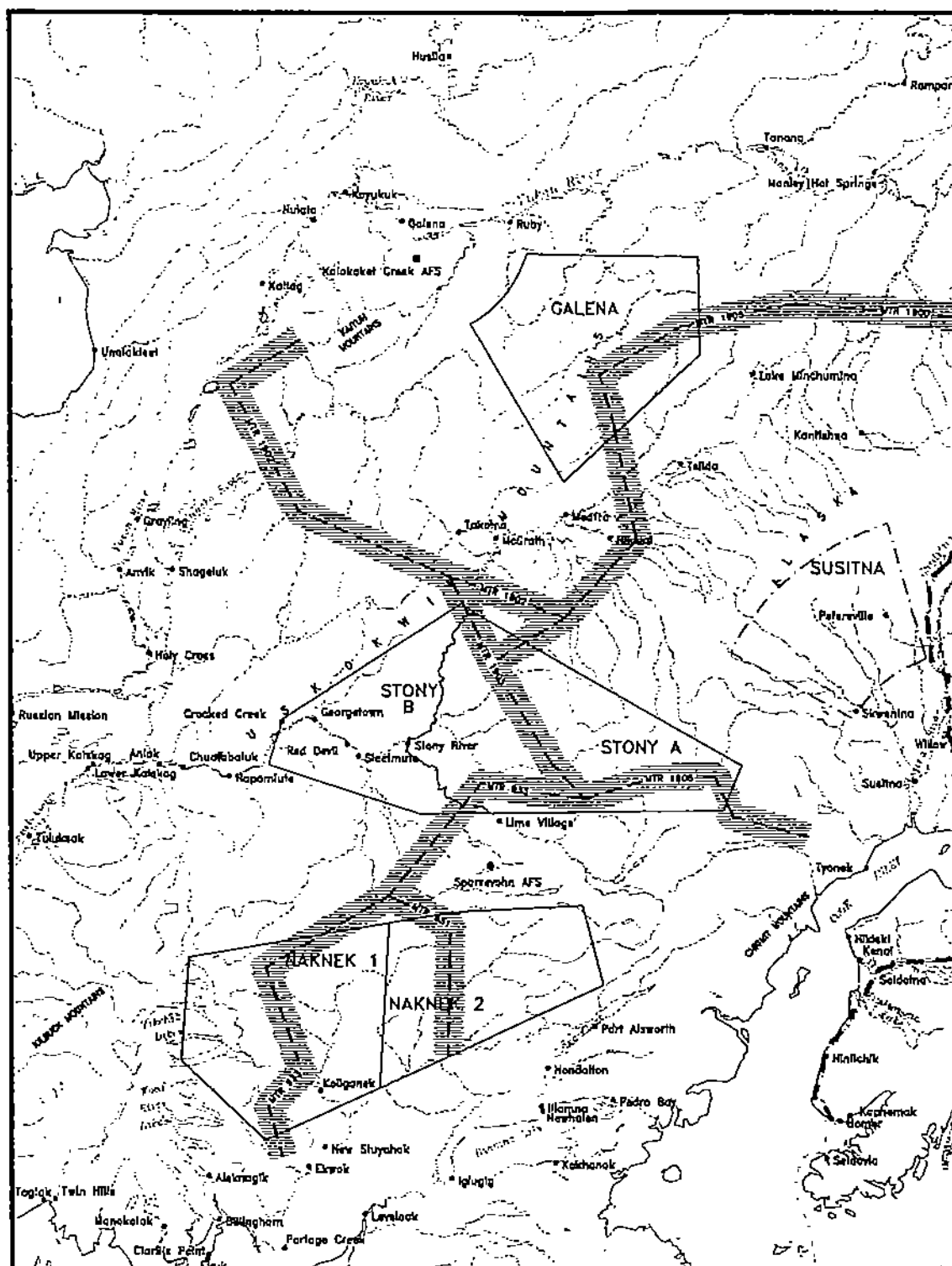


Figure 4-12
Western Region
Military Training Routes
Proposed Action

Legend:

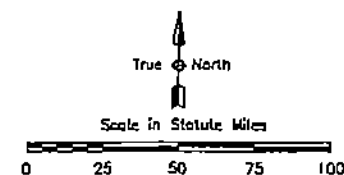
Airspace:

- MDA Boundary
- - - Adjacent MDA Boundary
- == Military Training Route

Sources:

Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, 11AF
Cities/Towns: AK DCRA & USGS - Dictionary of Alaska Place Names

Map Projection: Albers Equal-Area Conic Projection



While these MOAs represent a block of airspace designed to accomplish low-altitude tactical navigation and air-to-air training, the area is not entirely uncontrolled. Use of these blocks of airspace for military training must be scheduled through the 3 WG. Access, entry, and exit from the airspace would be controlled by an air traffic control agency for those aircraft operating on an IFR flight plan. This is the case for most operations in this region. However, aircraft do occasionally choose to proceed to and from the MOAs under VFR procedures and not under the control of an air traffic control agency. Though the MOAs are opened for extended hours of operations throughout the day, they are not in continuous use on a daily basis. Policy for joint use of these airspaces is based on the "see-and-avoid" concept. 11th Air Force flying operations in these areas further enhance this concept with the ability of the F-15 and F-16 airborne radar's ability to detect small (Cessna and Piper-sized) targets moving at slow rates of speed at ranges of 10 to 20 miles. The proposed MOA boundaries define airspace within which non-participating VFR aircraft are expected to operate with greater caution (see and avoid). With the lowering of the floor of STONY B MOA to 100 feet AGL, there would be increased potential for Air Force flight operations in the region to interact with civil, non-participating aviation in the area along the Kuskokwim and Holitna rivers from Sleetmute northeast to Stony River No 2, Sleetmute west to Red Devil, and Sleetmute south to the border of STONY B. Civil flight activities in this area increase during the summer months, and to minimize the potential for adverse impact, it is necessary that both military and civil aviation maintain a "high vigilance" for other aircraft when operating in this area within several miles of the rivers during the summer months to avoid any significant adverse impacts.

4.2.2.4.1 Western Region Routine and Joint/Combined Training

The 3 WG at Elmendorf would continue to be the primary user of all the MOAs in the region. The STONY A and STONY B MOAs would also continue to account for a high percentage of overall operations due to the Alaska Air Combat Maneuvering Instrumentation (ACMI) coverage of both the STONY A and B MOAs. It would be expected with the creation of the FOX MOA, in the Southcentral Region, that operations in the STONY and NAKNEK MOAs could decrease slightly as some air-to-air activity would shift to the FOX MOA, especially the ability for Dissimilar Air Combat Training (DACT) with the F-16s from Eielson AFB. Lowering of the floor in STONY B would further enhance its ability as an area for low-altitude air-to-ground navigation for the F-15Es at Elmendorf AFB and expand its usability as part of the Alaska ACMI area. Table 2-7 depicts the estimated daily usage of the MOAs in the Western Region under the Proposed Action.

Under the Proposed Action, supersonic operations would be permitted in conjunction with training activities down to an altitude of 5,000 feet AGL in the STONY A and STONY B MOAs (no increase over existing conditions). Supersonic occurrences are generally associated with air-to-air training activities and occur during closure for intercepts or during escape and evasive maneuvers. It is estimated that approximately 426 monthly routine air-to-air training sorties could be expected to be conducting training that could potentially result in a supersonic occurrence.

4.2.2.4.2 Western Region Major Flying Exercises

MOAs in the Western Region are not anticipated to be used for MFEs under the Proposed Action. However, the MOAs in the region, especially STONY A and STONY B, would continue to be used (as they are today) for limited air-to-air surge exercises by the 3 WG at Elmendorf AFB. During an MFE in the other regions, it would be expected that on average, routine sorties in the Western Region could decrease by up to 20 percent as some of these sorties would be allocated to the MFE. It is not expected that MFE operations would be ongoing in other regions at the same time the 3 WG was conducting an air-to-air surge exercise in the Western Region.

4.2.2.4.3 Civilian Aircraft Operations

It is anticipated that under the Proposed Action, civilian aircraft operations in the Western Region would continue as they are today; however, the potential is there for the growth of more direct routings into and through the areas (especially the STONY MOAs) with the advent of GPS equipment. As noted earlier in section 4.2.2.4, the civil operations along the Kuskokwim and Holitna river systems in the STONY B MOA increase during the summer

months. It is not expected that military flight operations would create a significant adverse impact in the summer months.

4.2.2.4.4 Western Region Aviation Safety

The Proposed Action would lower the floor of the STONY B MOA from 3,000 feet AGL to 100 feet AGL. As stated in section 4.2.2.4.1, this lower floor would impact four public use airports in the region necessitating the establishment of an exclusion area for MOA operations of 1,500 feet AGL and 3 NM radius around these airports. Areas under the STONY B MOA are also estimated to be serviced by several dozen air taxi and outfitter services transporting hunters, fishermen, and river and lake float trip recreation parties. Operations in the STONY B MOA are expected to be less intensive than STONY A (where the center of the Alaska ACMI is located) but would now be conducted at lower altitudes than previously authorized. As was discussed in section 3.2.6.2, Air Force records indicate there have been no midair collisions between military and civil aircraft in the State of Alaska, and the only near miss reports filed since 1991 have been in the vicinity of Eielson and Elmendorf AFBs. This situation would require an increased need for vigilance on the part of both military and civil aviation operating in the proposed STONY B MOA to minimize the increased potential of a midair collision hazard.

4.2.2.4.5 Bird Aircraft Strike Hazard

The Bird Strike Hazard Evaluations for the proposed Alaska MOAs are designed to minimize the risk of a damaging bird strike (refer to Appendix H). Operational recommendations are based on the severity of the bird strike hazard at a particular time of day, month, and segment of a low-altitude route or low-altitude MOA operation, and are intended for use by airspace planners and pilots.

BASH evaluations that identify specific hazards and provide associated recommendations for each MOA are included in Appendix H. Local hazards for Elmendorf AFB and Eielson AFB are best identified by on-site surveys. The Air Force BASH Team has visited these bases, and the reports have been incorporated into the base BASH plans. These plans should be referred to by mission planners to obtain the best local BASH reduction information.

Migratory and breeding waterfowl, raptors, and cranes may present severe hazards to aircraft operations, especially along the Alaska river systems. The bird strike hazard potential can be significantly reduced by implementing the avoidance recommendations (refer to Appendix H). However, these recommendations are general in nature since specific flight paths within the MOAs have not been addressed. As a result, avoidance recommendations necessary to avoid hazards within the large areas and wide altitude ranges may be too restrictive to meet training objectives. Enough data are available to develop a risk algorithm and construct a BAM that would provide a more refined flight risk. Bird/aircraft strike hazards would be minimized with implementation of the BASH recommendations in Appendix H.

4.2.3 Alternative A

4.2.3.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety

See section 4.2.2.1.

4.2.3.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety

Under Alternative A, the CLEAR CREEK MOA would not be created. The other proposed MOA modifications and aircraft operations (both routine and exercise) would continue to occur in the Southern Interior Region. Figure 4-13 depicts the Southern Interior Region under Alternative A. The potential adverse interactions between military aircraft and civil aircraft on V-444 caused by the ceiling of CLEAR CREEK MOA would not occur. Other potential adverse interactions between military and civilian aviation along the highway, VFR corridors, and along the Alaska Pipeline could still occur and require resolution. Under Alternative A, operations planned for the CLEAR CREEK MOA would require rerouting through the BIRCH and EIELSON MOAs for entry in R-2211 airspace. It is expected that operations in BIRCH and EIELSON could increase by up to 10 percent over the Proposed Action if this alternative is implemented. This small increase is not expected to create any additional potential for significant adverse impact in the region. Under Alternative A, operations planned for the CLEAR CREEK MOA would require routing through the BIRCH and EIELSON MOAs for entry in R-2211 airspace for holding during recoveries back into Eielson AFB. These additional operations should not increase the potential for significant adverse impacts in the region. Impact levels identified in section 4.2.2.2 would remain the same under this Alternative.

This Page Intentionally Left Blank

Figure 4-13
Southern Interior Region
Alternative A

Legend:

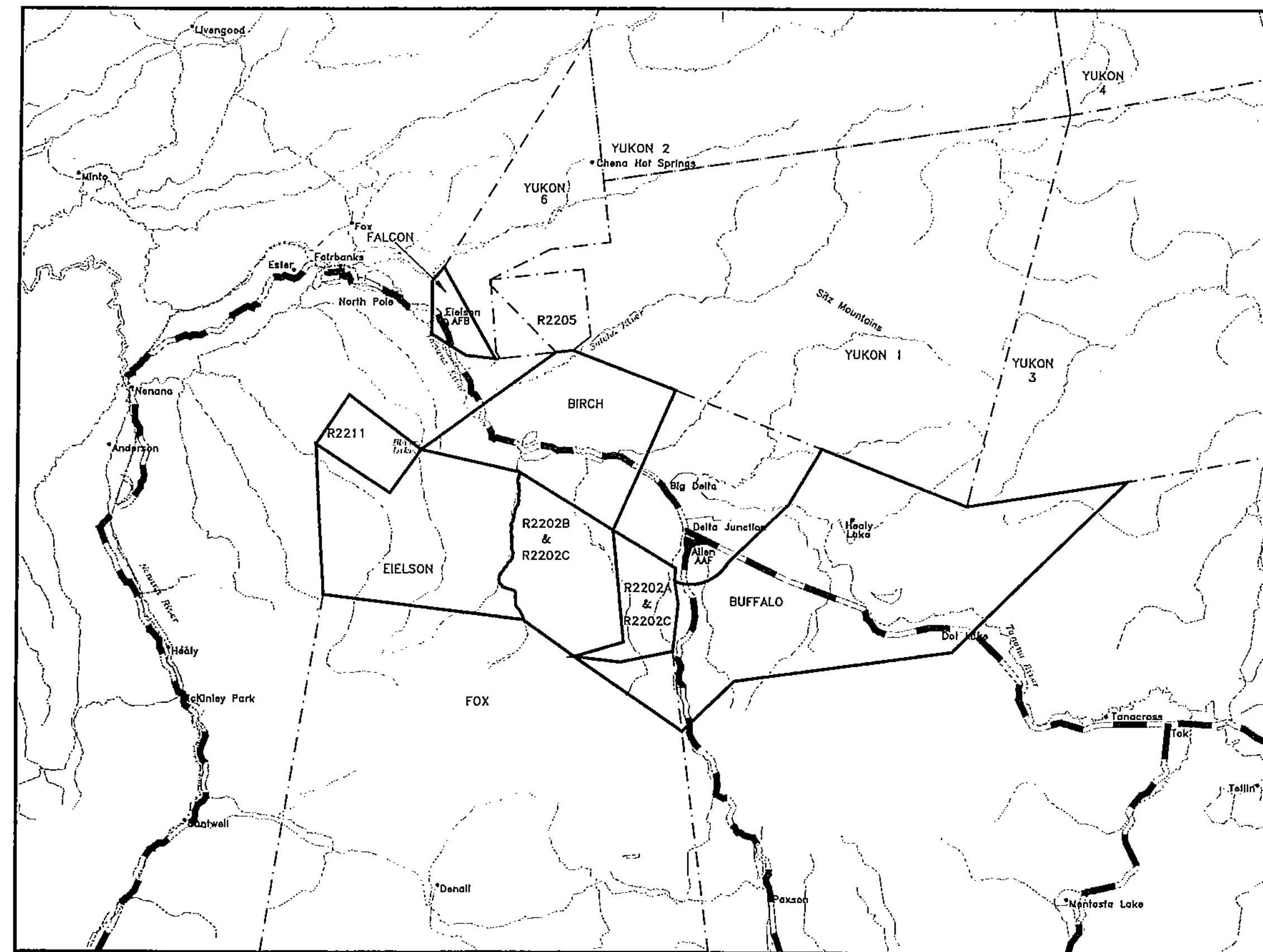
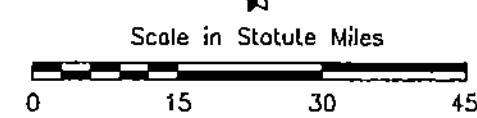
Airspace:

- MOA/RA Boundary
- - - Adjacent MOA/RA Boundary

Sources:

Features: USGS - 1:2,000,000 DLG Data
 Airspace: US Air Force, 11AF
 Cities/
 Towns: AK DCRA & USGS - Dictionary
 of Alaska Place Names

Map Projection: Albers Equal-Area
 Conic Projection



4.2.3.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety

See section 4.2.2.3.

4.2.3.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety

See section 4.2.2.4.

4.2.4 Alternative B

4.2.4.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety

Under Alternative B, the proposed YUKON 4 and YUKON 5 MOAs would not be created and the total low-altitude airspace (i.e., below 2,000 feet AGL) in the YUKON MOAs (1, 2, 3, and 6) would total approximately 16,540 square miles versus the 21,000 square miles under the Proposed Action (Figure 4-14). To replace the proposed YUKON 4 and YUKON 5 MOAs, the TANANA MOA would be created in the Southcentral Region. The potential impacts of Alternative B in the Southcentral Region are discussed in section 4.2.4.3.

4.2.4.1.1 Northern Interior Region Routine Training and Joint Combined/Training

Under this alternative, no routine (or combined/joint) training would be conducted in the areas proposed for the YUKON 4 or 5 MOAs. The only activities that could be authorized would be military operations along MTR 954 (which is not part of the Proposed or Alternative Actions), and in any FAA-designated air traffic controlled assigned airspace (ATCAA) that could be created above the areas covered by the YUKON 4 and YUKON 5 MOAs. Lowest possible floor for an ATCAA in this area is Flight Level (FL) 180 (roughly equivalent to 18,000 feet MSL). MOA operations planned for the YUKON 4 and YUKON 5 MOAs would require shifting to the proposed TANANA MOA in the Southcentral Region and are discussed in section 4.2.4.3.

4.2.4.1.2 Northern Interior Region Major Flying Exercises

MFE activities below FL 180 would not be conducted in the airspace proposed for the YUKON 4 and 5 MOAs. Activities planned for these regions would be shifted to the proposed TANANA MOA and are addressed in the Southcentral Region (see section 4.2.4.3). With new low-altitude airspace to the south of YUKON 3, it is expected that during an MFE more concentrated low-altitude flying would be occurring in the YUKON 3 region flowing north/south across the border with the TANANA MOA, whereas under the Proposed Action military traffic would tend to flow west toward the YUKON 1 MOA and the air-to-ground weapons ranges.

This Page Intentionally Left Blank

Figure 4-14
Northern Interior Region
Alternative B

Legend:

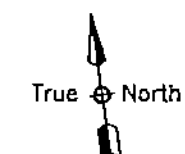
Airspace:

- MOA/RA Boundary
- - - Adjacent MOA/RA Boundary
- ▨ Military Exclusion Area

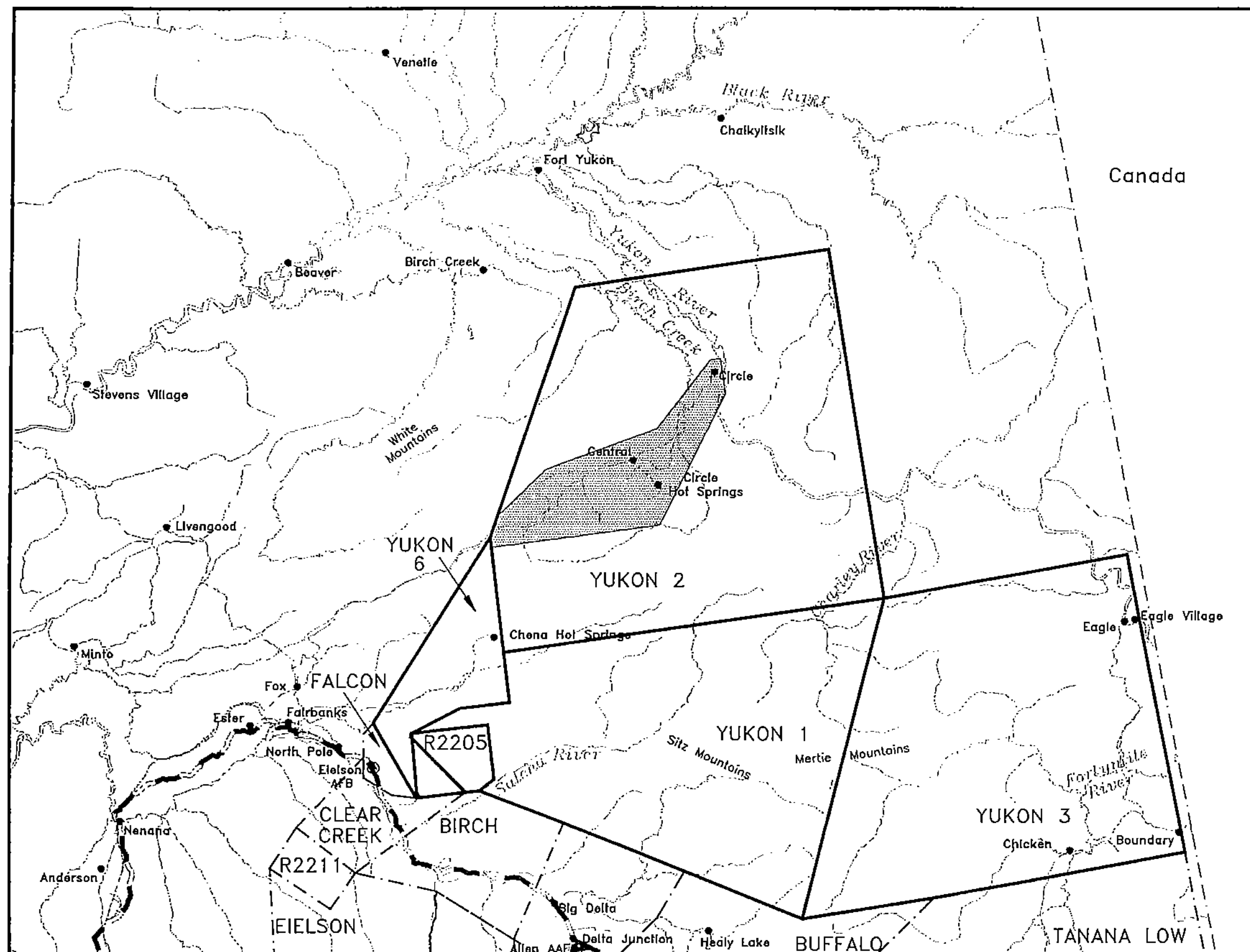
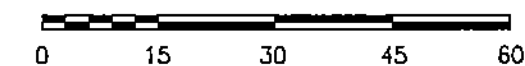
Sources:

Features: USGS - 1:2,000,000 DLG Data
 Airspace: US Air Force, 11AF
 Cities/
 Towns: AK DCRA & USGS - Dictionary
 of Alaska Place Names

Map Projection: Albers Equal-Area
 Conic Projection



Scale in Statute Miles



4.2.4.1.3 Civilian Aircraft Operations

Under Alternative B, the potential for adverse interactions between military aircraft and the Ben Creek airport would not occur; nor would the other potential conflicts along uncharted VFR flyways and landing locations in the wilderness areas under the proposed YUKON 4 MOA. Other potential impacts described in section 4.2.2.1.3 would still be valid. During an MFE, these potential interactions could be concentrated more in the YUKON 3 MOA as the proposed TANANA MOA would create a north/south flow of military aircraft in the area with potential adverse impacts.

4.2.4.1.4 Northern Interior Region Aviation Safety

See section 4.2.2.1.4. However, potential impacts in the YUKON 4 MOA would not be a factor under this alternative.

4.2.4.1.5 Bird Aircraft Strike Hazard

See section 4.2.2.1.5 and Appendix H. Note that the evaluations for the YUKON 4 and 5 MOAs would not be applicable under this alternative.

4.2.4.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety

Under Alternative B, the Southern Interior Region MOAs would be as shown in Figure 4-4.

4.2.4.2.1 Southern Interior Region Routine and Joint/Combined Training

Under Alternative B, the TANANA MOA would be created in the Southcentral Region. This alternative MOA would lie to the east of the BUFFALO MOA, and there would be a potential for increased operations in the BUFFALO MOA from sorties transitioning to/from TANANA. For these routine operations, it is not expected that the additional use of the BUFFALO MOA would create a significant adverse impact.

4.2.4.2.2 Southern Interior Region Major Flying Exercises

The establishment of the TANANA MOA adjacent to the BUFFALO MOA could increase the military air traffic flow along the Alaska Highway during an MFE. Under the existing conditions, and as described under the Proposed Action, military sorties would typically travel from the YUKON 1 MOA into and out of the R-2202 area and the Oklahoma range. Under this alternative, potentially more military sorties could be concentrated along the Alaska Highway at low-altitude transiting from TANANA into BUFFALO and to the Oklahoma range creating potential adverse impacts.

4.2.4.2.3 Civilian Aircraft Operations

Under Alternative B, civilian aircraft operations along the Northway to Fairbanks corridor could continue to be adversely impacted. The greatest risk of increased potential for aircraft interactions in the region would occur during weather conditions where a low ceiling (2,000 feet AGL) precludes civil aviators from flying at higher altitudes through or over the MOAs. In this case, it is highly possible that both military and civil non-participating aircraft could simultaneously transit these areas under the weather, but confined to a relatively small block of airspace due to the low ceiling conditions.

4.2.4.2.4 Southern Interior Region Aviation Safety

Under Alternative B, the potential for increased midair collision hazards could be higher than described in section 4.2.2.2.4 due to the increased number of military aircraft flying along the Alaska Highway into the BUFFALO

MOA as they transition into and out of the Oklahoma range (especially during an MFE). "Getting the word out" through NOTAMs and other forums on planned activity along the highway transiting between BUFFALO and the TANANA MOA would be essential to minimize the potential adverse impacts to aviation safety in the region.

4.2.4.2.5 Bird Aircraft Strike Hazard

No changes to the Bird Strike Hazard Evaluations, as described in section 4.2.2.2.5 and Appendix H, would occur under this alternative.

4.2.4.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety

Under Alternative B, the TANANA MOA would be created to replace the proposed YUKON 4 and 5 MOAs of the Northern Interior Region. The proposed TANANA MOA, depicted in Figure 4-15, would extend approximately 38 miles south from the southeast corner of YUKON 3 MOA, over to between Tok and Tanacross, and then down to the southeast corner of the FOX MOA. The northern boundary would lie along the southern boundary of the YUKON 3 and BUFFALO MOAs with the western border along the eastern border of the FOX MOA. The floor proposed for the TANANA MOA would be 300 feet AGL from the eastern border to longitude 145 degrees west. West of that line, the proposed altitude is 3,000 feet AGL to the border with the FOX MOA. The 145 degree longitude line roughly equates to the eastern boundary of the FOX 2 TMOA. Additional details on the TANANA MOA are outlined in section 2.4.5.3 and Table 2-4. Under this alternative, approximately 4,980 square miles of airspace for low-altitude operations down to 300 feet AGL would be available in the TANANA MOA east of the 145 degree longitude line and an additional 1,850 square miles of airspace would be created at 3,000 feet AGL to the west of the 145 degree longitude. This alternative MOA would also overlie MTRs 937 and 940 (see Figure 4-14). If this alternative is implemented, airspace scheduling and management of both the alternative TANANA MOA and the MTRs coincident with the MOA would become the joint responsibility of the 354 FW and the 3 WG.

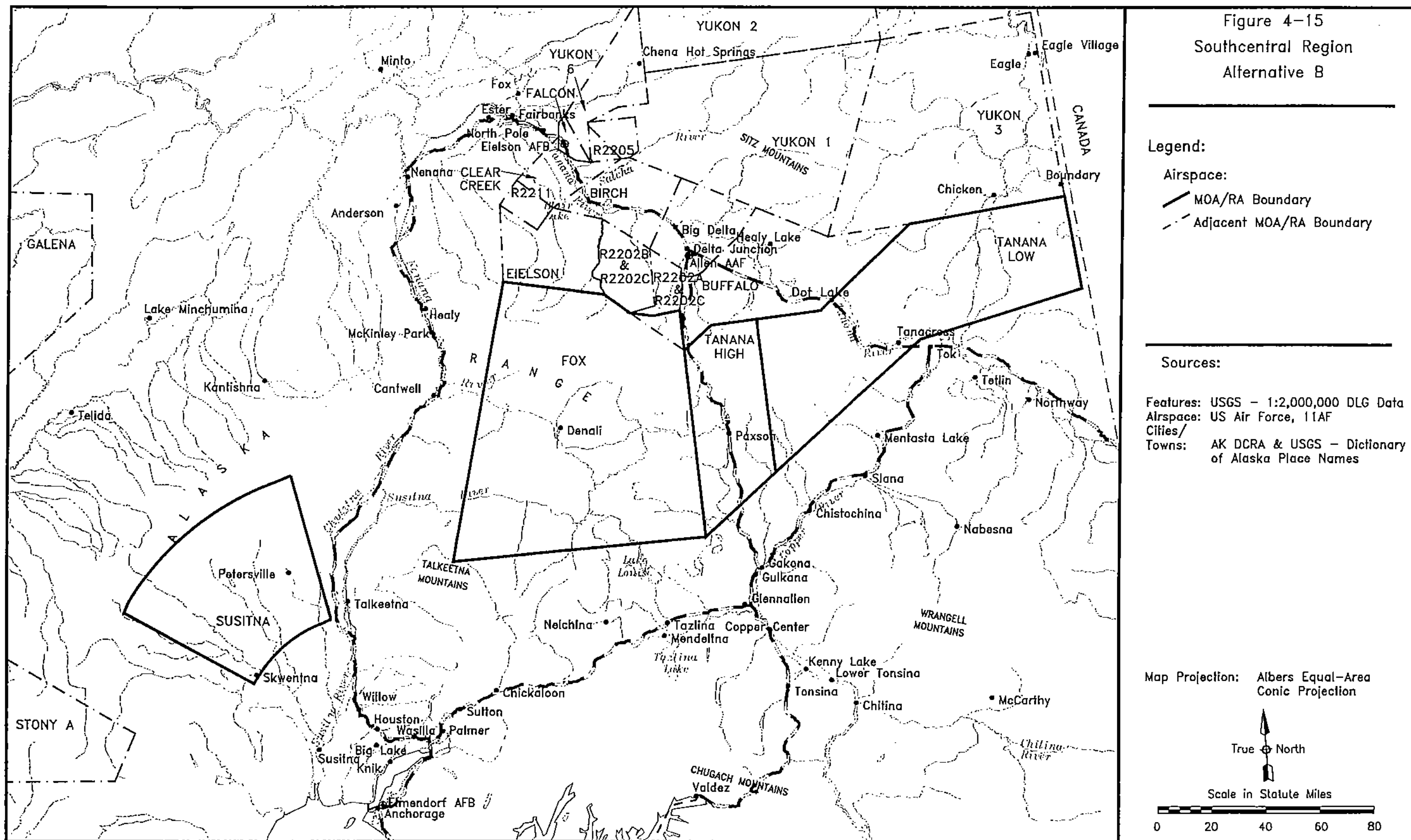


Figure 4-16
Southcentral Region
Military Training Routes
Alternative B

Legend:

Airspace:

MOA/RA Boundary

Adjacent MOA/RA Boundary

Military Training Route

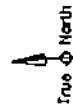
Sources:

Features: USGS - 1:2,000,000 DLG Data

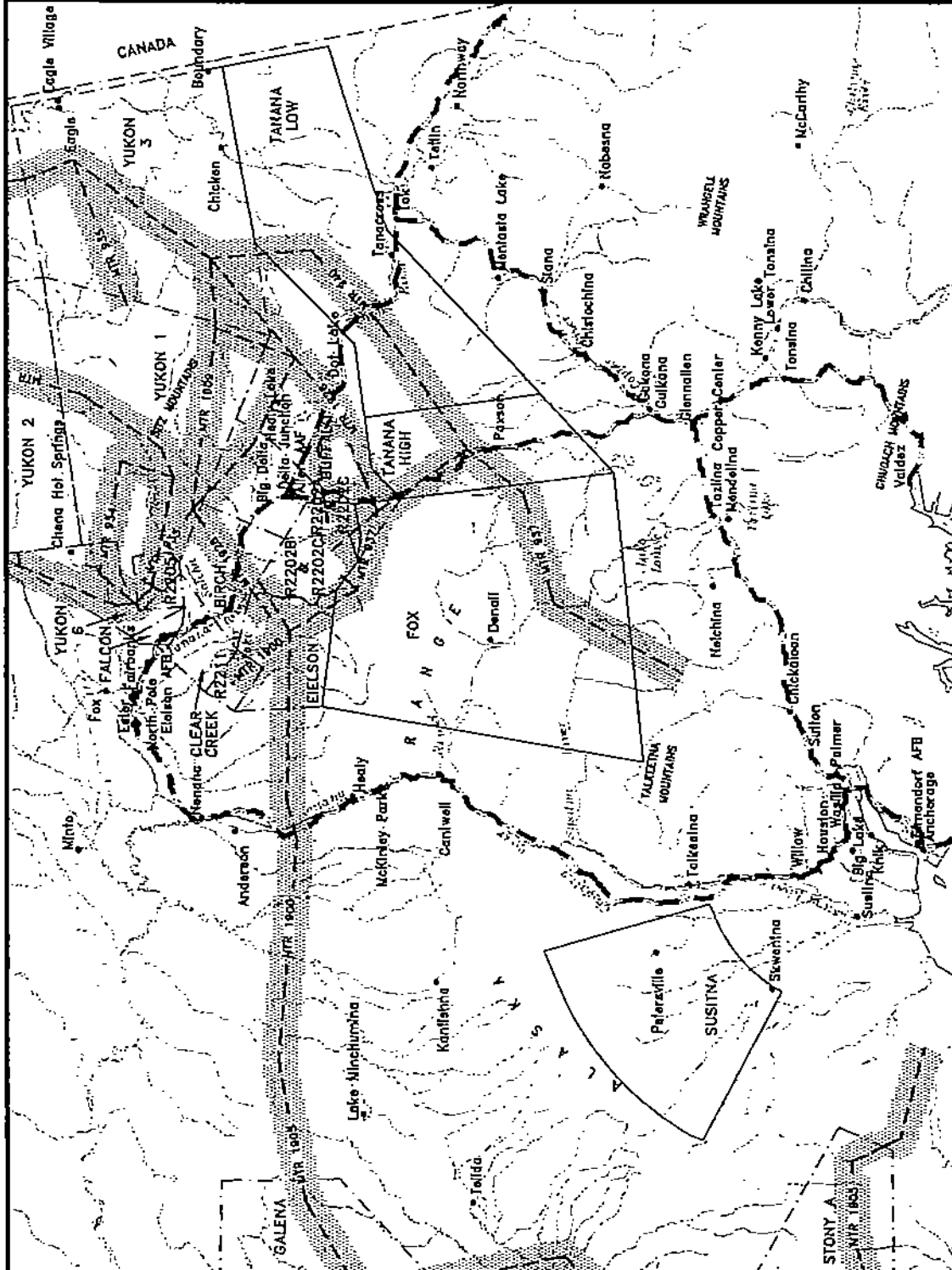
Airspace: US Air Force, 11AF

Cities/
Towns: AK DCRA & USGS - Diellenary
of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection



Scale in Statute Miles



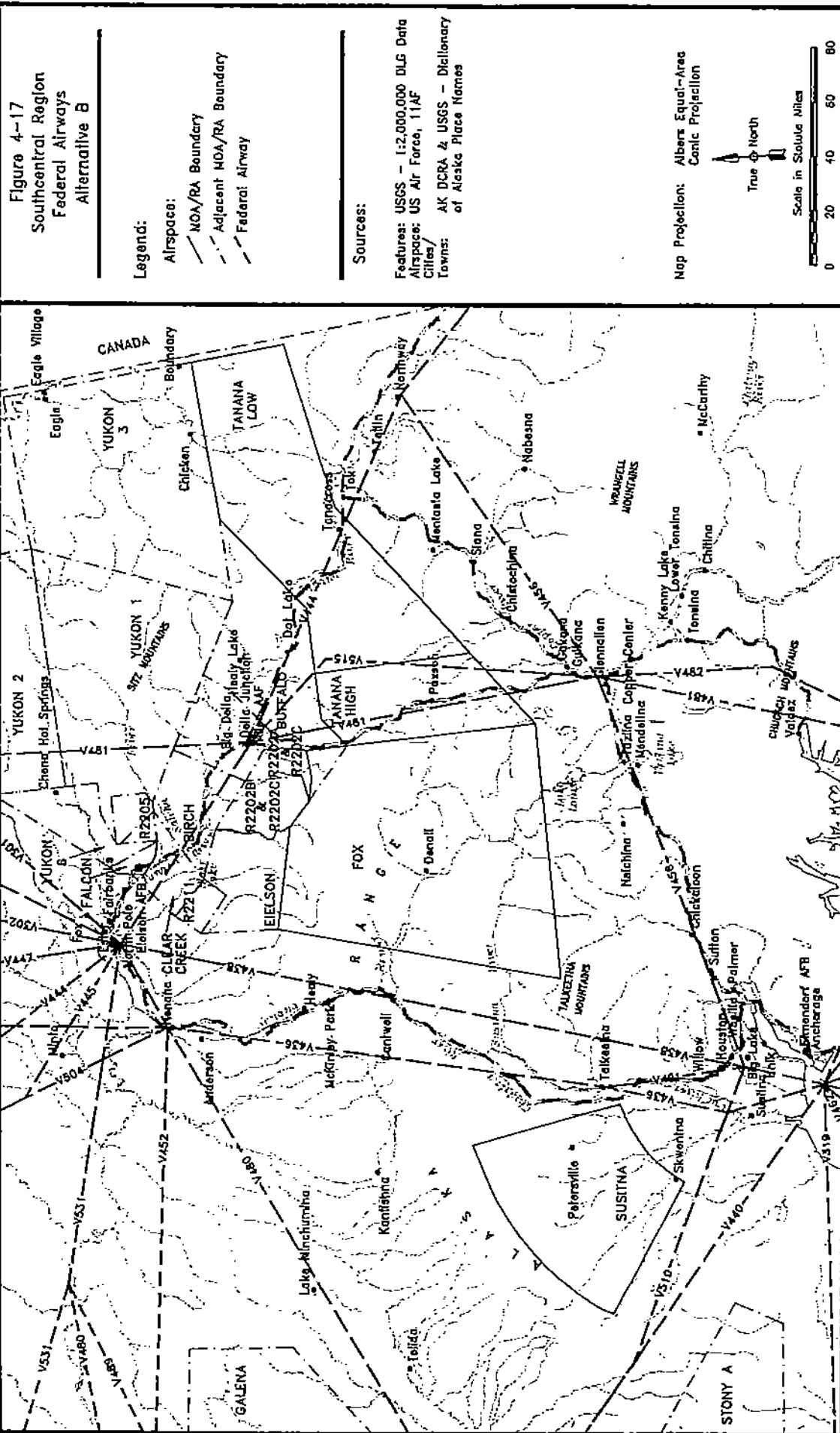
Three federal airways (V-444, V-481, and V-515) lie within the proposed TANANA MOA (see Figure 4-17). Minimum enroute altitudes on the airways are 8,000 feet MSL for V-444 and 12,000 feet MSL for V-481 and V-515. All of these altitudes would be within the MOA area. With the airport at Tok being a port of entry into the U.S. airspace, there is a large volume of traffic along the airway and the highway. Under Instrument Meteorological Conditions (IMC) where transient aircraft would require IFR flight plans as they proceed up towards Fairbanks, the activation of the TANANA MOA would significantly impact the ability to obtain an IFR clearance through the area. Further, the relatively low floor in the western portion of the TANANA MOA (3,000 feet AGL) would contribute to the same restrictions on IFR flight along V-481 and V-515. Failure to release TANANA MOA airspace (during IMC conditions) from the Air Force (when not being used) back to the FAA could create significant adverse impacts and delays for non-participating civil aviation attempting to transit along airways underlying the MOA.

The proposed TANANA MOA does not overlie any public use airports. However, from comments received during a public information meeting in the Tok area, plus comments received on an airspace survey, it was determined that a significant number of civil aviators proceed north out of Tok to areas all the way up into the YUKON 3 MOA. These activities include hunting/fishing trips, sightseeing, and other recreational activities. No specific data exist on all the landing locations or on the extent of the activity into the area. Inasmuch as VFR aircraft operations are not denied access to MOAs, the creation of the TANANA MOA would not preclude this continual VFR use. However, the introduction of low-altitude military tactical aircraft training on a daily basis as opposed to no previous operations in the area may create collision hazards that do not currently exist. Compliance with aircraft right-of-way regulations contained in *FAR 91* and *AFI 11-206* would require a high degree of attention on the part of both military and civil pilots, and would require that civil pilots familiarize themselves with all information that would be available on the revised aeronautical charts, through the flight service agencies in Northway and Fairbanks, via local NOTAMs, and from the Air Force directly on the use of the MOAs.

While this MOA represents a block of airspace designed to accomplish air-to-ground and air-to-air training, the area is not entirely uncontrolled. Use of these blocks of airspace for military training must be scheduled through the 354 FW. Access, entry, and exit from the airspace is controlled by an air traffic control agency for those aircraft operating on an IFR flight plan. However, Air Force aircraft could choose to enter the airspace on a VFR flight plan and not be under control of an air traffic control agency. Though the MOA is opened for extended hours of operations throughout the day, it is not in continuous use on a daily basis. Policy for joint use of this airspace is based on the "see-and-avoid" concept.

The TANANA MOA has been analyzed as substitute airspace for YUKON 4 and 5 MOAs, which are designated full-up maneuvering MOAs in the Proposed Action. As such, the TANANA MOA is also assessed based on its ability to support similar types of training. The TANANA MOA, unlike YUKON 4 and 5 MOAs, is located in a region of the state where extensive civil aviation activity occurs. Additionally, the TANANA MOA would be cut by both the busiest VFR corridor in Alaska and three FAA-designated IFR Victor Routes.

The maneuvering portions of aerial engagements are the most mentally and physically demanding portions of the air combat training arena. The ability of aircrews to simultaneously interact in a tactically sound manner in the designated scenario while detecting and monitoring high levels of civil aviation traffic is limited. Given the high volume of civil aviation traffic in the TANANA MOA, the potential for unaware interaction between military and civil aircraft would be high—a safety concern. Restricting air combat training to limited maneuvering (180 degrees of turn or less) would increase the military aircrews' ability to detect and monitor civil aircraft. However, this restriction would reduce the overall utility of the airspace for air combat training to such a degree as to render it unsuitable as a substitute airspace for YUKON 4 and 5 MOAs.



The proposed MOA boundaries define airspace within which non-participating VFR aircraft are expected to operate with greater caution (see and avoid). The current lack of active FAA/military radar and two-way radio coverage over the region significantly increases the midair collision potential. No active pilot advisories would be available to the military or civil aviation utilizing the areas, especially along the Alaska Highway, and a significant adverse impact would be potentially created. This situation is further degraded with the TANANA MOA being proposed as a maneuvering airspace as opposed to the Southern Interior Region MOAs which are being used to simply transit to/from the Oklahoma air-to-ground range.

4.2.4.3.1 Southcentral Region Routine and Joint/Combined Training

Under Alternative B, routine training as described in section 4.2.2.1.1 for the YUKON 4 and 5 MOAs of the Northern Interior Region would be shifted to the TANANA MOA. Operations would consist of both air-to-air training and low-altitude air-to-ground training. It is expected that the TANANA MOA would average approximately three sorties per day (see Table 2-7).

Under Alternative B, supersonic operations would be permitted in conjunction with routine training activities down to an altitude of 5,000 feet AGL in the TANANA MOA (an increase of 6,830 square miles over the Proposed Action for the region). Supersonic occurrences are generally associated with air-to-air training activities and occur during the closure for intercepts or during escape and evasive maneuvers. It is estimated that up to 23 sorties per month would be conducting training activities that could potentially result in supersonic occurrences in this portion of the region.

4.2.4.3.2 Southcentral Region Major Flying Exercises

Under Alternative B, the TANANA MOA could be used for MFEs up to 60 days per year. The TANANA MOA would be used in the same manner as proposed for the YUKON 4 and YUKON 5 MOAs. Primary activities in the MOA would be aircraft marshalling either before or after the main flying activities and potential for periphery air-to-air engagements away from the main areas in YUKON 1 and YUKON 2 MOAs. It is expected that the TANANA MOA could experience up to 170 sorties per MFE flying day.

Under Alternative B, supersonic operations would be permitted in conjunction with MFE activities down to an altitude of 5,000 feet AGL in the TANANA MOA. Supersonic occurrences are generally associated with air-to-air training activities and occur during the closure for intercepts or during escape and evasive maneuvers.

4.2.4.3.3 Civilian Aircraft Operations

Under this alternative, civilian aircraft operations along the Northway to Fairbanks corridor during times of poor weather (IFR conditions) could result in significant adverse impacts. During these times, when civil aviation is unable to fly VFR through the TANANA MOA, and the MOA has not been released to the Air Route Traffic Control Center (ARTCC), IFR operations along V-444 would not be available. It is also expected that the risk of an increased potential for aircraft interactions in the TANANA MOA would occur during weather conditions where a low ceiling (2,000 feet AGL or less) precludes civil aviators from flying at higher altitudes through the MOAs. In this case, it is highly possible that both military and civil non-participating aircraft could be simultaneously transiting these areas under the weather but confined to a relatively small block of airspace due to the low ceiling conditions. This could create a significant adverse impact to the safety of civil flight operations.

4.2.4.3.4 Southcentral Region Aviation Safety

Under Alternative B, the creation of the TANANA MOA with a 300-foot AGL floor would add approximately 4,980 square miles of low-altitude airspace available on a daily basis across a major low-altitude VFR flyway. This area lies over an area of frequent VFR flights along the Alaska and Richardson Highways. Proposed operations in this MOA would be expected to occur on a daily basis as opposed to no regular high-speed

operations in the area today. Radar coverage provided by the special use Airspace Information System would be ineffective below 2,000 feet AGL in the TANANA MOA. Increased risks for midair collisions could exist along this flyways in the vicinity of the TANANA MOA requiring a significantly heightened awareness on the part of both military and general aviation in this congested area to minimize these potential midair collision hazards. Potential significant adverse impacts are expected.

4.2.4.3.5 Bird Aircraft Strike Hazard

Bird Hazard Evaluations for the TANANA MOA are contained in Appendix H.

4.2.4.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety

See section 4.2.2.4.

4.2.5 No Action Alternative

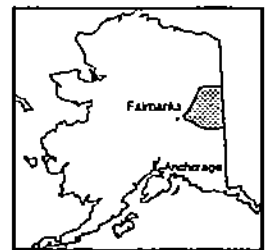
4.2.5.1 All Regions: Airspace Management, Aircraft Operations, and Aviation Safety

Under this alternative, the modifications to the special use airspace (MOAs/TMOAs) in the four regions would not be implemented. The utilization of the airspace in the regions would be as described in sections 3.2.2, 3.2.3, 3.2.4, and 3.2.5. No adverse impacts are expected in any regions.

4.2.6 Alternative A—Modified

4.2.6.1 Northern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety

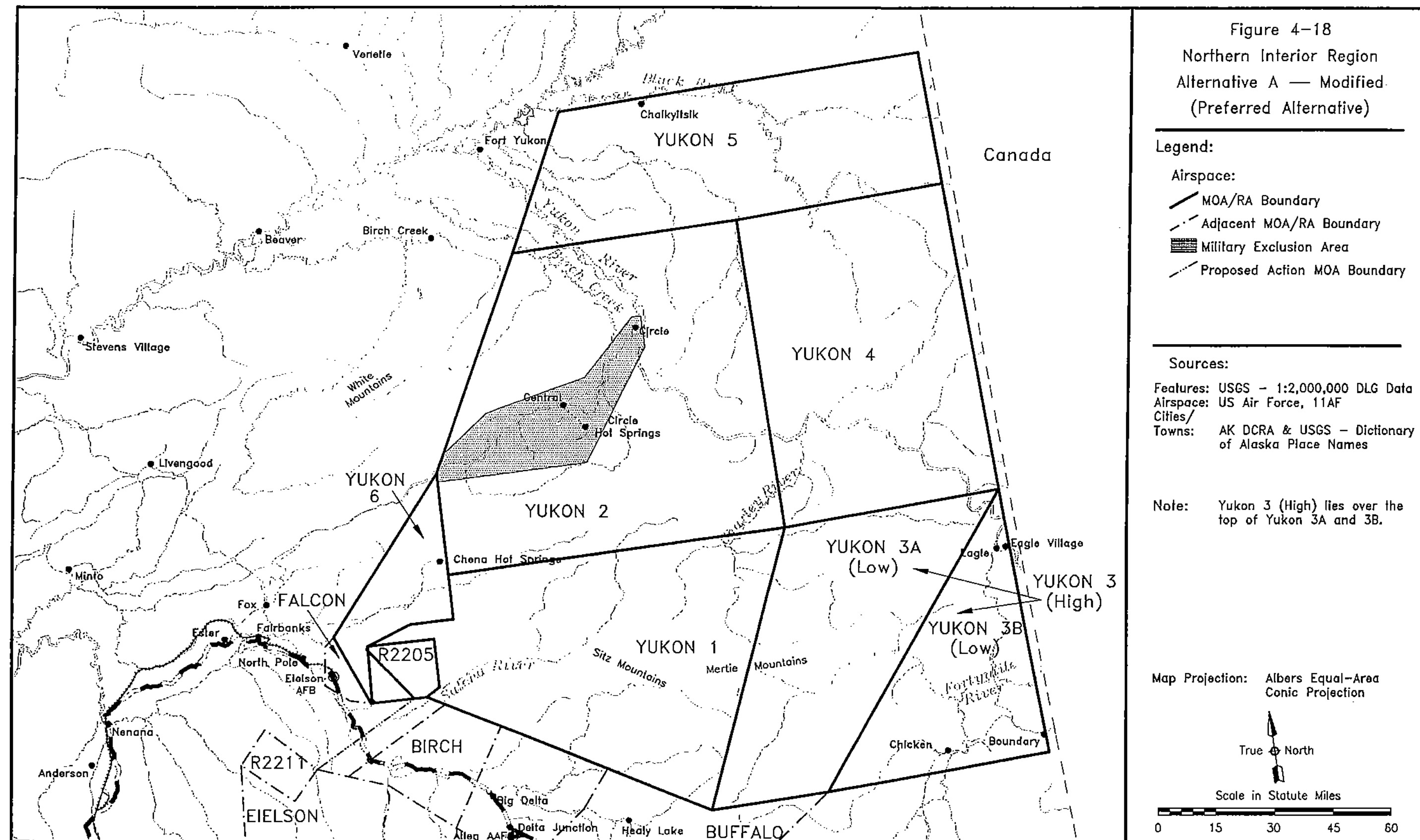
Under Alternative A—Modified, the general airspace configuration of the YUKON MOAs would remain the same as described under the Proposed Action in section 4.2.2.1 except as noted by the following changes. Under Alternative A—Modified, the YUKON 3 TMOA would be divided to create the permanent YUKON 3 (High), 3A (Low), 3B (Low), and 4 MOAs (see Figure 4-18). The YUKON 3A (Low) and 3B (Low) MOAs would lie directly under the YUKON 3 (High) MOA. Lateral division to create the YUKON 3A and 3B MOAs would be along a northeast to southwest line extending from the northeast corner of the YUKON 3 MOA (as described under the Proposed Action) to the southwest where the northeast corner of the BUFFALO MOA intersects the southern boundary of the YUKON 3 MOA (as described under the Proposed Action). YUKON 3A (Low) would be to the north and west of the line, YUKON 3B (Low) would encompass the area south and east of the line. YUKON 3A (Low) would extend from 100 feet AGL up to but not including 10,000 feet MSL. YUKON 3B (Low) would extend from 2,000 feet AGL up to but not including 10,000 feet MSL. YUKON 3 (High) would start at 10,000 feet MSL and extend up to but not including FL 180. YUKON 4 MOA would have the same configuration as described under the Proposed Action. Hours of operation for the YUKON 3 (High) and 4 MOAs would be the same as described under the Proposed Action. Hours of operation for the YUKON 3A (Low) and 3B (Low) MOAs would be from 10:00 a.m. to 11:30 a.m. and from 1:30 p.m. to 3:00 p.m., Monday through Friday, and other times between the hours of 7:00 a.m. and 10:00 p.m. by NOTAM.



The YUKON 5 MOA would also be established, and would have the same lateral configuration as described under the Proposed Action. The floor of the YUKON 5 MOA would be raised to 5,000 feet AGL, and the MOA would extend up to but not including FL 180. The YUKON 5 MOA would only be activated for MFE training. Routine daily training would not be authorized in the MOA. During MFE training, the MOA would only be

activated for up to 60 days per year; the MFE hours of operation would be the same as described under the Proposed Action for YUKON 5 MOA.

The YUKON 3B (Low) MOA would overlie the three public use airports at Chicken, Eagle, and Boundary, however, the higher floor of the YUKON 3B (Low) MOA would preclude the need to create a 3 NM exclusion zone around these airports. Further subdividing the YUKON 3 MOA would enhance civil, non-participating access to the communities under the YUKON 3B (Low) MOA on a full-time basis, and improve general access throughout the entire region of YUKON 3A (Low) and 3B (Low) MOAs. Air Force use of the MOAs for 1½ hours in the morning and another 1½ hours in the afternoon, with a 2-hour period in the middle of the day when the MOAs would not be activated, would provide a larger flying window for general aviation below 10,000 feet MSL in the area.



4.2.6.1.1 Northern Interior Region Routine Training and Joint/Combined Training

Under this alternative, operations are expected to remain as described in section 4.2.2.1.1 except as noted. During routine training, average daily aircraft operations rates would not be expected to exceed eight aircraft operations per day in the YUKON 3 (High), 3A (Low), and 3B (Low) MOAs (combined) and eight operations per day in the YUKON 4 MOA. This is an increase of approximately 4 sorties per day per MOA as the 11th Air Force has decided, under this alternative, to reduce the number of OA-10A LATN operations outside of MOA airspace and to reallocate those sorties to YUKON 3A (Low), 3B (Low), and 4. Also, the very small fraction of routine sorties allocated to YUKON 5 under the Proposed Action are reallocated to YUKON 4 under this alternative.

Under this alternative, 20,300 square miles [YUKON 1, 2, 3 (High) and 4 MOAs] of airspace in the region would be authorized for supersonic operations during routine training. Also as part of Alternative A—Modified, the floor for supersonic operations in all the MOAs [YUKON 1, 2, 3 (High), 4, and 5] would be raised to 12,000 feet MSL or 5,000 feet AGL, whichever is higher. An analysis comparing the terrain versus the supersonic floor under this alternative provides some valuable insight. The new 12,000 foot MSL floor for supersonic operations provides that approximately 46 percent of the entire area requested for supersonic operations would be at or above 10,000 feet AGL, approximately 91.5 percent would be above 8,000 feet AGL, and less than 9 percent of the total airspace would be between 5,000 and 8,000 feet AGL.

4.2.6.1.2 Northern Interior Region Major Flying Exercises

MFE operations in the region would be expected to remain as described in section 4.2.2.1.2, except average daily aircraft operations rates would not be expected to exceed 168 aircraft operations per day in the YUKON 3 (High), 3A (Low), and 3B (Low) MOAs (combined) and 168 aircraft operations per day in the YUKON 4 MOA. MFE operations in YUKON 5 MOA would not change from what is anticipated under the Proposed Action.

Under this alternative, 23,870 square miles [YUKON 1, 2, 3 (High), 4, and 5 MOAs] of airspace in the region would be authorized for supersonic operations during MFEs. As part of Alternative A—Modified, the floor for supersonic operations in all the MOAs [YUKON 1, 2, 3 (High), 4, and 5] would be raised to 12,000 feet MSL or 5,000 feet AGL, whichever is higher.

4.2.6.1.3 Civilian Aircraft Operations

Civilian aircraft operations as described in section 4.2.2.1.3 would not be expected to change in nature; however, splitting the YUKON 3 MOA to high and low segments, with reduced hours of operation over what was previously proposed, should improve civilian access to areas under YUKON 3 MOA including the communities of Eagle, Boundary, and Chicken.

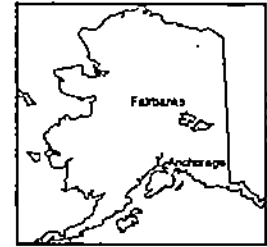
4.2.6.1.4 Northern Interior Region Aviation Safety

Alternative A—Modified would increase the permanent airspace available for low-altitude military aircraft operations in areas with known low-altitude civil aviation. Establishing the YUKON 3A (Low) and 4 MOAs with floors of 100 feet AGL would add approximately 7,460 square miles of low-altitude airspace over portions of the Yukon-Charley Rivers National Preserve, the Charley National Wild and Scenic River, and about 27 percent of the Fortymile National Wild and Scenic River. YUKON 3B (Low) would place an additional 60 percent of the Fortymile River under a MOA floor of 2,000 feet AGL. The higher floors available combined with limited hours of operations for the low MOAs makes access to the area under YUKON 3 (High) at less than 10,000 feet MSL available approximately 21 hours a day during the week. This should significantly reduce the midair collision potential in this area.

4.2.6.1.5 Bird Aircraft Strike Hazard

See section 4.2.2.1.5.

4.2.6.2 Southern Interior Region Airspace Management, Aircraft Operations, and Aviation Safety



Under Alternative A—Modified, permanent MOAs would be established in this region as described in section 4.2.3.2 except as noted below. The BUFFALO MOA would have the same configuration as described except for the addition of four civilian flight corridors (military exclusion zones) through the MOA (see Figure 4-19). Civil flight corridors extending from the surface to 500 feet AGL would be established 2 NM either side of the Alaska Highway and ½ NM either side of the Richardson Highway. Above these two low corridors, two higher corridors of the same width as those below would be established between 4,000 and 6,000 feet MSL along the Alaska and Richardson Highways. These two high corridors would permit VFR hemispheric flight through the MOA at 4,500/5,500 feet MSL along the two highways through the MOA. Figure 4-20 displays two cross-sections in the BUFFALO MOA. Cross-sectional representations of these VFR corridors, at the locations of the cross-sections lines, are shown in Figure 4-21 and Figure 4-22. The BIRCH MOA would be established under this alternative, except that the western boundary would be moved approximately 5 NM to the southeast, removing the Salcha River and Harding Lake areas from under the MOA. The floor of the BIRCH and FALCON MOAs would also be raised to 500 feet AGL versus the 100 feet AGL originally proposed. The use of chaff and flares would not be authorized in FALCON MOA.

4.2.6.2.1 Southern Interior Region Routine Training and Joint/Combined Training

See section 4.2.2.2.1.

4.2.6.2.2 Southern Interior Region Major Flying Exercises

See section 4.2.2.2.2.

4.2.6.2.3 Civilian Aircraft Operations

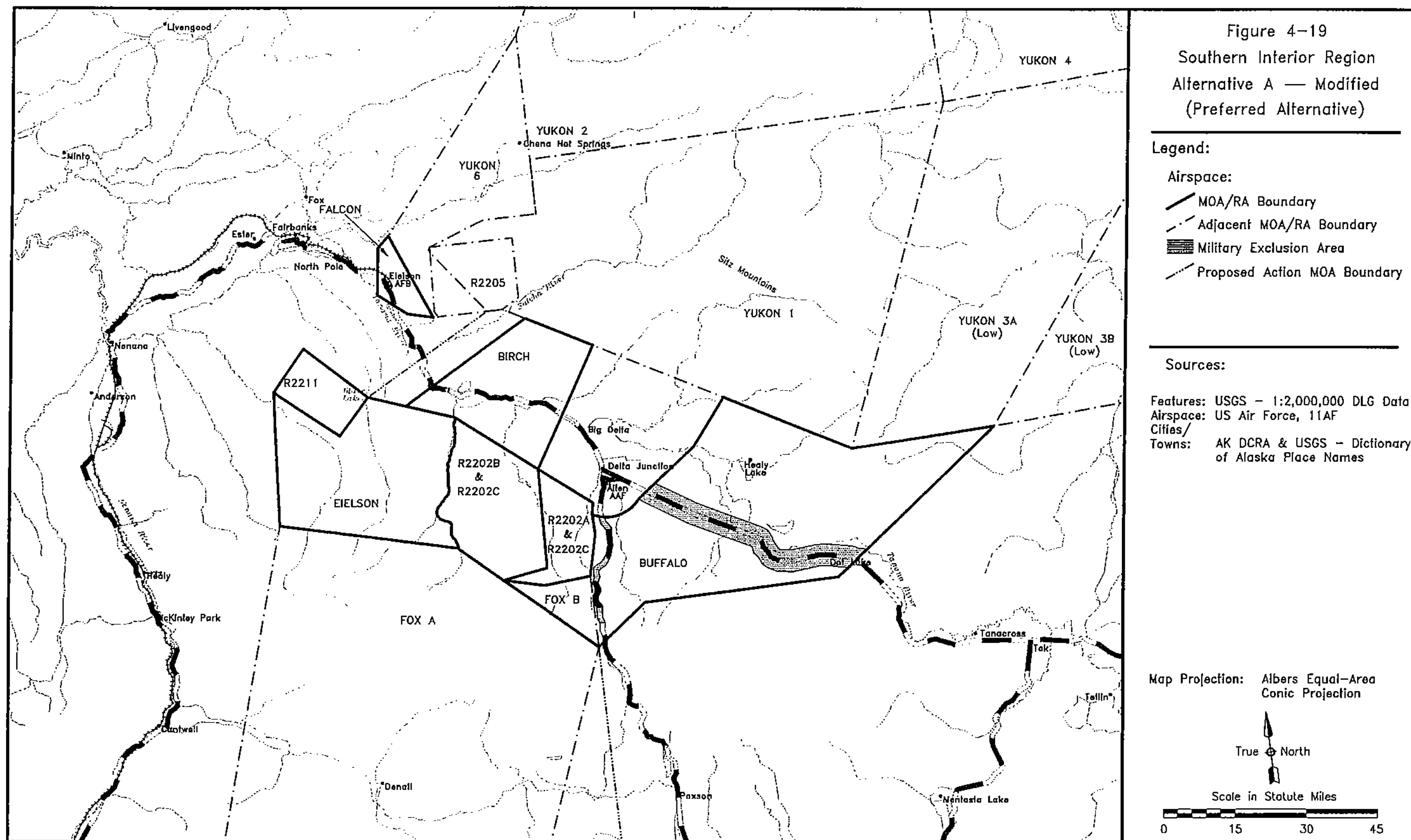
It is not expected that the nature of civilian operations along the highways and in the areas of the MOAs would change from what is described in section 4.2.2.2.3. However, the creation of the VFR corridors through BUFFALO and the subsequent raising of the floors of the other MOAs would enhance overall access through the areas and minimize potential adverse impacts.

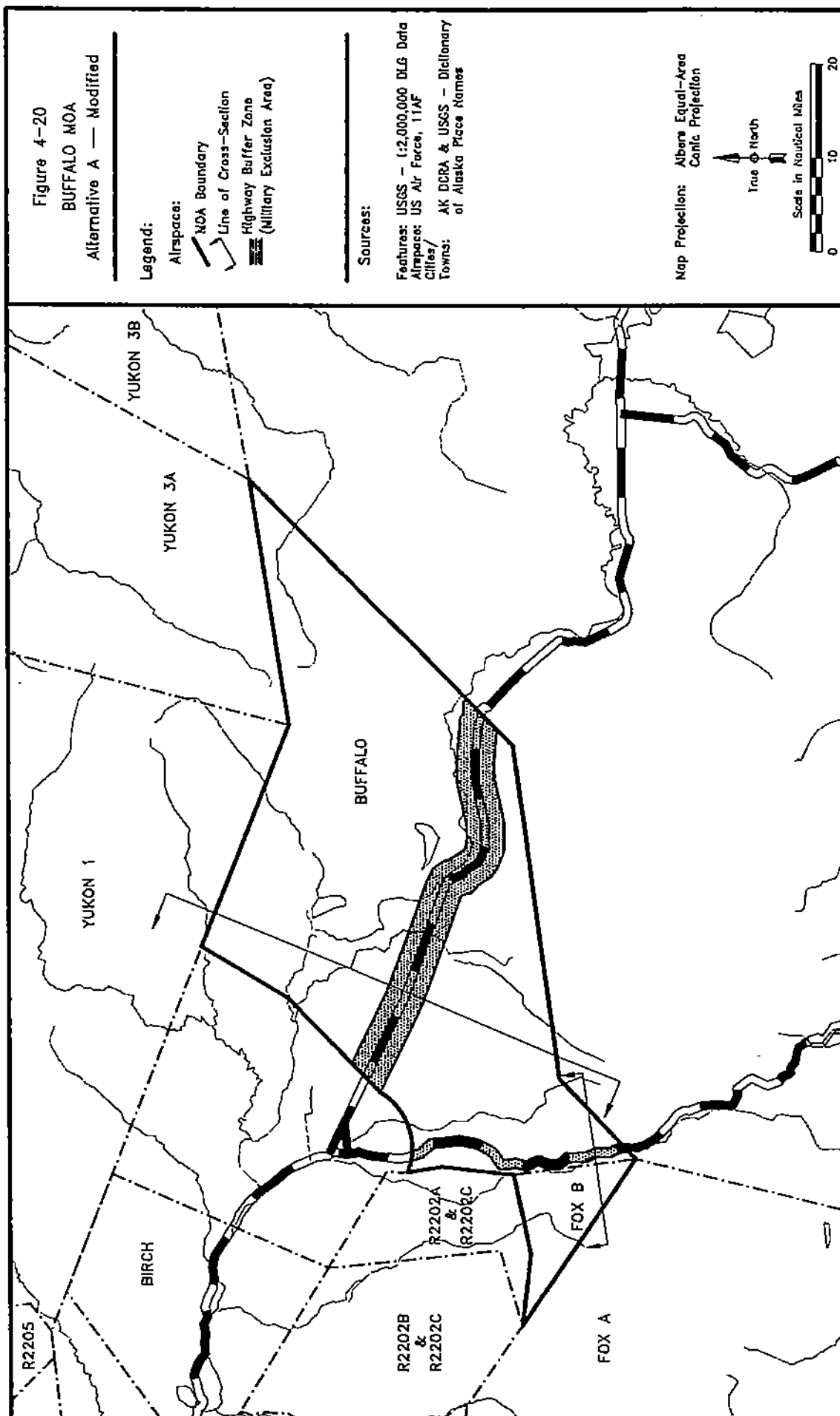
4.2.6.2.4 Southern Interior Region Aviation Safety

Overall aviation safety throughout the region should improve with the aforementioned enhancements used in conjunction with the Special Use Airspace Information Service (SUAIS), which covers nearly all of the airspace down to very low altitudes except for the eastern portion of BUFFALO.

4.2.6.2.5 Bird Aircraft Strike Hazard

See section 4.2.2.2.5.





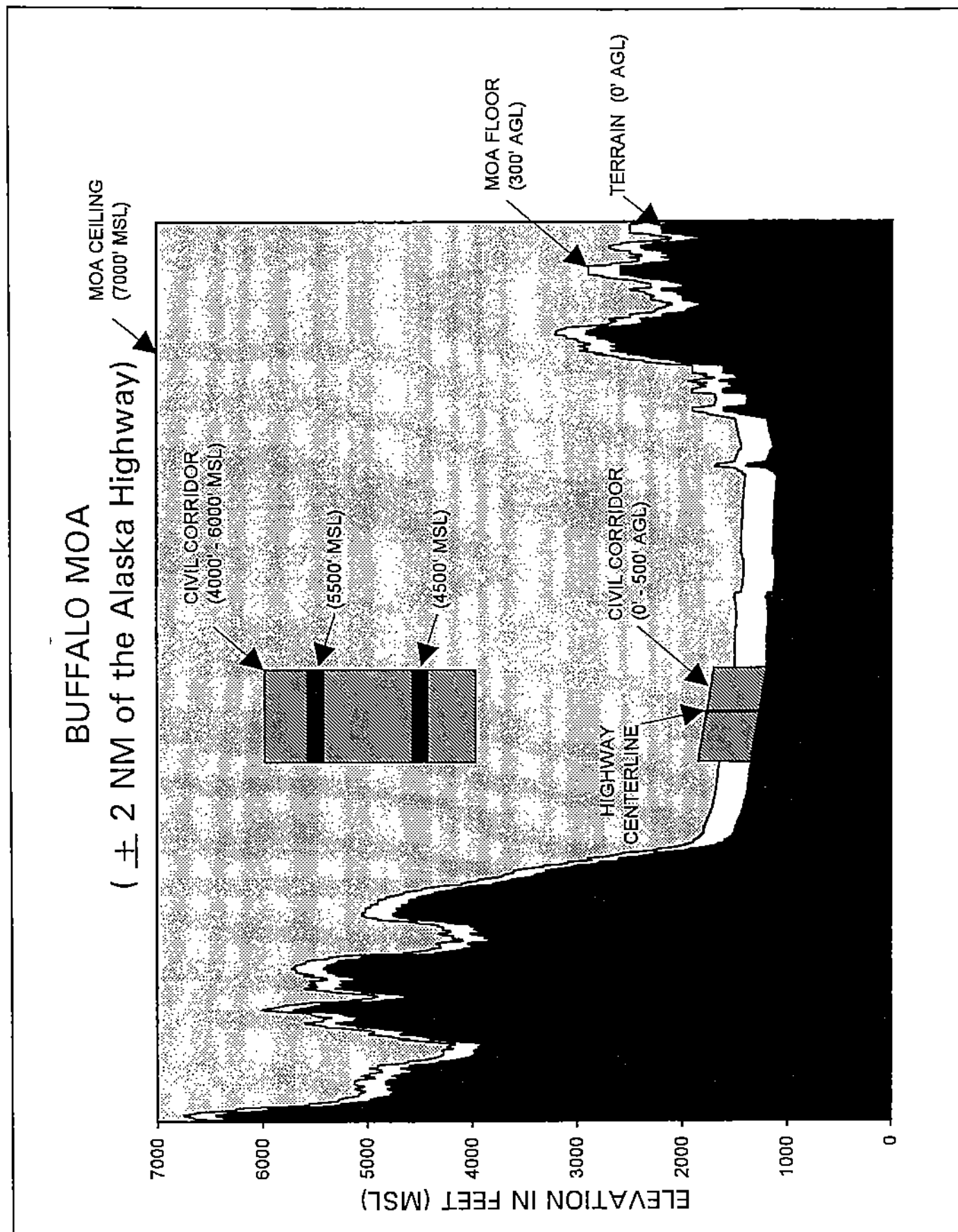


Figure 4-21 Example Civil Flight Corridors Through the BUFFALO MOA along the Alaska Highway

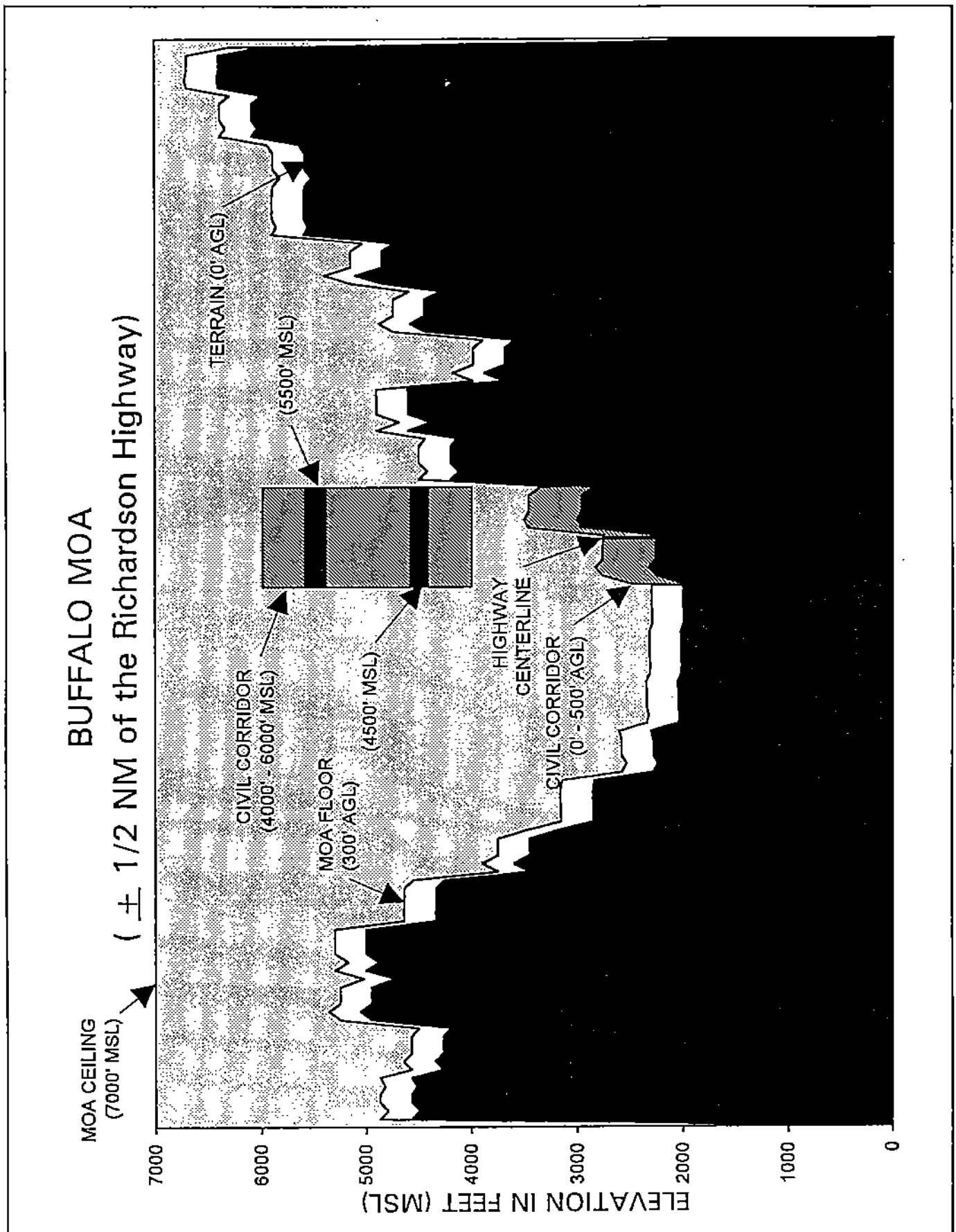
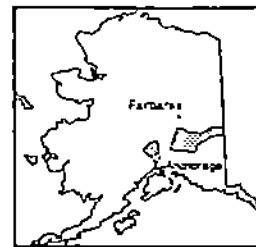


Figure 4-22 Example Civil Flight Corridors Through the BUFFALO MOA along the Richardson Highway

4.2.6.3 Southcentral Region Airspace Management, Aircraft Operations, and Aviation Safety



Under Alternative A—Modified, the FOX MOA would have the same basic configuration as described in the Proposed Action except that the southeastern corner of the FOX MOA would be moved approximately 20 NM to the west (see Figure 4-23). This adjustment to the MOA boundaries reduces the overall size of the FOX MOA by approximately 910 square miles (or about 12 percent) from the size of the FOX MOA considered under the Proposed Action. The floor throughout the MOA would be raised from 3,000 feet AGL to 5,000 feet AGL.¹ All other elements of this alternative are as described in section 4.2.2.3.

4.2.6.3.1 Southcentral Region Routine Training and Joint/Combined Training

There would be no change from section 4.2.2.3.1 except for supersonic operations. As part of Alternative A—Modified, the floor for supersonic operations in both FOX and SUSITNA MOAs would be raised to 12,000 feet MSL or 5,000 feet AGL, whichever is higher. Further, supersonic operations in the SUSITNA MOA would be limited to those required to perform Functional Check Flights (FCFs) or Operational Check Flights (OCFs) and would be accomplished along an east-west line in the southern portion of the MOA, away from Denali NPP.

Under this alternative, the modified FOX MOA (6,550 square miles) would be authorized for supersonic operations during routine training. An analysis comparing the terrain versus the supersonic floor under this alternative provides additional information on terrain clearances. The new 12,000 foot MSL floor for supersonic operations provides that approximately 19 percent of the entire area requested for supersonic operations would be at or above 10,000 feet AGL, approximately 68 percent would be above 8,000 feet AGL, and about 32 percent of the total airspace would be between 5,000 and 8,000 feet AGL.

4.2.6.3.2 Southcentral Region Major Flying Exercises

There would be no change from section 4.2.2.3.2 except for the reduced area of the FOX MOA and the increased floors for both subsonic and supersonic operations.

4.2.6.3.3 Civilian Aircraft Operations

It is not expected that the character of civil operations would change from what was described in section 4.2.2.3.3, however, the access under the FOX MOA would be enhanced with the 2,000 foot increase in the MOA floor over the Proposed Action. This should minimize future civil/military flight conflicts and enhance the opportunity for direct routing under the MOA when GPS equipment becomes more widely available for civil users.

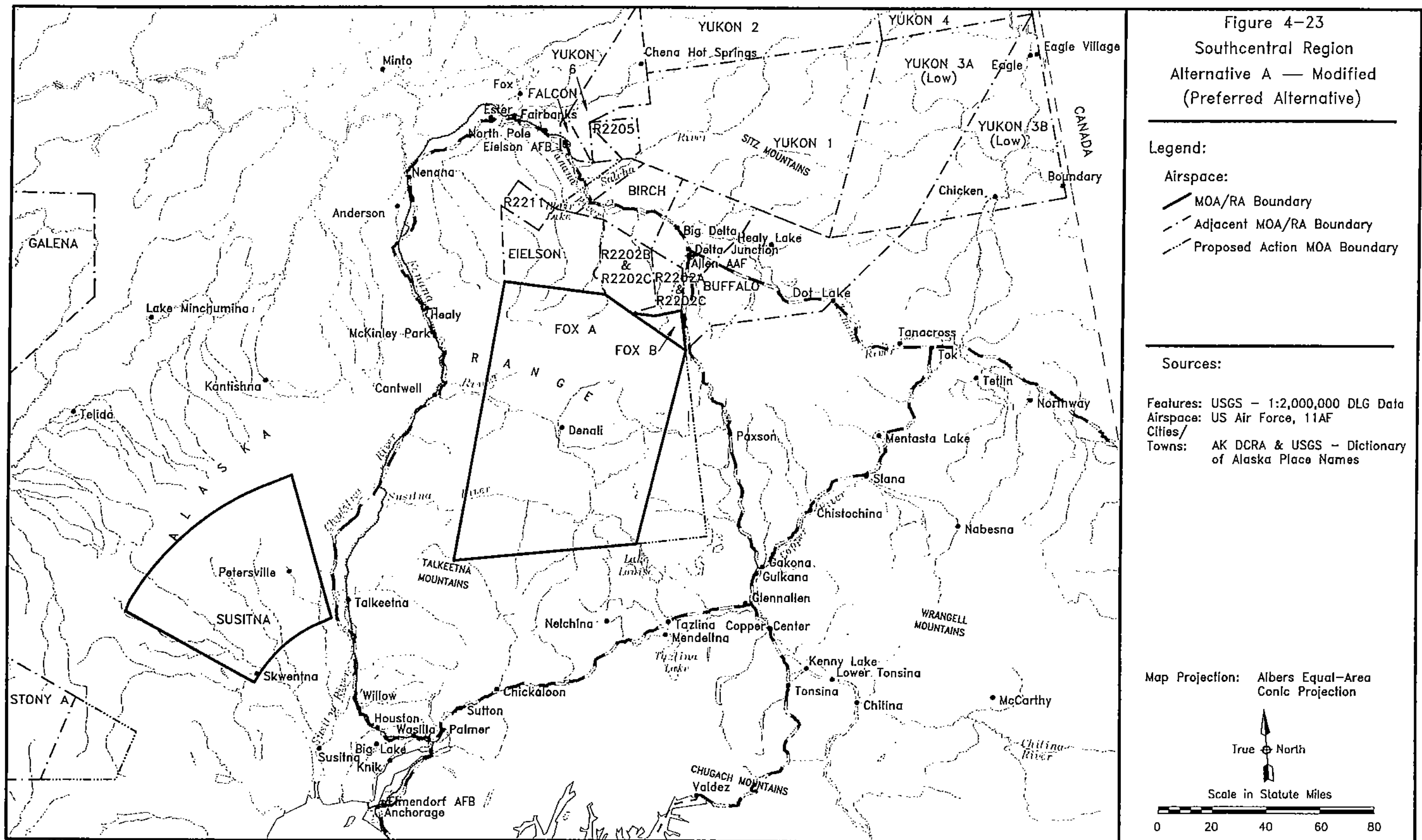
4.2.6.3.4 Southcentral Region Aviation Safety

There would be no change from section 4.2.2.3.4 except that the majority of the Gulkana and Delta National Wild and Scenic Rivers would no longer be under the MOA, and approximately 10 miles of the Denali Highway west of Paxson would also no longer be under the MOA.

4.2.6.3.5 Bird Aircraft Strike Hazard

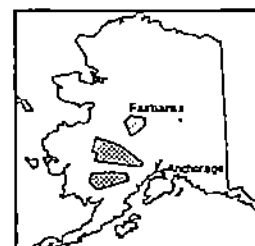
See section 4.2.2.3.5.

¹The very northeast corner of the FOX MOA (FOX B) overlapping the BUFFALO MOA would have a floor of 7,000 feet MSL.



4.2.6.4 Western Region Airspace Management, Aircraft Operations, and Aviation Safety

Under Alternative A—Modified, the eastern boundaries of both the STONY A and NAKNEK 2 MOAs are moved to the west (see Figure 4-24). The STONY A eastern boundary is moved approximately 20 NM to the west, and the size of STONY A MOA is reduced by approximately 11 percent (or 670 square miles) of its existing size. The eastern border of the NAKNEK 2 MOA is moved approximately 10 NM to the west, and the size of the MOA is reduced approximately 11 percent (or 460 square miles) of its existing size. The reductions in both the STONY A and NAKNEK MOAs were designed to remove the MOAs from over the Lake Clark NPP. No other actions in the Western Region are associated with Alternative A—Modified.



4.2.6.4.1 Western Region Routine Training and Joint/Combined Training

See section 4.2.2.4.1.

4.2.6.4.2 Western Region Major Flying Exercises

See section 4.2.2.4.2.

4.2.6.4.3 Civilian Aircraft Operations

See section 4.2.2.4.3.

4.2.6.4.4 Western Region Aviation Safety

See section 4.2.2.4.4.

4.2.6.4.5 Bird Aircraft Strike Hazard

See section 4.2.2.4.5.

This Page Intentionally Left Blank

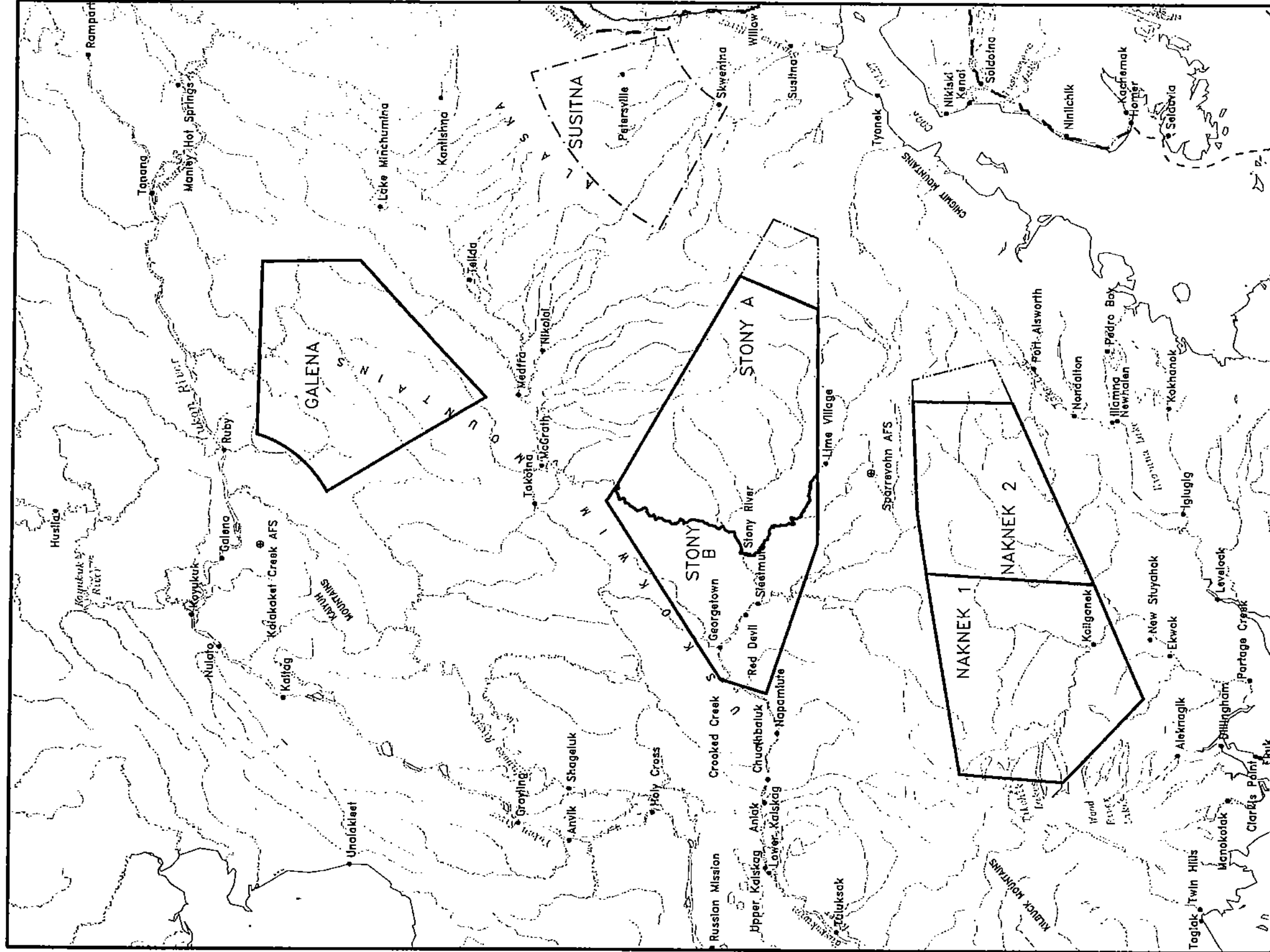


Figure 4-24

Western Region
Alternative A — Modified
(Preferred Alternative)

Legend:

Airspace:

- MOA Boundary
- Adjacent MOA Boundary
- Proposed Action MOA Boundary

Sources:

Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, 11AF
Cities/Towns: AK DCRA & USGS - Dictionary of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection

True North

Scale in Statute Miles

0 25 50 75 100

4.2.7 Accident Potential

As described in Chapter 3, the Air Force defines three categories of aircraft mishaps: classes A, B, and C. Based on the past number of mishaps at all installations, the military services calculate the Class A mishap rate per aircraft based on 100,000 flying hours. These Air Force mishap reports focus on analyzing the specific causes of an accident rather than the environment in which the aircraft was operating. Statistics show that 70 to 75 percent of all major accidents occur on or within 5 miles of a runway. The majority of these accidents involve a take-off or landing incident. The general category of Air Force flying activity with the highest mishap rate other than take-offs and landings is high-performance maneuvering, such as that typically occurring in a MOA.

To estimate potential risk to individuals from flying activities, individual aircraft major mishap rates and projected flying hours can be used to predict the probability of an aircraft mishap. Table 4-2 provides predicted Class A mishap rates in Alaska for flying associated with routine training and MFEs for the Proposed and Alternative Actions except the No Action Alternative. Note that regular F-16C operations in Alaska began in the summer of 1991 with the beddown of 24 F-16C aircraft at Eielson AFB; the two Class A mishaps shown occurred in 1993. Between January 1990 and August 1995, one F-15C Class A mishap occurred. Estimates of accident potential for the No Action Alternative would be the same as shown in Table 3-1. Estimates in Table 4-2 show a slightly reduced period expected between Class A mishaps than Table 3-1 due to the increased number of aircraft sorties associated with MFE operations under the Proposed Action and Alternatives and the subsequent increase in flying hours.

Table 4-2 Predicted Class A Mishap Rates and Summary of Class A Mishaps for Aircraft Flying in Alaska (Proposed Action and Alternatives A, B, and A—Modified)

Aircraft Type	Annual Flying Hours in Alaska	Predicted Class A Mishaps per 100,000 Flying Hours ¹	Predicted Years Between Class A Mishaps in Alaska	Actual Class A Mishaps in Alaska Since 1983 ²
F-15C	17,794	1.90	3.0	8
F-14	675	5.88	25.2	0
F-18	2,835	2.08	17.0	0
F-4	405	3.12	79.1	0
F-15E	8,329	1.90	6.3	0
F-16	13,636	4.24	1.7	2
A/OA-10	7,031	3.35	4.2	1
A-6	405	0.00	N/A	0
A-7	405	0.00	N/A	0
F-111	405	2.18	113.3	0
F-5	135	0.00	N/A	0
B-52	405	3.11	79.4	0
B-1	270	3.31	111.9	0
C-130	4,402	0.34	66.8	0
C-141	135	0.49	1,511.7	0
Tornado	540	8.80	21.0	0

¹ 1994 Air Force Class A Mishap Rate (Air Force-Wide).

² USAF 1993a.

4.3 Noise

4.3.1 Issues/Concerns

Issues and concerns pertaining to noise created by aircraft operations resulting from the Proposed Action or Alternatives include:

- Noise impacts on quality of life, animals, and structures.
- Noise impacts on residential areas on and near Eielson and Elmendorf AFBs.
- The methodologies used to assess potential impacts (modeling versus monitoring).

Noise, in itself, is not a resource to be affected, but a source of potential impact on other resources such as recreation and wildlife. Possible effects of noise resulting from implementation of the Proposed or Alternative Actions are explored in the sections on biological resources (4.5), recreation resources (4.6), subsistence resources (4.7), and land use (4.8). Natural quiet may be considered a resource that could be affected and potential effects on this aspect of the environment are addressed in the land use section.

4.3.1.1 Impact Assessment Approach (Methodology)

Noise is one of the more important concerns associated with low-altitude aircraft operations and with military operations in the vicinity of Eielson and Elmendorf AFBs. As described in section 3.3.1, and used for the assessment of the existing conditions in these areas, the U.S. Department of Defense (DoD) employs several computer models to predict the noise impacts for these types of operations. The NOISEMAP computer program is used to predict the Day-Night Average A-Weighted Sound Level (DNL) around the airfields. When this information is combined in a geographic information system along with census data, an estimate of the number of persons that would be exposed to $DNL \geq 65$ decibels (dB) can be obtained. In the MOAs, the MOAMAP computer program (utilizing the ROUTEMAP algorithms) is used to generate an estimate of the Onset Rate Adjusted Monthly Day-Night Average A-weighted Sound Level (L_{dnmr}) produced by low-altitude flight operations. Impacts of supersonic operations are assessed using the methodology known as the White Sands Missile Range (WSMR) model (see section 3.3.1 for a description of the analysis of supersonic impacts). Assessments for all facets of the Proposed and Alternative Actions focuses on determining the sound level changes associated with the changes in Air Force flight operations in various regions.

4.3.1.1.1 Population Distribution and Noise Exposure

In 1972, Congress enacted the Noise Control Act (NCA), Public Law 92-574. Among the requirements of the NCA was a directive to the U.S. Environmental Protection Agency (EPA) to ". . . publish information on the levels of environmental noise, the attainment and maintenance of which in defined areas under various conditions are requisite to protect the public health and welfare with an adequate margin of safety." The resulting report, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974), is commonly referred to as the Levels Document. In the Levels Document, the EPA reported that the best metrics to describe the effects of environmental noise in a simple, uniform, and appropriate way were:

- the Long-Term Equivalent A-Weighted Sound Level (L_{eq}); and
- the Day-Night Average A-Weighted Sound Level (DNL), a variant of L_{eq} that incorporates a 10 dB "penalty" for nighttime noise.

The protective levels identified in the Levels Document do not constitute standards as they do not account for the cost or feasibility of achievement. It is also pertinent that the Levels Document defines the public health and welfare in broad terms, based on the World Health Organization's definition of health as complete physical and mental well-being and not merely the absence of disease and infirmity.

In response to a request by the EPA, the National Academy of Science's Committee on Hearing, Bioacoustics and Biomechanics (CHABA), Working Group 69, held deliberations from 1972 to 1976. The result of this effort was the publication of CHABA's *Guidelines for Preparing Environmental Impact Statements on Noise* (NRC 1977). These guidelines were proposed for the uniform description and assessment of various noise environments in an EIS. Following publication of the CHABA *Guidelines*, Schultz published his "Synthesis of Social Surveys on Noise Annoyance" in 1978. Schultz's synthesis of the dose-effect relationship provided the best tool available to environmental planners for predicting noise-induced chronic annoyance. Chronic annoyance is the implicit basis for noise-related habitability criteria such as those adopted by various government agencies (DoD 1978). In 1979, the Federal Interagency Committee on Urban Noise (FICUN) was formed to put the various federal agencies' policies and guidance on environmental noise into perspective. The result was the publication of *Guidelines for Considering Noise in Land Use Planning and Control* (FICUN 1980). The *Guidelines* do not replace individual federal agency criteria, but serve as a point-of-departure for each agency's programs, and for facilitating the consideration of noise in all land use planning and interagency/intergovernmental processes. The FICUN established DNL as the descriptor to be used for all noise sources. In 1982, the EPA published *Guidelines for Noise Impact Analysis* based on the CHABA *Guidelines*. The purpose of the EPA *Guidelines* was to provide decision makers, both in the public and private sectors, with analytic procedures that could be used uniformly to express and quantify impacts from noise. Individual agencies have developed their own guidance for assessing aircraft noise in National Environmental Protection Act (NEPA) documents. In 1990, the American National Standards Institute (ANSI) revised their 1980 standard on *Sound Level Descriptors for Determination of Compatible Land Use* (ANSI 1990b). This new standard continues to identify DNL as the "acoustical measure to be used in assessing compatibility between various land uses and outdoor noise environment." The standard further states:

Ordinarily, land uses are of long-term, continuing nature, and the yearly day-night average sound level is appropriate for these land uses. For other land uses, compatibility is to be assessed by the average sound level during the time interval of interest for the land use involved.

In December 1990, the Federal Interagency Committee on Noise (FICON) was formed to review federal policies governing the assessment of airport noise impacts. The FICON review focused primarily on the manner in which noise impacts are determined, including whether aircraft noise impacts are fundamentally different from other transportation noise impacts; the manner in which noise impacts are described; the extent of impacts below DNL 65 dB that should be reviewed in a NEPA document; the range of FAA-controlled mitigation options (noise abatement and flight track procedures) analyzed; and the relationship of the FAA Federal Aviation Regulation (FAR) Part 150 process to the NEPA process, including ramifications to the NEPA process if they are separate, and exploration of the means by which the two processes can be handled to maximize benefits. Among the technical conclusions reached by the FICON, the following are particularly germane:

- There are no new descriptors or metrics of sufficient scientific standing to substitute for the DNL cumulative noise exposure metric;
- The methodology employing DNL as the noise exposure metric and appropriate dose-response relationships (primarily the Schultz curve for Highly Annoyed [HA]) to determine noise impacts on populations is considered the appropriate one for civil and military aviation scenarios in the general vicinity of airports;
- Federal agencies generally conduct noise assessments at DNL levels of ≥ 65 dB. For a variety of reasons, noise predictions and interpretations are frequently less reliable below DNL 65 dB. DNL prediction models tend to degrade in accuracy at large distances from an airport. Therefore, predictions of noise exposure and impact below DNL 65 dB should take the possibility of such inaccuracy into account;
- DNL is sometimes supplemented by other metrics, on a case-by-case basis;

- Noise analyses should address impacts in the areas of (1) health and welfare, (2) environmental degradation/impact, and (3) land use planning; and
- Complaints are an inadequate indicator of noise effects on a population.

Sleep Disturbance

Because limited operations at both Eielson and Elmendorf AFB could occur between the hours of 10:00 p.m. and 7:00 a.m., sleep disturbance could be a potential impact. The 10 dB penalty applied to noise events that occur between 10:00 p.m. and 7:00 a.m. is designed to include annoyance resulting from sleep disturbance.

Although DNL is still considered the most appropriate single metric for characterizing the long-term noise environment, the need to provide supplemental information on potential sleep disturbance has been recognized by federal agencies (FICON 1992). In an effort to develop a dose-response relationship between noise exposure and sleep disturbance, the Air Force sponsored an intensive analysis of available research on the effects of noise exposure and sleep disturbance. Recognizing the need to provide some quantitative basis for evaluating sleep disturbance to supplement analysis based on DNL, the Air Force developed a recommended interim dose-response model that predicts the percent of persons expected to be awakened as a function of the sound exposure level (SEL) of a single event (% Awakened). These data are based on statistical analysis of the data reviewed by Pearson et al. (1989) and include data obtained under both laboratory and field conditions. Data obtained under laboratory conditions indicated significantly higher levels of response to a given SEL than data obtained under field conditions. However, since neither data set was considered adequate, both were included in the statistical analysis conducted by the Air Force. The need for carefully planned and controlled studies under field conditions was emphasized by the FICON (1992). Additional information on sleep disturbance and this interim dose-response model is provided in Appendix F.

In December 1992, the first report of a comprehensive field study conducted by the Civil Aviation Authority of the British Department of Transport was released (Ollerhead et al. 1992). This study was conducted under carefully controlled field conditions and used devices known as actimeters to measure fine limb movements, usually of the wrist, which are indicative of sleep disturbance. Four hundred subjects were monitored for a total of 5,742 subject-nights, during which a total of 4,823 aircraft noise events were logged during the 120 measurement nights and outdoor noise levels ranged from 60 dBA to more than 100 dBA L_{max} . Actimetry data were correlated with sleep-electroencephalography (EEG) records for 178 subject-nights and showed good agreement between actimetrically determined arousals and EEG determined awakenings.

Based on the data obtained during this study, the authors reached the following conclusions concerning the effects of aircraft noise on sleep:

- All subjective reactions vary greatly from person to person and from time to time, and sleep disturbance is no exception. Deviations from the average can be very large. Even so, this study indicates that, once asleep, very few people living near airports are at risk of any substantial sleep disturbance due to aircraft noise, even at the highest event noise levels.
- At outdoor noise event levels below 90 dBA SEL (80 dBA L_{max}), average sleep disturbance rates are unlikely to be affected by aircraft noise. At higher noise levels, and most of the events upon which these conclusions are based were in the range of 90 to 100 dBA SEL (80 to 95 dBA L_{max}), the chance of the average person being awakened is about 1 in 75. Compared to the overall average of about 18 nightly awakenings, this probability indicates that even large numbers of nighttime aircraft noise events will cause very little increase in the average person's nightly awakenings. Therefore, the results of this study provide no evidence to suggest that aircraft noise is likely to cause harmful after-effects.

More detailed information concerning this study, and the relationship between aircraft noise and sleep disturbance and SEL are presented in Appendix F. The results of the Ollerhead study (1992) indicate a much lower response than predicted by the Air Force's interim model (i.e., a 1.3 percent probability of awakening due to an outdoor SEL of 90 to 95 dBA as opposed to the 16 to 25 percent predicted by the interim model).

4.3.1.1.2 Environmental Degradation/Impact

The FICON report concluded that: 1) Under NEPA, environmental degradation might have to be assessed around airports even if there is no clear effect on public health and welfare; and 2) A 3 dB increase in the DNL environment represents a doubling of sound energy and is an indicator of the need for further analysis, although smaller increases may indicate similar need. In other words, the impact of an incremental change in noise level depends, in part, on the existing level of the noise environment. FICON policy recommendations included: 1) Continue use of the DNL metric as the principal means for describing long-term noise exposure to civil and military aircraft operations; and 2) If screening analysis shows that noise-sensitive areas (i.e., schools, hospitals, churches, etc.) will be at or above DNL 65 dB and will have an increase of DNL 1.5 dB or more, further analysis should be conducted of noise-sensitive areas between DNL 60 to 65 dB having an increase of DNL 3 dB or more due to the proposed noise exposure.

Much of the criticism of the use of DNL for community annoyance and land use compatibility around airports stems from the nature of the metric. Although DNL is strongly influenced by the maximum sound level, it is much lower in value and therefore may not convey the loudness of individual overflights. DNL takes into account the magnitude of sound levels of all individual events that occur during the 24-hour period, the number of events, and an increased sensitivity to noise during typical sleeping hours. DNL is an average in that it accumulates all the noise exposure over a 24-hour period and divides the total by the number of seconds in a day. The logarithmic nature of the dB unit on which DNL is based causes sound levels of the loudest events to control the 24-hour average.

Ambient sound in a wilderness setting is in the range of DNL 20 to 30 dB, while rural residential areas range between DNL 30 to 50 dB, and urban residential areas average from DNL 60 to 70 dB (FICON 1992). However, in outdoor areas where quiet is a basis for use, "there is no reason to suspect that the general population will be at risk from any of the identified effects of noise" (i.e., activity interference or annoyance) when sound levels are DNL 55 dB or less (EPA 1978). ANSI has also suggested that land uses in "extensive natural wildlife and recreation areas" are likely to be considered compatible with DNL 60 dB or less (ANSI 1990b). The methodology employing DNL and %HA has been successfully used throughout the United States and in a variety of settings, ranging from urban to rural. While rural Alaska may be a distinct category in terms of ambient noise and resident profiles, there is no clear evidence to suggest that the DNL and %HA methodology is inappropriate, nor is there any other more appropriate methodology available.

In 1992, the National Park Service (NPS) published a report on the "Effects of Aircraft Altitude Upon Sound Levels on the Ground" (Anderson and Horonjeff 1992). Based on a review of existing literature, the report discusses the effectiveness of using altitude restrictions to mitigate adverse effects of aircraft sound within the National Park System. Key determinations from the report are summarized below.

Two factors determine the sound level experienced on the ground as a result of low-altitude aircraft operations. The actual altitude of the aircraft (or its height above the ground) and the horizontal range of the aircraft from the receptor combine to determine the actual slant range or slant distance from the receptor. Sound levels are reduced with slant distance from the source of the sound. However, the rate that sound levels are reduced as distances increase and the "complicating factors" that affect this rate of drop-off are not so well understood. The complicating factors that affect the sound divergence consist of:

- atmospheric absorption, which depends strongly on the aircraft's sound frequency range as well as environmental conditions such as temperature, humidity, and atmospheric pressure;

- attenuation due to intervening terrain and heavily wooded areas;
- ground attenuation, which also depends heavily on the same factors as atmospheric absorption along with wind speed/direction and vertical temperature gradients; and
- the particular acoustical descriptor that is of concern as an aircraft flies by. Various descriptors have been commonly used to describe the sound level history as an aircraft flies by a point on the ground. As an aircraft approaches, the sound levels first increase, reach a maximum, and then decrease as the aircraft recedes into the distance.

The NPS literature review concluded that:

- Sound levels decrease by 6 dB for every doubling of slant distance from any source of sound, including aircraft overflights. Since a 3 dB reduction in sound levels represents a halving of the sound energy, a 6 dB decrease in sound levels was determined to be easily sensed by people, even when they were not being attentive to the sound.
- Atmospheric absorption accounts for a 1 to 2 dB decrease in sound levels for each 1,000 foot increase in slant distance.
- Applying the above two factors, it was determined that step increases in slant distance would produce a corollary step decrease in sound levels.
- Where intervening hills or heavily forested areas interrupt the sound path, these hills and forested areas produce a corresponding reduction in the aircraft's sound level on the ground. Generally, intervening hills produce a 15 to 25 dB reduction in sound levels, and a 10 to 15 dB reduction is produced by intervening heavily wooded areas. This sound level reduction occurs at relatively low altitudes, but only at relatively large horizontal distances. Contrary to some of the trends discussed above, increasing an aircraft's altitude above the intervening hills to where the aircraft comes into direct view of the listener would actually increase the sound levels on the ground. If the aircraft altitude continues to increase to where the intervening hills and wooded areas are no longer a factor in attenuating the sound levels, then the sound levels on the ground would begin to decrease as aircraft altitude is further increased.
- Similar to the effects of intervening hills, "acoustically soft" terrain (grassland or other ground that contains root structure, plowed or aerated earth, snow or other "fissured" ground) reduces sound levels when sound paths "graze" across such terrain. This reduction can be as large as 10 to 15 dB when the elevation angle of the aircraft is very small. Raising the aircraft's altitude higher above the ground causes an initial increase in the sound level as the aircraft rises above the ground's influence. Once the aircraft is high enough, the ground's influence is lost and continued increases in altitude would cause a corresponding decrease in sound levels.

Using the complicating factors and the general findings identified above, the NPS study came to the following conclusions on the effectiveness of increasing aircraft overflight altitude as an effective mitigation measure:

- Increasing slant distances from approximately 125 feet to 1,000 feet would produce very large reductions in sound levels (on the order of 15 to 25 dB). Increases from 1,000 to 2,000 feet would produce smaller, but still moderate to substantial reductions (on the order of 4 to 8 dB). Between 2,000 and 7,000 feet above the ground, 1,000 foot increases produce considerably smaller reductions in sound levels (on the order of 3 to 5 dB); and 1,000 foot increases in altitude above 7,000 feet above the ground result in only very small reductions in sound level (around 2 to 3 dB for each 1,000 foot increment), and have little potential for effective mitigation (Anderson and Horonjeff 1992). To achieve reductions

on the order of 4 to 10 dB, a doubling of the slant distance between the aircraft and the receptor is required.

- If altitude restrictions are attempted as a mitigation measure, care must be taken to avoid the loss of attenuation contributed by the soft ground; intervening hills or heavily wooded areas.

In summary, the report does not recommend any particular "inaudibility" distance as a minimum altitude restriction for two reasons: 1) inaudibility depends strongly upon background sound levels, which are difficult to predict and which vary significantly from day to day, hour to hour, and even moment to moment; 2) inaudibility depends strongly on the type of aircraft and its speed.

Since aircraft sound also reduces with increased horizontal distance, which relates directly to increased slant distance, the chances of obtaining additional attenuation improves for low flying aircraft if the sound passes over acoustically soft ground, is interrupted by hills, or is subject to heavily wooded areas. For this reason, offsetting low-altitude aircraft flight tracks away from sensitive areas of a park or preserve is a potentially effective mitigation measure versus establishing increased overflight restrictions.

Along with predicting an energy-averaged noise metric such as DNL and L_{dnmr} , any analysis of low-altitude aircraft flight operations should also consider supplemental single event metrics such as L_{max} and SEL. L_{max} is the single event Maximum Sound Level. SEL is the Sound Exposure Level, which reflects both the maximum sound level and event duration. For evaluating health effects on people such as speech and sleep disturbance, SEL may be used. However, no clear cause-and-effect relationship exists between single event sound levels and human health and welfare. L_{max} is sometimes used to characterize the potential sound exposure of animals due to low-altitude aircraft operations. L_{max} is believed to be one of the metrics most frequently employed in laboratory and field studies, although studies often fail to identify the type of metric used. Instead, researchers typically present sound levels in simple decibel readings. L_{max} and SEL values vary widely with type of aircraft, altitude, and airspeed. Estimated L_{max} and SEL values of the aircraft expected to be flying in the regions under consideration have been included in Appendix E. Summary L_{max} and SEL information is provided in Table 4-3 and Table 4-4 for these aircraft at key altitudes.

Table 4-3 Summary of Maximum Sound Levels for Selected Altitudes Above Ground Level

Aircraft	Maximum Sound Level (L_{max}) at Key Altitudes Above Ground Level				
	100 Feet	500 Feet	2,000 Feet	5,000 Feet	10,000 Feet
F-15	120.5 dB	104.1 dB	89.2 dB	< 85 dB	< 85 dB
F-16	118.2 dB	102.9 dB	87.4 dB	< 85 dB	< 85 dB
A-10A	110.5 dB	94.5 dB	< 85 dB	< 85 dB	< 85 dB
F-14	118.5 dB	100.8 dB	< 85 dB	< 85 dB	< 85 dB
F-18	125.2 dB	109.5 dB	94.4 dB	< 85 dB	< 85 dB
A-6	117.7 dB	103.2 dB	89.8 dB	< 85 dB	< 85 dB
A-7	115.2 dB	98.8 dB	< 85 dB	< 85 dB	< 85 dB
B-1	131.5 dB	116.5 dB	102.2 dB	90.7 dB	< 85 dB
B-52G	120.1 dB	104.6 dB	89.2 dB	< 85 dB	< 85 dB
C-130	106.1 dB	91.1 dB	< 85 dB	< 85 dB	< 85 dB
C-141	109.9 dB	93.8 dB	< 85 dB	< 85 dB	< 85 dB
F-111F	125.2 dB	109.4 dB	93.2 dB	< 85 dB	< 85 dB
F-4	125.1 dB	109.2 dB	94.2 dB	< 85 dB	< 85 dB
F-5	110.9 dB	95.5 dB	< 85 dB	< 85 dB	< 85 dB
Tornado	122.0 dB	106.2 dB	90.5 dB	< 85 dB	< 85 dB

Table 4-4 Summary of Sound Exposure Levels for Selected Altitudes Above Ground Level

Aircraft	Sound Exposure Level (SEL) at Key Altitudes Above Ground Level				
	100 Feet	500 Feet	2,000 Feet	5,000 Feet	10,000 Feet
F-15	121.4 dB	109.1 dB	97.9 dB	88.8 dB	80.6 dB
F-16	113.4 dB	102.2 dB	90.3 dB	79.7 dB	69.1 dB
A-10A	107.1 dB	95.2 dB	82.2 dB	71.7 dB	< 65 dB
F-14	114.2 dB	100.7 dB	82.1 dB	68.4 dB	< 65 dB
F-18	122.4 dB	110.9 dB	99.4 dB	89.9 dB	81.1 dB
A-6	114.8 dB	104.5 dB	94.7 dB	87.5 dB	81.8 dB
A-7	112.2 dB	100.0 dB	87.4 dB	76.8 dB	67.1 dB
B-1	125.8 dB	115.1 dB	104.4 dB	95.2 dB	86.1 dB
B-52G	117.8 dB	106.6 dB	94.7 dB	84.8 dB	75.6 dB
C-130	105.5 dB	94.7 dB	83.8 dB	75.0 dB	67.2 dB
C-141	109.3 dB	97.3 dB	83.3 dB	71.1 dB	< 65 dB
F-111F	124.6 dB	113.0 dB	100.4 dB	89.6 dB	79.9 dB
F-4	123.5 dB	111.8 dB	10.4 dB	90.7 dB	81.3 dB
F-5	109.5 dB	98.3 dB	86.1 dB	74.8 dB	< 65 dB
Tornado	120.0 dB	108.4 dB	96.3 dB	86.2 dB	77.0 dB

While no absolute standards define the threshold of "significant adverse impact" for the noise environment, there are common precepts, based on empirical studies, regarding what constitutes adverse acoustical impacts in certain settings. The impact of a noise environment on people regularly experiencing that environment stems from the degree to which the noise interferes with activities such as speech, sleep, listening to radio and television, and the degree to which human health may be impaired (e.g., hearing loss). The total impact of a particular noise environment is a function of the sound level and the size of the population experiencing it. A DNL < 55 dB in a residential area will have negligible impact on public health and welfare. Adverse effects remain fairly low in the DNL 55 to 64 dB range and increase rapidly above DNL 65 dB. Noise can have both physiological and psychological impacts. Long-term, continuous exposure (e.g., 40 years) to DNL or L_{dn} 70 dB or greater, minus a 5 dB margin of safety, could induce hearing damage. This would be typical in an industrial setting where noise levels are continuous throughout the day. Average noise levels due to aircraft operations do not fit this profile as they are more transient in nature. For more detailed information, refer to Appendix F. The Proposed and Alternative Actions would not result in average noise levels even approaching those that might cause physiological damage (e.g., hearing loss). The real impact from the transient nature of aircraft-generated noise is psychological and is characterized as annoyance. The degree of change between existing conditions and what the noise environment would be under the Proposed or Alternative Actions determines the severity of potential impact.

In considering the potential impacts of noise (subsonic and supersonic) on various activities or physical structures, agencies such as the Air Force, EPA, and HUD have drawn some conclusions on noise level impacts. Descriptions of potential impacts are presented below for aircraft generated noise in the MOAs, aircraft-generated noise around the airfields, and the potential impacts on structures from sonic booms. These levels of impacts form the basis for assessments of noise later in this volume.

Subsonic MOA Operations: Onset Rate Adjusted Monthly Day-Night Average A-Weighted Sound Level (L_{dnmr}) is used to assess subsonic impacts. The C-Weighted Day-Night Average Sound Level (L_{cdn}) is used to assess sonic boom impacts.

L_{dnmr} and/or $L_{cdn} < 55$ dB

- Level recommended by the EPA as the maximum outdoor level to avoid any interference with outdoor activities (USAF 1978).
- Less than 4 percent of population expected to be Highly Annoyed by average subsonic noise levels of $L_{dnmr} < 55$ dB.
- Less than 6 percent of population expected to be Highly Annoyed by average supersonic noise levels of $L_{cdn} < 55$ dB. $L_{cdn} 55$ dB is approximately equivalent to $L_{dnmr} 59$ dB when compared for equal annoyance levels.

L_{dnmr} and/or $L_{cdn} \geq 55$ dB but < 65 dB

- Four to 14 percent of population expected to be Highly Annoyed by average subsonic noise levels of $L_{dnmr} \geq 55$ dB but < 65 dB.
- Six to 23 percent of population expected to be Highly Annoyed by average supersonic noise levels of $L_{cdn} \geq 55$ dB but < 65 dB. $L_{cdn} 55$ dB to 65 dB is approximately equivalent to $L_{dnmr} 59$ dB to 70 dB when compared for equal annoyance levels.

L_{dnmr} and/or $L_{cdn} \geq 65$ dB

- Over 24 percent of population expected to be Highly Annoyed by average subsonic noise levels of $L_{dnmr} \geq 65$ dB.
- Over 23 percent of population expected to be Highly Annoyed by average supersonic noise levels of $L_{cdn} \geq 65$ dB. $L_{cdn} 65$ dB is approximately equivalent to $L_{dnmr} 70$ dB when compared for equal annoyance levels.

Airfield Environs: Day-Night Average A-Weighted Sound Level (DNL) from aircraft operations in the vicinity of Air Force installations.

DNL < 60 dB

- At these noise levels, less than 7 percent of the exposed population is expected to be Highly Annoyed; average community reaction expected to be none to slight; noise considered no more important than various other factors of the community environment (USAF 1984; EPA 1982).

DNL ≥ 60 dB and < 65 dB

- At these levels, approximately 7 to 12 percent of the exposed population would be expected to be Highly annoyed; average community reaction expected to be slight to moderate; noise may be considered an adverse impact of the community environment (USAF 1984; EPA 1982).
- No special insulation is required for residences, classrooms, libraries, churches, hospitals, or nursing homes (USAF 1978).

- Noise exposure may be of some concern, but common building construction practices make the indoor environment acceptable and the outdoor environment will be reasonably pleasant for recreation and play (HUD 1985).

DNL $\geq$ 65 dB

- At these levels greater than 12 percent of the exposed population would be expected to be Highly Annoyed; average community reaction expected to be significant to severe (DNL $\geq$ 70 dB); noise is considered an important aspect of the community environment (USAF 1984; EPA 1982).
- At levels DNL $\geq$ 75 dB the average community reaction is expected to be very severe; noise is likely to be the most important of all adverse aspects of the community environment; very significant disturbance of normal voice or relaxed conversation would be likely outdoors; and hearing loss may begin to occur in sensitive individuals depending on actual noise levels received at the ear (USAF 1984; EPA 1982).

Supersonic Operations and Sonic Booms: Changes in Peak Overpressure (symbolized Δp) can result in property damage or failure patterns in conventional structures. Clarkson and Mayes (1972) conclude that, with the exception of occasional window breakage and damage to bric-a-brac, sonic booms of less than 11 pounds per square foot (psf) should not damage "building structures in good repair." Haber et al. (1989) in their review of the effect of aircraft noise and sonic booms on structures describe failure patterns in conventional structures due to peak overpressure. These patterns are listed below.

$\Delta p \geq 0.5$ psf but ≤ 4.0 psf

- Cracks in Plaster: Fine; extensions of existing; more in ceiling; over door frames; between some plaster boards (2.0 psf). Potential for clean breaks in plaster board joints (2.0 to 4.0 psf).
- Cracks in Glass: Rarely shattered; either partial or extension of existing. No glass flying.
- Damage to Roofs: Slippage of existing loose tiles/slates; sometimes new cracking of old slates at nail holes (< 2.0 psf). Potential for breakage of eroded nails/pegs (2.0 to 4.0 psf).
- Damage to Outside Walls: Existing cracks in stucco extended.
- Bric-a-brac: Those carefully balanced or on edges can fall; fine glass, e.g.; large goblets.
- Other: Dust may fall in chimneys.

$\Delta p > 4.0$ psf but ≤ 10.0 psf

- Cracks in Plaster: Partial ceiling collapse of good plaster; complete collapse of very new, incompletely cured or very old plaster.
- Cracks in Glass: Regular failures with a population of well-insulated glass. Some glass will fail, glass pieces can drop out, some glass flying could occur.
- Damage to Roofs: High probability rate of failure in nominally good slate, slurry-wash; some chance of failures in tiles on modern roofs; light roofs or large area roofs can move.
- Damage to Outside Walls: Old free-standing walls in fairly good condition can collapse.
- Damage to Inside Walls: Dividing walls known to move at 10 psf (usually due to acoustic coupling in the room).

$\Delta p > 10.0$ psf

- Cracks in Plaster: Most plaster affected.
- Cracks in Glass: Some good glass will fail regularly to sonic booms from the same direction. Glass with existing faults could shatter and fly. Large window frames move.
- Damage to Roofs: Most slate/slurry roofs affected, some badly; large roofs having good tile can be affected; some roofs bodily displaced causing gable-end and wall-plate cracks.
- Damage to Inside Walls: Internal walls can move even if carrying fittings; secondary damage due to water leakage.
- Bric-a-brac: Some nominally secure items can fall (e.g. pictures; especially if fixed to inside walls).
- Other: Chimneys dislodge if not in good condition.

There is no conclusive evidence that exposure to a sonic boom in the range of peak overpressures expected from air combat training activities has any adverse physiological effect on people. Sonic booms may be an irritant to outdoor recreationists, particularly those engaged in hunting, camping, and hiking, but the degree of personal irritation is difficult to predict. The attention given to a sonic boom immediately after its occurrence (e.g., conversation and comments about it or disruption of a group activity such as a classroom or a clinical activity) are actually extended interruptions either with or without a startle effect. Sonic booms in the 2 to 3 psf range are most common and are similar to noises such as metal-beating, detonating toy caps and firecrackers, and firing handguns.

One of the most comprehensive studies on sonic boom exposure of a large community was conducted over a 6-month period in Oklahoma City in 1964. The community was exposed to 8 sonic booms per day over the 6-month period at a median peak overpressure of 1.2 psf. Using the results of this study, EPA concluded that at 8 sonic booms per day the median peak overpressure must be well below 1 psf if no annoyance is to be reported (EPA 1974). A more difficult problem noted by EPA was how to interpret the effect on public health and welfare of more frequent sonic booms. The EPA ultimately determined that little or no annoyance would occur with one sonic boom per day below the level of 0.75 psf. Above that peak overpressure, some level of annoyance could occur.

Startle response was investigated by exposing groups of volunteers to 5 to 12 booms per day ranging from 1.2 to 12.8 psf. The results showed that a startle reaction could be measured by an increase in gross muscular movements and a slight increase in heartbeat frequency (about 2 beats per minute). Changes were momentary and disappeared within a few seconds. When test subjects were exposed to the noise of a pistol shot, the heartbeat frequency increased approximately 9 beats per minute.

According to the EPA, a number of factors must be considered in predicting the auditory effect of impulse noise on people: Duration and rise time of the event, the number of and time interval between events, the audiometric frequency, and the peak sound pressure level. Other considerations include an individual's susceptibility to inner ear damage, orientation of the ear with respect to the noise, and additive conditions of other continuous noises. The energy of a sonic boom is primarily in the frequency range of 25 to 100 hertz (considerably below that of gunfire and most industrial noise).

Future research may provide a better understanding of the relationship between noise and physiological ill-health; however, in the interim, decisions must be based on data supported by the scientific community. The Air Force concludes that, except for potential annoyance or startle, no other long-term effects associated with sonic boom exposure are likely.

4.3.2 Proposed Action

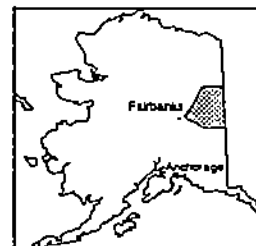
The sound levels presented in this section are predictions. Actual values of the noise levels experienced would vary due to temperature inversions, humidity, distance from the source, number of aircraft generating the noise, and other site-specific and environmental conditions. Aircraft-generated noise is not, in itself, a resource that would be impacted or require mitigation; but rather may impact other resources such as wildlife or recreation. This section describes the subsonic and supersonic noise levels estimated for the MOAs being considered under the Proposed and Alternative Actions. The potential impacts of these noise levels is discussed in the sections addressing biological resources, recreation, subsistence, and land use. L_{dnmr} levels less than 55 dB are not indicated in the text. References are made to compare relative noise levels between MOAs in a region.

4.3.2.1 Northern Interior Region

4.3.2.1.1 YUKON MOAs

Subsonic

It is projected that for the anticipated routine daily aircraft operations in each of the MOAs (YUKON 1 through YUKON 6), the maximum L_{dnmr} would be less than 55 dB. Noise levels in the YUKON 1 and YUKON 2 MOAs would be approximately the same as currently experienced during routine training. Noise levels in the YUKON 3 and YUKON 4 MOAs are estimated to be L_{dnmr} 2-5 dB lower than those in the YUKON 1 and YUKON 2 MOAs. Noise levels in YUKON 6 MOA are expected to be approximately L_{dnmr} 1-3 dB lower than the maximum levels estimated for YUKON 1. YUKON 5 MOA would experience the lowest noise levels in the complex due to its high floor (3,000 feet AGL) and low anticipated daily usage.



Under the Proposed Action, the Northern Interior Region MOAs available for an MFE would be essentially the same as are used currently, except that the MOA floors in the proposed YUKON 3 and YUKON 4 MOAs would be 100 feet AGL versus the current 3,000 feet AGL in the YUKON 3 TMOA. These lower floors, on the east side of the region, would contribute to higher noise levels in that portion of the region than currently experienced in the areas during an MFE. Overall noise exposure levels in the region are estimated to increase by L_{dnmr} 2-5 dB over existing MFE conditions; however, noise levels in all MOAs in the region would remain below L_{dnmr} 55 dB. The largest expected increase in aircraft noise levels (L_{dnmr} 4 dB) is anticipated in the YUKON 3 and YUKON 4 MOAs due to the increase MFE operations and lower MOA floors compared to existing conditions. Highest overall aircraft noise levels are still expected in the YUKON 6 MOA and in the vicinity of R-2205. These levels are estimated to be L_{dnmr} 1-2 dB higher than the highest noise levels throughout the remainder of YUKON 1. Noise levels in YUKON 3, YUKON 4, and YUKON 5 MOAs would average L_{dnmr} 2-8 dB lower than those experienced in YUKON 1 and YUKON 2 MOAs.

Supersonic

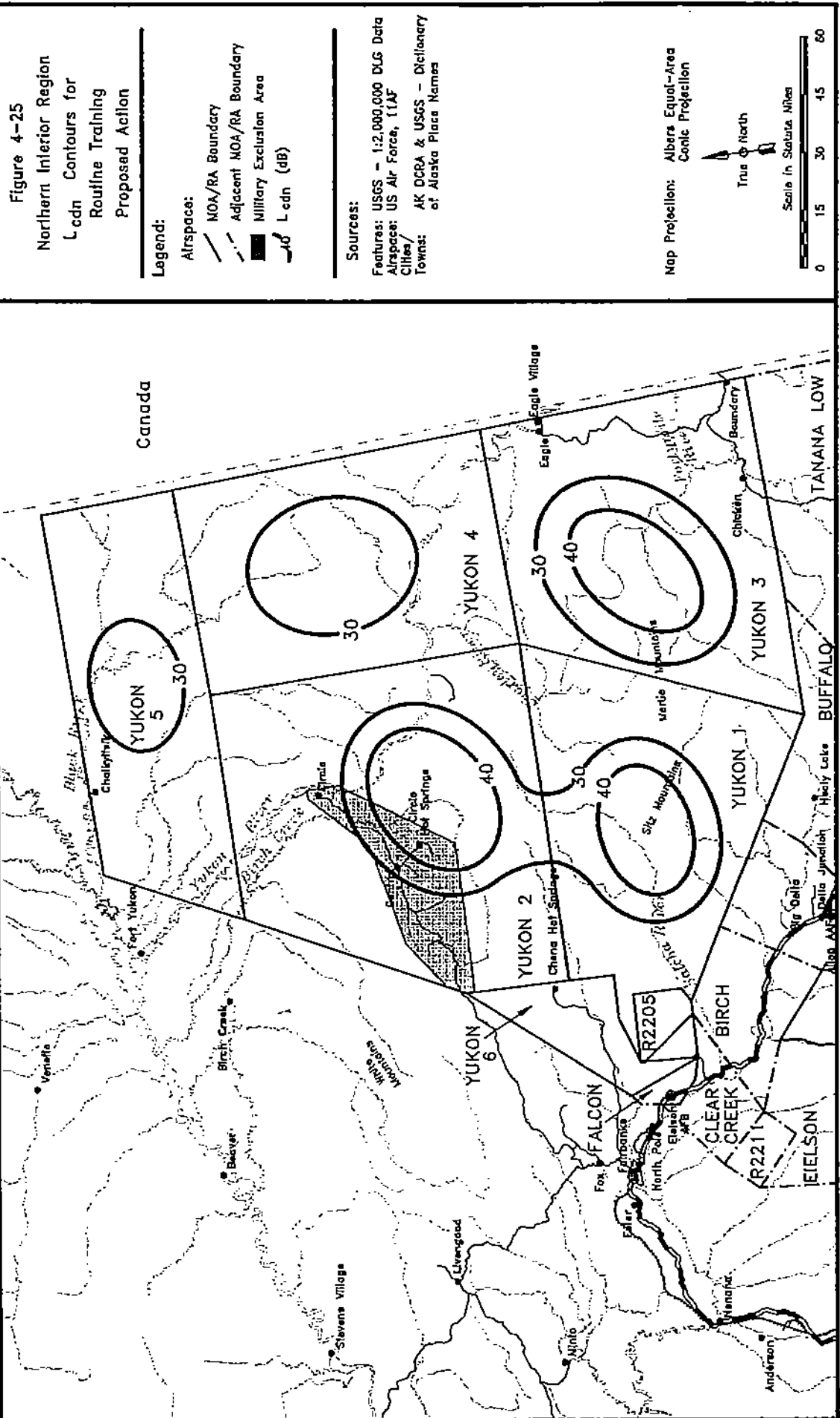
Under the Proposed Action, supersonic operations would be authorized down to 5,000 feet AGL in the YUKON 1 through YUKON 5 MOAs. As described in section 4.2.2.1.1 and Table 4-1, it is estimated that approximately 174 routine air-to-air training sorties would be using the YUKON MOAs on a monthly basis. As discussed in section 3.3.1, the potential noise impacts of supersonic operations can be assessed by using the WSMR model for predicting the L_{cdn} associated with potential supersonic operations. Table 4-5 summarizes the maximum predicted L_{cdn} levels and the average number of sonic booms per month in the center of the air-to-air training areas as a result of supersonic operations that may occur incidental to air-to-air training. Compared to the existing conditions in the YUKON 2 MOA (the only MOA in the complex currently authorized for routine supersonic operations below 30,000 feet MSL), the maximum L_{cdn} is 4 dB lower than predicted for current operations. The primary reason for this lowering is that under the Proposed Action, air-to-air training sorties would be allocated additional areas, and less sorties would be confined to the YUKON 2 MOA airspace. The

other MOAs (YUKON 1, YUKON 3, YUKON 4, and YUKON 5) are not currently authorized for supersonic operations on a routine basis. Figure 4-25 depicts the L_{cdn} contours for sonic boom exposures during a typical month of routine training.

Table 4-5 Maximum C-weighted, Day-Night Average Sound Levels and Average Number of Sonic Booms per Month Resulting from Supersonic Operations

MOA	L_{cdn} (dB)	Average Number of Sonic Booms Per Month
YUKON 1	42.3	1.30
YUKON 2	42.4	1.32
YUKON 3	41.2	1.00
YUKON 4	36.9	0.36
YUKON 5	33.9	0.20

The single event noise impacts associated with sonic booms are characterized by the change in peak overpressure (Δp) and are predicted by the BOOM 10c model. Operations in the YUKON MOAs would create carpet boom Δp (for sonic booms that propagate to the ground) from a high of 14.8 psf (for an F-15 E at Mach 1.05, in a 30 degree dive at 5,000 feet AGL [highly unlikely to occur]) down to a low of 1.5 psf (for an F-16 C, at Mach 1.20, level flight at 30,000 feet AGL). Associated C-weighted SELs for these individual booms range from 125.0 dB down to 105.1 dB. Clarkson and Mayes (1972) concluded that, with the exception of window glass breakage, booms less than 11 psf should not damage "building structures in good repair." Similarly, the Air Force (see Appendix F) has established that measured booms with Δp as high 144 psf have occurred with no injury to people. The levels of sonic booms predicted for the YUKON MOAs would be well below the level of Δp 144 psf. They would be of sufficient magnitude to cause startle in people and animals, but short of window breakage and would not be expected to cause injury to people or significant structural damage. The majority of sonic booms resulting from air-to-air training would range from 2.0 to 3.0 psf throughout the region.



Under the Proposed Action, supersonic operations would also be authorized in the YUKON 1 through YUKON 5 MOAs during an MFE. For purposes of this analysis, it was predicted that three air-to-air engagement areas could potentially evolve in the Northern Interior Region (and a fourth in the Southcentral Region that will be discussed later in this section) as a result of expanded supersonic areas being available under the Proposed Action. The first area would be located approximately 50 miles north and east of the northeastern corner of the Stuart Creek air-to-ground weapons range; the second area would be located generally north of the Steese Highway Flight Avoidance Area and eastward; the third area would occur around the intersection of the YUKON 1 through 4 MOAs. It was further assumed that each air-to-air sortie could participate in at least two of the engagement areas during an exercise. Using these assumptions, MFEs would generate an equivalent of 1,890 air-to-air sorties during a month (plus the routine training sorties utilizing the region's airspace). Expected operations in these three MFE air-to-air engagement areas, and the maximum L_{cdn} values, and average number of sonic booms per month associated with these MFE operations are outlined in Table 4-6. These maximum L_{cdn} values would occur at the center of each potential air-to-air area. Air-to-air operations that could involve a supersonic event or sonic boom would be the combination of MFE and routine training occurring in other portions of the region. Figure 4-26 depicts the predicted L_{cdn} contours for supersonic operations during an MFE flying month. Contours depicted in Figure 4-26 are a combination of MFE and routine operations occurring in the Northern Interior Region, during a period when up to 15 flying days per month were devoted to MFE training (with reduced routine training on those days), and the remaining days were strictly devoted to routine training.

Table 4-6 Predicted Monthly Air-to-Air Operations, C-weighted, Day-Night Average Sound Levels, and Average Number of Sonic Booms per Month as a Result of MFE Activities During an MFE Flying Month

NORTHERN INTERIOR REGION	OPERATIONS	L_{cdn} (dB)	Average Number of Sonic Booms per Month
AREA 1 (north-central YUKON 1 MOA)	567	52.5	13.60
AREA 2 (east-central YUKON 2 MOA)	378	50.8	9.08
AREA 3 (north-central YUKON 1 MOA to east-central YUKON 2 MOA)	567	52.5	13.60

Figure 4-26
Northern Interior Region
Lcdn Contours for
MFE Operations
Proposed Action

Legend:

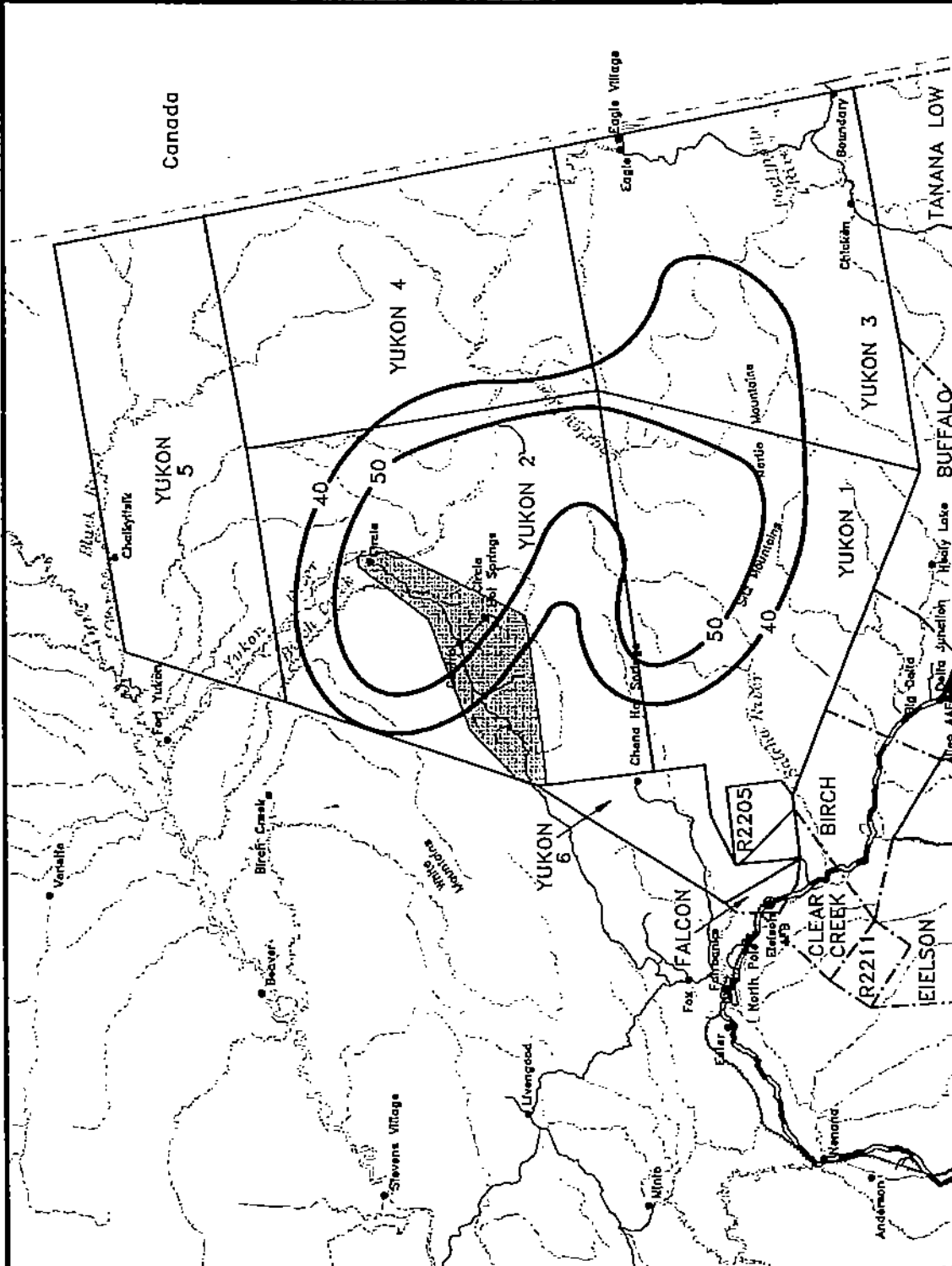
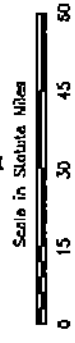
Airspace:

- NOA/RA Boundary
- Adjacent NOA/RA Boundary
- Military Exclusion Area
- Lcdn (dB)

Sources:

Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, IIAF
Cities/Towns: AK DCRA & USGS - Dictionary of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection



4.3.2.1.2 Stuart Creek Air-to-Ground Weapons Range (R-2205)

Subsonic

As described in section 3.3.3.2, two models are used to assess the noise impacts of subsonic aircraft operations on the air-to-ground ranges. The NOISEMAP model is used to determine the sound levels in the immediate vicinity of the impact areas, and the MOAMAP model is used to evaluate the aircraft noise levels throughout the remainder of the restricted areas. The analysis indicates that with no significant change in planned routine daily training in the area, the DNL in the immediate area of the Stuart Creek Impact Areas would remain at approximately DNL 63 dB and would not be expected to change for routine training operations under the Proposed Action. Outside of the immediate target area, the L_{dnmr} levels would be less than 55 dB as in the adjoining YUKON 1 and YUKON 6 MOAs.

When the increased MFE operations are added under the Proposed Action, the DNL in the immediate area of the Stuart Creek Impact Area, would increase by 2 dB to approximately DNL 65 dB in the center of the target array areas. Outside of the immediate target area, the L_{dnmr} levels would be less than 55 dB as in the YUKON 1 and YUKON 6 MOAs, but would be higher than that experienced during a month when no MFE operations were being flown.

4.3.2.2 Southern Interior Region

4.3.2.2.1 BIRCH, EIELSON, BUFFALO, CLEAR CREEK, and FALCON MOAS



Subsonic

Under the Proposed Action the BIRCH, EIELSON, and BUFFALO MOAs would be available for routine daily training. The noise levels in these MOAs would be less than L_{dnmr} 55 dB. The highest noise level is predicted in the BIRCH MOA with BUFFALO and EIELSON MOAs being L_{dnmr} 4-5 dB lower than BIRCH. With only occasional usage and a higher floor than the other MOAs in the region, the maximum noise exposure levels due to aircraft operations in the CLEAR CREEK MOA would be less than L_{dnmr} 55 dB and at least L_{dnmr} 10 dB lower than predicted for the BIRCH MOA. Use of the FALCON MOA would create a noise exposure level less than L_{dnmr} 55 dB and at least L_{dnmr} 8 dB lower than aircraft noise levels in the BIRCH MOA. Aircraft flight operations into and out of Eielson AFB would be the dominant noise source in the area.

During an MFE, the L_{dnmr} would increase 10 to 12 dB over routine daily training months in these MOAs, but would remain less than L_{dnmr} 55 dB. This increase in noise exposure levels would be approximately L_{dnmr} 2 to 4 dB greater than currently experienced during an MFE. This increase would be attributable to increases in the maximum number of daily sorties authorized to fly in an MFE, the potential for an MFE to last up to 15 days, and the lowering of the floor in the BUFFALO MOA from 1,000 feet AGL in the BUFLO TMOA to 300 feet AGL in the BUFFALO MOA. During an MFE, noise exposure levels in the CLEAR CREEK MOA would increase by L_{dnmr} 3 to 4 dB over routine training operations, but remain below L_{dnmr} 55 dB. Further, the maximum noise exposure levels in the MOA are expected to be L_{dnmr} 8 to 13 dB less than the noise levels in the BIRCH, EIELSON, and BUFFALO MOAs. Noise exposure levels during an MFE in the FALCON MOA would increase by L_{dnmr} 4 to 5 dB over routine training operations, but remain below L_{dnmr} 55 dB. The maximum noise levels in the FALCON MOA would be L_{dnmr} 4 to 9 dB less than the noise exposure levels in the BIRCH, EIELSON, and BUFFALO MOAs.

Supersonic

Supersonic operations in the MOAs and RAs of the Southern Interior Region would not be permitted below 30,000 feet MSL.

4.3.2.2.2 Oklahoma Air-to-Ground Weapons Range (R-2202) and Blair Lakes Air-to-Ground Weapons Range (R-2211)

Subsonic

The DNL in the immediate area of the Oklahoma range is 60 dB and would not be expected to change for routine training operations under the Proposed Action. Outside of the immediate target areas, the aircraft noise levels would be less than L_{dnmr} 55 dB and be consistent with those in the surrounding BIRCH, EIELSON, and BUFFALO MOAs.

The DNL in the immediate area of the Blair Lakes range is approximately 71 dB and would not be expected to change for routine training operations under the Proposed Action. Outside of the immediate target areas, the noise levels would be less than L_{dnmr} 55 dB as in the adjoining BIRCH, EIELSON, and CLEAR CREEK MOAs.

Under the Proposed Action, the increased MFE operations would contribute to an increase in the DNL in the area near the center of the Oklahoma range to 65 dB in R-2202. Outside of this center area, the DNL would decrease to below 55 dB in 2 to 3 miles. L_{dnmr} noise levels throughout the remainder of the restricted area would be less than 55 dB, but would be 3 to 4 dB higher than currently experienced during MFEs and 10 to 12 dB higher than months when only routine training was being flown.

The increase in MFE operations under the Proposed Action would not change operations at the Blair Lakes range. The airspace (R-2211) over the range would continue to be used as a holding area for aircraft awaiting clearance into the Eielson AFB traffic pattern. Noise exposure levels at Blair Lakes range, in the immediate vicinity of the target impact areas, would decrease slightly due to a small reduction in routine operations during an MFE. Within R-2211, $L_{dnmr} < 55$ dB would be experienced throughout the area, outside of the immediate area of the targets, and be about the same as experienced in the EIELSON MOA to the south.

4.3.2.3 Southcentral Region

4.3.2.3.1 FOX and SUSITNA MOAs

Subsonic

Under the Proposed Action, the FOX MOA would be available for routine daily training and would be a second prime air-to-air training area within flying distance of both Elmendorf- and Eielson-based aircraft. Air-to-air training missions would occur daily in this region, and with a floor of 3,000 feet AGL, the L_{dnmr} is predicted to be less than L_{dnmr} 55 dB for all routine operations.



The SUSITNA MOA would continue to be used as an air-to-air training area under the Proposed Action. With the creation of the FOX MOA, some reduction in daily sorties in the SUSITNA MOA could occur. Maximum noise levels in the SUSITNA MOA are estimated to be L_{dnmr} 6 dB less than in the FOX MOA and would continue to be less than L_{dnmr} 55 dB.

With the proposed increase in MFE operations, during months when MFEs are being flown, the noise levels in the FOX MOA would increase by L_{dnmr} 3 to 4 dB over the existing MFE conditions and by L_{dnmr} 6 dB over routine training noise levels. As for routine training, the majority of MFE activity would occur in the southern two-thirds of the MOA.

The SUSITNA MOA would not be used for MFEs, and the sound levels in the MOA would remain the same as predicted for routine operations.

Supersonic

Under the Proposed Action, supersonic operations would be authorized down to 5,000 feet AGL in the FOX MOA. An average of 15.8 air-to-air sorties would use the FOX MOA daily or approximately 316 sorties per month. It is anticipated that because of the high terrain in the northern third of the FOX MOA, the most useful training area would be the portion of the airspace south of the Alaska Range. Operations in this portion of the MOA would generally run along a northeast/southwest line in the MOA. Given the estimated number of monthly routine operations under the Proposed Action, it is predicted that the maximum noise levels due to supersonic operations in the center of the air-to-air training would be approximately L_{cdn} 50.0 dB with an average of 7.6 sonic booms per month in the center. Figure 4-27 depicts the L_{cdn} contours for sonic boom exposure that would occur during a month when only routine training is underway.

Under the Proposed Action, minimum supersonic operating altitudes in the SUSITNA MOA would not change. However, with the establishment of the FOX MOA to the east, operations in the SUSITNA MOA could decrease slightly. With this reduction in monthly air-to-air training sorties, the maximum L_{cdn} predicted for the SUSITNA MOA would be approximately 41.4 dB and average 1.2 sonic booms per month. Sonic boom contours associated with air-to-air training in the SUSITNA MOA under the Proposed Action are shown in Figure 4-27.

Southcentral Region
Lcdn Confours for
Routine Training
Proposed Action

Legend:

Airspace:

MOA/RA Boundary

--- Adjacent MOA/RA Boundary

7. $\text{BP} \rightarrow \text{BP}$

Sources:

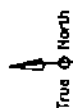
Features: USGS - 1:2,000,000 DLG Data

Almapac: US Air Force, IIAF

C17H03/

Towns: AK DCRA & USGS - Dictionary of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection



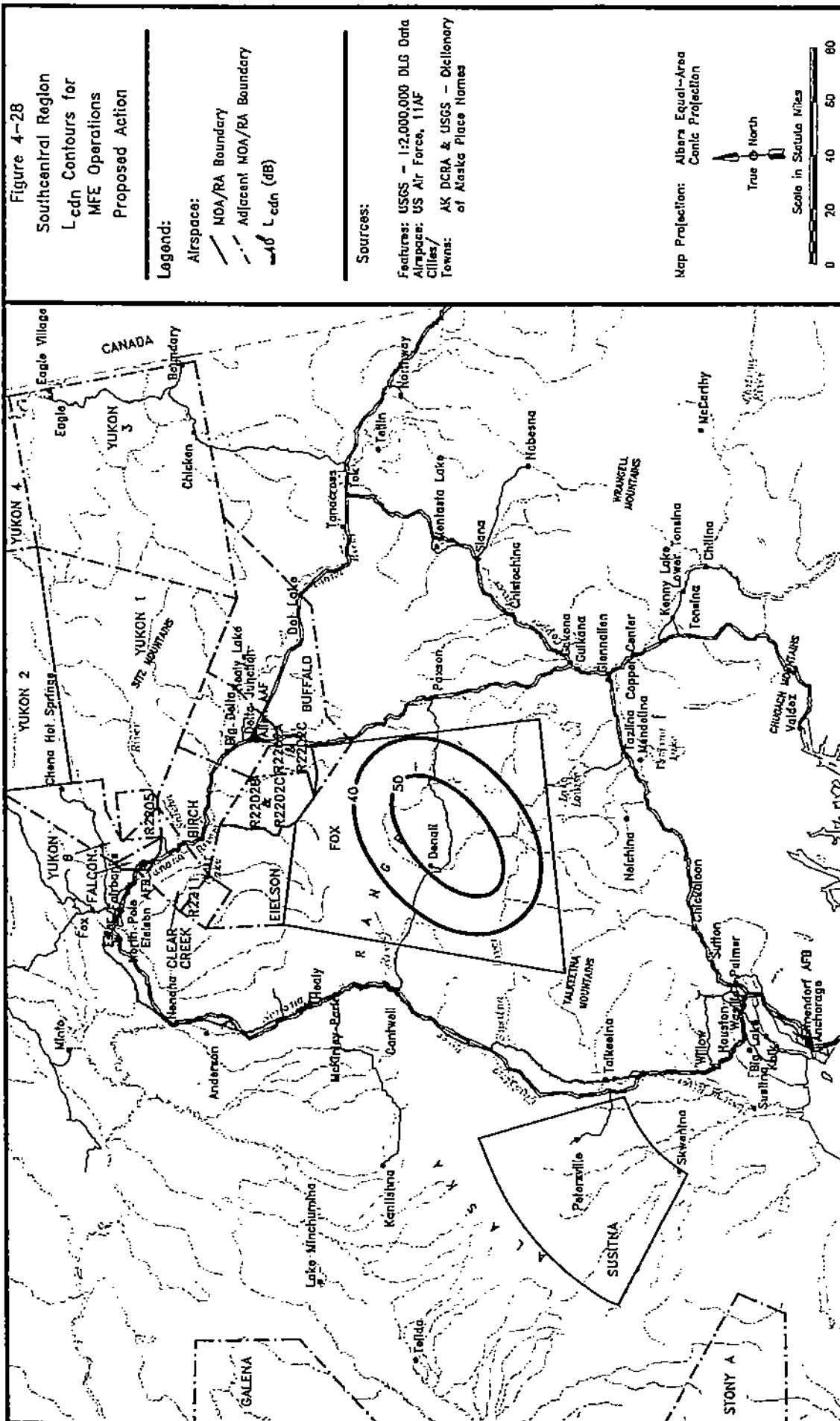
Scola in Statute Miles



Maximum peak overpressures (and the associated C-weighted SELs) would be expected to be slightly less than would be experienced in the YUKON MOAs, due to the higher terrain elevation (above mean sea level) underlying the MOAs. Maximum Δp levels as a result of sonic booms could be of sufficient magnitude to startle people and animals, but short of window breakage, would not be expected to cause injury to people or significant structural damage.

Under the Proposed Action, supersonic operations would be authorized in the FOX MOA down to a floor of 5,000 feet AGL. As described in section 4.3.2.1.1, up to four air-to-air engagement areas could evolve in the YUKON and FOX areas during an MFE. Three of the areas are expected to be in the YUKON MOAs (described under the Northern Interior Region) with the fourth in the FOX MOA. Apportioning the air-to-air sorties as described previously, it is assumed that during an MFE flying month, up to 378 MFE air-to-air sorties and up to 269 routine training sorties could train in this area. The maximum noise level expected to occur in the center of this area as a result of total monthly MFE and routine training is approximately $L_{\text{eq}} 53.1$ dB with an average of 15.5 sonic booms per month occurring in the center of the area. Figure 4-28 depicts the L_{eq} contours for expected air-to-air training in the Southcentral Region during a period when up to 15 flying days per month are devoted to MFE training (with reduced routine training on those days), and the remaining days of the month are strictly devoted to routine training.

The SUSITNA MOA would not be used for MFEs, and the sound levels in the MOA would remain the same as predicted for routine operations (approximately $L_{\text{eq}} 41.4$ dB).

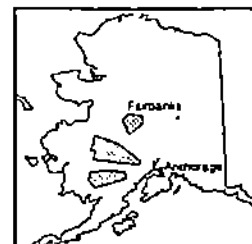


4.3.2.4 Western Region

4.3.2.4.1 STONY A and B, NAKNEK 1 and 2, and GALENA MOAs

Subsonic

Under the Proposed Action, the floor of the STONY B MOA would be lowered to 100 feet AGL to match the existing floor in STONY A. Operations in the MOAs would remain essentially unchanged with predominantly air-to-air training in the vicinity of the Alaska ACMI Range as described in section 4.2.2.4.1. The lower floor in STONY B would enhance its use as a low-altitude air-to-ground navigation area, predominantly for F-15E aircraft from Elmendorf AFB. With the creation of the FOX MOA in the Southcentral Region, it is also expected that some air-to-air training (training above 5,000 feet AGL) would shift away from the STONY A and B MOAs. Considering all these factors, it is predicted the maximum noise levels in the STONY A and STONY B MOAs would remain below L_{dnmr} 55 dB and be approximately the same as the existing STONY A MOA and L_{dnmr} 1 to 2 dB higher in STONY B.



The Proposed Action would alter the technical definition of the internal boundary between NAKNEK 1 and NAKNEK 2 MOAs. It is expected that flight operations in the NAKNEK MOAs may be reduced as operations begin in the FOX MOA. Under these conditions, the maximum noise levels experienced under the NAKNEK MOAs would remain below L_{dnmr} 55 dB, would be L_{dnmr} 10-12 dB lower than in the STONY MOAs, and are expected to decrease from existing conditions.

The Proposed Action would not increase the use of the GALENA MOA over existing conditions. It is expected that the maximum noise levels in the GALENA MOA would remain unchanged and less than L_{dnmr} 55 dB.

The STONY MOAs would not be used for MFE activity as characterized in the Northern and Southern Interior Regions, but would be used as they are today for limited air-to-air surge exercises by the 3 WG at Elmendorf AFB. During a surge exercise month, it is predicted that the maximum noise levels for the MOAs would increase by L_{dnmr} 2 to 3 dB but would remain below L_{dnmr} 55 dB.

MFES would not occur in the NAKNEK or GALENA MOAs.

Supersonic

Under the Proposed Action, supersonic operations would be authorized down to a floor of 5,000 feet AGL in the STONY A and STONY B MOAs. Primary air-to-air training activities occur around the Alaska ACMI as described in section 4.2.2.4.1. The maximum number of monthly air-to-air training sorties expected to occur in this area is estimated at 426. The maximum L_{cdn} value expected to occur in the center of this area would be approximately 51.3 dB with an average 10.2 sonic booms per month. This is slightly lower than the L_{cdn} 52.0 dB estimated for existing operations in the region. Figure 4-29 depicts the L_{cdn} contours expected for air-to-air training in the Western Region during routine training.

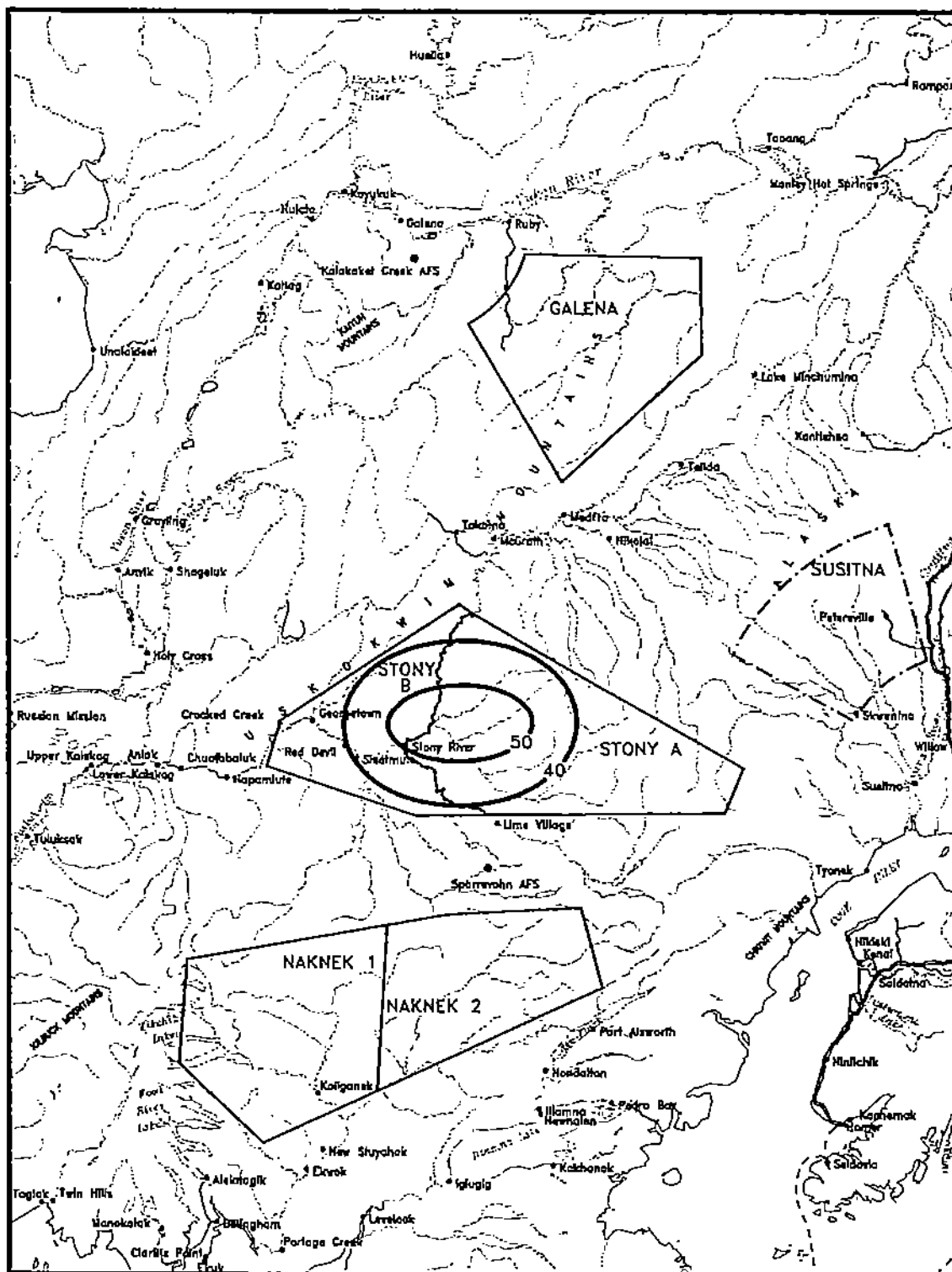


Figure 4-29
Western Region
Lcdn Contours for
Routine Training
Proposed Action

Legend:

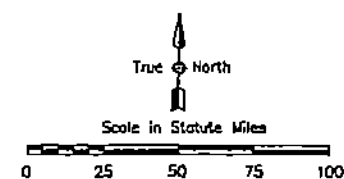
Airspace:

- MOA Boundary
- - - Adjacent MOA Boundary
- Lcdn (dB)

Sources:

Features: USGS - 1:2,000,000 DLG Data
Airspace: US Air Force, 11AF
Cities/
Towns: AK DCRA & USGS - Dictionary
of Alaska Place Names

Map Projection: Albers Equal-Area
Conic Projection



During a surge exercise, the number of monthly air-to-air training sorties using the STONY A and B MOAs would not change from current operations. Supersonic operations would be authorized down to 5,000 feet AGL in the STONY A and B MOAs. Under these conditions, it is estimated that the maximum noise levels due to sonic booms in the MOAs would be L_{dn} 54.1 dB with an average 19.5 sonic booms per month at the center of the training area, and the contours would be slightly expanded over those shown in Figure 4-29.

Maximum peak overpressures (and the associated C-weighted SELs) would be expected to be approximately the same as experienced in the YUKON MOAs due to the similar terrain elevations (above mean sea level) underlying the MOAs. Maximum Δp levels as a result of sonic booms could be of sufficient magnitude to cause startle in people and animals; but short of window breakage, would not be expected to cause injury to people or significant structural damage.

Supersonic operations below 30,000 feet MSL are not permitted in the NAKNEK or GALENA MOAs.

4.3.3 Alternative A

4.3.3.1 Northern Interior Region

Under Alternative A, noise levels in the Northern Interior Region would be the same as predicted for the Proposed Action.

4.3.3.2 Southern Interior Region

Under Alternative A, the operations planned for the CLEAR CREEK MOA would be shifted to the BIRCH and EIELSON MOAs. Even with increased sorties, noise levels in these MOAs would remain below L_{dnmr} 55 dB and would be expected to increase by less than L_{dnmr} 1 dB over the Proposed Action.

4.3.3.3 Southcentral Region

Under Alternative A, noise levels in the Southcentral Region would be the same as predicted for the Proposed Action.

4.3.3.4 Western Region

Under Alternative A, noise levels in the Western Region would be the same as predicted for the Proposed Action.

4.3.4 Alternative B

4.3.4.1 Northern Interior Region

Under Alternative B, the YUKON 4 and 5 MOAs would not be created, but alternative Airspace (the TANANA MOA) would be established in the Southcentral Region. Supersonic operations in the area would not be authorized below FL 300. No MFE operations would be allowed in the region of the YUKON 4 or 5 MOAs below FL 180. It is anticipated that potential locations where supersonic activities would take place would shift to the southern border of YUKON 3 where it would parallel the northern border of the TANANA MOA. This area would replace the AREA 2, defined in Table 4-6, and the expected maximum L_{dn} from supersonic operations in the southern portion of YUKON 3 MOA would be 50.8 dB with an average 9.1 sonic booms per month in the center of the area. No other changes in noise levels either subsonic and/or supersonic are expected under this alternative.

4.3.4.2 Southern Interior Region

Under Alternative B, it is expected that the potential slight increase in low-altitude air-to-ground training in the TANANA MOA that may cause additional traffic in the BUFFALO MOA of this region would cause the subsonic noise levels in the region of the BUFFALO MOA to increase less than L_{dnmr} 1 dB. No changes in supersonic operations would occur.

4.3.4.3 Southcentral Region

Subsonic

It is projected that under Alternative B, the maximum L_{dnmr} would be less than 55 dB throughout the entire TANANA MOA. Noise levels in the FOX and SUSITNA MOAs would not change under this alternative. During an MFE, subsonic noise is expected to increase by up to L_{dnmr} 5 to 7 dB throughout the TANANA MOA, and to be the highest near the northern border with YUKON 3 MOA and the northwestern edge near the BUFFALO MOA. In all cases, the maximum average noise levels would remain less than L_{dnmr} 55 dB.

Supersonic

Under this alternative, supersonic operations would be authorized down to 5,000 feet AGL throughout the TANANA MOA. During routine training the maximum L_{odn} would be 38.7 dB with an average 0.60 sonic booms per month. It is anticipated that during an MFE, one of the air-to-air engagement areas would migrate to near the border of YUKON 3 and TANANA MOA under this alternative. In this case, it is expected that up to 378 MFE air-to-air sorties would be using this area during a 15-day exercise period, and the maximum sonic boom impacts from these operations would be approximately L_{odn} 50.8 dB with an average 9.1 sonic booms per month. Single-event impacts would be as described in section 4.3.2.1.1.

4.3.4.4 Western Region

Under Alternative B, there would be no changes in operations or aircraft noise levels in the Western Region. Predicted noise levels would be as discussed in section 4.3.2.4.1.

4.3.5 No Action Alternative

4.3.5.1 All Regions

Under the No Action Alternative, the MOAs in the four regions would not be modified. The use of the airspace and the predicted noise impacts, both subsonic and supersonic, in all four regions would be as discussed in sections 3.3.3, 3.3.4, 3.3.5, and 3.3.6.

4.3.6 Alternative A—Modified

4.3.6.1 Northern Interior Region

Subsonic

Under Alternative A—Modified, subsonic noise levels would not be expected to change for routine or MFE operations in YUKON 1, 2, or 6 MOAs. Subsonic noise levels for routine operations are expected to increase L_{dnmr} 1 to 2 dB in the YUKON 3 and 4 MOAs due to increased low-altitude A-10 LATN-type operations in the YUKON 3A (Low) and YUKON 4 MOAs. Establishing YUKON 3B (Low) with a floor of 2,000 feet AGL would make the area less attractive for low-altitude training; however, an aircraft overflight at 2,000 feet AGL

would reduce the L_{max} experienced at ground level by approximately 30 dB over the L_{max} associated with an overflight at 100 feet AGL. Routine training would not be authorized in YUKON 5 MOA; hence, no change in noise level is expected over existing conditions. During an MFE, subsonic noise levels are expected to remain as described in the Proposed Action except for the area under YUKON 3B (Low) and YUKON 5 MOAs. With their higher floors, the average noise levels during an MFE would be L_{dnmr} 3-5 dB lower than under the Proposed Action.

Supersonic

Under this alternative, the floor for supersonic operations would be established at 12,000 feet MSL or 5,000 feet AGL, whichever is higher. Raising the floor would decrease the maximum peak overpressures experienced at ground level.

4.3.6.2 Southern Interior Region

Under Alternative A—Modified, the average monthly subsonic noise levels for both routine and MFE training would be expected to decrease by L_{dnmr} 1 to 2 dB for the BIRCH and FALCON MOAs with the floors being raised to 500 feet AGL. The western boundary of BIRCH would be moved to the southeast, removing all portions of the Salcha River and the Harding Lake area that were previously under the BIRCH MOA as described in the Proposed Action.

4.3.6.3 Southcentral Region

Subsonic

Under Alternative A—Modified, the higher floor of the FOX MOA would decrease noise levels by L_{dnmr} 1 to 2 dB throughout the area. The L_{max} attributable to a single overflight would be approximately L_{max} 5 dB less at 5,000 feet AGL than at 3,000 feet AGL. The higher floor would mask more of the subsonic noise levels due to MOA operations, and operations along MTR 937 would be the more dominant source of aircraft noise in the vicinity of the MTR, but would be less than L_{dnmr} 55 dB.

Supersonic

The floor for supersonic operations would be raised in this region. Overall, the expected peak overpressures from a sonic boom would be less than those that may occur at a lower floor.

4.3.6.4 Western Region

Under this alternative, the subsonic and supersonic noise levels are expected to remain the same as discussed in the Proposed Action.

This Page Intentionally Left Blank

4.4 Chaff and Flares/Hazardous Operations

4.4.1 Issues/Concerns

The Proposed and Alternative Actions could pose potential increased risks related to the use of chaff and flares, laser use, munitions use and handling, and the adequacy of emergency response procedures. If there is a potential for impact, the question to be answered is "are adequate guidelines and procedures in place to prevent an unacceptable risk of potential adverse impacts?" Impacts are defined as follows:

Level I (No/Negligible Impact): Procedures, areas, and times of the year for employment of chaff and flares would not increase the risk of wildfire or other environmental degradation. Airborne lasers would continue to be used in the eye-safe "training mode" throughout the MOAs/ranges or in the non-eye-safe "combat mode" on the air-to-ground weapons ranges only in accordance with current operational restrictions and safety practices. Munitions would continue to be used in accordance with current Air Force guidance. Aircraft emergency fuel jettison would continue to be conducted in existing designated areas and in accordance with all applicable procedures and reporting requirements. Hazardous materials and hazardous waste would continue to be handled in accordance with applicable guidelines and regulations.

Level II (Adverse, but Not Significant Impact): Procedures, areas, and times of the year for employment of chaff and flares could increase risk of wildfire, but such risk would be within the response capability of existing emergency management plans and agencies. Analysis not conducted for this level on airborne lasers, munitions use and handling, aircraft emergency fuel jettison procedures, or hazardous materials and wastes as no impacts would be anticipated.

Level III (Significant Adverse Impact): Procedures, areas, and times of the year for employment of chaff and flares could create an increased risk of wildfire, but such risk would be beyond the expected response capability of existing emergency management plans and agencies. Analysis not conducted for this level on airborne lasers, munitions use and handling, aircraft emergency fuel jettison procedures, or hazardous materials and wastes as no impacts would be anticipated.

4.4.2 Proposed Action

4.4.2.1 Chaff and Flares

Chaff and flares are used by the military as a defensive mechanism to avoid aircraft detection by enemy radars or to provide self-protection from enemy missile attacks on airborne aircraft. The characteristics and use of the chaff/flares employed by the Air Force in Alaska are described in section 3.4.2. In Alaska, the Air Force uses only self-protection flares in the MOAs; illuminating flares are only used on the air-to-ground weapons ranges. White phosphorous flares or munitions are not used by the Air Force in Alaska. Chaff and flares would be used in accordance with the operational procedures outlined in section 3.4.2.4.

4.4.2.1.1 Environmental Impacts of Chaff

Potential impacts from chaff can result from its physical and chemical characteristics. A detailed description of the composition of chaff is provided in section 3.4.2.1.

Human Exposure

Potential human health issues associated with chaff include effects from inhalation, ingestion, or skin contact. A nuisance exposure, defined as a slight external irritating discomfort, could occur if chaff were to lodge beneath clothing (National Guard Bureau 1990). Inhalation concentrations would be too low to cause effects, and humans are not likely to ingest plant material with superficial chaff deposits. Inhalation of fiberglass has been studied as a workplace hazard, and there is no conclusive evidence that inhalation of man-made glass fibers have any chronic effects. However, it should be noted that the National Institute for Occupational Safety and Health (NIOSH) considers crystalline silica (as a respirable dust) a potential human carcinogen.

Livestock

In 1952, in response to claims of ill effects on livestock by local farmers in the area surrounding Wright-Patterson AFB, the Air Force Aeromedical Laboratory conducted studies on the aluminum foil chaff then being used by the Air Force. This early chaff was comprised mostly of aluminum and small amounts of lead. The study concluded that a cow would need to ingest 70 pounds of chaff to obtain a minimum lethal dosage, and this would have resulted in lead rather than aluminum poisoning. Concentrations of chaff in the soil from Air Force operations would not be sufficient to provide this level of consumption. The study concluded that chaff was not toxic to livestock. (NOTE: Aluminum foil chaff is no longer used by the Air Force, nor is lead a component of chaff.)

A study performed by the Canadian Department of Agriculture in 1972 on behalf of the Canadian Armed Forces examined the acute effects of ingestion of chaff on cattle. Six calves were fed from 0 to 0.125 ounces of fiberglass chaff daily for 14 days. It was found that the animals rejected clumps of chaff as large as 0.5 ounces, and would only consume the high concentrations of chaff when thoroughly mixed with hay and molasses. The experimental cattle gained weight at the same rate as calves which were fed chaff-free hay. Postmortem studies of the calves found no lesions of significance in any organs. A few fibers were trapped in the reticulum, but did not appear to cause any cellular reaction (National Guard Bureau 1990). The test demonstrated that chaff passes through the digestive system of cattle, and only insignificant amounts are retained in the body. Blood samples taken at the beginning and end of the 14-day period were normal, and there was no evidence of digestive disturbance or other clinical symptoms (National Guard Bureau 1990; USAF 1989).

The materials in chaff are considered nontoxic and are not harmful to livestock. The review conducted for SAC concluded that chaff presented no hazards to livestock health (USAF 1989).

Fish and Wildlife

There is little evidence of impacts of chaff on fish and wildlife. Wildlife species tend to have more efficient digestive systems than livestock, and more of the chaff components may be digested and absorbed. However, considering the low concentrations of chaff from military operations and the documented lack of oral toxicity of aluminum or fiberglass, impacts to wildlife would be anticipated to be minimal. The amount of chaff ingested would probably be much less than the amount of aluminum and silica consumed daily via dirt and sand normally on forage. Notable increases in aluminum concentrations in surface water bodies would be unlikely, and effects on aquatic life would not be expected. Wind-blown particles would tend to concentrate on the lee side of water bodies where nutrient levels are higher. Surface feeding wildlife, such as ducks, may consume chaff particles on the surface of vegetation or from the mud while foraging. These would either pass through the digestive system or form compacted pellets in the gizzard. Only in extreme cases is this likely to be fatal. Studies of six aquatic organisms (benthic worms, American oysters, blue mussels, blue crabs, menhaden, and killifish) exposed to high concentrations of chaff had no increase in mortalities (National Guard Bureau 1990; USAF 1978). This study concluded that the lower concentrations, likely to result from military training operations, would cause no environmental impact.

Vegetation

Vegetation is exposed to high levels of silica and aluminum found naturally in the soil. Aluminum occurs naturally in plant tissue, and uptake of toxic levels attributed to chaff deposition would be unlikely. Considering the wide ground dispersion and lack of toxicity, impacts to vegetation are highly unlikely.

Land

Detailed authoritative data concerning the effects of chaff on land is lacking. However, with the wide dispersion pattern of chaff and the small amounts actually deposited per acre (approximately a maximum of one dipole per square foot per chaff release), no impact to land resources is anticipated from the deployment of chaff during low-altitude aircraft operations.

Water Resources

Chaff is relatively insoluble in water. Chaff landing on water would either be submerged or driven across the surface by the wind. Chaff in water bodies could be consumed by livestock, wildlife, and fish. No change in dissolved oxygen content or temperature from the introduction of chaff into the water would be expected. A study, in which Chesapeake Bay was spiked with chaff, resulted in extremely low increases in the concentration of aluminum or other metals. No appreciable increases were noted after 13 days (Block and Schiff 1977; USAF 1989). Undissolved chaff would not enter public drinking water systems since it would be filtered out by screens and settling tanks (National Guard Bureau 1990).

Radio Frequency and Air Traffic Control Safety

The function of chaff is to interfere with radars operating at wavelengths twice the length of the chaff fibers. Most training chaffs operate on E-J radar/radio frequency bands (2,000 to 18,000 MHz). These are well outside the frequency range of radio and television stations (5 to 100 MHz and 200 to 600 MHz, respectively). Air traffic control frequencies (2,000 to 5,000 MHz) can be affected by chaff. Chaff clouds appear as rain storms on radar screens. Chaff use is limited to restricted airspace and MOAs, and is closely coordinated with the FAA to ensure no interference with non-military air traffic. Inadvertent chaff drops are infrequent and there are procedures to stop further drops when they are detected.

Air Quality

Chaff does not contribute to atmospheric pollution because it is not an airborne contaminant, or a catalytic contributor to any form of air pollution (Taylor 1982; National Guard Bureau 1990). Chaff strands are too large and diffuse to serve as nuclei for water droplet or ice crystal formation and would have no effect on the atmosphere.

Electronic Equipment

No damage resulting from use of chaff would occur to electrical or telephone wires, TV antennas, or home appliances.

Conclusion

A maximum of 90,000 pounds of chaff is presently allocated for use in Alaskan airspace, and this amount would not increase (Hanson 1995). Based on this, the deposition rate (assuming an even distribution) would be about 0.037 ounces of chaff per acre. Aluminum-coated fiberglass chaff exhibits no characteristics that would be considered a health hazard. The individual chemical components of chaff (silica oxide, aluminum oxide, and stearic acid) are not hazardous. Given the dispersion characteristics of chaff releases and the size of the land

areas over which chaff would be released, no short- or long-term adverse environmental impacts would be anticipated.

4.4.2.1.2 Environmental Impacts of Flares

Brush or forest fires ignited by flares released during training operations, although considered rare events, could occur and would result in some loss of wildlife and habitat. The potential for such fires, due to flares, is contingent upon several parameters, including drop altitude, vegetation type, and fire hazard. In a 1988 message to other Air Force units, HQ Tactical Air Command published minimum altitude restrictions for release of flares based on aircraft type, flare and ejection mechanism, type of airspace (MOA, MTR, etc.), land status (DoD-owned or controlled or other), and surface conditions under the airspace (land or water; and, if land, existing fire hazard rating) (USAF 1988). Although Air Force standards are based on safety considerations, they also afford protection from environmental impacts. The Air Force has established minimum altitudes for flare release that assure burnout plus three seconds of fall time before surface impact, in order to preclude the ignition of ground fires (USAF 1988).

Under the Proposed Action, chaff and flares could be used for routine training over a larger area of the state than is currently authorized. Increased use of chaff and flare, in accordance with current 11th Air Force guidelines, could occur in the following regions:

- Northern Interior Region—an increase of 13,750 square miles (YUKON 3, 4, 5, and 6 MOAs),
- Southern Interior Region—an increase of 4,450 square miles (BIRCH, BUFFALO, EIELSON, CLEAR CREEK, and FALCON MOAs) and the
- Southcentral Region—an increase of 7,460 square miles (FOX MOA).

Previous Air Force assessments have determined that the use of airborne chaff (under appropriate guidelines) does not produce any significant adverse environmental impact. As described in sections 3.4.2.3 and 3.4.2.4, the 11th Air Force has established very restrictive procedures for the employment of chaff and flares. These procedures are particularly restrictive during periods of potentially high fire indexes (USAF 1993b; USAF 1993d [copies in Appendix E]). The use of chaff and flares would continue under the specific 11th Air Force directives for use of chaff and flares in Alaska:

- Chaff/flare systems will not be armed unless in an approved area with an intent to dispense chaff and/or flares.
- Use of flares is authorized in permanent MOAs and restricted areas with the following restrictions:
 - Overland, from June 1 through September 30, flares may only be employed above 5,000 feet AGL.
 - Overland, from October 1 through May 31, minimum altitude for flare use in permanent MOAs is 2,000 feet AGL. Minimum altitude for flares in restricted areas is the most restrictive of Joint Regulation 55-79, as supplemented, or unit flying regulations.
- There is no restriction on flare employment when operating in overwater ranges.

The Air Force's multi-fold altitude increase in safety margin for flare burnout is a proactive approach to preventing a source of ignition from reaching the ground. Using these guidelines provides an adequate margin of safety, and flare use during both routine training and MFEs would not exceed a Level I impact. Additionally, in its Report to Congress (NPS 1994, 10.7), the NPS states that "eliminating the dropping of flares below 2,000 feet elevation eliminated the potential for wildfire and associated impacts to endangered species . . ." The operational restrictions for flare use in Alaska meet or substantially exceed the altitude restriction sanctioned by the NPS.

4.4.2.2 Laser Use

Current 11 Air Force operational procedures for the employment of airborne lasers by tactical aircraft are in place to protect against accidental operation of laser equipment in non eye-safe modes. The majority of training would continue to use eye-safe "training mode" settings with use of the "combat modes" restricted to the air-to-ground weapons ranges. Specific range procedures are established for the use of the combat mode, and its use is prohibited in the MOAs. A Level I impact from airborne laser operations would occur as a part of the Proposed Action.

4.4.2.3 Munitions Use and Handling

Only munitions previously authorized for use on the Oklahoma (R-2202) and Stuart Creek (R-2205) air-to-ground weapons ranges would be carried (see USAF 1992b for a list of authorized munitions). The only live munitions authorized for use are the Mk82 bomb, Mk84 bomb, 2.75 FFARs (fold-fin rockets with high explosive warheads), 7.62/20mm/30mm ammunition, and AGM 65 Maverick missiles. All other munitions are inert. There would be no change in the types or increase in the quantities used with implementation of any of the alternatives. Acquisition, transportation, storage, and use of munitions would continue to be handled in accordance with all applicable state and federal laws and regulations, as well as Air Force regulations.

It is expected that under the Proposed Action no increase in munitions expenditures would occur during routine training or during an MFE. All munitions are transported and stored in accordance with Air Force and DoD regulations to ensure utmost security, safety of personnel, and protection of the environment. The types and numbers of munitions currently being expended or expected to be expended in the future are well within the current capacity of the air-to-ground weapons ranges and their annual range cleanup procedures. Current safeguards on weapons systems would continue to be sufficient to preclude any increased risk of adverse impacts due to munitions use and handling, thus, the potential impacts are assessed at Level I.

4.4.2.4 Emergency Response Procedures

4.4.2.4.1 Fire Management

The expenditure of flares over a wider area than currently authorized, could increase the risk of an inadvertent fire being started. Procedures have been coordinated and are in place between the 11th Air Force and the Alaska Fire Service for the detection, reporting, and suppression of fires, both on the air-to-ground ranges, and outside of those range boundaries, along with procedures for restricting their use during periods of higher fire indexes (USAF 1993d). Level I impacts are expected since the increased potential of an inadvertent fire would not be expected to have an adverse impact on the ability of the appropriate agencies to combat such fires, as long as the guidelines set forth by the Air Force and 11th Air Force are adhered to by the aircrews.

4.4.2.4.2 Aircraft Emergency Fuel Release Procedures

As stated in section 3.4.5.2, the only Alaska-based aircraft capable of fuel jettison are the F-15 and the KC-135. Fuel jettison is restricted to sorties that are prematurely curtailed due to inflight emergencies, weather recalls, or other unusual circumstances. Aircraft fuel burning through normal combustion is the preferred method to reduce weight if time and premature landing circumstances permit. When flight safety would be compromised by fuel burning, fuel is jettisoned. This occurs on an extremely small number of sorties per year. F-15s are required to jettison fuel at or above 5,000 feet AGL in a designated area away from populated areas. KC-135s are required to jettison fuel at or above 25,000 feet MSL. Jettisoning at these altitudes or higher ensures fuel vaporization to preclude it reaching the ground in liquid form. There are currently no EPA regulations or restrictions concerning fuel jettisoning from either commercial or military aircraft. Level I impacts are expected for any emergency aircraft fuel jettisoning events.

4.4.2.4.3 Hazardous Materials and Wastes

Since the aircraft generating the additional MFE sorties proposed in this EIS would be transient aircraft, major maintenance would not occur on these aircraft at either Eielson or Elmendorf AFB except in an emergency. Therefore, the types of hazardous materials present at the bases would be unchanged, while any increase in the amounts of hazardous materials present and the amounts of hazardous waste generated would be expected to be negligible. The handling and use of hazardous materials would remain subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Emergency Planning and Community Right-to-Know Act (EPCRA), Air Force Occupational Safety and Health standards, and state regulations. Additional hazardous waste, regardless of quantity, would continue to be handled in accordance with the procedures for large quantity generators established by the Resource Conservation and Recovery Act (RCRA).

Actual discharges of hazardous materials and hazardous wastes are possible and would be reported in accordance with state and federal law, although the potential for such occurrences is thought to be slight. Releases would be the subject of immediate response by trained personnel, and the potential for damage to human health or the environment is minimal.

Both bases currently have pollution prevention programs in place, such as hazardous material pharmacies, to control ordering and use of hazardous materials to minimize the amount of hazardous materials used and, consequently, the amount of hazardous waste generated. Part of this pollution prevention effort is finding and using suitable substitutes for hazardous materials whenever possible.

4.4.3 Alternative A

Under Alternative A, the CLEAR CREEK MOA would not be established. Compared to the Proposed Action, this would reduce the area available for chaff and flare use by 400 square miles. Only Level I impacts are expected.

4.4.4 Alternative B

Under Alternative B, YUKON 4 and 5 MOAs would not be established, but the TANANA MOA would be. This would result in a net decrease of approximately 1,200 square miles of airspace where chaff and flares could be employed compared to the Proposed Action. Only Level I impacts are expected.

4.4.5 No Action Alternative

Under the No Action Alternative, no additional areas would be authorized for use of chaff and flares. Procedures and policies for use would remain as described in section 3.4.2, 3.4.2.3. Impacts are assessed at Level I; however, aircrew training, especially during MFEs, would be less than optimum.

4.4.6 Alternative A—Modified

Under Alternative A—Modified, the area available for use of chaff and flares would be the same as for the Proposed Action except use would not be permitted in the FALCON MOA. Procedures and policies for use would remain as described in section 3.4.2.3 and 3.4.2.4.

4.5 Biological Resources

4.5.1 Issues and Concerns

The topical areas of concern in this analysis, as identified and described in the biological resources section of Chapter 3 (see section 3.5), are biodiversity, protected species, waterfowl, raptors, caribou, moose, Dall sheep, brown bear, black bear, bison, wolves, and furbearers. Several aspects of the proposed changes in the use and configuration of MOA airspace, with their potential to affect these areas of concern, were identified during the agency and public scoping process. Aircraft noise was most important among these, with visual impacts, chaff effects, and incidence of wild fire caused by flares and aircraft crashes cited as secondary considerations.

Of these aspects, visual impacts (i.e., startling and associated disturbance resulting from the sudden appearance of aircraft) have not been studied enough to treat separately; they will be viewed in this analysis as correlates of low-altitude aircraft noise. Potential impacts of chaff and wild fire associated with flares and crashes are dealt with in section 4.4, which indicates there are no potential impacts warranting further attention. Thus, aircraft noise, both routine operating noise and sonic booms, is the focus of this section. In more specific terms, the assessment of the potential for noise-related, long-term, local or regional population- and ecosystem-level impacts is the goal.

4.5.1.1 Impact Assessment Approach

The first step in conducting this assessment was to review the literature and other sources of existing information to determine what is known about the potential impacts in question. As noted in section 4.5.1.2, comprehensive reviews of existing information conducted within the last several years have concluded that short-term, individual, behavioral responses of a few species to aircraft noise have been the focus of most research to date. These reviews typically conclude that no important negative impacts have been documented and then cite the need to expand the scope of research to examine longer time horizons and populations and ecosystems rather than individuals. Thus, the objective at this stage was to determine whether any new research had responded to this critique and produced more relevant findings.

The next step was to identify potential biological effects on the basis of established knowledge, rather than speculation, to the extent possible. The expertise of biologists with resource-management agencies and on the EIS interdisciplinary team augmented the review of existing information in this regard. General and species-specific effects were addressed. The results are presented in section 4.5.1.3.

The third step was to systematically quantify these impacts to allow for comparison of alternatives. The most objective basis for comparison were tallies of the acreage of known critical-phase habitat and nesting sites. To go beyond these tallies and address the significance of impacts, impact levels were assigned for no or minor impact, moderate impact, and major, significant impact. Impacts considered in the comparison are identified in section 4.5.1.4.

The fourth step was to compare the alternatives under consideration on the basis of identified, potential impacts. The results of this comparison are reported in section 4.5.2.

The fifth step was to identify measures to mitigate any potential negative effects identified and judge the efficacy of these measures. These issues are discussed in section 4.11.1.4.

The last step was to review special considerations, including the cumulative effects of proposed changes in MOA airspace use and configuration, in conjunction with other human-caused impacts on the resources in question,

short-term uses vs. long-term productivity, and irreversible and irretrievable commitment of resources. These are addressed in section 4.11.4.

Note that noise measurement methods and the units they employ are described in Appendix F.

4.5.1.2 Summary and Critique of Existing Information

Only in the last 20 years have the impacts of aircraft noise on wildlife been studied; originally by wildlife management biologists concerned by the effects of their aerial surveys on studied species, and more recently by researchers focusing directly on impacts due to military, agency, commercial and general aviation overflights of refuges, preserves, parks, and other wildlife habitats of concern. Several recent literature reviews have been conducted to assess the state of knowledge on the topic (Bowles, Tabachnick, and Fidell 1991; Gladwin, Mancini, and Villella 1988). Regarding the effects of military overflights on the general geographic and topical areas of concern in this analysis, two recent Environmental Assessments (EAs) have been conducted (USAF 1992; USAF 1993). The two reviews and two EAs are hereby included by reference in this analysis.

For the purposes of this EIS, the following summarizes the state of knowledge:

Insufficient evidence exists to make conclusive statements regarding the effects of aircraft noise and sonic booms on populations of wild animals associated with any military [flight training activities]. Relationships between aircraft noise and wild animal responses have been observed (e.g., startle, short-term behavior change); however, the character of this relationship has only recently begun to be documented with scientifically designed studies. Responses of various animal species may be covert and unnoticeable based on observations, and still be detectable on a physiological basis. A detectable physiological response does not equate directly with either individual animal or population harm. Studies completed to date on a variety of species indicate that physiological effects are transitory and short-term. Individual animal responses have the potential to cause direct injury. Physiological change impacts have not yet been adequately addressed in the scientific literature to support a cause-and-effect relationship between events. Some species of animals such as caribou, bighorn sheep, and some species of waterfowl may be sensitive to disturbances during selective periods of their life-cycles (e.g., breeding, migrations, lambing, etc.). Grizzly bears may also be sensitive to aircraft noise in some segments of their life-cycle (e.g., denning or breeding). Where these situations are apparent, efforts may be made to avoid direct overflights either temporally or spatially.

Habituation to aircraft noise occurs with most species. In particular, if a species is subjected to a "disturbing" noise, the animal will generally leave the vicinity of the noise generation or may not return to that area in the near future. No scientific evidence was found during this review to support the contention of individual or population harm based on exposure to any level of noise generated by U.S. Air Force aircraft.

Studies which address various aspects of the physiological changes associated with noise should be developed and conducted following a standardized format. It is essential that a standardized format be developed to preclude or reduce redundant or incompatible efforts in the future.

Reflected in the literature is the truism that short-term studies (which include many of the reviewed noise reports) cannot assess the effects of noise on populations or even individuals other than to note startle and reaction responses. Future efforts should be directed in a fashion to reduce the area of insufficiency.

Aircraft noise impacts on many of the topical areas of concern in this analysis have not been sufficiently studied. Short-term studies of effects on individual behavior shed little light on biodiversity impacts. Of the individual species of concern, caribou have been the subject of several studies. Work on wild sheep, bison, and brown bears has been minimal. Effects on moose, black bears, wolves, and furbearers have only been hypothesized. Relevant studies among these are cited in the following sections.

The purpose of further literature review in this assessment was to determine whether additional research has been conducted in response to the cited research needs, generating findings which would support a more comprehensive and valid assessment of the proposed flight-training activities. Recent findings are summarized here and detailed in the discussions of species-specific impacts which follow.

The Air Force has sponsored research intended to use energy-budget modelling to project long-term, population-level impacts of low-altitude jet overflights on caribou; however, work published to date, under this project, deals only with measurement of the immediate behavioral responses to jet noise which will ultimately provide the input for modelling (Murphy et al. 1993). This project is ongoing. Research on caribou in Labrador and Quebec has been completed, suggesting decreased calf survival associated with military jet overflights (Harrington and Veitch 1990; Harrington and Veitch 1991; and Harrington and Veitch 1992).

Recent studies funded by the Air Force have investigated the physiological effects of sonic booms and low-altitude jet overflights on pronghorn antelope, Rocky Mountain elk, and bighorn sheep (Workman et al. 1992). This type of research begins to establish baselines on the physiological effects of noise disturbance upon which all higher-level responses are based, but it does not provide insights of great importance to this assessment.

Recent research suggests the statement, (in the summary quoted above), that habituation to aircraft noise occurs in most species, may not be entirely correct. At one extreme, Harrington and Veitch (1991) state that startle is a reflex behavior which cannot be eliminated through habituation. At the other extreme, observed overflights of apparently habituated caribou resulted in increased heart rates, but no visible outward behavior change (USAF 1993). In perhaps the most exhaustive study to shed light on this issue to date, Murphy et al. (1993) found that caribou in the Delta herd, widely thought to be quite habituated to jet noise, still responded in characteristic ways to low-altitude overflights. Habituation may require more regularity in disturbance than is demonstrated by flight training operations, and may actually be the result of lowered hearing thresholds resulting from noise damage to hearing organs (see section 4.5.1.3). In any case, habituation is apparently exhibited as a gradient rather than a "yes/no" phenomenon.

Overall, while recent research has opened some new doors and pending investigations hold promise, the conclusions outlined in the summary quoted above still hold. Estimation of aircraft-noise impacts beyond short-term physiological and behavioral responses remains speculative, particularly for species other than caribou.

4.5.1.3 Potential Biological Effects

Work by Janssen (1980) provides a framework for identifying and assessing the potential for longer-term effects above the level of the individual. He describes three levels of potential noise effects on wildlife. Primary effects are direct impacts to hearing organs, including temporary or permanent hearing impairment, ear-drum rupture or deafness. Secondary effects include stress and associated physiological responses, behavior changes including the startle reflex, interference with mating or other reproductive stages, and reduced ability to obtain adequate food, water or cover. Tertiary effects result from primary and secondary effects and include changes in age and sex ratios, population declines, habitat abandonment, and potential species extinction.

Potential Primary Impacts

Very little research has been done on the effects of aircraft noise on bird and wildlife hearing. Most work on hearing damage concerns humans and mammals and concentrates on the nature of the noise causing the damage. Damage to hearing evidently results from a combination of intensity and duration, with continuous noise being much more detrimental than intermittent noise, as the research cited below indicates.

Work by Bondello and Brattstrom (1979) indicated that kangaroo rats (*Dipodomys deserti*), a nocturnal, desert species requiring extremely sensitive hearing to avoid predators, suffered some hearing loss for 21 days after a 500-second exposure to constant 95 dB noise. Desert wildlife are apparently at greatest risk of such damage.

Henderson and Hamernik (1978) found that chinchillas exposed to 50 pulses of 155 dB noise with 60 seconds between each pulse showed little Permanent Threshold Shift (PTS). It is hypothesized that a quiet interval between noise pulses allows recovery from auditory fatigue or damage. Supporting this, Johansson, Kylin, and Reopstorff (1973) found that for both Noise-Induced Permanent Threshold Shift (NIPTS) and Temporary Threshold Shift (TTS) a quiet interval of more than 10 seconds caused noise to be about 6 dB less effective in causing threshold shifts.

Low-altitude jet aircraft flight exposes organisms to a very short-term, high-intensity sound. Maximum Sound Level (L_{max}) values for military aircraft range from 73 to 118.3 dB, with exposure to these peak levels being "instantaneous" (see Appendix F, Table F-2). After this instantaneous exposure, the sound pressure declines in a matter of seconds. In light of the research noted above, it is extremely unlikely that noise of this intensity and duration would have any notable effect on mammalian hearing.

A few studies have addressed hearing loss specifically in birds. Research indicates that bird hearing is similar to mammals with the exception that birds can apparently regenerate damaged auditory hair cells and recover from noise induced damage (Gutin 1993).

In another study, Marler et al. (1973) exposed canaries to constant 95 to 100 dB noise for 40- and 200-day durations. The exposed birds experienced 20 dB and 50 to 60 dB TTSs, respectively. The study found that the canaries could not sing while the noise was present due to masking effect, but with the return of quiet the birds restored their complete singing syllable repertoire. The study concluded that even the 60 dB hearing loss was not enough to prevent the bird from hearing its own song.

Note that the proposed flight operations will not come near to creating the combination of noise intensity and duration utilized in the Marler et al. experiments (1973). Therefore, it is doubtful that songbirds in the area could, in the worst case, experience anything more than a slight TTS. The likelihood that this slight TTS would affect the birds' ability to sing or detect other songs or predators is remote.

Additionally, songbirds are known to generate 80 to 90 dB while singing (Marler et al. 1973), so it is doubtful that occasional aircraft overflights would cause any more noise than that already experienced by the birds.

Overall, this limited research indicates that noise disturbances of the intensity and duration anticipated to occur under this proposal would have negligible impact on the hearing of wildlife species. This conclusion is consistent with the findings of other investigations of this issue (USFS 1992; Bowles, Tabachnick, and Fidell 1991; Gladwin, Mancini, and Villella 1988).

Potential Secondary Impacts

Potential secondary effects are associated with startling and stress. The startle reflex is an interruption of pre-noise behavior indicated by an alert stance, by getting up from a lying position, or by shifting to a faster gait (Espmark 1972). Stress can be defined in two ways, physiological and energetic. Physiological stress occurs

when a continued irritant, such as noise, results in the production of blood hormones which increase glucose levels and heart rate (Ha 1988). Glucose is the body's source of energy for carrying out life functions. Increased amounts of oxygen are required to "burn" glucose in respiration. An increased heart rate indicates that more oxygen is being provided and more energy expended by various muscles, including the muscles used to run away from danger. Because heart rate is measurable in field experiments, studies have used it as an indication of physiological stress (e.g., Workman et al. 1992).

Energetic stress occurs when an animal is forced to use excess energy during periods of already high energy consumption or when food to replace energy is limited (Ha 1988). For example, high amounts of energy are used by ungulates while running from predators, and energy stress can become acute if this occurs at the end of winter when energy reserves are low and forage is scarce. Energy limiting periods include the end of winter and the birth and rearing seasons for most animals, the end of the rutting season for many ungulates, the insect-harassment season for caribou, and denning times for bears and wolves.

Startling, and energetic and physiological stress associated with aircraft noise can be manifested in a number of negative impacts including abandonment of bear dens (Pearson 1975), temporary site abandonment by caribou (Harrington and Veitch 1991), and caribou calf injury or abandonment (Harrington and Veitch 1992).

Potential Tertiary Impacts

Impacts at the population level and beyond fall under this heading and, as noted above, the literature on these impacts is mostly conjectural (Manci et al. 1988). Planned research on caribou using population-level, energy-based modelling (Murphy et al. 1993) should provide the first adequately data-based insights. A number of factors must be considered when investigating mortality at the population level. For the species in question these include: inclement climate; hunting, trapping and poaching; predation; poor forage availability or quality; and disease. Individually these factors can cause mortality, but more often they function in combination, often synergistically. While the literature contains no instance of noise directly causing death in any species of concern here (Janssen 1980), noise-induced startling and physiological and energetic stress logically make animals more vulnerable to the other noted mortality-inducing factors.

The potential, relative contribution of aircraft noise to population-level effects, such as changes in age and sex ratios, population reduction, and extermination, logically depends on several variables, including: the season when the disturbance occurs, particularly if it occurs during a sensitive life-cycle phase; the number of animals present when the noise disturbance occurs; of this total, the number of animals of each sex and age class which are physically and behaviorally susceptible to noise effects; and the nature of the noise disturbance itself, for example its level, frequency, duration, and areal and spatial extent.

It should be noted that the relationship between noise-induced stress and predation is a community- as well as population-level interaction (Allen and Hoekstra 1992), a prime example of how tertiary effects extend beyond the population level to affect groups of species rather than just individual species.

Any significant adverse impact to biological resources associated with aircraft noise is likely the result of cumulative effects rather than the noise alone.

Analytical Framework

The integration of primary, secondary and tertiary impacts indicates in general terms the longer term, higher level wildlife impacts potentially occurring as a result of proposed changes in the use and configuration of MOA airspace.

A better understanding of primary effects of aircraft noise is needed before the whole picture becomes clear, but much can be determined without it.

The secondary effects of proposed changes, on the other hand, are essential to this analysis; they are the only effects which can be outlined with any certainty at all. The key aspects to be considered are the noise levels required to trigger startle reflexes and stress in a given species, the life-cycle phases when these species are most sensitive to noise disturbance, and the geographic location of populations during these sensitive phases. Knowledge of these aspects provides insight on the potential tertiary effects—at levels beyond the individual and its immediate responses—with which this EIS is concerned. Again, aircraft noise must be looked at as part of the cumulative picture. These insights remain speculative, but they are derived by a systematic process which is as data-based as possible given the lack of comprehensive information.

Available information on these aspects are presented for the topical areas of concern under the following headings.

4.5.1.3.1 Biodiversity

West (1993) has defined biodiversity as "a multifaceted phenomenon involving the variety of organisms present, the genetic differences among them, and the communities, ecosystems and landscape patterns in which they occur." Since research to date has focused on secondary effects on individuals, impacts on species present, genetic diversity, and communities, ecosystems and landscapes can only be inferred.

Proposed activities are unlikely to change the number of species present in the areas potentially affected. The American and arctic peregrine falcons are the only known species in the area whose populations have been considered at risk. These populations have evidently increased recently, in spite of ongoing flight- training activities which do not differ significantly from those proposed.

Genetic diversity is the degree of genetic variability within a population. A significant loss in genetic diversity occurs when a population is reduced to, or below, its effective size. Effective size is the number of individuals required to provide enough genetic diversity to allow the population to respond and survive in the face of broad environmental change. With the exception of American and arctic peregrine falcons, reduction of present populations to effective populations appears unlikely for the species of concern in this analysis because all others are currently abundant, with ranges extending well beyond the area potentially disturbed. Genetic diversity could potentially be decreased locally by changes in population structure, population size or habitat use associated with military aircraft noise.

Community, ecosystem and landscape effects become increasingly complex; however, in the absence of important impacts on populations and genetic diversity, it is unlikely that any discernible impact at higher levels will occur as a result of proposed military flying activities. Local shifts in community and ecosystem composition and in landscape use are possible. For instance, reduced ungulate populations would reduce grazing pressure on forage plants, potentially causing shifts in plant species composition.

4.5.1.3.2 Protected Species

As indicated in Chapter 3 (see section 3.5.2.2), the only protected species of concern in this analysis is the American peregrine falcon. No other federally listed species would be affected by proposed activities.

While the American peregrine subspecies remains federally listed as endangered, the State of Alaska recently down-listed it from endangered to a newly created status, Species of Special Concern. Populations at large and in the area underlying current MOA/TMOA airspace are doing well.

Military low-altitude flight operations in Alaska have had restrictions imposed in the regions of peregrine index populations along the following river corridors: Upper Yukon River (between Circle, Alaska, and the Alaska-Yukon Territory border), Charley River, Kandik River, and Porcupine River. Originally, these USFWS-recommended restrictions prohibited aircraft flights during the breeding period, April 15 through August 31, below an altitude of 1,500 feet AGL and within 1 mile of nest sites. These overflight restrictions were consistent

with recommendations to protect peregrines provided by a group of raptor researchers. A table of these restrictions was compiled by Roseneau, Tull, and Nelson (1981).

Overflight restrictions were increased in a 1993 Biological Opinion and 1994 Supplement (Appendix I) resulting from consultation, under Section 7 of the ESA, between the Air Force and the USFWS regarding potential adverse impacts associated with Air Force airspace activities. The Proposed Action addressed in this EIS was included in this consultation. The Biological Opinion increased the peregrine overflight restrictions to 2,000 feet AGL and 2 miles. With these restrictions in force, no take (i.e., killing, wounding, harassing, or otherwise harming) is expected in the protected, index population area. A take of six peregrines per year at the known, unprotected nest sites outside the restrictions zone is anticipated in the Biological Opinion. The Air Force, in conjunction with the USFWS, is monitoring this incidental take.

In June of 1994, the Air Force and the NPS signed an interagency agreement to collaborate on a 5-year effort to inventory and monitor populations of peregrine's neotropical migrant bird prey in the Yukon-Charley Rivers National Preserve. A similar agreement with the USFWS regarding the peregrine falcons themselves is forthcoming. It is envisioned to include a larger portion of interior and northern Alaska, and to allow assessment of the efficacy of the restrictions imposed to protect the index population. If population declines or substantial threats to the population are detected, the USFWS may consider re-listing the species (Sousa 1993).

Given the restrictions in place to protect them and the planned monitoring effort, the peregrine's status is unlikely to be affected by proposed changes in MOA use and configuration. Potential effects on peregrines are discussed further in section 4.5.1.3.4.

4.5.1.3.3 Waterfowl

Aircraft activities associated with low-altitude military training operations have the potential to disturb staging, nesting, molting, and non-breeding waterfowl; however, there have been no long-term studies on the cumulative effects of aircraft disturbances to nesting or migrating waterfowl. It should also be noted that most research reviewed below did not involve the military jet aircraft addressed in this analysis.

The impact of human disturbance varies among waterfowl species (Burger 1981; and Bartelt 1986) and depends on their wariness and their capability to habituate to disturbing events. Disturbance of greater snow geese affects their feeding activities and their subsequent use of the foraging area (Belanger and Bedard 1989). These researchers found that time spent in flight and time to resume feeding were greater after disturbance by aircraft than after various other types of disturbance. When disturbance exceeded two occurrences per hour, it produced a 50-percent drop in the mean number of geese present in the sanctuary the next day. The research areas may have been critically small, and these findings may apply only to snow geese.

Some research indicates that aircraft overflights of staging goose concentrations should be limited; however, the consequences of aircraft disturbance on the energy budget of staging geese and the long-term effects of disturbance need further investigation. One could argue that the population effect of goose avoidance of suitable habitat could be equivalent to that caused by habitat loss. Belanger and Bedard (1989) recommended a maximum aircraft disturbance rate of one occurrence per hour to improve and maintain the carrying capacity of staging goose habitats. Ward (1993) does not concur that this would adequately protect brant geese at Izembek Lagoon; however, data are not available from interior Alaska for comparison.

Geese, especially snow geese and brant, tended to flush at greater distances when aircraft were under 1,000 feet (Gollop et al. 1974; Schweinsburg 1974; Gunn and Livingston 1974; Edwards et al. 1979; Ward et al. 1986; Speich et al. 1987; Lamp 1989). Snow geese reacted to 59 percent of low-altitude military overflights, 32 percent by flushing and 29 percent by alert posture (Lamp 1989). Canada geese exhibited only minor reactions, and ducks had minor reactions to 16 percent of the aircraft disturbances and major reactions to 13 percent. Migrant species

appeared to be most sensitive, and species which nested in the test area were less sensitive or not sensitive. Sound levels ranged from 82-98 dB.

Response by brant geese was greater to a Bell 205 helicopter than to a Piper Navajo twin-engine aircraft. The threshold noise level was 49 dB for alert response and 58 dB for flight response (Ward and Stehn 1990). There was evidence that noise rather than visual cues triggered the behavioral response. This research suggested that brant seasonal responses to disturbances may vary. For example, staging and wintering brant are more tolerant of disturbance than flightless (molting) birds. Molting brant do not habituate to aircraft disturbances (Derksen, Tatlor, and Weller 1990; Derksen et al. 1992). Although the vulnerable molting brant are more responsive to aircraft overflight, the most critical period is probably nesting (Ward 1993).

The spring nesting and fall staging periods are considered most critical for trumpeter swans (Carson 1993). On the Copper River delta, the typical response of trumpeter swans to commercial airliner, fixed-wing, and helicopter overflight at less than 2,000 feet was a head-up posture for a mean duration of 54 seconds (Henson and Grant 1991). Aircraft disturbance never caused incubating females to leave the nest or broods to seek cover.

While species-specific responses to low-altitude overflights evidently vary considerably, this evidence suggests that jet overflights of breeding concentrations and staging areas during key life-cycle periods associated with these areas could negatively impact waterfowl populations through stress, lowered reproductive rates, and habitat dislocation. Snow geese, brant, and trumpeter swans may be the most susceptible. While the actual and proposed MOA airspace overlies little important snow goose or brant habitat, critical trumpeter swan breeding areas are potentially affected, particularly in the southern two-thirds of the SUSITNA MOA (see section 3.5.5.1.1), the central and southeastern portions of the FOX MOA (see section 3.5.5.1.2), the southern end of the FOX 2 TMOA (see section 3.5.5.1.3) and the southern portion of the TANANA MOA (see section 3.5.5.1.4).

4.5.1.3.4 Raptors

Most accounts suggest that aircraft passes do not modify raptor behavior in more than a short-term manner (Windsor 1977; Nelson 1979; Ellis 1981). Severe reactions, such as taking flight, were recorded when aircraft passed within 500 to 1,500 feet of the nest at altitudes below 1,000 feet in these studies. Lamp (1989) observed only minor reactions to low-altitude military overflights from a variety of raptors, including bald eagles, golden eagles, northern goshawks and other species. All raptor nests were successful in fledging young. The low-altitude subsonic sound level ranged from 69 to 113 dB with 14-second average duration.

Aircraft activities associated with low-altitude military training operations do have the potential to disturb nesting raptors. The sudden appearance of an aircraft near a raptor nest can cause an incubating or brooding bird to flush quickly and to possibly destroy the eggs or nestlings (White and Sherrod 1973).

Ambrose (1992) has frequently observed peregrine nestlings in a vulnerable position near the adult's feet, where an adult startle could result in the nestling being kicked off the nest scrape. Perhaps the greatest impact that disturbance could have on nesting peregrines during incubation would be to keep adults off the nest scrape, thereby exposing the eggs to weather and predators. However, studies indicate that this type of disturbance is not a probable result of aircraft overflight. Helicopters and fixed-wing aircraft did not elicit severe reactions from peregrines at distances greater than 2,000 feet (Ritchie 1987).

In Ellis' (1981) southwest U.S. study, several raptor species were overflown by military aircraft during the nestling phase. Red-tailed hawks and prairie falcons usually tolerated jet aircraft passing within 100 yards and level with the nest. The birds observed were noticeably alarmed by noise stimuli from 82 to 114 dB, but the negative responses were brief and never limited productivity (i.e., the production of young).

Nesting gyrfalcons flushed from aircraft overflights at 500 feet and adopted stress postures during overflights at 1,000 feet (Platt 1975). However, disturbance was not productivity limiting during the term of the study.

Thirteen gyrfalcon nest sites were disturbed by helicopter overflights at 500, 1,000 and 2,000 feet (Platt 1977). There was no difference in breeding success between disturbed and undisturbed nests. However, there was a statistically significant difference in reoccupation of the nest sites in the following year: disturbed falcons sought new nest sites (within the study area), while 75 percent of the undisturbed nests were reoccupied.

Low-altitude helicopter overflights flushed 53 percent of nesting red-tailed hawks in an area where flights had not previously occurred (Anderson, Rongstad, and Mytton 1989). In an area which had prior overflights, only 8 percent flushed. This study indicates that red-tailed hawks habituate to low-altitude helicopters.

In areas of Alaska where peregrine eyries have not had overflight restrictions, there are no indications of negative population impacts. White and Sherrod (1973) found that productivity estimates of raptors from areas not surveyed by helicopters were similar to productivity estimates of raptors surveyed by helicopters. The high frequency whine made by some of the jet-engine helicopters seemed to be much less disturbing to nesting raptors (bald eagles, golden eagles, peregrine falcons, gyrfalcons and rough-legged hawks) than the low-frequency noise of the piston-powered craft. Birds were least disturbed and often continued to feed their young or perch on a cliff when aircraft flew parallel to a cliff at an initial distance of one-half mile with gradual approach toward the nest.

In Alaska, where a few individuals of a scattered regional population may be exposed to aircraft overflight, a discernible impact on the population is unlikely. Further, to attribute a raptor population decline to a single stressor is unrealistic. A raptor population could be limited by declines in fluctuating prey on the breeding grounds, a change in nest site availability, disease, weather, or factors operating on the non-breeding grounds. Clearly, food availability and environmental variables such as weather and habitat change are not independent in their potential effects, and attempts to analyze them as mutually distinct is biologically unrealistic. In short, aircraft overflight disturbance must be viewed as one of a number of factors which, in combination, can result in reduction of raptor populations.

Raptor breeding concentrations along the Yukon, Kandik and Charley rivers (see section 3.5.3.2) are currently protected by the overflight restrictions described in section 4.5.1.3.2. Concentrations along the Tanana River (see section 3.5.4.2), and in the area underlying the southeastern portion of the FOX MOA and the southern ends of the FOX 2 TMOA and the TANANA MOA (see section 3.5.5.2) are, therefore, the main areas where notable adverse impacts are possible.

4.5.1.3.5 Caribou

Caribou are probably the most studied of the species addressed in this analysis in the area of aircraft-noise impacts on wildlife. A noise threshold of 85 dB at 1-minute duration from aircraft at an altitude less than 500 feet AGL was observed to make caribou nervous, startle, panic and run (Golden et al. 1979). A study by Calef, Debrock, and Lortie (1976) of military aircraft noise effects on caribou suggest that pregnant cows may be vulnerable to injury prior to and during birth.

Perhaps the most studied caribou are those in Alaska's Delta herd. Davis, Valkenburg, and Boertje (1985) found that the herd has long been exposed to a range of disturbances including: military aircraft overflights and ordnance delivery at nearby bombing and artillery ranges, habitat alteration due to fire and mining, and development of communities, industrial complexes, roads and railroads, pipelines, and airfields on their historic range. From the 1950s to the mid-1970s, the herd's number declined, but through the 1980s it increased at an annual rate of 19 to 22 percent. The authors speculated that the Delta herd became habituated to a wide range of disturbances and was thus relatively insensitive to aircraft noise, and that exposure to frequent thunderstorms and mining noise may have been important factors in this habituation.

Other research compared responses to aircraft overflights between caribou in the Delta herd that had not been hunted and hunted animals in the Western Arctic herd (Valkenberg and Davis 1985). They found that caribou

that had not been hunted responded less actively to overflights than the hunted animals. Whether hunting or habituation to overflights was the explanatory variable was not clear.

Murphy et al. (1993) found that the response of Delta herd caribou to aircraft noise was less in winter relative to insect and post-calving seasons. Caribou were slightly more responsive in the insect season, and had increased activity relative to the other two seasons during post-calving season.

Harrington and Veitch (1990 and 1991), studying woodland caribou in Canada, observed greater activity, specifically startle response and running away from aircraft, in their test herds of cow/calf pairs during and immediately after low-altitude jet overflights, particularly during calving, rutting, and early winter. They identified a number of hypothetical negative impacts to calves associated with the frequency of exposure to low-altitude overflights during and after calving. These impacts included: reduced milk production and calf thyroid function during the post-calving period; stillbirths; cow/calf separations or injuries to newborn calves; and death due to miring in snow during panic flight caused by winter overflights.

Building on these studies, Harrington and Veitch (1992) reported a negative correlation between caribou cow exposure to military aircraft overflights and calf survival during the early post-calving and the insect-harassment seasons. No such correlation was found during the pre-calving, pre-insect-harassment, and late post-calving seasons. The suggested reasons for increased calf mortality included stillbirths, injuries, cow-calf separation, and reduced lactation resulting in arrested development. Harassment by insects has high energy costs and can lead to abandonment of quality foraging habitat, reduction in feeding, and loss of blood, particularly when other stresses such as overflights occur at the same time. All of these effects can make calves more vulnerable to mortality-inducing factors.

Gunn et al. (1985), studying the Beverly herd in the Northwest Territories, observed that frequency and duration of nursing decreased following helicopter landings in the vicinity of caribou after calving. Other activity patterns were readily interrupted, and cow-calf groups were displaced by distances up to two miles.

The greatest concentrations of caribou occur during rutting, calving, post-calving, and the fall migration. Indirect effects of aircraft noise through disruption of these activities probably pose the greatest known threat of important negative impacts on biological resources considered in this assessment. Impacts to herds or local populations unhabituated to aircraft overflights could occur as a result of startling, flight, and resulting energy loss and susceptibility to mortality-inducing factors. While the reviewed literature suggests that herds regularly exposed to overflights may habituate and become less prone to startle and panic, important population-level impacts could result from more subtle responses such as reduced foraging, decreased lactation and nursing, and habitat displacement as noted above. Relative to the other species of concern, caribou have the largest populations and the greatest number of animals concentrating at any one time beneath the airspace addressed here, therefore, they are the species exposed to potential impacts of the greatest magnitude.

Of the caribou herds potentially affected by the alternatives under consideration, two warrant particular attention. From 1989 to 1993, the Delta herd fell by more than 50 percent, and hunting of the herd was not allowed in 1992 (see section 3.5.4.4). The Mentasta herd, which frequently uses winter range under MOA airspace, declined by about 70 percent from 1987 to 1993 (see section 3.5.5.4.4). Reasons for these declines are unclear, but ADF&G management goals are to increase numbers.

4.5.1.3.6 Moose

Specific studies on the effects of military aircraft noise on moose have not been conducted, therefore little is known about potential long-term impacts. Moose were observed to startle and increase their walking pace when exposed to 82 to 92 dB at 1-minute duration from civilian, propeller-driven aircraft flying at 300 feet AGL (Golden et al. 1979). Moose may be more susceptible to aircraft noise during calving (USAF 1992). Aircraft noise may also stress moose in winter during deep snow conditions (USAF 1992). Since moose populations are

concentrated in river valleys which also tend to channel military overflights, they are exposed to this disturbance more than other ungulate species.

On the other hand, moose habitat tends to include more abundant cover, and moose may seek such cover or remain still rather than running when disturbed. This may reduce energy stress and associated negative impacts. Moose are also thought to habituate more to human disturbance than do most other wild ungulates. These factors may limit the magnitude of potential impacts.

The greatest concentrations of moose occur during winter, calving and rutting. The potential for important impacts to local populations is greatest during these periods. The nature of the impacts is probably similar to those outlined above for caribou.

While moose populations in some areas, such as most of the Northern Interior Region, are at low-density equilibrium, most are considered to be doing well (see sections 3.5.3.5, 3.5.4.5, 3.5.5.5, and 3.5.6.5).

4.5.1.3.7 Dall Sheep

Dall sheep are not well studied in regard to overflight impacts. They exhibited startle behavior, panic and running in response to noise levels greater than 75 dB at 1-minute duration from civilian, propeller-driven aircraft at less than 1,000 feet AGL in all seasons (Golden et al. 1979). Periods of greatest concentration are on winter ranges, during lambing, and at mineral licks between mid-May and the end of June. The precipitous terrain they typically inhabit makes falling during panic flight a hazard, especially for lambs. There is some evidence that predators key on mineral licks and that disturbance when sheep are concentrated at these areas may result in increased loss to predation (Heimer 1994a). Beyond these specific potential impacts, Dall sheep are probably susceptible to the general impacts outlined above for caribou.

While at least one recent study involving bighorn sheep indicated a low probability for population-level impacts as a result of low-level overflights (Workman et al. 1992), another focusing on desert bighorns was inconclusive (Lamp 1989). The fact that Dall sheep populations are concentrated on limited ranges and have a high degree of fidelity to these ranges increases their potential susceptibility to population-level impacts relative to more numerous and widely distributed species. All in all, the data suggest a conservative approach to assessing impact.

Several Dall sheep populations potentially affected by this proposal currently warrant attention because numbers are lower than desired by the management agencies. These occur in the northern Alaska Range and in the Tanana hills around the headwaters of the Charley River and around Twin Mountain. The northern Alaska Range populations are important for sport hunting, and numbers in all these populations have decreased in recent years, probably as a result of inclement weather and predation (see sections 3.5.3.6, 3.5.4.6, and 3.5.5.6).

4.5.1.3.8 Brown and Black Bears

Specific studies on the effects of military aircraft noise on black and brown bears have not been conducted, so little is known about potential long-term impacts. Noted impacts are based on civilian aircraft overflights. Brown bears have been observed to panic, stumble, and run when exposed to noise exceeding 81 dB from aircraft at less than 500 feet AGL (Golden et al. 1979). Bears may be more sensitive to overflights than ungulates (Quimby 1974). Bears were observed to retreat to their dens (Harding 1976) when disturbed by aircraft. Disturbance during periods when dens are sought may cause abandonment of potential den sites (USAF 1992). Bears are probably most sensitive to military aircraft noise when they concentrate to feed on specific resources such as new grass in the spring, fish in the summer, and berries in the fall (USAF 1992). Other critical periods are mating and postpartum.

In light of these known and inferred effects, study of the impact of overflights on denning bears was ranked as the second highest priority at a joint Air Force/USFWS workshop convened to begin planning research on military overflight impacts on wildlife (Asherin and Gladwin 1988). The limited evidence suggests that military

overflights could potentially contribute to discernible negative impacts on local bear populations. In areas where hunting pressure has historically been heavy, such as the northern Alaska Range, population declines, possibly due to hunting, have been documented (ADF&G 1993c) (see section 3.5.4.7).

4.5.1.3.9 Bison

Bison were observed to become nervous, get up from resting positions, and run when exposed to 85 to 95 dB at 1 minute duration from civilian aircraft at less than 300 feet AGL (Golden et al. 1979). Bison appear insensitive or habituated to military aircraft noise in the few experiments which have been conducted on them (Frazier 1972). Critical periods are likely to be rutting, calving, and post-calving.

Bison are not native to Alaska. Herds are maintained on generally small, defined ranges and managed relatively intensively. Management schemes control most factors influencing bison numbers and herd health (see section 3.5.4.9). In light of this management regime, it is unlikely the proposed activities would have any important population impact in spite of their low numbers.

4.5.1.3.10 Wolf

Specific studies on the effects of military aircraft noise on gray wolves have not been conducted, so little is known about potential long-term impacts. However, the periods when dens are sought and after the birth of cubs are considered the most important times in terms of susceptibility to noise disturbance (Taylor 1994). Gray wolves are less likely to choose or stay in dens where they are disturbed. Other potentially sensitive periods are mating and parturition.

While some potential for direct impacts to denning wolves is suggested, indirect impacts through alteration of prey quantity or distribution are more likely. Therefore, potential impacts to caribou and moose provide the best gauge of population-level effects on wolves (see sections 4.5.1.3.5 and 4.5.1.3.6).

4.5.1.3.11 Furbearers

Specific studies on the effects of military aircraft noise on furbearers have not been conducted, thus, little is known about potential long-term impacts. Furbearer populations would likely be most susceptible during life-cycle phases associated with reproduction, but even during these phases the habits, habitats, and population characteristics of furbearers would make notable impact by aircraft noise unlikely. All furbearers in question are abundant and widely distributed in the state and, thus, not vulnerable to important population-level impacts.

4.5.1.4 Impacts Considered in Comparison of Alternatives and Mitigation Recommendations

It is clear that projecting long-term, population- and ecosystem-level impacts on the basis of documented short-term, individual, behavioral effects remains somewhat speculative. In order to retain the greatest validity, this analysis therefore focuses as much as possible on what is known on the basis of empirical data.

The first key point is that at some threshold of noise, the species of concern in this assessment exhibit a startle reaction associated with activity disturbance, physiological stress, and increased energy expenditure. For the purposes of this analysis, this behavioral threshold is 85 dB for caribou, moose and bear (see sections 4.5.1.3.5, 4.5.1.3.6, and 4.5.1.3.8). For the evidently more sensitive Dall sheep, 75 dB is considered the threshold (see section 4.5.1.3.7).

Second, negative impacts stemming from the individual startle reflex are likely to be most detrimental to groups, populations, communities, and ecosystems during critical life-cycle phases including wintering, reproduction, rearing, and other species-specific phases.

Third, aircraft noise is more likely to contribute to notable adverse effects in a cumulative manner with other, more important mortality-inducing factors than to directly cause such effects.

Venturing beyond these data-based conclusions, into issues such as the effect of frequency or duration of noise disturbance, becomes overly speculative. Probability of disturbance is another factor which could be considered, but two considerations limit its utility. First, accurate calculation of the probability of an individual or group of animals being overflown at an altitude causing noise above a given threshold is not feasible. Second, probabilities are not a strong basis for impact analysis, particularly in light of the lack of knowledge of the relationship between noise parameters and severity of negative effects.

With these generalities in place, determining the significance of potential impacts and then comparing the alternatives assessed in this analysis required examination of the differences among the biological resources affected under each alternative. To establish impact levels, four factors were considered:

1. The magnitude of affected habitats and other quantifiable characteristics (e.g., square miles of caribou winter range and trumpeter swan nest counts).
2. The local, regional (statewide), and overall abundance, and population trend of the species under consideration. Protective status is a factor.
3. The importance of the species—and populations, herds, or other subunits of the species—in terms of its ecological function, human uses, and the management objectives of relevant agencies.
4. The sensitivity of the species to disturbance by aircraft overflight. This is the variable least understood by the biological community.

These factors serve to distinguish not only which species are most susceptible to adverse impacts, but also which populations, herds or other subunits within a species are more vulnerable. It is important to note that the status of species and subunits within them is dynamic; only through liaison with natural resource management agencies can impact levels and associated mitigation be kept current. These factors were subjectively evaluated to establish an impact level for each species and topical area of concern. These impact levels are:

- Impact Level I:** No impact or minor impact; individuals may be affected, but no change or negligible change in numbers or distribution.
- Impact Level II:** Moderate impact; may help cause or maintain minor reduction or displacement of local, regional or entire populations.
- Impact Level III:** Major, significant impact; may help cause or maintain substantial reduction or large-scale dislocation of local, regional or entire populations.

As noted above, the most reliable and objective factor in determining impact levels was the first, the magnitude of affected habitats and other quantifiable variables. Section 4.5.2.3 outlines differences among alternatives on this basis. In section 4.5.2.4, impact levels are presented, and alternatives are compared on a more comprehensive but subjective level.

4.5.2 Comparison of Alternatives

4.5.2.1 Effects on Biodiversity

As noted in section 4.5.1.3.1, the highest-level potential biodiversity impact of changed MOA use and configuration is altered patterns of wildlife use, and possibly plant distribution, on landscapes underlying the MOAs. Noise-caused changes in a single species' pattern of land use could have many spin-off impacts, for example, on the plants or animals upon which that species feeds, on those which feed upon it, and on those which compete for the same resources (Naiman 1988).

The exact nature and extent of such community- and system-level effects is clearly speculative. What is certain is that only individual- and species-level impacts, separately and collectively, could cause them. So again this analysis falls back on the lowest common denominator, disturbance of individuals, especially during sensitive phases of their life-cycles. In the absence of more concrete information on community and ecosystem impacts, the spatial extent of all habitat disturbed by aircraft noise under each alternative is the best indicator of the alternatives' relative impact on biodiversity. For this reason, the total area affected under each alternative, as well as key habitats of species of concern and other species-specific variables, is included in Table 4-7 below summarizing impacts. The No Action Alternative would affect the most area.

There is little difference in effects on biodiversity among the Proposed and Alternative Actions. No discernible large-scale effect on biodiversity is anticipated under any alternative considered. Genetic diversity in local populations of given species could be effected. See species-specific effects below.

4.5.2.2 Effects on Protected Species

The American subspecies of the peregrine falcon is the only protected species of concern in this analysis as determined by consultation with the FWS under Section 7 of the ESA. Since the nest-avoidance restrictions stipulated in the 1993 Biological Opinion would remain in force regardless of the alternative selected, there would be no difference among the No Action Alternative, the Proposed Action and the action alternatives in this regard. No significant impact is anticipated under any alternative.

4.5.2.3 Habitat-Specific Effects

As noted, noise levels eliciting startle reflexes and geographic location of sensitive-phase habitats are the most objective factors considered in comparison of alternatives on the basis of biodiversity impacts, protected species impacts, and impacts on other species specifically addressed. As described in the biological resources section of Chapter 3 (see section 3.5), sensitive-phase habitats for some species have not been delimited for various reasons. Some species in question, such as rutting Dall sheep, do not necessarily seek particular habitats. Some habitats are too widely dispersed to be delimited for some species, such as denning black bears. For other species, such as most furbearers, specialized habitats have simply not been identified.

Objective comparison of alternatives on the basis of sensitive-period habitat affected required identification of species susceptible to potential population-level impacts, as indicated in section 4.5.1, and of sensitive-period habitats or related indicators for these species which have been documented and quantified, as indicated in Chapter 3 (see section 3.5.2.3). Compilation of this information provided the variables upon which the Proposed Action, the No Action Alternative, Alternatives A and B, and Alternative A—Modified are compared, presented in Table 4-7 (see Appendix G for more detailed information).

Some explanation of how the summary table was developed is in order. First, an "inventory" of the variables under all possible MOAs/TMOAs was compiled. Nest sites, major and minor migration routes, and mineral licks were counted. Total area affected, waterfowl concentration and breeding areas, raptor breeding areas, general

and sensitive-phase habitats for caribou, moose and Dall sheep, and brown bear general distribution areas were measured in square miles.

Second, these quantities in each MOA/TMOA were determined to be "in or out" according to criteria established for potential negative impact on the variable in question. These criteria generally were drawn from the literature previously cited. Total MOA/TMOA area was simply additive. For nest sites, waterfowl concentration and breeding areas, and for raptor breeding areas, the criterion was whether overflights at altitudes under 2,000 feet AGL or sonic booms from altitudes under 30,000 feet would occur. For major and minor migration routes, the criterion was simply whether they existed within the airspace in question. For caribou and moose sensitive-phase habitats and for brown bear general distribution areas, it was whether noise levels above 85 dB or sonic booms would be generated. For Dall sheep habitats and mineral licks, 75 dB or sonic booms from under 30,000 feet were the criteria. Resources protected by avoidance restrictions currently in place, such as raptor nests in the Yukon, Kandik and Charley river drainages, were dropped from the analysis if the restrictions in place are equal to or greater than the impact criteria established here.

Third, the MOAs/TMOAs under each alternative were defined, and the variable values above the stipulated criteria for each MOA/TMOA were summed under the appropriate alternative. The results of this phase of the analysis are presented in tabular form in Appendix G.

Table 4-7 Comparison of Alternatives on the Basis of Affected Habitat and Other Quantifiable Variables

Comparison Variable	No Action Alternative ¹	Proposed Action	Alternative A	Alternative B	Alternative A-Modified
Total Air Space (sq. miles)	70,970	63,420	63,020	62,200	60,780
Peregrine falcon nests (no.)	63	127	127	126	127
Bald eagle nests (no.)	88	154	154	263	134
Golden eagle nests (no.)	8	24	24	31	24
Trumpeter swan nests (no.)	173	725	725	801	577
Waterfowl concentration areas (sq. miles)	746	606	606	604	606
Waterfowl breeding areas (sq. miles)	3,093	9,649	9,649	8,808	9,263
Raptor breeding areas (sq. miles)	1,243	2,063	2,063	2,286	1,725
Bird Migration routes, major (no.)	12	13	12	12	12
Bird Migration routes, minor (no.)	9	7	7	7	7
Caribou general distribution (sq. miles)	21,864	31,885	31,731	33,308	30,647
Caribou calving areas (sq. miles)	3,753	7,276	7,276	8,850	6,151
Caribou summer areas (sq. miles)	73	3,182	3,182	3,182	3,182
Caribou rutting areas (sq. miles)	0	319	319	319	103
Caribou winter use areas (sq. miles)	11,578	21,519	21,473	24,434	20,658
Moose general distribution (sq. miles)	40,017	49,762	49,362	47,322	48,070
Moose calving concentration areas (sq. miles)	3,140	6,389	6,060	7,433	5,750
Moose rutting concentration areas (sq. miles)	5,987	8,519	8,190	9,485	7,905
Moose winter concentration areas (sq. miles)	9,862	14,764	14,364	14,619	13,865
Dall sheep general distribution (sq. miles)	7,139	6,528	6,528	7,861	6,008
Dall sheep winter and lambing areas (sq. miles)	497	497	497	492	497
Dall sheep mineral licks (no.)	43	70	70	100	37
Brown bear general distribution (sq. miles)	42,420	54,160	53,760	52,940	51,980

Population counts or densities were not brought into the comparison for several reasons. First, reliable figures are generally not available. Second, current figures reflect a number of factors other than habitat potential and are, therefore, a moving target. Third, all populations of these species are important to someone and warrant similar consideration. This framework allows comparison of the alternatives' species-specific impacts on the basis of the sensitive-period habitats affected. The differences among alternatives are not great and can be summarized as follows.

The Proposed Action, in comparison to the No Action Alternative MFE scenario, would impact more nests of all noted species and more caribou, moose and brown bear sensitive-period habitats. Dall sheep habitats would be about equally affected. While the overall area involved is less, lowered floors and increased supersonic

¹Includes both Routine and MFE Airspace.

activity at lower altitudes in the Northern Interior Region MOAs under the Proposed Action account for most of these differences. The gap is widened substantially for most variables when the No Action Alternative routine operations scenario is brought into the comparison, and considerably more Dall sheep habitat is impacted. Alternative A, under which the Clear Creek MOA would be eliminated, does not vary notably from the Proposed Action in any respect. Alternative B, with the addition of the Tanana MOA and elimination of the Yukon 4 and 5 MOAs, would impact more eagle and swan nests, less waterfowl breeding area, and more Dall sheep general distribution area and mineral licks than the Proposed Action.

Overall, the No Action Alternative would impact these resources the least, particularly under the routine operations scenario. Alternative A—Modified would affect resources more than the No Action Alternative, but less than the Proposed Action, Alternative A, or Alternative B. Alternative B would have the greatest impact by a narrow margin, and there would be no appreciable difference between the Proposed Action and Alternative A.

4.5.2.4 Impact Levels

Three impact levels were defined in section 4.5.1.4. This section first outlines the effects at each level likely to occur under each alternative. Given the magnitude of the biological resources potentially affected, this is done in general terms. Following this overview, the alternatives are compared on the basis of significant, Level III impacts. Since fewer resources are susceptible to significant impacts, more specific terms are employed in this comparison, presented in Table 4-8.

Regarding biodiversity, the conclusions outlined in section 4.5.2.1 hold. Level II impacts could possibly occur as a result of species-specific impacts addressed below. Otherwise, Level I impacts are expected regardless of the alternative selected.

Peregrine falcons, the only protected species addressed, are protected by exclusionary zones along the river corridors supporting the major, index populations. Thus, Level I impacts are anticipated for populations breeding in the exclusionary zones, while populations outside the zones may be subject to Level II impacts. There is no notable difference among alternatives in this regard.

Among waterfowl, trumpeter swans are the only species with a large proportion of its key breeding habitat under the MOA airspace being considered. Under the Proposed Action or Alternative A, Level III impacts are possible on swans nesting along the west fork of the Gulkana River beneath the southern portions of the FOX MOA and, to a lesser degree, along the three major drainages beneath the SUSITNA MOA. Alternative A—Modified and the No Action Alternative would eliminate this potential for Level III impacts to the major Gulkana swan populations, while Alternative B would create the potential for impact to a few swan nesting areas along the Tanana River under the TANANA MOA.

All waterfowl concentration and breeding areas underlying MOA airspace with floors lower than 2,000 feet AGL or supersonic flight are susceptible to potential Level II impacts. As indicated in Table 4-7, the No Action Alternative would affect more concentration area. The No Action Alternative, Alternative B, and Alternative A—Modified would affect less breeding area. Otherwise the alternatives are similar in this regard. All other waterfowl resources would be subject to Level I impacts regardless of the alternative selected.

With current exclusionary zones in force to protect peregrine index populations, no Level III impacts on raptors are likely under any alternative. All raptor breeding areas and nesting concentrations overflown at less than 2,000 feet AGL or at supersonic speeds (Figure 3-28) may be subject to Level II impacts. As indicated in Table 4-7, the Proposed Action and Alternative A are the same in this regard, while the No Action Alternative would have much less impact, Alternative A—Modified considerably less impact, and Alternative B more. All other anticipated raptor impacts would be Level I.

Regarding caribou, only the Delta herd is deemed susceptible to Level III impacts because of its economic importance and sustained low population. Under the No Action Alternative, considerably less winter range used by the herd would be affected, while Alternative A and Alternative A—Modified would affect slightly less. Otherwise, all alternatives pose the same potential effect on the herd. Overflight of any caribou critical-phase habitat (calving, post-calving, insect-season, rutting and wintering) at altitudes less than 3,000 feet AGL or at supersonic speeds could result in Level II impacts. As noted in Table 4-7, the No Action Alternative would affect substantially less critical-habitat area. Alternative A—Modified would affect notably less rutting habitat and slightly less calving area. Level I impacts to all non-critical caribou habitat would be likely under all alternatives.

On the basis of current information, no moose would be exposed to Level III impacts under any alternative. Level II impacts would be possible for moose whose critical-season habitats would be overflowed at altitudes less than 3,000 feet AGL or supersonic speeds. In terms of calving, rutting and wintering habitat affected, the No Action Alternative and Alternative A—Modified would affect less and Alternative B slightly more, than the Proposed Action and Alternative A (Table 4-7). Similar Level I impacts would occur on non-critical moose habitats under all alternatives.

Dall sheep populations in the northern Alaska Range and in the Tanana hills are deemed susceptible to Level III impacts on the basis of their low numbers, importance to sport and subsistence hunters and, in the case of the Tanana hills populations, poor habitat. Since critical wintering and lambing habitats and mineral licks have not been delimited through much of the distribution of these populations, comparison of the alternatives is based largely on general habitat by default. Alternative A—Modified would affect the smallest amount of general habitat. The Proposed Action and Alternative A would impact the same amount of habitat used by these populations. The No Action Alternative would impact slightly more habitat, and Alternative B would impact considerably more.

Other Dall sheep populations in the zone of influence would be subjected to Level II impacts on habitats overflowed at altitudes less than 5,000 feet AGL or supersonic speeds. As indicated in Table 4-7, Alternative A—Modified would affect the least sheep habitat. The No Action Alternative would impact more, and Alternative B considerably more. No Level I impacts on Dall sheep have been identified.

In that brown and black bears are widely distributed on large ranges throughout the zone of influence, Level III impacts are unlikely under any alternative. However, limited information suggests that Level II impacts may result from overflights of bear habitat at altitudes under 3,000 AGL or at supersonic speeds. Alternative A—Modified and the No Action Alternative would affect less brown bear habitat than the other alternatives (Table 4-7).

The only potential for Level II or III impact to wolves would be through impacts at the same levels to the wolves' primary prey, caribou and moose. However, since wolves rarely rely exclusively on single prey and cover relatively wide ranges, the potential for Level III impacts is slight. Level II impacts would be possible on wolf populations in any area subjected to Level II or higher impacts on caribou or moose. Refer to relevant paragraphs above. Otherwise, wolf impacts would likely be limited to Level I regardless of the alternative.

Given the intensive management regime governing the Delta bison herd, no impact above Level I is anticipated under any alternative.

Given the abundance and wide distribution of the furbearers under consideration, no Level III impacts would likely result from implementation of any alternative. Scattered Level II impacts would be possible, but Level I impacts would be the rule.

In summary, potential Level III impacts could accrue to trumpeter swans, Delta herd caribou and Dall sheep in the northern Alaska Range and the Tanana hills under any alternative. Differences between the Proposed Action and Alternative A would be negligible. Regarding trumpeter swans, the No Action Alternative would affect the

least swan breeding area, while Alternative A—Modified would affect the least concentration area. Regarding the Delta herd caribou, the No Action Alternative would again have the least impact, and all other alternatives would have more. Regarding northern Alaska Range and Tanana Hills Dall sheep, Alternative A—Modified would have the least impact. Overall, the preferable alternative in terms of biological resources would be the No Action Alternative. Alternative A—Modified would not be substantially different in many cases, and would be better in some. The Proposed Action and Alternative A would be less desirable, and Alternative B would be the least desirable.

Table 4-8 Comparison of Alternatives on the Basis of Potential Significant Adverse (Level III) Impacts to Biological Resources¹

Comparison Variable	No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative A—Modified ²
Biodiversity	Same as Proposed Action.	None likely without significant impacts to individual species addressed below.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Protected Species	Same as Proposed Action.	None, with current Flight Avoidance Areas in force.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Waterfowl	Trumpeter swans breeding under SUSITNA MOA.	Trumpeter swans breeding under SUSITNA and FOX MOAs.	Same as Proposed Action.	Same as Proposed Action, except some additional trumpeter swans breeding under TANANA MOA.	Same as Proposed Action, except swans breeding along Gulkana river (under FOX MOA) largely removed.
Raptors	Same as Proposed Action.	None, with current Flight Avoidance Areas protecting peregrine index populations.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Caribou	Same as Proposed Action, except impacts to habitat under FOX 1 TMOA and CLEAR CREEK MOA eliminated.	Delta caribou herd with critical-phase habitat under CLEAR CREEK, BIRCH, EIELSON, and FOX MOAs, R-2202 and R-2211.	Same as Proposed Action, except impacts to wintering habitat under CLEAR CREEK MOA eliminated.	Same as Proposed Action.	Same as Proposed Action, except impacts to habitat under CLEAR CREEK MOA eliminated.
Moose	Same as Proposed Action.	None currently identified.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Dall Sheep	Same as Proposed Action, but more habitat affected.	Northern Alaska Range and Tanana Hills population.	Same as Proposed Action.	Same as Proposed Action, but substantially more habitat affected.	Same as Proposed Action.
Brown and Black Bears	Same as Proposed Action.	None.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Bison	Same as Proposed Action.	None due to intensive management of Delta herd.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Wolves	Same as Proposed Action.	None without significant impact to prey species addressed above.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.
Furbearers	Same as Proposed Action.	None identified.	Same as Proposed Action.	Same as Proposed Action.	Same as Proposed Action.

¹Refer to Table 4-7 for quantification of the habitat variables.

²Although the amount of habitat affected would be comparable or equal to the Proposed Action, the floors of FOX, YUKON 3B (Low), and YUKON 5 MOAs would be higher and would minimize the probability of behavioral responses due to subsonic single event sound levels.

4.6 Recreation

4.6.1 Background

Aircraft noise in outdoor recreation settings is of considerable concern, as evidenced by the number of comments received during scoping and the ongoing efforts of various resource management agencies to determine the effects of aircraft overflights on visitor enjoyment and agency resources. Yet substantial disagreement exists on what constitutes unacceptable effects on outdoor recreation, given that levels of acceptability depend on the values and desires of the individual making the judgement. The magnitude of any effect on recreational experience is in every case a matter of individual perception.

The research that deals with motivation, expectations, and preferences for outdoor recreation experiences supports relatively few useful inferences for impact assessment. While identification and measurement of outdoor recreation motivation and desired psychological experiences have been exhaustively studied, the recreation sociology literature has not clarified the effects of physical stimuli on experiences. Numerous studies have sought patterns of association between experience preferences and environmental attribute preferences, but these efforts have had only limited success, and the findings lack the consistency necessary for unambiguous interpretations (USFS 1992).

In a study conducted for the U.S. Forest Service to determine the potential short-term effects of aircraft overflights on outdoor recreationists in three National Forest System wildernesses, Fidell et al. (1992) found:

- Little evidence that overflights diminished recreationists' overall enjoyment of their wilderness visits, nor their intention to return for additional visits;
- The most significant impact of aircraft overflights on respondents was associated with the noise exposure generated by the overflight—respondents were more strongly annoyed by aircraft noise than by the sight of aircraft or their condensation trails;
- Most respondents (75-92 percent) were not annoyed by the noise of overflights, a minority (7-12 percent) was slightly or moderately annoyed, and a smaller minority (1-12 percent) was highly annoyed;
- Although overflights annoyed some respondents, other aspects of their visits (such as inadequate trail maintenance, crowding, insects and weather) were much more frequently cited as the least liked feature of the visits, and fewer than 1 percent of respondents spontaneously mentioned aircraft noise or other aircraft-related issues as aspects of their visits that they liked least;
- The duration of the visits was not strongly related to noise-induced annoyance;
- Noticeability of aircraft and annoyance were unrelated to the type of activity recreationists were engaged in at the time of exposure to aircraft noise;
- Aircraft which typically produce greater noise levels (i.e., high-speed military aircraft and helicopters operating at low-altitude) were reported to be more annoying than small propeller-driven aircraft and high-altitude jet transports; yet
- Most visitors highly enjoyed their visits, intended to return, and did not report the presence of aircraft as the least liked aspect of the visits.

The three wildernesses studied were selected for their high to medium exposure to overflight (including military aircraft overflight) and high visitor use rates. Although application of the conclusions to other recreation resources may be limited because of the purposeful selection of these wildernesses, the conclusions are nonetheless informative. In a subsequent *Report to Congress: Potential Impacts of Aircraft Overflights of National Forest System Wildernesses*, the U.S. Forest Service (1992) reached similar conclusions, specifically:

- Seeing aircraft had less impact on visitors than hearing them;

- The principal adverse impact of aircraft overflight was aircraft noise-induced annoyance, but annoyance (in varying degrees) was reported by only a small percentage of outdoor recreationists; and
- There were few adverse impacts to wilderness users resulting from overflights.

The authors did note, however, that "...the most meaningful aircraft-related problems for wilderness users are [found in] those wildernesses at which the greatest numbers of outdoor recreationists are most commonly exposed to the noisiest overflights; i.e., low-altitude, high-speed tactical military operations and low-flying helicopters" (ibid.). The study also reported that aircraft noise intrusions on the indigenous sounds of wildernesses are readily audible in large areas; and aircraft overflights are audible even when their A-weighted sound pressure levels are comparable to the A-weighted level of indigenous sounds. Two other caveats to the study should also be noted. First, wildernesses in Alaska were specifically excluded from the study; the reason for this exclusion was not stated. Second, the study found that military overflights are not encountered by most wilderness users due to the relatively low number and infrequency of such overflights.

4.6.2 Methodology and Assumptions

A methodology for determining noise impacts was devised by Harrison et al. (1980) in *Predicting Impact of Noise on Recreationists*. This methodology is explained more fully in section 3.6. Briefly, it uses a typology of appropriate or acceptable human-related sounds to categorize recreation areas (settings). The categories are: modern, semi-modern, semi-primitive, or primitive. In section 3.6, the outdoor recreation resources (i.e., those areas that are owned, managed, or otherwise administered by federal or state government) in the Region of Influence were characterized according to this typology. Each recreation resource was then assigned a subjective, assumption-based "sensitivity to impact" ranking (high, medium, or low) based on three factors:

- 1) The degree to which noise resulting from aircraft overflight of any kind would be considered inconsistent with the recreation opportunity setting of the resource;
- 2) Visitor use levels (when known)—comparatively high visitor use levels connote greater sensitivity; and
- 3) The percentage of the resource that is now or would be located beneath a MOA(s)—the higher the percentage, the greater the sensitivity (percentages may vary between alternatives).

Because modern and semi-modern recreation opportunity settings are, by definition, less sensitive to noise intrusions, this analysis focuses primarily on those resources characterized as semi-primitive or primitive, although all identified recreation resources are evaluated. The fact that much of the lands in the Region of Influence are wilderness in character (i.e., semi-primitive or primitive) tends to focus the analysis on these areas as well.

It is important to note that it is not the inconsistency of a noise per se that is of concern, but the consequences of the inconsistency. The basic problem of inconsistency is that it "introduces the potential for triggering a chain of events that might alter the entire nature of the intended opportunity" (Clark and Stankey 1979). Harrison et al. (1980) identified two possible consequences of inconsistency: 1) The inconsistency (impact) is acceptable (to the recreationist) and does not detract from his or her satisfaction; or 2) the inconsistency (impact) is unacceptable (to the recreationist) and may lead to a decline in satisfaction and, perhaps, to a decision not to return to that location.

In reality, the consequences will range along a continuum. The inconsistency (impact) will be acceptable to some recreationists and unacceptable to others. Of those who find it unacceptable, some will adjust to the inconsistency by accepting (seeking) an altered recreation experience in the same location; some will be unwilling/unable to alter the experience they desire and will seek it in another location. Some outdoor recreationists may enjoy observing military aircraft overflights and will not be annoyed at all by the sound or sight of the aircraft. Others may enjoy observing occasional aircraft overhead, but will be annoyed by more frequent overflight. In general,

it is assumed that most individuals engaged in recreation in modern to semi-modern recreation opportunity settings will be less annoyed, or not annoyed at all, by overflight.

Based on what is known about visitor appreciation of natural settings, solitude, and quiet; the types of recreational opportunities available throughout Alaska; and information on visitor usage; it is concluded that overflights of semi-primitive and primitive recreation setting opportunity areas (i.e., designated and *de facto* wilderness), where mechanical sounds are not common and are considered inappropriate, would disturb the highest proportion of recreationists. Calculating the actual number of individuals disturbed by aircraft overflight is not possible, however, because 1) it is impossible to accurately predict the actual number of overflights of any given area beneath a MOA, 2) it is impossible to gauge the extent of disturbance of any given overflight, 3) the number of overflights of an area would vary from day to day, and 4) disturbance would vary from individual to individual. As it is not possible to quantify impacts on recreation resources and experiences, the sensitivity rankings presented in section 3.6 are fundamental to determining the significance of potential impacts.

Information pertaining to the types and levels of sport hunting and commercial recreation activities in the Region of Influence is also factored into the impact analysis. However, while it is possible to identify high sport hunting use areas, it is not feasible to determine what the effects on actual sport hunting (effort, experience, or success) would be. In light of this, this EIS assumes that the analysis of potential impacts on wildlife resources (see section 4.5) and the analysis of potential impacts on recreation resources contained in this section comprise a sufficient analysis of sport hunting. Potential effects on aircraft access to recreation resources, including high sport hunting use areas, and on the [aviation] safety of recreation users and providers are addressed in the section on Airspace Management, Aircraft Operations, and Aviation Safety (see section 4.2).

In this EIS, impact level determinations are based on four factors:

- A recreation area's sensitivity ranking (identified in section 3.6);
- The use and configuration of any existing overlying MOA(s) or previously utilized TMOA(s);
- The use and configuration of the Proposed and Alternative Action MOA(s); and
- The presence and effectiveness of an existing Flight Avoidance Area.

Impacts are defined as follows:

Level I (Negligible Impact): In general, Level I impacts would be expected for any area subject to only occasional, short-term exposure to aircraft noise levels inconsistent with the area's recreation opportunity setting, which would not result in any alteration of the setting. Areas with a low (L) sensitivity ranking, regardless of the history of overlying airspace configuration or use, are considered probable candidates for Level I impacts. Areas with a medium (M) sensitivity ranking, but with an existing permanent MOA with a configuration and use similar to that proposed, are also considered probable candidates for Level I impacts.

Level II (Adverse, but Not Significant Impact): In general, Level II impacts would be expected for areas subject to frequent, but irregular short-term exposure to aircraft noise levels inconsistent with the area's recreation opportunity setting, which would temporarily alter the setting. Areas with a medium (M) sensitivity ranking, regardless of the history of overlying airspace configuration or use, are considered probable candidates for Level II impacts. Areas with a high (H) sensitivity ranking, but with an existing permanent MOA with a configuration and use similar to that proposed, are also considered probable candidates for Level II impacts.

Level III (Significant Adverse Impact): Generally, Level III impacts would be anticipated for areas subject to regular, repeated, or continuous exposure to noise levels inconsistent with the area's recreation opportunity setting, which would permanently alter the setting. Areas with a high (H) sensitivity ranking and no existing permanent MOA with a configuration and use similar to that proposed are considered probable candidates for Level III impacts.

4.6.3 Impacts Common to All Alternatives

Although some of the recreation resources are currently exposed to aircraft overflights, it is possible that these areas would be exposed to increased numbers of aircraft overflights subsequent to implementation of the Proposed or Alternative Actions. Areas that presently underlie TMOAs would be subject to routine training aircraft activities in addition to MFE aircraft activities, while areas that would be located beneath newly established MOAs would be exposed to routine and possibly MFE training for the first time.

During routine training, aircraft activity in any specific area would occur in low numbers and would be generally dispersed over broad geographic areas (see Chapter 2 and section 4.2 for a description of training activities for each of the alternatives). Because routine training operations in a MOA would follow random flight paths that vary horizontally and vertically on a daily basis, regular, repeated, or continuous exposure to aircraft-generated noise would be unlikely. Although disturbance of recreation activities in primitive and semi-primitive settings could occur, it would be short-term, consisting of isolated and infrequent overflights, and of low intensity (i.e., low numbers of aircraft). Given these characteristics, routine training activities alone would not be expected to result in a permanent alteration of an area's recreation opportunity setting (i.e., Level III impacts).

Although MFE training alone would not be expected to permanently alter an area's setting, Level III impacts to recreation areas of high sensitivity could be sustained during the MFE period itself due to the intensive and possibly repetitive nature of aircraft overflights. In all of the regions, the most critical recreation period occurs, roughly, between June 15 and September 15. MFEs conducted during this period *could* result in Level III impacts for recreation resources with high sensitivity, and Level II impacts for recreation resources with medium sensitivity. In general, recreation use levels are lower during the remainder of the year, and MFEs would not be expected to result in greater than Level I impacts.

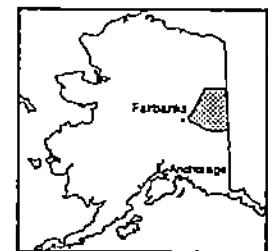
4.6.4 Area-Specific Effects

The information on an area's sensitivity to impact, use and configuration of any existing overlying MOA, use and configuration of any proposed MOA, and presence of any effective Flight Avoidance Area provided a framework in which to compare the Proposed Action, the No Action Alternative, and the Alternative Actions. The differences among alternatives are summarized below and presented in tabular form in Table 4-9 to facilitate comparison between alternatives. Resources not specifically discussed are predicted to sustain Level I (negligible) or no impacts under any of the alternatives.

4.6.4.1 Northern Interior Region

Steese National Conservation Area and Birch Creek National Wild River: There would be no difference among the Proposed and Alternative Actions, including Alternative A—Modified, in terms of potential impact. Under all alternatives, 70 percent of the conservation area would be affected, and potential Level II impacts are predicted.

Yukon-Charley Rivers National Preserve and Charley National Wild River: Impacts would be the same under all alternatives, including Alternative A—Modified. Level II impacts could occur under the YUKON 1 and 2 MOAs; Level III impacts under the YUKON 3 and 4 MOAs.



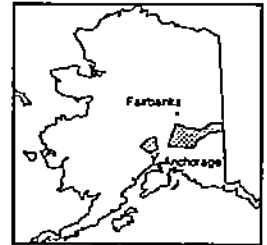
Fortymile National Wild and Scenic River: An estimated 87 percent of the river would be affected under all alternatives except Alternative B, which would affect an additional 10 percent under the TANANA MOA in the Southcentral Region. Alternative A—Modified could result in Level III impacts to 27 percent of the river system (the Joseph and Middle forks) and Level I impacts to the other 60 percent [due to the 2,000-foot AGL floor of the YUKON 3B (Low) MOA]. Level III impacts are predicted with the Proposed Action and Alternatives A and B. Level I impacts could occur under the No Action Alternative only during MFEs.

Taylor Highway: About 50 percent of the Taylor Highway and associated recreation opportunities would be affected under all alternatives except Alternative B, which would affect 100 percent of the highway. Level II impacts are predicted for the Proposed Action and Alternatives A and B; Level I for the No Action Alternative only during MFEs (the YUKON 3 TMOA would not exist at other times) and Alternative A—Modified [the YUKON 3B (Low) MOA would have a floor of 2,000 feet AGL].

Walker Fork Campground: One hundred percent of the campground would be affected under all alternatives. Level II impacts are predicted for the Proposed Action and Alternatives A and B; Level I impacts could occur with implementation of Alternative A—Modified or the No Action Alternative.

4.6.4.2 Southcentral Region

Gulkana National Wild River (Main Stem): The main stem of the river would not be affected at all under the Proposed Action, Alternative A, or Alternative A—Modified. Ninety-six percent of the river could sustain Level III impacts under Alternative B. The No Action Alternative could result in Level II impacts only during MFEs.



Gulkana National Wild River (Middle Fork): Under Alternative A—Modified, the Middle Fork would not be affected. With implementation of the Proposed Action or Alternative A, some 53 percent of the river could see Level III impacts, while 100 percent of the river could be significantly adversely affected (Level III) under Alternative B. The No Action Alternative could result in Level II impacts during MFEs only.

Gulkana National Wild River (West Fork): An estimated 13 percent of the West Fork would be affected under Alternative A—Modified, with Level I impacts predicted due to the high (5,000 feet AGL) floor of the overlying FOX MOA. Fifty-five percent of the fork would be affected under the Proposed Action and Alternative A, with Level III impacts predicted. Alternative B would affect 97 percent of the fork and could result in Level III impacts. The No Action Alternative would affect 100 percent of the fork with possible Level II impacts only during MFEs.

Delta National Wild River: The river would not be affected under Alternative A—Modified. An estimated 48 percent would be affected by implementation of the Proposed Action or Alternative A, with Level III impacts predicted. One hundred percent of the river would be affected by Alternative B, resulting in Level III impacts. The No Action Alternative would affect 100 percent of the river, but potentially cause Level II impacts only during MFEs.

Denali Highway: Some 59 percent of the Denali Highway and associated trails and recreation resources would be affected by Alternative A—Modified, with Level I impacts likely due to the high floor of the proposed FOX MOA. About 68 percent of the highway would be under the MOA with implementation of the Proposed Action or Alternative A, and Level III impacts are predicted. Under Alternative B, 82 percent of the highway would be affected, and Level III impacts are likely. The No Action Alternative would also affect 82 percent of the highway, but Level II impacts are predicted only during MFEs.

Tangle Lakes and Tangle River Campgrounds, Tangle Lakes National Register Archaeological District: These areas would not be affected under Alternative A—Modified. They could sustain Level II impacts under the

Proposed Action and Alternatives A and B; Level I impacts only during MFEs with implementation of the No Action Alternative.

Brushkana Campground: The campground would underlie the FOX MOA as part of Alternative A—Modified; but with a floor of 5,000 feet AGL, the effect is predicted to be negligible (Level I). Level II impacts are predicted with the Proposed Action and Alternatives A and B. The No Action Alternative is expected to produce Level I impacts only during MFEs.

Proposed West Fork Gulkana River ACEC: Twenty percent of this Area of Critical Environmental Concern would be affected by Alternative A—Modified, potentially resulting in Level I effects (due to the 5,000-foot AGL floor of the FOX MOA). About 85 percent of the area would be affected by all other action alternatives, possibly resulting in Level III impacts. The No Action Alternative would also affect 85 percent of the area, but produce potential Level II impacts only during MFEs.

Richardson Highway: The highway and associated trails and recreation resources would not be affected under any alternative except Alternative B, which could result in Level III impacts, and the No Action Alternative, which could produce Level II impacts only during MFEs.

West Fork Campground: This campground would only be affected under Alternative B, with possible Level II impacts predicted.

Table 4-9 Comparison of Alternatives on the Basis of Potential Adverse (Level II and III) Impacts to Recreation Resources

Recreation Resource	No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative A—Modified
Steese National Conservation Area & Birch Creek National Wild River	Same as Proposed Action	YUKON 2 70% - Level II	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Yukon-Charley Rivers National Preserve	YUKON 1/2 43% - Level II	YUKON 1/2 43% - Level II	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
	YUKON 3 TMOA 54% - Level I for MFEs only	YUKON 3/4 54% - Level III			
Charley National Wild River	YUKON 1/2 ≈ 50% - Level II	YUKON 1/2 ≈ 50% - Level II	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
	YUKON 3 TMOA ≈ 50% - Level I for MFEs only	YUKON 3/4 ≈ 50% - Level III			
Fortymile National Wild & Scenic River	YUKON 3 TMOA 87% - Level I for MFEs only	YUKON 3 87% - Level III	Same as Proposed Action	YUKON 3, TANANA 97% - Level III	YUKON 3A (Low) 27% - Level III YUKON 3B (Low) (2,000 ft AGL Floor) 60% - Level I
Taylor Highway	YUKON 3 TMOA ≈ 50% - Level I for MFEs only	YUKON 3 ≈ 50% - Level II	Same as Proposed Action	YUKON 3 TANANA ≈ 100% - Level II	YUKON 3B (Low) (2,000 ft AGL Floor) 100% - Level I
Walker Fork Campground	YUKON 3 TMOA 100% - Level I for MFEs only	YUKON 3 100% - Level II	Same as Proposed Action	Same as Proposed Action	YUKON 3B (Low) (2,000 ft AGL Floor) 100% - Level I
Gulkann National Wild River Main Stem	FOX 2 TMOA 96% - Level II for MFEs only	Not affected	Not affected	TANANA 96% - Level III	Not affected
Gulkana National Wild River Middle Fork	FOX 1/2 TMOAs 100% - Level II for MFEs only	FOX 53% - Level III	Same as Proposed Action	FOX, TANANA 100% - Level III	Not affected
Gulkana National Wild River West Fork	FOX 1/2 TMOAs 100% - Level II for MFEs only	FOX 55% - Level III	Same as Proposed Action	FOX, TANANA 97% - Level III	FOX A (5,000 ft AGL Floor) 13% - Level I Not affected
	FOX 1/2 TMOAs 100% - Level II for MFEs only	FOX 48% - Level III			
Delta National Wild River			Same as Proposed Action	FOX, TANANA 100% - Level III	

Recreation Resource	No Action Alternative	Proposed Action	Alternative A	Alternative B	Alternative A—Modified
Denali Highway	FOX 1/2 TMOAs 82% - Level II for MFEs only	FOX 68% - Level III	Same as Proposed Action	FOX, TANANA 82% - Level III	FOX A (5,000 ft AGL Floor) 59% - Level I
Tangle Lakes & Tangle River Campgrounds; Tangle Lakes National Register Archaeological District	FOX 1/2 TMOAs 100% - Level I for MFEs only	FOX 100% - Level II	Same as Proposed Action	Same as Proposed Action	Not affected
Brushkann Campground	FOX 1 TMOA 100% - Level I for MFEs only	FOX 100% - Level II	Same as Proposed Action	Same as Proposed Action	FOX A (5,000 ft AGL Floor) 100% - Level I
Proposed West Fork Gulkann River ACEC	FOX 1 TMOA 85% - Level II for MFEs only	FOX 85% - Level III	Same as Proposed Action	FOX, TANANA 85% - Level III	FOX A (5,000 ft AGL Floor) 20% - Level I
Richardson Highway	FOX 2 TMOA Level II for MFEs only	Not affected	Not affected	TANANA Level III	Not affected
West Fork Campground	Same as Proposed Action	Not affected	Same as Proposed Action	TANANA 100% - Level II	Not affected

4.6.5 Commercial Recreation

Tourism and commercial outdoor recreation, including natural resource-dependent wilderness-based concerns, are very important to Alaska's economy, while the viability of individual operations is of obvious consequence to owners and staff. Visitors and residents alike pay several hundred to several thousand dollars for guided wilderness trips, depending on type, length, and location of trip; likewise, guided fishing trips can cost up to \$2,000 or more, and guided big game hunts can run upwards of \$12,000 and probably average \$6,000 to \$7,000. However, there is no evidence (empirical or theoretical) that recreationists, including tourists and other consumers of commercial recreation services, would decide to go elsewhere to recreate on the basis of implementation of the Proposed or Alternative Actions. In fact, in response to Public Law (P.L.) 100-91 (the National Park Overflights Act of 1987), the U.S. Forest Service (USFS 1992, 2-18) reported to Congress that "No statistically reliable relationships were found between annoyance due to the sight or sound of [aircraft] overflights and respondents' reported intent to revisit." Although visitors "judged low-flying jets and helicopters more annoying to hear than high-altitude jets and small private aircraft, . . . [w]ilderness visit enjoyment showed little relationship with annoyance due to the sound or sight of aircraft." Almost all respondents questioned in short- and intermediate-term studies reported their intent to return to the area, and no visitor, out of 2,020 interviewed, cited aircraft overflights or other aircraft issues as reasons for not returning. Other studies conducted for the U.S. Forest Service and the National Park Service (NPS) reaffirm these findings. For example, in a study of the intermediate term effects of aircraft overflights on Outdoor recreationists in twelve wildernesses, Tabachnick et al. (1994, 30) found "no statistically significant association . . . between intention to revisit and aircraft-induced annoyance."

The NPS, in its Report to Congress ". . . on Effects of Aircraft Overflights on the National Park System (1994, 6.6), concluded that only "[a]bout 2 to 3 percent of all visitors . . . can be expected to report impact from hearing or seeing aircraft overflights." However, "A higher percentage of backcountry than frontcountry visitors report hearing aircraft and are more likely to experience impact from these aircraft."

The NPS' recommendations for identifying sites for impact analysis and potential mitigation cite three important criteria:

- 1) Frequency of Overflights—How many overflights per hour occur regularly during periods of visitation?
- 2) Visitation Rates—How many visitors per hour or per day pass through the candidate site?
- 3) Recreational Opportunity—What are the important dimensions of the intended opportunity: unobstructed views, solitude, remote location, transportation access, etc.?

These criteria are very similar to the criteria used in the EIS to determine potential impacts to recreation resources. The EIS used: 1) a "sensitivity to impact" ranking, which was based on the degree to which noise resulting from aircraft overflight would be considered inconsistent with the recreation opportunity setting of an area, visitor use levels, and the percentage of the area located beneath a MOA(s); 2) the use and configuration of any existing overlying MOA(s); 3) the proposed use and configuration of any new MOA(s); and 4) the presence and effectiveness of any existing Flight Avoidance Area (see section 4.6.2). Although wildernesses in Alaska were not considered in the studies undertaken for P.L. 100-91, as the most recent and comprehensive research available on the issue of potential impacts of aircraft overflights on wilderness areas, these studies are very applicable to the issues examined in the EIS and comprise the best information available on the subject.

Section 3.6.7 contains information regarding the locations of major commercial recreation attractions, types of commercial recreation activities, use levels, and seasons of operation (including peak periods by activity) in the Region of Influence. All identified major commercial recreation resources fall into one or more of the following categories:

- 1) Proposed and Alternative Actions represent either no change from existing conditions or a reduction in flying activity (e.g., Birch Creek National Wild River, Wood-Tikchik State Park);
- 2) Existing Flight Avoidance Area in place (e.g., Yukon River, Chena River State Recreation Area); or
- 3) Alternative A—Modified reduces or eliminates potential adverse impact (e.g., Gulkana National Wild River; Fortymile National Wild, Scenic, and Recreational River).

As there is no evidence that recreationists would choose to go elsewhere to recreate on the basis of exposure to or knowledge of aircraft overflights, potential impacts to commercial recreation are predicted to be Level I or less.

4.7 Subsistence

4.7.1 Background

Subsistence, which is central to the rural Alaskan's way of life, is not a behavior that can be singled out as a solitary activity in an individual's life or as a characteristic of a community. Rather, subsistence is a set of intertwined activities that, in total, make up a way of life. In examining changes to elements of this way of life, discrete "subsistence use patterns" can be distinguished; these have been described in section 3.7 to the extent possible using existing data (see also Appendix J). These use patterns integrate the factors defining subsistence found in the Alaska National Interest Lands Conservation Act (ANILCA): continued economic or physical reliance on subsistence, subsistence as a cultural value, and subsistence as an integral part of custom and tradition (FSB 1992).

The far-reaching extent to which impacts to subsistence could be felt is described in detail in the *Final Environmental Impact Statement on Subsistence Management for Federal Public Lands in Alaska*, (FSB 1992). In summary, disruption of the subsistence cycle could impact the community social organization. Tasks associated with subsistence reflect and reinforce the roles of husbands, wives, grandparents, children, and friends. Disruption of the subsistence cycle also could undercut traditional leadership, family ties, and kinship networks and could threaten a community's stability and sense of well-being. Cultural values in rural Alaska include strong ties to subsistence food, the environment and its wildlife, the family, the virtues of sharing the proceeds of the hunt, spirituality, and independence. A serious disruption of subsistence use patterns could alter these cultural values. For the system of sharing to operate properly, some households in a community must be able to produce, rather consistently, a surplus of subsistence goods. It is generally more difficult for a household to harvest a surplus of food than to adequately satisfy its own needs. For this reason, sharing, and the supply of subsistence foods in the sharing network, may be more sensitive to harvest disruptions than the consumption of these foods by active producers (FSB 1992).

4.7.2 Methodology and Assumptions

Because of the dependence of many Alaskans on subsistence resources, low-altitude aircraft operations and their potential impact on wildlife have special significance. Villages that are more dependent on seasonally migratory wildlife such as caribou are particularly vulnerable to wildlife disturbances since (1) most hunters must congregate at specific, critical times for hunting, (2) animals are concentrated in critical locations only at specific times, and (3) any disruptions in migration paths or timing may affect the likelihood of harvest success and the amount of effort necessary to transport harvested resources (Georgette and Loon 1988).

No reports have been identified that specifically address the effects of low-altitude aircraft operations on subsistence activities. The basis of the analysis presented here is the assumption that an activity would adversely impact subsistence if it diminished or removed availability of (access to and use of) subsistence resources. Availability of subsistence resources could be diminished or removed by a reduction in subsistence resources (i.e. subsistence wildlife populations) or changes in subsistence resource distribution patterns as a result of the implementation of the Proposed Action or Alternatives. Such effects on subsistence resources could result in increased levels of subsistence effort and/or reduced harvest. Increased levels of effort and/or reduced harvest could impair the ability of communities to subsist and, subsequently, adversely affect the subsistence way of life, cultural stability, and economic stability. Much of this analysis and methodology has been based on the methods of analysis used in the federal subsistence management EIS (FSB 1992), the *Environmental Assessment of Major Flying Exercises in Alaska* (USAF 1993), and the *Environmental Assessment of the Expansion and Upgrade of Military Training Routes, Alaska* (USAF 1992).

In this EIS, impacts to subsistence are determined by

- 1) the degree to which resource availability (identified wildlife population) would be diminished as a result of implementation of the Proposed or Alternative Actions;
- 2) the level and type of subsistence use in the affected region; and
- 3) the presumed degree of sensitivity of the subsistence community (see section 3.7).

The primary effect of military aircraft overflight would be noise/visual intrusion potentially causing wildlife to react, and thereby possibly affecting subsistence hunting success and level of effort. Assessment of potential impacts to wildlife are based on the analyses of noise effects on wildlife presented in sections 3.5 and 4.5. An assumption is that an alternative would have the same impact on all communities that use a given area for subsistence. Therefore, the sensitivity of a community to impacts ultimately determines the significance of the potential impact.

Impacts are described in the following terms: primary area of subsistence use; species of primary importance; the anticipated change in availability of species of primary importance; the timing of anticipated impacts relative to critical hunting periods; and the level of anticipated impacts in relation to the sensitivity ranking of identified subsistence communities.

This analysis looks only at the potential impacts to subsistence hunting. Fishing and trapping activities are not considered here. Based on the analysis of wildlife resources (see sections 3.5 and 4.5), adverse impacts to furbearers (trapping resources) or fish would not be anticipated under any of the alternatives. Additionally, access to subsistence use areas is not addressed here. Implementation of the Proposed Action or any of the Alternatives would not restrict civil aviation access into the subsistence areas, nor would it restrict ground access to areas underlying the MOAs (see section 4.2 for potential impacts on civil aviation).

It is important to emphasize here that it is not possible to meaningfully quantify or determine definitive impacts. Wildlife respond to noise to varying degrees, potentially resulting in a reduction of the availability (to an undeterminable degree) of that resource to the subsistence hunter. Because this analysis is unable to accurately quantify such shifts (in wildlife due to noise), use of sensitivity ranking of subsistence users/community is key to determining the significance of potential impacts.

Measures to mitigate impacts identified in this analysis have been developed, and analyzed and are presented at the end of each regional section. Mitigation measures were developed based on the analysis of impacts of aircraft overflights on wildlife presented in section 4.5. In that analysis, behavioral thresholds are taken to be 85 dB for caribou and moose (see section 4.5.1.4). To mitigate impacts to subsistence, the altitude of 3,000 feet AGL was chosen because it is the altitude above which direct overflight by the predominant aircraft (F-15s and F-16s) would produce sound levels less than 85 dB (see Appendix E), thereby minimizing the likelihood of behavioral responses by caribou and moose that could potentially be adverse to subsistence efforts.

4.7.3 Impacts Common to All Alternatives

Various studies indicate that noise from low-altitude flights can cause wildlife to startle and bolt or flee (Calef, DeBrock, and Lortie 1976; Golden et al. 1979; Harrington and Veitch 1991; Bowles, Tabachnick, and Fidell 1991), and that some wildlife experience physiological stresses from low-altitude flights (Ha 1988) (see also biological resources assessment, section 4.5). Noise may affect a subsistence resource by causing wildlife to startle and flee. However, startle and flight reactions are typically short-lived. For example, Harrington and Veitch's (1991) observations of low-altitude (100 feet AGL) jet aircraft overflights of woodland caribou indicated an initial startle response, but otherwise brief overt reaction. If animals began to run, maximum rate was reached almost immediately and within five to ten seconds they had stopped running. Within a minute most animals appeared to relax their vigilance, and resumed former activities within several minutes of an overflight (ibid).

In a situation where a subsistence hunter is stalking an animal on foot, overflight-induced wildlife flight response could have obvious ramifications, particularly if overflights were to occur repeatedly within a short period of time (such as within 2 to 4 hours). If disturbance to wildlife occurred during a critical subsistence hunting period, the level of subsistence effort could feasibly be increased by an estimated 2 to 7 days, increasing the possibility for reduced subsistence harvest. Repetitive overflights would be most likely to occur during MFEs when large numbers of low-flying aircraft could pass through a given area within a period of a few hours each day, for up to 10 to 15 days at a time.

During routine training, average daily flights in any specific area would occur in low numbers and would be generally dispersed over a broad geographic area (see description of Proposed Action and Alternatives, section 2.3). Although some proportion of routine training occurs at low-altitude, there would be a substantially lower potential for repetitive disruption of hunting activities in a specific area than there would be during an MFE. Although disruption of subsistence activity under these conditions could occur, it would be short-lived (isolated instances of overflight not concentrated over several hours in specific area) and of low intensity (low numbers of aircraft). This level of disruption would not be expected to cause increased levels of effort of more than 1 to 2 days, and would not be expected to reduce the amount of overall subsistence harvest.

Impacts are defined as follows:

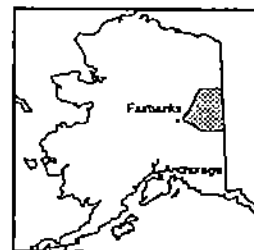
Level I: Impacts from dispersed and less frequent overflights resulting in an increased level of effort of up to 1 to 2 days, but not anticipated to result in reduced harvest levels. Or: Isolated instances of aircraft overflight; not repetitive (not occurring repetitively in a few hours or less); not occurring during critical subsistence hunting periods and not occurring over predominant subsistence use area. Such overflights would be expected to result in no increased level of effort; harvest levels would not be affected. As such, Level I impacts are considered negligible.

Level II: Repetitive, concentrated impacts from overflights resulting in a potential increased level of effort of 2 to 7 days, subsequently increasing the likelihood of reduced harvest levels during the primary/critical subsistence season for communities with a medium (M) sensitivity ranking. Level II impacts would be considered adverse, but not significantly adverse.

Level III: Repetitive, concentrated impacts from overflights resulting in a potential increased level of effort of 2 to 7 days, subsequently increasing the likelihood of reduced harvest levels during the primary/critical subsistence season for communities with a high (H) sensitivity ranking.

4.7.4 Northern Interior Region

The most critical hunting period in the Northern Interior Region takes place in the fall, between August and September, when communities are participating in the fall moose hunt. MFEs conducted during the August to September moose hunt in MOAs overlying the majority of subsistence use areas could have Level III impacts (potential for reduced harvest levels) to communities of high sensitivity and Level II impacts (potential for reduced harvest levels) to communities of medium sensitivity.



Subsistence hunting activities during the rest of the year (outside of August and September) in the Northern Interior Region are generally dispersed throughout the winter months for moose and caribou (primary species of concern). The primary subsistence species' populations are currently in stable condition or increasing. Anticipated impact from MFEs to subsistence harvest at times other than during the August to September hunt would not be expected to exceed Level I (i.e., would not result in reduced harvest levels).

In areas where low numbers of average daily flights would occur during routine training, such flights would be generally isolated, not repetitive, and not typically concentrated in any specific area over a short time. It would

be anticipated that such routine training activities would not result in increased levels of effort of more than a day; this would not be anticipated to affect (reduce) harvest levels. Impacts would not be expected to exceed Level I.

Although these communities may conduct some subsistence activity under the YUKON 2 or proposed YUKON 5 MOAs, Ft. Yukon, Birch Creek, Venetie, and Arctic Village have low sensitivity ranking based on the determination that the majority of their subsistence use areas would not be located under any MOA under any of the alternatives. Additionally, critical subsistence species populations (moose and caribou) are stable or increasing. Therefore, it is anticipated that impacts to these communities subsistence resources and harvests would be negligible.

4.7.4.1 Proposed Action

YUKON 2. Under the Proposed Action, the majority of the subsistence use area for the communities of Circle and Central would be located under the YUKON 2 MOA. Because Circle has a high sensitivity ranking, MFEs conducted during August and September (fall hunt) could result in Level III impacts to subsistence; while Central, with a medium sensitivity ranking, could experience Level II impacts. However, there is (and would continue to be) a year-round Flight Avoidance Area over the Steese Highway corridor, with a 2,000 foot AGL floor which would reduce the level of animal startle and disturbance. The Steese Highway corridor is the area where the subsistence harvest for these communities is concentrated. Because this Flight Avoidance Area would lower the potential for substantial wildlife response, potential impacts would be Level II for Circle, and Level I for Central. (No change from the No Action Alternative.)

YUKON 3 MOA. The primary subsistence areas of the communities of Eagle Village, Eagle City, and Chicken are concentrated along the Taylor Highway and would be located under the YUKON 3 MOA. Under the Proposed Action, the MOA floor would be 100 ft AGL (substantially lower than No Action Alternative), and routine and MFE training would be conducted. MFEs conducted during the fall hunt could result in Level III impacts to the community of Eagle Village (high sensitivity), and Level II to Eagle City and Chicken (medium sensitivity). There would continue to be a Flight Avoidance Area in the YUKON 4 MOA (where lesser amounts of subsistence for these communities occur) and the northeastern corner of the YUKON 3 MOA for peregrine falcon protection over the Yukon, Charley, Kandik and Porcupine rivers. The Flight Avoidance Area extends 2 miles either side of the rivers, and goes from the surface to 2,000 feet AGL (15 April to 31 August). However, it would not mitigate adverse effects during the critical hunting period under the YUKON 3 MOA.

YUKON 5 MOA. Large numbers of aircraft would use the YUKON 5 MOA during MFEs; the MOA would also be used (minimally) for routine training. However, the floor of the MOA would be 3,000 ft. AGL (1,000 feet higher than No Action Alternative), and the typical use of the MOA would occur at high altitudes (above 18,000 ft MSL). Therefore, the impacts on wildlife resulting in startle and flight would be negligible; no effects to subsistence harvest would be anticipated. The impact of aircraft overflights in this MOA to the subsistence of the community of Chalkyitsik (medium sensitivity) would be anticipated to be less than Level I.

4.7.4.2 No Action Alternative

YUKON 2. Under the No Action Alternative, the majority of the subsistence use area for the communities of Circle and Central would be located under the YUKON 2 MOA. Because Circle has a high sensitivity ranking, MFEs conducted during August and September (fall hunt) could result in Level III impacts to subsistence for the community of Circle and Level II impacts for Central (medium sensitivity). However, there is (and would continue to be) a Flight Avoidance Area over the Steese Highway corridor, year round, with a 2,000 feet AGL floor which would minimize the level of animal startle and disturbance. The Steese Highway corridor is the area where the subsistence harvest for these communities is concentrated. Because this Flight Avoidance Area would lower the potential for substantial wildlife response in the primary subsistence area, potential impacts to subsistence are predicted to be Level II for Circle and Level I for Central.

YUKON 3 TMOA. The primary subsistence areas of the communities of Eagle Village, Eagle City, and Chicken are located under the YUKON 3 TMOA and concentrated along the Taylor Highway. Under the No Action Alternative, this MOA would not be used for routine training, but for MFEs only. This MOA would have a floor of 3,000 feet AGL, and subsequently, impacts to wildlife would be expected to be minimal. Therefore, MFEs conducted during the fall hunt would not be expected to result in increased levels of effort of more than 1 to 2 days, with no anticipated reduction of harvest. For these communities, Level I impacts would be anticipated. There is and would continue to be a Flight Avoidance Area in the YUKON 4 MOA (where minority amounts of subsistence by these communities occur) for peregrine falcon protection over the Yukon, Charley, Kandik and Porcupine Rivers. However, this would not mitigate adverse effects in the YUKON 3 TMOA. It extends 2 miles either side of the rivers, and goes from the surface to 2,000 feet AGL (15 April to 31 August).

YUKON 5 TMOA. No routine training would occur in this MOA under the No Action Alternative. Large numbers of aircraft would use the YUKON 5 TMOA during MFEs. However, the floor of the TMOA would be 2,000 feet AGL, and the typical use of the TMOA would occur at high altitudes (above 18,000 feet MSL). Therefore, the potential for impacts on wildlife resulting in startle and flight would be negligible. The majority of the subsistence area of the community of Chalkyitsik, sensitivity rank medium, is located under the YUKON 5 TMOA. Impacts to subsistence in this area would be less than Level I.

4.7.4.3 Alternative A

Impacts under Alternative A are expected to be the same as the Proposed Action (see section 4.7.4.1).

4.7.4.4 Alternative B

Impacts to subsistence under Alternative B are expected to be the same as the Proposed Action for the communities of Eagle Village (Level III), Eagle City (Level II), Circle (Level II), and Central (Level I) (see section 4.7.4.1). Because there would be no YUKON 5 MOA or TMOA under Alternative B, there would be no anticipated impacts to subsistence for Chalkyitsik.

YUKON 3, TANANA MOAs. Under Alternative B, the majority of the subsistence use area for the community of Chicken would be located under the YUKON 3 and TANANA MOAs. The floor of the YUKON 3 would be 100 feet AGL; the floor of TANANA (eastern portion, where subsistence occurs) would be 300 feet AGL. Chicken has been ranked as having medium sensitivity. Level II impacts could occur during MFEs conducted during the fall hunt. Impacts from aircraft overflights at other times would not be anticipated to exceed Level I, the same as under the Proposed Action.

4.7.4.5 Alternative A—Modified

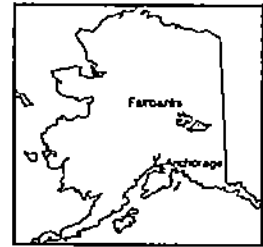
YUKON 2. Impacts to YUKON 2 are expected to be the same as the Proposed Action (see section 4.7.4.1).

YUKON 3. The primary subsistence areas of Eagle Village, Eagle City, and Chicken are concentrated along the Taylor Highway under the YUKON 3B (Low) MOA, which would have a 2,000 foot AGL floor. Level III impacts may occur for Eagle Village during MFEs conducted in August and September, and Level II impacts for Eagle City and Chicken. However, the higher floor identified with this alternative, although not high enough to obviate the likelihood of any behavioral responses by caribou and moose, would have a minimizing effect. There would continue to be a peregrine falcon Flight Avoidance Area over the Yukon, Charley, Kandik, and Porcupine rivers in the YUKON 4 MOA (where lesser amounts of subsistence activities by these communities occur) and the northeastern corner of the YUKON 3 MOA. This Flight Avoidance Area extends from the surface to 2,000 feet AGL, 2 miles either side of the rivers, from April 15 to August 31. It would not mitigate adverse effects during the critical hunting period under the YUKON 3 MOA.

YUKON 5. The community of Chalkyitsik has a majority of its subsistence area under this MOA. No routine training would occur in this MOA under Alternative A—Modified. Although large numbers of aircraft would use the MOA during MFEs, the floor of the MOA would be 5,000 feet AGL. The potential for significant adverse effects to the subsistence resources or activities would be less than Level I.

4.7.5 Southern Interior Region

While residents of the community of Delta Junction may participate in subsistence hunting, the community has been ranked as having low sensitivity. Because there are existing employment opportunities (Fort Greely, the trans-Alaska oil pipeline, and agriculture) in this predominantly non-Native community, impacts to subsistence resources and a subsistence way of life would be negligible for the community of Delta Junction.



The most critical hunting period in the Southern Interior Region takes place in August and September when communities (Healy Lake and Dot Lake) are participating in the fall moose hunt. Additionally, caribou hunting during August and September and during December through February is important to Dot Lake area residents. Moose populations in the eastern portion of the region, north of the Alaska Highway, are of low density and stable or declining. Moose populations in other Southern Interior Region subsistence areas for these communities are generally stable or increasing. Concentrated, repetitive flights (such as during MFEs) conducted during the fall moose and caribou hunt in MOAs overlying the majority of subsistence use areas could have Level III impacts (potential for reduced harvest levels) on Dot Lake and Healy Lake, ranked with high sensitivity.

4.7.5.1 Proposed Action

The majority of the subsistence use area for Healy Lake would occur under the proposed BUFFALO MOA, and to a lesser extent, the YUKON 1 MOA. MFEs conducted during the September moose hunt in the BUFFALO MOA could have Level III impacts to the subsistence of Healy Lake, ranked with high sensitivity. Approximately half of the subsistence area of Dot Lake would be located under the BUFFALO MOA. There could be Level III impacts to the subsistence activity of the community of Dot Lake if MFEs were conducted in the BUFFALO MOA during the August to September hunt period.

The floors for the proposed MOAs would be substantially lower under the Proposed Action than under the No Action Alternative, with the potential for greater disturbance to wildlife in these areas. There is an existing Flight Avoidance Area around the community of Healy Lake (consisting of a 3-mile radius around the village, surface to 6,000 feet MSL, year round), which would mitigate effects in the vicinity of the village, but not in outlying areas.

4.7.5.2 No Action Alternative

Under the No Action Alternative, the majority of the subsistence use area of Dot Lake would not be located under the MOAs. Because only a small portion would be located under the previously utilized BUFLO and YUKON 3 TMOAs, this community would have a sensitivity ranking of medium under the No Action Alternative. Only MFEs would be conducted in these TMOAs; additionally, the BUFLO TMOA floor is 1,000 feet AGL. Under the methodology presented in this EIS, MFEs conducted during the fall hunt could have Level III impacts to the community of Healy Lake, but would not be expected to exceed Level II impacts for the community of Dot Lake (based on lowered sensitivity). Impacts would not exceed Level I during the remainder of the year.

Under the No Action Alternative, however, impacts would not change from existing conditions. The Air Force and the community of Healy Lake have worked to establish the existing Flight Avoidance Area around the community of Healy Lake (which consists of a 3-mile radius around the village, surface to 6,000 feet MSL, year round), which would mitigate effects in the vicinity of the village, but not in outlying areas. Although the

methodology used here indicates that Level III impacts could occur during MFEs conducted during the fall hunt for Healy Lake, significant adverse impacts to subsistence harvest activities have not been documented due to the ongoing Air Force activities in this region.

4.7.5.3 Alternative A

Impacts under Alternative A are expected to be the same as the Proposed Action.

4.7.5.4 Alternative B

Impacts to the community of Healy Lake are expected to be the same as the Proposed Action (Level III during MFEs conducted during the fall hunt). However, under Alternative B, 100 percent of the subsistence area of the community of Dot Lake would be located under MOA airspace. MFEs conducted in the TANANA and BUFFALO MOAs and routine training conducted in the BUFFALO MOA during the August to September moose and caribou hunt could result in Level III impacts to the community of Dot Lake. MFEs during the winter caribou hunt (December to February) could have Level II impacts on Dot Lake. Impacts would not be expected to exceed Level I during the remainder of the year. These impacts would likely be greater than under the Proposed Action since all of the community's subsistence area would be affected.

4.7.5.5 Alternative A—Modified

Impacts associated with this alternative are expected to be the same as the Proposed Action.

4.7.6 Southcentral Region

The most critical hunting period in the Southcentral Region takes place in the fall during the mid-August through September moose and caribou hunt. MFEs conducted during the fall hunt in MOAs overlying the majority of the subsistence use areas could result in Level III (potential for reduced harvest levels) impacts to communities of high sensitivity and Level II (little potential for reduced harvest levels) impacts to communities of medium sensitivity.



Subsistence hunting activities during the rest of the year are generally dispersed throughout the winter months. The status of moose and caribou populations varies throughout the region (see biological resources, and Table 3-14). Where subsistence species populations are stable or increasing, anticipated impacts from military aircraft overflights to subsistence harvest at times other than during the August to September hunt would not be expected to exceed Level I for communities with high sensitivity (i.e., would not result in reduced harvest levels). Where species populations (of primary importance) are decreasing, communities with high sensitivity could experience Level II impacts.

Although these communities may conduct some subsistence activities under Southcentral Region MOAs, Gakona, Gulkana, Chistochina, Mentasta Lake, Nabesna Road area, Talkeetna, and Trapper Creek have low sensitivity ranking based on the determination that the majority of their subsistence use areas would not be located under any MOA under any of the alternatives. It is anticipated that impacts to these communities' subsistence resources and harvests would be negligible under any alternative.

4.7.6.1 Proposed Action

Because the majority of their subsistence use area would not occur under the MOAs established under the Proposed Action, impacts would be negligible for the communities of Tok and Tanacross.

The Upper Petersville Road and a primary subsistence use area for Skwentna would be located under the SUSITNA MOA. Both of these communities have been ranked as having medium sensitivity. Only routine

training would be conducted in the SUSITNA MOA, and the average number of overflights would be less than 3 per day. Additionally, the floor of the MOA would be 5,000 feet AGL, minimizing any potential disturbance to wildlife. Impacts would not be anticipated to exceed Level I for these two communities.

4.7.6.2 No Action Alternative

Under the No Action Alternative, impacts to the communities identified in this region are expected to be the same as the Proposed Action.

4.7.6.3 Alternative A

Under this alternative, impacts to the communities in the region are expected to be the same as the Proposed Action.

4.7.6.4 Alternative B

Under Alternative B, the primary subsistence use areas for the communities of Tanacross, Tok, and Paxson would be located under the TANANA MOA. The eastern portion of this MOA would have a floor of 300 feet AGL in the Tok and Tanacross subsistence areas; the floor would be 3,000 feet AGL over Paxson's subsistence area. The status of moose populations under the TANANA MOA is variable, decreasing in areas south of the Alaska Highway. MFEs conducted during the fall (mid-August through September) moose and caribou hunt could have Level III impacts to the subsistence activity of Tanacross (high sensitivity), and could result in Level II impacts during MFEs conducted during the December to February caribou hunt. Impacts would not exceed Level I for Tanacross at other times of the year. Impacts would not be expected to exceed Level I for the communities of Tok and Paxson (low sensitivity).

Impacts to the subsistence activities for the communities of Skwentna and Upper Petersville Road are expected to be the same as the Proposed Action (Level I).

4.7.6.5 Alternative A—Modified

Impacts associated with this alternative are expected to be the same as the Proposed Action.

4.7.7 Western Region

The most critical subsistence use period identified in the Western Region is the fall moose and caribou hunting period ranging from mid-August through September, and into October for some communities. Although wildlife populations in this region are generally stable to increasing, communities in the Western Region strongly exhibit overall high sensitivity to subsistence impacts. Surge exercises consisting of high levels of aircraft activity conducted during the fall hunting season and during the spring waterfowl hunting season could have Level III impacts to communities of high sensitivity. However, surge exercise levels would be low (less than 17 operations/day, maximum average) and dispersed over a very large area. Therefore, surge exercises conducted during critical hunting periods could result in Level II impacts.



Although these communities may conduct some subsistence activities under the GALENA MOA, Lake Minchumina, McGrath, Nikolai, Ruby, Takotna, and Telida have low sensitivity ranking based on the determination that the majority of their subsistence use areas would not be located under any MOA under any of the alternatives. It is anticipated that impacts to these communities subsistence resources and harvests would be negligible under any alternative.

4.7.7.1 Proposed Action

NAKNEK MOAs. Under the Proposed Action no MFEs would be conducted in the NAKNEK MOAs. The majority of the subsistence use area for the community of Koliganek (high sensitivity) would be located under the NAKNEK 1 MOA. No changes in the existing MOA structure or operations would occur under the Proposed Action except for a decrease in the number of daily aircraft activities conducted. No MFEs would be conducted; the floor of NAKNEK would remain at 3,000 feet AGL, minimizing disturbances to wildlife; and aircraft overflights would be less frequent than existing numbers of overflights. Increases in levels of effort would not be anticipated to be greater than 1 to 2 days during the fall hunt. Impacts, therefore, would not be expected to exceed Level I during the fall hunt; at other times, anticipated impacts would be negligible. The reduction in daily operations under the Proposed Action would have an overall beneficial impact in the NAKNEK MOAs.

STONY MOAs. The communities of Lime Village, Red Devil, Sleetmute, and Stony River have been identified as having the majority of their subsistence use areas under the STONY A or B MOAs, and have been ranked with high sensitivity. Although it is likely that important subsistence activity for the community of Napamiute takes place under the STONY B MOA, the majority of the subsistence use areas of Napamiute and Chuathbaluk would not occur under the STONY A or B MOAs, and STONY C TMOA would not be established under the Proposed Action. The floor of the STONY B MOA would be lowered to 100 feet AGL; the floor of the STONY A MOA would remain at 100 feet AGL (no change).

For communities whose majority of subsistence activities occur under STONY A and B MOAs, the critical hunting period occurs between mid-August and September. Sleetmute also relies heavily on waterfowl harvest in the spring (April to May), and it is likely that other communities in the area rely on waterfowl harvest in the spring. Surge exercises and routine training during the spring waterfowl hunt (April to May) and during the fall hunt (mid-August to September) could result in Level II impacts to the subsistence of the communities of Lime Village, Red Devil, Sleetmute, Stony River, and Napamiute. Because wildlife populations are generally stable or increasing in this area, impacts from aircraft activity at other times would not be anticipated during critical hunting periods, and therefore, are not expected to exceed Level I impacts. The majority of Chuathbaluk's subsistence effort would not occur under the Proposed Action MOAs and impacts would not be expected to exceed Level I.

Existing Flight Avoidance Areas (three-mile radius, 1,500 foot AGL floor, year-round) around the Crooked Creek, Red Devil, Sleetmute, and Stony River community airports would mitigate effects in the vicinities of the villages, but not in outlying areas.

GALENA MOA. No primary subsistence use areas were identified under the GALENA MOA, although several communities may conduct a portion of their subsistence under this MOA. No MFEs would be conducted in this MOA; daily aircraft activities would be minimal and less than the number that would occur under the No Action Alternative, resulting in an overall beneficial impact. Impacts to subsistence in this MOA would, therefore, be anticipated to be negligible.

4.7.7.2 No Action Alternative

NAKNEK MOAs. Under the No Action Alternative, routine training aircraft overflights would occur slightly more frequently than under the Proposed Action (see Table 2-7). However, impacts would not be expected to exceed Level I during the fall hunting season and would be negligible at other times (same as Proposed Action).

STONY MOAs. Chuathbaluk and Napamiute conduct the majority of their subsistence activities in an area under the STONY C TMOA. Under the No Action Alternative, the STONY C TMOA could be activated for surge exercise training; no routine training would be conducted. Because the average daily aircraft activity in this

TMOA would be quite low (less than 18 operations/day, maximum average), impacts would not be anticipated to exceed Level II for these communities during the mid-August to September hunting period.

Under the No Action Alternative, the floor of the STONY B MOA would remain at 3,000 feet AGL, thereby minimizing disturbances to primary species (moose, caribou, waterfowl). Additionally, average daily aircraft operations would not exceed 22 operations/day (maximum average). Therefore, impacts resulting from MFEs conducted during the critical harvest periods (mid-August through September for all communities, and additionally, from mid-April to mid-May for Sleetmute) would not be anticipated to exceed Level I impacts for Red Devil, Sleetmute and Stony River. For the community of Lime Village, whose majority of subsistence harvest occurs under the STONY A MOA (floor of 100 feet AGL), MFEs conducted during the fall hunt could result in Level II impacts. Impacts from routine training during the fall hunting period (mid-August through September) would not be expected to exceed Level II. Impacts to Lime Village subsistence at other times of the year would not exceed Level I.

Existing Flight Avoidance Areas (three-mile radius, 1,500 foot AGL floor, year-round) around the Crooked Creek, Red Devil, Sleetmute, and Stony River community airports would mitigate effects in the vicinities of the villages, but not in outlying areas.

GALENA MOA. Impacts under the No Action Alternative are expected to be the same as the Proposed Action.

4.7.7.3 Alternative A

For all MOAs, impacts under Alternative A are expected to be the same as the Proposed Action.

4.7.7.4 Alternative B

For all MOAs, impacts under Alternative B are expected to be the same as the Proposed Action.

4.7.7.5 Alternative A—Modified

Impacts associated with this alternative are expected to be the same as the Proposed Action.

4.8 Land Use

4.8.1 Background

Of the 120 questionnaires received during scoping, approximately 71 percent of the respondents ranked the issue of land use as "Very Important," and 18 percent as "Somewhat Important." About 91 percent of the respondents considered the issue of aesthetics/quality of life to be "Very Important," while another 8 percent thought it was "Somewhat Important."

In section 3.8, the ownership status, use, management, and aesthetic characteristics of the lands in the Region of Influence were described. It is improbable that the Proposed or Alternative Actions would have any effect on land ownership status, land selections by the State of Alaska or Alaska Native Corporations, or conveyance decisions. The Proposed Action and Alternatives would not conflict with the land management plans, or policies of the federal, state, and municipal lands underlying the existing and proposed MOAs. Therefore, the focus of this section is narrowed to the characteristics of land use and aesthetics, particularly rural/remote residential land uses under the proposed MOAs and residential land uses on and adjacent to Eielson and Elmendorf AFBs. The potential effects on specific land uses such as recreation and subsistence are described in sections 4.6 and 4.7, respectively, and are not addressed here.

4.8.1.1 General Methods and Assumptions

The potential for the Proposed or Alternative Actions to affect land use and aesthetics or the quality of life is defined by several factors:

- the geographic location of proposed MOAs;
- the schedule of proposed military operations, including routine training and MFES;
- the number and type of aircraft involved in routine training and MFES;
- the nature (air-to-air or air-to-ground) and duration of aircraft operations;
- the altitude and speed (subsonic or supersonic) of aircraft during routine training and MFES;
- the noise levels generated by passing aircraft; and
- the current or designated future land use.

Use of airspace is not subject to land use plans and regulations. However, activities occurring in airspace can affect land uses. The primary effects are the audible and visual presence of aircraft, which can affect land uses and the aesthetic values or quality of life of an area. This is of particular concern in rural or remote residential areas where there has not historically been much exposure to low-altitude, high speed aircraft overflight and associated noise levels. It is assumed that such aircraft overflights would detract from wilderness settings and degrade aesthetic values.

The American National Standards Institute revised standard on *Sound Level Descriptors for Determination of Compatible Land Use* (ANSI S12.40-1990) makes the following statement:

The compatibility of various land uses with the outdoor noise environment at a site is dependent on factors such as the following:

- (i) *Acoustical factors*, such as the sound level at the site and its variation with time; the sound isolation provided by the buildings where people experience the effects of outdoor noise; and the noise environment generated indoors by indoor sources, including sounds produced by people themselves.
- (ii) *Nonacoustical factors*, such as the type of human activity associated with a specific land use; the differing responses of individuals to the same noise

environment; attitudes toward the noise sources and the persons responsible for creating the noise; familiarity with an intruding noise through previous experiences; the disturbance of an activity or the annoyance caused by the noise; specific requirements of individual communities; the cost of achieving lower average sound levels; and the technical feasibility of reducing the sound levels.

The new standard continues to specify the Day-Night Average A-Weighted Sound Level (DNL) as the "acoustical measure to be used in assessing compatibility between various land uses and an outdoor noise environment." In addition, for some land uses (i.e., uses that are not long-term and continuing in nature), "...compatibility is to be assessed by the average sound level during the time interval of interest for the land use involved." DNL takes into account the magnitude of sound levels of all individual events that occur during a 24-hour period, the number of events, and the increased sensitivity to noise during typical sleeping hours (10:00 p.m. to 7:00 a.m.). DNL is an average in that it accumulates all the noise exposure over a 24-hour period and divides the total by the number of seconds in a day. The logarithmic nature of the decibel (dB) unit on which DNL is based causes the loudest events to control the 24-hour average. In an appendix to the standard, ANSI specified (in terms of DNL) the outdoor noise environment "likely to be considered compatible" with different land uses (ANSI 1990). Although Alaska, with large tracts of *de facto* wilderness, may be a distinct category in terms of ambient noise and resident characteristics, there is no evidence to suggest that DNL is an inappropriate measure for assessing land use impacts, nor is there any more appropriate methodology available. Table 4-10 presents the DNL ranges of particular interest for this EIS.

Military aircraft are transitory fixtures in a landscape, having both visual and audible features. The nature of their impact depends on the sensitivity of the resource affected, the distance from which they are viewed, and the length of time they are visible, the noise level they produce, and the length of time they are audible. Aircraft altitude relative to a viewer plays a key role in determining impacts. People's eyes are typically drawn to the horizon more than overhead, and they are less likely to notice aircraft at higher altitudes. In heavily forested areas, most views are screened or extremely brief; the lower the aircraft altitude, the more likely views of it are to be screened. The noise generated by high-speed aircraft is much different than that generated by small civil aircraft. The onset rate of high-speed aircraft often produces a "startle effect," which occurs when a very loud noise is experienced in a setting where it is not expected and when there is no visible or audible warning. This startle effect can decrease the quality or aesthetic value of a wilderness setting by disrupting the tranquility and solitude of the place. On the other hand, aircraft operating at high speeds are only visible and audible for very short periods of time. For example, an F-16 moving at 550 miles per hour travels 9.17 miles per minute. In 10 seconds, it travels 1.53 miles, and in 30 seconds, almost 5 miles. Thus, the visual effect is very short in duration. Audible duration, however, is highly dependent on a site's ambient sound levels and intervening terrain and vegetation (Dunholter 1989; Anderson 1992).

Table 4-10 Land Use Compatibility with Yearly Day-Night Average A-Weighted Sound Levels (DNL)

Land Use	Compatible DNL Range	Marginally Compatible DNL Range
Residential - Single Family, Extensive Outdoor Use	less than DNL 55 dB	DNL 55 - 64 dB
Residential - Multiple Family, Moderate Outdoor Use	less than DNL 60 dB	DNL 60 - 64 dB
Residential - Multi Story, Limited Outdoor Use	less than DNL 60 dB	DNL 60 - 64 dB
Transient Lodging	less than DNL 65 dB	DNL 65 - 69 dB
School Classrooms, Libraries, Religious Facilities	less than DNL 60 dB	DNL 60 - 64 dB
Hospitals, Clinics, Nursing Homes, Health Related Facilities	less than DNL 60 dB	DNL 60 - 64 dB
Neighborhood Parks	less than DNL 55 dB	DNL 55 - 69 dB
Playgrounds, Golf Courses, Riding Stables, Water Recreation, Cemeteries	less than DNL 60 dB	DNL 60 - 74 dB
Office Buildings, Personal Services, Business and Professional	less than DNL 65 dB	DNL 65 - 74 dB
Commercial - Retail, Movie Theaters, Restaurants	less than DNL 65 dB	DNL 65 - 74 dB
Commercial - Wholesale, Some Retail, Ind., Mfg., Utilities	less than DNL 70 dB	DNL 70 - 79 dB
Livestock Farming, Animal Breeding	less than DNL 65 dB	DNL 65 - 74 dB
Agriculture (Except Livestock)	less than DNL 75 dB	DNL 75 - 84 dB
Extensive Natural Wildlife and Recreation Areas	less than DNL 60 dB	DNL 60 - 74 dB

Source: ANSI 1990.

4.8.1.2 Methodology and Assumptions

This analysis relies on the ANSI standard (1990). It assumes that any land use that would be exposed by implementation of the Proposed Action or an Alternative to average sound levels considered incompatible would be considered adversely affected. The significance of any adverse effects due to the Proposed or Alternative Actions would depend on the nature of the land uses occurring under an existing or proposed MOA; whether the MOA is an existing permanent or previously utilized temporary MOA; whether or not the MOA is currently used for routine training or MFEs only; whether or not supersonic operations are currently permitted; whether military aircraft operations would be increased, decreased, introduced for the first time, or would remain the same; and the presence of existing Flight Avoidance Areas.

The aesthetics of an area, defined for the purposes of this EIS as the combined effects of the natural and man-made features of an environment, are determined by the values placed by individuals on the visual, cultural, socioeconomic, and natural elements in the environment. No attempt has been made here to directly assess the impacts of aircraft overflights on aesthetics because of the highly subjective nature of such an assessment. For example, to some observers a low-altitude, high-speed aircraft flying nearby may be an enjoyable experience, while others may consider it an intrusion. Further, the same individual may respond quite differently to overflights at different times, in different situations. Therefore, for this EIS, the issue of aesthetics is considered to be addressed through the analysis of potential effects on specific land uses (e.g., recreation, subsistence).

4.8.2 Environmental Consequences (All MOAs)

4.8.2.1 Proposed Action

The following MOAs were identified as having rural/remote residential areas that are particularly sensitive to aesthetic impacts. This determination was based primarily on the history of complaints and the public testimony received during scoping.

- YUKON 1 MOA, in particular residences along the Salcha River;
- BIRCH MOA, in particular residences along the Salcha River;
- CLEAR CREEK MOA; and
- STONY B MOA, especially the villages of Sleetmute, Stony River, Red Devil, and Crooked Creek; and traditional Alaska Native fish camps (typically active from June 1 through October 15 and located along the Stony and Kuskokwim rivers).

However, under the Proposed Action, L_{dnmr} levels, and therefore DNL levels, would continue to be less than 55 dB in each of the existing and proposed MOAs. Further, the Air Force adheres to the operational restrictions outlined in *FAR 91.119* and *AFR 60-16* that require a minimum operating altitude of 1,000 feet AGL over towns and settlements and a minimum avoidance distance of 500 feet for structures in less populous areas. Therefore, land uses under any of the MOAs would generally not be considered to be significantly adversely affected.

4.8.2.2 No Action Alternative

Under the No Action Alternative, L_{dnmr} levels would also continue to be less than 55 dB in each of the existing permanent and previously utilized temporary MOAs, and somewhat less than would occur under the Proposed Action. Therefore, land uses under any of the MOAs would generally not be considered to be significantly adversely affected.

4.8.2.3 Alternative A

The CLEAR CREEK MOA would not be established and rural/remote residences in the area underlying this MOA would not experience any direct aircraft overflight effects. Although the adjacent BIRCH and EIELSON MOAs would absorb the small number of aircraft operations displaced from the CLEAR CREEK MOA, this would have a negligible effect on average noise levels in these MOAs.

Under Alternative A, L_{dnmr} levels, and therefore DNL levels, would continue to be less than 55 dB in each of the existing and proposed MOAs. The Air Force would continue to adhere to the operational restrictions outlined in *FAR 91.119* and *AFR 60-16*. Therefore, land uses under any of the MOAs would generally not be considered to be significantly adversely affected.

4.8.2.4 Alternative B

The YUKON 4 and 5 MOAs would not be established and rural/remote residence in the area underlying these MOAs would not experience any direct aircraft overflight effects. The TANANA MOA would be established, along with the YUKON 1-4 and 6 MOAs and the remainder of the Proposed Action's Southern Interior, Southcentral, and Western Region MOAs. In addition to the MOAs identified for the Proposed Action as having rural/remote residential areas with higher sensitivity to aesthetic impacts, portions of the TANANA MOA were also found to contain rural/remote residential areas of higher sensitivity. In particular, residences in and around Paxson, Tanacross, Dot Lake, and Tok, and along the Richardson and Alaska highways. Again, this determination was based primarily on the history of complaints and the public testimony received during scoping.

Under Alternative B, L_{dnmr} levels, and therefore DNL levels, would continue to be less than 55 dB in each of the existing and proposed MOAs. The Air Force would continue to adhere to the operational restrictions outlined in *FAR 91.119* and *AFR 60-16*. Therefore, land uses under any of the MOAs would generally not be considered to be significantly adversely affected.

4.8.2.5 Alternative A—Modified

The boundaries of BIRCH MOA would be modified to exclude the Salcha River, and the CLEAR CREEK MOA would not be established. Rural/remote residences in the areas underlying these MOAs would not experience any aircraft overflights and associated effects. Although the modified BIRCH and EIELSON MOAs would absorb the small number of aircraft operations displaced from the CLEAR CREEK MOA, this would have a negligible effect on average noise levels in these MOAs.

4.8.3 Environmental Consequences: Eielson and Elmendorf AFBs

4.8.3.1 Eielson Air Force Base

Under either the Proposed or Alternative Actions, the changes in noise levels associated with aircraft activities at Eielson AFB would be created by a composite of routine training operations and the proposed increase in MFE flying activity. The noise contours that would occur under the Proposed or Alternative Actions are shown in Figure 4-30.

Level II impacts are predicted for 689 on-base residents not previously exposed to $DNL \geq 65$ dB, 176 of whom are predicted to be "highly annoyed" by this exposure. No on-base residents would be exposed to $DNL \geq 75$ dB. An estimated 1,283 on-base residents in the DNL 65 to 69 dB range would experience a 1 dB increase while some 45 would experience a 2 dB increase. Two hundred and eighty on-base residents in the DNL 70 to 74 dB range would experience a 1 dB increase. Level I impacts are predicted for off-base residents. There would be an additional estimated 55 off-base residents exposed by implementation of the Proposed Action or an Alternative to $DNL \geq 65$ dB, with an increase of 12 in the number anticipated to be "highly annoyed." No off-base residents would be exposed to $DNL \geq 75$ dB. All off-base residents exposed to $DNL \geq 65$ dB would experience roughly a 1 dB increase. Noise contours around Eielson AFB are illustrated in Figure 4-30. Table 4-11 and Table 4-12 depict the number of on- and off-base residents that would be exposed to $DNL \geq 65$ dB, the number expected to be "highly annoyed," and the land area affected.

As discussed in section 3.3.5.3, sleep disturbance can be an important factor in the potential annoyance of persons exposed to nighttime operations around an airfield. As part of the Proposed and Alternative Actions, up to two MFEs per year could be expected to include some operations between 10:00 p.m. and 11:00 p.m., consisting only of recoveries (arrivals) of MFE aircraft back at Eielson AFB after departures earlier in the evening. These nighttime arrivals would slightly increase the potential number of residents in the vicinity of Eielson AFB expected to be awakened due to aircraft operations. Up to 380 residents in the vicinity of Eielson AFB would be exposed to different nighttime operations (including nighttime MFE arrivals) on any given evening. Of these 380 residents, the Air Force interim procedure for predicting average percent awakened estimates 91 would be awakened (an increase of 30 people on an MFE evening); the methodology developed by Ollerhead (1992) predicts 6 residents potentially awakened (an increase of 3 people on an MFE evening).

The on-base land area exposed to $DNL \geq 65$ dB would increase by 1.30 square miles, from 8.51 to 9.81 square miles. This increase would generally occur to the east and south of the runway, and accounts for the 689 on-base residents that would move into $DNL \geq 65$ dB noise contours. The off-base land area exposed to $DNL \geq 65$ dB would increase by 0.62 square miles, from 1.28 to 1.90 square miles. This would occur primarily in the Moose Creek area north of the base, and also adjacent to the southern base boundary. Additional residential development is likely in both of these areas; however, the rural nature of the areas would probably continue the trend for lower density residential development and minimize potential increases in population affected by aircraft noise.

Implementation of the Proposed Action or any of the Alternative Actions would result in increases in the number of on- and off-base residents exposed to DNL $\geq$ 65 dB, and thus in the number of residents likely to be "highly annoyed" by aircraft-generated noise. Level II impacts are predicted for some on-base residents and Level I impacts for areas adjacent to the base. However, potential adverse impacts would be minimized by the following factors:

- 1) No on-base residents would be exposed to DNL $\geq$ 75 dB, and the majority of those exposed to DNL $\geq$ 65 dB (1,328 or 83 percent) would reside in the DNL 65 to 69 dB contour;
- 2) No off-base residents would be exposed to DNL $\geq$ 75 dB, and the majority of those exposed to DNL $\geq$ 65 dB (216 or 96 percent) would reside in the DNL 65 to 69 dB contour;
- 3) Quiet hours are generally enforced between 11:00 p.m. and 7:00 a.m.;
- 4) MFE sorties would normally occur during the daytime (i.e., between 7:00 a.m. and 10:00 p.m.) with only a small number of arrivals (i.e., on-base landings) between 10:00 p.m. and 11:00 p.m. during twice-yearly nighttime MFEs;
- 5) The Air Force limits non-mission essential use of afterburners;
- 6) The Air Force has an ongoing policy of routing flight tracks to avoid overflying noise sensitive areas, to the maximum extent possible, within the parameters of runway alignment, wind direction, and mission requirements;
- 7) It is Air Force policy to ensure that the proper Noise Level Reduction measures (outdoor to indoor) are incorporated in the design and construction or modification of all on-base buildings situated within the DNL $\geq$ 65 dB contours;
- 8) As a result of the extreme climate conditions of Eielson and Elmendorf AFBs, energy conservation practices (e.g., insulation) in both on- and off-base housing contribute to indoor noise level reductions; and
- 9) Since the mid-1970s, the Air Force has published Air Installation Compatible Use Zone (AICUZ) studies, which advise local governments to direct noise sensitive development away from high noise areas near Air Force Bases. The AICUZ program continues in effect at Eielson AFB, and will be updated to reflect the noise levels of the alternative selected by the Air Force. Potential mitigation for airfield noise is identified as part of the AICUZ revision process.

In addition, the 354 FW would continue to monitor and respond to community reactions to aircraft operations via its noise complaint process (administered through the Eielson AFB Public Affairs Office). Therefore, implementation of the Proposed Action or any of the Alternative Actions is not expected to have any significant adverse impact on land use on or in the vicinity of Eielson AFB.

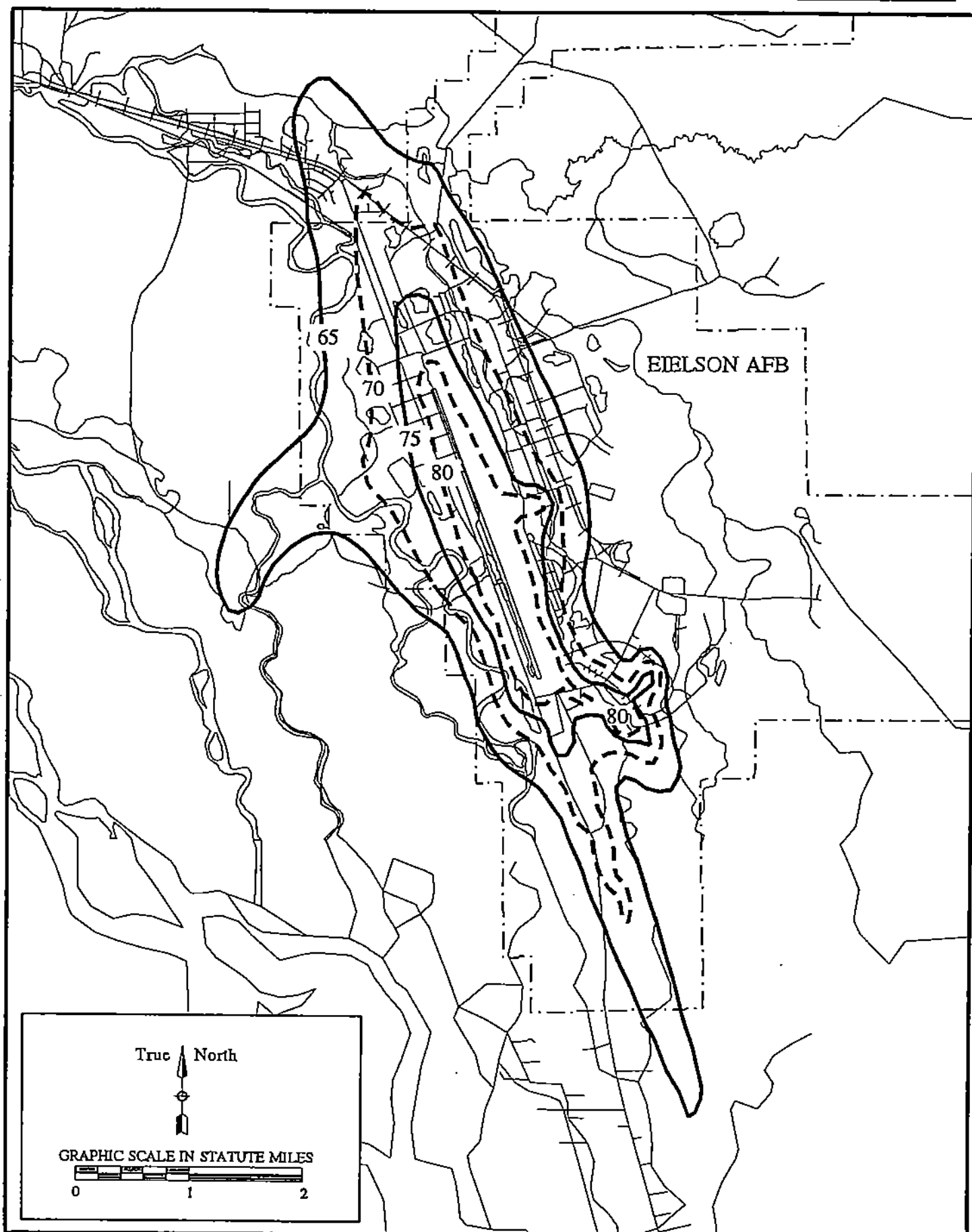


Figure 4-30 DNL Contours for Proposed Action Operations at Eielson AFB - Routine Daily Training Plus Six MFEs per Year

Table 4-11 On-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Eielson AFB Proposed Operations - Routine Daily Training plus Six MFEs per Year

DNL Intervals (dB)	Proposed Operations		
	Area (mi ²)	No. of Persons	No. Highly Annoyed
65 - 69	4.23	1,328	279
70 - 74	2.84	280	90
75 - 79	1.45	0	0
≥ 80	1.29	0	0
Totals:	9.81	1,608	369

Sources: USAF 1993b; U.S. Bureau of the Census 1990.

Table 4-12 Off-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Eielson AFB Proposed Operations - Routine Daily Training Plus Six MFEs per Year

DNL Intervals (dB)	Proposed Operations		
	Area (mi ²)	No. of Persons	No. Highly Annoyed
65 - 69	1.86	216	45
70 - 74	0.04	10	3
75 - 79	0.00	0	0
≥ 80	0.00	0	0
Totals:	1.90	226	48

Sources: USAF 1993b; U.S. Bureau of the Census 1990.

4.8.3.2 Elmendorf Air Force Base

Under either the Proposed or Alternative Actions, F-15 operations remain the dominant noise source with C-130s, C-12s, and E-3s contributing to a lesser degree. Changes in noise levels would be created by a combination of routine training operations and the proposed increase in MFE flying activity. The noise contours that would occur under the Proposed or Alternative Actions are shown in Figure 4-31.

Level II impacts are predicted for 504 off-base residents not previously exposed to DNL $\geq$ 65 dB, 106 of whom are predicted to be "highly annoyed." No off-base residents would be exposed to DNL $\geq$ 70 dB. An estimated 217 off-base residents in the DNL $\geq$ 65 dB range would experience a 1 dB increase; 784 would experience less than a 1 dB increase. Level I impacts are predicted for on-base residents. There would be no increase in the

number of on-base residents exposed to $\text{DNL} \geq 65$ dB; however, due to shifting of noise contours, an additional three residents would be expected to be "highly annoyed." Fourteen on-base residents currently exposed to DNL 70 to 74 dB would experience an estimated 1 dB increase and would shift into the DNL 75 to 79 dB contour. All other on-base residents would experience an increase of less than 1 dB. Noise contours around Elmendorf AFB are illustrated in Figure 4-30. Table 4-13 and Table 4-14 depict the number of on- and off-base residents that would be exposed to $\text{DNL} \geq 65$ dB, the number expected to be "highly annoyed," and the land area affected.

As discussed in section 3.3.5.3, sleep disturbance can be an important factor in the potential annoyance of persons exposed to nighttime operations around an airfield. As part of the Proposed and Alternative Actions, up to two MFEs per year could be expected to include some operations between 10:00 p.m. and 11:00 p.m., consisting only of recoveries (arrivals) of MFE aircraft back at Elmendorf AFB after departures earlier in the evening. These nighttime arrivals would slightly increase the potential number of residents in the vicinity of Elmendorf AFB expected to be awakened due to aircraft operations. Up to 6,653 residents in the vicinity of Elmendorf AFB would be exposed to different nighttime operations (including nighttime MFE arrivals) on any given evening, an increase of 200 over existing conditions. However, of these 6,653 residents, the Air Force interim procedure for predicting average percent awakened estimates 1,228 would be awakened (an increase of only 33 people on an MFE evening); the methodology developed by Ollerhead (1992) predicts 71 residents potentially awakened (an increase of only 2 people on an MFE evening).

The on-base land area exposed to $\text{DNL} \geq 65$ dB would increase by 0.50 square miles, from 15.64 to 16.14 square miles. This increase would generally occur to the north and west of the runways, but does not affect any additional on-base housing areas. The off-base land area exposed to $\text{DNL} \geq 65$ dB would increase by 0.89 square miles, from 2.94 to 3.83 square miles. This would occur south of the base in the Mountain View area, over the Knik Arm to the west of the airfield, and over Fort Richardson to the east. However, none of the Fort Richardson cantonment area would be affected.

Implementation of the Proposed Action or any of the Alternative Actions would result in increases in the number of off-base residents exposed to $\text{DNL} \geq 65$ dB, and thus in the number of residents likely to be "highly annoyed" by the aircraft-generated noise. Level II impacts are predicted for some residents located off-base, but adjacent to Elmendorf; Level I impacts for on-base residents. However, potential adverse impacts would be minimized by the following factors:

- 1) No on-base residents would be exposed to $\text{DNL} \geq 80$ dB, and the majority of those exposed to $\text{DNL} \geq 65$ dB (2,673 or 92 percent) would reside in the DNL 65 to 74 dB contours;
- 2) No off-base residents would be exposed to $\text{DNL} \geq 70$ dB;
- 3) Quiet hours are generally enforced between 11:00 p.m. and 7:00 a.m.;
- 4) MFE sorties would normally occur during the daytime (i.e., between 7:00 a.m. and 10:00 p.m.) with only a small number of arrivals (i.e., on-base landings) between 10:00 p.m. and 11:00 p.m. during twice-yearly nighttime MFEs;
- 5) The Air Force limits non-mission essential use of afterburners;
- 6) The Air Force has an ongoing policy of routing flight tracks to avoid overflying noise sensitive areas, to the maximum extent possible, within the parameters of runway alignment, wind direction, and mission requirements;
- 7) It is Air Force policy to ensure that the proper Noise Level Reduction measures (outdoor to indoor) are incorporated in the design and construction or modification of all on-base buildings situated within the $\text{DNL} \geq 65$ dB contours;
- 8) As a result of the extreme climate conditions of Eielson and Elmendorf AFBs, energy conservation practices (e.g., insulation) in both on- and off-base housing contribute to indoor noise level reductions; and

- 9) Since the mid-1970s, the Air Force has published AICUZ studies, which advise local governments to direct noise sensitive development away from high noise areas near Air Force Bases. The AICUZ program continues in effect at Elmendorf AFB, and will be updated to reflect the noise levels of the alternative selected by the Air Force. Potential mitigation for airfield noise is identified as part of the AICUZ revision process.

In addition, the 3 WG would continue to monitor and respond to community reactions to aircraft operations via its noise complaint process (administered through the Elmendorf AFB Public Affairs Office). Therefore, it is not expected that implementation of the Proposed Action or any of the Alternative Actions would have any significant adverse impact on land uses in the vicinity of Elmendorf AFB.

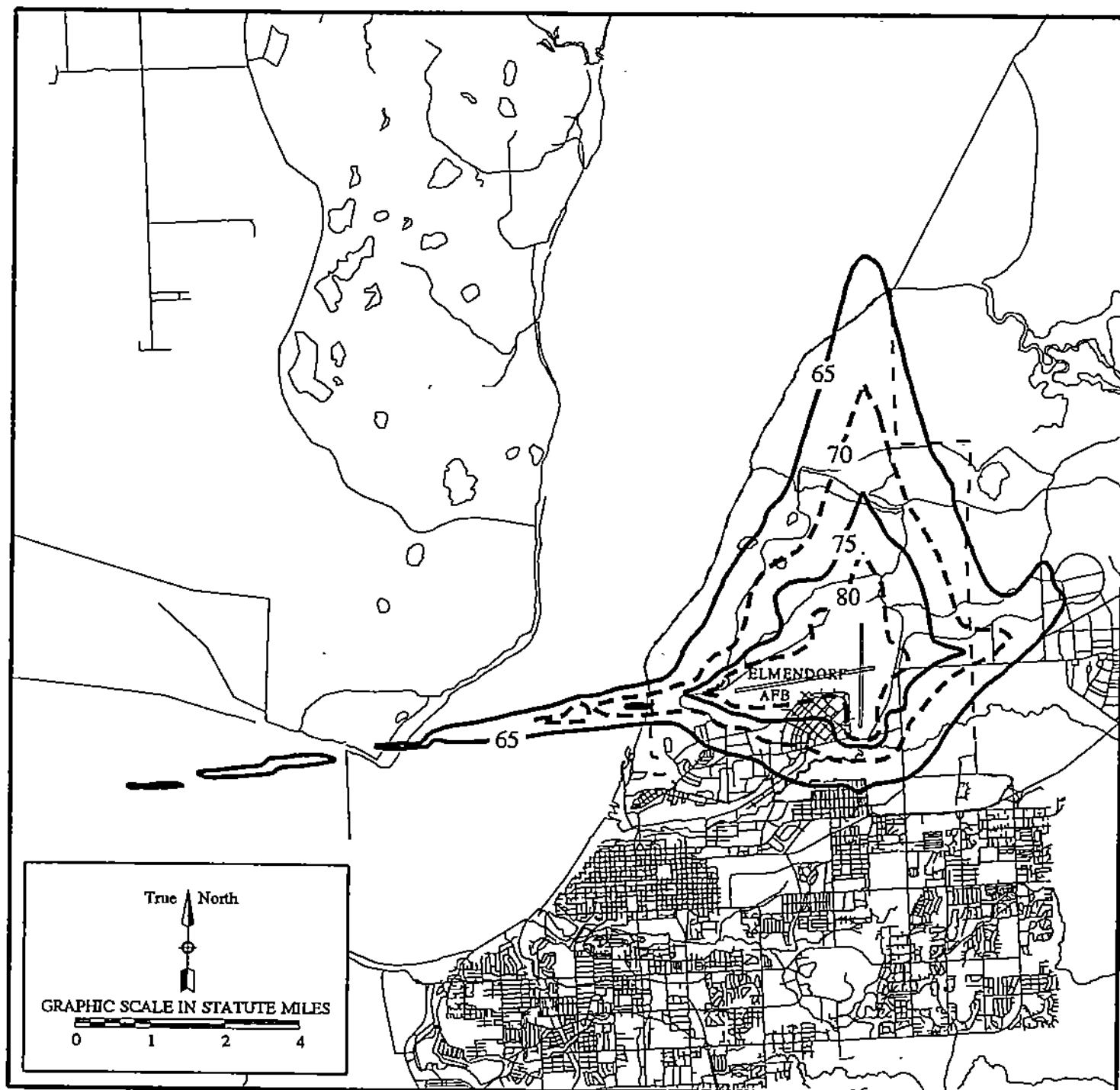


Figure 4-31 DNL Contours for Proposed Action Operations at Elmendorf AFB - Routine Daily Training Plus Six MFEs per Year

Table 4-13 On-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Elmendorf AFB Proposed Operations - Routine Daily Training plus Six MFEs per Year

DNL Intervals (dB)	Proposed Operations		
	Area (mi ²)	No. of Persons	No. Highly Annoyed
65 - 69	6.46	1,145	240
70 - 74	4.18	1,528	489
75 - 79	2.94	232	107
≥ 80	2.56	0	0
Totals:	16.14	2,905	836

Sources: USAF 1993b; U.S. Bureau of the Census 1990.

Table 4-14 Off-Base Population Exposure to Aircraft Noise $\geq$ DNL 65 dB from Elmendorf AFB Proposed Operations - Routine Daily Training Plus Six MFEs per Year

DNL Intervals (dB)	Proposed Operations		
	Area (mi ²)	No. of Persons	No. Highly Annoyed
65 - 69	3.39	1,001	210
70 - 74	0.37	0	0
75 - 79	0.07	0	0
≥ 80	0.00	0	0
Totals:	3.83	1,001	210

Sources: USAF 1993b; U.S. Bureau of the Census 1990.

4.9 Air Quality

4.9.1 Issues/Concerns

Air quality issues include the effects of increased aircraft operations on nonattainment areas and PSD Class I air quality areas close to the Region of Influence of the Proposed Action and Alternatives. Concerns include the effects of additional carbon monoxide levels in the Fairbanks and Anchorage nonattainment areas, and effects of aircraft operations on visibility in the Denali National Park and Preserve PSD Class I air quality area. However, most of the state is designated a Class II air quality area, which allows moderate growth. New or modified sources of air emissions may use up to 25 percent of the National Ambient Air Quality Standards (NAAQS).

4.9.1.1 Impact Assessment Methodology

The screening methodologies described in section 3.9 were used to determine the order of magnitude of pollutant concentrations, particularly carbon monoxide levels, expected to be created by implementation of either the Proposed Action or any of the Alternatives. If the estimates derived through use of this screening were 50 percent of the NAAQS, a more sophisticated model would be used to more accurately determine the pollutant concentrations that would be expected.

Short-term downfield pollutant concentrations were estimated using data from the *Aircraft Engine Emissions Estimator* (Seitchek 1985), which were derived using the Air Quality Assessment Model (AQAM) short-term program. These estimates use a point located five kilometers from the start of the runway, along the runway centerline, assuming a small tailwind and a straight climbout.

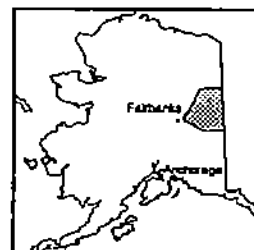
4.9.2 Proposed Action

Implementation of the Proposed Action would result in an increase in aircraft operations, during MFEs, at Eielson and Elmendorf AFBs and in the MOAs. This would lead to a slight increase in air emissions in these areas.

4.9.2.1 Northern Interior Region

4.9.2.1.1 Military Operations Areas

Under the Proposed Action, total winter routine daily operations would remain the same, with some redistribution of operations among the MOAs. Pollutant concentrations resulting from Air Force aircraft operations would remain essentially the same as described for the baseline conditions.



The highest level of aircraft operations would continue to occur during the summer months of June, July, and August, when most of the MFEs would take place. The YUKON 1 MOA would have the highest number of operations below the mixing height of the MOAs. Air pollutant concentrations in the YUKON 1 MOA would therefore be the highest of any MOA assessed in this EIS. Therefore, YUKON 1 is the only MOA for which pollutant concentrations were estimated, since the other MOAs would have even lower pollutant concentrations. Pollutant concentrations were estimated using the same methodology as described in section 3.9.2, and are depicted in Table 4-15. These pollutant concentrations would be such a small percentage of the NAAQS that no appreciable impacts to air quality would result.

Table 4-15 Aircraft Air Pollutant Emissions Estimates for the YUKON 1 MOA: Proposed Action

Pollutant	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Time	Percentage of Primary NAAQS
Carbon Monoxide	46.4	1-Hour	0.1
Nitrogen Oxides	1.5	Annual	1.5
Particulates	1.9	24-Hour	1.3
Sulfur Dioxide	1.7	24-Hour	1.0

4.9.2.2 Southern Interior Region

4.9.2.2.1 Eielson AFB

There would be an increase in air emissions at Eielson AFB. Air pollutant emissions that would result from aircraft operations and maintenance are presented in Table 4-16. These figures indicate there would be an increase in carbon monoxide emissions of 18 percent over baseline, 11 percent for hydrocarbons, 22 percent for nitrogen oxides, and 20 percent for particulates. Using downfield pollutant concentration estimates from the *Aircraft Engine Emissions Estimator* (Seitchek 1985), approximate carbon monoxide concentrations due to routine winter daily aircraft operations for the North Pole portion of the Fairbanks carbon monoxide nonattainment area would be $22 \mu\text{g}/\text{m}^3$. Summer concentrations, on an MFE day, would be $87.2 \mu\text{g}/\text{m}^3$ during the hours when the MFE aircraft take off (one hour in the morning and one hour in the afternoon).

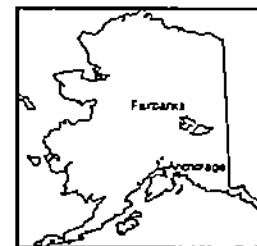


Table 4-16 Aircraft Air Pollutant Emissions Estimates for Eielson AFB, Alaska: Proposed Action

Location	Pollutants Emitted (Tons per Year)				
	CO	HC	NO _x	PM ₁₀	SO ₂
Eielson AFB	382.8	180.3	106.9	4.9	16.1
Increase From Baseline	59.2	18.4	19.3	0.8	2.7

Because Eielson AFB is close to the North Pole carbon monoxide nonattainment area, the Proposed Action was analyzed to determine the need for an air quality conformity determination. Under the Clean Air Act, as amended, actions are considered to have no appreciable effect on the adopted timetable for returning an area to conformance with the NAAQS if the levels of pollutants are below certain levels. For carbon monoxide, this level is 100 tons per year. The increase in air emissions due to the proposed increase in aircraft operations would result in a net increase in carbon monoxide emissions of less than 100 tons per year. Therefore, the Proposed Action and Alternatives are exempted from further conformity analyses pursuant to 40 CFR 93.153(c)(1).

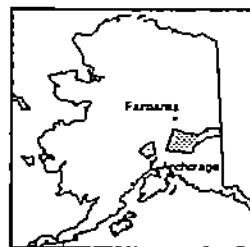
4.9.2.2.2 Military Operations Areas

Pollutant concentrations would be such a small percentage of the NAAQS that no appreciable effect on air quality or visibility would result.

4.9.2.3 Southcentral Region

4.9.2.3.1 Elmendorf AFB

Elmendorf AFB's location adjacent to the Anchorage carbon monoxide nonattainment area results in the potential for indirect effects of activities on the base to occur in the nonattainment area. The State of Alaska has interpreted the provisions of the Clean Air Act to include analysis of the potential for effects of such activities on the nonattainment area. This analysis includes determination of conformity with the Alaska State Implementation Plan and goals for reducing levels of carbon monoxide in the Municipality. Clean Air Act requirements are described in Appendix K.



Estimates of air emissions generated by the types of transient and based aircraft at Elmendorf AFB were modeled using the Aircraft Emissions Estimator methodology described in Appendix K. These estimates are presented in Table 4-17. The estimates indicate an approximate 6 percent increase in carbon monoxide emitted by aircraft operations over baseline estimates, and 2 to 8 percent increases in the other pollutants modeled. Refer to Table 3-40 and Table 3-42 in sections 3.9.3.1 and 3.9.4.1 for the baseline figures.

Table 4-17 Aircraft Air Pollutant Emissions Estimates for Elmendorf AFB, Alaska: Proposed Action

Location	Pollutants Emitted (Tons per Year)				
	CO	HC	NO _x	PM ₁₀	SO ₂
Elmendorf AFB	520.8	195.4	210.5	10.5	37.8
Increase From Baseline	30.1	4.6	15.6	0.7	2.8

The increase in air pollutant emissions due to increased aircraft operations and motor vehicle use during MFEs would result in a net increase in carbon monoxide emissions of less than 100 tons per year, a de minimis increase in emissions. Therefore, the Proposed Action is exempted from further conformity analyses pursuant to 40 CFR 93.153(c)(1).

4.9.2.3.2 Military Operations Areas

With the establishment of a permanent FOX MOA, use of the SUSITNA MOA would decrease by two thirds, reducing air emissions by a similar amount. Maximum use of the FOX MOA would occur during MFEs, but most operation would continue to be limited to the southern two thirds of the MOA. Concentrations of air emissions in the FOX MOA would remain below 0.01 $\mu\text{g}/\text{m}^3$ for the NAAQS pollutants and would not be expected to affect air quality or visibility.

4.9.2.4 Western Region

4.9.2.4.1 Military Operations Areas

Fewer aircraft operations are proposed for this region than for the Northern Interior Region, analyzed above. Since the air pollutant concentrations estimated for the Northern Interior Region are so low and would be even lower in the Western Region, no appreciable impacts on air quality would be expected to occur in this area. This region was not further analyzed.



4.9.3 Alternative A

This alternative is identical to the Proposed Action except the CLEAR CREEK MOA would not be established. The aircraft operations proposed for this MOA would be shifted to the BIRCH and EIELSON MOAs. The number of aircraft operations proposed for either the BIRCH or EIELSON MOAs would result in total operations that are less than the number modeled for the YUKON 1 MOA, and thus would not result in air emissions that would have an appreciable effect on local or regional air quality. These MOAs would not be located in nonattainment or maintenance areas.

4.9.4 Alternative B

This alternative would establish the TANANA MOA adjacent to and east of the FOX MOA, and adjacent to and south of the BUFFALO and YUKON 3 MOAs. The MOA would not be located within a nonattainment or maintenance area. The number of aircraft operations proposed for this area would be fewer than was modeled for the Proposed Action for YUKON 1 MOA, and thus would not appreciably affect local or regional air quality.

4.9.5 No Action Alternative

The No Action Alternative would consist of continuing current aircraft operations in the airspace as presently configured. Air pollutant emissions would remain as described in section 3.9.

4.9.6 Alternative A—Modified

Implementation of this alternative would result in air quality effects equivalent to those predicted for the Proposed Action. There would be no appreciable effect on local or regional air quality, nonattainment areas, or PSD Class I areas.

4.10 Socioeconomics

4.10.1 Eielson Air Force Base

The Proposed Action would not change the number of permanent personnel assigned to Eielson AFB. There would be an estimated maximum of 1,015 transient personnel traveling to the base for each MFE (assumes a 30 percent increase in transient personnel over the number deployed for 1993 MFEs). Thus, a total of 6,090 transient personnel would travel to Eielson AFB annually for MFEs. The Air Force intends to house all transient MFE personnel on-base, but there would be an increased demand for goods and services, both on- and off-base. It is estimated that transient personnel spend approximately \$55.00 per day for goods and services (food, entertainment, some transportation, sundries) (Troebler 1995). Assuming each individual's stay lasts 15 days and that each individual spends \$55.00 per day, a total of \$825.00 would be spent per person per MFE. With an estimated maximum of 1,015 transient personnel per MFE, each MFE would result in an input of \$837,375.00 to the local economy. If the proposed maximum of six MFEs were conducted each year, the net input would be \$5,024,250.00. While each of the figures used in this equation represents the maximum anticipated (i.e., the maximum estimated MFE participants, the maximum MFE-related stay, the maximum number of MFEs conducted per year) and therefore the high end of probable socioeconomic effects, this figure is indicative of the beneficial effect transient military personnel spending can have on local and statewide economies. The capacity of the existing commercial establishments, both on- and off-base are expected to be adequate to meet the increase in demand. Thus, there would be no adverse impact on the community (socioeconomic) resources of the Fairbanks North Star Borough or the surrounding region. There would, however, be a beneficial impact resulting from additional spending by transient military personnel.

Implementation of the No Action Alternative would result in continuation of MFEs at current levels, with no adverse impact on community (socioeconomic) resources anticipated.

Under Alternatives A, B, and Alternative A—Modified, the socioeconomic effects would be the same as for the Proposed Action. There would be no adverse impact on community (socioeconomic) resources; and there would be a beneficial impact resulting from additional spending by transient military personnel.

4.10.2 Elmendorf Air Force Base

The Proposed Action would not change the number of permanent personnel assigned to Elmendorf AFB. Using the same assumptions and methodology employed for Eielson AFB, there would be an estimated maximum of 322 transient personnel traveling to the base for each MFE, resulting in a total of 1,932 MFE transient personnel annually. There would be increased demand for goods and services (food, entertainment, some transportation, sundries). Again, assuming each individual's stay lasts 15 days and that each individual spends at least \$55.00 per day (a conservative estimate for personnel housed off-base), a total of \$825.00 would be spent per person per MFE. With an estimated maximum of 322 transient personnel per MFE, each MFE would result in an input of \$265,650.00 to the local economy. If the proposed maximum of six MFEs were conducted each year, the net input would be \$1,593,900.00. While each of the figures used in this equation represents the maximum anticipated (i.e., the maximum estimated MFE participants, the maximum MFE-related stay, the maximum number of MFEs conducted per year) and therefore the high end of probable socioeconomic effects, this figure is indicative of the beneficial effect transient military personnel spending can have on local and statewide economies. The capacity of the existing commercial establishments, both on- and off-base are expected to be adequate to meet the increase in demand. Thus, there would be no adverse impact on the community (socioeconomic) resources of the Municipality of Anchorage or the surrounding region. In addition, there would be a beneficial impact resulting from additional spending by transient military personnel.

Implementation of the No Action Alternative would result in continuation of MFEs at current levels, with no adverse impact on community (socioeconomic) resources anticipated.

Under Alternatives A, B, and Alternative A—Modified, the socioeconomic effects would be the same as for the Proposed Action. There would be no adverse impact on community (socioeconomic) resources; and there would be a beneficial effect from the additional spending by transient military personnel.

4.10.3 Galena Airport and King Salmon Airport

Under the Proposed Action, a maximum of 40 transient personnel would be deployed to each of these forward operating bases for up to 3 to 4 MFEs per year, for an estimated 2-day stay (Hanson 1994). These transient personnel would be housed on-base. The contracts in place for facilities and services are adequate to support this level of deployment, and no off-site facilities or services would be required (*ibid.*). Thus, there would be no adverse effect on the socioeconomic resources of the local communities.

Implementation of the No Action Alternative would result in continuation of MFEs at current levels, with no adverse impact on socioeconomic resources anticipated.

Under Alternatives A, B, and Alternative A—Modified, the socioeconomic effects would be the same as for the Proposed Action. There would be no adverse impact on socioeconomic resources.

4.10.4 Military Operations Areas

Potential socioeconomic impacts to commercial recreation resources and activities are addressed in detail in section 4.6.5. However, as there is no evidence that recreationists would choose to go elsewhere to recreate on the basis of exposure to or knowledge of aircraft overflights, potential impacts to commercial recreation are predicted to be Level I or less.

4.11 Other Environmental Consequences

4.11.1 Cumulative Impacts

4.11.1.1 Airspace Management, Aircraft Operations, and Aviation Safety

Cumulative impacts must consider the totality of flying activities or factors affecting flying throughout the Region of Influence. This includes not only Air Force activities in the MOAs, but also DoD flights along the MTRs; Air Force slow speed operations outside of the MOAs, such as OA-10A and C-130 operations in the LATN areas; other non-Air Force operations, such as Army helicopter flights out of Fort Greely or Fort Wainwright; civil flights (e.g., pleasure, for hire, mail carrier, agency, and firefighting) throughout the affected airspace; the occasional closure of airspace by Fort Greely for Controlled Fire Areas (CFAs) for artillery shots into the ranges west of the Richardson Highway; the FAA airway structure; and the terrain, season, and weather. Operations on the MTRs that are coincident with the MOAs would continue at rates similar to those currently being flown today. Approximately 8 MTR sorties per day are flown during the summer months and approximately 5 sorties per day are flown during the winter. Likewise, C-130 and OA-10A operations in the LATN areas are not expected to change. Army operations, however, are expected to decline over the years. All uses of overlapping military airspace would require coordination between the 354 FW, 3 WG, and the Army. De-confliction of potential military/civil conflicts will be required of these new MOAs when approved. Areas of multiple military airspace uses coinciding with high civil use, such as in the Southern Interior Region along the Alaska and Richardson Highways and V-444, present the most difficult problem—providing the Air Force access to R-2202 and the Oklahoma air-to-ground weapons range while not diminishing civil aviation access along the highways with a reasonable sense of security. The Proposed and Alternative Actions are designed to maintain the integrity of the existing federal airway structure. Alternative A—Modified, which stratifies the lower portions of the YUKON 3 MOA, creates VFR corridors through BUFFALO MOA, raises the floors of FALCON and BIRCH MOAs, and eliminates the CLEAR CREEK MOA, would minimize civil aviation disruptions along the Alaska and Richardson Highways. As the civil aviation community modernizes equipment over the next decade, the desire for more direct, off-airway routings from hub areas such as Fairbanks to points east would most likely evolve. Such routings could impact the viability and training usefulness of the YUKON 1 and 2 MOAs. To a lesser extent, similar demands for direct routings may evolve in the Western Region from communities such as Aniak, Dillingham, and McGrath and may impact the STONY MOAs.

4.11.1.1.1 Conclusion

Implementation of the Proposed Action or any of the other Alternative Actions is not anticipated to have measurable long-term adverse impacts on airspace management, aircraft operations, or aviation safety.

4.11.1.2 Noise

Subsonic

Cumulative noise levels throughout the Region of Influence are a product of many sources. Noise levels are primarily affected by transportation or industrial noise and are closely related to population density and associated infrastructure. In the absence of significant noise sources such as interstate highways, major truck routes, railroads, airports, mining, logging, and agricultural activities, noise levels in rural and wilderness areas are typically in the range of DNL 35 to 50 dB. In addition to military aircraft-generated noise associated with subsonic operations in the MOAs, other subsonic military aircraft operations (low-altitude MTR training flights, C-130 LATN flights, and Army helicopter operations) contribute in varying degrees to DoD-generated noise throughout the MOAs in the Region of Influence.

In the YUKON MOAs, flights along the MTRs would increase the average noise levels approximately L_{dnmr} 2-3 dB in YUKON 1, 2, and 6 MOAs during an MFE flying month. The outlying MOAs, YUKON 3 and 4, would experience an even greater contribution of up to L_{dnmr} 4-7 dB increase due to MTR operations as their average noise levels are less than the YUKON 1 and 2 MOAs during an MFE flying month. The BIRCH, EIELSON, and BUFFALO MOAs would be expected to experience an increase of L_{dnmr} 1-3 dB with coincident MTR operation during an MFE month. Aircraft operations in the FOX MOA (with a higher floor) would be a much less dominant noise source in this area than aircraft operations along MTR 937. With the addition of this noise source, the average noise levels near MTR 937 are expected to be at least L_{dnmr} 10 dB greater than those solely from MOA operations. In the Western Region, the STONY MOAs would experience an increase of L_{dnmr} 6-9 dB in average noise levels in the vicinity of MTRs through the MOAs. As in the case of the FOX MOA, the NAKNEK MOAs (with higher floors) and the GALENA MOA (with low usage) would not be the dominant noise source in the area. Low-altitude MTR operations would be more dominant in the immediate vicinity of the MTRs than would noise levels generated by MOA operations. In all cases, the average noise levels are expected to remain less than L_{dnmr} 55 dB. It should be noted that FAA restrictions on airspace use and flight de-confliction preclude concurrent (i.e., simultaneous) use of MTRs and MOAs.

Other low-altitude operations include C-130 low-altitude flights in the LATN areas and in the vicinity of drop zones, occasional Army helicopter operations, civil helicopter operations (especially along the trans-Alaska oil pipeline), and other civil aircraft operations throughout the Region of Influence. In areas where these operations are coincident with the MOAs, the total of all additional contributions is expected to increase the average noise levels by L_{dnmr} 1 dB.

The highest potential cumulative subsonic noise levels are expected to occur in an area circumscribed by the border of the Stuart Creek air-to-ground weapons range (R-2205) in the YUKON 1 MOA, south through the BIRCH MOA, and into the Oklahoma air-to-ground weapons range (R-2202). This area sustains a high number of sorties during an MFE and also contains several MTRs, a portion of the C-130 LATN area, several C-130 drop zones, operations along the trans-Alaska oil pipeline, and civil aviation along the Richardson Highway between Delta Junction and Fairbanks. All of these factors contribute to a cumulative noise environment approaching L_{dnmr} 55 dB during an MFE month. This area would encompass the very southern portion of YUKON 1 (adjoining the BIRCH MOA and in the vicinity of the intersection of MTRs 928, 935, and 1909), through the center of the BIRCH MOA (coincident with MTR 928), and down through the eastern half of the EIELSON MOA in the areas of MTRs 1900, 937, and 928. During a non-MFE month, the total contribution of all additional (non-MOA) flight activities would be greater due to lower MOA noise levels; however, the total average noise levels would be L_{dnmr} 5 dB less than during an MFE month.

Supersonic

In addition to the noise levels generated by low-altitude subsonic flight activities, occasional impulsive noises such as sonic booms would occur as a result of air-to-air training activities. These sonic booms are similar to the noise generated by artillery firing or explosive devices. Sonic booms would be highly dispersed, occur more frequently during an MFE, and average 2 to 4 psf of overpressure. At these levels, except for possible occasional window breakage or damage to bric-a-brac, no structural damage should occur. Likewise, except for potential annoyance or startle associated with a sonic boom, no other long-term effects can be identified.

4.11.1.2.1 Conclusion

No cumulative adverse impacts on sound levels are predicted. Even considering all of the noise sources, average subsonic sound levels would remain below L_{max} 55 dB in most MOAs and only approach L_{max} 55 dB in the area between the Stuart Creek and Oklahoma air-to-ground ranges. The occasional sonic booms that may be recorded are not expected to cause any long-term cumulative human health effects or structural damage.

4.11.1.3 Chaff and Flares/Hazardous Operations

No significant adverse environmental impacts stemming from the proposed use of chaff and flares, munitions, emergency fuel release, or hazardous materials and waste handling are anticipated, nor are any significant adverse impacts on fire management activities predicted.

4.11.1.3.1 Conclusion

As no significant adverse impacts related to the proposed use of chaff and flares or other hazardous operations have been identified, it is unlikely that the Proposed or Alternative Actions would contribute to cumulative adverse environmental impacts.

4.11.1.4 Biological Resources

Alaska's biological resources exist in an increasingly unstable environment, and human activities account for most of the instability. In assessing cumulative impacts on these resources, it is again most useful to start at the lower end of the complexity scale and project impacts upward. Caribou have been identified as the single species most susceptible to important individual and population level impacts. Dall sheep are probably second on the list of potentially affected species, and from there the ranking becomes hazy. Caribou thus provide the best example to carry through in discussing cumulative effects.

In their natural environment, caribou are exposed to the threats of inclement climate and associated deficits in forage availability and quality. Predation is also a major influence, as is disease. When human activities such as subsistence and sport hunting and habitat destruction are added to natural threats, the welfare of caribou populations becomes more problematic. In this scenario, passive, human-caused disturbances such as aircraft noise can validly be viewed as relatively insignificant. The operative term is "relatively."

When the more influential forces in the caribou's environment are within normal tolerances, the impact of disrupting vital life-cycle activities with jet overflights would probably not cause discernible population-level effects. However, as evidenced by the cyclical nature of caribou populations, major environmental and human-related factors can swing widely. Caribou populations can fall into trouble. The current status of the Mentasta herd is a good example. Under these conditions, minor disturbances can become major, slowing or preventing the cyclical rebound when natural conditions improve.

When a caribou population is maintained at artificially low levels by human activities, spin-off effects begin to manifest at the community level. For example, predator population cycles, which typically mimic but slightly lag prey cycles, are also retarded. Predators then serve to lock the caribou population in at reduced population

levels. With less grazing pressure, vegetation communities begin to change. In this way, population-level effects can expand to the community level, to the ecosystem level and to the landscape level. Important negative impacts are possible at each.

This leads to the question of how important the proposed changes in airspace use and configuration are in the context of cumulative human-caused impacts. This proposal's potential impacts stem from aircraft noise. There are a number of other sources of aircraft noise in the Region of Influence, including other Air Force flight training programs involving similar aircraft and noise types and levels (e.g., the MTRs). It should be noted that most other aircraft noise involves aircraft types, particularly light fixed-wing aircraft and helicopters, that reportedly have more severe impacts on wildlife than military jets. Additional sources of aircraft noise include other Department of Defense programs, particularly those of the Army; flight operations of governmental agencies; and commercial and general aviation. In a large state with few highways, aircraft are essential and common.

Quantification of flight numbers, aircraft types and noise generated by these other sources is difficult if not impossible. The best numbers available are reported in the aviation safety analysis (see section 4.4). To summarize those figures, it is safe to say that the change in the number of aircraft overflights of MOA airspace resulting from implementation of the Proposed Action or an Alternative Action would be very minor in relation to current levels of military and civilian aircraft activity.

Other sources of human-caused disturbance include hunting, trapping, mining, and construction of utilities, all of which directly or indirectly impact wildlife populations and the natural systems of which they are a part.

4.11.1.4.1 Conclusion

In this scenario of increasing disturbance of biological systems, this proposal is in all likelihood a minor consideration. However, cumulative human actions are likely to have increasingly substantial impacts on Alaska's biological resources. In contributing to this total, and in exacerbating the impact of more important influences, implementation of the Proposed Action or an Alternative Action could hasten this process. This is especially true in the more isolated portions of the affected area. The proposed mitigation would ameliorate this effect.

4.11.1.5 Recreation Resources

Cumulative adverse impacts to recreation and, in particular, to primitive and semi-primitive recreation opportunity settings, would accrue from the impacts of the Proposed or Alternative Actions combined with other ongoing or planned projects in the Region of Influence. Other activities include continued or increased oil and gas exploration and development (e.g., Arctic National Wildlife Refuge); development of other economies (e.g., mineral exploration and extraction, time harvests in the Tanana Valley State Forest); rural development efforts (e.g., paving the Denali Highway, building roads to McGrath or Cordova); increased private and commercial recreation use (e.g., constructing a resort on the Chulitna River); increased rural tourism (e.g., the Alaska Native Tourism Council's efforts); and changes in regulations and management plans governing the administration and use of dedicated and multiple-use areas. The probability of any or all of these activities occurring, and to what level, is unknown. However, impacts attributable to military aircraft overflight are moderate when compared with those associated with consumptive and terrain-altering activities such as mining, logging, and other types of development.

4.11.1.5.1 Conclusion

For high sensitivity areas, implementation of the Proposed Action or one of the Alternative Actions in conjunction with the activities outlined above could contribute to the degradation of recreation resources over time. In the larger context of more invasive and permanent activities, this contribution is likely to be minor.

4.11.1.6 Subsistence Resources

Many activities and projects that could have cumulative impacts on subsistence lifestyle, patterns, and use can be considered (e.g., changes in subsistence regulations and rural determinations). Federal and state resources management can also affect wildlife populations, adversely or beneficially. As the economy of Alaska shifts away from dependency on oil resources, other economies will be developed or expanded. Increases in private and commercial recreation use (and, in particular, sport hunting), tourism, and development of rural areas (e.g., implementing timber harvests in the Tanana Valley State Forest), road developments (e.g., paving the Denali Highway, establishing roads to Cordova and McGrath), and potential increases in gas and oil exploration and development would increase potential for impacts to subsistence and remote lifestyles.

Development would be likely to bring in more people, civil aircraft, regulations, and bureaucracy. Increasing motorized use of remote and rural lands would be likely to increase degradation of wildlife habitat, as well as degradation of the remote Alaska experience. If subsistence demand follows increasing population trends, increased numbers of subsistence users can be expected, resulting in further pressures on subsistence resources and patterns of use. Climate factors such as severe winters and biological factors such as disease and predation can and do adversely impact the availability of subsistence wildlife resources.

4.11.1.6.1 Conclusion

The Proposed Action or Alternatives by themselves are not anticipated to have measurable long-term impacts on wildlife populations, and subsequently subsistence resources. In considering the cumulative impacts of all past, present, and foreseeable activities, perhaps one of the greatest threats, collectively, is perceptual impacts. Perceived threats to subsistence harvests and to the importance—both real and psychological—of subsistence to the rural Alaskan lifestyle can contribute significantly to rural Alaskans' anxieties regarding new proposals. However, wildlife and wildlife harvest is intensively managed in the state, and subsistence use is given priority over other consumptive users on federal public lands. For these reasons, it is anticipated that long-term adverse cumulative impacts would be averted.

4.11.1.7 Land Use

In addition to Air Force aircraft operations, other ongoing or planned activities within the Region of Influence may affect land use and aesthetics. These activities include continued or increased oil and gas exploration and development, development of other economies, rural development efforts, increased civil aviation activities, and changes in regulations and management plans governing land uses on state and federal lands.

4.11.1.7.1 Conclusion

As no significant adverse impacts to land use or aesthetics have been identified, it is unlikely that implementation of the Proposed Action or any of the Alternative Actions would contribute to cumulative adverse impacts.

4.11.1.8 Air Quality

In addition to Air Force aircraft operations, commercial and private aircraft operate in the Region of Influence, and there are a number of stationary sources, mainly coal fired power plants, contributing air emissions. Additionally, motor vehicle usage and use and grading of dirt roads have an adverse effect on air quality. Climatological conditions in the Region of Influence, particularly little wind and long periods of low light, contribute to low levels of air mixing and result in low dispersion of air pollutants.

4.11.1.8.1 Conclusion

Aircraft operations in the MOAs that occur above the mixing height would not affect ground level air quality. Aircraft operations that occur below the mixing height would produce very small pollutant concentrations that, even in addition to the other air pollution sources in the area, would not contribute levels of pollution that would approach the state and federal standards applicable to the areas in which the MOAs would be located.

4.11.1.9 Socioeconomics

In addition to Air Force actions, numerous other ongoing or planned activities and projects within the Region of Influence may affect socioeconomics. The Proposed and Alternative Actions are, within this context, a minor consideration. Implementation of the Proposed or Alternative Actions would benefit the local economies of Eielson and Elmendorf AFBs with cash infusions by transient personnel associated with MFEs.

4.11.1.9.1 Conclusion

As no significant adverse impacts to socioeconomics have been identified, it is unlikely that the Proposed or Alternative Actions would contribute to cumulative adverse impacts.

4.11.2 Unavoidable Adverse Impacts

4.11.2.1 Airspace Management, Aircraft Operations, and Aviation Safety

Routine military flight operations and increased MFE operations in newly established MOAs have some potential to disrupt non-participating flight operations. Combining procedural mitigations with pro-active information systems to increase pilots' situational awareness would minimize the potential adverse impacts to non-participating aviation associated with routine and increased MFE operations in these areas.

4.11.2.2 Noise

No unavoidable adverse impacts on the sound environment are expected from implementation of the Proposed or Alternative Actions. Although the single-event sound levels of some overflights could be considerable, average sound levels would remain below L_{dnmr} 55 dB.

4.11.2.3 Chaff and Flares/Hazardous Operations

No unavoidable adverse impacts due to the use of chaff and flares or any hazardous operations are anticipated.

4.11.2.4 Biological Resources

MOA-based flight training may occasionally disrupt routine and critical-phase wildlife activities and pose some potential threats to individual animals, selected wildlife populations, and perhaps some wildlife communities. These potential unavoidable adverse impacts should remain fairly localized.

4.11.2.5 Recreation Resources

Military aircraft activities may periodically disrupt recreation activities and temporarily alter the recreation opportunity setting of an area. These unavoidable adverse effects would be localized and short-term.

4.11.2.6 Subsistence Resources

Military flight operations may briefly disrupt subsistence activities and it is also possible that they may cause some behavioral responses in individual animals and wildlife populations important to subsistence users. Because of

the nature of the proposed activities and the intensive management afforded wildlife and subsistence uses, these impacts should be localized and minimal.

4.11.2.7 Land Use

Land use activities occurring under the MOAs and on or adjacent to Eielson and Elmendorf AFBs may be affected by the proposed military aircraft activities. However, any disruptions would be extremely brief and localized, and would not result in any significant adverse impacts on land use.

4.11.2.8 Air Quality

The low levels of air pollutant concentrations in the MOAs that would result from implementation of the Proposed Action or any of the Alternatives would not result in unavoidable adverse impacts to air quality.

4.11.2.9 Socioeconomics

No unavoidable adverse effects on socioeconomics within the Region of Influence would occur.

4.11.3 Relationship between Short-Term Uses and Long-Term Productivity

The value of the proposed changes in MOA configuration and use (short-term use of the environment) must be weighed against the need to maintain and enhance the long-term productivity of the environment. In that no new facilities or infrastructure would be built, no permanent changes to the landscape introduced, no species likely to be threatened with extinction, no resources apt to be eliminated, and the resources potentially affected are generally renewable, a substantial reduction of long-term environmental productivity is unlikely.

4.11.4 Irreversible and Irretrievable Commitments of Resources

The proposed changes in MOA configuration and use would require some irreversible and irretrievable commitment of resources such as fuels and other consumables, and labor. This expenditure of resources would not differ in kind or be notably greater than that which already occurs and would continue to occur regardless of the alternative selected.

This Page Intentionally Left Blank

4.12 Mitigation

Mitigation actions are activities that are not specifically required by existing laws or regulations, but can be implemented to avoid or minimize the environmental impacts of an action. The Council on Environmental Quality (CEQ) regulations at 40 *CFR* 1508.20 define mitigation to include actions that:

- Avoid the impact altogether by not taking a certain action or parts of an action.
- Minimize impacts by limiting the degree or magnitude of the action and its implementation.
- Rectify the impact by repairing, rehabilitating, or restoring the affected environment.
- Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action.
- Compensate for the impact by replacing or providing substitute resources or environments.

CEQ further stipulates that the mitigation measures discussed in an EIS must cover the range of impacts of the proposed action. Measures must be considered even for impacts that by themselves would not be considered "significant." Once the proposal itself is considered as a whole to have significant effects, all of its specific effects on the environment (whether or not "significant") must be considered and mitigation measures developed where it is feasible to do so.

Predicted short-term (5 to 10 years), continuous or long-term (up to 20 years or beyond), and unpredictable impacts are the types of effects that could require mitigation. To provide an appropriate level of mitigation for any impact, the extent and magnitude of the impact on the resources must be known. Some of the mitigations described in the Draft EIS were carried forward to the Final EIS. Many other mitigation measures came about from suggestions received during the public comment period on the Draft EIS.

Table 4-18 summarizes mitigation measures that could be used to avoid, minimize, or remedy the potential environmental impacts associated with the Proposed or Alternative Actions. The anticipated efficacy of each measure for specific resources is also presented. For the most part, impacts and, therefore, mitigations fall into one of two categories: 1) potential conflicts with general aviation, and 2) noise concerns. Noise is the primary source of potential impacts to biological resources, recreation, subsistence, and land use. Noise impact mitigations were developed for the F-15 and F-16—the aircraft that would be the predominant users of the MOAs. Although other aircraft capable of producing slightly higher noise levels could occasionally use the MOAs, the differences in single-event maximum noise levels among these aircraft are minimal (2 to 4 dB higher), use levels predicted for these aircraft are low, and their activities would be dispersed over large areas. Given these factors, mitigation designed to alleviate noise impacts from F-15 and F-16 aircraft should be adequate. The mitigations listed are technically feasible measures the Air Force would be able to execute.

Measures designed to mitigate the noise-derived adverse impacts identified in this analysis were developed based on a review of pertinent background information, including an Interagency Agreement between the NPS, USFWS, BLM, and FAA (1993) that, while not binding upon the Air Force, encourages pilots making VFR flights over noise sensitive areas to ". . . make every effort to fly not less than 2,000 feet above the surface, weather permitting. . ." and a recently completed study prepared for the NPS by Anderson and Horonjeff (1992). The NPS study examined the effect of aircraft altitude on sound levels on the ground. Briefly, it suggested that enforcing minimum altitude restrictions above NPS units is an effective mitigation only when aircraft are operating at relatively low altitudes to begin with. The greatest acoustical benefit occurs when aircraft slant distance (height above ground) is increased from 125 feet to 1,000 feet (decreasing maximum sound level by 24 dB), then to 2,000 feet (an additional 8 dB decrease), and then to 3,000 feet (an additional 5 dB decrease). Increasing slant distance further, from 3,000 to 5,000 feet, results in moderate to substantial sound level reductions (roughly a 4 dB reduction for each 1,000-foot increase). Beyond 5,000 feet, each 1,000-foot increase produces only a "very small" reduction in sound level (about 2 dB for each 1,000-foot step) (*ibid.*). The study

concluded that minimum altitude restrictions over NPS units should be applied on a case-by-case basis for site-specific sensitivities and declined to recommend any minimum altitude restriction for NPS units in general.

For some short- and long-term effects, impacts cannot be precisely estimated now due to their complexity or the low probability of their occurrence. Additional information will be required to develop suitable mitigation. Actual impacts will be measured through an impact monitoring program designed to detect changes in biological, social, and/or physical parameters. Detection of changes that exceed the maximum acceptable level or threshold (as determined by the appropriate regulatory agency or agencies) would trigger a mitigation response plan.

In its Record of Decision (ROD), the Air Force will identify which mitigation measures will be adopted and which, if any, will not, with an explanation of why they will not be adopted. The ROD will also include a mitigation implementation and monitoring plan.

Table 4-18 Potential Mitigation Measures

Mitigation	MOA(s) Affected	Resource(s) Mitigated	Effectiveness
MOA Altitude (Floor or Ceiling) and Internal Boundary Changes			
Raise the minimum altitude (floor) to 5,000 ft AGL.	YUKON 5 FOX	Aviation Safety Biological Resources Recreation Subsistence Land Use	This would reduce single-event and average noise levels, and improve civil aviation access.
Raise the minimum altitude (floor) to 500 ft AGL.	BIRCH FALCON CLEAR CREEK*	Aviation Safety	This would improve civil aviation access along major VFR flyways, including the Alaska and Richardson highways and the trans-Alaska oil pipeline.
Establish a civilian flight corridor at 4,000 ft MSL to 6,000 ft MSL to protect the VFR hemispheric altitudes of 4,500 ft MSL and 5,500 ft MSL, 2 nautical miles (NM) either side of the Alaska Highway. Establish a civilian flight corridor at 4,000 ft MSL to 6,000 ft MSL to protect the VFR hemispheric altitudes of 4,500 ft MSL and 5,500 ft MSL, ½ NM either side of the Richardson Highway.	BUFFALO TANANA (Alt. B)	Aviation Safety	This would improve civil aviation access along major VFR flyways, including the Alaska and Richardson highways and the trans-Alaska oil pipeline.
Raise the floor to 500 ft AGL below the civilian flight corridor, 2 NM either side of the Alaska Highway and ½ NM either side of the Richardson Highway.	BUFFALO TANANA (Alt. B)	Aviation Safety	This would improve civil aviation access along major VFR flyways, including the Alaska and Richardson highways and the trans-Alaska oil pipeline.
Raise the floor to 5,000 ft AGL west of the line from 63°37'00" N, 145°00'00"W to 62°47'37" N, 145°00'00"W.	TANANA (Alt. B)	Aviation Safety Recreation Subsistence Land Use	This would reduce single-event and average noise levels and potential impacts to the Tangle Lakes/Tangle River area, Gulkana and Delta National Wild Rivers, Denali Highway, Proposed West Fork of the Gulkana River ACEC ¹ , and Richardson Highway.

Mitigation	MOA(s) Affected	Resource(s) Mitigated	Effectiveness
Raise the floor to 2,000 ft AGL east of the line from 64°59'59"N, 143°00'00"W to 63°23'00"N, 143°05'00"W.	TANANA (All B)	Aviation Safety Recreation Subsistence Land Use	This would reduce single-event and average noise levels and potential impacts to the Fortymile National Wild River, Taylor Highway, and West Fork Campground; and improve civil aviation access to Eagle, Chicken, and Boundary from Tok.
Divide the MOA into horizontal and vertical sections and raise the floor to 2,000 ft AGL east and south of the line running from the northeast corner of YUKON 3 MOA to the intersection with the northeast corner of BUFFALO MOA (from 64°59'59"N, 141°05'00"W to 63°59'59"N, 143°00'00"W).	YUKON 3A (Low) YUKON 3B (Low) YUKON 3 (High)	Aviation Safety Recreation Subsistence	This would reduce single-event and average noise levels and potential impacts to the Fortymile National Wild River, Taylor Highway, and Walker Fork Campground; and improve civil aviation access to Eagle, Chicken, and Boundary from Tok.
MOA External Boundary Changes			
Move the northwest boundary approximately 5 NM to the southeast (terminal points at 64°31'17"N, 146°09'31"W and 64°17'43"N, 147°03'29"W).	BIRCH	Aviation Safety Recreation Subsistence Land Use	This would avoid the Salcha River and Harding Lake areas. Resources and activities in these areas would not be exposed to direct aircraft overflights and associated noise levels.
Move the southeast corner approximately 20 NM to the west (terminal points at 63°30'00"N, 145°54'00"W and 62°30'00"N, 146°43'19"W).	FOX	Aviation Safety Biological Resources Recreation Subsistence Land Use	This would avoid the Gulkana and Delta National Wild Rivers, Tangle Lakes area, Richardson Highway, proposed West Fork of the Gulkana River ACEC, and trumpeter swan nesting areas. Resources and activities in these areas would not be exposed to direct aircraft overflights and associated noise levels.
Move the eastern boundary approximately 20 NM to the west (terminal points at 61°51'22"N, 153°14'44"W and 61°25'01"N, 153°38'39"W).	STONY A	Recreation	This would avoid Lake Clark National Park and Preserve, and prevent visitors and resources from being exposed to direct aircraft overflights and associated noise levels.

Mitigation	MOA(s) Affected	Resource(s) Mitigated	Effectiveness
Move the eastern boundary approximately 10 NM to the west (terminal points at 60°52'33"N, 154°43'15"W and 60°18'58"N, 154°43'15"W).	NAKNEK 2	Recreation	This would avoid Lake Clark National Park and Preserve, and prevent visitors and resources from being exposed to direct aircraft overflights and associated noise levels.
Use Restrictions — MFEs			
Conduct no MFEs during September, December, or January.	All MOAs	Aviation Safety Recreation Subsistence Land Use	This would minimize potential impacts to sport and subsistence hunting and other late season recreation and aviation activities.
Provide a minimum 2-week break between MFEs.	All MOAs	Biological Resources Recreation Land Use	This would minimize potential impacts to wildlife and recreationists by providing periods when outdoor activities could be planned to avoid MFEs and providing quiet periods for wildlife.
Conduct no MFEs the week prior to and the week following the 4th of July.	All MOAs	Recreation	This would minimize potential impacts during one of the highest recreation use periods of the year.
Limit use to MFEs only.	YUKON 5 th	Aviation Safety Biological Resources Recreation Subsistence	This would maintain the <i>status quo</i> for military aircraft operations in the area.
Use Restrictions — Supersonic Operations			
Limit supersonic operations to Functional Check Flights (FCFs) and Operational Check Flights (OCFs) along an east/west line south of the Denali National Park and Preserve.	SUSITNA	Recreation	This would minimize potential noise (sonic boom) effects on the resources and users of Denali National Park and Preserve and the community of Petersville.
Conduct supersonic operations at or above 5,000 ft AGL or 12,000 ft MSL, whichever is higher. NOTE: Supersonic operations in STONY A and B MOAs would continue to be conducted at or above 5,000 ft AGL or 10,000 ft MSL, whichever is higher.	YUKON 1-5 SUSITNA FOX TANANA (Alt. B)	Biological Resources Recreation Subsistence Land Use	This would reduce the maximum peak overpressures from sonic booms, minimizing potential impacts associated with supersonic operations.

Mitigation	MOA(s) Affected	Resource(s) Mitigated	Effectiveness
Flight Avoidance Areas and Overflight/Operational Restrictions			
Establish a Flight Avoidance Area over the Kuskokwim and Holitna rivers (east and south of the community of Red Devil) of 2,000 ft AGL and 2 NM either side of the river centerlines. Effective from May 15 to September 15.	STONY B	Biological Resources Aviation Safety Land Use	This would improve civil aviation access to communities along the rivers; and would reduce single-event and average noise levels and potential impacts to residents, subsistence users, recreationists, and wildlife along the rivers.
Increase the existing peregrine falcon Flight Avoidance Areas (2,000 ft AGL and 2 NM either side of the river centerline) on the Charley, Kandik, and Yukon rivers to extend from April 15 to September 15.	YUKON 1-4	Biological Resources Recreation Aviation Safety	This would reduce noise levels and enhance civil aviation access along the rivers.
Establish a Flight Avoidance Area over the Nowitna National Wild River (2,000 ft AGL and 2 NM either side of the river centerline) from May 15 to July 15.	GALENA	Biological Resources Recreation Aviation Safety	This would reduce noise levels and enhance civil aviation access along the river.
Protect "at risk" wildlife populations by restricting overflights during critical life-cycle periods. "At-risk" populations and temporal and spatial protection parameters to be established through consultation with management agencies, and the smallest practicable and effective area mitigated.	All MOAs	Biological Resources	This would reduce noise levels and the potential for negative behavioral responses. The focus on "at risk" populations during critical life-cycle periods minimizes the likelihood of long-term negative effects.
Protect the Delta caribou herd by establishing a minimum overflight altitude of 3,000 ft AGL over calving areas (nominally from May 15 to June 15).	BIRCH EIELSON	Biological Resources	This would reduce noise levels and the potential for negative behavioral responses.
Protect Dall sheep in the Northern Alaska Range and the Tanana Hills by establishing a minimum overflight altitude of 5,000 ft AGL over lambing areas and spring mineral licks (nominally from May 15 to June 15) and over rutting areas (nominally from November 15 to December 15).	YUKON 1-4 BUFFALO EIELSON FOX	Biological Resources	This would reduce noise levels and the potential for negative behavioral responses.

Mitigation	MOA(s) Affected	Resource(s) Mitigated	Effectiveness
Communication and Information Exchange			
Continue to provide the Special Use Airspace Information Service (SUAIS).	EIELSON BIRCH BUFFALO YUKON 1, 2, and 3	Aviation Safety	This would increase situational awareness of all aviators operating in the Interior MOAs.
Continue the in-state toll free number (1-800-538-6647).	All MOAs	Recreation Subsistence Land Use	This would provide the public with a mechanism for obtaining information on Air Force aviation activities and MFE schedules, and conveying information and/or concerns to the Air Force.
Notify Alaska press outlets of the annual MFE schedule for release in publications such as the <i>Milepost</i> , visitor and travel guides, and various newspapers.	All MOAs	Aviation Safety Recreation Subsistence Land Use	This would enable individuals to plan activities around the MFE schedule if they wished.
Continue operation of the Alaska Civil/Military Aviation Advisory Committee (ACMAAC).	All MOAs	Airspace Management Aviation Safety	This would provide for direct dialogue between airspace users to resolve potential impacts to aviation activities.
Establish a Resource Protection Council consisting of three inter-agency (federal, state, and Air Force) coordination teams: 1) Resource Protection/Mitigation, 2) Public Information, and 3) Research and Monitoring.	All MOAs	Biological Resources Recreation Subsistence Land Use	This would provide a forum for monitoring the efficacy of mitigation measures, providing information to the public, and identifying and filling data gaps.

Note: Unless otherwise indicated, mitigation would be year-round.

²Under Alternative A—Modified, the CLEAR CREEK MOA would not be established.

³Under Alternative A—Modified, the floors of YUKON 5 MOA and FOX MOA would be 5,000 ft AGL year-round.

⁴Area of Critical Environmental Concern (ACEC).

This Page Intentionally Left Blank

CHAPTER 5

BIBLIOGRAPHY

This bibliography contains works cited in the EIS, as well as works consulted by the preparers but not cited. It is organized by section, mirroring the arrangement of the EIS.

Purpose of and Need for Proposed Action (Chapter 1) and Description of the Proposed Action and Alternatives (Chapter 2)

- Anderson, Grant S., and Richard D. Horonjeff. 1992. *Aircraft Overflight Study: Effect of Aircraft Altitude Upon Sound Levels at the Ground*. NPOA Report No. 91-4. Lexington, Mass.: National Park Service. Prepared by Harris, Miller, Miller & Hanson, Inc.
- Fink, Richard J. 1994. The National Wildlife Refuges: Theory, Practice, and Prospect. *Harvard Environmental Law Review* 18:n.p.
- Murphy, Stephen M., Michael D. Smith, Robert G. White, Julie A. Kitchens, B. Andrew Kugler, and David S. Barber. 1993. *Behavioral Responses of Caribou to Low-Altitude Jet Aircraft*. AL/OE-TR-1994-0117. Wright-Patterson AFB, Ohio: Air Force Materiel Command, Armstrong Laboratory.
- President. 1988. Executive Order No. 12630: Governmental Actions and Interference with Constitutionally Protected Property Rights. *53 Federal Register* 8859.
- U.S. Air Force (USAF). 1974. *Final Environmental Statement: Air Force Blair Lakes Range Operations*. n.p.: n.p.
- _____. 1986a. *Environmental Assessment: Military Operations Areas, 1986 Update, Alaska*. Elmendorf AFB, Alaska: Headquarters, Alaskan Air Command. Prepared by EnviroSphere Company.
- _____. 1986b. *Environmental Assessment of the Proposed Low-Level Instrument Route 942*. n.p.: n.p.
- _____. 1988. *Environmental Assessment: Establishment of the Alaska Air Combat Maneuvering Instrumentation System (ACMI) in Stony MOA*. n.p.: n.p.
- _____. 1991a. *Environmental Assessment: Proposed Beddown of F-15E Squadron, Elmendorf AFB, Alaska*. Elmendorf AFB, Alaska: 11 AF. Prepared by Spectrum Sciences & Software, Inc.
- _____. 1991b. *Environmental Assessment: Proposed Conversion to F-16C/D Squadron, Eielson AFB, Alaska*. Elmendorf AFB, Alaska: 11 AF. Prepared by Spectrum Sciences & Software, Inc.
- _____. 1992a. *CATEX/Record of Environmental Consideration: Cope Thunder Range Microwave Link (CTRML)*. Elmendorf AFB, Alaska: 11 AF.
- _____. 1992b. *Environmental Assessment: Major Flying Exercises/Cope Thunder 1992*. Elmendorf AFB, Alaska: 11 AF.
- _____. 1992c. *Environmental Assessment of the Expansion and Upgrade of Military Training Routes, Alaska*. Elmendorf AFB, Alaska: 11 AF. Prepared by ENSR Consulting and Engineering.
- _____. 1992d. *Environmental Assessment of the Upgrade of Target Arrays: Fort Wainwright and Fort Greely, Alaska*. Elmendorf AFB, Alaska: 11 AF. Prepared by Louis Berger & Associates, Inc.
- _____. 1992e. *Quarry Hill Range Microwave Link Facility*. n.p.: n.p.

- _____. 1993a. *Environmental Assessment of Major Flying Exercises in Alaska*. Elmendorf AFB, Alaska: 11 AF. Prepared by Spectrum Sciences & Software, Inc.
- _____. 1993b. *U.S. Air Force Airspace Master Plan*. USAF Flight Standards Agency. n.p.: n.p. Prepared by Booz-Allen & Hamilton, Inc.
- _____. 1993c. *Yukon Measurement and Debriefing System: Environmental Assessment*. Elmendorf AFB, Alaska: 11 AF. Prepared by Spectrum Sciences & Software, Inc.
- _____. 1993d. *3rd Wing OPLAN 355-1: Disaster Preparedness*. Elmendorf AFB, Alaska: 3 WG/CC.
- _____. 1993e. *Eielson AFB OPLAN 355-1: Disaster Preparedness*. Eielson AFB, Alaska: 354 SPTG/CC.
- _____. 1994a. *3rd Wing OPLAN 19-1: Spill Response*. Elmendorf AFB, Alaska: 3 WG/CC.
- _____. 1994b. *3rd Wing OPLAN 127-1: Mishap Response*. Elmendorf AFB, Alaska: 3 WG/CC.
- U.S. Army (USA). 1980a. *Final EIS Concerning Proposed Land Withdrawal for the 172nd Infantry Brigade (Alaska) at Fort Wainwright*.
- _____. 1980b. *Final EIS Concerning Proposed Land Withdrawal for the 172nd Infantry Brigade (Alaska) at Fort Greely*.
- U.S. Federal Aviation Administration (FAA). 1993. *Procedures for Handling Airspace Matters (7400.2)*. n.p.: FAA.
- U.S. National Park Service, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, and Federal Aviation Administration. 1993. *Interagency Agreement Between National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and Federal Aviation Administration*. n.p.: n.p.
- White, Robert G., Julie A. Kitchens, Bret R. Luick, Stephen M. Murphy, Michael D. Smith, B. Andrew Kugler, and David S. Barber. 1993. *Energy Expenditures of Caribou Responding to Low-Altitude Jet Aircraft*. AL/OE-TR-1994-0180. Brooks AFB, Texas: Air Force Materiel Command, Armstrong Laboratory.

Physical Considerations

- Alaska Northwest Books. 1991. *Facts About Alaska*. Seattle, Wash.: Alaska Northwest Books.
- Alaska Department of Fish and Game (ADF&G). 1986a. *Alaska Habitat Management Guide, Southcentral Region, Volume II: Distribution, Abundance and Human Use of Fish and Wildlife*. Anchorage, Alaska: ADF&G.
- _____. 1986b. *Alaska Habitat Management Guide, Western and Interior Regions: Distribution, Abundance and Human Use of Fish and Wildlife; and Map Atlas*. Anchorage, Alaska: ADF&G.
- LaChapelle, Edward R. 1985. *The ABC of Avalanche Safety*. Seattle, Wash.: The Mountaineers.
- Lillard, D.C., T.L. Parrott, and D.B. Gallagher. 1965. Effect of Sonic Booms of Varying Overpressures on Snow Avalanches. FAA Report No. SST 65-9. In *Survey of Sonic Boom Phenomena for the Non-Specialist*. Slutsky, Simon. 1975. FAA-RD-75-68. Federal Aviation Administration. Prepared by H.H. Aerospace Design Company. Springfield, Va.: National Technical Information Service.
- Miller, J.F. 1963. *Probable Maximum Precipitation and Rainfall-Frequency Data for Alaska for Areas 400 Square Miles, Duration to 24 Hours and Return Periods from 1 to 100 Years*. Technical Paper No. 47. Washington, D.C.: U.S. Department of Commerce.
- Perla, Ronald I., and M. Martinelli, Jr. 1975. *Avalanche Handbook*. U.S. Department of Agriculture, Agriculture Handbook 489.
- Searby, H.W. 1975. *Climates of the States: Alaska*. Climatography of the United States No. 60-49. Washington, D.C.: U.S. Department of Commerce.
- Selkregg, Lidia L. 1976. *Alaska Regional Profiles*. Anchorage, Alaska: Arctic Environmental Information and Data Center.
- Wahrhaftig, Clyde. 1965. *Physiographic Divisions of Alaska*. U.S. Geological Survey Professional Paper No. 482. Washington, D.C.: U.S. Government Printing Office.

Airspace Management, Aircraft Operations, and Aviation Safety

- Arrington, David, USAF BASH Team, Tyndall AFB, Fla. 1993. *Personal communication with Mike Thompson, Spectrum Sciences & Software, Inc., n.d.*
- Bergt, Derril, Military Operations Officer, FAA. 1994. *Personal communication with William Ham, Spectrum Sciences & Software, Inc., June 8.*
- Butler, W., and R. Gill. 1993. *Waterfowl, Raptor, and Shorebird Migratory and Breeding Distributions in Alaska [USGS DLG]; 1:2,000,000.* Anchorage, Alaska: U.S. Fish and Wildlife Service.
- Federal Aviation Administration (FAA). 1993. *Terminal Areas Forecasts, FY 1993-2005, FAA-APO-93-9, July 1993.*
- Kessel, B. 1984. Migration of Sandhill Cranes, *Grus canadensis*, in East-central Alaska with Routes through Alaska and Western Canada. *The Canadian Field-Naturalist* 98 (3):279-292.
- King R. 1993. *Waterfowl, Raptor, and Shorebird Migratory and Breeding Distributions in Alaska [USGS DLG]; 1:2,000,000.* Fairbanks, Alaska: U.S. Fish and Wildlife Service.
- Mindell, D.P. 1983. *Nesting Raptors in Southwestern Alaska: Status, Distribution, and Aspects of Biology.* BLM/AK/TR-83/08. Anchorage, Alaska: U.S. Bureau of Land Management.
- Thompson, Michael M. 1993. *Bird Avoidance Model Description Supplement to Programmer's Manual.* Tyndall AFB, Fla.: HQ AFCESA/DMPS.
- U.S. Air Force (USAF). 1986. *Environmental Assessment: Military Operations Areas 1986 Update, Alaska.* Elmendorf AFB, Alaska: Pacific Air Forces.
- _____. 1989. *Fish and Wildlife Management Plan for Eielson Air Force Base, Alaska, Fourth Revision, January 1989 to December 1991.* Eielson AFB, Alaska: Civil Engineering Squadron. Prepared by G. von Rueden, Natural Resource Manager.
- _____. 1991a. *Environmental Assessment: Proposed Beddown of F-15E Squadron, Elmendorf AFB, Alaska.* Elmendorf AFB, Alaska: Pacific Air Forces. Prepared by Spectrum Sciences and Software, Inc.
- _____. 1991b. *Environmental Assessment: Proposed Beddown of F-16C/D Squadron, Eielson AFB, Alaska.* Eielson AFB, Alaska: Pacific Air Forces. Prepared by Spectrum Sciences and Software, Inc.
- _____. 1992a. *Environmental Assessment of the Expansion and Upgrade of Military Training Routes, Alaska.* Elmendorf AFB Alaska: 11th Air Force. Prepared by ENSR Consulting and Engineering.
- _____. 1992b. *Air Installation Compatible Use Zone (AICUZ) Study: Eielson AFB.* Eielson AFB, Alaska: Civil Engineering.
- _____. 1992c. *Air Installation Compatible Use Zone (AICUZ) Study: Elmendorf AFB.* Elmendorf AFB, Alaska: Civil Engineering.
- _____. 1992d. *11th Air Force Supplement, Air Force Regulation 50-46.* Elmendorf AFB, Alaska.
- _____. 1993a. *Operations Information Data Package.* Elmendorf AFB, Alaska: 11 AF/DOO.
- _____. 1993b. *Environmental Assessment: Major Flying Exercises in Alaska.* Elmendorf AFB, Alaska: Pacific Air Forces. Prepared By Spectrum Sciences and Software, Inc.
- _____. 1993c. *Aircrew Inflight Guide: C-130 Operations (2 Jan 1993).* Elmendorf AFB, Alaska: 3 OSS/DOWA.
- _____. 1993d. *F-15 E Inflight Guide (12 Apr 1993).* Elmendorf AFB, Alaska: 3 OG/CCX.

- _____. 1993e. *355 FS Handy Operational Guide (20 Sep 1993)*. Eielson AFB, Alaska: 354 OG/DOV.
- _____. 1993f. *F-15 C Inflight Guide (1 Oct 1993)*. Elmendorf AFB, Alaska: 3 OG/CCX.
- _____. 1993g. *354th Viper Guide (21 Oct 1993)*. Eielson AFB, Alaska: 354 OG/DOV.
- U.S. Army (USA). 1993. *Personal communication (letter) from Capt Kenneth Prygoski, 6 Infantry Division (Light), Army Flight Operations to Maj Bob Siter, 11 AF/DOOQ, regarding 6th Aviation Brigade Flight Profile*.
- U.S. Federal Aviation Administration (FAA). 1993. *Procedures for Handling Airspace Matters (7400.2)*. n.p.: FAA.

Noise

- American National Standards Institute (ANSI). 1990a. *Acoustical and Electroacoustical Terminology*. ANSI S1.1 (Draft). New York, N.Y.: Acoustical Society of America.
- _____. 1990b. *Sound Level Descriptors for Determination of Compatible Land Use*. ANSI S12.40-1990. New York, N.Y.: Acoustical Society of America.
- Anderson, Grant S., and Richard D. Horonjeff. 1992. *Aircraft Overflight Study: Effect of Aircraft Altitude Upon Sound Levels at the Ground*. NPOA Report No. 91-4. Lexington, Mass.: U.S. National Park Service. Prepared by Harris, Miller, Miller, and Hanson, Inc..
- Clarkson, Brian L., and William M. Mayes. 1972. Sonic Boom-Induced Building Structures Responses Including Damage. *J. Acoustical Society of America* 51 (Feb):742-757.
- Cook, Brenda W., and M.J. Lucas. 1993. *A Review of Air Force Policy and Noise Models Pertaining to the Noise Environment Under Low-Altitude, High-Speed Training Areas*. n.p.: n.p.
- Federal Interagency Committee on Noise (FICON). 1992. *Federal Agency Review of Selected Airport Noise Analysis Issues: Volume I, Policy Report, Technical Report*. n.p.: FICON.
- Federal Interagency Committee on Urban Noise (FICUN). 1980. *Guidelines for Considering Noise in Land Use Planning and Control*. Washington, D.C.: U.S. Government Printing Office.
- Haber, J.D. Nakaki, C. Taylor, G. Knipprath, V. Koppam, and M. Legg. 1989. *Effects of Aircraft Noise and Sonic Booms on Structures: An Assessment of the Current State of Knowledge*. HSD-TR-89-002. Wright-Patterson AFB, Ohio: Air Force, Noise and Sonic Boom Impact Technology Program. Prepared by BBN Systems and Technologies Corporation.
- National Research Council (NRC). 1977. *Guidelines for Preparing Environmental Impact Statements on Noise*. Report of Working Group 69; Committee on Hearing, Bioacoustics, and Biomechanics, Assembly of Behavioral and Social Sciences. Washington, D.C.: National Academy of Sciences.
- North Atlantic Treaty Organization (NATO). n.d. *Aircraft Noise in a Modern Society: Final Report of the Pilot Study*. Number 185. n.p.: NATO, Committee on the Challenges of Modern Society.
- Ollerhead, J.B., et al. 1992. *Report of a Field Study of Aircraft Noise and Sleep Disturbance*. London, U.K.: Civil Aviation Authority, Department of Safety, Environment and Engineering.
- Pearson, K., D. Barber, and B. Tabachnick. 1989. *Analysis of the Predictability of Noise-Induced Sleep Disturbance*. HAD-TR-89-029. Brooks AFB, Texas: Advanced Development Program Office, Noise and Sonic Boom Impact Technology, Human Systems Division.
- Plotkin, Kenneth J., Vijay R. Desai, Carey L. Moulton, Michael J. Lucas, Ronald Brown. 1989. *Measurement of Sonic Booms Due to ACM Training at White Sands Missile Range*. Wyle Research Report WR 89-18. Arlington, Va.: Wyle Laboratories.
- Schultz, T.J. 1978. Synthesis of Social Surveys on Noise Annoyance. *J. Acoustical Society of America* 54 (2):377-405.
- U.S. Air Force (USAF). 1978. *Environmental Protection: Planning in the Noise Environment*. AFM-19-10. Washington, D.C.: U.S. Government Printing Office.
- _____. 1984. *Assessing Noise Impact of Air Force Flying Operations: Guidelines*. Washington, D.C.: HQ/USAF.
- _____. 1992a. *Environmental Assessment of the Expansion and Upgrade of Military Training Routes, Alaska*. Elmendorf AFB, Alaska: 11th Air Force. Prepared by ENSR Consulting and Engineering.

- _____. 1992b. *Air Installation Compatible Use Zone (AICUZ) Study: Eielson AFB*. Eielson AFB, Alaska: Civil Engineering.
- _____. 1992c. *Air Installation Compatible Use Zone (AICUZ) Study: Elmendorf AFB*. Elmendorf AFB, Alaska: Civil Engineering.
- _____. 1993a. *Operations Information Data Package*. Elmendorf AFB, Alaska: 11 AF/DOO.
- _____. 1993b. *Environmental Assessment: Major Flying Exercises in Alaska*. Elmendorf AFB, Alaska: Pacific Air Forces. Prepared By Spectrum Sciences and Software, Inc.
- U.S. Department of Housing and Urban Development (HUD). 1985. *The Noise Guidebook*. HUD-953-CPD. Washington, D.C.: U.S. Government Printing Office.
- U.S. Environmental Protection Agency (EPA). 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety*. EPA-ONAC-550/9-74-004. Washington, D.C.: U.S. Government Printing Office.
- _____. 1976. *About Sound*. Washington D.C.: EPA.
- _____. 1978. *Protective Noise Levels: Condensed Version of EPA Levels Document*. EPA-550/9-79-100. Springfield, Va.: National Technical Information Service.
- _____. 1981. *Noise Effects Handbook: A Desk Reference to Health and Welfare Effects of Noise*. Fort Walton Beach, Fla.: National Association of Noise Control Officials.
- _____. 1982. *Guidelines for Noise Impact Analysis*. EPA-550/9-82-001. Washington, D.C.: U.S. Government Printing Office.
- U.S. Forest Service (USFS). 1992. *Report to Congress: Potential Impacts of Aircraft Overflights of National Forest System Wildernesses*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: U.S. Government Printing Office.
- U.S. National Park Service (NPS). 1994. *Report to Congress: Report on Effects of Aircraft Overflights on the National Park System*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: NPS.

Chaff and Flares/Hazardous Operations

- Air National Guard Readiness Center. 1992. *Final Environmental Impact Statement: Aircraft Conversions at the 103 Fighter Group, Bradley International Airport, Connecticut, and the 104 Fighter Group, Barnes Municipal Airport, Massachusetts, and Changes in Utilization of Military Training Airspace, Volume IVb, Appendix I*. Andrews AFB, Md.: Air National Guard.
- American Physical Society. 1995. *Statement by the Council of the American Physical Society, April 1995: Power Line Fields and Public Health*. Washington, D.C.: American Physical Society.
- Block, R.B., and Schiff, S.C. 1977. *Effects of Aluminized Fiberglass on Representative Chesapeake Bay Marine Organisms*. Washington, D.C.: Systems Consultants, Inc.
- Braun, B.A., and J.A. Zirtolli. 1983. *Environmental Fate of Hydrazine Fuels in Aqueous and Soil Environments*. ESL-TR-82-45. Tyndall AFB, Fla.: n.p. Cited in U.S. Air National Guard Readiness Center. 1992. *Final Environmental Impact Statement: Aircraft Conversions at the 103 Fighter Group, Bradley International Airport, Connecticut, and the 104 Fighter Group, Barnes Municipal Airport, Massachusetts, and Changes in Utilization of Military Training Airspace*.
- Hanson, Maj Virgil, 611 ASG/LGV. 1995. *Personal communication (telephone call) with Susan Means, Spectrum Sciences & Software, Inc., May*.
- Harrah, C.B. 1982. *Biological Effects of Hydrazine*. Second Conference on the Environmental Chemistry of Hydrazine Fuels, 15 February 1979. ESL-TR-82-22. Tyndall AFB, Fla.: n.p. Cited in U.S. Air National Guard Readiness Center. 1992. *Final Environmental Impact Statement: Aircraft Conversions at the 103 Fighter Group, Bradley International Airport, Connecticut, and the 104 Fighter Group, Barnes Municipal Airport, Massachusetts, and Changes in Utilization of Military Training Airspace*.
- Hudson, R.F. 1982. *Environmental Impact Process and Hydrazine Fuels for Air Force Space Shuttle Program*. Second Conference on the Environmental Chemistry of Hydrazine Fuels, 15 February 1979. ESL-TR-82-22. Tyndall AFB, Fla.: n.p. Cited in U.S. Air National Guard Readiness Center. 1992. *Final Environmental Impact Statement: Aircraft Conversions at the 103 Fighter Group, Bradley International Airport, Connecticut, and the 104 Fighter Group, Barnes Municipal Airport, Massachusetts, and Changes in Utilization of Military Training Airspace*.
- Kane, D.A., and K.J. Williamson. 1982. *Toxicity of Hydrazine to Selected Bacteria*. Second Conference on the Environmental Chemistry of Hydrazine Fuels, 15 February 1979. ESL-TR-82-22. Tyndall AFB, Fla.: n.p. Cited in U.S. Air National Guard Readiness Center. 1992. *Final Environmental Impact Statement: Aircraft Conversions at the 103 Fighter Group, Bradley International Airport, Connecticut, and the 104 Fighter Group, Barnes Municipal Airport, Massachusetts, and Changes in Utilization of Military Training Airspace*.
- National Guard Bureau (NGB). 1990. *Environmental Effects of Air National Guard Chaff Training Activities*. Andrews AFB, Md.: National Guard Bureau, Environmental Division. Prepared by Science and Engineering Associates, Inc.
- Section IV: H-70 Fuel Spill Management and Neutralization. 1992. In *Technical Order (T.O.) 1F-16CG-2-49GS-00-1*. Washington, D.C.: U.S. Government Printing Office.
- Taylor, William E. 1982. *Use of R6406 and R6407 for Chaff/Flare Drops*. n.p.: n.p.
- U.S. Air Force (USAF). 1978. *Environmental Effects of Chaff*. Brooks AFB, Texas: Systems Command, Occupational and Environmental Health Laboratory, Aerospace Medical Division.
- _____. 1983. *Air Force Regulation (AFR) 127-100: Explosive Safety Standards*. n.p.: n.p.

- _____. 1987. *Air Force Regulation (AFR) 55-79: Aircrew/Weapons Controller Procedures for Air Operations*. n.p.: n.p.
- _____. 1988. *Self-Protection Flare Training*. Langley AFB, Va.: Tactical Air Command.
- _____. 1989. *Identifying and Evaluating the Effects of Dispensing Chaff from Military Aircraft*. Offutt AFB, Nebraska: Headquarters, Strategic Air Command. Prepared by Science and Engineering Associates, Inc.
- _____. 1991a. *Environmental Assessment: Proposed Beddown of F-15E Squadron, Elmendorf AFB, Alaska*. Elmendorf AFB, Alaska: Pacific Air Forces. Prepared by Spectrum Sciences and Software, Inc.
- _____. 1991b. *Environmental Assessment: Proposed Beddown of F-16C/D Squadron, Eielson AFB, Alaska*. Eielson AFB, Alaska: Pacific Air Forces. Prepared by Spectrum Sciences and Software, Inc.
- _____. 1992a. *Aircraft Operations for the Environmental Assessment: Major Flying Exercises in Alaska*. Elmendorf AFB, Alaska: Pacific Air Forces.
- _____. 1992b. *Environmental Assessment of the Upgrade of Target Arrays: Fort Wainwright and Fort Greely, Alaska*. Elmendorf AFB, Alaska: 11th Air Force. Prepared by Louis Berger & Associates, Inc.
- _____. 1993a. *Operations Information Data Package*. Elmendorf AFB, Alaska: 11 AF/DOO.
- _____. 1993b. *FCIF Item: 11 AF Chaff/Flare Restrictions*. Elmendorf AFB, Alaska: 11 AF/DO.
- _____. 1993c. *Environmental Assessment: Major Flying Exercises in Alaska*. Elmendorf AFB, Alaska: Pacific Air Forces. Prepared by Spectrum Sciences and Software, Inc.
- _____. 1993d. *Message: Fire Index Restrictions on Weapons Delivery*. Elmendorf AFB, Alaska: 11 AF/DO.
- _____. 1993e. *Eielson AFB OPLAN 355-1: Disaster Preparedness*. Eielson AFB, Alaska: 354 SPTG/CC.
- _____. 1993f. *3rd Wing OPLAN 355-1: Disaster Preparedness*. Elmendorf AFB, Alaska: 3 WG/CC.
- _____. 1993g. *Oil and Hazardous Substance Discharge Prevention and Contingency Plan: Eielson AFB, Alaska*. Eielson AFB, Alaska: 354th Fighter Wing.
- _____. 1994a. *3rd Wing OPLAN 19-1: Spill Response*. Elmendorf AFB, Alaska: 3 WG/CC.
- _____. 1994b. *3rd Wing OPLAN 127-1: Mishap Response*. Elmendorf AFB, Alaska: 3 WG/CC.
- _____. 1994c. *3rd Wing Oil and Hazardous Substance Discharge Prevention and Contingency Plan (C-PLAN)*. Elmendorf AFB, Alaska: 3 WG.
- U.S. Air Force, U.S. Army, U.S. Department of the Interior. 1991. *Special Nevada Report*. DE-AC08-88NV10715. n.p.: U.S. Air Force, U.S. Army, U.S. Department of the Interior. Prepared by Science Applications International Corporation, Desert Research Institute.
- U.S. Army. 1980a. *Final Environmental Impact Statement: Land Withdrawal, 172D Infantry Brigade (Alaska) at Fort Greely, Alaska*. Fort Richardson, Alaska: U.S. Army.
- _____. 1980b. *Final Environmental Impact Statement: Land Withdrawal, 172D Infantry Brigade (Alaska) at Fort Wainwright, Alaska*. Fort Richardson, Alaska: U.S. Army.
- _____. 1991. *Memorandum: Temporary Suspension of White Phosphorous Munitions Firing onto Wetland Areas*. Washington, D.C.: U.S. Army, Office of the Assistant Secretary.
- _____. 1992. *Memorandum: Temporary Suspension of White Phosphorous Munitions on Alaska Training Ranges*. Fort Richardson, Alaska: U.S. Army, Headquarters, U.S. Army Garrison, Alaska.

- _____. 1993. *Memorandum for 343 WG/CC: White Phosphorous Munitions on Alaska Training Ranges*. Fort Wainwright, Alaska: U.S. Army, Headquarters, 6th Infantry Division (Light) and U.S. Army Garrison, Alaska.
- U.S. Bureau of Land Management. 1993. Lighting Strikes Extend Fire Season. *BLM-Alaska Frontiers* (September):5.
- _____. 1994a. *Fort Greely: Proposed Resource Management Plan [and] Final Environmental Impact Statement*. Anchorage, Alaska: U.S. BLM.
- _____. 1994b. *Fort Wainwright Yukon Maneuver Area: Proposed Resource Management Plan [and] Final Environmental Impact Statement*. Anchorage, Alaska: U.S. BLM.
- U.S. Department of Health and Human Services. 1990. *NIOSH Pocket Guide to Chemical Hazards*. Washington, D.C.: U.S. Government Printing Office.
- U.S. Federal Aviation Administration (FAA). 1993. *Procedures for Handling Airspace Matters (7400.2)*. n.p.: FAA.
- U.S. Environmental Protection Agency (EPA). 1992. *EMF in Your Environment: Magnetic Field Measurements of Everyday Electrical Devices*. Washington, D.C.: U.S. Government Printing Office.
- U.S. National Park Service (NPS). 1994. *Report to Congress: Report on Effects of Aircraft Overflights on the National Park System*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: NPS.
- U.S. Office of Technology Assessment. 1989. *Biological Effects of Power Frequency Electric and Magnetic Fields: Background Paper*. OTA-BP-E-53. Washington, D.C.: U.S. Government Printing Office.
- University of Alaska. 1994. Fire: Examining Its Forest Regeneration Potential. *Forest Sciences Notes* 2 (June):1-5.
- Viereck, Leslie A., and Linda A. Schandelmeier. 1980. *Effects of Fire in Alaska and Adjacent Canada: A Literature Review*. BLM/AK/TR-80/06. Anchorage, Alaska: U.S. BLM.

Biological Resources

- Alaska Department of Fish and Game (ADF&G). 1985. *Alaska Habitat Management Guide. Southcentral Region, Volume II: Distribution, Abundance and Human Use of Fish and Wildlife*. Division of Habitat. Juneau, Alaska: ADF&G.
- _____. 1986a. *Alaska Habitat Management Guide. Western and Interior Regions: Distribution, Abundance and Human Use of Fish and Wildlife*. Barnhill, C.A. Division of Habitat. Juneau, Alaska: ADF&G.
- _____. 1986b. *Alaska Habitat Management Guide. Arctic Region: Map Atlas*. Barnhill, C.A. Juneau, Alaska: ADF&G.
- _____. 1989a. *Federal Aid in Wildlife Restoration Research Progress Report: Status, Movements, Range Use Patterns, and Limiting Factors of the Fortymile Caribou Herd*. Valkenburg, P. and James L. Davis. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1989b. Wildlife Notebook Series. *Brown Bear*.
- _____. 1989c. Wildlife Notebook Series. *Lynx*.
- _____. 1989d. Wildlife Notebook Series. *Beaver*.
- _____. 1989e. Wildlife Notebook Series. *Land Otter*.
- _____. 1989f. Wildlife Notebook Series. *Marten*.
- _____. 1989g. Wildlife Notebook Series. *Mink*.
- _____. 1990a. *Dall Sheep: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1988 - 30 June 1989*. Division of Wildlife Conservation. Sid. O. Morgan (ed.) Vol. XX, Part II, Project W-23-2, Study 6.0, May 1990.
- _____. 1990b. *Federal Aid in Wildlife Restoration, Research Final Report: Factors Limiting Moose Population Growth in Subunit 20E*. Division of Wildlife Conservation. Gasaway, William C. et al. Juneau, Alaska: ADF&G.
- _____. 1991a. *Alaska Wildlife Harvest Summary 1989-90*. Division of Wildlife Conservation. Enid Goodwin, Project Leader.
- _____. 1991b. *Brown Bear: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1990 - 30 June 1991*. Division of Wildlife Conservation. Susan M. Abbott (ed.) Vol XXII, Part V, Project W-23-4, Study 4.0, December 1991.
- _____. 1991c. *Federal Aid in Wildlife Restoration, Research Progress Report: Ecology of Martens in Southeast Alaska*. Division of Wildlife Conservation. Flynn, Rodney W. Juneau, Alaska: ADF&G.
- _____. 1991d. *Wolf: Federal Aid in Wildlife Restoration, Survey-Inventory Management Report, 1 July 1989 - 30 June 1991*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1991e. *Moose: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1990 - 30 June 1991*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1991f. *Research Progress Report, 1 April 1988 - 30 March 1989: Population Dynamics of the Mentasta Caribou Herd*. Division of Wildlife Conservation. Lieb James, W., W. Brad Cella, and Robert W. Tobey.

- _____. 1992a. *Caribou: Federal Aid in Wildlife Restoration, Survey-Inventory Management Report, 1 July 1989 - 30 June 1991*. Division of Wildlife Conservation. Susan M. Abbott (ed.). Projects W-23-3, W-23-4, Study 3.0, February 1992.
- _____. 1992b. *Federal Aid in Wildlife Restoration, Research Progress Report: Ecology of Martens in Southeast Alaska*. Division of Wildlife Conservation. Flynn, Rodney W. and Gail Blundell. Juneau, Alaska: ADF&G.
- _____. 1992c. *Federal Aid in Wildlife Restoration, Research Progress Report: Investigation of Regulating and Limiting Factors in the Delta Caribou Herd*. Division of Wildlife Conservation. Valkenburg, Patrick. Juneau, Alaska: ADF&G.
- _____. 1992d. *Dall Sheep: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities 1 July 1991 - 30 June 1992*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1992e. *Caribou: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1991 - 30 June 1992*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1992f. *Wolf: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1991 - 30 June 1992*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1992g. *Bison: Federal Aid in Wildlife Restoration, Survey-Inventory Management Report, 1 July 1989 - 30 June 1991*. Division of Wildlife Conservation. Projects W-23-3 and W-23-4, Study 1.0. February 1992. Juneau, Alaska: ADF&G.
- _____. 1993a. *Moose: Federal Aid in Wildlife Restoration, Survey-Inventory Management Report, 1 July 1989 - 30 June 1991*. Division of Wildlife Conservation. Susan M. Abbott (ed.) Projects W-23-3 and W-23-4, Study 1.0, February 1993.
- _____. 1993b. *Black Bear: Federal Aid in Wildlife Restoration, Management Report of Survey-Inventory Activities, 1 July 1990 - 30 June 1992*. Division of Wildlife Conservation. Susan M. Abbott (ed.) Projects W-23-4/5, Study 17.0, August 1993.
- _____. 1993c. *Brown Bear: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1992 - 30 June 1993*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1993d. *Caribou: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1992 - 30 June 1993*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1993e. *Black Bear: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1992 - 30 June 1993*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1993f. *Bison: Federal Aid in Wildlife Restoration, Annual Performance Report of Survey-Inventory Activities, 1 July 1992 - 30 June 1993*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1993g. *Furbearers: Federal Aid in Wildlife Restoration, Survey-Inventory Management Report, 1 July 1989 - 30 June 1991*. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. 1993h. *Federal Aid in Wildlife Restoration, Research Final Report: Testing Socially Acceptable Methods of Managing Predation—Reducing Predation on Caribou and Moose Neonates by Diversionary Feeding of Predators, Macomb Plateau, 1990 - 93*. Division of Wildlife Conservation. Boertje, Rodney D. et al. Juneau, Alaska: ADF&G.

- _____. 1993i. *Federal Aid in Wildlife Restoration, Research Progress Report: Factors Limiting the Fortymile Caribou Herd*. Division of Wildlife Conservation. Boertje, Rodney D. et al. Juneau, Alaska: ADF&G.
- _____. 1993j. *Wildlife Watcher's Newsletter*, Winter 1993-94, Vol. 12, No.1. Division of Wildlife Conservation. Juneau, Alaska: ADF&G.
- _____. *Alaska State Hunting Regulations No.34: Effective Dates July 1, 1993 - June 30, 1994*. Juneau, Alaska: ADF&G.
- Allen, T.F.H. and T.W. Hoeksstra. 1992. *Toward a Unified Ecology*. New York: Columbia University Press.
- Ambrose, Skip, Endangered Species Specialist, Northern Alaska Ecological Services, USFWS. 1992. *Personal communication (meeting) with Mike Thompson, Spectrum Sciences & Software, Inc., September 10*. Fairbanks, Alaska: USFWS, Endangered Species Division.
- Ambrose, R.E. 1993. *Peregrine Falcon, Bald Eagle, and Other Raptor Nest Site Data in Alaska [Datafile]*. Fairbanks, Alaska: USFWS.
- Anderson, D.E., O.J. Rongstad, and W.R. Mytton. 1989. Response of Nesting Red-Tailed Hawks to Helicopter Overflights. *The Condor* 91:296-299.
- Armstrong, Robert H. 1990. *Guide to the Birds of Alaska*. Anchorage, Alaska: Alaska Northwest Books.
- Asherin, D.A., and D.N. Gladwin. 1988. *Effects of Aircraft Noise and Sonic Booms on Fish and Wildlife: A Research Needs Workshop*. NERC-88/23. Ft. Collins, Colo.: USFWS, National Ecology Research Center.
- Banfield, A.W.F. 1974. *The Mammals of Canada*. Toronto: University of Toronto Press.
- Bartelt, G.A. 1986. Effects of Disturbance and Hunting on the Behavior of Canada Goose Family Groups in Eastcentral Wisconsin. *Journal of Wildlife Management* 51 (3):517-522.
- Belanger, L., and J. Bedard. 1989. Responses of Staging Greater Snow Geese to Human Disturbance. *Journal of Wildlife Management* 53 (3):713-719.
- Bennett, Al, Biologist, Lake Clark National Park and Preserve. 1993. *Personal communication (letter) with Spectrum Sciences & Software, Inc., December 1*.
- Bente, P.J., and J.M. Wright. 1993. *Documentation of Peregrine Falcon Nest Sites in Relation to State Land Use Proposals, Research Final Report, Project SE-2-7*. Juneau, Alaska: ADF&G, Division of Wildlife Conservation.
- Bergerud, A.T. 1978. Caribou. In *Big Game of North America: Ecology and Management*. Schmidt, John L., and Douglas L. Gilbert (eds.). Harrisburg, Pa.: Stackpole Books.
- Bertram, Mark, Wildlife Biologist, Yukon Flats National Wildlife Refuge. 1993. *Personal communication (telephone call) with Mike Thompson, Spectrum Sciences & Software, Inc., October 26*.
- Boertje, R.D., and R.O. Stephenson. 1992. Effects of Ungulate Availability on Wolf Reproductive Potential in Alaska. *Canadian Journal of Zoology* 70:2441-2443.
- Boertje, Rod, Wildlife Biologist, Fairbanks, ADF&G. 1993. *Personal communication (meeting) with Neal Artz, Pioneer Environmental Services, Inc., November 9*.
- Bondello, M.C., and B.H. Brattstrom. 1979. *The Experimental Effects of Off-Road Vehicle Sounds on Three Species of Desert Vertebrates*. n.p.: BLM.

- Bowles, Ann, Barbara Tabachnick, and Sanford Fidell. 1991. *Review of the Effects of Aircraft Overflights on Wildlife (Draft)*. Report No. 7500. Denver, Colo.: U.S. National Park Service. Prepared by BBN Systems and Technologies.
- Bowyer, R. Terry, and David M. Leslie, Jr. 1992. *Ovis dalli: Mammalian Species No. 393*. American Society of Mammalogists.
- Brown, L., and D. Amadon. 1989. *Eagles, Hawks and Falcons of the World*. Secaucus, New Jersey: Wellfleet Press.
- Burger, Joanna. 1981. Behavioral Responses of Herring Gulls *Larus argentatus* to Aircraft Noise. *Environmental Pollution (Series A)* 24:177-184.
- Butler, W., and R. Gill. 1993. *Waterfowl, Raptor, and Shorebird Migratory and Breeding Distributions in Alaska*. Anchorage, Alaska: USFWS.
- Cade, T.J. 1960. Ecology of the Peregrine and Gyrfalcon Populations in Alaska. *Univ. California Publ. Zoology* 63:151-290.
- _____. 1982. *The Falcons of the World*. Ithaca, N.Y.: Cornell University Press.
- Cade, T.J., and C.M. White. 1976. The 1975 North American Peregrine Falcon Survey. *Canadian Field-Naturalist* 90:228-273.
- Cade, T. J., J.H. Enderson, C.G. Thelander, and C.M. White. 1988. *Peregrine Falcon Populations*. Boise, Idaho: The Peregrine Fund, Inc.
- Calef, G. W., E.A. Debrock, and G.M. Lortie. 1976. The Reaction of Barren-Ground Caribou to Aircraft. *Arctic* 29 (4):201-212.
- Carson, Al, Habitat Biologist, Habitat and Restoration Division, ADF&G. 1993. *Personal communication (letter) with Susan Means, Spectrum Sciences & Software, Inc., November 23*.
- Clark, Tim W., et al. 1987. *Martes americana: Mammalian Species No. 289: 1-8*. The American Society of Mammalogists.
- Clark, R.G. 1982. Nest Site Selection by Sharp-Shinned Hawks in Interior Alaska. In *A Symposium and Workshop on Raptor Management and Biology in Alaska and Western Canada*. Ladd, W.N., and P.F. Schempf (eds.). Anchorage, Alaska: USFWS.
- Colinvaux, P. 1986. *Ecology*. N.Y.: John Wiley and Sons.
- Conant, B. 1993. *Trumpeter Swan and Tundra Swan Survey Data in Alaska [Datafile]*. Juneau, Alaska: USFWS.
- Conant, B., and D.J. Groves. 1992. *Alaska-Yukon Waterfowl Breeding Population Survey, May 24-June 21, 1992*. Juneau, Alaska: USFWS.
- _____. 1993a. *Alaska-Yukon Waterfowl Breeding Population Survey, May 15 to June 16, 1993*. Juneau, Alaska: USFWS.
- _____. 1993b. *Waterfowl Breeding Population Survey Data in Alaska [Datafile]*. Juneau, Alaska: USFWS.
- Conant, B., J.I. Hodges, D.J. Groves, and J.G. King. 1991. *Alaska Trumpeter Swan Report 1990*. Juneau, Alaska: USFWS, Migratory Bird Management.
- Conant, B., J.I. Hodges, and J.G. King. 1991. Continuity and Advancement of Trumpeter Swan *Cygnus buccinator* and Tundra Swan *Cygnus columbianus* Population Monitoring in Alaska. *Wildfowl*: 125-136.

- Cooper, B.A. 1992. *Radar Studies of Bird Migration at Quarry Hill, Eielson AFB: Spring and Fall, 1992*. Report for U.S. Air Force, Eielson AFB, Alaska.
- Cooper, B.A., R.J. Ritchie, B.A. Anderson, and L.C. Byrne. 1991. *Alaska Over-the-Horizon Backscatter Radar System: A Synthesis of the Avian Research Program, 1987-1990*. Final report prepared for Arctic Environmental Information and Data Center, Anchorage, Alaska; and Department of the Air Force, Hanscom AFB, Mass. Prepared by Alaska Biological Research, Inc.
- Craighead, John J., Maurice G. Hornocker and Frank C. Craighead, Jr. 1969. Reproductive Biology of Young Female Grizzly Bears. *Journal of Reproductive Fertility* Suppl. 6 (1969):447-475.
- Davis, J.L., P. Valkenburg, and R.D. Boertje. 1985. Disturbance of the Delta Caribou Herd. In *Proceedings of the First North American Caribou Workshop, Whitehorse, Y.T.* Martell, A.M., and D.E. Russel (eds.). Ottawa, Ontario: Canadian Wildlife Service Publication.
- Denton, Jeff, Wildlife Biologist, BLM Anchorage District. 1993. *Personal communication with M. Robards, ENSR Consulting and Engineering, November 9.*
- Derksen, D.V., E.J. Tatlor, and M.W. Weller. 1990. *Effects of Aircraft on Behavior and Ecology of Molting Brant near Teshekpuk Lake, Alaska 1989: Progress Report*. College Station, Texas: Department of Wildlife and Fisheries Sciences.
- Derksen, D.V., K.S. Bollinger, D. Esler, K.C. Jensen, E.J. Taylor, and M.W. Weller. 1992. *Effects of Aircraft on Behavior and Ecology of Molting Brant near Teshekpuk Lake, Alaska 1992: Progress Report*. College Station, Texas: Department of Wildlife and Fisheries Sciences.
- Edwards, R.G., A.B. Broderson, R.W. Barbour, D.F. McCoy, and C.W. Johnson. 1979. *Assessment of the Environmental Compatibility of Differing Helicopter Noise Certification Standards*. U.S. Department of Transportation. DOT-FA78WA-4194. Prepared by Watkins and Associates, Inc. and the University of Kentucky.
- Ellis, D. H. 1981. *Responses of Raptorial Birds to Low-Level Military Jets and Sonic Booms*. Institute for Raptor Studies, USFWS.
- Espmark, Y. 1972. Behavior Reactions of Reindeer Exposed to Sonic Boom. *Deer* 2:800-802.
- Faro, J.B. 1990. *Federal Aid in Wildlife Restoration, Annual Report of Survey-Inventory Activities: Brown/Grizzly Bears*. S. Morgan (ed.) Part V. Vol. XX. Project W-23-2. Study 4.0. Juneau, Alaska: ADF&G.
- Frazier, A.R. 1972. *Noise Survey: F-105 Overflights, Wichita Mountains Wildlife Refuge and Vicinity, Fort Sill, OK*. Springfield, Va.: National Technical Information Service.
- Gabrielson, I.N., and F.C. Lincoln. 1959. *The Birds of Alaska*. Harrisburg, Penn.: Stackpole Company.
- Gardner, Craig, Area Biologist, Tok, ADF&G. 1994. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., February 2.*
- Gibson, D.D. 1993. *Checklist of Alaska Birds*. Fairbanks, Alaska: University of Alaska.
- Gibson, Dan, Curator, Natural History Museum, University of Alaska, Fairbanks. 1994. *Personal communication (telephone call) with R. Washington-Allen, Pioneer Environmental Services, Inc., April 15.*
- Gladwin, D.N., K.M. Mancini, and R. Villella. 1988. *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: Bibliographic Abstracts*. NERC-88/32. Ft. Collins, Colo.: USFWS, National Ecology Research Center.
- Golden, J., R.P. Ouellette, S. Saari, and P.N. Cheremisinoff. 1979. *Environmental Impact Data Book*. Ann Arbor, Mich.: Ann Arbor Science.

- Gollop, M.A., J.E. Black, B.E. Felske, and R.A. Davis. 1974. *Disturbance Studies of Breeding Black Brant, Common Eiders, Glaucous Gulls and Arctic Terns at Nunakuk Spit and Philips Bay, Yukon Territory, July, 1972*. Alaskan Arctic Gas Study Company.
- Gollop, M.A., R.A. Davis, J.P. Prevet, and B.E. Felske. 1972. Disturbance Studies of Terrestrial Breeding Bird Populations. *Arctic Gas Biological Report Series* 14 (June):97-152.
- Graham, R. W. 1986. Response of Mammalian Communities to Environmental Changes During the Late Quaternary. In *Community Ecology*. Diamond, J., and T. Case (eds.). N.Y.: Harper and Row.
- Gunn, W.W.H., and J.A. Livingston. 1974. *Disturbance to Birds by Gas Compressor Noise Simulators, Aircraft and Human Activity in the Mackenzie Valley and the North Slope, 1972*. Canadian Arctic Gas Study Limited and Alaskan Arctic Gas Study Company.
- Gunn, A., F.L. Miller, R. Glaholt, and K. Jingfors. 1985. Behavioral Responses of Barren Ground Caribou Cows and Calves to Helicopters on the Beverly Herd Calving Grounds, Northwest Territories. In *Proceedings of the First North American Caribou Workshop, Whitehorse, Y.T.* Martell, A.M., and D.E. Russel (eds.). Ottawa: Canadian Wildlife Service Publication.
- Gutin, J. C. 1993. Vibrations. *Discover* 14:45-54.
- Ha, J.C. 1988. Measurement and Modeling of Physiological Stress. In *Effects of Aircraft Noise and Sonic Booms on Fish and Wildlife: A Research Needs Workshop*. NERC-88/23. Asherin, D.A., and D.N. Gladwin (eds.). Ft. Collins, Colo.: USFWS, National Ecology Research Center.
- Hansen, A.J., M.I. Dyer, H.H. Shugart, and E.L. Boeker. 1986. *Behavioral Ecology of Bald Eagles Along the Northwest Coast: A Landscape Perspective*. n.p.: U.S. Department of Energy, Environmental Sciences Division, Oak Ridge National Lab.
- Hansen, A.J., E.L. Boeker, and J.I. Hodges. 1983. Preliminary Observations: Ecology of Bald Eagles in the Chilkat Valley, Alaska. In *Proceedings of First International Symposium on Bald Eagles and Ospreys; 1981 Oct 28*. Bird, D. M. (ed.) Montreal, Canada: Raptor Research Foundation, Inc.
- Harding, L.E. 1976. Den Site Characteristics of Arctic Coastal Grizzly Bears (*Ursus arctos* L.) on Richards Island, Northwest Territories, Canada. *Canadian Journal Zoology* 54:1357-1363.
- Harrington, F.H., and A.M. Veitch. 1990. *Impacts of Low Level Jet Fighter Training on Caribou in Labrador and Northern Quebec*. Report Presented to the Newfoundland-Labrador Wildlife Division, December 1989. (Unpublished manuscript available at Newfoundland-Labrador Wildlife Division, P.O. Box 8700, St. John's Newfoundland A/B, 709-729-2631.)
- _____. 1991. Short-Term Impacts of Low-Level Jet Fighter Training on Caribou in Labrador. *Arctic* 44:318-327.
- _____. 1992. Calving Success of Woodland Caribou Exposed to Low-Level Jet Overflights. *Arctic* 45:213-218.
- Heimer, W.E. 1988. Toward a Working Hypothesis for Mountain Sheep Management. *Proc. Bienn. Symp. North. Wild Sheep and Goat Council* 6:39-46.
- _____. 1989. Wildlife Notebook Series. *Dall Sheep*. n.p.: ADF&G.
- Heimer, Wayne, Wildlife Biologist, Fairbanks, ADF&G. 1993. *Personal communication (meeting) with Neal Artz, Pioneer Environmental Services, Inc., November 8.*

- _____. 1994a. *Personal communication (telephone call) with Neal Artz and Marisa Ernst, Pioneer Environmental Services, Inc., March 15.*
- _____. 1994b. *Personal communication (FAX) with Marisa Ernst, Pioneer Environmental Sciences, Inc., March 21.*
- Hemming, J.E. 1970. *The Distribution and Movement Patterns of Caribou in Alaska*. Wildl. Tech. Bull. No. 1. Juneau, Alaska: ADF&G.
- Henderson, D., and R.P. Hamernik. 1978. Impulse Noise-Induced Hearing Loss: An Overview. In *Noise and Audiology*. David M. Lipscomp (ed.). n.p.: University Park Press.
- Henson, P., and T.A. Grant. 1991. The Effects of Human Disturbance on Trumpeter Swan Breeding Behavior. *Wildlife Society Bulletin* 19:248-257.
- Hodges, J.I., J.G. King, and R. Davies. 1983. Bald Eagle Breeding Population Survey of Coastal British Columbia. In *Proceedings of First International Symposium on Bald Eagles and Ospreys; 1981 Oct 28*. Bird, D. M. (ed.) Montreal, Canada: Raptor Research Foundation, Inc.
- Hughes, J. 1986. *Distribution, Abundance, and Productivity of Osprey in Interior Alaska*. Anchorage, Alaska: ADF&G.
- _____. 1993. *Osprey and Other Raptor Nest Site Data in Alaska [Datafile]*. Hughes, J. (ed.) Anchorage, Alaska: ADF&G.
- Hughes, J., and J. Wright. 1990. *Ospreys in Interior Alaska, Annual Report*. n.p.: ADF&G.
- Isleib, M.E., and B. Kessel. 1973. Birds of the North Gulf Coast: Prince William Sound Region, Alaska. *Biol. Pap. Univ. Alaska* 14:149.
- Janssen, R. 1980. Future Scientific Activities in Effects of Noise on Animals. In *American Speech-Language-Hearing Association Report Number 10*.
- Jenkins, Kurt, Wildlife Biologist, Wrangell-St. Elias Field Station, U.S. National Biological Survey. 1994. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., February 2.*
- Jenson, K.C. 1990. *Responses of Molting Pacific Black Brant to Experimental Aircraft Disturbance in the Teshekpuk Lake Special Area, Alaska*. Ph.D. Dissertation. College Station, Texas: Texas A&M University.
- Johansson, B., B. Kylin, and S. Reopstorff. 1973. Evaluation of the Hearing Damage Risk from Intermittent Noise According to the ISO Recommendations. In *Proceedings of the International Congress on Noise as a Public Health Problem*. W. Dixon Ward (ed.). EPA-550-9-73-008. n.p.: U.S. Environmental Protection Agency.
- Jonkel, Charles. 1978. Black, Brown (Grizzly) and Polar Bears. In *Big Game of North America: Ecology and Management*. Schmidt, John L., and Douglas L. Gilbert (eds.). Harrisburg, Pa.: Stackpole Books.
- Kessel, B. 1979. *Migration of Sandhill Cranes, Upper Tanana River Valley, Alaska*. Northwest Alaskan Pipeline Company; 468085-9-KO49. Fairbanks, Alaska: University of Alaska, Fairbanks.
- _____. 1984. Migration of Sandhill Cranes, *Grus canadensis*, in East-central Alaska with Routes through Alaska and Western Canada. *The Canadian Field-Naturalist* 98 (3):279-292.
- King, J. G. 1980. The Status and Future of the Alaska Population of *Cygnus buccinator*. In *Second International Swan Symposium, Sapporo, Japan*. Matthews, G.V.T., and M. Smart (eds.). Slimbridge, U.K.: International Waterfowl Research Bureau.

- King, J.G., and J.I. Hodges. 1980. A Correlation between *Cygnus columbianus* Territories and Water Bodies in Western Alaska. In *Second International Swan Symposium, Sapporo, Japan*. Matthews, G.V.T., and M. Smart (eds.). Slimbridge, U.K.: International Waterfowl Research Bureau.
- King, J.G., F.C. Robards, and C.J. Lensink. 1972. Census of the Bald Eagle Breeding Population in Southeast Alaska. *Journal of Wildlife Management* 36 (4):1292-1295.
- King R. 1993. *Waterfowl, Raptor, and Shorebird Migratory and Breeding Distributions in Alaska*. Fairbanks, Alaska: USFWS.
- Kryter, K.D. 1984. *Physiological, Psychological, and Social Effects of Noise*. NASA Reference Publication 1115. Springfield Va.: NTIS.
- Lamp, R.E.. 1989. *Monitoring the Effects of Military Air Operations at the Naval Air Station Fallon on the Biota of Nevada*. n.p.: Nevada Department of Wildlife.
- Lincer, J.L., W.S. Clark, and M.N. LeFranc, Jr. 1979. Working Bibliography of the Bald Eagle. In *Natl. Wildl. Fed. Sci. and Tech. Series* 2:344.
- Linscombe, Greg, N. Kinler, and R.G. Aulerich. 1987. Mink (*Mustela vison*). In *Wild Mammals of North America*. Chapman, Joseph A., and George A. Feldhamer (eds.). Baltimore, Md.: Johns Hopkins University Press.
- Lipkin, Rob, Botanist, Alaska National Heritage Program. 1994. *Personal communication (telephone call) with R. Washington-Allen, Pioneer Environmental Services, Inc., January 27*.
- Manci, K. M., Gladwin, D.N., Vilella, R., and M. G. Cavendish. 1988. *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis*. NERC-88/29. Ft. Collins, Colo.: USFWS, National Ecology Research Center.
- Marler, P., M. Konishi, A. Lutjen, and M.S. Waser. 1973. Effects of Continuous Noise on Avian Hearing and Vocal Development. *Proc. Nat. Acad. Sci. USA* 70 (5):n.p.
- McGowan, J.D. 1975. Nesting Habits and Reproductive Success of Goshawks in Interior Alaska. In *Raptor Research Report* 3:147-152.
- McKechnie, Alexie M., and Douglas N. Gladwin. 1993. *Aircraft Overflight Effects on Wildlife Resources*. NPOA Report No. 93-8. Denver, Colo.: U.S. National Park Service. Prepared by Harris, Miller, Miller & Hanson, Inc.
- McNay, Mark, Pat Valkenburg, Ken Whitten, and Rod Boertje, Wildlife Biologists, Fairbanks, ADF&G. 1993. *Personal communication (telephone call) with Roy Hugie, Neal Artz and Marisa Ernst, Pioneer Environmental Services, Inc., December 8*.
- Meagher, Margaret Mary. Bison. In *Big Game of North America: Ecology and Management*. Schmidt, John L., and Douglas L. Gilbert (eds.). Harrisburg, Pa.: Stackpole Books.
- Mech, L. David. 1974. *Canis lupus*. Mammalian Species, No. 37. The American Society of Mammalogists.
- Mendenhall, Vivian. 1993. *Seabird Survey Data in Alaska [Datafile]*. Juneau, Alaska: USFWS.
- Merritt, Ron, USAF BASH Team Chief. 1993. *Personal communication (meeting) with Mike Thompson, Spectrum Sciences & Software, Inc., March 12*.
- Miller, Frank L. 1987. Caribou (*Rangifer tarandus*). In *Wild Mammals of North America*. Chapman, Joseph A., and George A. Feldhamer (eds.). Baltimore, Md.: Johns Hopkins University Press.
- Miller, S.D. 1985. *Personal communication (meeting) with M.C. McShane (Envirosphere Company), October 24, 1985*. Cited in *Environmental Assessment for Military Operations Areas, 1986 Update*.

- Miller, S.D., and W.B. Ballard. 1982. Density and Biomass Estimates for an Interior Alaskan Brown Bear, *Ursus arctos*, Population. *The Canadian Field-Naturalist* 96:448-454.
- Miller, S.D., E.F. Becker, and W.B. Ballard. 1987. Black and Brown Bear Density Estimates Using Modified Capture-Recapture Techniques in Alaska. *Int. Conf. Bear Res. and Manage* 7:23-35.
- Mindell, D.P. 1983. *Nesting Raptors in Southwestern Alaska: Status, Distribution, and Aspects of Biology*. BLM/AK/TR-83/08. Anchorage, Alaska: BLM.
- Murphy, Stephen M., Michael D. Smith, Robert G. White, Julie A. Kitchens, B. Andres Kugler, and David S. Barber. 1993. *Behavioral Responses of Caribou to Low-Altitude Jet Aircraft*. AL/OE-TR-1994-0117. Wright-Patterson AFB, Ohio: Air Force Materiel Command, Armstrong Laboratory.
- Naiman, R.J., ed. 1988. How Animals Shape Their Ecosystems. *BioScience* 38:750-800.
- National Defense, Canada. 1989. *Goose Bay EIS: An Environmental Impact Statement on Military Flying Activities in Labrador and Quebec. Final Report*.
- Nelson, R.W. 1979. *Flying with Raptors: Dangers and Discoveries*. Davis, Calif.: Raptor Research Foundation Meetings.
- Nichols, Lyman, Jr. 1978. Dall's Sheep. In *Big Game of North America: Ecology and Management*. Schmidt, John L., and Douglas L. Gilbert (eds.). Harrisburg, Pa.: Stackpole Books.
- Osborne, T.D., Area Biologist, Galena, ADF&G. 1985. *Personal communication (telephone call) with M.C. McShane, Envirosphere Co., November 13*. Cited in *Environmental Assessment for Military Operations Areas, 1986 Update*.
- Pearson, A.M. 1975. The Northern Interior Grizzly Bear, *Ursus arctos* L. *Canadian Wildlife Report, Service Number 34*. Ottawa, Canada: Information Canada.
- Pegau, R.E. 1984. *Federal Aid in Wildlife Restoration, Annual Report of Survey-Inventory Activities, Progress Report: Caribou, GMU 19 and 21* Vol. 14, Project W-22-2, Job 3.0. Juneau, Alaska: ADF&G.
- Peterson, Steve, Senior Staff Biologist, Juneau, ADF&G. 1994. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., February 3*.
- Platt, J.B. 1975. A Study of Diurnal Raptors that Nest on the Yukon North Slope with Special Emphasis on the Behavior of Gyrfalcons During Experimental Overflights by Aircraft. *Arctic Gas Biological Report Series* 30 (2):40.
- _____. 1977. *The Breeding Behavior of Wild and Captive Gyrfalcons in Relation to Their Environment and Human Disturbance*. Ithaca, N.Y.: Cornell University.
- Poole, A.F. 1989. *Ospreys: A Natural and Unnatural History*. Cambridge: Cambridge University Press.
- Quimby, R. 1974. Grizzly Bear. In *Mammal Studies in Northeastern Alaska with the Emphasis within the Canning River Drainage*. R. D. Jakimchuk (ed.). Biological Report Series Vol. 24. n.p.: Renewable Resources Consulting Services Ltd., Canadian Arctic Gas Study Ltd.
- Reynolds, Harry, Wildlife Biologist, Fairbanks, ADF&G. 1993. *Personal communication (telephone call) with Neal Artz, Pioneer Environmental Services, Inc., November 17*.
- Richmond, Alan, Natural Resources Manager, Elmendorf AFB. 1994a. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., January 31*.

- _____. 1994b. *Personal communication (FAX) with Marisa Ernst, Pioneer Environmental Services, Inc., February 3.*
- Ritchie, R.J., and J.A. Curatolo. 1982. Notes on Golden Eagle Productivity and Nest Site Characteristics, Porcupine River, Alaska, 1979-1982. *Raptor Research* 16 (4):123-127.
- Ritchie, R.J. 1984. *The Results of Raptor Surveys Along the Porcupine River and Salmon Fork of the Black River, Alaska, 1984.* Unpublished report. Fairbanks, Alaska: USFWS. Prepared by Alaska Biological Research.
- _____. 1987. *Response of Adult Peregrine Falcons to Experimental and Other Disturbances Along the trans-Alaska Pipeline System, Sagavanirktok River, Alaska, 1985, 1986.* Report to Alyeska Pipeline Service Co., Anchorage, AK.
- Roseneau, D.G., C.E. Tull, and R.W. Nelson. 1981. *Protection Strategies for Peregrine Falcons and Other Raptors Along the Planned Northeast Alaskan Gas Pipeline Route.* 478085-9-K127. n.p.: Fluor Northwest, Inc.
- Schempf, P.F. 1989. Raptors in Alaska. In *Proc. Western Raptor Manage. Symp. and Workshop, Tech. Ser. No. 12.* Washington, D.C.: National Wildlife Federation.
- _____. 1993. *Bald Eagle, Peregrine, and Other Raptor Nest Site Data in Alaska [Datafile].* Juneau, Alaska: USFWS.
- Schmidt, John L., and Douglas L. Gilbert, eds. 1978. *Big Game of North America: Ecology and Management.* Harrisburg, Pa: Stackpole Books.
- Schweinsburg, R.E. 1974. *Disturbance Effects of Aircraft to Waterfowl on North Slope Lakes, June, 1972.* Report for the Alaskan Arctic Gas Study Company.
- Seavoy, Roger, Area Biologist, McGrath, ADF&G. 1993. *Personal communication with M. Robards, ENSR Consulting and Engineering, n.d.*
- Skoog, R.O. 1963. *Federal Aid in Wildlife Restoration: Caribou Report.* Project W-6-R-4. Juneau, Alaska: ADF&G.
- _____. 1968. *Ecology of Caribou (Rangifer tarandus granti) in Alaska.* Ph.D. Thesis. Berkley, CA: University of California.
- Sousa, P.J. 1993. *Personal communication (letter) with Lt Col Michael T. Probasco, March 31.*
- Speich, S.M., B.L. Troutman, A.C. Geiger, P.J. Meehan-Martin, and S.J. Jefferies. 1987. *Evaluation of Military Flight Operations on Wildlife of the Copalis National Wildlife Refuge, 1984-85.* n.p.: Washington Department of Game; Department of the Navy, Western Division.
- Strickland, M.A., C.W. Douglas, M. Novak, and N.P. Hunziger. 1987. Marten (*Martes americana*). In *Wild Mammals of North America.* Chapman, Joseph A., and George A. Feldhamer (eds.): Baltimore, Md.: Johns Hopkins University Press.
- Taylor, K.P. 1985a. *Federal Aid in Wildlife Restoration, Survey-Inventory Progress Report: Caribou (GMUs 9A, 9B, 16, 17, 18, 18B, and 19C).* Vol. 16, Project W-22-4, Job 3.0. Juneau, Alaska: ADF&G.
- _____. 1985b. *Federal Aid in Wildlife Restoration, Annual Report of Survey-Inventory Activities: Moose (GMU 17).* Part VIII Moose, Vol. 15, Project W-22-3, Job 1.0. Juneau, Alaska: ADF&G.

- _____. Regional Management Coordinator, Fairbanks, ADF&G. 1994. *Personal communication (telephone call) with Neal Artz and Marisa Ernst, Pioneer Environmental Services, Inc., February 1.*
- Tobey, Bob, Area Biologist, Unit 13, Glennallen, ADF&G. 1994. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., February 2.*
- Tumlison, Renn. 1987. *Felis lynx: Mammalian Species No. 269.* The American Society of Mammalogists.
- U.S. Air Force (USAF). 1989. *Fish and Wildlife Management Plan for Eielson Air Force Base, Alaska. Fourth Revision, January 1989 to December 1991.* Eielson AFB, Alaska: Civil Engineering Squadron. Prepared by G. von Rueden, Natural Resource Manager.
- _____. 1992. *Environmental Assessment of the Expansion and Upgrade of Military Training Routes, Alaska.* Elmendorf AFB, Alaska: 11th Air Force. Prepared by ENSR Consulting and Engineering.
- _____. 1993. *Environmental Assessment: Major Flying Exercises in Alaska.* Elmendorf AFB, Alaska: 11th Air Force. Prepared by Spectrum Sciences and Software, Inc.
- U.S. Bureau of Land Management (BLM). 1990a. Durtsche, Bruce M., and Winston Hobgood. *Distribution, Movements and Seasonal Use Areas of Caribou in the White Mountains National Recreation Area, Alaska, 1982-1988.* BLM-Alaska Open File Report 29. Anchorage, Alaska: BLM, Alaska State Office.
- _____. 1990b. Durtsche, Bruce M., Winston Hobgood, and Jan Burris. *Distribution, Movements and Seasonal Use Areas of Radio-Tagged Dall Sheep in the White Mountains-Tanana Hills, Alaska, 1983 - 1989.* BLM-Alaska Open File Report 30. Anchorage, Alaska: BLM, Alaska State Office.
- _____. 1993. *Areas of Critical Environmental Concern (ACEC).*
- U.S. BLM and U.S. Army, 6th Infantry Division (Light). 1994. *Fort Wainwright - Yukon Maneuver Area: Proposed Resource Management Plan and Final Environmental Impact Statement.* Anchorage, Alaska: BLM, Military Withdrawals Planning Team, Division of Resources (931).
- U.S. Fish and Wildlife Service (USFWS). 1982. *Recovery Plan for the Peregrine Falcon: Alaska Population.* Anchorage, Alaska: USFWS, Prepared by Region 7 in cooperation with the Alaska Peregrine Falcon Recovery Team.
- _____. 1994. *Endangered, Threatened and Candidate Species in Alaska.* Fairbanks, Alaska: Ecological Services.
- U.S. Geological Survey (USGS). 1983. *U.S. Man in the Biosphere Program.* M. Goigel Turner. Reston, Va.: USGS.
- U.S. Forest Service (USFS). 1992. *Report to Congress: Potential Impacts of Aircraft Overflights of National Forest System Wildernesses.* Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: U.S. Government Printing Office.
- U.S. National Park Service (NPS). 1994. *Report to Congress: Report on Effects of Aircraft Overflights on the National Park System.* Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: NPS.
- Valkenburg, P., Wildlife Biologist, Fairbanks, ADF&G. 1991. *Personal communication with Jim Duncan, ENSR Consulting and Engineering, n.d.*
- _____. 1994. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., February 4.*

- Valkenburg, P., and J.L. Davis. 1985. The Reaction of Caribou to Aircraft: A Comparison of Two Herds. In *Proceedings of the First North American Caribou Workshop*. Whitehorse, Y.T. Martell, A.M., and D.E. Russel (eds.). Ottawa, Canada: Canadian Wildlife Service Publication.
- Van Daele, L.J., Area Biologist, Unit 17, Dillingham, ADF&G. 1993. *Personal communication with M. Robards, ENSR Consulting and Engineering, November*.
- Viereck L.A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. *The Alaska Vegetation Classification*. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-286.
- von Rueden, Gerry, Natural Resources Manager, Eielson AFB. 1994. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., February 3*.
- Ward, David, Wildlife Biologist, Research Division, USFWS. 1993. *Personal communication with Mike Thompson, Spectrum Sciences & Software, Inc., July 16*.
- Ward, D.H., and R.A. Stehn. 1990. *Response of Brant and Other Geese to Aircraft Disturbances at Izembek Lagoon, Alaska*. 14-12-0001-30332. Anchorage, Alaska: Minerals Management Service.
- Ward, D.H., E.J. Taylor, M.A. Wotawa, R.A. Stehn, D.V. Derksen, and C.J. Lensink. 1986. *Behavior of Pacific Black Brant and Other Geese in Response to Aircraft Overflights and Other Disturbances at Izembek Lagoon, Alaska*. 1986 Annual Report. USFWS, Alaska Fish and Wildlife Research Center.
- West, Ed, and Julie Michaelson, University of Alaska, Anchorage, Environment and Natural Resources Institute, Alaska National Heritage Program. 1994a. *Personal communication (telephone call) with R. Washington-Allen, Pioneer Environmental Services, Inc., January 25*.
- _____. 1994b. *Personal communication (FAX) with R. Washington-Allen, Pioneer Environmental Services, Inc., January 25*.
- West, Neil E. 1993. Biodiversity of Rangelands. *Journal of Range Management* 46:2-13.
- White, C.M., and S.K. Sherrod. 1973. Advantages and Disadvantages of the Use of Rotor-Winged Aircraft Surveys. *Raptor Research* 7 (3-4):97-104.
- White, Robert G., Julie A. Kitchens, Bret R. Luick, Stephen M. Murphy, Michael D. Smith, B. Andrew Kugler, and David S. Barber. 1993. *Energy Expenditures of Caribou Responding to Low-Altitude Jet Aircraft*. AL/OE-TR-1994-0180. Brooks AFB, Texas: Air Force Materiel Command, Armstrong Laboratory.
- Whitman, J. 1989. The Alaska Range West and South of Denali National Park Sheep Survey-Inventory Progress Report: Federal Aid in Wildlife Restoration Program Report. In *Annual Report of Survey-Inventory Activities*. S.O. Morgan (ed.) Part II. Vol XIX. PROJ-W-23-1. Juneau, Alaska: ADF&G.
- Whitten, Ken, Wildlife Biologist, Fairbanks, ADF&G. 1993. *Personal communication (telephone call) with Neal Artz, Pioneer Environmental Sciences, Inc., November 5*.
- _____. 1994. *Personal communication (telephone call) with Marisa Ernst, Pioneer Environmental Services, Inc., March 25*.
- Wilson, Don E. 1987. Wolverine (*Gulo gulo*). In *Wild Mammals of North America*. Chapman, Joseph A., and George A. Feldhamer (eds.). Baltimore, Md.: Johns Hopkins University Press.
- Windsor, J. 1977. *The Response of Peregrine Falcons (Falco peregrinus) to Aircraft and Human Disturbances*. Ottawa, Canada: Environmental Social Programs.
- Workman, G., T.D. Bunch, J.W. Call, R.C. Evans, L.S. Neilson, and E.M. Rawlings. 1992. *Sonic Boom/Animal Disturbance Studies on Pronghorn Antelope, Rocky Mountain Elk, and Bighorn Sheep*. Hill AFB, Utah: Air Force.

World Conservation and Monitoring Centre. 1992. *Global Biodiversity Status of the Earth's Living Resources*. London: Chapman and Hall.

Recreation

- Alaska Department of Commerce and Economic Development (ADCED). 1991. *Alaska's Visitor Industry: An Economic Profile*. Juneau, Alaska: ADCED, Division of Tourism. Prepared by McDowell Group.
- _____. 1993a. *Alaska Visitor Statistics Program: Alaska Visitor Expenditures, Summer 1993*. Juneau, Alaska: ADCED, Division of Tourism. Prepared by McDowell Group.
- _____. 1993b. *Alaska Visitor Statistics Program: Alaska Visitor Patterns, Opinions and Planning, Summer 1993*. Juneau, Alaska: ADCED, Division of Tourism. Prepared by McDowell Group.
- _____. [1994a]. *Alaska Visitor Statistics Program: Alaska Visitor Arrivals, Fall/Winter 1993-1994*. Juneau, Alaska: ADCED, Division of Tourism. Prepared by McDowell Group.
- _____. 1994b. *Big Game Commercial Services Board: Register of Licenses*. Juneau, Alaska: ADCED, Division of Occupational Licensing.
- Alaska Department of Community and Regional Affairs (ADCRA). 1987. *Ruby Community Profile (Draft)*. Anchorage, Alaska: ADCRA. Prepared by Fison & Associates.
- Alaska Department of Fish and Game (ADF&G). 1992. *Guide-Outfitter Areas (map)*. Anchorage, Alaska: ADF&G, Division of Wildlife Conservation.
- _____. 1993a. *Alaska Sport Fishing Regulations Summary*. Juneau, Alaska: ADF&G.
- _____. 1993b. *Alaska State Hunting Regulations: Effective Dates July 1, 1993-June 30, 1994, No. 34*. Juneau, Alaska: ADF&G.
- _____. Division of Wildlife Conservation. 1993c. *Alaska Wildlife Harvest Summary: 1991-1992*. Anchorage, Alaska: ADF&G.
- _____. 1993d. *Federal Aid in Wildlife Restoration Annual Performance Report of Survey-Inventory Activities: 1 July 1992 - 30 June 1993 (Caribou, Brown Bear, Black Bear, Dall Sheep, Mountain Goat, Moose, Bison, Wolf, Furbearers)*. Juneau, Alaska: ADF&G.
- Alaska Department of Labor (ADL). 1991. *Alaska Population Overview: 1990 Census and Estimates*. Anchorage, Alaska: ADL, Research and Analysis Section and Demographic Unit.
- Alaska Department of Natural Resources (ADNR). n.d. *A Summary Development Guide for the Lake Louise Study Area*. Anchorage, Alaska: ADNR, Division of Parks. Prepared by the Alaska Environmental Group.
- _____. n.d. *Alaska Recreation Trail Plan*. n.p.: ADNR, Division of Parks.
- _____. n.d. *Wood-Tikchik State Park (brochure)*. n.p.: n.p.
- _____. 1982. *Alaska State Park System: Statewide Framework*. n.p.: ADNR, Division of Parks, Park Planning Section.
- _____. 1984a. *Susitna Area Plan: Recreation*. Anchorage, Alaska: ADNR, DPOR and Division of Land and Water Management.
- _____. 1984b. *Bristol Bay Area Plan for State Lands*. Anchorage, Alaska: ADNR, ADF&G, ADEC.
- _____. 1985. *Susitna Area Plan*. Anchorage, Alaska: ADNR, ADF&G, Matanuska-Susitna Borough.
- _____. 1986. *Kuskokwim Area Plan: Recreation Element*. Anchorage, Alaska: ADNR, Division of Land and Water Management and Division of Parks and Outdoor Recreation.
- _____. 1987. *Wood-Tikchik State Park Management Plan*. Anchorage, Alaska: ADNR, DPOR.
- _____. 1988a. *Kuskokwim Area Plan for State Lands*. Anchorage, Alaska: ADNR, ADF&G.

- _____. 1988b. *Tanana Valley State Forest: Forest Management Plan*. Anchorage, Alaska: ADNR, Division of Forestry.
- _____. 1988c. *Outdoor Recreation: Alaska*. n.p.: ADNR, DPOR.
- _____. 1989a. *Recreation Resources; Susitna Regional Forest Plan*. n.p.: ADNR.
- _____. 1989b. *Denali State Park Master Plan*. Anchorage, Alaska: ADNR, DPOR.
- _____. 1990. *Nushagak and Mulchatna Rivers: Recreation Management Plan*. Anchorage, Alaska: ADNR, ADF&G, Bristol Bay Coastal Resource Service Area.
- _____. 1991a. *Tanana Basin Area Plan for State Lands*. Adopted 1985, Updated 1991. Fairbanks, Alaska: ADNR, Land Resources Section.
- _____. 1991b. *Susitna Basin Recreation Rivers Management Plan and Resources Assessment*. Anchorage, Alaska: ADNR, Division of Land, Land and Resources Section.
- _____. 1991c. *Denali State Park*. Anchorage, Alaska: ADNR, DPOR.
- _____. 1992. *1992 Hellenthal Survey Results*. n.p.: ADNR, DPOR.
- _____. 1993a. *Fact Sheet: Nelchina Public Use Area*. Anchorage, Alaska: ADNR.
- _____. 1993b. *Alaska State Parks (brochure)*. Anchorage, Alaska: ADNR, DPOR.
- _____. 1993c. *Alaska State Parks Commercial Use Vendors*. Anchorage, Alaska: ADNR, DPOR.
- Alaska Geographic Society. 1981. Alaska National Interest Lands: The D-2 Lands. *Alaska Geographic* 8 (4).
- Alaska Land Use Council. 1990. *Alaska National Interest Lands Conservation Act: Section 1201(l) Recommendations*. n.p.: n.p.
- Alaska Land Use Council. 1982. *A Synopsis for Guiding Management of Wild, Scenic, and Recreational River Areas in Alaska*. Anchorage, Alaska: Alaska Land Use Council.
- Alaska Natural History Association. 1989. *Public Lands Campgrounds in Central Alaska: Accessible by Road*. n.p.: ANHA.
- Alaska Northwest Books. 1991a. *The Alaska Wilderness Milepost*. Seattle, Washington: Alaska Northwest Books.
- _____. 1991b. *Facts About Alaska: The Alaska Almanac*. 15th edition. Seattle, Washington: Alaska Northwest Books.
- _____. 1992. *The Milepost*. Seattle, Washington: Alaska Northwest Books.
- Alaska Road and Recreation Maps. 1983. *Parks Highway Road & Recreation Map: Anchorage to Fairbanks via Denali Park*. Anchorage, Alaska: Alaska Road and Recreation Maps.
- Alaska Wilderness Recreation & Tourism Association (AWRTA). 1994. *1994 Directory of Business Members*. Valdez, Alaska: AWRTA.
- _____. 1995. *Personal communication (telephone call, FAX, letter) with Susan Means, Spectrum Sciences & Software, Inc., April*. Valdez, Alaska: AWRTA.
- Anderson, Grant S., and Richard D. Horonjeff. 1992. *Aircraft Overflight Study: Effect of Aircraft Altitude Upon Sound Levels at the Ground*. NPOA Report No. 91-4. Lexington, Mass.: National Park Service. Prepared by Harris, Miller, Miller & Hanson, Inc.

- Bristol Bay Coastal Resource Service Area (BBCRSA). 1986. *Commercial Recreation Service Providers Study: Bristol Bay Coastal Resource Service Area*. n.p.: BBCRSA. Prepared by Jon Isaacs and Associates.
- Bristol Bay Study Group. 1984. *Proposed Bristol Bay Cooperative Management Plan and Revised Draft Environmental Impact Statement*. Anchorage, Alaska: ADNR and USFWS.
- Brockman, C. Frank, Lawrence C. Merriam, Jr., William R. Catton, Jr., and Barney Dowdle. 1979. *Recreational Use of Wild Lands*. New York, N.Y.: McGraw-Hill Book Company.
- Buckle, Bishop T., Deputy State Director, U.S. Bureau of Land Management. 1994. *Personal communication (letter) with Colonel Richard S. Hassan, 11 AF/LG, May 3*.
- Clark, Roger N., and George H. Stankey. 1979. *The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research*. PNW-98. Seattle, Wash.: U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station.
- Cole, David N., Margaret E. Petersen, and Robert C. Lucas. 1987. *Managing Wilderness Recreation Use: Common Problems and Potential Solutions*. General Technical Report INT-230. Ogden, Utah: U.S. Forest Service, Intermountain Research Station.
- DeLorme Mapping. 1992. *Alaska Atlas & Gazetteer*. Freeport, Maine: DeLorme Mapping.
- Dick, Jan, Chief Ranger, Yukon-Charley Rivers National Preserve. 1993. *Personal communication (telephone call) with Karen McKibbin, Spectrum Sciences & Software, Inc., November 24*.
- Dunholter, Paul H., V.E. Mestre, R.A. Harris, and L.F. Cohn. 1989. *Methodology for the Measurement and Analysis of Aircraft Sound Levels within National Parks*. MGA Technical Report No. 89-P07. Newport Beach, Calif.: Mestre Greve Associates. Prepared for U.S. National Park Service.
- Fidell, Sanford, and Laura Silvati. 1990. Relating the Annoyance of Aircraft Overflights to Their Audibility by Outdoor Recreationists. In *Proceedings of Noise-Con 90: Reducing the Annoyance of Noise*. Ilene J. Busch-Vishniac (ed.). New York, N.Y.: Noise Control Foundation.
- Fidell, Sanford, Laura Silvati, and Karl Pearsons. 1990. *Acoustic Measurements of Sonic Booms and Ambient Sound Levels in the Selway-Bitterroot Wilderness Area*. [Denver, Colo.]: U.S. National Park Service. Prepared by BBN Systems and Technologies Corporation.
- Fidell, Sanford, L. Silvati, B. Tabachnick, R. Howe, K.S. Pearsons, R.C. Knopf, J. Gramann, and T. Buchanan. 1992. *Short Term Effects of Aircraft Overflights on Outdoor Recreationists in Three Wildernesses*. NPOA Report No. 91-2. n.p.: U.S. Forest Service and U.S. National Park Service. Prepared by BBN Systems and Technologies Corporation.
- Fields, James M. 1990. A Quantitative Summary of Non-Acoustical Variables' Effects on Reactions to Environmental Noise. In *Proceedings of Noise-Con 90: Reducing the Annoyance of Noise*. Ilene J. Busch-Vishniac (ed.). New York, N.Y.: Noise Control Foundation.
- Hammitt, William E. 1982. Cognitive Dimensions of Wilderness Solitude. *Environment and Behavior* 14 (4):478-493.
- Harrison, Robin T., Roger N. Clark, and George H. Stankey. 1980. *Predicting Impact of Noise on Recreationists*. ED&T Project No. 2688. San Dimas, Calif.: U.S. Forest Service, San Dimas Equipment Development Center.
- Harrison, Robin T., Lawrence A. Hartman, and William J. Makel. 1990. Annoyance From Aircraft Overflights in Wildernesses. In *Proceedings of Noise-Con 90: Reducing the Annoyance of Noise*. Ilene J. Busch-Vishniac (ed.). New York, N.Y.: Noise Control Foundation.

- Horonjeff, Richard D., Yuki Kimura, Nicholas P. Miller, William E. Robert, Christopher F. Rossano, and Gonzalo Sanchez. 1992. *Aircraft Management Studies: Acoustic Data Collected at Grand Canyon National Park*. Report No. 290940.18. n.p.: U.S. National Park Service. Prepared by Harris, Miller, Miller & Hanson, Inc.
- Horonjeff, Richard D., Nicholas P. Miller, William E. Robert, Christopher F. Rossano, and Gonzalo Sanchez. 1993. *Aircraft Management Studies: Acoustic Data Collected at Haleakala and Hawaii Volcanoes National Parks (Draft)*. Report No. 290940.18B. n.p.: U.S. National Park Service. Prepared by Harris, Miller, Miller & Hanson, Inc.
- Iditarod Trail Committee. 1994. *Iditarod Race Route (map)*. Wasilla, Alaska: ITC.
- Jettmar, Karen. 1993. *The Alaska River Guide: Canoeing, Kayaking, and Rafting in the Last Frontier*. Seattle, Washington: Alaska Northwest Books.
- Kajdan, Lawrence J., Outdoor Recreation Planner, BLM Glennallen District. 1993. *Personal communication (telephone call and letter) with Jon Isaacs, Jon Issacs and Associates, and Susan Means and Karen McKibbin, Spectrum Sciences & Software, Inc., November 24 and 30.*
- Kelly, Lon, Recreation Specialist, BLM Steese/White Mountains District. 1994. *Personal communication (FAX) with Susan Means, Spectrum Sciences & Software, Inc., February 17.*
- MARCOA Publishing, Inc. 1992. *Anchorage Salutes Elmendorf Air Force Base*. San Diego, Calif.: MARCOA.
- Mosby, Jack, and David Dapkus. 1992. *Alaska Paddling Guide*. Anchorage, Alaska: J & R Enterprises.
- National Geographic Society. 1984. *A Guide to Our Federal Lands*. n.p.: National Geographic Society.
- Nemeth, Dave, Concessions Specialist, Denali National Park and Preserve. 1993. *Personal communication (telephone call) with Karen McKibbin, Spectrum Sciences & Software, Inc., December 14.*
- Panarese, Pete, Chief, Field Operations, Division of Parks and Outdoor Recreation, ADNR. 1993. *Personal communication (meeting) with Jon Isaacs, Jon Isaacs and Associates, and Karen McKibbin and Susan Means, Spectrum Sciences & Software, Inc., September 8.*
- Palmer, Tim. 1993. *The Wild and Scenic Rivers of America*. Washington, D.C.: Island Press.
- Purdum, Ron, Ranger/Pilot, Denali National Park and Preserve. 1993. *Personal communication (letter) with U.S. Air Force, HQ 11 AF/EIS, November 23.*
- Riley, Laura, and William Riley. 1992. *Guide to the National Wildlife Refuges*. Revised and expanded. New York, N.Y.: Macmillan Publishing Co.
- Roberts, Claire, Area Ranger, Lake Clark National Park and Preserve. 1993. *Personal communication (telephone call) with Karen McKibbin, Spectrum Sciences & Software, Inc., November 30.*
- Rossmann, Betty B., and Z. Joseph Ulehla. 1977. Psychological Reward Values Associated with Wilderness Use: A Functional-Reinforcement Approach. *Environment and Behavior* 9 (1):41-66.
- Schlapfer, Jake, Outdoor Recreation Planner, BLM Anchorage District. 1993. *Personal communication (meeting) with Jon Isaacs, Jon Isaacs and Associates, and Susan Means, Spectrum Sciences & Software, Inc., November 3.*
- Schoepfle, G.M., E.J. Szarleta, and S. Schexnayder. How Severe is Severe: Public Involvement and Systematic Understanding of Wilderness as a Resource. In *Environmental Analysis: The NEPA Experience*. Boca Raton, Fla.: Lewis Publishers.
- Simmerman, Nancy Lange. 1991. *Alaska's Parklands: The Complete Guide*. Revised edition. Seattle, Wash.: The Mountaineers.

- Sneddon, Matthew, Laura Silvati, Karl Pearsons, and Sanford Fidell. 1993. *Measurements and Analyses of the Indigenous Sound Environment of Coniferous Forests*. Report No. 7210. NPOA 91-1. Denver, Colo.: U.S. National Park Service. Prepared by BBN Systems and Technologies.
- Stankey, George H., David N. Cole, Robert C. Lucas, Margaret E. Petersen, and Sidney S. Frissell. 1985. *The Limits of Acceptable Change (LAC) System for Wilderness Planning*. General Technical Report INT-176. Ogden, Utah: U.S. Forest Service, Intermountain Forest and Range Experiment Station.
- Tabachnick, Barbara G., Richard H. Howe, and Sanford Fidell. 1992. *Estimation of Aircraft Overflight Exposure in National Parks and Forest Service Wildernesses*. NPOA Report No. 92-1. Denver, Colo.: U.S. National Park Service. Prepared by BBN Systems and Technologies Corporation.
- Tabachnick, Barbara, Sanford Fidell, Laura Silvati, Richard C. Knopf, James Gramann, and Thomas Buchanan. 1994. *Intermediate Term Effects of Aircraft Overflights on Outdoor Recreationists in Twelve Wildernesses*. NPOA Report No. 91-5. [Denver, Colo.]: U.S. National Park Service. Prepared by BBN Systems and Technologies.
- U.S. Air Force (USAF). 1986. *Environmental Assessment: Military Operations Areas 1986 Update, Alaska*. Elmendorf AFB, Alaska: USAF HQ/AAC. Prepared by Envirosphere Company.
- _____. 1991. *Commander's Summary: Comprehensive Plan, Elmendorf Air Force Base, Alaska*. n.p.:n.p.
- _____. 1992. *Draft AICUZ Study: Elmendorf AFB, Alaska*. Elmendorf AFB, Alaska: U.S. Air Force.
- _____. 1993. *Environmental Assessment: Major Flying Exercises in Alaska*. Elmendorf AFB, Alaska: U.S. Air Force, 11 AF. Prepared by Spectrum Sciences and Software, Inc.
- U.S. Bureau of Land Management (BLM). n.d. *Southcentral Draft Resource Management Plan and Draft Environmental Impact Statement*. n.p.: n.p.
- _____. n.d. *Amendment to EA-AK-040-89-9019 for Special Recreation Use Permits (Game Management Unit 19)*. Anchorage, Alaska: BLM, Anchorage District Office.
- _____. 1982a. *BLM Land Use Plan for Southwest Alaska: A Summary*. Anchorage, Alaska: BLM, Anchorage District Office.
- _____. 1982b. *The Iditarod National Historic Trail Seward to Nome Route, Volume Two: Resource Inventories*. Anchorage, Alaska: BLM, Anchorage District Office; in cooperation with the ADNRP, Division of Parks.
- _____. 1986a. *The Iditarod National Historic Trail Seward to Nome Route: A Comprehensive Management Plan*. Anchorage, Alaska: BLM, Anchorage District Office.
- _____. 1986b. *Proposed Resource Management Plan and Final Environmental Impact Statement for the Central Yukon Planning Area*. Fairbanks, Alaska: BLM, Fairbanks District Office, Northwest Resource Area.
- _____. 1986c. *Resource Management Plan and Record of Decision for the Central Yukon Planning Area*. BLM-AK-PT-86-031-1610-026. Fairbanks, Alaska: BLM, Fairbanks District Office, Northwest Resource Area.
- _____. 1988a. *BLM Recreation Guide: Alaska River Adventures*. BLM-AK-GI-88-007-8351-912. n.p.: n.p.
- _____. 1988b. *Fortymile River Placer Mining: Final Cumulative Environmental Impact Statement*. Anchorage, Alaska: BLM, Alaska State Office.
- _____. 1988c. *The Iditarod National Historic Trail (brochure)*. Anchorage, Alaska: BLM, Anchorage District Office.

- _____. 1989a. *Recreation 2000: Alaska Strategy Plan*. n.p.
- _____. 1989b. *Environmental Assessment for Special Recreation Permits*. EA-AK-040-89-9019. Anchorage, Alaska: BLM, Anchorage District Office.
- _____. 1990. *Public Land Statistics: 1989*. Vol. 174. BLM/YA/PT-90/001+1165. Washington, D.C.: U.S. Government Printing Office.
- _____. 1991a. *Public Land Statistics: 1990*. Vol. 175. BLM/SC/PT-91/006+1165. Washington, D.C.: U.S. Government Printing Office.
- _____. 1991b. *Decision Record: Finding of No Significant Impact and ANILCA 810(a) Finding*. AA-71838; AA-73479. Anchorage, Alaska: BLM, Anchorage District Office.
- _____. 1992. *Public Land Statistics: 1991*. Vol. 176. BLM/SC/PT-92/011+1165. Washington, D.C.: U.S. Government Printing Office.
- _____. 1993a. *Environmental Assessment EA-040-93-020 for Commercial Use of the Rohn River Site*. Anchorage, Alaska: BLM, Anchorage District Office.
- _____. 1993b. Frontier Flashes. *Frontiers* (Nov):12.
- _____. 1993c. *MDP Data Files*. Anchorage, Alaska: BLM.
- _____. 1993d. *Public Land Statistics: 1992*. Vol. 177. BLM/SC/ST-93/002+1165. Washington, D.C.: U.S. Government Printing Office.
- _____. 1994. *Public Land Statistics: 1993*. Vol. 178. BLM/SC/ST-94/001+1165. Washington, D.C.: U.S. Government Printing Office.
- U.S. Fish and Wildlife Service (USFWS). 1987a. *Innoko National Wildlife Refuge: Final Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review*. Anchorage, Alaska: USFWS.
- _____. 1987b. *Nowitna National Wildlife Refuge: Final Comprehensive Conservation Plan, Environmental Impact Statement, Wilderness Review, and Wild River Plan*. Anchorage, Alaska: USFWS.
- _____. 1987c. *Yukon Flats National Wildlife Refuge: Final Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review*. Anchorage, Alaska: USFWS.
- U.S. Forest Service (USFS). 1990. *The Recreation Opportunity and Spectrum (ROS) Primer and Field Guide*. R6-REC-021-90. [Washington, D.C.]: U.S. Government Printing Office.
- _____. 1992. *Report to Congress: Potential Impacts of Aircraft Overflights of National Forest System Wildernesses*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: U.S. Government Printing Office.
- U.S. National Park Service (NPS). 1984. *General Management Plan and Environmental Assessment: Lake Clark National Park and Preserve, Alaska*. n.p.: n.p.
- _____. 1986a. *Aircraft Management Plan Environmental Assessment: Grand Canyon National Park, Arizona*. n.p.: NPS.
- _____. 1986. *General Management Plan, Land Protection Plan, and Wilderness Suitability Review: Denali National Park and Preserve, Alaska*. n.p.: n.p.
- _____. 1988. *Final Environmental Impact Statement for the Wilderness Recommendation: Denali National Park and Preserve, Alaska*. n.p.: n.p.
- _____. 1989. *National Park Service Statistical Abstract*. Washington, [D.C.]: NPS, Statistical Office.

- _____. 1990. *National Park Service Statistical Abstract*. Washington, [D.C.]: NPS, Socio-Economic Studies.
- _____. 1991. *National Park Service Statistical Abstract*. Denver, Colo.: NPS, Socio-Economic Studies Division.
- _____. 1992. *National Park Service Statistical Abstract*. Denver, Colo.: NPS, Socio-Economic Studies Division.
- _____. 1993a. *National Park Service Statistical Abstract*. Denver, Colo.: NPS, Socio-Economic Studies.
- _____. 1993b. *Directory of Commercial Visitor Services*. Anchorage, Alaska: NPS, Alaska Regional Office, Concessions Management Division.
- _____. 1994. *Report to Congress: Report on Effects of Aircraft Overflights on the National Park System*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: NPS.
- U.S. National Park Service, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, and Federal Aviation Administration. 1993. *Interagency Agreement Between National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and Federal Aviation Administration*. n.p.: n.p.
- U.S. Travel and Tourism Administration. n.d. *Rural Tourism Handbook: Selected Case Studies and Development Guide*. Washington, D.C.: U.S. Department of Commerce, Travel and Tourism Administration.
- Vernimen, Dick, District Manager, BLM Anchorage District. 1993. *Personal communication (meeting) with Jon Isaacs, Jon Isaacs and Associates, and Karen McKibbin and Susan Means, Spectrum Sciences & Software, Inc., October 27*.
- Woodring, Jeannie. 1994a. Ecotourism: Exploring the Last Frontier of Travel. *Alaska Business Monthly* (May):50-55.
- _____. 1994b. Ready, Set, Go—Another Red-Hot Tourism Year. *Alaska Business Monthly* (May):30-37.

Subsistence

- Alaska Department of Community and Regional Affairs (ADCRA). 1995. *Community Information Summaries: Excerpts from the DCRA Community Database*. Juneau, Alaska: ADCRA, Department of Community and Regional Affairs.
- Alaska Department of Fish and Game (ADF&G). n.d. *Alaska State Hunting Regulations No. 32*. Juneau, Alaska: ADF&G.
- _____. n.d. *Trapper Questionnaire Statewide Report: 1992-93*. n.p.: n.p.
- _____. 1985. *Alaska Habitat Management Guide, Southcentral Region: Volume I: Life Histories and Habitat Requirements of Fish and Wildlife; Volume II: Distribution, Abundance, and Human Use of Fish and Wildlife; and Map Atlas*. Juneau, Alaska: ADF&G.
- _____. 1986. *Alaska Habitat Management Guide, Western and Interior Regions: Distribution, Abundance, and Human Use of Fish and Wildlife; and Map Atlas*. Juneau, Alaska: ADF&G.
- _____. 1991. *Community Profile Data Base*. Anchorage, Alaska: ADF&G.
- Alaska Department of Labor (ADL). 1991. *Alaska Population Overview: 1990 Census & Estimates*. Juneau, Alaska: ADL.
- Alaska National Interest Lands Conservation Act (ANILCA)*. U.S. Public Law 96-487. 96th Congress, 2 December 1980.
- Alaska Native Claims Settlement Act (ANCSA)*. U.S. Public Law 92-203. 92nd Congress, 18 December 1971.
- Alaska Northwest Books. 1991. *The Alaska Wilderness Milepost*. Seattle, Washington: Alaska Northwest Books.
- Antonson, Joan M., and William S. Hanable. 1992. *Alaska's Heritage*. 2d ed. Anchorage, Alaska: Alaska Historical Commission.
- Bowles, Ann, Barbara Tabachnick, and Sanford Fidell. 1991. *Review of the Effects of Aircraft Overflights on Wildlife (Draft)*. Report No. 7500. Denver, Colo.: U.S. National Park Service. Prepared by BBN Systems and Technologies.
- Brelsford, Taylor, Raymond Peterson, and Terry L. Haynes. 1986. *An Overview of Resource Use Patterns in the Central Kuskokwim: Aniak, Crooked Creek and Red Devil*. Technical Paper 141. n.p.: ADF&G, Division of Subsistence.
- Calef, G.W., E.A. DeBrock, and G.M. Lortie. 1976. The Reaction of Barren-Ground Caribou to Aircraft. *Arctic* 29 (4):201-212.
- Case, David S. 1984. *Alaska Natives and American Laws*. rev. ed. n.p.: University of Alaska Press.
- Caulfield, Richard A. 1979. *Subsistence Use In and Around the Proposed Yukon-Charley National Rivers*. Occasional Paper 20. Fairbanks, Alaska: Anthropology and Historic Preservation Cooperative Park Studies Unit, University of Alaska, Fairbanks.
- _____. 1983. *Subsistence Land Use in the Upper Yukon-Porcupine Region, Alaska*. Technical Paper 16. Juneau, Alaska: ADF&G, Division of Subsistence.
- Charnley, Susan. 1982. *Resource Use Areas in the Aniak and Oskawalik River Drainages*. Technical Paper 50. n.p.: ADF&G, Division of Subsistence.
- _____. 1983. *Moose Hunting in Two Central Kuskokwim Communities: Chuathbaluk and Sleetmute*. Technical Paper 76. n.p.: ADF&G, Division of Subsistence.

- _____. 1984. *Human Ecology of Two Central Kuskokwim Communities: Chuathbaluk and Sleetmute*. Technical Paper 81. n.p.: ADF&G, Division of Subsistence.
- Ellanna, Linda J., and Polly C. Wheeler. 1989. Wetlands and Subsistence-Based Economies in Alaska, U.S.A. *Arctic and Alpine Research* 21 (4):329-340.
- Fall, James A., and Dan J. Foster. 1987. *Fish and Game Harvest and Use in the Middle Susitna Basin: The Results of a Survey of Residents of the Road-Connected Areas of Game Management Units 14B and 16A, 1986*. Technical Paper 143. n.p.: ADF&G, Division of Subsistence.
- Federal Subsistence Board (FSB). 1992. *Final Environmental Impact Statement on Subsistence Management for Federal Public Lands in Alaska, Vol. I*. Anchorage, Alaska: USFWS, BLM, NPS, and BIA; and U.S. Forest Service.
- Gallagher, Thomas J. 1992. Language, Native People, and Land Management in Alaska. *Arctic* 45 (2):145-149.
- Georgette, S., and H. Loon. 1988. *The Noatak River: Fall Caribou Hunting and Airplane Use*. ADF&G Technical Paper 162. Anchorage, Alaska: ADF&G.
- Golden, J., R. P. Ouellette, S. Saari, and P.N. Cheremisinoff. 1979. *Environmental Impact Data Book*. Ann Arbor Science.
- Ha, J.C. 1988. Measurement and Modeling of Physiological Stress. In *Effects of Aircraft Noise and Sonic Booms on Fish and Wildlife: A Research Needs Workshop*. NERC-88/23. Asherin, D.A., and D.N. Gladwin (eds.). Ft. Collins, Colo.: USFWS, National Ecology Research Center.
- Harrington, Fred H., and Alasdair M. Veitch. 1991. Short-Term Impacts of Low-Level Jet Fighter Training on Caribou in Labrador. *Arctic* 44 (4):318-327.
- Haynes, T.L., M. Case, J.A. Fall, L. Halpin, and M. Robert. 1984. *The Use of Copper River Salmon and Other Wild Resources by Upper Tanana Communities, 1983-1984*. Technical Paper 115. Fairbanks, Alaska: ADF&G, Division of Subsistence.
- Huntington, Henry P. 1992. *Wildlife Management and Subsistence Hunting in Alaska*. Seattle, Wash.: University of Seattle Press.
- Kari, Priscilla Russell. 1983. *Land Use and Economy of Lime Village*. Technical Paper 80. n.p.: ADF&G, Division of Subsistence.
- _____. 1985. *Wild Resource Use and Economy of Stony River Village*. Technical Paper 108. n.p.: ADF&G, Division of Subsistence.
- Langdon, Steve J. 1986. *Contemporary Alaskan Native Economies*. Lanham, Md.: University Press of America.
- _____. 1989. *The Native People of Alaska*. 2d ed. Anchorage, Alaska: Greatland Graphics.
- Manci, K.M., D.N. Gladwin, R. Vilella, and M.G. Cavendish. 1988. *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis*. NERC-88/29. Ft. Collins, Colo.: USFWS, National Ecology Research Center.
- Marcotte, James R. 1991. *Wild Fish and Game Harvest and Use by Residents of Five Upper Tanana Communities, Alaska, 1987-88*. Technical Paper 168. Juneau, Alaska: ADF&G, Division of Subsistence.
- Martin, Gayle. 1983. *Use of Natural Resources by the Residents of Dot Lake, Alaska*. Technical Paper 78. n.p.: ADF&G, Division of Subsistence.
- Mayo, Will. 1995. Native Leader Offers a History Lesson on Subsistence. *Anchorage Daily News* (10 February):D10.

- McCollum, Daniel W., and John C. Bergstrom. 1992. Measuring Net Economic Value and Regional Economic Impact. In *Valuing Wildlife Resources in Alaska*. Boulder, Colo.: Westview Press.
- McKechnie, Alexie M., and Douglas N. Gladwin. 1993. *Aircraft Overflight Effects on Wildlife Resources*. NPOA Report No. 93-8. Denver, Colo.: U.S. National Park Service. Prepared by Harris, Miller, Miller & Hanson, Inc.
- McMillan, Patricia O., and Sal V. Cuccarese. 1988. *Alaska Over-the-Horizon Backscatter Radar System: Characteristics of Contemporary Subsistence Use Patterns in the Copper River Basin and Upper Tanana Area*. Anchorage, Alaska: Alaska Environmental Information and Data Center, University of Alaska.
- Morgan, Lael, ed. 1979. *Alaska's Native People*. Alaska Geographic, vol. 6, no. 3. Anchorage, Alaska: Alaska Geographic Society.
- Naske, Claus-M., and Herman E. Slotnick. 1987. *Alaska: A History of the 49th State*. 2d ed. Norman, Oklahoma: University of Oklahoma Press.
- Nelson, Richard K. 1986. *Hunters of the Northern Forest: Designs for Survival Among the Alaskan Kutchin*. Chicago, Ill.: University of Chicago Press.
- President. 1994. Executive Order No. 12898: Federal Actions to Address Environmental Justice in Minority and Low-Income Populations.
- Schroeder, Robert F., David B. Andersen, Rob Bosworth, Judith M. Morris, and John M. Wright. 1987. *Subsistence in Alaska: Arctic, Interior, Southcentral, Southwest, and Western Regional Summaries*. Technical Paper 150. Juneau, Alaska; ADF&G, Division of Subsistence.
- Stickney, Alice. 1981. *Middle Kuskokwim Food Survey - II*. Technical Paper 21. n.p.: ADF&G, Division of Subsistence.
- Stokes, J. 1985. *Natural Resource Utilization of Four Upper Kuskokwim Communities*. Technical Paper 86. Anchorage, Alaska: ADF&G, Division of Subsistence.
- Sumida, Valerie, and Clarence Alexander. 1985. *Moose Hunting by Residents of Beaver, Birch Creek, Fort Yukon, and Stevens Village in the Western GMU 25(D)*. Technical Paper 121. n.p.: ADF&G, Division of Subsistence.
- Sumida, Valerie, and David Andersen. 1990. *Patterns of Fish and Wildlife Use for Subsistence in Fort Yukon, Alaska*. Technical Paper 179. n.p.: ADF&G, Division of Subsistence.
- U.S. Air Force (USAF). 1992. *Environmental Assessment of the Expansion and Upgrade of Military Training Routes, Alaska*. Elmendorf AFB, Alaska: 11th Air Force. Prepared by ENSR Consulting and Engineering.
- _____. 1993. *Environmental Assessment: Major Flying Exercises in Alaska*. Elmendorf AFB, Alaska.: 11th Air Force. Prepared by Spectrum Sciences and Software, Inc.
- U.S. Bureau of Land Management (BLM). 1988. *Fortymile River Placer Mining: Final Cumulative Environmental Impact Statement*. Fairbanks: BLM.
- U.S. Department of the Interior, and U.S. Department of Agriculture. [1991]. *Interagency Airspace Coordination Guide*. n.p.: n.p.
- U.S. Fish and Wildlife Service (USFWS). 1994. *Subsistence Management Regulations for the Harvest of Fish and Wildlife on Federal Public Lands in Alaska*. Anchorage, Alaska: USFWS, Office of Subsistence Management.

- U.S. Forest Service (USFS). 1992. *Report to Congress: Potential Impacts of Aircraft Overflights of National Forest System Wildernesses*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: U.S. Government Printing Office.
- U.S. National Park Service (NPS). 1994. *Report to Congress: Report on Effects of Aircraft Overflights on the National Park System*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: NPS.
- Wolfe, Robert J. 1991. *Trapping in Alaska Communities with Mixed, Subsistence-Cash Economies*. Technical Paper 217. Juneau, Alaska: ADF&G, Division of Subsistence.

Land Use

- Alaska Department of Community and Regional Affairs (ADCRA). 1979. *Community Profiles: Crooked Creek, Georgetown*. Prepared by Darbyshire and Associates. n.p.: ADCRA.
- _____. 1987. *Ruby Community Profile (Draft)*. n.p.: ADCRA. Prepared by Fison & Associates.
- _____. 1993. *Community/Borough Map*. Anchorage, Alaska: ADCRA.
- Alaska Department of Fish and Game (ADF&G). 1980. *Delta Bison Management Plan*. n.p.: ADF&G.
- Alaska Department of Labor (ADL). 1991. *Alaska Population Overview: 1990 Census and Estimates*. Anchorage, Alaska: ADL, Research and Analysis Section and Demographic Unit.
- Alaska Department of Natural Resources (ADNR). 1984. *Bristol Bay Area Plan for State Lands*. Juneau: ADNR, ADF&G, and Alaska Department of Environmental Conservation.
- _____. 1985. *Susitna Area Plan*. Anchorage, Alaska: ADNR, ADF&G, Matanuska-Susitna Borough, and U.S. Dept. of Agriculture.
- _____. 1986. *Copper River Basin Area Plan for State Lands*. Anchorage: ADNR and ADF&G.
- _____. 1987. *Wood-Tikchik State Park Management Plan*. Anchorage, Alaska: ADNR, Division of Parks and Outdoor Recreation.
- _____. 1988a. *Kuskokwim Area Plan for State Lands*. Anchorage, Alaska: ADNR, ADF&G.
- _____. 1988b. *Tanana Valley State Forest: Forest Management Plan*. Anchorage, Alaska: ADNR, Division of Forestry.
- _____. 1989. *Denali State Park Master Plan*. n.p.: ADNR, Division of Parks and Outdoor Recreation.
- _____. 1991a. *Alaska Land Status (map)*. Anchorage, Alaska: ADNR.
- _____. 1991b. *Susitna Basin Recreation Rivers Management Plan*. Anchorage, Alaska: ADNR, Division of Land, Land Resources Section; and ADF&G.
- _____. 1991c. *Tanana Basin Area Plan for State Lands*. Adopted 1985, updated 1991. Fairbanks, Alaska: ADNR, Land Resources Section.
- _____. 1993a. *Area Plans (brochure)*. Anchorage, Alaska: ADNR, Land and Resources Section.
- _____. 1993b. *Fact Sheet: Nelchina Public Use Area*. Anchorage, Alaska: ADNR, Division of Land.
- _____. 1994. *State of Alaska General Land Status (map)*. Anchorage, Alaska: ADNR, Division of Support Services, Land Records Information Section.
- Alaska Department of Transportation and Public Facilities (ADOT). 1981. *Environmental Assessment: Denali Highway Cantwell to Paxson*. n.p.: ADOT.
- Alaska National Interest Lands Conservation Act (ANILCA)*. U.S. Public Law 96-487. 96th Congress, 2 December 1980.
- Alaska Northwest Books. 1991. *The Alaska Wilderness Milepost*. Bothell, Wash.: Alaska Northwest Books.
- American National Standards Institute (ANSI). 1990. *Sound Level Descriptors for Determination of Compatible Land Use*. ANSI S12.40-1990. New York, N.Y.: Acoustical Society of America.
- Anderson, Grant S., and Richard D. Horonjeff. 1992. *Aircraft Overflight Study: Effect of Aircraft Altitude Upon Sound Levels at the Ground*. NPOA Report No. 91-4. Lexington, Mass.: U.S. National Park Service. Prepared by Harris Miller Miller & Hanson, Inc.

- Dunholter, P.H., V.E. Mestre, R.A. Harris, and L.F. Cohn. 1989. *Methodology for the Measurement and Analysis of Aircraft Sound Levels within National Parks*. MGA Technical Report No. 89-P07. Newport Beach, Calif.: U.S. National Park Service. Prepared by Mestre Greve Associates.
- Fairbanks North Star Borough. 1988. *Title 18: Zoning Ordinance*. Fairbanks, Alaska: FNSB, Department of Community Planning.
- _____. 1990. *Fairbanks North Star Borough: Comprehensive Plan*. Fairbanks, Alaska: FNSB, Department of Community Planning.
- Federal Interagency Committee on Noise (FICON). 1992. *Federal Agency Review of Selected Airport Analysis Issues*. n.p.: FICON.
- Federal Land Policy and Management Act of 1976 (FLPMA)*. U.S. Public Law 94-579. 94th Congress, 21 October 1976.
- Kajdan, Lawrence, Outdoor Recreation Planner, BLM Glennallen District. 1993. *Personal communication (telephone call) with Susan Means, Karen McKibbin, Spectrum Sciences & Software, Inc., and Jon Isaacs, Jon Isaacs and Associates, November 24.*
- Mushovic, K.J., Land Use Planner, BLM Glennallen District. 1993. *Personal communication (telephone call) with Susan Means, Spectrum Sciences & Software, Inc., November 17.*
- Ollerhead, J.B., et al. 1992. *Report of a Field Study of Aircraft Noise and Sleep Disturbance*. London, U.K.: Civil Aviation Authority, Department of Safety, Environment and Engineering.
- Palmer, Tim. 1993. *The Wild and Scenic Rivers of America*. Washington, D.C.: Island Press.
- Roberts, Claire, Area Ranger, Lake Clark National Park and Preserve. 1993. *Personal communication (telephone call) with Karen McKibbin, Spectrum Sciences & Software, Inc., November 30.*
- U.S. Air Force (USAF). 1993a. *Environmental Assessment: Major Flying Exercises in Alaska*. Elmendorf AFB, Alaska: 11th Air Force. Prepared by Spectrum Sciences and Software, Inc.
- _____. 1993b. *Operations Information Data Package*. Elmendorf AFB, Alaska: 11 AF/DOO.
- U.S. Bureau of the Census. 1990. *TIGER Line Census Files and 1990 Census of Population and Housing, Public Law 94-171 Data*. Washington, D.C.: Bureau of the Census, Data User Services Division.
- U.S. Bureau of Land Management (BLM). 1980. *Fortymile River Management Framework Plan*. Fairbanks, Alaska: BLM, Fairbanks District Office.
- _____. 1983a. *Fortymile River—River Management Plan*. Fairbanks, Alaska: BLM.
- _____. 1983b. *Steese National Conservation Area Master Habitat Management Plan*. Fairbanks, Alaska: BLM.
- _____. 1983c. *Steese National Conservation Area Recreation Activity Management Plan*. Fairbanks, Alaska: BLM.
- _____. 1983d. *River Management Plan for the Birch Creek National Wild River*. Fairbanks, Alaska: BLM.
- _____. 1984. *Steese National Conservation Area Resource Management Plan and Final EIS*. Fairbanks, Alaska: Fairbanks District Office, Yukon Resource Area.
- _____. 1986. *Central Yukon Planning Area Resource Management Plan*. BLM-AK-PT-86-031-1610-026. Fairbanks, Alaska: BLM, Fairbanks District Office, Northwest Resource Area.
- _____. 1988a. *Birch Creek Placer Mining Final Cumulative Environmental Impact Statement*. Anchorage, Alaska: BLM, Alaska State Office.

- _____. 1988b. *Fortymile River Placer Mining Final Cumulative Environmental Impact Statement*. Anchorage, Alaska: BLM, Alaska State Office.
- _____. 1992. *Public Land Laws of Alaska*. Anchorage, Alaska: BLM, Division of Conveyance Management.
- U.S. Fish and Wildlife Service (USFWS). 1987a. *Nowitna National Wildlife Refuge Final Comprehensive Conservation Plan, Wild River Plan, Wilderness Review and Environmental Impact Statement*. Anchorage, Alaska: USFWS.
- _____. 1987b. *Yukon Flats National Wildlife Refuge Final Comprehensive Conservation Plan, Environmental Impact Statement, and Wilderness Review*. Anchorage, Alaska: USFWS.
- U.S. Forest Service (USFS). 1992. *Report to Congress: Potential Impacts of Aircraft Overflights of National Forest System Wildernesses*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: U.S. Government Printing Office.
- U.S. National Park Service (NPS). 1984. *General Management Plan and Environmental Assessment: Lake Clark National Park and Preserve, Alaska*. n.p.: NPS.
- _____. 1985. *Yukon-Charley National Preserve and Charley National Wild River: Comprehensive Conservation Plan/Environmental Impact Statement/Wilderness Review*. n.p.: NPS.
- _____. 1986. *Denali National Park and Preserve, Alaska: General Management Plan, Land Protection Plan, and Wilderness Suitability Review*.
- _____. 1988. *Final Environmental Impact Statement for the Wilderness Recommendation: Denali National Park and Preserve, Alaska*.
- _____. 1994. *Report to Congress: Report on Effects of Aircraft Overflights on the National Park System*. Prepared Pursuant to Public Law 100-91: The National Park Overflights Act of 1987. Washington, D.C.: NPS.
- Vernimen, Dick, District Manager, BLM Anchorage District. 1993. *Personal communication with Jon Isaacs, Jon Isaacs and Associates, and Karen McKibbin and Susan Means, Spectrum Sciences & Software, Inc., October 27*.

Air Quality

- Alaska Department of Environmental Conservation (ADEC). 1994. *State Air Quality Control Plan, Volume II: Analysis of Problems, Control Actions*. Juneau, Alaska: ADEC.
- Alaska Northwest Books. 1991. *Facts About Alaska: The Alaska Almanac*. 15th edition. Bothell, Wash.: Alaska Northwest Books.
- Anchorage Air Pollution Control Agency. 1988. *Anchorage International Airport Mixing Heights*. Anchorage, Alaska: Anchorage Air Pollution Control Agency.
- _____. 1992. *AMATS Air Quality Trends Update*. Anchorage, Alaska: Anchorage Air Pollution Control Agency.
- Bosco, Joseph A. 1990. International Law Regarding Outerspace: An Overview. *J. Air L. & Com.* 55:609.
- Bowling, Sue Ann. 1984. Modifications Necessary to Use Standard Dispersion Models at High Latitudes. *Atmospheric Environment* 19 (1):93-97.
- _____. 1984. *Project Summary: Meteorological Factors Responsible for High CO Levels in Alaskan Cities*. Corvallis, Oregon: U.S. EPA.
- _____. 1986. Climatology of High-Latitude Air Pollution as Illustrated by Fairbanks and Anchorage, Alaska. *Journal of Climate and Applied Meteorology* 25 (1):22-34.
- _____. Alaska Climate Research Center, Geophysical Institute, University of Alaska, Fairbanks. 1994. *Personal communication with Lisa M. Montee, Spectrum Sciences & Software, Inc., February 2*.
- Bowling, Sue Ann, and Glenn E. Shaw. 1992. The Thermodynamics of Pollutant Removal as an Indicator of Possible Source Areas for Arctic Haze. *Atmospheric Environment* 26A (16):2953-2961.
- Brownell, F. William, and Lee B. Zeugin. 1992. *Clean Air Act Handbook*. Rockville, Md.: Government Institutes.
- Coutts, Jack, ADEC, Fairbanks District. 1994. *Personal communication with Lisa M. Montee, Spectrum Sciences & Software, Inc., January 20*.
- Liebsch, E.J., J.B. Harper, J.M. Bownds, and M.W. Yambert. 1991. *Multiple Aircraft Instantaneous Line Source (MAILS) Dispersion Model User's Guide*. Rev. 3.0. Tyndall AFB, Fla.: Air Force Engineering and Services Center, Engineering Services Laboratory. Prepared by Oak Ridge National Laboratory.
- Opperman, Larry, 3 WG/CEV. 1994. *Personal communication with Lisa M. Montee, Spectrum Sciences & Software, Inc., March 23*.
- President. 1979. Executive Order No. 12114: Environmental Effects Abroad of Major Federal Actions. 44 *Federal Register* 1957.
- Seitchek, Glenn D. 1985. *Aircraft Engine Emissions Estimator*. Tyndall AFB, Fla.: Air Force Engineering and Services Center, Engineering Services Laboratory.
- Sierra Research, Inc. 1991. *Anchorage Air Quality Improvement Plan: Contingency Plan and Planned SIP Revisions, Volume I: Technical Summary*. Sacramento, Calif.: Sierra Research, Inc.
- _____. 1993a. *Anchorage Base Year Carbon Monoxide Emission Inventory*. Sacramento, Calif.: Sierra Research, Inc.
- _____. 1993b. *Fairbanks Base Year Carbon Monoxide Emission Inventory*. Sacramento, Calif.: Sierra Research, Inc.

- U.S. Air Force (USAF). 1992a. *Eielson AFB Air Installation Compatible Use Zone Study*. Eielson AFB, Alaska: 343 WG/CC.
- _____. 1992b. *Elmendorf AFB Air Installation Compatible Use Zone Study*. Elmendorf AFB, Alaska: 3 WG/CC.
- U.S. Environmental Protection Agency (EPA). 1994. *Technology Transfer Bulletin Board System*. Research Triangle Park, North Carolina: EPA.
- U.S. General Accounting Office (GAO). 1992. *Air Pollution: Global Pollution from Jet Aircraft Could Increase in the Future*. GAO/RCED-92-72. Washington, D.C.: GAO.
- Zannetti, Paolo. 1990. *Air Pollution Modeling Theories, Computational Methods and Available Software*. New York: Van Nostrand Reinhold.

Socioeconomics

- Alaska Department of Community and Regional Affairs (ADCRA). 1993. *Selected Population Statistics for Alaskan Communities*. n.p.: ADCRA.
- Asselin, Airman John, 3rd Wing, Public Affairs. 1994. *Personal communication (telephone call) with Susan Means, Spectrum Sciences & Software, Inc., May 27.*
- Beyer, TSgt Ken, 354th Fighter Wing, Public Affairs. 1994. *Personal communication (telephone call and FAX) with Susan Means, Spectrum Sciences & Software, Inc., May 31.*
- Clarke, Jim. 1993. Air Force Training Exercises Bring Cash, Noise to Interior. *Anchorage Daily News* (17 April):B6.
- Hanson, Maj Virgil, 611 ASG/LGV. 1994. *Personal Communication (telephone call) with Susan Means, Spectrum Sciences & Software, Inc., May 31.*
- Proctor, SSgt Ann, U.S. Alaskan Command, Public Affairs. 1994. *Personal communication (telephone call and FAX) with Susan Means, Spectrum Sciences & Software, Inc., May 27 and June 3.*
- Sullivan, P.M., 353rd Fighter Wing/DOU. 1994. *Personal communication (FAX) with Maj Bob Siter, 11 AF/DOOQ, February 28.*
- Troeber, Capt Sandra K., 354th Fighter Wing, Public Affairs. 1995. *Personal communication (telephone call) with Susan Means, Spectrum Sciences & Software, Inc., February 27.*
- Turner, Capt Gary, 354th Fighter Wing, Public Affairs. 1993. *Personal communication (FAX) with Susan Means, Spectrum Sciences & Software, Inc., August 13.*
- _____. 1994. *Personal communication (telephone call) with Karen McKibbin, Spectrum Sciences & Software, Inc., May 27.*
- U.S. Air Force (USAF). n.d. *Eielson Air Force Base Community Relations Plan for Environmental Restoration*. [Eielson AFB, Alaska]: 343rd Wing.
- _____. 1991. *Economic Resource Impact Statement (ERIS) Elmendorf AFB, Alaska: Fiscal Year 1990*. Elmendorf AFB, Alaska: 21st Tactical Fighter Wing, Cost Analysis Branch.
- _____. [1992]. *FY 91 Economic Resource Impact Statement: Eielson Air Force Base Alaska*. Eielson AFB, Alaska: 343rd Wing.
- _____. 1994. *Fact Sheet: Cope Thunder*. Eielson AFB, Alaska: 354th Fighter Wing/Public Affairs.

CHAPTER 6

PERSONS AND AGENCIES CONTACTED

ALASKA DEPARTMENT OF COMMERCE AND ECONOMIC DEVELOPMENT

Juneau.

Phil Breuser. Division of Occupational Licensing. Game Board.

Kaylene Wirth. Division of Occupational Licensing. Game Board.

Anchorage.

Alaska Division of Tourism.

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Jeffrey Anderson. Environmental Engineer. Juneau.

Jack Coutts. Fairbanks District Office.

Randall Lucas. Environmental Engineer. Juneau.

Sally Ryan. Air Quality Management. Juneau.

ALASKA DEPARTMENT OF FISH AND GAME

Juneau.

Steve Peterson. Senior Staff Biologist.

Frank Rue. Director. Habitat and Restoration Division.

Anchorage.

Carol Barnhill. Habitat Division.

Joe Campbell. Fish and Wildlife Protection Agent.

Al Carson. Habitat Biologist. Habitat and Restoration Division.

Jom Fall. Subsistence Division.

Howard Golden. Wildlife Biologist.

Jeff Hughes. Raptor Biologist.

John Morrison.

Suzanne Miller. Biometrician.

Jodie Seitz. Subsistence Division.

Becky Strauch.

Lance Trasky. Regional Supervisor. Habitat Division.

John Westlund. Wildlife Conservation Division.

Fairbanks.

Rod Boertje. Fairbanks. Wildlife Biologist.

Wayne Heimer. Wildlife Biologist.

Mark McNay. Wildlife Biologist.

Al Ott. Regional Supervisor. Habitat Division.

Harry Reynolds. Wildlife Biologist.

Bob Stephenson. Ft. Yukon Area Biologist.

Ken Taylor. Regional Management Coordinator.

Alan Townsend. Habitat Biologist. Habitat and Restoration Division.

Pat Valkenburg. Wildlife Biologist.

Ken Whitten. Wildlife Biologist.

Jack Winters. Wildlife Biologist.

Other Area Offices (ADF&G).

Steve Dubois. Area Biologist. Delta Junction.
Craig Gardner. Area Biologist. Tok.
Tim Osborne. Area Biologist. Galena.
Roger Seavoy. Area Biologist. McGrath.
Bob Tobey. Area Biologist (Unit 13). Glennallen.
Larry Van Daele. Area Biologist (Unit 17). Dillingham.

ALASKA DEPARTMENT OF GOVERNMENTAL COORDINATION

Sally Gibert.
Arlene Murphy. Administrative Coordinator.

ALASKA DEPARTMENT OF NATURAL RESOURCESAnchorage.

Judith Bittner. State Historic Preservation Officer. Division of Parks and Outdoor Recreation. Office of History and Archaeology.
Jack Davis. Land Status Information.
Dave Kelley. Southcentral Region Division of Lands.
Dianne Lyles. Lands Records Information Section.
Dick Mylius. Division of Lands.
Pete Panarese. Chief, Field Operations. Alaska State Parks.
Kathryn Reid. Alaska State Parks. Planning and Operation Services.
Tim Smith. Archaeologist. Division of Parks and Outdoor Recreation. Office of History and Archaeology.
Ron Van Pelt.
Marty Wellbourn. Chief, Resource Assessment and Development Section. Division of Land.

Northern Regional Office. Fairbanks.

Bob Craig. Division of Land.
Rick Smith. Natural Resource Manager. Division of Land and Water Management.
Nancy Welch. Division of Land.

ALASKA DEPARTMENT OF TRANSPORTATION

Diana Strain. Office of Airline Statistics. Alaska Aviation Field Office.

U.S. AIR FORCE

Colonel Henry Aulwurm. 11 AF/DE. Elmendorf AFB.
Paula Fowler. 354 CES/CEVC. Eielson AFB.
Lt Colonel John Gumpert. 11 AF/DOOW. Elmendorf AFB.
Lt Colonel Spanky Heiniger. 11 AF/DOOW. Elmendorf AFB.
Captain Chuck Link. 11 AF/AFREP. Elmendorf AFB.
Ron Merritt. USAF BASH Team Chief. Tyndall AFB, Florida.
Larry Opperman. 3WG/CEV. Elmendorf AFB.
Alan Richmond. Natural Resources Manager and Historic Preservation Officer. Environmental Resources. Elmendorf AFB.
Lt Colonel Jim Thompson. 11 AF/DOO. Elmendorf AFB.
Gerry von Rueden. Natural Resources Manager. Eielson AFB.

U.S. ARMY

Junior Kerns. Natural Resources Specialist. Environmental Resources Branch. Ft. Wainwright.

U.S. ARMY CORPS OF ENGINEERS

Guy McConnell. Biologist. Alaska District. Anchorage.

U.S. BUREAU OF INDIAN AFFAIRS

Dr. D.C. Tomlin. Anchorage.

U.S. BUREAU OF LAND MANAGEMENTAlaska State Office. Anchorage.

Paul Boos. Lead Recreation Planner.

Bishop T. Buckle. Deputy State Director. Lands and Renewable Resources.

Jim Ducker. Primary Point-of-Contact for MOA EIS Project. Alaska State Office.

Brenda Moeller. Branch Chief. Branch of Applications.

Marty Rapp. Information Resources Management.

Jim Robson. Information Resources Management.

Edward F. Spang. State Director, Alaska.

Bill Waldron. Information Resources Management.

Bonnie Weller. Information Resources Management.

Anchorage District Office. Anchorage.

Russ Blome. Lands/Realty.

Jeff Denton. Wildlife Biologist.

Sandy Dunn. Assistant District Manager, Lands.

Clinton Hanson. Assistant District Manager. Resources.

Jake Schlapfer. Outdoor Recreation Planner.

Julia Steele. Cultural Resource Specialist.

Dick Vernimen. District Manager.

Glennallen District Office. Glennallen.

Lawrence J. Kajdan. Outdoor Recreation Planner.

Gene Keith. District Manager.

Pat McCoy. Cultural Resource Specialist.

K.J. Mushovic. Land Use Planner.

Steese/White Mountains District Office. Fairbanks.

Jim Herriges. Wildlife Biologist.

Winston Hobgood.

Lon Kelly. Recreation Specialist.

Kobuk District Office. Fairbanks.

Gary Foreman.

Anne Morekill. Biologist.

Susan Will. Planner.

U.S. FEDERAL AVIATION ADMINISTRATION

Derril Bergt. Military Operations Officer. Anchorage.

U.S. FISH AND WILDLIFE SERVICEAlaska Regional Office, Anchorage.

Taylor Brelsford. Subsistence Division.
Bill Butler. Waterfowl Biologist and Survey Pilot.
Dirk Derksen. Chief of Research (Bird Branch).
Steve Ebbert. Realty Division.
Bob Gill. Biologist and Survey Pilot.
Colleen Handel. Shorebird Biologist.
Bob Leedy. Chief, Migratory Bird Management.
Vivian Mendenhall. Seabird Biologist.
Mary Lynn Nation. Secondary Point-of-Contact.
Walter O. Steiglitz. Regional Director.
David Ward. Wildlife Biologist.

Fairbanks Field Office.

Skip Ambrose. Endangered Species Specialist. Northern Alaska Ecological Services.
Larry Bright. USFWS Primary Point-of-Contact for MOA EIS Project.
Janey Fadely. Endangered Species Specialist. Endangered Species, Northern Alaska Ecological Services.
Rod King. Waterfowl Biologist and Survey Pilot. Migratory Bird Management.
George Sharrid. Subsistence Division.
Ted Swem. Raptor Biologist.

Juneau Field Office.

Bruce Conant. Waterfowl Biologist and Survey Pilot.
Debbie Groves. Biologist.
Mike Jacobsen. Raptor Biologist.
Phil Schempf. Raptor Biologist.

Yukon Flats National Wildlife Refuge (Fairbanks).

Mark Bertram. Wildlife Biologist.
Ted Heuer. Refuge Manager.
Mike Vivion. Refuge Pilot.

Nowitna National Wildlife Refuge (Galena).

Paul Liedberg. Assistant Refuge Manager.

U.S. NATIONAL BIOLOGICAL SURVEY

Kurt Jenkins. Wildlife Biologist. (Wrangell-St. Elias Field Station)

U.S. NATIONAL PARK SERVICEAlaska Regional Office, Anchorage.

Bruce Dale. Wildlife Biologist.
Joan Darnell. Chief, Environmental Quality. MOA EIS Primary Point-of-contact.
John M. Morehead. Regional Director.
Larry Wright. MOA EIS Secondary Point-of-Contact.

Yukon-Charley Rivers National Park and Preserve.

Jan Dick. Chief Ranger. Eagle.
Kevin Fox. Biologist. Eagle.
Paul Guraedy. Superintendent. Fairbanks.
Dennis Knuckles. Ranger/Pilot. Eagle.
Penny Knuckles. Chief, Natural Resources. Eagle.

Denali National Park and Preserve.

Ken Kehrer. Chief Ranger. Denali.
Dave Nemeth. Concessions Specialist. Denali.
Gordon Olson. Denali.
Ron Purdum. Ranger/Pilot. Denali.
Ken Stahlnecher. Biologist. Denali.
J.D. Swed. South District Mountaineering Ranger. Talkeetna.

Lake Clark National Park and Preserve.

Al Bennet. Biologist. Port Alsworth.
Claire Roberts. Area Ranger. Port Alsworth.
Ralph Tingey. Superintendent. Anchorage.

UNIVERSITY OF ALASKAAnchorage

Rob Lipkin. Botanist. Environment and Natural Resources Institute, Alaska Natural Heritage Program.
Julie Michaelson. Data Manager. Environment and Natural Resources Institute, Alaska Natural Heritage Program.
Ed West. Biologist. Environment and Natural Resources Institute, Alaska Natural Heritage Program.

Fairbanks

Sue Ann Bowling. Alaska Climate Research Center, Geophysical Institute.
Dan Gibson. Curator. Natural History Museum.

OTHER PERSONS AND AGENCIES CONTACTED

Council of Athabascan Tribal Governments.
Sue Flensburg. Director, Bristol Bay Coastal Resource Area, Dillingham Coastal Zone Management Office.
Tom George. Alaska Aviation Foundation.
Paul Kameroff. Kuskokwim Native Association, Aniak.
Nancy Lethcoe. Alaska Wilderness Recreation and Tourism Association.
Ellis McElroy. Alaska Aviation Forum. Anchorage.
Stephen Morris. Air Quality Program Manager. Anchorage Air Pollution Control Agency. Department of Air Quality and Environmental Services.
National Weather Service, Fairbanks, Alaska.
Paul Ptacek. Cartographer. U.S. Geological Survey, Anchorage.
Helen Welch. Alaska Professional Hunters Association.
George Yaska. Tanana Chiefs Conference. Fairbanks.

This Page Intentionally Left Blank

CHAPTER 7

PREPARERS AND REVIEWERS

7.1 LIST OF PREPARERS

The names, expertise, and experience of individuals with primary responsibilities in the preparation of the EIS are listed below. The tasks or sections for which each person was responsible appear in parentheses at the end of each entry.

Spectrum Sciences & Software, Inc.—Anchorage, Alaska; Fort Walton Beach, Florida.

Rudy Arrieta. M.S. Environmental Engineering. Fourteen years modeling biological and natural systems and acoustical phenomena. (Noise Modeling; MOAMAP)

Brian Bowzer. B.S. Cartography. Four years computer systems applications, modeling, and geographic information analysis. (GIS; Population Estimates)

William H. Ham. B.S. Electrical Engineering. Twenty years operational flying; six years airspace planning/design; four years environmental impact analysis and aircraft noise analysis. (Project Manager, Florida; Airspace Management, Aircraft Operations, and Aviation Safety; Noise Modeling and Analysis; Chaff and Flares/Hazardous Operations; Document Production)

Luci Hawkins. A.S. Drafting and Design Technology. Seven years mechanical and cartographic computer aided drafting and design. (Resource and Airspace Mapping)

Larry McGlothlin. M.A. Management/Human Relations; B.S. Education. Twenty-two years operational flying experience (including three years experience as an air facility manager); five years as a land use, aircraft noise, and airport planner; and nine years experience in environmental planning. (Project Principle; Airspace Management, Aircraft Operations, and Aviation Safety; Noise Modeling; Public Involvement)

Karen McKibbin. B.A. Liberal Arts and Sciences. Graduate studies in American Studies. Five years natural resources and environmental education writer and editor; three years environmental impact analysis; two years archaeological survey and excavation; one year cultural resource regulations and permitting. (Cultural Resources; Subsistence; Physical Environment; Document Production)

Susan Means. M.S. Natural Resources and Outdoor Recreation Management, M.S. Library and Information Management; one year recreation planning; nine years environmental information management; four years environmental impact analysis. (Project Manager, Alaska; Recreation; Land Use; Socioeconomics; Physical Environment; Document Production)

Lisa Milliman. B.S. Urban Environmental Studies. Seven years land use planning; five years environmental regulation and permitting; four years environmental impact analysis. (Air Quality)

Ken Shepardson. B.S. Systems Sciences, Graduate Studies in System Sciences. Nine years computer systems applications, modeling, and geographic information analysis. (Noise Modeling; GIS)

Mike Thompson. M.S. Biology; B.A. Biology. Twenty-five years of professional experience. (Biological Resources [Avian Species]; BASH/BAM Analysis)

Michael Truffa. Ten years microcomputer applications programming; five years environmental impact analysis; three years noise modeling; three years computer-aided cartography. (GIS; Resource and Airspace Mapping; Document Production)

ENSR Consulting and Engineering--Anchorage, Alaska.

Brian Hoefler. M.S. Civil Engineering; B.S. Civil and Environmental Engineering. Ten years of professional experience. (Scoping Report)

Martin Robards. B.S. Marine Biology. Six years of professional experience. (Biological Resources; Physical Environment)

Margaret Sharpe. Eleven years of professional experience, proofreading/editing; three years of environmental document review. (Document Technical Edit)

Pioneer Environmental Services--Logan, Utah.

Neal Artz. Ph.D. Range Sciences; B.S. Renewable Natural Resources/Communications. Eighteen years natural resource management and environmental consulting. (Biological Resources)

Marisa Ernst. B.S. Rural and Environmental Engineering. Seven years consulting; one year environmental consulting. (Biological Resources)

Robert A. Washington-Allen. M.S. Range Science. B.S. Zoology. Five years natural resource management (wildlife and livestock), ecological monitoring, GIS, and remote sensing. (Biological Resources)

Jon Isaacs & Associates--Anchorage, Alaska.

Jonathan D. Isaacs. B.A. Environmental Studies; Graduate studies in Planning and Economics. Twenty years land use planning, environmental impact analysis, and socioeconomics assessment. (Recreation; Subsistence; Land Use; Socioeconomics)

Stephen Braund & Associates--Anchorage, Alaska.

Bill Simeone. Ph.D. Anthropology. Ten years cultural and socioeconomic assessment, and environmental impact analysis. (Subsistence)

7.2 LIST OF REVIEWERS

The names of individuals who reviewed the EIS are listed below. The EIS section(s) for which each person was responsible is in parentheses at the end of each entry.

Betty Anderson. Alaska Biological Research, Inc., Fairbanks, AK. (Biological Resources)

John Baie. HQ USAF/CEVP, Washington, D.C. (Document Review)

Paul Bates. CDR USARAK, Fort Richardson, AK. (Document Review)

Ralph Becker. Bear West Company, Inc., Salt Lake City, UT. (NEPA Compliance and Document Review)

Derril Bergt. Federal Aviation Administration, Military Operations Officer, Anchorage, AK. (Document Review)

Peter E. Bogey. HQ USAF/JACE, Washington, D.C. (NEPA Compliance and Document Review)

Karen Caddis-Burrell. ENSR Consulting and Engineering, Fort Collins, CO. (Subsistence)

Lt. Colonel James Conrad. 11 AF/JA, Elmendorf AFB, AK. (NEPA Compliance and Document Review)

Major J.W. Daughtry. 353 FS/DOO, Eielson AFB, AK. (Document Review)

Jim Duncan. ENSR Consulting and Engineering, Acton, MA. (Biological Resources)

Scott L. Ellis. ENSR Consulting and Engineering, Fort Collins, CO. (NEPA Compliance)

Lee Ann Gardner. ENSR Consulting and Engineering, Anchorage, AK. (NEPA Compliance and Document Review)

Major G. Virgil Hanson. 611 ASG/LGV, Elmendorf AFB, AK. (Project Oversight and Document Review)

Colonel Richard S. Hassan. 611 ASG/CC, Elmendorf AFB, AK. (Project Oversight and Document Review)

Brian Hoefler. ENSR Consulting and Engineering, Anchorage, AK. (Air Quality)

James W. Hostman. 611 ASG/LGV, Elmendorf AFB, AK. (Project Oversight and Document Review)

Dr. Roy D. Hugie. Pioneer Environmental Services, Logan, UT. (Biological Resources)

Captain Harold Keck. AFCEE/ECA, Air Force Center for Environmental Excellence, Brooks AFB, Texas. (Document Review)

Jack Kruse. Institute of Social and Economic Research, University of Alaska, Anchorage. (Subsistence)

Major Robert Kull. AL/OEBN, Noise Effects Branch, Wright-Patterson AFB, OH. (Noise)

Dr. Robert Landis. HQ PACAF/CEVP, Hickam AFB, HI. (Document Review)

Brian Lawhead. Alaska Biological Research, Inc., Fairbanks, AK. (Biological Resources)

Nilda Mesa. SAF/MIQ, Assistant Deputy for Environment, Washington, D.C. (NEPA Compliance and Document Review)

Connie Minish. Spectrum Sciences & Software, Inc., Alexandria, VA. (Socioeconomics)

Lisa Milliman. Spectrum Sciences & Software, Inc., Fort Walton Beach, FL. (Recreation and Land Use)

Stephen Murphy. Alaska Biological Consultants, Inc., Fairbanks, AK. (Biological Resources)

Major Mohsen Parhizkar. HQ USAF/CEVP, Washington, D.C. (Document Review)

Major L. Brad Peck. ALCOM/J74, Elmendorf AFB, AK. (Document Review)

Bill Quirk. CDR 6th INF DIV (L), Fort Richardson, AK. (Document Review)

Peter Ribbens. ENSR Consulting and Engineering, Anchorage, AK. (Chaff and Flares/Hazardous Operations)

Bob Ritchie. Alaska Biological Research, Inc., Fairbanks, AK. (Biological Resources)

Lt. Colonel Richard Roberts. HQ USAF/XOOA, Washington, D.C. (Document Review)

Sophie Sawyer. ENSR Consulting and Engineering, Fort Collins, CO. (NEPA Compliance and Document Review)

Captain Leigh Scarboro. 354 OSS/OSCR, Eielson AFB, AK. (Document Review)

Major Cameron E. Shackleford. HQ USAF/CEVP, Washington, D.C. (Document Review)

Lt. Colonel Bob Siter, 611 ASG/DOOQ, Elmendorf AFB, AK. (Airspace Management, Aircraft Operations, and Aviation Safety)

Dan Slater. ENSR Consulting and Engineering, Anchorage, AK. (Noise and Air Quality)

Bill Thiesen. ENSR Consulting and Engineering, Fort Collins, CO. (Recreation, Land Use, and Socioeconomics)

Captain Sandra K. Troeber. 354 FW/PA, Eielson AFB, AK. (Document Review)

Captain Greg Tures. 611 ASG/LGV, Elmendorf AFB, AK. (Project Oversight and Document Review)

D.W. Walter. ENSR Consulting and Engineering, Anchorage, AK. (Airspace Management, Aircraft Operations, and Aviation Safety)

Jim Wilder. ENSR Consulting and Engineering, Redmond, WA. (Air Quality)

CHAPTER 8

FINAL EIS DISTRIBUTION LIST

The Final EIS was distributed to the following agencies, organizations, and individuals. The Executive Summary of the Final EIS was distributed to all interested individuals.

SAF/MIQ
Pentagon, Room 5C886
Washington, DC 20330-1660

SAF/PATR
Pentagon, Room 5C875
Washington, DC 20330

HQ USAF/CEVP
1260 Air Force Pentagon Room 5D376
Washington, DC 20330-1260

HQ USAF/JACE
Building 5683, First Floor
Bolling AFB, DC 20332

HQ PACAF/CEV
25 E. Street, Suite D-306
Hickam AFB, HI 96853-5412

HQ PACAF/PA
25 E. Street, Suite I-106
Hickam AFB, HI 96853-5496

Lt Col Charlton
PACAF/DOIT
25 E. Street, Suite I-232
Hickam AFB, HI 96853

Captain Harold Keck
AFCEE/ECA
8106 Chennault Road
Brooks AFB, TX 78235-5318

Bill Jacobs
AFCEE/ESRT
Brooks AFB, TX 78235-5000

Lt Col Sam Rupe
AFLSA/JACE-WR
6300 Sansome Street, Suite 1334
San Francisco, CA 94111-2278

ALCOM/J44 (Maj LaMoe)
5800 G Street, Suite 203
Elmendorf AFB, AK 99506-2150

Larry Finegold
AL/OEBN
2610 Seventh Street
Wright-Patterson AFB, OH 44533-7901

Paul Sharp
AL/OEBN
2610 Seventh Street
Wright-Patterson AFB, OH 45433-7901

John Cloe, Historian
11 AF/HO
6900 Ninth Street, Suite 204
Elmendorf AFB, AK 99506-2255

611 ASG/LGV
5800 G Street, Suite 203
Elmendorf AFB, AK 99506-2150

3 CES/CEVP
22040 Maple Street
Elmendorf AFB, AK 99506-3240

3 WG/CC, 3 OG/CC
11530 Q Street, Suite 200
Elmendorf AFB, AK 99506-2850

3 WG/JA
2900 9th Street, Suite 330
Elmendorf AFB, AK 99506-2470

3 WG/PA
6920 12th Street, Suite 120
Elmendorf AFB, AK 99506-2530

354 CES/CEV
2258 Central Avenue, Suite 1
Eielson AFB, AK 99702-2225

354 FW/CC, 354 FW/DO
3112 Broadway Avenue, Suite 1
Eielson AFB, AK 99702-2325

354 FW/PA
3112 Broadway Avenue, Suite 5
Eielson AFB, AK 99702-1870

Fort Wainwright Public Affairs Officer
6th Infantry Division
1060 Gaffney Road, #5900
Fort Wainwright, AK 99703-5900

Alaska Dept. of Environmental Conservation
Southcentral Regional Office
3601 C Street
Anchorage, AK 99503

Alaska Dept. of Environmental Conservation
Northern Regional Office
610 University Avenue
Fairbanks, AK 99709-3634

Steve Dubois, Area Biologist
Alaska Dept. of Fish & Game
P.O. Box 605
Delta Junction, AK 99737

Terry Haynes, Statewide Coordinator
Subsistence Division
Alaska Dept. of Fish & Game
1300 College Road
Fairbanks, AK 99701-1599

Al Ott, Regional Supervisor
Habitat & Restoration
Alaska Dept. of Fish & Game
1300 College Road
Fairbanks, AK 99709-4173

Lance Trasky, Regional Supervisor
Habitat & Restoration
Alaska Dept. of Fish & Game
333 Raspberry Road
Anchorage, AK 99518-1599

Environmental Coordinator
Alaska Dept. of Natural Resources
3601 "C" Street, Suite 200
Anchorage, AK 99503

Judy Bittner
State Historical Preservation Officer
Alaska Dept. of Natural Resources
3601 "C" Street, Suite 1278
Anchorage, AK 99503

Tomas Boutin, Director
Division of Forestry
Alaska Dept. of Natural Resources
3601 "C" Street, Suite 1058
Anchorage, AK 99503

Les Fortune
Division of Forestry
Alaska Dept. of Natural Resources
3700 Airport Way
Fairbanks, AK 99709

Carl Siebe, Airports Engineer
Statewide Aviation
Alaska Dept. of Transportation & Public Facilities
P.O. Box 196900
Anchorage, AK 99519-6900

Norm Piispanen
Alaska Dept. of Transportation
Planning Department
2301 Peger Road
Fairbanks, AK 99709-5316

Rose Lynn Smith
Alaska Dept. of Natural Resources
Lands Division, Northern Regional Office
3700 Airport Way
Fairbanks, AK 99709

President
Alaska Wilderness Recreation & Tourism Assoc.
P.O. Box 1353
Valdez, AK 99686

Kevin Harum / Cliff Eames
Alaska Center for the Environment
519 W. 8th Avenue
Anchorage, AK 99501

Stephen Wells, Director
Alaska Wildlife Alliance
P.O. Box 202022
Anchorage, AK 99520

Steve Rinehart, Reporter
Anchorage Daily News
1001 Northway Drive
Anchorage, AK 99508

Director
Anchorage Office of the Governor
3601 "C" Street, Suite 758
Anchorage, AK 99503

Commander
6th Infantry Division (Light)
APVR-PW-ENV
Fort Wainwright, AK 99703-5500

Calvin Simeon / Greg Roczicka
Association of Village Council Presidents
Pouch 219
Bethel, AK 99559

Jon Oscar
CENALIULRIIT Coastal District
P.O. Box 107
Tununak, AK 99681

Karen Solomon
Document Department
Colorado State University Library
Fort Collins, CO 80523

Superintendent
Denali National Park & Preserve
P.O. Box 9
Denali National Park, AK 99755

Douglas Johnson, Chief
Environmental Office
Directorate of Public Works
600 Richardson Drive, #6500
Fort Richardson, AK 99506-6500

Department of the Army
Environmental Resources Division
APVR-FW-PW-ER
Fort Wainwright, AK 99703-6500

Derril Bergt
Military Operations Officer
Federal Aviation Administration
Air Traffic Division, AAL-500
222 W. 7th Avenue, #14
Anchorage, AK 99513-5787

Dennis Ward
Flight Standards District Office
Federal Aviation Administration
6450 Airport Way
Fairbanks, AK 99709

Ken Hudson / Don Webster
Mat-Su Borough
350 E. Dahlia Avenue, Box 1608
Palmer, AK 99645

John Duffy, Planning Director
Matanuska-Susitna Borough
350 E. Dahlia Avenue
Palmer, AK 99645-6488

Mark Wright
Modern Technology Corporation
2258 Central Avenue
Eielson AFB, AK 99705-2225

David Cline, President
National Audubon Society
308 "G" Street, #217
Anchorage, AK 99501

Joan B. Darnell, Chief
Environmental Quality
National Park Service, Alaska Regional Office
2525 Gambell Street, Room 107
Anchorage, AK 99503-2517

Clarence Summers
Subsistence Division
National Park Service
2525 Gambell Street, Room 107
Anchorage, AK 99503

Chip Dennerline, Director
National Parks & Conservation Assoc.
329 F Street, #208
Anchorage, AK 99501

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

Northern Alaska Environmental Center
218 Driveway
Fairbanks, AK 99701

Grace Bukowski
Rural Alliance for Military Accountability
P.O. Box 60036
Reno, NV 89506

Brian Hoppy
SEA Inc.
7918 Jones Branch Drive, Suite 500
McLean, VA 22102-3318

Alaska Chapter
Sierra Club
P.O. Box 103441
Anchorage, AK 99510-3441

Dick Hingson
Sierra Club, Los Angeles Chapter
3345 Wilshire Blvd., Suite 508
Los Angeles, CA 90010-1816

John Huff
STRA, Inc.
1100 Wilson Blvd., Suite 1700
Arlington, VA 22209

Chris Hunter
The Environmental Company
P.O. Box 5127
Charlottesville, VA 22905

Allen E. Smith, Director
The Wilderness Society
430 W. 7th Avenue, Suite 210
Anchorage, AK 99501

Patti Billman
Tri-Lakes Community
HC01 Box 1706
Glennallen, AK 99588

James Ducker
U.S. Bureau of Land Management
222 W. 7th Avenue, #13
Anchorage, AK 99513

John Sparks
U.S. Congressman Bill Brewster
1727 Longworth HOB
Washington, DC 20515

Don Young
U.S. Congressman
Federal Building, Box 10
101 12th Avenue
Fairbanks, AK 99701

Don Young
U.S. Congressman
222 West 7th Avenue, #3
Anchorage, AK 99513-7595

Guy McConnell
CENPA-EN-CW-ER
U.S. Corps of Engineers Alaska District
P.O. Box 898
Anchorage, AK 99506-0898

Gary Cummins
Office of Environmental Policy & Compliance
U.S. Department of the Interior / MS 2340
1849 "C" Street N.W.
Washington, DC 20240

Paul D. Gates
Regional Environmental Officer
U.S. Department of the Interior
1689 "C" Street, Suite 119
Anchorage, AK 99501-5151

Federal Facilities Coordinator
U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, #19
Anchorage, AK 99513-7588

Dean Kohlhoff
Associate Professor of History
Valparaiso University, Dept. of History
Valparaiso, IN 46383

Kathy Veit, Branch Chief
Program Coordination Branch
U.S. Environmental Protection Agency - Region 10
1200 Sixth Avenue
Seattle, WA 98101

Liz Dodd
Sierra Club Legal Defense Fund
325 Fourth Street
Juneau, AK 99801

Larry Bright
U.S. Fish & Wildlife Service
101 12th Avenue, Box 19, Room 232
Fairbanks, AK 99701-6267

Vince Mathews
U.S. Fish & Wildlife Service
Subsistence Division
1011 E. Tudor Road
Anchorage, AK 99503

Mary Lynn Nation
Regional Environmental Coordinator
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

Frank Murkowski
U.S. Senator
222 W. 7th Avenue, #1
Anchorage, AK 99513-7570

Frank Murkowski
U.S. Senator
Federal Building, Box 7
101 12th Avenue
Fairbanks, AK 99701

Ted Stevens
U.S. Senator
222 W. 7th Avenue, #2
Anchorage, AK 99513-7569

Ted Stevens
U.S. Senator
Federal Building, Box 4
101 12th Avenue
Fairbanks, AK 99701

The *Final* EIS is available for public inspection at the following locations:

■ Anchorage	Anchorage Law Library Arctic Environmental Information & Data Center Bureau of Land Management Alaska Resources Library Consortium Library, University of Alaska, Anchorage
■ Aniak	Public Library
■ Arctic Village	Old Community Hall
■ Bethel	Kuskokwim Consortium Library
■ Chalkyitsik	Village Council Building
■ Circle/Central	Circle Hot Springs Resort
■ Delta Junction	Public Library
■ Denali National Park	Denali National Park Library
■ Dillingham	Public Library
■ Eagle	Eagle School Library
■ Fairbanks	Noel Wien Public Library Rasmuson Library, University of Alaska
■ Fort Yukon	Native Village Building
■ Glennallen	Copper Valley Community Library
■ Juneau	Alaska State Library
■ Lime Village	Lime Village School
■ McGrath	McGrath Community Library
■ North Pole	Public Library
■ Palmer	Public Library
■ Sleetmute	Sleetmute School
■ Talkeetna	Public Library
■ Tok	Public Library
■ Venetie	Tribal Council Office
■ Wasilla	Public Library

In addition, a copy was provided to the National Technical Information Service (NTIS), a clearinghouse for U.S. government publications (703-487-4650).

CHAPTER 9

INDEX

Advisory Council on Historic Preservation	1-9
aesthetics	3-285, 3-290, 3-292, 3-293, 3-295, 3-296, 3-297, 3-304, 3-305, 3-306, 3-307, 3-308, 3-318, 3-320, 3-321, 3-334, 3-337, 4-147, 4-149, 4-169
Ahtna, Inc.	3-317, 3-319, 3-321
Air Force Reserve	2-4
Air National Guard	2-4, 3-23, 3-35, 3-45, 3-83, 3-353
air quality	
conformity determinations	1-8, 1-9, 3-341, 4-160
nonattainment areas	1-6, 1-9, 3-341, 3-342, 3-344, 3-345, 3-346, 3-347, 3-348, 4-159, 4-160, 4-161, 4-162
Prevention of Significant Deterioration	1-6, 3-341, 3-348, 3-349, 4-159, 4-162
air refueling	1-3, 1-4, 2-1, 2-2, 2-23, 2-27, 3-23, 3-35, 3-45
Air Traffic Control Assigned Airspace (ATCAA)	2-2, 2-3, 2-52, 3-15, 4-41
air-to-ground weapons ranges	
Blair Lakes	1-2, 1-9, 2-2, 2-6, 2-21, 2-22, 2-27, 2-30, 2-35, 2-50, 2-52, 3-3, 3-7, 3-27, 3-32, 3-33, 3-32, 3-36, 3-71, 3-144, 3-146, 3-148, 3-150, 3-153, 3-225, 3-268, 3-304, 3-305, 3-306, 4-19, 4-90
Oklahoma	1-2, 1-9, 2-2, 2-21, 2-22, 2-26, 2-27, 2-50, 2-52, 2-53, 3-3, 3-7, 3-18, 3-27, 3-31, 3-32, 3-35, 3-36, 3-68, 3-71, 3-72, 3-79, 3-144, 3-146, 3-149, 3-150, 3-151, 3-153, 3-154, 4-11, 4-19, 4-45, 4-46, 4-52, 4-83, 4-90, 4-105, 4-165, 4-166, 4-167
Stuart Creek	1-9, 2-2, 2-21, 2-22, 2-26, 2-50, 2-52, 2-53, 3-3, 3-7, 3-15, 3-16, 3-18, 3-22, 3-23, 3-35, 3-66, 3-67, 3-68, 3-70, 3-71, 3-79, 3-105, 3-107, 3-109, 3-112, 3-113, 3-115, 3-117, 4-10, 4-11, 4-19, 4-87, 4-89, 4-105, 4-166, 4-167
Airborne Warning and Control System (AWACS). <i>see</i> aircraft	
aircraft	
Airborne Warning and Control System (AWACS)	2-2, 3-67
C-130	3-15, 3-17, 3-23, 3-40, 3-43, 3-45, 3-61, 3-70, 3-72, 3-73, 3-75, 3-323, 4-72, 4-79, 4-80, 4-154, 4-165, 4-166
F-15	1-3, 1-9, 2-1, 2-23, 2-33, 2-59, 3-12, 3-15, 3-18, 3-22, 3-23, 3-27, 3-32, 3-35, 3-36, 3-40, 3-43, 3-49, 3-54, 3-58, 3-60, 3-61, 3-65, 3-81, 3-82, 3-323, 3-342, 4-8, 4-10, 4-14, 4-19, 4-35, 4-71, 4-72, 4-79, 4-80, 4-85, 4-95, 4-105, 4-154, 4-173
F-16	1-3, 1-9, 2-1, 2-23, 2-33, 2-59, 3-12, 3-15, 3-18, 3-22, 3-23, 3-27, 3-32, 3-35, 3-36, 3-40, 3-43, 3-54, 3-58, 3-60, 3-61, 3-65, 3-81, 3-83, 3-84, 3-308, 3-342, 4-8, 4-10, 4-14, 4-19, 4-21, 4-35, 4-71, 4-72, 4-79, 4-80, 4-85, 4-138, 4-148, 4-173
OA-10A	1-3, 1-4, 2-1, 2-50, 3-18, 3-22, 3-23, 3-24, 3-27, 3-32, 3-35, 3-36, 3-40, 3-45, 3-58, 3-61, 3-72, 3-73, 3-82, 3-308, 3-342, 4-10, 4-19, 4-57, 4-72, 4-165
aircraft operations. <i>see</i> sections 3.2 and 4.2 and Appendices C and E	
airspace management. <i>see</i> sections 3.2 and 4.2 and Appendix D	
airspace standards	2-1, 2-3
Alaska Air Combat Maneuvering Instrumentation (ACMI)	2-2, 2-24, 2-28, 2-67, 2-68, 3-49, 3-74, 4-35, 4-36, 4-95
Alaska Fire Service	3-82, 4-105

- Alaska Highway . . . 2-34, 2-35, 3-37, 3-46, 3-149, 3-153, 3-168, 3-170, 3-172, 3-216, 3-240, 3-241, 3-279, 3-280, 3-298, 3-303, 3-304, 3-305, 3-306, 3-320, 4-45, 4-52, 4-58, 4-62, 4-142, 4-144, 4-175
- Alaska National Interest Lands Conservation Act (ANILCA) 3-273, 3-320, 3-334, 3-337, 3-338, 3-340, 4-137
- Alaska Native Claims Settlement Act (ANCSA) 3-91, 3-285
- Alaska Native corporations . . . 3-91, 3-285, 3-286, 3-289, 3-292, 3-293, 3-294, 3-296, 3-298, 3-311, 3-317, 3-319, 3-321, 3-326, 3-330, 3-334, 3-335, 3-336, 4-147
see also individual village or regional corporation name
- Alternative A (No CLEAR CREEK MOA Alternative), description of 2-6, 2-29
- Alternative A—Modified, description of 2-7, 2-33
- Alternative B (TANANA MOA Alternative), description of 2-6, 2-31
- alternatives. *see* the name of specific alternative
- alternatives, comparison of 2-37, 2-54
see also Appendix N
- Anchorage 1-5, 1-6, 1-10, 2-2, 3-12, 3-23, 3-40, 3-45, 3-46, 3-95, 3-96, 3-173, 3-176, 3-177, 3-232, 3-233, 3-234, 3-238, 3-248, 3-251, 3-259, 3-264, 3-273, 3-274, 3-330, 3-334, 3-336, 3-341, 3-342, 3-346, 3-347, 3-348, 3-354, 4-21, 4-27, 4-159, 4-161, 4-163
- arctic peregrine falcon 3-90, 3-93
- Arctic Village 1-5, 3-274, 3-275, 3-276, 3-277, 4-140
- Areas of Critical Environmental Concern (ACECs) 3-163, 3-164, 3-166, 3-236, 3-239, 3-240, 3-247, 3-248, 3-330, 4-132, 4-134, 4-176, 4-179
- avalanches 3-2
- aviation safety. *see* sections 3.2 and 4.2
- bald eagles . . 3-59, 3-87, 3-88, 3-91, 3-92, 3-107, 3-108, 3-121, 3-124, 3-131, 3-145, 3-146, 3-165, 3-166, 3-167, 3-191, 3-339, 4-114, 4-115, 4-122
- beaver . . 3-87, 3-102, 3-103, 3-110, 3-117, 3-118, 3-154, 3-170, 3-179, 3-180, 3-192, 3-193, 3-194, 3-199, 3-238, 3-291
- Beaver Creek National Wild River 3-291
- Beaver Mountain herd. *see* caribou
- Big River herd. *see* caribou
- biodiversity 1-6, 3-87, 3-88, 3-89, 4-107, 4-109, 4-112, 4-120, 4-123, 4-126
- biological resources. *see* sections 3.5 and 4.5 and Appendix G
- Birch Creek National Wild River . . 3-212, 3-213, 3-214, 3-221, 3-267, 3-291, 3-292, 3-294, 3-338, 4-130, 4-133, 4-136
- Birch Creek, community of . . . 3-3, 3-109, 3-110, 3-111, 3-113, 3-212, 3-213, 3-214, 3-221, 3-267, 3-274, 3-276, 3-277, 3-291, 3-292, 3-294, 3-338, 4-130, 4-133, 4-136, 4-140
- Birch Lake State Recreation Site 3-224, 3-225, 3-231
- bird migration 3-88, 3-109, 3-146, 3-167, 3-192, 4-122
- bird strikes 3-12, 3-58, 3-105, 3-107, 3-143, 3-145, 3-163, 3-165, 3-189, 3-190, 4-3, 4-12, 4-20, 4-27, 4-36, 4-45, 4-46, 4-53, 4-58, 4-64, 4-67
see also Appendix H
- birds. *see* individual species names
- bison 3-87, 3-89, 3-100, 3-101, 3-116, 3-152, 3-153, 3-161, 3-177, 3-178, 3-187, 3-193, 3-198, 3-261, 3-262, 3-263, 3-298, 3-303, 4-107, 4-109, 4-118, 4-124, 4-126
- black bear(s) . . 3-87, 3-100, 3-104, 3-116, 3-152, 3-176, 3-177, 3-194, 3-197, 3-198, 3-234, 3-235, 3-261, 3-262, 3-263, 3-265, 3-275, 3-278, 3-280, 3-282, 3-340, 4-107, 4-109, 4-117, 4-120, 4-124, 4-126
 population density 3-116, 3-152, 3-177, 3-198
- Blair Lakes range. *see* air-to-ground weapons ranges
- bombing ranges. *see* air-to-ground weapons ranges
- bombs. *see* munitions
- brant 3-122, 3-123, 3-124, 3-125, 3-126, 3-127, 4-113, 4-114

Bristol Bay Coastal Resource Service Area	3-335, 3-336
Bristol Bay Native Corporation	3-335
brown bear(s)	3-87, 3-98, 3-99, 3-100, 3-102, 3-109, 3-115, 3-152, 3-171, 3-172, 3-175, 3-176, 3-177, 3-196, 3-197, 3-234, 3-235, 3-261, 3-262, 3-263, 3-265, 3-275, 3-278, 3-283, 4-107, 4-109, 4-117, 4-121, 4-122, 4-124
population density	3-115, 3-152, 3-175, 3-176, 3-197
Brushkana Campground	3-236, 3-247, 3-320, 4-132, 4-134
C-130. <i>see</i> aircraft	
Calista Corporation	3-334
Canada geese	3-59, 3-105, 3-124, 3-143, 3-163, 3-164, 3-165, 3-189, 3-190, 3-192, 4-113
caribou	
as subsistence resource	3-275, 3-276, 3-277, 3-278, 3-279, 3-280, 3-282, 3-284, 3-285 4-137, 4-138, 4-139, 4-140, 4-141, 4-142, 4-143, 4-144, 4-146
Beaver Mountain herd	3-192, 3-193
Big River herd	3-193, 3-194
Delta-Yanert herd	3-147, 3-148, 3-149, 3-167, 3-171, 4-126
Fortymile herd	3-109, 3-110, 3-111, 3-112, 3-147, 3-148, 3-149, 3-168, 3-169, 3-170
Macomb herd	3-95, 3-147, 3-148, 3-149, 3-168, 3-169
Mentasta herd	3-95, 3-109, 3-111, 3-168, 3-169, 3-170, 4-116
Mulchatna herd	3-193, 3-194, 3-197, 3-198
Nelchina herd	3-109, 3-111, 3-147, 3-167, 3-168, 3-169, 3-170
Porcupine herd	3-99, 3-110, 3-111, 3-112
Rainy Pass herd	3-167, 3-193, 3-194
Sunshine Mountain herd	3-192, 3-193
White Mountains herd	3-110, 3-111, 3-112
Central	3-24, 3-213, 3-216, 3-217, 3-274, 3-276, 3-277, 3-282, 3-291, 3-292, 3-294, 3-311, 3-329, 3-330, 3-331, 3-336, 3-337, 4-11, 4-87, 4-140, 4-141
chaff	1-6, 2-3, 2-5, 2-6, 2-7, 2-8, 2-35, 2-52, 3-77, 3-78, 3-79, 4-58, 4-101, 4-102, 4-103, 4-104, 4-106, 4-107, 4-167, 4-170
Chalkyitsik	1-5, 3-213, 3-274, 3-276, 3-277, 3-295, 3-296, 4-140, 4-141, 4-142
Chalkyitsik Village Corporation	3-296
Charley National Wild River	3-212, 3-213, 3-222, 3-267, 3-286, 3-289, 3-290, 3-291, 3-293, 3-294, 3-338, 4-130, 4-133
Chena Hot Springs Road	3-215, 3-216, 3-296, 3-297
Chena River State Recreation Area	3-212, 3-215, 3-216, 3-223, 3-268, 3-289, 4-136
Chicken	3-170, 3-214, 3-274, 3-276, 3-277, 3-293, 3-321, 4-8, 4-54, 4-57, 4-140, 4-141, 4-176
Chilikadrotna National Wild River	3-194, 3-251, 3-252, 3-334, 3-336
Chistochina	3-168, 3-171, 3-172, 3-274, 3-280, 3-281, 3-282, 3-322, 4-143
Chuathbaluk	3-274, 3-283, 3-284, 3-332, 3-334, 4-145
Circle	1-5, 3-18, 3-24, 3-68, 3-109, 3-111, 3-212, 3-213, 3-216, 3-217, 3-266, 3-276, 3-277, 3-291, 3-292, 3-294, 4-112, 4-140, 4-141
Circle Hot Springs	1-5, 3-3, 3-24, 3-113, 3-216, 3-217, 3-274, 3-291, 3-292, 3-294
Circle Village Corporation	3-292
civil aviation	1-2, 1-5, 1-8, 2-2, 2-3, 2-59, 3-7, 3-12, 3-24, 3-37, 3-46, 3-60, 3-70, 3-72, 3-73, 3-75, 4-12, 4-20, 4-35, 4-36, 4-37, 4-50, 4-52, 4-53, 4-54, 4-57, 4-75, 4-108, 4-138, 4-148, 4-165, 4-166, 4-168, 4-169, 4-173, 4-175, 4-176, 4-178
Clean Air Act	1-8, 3-341, 4-160, 4-161
commercial recreation	3-207, 3-211, 3-264, 3-265, 3-266, 3-267, 3-270, 4-129, 4-135, 4-136, 4-164, 4-168, 4-169
communities. <i>see</i> individual community name	
conformity determinations. <i>see</i> air quality	

Controlled Firing Areas	2-2
Cook Inlet Region, Inc.	3-317, 3-319, 3-335
cooperating agency	1-8
Council on Environmental Quality (CEQ)	1-4, 1-7, 1-8, 4-1, 4-173
cultural resources	1-6, 1-7, 1-9
determination of No Adverse Effect	1-6
	<i>see also</i> Appendix L
cumulative impacts	1-7, 2-54, 3-43, 3-63, 3-67, 3-70, 3-71, 3-73, 3-75, 3-87, 4-74, 4-107, 4-111, 4-112, 4-113, 4-119, 4-165, 4-166, 4-167, 4-168, 4-169, 4-170
	<i>see also</i> section 4.11
Dall sheep	3-87, 3-97, 3-98, 3-113, 3-114, 3-115, 3-141, 3-151, 3-152, 3-159, 3-173, 3-174, 3-175, 3-185, 3-196, 3-205, 3-237, 3-261, 3-262, 3-263, 3-265, 3-269, 3-275, 3-278, 3-280, 3-282, 3-283, 3-338, 3-339, 4-107, 4-117, 4-118, 4-120, 4-121, 4-122, 4-123, 4-124, 4-126, 4-167, 4-178
mineral licks	3-97, 3-114, 3-115, 3-151, 3-152, 3-173, 3-174, 4-117, 4-120, 4-121, 4-122, 4-123, 4-124, 4-178
damage claims.	<i>see</i> Appendix O
decision-maker	1-1, 1-4
Delta Bison Range	3-298, 3-303
Delta Junction	1-5, 2-32, 3-18, 3-24, 3-36, 3-37, 3-46, 3-60, 3-73, 3-100, 3-123, 3-152, 3-153, 3-163, 3-164, 3-177, 3-178, 3-215, 3-274, 3-278, 3-279, 4-13, 4-27, 4-142, 4-166
Delta National Wild, Scenic, and Recreational River	3-235, 3-238, 3-248
Denali Highway	3-168, 3-172, 3-235, 3-236, 3-237, 3-238, 3-239, 3-240, 3-241, 3-247, 3-268, 3-319, 3-320, 4-27, 4-64, 4-131, 4-134, 4-168, 4-169, 4-175
Delta-Yanert herd.	<i>see</i> caribou
Denali National Park and Preserve	1-6, 2-36, 2-46, 3-232, 3-248, 3-268, 3-270, 3-311, 3-317, 3-339, 3-341, 3-348, 4-64, 4-159, 4-177
Denali Park Road	3-232, 3-348
Denali State Park	3-232, 3-233, 3-249, 3-311, 3-317, 3-318
Deshka State Recreation River	3-234, 3-249
Dineega Corporation	3-330
Donnelly Creek State Recreation Site	3-224, 3-225, 3-231, 3-298, 3-303
Dot Lake Native Corporation	3-321
Doyon Ltd.	3-289, 3-292, 3-293, 3-294, 3-296, 3-317, 3-319, 3-321, 3-330, 3-334
ducks	3-59, 3-88, 3-91, 3-103, 3-105, 3-106, 3-121, 3-122, 3-123, 3-124, 3-125, 3-126, 3-127, 3-143, 3-144, 3-146, 3-163, 3-164, 3-165, 3-189, 3-190, 3-192, 4-102, 4-113
Eagle (Eagle City)	1-5, 3-46, 3-98, 3-104, 3-212, 3-214, 3-215, 3-221, 3-266, 3-274, 3-276, 3-277, 3-293, 4-8, 4-54, 4-57, 4-140, 4-141, 4-176
Eagle Campground	3-212, 3-214, 3-215, 3-221
Eagle River, community of	3-177, 3-342, 3-354
Eagle Village	3-274, 3-276, 3-277, 3-293, 4-140, 4-141
Eagle Village Corporation	3-293
economics (socioeconomics).	<i>see</i> sections 3.10 and 4.10
Eielson Air Force Base	
average daily sorties from	2-50
Economic Impact Region	3-353, 3-354
Eielson Range Control	3-15, 3-18, 3-27, 3-32, 3-82
Elmendorf Air Force Base	
average daily sorties from	2-50
Economic Impact Region	3-353, 3-354
emergency response procedures	3-82, 4-105
Endangered Species Act of 1973	1-8, 3-90, 3-92, 3-93, 3-94, 3-105, 4-113, 4-120

environmental justice. *see* Executive Order 12898

Executive Order 12898 (Environmental Justice) 1-9
see also Appendix P

F-15. *see* aircraft

F-16. *see* aircraft

Fairbanks 1-5, 1-6, 1-10, 2-2, 3-18, 3-23, 3-24, 3-32, 3-36, 3-37, 3-45, 3-46, 3-89, 3-95, 3-96,
 3-102, 3-147, 3-149, 3-150, 3-152, 3-212, 3-215, 3-216, 3-224, 3-225, 3-226, 3-232,
 3-253, 3-254, 3-264, 3-273, 3-274, 3-289, 3-296, 3-298, 3-305, 3-306, 3-338, 3-341,
 3-342, 3-343, 3-344, 3-345, 3-353, 3-354, 4-8, 4-11, 4-12, 4-13, 4-14, 4-20, 4-45, 4-50,
 4-52, 4-159, 4-160, 4-163, 4-165, 4-166

Federal Aviation Act 1-9

Federal Aviation Administration (FAA), as a cooperating agency 1-8

Federal Register 1-4, 1-5, 1-6

Fielding Lake State Recreation Site 3-238, 3-240, 3-249

firefighting 2-3, 3-24, 3-82, 3-83, 4-165

fires 1-6, 3-77, 3-82, 3-84, 3-90, 3-96, 3-114, 4-101, 4-104, 4-105, 4-107, 4-115, 4-167

fish, as subsistence resources 3-273, 3-275, 3-276, 3-277, 3-278, 3-280, 3-281, 3-282, 3-284, 4-138

fishing, recreational 3-207, 3-208, 3-211, 3-213, 3-214, 3-215, 3-216, 3-217, 3-225, 3-226,
 3-227, 3-236, 3-237, 3-239, 3-241, 3-243, 3-244, 4-135, 3-245, 3-246, 3-247,
 3-259, 3-260, 3-261, 3-262, 3-263, 3-269, 3-273, 3-274, 3-275, 3-277, 3-278

flares 1-6, 2-3, 2-5, 2-6, 2-7, 2-8, 2-35, 2-52, 3-77, 3-78, 3-79, 3-82, 4-58, 4-101, 4-104,
 4-105, 4-106, 4-107, 4-167, 4-170

Flight Avoidance Areas, definition of 2-19
see also Appendix B

Fort Egbert National Historic Site 3-212, 3-214, 3-215, 3-221

Fort Greely . . . 1-10, 3-27, 3-35, 3-36, 3-37, 3-46, 3-149, 3-152, 3-154, 3-225, 3-278, 3-298, 3-303, 3-304,
 4-142, 4-165

Fort Richardson 3-45, 3-173, 3-323, 4-155

Fort Wainwright . . . 1-10, 3-15, 3-23, 3-36, 3-45, 3-215, 3-225, 3-286, 3-289, 3-290, 3-296, 3-304, 3-305,
 3-306, 3-307, 3-308, 4-165

Fort Yukon 1-5, 3-24, 3-213, 3-274, 3-275, 3-276, 3-277, 3-341, 4-140

Fortymile herd. *see* caribou

Fortymile National Wild, Scenic, and Recreational River . . 3-212, 3-214, 3-221, 3-239, 3-248, 3-267, 3-268,
 3-292, 3-293, 3-321, 4-136

fuel jettison 1-6, 3-77, 3-82, 3-83, 4-101, 4-105

Gakona 3-168, 3-171, 3-172, 3-241, 3-274, 3-280, 3-281, 3-282, 3-322, 4-143

Galena Airport 2-24, 2-29, 3-49, 4-164

Game Management Units (GMUs). *see* Appendix M

geese 3-59, 3-88, 3-91, 3-105, 3-106, 3-107, 3-121, 3-122, 3-123, 3-124, 3-125, 3-126, 3-127, 3-143,
 3-144, 3-146, 3-163, 3-164, 3-165, 3-189, 3-190, 3-192, 3-339, 4-113, 4-114

George Parks Highway . . 3-37, 3-45, 3-46, 3-171, 3-232, 3-233, 3-234, 3-304, 3-305, 3-307, 3-311, 3-317,
 3-318, 3-348

general aviation. *see* civil aviation

Glenn Highway 3-237, 3-238, 3-280

Glennallen 1-5, 3-37, 3-73, 3-169, 3-235, 3-236, 3-238, 3-239, 3-247, 3-264, 3-274

golden eagles . . 3-59, 3-87, 3-88, 3-92, 3-98, 3-104, 3-107, 3-108, 3-121, 3-122, 3-146, 3-166, 3-191, 4-114,
 4-115, 4-122

greater white-fronted geese . . . 3-59, 3-105, 3-143, 3-146, 3-163, 3-164, 3-165, 3-189, 3-190, 3-192, 3-339

Tule subspecies 3-165

Gulkana National Wild River 3-235, 3-236, 3-238, 3-239, 3-241, 3-247, 3-268, 3-321, 3-339, 4-131,
 4-133, 4-136

- Gulkana River . 3-163, 3-164, 3-171, 3-173, 3-175, 3-176, 3-235, 3-236, 3-239, 3-241, 3-247, 3-319, 3-322, 4-123, 4-126, 4-132, 4-134, 4-175, 4-176
- gyrfalcon 3-59, 3-87, 3-88, 3-94, 3-107, 3-108, 3-146, 3-166, 4-114, 4-115
- Harding Lake State Recreation Area 3-37, 3-224, 3-231, 3-268, 3-305, 3-306
- hazardous materials/hazardous waste 3-82
- Healy Lake 3-105, 3-146, 3-225, 3-274, 3-275, 3-278, 3-279, 3-289, 3-303, 3-304, 4-142, 4-143
- Healy Lake Village Corporation 3-289
- hearings. *see* public hearings
- helicopters 3-23, 3-36, 3-37, 3-45, 3-70, 3-72, 3-73, 4-14, 4-114, 4-115, 4-116, 4-127, 4-128, 4-135, 4-165, 4-166, 4-168
- hunting
- species hunted 3-87, 3-93, 3-96, 3-97, 3-99, 3-101, 3-102, 3-103, 3-105, 3-115, 3-147, 3-150, 3-152, 3-168, 3-169, 3-171, 3-172, 3-173, 3-174, 3-175, 3-176, 3-178, 3-192, 3-193, 3-195, 3-197, 3-198, 4-111, 4-116, 4-117, 4-118
- sport 3-87, 3-101, 3-152, 3-169, 3-193, 3-208, 3-211, 3-213, 3-214, 3-215, 3-216, 3-225, 3-226, 3-233, 3-235, 3-237, 3-239, 3-240, 3-251, 3-261, 3-265, 3-281, 3-332, 4-117, 4-129, 4-167, 4-169
- subsistence 3-273, 3-275, 3-276, 3-278, 3-280, 3-281, 3-282, 3-284, 3-285 4-137, 4-138, 4-139, 4-140, 4-141, 4-142, 4-143, 4-144, 4-145, 4-146
- Iditarod National Historic Trail 3-232, 3-233, 3-248, 3-252, 3-253, 3-254, 3-259
- Iditarod Trail Sled Dog Race 3-233, 3-254
- Innoko National Wildlife Refuge 3-252, 3-253, 3-259, 3-331, 3-334, 3-340
- interagency coordination 1-8
- Intergovernmental Coordination Act 1-8
- King Salmon Airport 2-29, 4-164
- Koliganek 3-194, 3-252, 3-274, 3-283, 3-284, 3-335, 3-337, 4-145
- Koliganek Natives Ltd. 3-335
- Kuskokwim Corporation 3-334
- Kuskokwim Native Association 3-334
- Lake Clark National Park and Preserve . 2-8, 2-65, 3-251, 3-252, 3-259, 3-269, 3-331, 3-332, 3-334, 3-335, 3-336, 3-339, 4-67, 4-176, 4-177
- Lake Creek State Recreation River 3-234, 3-235, 3-249
- Lake Minchumina 3-123, 3-143, 3-144, 3-274, 3-283, 3-284, 3-329, 3-331, 4-144
- land management 3-82, 3-221, 3-247, 3-248, 3-259, 3-285, 3-289, 3-291, 3-293, 3-294, 3-295, 3-296, 3-303, 3-304, 3-305, 3-307, 3-308, 3-317, 3-320, 3-321, 3-330, 3-333, 3-336, 4-147
- land ownership. *see* land status
- land status 1-6, 3-91, 3-285, 3-286, 3-287, 3-290, 3-292, 3-294, 3-295, 3-296, 3-298, 3-299, 3-301, 3-304, 3-305, 3-306, 3-307, 3-311, 3-313, 3-315, 3-319, 3-320, 3-326, 3-327, 3-329, 3-331, 3-335, 4-104
- land use. *see* sections 3.8 and 4.8
- lasers 1-3, 1-6, 2-4, 3-32, 3-35, 3-43, 3-77, 3-81, 4-101, 4-105
see also Low-Altitude Navigation and Targeting Infrared for Night [LANTIRN]
- Lime Village 1-5, 3-193, 3-194, 3-195, 3-274, 3-283, 3-284, 3-332, 3-334, 4-145, 4-146
- Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) 1-3, 2-4, 3-32
see also lasers
- Low-Altitude Tactical Navigation (LATN) 2-2, 2-21, 2-22, 2-26, 2-27, 2-33, 3-15, 3-17, 3-23, 3-24, 3-32, 3-36, 3-37, 3-40, 3-43, 3-45, 3-49, 3-58, 3-70, 3-72, 3-73, 3-75, 4-35, 4-57, 4-98, 4-165, 4-166
- lynx 3-87, 3-90, 3-102, 3-103, 3-104, 3-117, 3-118, 3-154, 3-179, 3-180, 3-199
- Macomb herd. *see* caribou

Major Flying Exercise (MFE)	
description of	2-4
training day, definition of	2-4
marten	3-87, 3-102, 3-103, 3-104, 3-106, 3-107, 3-117, 3-118, 3-154, 3-179, 3-180, 3-199
McGrath	1-5, 3-54, 3-55, 3-274, 3-283, 3-284, 3-331, 3-332, 4-144, 4-165, 4-168, 4-169
Mentasta herd. <i>see</i> caribou	
Mentasta Lake	3-280, 3-281, 3-282, 3-321, 4-143
methodology	2-50, 2-52, 2-54, 3-64, 3-65, 3-68, 3-71, 3-74, 3-87, 3-274, 3-283, 3-308, 3-323, 4-1, 4-3, 4-73, 4-74, 4-76, 4-128, 4-137, 4-142, 4-143, 4-148, 4-149, 4-151, 4-155, 4-159, 4-161, 4-163
Military Operations Area (MOA), description of	3-7
	<i>see also</i> Appendix D
Military Operations Areas, coordinates. <i>see</i> Appendix B	
Military Training Route(s) (MTRs)	1-7, 1-9, 1-10, 2-2, 2-53, 3-15, 3-18, 3-19, 3-23, 3-32, 3-33, 3-36, 3-43, 3-44, 3-45, 3-49, 3-53, 3-54, 3-64, 3-65, 3-70, 3-71, 3-72, 3-73, 3-75, 3-77, 3-237, 3-241, 3-348, 4-3, 4-8, 4-9, 4-13, 4-18, 4-21, 4-26, 4-29, 4-34, 4-41, 4-46, 4-49, 4-99, 4-104, 4-137, 4-165, 4-166, 4-168
mining	3-66, 3-70, 3-71, 3-72, 3-73, 3-74, 3-75, 3-212, 3-213, 3-214, 3-215, 3-216, 3-225, 3-237, 3-289, 3-290, 3-291, 3-292, 3-293, 3-294, 3-295, 3-296, 3-297, 3-311, 3-317, 3-319, 3-321, 3-329, 3-330, 3-331, 3-332, 3-334, 4-115, 4-166, 4-168
mineral lick. <i>see</i> Dall sheep	
mink	3-87, 3-102, 3-104, 3-117, 3-118, 3-179, 3-180, 3-199
mitigation	2-1, 2-54, 2-59, 2-60, 2-67, 2-68, 3-64, 3-84, 4-74, 4-77, 4-78, 4-84, 4-118, 4-119, 4-135, 4-138, 4-152, 4-156, 4-168, 4-173, 4-174, 4-175, 4-179
	<i>see also</i> section 4.12
missiles. <i>see</i> munitions	
Moon Lake State Recreation Site	3-239, 3-240, 3-249
moose	
population density	3-112, 3-117, 3-149, 3-150, 3-170, 3-172, 3-176, 3-194, 3-195
as subsistence resource	3-273, 3-275, 3-276, 3-277, 3-278, 3-279, 3-280, 3-281, 3-282, 3-284, 3-285, 4-138, 4-139, 4-140, 4-141, 4-142, 4-143, 4-144, 4-146
Moose Creek	3-234, 3-308, 3-317, 3-353, 4-151
MTNT, Ltd.	3-330
Mulchatna herd. <i>see</i> caribou	
Mulchatna National Wild River	3-251, 3-259, 3-339
multinational exercises	2-4
munitions	1-4, 1-6, 2-2, 2-3, 2-52, 3-22, 3-27, 3-32, 3-65, 3-77, 3-78, 3-79, 3-81, 3-82, 3-83, 4-11, 4-73, 4-101, 4-105, 4-115, 4-167
	<i>see also</i> Appendix C
Nabesna Road area	3-280, 3-282, 4-143
Napamiute	3-274, 3-283, 3-284, 3-332, 4-145
National Airspace System	3-7
National Ambient Air Quality Standards (NAAQS)	3-341, 3-342, 3-343, 3-349, 4-159, 4-160, 4-161
National Command Authority	1-3
National Environmental Policy Act (NEPA)	1-4, 1-7, 1-9, 2-54, 3-77, 4-1, 4-74, 4-76
National Historic Preservation Act	1-9
National Wild and Scenic Rivers System	3-212, 3-214, 3-254
Nelchina herd. <i>see</i> caribou	
Nelchina Public Use Area	3-46, 3-235, 3-237, 3-249, 3-268, 3-319, 3-320, 4-27
Nikolai	3-274, 3-283, 3-284, 3-331, 4-144
No Action Alternative, description of	2-6, 2-25
No CLEAR CREEK MOA Alternative. <i>see</i> Alternative A and Alternative A—Modified	

noise. <i>see</i> sections 3.3 and 4.3 and Appendix F	
noise complaints. <i>see</i> Appendix O	
Noise/Flight Sensitive Area list	2-19
	<i>see also</i> Appendix B
nonattainment areas. <i>see</i> air quality	
North Pole	3-342, 3-353, 4-160
northern goshawk	3-59, 3-87, 3-88, 3-94, 3-95, 3-107, 3-108, 3-145, 3-146, 3-166, 3-190, 4-114
Northern Interior Region, description of	2-19
Notice of Intent (NOI)	1-4
Nowitna National Wild River	3-253, 3-254, 3-259, 3-269, 3-331, 3-339, 4-178
Nowitna National Wildlife Refuge	3-253, 3-254, 3-259, 3-269, 3-329, 3-330, 3-331, 3-339
OA-10A. <i>see</i> aircraft	
Oklahoma range. <i>see</i> air-to-ground weapons ranges	
ordnance. <i>see</i> munitions	
osprey	3-59, 3-87, 3-94, 3-145, 3-146, 3-165, 3-166, 3-191
Parks Highway. <i>see</i> George Parks Highway	
Paxson	3-168, 3-171, 3-172, 3-173, 3-236, 3-237, 3-238, 3-239, 3-240, 3-241, 3-248, 3-274, 3-280, 3-282, 3-319, 3-321, 3-339, 4-64, 4-144, 4-150
Paxson Lake Campground	3-239, 3-248
Peale's peregrine falcon	3-93
peregrine falcon	1-8, 3-59, 3-87, 3-88, 3-90, 3-91, 3-92, 3-93, 3-94, 3-107, 3-108, 3-121, 3-122, 3-135, 3-145, 3-146, 3-165, 3-166, 3-190, 3-191, 3-338, 3-339, 3-340, 4-112, 4-113, 4-114, 4-115, 4-120, 4-122, 4-123, 4-126, 4-140, 4-141, 4-178
	<i>see also</i> Appendix I
physical environment. <i>see</i> section 3.1	
Pinnell Mountain National Recreation Trail	3-212, 3-221
pipeline. <i>see</i> trans-Alaska oil pipeline	
Pleasant Valley	3-215
population density. <i>see</i> individual species	
Porcupine herd. <i>see</i> caribou	
Preferred Alternative	2-1, 2-65, 2-66, 2-67
Prevention of Significant Deterioration. <i>see</i> air quality	
Proposed Action, description of	2-5, 2-20
protected species	1-6, 3-87, 3-88, 3-89, 3-90, 3-105, 4-107, 4-112, 4-120, 4-123, 4-126
	<i>see also</i> Appendix I
public comment period	1-6, 4-173
public hearings	1-6
public involvement	1-5
quality of life	1-6, 3-285, 3-290, 3-292, 3-293, 3-295, 3-296, 3-297, 3-304, 3-305, 3-306, 3-307, 3-308, 3-318, 3-320, 3-321, 3-330, 3-334, 3-337, 4-73, 4-147
Rainy Pass herd. <i>see</i> caribou	
ranges. <i>see</i> air-to-ground weapons ranges	
raptors. <i>see</i> individual species names	
Record of Decision (ROD)	1-4, 2-59, 4-174
recreation. <i>see</i> sections 3.6 and 4.6	
recreation areas. <i>see</i> individual area name (e.g., Denali National Park)	
Recreation Opportunity Setting	3-207, 3-208, 3-211, 3-212, 3-213, 3-214, 3-215, 3-216, 3-224, 3-225, 3-226, 3-234, 3-237, 3-239, 3-240, 3-242, 3-243, 3-246, 3-258, 3-259, 3-260, 3-261, 3-262, 3-263, 3-268, 4-128, 4-129, 4-130, 4-135
Red Devil	3-54, 3-55, 3-253, 3-274, 3-283, 3-284, 3-332, 3-334, 4-29, 4-35, 4-145, 4-146, 4-150, 4-178
Regions, description of the four EIS regions	2-19

Restricted Area (RA)	1-2, 1-9, 2-2, 2-6, 2-21, 2-22, 2-26, 2-27, 2-30, 2-35, 2-50, 2-52, 3-3, 3-7, 3-11, 3-12, 3-15, 3-16, 3-18, 3-22, 3-23, 3-27, 3-31, 3-32, 3-33, 3-32, 3-35, 3-36, 3-37, 3-66, 3-67, 3-68, 3-71, 3-72, 3-73, 3-79, 3-81, 3-105, 3-107, 3-109, 3-112, 3-113, 3-115, 3-117, 3-144, 3-146, 3-148, 3-149, 3-150, 3-151, 3-152, 3-153, 3-154, 3-304, 3-306, 4-10, 4-11, 4-19, 4-20, 4-37, 4-45, 4-84, 4-89, 4-90, 4-103, 4-104, 4-105, 4-126, 4-165, 4-166
Richardson Highway	2-32, 2-34, 2-35, 3-37, 3-46, 3-60, 3-73, 3-150, 3-216, 3-226, 3-236, 3-239, 3-240, 3-241, 3-268, 3-280, 3-289, 3-298, 3-303, 3-305, 3-306, 3-307, 3-320, 3-339, 4-13, 4-58, 4-63, 4-132, 4-134, 4-165, 4-166, 4-175, 4-176
river otter	3-87, 3-102, 3-103, 3-117, 3-118, 3-154, 3-179, 3-180, 3-199
rough-legged hawk	3-59, 3-87, 3-88, 3-92, 3-94, 3-108, 3-121, 3-122, 3-191, 4-115
routine training, description of	2-4
routine training day, definition of	2-4
Ruby	3-253, 3-254, 3-274, 3-283, 3-284, 3-329, 3-330, 4-144
Salcha River	2-65, 3-105, 3-109, 3-110, 3-111, 3-112, 3-113, 3-114, 3-145, 3-149, 3-150, 3-216, 3-224, 3-226, 3-231, 3-289, 3-290, 3-292, 3-305, 3-306, 3-307, 4-58, 4-99, 4-150, 4-151, 4-176
Salcha River State Recreation Site	3-224, 3-226, 3-231, 3-306
scoping	1-4, 1-5, 1-6, 1-7, 2-6, 2-54, 3-24, 3-37, 3-46, 3-55, 3-60, 3-87, 3-207, 3-273, 3-274, 3-290, 3-318, 3-353, 4-107, 4-127, 4-147, 4-150
seasonal round. <i>see</i> subsistence	
Section 7 Consultation. <i>see</i> Endangered Species Act	
Section 106 Consultation. <i>see</i> National Historic Preservation Act	
Skwentna	3-173, 3-233, 3-235, 3-274, 3-280, 3-282, 3-318, 4-143, 4-144
sleep disturbance	3-64, 3-308, 3-323, 4-75, 4-76, 4-78, 4-151, 4-155
Sleetmute	1-5, 3-54, 3-55, 3-253, 3-274, 3-283, 3-284, 3-332, 3-334, 4-29, 4-35, 4-145, 4-146, 4-150
snow geese	3-59, 3-122, 3-124, 3-165, 4-113, 4-114
socioeconomics. <i>see</i> sections 3.10 and 4.10	
sonic booms	3-2, 3-43, 3-63, 3-64, 3-65, 3-68, 3-70, 3-72, 3-73, 3-74, 3-75, 4-10, 4-11, 4-21, 4-81, 4-82, 4-83, 4-84, 4-85, 4-86, 4-85, 4-87, 4-88, 4-91, 4-92, 4-91, 4-93, 4-94, 4-95, 4-96, 4-97, 4-98, 4-99, 4-107, 4-108, 4-109, 4-121, 4-167, 4-177
sortie, definition of	2-4
Sourdough Campground	3-240, 3-248
Southcentral Interior Region, description of	2-19
Southern Interior Region, description of	2-19
Special Use Airspace (SUA)	2-2, 3-7, 3-18, 3-27, 3-58, 3-60, 3-65, 4-8, 4-12, 4-14, 4-20, 4-53, 4-58, 4-179 <i>see also</i> Appendix D
Special Use Airspace Information Service (SUAIS)	3-18, 3-27, 3-60, 4-58, 4-179
State Historic Preservation Officer (SHPO)	1-6, 1-7, 1-9 <i>see also</i> Appendix L
Steese Highway	3-68, 3-110, 3-111, 3-113, 3-212, 3-213, 3-214, 3-216, 3-217, 3-276, 3-290, 3-291, 3-292, 3-294, 3-296, 3-338, 4-10, 4-11, 4-87, 4-140
Steese National Conservation Area	3-212, 3-213, 3-221, 3-267, 3-290, 3-291, 3-292, 3-294, 3-296, 3-297, 3-338, 4-130, 4-133
Stony River, community of	3-54, 3-55, 3-253, 3-274, 3-283, 3-284, 3-332, 3-333, 3-334, 4-29, 4-35, 4-145, 4-146, 4-150
Stuart Creek range. <i>see</i> air-to-ground weapons ranges	
subsistence. <i>see</i> sections 3.7 and 4.7 and Appendix J	
subsistence resources. <i>see</i> individual species	
subsistence, seasonal round	3-278, 3-280, 3-281, 3-284, 4-137 <i>see also</i> Appendix J
Sunshine Mountain herd. <i>see</i> caribou	

supersonic	1-1, 1-3, 1-4, 2-1, 2-2, 2-3, 2-5, 2-6, 2-7, 2-19, 2-20, 2-21, 2-22, 2-23, 2-24, 2-25, 2-26, 2-27, 2-28, 2-29, 2-33, 2-34, 2-35, 2-36, 2-52, 2-53, 2-65, 2-66, 2-67, 2-68, 2-38, 2-39, 2-40, 2-41, 2-42, 2-43, 2-44, 2-45, 2-46, 2-47, 2-48, 2-49, 3-2, 3-12, 3-22, 3-23, 3-27, 3-40, 3-43, 3-49, 3-54, 3-63, 3-65, 3-67, 3-68, 3-69, 3-70, 3-71, 3-72, 3-73, 3-74, 3-75, 3-76, 4-10, 4-11, 4-19, 4-21, 4-22, 4-27, 4-35, 4-52, 4-57, 4-64, 4-73, 4-81, 4-82, 4-84, 4-85, 4-87, 4-89, 4-91, 4-93, 4-95, 4-97, 4-98, 4-99, 4-122, 4-123, 4-124, 4-147, 4-149, 4-167, 4-177
Takotna	3-274, 3-283, 3-284, 3-331, 3-333, 4-144
Talkeetna	1-5, 3-4, 3-46, 3-73, 3-97, 3-168, 3-170, 3-171, 3-174, 3-175, 3-232, 3-237, 3-274, 3-280, 3-281, 3-282, 3-319, 3-320, 4-143
Tanacross	3-4, 3-274, 3-278, 3-280, 3-282, 3-321, 4-46, 4-143, 4-144, 4-150
Tanacross, Inc.	3-321
TANANA MOA Alternative.	<i>see</i> Alternative B
Tanana Valley State Forest	3-212, 3-215, 3-223, 3-224, 3-225, 3-231, 3-239, 3-240, 3-250, 3-289, 3-296, 3-297, 3-298, 3-303, 3-305, 3-306, 3-321, 3-322, 4-168, 4-169
Tangle Lakes Campground	3-236, 3-247
Tangle Lakes National Register Archaeological District	3-236, 3-247, 4-134
Tangle River Campground	3-236, 3-247
Taylor Highway	3-110, 3-111, 3-169, 3-172, 3-176, 3-214, 3-215, 3-216, 3-239, 3-267, 3-268, 3-276, 3-278, 3-280, 3-292, 3-293, 3-320, 4-131, 4-133, 4-140, 4-141, 4-176
Telida	3-274, 3-283, 3-284, 3-329, 3-330, 3-331, 4-144
Tok	3-4, 3-46, 3-146, 3-148, 3-151, 3-168, 3-169, 3-173, 3-174, 3-264, 3-274, 3-280, 3-282, 3-321, 4-46, 4-50, 4-143, 4-144, 4-150, 4-176
Tors Trail	3-215, 3-223
tourism	3-207, 3-270, 3-292, 3-317, 3-318, 3-321, 3-353, 4-135, 4-168, 4-169
training day, definition of	2-4
trans-Alaska oil pipeline	3-37, 3-60, 3-70, 3-72, 3-73, 3-278, 4-14, 4-20, 4-37, 4-142, 4-166, 4-175
Trapper Creek	3-274, 3-280, 3-281, 3-282, 4-143
trapping	3-102, 3-103, 3-104, 3-117, 3-178, 3-179, 3-199, 3-233, 3-253, 3-261, 3-263, 3-275, 3-276, 3-280, 3-283, 3-295, 3-329, 3-331, 3-332, 3-334, 3-335, 3-337, 4-111, 4-138, 4-168
trumpeter swan	3-59, 3-87, 3-88, 3-91, 3-105, 3-106, 3-107, 3-129, 3-143, 3-144, 3-163, 3-164, 3-189, 3-190, 3-318, 3-339, 4-114, 4-119, 4-122, 4-123, 4-124, 4-126, 4-176
Tule geese.	<i>see</i> greater white-fronted geese
tundra swan	3-88, 3-190
Tyone Village	3-319
Upper Petersville Road	3-274, 3-280, 3-281, 3-282, 4-143, 4-144
Venetie	1-5, 3-274, 3-276, 3-277, 4-140
villages.	<i>see</i> individual village name
visitor use of recreation areas	3-210, 3-211, 3-213, 3-214, 3-215, 3-223, 3-224, 3-225, 3-231, 3-232, 3-233, 3-236, 3-237, 3-239, 3-240, 3-250, 3-251, 3-252, 3-254, 3-260, 4-127, 4-128, 4-135
Walker Fork Campground	3-214, 3-221, 4-131, 4-133, 4-176
Warning Area (WA)	2-2, 3-82
waterfowl, as subsistence resource	3-275, 3-276, 3-277, 3-278, 3-280, 3-282, 3-284, 3-285, 4-144, 4-145, 4-146
weapons ranges.	<i>see</i> air-to-ground weapons ranges
West Fork Campground	3-239, 3-248, 4-132, 4-134, 4-176
Western Region, description of	2-19
white-fronted geese.	<i>see</i> greater white-fronted geese
White Mountains herd.	<i>see</i> caribou
white phosphorous	4-101
Wild and Scenic Rivers.	<i>see</i> river name

- wilderness 1-6, 3-65, 3-66, 3-70, 3-71, 3-73, 3-75, 3-207, 3-208, 3-210, 3-213, 3-232, 3-233, 3-236, 3-238, 3-239, 3-252, 3-264, 3-265, 3-266, 3-270, 3-271, 3-289, 3-290, 3-291, 3-292, 3-293, 3-294, 3-295, 3-296, 3-311, 3-317, 3-330, 3-331, 3-334, 3-336, 3-337, 3-339, 3-341, 4-45, 4-76, 4-127, 4-128, 4-129, 4-135, 4-147, 4-148, 4-166
- wildfires. *see* fires
- wildlife. *see* individual species and sections 3.5 and 4.5
- wolverine 3-87, 3-102, 3-103, 3-104, 3-117, 3-118, 3-154, 3-169, 3-179, 3-180, 3-199, 3-261, 3-262, 3-263, 3-338, 3-339
- wolves 3-87, 3-95, 3-97, 3-98, 3-101, 3-102, 3-103, 3-104, 3-109, 3-112, 3-114, 3-116, 3-117, 3-118, 3-149, 3-151, 3-153, 3-154, 3-168, 3-169, 3-171, 3-172, 3-174, 3-176, 3-177, 3-178, 3-179, 3-193, 3-195, 3-198, 3-199, 3-238, 3-261, 3-262, 3-263, 3-338, 3-339, 4-107, 4-109, 4-111, 4-118, 4-124, 4-126
 population densities 3-116, 3-117, 3-118, 3-153, 3-154, 3-178, 3-179, 3-198, 3-199
- Wood-Tikchik State Park 3-251, 3-260, 3-269, 3-335, 3-336, 3-337, 4-136
- Yukon Flats National Wildlife Refuge 3-106, 3-107, 3-212, 3-213, 3-222, 3-267, 3-291, 3-294, 3-295, 3-338
- Yukon Measurement and Debriefing System (Yukon MDS) 1-10, 2-2, 2-67, 2-68
- Yukon Quest International Sled Dog Race 3-216
- Yukon River 3-1, 3-3, 3-5, 3-58, 3-91, 3-92, 3-93, 3-105, 3-106, 3-107, 3-108, 3-109, 3-110, 3-111, 3-113, 3-114, 3-115, 3-116, 3-189, 3-190, 3-191, 3-192, 3-195, 3-198, 3-212, 3-213, 3-253, 3-254, 3-266, 3-276, 3-291, 3-294, 3-295, 3-329, 3-338, 3-339, 4-112, 4-136
- Yukon-Charley Rivers National Preserve . . 3-212, 3-213, 3-222, 3-267, 3-286, 3-289, 3-290, 3-291, 3-292, 3-293, 3-294, 3-295, 3-338, 4-12, 4-57, 4-113, 4-130, 4-133

This Page Intentionally Left Blank