U.S. Department of the Interior
Bureau of Land Management

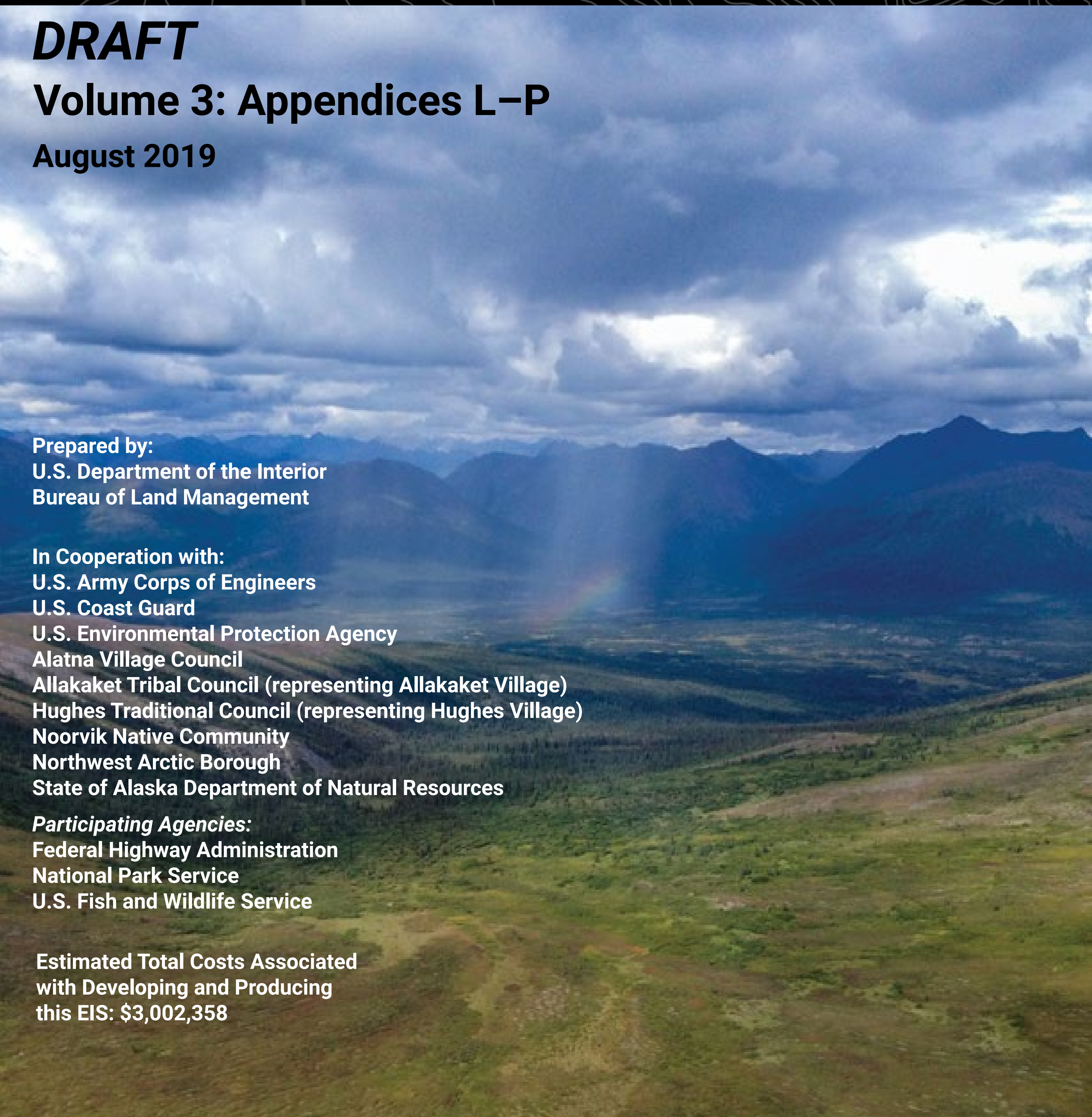
Ambler Road

Environmental Impact Statement

DRAFT

Volume 3: Appendices L–P

August 2019



Prepared by:
U.S. Department of the Interior
Bureau of Land Management

In Cooperation with:
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Environmental Protection Agency
Alatna Village Council
Allakaket Tribal Council (representing Allakaket Village)
Hughes Traditional Council (representing Hughes Village)
Noorvik Native Community
Northwest Arctic Borough
State of Alaska Department of Natural Resources

Participating Agencies:
Federal Highway Administration
National Park Service
U.S. Fish and Wildlife Service

Estimated Total Costs Associated with Developing and Producing this EIS: $3,002,358

Mission

Sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

Cover Photo: Looking north at the Brooks Range from the Alatna Hills. Photo by Crystal Glassburn (BLM).

DOI-BLM-AK-F030-2016-0008-EIS
BLM/AK/PL- 19/013+1610+F030

Ambler Road

Draft Environmental Impact Statement

Volume 3: Appendices L–P

Prepared by:
U.S. Department of the Interior
Bureau of Land Management

In Cooperation with:
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Environmental Protection Agency
Alatna Village Council
Allakaket Tribal Council (representing Allakaket Village)
Hughes Traditional Council (representing Hughes Village)
Noorvik Native Community
Northwest Arctic Borough
State of Alaska Department of Natural Resources
Participating Agencies:
Federal Highway Administration
National Park Service
U.S. Fish and Wildlife Service

August 2019

Estimated Agency Total Costs Associated with Developing and Producing this EIS: $3,002,358

This page is intentionally left blank.

Table of Contents

Volume 2 – List of Appendices

This page is intentionally left blank.

Appendix L:

Subsistence Uses and Resources

This page is intentionally left blank.

Table of Contents

Tables

Figures

Maps

List of Acronyms

AAC	Alaska Administrative Code
ADF&G	Alaska Department of Fish and Game
AIDEA	Alaska Industrial Development and Export Authority
AMDIAR	Ambler Mining District Industrial Access Road
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
ATV	All-terrain vehicle
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
DMTS	Delong Mountain Transportation System
DOI	Department of the Interior
EIS	Environmental Impact Statement
FWS	U.S. Fish and Wildlife Service
GAAR	Gates of the Arctic National Park and Preserve
GMU	Game Management Unit
GPS	Global positioning system
HHH	Hodzana Hills Caribou Herd
NPS	National Park Service
ROW	Right-of-way
SLM	Small Land Mammals
SRB&A	Stephen R. Braund & Associates
TH	Teshekpuk Herd
WAH	Western Arctic Caribou Herd
WG	Working Group

This page is intentionally left blank.

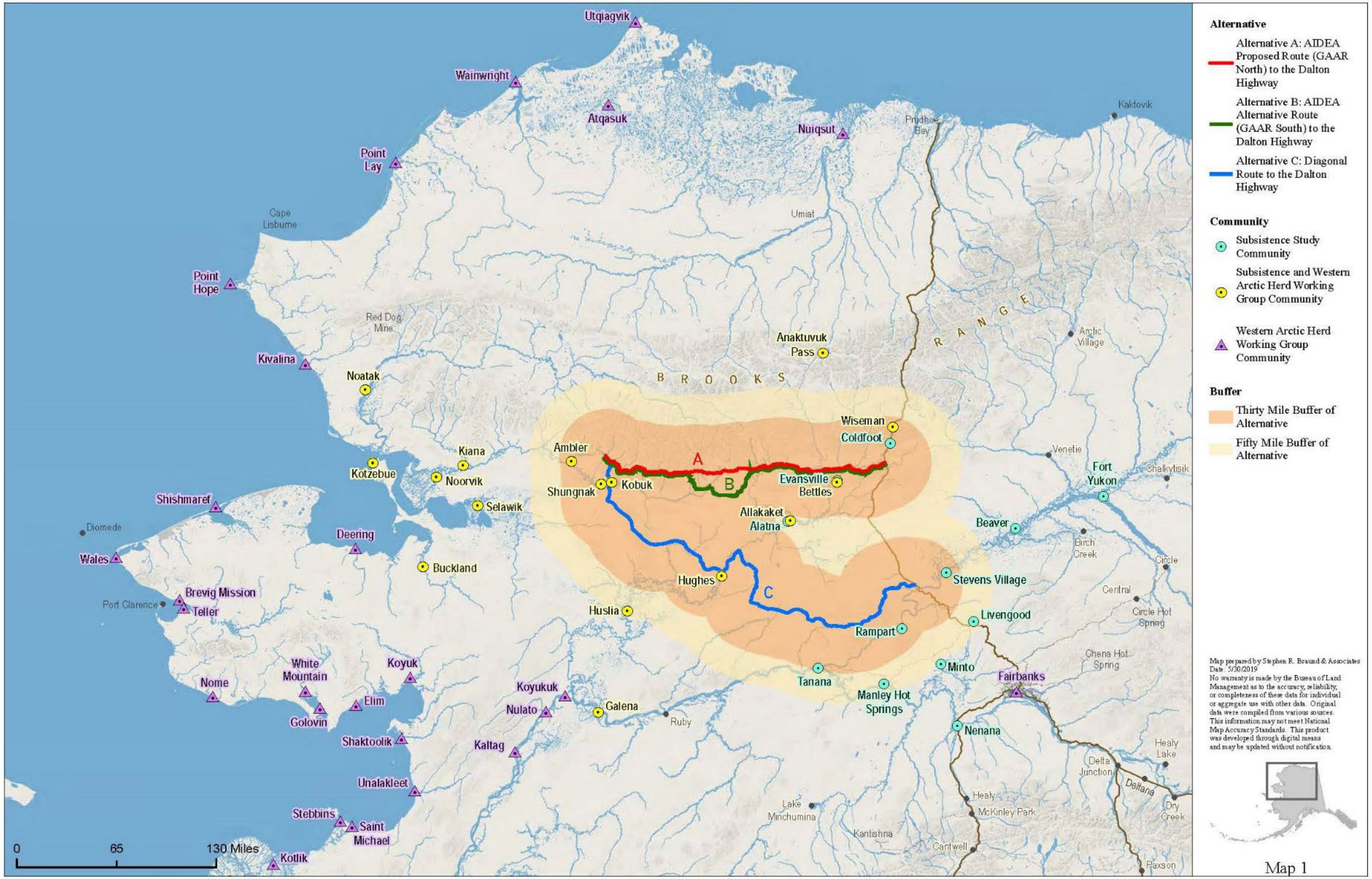
1. Introduction

The Alaska Industrial Development and Export Authority (AIDEA) is proposing to construct an all-season industrial access transportation corridor extending from the Dalton Highway to the Ambler Mining District in Northwest Alaska. The road would provide access for exploration and development of the Ambler Mining District and is referred to as the Ambler Mining District Industrial Access Road (AMDIAR). The U.S. Bureau of Land Management (BLM) is developing an Environmental Impact Statement (EIS) in response to a right-of-way (ROW) application from AIDEA. The EIS will analyze the potential impacts of the road on physical characteristics, biological resources, and social systems, including subsistence uses and resources. This Subsistence Technical Report has been prepared to inform the affected environment and environmental consequences section of the Ambler Road EIS. The report provides an overview of subsistence uses in potentially affected communities and regions, in addition to a discussion of the potential impacts of the AMDIAR on subsistence resources and uses.

2. Study Area

The subsistence study area for the Ambler Road EIS includes communities that harvest subsistence resources within or near the project area, use project area to access subsistence use areas, or harvest resources that migrate through the project area and are later harvested elsewhere. For the purposes of the subsistence analysis, to capture the above study communities, the study team included any community located within 50 miles of one more of the project alternatives, and any community with documented subsistence use areas within 30 miles of one or more of the project alternatives. These criteria aim to capture communities that may experience direct or indirect impacts on their subsistence uses resulting from construction and operation of the AMDIAR. Based on the criteria, there are 27 primary subsistence study communities (see Table 1 and Map 1). The study team grouped these subsistence study communities into five primary regions based on their location. These regions include Kobuk River region, Kotzebue Sound region, Koyukuk River region, Tanana River region, and Yukon River region. In addition, the project is within the range of the Western Arctic Caribou Herd (WAH), a highly migratory and important subsistence resource to communities in Western and Northwestern Alaska. This section includes a separate subset of the 42 members of the WAH working group (WG) (Map 1); these caribou subsistence study communities are referred to as the WAH study communities and include 16 of the subsistence study communities listed in Table 1. Inclusion of the WAH study communities captures potential indirect or cumulative impacts to communities who use caribou that migrate through the project area and are later harvested elsewhere.

This page is intentionally left blank.



Map 1. Subsistence and Western Arctic Caribou Herd study communities

This page is intentionally left blank.

Table 1. Ambler Road EIS subsistence and WAHWG study communities

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAHWG	Subsistence study community study region
1	Alatna	SUB	Yes	Yes	Yes	Yes	Koyukuk River
2	Allakaket	SUB/WAH	Yes	Yes	Yes	Yes	Koyukuk River
3	Ambler	SUB/WAH	Yes	Yes	Yes	Yes	Kobuk River
4	Anaktuvuk Pass	SUB/WAH	No	Yes	Yes	Yes	Koyukuk River
5	Atqasuk	WAH	No	No	No	Yes	N/A
6	Beaver	SUB	No	No	Yes	No	Yukon River
7	Bettles	SUB/WAH	Yes	Yes	Yes	Yes	Koyukuk River
8	Brevig Mission	WAH	No	No	No	Yes	N/A
9	Buckland	SUB/WAH	No	No	Yes	Yes	Kotzebue Sound
10	Coldfoot	SUB	Yes	Yes	Yes	No	Koyukuk River
11	Deering	WAH	Yes	No	No	Yes	N/A
12	Elim	WAH	Yes	No	No	Yes	N/A
13	Evansville	SUB	Yes	Yes	Yes	No	Koyukuk River
14	Fairbanks	WAH	No	No	No	Yes	N/A
15	Galena	SUB/WAH	No	Yes	Yes	Yes	Yukon River
16	Golovin	WAH	Yes	No	No	Yes	N/A
17	Hughes	SUB/WAH	Yes	Yes	Yes	Yes	Koyukuk River
18	Huslia	SUB/WAH	Yes	No	No	Yes	Koyukuk River
19	Kaltag	WAH	No	No	No	Yes	N/A
20	Kiana	SUB/WAH	No	Yes	Yes	Yes	Kobuk River
21	Kivalina	WAH	Yes	No	No	Yes	N/A
22	Kobuk	SUB/WAH	Yes	Yes	Yes	Yes	Kobuk River
23	Kotlik	WAH	No	No	No	Yes	N/A
24	Kotzebue	SUB/WAH	No	No	Yes	Yes	Kotzebue Sound
25	Koyuk	WAH	Yes	No	No	Yes	N/A
26	Koyukuk	WAH	No	No	No	Yes	N/A
27	Livengood	SUB	Yes	No	No	No	Yukon River

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAHWG	Subsistence study community study region
28	Manley Hot Springs	SUB	Yes	No	Yes	No	Tanana River
29	Minto	SUB	Yes	No	Yes	No	Tanana River
30	Nenana	SUB	No	No	Yes	No	Tanana River
31	Noatak	SUB/WAH	No	No	Yes	Yes	Kotzebue Sound
32	Nome	WAH	No	No	No	Yes	N/A
33	Noorvik	SUB/WAH	No	No	Yes	Yes	Kobuk River
34	Nuiqsut	WAH	No	No	No	Yes	N/A
35	Nulato	WAH	No	No	No	Yes	N/A
36	Point Hope	WAH	No	No	No	Yes	N/A
37	Point Lay	WAH	No	No	No	Yes	N/A
38	Rampart	SUB	Yes	Yes	Yes	No	Yukon River
39	Selawik	SUB/WAH	No	Yes	Yes	Yes	Kotzebue Sound
40	Shaktoolik	WAH	No	No	No	Yes	N/A
41	Shishmaref	WAH	No	No	No	Yes	N/A
42	Shungnak	SUB/WAH	Yes	Yes	Yes	Yes	Kobuk River
43	St. Michael	WAH	No	No	No	Yes	N/A
44	Stebbins	WAH	No	No	No	Yes	N/A
45	Stevens Village	SUB	Yes	Yes	Yes	No	Yukon River
46	Tanana	SUB	Yes	Yes	Yes	No	Tanana River
47	Teller	WAH	No	No	No	Yes	N/A
48	Unalakleet	WAH	No	No	No	Yes	N/A
49	Utqiagvik	WAH	No	No	No	Yes	N/A
50	Wainwright	WAH	No	No	No	Yes	N/A
51	Wales	WAH	No	No	No	Yes	N/A
52	White Mountain	WAH	Yes	No	No	Yes	N/A
53	Wiseman	SUB/WAH	Yes	Yes	Yes	Yes	Koyukuk River

Note: SUB = Subsistence Study Community; WAH = Western Arctic Caribou Herd Working Group Study Community; WAHWG = Western Arctic Caribou Herd Working Group

3. Subsistence Definition and Regulatory Setting

Subsistence uses are central to the customs and traditions of indigenous peoples in Alaska. Subsistence customs and traditions encompass processing, sharing networks, cooperative and individual hunting, fishing, gathering, and ceremonial activities. These activities are guided by traditional knowledge based on a long-standing relationship with the environment. Both federal and state regulations define subsistence uses to include the customary and traditional uses of wild renewable resources for food, shelter, fuel, clothing, and other uses (Alaska National Interest Lands Conservation Act [ANILCA], Title VIII, Section 803, and Alaska Statute 16.05.940[33]). The Alaska Federation of Natives views subsistence to not only encompass the practices of hunting, fishing, and gathering, but as a way of life that has sustained Alaska Natives for thousands of years and a set of values associated with those practices (Alaska Federation of Natives 2012).

Subsistence fishing and hunting are traditional activities that include transmission of traditional knowledge between generations, maintain the connection of people to their land and environment, and support healthy diet and nutrition in rural communities in Alaska. The Alaska Department of Fish and Game (ADF&G) estimates that the annual wild food harvest in rural areas Interior Alaska is approximately 6.4 million pounds, or 613 pounds per person per year; and in the Arctic it is approximately 10.5 million pounds, or 516 pounds per person per year (Wolfe 2000). Subsistence harvest levels vary widely among individuals in a community, from one community to the next, and from year to year. Sharing of subsistence foods is common in rural Alaska and can exceed 80 percent of households giving or receiving resources (ADF&G 2019). The term harvest and its variants – harvesters and harvested – are used as the inclusive term to characterize the broad spectrum of subsistence activities, including hunting, fishing, trapping, and gathering.

Subsistence is part of a rural economic system called a “mixed, subsistence-market” economy, wherein families invest money into small-scale, efficient technologies to harvest wild foods (Wolfe 2000). According to Walker and Wolfe (1987), fishing and hunting for subsistence resources provides a reliable economic base for rural regions; these important activities are conducted by domestic family groups who have invested in subsistence equipment such as fish wheels, gillnets, motorized skiffs, rifles, traps, all-terrain vehicles (ATVs) and snowmachines. Subsistence is not oriented toward sales, profits, or capital accumulation (commercial market production), but is focused toward meeting the self-limiting needs of families and their extended kin and communities. Participants in this mixed economy in rural Alaska augment their subsistence production by cash employment. Cash (from activities such as commercial fishing, trapping, and/or wages from public sector employment, construction, firefighting, oil and gas industry, or other services) provides the means to purchase the equipment, supplies, and gas used in subsistence activities. The combination of subsistence and commercial-wage activities provides the economic basis for the way of life so highly valued in rural communities (Walker and Wolfe 1987).

Participation in subsistence activities promotes transmission of traditional knowledge from generation to generation and serves to maintain peoples’ connection to the physical and biological environment. The subsistence way of life encompasses cultural values such as sharing, respect for elders, respect for the environment, hard work, and humility. In addition to being culturally important, subsistence is a critical source of nutrition for residents in areas of Alaska where food prices are high. While some people earn income from employment, these and other residents rely on subsistence to sustain them throughout the year and, as noted above, use money from the cash economy to support subsistence activities. Furthermore, subsistence activities support a healthy diet and contribute to residents’ and communities’ social, spiritual, and physical well-being.

In the State of Alaska, subsistence is regulated in multiple ways including federal and state regulations and local traditions, norms, and values that guide subsistence hunting and fishing practices. The AMDIAR is located on state, federal (BLM, National Park Service [NPS], and U.S. Fish and Wildlife Service [FWS]), and private (including Native corporation) lands. The federal and state governments regulate subsistence hunting and fishing in the state under a dual-management system. The federal government recognizes subsistence priorities for rural residents on federal public lands, while Alaska considers all residents to have an equal right to hunt and fish when resource abundance and harvestable surpluses are sufficient to meet the demand for all subsistence and other uses.

The U.S. Congress adopted ANILCA recognizing that "the situation in Alaska is unique" regarding food supplies and subsistence practices. ANILCA specifies that any decision to withdraw, reserve, lease, or permit the use, occupancy, or disposition of public lands must evaluate the effects of such decisions on subsistence uses and needs (16 U.S. Code 3111–3126). In 1990, the U.S. Department of the Interior (DOI) and the U.S. Department of Agriculture established a Federal Subsistence Board to administer the Federal Subsistence Management Program (55 Federal Register 27114). The Federal Subsistence Board, under Title VIII of ANILCA and regulations at 36 Code of Federal Regulations (CFR) 242.1 and 50 CFR 100.1, recognizes and regulates subsistence practices for rural residents on federal lands. Federal regulations recognize subsistence activities based on a person's residence in Alaska, defined as either rural or nonrural. Only individuals who permanently reside outside federally designated nonrural areas are considered rural residents and qualify for subsistence harvesting on federal lands under federal subsistence regulations. Nonrural residents may harvest fish and game on most federal lands (unless these are closed to non-federally qualified subsistence uses), but these harvests occur under state regulations. The Fairbanks nonrural area is the closest nonrural area to the project area. All of the 27 subsistence study communities are located outside federal nonrural areas and therefore are qualified as subsistence users on most federal lands.

The Alaska Board of Fisheries and the Alaska Board of Game have adopted regulations enforced by the state for subsistence fishing and hunting on all state lands (except nonsubsistence areas) and waters, and private lands, including those lands conveyed to Alaska Native Claims Settlement Act (ANCSA) groups. State law is based on Alaska Statute 16 and Title 5 of the Alaska Administrative Code (AAC) (05 AAC 01, 02, 85, 92, and 99) and regulates state subsistence uses. Under Alaska law, when there is sufficient harvestable surplus to provide for all subsistence and other uses, all Alaskan residents qualify as eligible subsistence users.

The state distinguishes subsistence harvests from personal use, general hunting, sport, or commercial harvests based on where the harvest occurs and the resource being harvested, not where the harvester resides (as is the case under federal law). More specifically, state law provides for subsistence hunting and fishing regulations in areas outside the boundaries of "nonsubsistence areas," as defined in state regulations (5 AAC 99.015). According to these regulations, a nonsubsistence area is "an area or community where dependence upon subsistence is not a principal characteristic of the economy, culture, and way of life of the area or community" (5 AAC 99.016).

Activities permitted in these nonsubsistence areas include general hunting and personal use, sport, guided sport, and commercial fishing. There is no subsistence priority in these areas; therefore, no subsistence hunting or fishing regulations manage the harvest of resources. The closest state nonsubsistence area to the project is the Fairbanks Nonsubsistence Area. The entire project lies outside state nonsubsistence areas and therefore hunting and fishing on state lands in the project area may qualify as subsistence under state regulations.

4. Data Sources

Sources of subsistence data for the study communities are provided in Table 2, which shows data that can be incorporated into subsistence use area maps, tables, and figures discussed in Section 5 "Overview of Subsistence Uses." Additional data on subsistence include ethnographic studies on harvest methods, traditional knowledge studies, or subsistence studies which are specific to a geographic area or season. These sources are not shown in Table 2 because they include data which are not comparable to other comprehensive data sources within the region or because they provide qualitative information and cannot be incorporated into study maps, tables, or figures.

4.1. Harvest Data

Harvest data for the study communities are available primarily through the ADF&G, Division of Subsistence, although other agencies or entities have periodically conducted subsistence harvest studies in the region. Harvest data provide quantitative estimates of the amount of fish and game harvested by each study community, by subsistence species, in addition to household-level harvest and participation rates. They are useful for analyzing community harvests and uses (e.g., household participation and sharing) over time, for determining community harvest levels by species, and for comparing subsistence resources to one another in terms of household uses and harvests. Harvest data accuracy depends on various factors, including survey sample sizes and the accuracy of harvester recall. However, they are generally the only source of information for quantitative community-wide harvests for all resources and are collected throughout Alaska.

Table 2. Subsistence data sources for Ambler Road EIS subsistence study communities

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Alatna	(ADF&G 2019)	ALL	1983	N/D	N/D	N/D	N/D
Alatna	(ADF&G 2019)	ALL	1984	N/D	N/D	N/D	N/D
Alatna	(Andersen, Brown, Walker, and Elkin 2004a)	NSF	2002	NSF	2002	N/D	N/D
Alatna	(Andersen, Brown, Walker, and Jennings 2004b)	LLM	2001-02	LLM	2001-02	N/D	N/D
Alatna	(Andersen, Utermohle, and Brown 1998)	LLM	1997-98	LLM	1997-98	N/D	N/D
Alatna	(Andersen, Utermohle, and Brown 2000)	LLM	1998-99	LLM	1998-99	N/D	N/D
Alatna	(Andersen, Utermohle, and Jennings 2001)	LLM	1999-00	LLM	1999-00	N/D	N/D
Alatna	(Brown, Walker, and Vanek 2004)	LLM	2002-03	LLM	2002-03	N/D	N/D
Alatna	(Clark and Clark 1978)	N/D	N/D	ALL	1961-62, 1968	N/D	N/D
Alatna	(Holen, Hazell, and Koster 2012)	ALL	2011	LLM	2011	Bears, SLM, Migratory Birds, Berries	2011
Alatna	(Jones, Arundale, Moses, Nictune, Simon, Williams, William, Henzie, William, Ambrose, Williams, and Beetus 1997)	N/D	N/D	N/D	N/D	ALL	Traditional
Alatna	(Marcotte and Haynes 1985)	ALL	1982	ALL	1982	ALL	1981-1982 1981-83
Alatna	(Ristroph, Allakaket Tribal Council, and Alatna Tribal Council 2019)	N/D	N/D	N/D	N/D	ALL	Traditional
Alatna	(SRB&A Unpublished)	N/D	N/D	ALL	2006-2015	ALL	2006-2015
Alatna	(Watson 2018)	N/D	N/D	N/D	N/D	ALL	Lifetime to 2012
Alatna	(YRDFA 2008)	N/D	N/D	ALL	Historic	N/D	N/D
Allakaket	(ADF&G 2019)	ALL	1983	N/D	N/D	N/D	N/D

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Allakaket	(ADF&G 2019)	ALL	1984	N/D	N/D	N/D	N/D
Allakaket	(Andersen et al. 2004a)	NSF	2002	NSF	2002	N/D	N/D
Allakaket	(Andersen et al. 2004b)	LLM	2001-02	LLM	2001-02	N/D	N/D
Allakaket	(Andersen et al. 1998)	LLM	1997-98	LLM	1997-98	N/D	N/D
Allakaket	(Andersen et al. 2000)	LLM	1998-99	LLM	1998-99	N/D	N/D
Allakaket	(Andersen et al. 2001)	LLM	1999-00	LLM	1999-00	N/D	N/D
Allakaket	(Brown et al. 2004)	LLM	2002-03	LLM	2002-03	N/D	N/D
Allakaket	(Holen et al. 2012)	ALL	2011	LLM	2011	ALL	2011
Allakaket	(Jones et al. 1997)	N/D	N/D	N/D	N/D	ALL	Traditional
Allakaket	(Marcotte and Haynes 1985)	ALL	1982	ALL	1982	ALL	1981-1982 1981-83
Allakaket	(Ristroph et al. 2019)	N/D	N/D	N/D	N/D	ALL	Traditional
Allakaket	(SRB&A Unpublished)	N/D	N/D	ALL	2006-2016	ALL	2006-2015
Allakaket	(Watson 2018)	N/D	N/D	N/D	N/D	ALL	Lifetime to 2012
Allakaket	(YRDFA 2008)	N/D	N/D	ALL	Historic	N/D	N/D
Ambler	(ADF&G 2019)	LLM, SLM	2003	N/D	N/D	N/D	N/D
Ambler	(Anderson, Anderson, Bane, Nelson, and Towarak 1998)	N/D	N/D	ALL	1974-1975	N/D	N/D
Ambler	(Braem 2012a)	LLM, SLM	2009-10	Moose, Caribou	2009-10	N/D	N/D
Ambler	(Braem, Mikow, Wilson, and Kostick 2015)	ALL	2012	ALL	2012	ALL	2012
Ambler	(Braem, Godduhn, Mikow, Brenner, Trainor, Wilson, and Kostick 2018)	Salmon, NSF	2012-2014	N/D	N/D	N/D	N/D
Ambler	(Georgette 2000)	Birds	1997	N/D	N/D	N/D	N/D
Ambler	(Schroeder, Anderson, and Hildreth 1987)	N/D	N/D	N/D	N/D	ALL	Lifetime ca 1925-1985
Ambler	(Watson 2018)	N/D	N/D	ALL	Post-1958	ALL	Lifetime to 2016

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Anaktuvuk Pass	(Adams, Stephenson, Dale, Ahgook, and Demma 2008)	Wolves	1986-1991	N/D	N/D	N/D	N/D
Anaktuvuk Pass	(Bacon, Hepa, Brower, Pederson, Olemaun, George, and Corrigan 2009)	ALL	1996-97, 1998-99, 1999-00, 2000-01, 2001-02, 2002-03	ALL	1996-97, 1998-99, 1999-00, 2000-01, 2001-02, 2002-03	N/D	N/D
Anaktuvuk Pass	(Brower and Opie 1996)	ALL	1994-95	ALL	1994-95	N/D	N/D
Anaktuvuk Pass	(Brown, Braem, Mikow, Trainor, Slayton, Runfola, Ikuta, Kostick, McDevitt, Park, and Simon 2016)	ALL	2014	LLM, SLM, Birds	2014	ALL	2014
Anaktuvuk Pass	(Fuller and George 1999)	ALL	1992	ALL	1992	N/D	N/D
Anaktuvuk Pass	(Holen et al. 2012)	ALL	2011	LLM	2011	ALL	2011
Anaktuvuk Pass	(Pedersen 1979)	N/D	N/D	N/D	N/D	ALL	Lifetime Pre-1979
Anaktuvuk Pass	(Pedersen and Hugo 2005)	Fish	2001-02, 2002-03	Fish	2001-02, 2002-03	Fish	2001-02, 2002-03
Anaktuvuk Pass	(Pedersen and Nageak 2009)	Caribou	2006-07	Caribou	2006-07	Caribou	2006-07
Anaktuvuk Pass	(Pedersen and Opie 1991)	Caribou	1990-91	N/D	N/D	N/D	N/D
Anaktuvuk Pass	(Pedersen and Opie 1992)	Caribou	1991-92	N/D	N/D	N/D	N/D
Anaktuvuk Pass	(Pedersen and Opie 1994)	Caribou	1993-94	N/D	N/D	N/D	N/D
Anaktuvuk Pass	(Spearman, Pedersen, and Brown 1979)	N/D	N/D	ALL	General	N/D	N/D

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Anaktuvuk Pass	(SRB&A 2013)	N/D	N/D	ALL	2001-2010	ALL	2001-2010
Beaver	(Andersen and Jennings 2001)	Birds	2000	Bird	2000	N/D	N/D
Beaver	(Brown and Godduhn 2015)	N/D	N/D	N/D	N/D	Salmon*	2010
Beaver	(Holen et al. 2012)	ALL	2011	LLM	2011	ALL	2011
Beaver	(Koskey and Mull 2011)	NSF	2005	NSF	2005	N/D	N/D
Beaver	(SRB&A 2007)	N/D	N/D	ALL	1997-2006	ALL	1997-2006
Beaver	(Stevens and Maracle n.d.)	LLM, SLM	2010-11	LLM, SLM	2010-11	N/D	N/D
Beaver	(Sumida 1989)	ALL	1984-85	ALL	1985	ALL	1930-86
Beaver	(Van Lanen, Stevens, Brown, Maracle, and Koster 2012)	LLM, SLM	2008-09, 2009-10	LLM, SLM	2008-09, 2009-10	N/D	N/D
Bettles	(ADF&G 2019)	ALL	1983	N/D	N/D	N/D	N/D
Bettles	(ADF&G 2019)	ALL	1984	N/D	N/D	N/D	N/D
Bettles	(Andersen et al. 2004a)	NSF	2002	NSF	2002	N/D	N/D
Bettles	(Andersen et al. 1998)	LLM	1997-98	LLM	1997-98	N/D	N/D
Bettles	(Andersen et al. 2000)	LLM	1998-99	LLM	1998-99	N/D	N/D
Bettles	(Andersen et al. 2001)	LLM	1999-00	LLM	1999-00	N/D	N/D
Bettles	(Brown et al. 2004)	LLM	2002-03	LLM	2002-03	N/D	N/D
Bettles	(Holen et al. 2012)	ALL	2011	LLM	2011	ALL	2011
Bettles	(Marcotte and Haynes 1985)	ALL	1982	ALL	1982	ALL	1981-82 1981-83
Bettles	(SRB&A Unpublished)	N/D	N/D	ALL	2006-2016	ALL	2006-2015
Bettles	(Watson 2018)	N/D	N/D	N/D	N/D	ALL	Lifetime to 2016
Buckland	(Braem 2012a)	LLM, SLM	2009-10	LLM, SLM	2009-10	N/D	N/D
Buckland	(Braem et al. 2018)	Salmon, NSF	2012-2014	N/D	N/D	N/D	N/D
Buckland	(Georgette 2000)	Birds	1996	N/D	N/D	N/D	N/D
Buckland	(Gonzalez, Mikow, and Kostick 2018)	LLM, SLM	2016-17	LLM, SLM	2016-17	N/D	N/D

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Buckland	(Kevin Waring Associates 1992)	N/D	N/D	Beluga, Caribou, Fish	c. 1980	N/D	N/D
Buckland	(Magdanz, Smith, Braem, and Koster 2011a)	ALL	2003	N/D	N/D	N/D	N/D
Buckland	(Satterthwaite-Phillips, Christopher Krenz, Glenn Gray, and Dodd 2016)	N/D	N/D	N/D	N/D	ALL*	Lifetime to 2014
Buckland	(Schroeder et al. 1987)	N/D	N/D	N/D	N/D	ALL	Lifetime ca 1925-1985
Coldfoot	(Holen et al. 2012)	ALL	2011	N/D	N/D	ALL	2011
Coldfoot	(SRB&A Unpublished)	N/D	N/D	ALL	2005-2014	ALL	2005-2014
Evansville	(ADF&G 2019)	ALL	1983	N/D	N/D	N/D	N/D
Evansville	(ADF&G 2019)	ALL	1984	N/D	N/D	N/D	N/D
Evansville	(Andersen et al. 2004a)	NSF	2002	NSF	2002	N/D	N/D
Evansville	(Andersen et al. 1998)	LLM	1997-98	LLM	1997-98	N/D	N/D
Evansville	(Andersen et al. 2000)	LLM	1998-99	LLM	1998-99	N/D	N/D
Evansville	(Andersen et al. 2001)	LLM	1999-00	LLM	1999-00	N/D	N/D
Evansville	(Brown et al. 2004)	LLM	2002-03	LLM	2002-03	N/D	N/D
Evansville	(Holen et al. 2012)	ALL	2011	LLM	2011	ALL	2011
Evansville	(Marcotte and Haynes 1985)	ALL	1982	ALL	1982	ALL	1981-1982 1981-83
Evansville	(SRB&A Unpublished)	N/D	N/D	ALL	2006-2015	ALL	2006-2015
Evansville	(Watson 2018)	N/D	N/D	N/D	N/D	ALL	Lifetime to 2016
Galena	(ADF&G 2019)	LLM	1996 -97	N/D	N/D	N/D	N/D
Galena	(Andersen et al. 2004b)	LLM	2001-02	LLM	2001-02	N/D	N/D
Galena	(Andersen et al. 1998)	LLM	1997-98	LLM	1997-98	N/D	N/D
Galena	(Andersen et al. 2000)	LLM	1998-99	LLM	1998-99	N/D	N/D
Galena	(Andersen et al. 2001)	LLM	1999-00	LLM	1999-00	N/D	N/D
Galena	(Brown, Koester, and Koontz 2010)	NSF	2006	NSF	2006	NSF*	2006

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Galena	(Brown, Brenner, Ikuta, Mikow, Retherford, Slayton, Trainor, Park, Koster, and Kostick 2015)	All	2010	LLM, SLM, Birds	2010	ALL	2010
Galena	(Brown et al. 2004)	LLM	2002-03	LLM	2002-03	N/D	N/D
Galena	(Marcotte 1988)	ALL	1985-1986	N/D	N/D	Fish	1986
Galena	(Robert and Andrews 1984)	N/D	N/D	Furbearers	1981-82	N/D	N/D
Hughes	(Andersen et al. 2004a)	NSF	2002	NSF	2002	N/D	N/D
Hughes	(Marcotte and Haynes 1985)	ALL	1982	ALL	1982	ALL	1981-1982; 1981-83
Hughes	(Watson 2018)	N/D	N/D	N/D	N/D	ALL	Lifetime to 2016
Hughes	(Webb 1999)	Migratory Birds	1998	N/D	N/D	N/D	N/D
Hughes	(Webb and Koyukuk/Nowitna Refuge Complex (U.S.) 2000)	Migratory Birds	1998-99	N/D	N/D	N/D	N/D
Hughes	(Wilson and Kostick 2016)	ALL	2014	LLM, SLM, Birds	2014	ALL	2014
Hughes	(YRDFA 2008)	N/D	N/D	ALL	Historic	N/D	N/D
Huslia	(Andersen et al. 2004a)	NSF	2002	NSF	2002	N/D	N/D
Huslia	(Andersen et al. 2004b)	LLM	2001-02	LLM	2001-02	N/D	N/D
Huslia	(Andersen et al. 1998)	LLM	1997-98	LLM	1997-98	N/D	N/D
Huslia	(Andersen et al. 2000)	LLM	1998-99	LLM	1998-99	N/D	N/D
Huslia	(Andersen et al. 2001)	LLM	1999-00	LLM	1999-00	N/D	N/D
Huslia	(Brown et al. 2004)	LLM	2002-03	LLM	2002-03	N/D	N/D
Huslia	(Marcotte 1986)	ALL	1983	ALL	1983	ALL	1981-83
Huslia	(Watson 2018)	N/D	N/D	N/D	N/D	ALL	Lifetime to 2016
Kiana	(ADF&G 2019)	LLM, SLM	1999	N/D	N/D	N/D	N/D
Kiana	(Anderson et al. 1998)	N/D	N/D	ALL	1974-1975	N/D	N/D
Kiana	(Braem 2012a)	LLM, SLM	2009-10	Moose, Caribou	2009-10	N/D	N/D

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Kiana	(Braem et al. 2018)	Salmon, NSF	2012-2014	N/D	N/D	N/D	N/D
Kiana	(Georgette 2000)	Birds	1996	N/D	N/D	N/D	N/D
Kiana	(Magdanz, Koster, Naves, and Fox 2011b)	ALL	2006	N/D	N/D	N/D	N/D
Kiana	(Magdanz et al. 2011a)	Fish	1994-2004	N/D	N/D	N/D	N/D
Kiana	(Schroeder et al. 1987)	N/D	N/D	N/D	N/D	ALL	Lifetime ca. 1925-1986
Kiana	(Wolfe and Paige 1995)	Birds	1993	N/D	N/D	N/D	N/D
Kobuk	(ADF&G 2019)	LLM, SLM	2004	N/D	N/D	N/D	N/D
Kobuk	(Anderson et al. 1998)	N/D	N/D	ALL	1974-1975	N/D	N/D
Kobuk	(Braem 2012a)	LLM, SLM	2009-10	Moose, Caribou	2009-10	N/D	N/D
Kobuk	(Braem et al. 2015)	ALL	2012	ALL	ca. 2012	ALL	2012
Kobuk	(Braem et al. 2018)	Salmon, NSF	2012-2014	N/D	N/D	N/D	N/D
Kobuk	(Georgette 2000)	Birds	1996-1997	N/D	N/D	N/D	N/D
Kobuk	(Magdanz et al. 2011a)	Fish	1994-2004	N/D	N/D	N/D	N/D
Kobuk	(Schroeder et al. 1987)	N/D	N/D	N/D	N/D	ALL	Lifetime ca. 1925-1985
Kobuk	(Watson 2018)	N/D	N/D	N/D	N/D	ALL	Lifetime to 2016
Kotzebue	(Braem, Mikow, Brenner, Godduhn, Retherford, and Kostick 2017)	ALL	2014	LLM, SLM, Birds	2014	ALL	2014
Kotzebue	(Georgette and Loon 1993)	ALL	1986	ALL	1986	N/D	N/D
Kotzebue	(Georgette 2000)	Birds	1997	N/D	N/D	N/D	N/D
Kotzebue	(Godduhn, Braem, and Kostick 2014)	LLM, SLM	2012 - 2013	N/D	N/D	N/D	N/D
Kotzebue	(Magdanz, Georgette, and Evak 1995)	ALL	1991	N/D	N/D	N/D	N/D
Kotzebue	(Mikow and Kostick 2016)	LLM, SLM	2013 - 2014	N/D	N/D	N/D	N/D

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Kotzebue	(Naves and Braem 2014)	Birds	2012	N/D	N/D	N/D	N/D
Kotzebue	(Satterthwaite-Phillips et al. 2016)	N/D	N/D	N/D	N/D	ALL*	Lifetime to 2014
Kotzebue	(Whiting 2006)	ALL	2002-2004	N/D	N/D	N/D	N/D
Manley Hot Springs	(ADF&G 2019)	LLM, Fish	2004	N/D	N/D	N/D	N/D
Manley Hot Springs	(Betts 1997)	N/D	N/D	ALL	General	ALL	1975-1995
Manley Hot Springs	(Brown, Slayton, Trainor, Koster, and Kostick 2014)	ALL	2012	N/D	N/D	ALL	2012
Minto	(ADF&G 2019)	LLM, SLM, NSF	2004	N/D	N/D	N/D	N/D
Minto	(Andrews 1988)	ALL	1983-84	ALL	1960-84	ALL	1960-84
Minto	(Andrews and Napoleon 1985)	N/D	N/D	N/D	N/D	Moose	1960-85
Minto	(Brown et al. 2014)	ALL	2012	N/D	N/D	ALL	2012
Minto	(Marcotte and Haynes 1985)	NSF	1994	N/D	N/D	N/D	N/D
Minto	(SRB&A Unpublished)	N/D	N/D	ALL	2006-2015	ALL	2006-2015
Nenana	(ADF&G 2019)	NSF, LLM, SLM	2004	N/D	N/D	N/D	N/D
Noatak	(ADF&G 2019)	ALL	1994	N/D	N/D	N/D	N/D
Noatak	(ADF&G 2019)	LLM, SLM	1999	N/D	N/D	N/D	N/D
Noatak	(ADF&G 2019)	LLM, SLM	2002	N/D	N/D	N/D	N/D
Noatak	(Braem and Kostick 2014)	LLM, SLM	2010-11	Caribou	2010-11	N/D	N/D
Noatak	(Braem et al. 2018)	Salmon, NSF	2012-2014	N/D	N/D	N/D	N/D
Noatak	(Georgette 2000)	Birds	1997	N/D	N/D	N/D	N/D
Noatak	(Magdanz, Braem, Robbins, and Koster 2010)	ALL	2007	N/D	N/D	ALL	2007
Noatak	(Mikow, Braem, and Kostick 2014)	LLM, SLM	2011-12	Caribou	2011-12	N/D	N/D
Noatak	(Satterthwaite-Phillips et al. 2016)	N/D	N/D	N/D	N/D	ALL*	Lifetime to 2014
Noatak	(SRB&A 2009)	N/D	N/D	ALL	1998-2007	ALL	1998-2007

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Noatak	(Schroeder et al. 1987)	N/D	N/D	N/D	N/D	ALL	Lifetime ca 1925-1985
Noorvik	(ADF&G 2019)	LLM, SLM	2002	N/D	N/D	N/D	N/D
Noorvik	(Anderson et al. 1998)			ALL	1974-1975	N/D	N/D
Noorvik	(Braem 2012b)	LLM, SLM	2008-09	LLM, SLM	2008-09	N/D	N/D
Noorvik	(Braem et al. 2017)	ALL	2012	LLM, SLM, Birds	2012	ALL	2012
Noorvik	(Braem et al. 2018)	Salmon, NSF	2013-2014	N/D	N/D	N/D	N/D
Noorvik	(Georgette 2000)	Birds	1996	N/D	N/D	N/D	N/D
Noorvik	(Satterthwaite-Phillips et al. 2016)	N/D	N/D	N/D	N/D	ALL*	Lifetime to 2014
Noorvik	(Schroeder et al. 1987)	N/D	N/D	N/D	N/D	ALL	Lifetime ca 1925-1985
Shungnak	(Andersen and Jennings 2001)	Birds	2000	Birds	2000	N/D	N/D
Shungnak	(Braem 2012b)	LLM, SLM	2008-09	Caribou	2008-09	N/D	N/D
Shungnak	(Braem et al. 2015)	ALL	2012	ALL	ca. 2012	ALL	2012
Shungnak	(Braem et al. 2018)	Salmon, NSF	2013-2014	N/D	N/D	N/D	N/D
Shungnak	(Magdanz, Walker, and Paciorek 2004)	ALL	2002	N/D	N/D	N/D	N/D
Shungnak	(Schroeder et al. 1987)	N/D	N/D	N/D	N/D	ALL	Lifetime ca 1925-1985
Shungnak	(Watson 2018)	N/D	N/D	ALL	pre-1958	ALL	Lifetime to 2016
Shungnak	(Wolfe and Paige 1995)	Birds	1993	N/D	N/D	N/D	N/D
Stevens Village	(ADF&G 2019)	LLM	1996	N/D	N/D	N/D	N/D
Stevens Village	(Brown et al. 2016)	ALL	2014	SLM, Birds	2014	N/D	N/D
Stevens Village	(SRB&A Unpublished)	N/D	N/D	ALL	2006-2015	ALL	2006-2015

Community	Source	Harvest data resource	Harvest data time period	Timing of subsistence resource	Timing of subsistence time period	Use areas resource	Use area time period
Stevens Village	(Stevens and Maracle n.d.)	LLM, SLM	2010-11	LLM, SLM	2010-11	N/D	N/D
Stevens Village	(Sumida 1988)	ALL	1983-84	ALL	N/D	ALL	1974-1984
Stevens Village	(Sumida and Alexander 1985)	N/D	N/D	Selected	1984	Moose, Furbearers	1974-1984
Stevens Village	(Van Lanen et al. 2012)	LLM, SLM	2008-09, 2009-10	LLM, SLM	2008-09, 2009-10	N/D	N/D
Stevens Village	(Wolfe and Scott 2010)	LLM, Fish	2008	N/D	N/D	N/D	N/D
Tanana	(Andersen et al. 1998)	LLM	1997-98	LLM	1997-98	N/D	N/D
Tanana	(Andersen et al. 2000)	LLM	1998-99	LLM	1998-99	N/D	N/D
Tanana	(Andersen et al. 2001)	LLM	1999-00	LLM	1999-00	N/D	N/D
Tanana	(Brown et al. 2010)	NSF	2006	NSF	2006	NSF	2006
Tanana	(Brown et al. 2016)	ALL	2014	LLM, SLM, Birds	2014	ALL	2014
Tanana	(Brown et al. 2004)	LLM	2002-03	LLM	2002-03	N/D	N/D
Tanana	(Case and Halpin 1990)	ALL	1987	ALL	1987	ALL	1968-1988
Tanana	(Wolfe and Scott 2010)	ALL	2008	N/D	N/D	N/D	N/D
Wiseman	(Holen et al. 2012)	ALL	2011	LLM	2011	ALL	2011
Wiseman	(Scott 1998)	ALL	1991	ALL		ALL	1992
Wiseman	(SRB&A Unpublished)	N/D	N/D	ALL	2006-2015	ALL	2006-2015

Notes: ca = circa; LLM = Large land mammals; N/D = No data; ALL = All resources/comprehensive; NSF = Non-salmon fish; SLM = Small land mammals
SRB&A requested these use area data for use in the Ambler Road EIS, but the data were either unavailable or not provided to SRB&A.

4.1.1 Subsistence Use Area and Travel Method Data

Subsistence use area data primarily measure the geographic extent of residents' use of their environment to harvest subsistence resources. There are various methods of representing subsistence use area data. The most common method is to show the outline of the extent of a community's use area during a certain time period. This method does not differentiate between areas used periodically or by one harvester and areas used by multiple harvesters on a regular basis. Another method is to track harvesters' activities using global positioning system (GPS) units and are the most accurate method for documenting residents' travel during a specific time period; however, such studies are not available for the study region and may underrepresent a community's traditional use areas due to the narrow temporal and spatial focus. A third method maps subsistence use areas on separate overlays during individual interviews with active harvesters and creates subsistence use area maps differentiating between areas where a small number of individuals reported using the area and areas where a higher number of individuals reported using the area. Alternatively, the maps may differentiate between areas where a high number of subsistence use areas or target resources were reported, versus areas where a low number of subsistence use areas or target resources were reported. This method provides a measure of harvest effort in terms of the number of respondents reporting subsistence activities within geographic areas and, in the case of multiple resource maps, includes the number of species targeted. The overlapping use area method does not represent harvest success or intensity of use in terms of frequency or duration of trips. It also generally does not represent all harvesters in the community, but rather a subset of harvesters systematically selected as particularly active and knowledgeable subsistence users. Subsistence mapping studies are also the most common source of information for characterizing travel methods used to access subsistence use areas; however, this type of information not always documented for all studies.

4.2. Timing of Subsistence Activities Data

Data on the timing of subsistence activities are available through various types of research including harvest studies (i.e., number harvested by month), subsistence mapping studies (i.e., months by use area, number of trips by month), and ethnographic studies (e.g., generalized depictions or narrative descriptions of subsistence activities by month or season). Data on the timing of subsistence activities are useful for characterizing a community's seasonal round, their use of the land, and for analyzing potential impacts based on the timing of subsistence activities in the context of the timing of development activities.

4.3. Resource Importance Data

Subsistence has both material/economic significance as well as cultural importance. This technical report chose several key subsistence indicators as measures of "Resource Importance" including harvest amount, sharing, and participation. The study team chose these indicators because they are available in a majority of subsistence harvest studies to allow for the measuring of change over time and/or they encompass a broad range of subsistence characteristics including material harvest, effort, and sharing. Measures of material and cultural importance are established through the use of available quantitative measures. While all subsistence activities and resources are of high importance to a community, the importance of individual resources relative to one another varies according to material and cultural measures. The ADF&G Division of Subsistence and Stephen R. Braund & Associates (SRB&A) subsistence studies have systematically collected community harvest and use data in Alaska since the 1980s. These data allow for the quantitative measurement of certain aspects of cultural and material importance of subsistence resources used in this analysis.

Resource Importance, as discussed in this report, is organized around 14 resource categories rather than at a species level, which number in the hundreds. Resource categories are based on species groupings such as salmon, non-salmon fish, berries, and small land mammals/furbearers; in some cases, single species represent their own resource category (e.g., caribou). The list of 14 resource categories are as follows (Table 3):

Table 3. Resource categories for subsistence impact analysis

Resource category number	Resource	Example species
1	Moose	N/A
2	Caribou	N/A
3	Dall sheep	N/A
4	Bear	Black and brown bear
5	Other large land mammals	Goat, elk, bison, deer
6	Small land mammals furbearers	Hare, fox, porcupine, wolf
7	Marine mammals	Bowhead, bearded seal, walrus
8	Migratory birds	Ducks, geese, crane
9	Upland birds	Grouse, ptarmigan
10	Bird eggs	Gull eggs, duck eggs
11	Salmon	Chinook, sockeye, coho
12	Non-salmon fish	Grayling, trout, sheefish, whitefish
13	Marine invertebrates	Clams, cockles, shrimp
14	Vegetation	Blueberries, cranberries, tundra tea, firewood

Note: N/A = Not applicable

In this analysis, material importance is quantitatively measured in terms of a resource's contribution toward each community's total subsistence harvest (i.e., edible pounds for each resource divided by the total edible pounds for all resources [percent of total harvest]). ADF&G data that can be used to quantitatively measure the cultural importance of subsistence resources include data related to participation (percent of households attempting harvests of each resource) and sharing (percent of households receiving each resource). These measures were chosen as informing the cultural importance of subsistence resources because participation in subsistence activities promotes the transmission of skills from generation to generation, and sharing of subsistence resources between households strengthens community cohesion in the region. Furthermore, both participation and sharing are key to the cultural identity of community members.

The ranges for material importance were developed based on the fact that all resource categories contribute to a cumulative 100 percent of harvest. Because many subsistence communities rely on a diverse resource base from which they harvest, it is not unusual for the top contributing resource categories to only contribute in the teens to lower 20 percent of harvest. Thus, the ranges for material importance below in Table 4 allow for all study communities to have a high, moderate, and low resources, and they reflect the nature of subsistence harvests across an often diverse resource base where few resource categories represent a high percentage of the total community harvest.

The ranges for cultural importance are specific to each community's unique behavior of attempting to harvest and receiving. This community-centric approach, where every community's ranges are defined based on that community's unique set of data, takes into account cultural variation between communities and between the way certain resources are harvested. Whereas, a community's harvest (material importance) will always total 100 percent, the cultural measures of importance are unique to each community and may exhibit a wide range of variation depending on the community's cultural and environmental setting (e.g., proximity to urban areas, regulatory restrictions, proximity to resources). For each variable by community, a range is determined by subtracting the lowest percentage of households within each variable (e.g., attempting to harvest) from the highest percentage of the same variable (e.g., 100-40 = 60). That range (e.g., 60) is then divided into thirds in order to determine the high, moderate, and low ranges (e.g., Low = 40–60; Moderate = 60–80; High = 80–100). As an example, in one community, the range of households trying to harvest different resources may be 20–50 percent, whereas in a second community it may be as high as 40–100 percent. Reasons for these differences may include work commitments, geographic and climatic restraints, urban disruption, or regulatory environment which limit or facilitate the opportunities for attempting to harvest. A community-centric approach takes into account the unique community range in both examples above, standardizing the high range to 40–50 percent for the first community and 80-100 percent for the second community.

Table 4. List of quantitative measures for material importance

Importance category / Quantitative measure	High (H)	Moderate (M)	Low (L)
Material importance % of total harvest (in pounds)	H $\geq$20%	20%> M $\geq$2%	L <2%

For the final determination as a high, moderate, or low resource of importance the top value from the three variables of percent of total harvest, percent of households attempting to harvest, and percent of households receiving is selected as the final classification of importance. For example, moose may represent 15 percent of total harvest (moderate), top third of households attempting to harvest (high), and bottom third in receiving (low). The final selection ranks moose overall as a resource of high importance in this example due to the cultural importance of participation and attempting to harvest. Lastly, if no harvest data exist for a particular resource, the final selection ranks that resource importance as "Indeterminate."

This analysis, while reflecting one method of quantitatively measuring the importance of subsistence resources, does not take into account a multitude of factors for which quantitative data do not exist (e.g., spirituality, ethics and values, ideologies, identities, celebration and ceremonies). Rankings of resources under high, moderate, and low importance should be viewed only in terms of the indicators presented here and not in terms of overall importance. Subsistence harvesters in the study communities routinely view all of the resources they harvest during their seasonal cycle of availability as important to their community and/or individual health and cultural identity. To take into account the aspects of subsistence such as spirituality, values, and identity that could be impacted and which are not easily characterized by quantitative data, the Project relies on the traditional knowledge and concerns identified in the scoping comments for this Project in both assessing impacts and providing potential mitigation measures and other potential strategies to minimize construction and operational impacts on resources and subsistence harvesters.

5. Overview of Subsistence Uses

5.1. Kobuk River

The Kobuk River region includes the communities of Ambler, Kiana, Kobuk, Noorvik, and Shungnak. Of these communities, Kobuk and Shungnak are closest to the proposed road corridors, followed by Ambler, Kiana, and Noorvik, which are located on the Kobuk River at varying distances downstream from the project corridors.

5.1.1 Subsistence Use Areas

Subsistence use areas for the Kobuk River region study communities are focused around the Kobuk River, but extending both south toward the Koyukuk River drainage and north into the Brooks Range and as far as the North Slope of Alaska. Residents' subsistence uses also extend downriver and into the marine waters of Kotzebue Sound and the Chukchi Sea. More recently documented subsistence use areas (Watson 2018; Satterthwaite-Phillips et al. 2016) indicate a smaller extent of overland travel. In particular, recent studies show less extensive travel to the north of the study communities into the Brooks Range and onto the North Slope. Watson (2018) discusses that some of the shifts in use areas may reflect changes in migratory routes of the WAH; changes in traditional hunting methods to avoid diverting caribou during their fall migration (thereby hunting them farther south); decreased need for extensive overland travel (e.g., less reliance on furbearer trapping); and increased reliance on fish resources (thus greater focus on riverine use areas). Except for Noorvik, subsistence use areas for Kobuk River region study communities overlap with the western portion of the project alternatives.

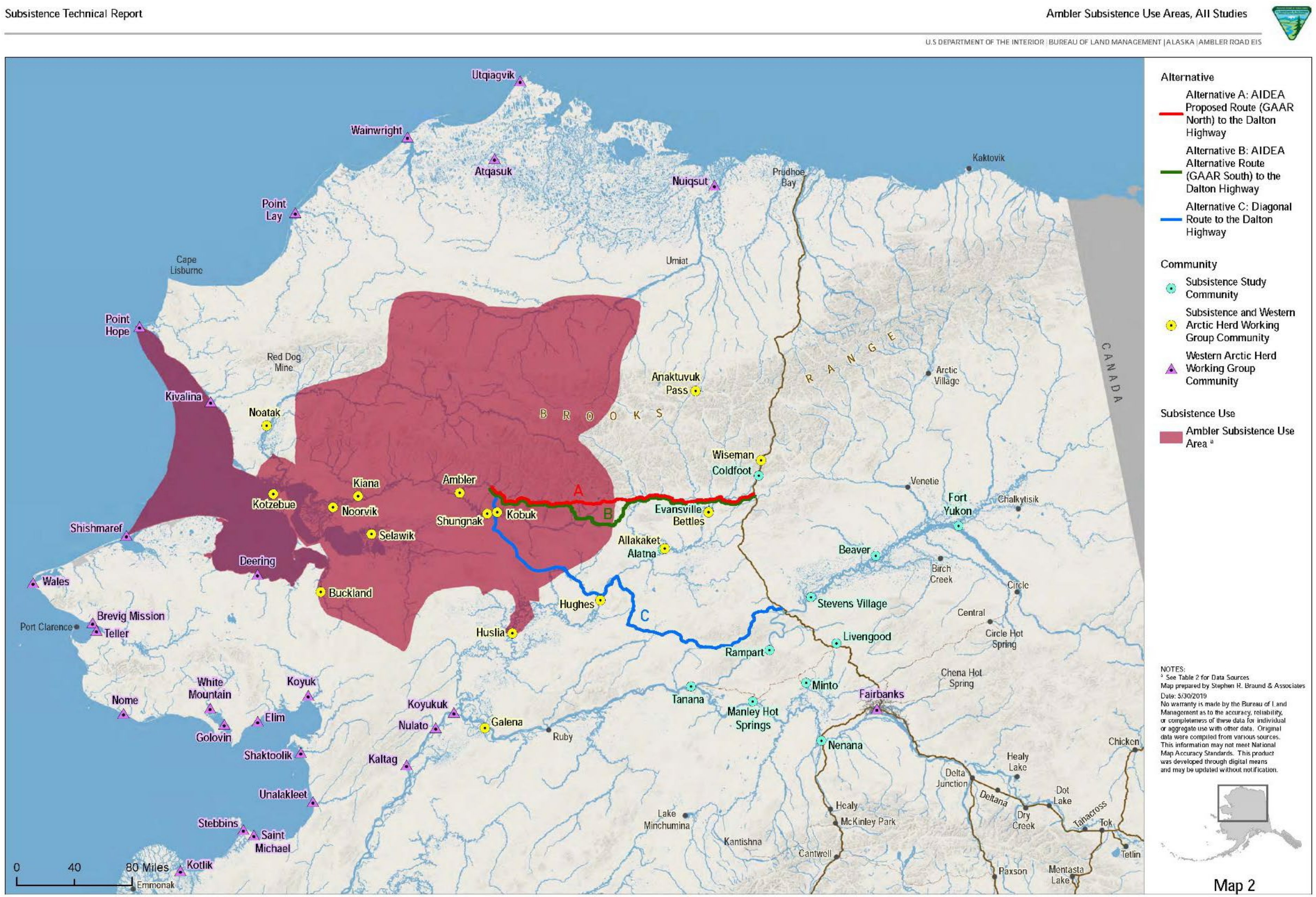
As shown on Map 2, Ambler subsistence use areas for all available time periods extend west to the Chukchi Sea and Kotzebue Sound; north through the Brooks Range onto the North Slope surrounding the headwaters of the Colville River; east to the headwaters of the Kobuk River; and south toward Buckland and Huslia. Recent subsistence use areas documented for Ambler (Watson 2018) indicate that the contemporary subsistence use area of Ambler is somewhat smaller in that use areas do not extend as far north into the Brooks Range. Contemporary use areas are focused around the Kobuk and Ambler rivers, north into the southern foothills of the Brooks Range, and south toward the Selawik and Koyukuk rivers. Based on Watson (2018), contemporary caribou hunting generally occurs along the Kobuk and Ambler rivers and in a large overland area south of the community toward Selawik River and Huslia. Moose hunting occurs in a similar area but with less extensive overland use. Furbearer trapping occurs in an overland area focused along the mid- to upper-Kobuk River and south toward Huslia and the Selawik River. Contemporary fishing occurs in a more extensive area than historic fishing and indicates a shift away from lakes toward rivers. Salmon and non-salmon fishing areas extend from Kotzebue Sound to the headwaters of the Kobuk River, along the Selawik area, and in the Koyukuk River drainage. Waterfowl hunting occurs over a similar area as fishing, focused along the entirety of the Kobuk River and in some overland areas both north and south of the river. Marine mammal hunting occurs downriver from Ambler into Kotzebue Sound. Contemporary berry harvesting areas extend along the Kobuk River and in a large overland area to the east, northeast, and southeast of the community, although respondents indicated that their primary berry harvesting areas are located closer to the community of Ambler.

As shown on Map 3, Kiana use areas occur in a large area extending along the Kobuk River, north into the Brooks Range and the headwaters of the Colville River, south toward Buckland, and west into Kotzebue Sound and along the Chukchi Sea coast. Kiana use areas are only available from Schroeder et al. (1987), which depict lifetime use areas for the period circa 1925–1986. More recent use areas are not available.

Kobuk subsistence use areas (Map 4) extend along the entire Kobuk River drainage to Norutak Lake, north into the Brooks Range, west into Kotzebue Sound, and south to an area surrounding Selawik Lake and River. Contemporary subsistence use areas as shown in Watson (2018) occur over a similar area but with lesser use to the north of the community into the Brooks Range and a greater focus along river drainages rather than large overland areas. Contemporary caribou hunting occurs in the upper Kobuk River, southern Brooks Range, and overland toward Buckland and the Dakli River. Moose hunting is focused solely long the Kobuk River upriver from Shungnak, in addition to a small overland area extending toward the Ambler River. Contemporary trapping is focused in a smaller area than historic trapping areas and occurs in an area near the Kobuk River and north toward the Ambler River. Fishing and waterfowl hunting both occur in a similar area which is focused along the Kobuk River upriver from Shungnak to Pah River. Contemporary marine mammal use areas occur within Kotzebue Sound, with the entire Kobuk River used for travel to those hunting areas. Finally, contemporary vegetation harvesting areas for Kobuk occur along the entire Kobuk River drainage downriver to the Kotzebue area.

Shungnak use areas (Map 6) for all time periods occur over a large area extending from the Colville River in the north to Buckland and Huslia in the south, west into Kotzebue Sound, and east to the headwaters of the Kobuk River. Contemporary use areas for Buckland as shown in Watson (2018) continue to occur in a large overland area which extends north into the Brooks Range although not as far as the North Slope. Contemporary use areas extend south to Buckland and Huslia but are primarily focused on the Kobuk River, Brooks Range to Noatak River, and south to Selawik River. Unlike other Kobuk River study communities, contemporary Shungnak use areas do not extend to marine areas in Kotzebue Sound. Caribou hunting generally occurs over a larger area than other resource pursuits, extending to the Noatak River in the north and the Buckland and Huslia areas in the south in addition to the mid- to upper-Kobuk River drainage. Moose hunting focuses along river drainages including the Ambler and Kobuk rivers. Sheep hunting extends north of the community of Shungnak into the Brooks Range as far as the Noatak River while trapping occurs in overland areas both north and south of the Kobuk River. Waterfowl hunting occurs along the Kobuk River and tributaries in addition to lakes and overland areas south of the community toward the Selawik and Dakli rivers. Similar to Ambler and Kobuk, Shungnak fishing areas have shifted from lake-focused fishing to fishing along the Kobuk River. Vegetation harvesting occurs relatively close to the community of Shungnak along the Kobuk River between Shungnak and Kobuk.

Noorvik is the only study community in the Kobuk River region whose use areas do not overlap directly with the project area; however, use areas for this community occur directly downriver from the project area on the Kobuk River and near Shungnak. As shown on Map 5, Noorvik subsistence use areas for all time periods extend from the Chukchi Sea as far as Point Hope and throughout Kotzebue Sound; north into the Brooks Range and as far as the upper Colville River; south toward Buckland and surrounding Selawik River, and east to Shungnak. According to Satterthwaite-Phillips et al. (2016), more recently documented subsistence use areas for the community of Noorvik indicate a shift to the south, with use areas focused along the Kobuk River, Kotzebue Sound, and south in overland areas near Buckland and Deering. Noorvik use areas for small game and large game extend along the Kobuk River near Ambler but with more intensive focus around the mouth of the Kobuk River and to the southwest of the community toward Deering and Buckland. Other resource pursuits, including plant gathering, bird hunting, and fishing, also focus around the lower Kobuk River and to the southwest of the community near Buckland and Deering. Fishing also occurs with great intensity in Kotzebue Sound and near the mouth of Selawik Lake (Satterthwaite-Phillips et al. 2016).



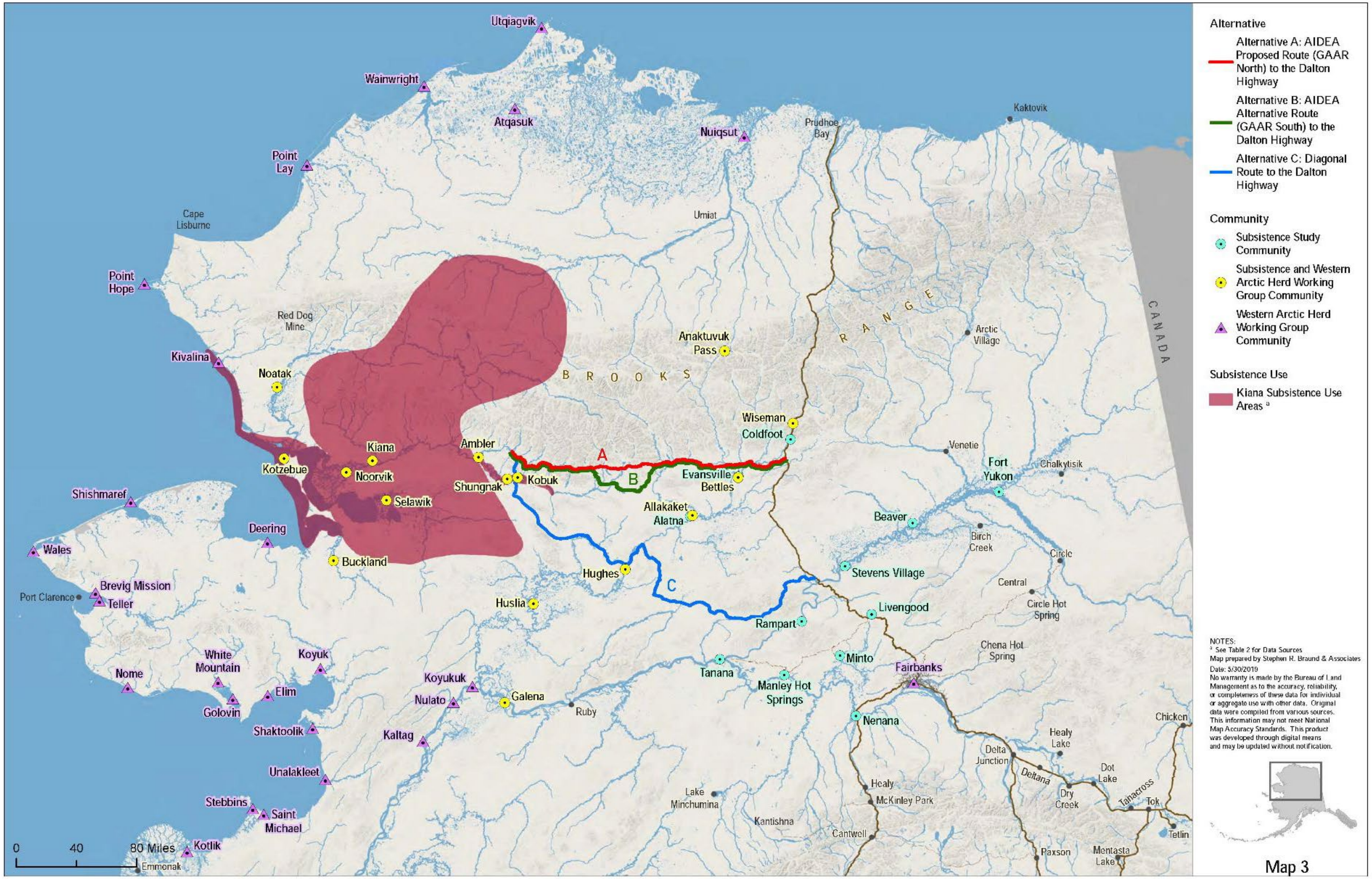
Map 2. Ambler subsistence use areas, all studies

This page is intentionally left blank.

Subsistence Technical Report

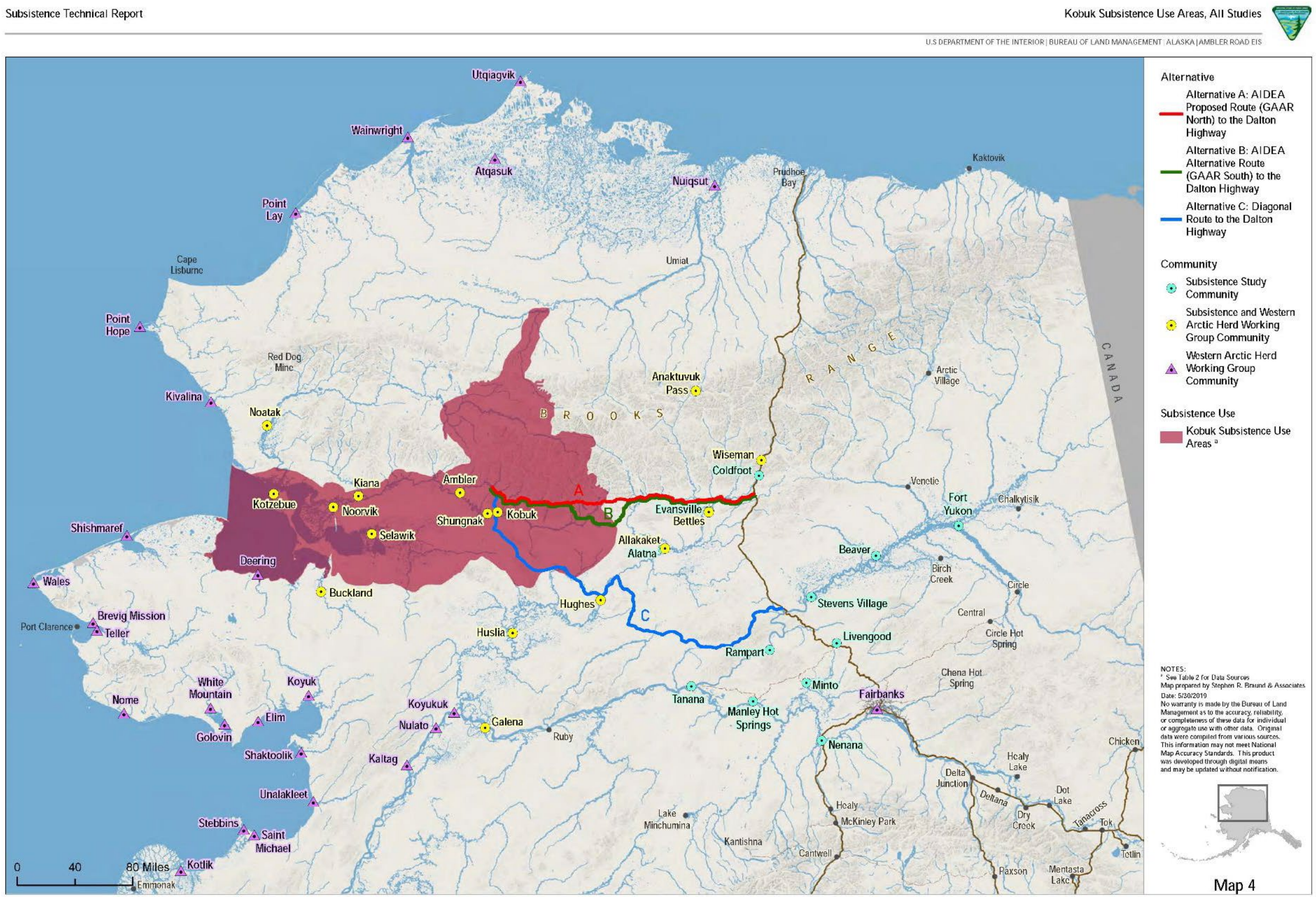
Kiana Subsistence Use Areas, All Studies

U.S DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | AMBLER ROAD EIS



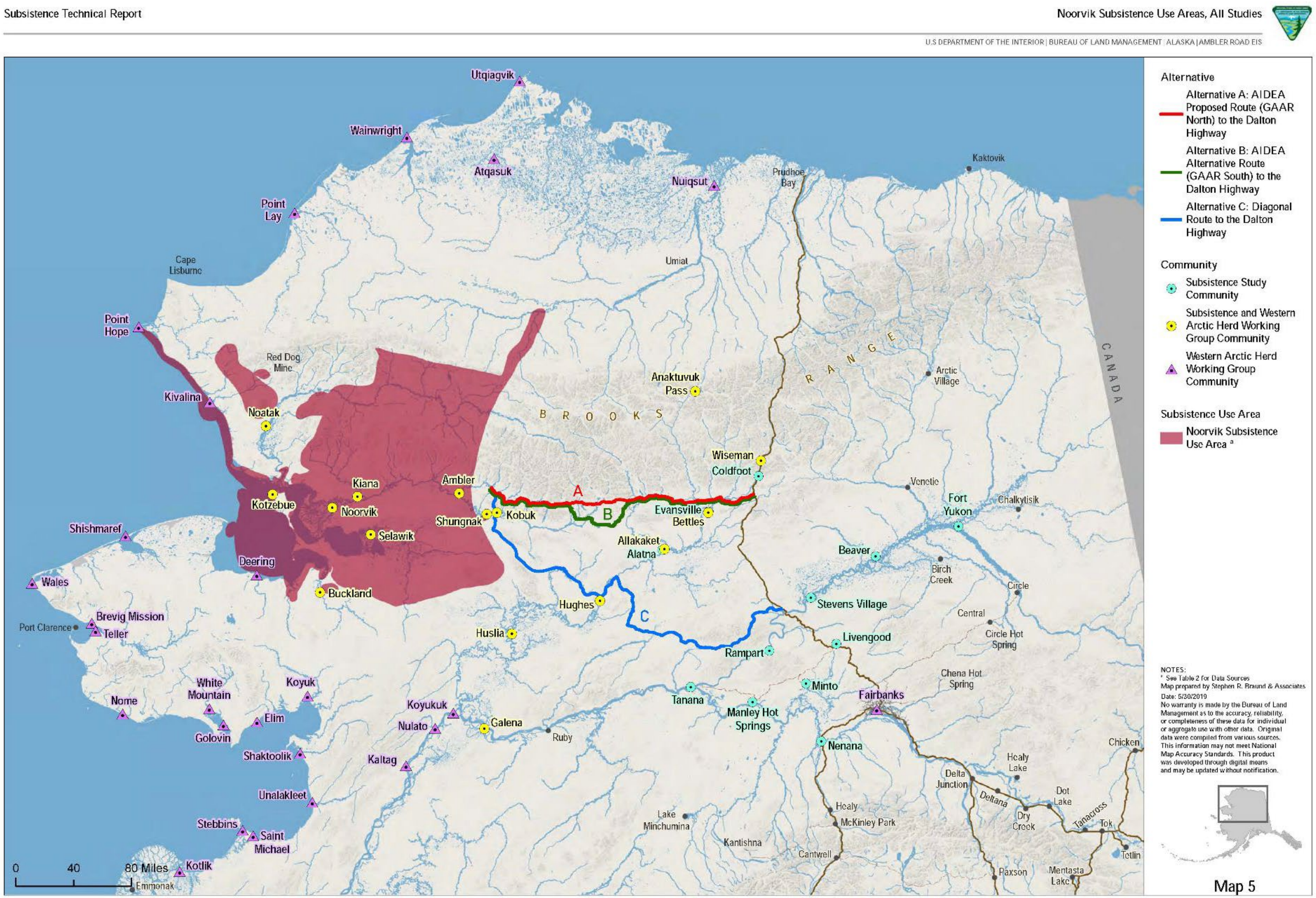
Map 3. Kiana subsistence use areas, all studies

This page is intentionally left blank.



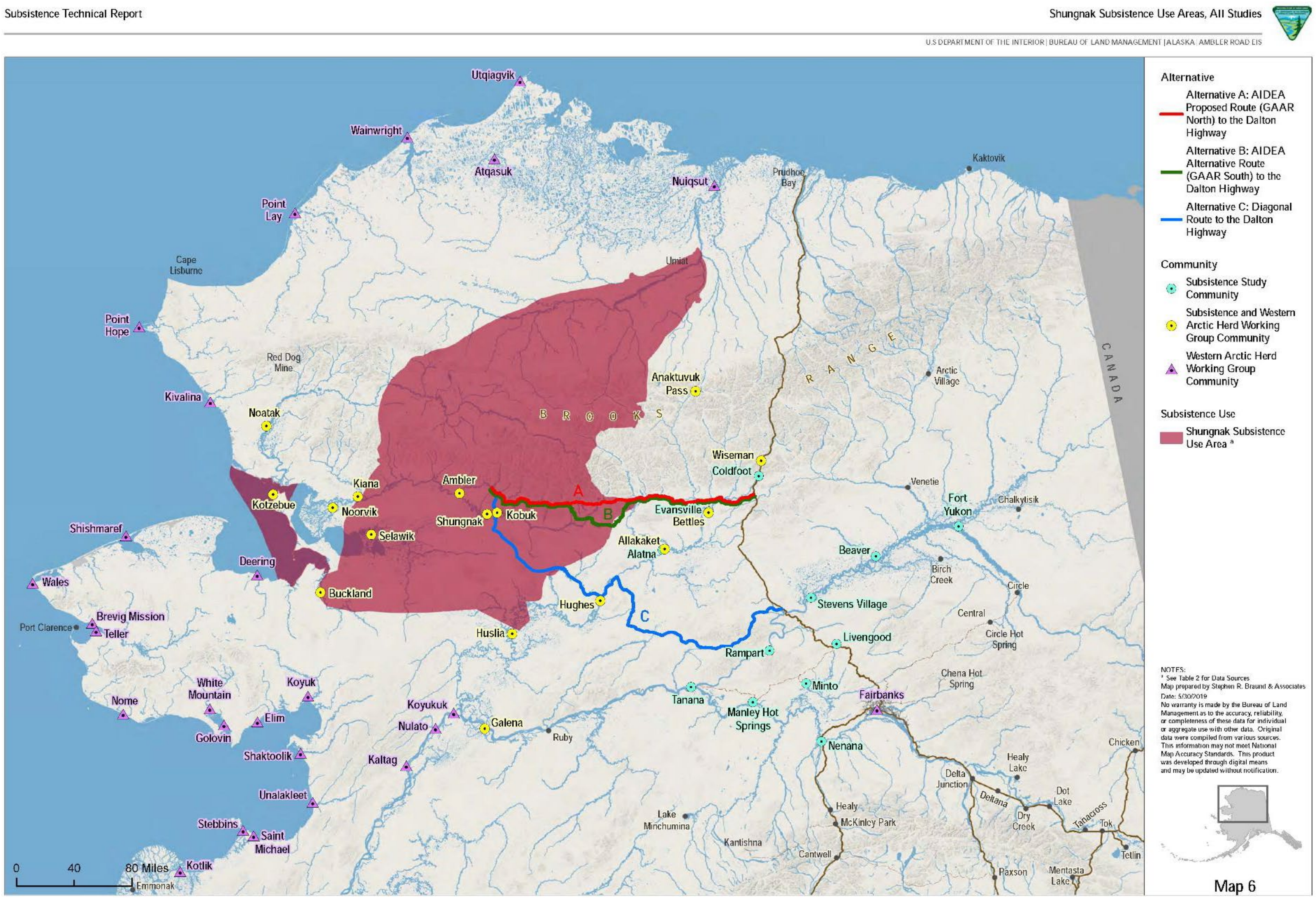
Map 4. Kobuk subsistence use areas, all studies

This page is intentionally left blank.



Map 5. Noorvik subsistence use areas, all studies

This page is intentionally left blank.



Map 6. Shungnak subsistence use areas, all studies

This page is intentionally left blank.

5.1.2 Harvest Data

Harvest data for the Kobuk River study communities are provided on Figure 1 through Figure 3 and in Table 5. As shown on Figure 1, based on an average of available data, caribou is the primary resource harvested among the study communities in terms of percentage of usable pounds (39 percent), followed by non-salmon fish (31 percent), and salmon (18 percent). Other resources which contribute smaller amounts in terms of pounds include moose, vegetation, migratory birds, small land mammals/furbearers, and marine mammals. Resource contribution varies by study community. Communities located farther downriver (Kiana and Noorvik) and closer to Kotzebue Sound show a higher reliance on marine mammals. In addition, the community of Ambler shows a higher reliance on caribou than some other communities and a lower reliance on salmon, although recent fish-only studies show higher per capita harvests of salmon for Ambler.

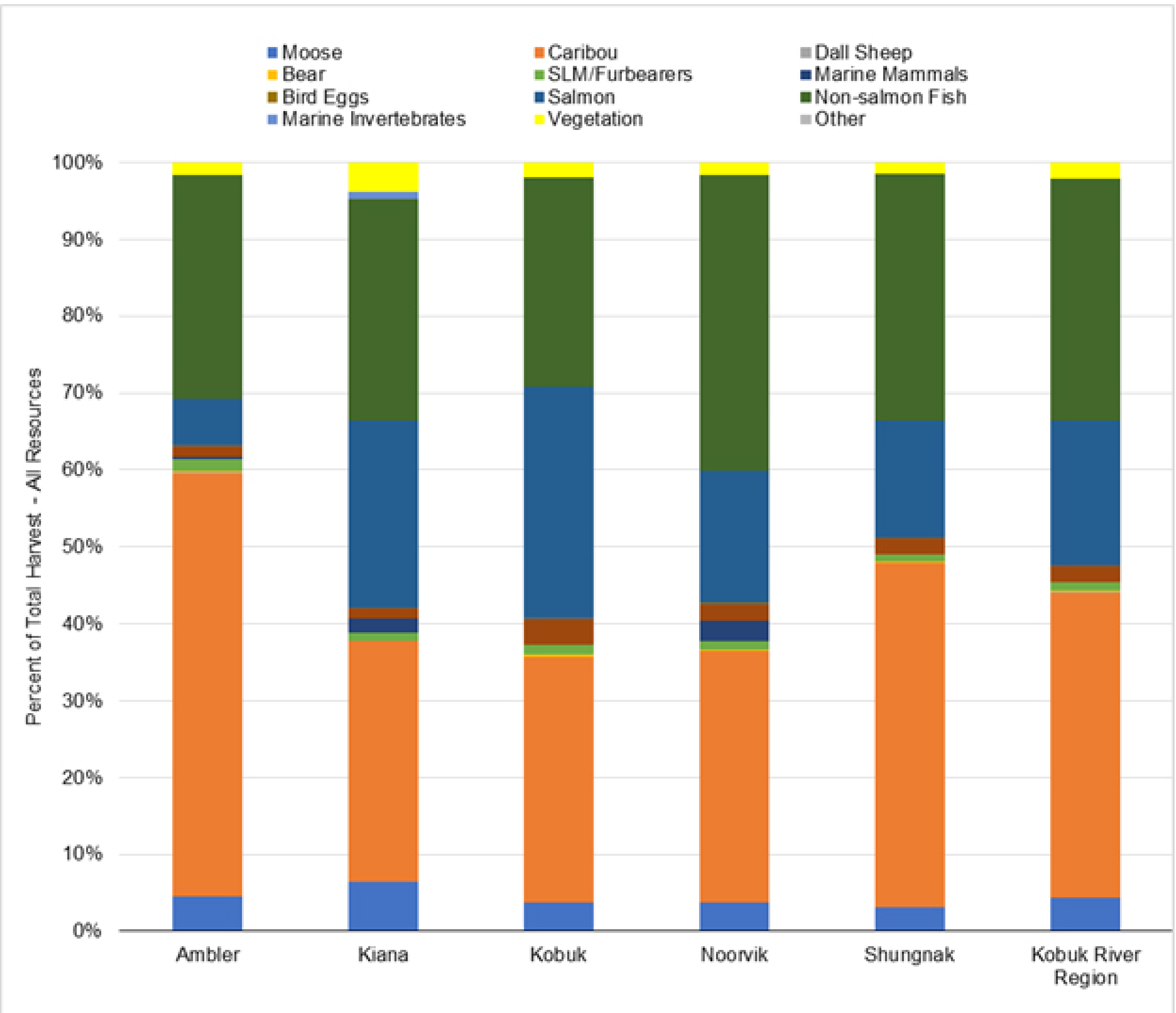


Figure 1. All resources percent of total harvest by Kobuk River region communities
Source: See Table 2

Average participation rates among Kobuk River communities, in terms of the average percentage of households attempting harvests by resource, are shown on Figure 2. Across all Kobuk River study communities, households most commonly participate in harvests of vegetation (85 percent of households), followed by non-salmon fish (74 percent), caribou (71 percent), and salmon (57 percent). Fewer households participate in harvests of Dall sheep, marine mammals, and small land mammals/furbearers. The average percentage of households receiving different resources is shown on Figure 3. This figure shows that while certain resources are not commonly harvested within a community, they may still be highly consumed through sharing. For example, while few Kobuk River region households participate in marine mammal hunting (less than 10 percent; Figure 2), an average of over 60 percent of households receive marine mammals. Other resources which are widely shared among Kobuk River region communities include non-salmon fish, salmon, caribou, vegetation, and migratory birds.

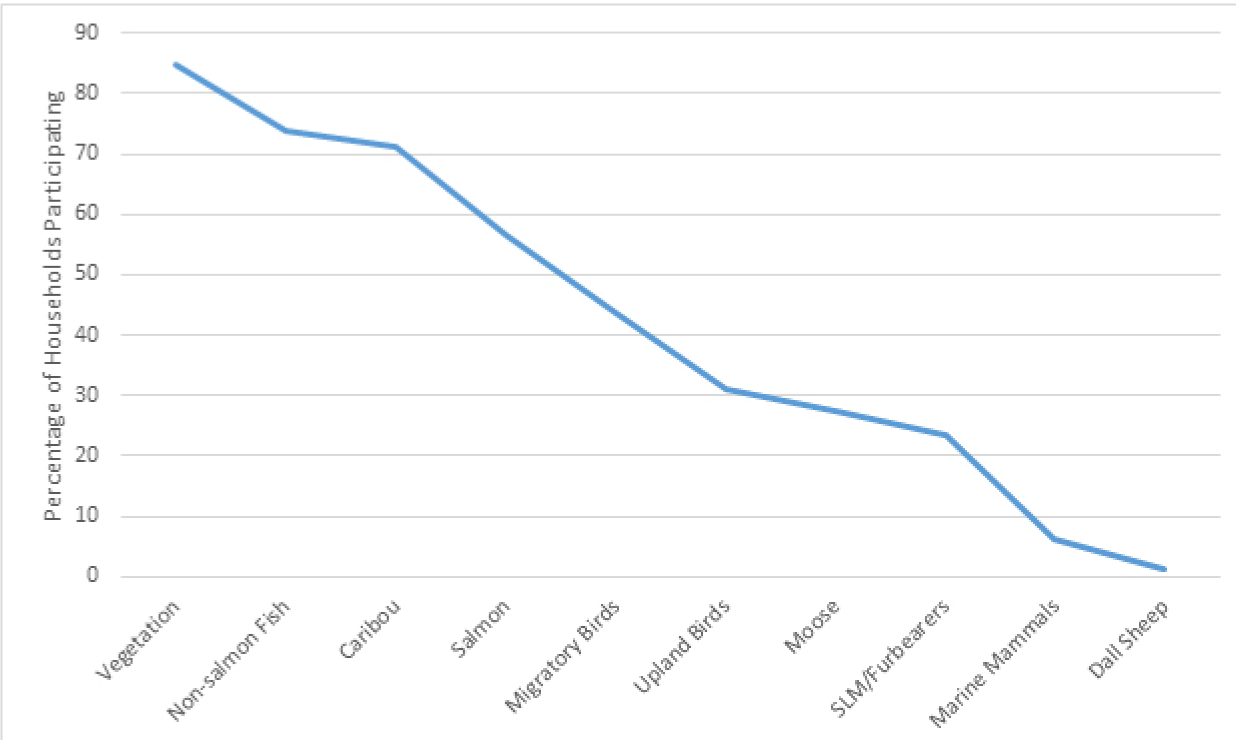


Figure 2. Percent of households attempting harvests of resources, Kobuk River region communities

Source: See Table 2

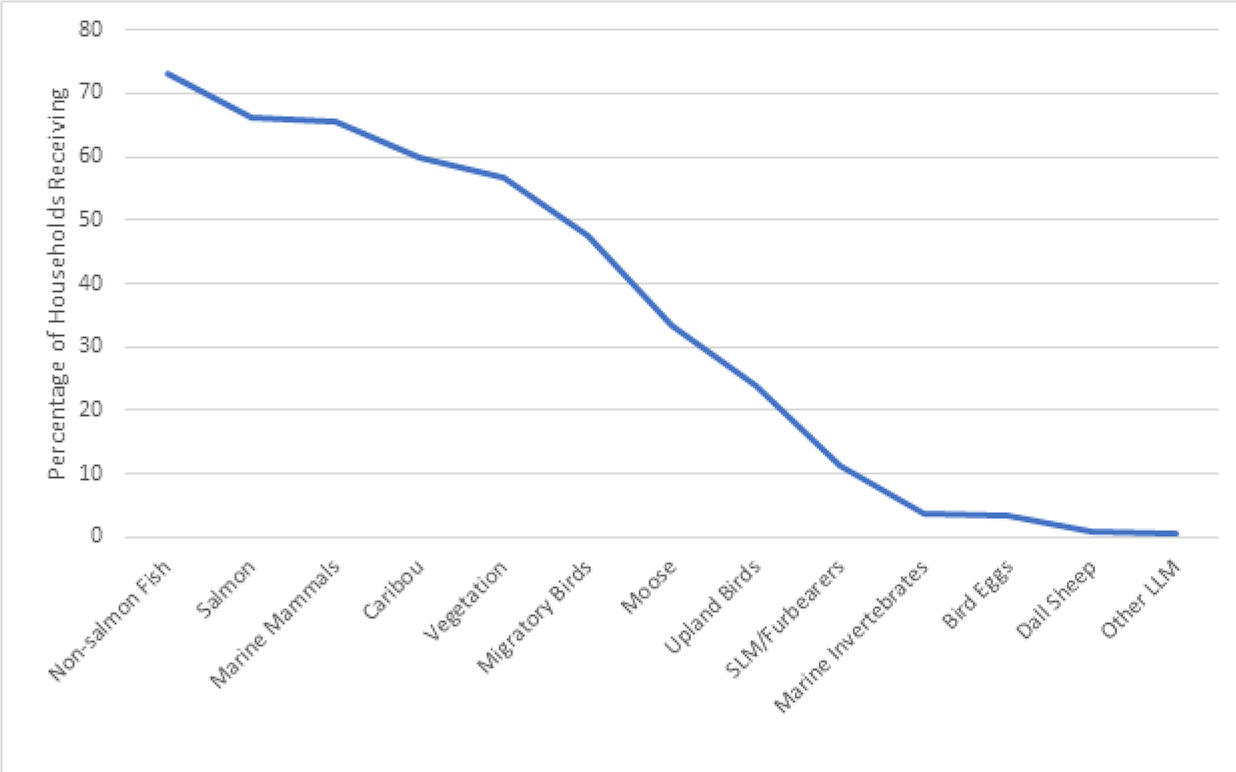


Figure 3. Percent of households receiving resources, Kobuk River region communities
Source: See Table 2

Table 5 shows average harvest and use data for the top five species harvested (in terms of average contribution toward the total subsistence harvest) by each of the Kobuk River Region study communities. Caribou is the top species in each of the study communities, contributing between 31.2 (Kiana) and 54.6 percent (Ambler) of the total subsistence harvest. Non-salmon fish species are also among the top five species for all study communities and include sheefish and whitefish (broad and humpback). Salmon – specifically chum salmon – are also among the top five species harvested in the study communities. Moose is among the top species harvested in Ambler, Kiana, and Kobuk. In addition, northern pike is a top species in the community of Noorvik.

Table 5. Average harvest and use data, top 5 species, Kobuk River region communities

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HHs receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% total harvest
Ambler	Caribou	88	74	69	56	51	489	66,473	937	255	54.6
Ambler	Broad whitefish	62	38	37	25	48	9,321	23,473	317	88	17.1
Ambler	Sheefish	87	72	69	47	56	1,481	20,966	291	84	7.5
Ambler	Chum salmon	76	53	52	34	57	2,902	20,262	281	80	5.4
Ambler	Moose	36	21	13	14	26	10	5,231	74	20	4.5
Kiana	Caribou	89	70	66	53	65	403	54,755	559	144	31.2
Kiana	Chum salmon	86	62	58	37	79	3,298	19,199	199	48	20.7
Kiana	Whitefish	60	44	42	N/A	N/A	10,834	22,189	234	58	16.7
Kiana	Moose	29	16	13	9	14	13	7,054	72	19	6.5
Kiana	Sheefish	76	59	57	32	58	1,485	15,018	154	37	5.4
Kobuk	Caribou	89	78	66	57	63	154	20,976	655	147	31.8
Kobuk	Chum salmon	83	63	60	38	54	2,174	12,841	384	84	29.5
Kobuk	Sheefish	94	81	79	42	43	903	10,199	306	67	23.3
Kobuk	Moose	48	45	16	16	43	6	2,958	95	21	3.8
Kobuk	Broad whitefish	27	19	19	9	14	543	1,738	55	12	1.8
Noorvik	Caribou	95	67	67	48	60	869	118,140	818	184	32.8
Noorvik	Sheefish	82	56	54	36	54	4,054	45,697	348	80	19.0
Noorvik	Chum salmon	89	47	45	42	66	15,408	93,115	719	165	16.3
Noorvik	Broad whitefish	78	45	42	33	53	12,063	38,603	297	68	9.1
Noorvik	Northern pike	59	43	41	25	27	6,347	20,945	161	37	4.8
Shungnak	Caribou	97	66	64	48	60	441	60,044	1,055	237	44.7

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HHs receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% total harvest
Shungnak	Chum salmon	78	52	50	30	58	4,691	28,070	452	105	14.8
Shungnak	Humpback whitefish	37	29	28	19	22	7,367	15,470	270	60	14.0
Shungnak	Sheefish	85	64	64	35	56	2,565	26,155	414	98	12.2
Shungnak	Broad whitefish	44	28	25	14	32	2,747	8,789	144	34	3.2

Source: See Table 2
Notes: HH = households; N/A = Not available

5.1.3 Timing of Subsistence Activities

Data on the timing of subsistence activities for Kobuk River study communities are provided in Table 6. This table shows the number of communities reporting subsistence activity or harvests within each month, based on the most recent data sources for each community. Overall, Kobuk River communities target the greatest number of resources during the month of October, with other periods of high activity also occurring in the earlier summer/fall months of August/September and in the spring months of April/May.

Early spring (March/April) is primarily spent on hunting and trapping of small land mammals, including hunting of upland birds. While residents no longer use spring muskrat camps regularly, some hunting of muskrats and beaver continues to occur. Geese and duck hunting peaks in April and May and remains an important spring activity with residents accessing harvest areas by boat and snowmachine depending on conditions (Braem et al. 2015). When available, residents may hunt WAH caribou during their spring migration north. Spring carnivals are important regional events, particularly for Kobuk and Koyukuk River communities, which center on the harvest and sharing of subsistence foods (Watson 2018).

Immediately after breakup, residents set nets for various non-salmon fish such as whitefish, graying, and northern pike (Braem et al. 2015). Harvesting of sheefish during their summer runs are a key summer activity for Kobuk River communities. Residents also harvest chum salmon and whitefish during the summer, sometimes staying at traditional fish camps, with harvesting of vegetation and hunting of large land mammals also occurring during this time. Hunting of large land mammals also occurs in summer but peaks during fall, when residents hunt for caribou, moose, and bear.

Fall is a major subsistence season for the Kobuk River region. Caribou hunting generally peaks in the fall months of September and October, and residents also resume hunting waterfowl as they migrate south. Residents also hunt other large land mammals such as moose and black bear. Residents continue to seine and set gillnets for fish into the fall, with whitefish replacing salmon and sheefish as the primary resource harvested during this time. Fall is also an important time for berry picking.

Hunting and fishing (through the ice) continues at somewhat lower levels into winter. Some individuals trap and hunt for beaver and other furbearers (e.g., wolf, wolverine, hare, and fox) in winter as well. When available during winter, hunters from the Kobuk River region may travel by snowmachine—sometimes great distances—to harvest caribou (Watson 2018). Residents also harvest ptarmigan during winter when they are available.

Table 6. Kobuk River region timing of subsistence activities, number of communities reporting subsistence activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon	2	2	2	5	5	5	5	5	5	5	5	5
Marine non-salmon fish	N/A	N/A	N/A	N/A	3	3	5	2	2	2	N/A	N/A
Caribou	5	5	5	5	5	3	3	5	5	5	5	5
Moose	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4	5	3	N/A	N/A
Bear	N/A	N/A	N/A	3	5	N/A	N/A	5	5	3	N/A	N/A
Furbearers	3	3	3	3	3	N/A	N/A	N/A	N/A	3	3	3
Small land mammals	5	5	5	5	5	N/A	N/A	N/A	N/A	2	5	5
Upland birds	5	5	5	5	N/A	N/A	N/A	N/A	N/A	2	5	5
Waterfowl	N/A	N/A	N/A	3	5	5	5	5	5	5	N/A	N/A
Plants and berries	N/A	N/A	N/A	N/A	N/A	5	5	5	5	5	2	N/A
Wood	5	5	5	5	5	3	N/A	2	2	2	5	5
Total number of resources per month	**6**	**6**	**6**	**8**	**8**	**6**	**5**	**8**	**8**	**11**	**7**	**6**

Source: Anderson et al. 1998; Braem 2012a; Braem et al. 2017
Notes: Apr = April; Aug = August; Dec = December; Feb = February; Mar = March; Jan = January; Jul = July; Jun = June; N/A = Not applicable (no or limited subsistence activity); Nov = November; Oct = October; Sep = September
Kobuk River region communities = 5 (Ambler, Kiana, Kobuk, Noorvik, and Shungnak)
Each cell contains the number of communities reporting subsistence activity or harvests during each month, based on the most recent data source for each community. Months with only one community report harvests or activity are not included in the table. Resources with no subsistence activity data available are not included in the table.

5.1.4 Travel Method

While systematic, quantitative data on travel methods are not available for Kobuk River subsistence study communities, several studies provide qualitative information on travel methods and routes in the Kobuk River region. Braem et al. (2015) note that boat and snowmachine are the primary used by residents to travel to subsistence harvesting areas and to and from other communities within the region. To a lesser extent, residents use ATVs to access overland areas during the snow-free season. However, while still not a primary mode of transportation, use of ATVs has increased over time. As stated in Braem et al. (2015), residents of Ambler use ATVs to "reach country that may be inaccessible by boat" and to save on gas by opting for short ATV trips over longer boating trips. Snowmachine travel can extend into mid-May assuming snow conditions allow. In recent years, residents have noted changes in snow conditions which affect certain subsistence activities generally carried out by snowmachine (e.g., furbearer harvesting, wood-gathering, and inter-community travel). Breakup generally occurs in mid- to late May when residents switch from snowmachine travel to boat travel along local rivers. Erosion has also affected river channels, and subsequently boat travel, for Kobuk River communities. Freeze-up generally occurs in mid-October and residents shortly thereafter begin traveling by snowmachine again which opens up larger overland areas for subsistence uses. For the study communities, the Kobuk River is a major transportation corridor throughout the year.

5.1.5 Resource Importance

While all subsistence activities and resources are of high importance to a community, the importance of individual resources relative to one another varies according to various material and cultural measures used in this analysis. This section provides an analysis of the relative importance of resources to each Kobuk River Region study community, based on selected measures of harvest (percentage of total harvest), harvest effort (percentage of households attempting harvests) and sharing (percentage of households receiving). The relative importance of subsistence resources to the individual Kobuk River study communities, based on selected variables, is provided in Table 7 through Table 11.

Based on this analysis, caribou, non-salmon fish, salmon, and vegetation are resources of high importance in all five Kobuk River Region study communities. In addition, marine mammals are a resource of high importance in four of the five study communities (Ambler, Kobuk, Noorvik, and Shungnak), and migratory birds are a resource of high importance in one study community (Shungnak). Resources of moderate importance in the study communities include moose (five study communities), small land mammals/furbearers (three study communities), migratory birds (four study communities), and upland birds (three study communities).

Table 7. Relative importance of subsistence resources based on selected variables, Ambler

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	21	26	5	M
2	Caribou	74	51	55	H
3	Dall sheep	2	2	0.1	L
4	Bear	N/A	N/A	0.2	L
5	Other large land mammals	N/A	1	N/A	L
6	Small land mammals/furbearers	19	9	2	M
7	Marine mammals	2	60	0.3	H
8	Migratory birds	40	30	1	M
9	Upland birds	40	26	0.2	M
10	Bird eggs	2	4	N/A	L
11	Salmon	55	62	6	H
12	Non-salmon fish	77	68	29	H
13	Marine invertebrates	2	2	0.1	L
14	Vegetation	85	51	2	H

Source: See Table 2
Notes: H = High; HH = Households; L = Low; M = Moderate; N/A = Not Available

Table 8. Relative importance of subsistence resources based on selected variables, Kiana

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	16	14	6	M
2	Caribou	70	65	31	H
3	Dall sheep	1	N/A	N/A	L
4	Bear	N/A	N/A	N/A	I
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	16	2	1	L
7	Marine mammals	10	N/A	2	M
8	Migratory birds	38	N/A	1	M
9	Upland birds	8	N/A	0.03	L
10	Bird eggs	1	N/A	N/A	L
11	Salmon	64	82	24	H
12	Non-salmon fish	68	N/A	29	H
13	Marine invertebrates	4	N/A	1	L
14	Vegetation	73	N/A	4	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 9. Relative importance of subsistence resources based on selected variables, Kobuk

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	45	43	4	M
2	Caribou	78	63	32	H
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	0.2	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	26	14	1	L
7	Marine mammals	N/A	63	N/A	H
8	Migratory birds	40	57	3	M
9	Upland birds	50	33	0.3	M
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	63	57	30	H
12	Non-salmon fish	85	71	27	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	87	80	2	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 10. Relative importance of subsistence resources based on selected variables, Noorvik

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	28	43	4	M
2	Caribou	67	60	33	H
3	Dall sheep	0.4	1	N/A	L
4	Bear	N/A	N/A	0.2	L
5	Other large land mammals	N/A	0.4	N/A	L
6	Small land mammals/furbearers	20	10	1	L
7	Marine mammals	11	67	3	H
8	Migratory birds	54	53	2	M
9	Upland birds	29	12	0.1	M
10	Bird eggs	20	5	0.1	L
11	Salmon	47	69	17	H
12	Non-salmon fish	70	81	38	H
13	Marine invertebrates	1	7	0.003	L
14	Vegetation	86	54	2	H

Source: See Table 2
Notes: H = High; HH = Households; L = Low; M = Moderate; N/A = Not Available

Table 11. Relative importance of subsistence resources based on selected variables, Shungnak

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	27	41	3	M
2	Caribou	66	60	45	H
3	Dall sheep	N/A	1	N/A	L
4	Bear	N/A	N/A	0.1	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	35	22	1	M
7	Marine mammals	2	71	0.1	H
8	Migratory birds	47	51	2	H
9	Upland birds	29	24	0.1	L
10	Bird eggs	N/A	2	N/A	L
11	Salmon	54	62	15	H
12	Non-salmon fish	69	72	32	H
13	Marine invertebrates	1	2	N/A	L
14	Vegetation	94	42	2	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

5.2. Kotzebue Sound

The Kotzebue Sound region includes the communities of Buckland, Kotzebue, Noatak, and Selawik. These communities are located to the west of the project corridors in Kotzebue Sound and along tributaries of Kotzebue Sound.

5.2.1 Subsistence Use Areas

Subsistence use areas for the Kotzebue Sound region study communities are focused around Kotzebue Sound, the Chukchi Sea coast, and lands and rivers surrounding Kotzebue Sound including the Brooks Range and the Noatak, Kobuk, Selawik, and Buckland rivers. More recently documented subsistence use areas for these study communities (Satterthwaite-Phillips et al. 2016) indicate a smaller extent of overland travel. Subsistence use areas for Kotzebue Sound region study communities do not overlap with the project alternatives but occur downriver from the alternatives or approach the project alternatives in overland areas from the west and north.

As shown on Map 7, Buckland subsistence use areas for all available time periods occur in a large overland area to the south and east of the community; along the Kobuk River to the community of Ambler; into Kotzebue Sound and along the coast near Kivalina; and north along the Noatak River. Recent subsistence use areas documented for Buckland (Satterthwaite-Phillips et al. 2016) indicate a shift in contemporary subsistence uses to the south. These use areas extend as far north as Kotzebue but do not occur along the Kobuk River or Noatak rivers. Instead, contemporary Buckland subsistence use areas are more focused along the Buckland River drainage and in overland areas to the south and east of Kotzebue Sound. Marine mammal hunting by Buckland residents occurs in Kotzebue Sound primarily near the mouth of the Buckland River and near Deering. Bird hunting and egg harvesting is also focused around the Buckland River with coastal hunting in Kotzebue Sound as well. Fishing occurs along the Buckland

River, in Kotzebue Sound, and in Selawik Lake, with the greatest amount of overlap occurring In Kotzebue Sound near the mouth of Selawik Lake, in the southern portion of Selawik Lake, and near the community of Buckland on the Buckland River. Large game hunting focuses to the south and east of the community, both along the Buckland River and in larger overland areas that extend south and east paralleling the Selawik River, with small game hunting and trapping occurring in similar overland areas. Finally, plant gathering in Buckland occurs most commonly along the Buckland River and in coastal areas near the mouth of the river (Satterthwaite-Phillips et al. 2016).

Map 8 shows Kotzebue subsistence use areas occurring throughout Kotzebue Sound and along the Chukchi Sea coast, along the Kobuk and Noatak rivers, and in overland areas which extend to the southwest, north, east and southeast of the community. More recently documented subsistence use areas documented in Satterthwaite-Phillips et al. (2016) show Kotzebue residents using similar areas for subsistence throughout Kotzebue Sound and along the Noatak River and Kobuk River drainages. In addition, more recently documented use areas extend as far as Point Hope in the north and in areas surrounding the Kivalina and Wulik rivers. Based on the data in Satterthwaite-Phillips et al. (2016), contemporary marine mammal use areas occur throughout Kotzebue Sound and along the Chukchi Sea coast to Point Hope. Bird hunting focuses on the lands near Kotzebue, around the mouth of the Kobuk River, along the Noatak River, and along the coast extending from the Delong Mountain Transportation System (DMTS), Cape to Cape Krusenstern, Sheshalik, and the mouth of the Noatak River. Kotzebue use areas for fish are most concentrated around the mouth of the Kobuk River, in various areas of Kotzebue Sound and along the Noatak River. Large and small game hunting game hunting by Kotzebue residents focuses on coastal areas of Kotzebue Sound, along the Kobuk and Noatak rivers, and in overland areas to the northeast of the community in the Brooks Range. Plant gathering activities are focused on coastal areas in Kotzebue Sound and along the Noatak River, with some plant harvesting also occurring near the mouth of the Kobuk River (Satterthwaite-Phillips et al. 2016).

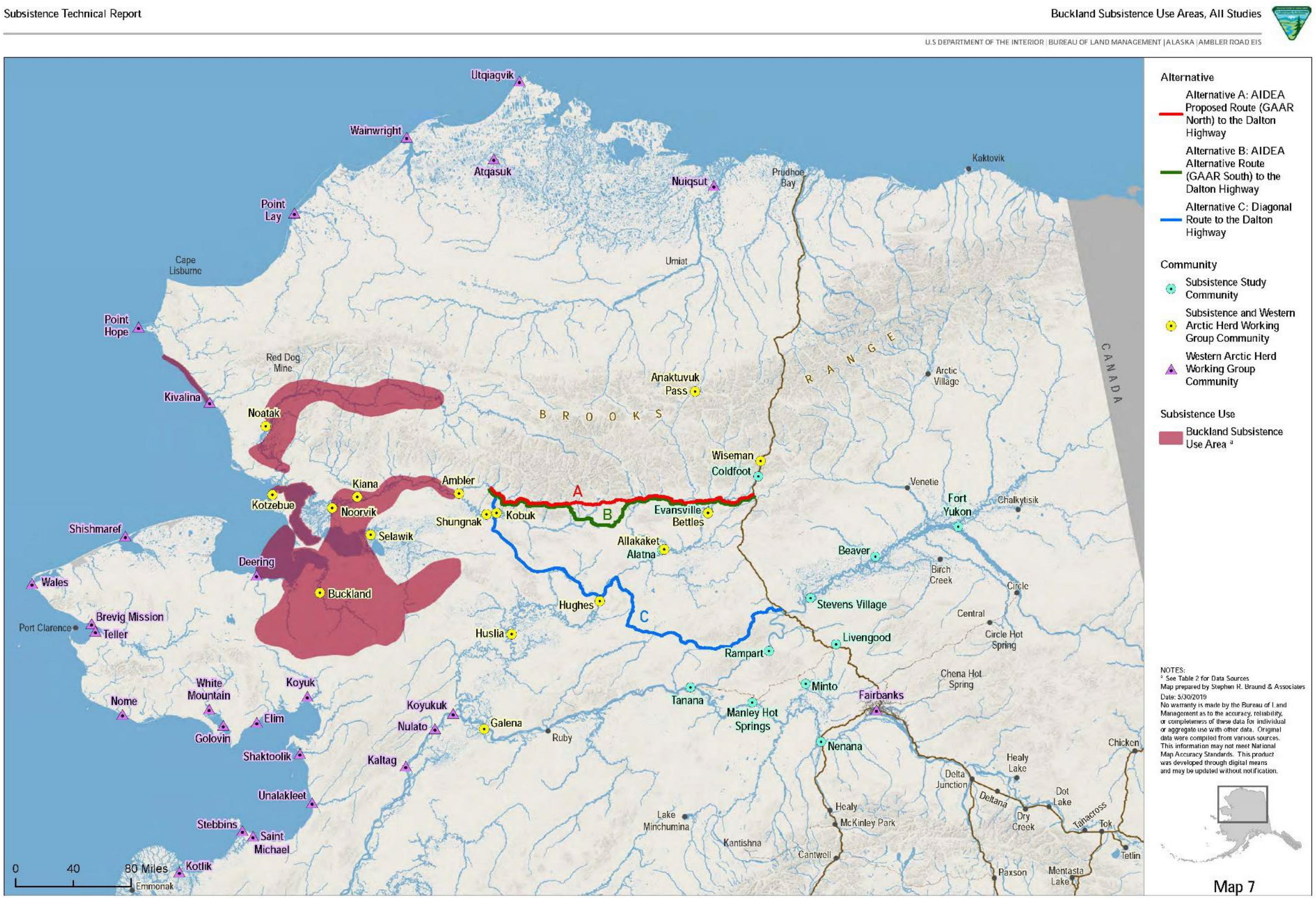
Noatak use areas for all time periods (Map 9) occur along the entire lower and upper Noatak River drainage, north onto the North slope, west to the Chukchi Sea coast and in marine waters of the Chukchi Sea, and south into Kotzebue Sound, along Kobuk river, and around the Selawik River drainage. More recently documented use areas occur in similar areas surrounding the Noatak River drainage but with less extensive use to the north of Brooks Range and south of the community along the Selawik River drainage. Marine mammal hunting by Noatak residents occurs throughout Kotzebue Sound and in marine waters off the Chukchi Sea coast as far as Point Hope. Bird hunting primarily occurs in overland areas surrounding the Noatak River, while fishing is focused along the Noatak River drainage with some fishing also occurring in coastal areas of Kotzebue Sound, particularly near Sheshalik. Contemporary large game and small game hunting in Noatak is focused heavily along the Noatak River drainage and in various overland areas surrounding the Noatak River. Plant gathering in Noatak is also focused around the Noatak River, with some coastal use areas identified as well (Satterthwaite-Phillips et al. 2016).

As shown on Map 10, Selawik subsistence use areas for all time periods occur in an area surrounding the Selawik Lake and river, extending east toward the upper Kobuk and Koyukuk river drainages, north into the Brooks Range and as far as the upper Colville River, and west into Kotzebue Sound and along the Chukchi Sea coast to Kivalina. More recently documented subsistence use areas (Satterthwaite-Phillips et al. 2016) are focused primarily to the south of the Kobuk River drainage, with a majority of subsistence harvesting activities occurring around Selawik Lake, Selawik River, and in overland areas to the south of the community. Bird hunting is focused to the east of Selawik Lake along Inland Lake, Selawik River, and Tagagawik River. Fishing occurs with the greatest concentrations in Selawik Lake and along Selawik River, with lesser use of Kotzebue Sound and in several locations along the Kobuk River. Large game hunting focuses along local lakes and waterways in addition to extending across larger overland areas both north and south of the community of Selawik. Small game hunting and trapping occurs in similar overland areas but focused to the east of Selawik Lake. Residents also have reported a couple of isolated hunting areas for large and small game along the Kobuk River. Plant gathering by Selawik residents is more concentrated near the community and around river and lakesides.

5.2.2 Harvest Data

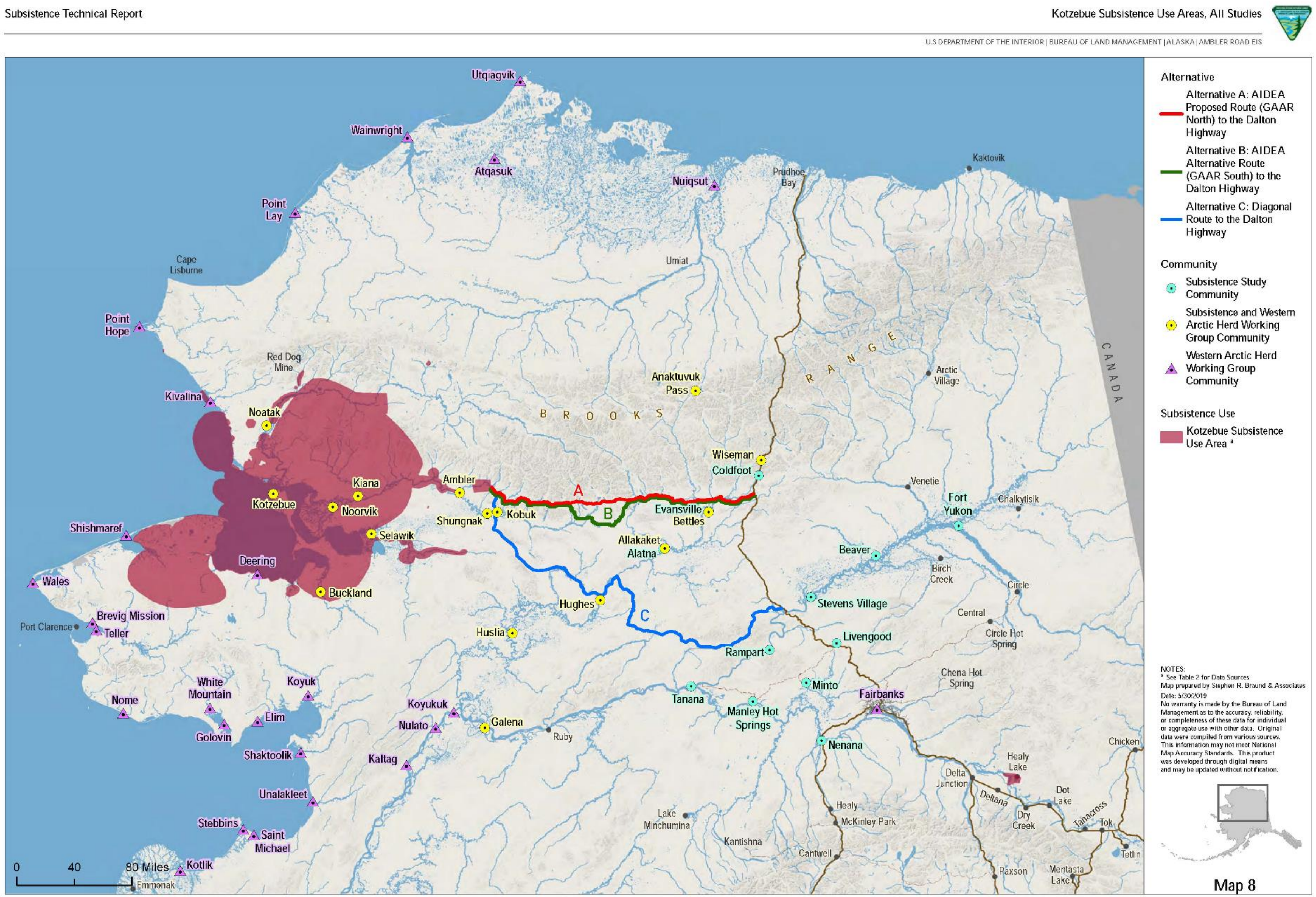
Harvest data for the Kotzebue Sound study communities are provided on Figure 4 through Figure 6 and in Table 12. As shown on Figure 4, based on an average of available data, non-salmon fish is the primary resource harvested among the study communities in terms of percentage of usable pounds (32 percent), followed closely by caribou (31 percent). Marine mammals (15 percent), and salmon (12 percent) also contribute a substantial amount to Kotzebue Sound study communities. Other resources which contribute smaller amounts in terms of pounds include moose, vegetation, and migratory birds. Resource contribution varies by study community. Selawik shows a much higher reliance on non-salmon fish than other Kotzebue Sound study communities, at 68 percent of the total subsistence harvest. Noatak and Buckland show a higher reliance on caribou, while Kotzebue harvests are nearly evenly split between caribou, non-salmon fish, salmon, and marine mammals.

This page is intentionally left blank.



Map 7. Buckland subsistence use areas, all studies

This page is intentionally left blank.



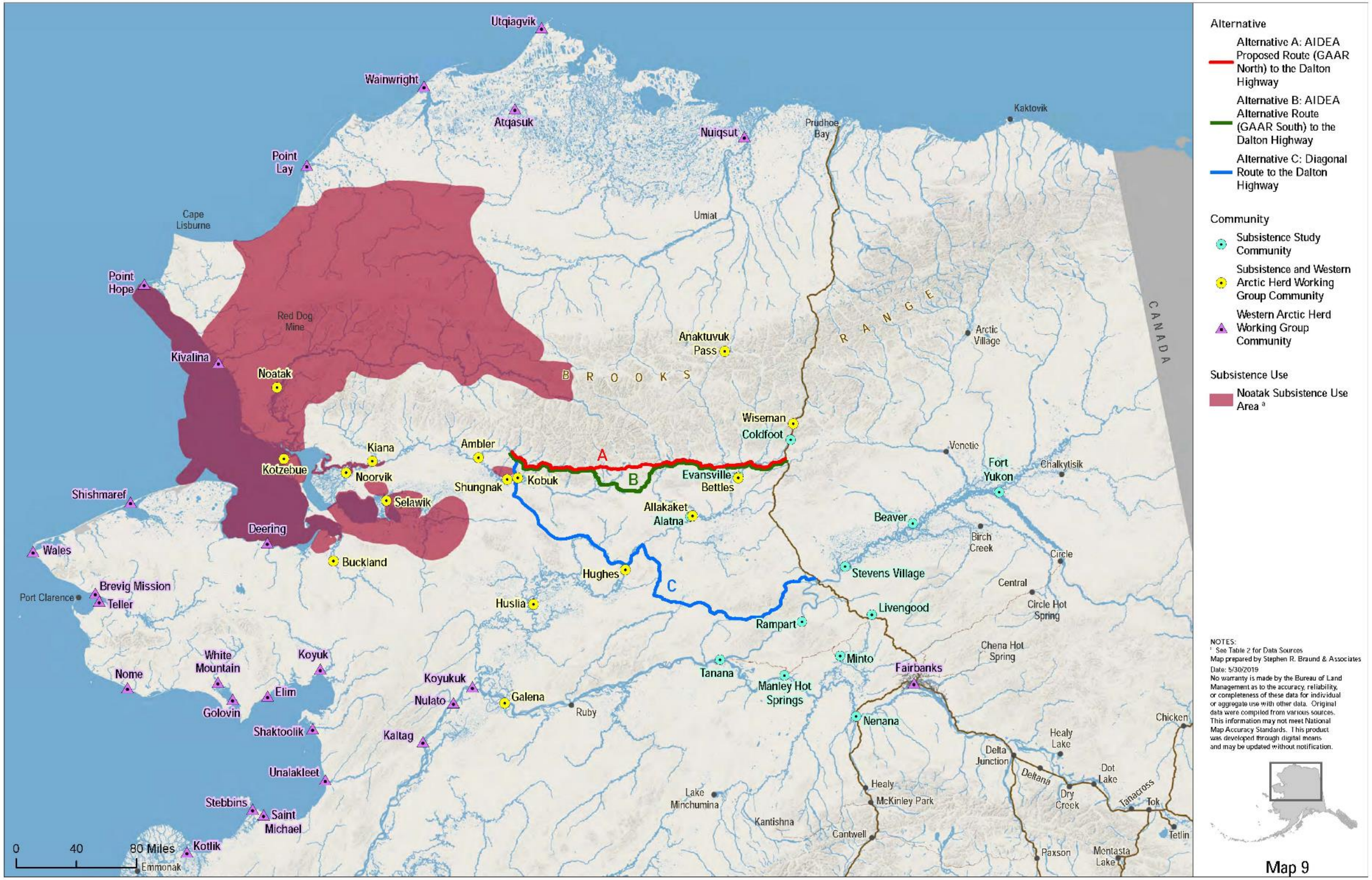
Map 8. Kotzebue subsistence use areas, all studies

This page is intentionally left blank.

Subsistence Technical Report

Noatak Subsistence Use Areas, All Studies

U.S DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT ALASKA | AMBLER ROAD EIS



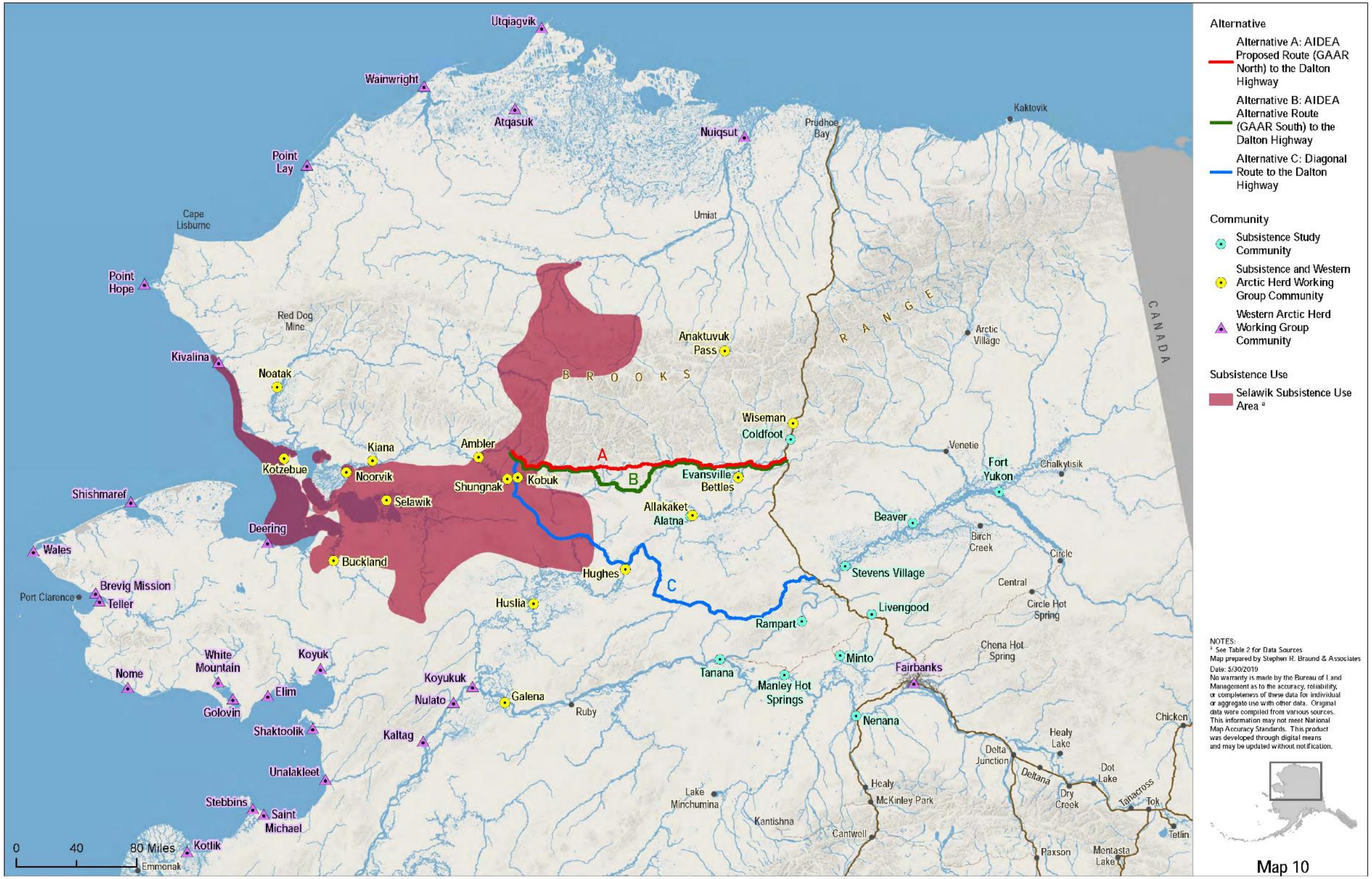
Map 9. Noatak subsistence use areas, all studies

This page is intentionally left blank.

Subsistence Technical Report

Selawik Subsistence Use Areas, All Studies

U.S DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | AMBLER ROAD EIS



Map 10.Selawik subsistence use areas, all studies

This page is intentionally left blank.

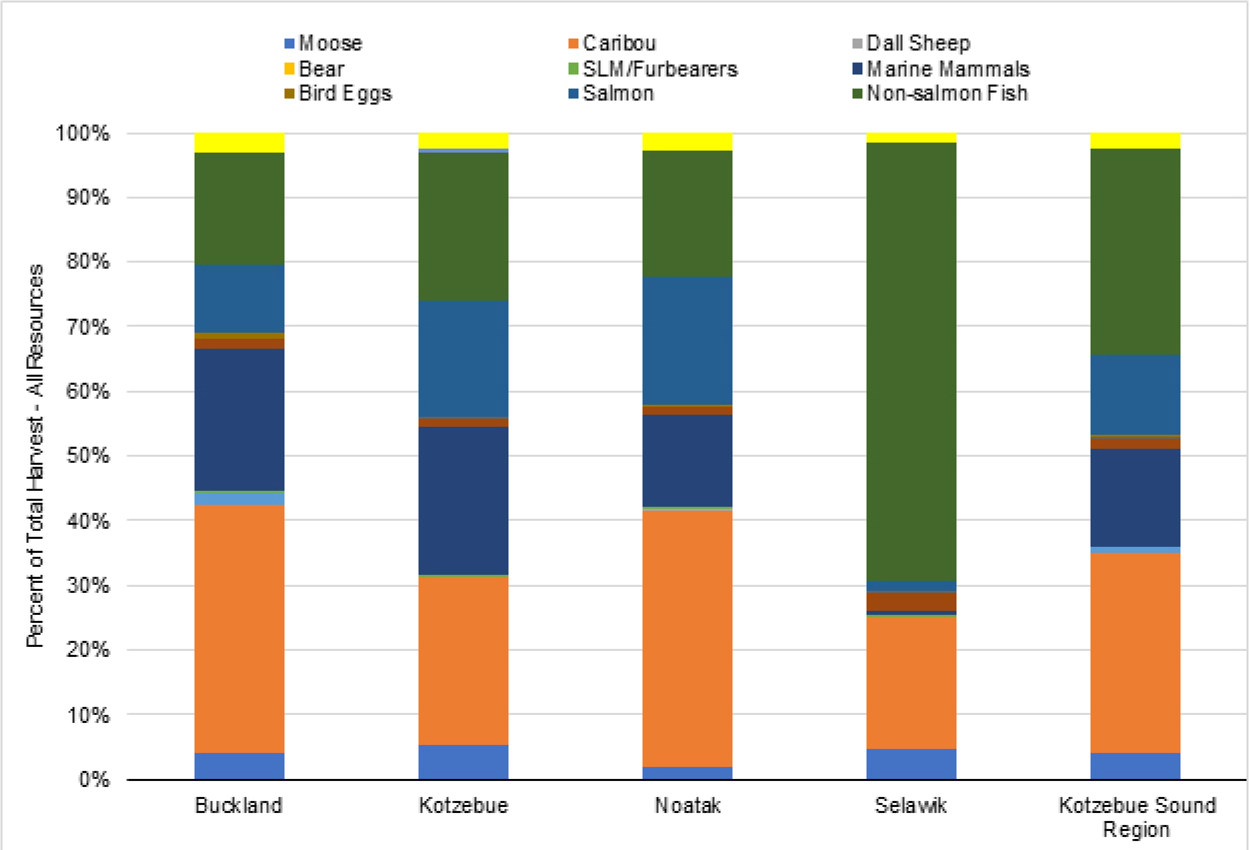


Figure 4. All resources percent of total harvest by Kotzebue Sound region communities
Source: See Table 2

Average participation rates among Kotzebue Sound study communities, in terms of the average percentage of households attempting harvests by resource, are shown on Figure 5. Across all Kotzebue Sound study communities, households most commonly participate in harvests of vegetation (80 percent of households), followed by non-salmon fish (74 percent), caribou (63 percent), salmon (47 percent), and migratory birds (43 percent). Fewer households participate in harvests of marine invertebrates, Dall sheep, other large land mammals, and small land mammals/furbearers. While an important resource in terms of harvest amounts, participation in marine mammal harvesting occurs among a smaller subset of households (23 percent). The average percentage of households receiving different resources is shown on Figure 6. Similar to the Kobuk River region, this figure shows that while certain resources are not as commonly harvested within a community, they may still be highly consumed through sharing. For example, while only 23 percent of households hunt marine mammals over 50 percent of households receive this resource. The most commonly shared resources in Kotzebue Sound communities (more than half of households receiving) include non-salmon fish, caribou, marine mammals, salmon, and vegetation.

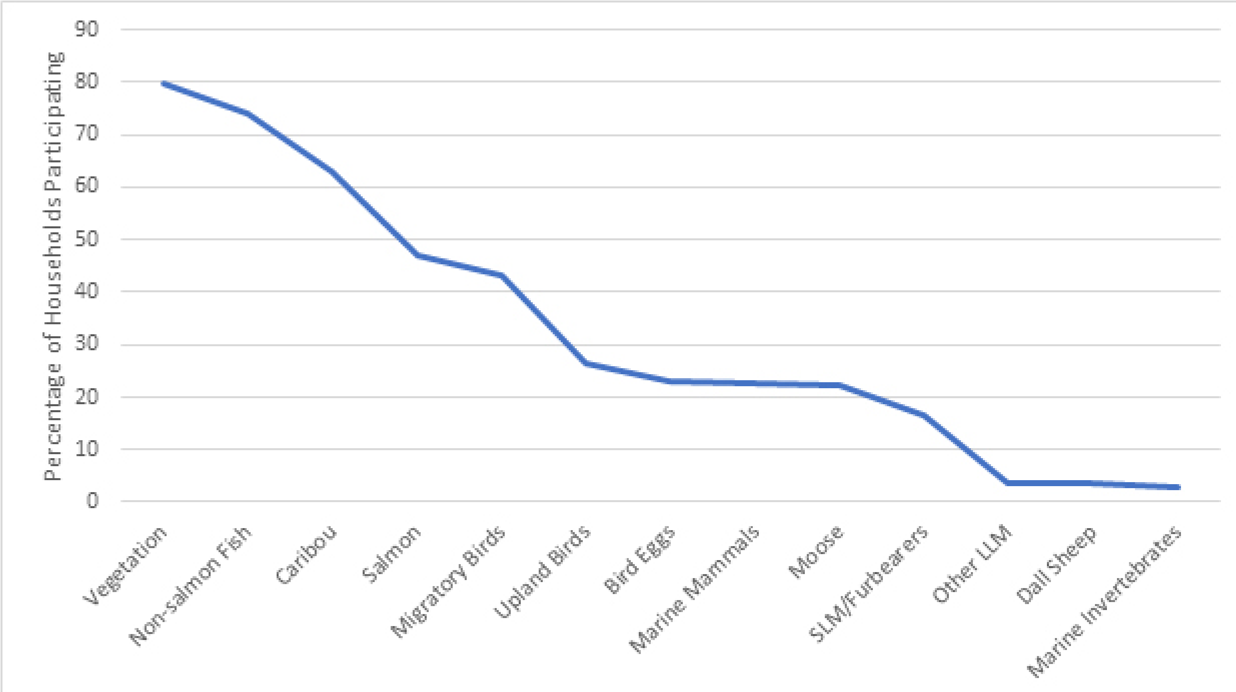


Figure 5. Percent of households attempting harvests of resources, Kotzebue Sound region communities

Source: See Table 2

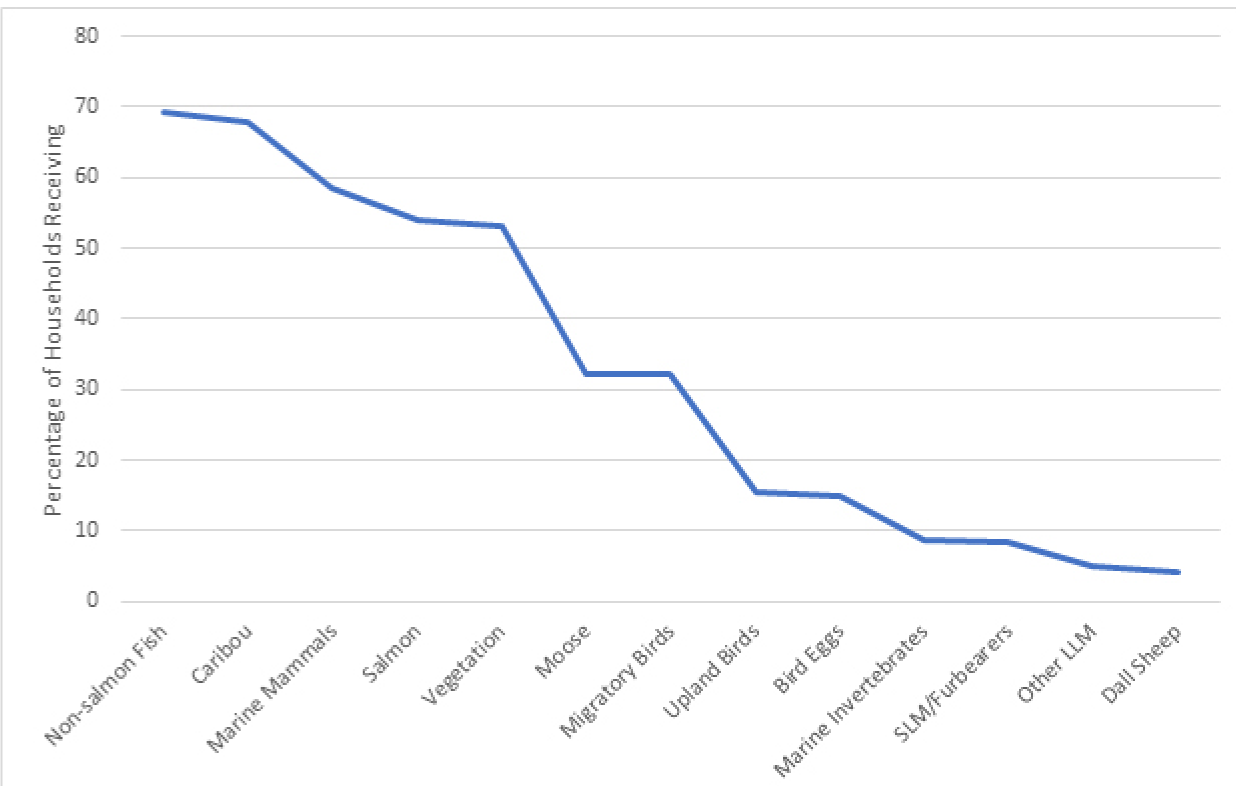


Figure 6. Percent of households receiving resources, Kotzebue Sound region communities

Source: See Table 2

Table 12 shows average harvest and use data for the top five species harvested (in terms of average contribution toward the total subsistence harvest) by each of the Kotzebue Sound Region study communities. Caribou is the top species in three of the four study communities (Buckland, Kotzebue, and Noatak), contributing between 25.7 percent and 39.6 percent of the total subsistence harvest. Broad whitefish is the top harvested resource in Selawik, at 33.2 percent of the harvest. Other non-salmon fish species are among the top five species in Kotzebue Sound study communities and include sheefish (Kotzebue and Selawik), smelt (Buckland), and Dolly Varden (locally called trout; Noatak). Salmon—specifically chum salmon—are among the top five species harvested in two of the study communities. Other top species in the Kotzebue Sound Region include moose (Buckland, Kotzebue), seal (spotted and bearded; Buckland, Kotzebue, and Noatak), and northern pike (Selawik).

5.2.3 Timing of Subsistence Activities

Data on the timing of subsistence activities for Kotzebue Sound study communities are provided in Table 13. This table shows the number of communities reporting subsistence activity or harvests within each month, based on the most recent data sources for each community. Overall, Kotzebue Sound communities target the greatest number of resources during the spring month of April, followed by the fall month of September.

In early spring (March/April), residents continue to trap and hunt for furbearers and small land mammals. Sheefish are also commonly harvested in the spring through the ice, while residents may also set nets to harvest whitefish and trout (Dolly Varden) during their spring runs. Geese and duck hunting peaks in May (Braem et al. 2017). When available, residents may also hunt WAH caribou during their spring migration north. Marine mammal hunting also begins during the spring months, as bearded seals begin migrating on the ice past Kotzebue Sound.

Salmon harvesting is a key summer activity which peaks in July and August. Harvesting of sheefish continues through summer as well. Harvesting of berries and wild plants begins in summer, as does hunting of large land mammals. Harvesting of marine mammals throughout the summer.

As with the Kobuk River region, subsistence harvesting in the Kotzebue Sound region peaks in fall. Caribou and moose hunting is most intense during the fall months of August through October, and residents also resume hunting waterfowl as they migrate south. Seal hunting continues into the fall as well during the open water months. Residents set nets for whitefish and trout as well during this time.

Hunting and fishing (through the ice) continues at somewhat lower levels into winter. For some residents, sheefish harvesting continues into the winter. Residents hunt caribou throughout the winter as they are available. Hunting and trapping of furbearers and small land mammals is most active during the winter and into the early spring.

Table 12. Average harvest and use data, top 5 species, Kotzebue Sound region communities

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HHs receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% Total harvest
Buckland	Caribou	84	71	68	57	58	622	84,558	915	186	38.3
Buckland	Bearded seal	N/A	N/A	N/A	N/A	N/A	111	32,270	367	79	14.3
Buckland	Smelt	84	72	71	47	42	49,823	18,433	193	39	8.9
Buckland	Moose	26	19	10	15	15	13	6,787	74	15	4.0
Buckland	Spotted seal	33	30	28	7	17	88	8,624	98	21	3.8
Kotzebue	Caribou	86	49	42	47	64	2,094	284,711	353	90	25.7
Kotzebue	Chum salmon	84	47	45	41	60	32,714	199,009	244	59	17.0
Kotzebue	Sheefish	82	54	52	42	52	39,545	217,497	271	66	15.9
Kotzebue	Bearded seal	55	23	19	25	40	22,179	218,447	274	67	15.6
Kotzebue	Moose	47	23	12	16	38	105	56,591	70	18	5.4
Noatak	Caribou	88	66	60	54	67	416	44,761	12,355	124	39.6
Noatak	Chum salmon	85	75	74	57	58	6,282	28,800	8,869	74	18.8
Noatak	Dolly Varden	90	78	69	63	67	6,685	18,724	3,207	42	12.8
Noatak	Bearded seal	52	19	32	40	56	48	12,579	7,176	42	10.6
Noatak	Whitefish	61	39	38	37	54	6,778	14,234	120	27	7.4
Selawik	Broad whitefish	66	44	43	36	42	29,252	93,626	544	115	33.2
Selawik	Caribou	97	65	59	67	82	969	131,801	810	174	20.4
Selawik	Sheefish	72	56	53	39	42	6,011	43,712	256	55	15.1
Selawik	Northern pike	63	51	46	34	31	11,612	37,485	218	47	11.5
Selawik	Humpback whitefish	31	21	19	16	20	8,515	16,930	98	21	5.2

Source: See Table 2
Note: HH = households; N/A = Not available

Table 13. Kotzebue Sound region timing of subsistence activities, number of communities reporting subsistence activity

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon fish	2	2	2	2	2	2	2	2	2	2	2	2
Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	N/A	N/A	N/A
Caribou	4	4	4	4	3	N/A	2	4	4	4	4	3
Moose	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	4	2	N/A	N/A
Bear	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	N/A	N/A	N/A
Other large land mammals	N/A	N/A	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Furbearers	3	3	2	2	N/A	N/A	N/A	N/A	N/A	N/A	2	3
Small land mammals	2	N/A	2	2	2	N/A	N/A	N/A	2	2	N/A	N/A
Marine mammals	N/A	N/A	N/A	2	2	3	2	2	3	2	N/A	N/A
Upland birds	2	2	2	2	N/A	N/A	N/A	N/A	N/A	N/A	2	2
Waterfowl	N/A	N/A	N/A	2	2	2	N/A	N/A	2	N/A	N/A	N/A
Plants and berries	N/A	N/A	N/A	N/A	N/A	2	2	2	2	N/A	N/A	N/A
Total number of resources per month	**5**	**4**	**5**	**8**	**5**	**4**	**4**	**6**	**9**	**5**	**4**	**4**

Source: Gonzalez et al. 2018; Georgette and Loon 1993; Braem et al. 2017; SRB&A 2009b; Mikow et al. 2014; Braem et al. 2013
Notes: Apr = April; Aug = August; Dec = December; Feb = February; Mar = March; Jan = January; Jul = July; Jun = June; N/A = Not applicable (no or limited subsistence activity); Nov = November; Oct = October; Sep = September
Kotzebue Sound Region Communities = 4 (Buckland, Kotzebue, Noatak, and Selawik).
Each cell contains the number of communities reporting subsistence activity or harvests during each month, based on the most recent data source for each community. Months with only one community report harvests or activity are not included in the table. Resources with no subsistence activity data available are not included in the table

5.2.4 Travel Method

While systematic, quantitative data on travel methods are not available for most Kotzebue Sound subsistence study communities, several studies provide qualitative and quantitative information on travel methods and routes in the Kotzebue Sound region. Primary travel corridors within the Kotzebue Sound region include the Noatak River, Kobuk River, and Kotzebue Sound, in addition to the Selawik and Buckland rivers. Similar to the Kobuk River region, snowmachines and boats are the primary mode of travel to subsistence harvesting areas, although ATVs are also present in the study communities as well (Satterthwaite-Phillips et al. 2016). A subsistence mapping and traditional knowledge study conducted in 2007 provides more quantitative data on travel methods for Noatak (SRB&A 2009). These data show Noatak residents traveling by boat primarily from May to September, with limited travel reported in April and October. Snowmachine travel generally occurs from November through April and dropping off in May. To a lesser extent, residents take four-wheelers during the summer months, primarily in July and August. Documented travel routes for the community of Noatak occur over a large area, with the Noatak River a primary travel corridor in addition to various overland snowmachine routes between Noatak and Kivalina, Kiana, Noorvik, Selawik, and Kotzebue.

5.2.5 Resource Importance

The relative importance of subsistence resources to the individual Kotzebue Sound study communities, based on selected variables, is provided in Table 14 through Table 17 (see Section 5.3.5 for discussion of methods). Based on this analysis, caribou, marine mammals, non-salmon fish, and vegetation are resources of high importance in all four study Kotzebue Sound Region study communities. In addition, salmon are a resource of high importance in three of the four study communities (Buckland, Kotzebue, and Noatak). Resources of moderate importance in the study communities include moose (four study communities), other large land mammals (one study community), migratory birds (four study communities), upland birds (two study communities), and salmon (one study community).

5.3. Koyukuk River

The Koyukuk River region includes the communities of Alatna, Allakaket, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Huslia, and Wiseman. These communities are located along the Koyukuk River drainage which is crossed in multiple locations by the AMDIAR project alternatives. Bettles and Evansville are located directly along the northern project corridor alternatives, while Hughes is located directly along the southern project corridor alternative. Alatna and Allakaket are located on the Koyukuk River between the northern and southern alternatives; Anaktuvuk Pass, Wiseman, and Coldfoot are located north of all project alternatives; and Huslia is located south of all project alternatives.

Table 14. Relative importance of subsistence resources based on selected variables, Buckland

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	19	15	4	M
2	Caribou	71	58	38	H
3	Dall sheep	N/A	N/A	N/A	N/A
4	Bear	N/A	N/A	0.02	L
5	Other large land mammals	9	6	2	M
6	Small land mammals/furbearers	25	9	0.3	L
7	Marine mammals	35	18	22	H
8	Migratory birds	51	36	2	M
9	Upland birds	N/A	N/A	N/A	N/A
10	Bird eggs	53	35	1	M
11	Salmon	49	49	11	H
12	Non-salmon fish	79	64	17	H
13	Marine invertebrates	2	1	0.004	L
14	Vegetation	82	46	3	H

Source: See Table 2
Notes: H = High; HH = Households; L = Low; M = Moderate; N/A = Not Available

Table 15. Relative importance of subsistence resources based on selected variables, Kotzebue

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	23	38	5	M
2	Caribou	49	64	26	H
3	Dall sheep	3	4	0.1	L
4	Bear	N/A	N/A	0.1	L
5	Other large land mammals	1	6	0.05	L
6	Small land mammals/furbearers	11	11	0.2	L
7	Marine mammals	26	70	23	H
8	Migratory birds	31	23	1	M
9	Upland birds	31	13	0.2	M
10	Bird eggs	14	13	0.1	L
11	Salmon	50	60	18	H
12	Non-salmon fish	74	76	23	H
13	Marine invertebrates	5	24	1	L
14	Vegetation	72	50	2	H

Source: See Table 2
Notes: H = High; HH = Households; L = Low; M = Moderate; N/A = Not Available

Table 16. Relative importance of subsistence resources based on selected variables, Noatak

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	12	23	2	M
2	Caribou	66	67	40	H
3	Dall sheep	4	5	0.3	L
4	Bear	N/A	N/A	0.1	L
5	Other large land mammals	1	3	0.2	L
6	Small land mammals/furbearers	11	4	0.1	L
7	Marine mammals	20	72	14	H
8	Migratory birds	46	29	1	M
9	Upland birds	20	17	0.1	L
10	Bird eggs	20	9	0.1	L
11	Salmon	77	62	20	H
12	Non-salmon fish	79	78	19	H
13	Marine invertebrates	1	3	0.02	L
14	Vegetation	85	64	3	H

Source: See Table 2
Notes: H = High; HH = Households; L = Low; M = Moderate; N/A – Not Available

Table 17. Relative importance of subsistence resources based on selected variables, Selawik

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	36	53	5	M
2	Caribou	65	82	20	H
3	Dall sheep	N/A	N/A	N/A	N/A
4	Bear	N/A	N/A	0.04	L
5	Other large land mammal	N/A	N/A	N/A	N/A
6	Small land mammal/furbearers	19	9	0.3	L
7	Marine mammals	10	75	1	H
8	Migratory birds	44	41	3	M
9	Upland birds	30	17	0.3	M
10	Bird eggs	6	3	0.02	L
11	Salmon	12	45	1	M
12	Non-salmon fish	65	59	68	H
13	Marine invertebrates	2	7	0.001	L
14	Vegetation	80	53	1	H

Source: See Table 2
Notes: H = High; HH = Households; L = Low; M = Moderate; N/A = Not Available

5.3.1 Subsistence Use Areas

Subsistence use areas for the Koyukuk River region study communities are focused around the upper and lower Koyukuk river drainages and various tributaries of the Koyukuk River, the upper Kobuk River, and overland areas surrounding the Koyukuk River and into the Brooks Range. Use areas for the northernmost Koyukuk River region study community of Anaktuvuk Pass extend onto the North Slope of Alaska and as far north as Nuiqsut, while use areas for the southernmost community of Huslia extend west to Kotzebue Sound and south to the Yukon River. More recently documented subsistence use areas for the study communities (Watson 2018; SRB&A Unpublished) indicate various changes to contemporary subsistence use areas compared to historic use areas, including certain changes brought about by establishment of the Gates of the Arctic National Park and Preserve (Watson 2018).

As shown on Map 11 and Map 12, Alatna and Allakaket subsistence use areas occur along the Koyukuk River between Huslia and the Dalton Highway, along the Alatna, Kanuti, and Hogatza rivers and various smaller tributaries of the Koyukuk River; and in various overland areas surrounding the Koyukuk River. Recent subsistence use areas documented for Alatna and Allakaket (Watson 2018; SRB&A Unpublished) indicate similar subsistence uses, with the greatest concentration of use occurring along the Koyukuk, Alatna, and Kanuti rivers. Ristroph et al. (2019) also recently documented traditional subsistence use areas in addition to place names that show similar areas of importance to Alatna and Allakaket; these use areas are displayed on Map 11 and Map 12 along with place name areas as documented by Jones et al. (1997). Areas of high overlapping use along the Alatna River are crossed by the northern project alternatives. Comparison of more recent use area data to historic use areas indicate a shift away from overland use and toward riverine use. According to Watson (2018) contemporary large land mammal hunting by Alatna and Allakaket hunters, including hunting of Dall sheep and moose, occurs along the Koyukuk and Alatna rivers. Hunting of Dall sheep is focused on drainages that extend into the Brooks Range (Alatna and John rivers), while moose hunting occurs along a more extensive riverine area including the Koyukuk River drainage both upriver and downriver from Alatna and Allakaket, Henshaw Creek, Kanuti River, and Hogatza River. Furbearer trapping occurs along the Kanuti River and along the Koyukuk as far as the Dalton Highway; recent furbearer trapping areas are more concentrated along river corridors than historic trapping areas (Watson 2018). Non-salmon fish harvesting is also focused along the Koyukuk River, Henshaw Creek, Alatna River, and Kanuti River, while salmon harvesting is limited primarily to the Alatna River and Henshaw Creek areas. Harvest of vegetation is also focused on the Alatna River and Henshaw Creek.

Map 13 shows use areas for Anaktuvuk Pass occurring throughout the Brooks Range and into the foothills of the Brooks Range on the North Slope. Use areas for this community extend into the John River which is a tributary of the Koyukuk River. In addition, community residents travel to the west and southwest of the community and have reported caribou and furbearer hunting areas which overlap with the terminus of the project alternatives. According to Brown et al. (2016), during the 2014 study year hunting for caribou, moose, and Dall sheep occurred in various drainages of the Brooks Range, including the John River, a tributary of the Koyukuk River. Caribou hunting also extended into the foothills of the Brooks Range on the North Slope. Various other resource activities extended into the John River drainage, including small land mammal hunting/trapping, non-salmon fish harvesting, and vegetation harvesting.

Use areas for Bettles and Evansville are shown on Map 14 and Map 15 and indicate use areas that extend along the foothills of the Brooks Range; along various drainages of the southern Brooks Range, including the Kobuk River, upper Koyukuk River, Alatna River, and John River; and along the Dalton Highway north of Coldfoot and Wiseman. Some isolated use areas occur on the North Slope. Recent studies indicate somewhat disjointed subsistence use areas which may reflect the increased use of planes for accessing harvesting areas, in addition to the creation of the Gates of the Arctic National Park which limits residents' access and harvesting activities. In terms of specific resources, contemporary Dall sheep use areas occur along the Koyukuk River, including the Middle Fork Koyukuk parallel to the Dalton Highway. Moose hunting occurs in a large area surrounding the upper Alatna River in the Brooks Range, and in an area surrounding the community along the John, Wild, and Koyukuk rivers. Trapping also occurs in an area surrounding the Alatna River and Iniakuk Lake, in addition to the John and Koyukuk rivers. Caribou hunting occurs near the communities of Bettles and Evansville, near Iniakuk Lake, and in the foothills of the Brooks Range on the North Slope. Residents access fish in various lakes and rivers of the Brooks Range in addition to the upper Kobuk River, John River, and North Fork Koyukuk River. Contemporary vegetation harvesting occurs in several areas of the Brooks Range surrounding Walker Lake, Iniakuk Lake, and Evansville and Bettles.

Coldfoot and Wiseman use areas are depicted on Map 16 and Map 17 and indicate subsistence harvesting activities surrounding the Dalton Highway in the Brooks Range and at various locations to the west and southwest of the communities including along the Koyukuk River, Alatna River, John River, and upper Kobuk River. Recently documented resource-specific use areas (SRB&A Unpublished) for the 2005–2014 time period show moose, caribou, bear and small land mammal hunting occurring primarily along the Dalton Highway in addition to various mountain passes extending off of the Dalton Highway. Dall sheep hunting occurs in larger areas off of the highway into the mountains. Hunting of large and small land mammals, in addition to bird hunting occurs primarily to the north of the communities although some activities occur farther south in or near the upper Koyukuk River drainages. Harvesting of non-salmon fish occurs primarily south of the communities along the Dalton Highway where it crosses the South Fork Koyukuk and Jim rivers, in addition to various small lakes in the Brooks Range.

Subsistence use areas for Hughes are shown on Map 18. Use areas for this community are primarily focused along the Koyukuk River between Huslia and Evansville/Bettles and along the Alatna River into the Brooks Range. In addition, Hughes subsistence harvesting areas extend overland from the community both south and north of the Koyukuk River. The southern project alternative crosses through the heart of Hughes subsistence harvesting areas near the community, while the northern alternatives cross through subsistence harvesting areas along the Alatna and John rivers. According to Watson (2018), contemporary subsistence use areas occur over a more extensive riverine area, although this may be attributed to the lack of documentation of Dall sheep use areas in earlier studies. Contemporary Dall sheep use areas occur along the Koyukuk River upriver from the community and substantial distances into the Alatna and John rivers. Contemporary and historic moose hunting occur in similar areas both upriver and downriver from the community of Hughes. Furbearer hunting and trapping occurs overland both north and south of the community and along the Koyukuk River between Huslia and Alatna/Allakaket. Salmon and non-salmon fish harvesting both occur in the Koyukuk River near Hughes, while vegetation harvesting occurs primarily downriver from the community.

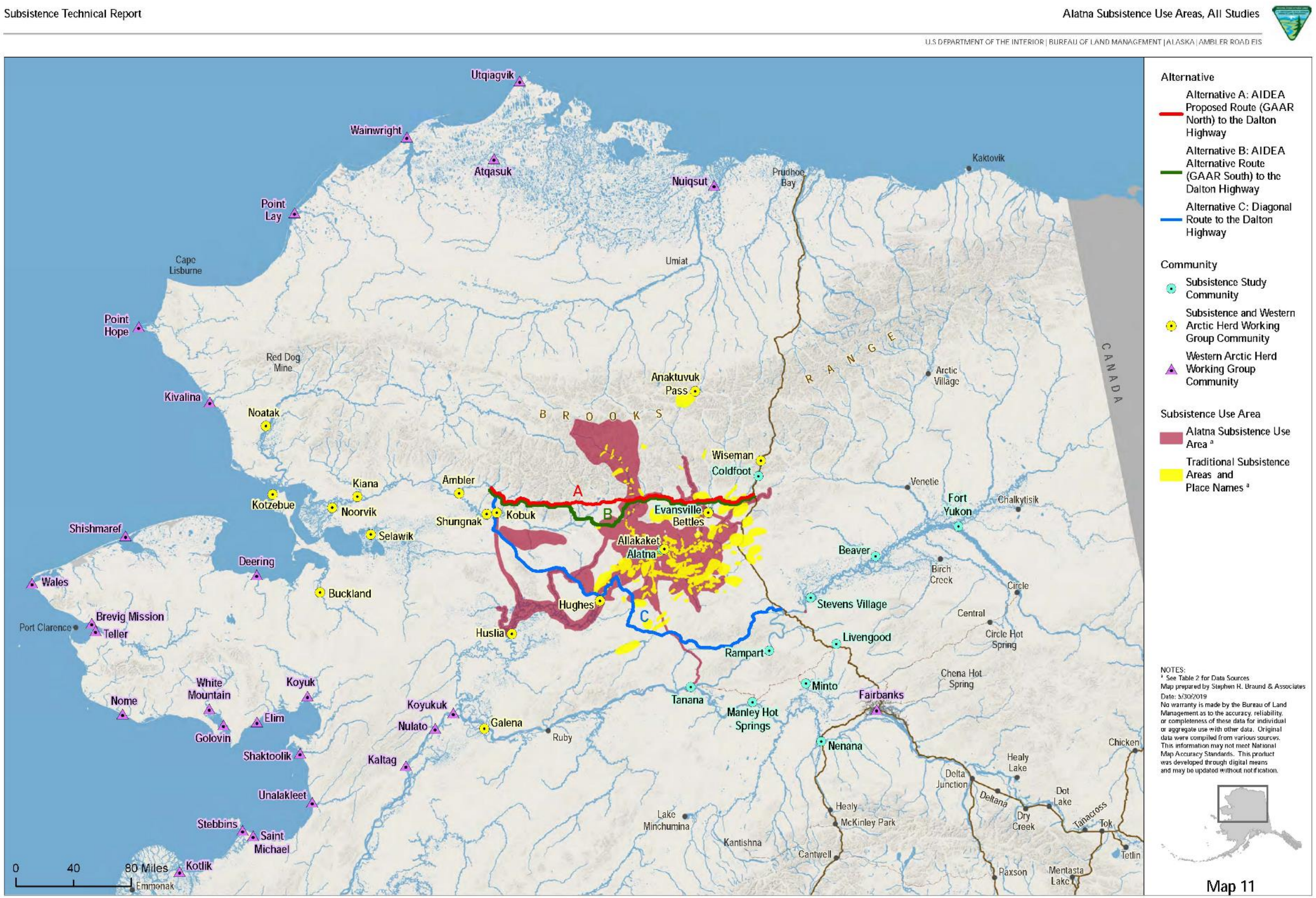
Huslia use areas (Map 19) occur along the mid- to lower-Koyukuk River, the Yukon River, and in large overland areas which extend to the north and west toward Buckland, Selawik, and along the Kobuk River from Shungnak to Kotzebue Sound. Huslia use areas, including overland hunting areas to the north of the community and use areas along the Koyukuk River, are overlapped with the southern project corridor. Watson (2018) indicates that the community's primary hunting areas occur along the Yukon River toward Ruby, along the Koyukuk River to Hughes, and in an overland areas between the Koyukuk River and the Kobuk River. Other overland areas, such as those toward Buckland, Selawik, and Kotzebue are less commonly used. More recent contemporary use areas compared to historic use areas indicate an expansion of harvest areas over time, although this may be partly attributed to underreporting of use areas during earlier studies (Watson 2018), as respondents characterized their contemporary areas as "traditional" areas that were used by their elders. Moose hunting by Huslia residents occurs along the

Yukon and Koyukuk rivers in addition to some overland use areas directly around the community. Caribou hunting extends over a larger overland area, including hunting areas between the Koyukuk River toward Selawik and Buckland, which is reflective of recent reports of changes in caribou distribution toward the Buckland area. Non-salmon fish harvesting occurs in various lake systems and creeks surrounding the Koyukuk River, including Clear Creek, Caribou Creek, and the Huslia River. Residents fish for salmon in various river systems including the Yukon, Koyukuk, and Kobuk rivers (Watson 2018).

5.3.2 Harvest Data

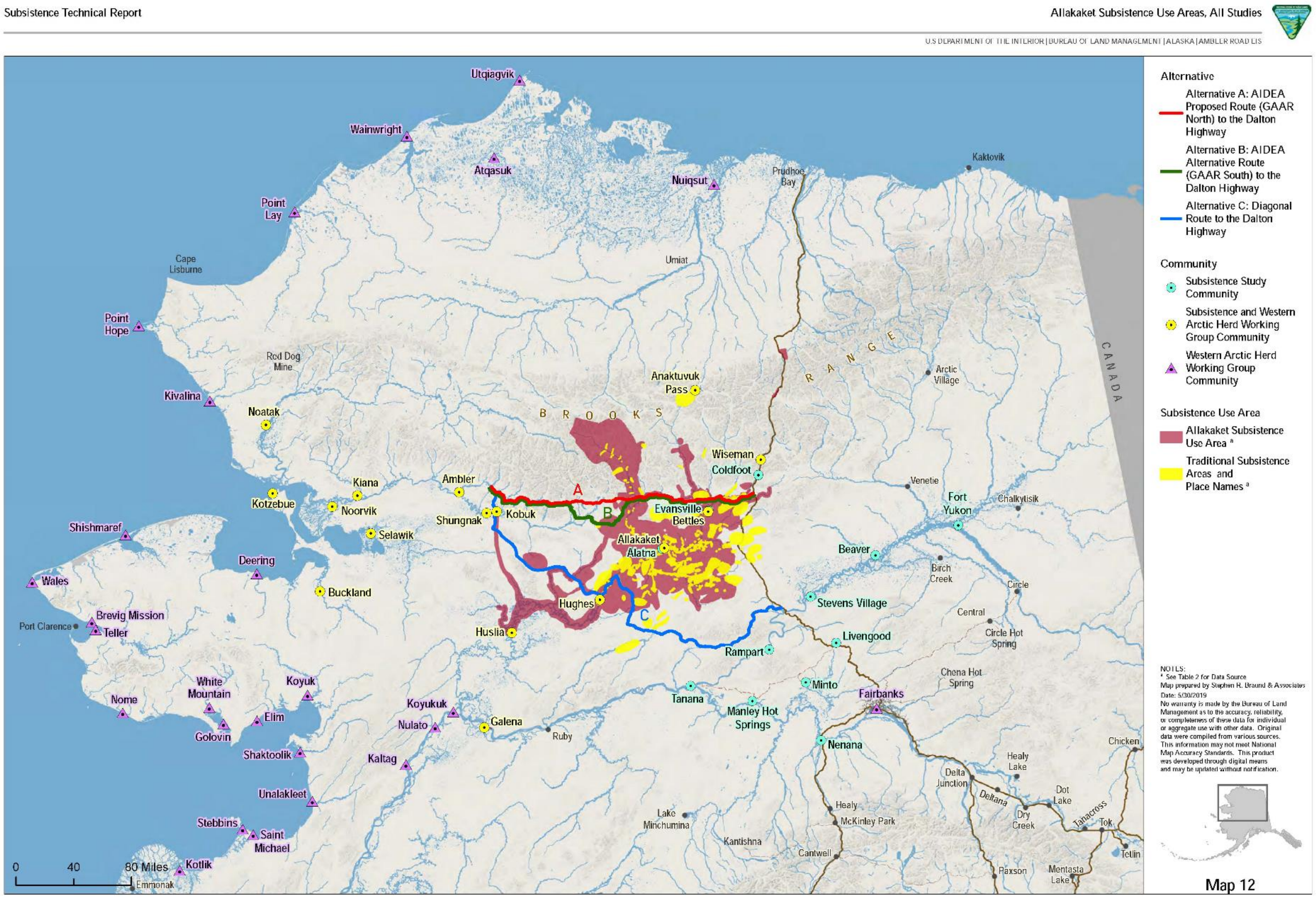
Harvest data for the Koyukuk River study communities are provided on Figure 7 through Figure 9 and in Table 18. As shown on Figure 7, based on an average of available data, salmon is the primary resource harvested among the study communities in terms of percentage of usable pounds (31 percent), followed closely by moose (28 percent) and caribou (26 percent). Non-salmon fish (12 percent) and vegetation (4 percent) also contribute a substantial amount to Koyukuk River Region study communities. Other resources which contribute smaller amounts in terms of pounds include Dall sheep, small land mammals, and migratory birds. Resource contribution varies widely among the Koyukuk River Region study communities, reflecting the large variation in geography and resource availability across the region. The communities of Anaktuvuk Pass and Coldfoot rely on caribou for a majority of their harvests, with caribou contributing over 80 percent of the harvest. Compared to the other subsistence study communities, these two communities have access to the Central Arctic Herd on the North Slope. Bettles, Evansville, and Wiseman rely primarily on moose for their subsistence harvests, while Alatna, Allakaket, Hughes, and Huslia rely primarily on non-salmon fish harvests.

This page is intentionally left blank.



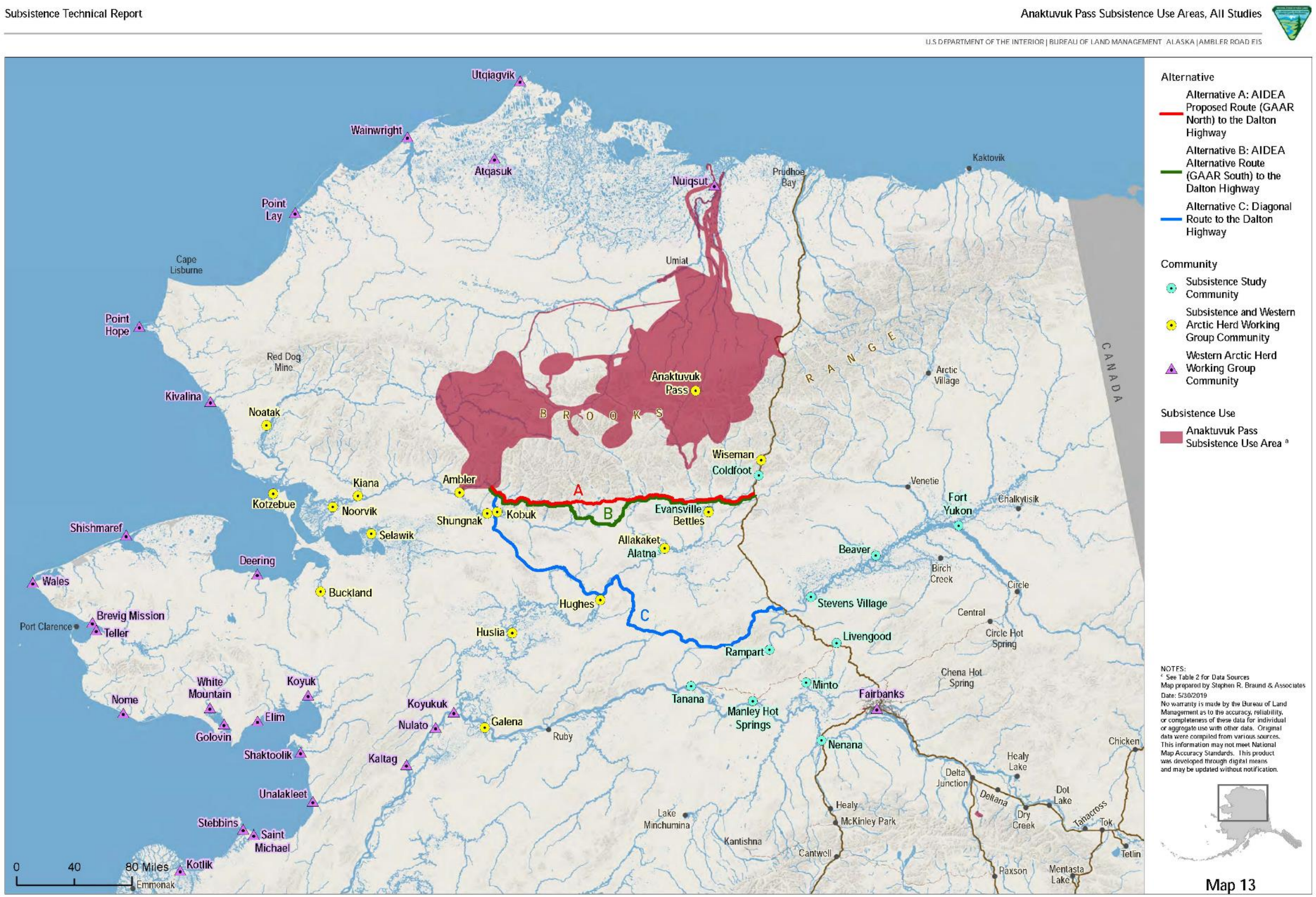
Map 11. Alatna subsistence use areas, all studies

This page is intentionally left blank.



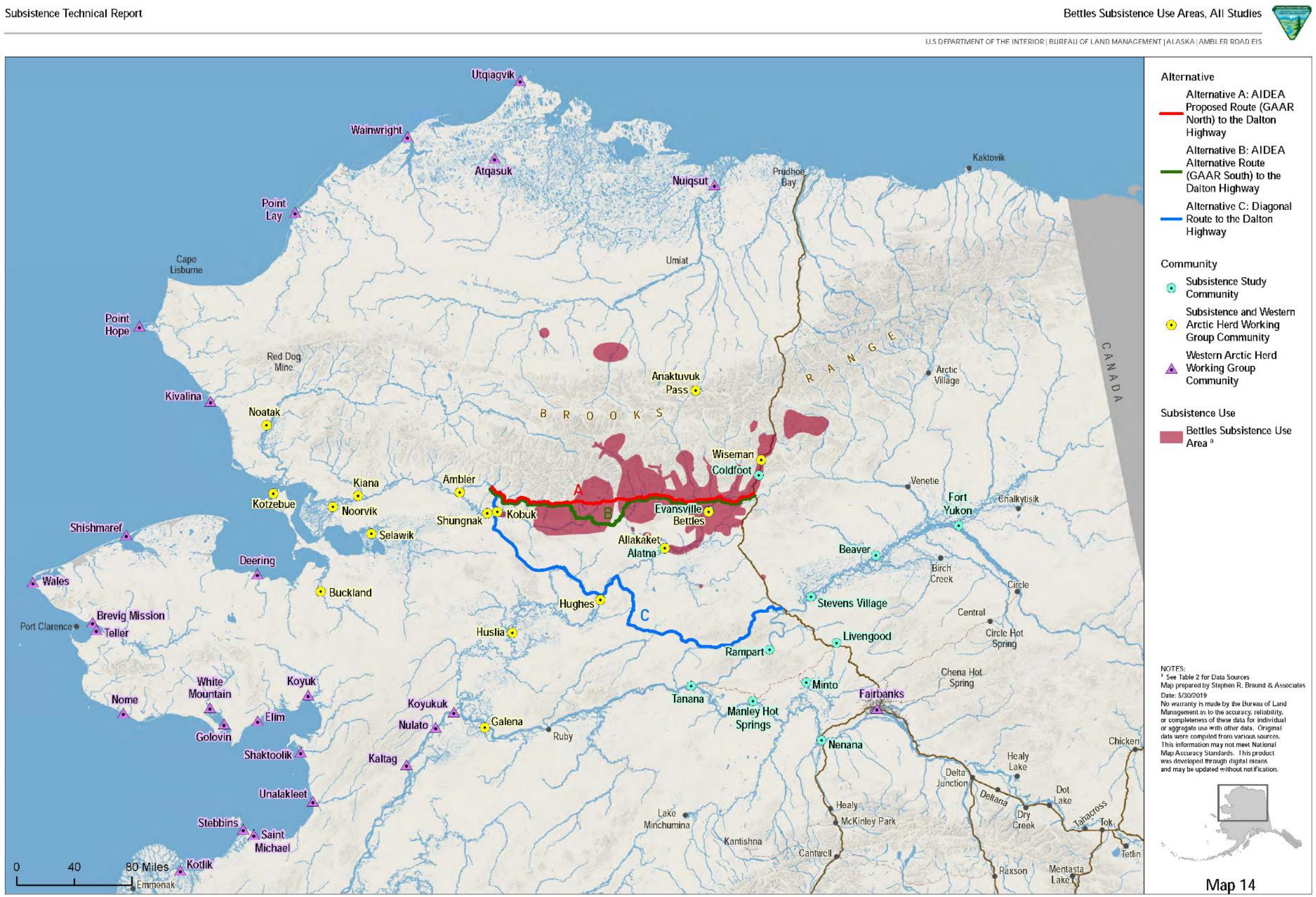
Map 12. Allakaket subsistence use areas, all studies

This page is intentionally left blank.



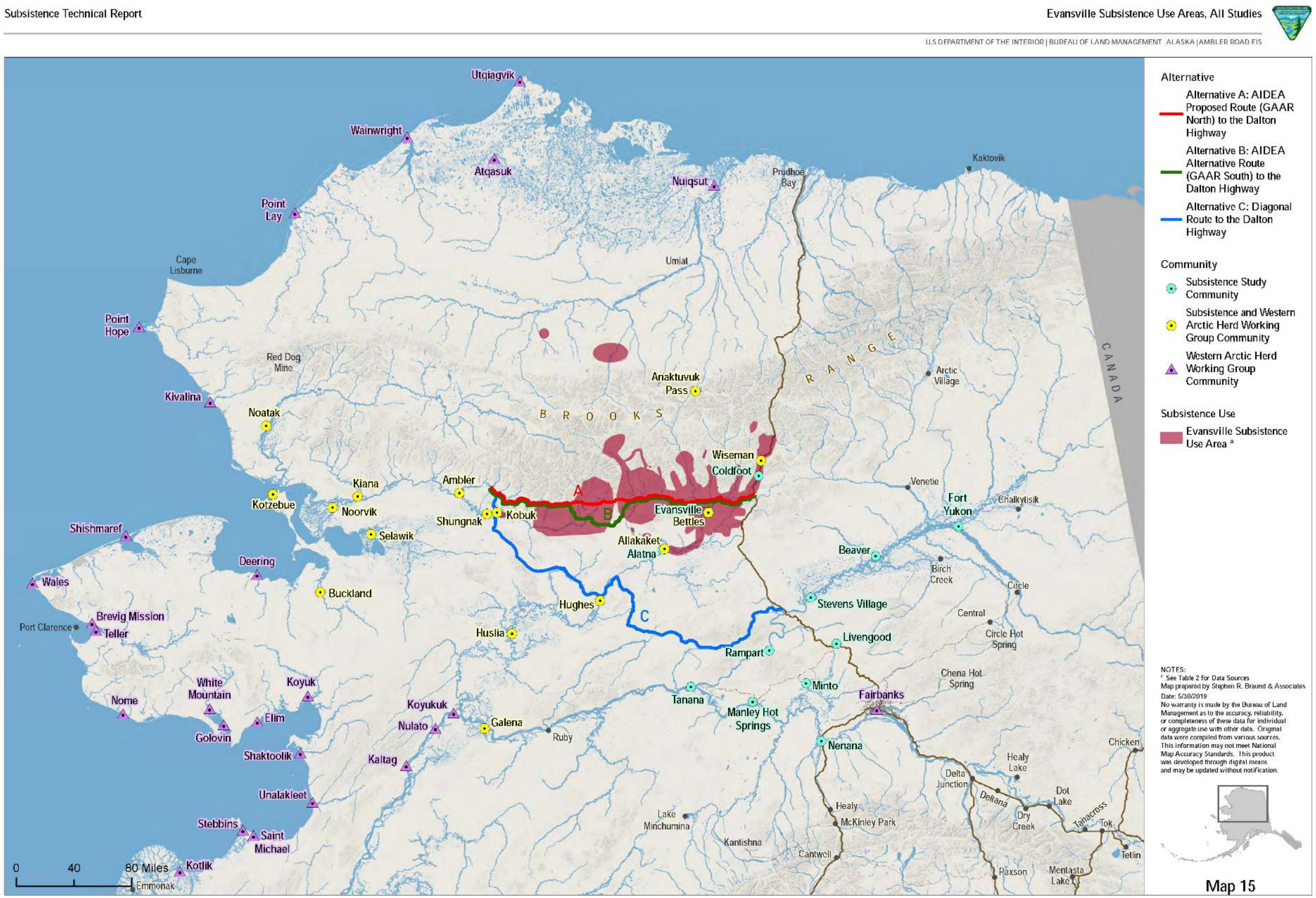
Map 13. Anaktuvuk Pass subsistence use areas, all studies

This page is intentionally left blank.



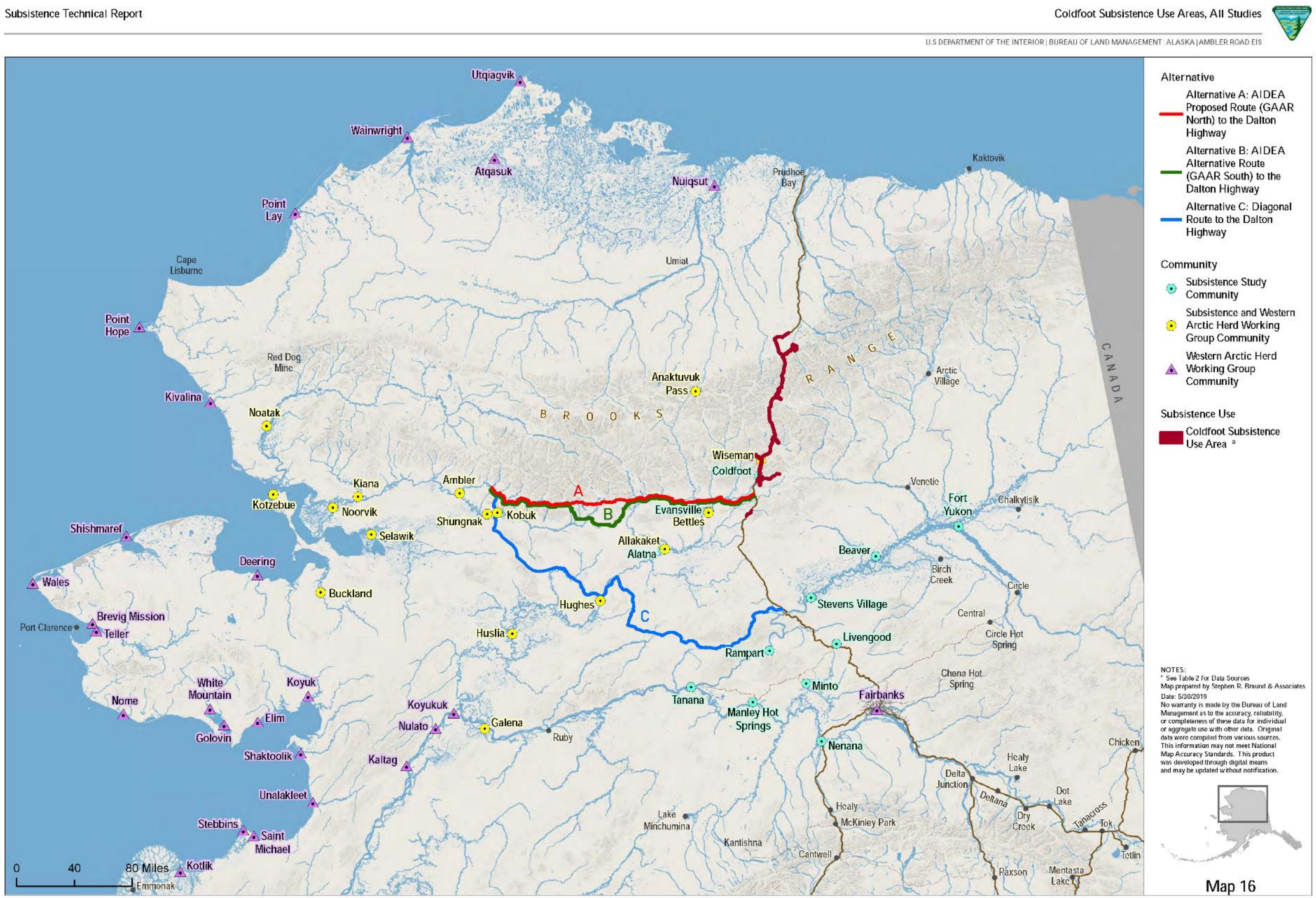
Map 14. Bettles subsistence use areas, all studies

This page is intentionally left blank.



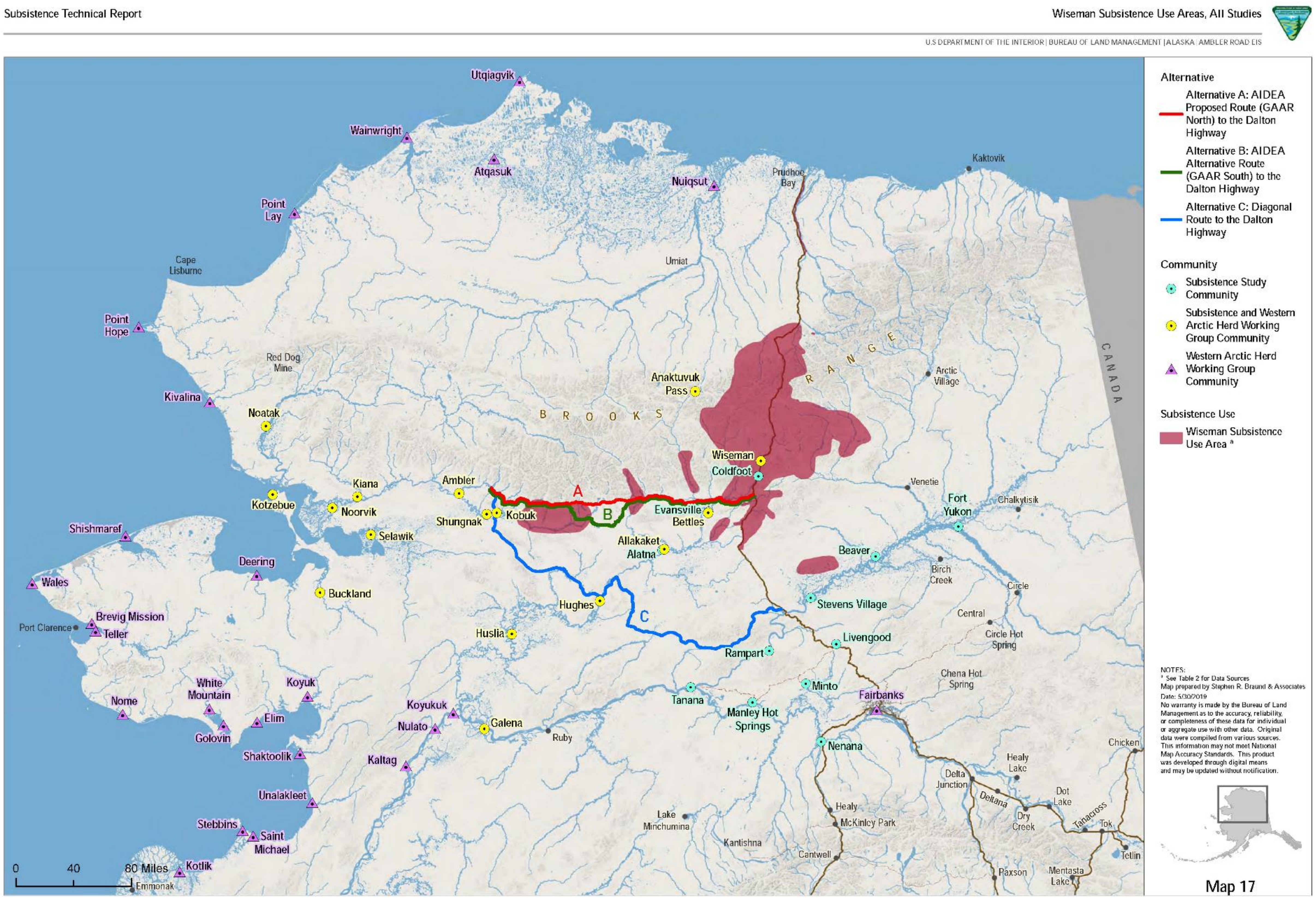
Map 15. Evansville subsistence use areas, all studies

This page is intentionally left blank.



Map 16. Coldfoot subsistence use areas, all studies

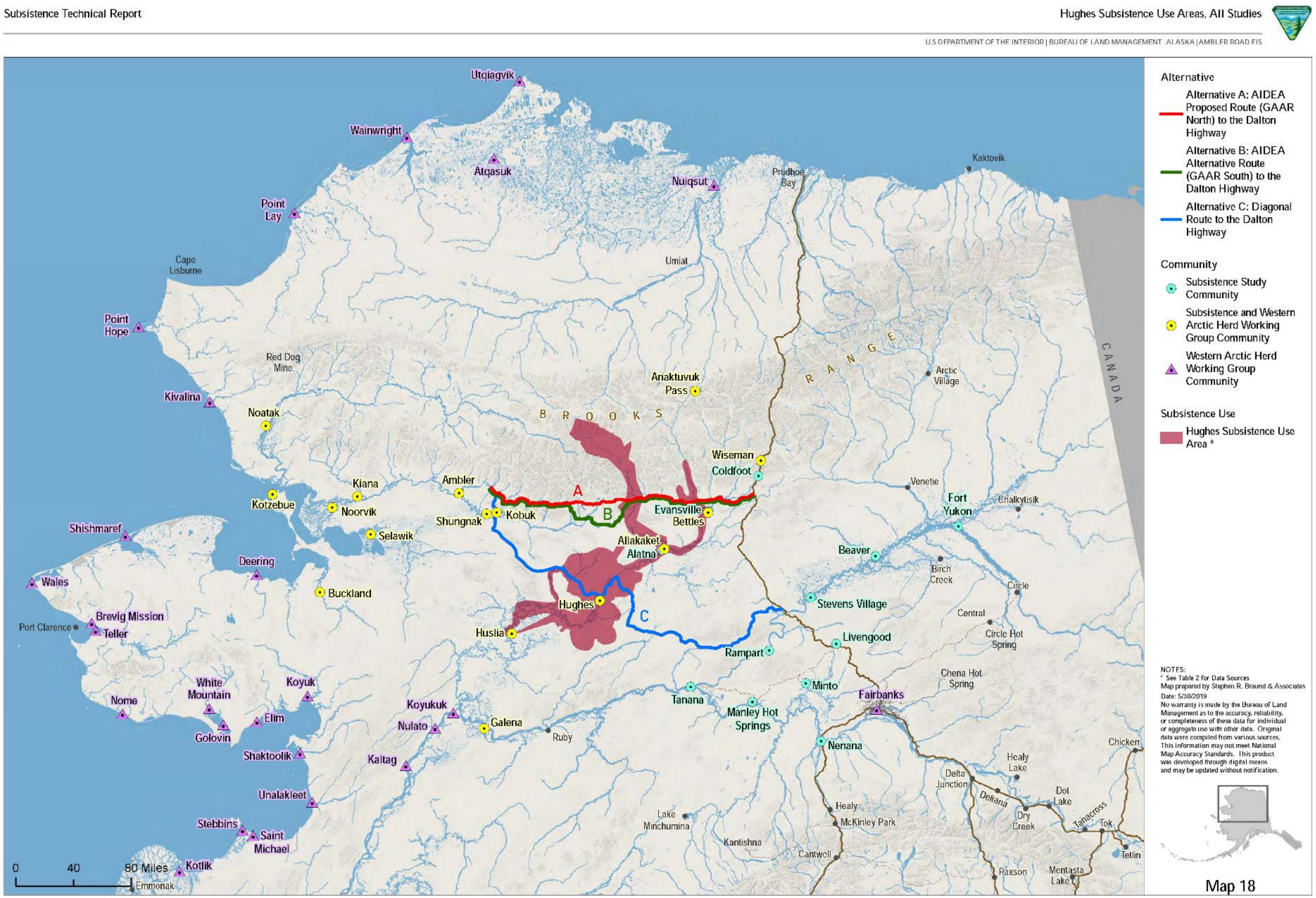
This page is intentionally left blank.



s

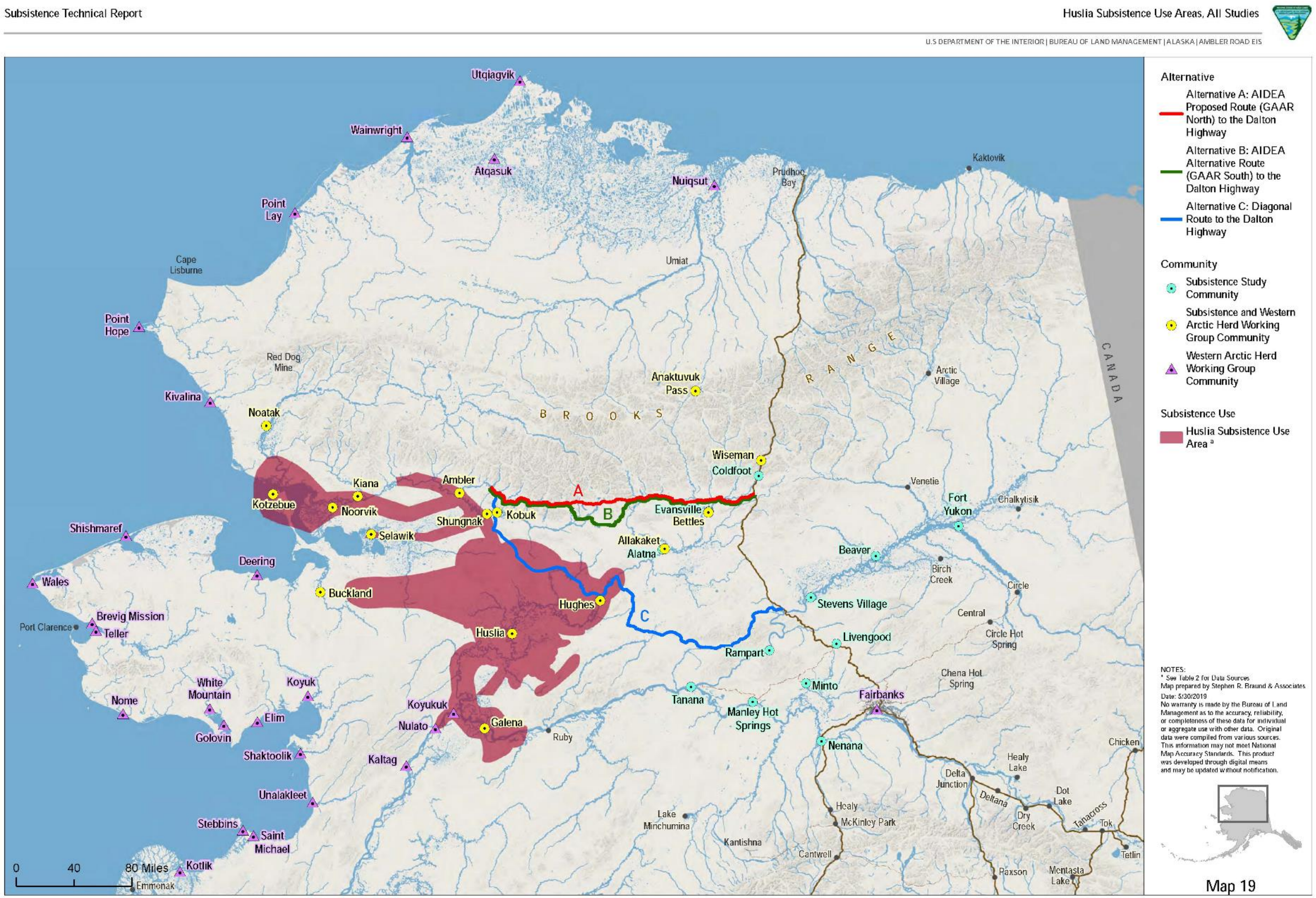
Map 17. Wiseman subsistence use areas, all studies

This page is intentionally left blank.



Map 18. Hughes subsistence use areas, all studies

This page is intentionally left blank.



Map 19. Huslia subsistence use areas, all studies

This page is intentionally left blank.

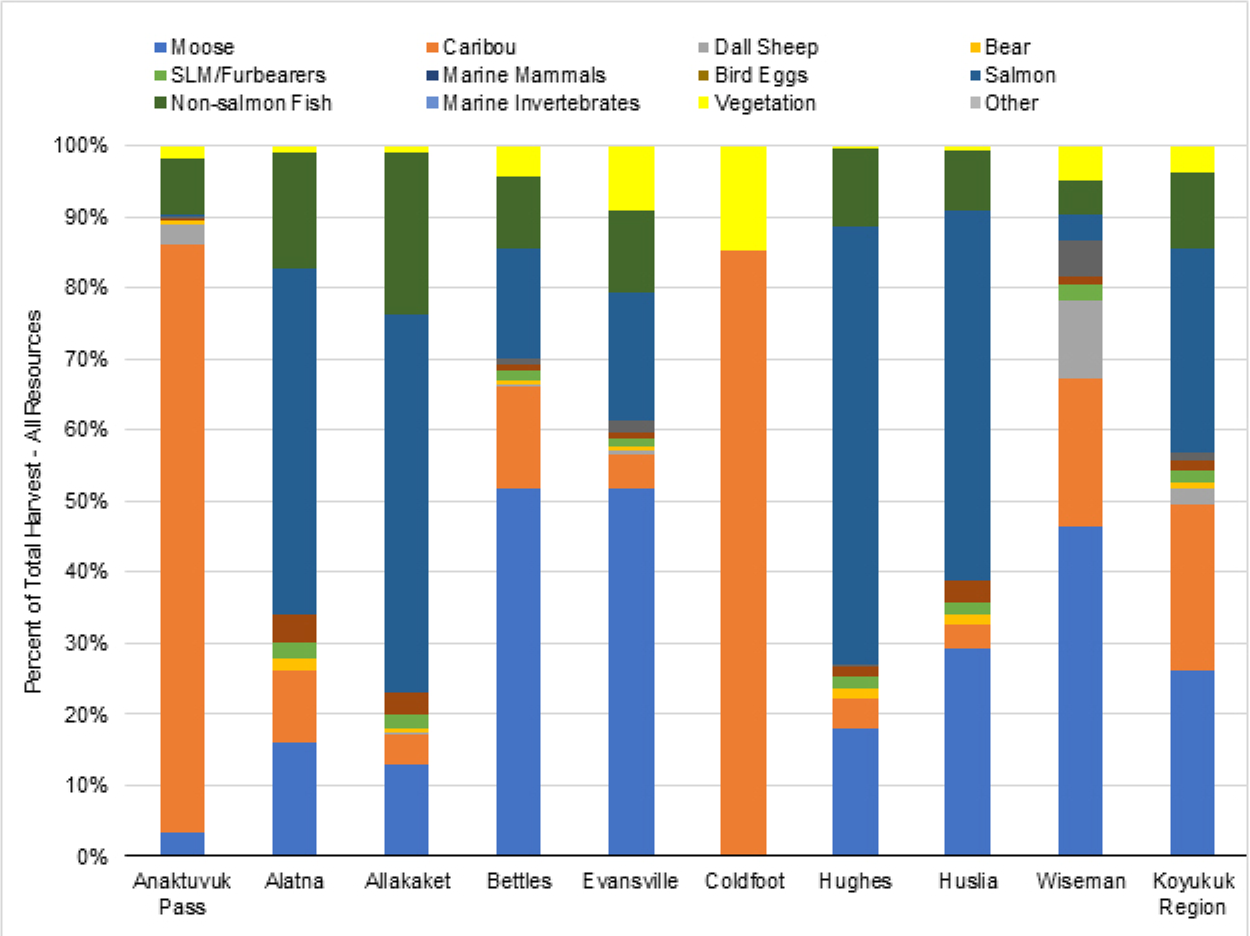


Figure 7. All resources percent of total harvest by Koyukuk River region communities
Source: See Table 2

Average participation rates among Koyukuk River Region study communities, in terms of the average percentage of households attempting harvests by resource, are shown on Figure 8. Across all Koyukuk River Region study communities, households most commonly participate in harvests of vegetation (89 percent of households), followed by non-salmon fish (59 percent), moose (54 percent), upland birds (49 percent), migratory birds (43 percent), and caribou (45 percent). Fewer households participate in harvests of marine mammals, salmon, Dall sheep, and small land mammals. While all communities report high participation rates overall, participation in specific resource harvesting activities varies by community. For example, while Dall sheep hunting is not particularly common for the region as a whole, a substantial percentage of households in Wiseman (80 percent) and Anaktuvuk Pass (32 percent) engage in this activity. The average percentage of households receiving different resources is shown on Figure 9. Similar to the Kobuk River and Kotzebue Sound regions, some resources which are not regularly harvested by Koyukuk River Region study communities are still highly consumed through sharing with other regions. For example, while only 1 percent of households hunt marine mammals, nearly 50 percent of households receive this resource. In addition to marine mammals, the most commonly shared resources in Koyukuk River Region communities (more than half of households receiving) include non-salmon fish, moose, vegetation, and salmon.

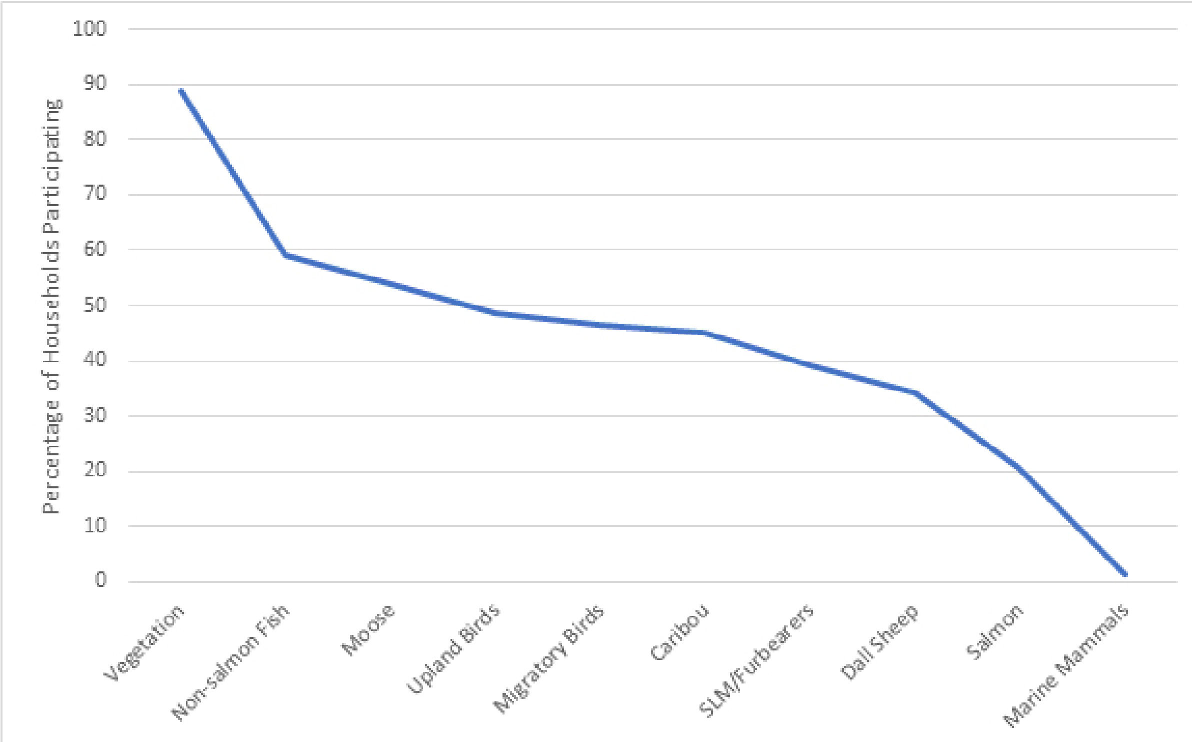


Figure 8. Percent of households attempting harvests of resources, Koyukuk River region communities
Source: See Table 2

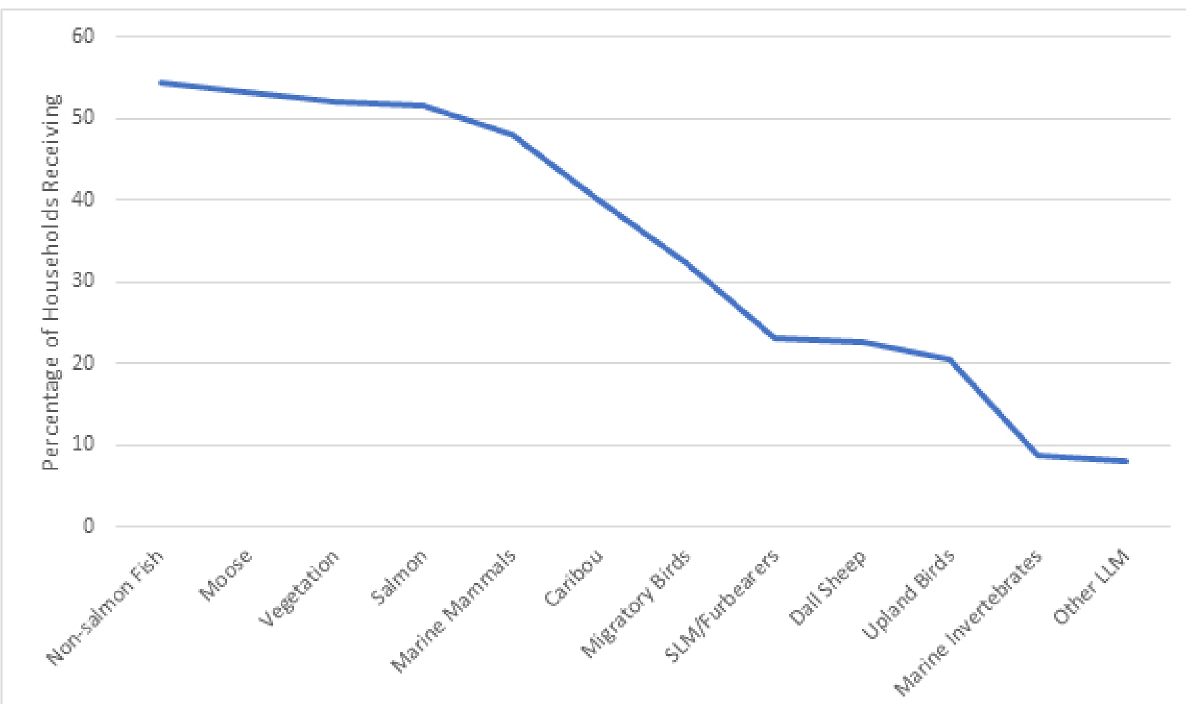


Figure 9. Percent of households receiving resources, Koyukuk River region communities
Source: See Table 2

Table 18 shows average harvest and use data for the top five species harvested (in terms of average contribution toward the total subsistence harvest) by each of the Koyukuk River Region study communities. Chum salmon is the top species in four of the nine study communities (Alatna, Allakaket, Hughes, and Huslia), contributing between 44 percent and 57 percent of the total subsistence harvest. Moose is the top harvested resource in three of the nine study communities (Bettles, Evansville, and Wiseman; between 46 and 52 percent), and caribou is the top harvested in two of the nine study communities (Anaktuvuk Pass and Coldfoot; 86 and 85 percent respectively). Other top species in the Kotzebue Sound Region include sheefish (Alatna, Allakaket, and Huslia), whitefish (Alatna, Allakaket, and Hughes), other salmon species (Chinook and sockeye; Allakaket and Evansville), Dall sheep (Anaktuvuk Pass, Wiseman), black bear (Huslia), and berries (Anaktuvuk Pass, Bettles, Coldfoot, Evansville, and Wiseman).

5.3.3 Timing of Subsistence Activities

Data on the timing of subsistence activities for Koyukuk River study communities are provided in Table 19. This table shows the number of communities reporting subsistence activity or harvests within each month, based on the most recent data sources for each community. Overall, Koyukuk River communities target the greatest number of resources during the spring months of April and the summer/fall months of August and September.

Spring (April-May) in the Koyukuk River Region is characterized by warming temperatures, breakup on the rivers, and lengthening days. Spring marks a decrease in seasonal harvests of furbearers, upland birds, and small land mammals; however, it also marks the beginning of the waterfowl hunting season, as ducks and geese arrive in the area. Koyukuk River Region residents occasionally harvest small land mammals, including marten, hare, and beaver, in the springtime, but harvest by month data show harvests more commonly occurring over the winter months (Van Lanen et al. 2012, Holen et al. 2012). Fishing for non-salmon fish occurs in the region during the springtime, either through the ice or after breakup in the open water. Harvests of caribou, bear, and sheep may also occur in the springtime in a number of communities.

While non-salmon fish and plants and berries are harvested year round in the Koyukuk River Region, during summer (June-August) residents begin to focus on fishing and collecting plants and berries. Salmon abundances vary throughout the region and therefore harvesting salmon is a strong focus of some communities, including Allakaket and Alatna, while other communities located further from the major salmon rivers (i.e., Bettles and Evansville) focus their fishing endeavors on non-salmon fish. Berries are a particularly important resource in the region; they are among the highest- used resources (in terms of the percentage of households using) in many of the communities (Holen et al. 2012). Most large land mammal subsistence activity, more commonly a fall activity, occurs at the end of the summer in August. However, communities hunt bear year round and may also take a caribou in July. Harvests of waterfowl occur during the summer months, although harvest activities decrease during the July nesting and rearing period.

Table 18. Average harvest and use data, top 5 species, Koyukuk River region communities

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HHs receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% total harvest
Alatna	Chum salmon	50	33	42	33	33	8,865	54,036	1,157	321	44
Alatna	Moose	98	75	50	41	74	15	7,905	355	117	16
Alatna	Caribou	83	57	27	34	60	12	1,498	133	46	10
Alatna	Sheefish	67	67	47	29	33	1,335	9,340	203	56	10
Alatna	Whitefish	N/A	N/A	56		14	7,512	6,761	140	38	5
Allakaket	Chum salmon	50	38	42	31	19	9,723	58,398	1,216	346	48
Allakaket	Moose	97	73	52	45	65	34	17,676	332	98	13
Allakaket	Sheefish	72	53	55	34	27	1,968	13,111	266	80	12
Allakaket	Humpback whitefish	44	30	27	17	25	1,611	4,817	86	31	7
Allakaket	Chinook salmon	48	29	39	24	33	317	5,374	111	32	4
Anaktuvuk Pass	Caribou	92	61	49	49	68	514	65,678	784	222	86.2
Anaktuvuk Pass	Moose	29	10	6	9	24	4	2,230	25	7	3.2
Anaktuvuk Pass	Dall sheep	48	24	16	19	36	22	2,249	26	8	2.9
Anaktuvuk Pass	Berries	84	76	76	42	44	728	1,978	22	6	2.0
Anaktuvuk Pass	Grayling	70	68	50	43	29	1,715	1,471	17	5	2.0
Bettles	Moose	88	35	24	40	62	8	3,792	193	72	51.5
Bettles	Chum salmon	13	13	13		0	338	2,057	79	29	14.3
Bettles	Caribou	62	29	18	32	32	11	1,387	106	38	14.1
Bettles	Char	38	8	8	8	38	264	429	16	6	5.4

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HHs receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% total harvest
Bettles	Berries	N/A	N/A	43	N/A	N/A	160	638	23	8	4.7
Coldfoot	Caribou	75	50	25	50	50	2	325	65	33	85.3
Coldfoot	Blueberry	100	100	100	0	0	14	40	8	4	10.5
Coldfoot	Low bush cranberry	25	25	25	0	0	4	15	3	2	3.9
Evansville	Moose	78	33	20	39	68	7	3,201	133	55	51.4
Evansville	Chum salmon	N/A	N/A	21	N/A	5	447	2,725	103	38	13.7
Evansville	Sockeye salmon	46	8	8	31	46	18	91	7	5	8.6
Evansville	Low bush cranberry	77	69	69	54	46	22	89	7	4	8.4
Evansville	Blueberry	85	85	85	46	46	21	84	6	4	8.0
Hughes	Chum salmon	46	19	19	15	39	15,195	56,895	2,474	603	57
Hughes	Moose	96	62	57	35	69	26	13,083	538	140	18
Hughes	Caribou	31	27	6	4	18	10	1,360	40	15	4
Hughes	Chinook salmon	N/A	N/A	68		16	586	10,603	482	112	7
Hughes	Humpback whitefish	51	29	29	14	27	1,959	5,877	219	86	5
Huslia	Chum salmon	N/A	N/A	43	14	41	22,583	102,603	1,800	533	49.3
Huslia	Moose	99	66	58	36	52	79	44,774	608	198	28.8
Huslia	Caribou	75	40	33	23	38	107	13,880	182	60	3.3
Huslia	Sheefish	60	31	34	20	37	896	5,815	85	27	3.0
Huslia	Black bear	60	34	23	18	37	29	3,240	47	15	2.9
Wiseman	Moose	100	80	60	60	40	4	1,890	432	166	46.4
Wiseman	Caribou	80	80	60	60	20	7	890	104	40	20.9

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HHs receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% total harvest
Wiseman	Dall sheep	75	80	40	25	25	5	468	42	16	10.8
Wiseman	Low bush cranberry	100	100	100	40	20	42	169	34	13	4.4
Wiseman	Ptarmigan	80	80	80	40	N/A	229	151	46	18	3.8

Source: See Table 2
Notes: HH = Households; N/A = Not Available

Table 19. Kotzebue Sound region timing of subsistence activities, number of communities reporting subsistence activity

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon fish	5	7	6	4	7	8	8	8	8	5	4	6
Marine non-salmon fish	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salmon	N/A	N/A	N/A	N/A	2	6	4	4	4	2	N/A	N/A
Caribou	8	9	8	9	5	N/A	3	6	6	6	8	8
Moose	5	4	5	3	N/A	N/A	N/A	6	9	7	4	4
Bear	3	4	5	6	9	4	8	9	6	6	5	2
Sheep	3	3	3	3	N/A	3	3	7	6	4	3	3
Furbearers	2	2	2	2	N/A	N/A	N/A	N/A	N/A	N/A	2	2
Small land mammals	9	9	9	8	7	3	4	6	6	6	9	9
Upland birds	9	9	9	7	6	4	4	8	9	9	9	9
Waterfowl	N/A	N/A	N/A	6	8	6	2	3	3	N/A	N/A	N/A
Eggs	N/A	N/A	N/A	N/A	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Plants and berries	2	2	2	2	3	6	8	8	8	3	2	2
Wood	6	6	6	6	6	6	6	6	6	6	6	6
Total number of resources per month	10	10	10	11	10	9	10	11	11	10	10	10

Source: Holen et al. 2012; SRB&A Unpublished; SRB&A 2013a; Brown et al. 2016; Marcotte and Haynes 1985; Wilson and Kostick 2016; Andersen et al. 2004b; Marcotte 1986
Notes: Apr = April; Aug = August; Dec = December; Feb = February; Mar = March; Jan = January; Jul = July; Jun = June; N/A = Not applicable (no or limited subsistence activity); Nov = November; Oct = October; Sep = September
Koyukuk River Region Communities = 9 (Alatna, Allakaket, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Huslia, and Wiseman)
Each cell contains the number of communities reporting subsistence activity or harvests during each month, based on the most recent data source for each community. Months with only one community report harvests or activity are not included in the table. Resources with no subsistence activity data available are not included in the table.

Many subsistence activities which occur over the summer, including fishing, waterfowl hunting, and large land mammal hunting, continue or amplify during the fall (September-October). Caribou and moose are particularly important resources for the northern communities in the Koyukuk River Region (i.e., Wiseman, Coldfoot, Evansville, and Bettles), and by weight make up the majority of the annual subsistence harvest in these communities. Moose harvests most commonly occur in the month of September and residents harvest caribou during the fall and into the winter months. Dall sheep and bear harvests continue in early fall and berry picking may also continue from the summer into fall. Fall in the Koyukuk River Region marks the end of waterfowl subsistence activity and an increase of harvests of upland birds, such as grouse and ptarmigan. Wood is collected year-round and in the fall is a particularly important resource to prepare for heating through the upcoming winter.

During the winter season (November-March), focus shifts to harvests of small land mammals and furbearers as watersheds freeze over creating conditions for travel to trapping grounds. Pelts of the small mammals and furbearers are prime over the winter season and residents of the region hunt or trap for the pelts and/or meat of small mammals for subsistence purposes. Large land mammal harvests, including caribou, moose, bears, and sheep, occur over the winter months although moose, bear, and sheep harvests occur with more frequency during other seasons. Ice fishing for non-salmon fish occurs over winter months. In Bettles and Evansville changing ice conditions have decreased winter non-salmon fishing subsistence activities in recent years (Holen et al. 2012). Residents of the Koyukuk River Region harvest upland birds throughout the winter and into the spring as the annual cycle of subsistence activities begins again.

5.3.4 Travel Method

A recent subsistence mapping study (SRB&A Unpublished) collected data on travel methods for a majority of Koyukuk River study communities. The data show that a majority of use areas in the study communities are accessed by boat and, to a lesser extent, snowmachine. Other methods used to access subsistence use areas include truck/car, plane, ATV, and foot. Primary travel methods used to search for resources within use areas are boat, snowmachine, and foot (SRB&A Unpublished). Access and search methods vary by community. For example, the communities of Bettles and Evansville rely more heavily on plane travel to access subsistence use areas, although Watson (2018) indicates that access to airplanes may decrease with the newer generations. In addition, Wiseman and Coldfoot report much heavier use of trucks/cars to access their harvesting areas, given their proximity to the Dalton Highway. The communities of Alatna and Allakaket are much more likely to use boats to access their harvesting areas than other Koyukuk River study communities. Data on travel methods for Anaktuvuk Pass (SRB&A 2013b) indicate a heavy reliance on ATVs and snowmachines rather than boats, which reflects the lack of access to navigable rivers near that community. Travel routes documented for Anaktuvuk Pass show various overland travel routes which follow mountain passes to the south toward Bettles and Evansville and to the southwest as far as Ambler. Finally, travel method data for the community of Hughes are available in Wilson and Kostick (2016) and indicate that boat is the primary method used by community households, followed closely by snowmachine and to a lesser extent, ATV. Watson (2018), who mapped contemporary subsistence use areas for a number of the Koyukuk River study communities (Allakaket, Alatna, Bettles, Evansville, Hughes, and Huslia) included access routes to subsistence use areas within the use areas mapped in that study; thus many of the use areas shown on Map 11 through Map 19 include travel routes as well.

5.3.5 Resource Importance

The relative importance of subsistence resources to the individual Koyukuk River Region study communities, based on selected variables, is provided in Table 20 through Table 28 (see Section 4.3 for discussion of methods). Based on this analysis, vegetation is of high importance in the largest number of

Koyukuk River study communities (eight communities), followed by moose and non-salmon fish (seven communities), salmon (six communities), and caribou (five communities). Other resources of high importance in the Koyukuk River Region study communities include marine mammals (three communities), upland birds (two communities), and migratory birds and Dall sheep (one community each).

Table 20. Relative importance of subsistence resources based on selected variables, Alatna

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	75	74	16	H
2	Caribou	57	34	10	M
3	Dall Sheep	N/A	9	0.1	L
4	Bear	N/A	N/A	1	L
5	Other LLM	N/A	N/A	N/A	I
6	SLM/Furbearers	67	67	2	M
7	Marine mammals	N/A	100	N/A	H
8	Migratory birds	83	83	4	H
9	Upland birds	83	50	0.2	H
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	33	50	48	H
12	Non-salmon fish	71	58	16	M
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	100	100	1	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M - Moderate; N/A = Not Available; LLM = Large land mammals; SLM = Small land mammals

Table 21. Relative importance of subsistence resources based on selected variables, Allakaket

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	16	14	6	M
2	Caribou	70	65	31	H
3	Dall sheep	1	N/A	N/A	L
4	Bear	N/A	N/A	N/A	I
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	16	2	1	L
7	Marine mammals	10	N/A	2	M
8	Migratory birds	38	N/A	1	M
9	Upland birds	8	N/A	0.03	L
10	Bird eggs	1	N/A	N/A	L
11	Salmon	64	82	24	H
12	Non-salmon fish	68	N/A	29	H
13	Marine invertebrates	4	N/A	1	L
14	Vegetation	73	N/A	4	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 22. Relative importance of subsistence resources based on selected variables, Anaktuvuk Pass

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	6	26	3	M
2	Caribou	66	68	84	H
3	Dall sheep	32	42	3	M
4	Bear	N/A	N/A	0.4	L
5	Other large land mammals	N/A	2	N/A	L
6	Small land mammals/furbearers	18	8	0.03	L
7	Marine mammals	1	60	N/A	H
8	Migratory birds	23	21	0.3	L
9	Upland birds	18	18	0.2	L
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	11	40	0.4	M
12	Non-salmon fish	74	61	8	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	79	47	2	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 23. Relative importance of subsistence resources based on selected variables, Bettles

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	35	62	51	H
2	Caribou	29	32	14	M
3	Dall sheep	13	19	0.4	L
4	Bear	N/A	N/A	1	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	50	13	1	M
7	Marine mammals	N/A	N/A	N/A	I
8	Migratory birds	13	N/A	1	L
9	Upland birds	25	13	1	L
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	13	25	15	M
12	Non-salmon fish	38	46	10	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	88	63	4	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 24. Relative importance of subsistence resources based on selected variables, Evansville

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	33	68	51	H
2	Caribou	18	50	5	H
3	Dall sheep	N/A	33	0.4	M
4	Bear	N/A	N/A	0.6	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	8	8	1.3	L
7	Marine mammals	N/A	23	N/A	L
8	Migratory birds	N/A	15	1	L
9	Upland birds	46	38	1.5	M
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	8	62	18	H
12	Non-salmon fish	38	60	12	H
13	Marine invertebrates	N/A	15	N/A	L
14	Vegetation	100	62	9	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 25. Relative importance of subsistence resources based on selected variables, Coldfoot

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	N/A	25	N/A	L
2	Caribou	50	50	85	H
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	N/A	I
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	N/A	N/A	N/A	I
7	Marine mammals	N/A	N/A	N/A	I
8	Migratory birds	N/A	N/A	N/A	I
9	Upland birds	N/A	25	N/A	L
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	N/A	25	N/A	L
12	Non-salmon fish	N/A	N/A	N/A	I
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	100	N/A	15	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 26. Relative importance of subsistence resources based on selected variables, Hughes

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	62	69	18	H
2	Caribou	27	18	4	M
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	1	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	31	12	2	M
7	Marine mammals	N/A	31	N/A	M
8	Migratory birds	46	19	1	M
9	Upland birds	46	4	0.2	M
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	19	50	61	H
12	Non-salmon fish	51	39	11	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	62	23	1	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 27. Relative importance of subsistence resources based on selected variables, Huslia

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	66	52	29	H
2	Caribou	40	38	3	M
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	1	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	N/A	18	2	M
7	Marine mammals	N/A	N/A	N/A	I
8	Migratory birds	N/A	27	3	M
9	Upland birds	N/A	7	0.1	L
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	N/A	52	51	H
12	Non-salmon fish	58	55	8	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	N/A	5	1	L

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 28. Relative importance of subsistence resources based on selected variables, Wiseman

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	80	40	46	H
2	Caribou	80	20	21	H
3	Dall sheep	80	25	11	H
4	Bear	N/A	N/A	N/A	I
5	Other large land mammals	N/A	20	N/A	L
6	Small land mammals/furbearers	60	N/A	2	M
7	Marine mammals	N/A	20	N/A	I
8	Migratory birds	60	20	1	M
9	Upland birds	80	20	5	H
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	20	100	4	H
12	Non-salmon fish	80	60	5	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	100	60	5	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

5.4. Tanana River

The Tanana River region includes the communities of Manley Hot Springs, Minto, Nenana, and Tanana. Tanana use areas are overlapped with the southern corridor alternative, while the three other Tanana River region communities have uses which occur within 30 miles of (but do not overlap with) the southern corridor. Three of four of the Tanana River region communities (Manley Hot Springs, Minto, and Nenana) are road-connected.

5.4.1 Subsistence Use Areas

Subsistence use areas for the Tanana River region study communities are focused around the Tanana River, Yukon River, Nenana River, and Minto Flats. For road-connected communities (e.g., Manley Hot Springs, Minto, and Nenana) use areas also occur along the Parks, Elliot, Steese, and/or Dalton highways. In the case of Nenana, documented use areas occur as far west as the Koyukuk River.

Manley Hot Springs subsistence use areas for all time periods are shown on Map 20. The community's harvesting activities occur in an area surrounding the community, along the Tanana River to its mouth, and upriver into the Minto Flats. In addition, use areas occur at several locations along the Yukon River. Use areas recently documented by the ADF&G (Brown et al. 2014) show salmon and non-salmon fish harvesting areas for the community occurring along the Tanana River and on the Yukon River at a location referred to as The Rapids. Additional non-salmon fish harvesting areas occur at various lakes and sloughs near the community. Large land mammal hunting for bears and moose occur along the Tanana River in addition to areas accessed along the local road system and several overland areas south and north of the community. Small land mammal hunting and trapping areas in addition to bird hunting and vegetation harvesting also occur in various overland areas north and south of the community and along the nearby road system. Vegetation harvesting areas also occur to the north of the community along the Yukon River.

Minto subsistence use areas (Map 21) occur throughout the Minto Flats, along the Elliot Highway, and along the Tanana, Kantishna, and Yukon rivers. Recent use areas documented for Minto (SRB&A Unpublished) show large land mammal (moose and bear) hunting concentrated in the Minto Flats including the Tolovana and Chatanika Rivers and Sawmill Slough. Small land mammal hunting and trapping is focused on the Chatanika and Tanana rivers in addition to various overland areas within the Minto Flats, to the north near the Elliot Highway, and at an isolated area long the Yukon River near Stevens Village. Waterfowl hunting is also concentrated within the Minto Flats close to the community and near Sawmill Slough, while upland bird hunting occurs most commonly along the road system out of Minto and along the Elliot Highway. Fishing for Minto residents occurs within the Minto Flats but with a majority of activity in the Tanana River and at various locations along the Yukon River. Non-salmon fish harvesting generally occurs closer to the community than salmon harvesting. Harvesting of berries and vegetation occur within the Minto Flats and to a lesser extent along the Elliot Highway.

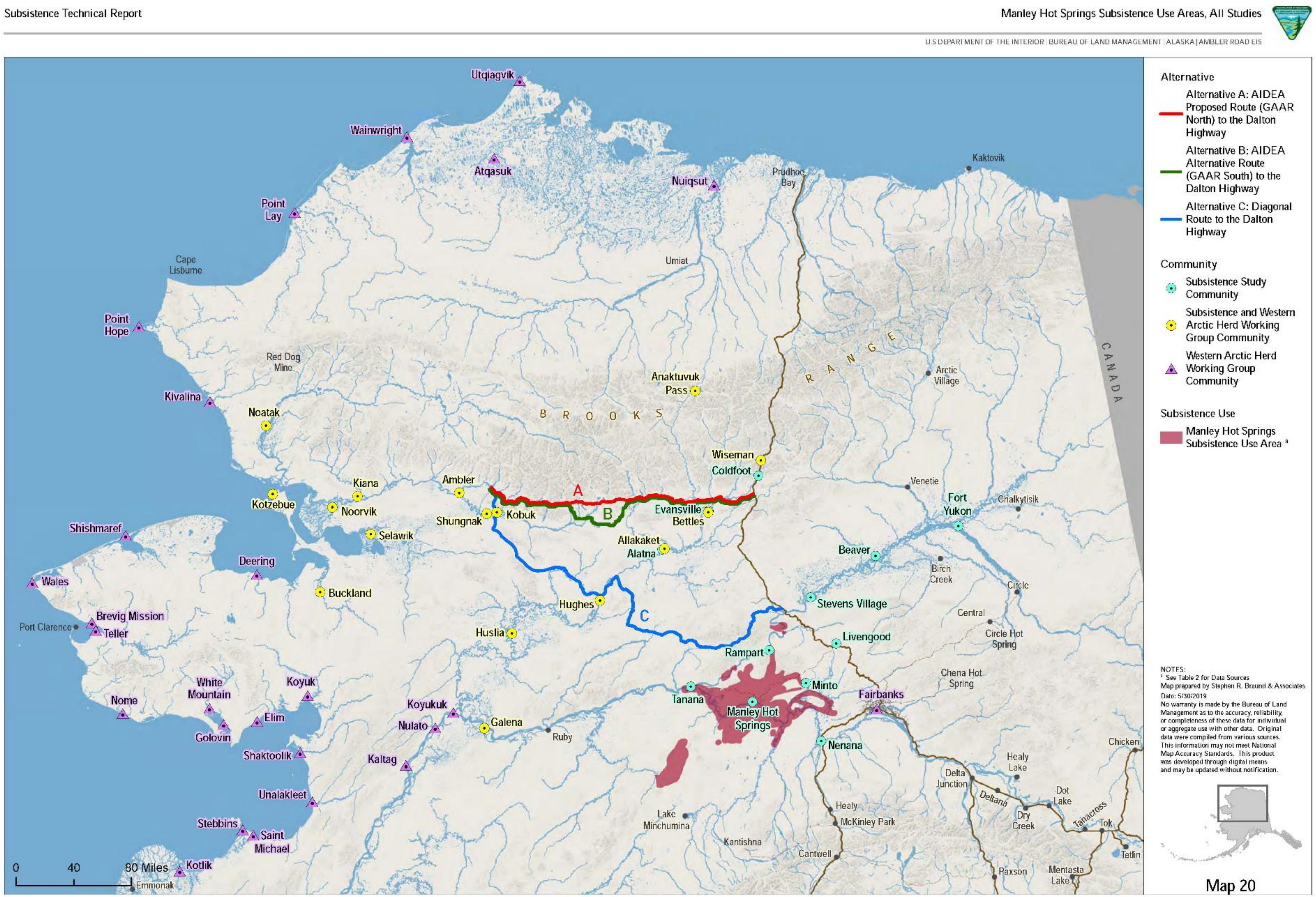
As shown on Map 22, Nenana use areas occur primarily along the Tanana, Nenana, and Kantishna rivers, portions of the Minto Flats, and along the highway system north and south of the community. Recent use areas documented for Nenana (SRB&A Unpublished) show large land mammal hunting for moose and bear occurring primarily along the Parks Highway south of the community and along the Tanana River and Minto Flats; waterfowl hunting occurs in a similar area. Caribou hunting by Nenana residents was reported primarily to the northeast of the community along the Steese Highway, while small land mammal and upland game hunting occur closer to the community and in overland areas extending north to the Elliot Highway. Salmon fishing by Nenana residents is focused along the Tanana River near the community, while non-salmon fish harvesting extends farther from the community into the Tanana River and Minto Flats. Vegetation harvesting occurs along the road system near to and south of the community of Nenana, in addition to various spots along the Tanana River and in the Minto Flats.

Of the four Tanana Region study communities, Tanana has uses closest to the AMDIAR project corridors, with subsistence use areas overlapping with the southern corridor alternative north of the Yukon River. Map 23 shows Tanana use areas extending along the Tanana and Yukon rivers and in overland areas both north and south of the Yukon River. Recently documented use areas for the 2014 time period (Brown et al. 2016) show moose hunting occur along the Yukon River downriver from their community, along the Tanana-Allakaket Winter Trail extending north of their community toward Allakaket, and along the Koyukuk River to Huslia. Small land mammal hunting and trapping occurs north of the community along the Tanana-Allakaket Winter Trail to its crossing with the Tozlina River, in addition to locations along the Yukon River and overland to the south of the community. Several caribou hunting areas were documented to the east and north of their community, including in the Ray Mountains. Fishing for salmon and non-salmon fish occurs on the Yukon River primarily in front of or upriver from the community of Tanana. Waterfowl hunting took place along the Yukon and Tanana rivers including the lake system surrounding Fish Creek and Fish Lake to the southeast of the community, while upland bird hunting occurred primarily in overland areas to the north and west of the community. Vegetation harvesting by Tanana residents took place in overland areas to the north of the community in addition to the Fish Creek/Fish Lake area southeast from the community.

5.4.2 Harvest Data

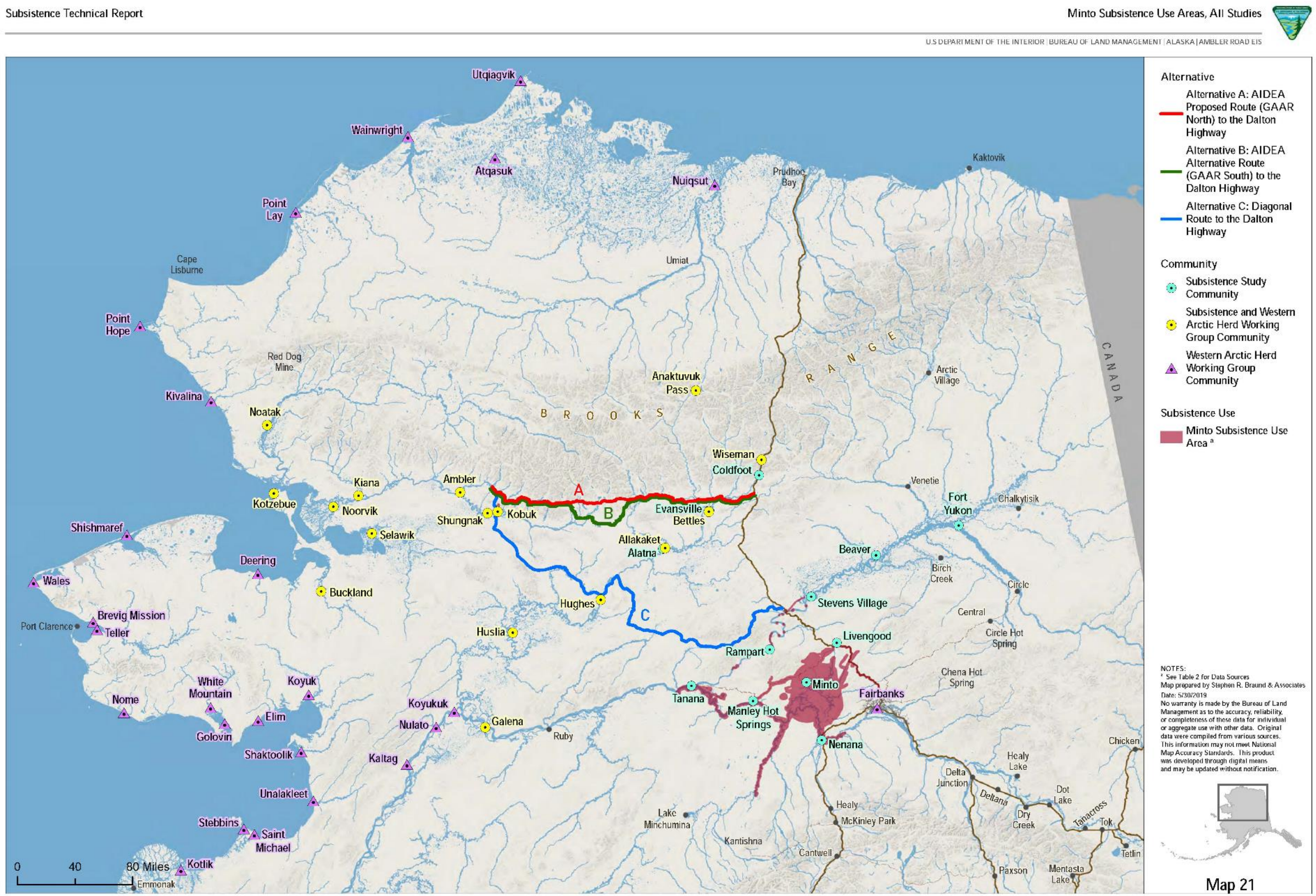
Harvest data for the Tanana River study communities are provided on Figure 10 through Figure 12 and in Table 29. As shown on Figure 10, based on an average of available data, salmon is the primary resource harvested among the study communities in terms of percentage of usable pounds (70 percent), followed by non-salmon fish (12 percent) and moose (11 percent). Other resources which contribute smaller amounts in terms of pounds include vegetation, small land mammals, migratory birds, and caribou. Resource contribution is relatively similar among the Tanana River Region study communities, although Minto relies more heavily on moose harvests than the other study communities, at 22 percent of the total harvest. Data on resource contribution are not available for the community of Nenana, for which there are no comprehensive (i.e., all resources) harvest studies.

This page is intentionally left blank.



Map 20. Manley Hot Springs subsistence use areas, all studies

This page is intentionally left blank.



Map 21. Minto subsistence use areas, all studies

This page is intentionally left blank.

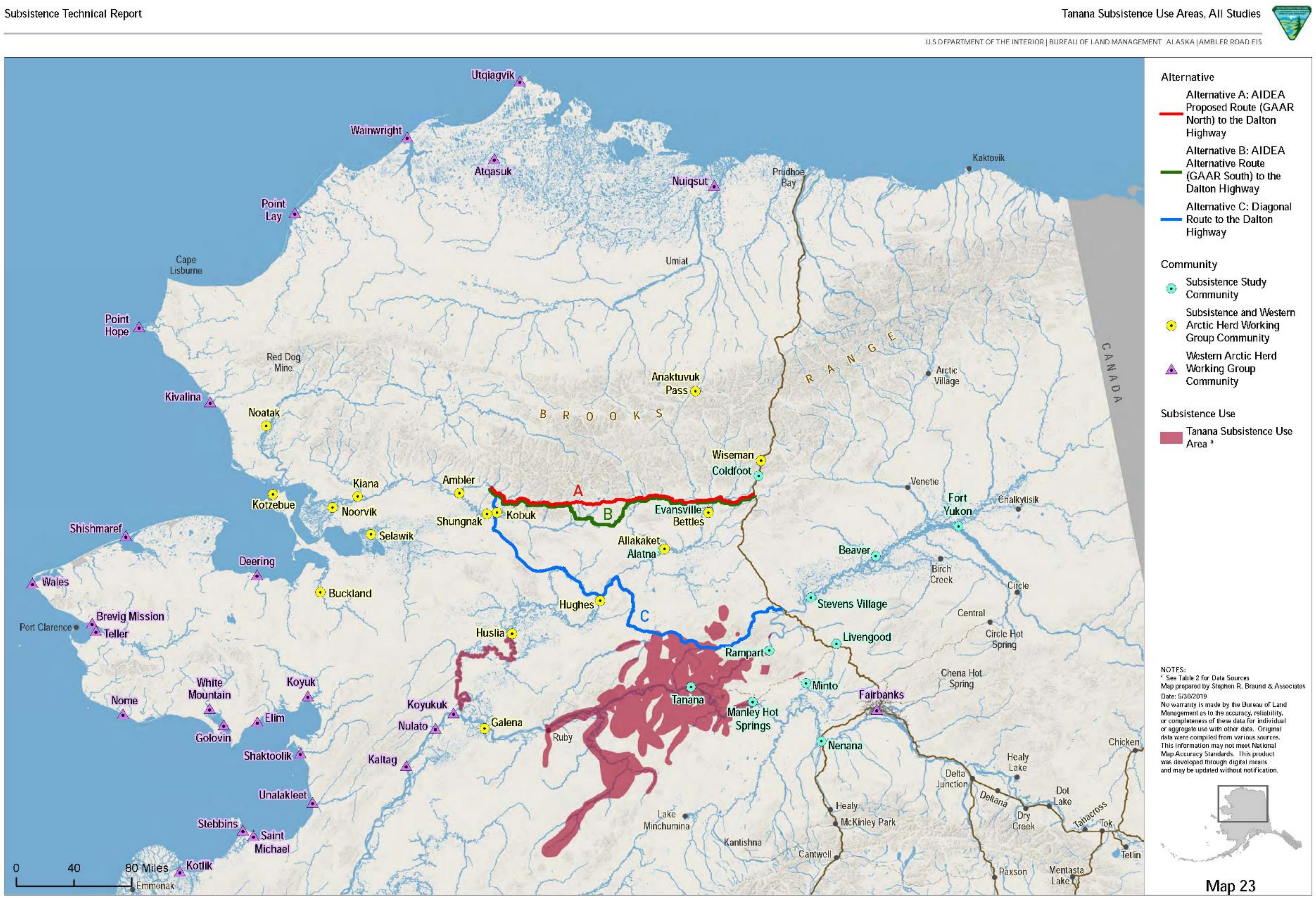
Subsistence Technical Report

Nenana Subsistence Use Areas, All Studies

U.S DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT | ALASKA | AMBLER ROAD EIS

Map 22. Nenana subsistence use areas, all studies

This page is intentionally left blank.



Map 23. Tanana subsistence use areas, all studies

This page is intentionally left blank.

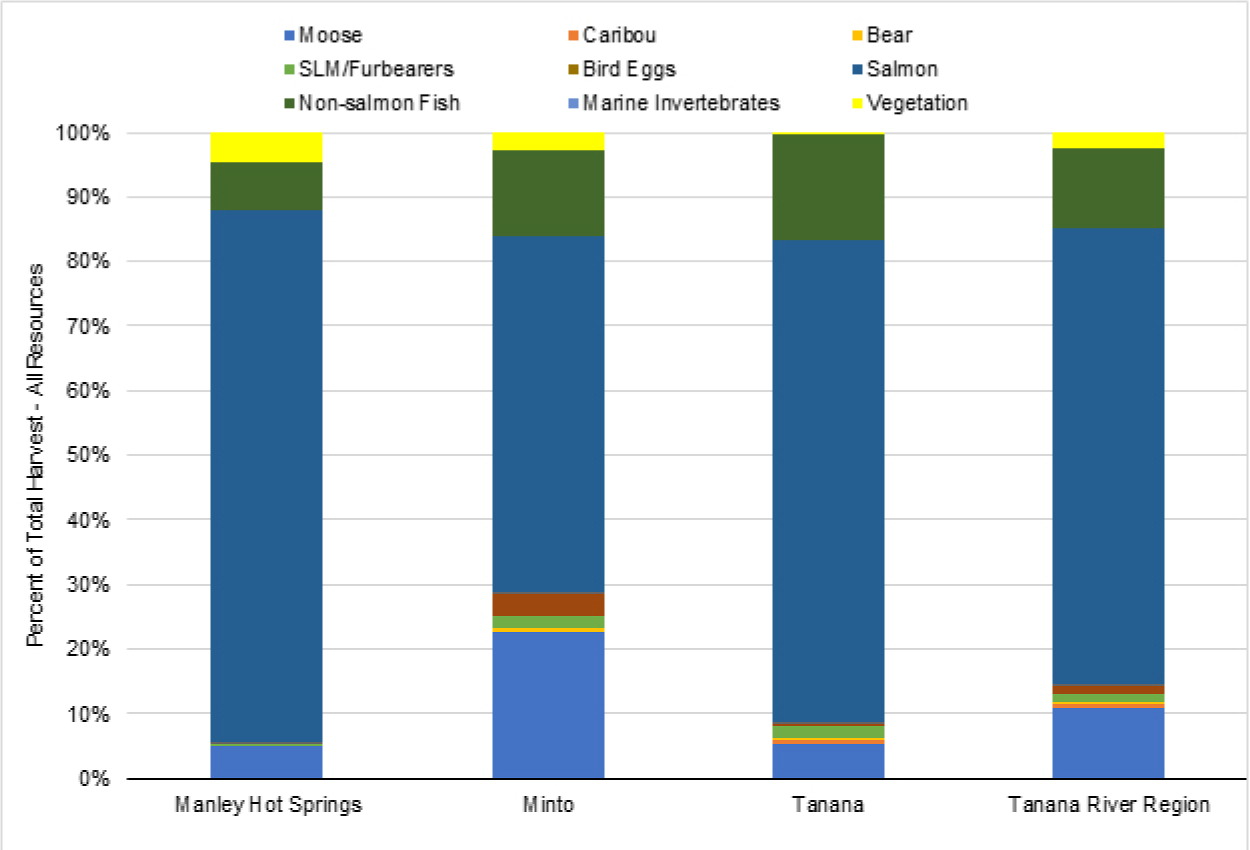


Figure 10. All resources percent of total harvest by Tanana River region communities
Source: See Table 2

Average participation rates among Tanana River Region study communities, in terms of the average percentage of households attempting harvests by resource, are shown on Figure 11. Across all Tanana River Region study communities, households most commonly participate in harvests of vegetation (86 percent of households), followed by moose (64 percent), salmon (56 percent), upland birds (55 percent), and non-salmon fish (53 percent). A smaller percentage of households participate in harvests of migratory birds and small land mammals, while participation in caribou hunting, bird egg harvesting, marine invertebrate harvesting, and Dall sheep hunting is minimal. The average percentage of households receiving different resources is shown on Figure 12. The most widely received resources in the region are also the most widely harvested. Salmon is the most commonly received resource among Tanana River Region study communities, followed by moose, vegetation, non-salmon fish, and migratory birds.

Table 29 shows average harvest and use data for the top five species harvested (in terms of average contribution toward the total subsistence harvest) by each of the Tanana River Region study communities. Data for Nenana are for selected land mammal and non-salmon fish species and are based on per capita harvests of these resources. For the three communities where data are available (Manley Hot Springs, Minto, and Tanana), chum salmon is the top species harvested, contributing between 34 percent and 54 percent of the total subsistence harvest. Chinook and coho salmon are also among the top species harvested in these communities, as is moose. Northern pike is among the top species harvested in Minto, whereas whitefish is a top species harvested in Tanana. Although limited data are available, data show Nenana residents harvesting an average of 83 pounds of moose per capita, and approximately two per capita pounds of humpback whitefish, beaver, and pike.

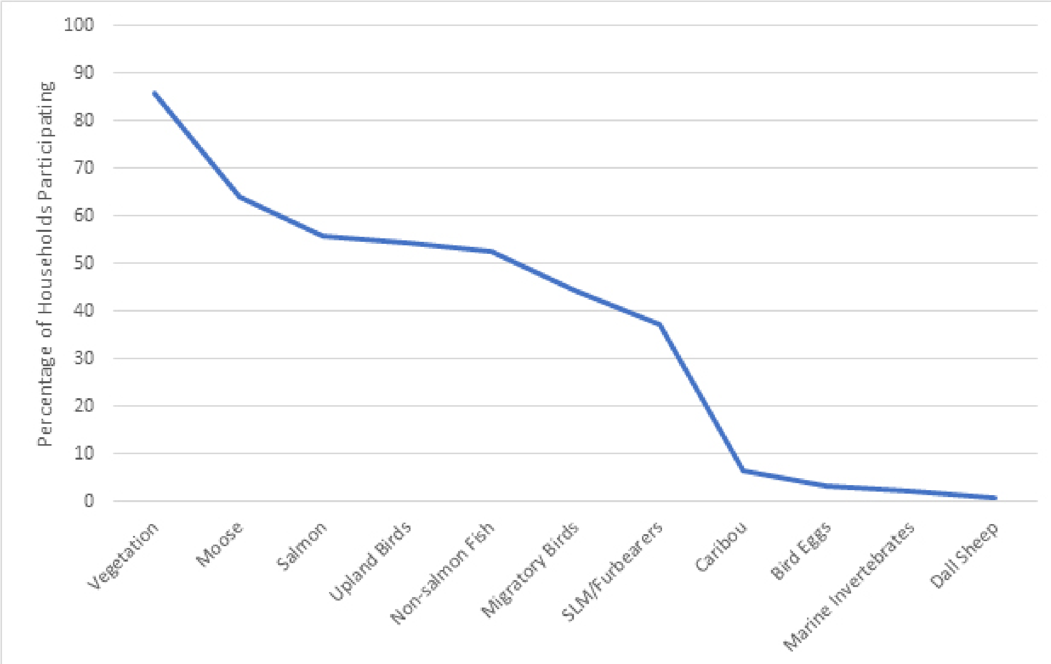


Figure 11. Percent of households attempting harvests of resources, Tanana River region communities

Source: See Table 2

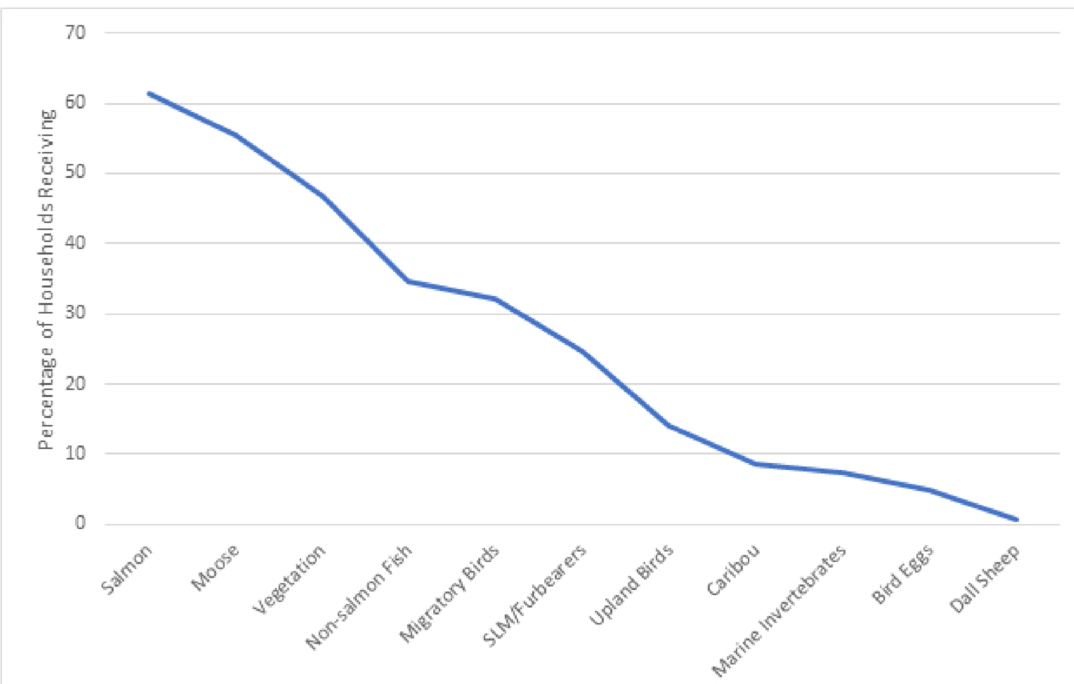


Figure 12. Percent of households receiving resources, Tanana River region communities

Source: See Table 2

Table 29. Average harvest and use data, top 5 species, Tanana River region communities

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HHs receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% total harvest
Manley Hot Springs	Chum salmon	32	15	12	15	20	3,586	17,992	310	146	34.3
Manley Hot Springs	Chinook salmon	80	29	20	29	68	979	12,958	223	105	24.7
Manley Hot Springs	Coho salmon	39	12	12	10	27	1,835	11,858	204	96	22.6
Manley Hot Springs	Moose	59	50	11	25	49	8	4,498	123	55	4.9
Manley Hot Springs	Northern pike	39	29	29	7	17	364	1,018	18	8	1.9
Minto	Chum salmon	41	44	44	11	24	12,578	62,903	1,294	336	40.4
Minto	Moose	90	70	39	34	74	32	18,732	309	96	22.5
Minto	Coho salmon	35	11	11	9	26	690	4,457	73	25	11.2
Minto	Chinook salmon	61	37	37	22	43	485	7,044	139	38	7.2
Minto	Northern pike	61	44	47	22	25	1,740	5,639	113	30	5.7
Nenana	Moose	49	69	22	8	29	62	40,213	223	83	N/A
Nenana	Humpback whitefish	5	5	5	2	2	342	1,028	6	2	N/A
Nenana	Beaver	8	7	7	3	3	75	1,013	6	2	N/A
Nenana	Pike	14	12	12	6	3	202	909	5	2	N/A
Nenana	Broad whitefish	13	7	7	6	8	336	673	4	1	N/A
Tanana	Chum salmon	70	66	62	28	27	67,411	400,317	3,127	1,158	53.7
Tanana	Whitefish	49	33	33	23	18	16,598	54,489	435	136	11.7
Tanana	Chinook salmon	92	53	52	46	47	4,769	81,079	633	270	10.9
Tanana	Coho salmon	35	30	27	7	10	14,374	71,870	561	106	9.6
Tanana	Moose	94	67	38	42	70	48	27,253	258	105	5.4

Source: See Table 2
Notes: HH = households; N/A = Not available
Comprehensive harvest years are not available for Nenana. The top species are based on available large land mammal, small land mammal, and non-salmon fish years and ranked based on per capita pounds. Other resources may be harvested in greater quantities.

5.4.3 Timing of Subsistence Activities

Data on the timing of subsistence activities for Tanana River study communities are provided in Table 30. This table shows the number of communities reporting subsistence activity or harvests within each month, based on the most recent data sources for each community. Overall, Tanana River communities target the greatest number of resources during August and September. In general, subsistence activities are at their highest between the months of April through October, with less activity in winter.

Spring (April–May) in the Tanana River Region is a transitional time when winter subsistence activities wane and activities that will occur throughout the summer begin. Subsistence activity for upland birds and furbearers declines in early spring as residents of the region shift focus to non-salmon fish and waterfowl as they migrate through the area. However, communities continue to harvest upland birds throughout the year except in the month of June, during the nesting and rearing period. Spring is a primary harvest time for bear in the region, although bear can be taken year round. Spring marks a decline of small land mammal harvests in general, though beaver and porcupine subsistence activity continues.

Summer (June–August) in the Tanana River Region is characterized by intensified fishing activities. Salmon fishing begins in June and continues through the fall as different species navigate the watersheds of the region. Non-salmon fish harvests, including whitefish and sheefish harvests, occur along with the summer salmon fishing. Waterfowl subsistence activity continues through the summer as well as harvests of small land mammals, namely squirrel. Residents of the region may target moose in late summer; however, harvests at that time are only occasional. The emergence and ripening of vegetation in the region allows for increased harvests of plants and berries.

The focus on fishing continues into the fall (September–October) with harvests of coho salmon and non-salmon fish; moose harvests begin to intensify at this time. Moose subsistence activity occurs year round, but is primarily in September-March. Bear subsistence activity continues and is particularly common in the fall in Tanana and Minto. Moose and bear are the most common large land mammal resources harvested in the region. Waterfowl subsistence activity intensifies to peak activity with the fall migration, particularly in Manley Hot Springs and Tanana. Ripe berries are collected into early fall and wood collection begins at the end of fall.

The focus of subsistence activity shifts in the winter (November–March), with the end of salmon fishing and the slowing of non-salmon fishing. Residents primarily harvest small land mammals and upland birds for fresh meat over the winter season. Furbearer pelts are in prime condition over the winter and residents report peak activity during this time. Moose subsistence activity may occur during December and wood collection continues to maintain a fuel supply.

Table 30. Tanana River region timing of subsistence activities, number of communities reporting subsistence activity

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon fish	3	3	4	4	4	4	4	4	4	4	4	4
Salmon	N/A	N/A	N/A	N/A	N/A	4	4	4	4	4	N/A	N/A
Caribou	N/A	2	2	2	N/A	N/A	N/A	2	2	N/A	2	N/A
Moose	4	4	4	2	2	3	3	2	4	4	3	4
Bear	2	2	4	3	4	4	4	4	4	3	2	2
Furbearers	2	2	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2
Small land mammals	4	4	4	4	3	3	2	3	4	4	4	4
Upland birds	4	4	4	4	3	N/A	2	4	4	4	4	4
Waterfowl	N/A	N/A	N/A	4	3	4	3	4	4	2	N/A	N/A
Eggs	N/A	N/A	N/A	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Plants and berries	N/A	N/A	N/A	2	2	3	4	4	4	2	N/A	N/A
Wood	3	3	3	3	3	3	3	3	3	3	3	3
Total number of resources per month	**7**	**8**	**8**	**9**	**9**	**8**	**9**	**10**	**10**	**9**	**8**	**7**

Source: Case and Halpin 1990; Brown et al. 2010; Brown et al. 2016; Betts 1997; Brown et al. 2014; SRB&A Unpublished
Notes: Apr = April; Aug = August; Dec = December; Feb = February; Mar = March; Jan = January; Jul = July; Jun = June; N/A = Not applicable (no or limited subsistence activity); Nov = November; Oct = October; Sep = September
Tanana River Region Communities = 4 (Manley Hot Springs, Minto, Nenana, and Tanana)
Each cell contains the number of communities reporting subsistence activity or harvests during each month, based on the most recent data source for each community. Months with only one community report harvests or activity are not included in the table. Resources with no subsistence activity data available are not included in the table.

5.4.4 Travel Method

A recent subsistence mapping study (SRB&A Unpublished) collected data on travel methods for a two of the four of Tanana River study communities (Minto and Nenana). The data show that a majority of use areas in the study communities are accessed by boat and, to a lesser extent, truck/car and snowmachine. Many use areas are accessible directly from the community. Other methods used to access subsistence use areas include truck/car and ATV. Both of these study communities have road access. Primary travel methods used to search for resources within use areas are boat, foot, and snowmachine (SRB&A Unpublished). Access and search methods vary by community. Nenana residents are more likely to use road vehicles to access subsistence harvesting areas, while Minto residents are more likely to use boats to access and search within their harvesting areas. Unlike many other rural communities who have abandoned the use of dog teams in winter for snowmachines, some individuals in the community of Tanana continue to run dog teams and use their teams to access winter harvesting areas (Brown et al. 2016).

5.4.5 Resource Importance

The relative importance of subsistence resources to the individual Tanana River Region study communities, based on selected variables, is provided in Table 31 through Table 34 (see Section 4.3 for discussion of methods). Based on this analysis, salmon and vegetation are of high importance in all communities where data are available, while moose is of high importance in three out of the four Tanana River Region study communities (Minto, Nenana, and Tanana). Other resources of high importance in the Tanana River Region study communities include upland birds (two communities), migratory birds (one community), non-salmon fish (one community), and small land mammals (one community).

5.5. Yukon River

The Yukon River region includes the communities of Beaver, Galena, Livengood, Rampart, and Stevens Village. Stevens Village use areas are overlapped with the eastern end of the southern corridor alternative, while the three Yukon River region communities of Beaver, Galena, and Rampart have uses which occur within 30 miles of (but do not overlap with) the southern corridor. Subsistence data are not available for Livengood.

5.5.1 Subsistence Use Areas

Subsistence use areas for the Yukon River region study communities (Map 24 through Map 27) are focused around the Yukon River system, extending from the Chalkyitsik area to the mouth of the Koyukuk River, in addition to along the Koyukuk River toward the southern corridor alternative near Hughes. A majority of use areas for the Yukon River region study communities are located to the east and south of the AMDIAR project alternatives.

Table 31. Relative importance of subsistence resources based on selected variables, Manley Hot Springs

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	50	49	5	M
2	Caribou	N/A	15	N/A	L
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	0.1	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	33	15	0.2	L
7	Marine mammals	N/A	N/A	N/A	I
8	Migratory birds	15	17	0.1	L
9	Upland birds	41	15	0.4	M
10	Bird eggs	5	5	0.01	L
11	Salmon	34	80	82	H
12	Non-salmon fish	45	47	7	M
13	Marine invertebrates	N/A	7	N/A	L
14	Vegetation	98	61	5	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 32. Relative importance of subsistence resources based on selected variables, Minto

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	70	74	22	H
2	Caribou	N/A	8	N/A	L
3	Dall sheep	1	N/A	N/A	L
4	Bear	N/A	N/A	1	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	48	35	2	M
7	Marine mammals	N/A	N/A	N/A	I
8	Migratory birds	69	46	3	H
9	Upland birds	48	7	0.3	M
10	Bird eggs	2	N/A	0.01	L
11	Salmon	54	80	55	H
12	Non-salmon fish	54	40	13	M
13	Marine invertebrates	2	N/A	0.001	L
14	Vegetation	87	35	3	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 33. Relative importance of subsistence resources based on selected variables, Nenana

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	69	29	N/A	H
2	Caribou	4	1	N/A	L
3	Dall sheep	1	1	N/A	L
4	Bear	N/A	N/A	N/A	I
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	15	5	N/A	L
7	Marine mammals	N/A	N/A	N/A	I
8	Migratory birds	N/A	N/A	N/A	I
9	Upland birds	73	N/A	N/A	H
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	73	26	N/A	H
12	Non-salmon fish	61	26	N/A	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	N/A	N/A	N/A	I

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 34. Relative importance of subsistence resources based on selected variables, Tanana

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	67	70	5	H
2	Caribou	10	10	1	L
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	0.3	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	54	44	2	H
7	Marine mammals	N/A	N/A	N/A	I
8	Migratory birds	49	34	0.5	M
9	Upland birds	55	21	0.3	H
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	62	59	74	H
12	Non-salmon fish	50	26	17	M
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	73	45	0.1	H

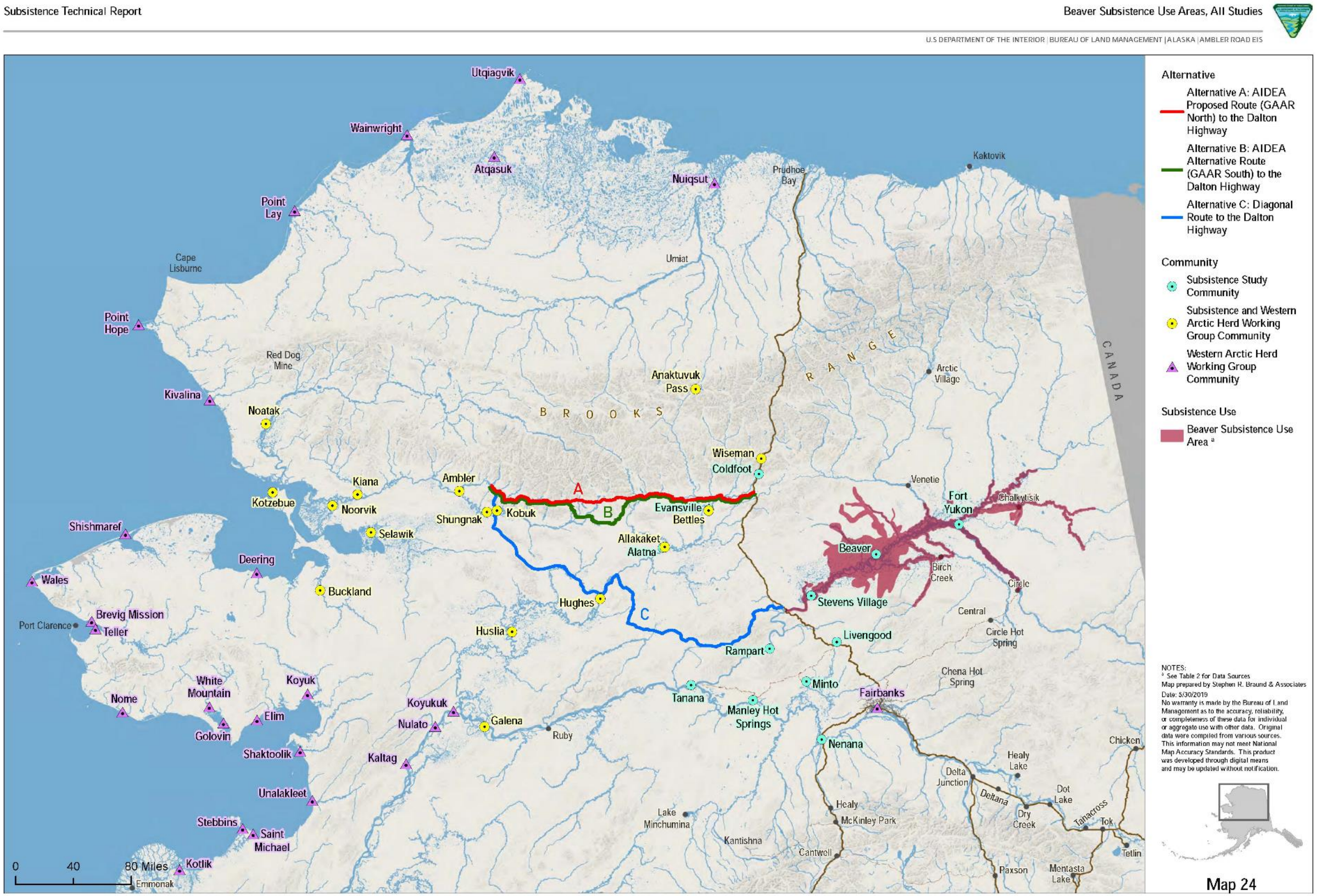
Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Beaver subsistence use areas for all time periods are shown on Map 24. The community's use areas cover an extensive river system with residents traveling along various drainages of the Yukon River between the Circle and the Dalton Highway; other primary river drainages used for subsistence harvesting activities include the Porcupine river, Black River, Beaver Creek, and Birch Creek. As shown in SRB&A (2007) Beaver use areas for moose and bear are most focused along the Yukon River between the mouths of Birch Creek and Stevens Village, while furbearer and small land mammal use areas extend farther from the community along the river system and include various traplines that extend both north and south of the community. Fishing areas are located in relatively close proximity to the community of Beaver on the Yukon River while waterfowl hunting and egg harvesting occur along the Yukon River to the Dalton Highway but with the greatest concentration in the sloughs and lakes surrounding the community.

Galena use areas (Map 25) occur farther downriver on the Yukon River and include large areas surrounding both the Yukon and Koyukuk rivers. Isolated harvesting areas occur even farther north toward Selawik, and Hughes, just south and west of the southern project corridor alternative. According to Brown et al. (2015), for the 2014 study year, salmon harvesting by Galena residents took place primarily along the Yukon River upriver from their community and downriver past the mouth of the Koyukuk River to Nulato. Non-salmon fish harvesting occurred on the Yukon River but also in various sloughs and lakes alongside the Yukon River and at a location on the Koyukuk River. Moose harvesting extended along the Yukon and Koyukuk rivers and in overland areas surrounding these drainages; small land mammal harvesting was focused primarily to the north of the community in overland areas between the Yukon River, Koyukuk River, and the community of Huslia. Waterfowl and bird harvesting generally occurred closer to the community of Galena with some isolated search areas reported farther to the north (along the Koyukuk River) and east of the community. Similarly, vegetation harvesting occurred close to the community with isolated harvesting areas reported along the Koyukuk River and near Huslia.

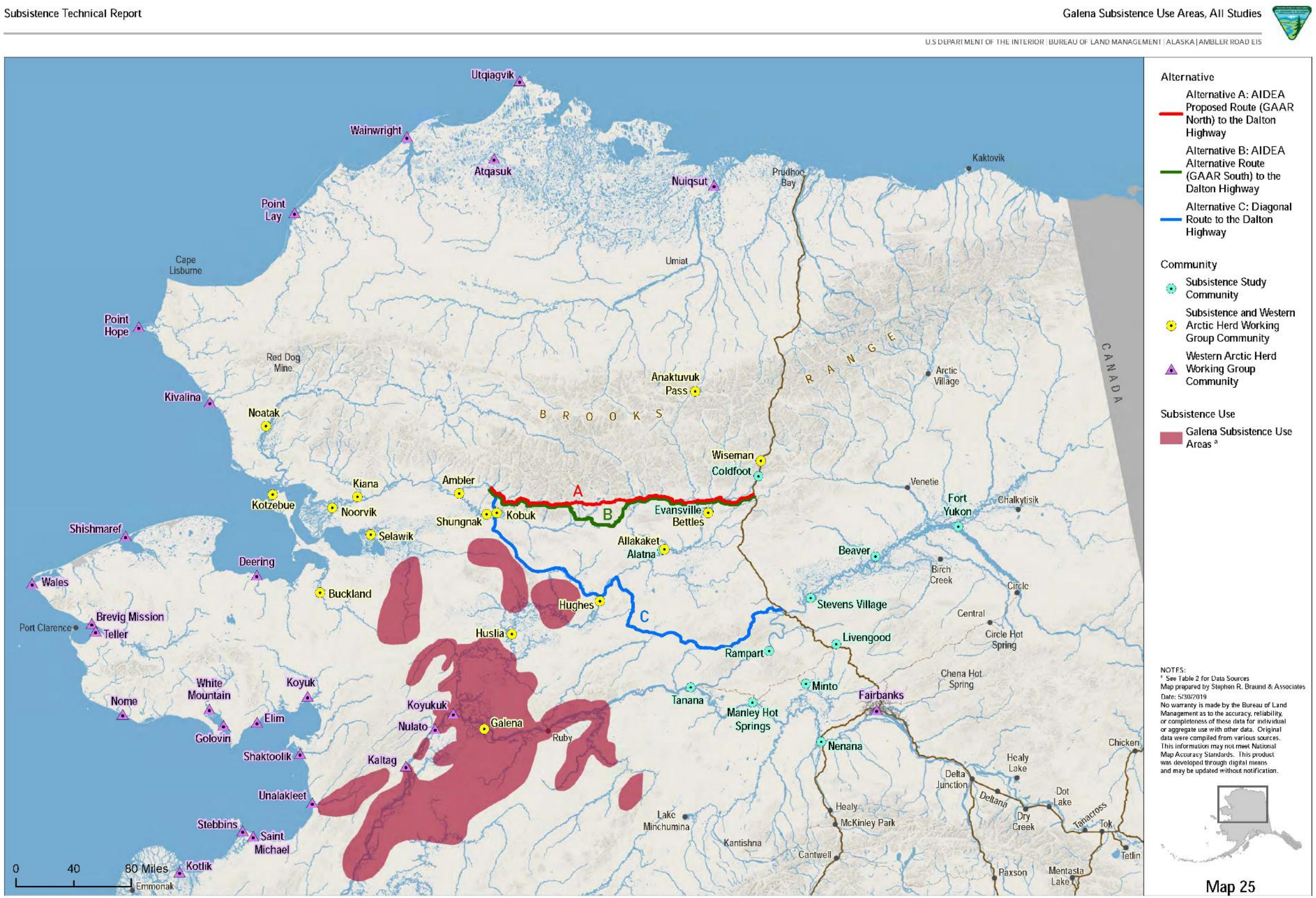
Rampart use areas are shown on Map 25 and show subsistence use areas focused relatively close to the community along the Yukon River downriver from the Dalton Highway, in addition to overland harvesting areas to the north and south of the community. Documented use areas for the 2014 time period (Brown et al. 2016) indicate a much smaller extent of harvesting areas for Rampart community residents in that year compared to previously documented use areas (Betts 1997). Brown et al. (2016) indicate the changes could be a result of the declining population of Rampart in addition to strong social and familial ties with Stevens Village which may have altered harvesting patterns. Use areas in 2014 were concentrated along the Yukon River directly near the community in addition to near Stevens Village. In addition, a couple of isolated harvesting areas were reported at greater distances from the community. Fishing occurred directly in front of the community of Rampart in addition to several locations upriver toward Stevens Village. Moose harvesting occurred at several isolated locations along Hess Creek, Tolovana River, and in a small area north of the Yukon River, while small land mammal and bird harvesting occurred directly near Rampart as well as at Stevens Village. Vegetation harvesting by Rampart households in 2014 occurred directly around the community.

This page is intentionally left blank.



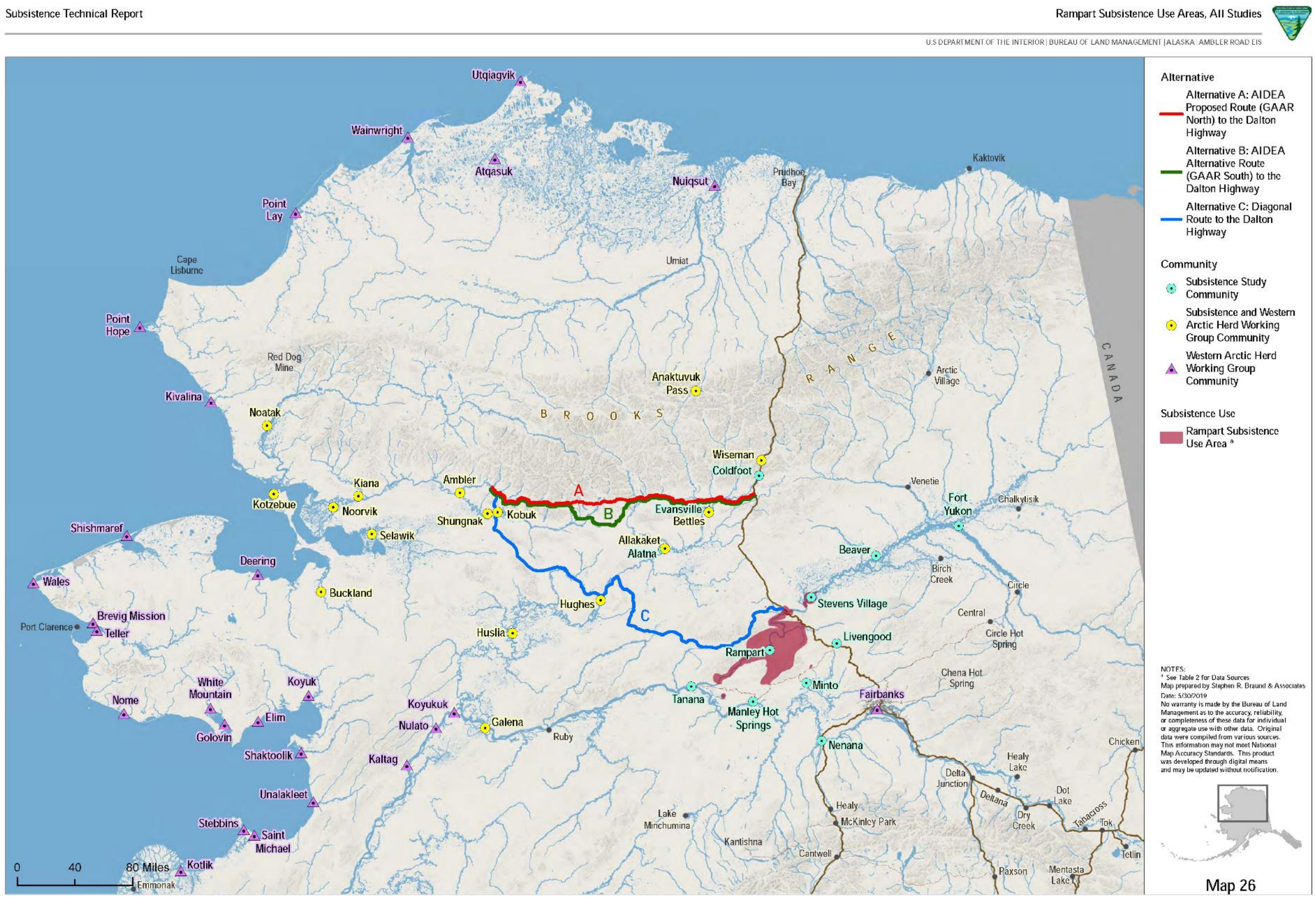
Map 24. Beaver subsistence use areas, all studies

This page is intentionally left blank.



Map 25. Galena subsistence use areas, all studies

This page is intentionally left blank.



Map 26. Rampart subsistence use areas, all studies

This page is intentionally left blank.

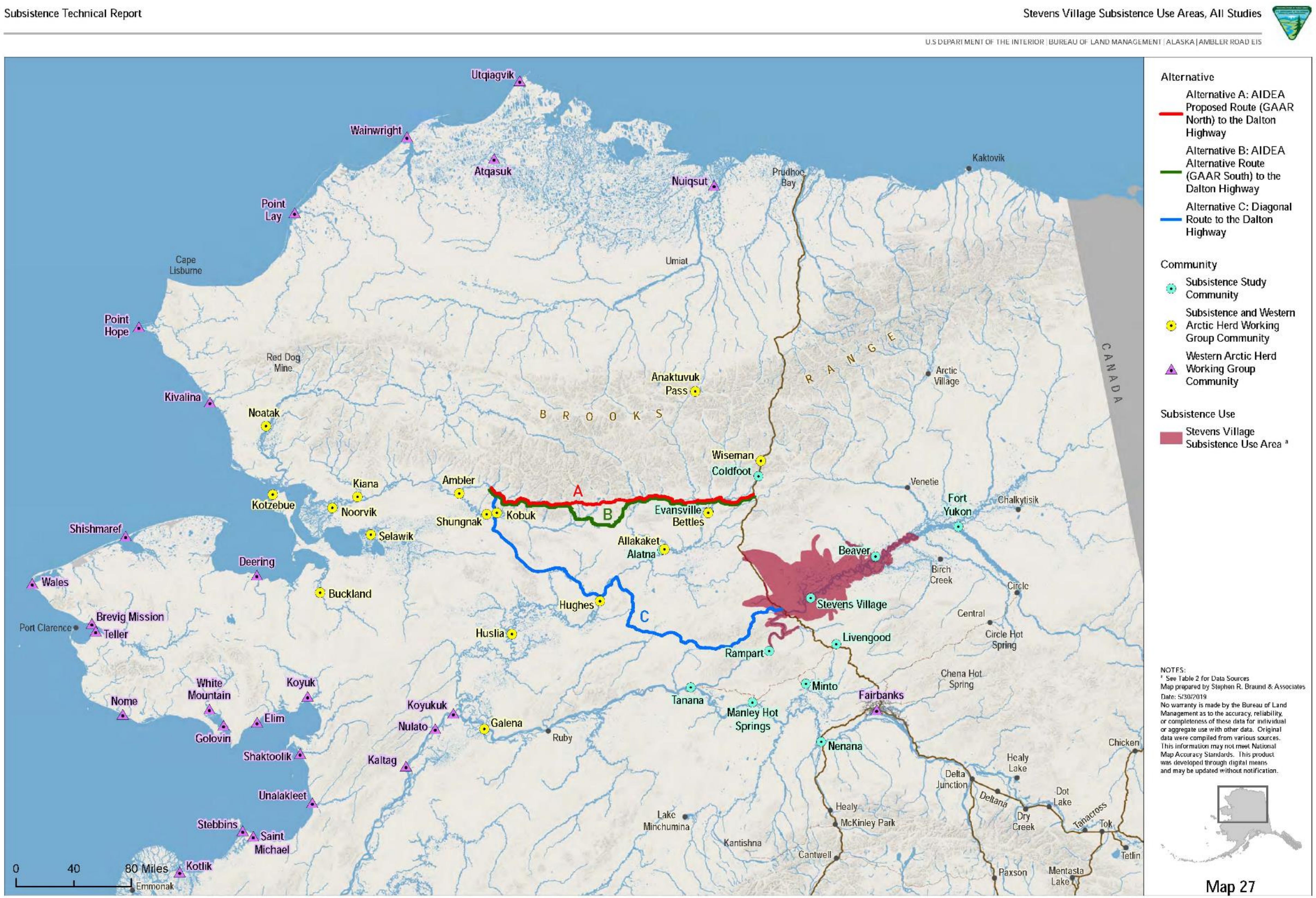
Stevens Village use areas (Map 27) extend along the Yukon River from the mouth of Birch Creek downriver to Rampart, in addition to larger overland use areas primarily to the north of the river. While most Stevens Village use areas remain to the east of the Dalton highway, certain overland and riverine uses cross to the west of the highway and overlap with the eastern portion of the southern corridor alternative. The population of Stevens Village has declined in recent years and an ADF&G comprehensive survey in 2015 found four eligible households. While many have moved away from the community to Fairbanks and other communities, residents continue to return to the community seasonally to engage in subsistence activities. Based on a recent mapping study with community seasonal and permanent residents (SRB&A Unpublished), contemporary use areas for the community are similar to historic use areas and are concentrated along the Yukon River between the Dalton Highway and Hodzana River, and in overland areas north and south of the Yukon River. The more recent research shows a greater extent of use areas extending downriver beyond the Dalton Highway with a high concentration of use areas near the mouth of the Ray River. Resource-specific use areas for the more recent mapping study are not available.

5.5.2 Harvest Data

Harvest data for the Yukon River study communities are provided on Figure 13 through Figure 15 and in Table 35. As shown on Figure 13, based on an average of available data, salmon is the primary resource harvested among the study communities in terms of percentage of usable pounds (63 percent), followed by moose (20 percent) and non-salmon fish (nine percent). Other resources which contribute smaller amounts in terms of pounds include small land mammals, migratory birds, vegetation, bear, and caribou. Resource contribution is relatively similar among the Yukon River Region study communities, Stevens Village relies more heavily on salmon, at 81 percent of the total harvest, and less heavily on moose.

Average participation rates among Yukon River Region study communities, in terms of the average percentage of households attempting harvests by resource, are shown on Figure 14. Similar to other study regions, resources with the highest participation rates are not necessarily those that provide the greatest portion of the harvest. Across all Yukon River Region study communities, and similar to the other study regions, households most commonly participate in harvests of vegetation (74 percent of households). Other common subsistence activities across the study region include harvesting of non-salmon fish (60 percent of households participating), followed by migratory birds (56 percent), salmon (56 percent), moose (50 percent), and small land mammals/furbearers (50 percent). A smaller percentage of households participate in harvests of upland bird, while participation in bird egg harvesting, caribou hunting, marine invertebrate harvesting, and other large land mammal harvesting is minimal. The average percentage of households receiving different resources is shown on Figure 15. In the Yukon River Region, the most widely received resources in the region are also the most widely harvested. Salmon is the most commonly received resource among Yukon River Region study communities, followed by moose, non-salmon fish, and small land mammals

This page is intentionally left blank.



Map 27. Stevens Village subsistence use areas, all studies

This page is intentionally left blank.

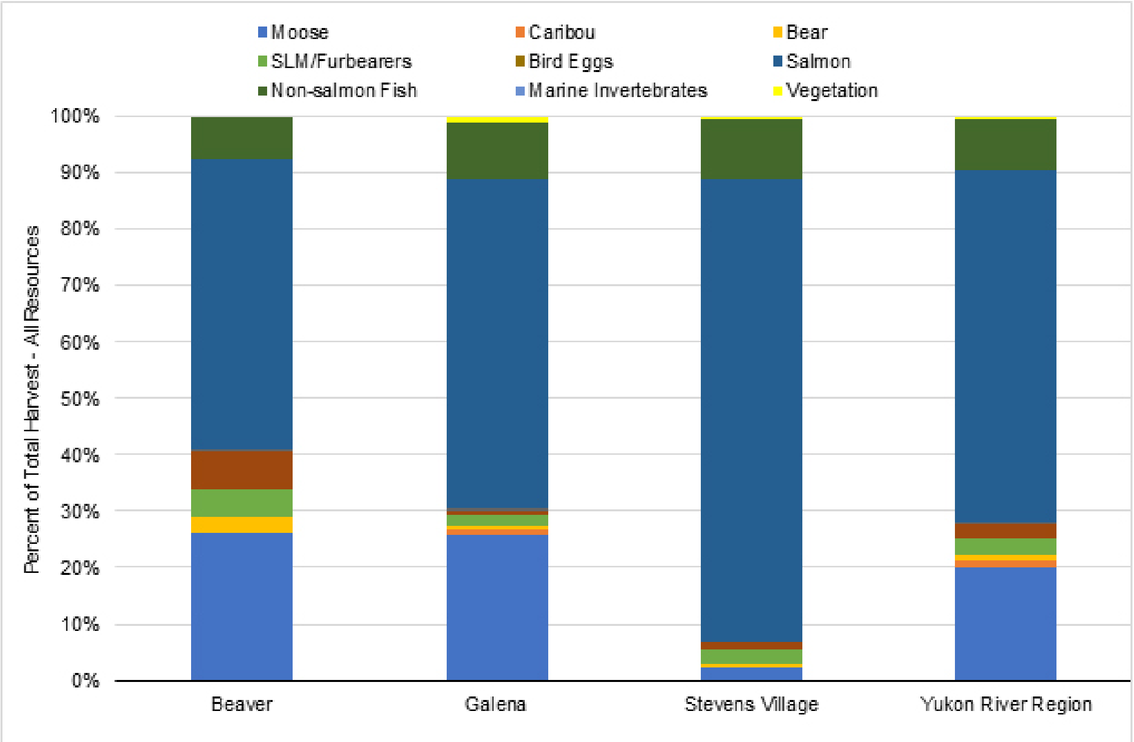


Figure 13. All resources percent of total harvest by Yukon River region communities
Source: See Table 2

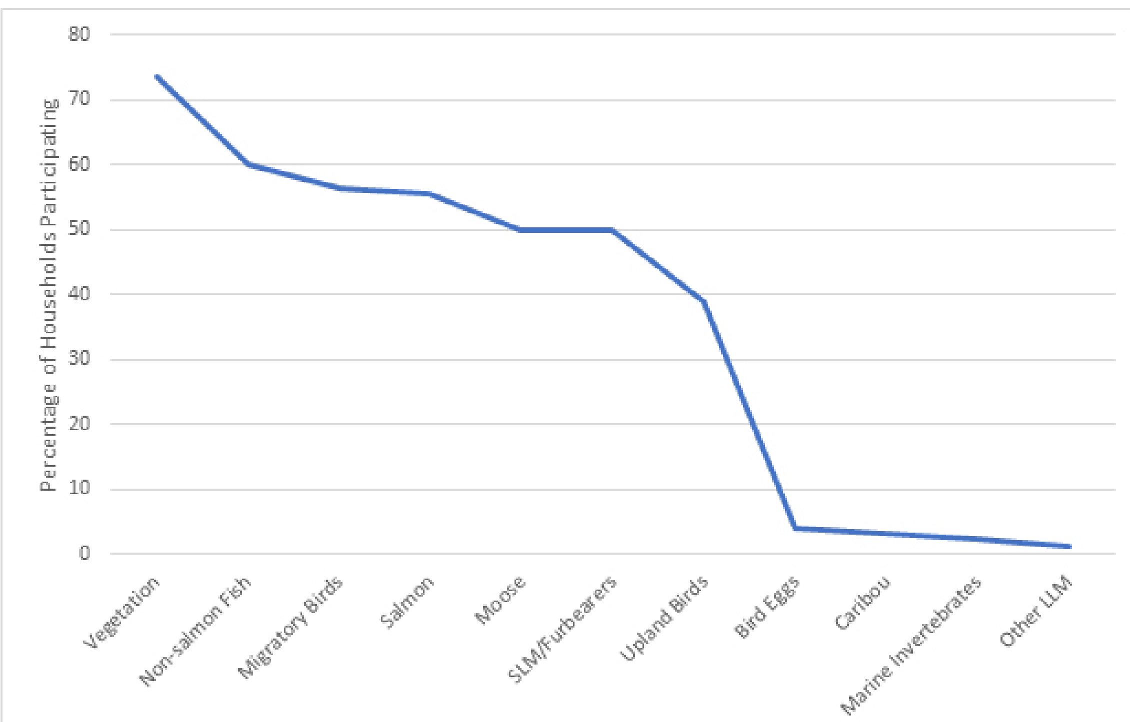


Figure 14. Percent of households attempting harvests of resources, Yukon River region communities
Source: See Table 2

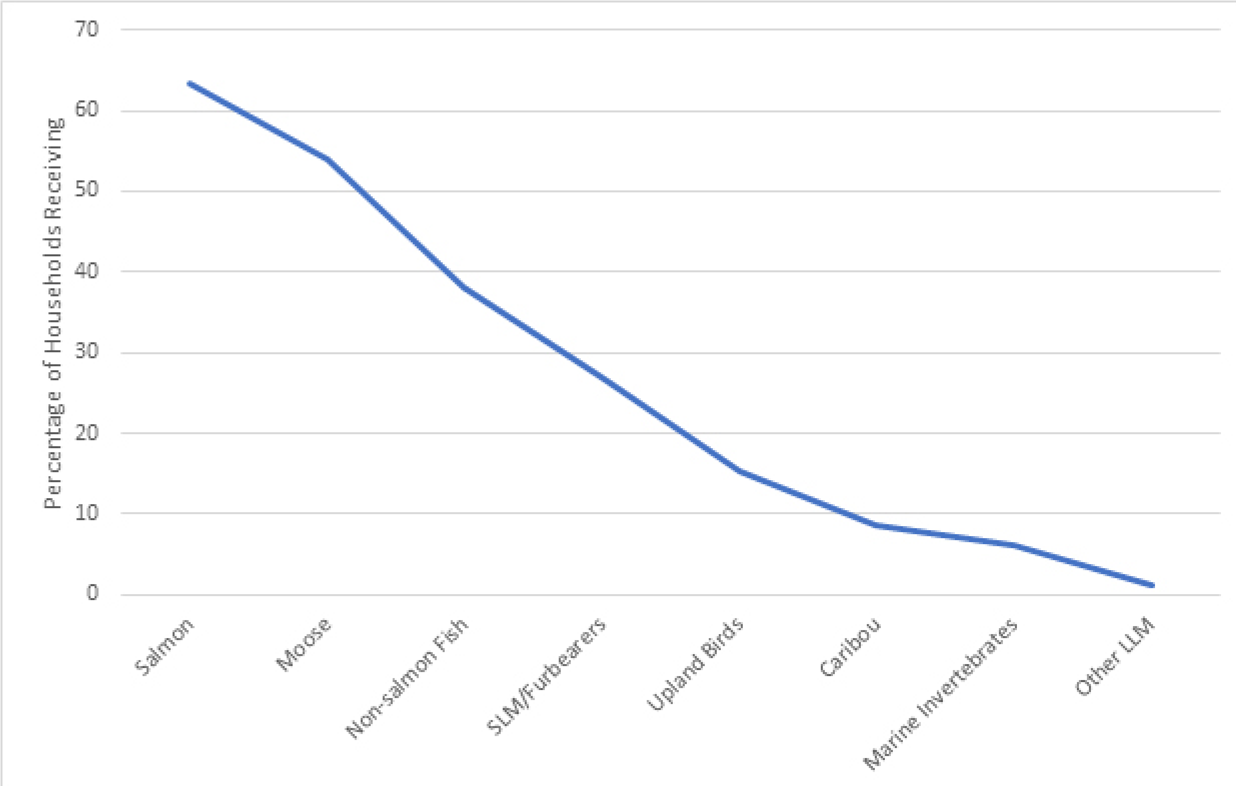


Figure 15. Percent of households receiving resources, Yukon River region communities
Source: See Table 2

Table 35 shows average harvest and use data for the top five species harvested (in terms of average contribution toward the total subsistence harvest) by each of the Yukon River Region study communities. Chum salmon is the top species harvested among all study communities, contributing between 26 percent and 65 percent of the total subsistence harvest. Moose and other salmon species (coho and Chinook salmon) are also top species among all four study communities. Other top harvested species among the study communities include black bear (Beaver), white-fronted geese (Beaver), whitefish (Galena, Rampart, and Stevens Village), burbot (Rampart), and sheefish (Stevens Village).

5.5.3 Timing of Subsistence Activities

Data on the timing of subsistence activities for Yukon River study communities are provided in Table 36 This table shows the number of communities reporting subsistence activity or harvests within each month, based on the most recent data sources for each community. Overall, Yukon River communities target the greatest number of resources during September. In general, subsistence activities are at their highest between the spring months of April and May and late summer/fall months of August and September, with less activity in winter.

Table 35. Average harvest and use data, top 5 species, Yukon River region communities

Community	Species	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% Total harvest
Beaver	Chum salmon	44	30	28	11	25	2,578	12,689	377	157	25.7
Beaver	Moose	33	27	12	12	28	10	5,927	277	90	25.1
Beaver	Chinook salmon	96	36	34	29	66	775	9,369	277	118	21.8
Beaver	Black bear	13	15	8	7	9	7	684	37	10	4.7
Beaver	White-fronted geese	56	52	52	25	8	390	1,213	33	15	4.4
Galena	Chum salmon	59	26	26	15	35	37,770	180,319	876	274	43.4
Galena	Moose	90	64	48	34	55	106	60,907	316	108	25.6
Galena	Chinook salmon	71	41	31	20	46	2,373	29,060	150	49	11.3
Galena	Coho salmon	13	11	11	8	1	1,092	5,775	37	14	5.4
Galena	Humpback whitefish	16	14	14	8	7	5,322	15,965	83	30	3.9
Rampart	Chum salmon	57	57	57	29	29	500	4,673	359	120	31.7
Rampart	Coho salmon	100	71	71	57	100	450	4,319	332	111	29.3
Rampart	Moose	86	57	57	43	86	4	4,011	309	103	27.2
Rampart	Humpback whitefish	43	43	43	29	14	90	501	39	13	3.4
Rampart	Burbot	71	71	71	29	43	53	236	18	6	1.6
Stevens Village	Chum salmon	50	50	47	25	0	6,927	27,583	1,241	438	65.1
Stevens Village	Chinook salmon	63	48	55	21	21	738	12,036	428	148	16.1
Stevens Village	Whitefish	39	39	51	22	2	940	2,186	100	36	6.4
Stevens Village	Moose	56	52	13	16	47	2	2,140	132	31	2.4
Stevens Village	Sheefish	32	32	37	23	1	87	575	29	11	2.4

Source: See Table 2
Notes: HH = households; N/A = Not available

Spring (April–May) in the Yukon River Region is characterized by warming temperatures, breakup on the rivers, and lengthening days. Spring marks a decrease in seasonal harvests of furbearers and upland birds; however, it also marks the beginning of the waterfowl hunting season, as ducks and geese arrive in the area. Yukon River Region residents occasionally harvest small land mammals, including marten, hare, and beaver, in the springtime, but harvest by month data show harvests more commonly occurring over the winter months (Holen et al. 2012, Van Lanen et al. 2012). Fishing for non-salmon fish occurs in the region during the springtime, either through the ice or after breakup in the open water. The first salmon harvests may also occur in May. Harvests of caribou and bear may also occur in the springtime in a number of communities.

During summer (June–August) residents of the Yukon River Region focus on fishing and collecting plants and berries. Salmon harvesting is a strong focus of certain communities, including Beaver, Rampart, and Stevens Village. Non-salmon fish harvesting also occurs throughout most of the year. Berries are a particularly important resource in the region; they are among the highest- used resources (in terms of the percentage of households using) in many of the communities (Holen et al. 2012). Most large land mammal subsistence activity, more commonly a fall activity, occurs at the end of the summer in August, though communities may take moose or bear year-round. Following spring caribou hunting, residents resume caribou harvesting in August and continue into November. Harvests of waterfowl occur during the summer months, although harvesting decreases during the July nesting and rearing period.

Many subsistence activities which occur over the summer, including fishing, waterfowl hunting, and large land mammal hunting, continue or amplify during the fall (September–October). Moose harvests occur throughout the year but most commonly in the month of September. Bear harvests continue in early fall and berry picking may also continue from the summer into the early fall. Fall in the Yukon River Region marks the end of waterfowl subsistence activity and increased focus on upland birds, such as grouse and ptarmigan. Wood is collected beginning in the fall and is a particularly important resource to prepare for heating through the upcoming winter.

During the winter season (November–March), focus shifts to harvests of small land mammals and furbearers as watersheds freeze over creating conditions for travel to trapping grounds. Pelts of the small mammals and furbearers are prime over the winter season and residents of the region hunt or trap for the pelts and/or meat of small mammals for subsistence purposes. Large land mammal harvests, including caribou, moose, and bears in early winter, occur over the winter months although moose and bear harvests occur with more frequency during other seasons. Ice fishing for non-salmon fish occurs during the early winter months. Residents of the Yukon River Region harvest upland birds throughout the winter and into the spring as the annual cycle of subsistence activities begins again.

5.5.4 Travel Method

A recent subsistence mapping study (SRB&A Unpublished) collected data on travel methods one of the Yukon River study communities (Stevens Village). In addition, previous research has documented travel methods and routes for Beaver (SRB&A 2007). For Stevens Village, the data show that a majority of use areas are accessed by boat with a much smaller percentage accessed by snowmachine, truck/car, or foot. Many use areas are accessible directly from the community. Primary travel methods used to search for resources within use areas are boat, snowmachine, with lesser use of foot and ATV (SRB&A Unpublished). Based on SRB&A (2007), the community of Beaver accesses the highest percentage of their use areas by boat (51 percent), followed by snowmachine (33 percent), four-wheeler (15 percent), and foot (10 percent). Travel routes for Beaver occur along the Yukon River and overland alongside the Yukon River between the community and Stevens Village (SRB&A 2007).

Table 36. Yukon River region timing of subsistence activities, number of communities reporting subsistence activity

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon fish	N/A	N/A	3	3	4	4	4	4	4	4	4	1
Salmon	N/A	N/A	N/A	N/A	2	3	3	3	3	2	N/A	N/A
Caribou	N/A	N/A	N/A	1	1	N/A	N/A	1	1	1	1	N/A
Moose	3	3	3	3	3	3	3	3	3	3	3	3
Bear	1	1	1	3	4	3	3	3	3	3	2	1
Furbearers	1	2	1	1		N/A	N/A	N/A	N/A	N/A	1	1
Small land mammals	2	2	2	2	2	2	2	2	2	2	2	2
Upland birds	3	3	3	3	2	2	2	2	3	3	3	3
Waterfowl	N/A	N/A	N/A	2	3	3	2	3	3		N/A	N/A
Eggs	N/A	N/A	N/A	N/A	N/A	2	3	3	3	N/A	N/A	N/A
Plants and berries	2	2	2	2	1	N/A	N/A	N/A	1	2	2	2
Wood	N/A	N/A	3	3	4	4	4	4	4	4	4	1
Total number of resources per month	**6**	**6**	**7**	**9**	**9**	**8**	**8**	**9**	**10**	**8**	**8**	**7**

Source: Andersen et al. 2001; Betts 1997; Brown et al. 2010; Brown et al. 2016; Sumida 1988; Holen et al. 2012; SRB&A 2007; Stevens; Maracle n.d.
Notes: Apr = April; Aug = August; Dec = December; Feb = February; Mar = March; Jan = January; Jul = July; Jun = June; N/A = Not applicable (no or limited subsistence activity); Nov = November; Oct = October; Sep = September
Yukon River Region Communities = 5 (Beaver, Galena, Livengood, Rampart, and Stevens Village)
Each cell contains the number of communities reporting subsistence activity or harvests during each month, based on the most recent data source for each community. Months with only one community report harvests or activity are not included in the table. Resources with no subsistence activity data available are not included in the table. No timing data exist for Livengood.

5.5.5 Resource Importance

The relative importance of subsistence resources to the individual Yukon River Region study communities, based on selected variables, is provided in Table 37 through Table 40 (see Section 4.3 for discussion of methods). Based on this analysis, moose, salmon, and vegetation are of high importance in all Yukon River Region study communities. Other resources of high importance in Yukon River Region study communities include migratory birds (two study communities), non-salmon fish (two study communities), and small land mammals (one study community). Marine mammals are of moderate importance in several study communities due to sharing and distribution networks from coastal communities; upland birds are also of moderate importance.

Table 37. Relative importance of subsistence resources based on selected variables, Beaver

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	27	28	25	H
2	Caribou	2	N/A	N/A	L
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	3	M
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	64	31	5	H
7	Marine mammals	N/A	4	N/A	L
8	Migratory birds	78	41	6	H
9	Upland birds	53	19	0.4	M
10	Bird eggs	4	N/A	N/A	L
11	Salmon	41	68	50	H
12	Non-salmon fish	56	38	7	M
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	84	56	N/A	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 38. Relative importance of subsistence resources based on selected variables, Galena

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	64	55	26	H
2	Caribou	5	10	1	L
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	1	L
5	Other large land mammals	1	1	0.3	L
6	Small land mammals/furbearers	29	23	2	M
7	Marine mammals	N/A	10	N/A	L
8	Migratory birds	30	19	1	M
9	Upland birds	49	9	1	M
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	49	56	58	H
12	Non-salmon fish	48	38	10	H
13	Marine invertebrates	3	6	0.1	L
14	Vegetation	79	19	1	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 39. Relative importance of subsistence resources based on selected variables, Rampart

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	57	86	27	H
2	Caribou	N/A	14	N/A	L
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	N/A	I
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	57	29	1	M
7	Marine mammals	N/A	57	N/A	M
8	Migratory birds	43	57	2	M
9	Upland birds	29	29	0.2	L
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	71	100	61	H
12	Non-salmon fish	86	71	8	H
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	57	86	0.2	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

Table 40. Relative importance of subsistence resources based on selected variables, Stevens Village

Number	Resource	% of HH trying	% of HHs receiving	% of total harvest	Final resource importance evaluation
1	Moose	52	47	2	H
2	Caribou	N/A	2	N/A	L
3	Dall sheep	N/A	N/A	N/A	I
4	Bear	N/A	N/A	0.4	L
5	Other large land mammals	N/A	N/A	N/A	I
6	Small land mammals/furbearers	50	25	3	M
7	Marine mammals	N/A	25	N/A	M
8	Migratory birds	75	23	1	H
9	Upland birds	25	5	0.2	L
10	Bird eggs	N/A	N/A	N/A	I
11	Salmon	61	29	81	H
12	Non-salmon fish	50	5	11	M
13	Marine invertebrates	N/A	N/A	N/A	I
14	Vegetation	75	25	1	H

Source: See Table 2
Notes: H = High; HH = Households; I = Indeterminate; L = Low; M = Moderate; N/A = Not Available

5.6. Subsistence Uses of the Western Arctic Herd

Table 41 provides caribou use and harvest averages across all available study years for the 42 caribou study communities listed in Table 1 and shown on Map 1. The 42 caribou study communities are members of the WAHWG and are subsistence users of the WAH. Caribou is a key subsistence resource for many of the WAHWG study communities. With few exceptions, use of caribou among the 42 study communities is high, with over 50 percent of households in 30 of the 42 study communities using caribou. The contribution of caribou toward the total subsistence harvest is highest in the communities of Anaktuvuk Pass, Ambler, Shungnak, Deering, Koyuk, Noatak, and Buckland. Caribou contributes an average of at least one-third of the total harvest in those communities. Caribou sharing ranges widely, with between 2 and 71 percent of WAHWG households giving caribou, and between 3 and 84 percent receiving caribou. On average, caribou contribute approximately 25 percent toward the total harvest for the study communities. Nearly half of households (48 percent) participate in caribou hunting, and residents harvest an average of 101 pounds of caribou annually.

Some of the caribou study communities with the highest average per capita harvests are those with use areas overlapping or close to the project area. These include Ambler, Buckland, Shungnak, Anaktuvuk Pass, Noorvik, Selawik, Noatak, and Kiana. Other caribou study communities with high average per capita harvests (over 100 pounds) include Kivalina, Deering, Wainwright, Atqasuk, Nuiqsut, Point Lay, and Koyuk. Several of these communities, including Anaktuvuk Pass and Nuiqsut, rely more heavily on other caribou herds such as the Teshekpuk Herd (TH) and Central Arctic Herd (CAH). While harvest data are only available for a limited number of study years for each community and therefore may not capture wide variations in annual harvests, review of individual study years suggest declining caribou harvests in several study communities. These include Elim, Kivalina, Kobuk, Kotzebue, Noatak, Selawik, and Shungnak. Thus, a number of study communities in the western portion of the project area may have experienced declines in caribou harvests in recent years. In contrast, several communities have seen a recent increase in caribou harvests in recent years, including Allakaket, Ambler, Deering, Hughes (based on two data points), Shishmaref, and Wainwright (based on two data points).

Table 41. Caribou subsistence harvest and use data, caribou study communities

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Allakaket	1981–82	N/A	N/A	6	N/A	6	6	724	19	5	0.5
Allakaket	1982–83	N/A	N/A	0	N/A	N/A	0	0	0	0	0.0
Allakaket	1983–84	N/A	N/A	4	N/A	N/A	4	471	8	3	0.4
Allakaket	1997	42	15	6	10	39	11	1,375	25	8	N/A
Allakaket	1998	100	55	26	20	86	43	5,623	92	29	N/A
Allakaket	1999	93	34	12	15	86	13	1,719	29	10	N/A
Allakaket	2001	21	7	7	3	15	9	1,170	19	7	N/A
Allakaket	2002–03	96	68	44	32	68	106	13,728	312	53	N/A
Allakaket	2011	76	48	33	48	62	95	12,350	217	84	16.0
Allakaket	Average	72	38	15	21	52	32	4,129	80	22	4.2
Ambler	2003	95	74	69	53	50	325	44,237	660	176	N/A
Ambler	2009	78	78	76	52	44	456	61,962	925	260	N/A
Ambler	2012	91	70	62	62	60	685	93,220	1,227	330	54.6
Ambler	Average	88	74	69	56	51	489	66,473	937	255	54.6
Anaktuvuk Pass	1990–91	N/A	N/A	55	N/A	N/A	592	69,964	985	223	N/A
Anaktuvuk Pass	1991–92	N/A	N/A	51	N/A	N/A	545	66,712	940	245	N/A
Anaktuvuk Pass	1992	N/A	74	N/A	N/A	N/A	600	70,222	889	260	82.6
Anaktuvuk Pass	1993–94	N/A	N/A	43	N/A	N/A	574	67,713	846	219	N/A
Anaktuvuk Pass	1994–95	N/A	N/A	N/A	N/A	N/A	322	43,846	516	153	83.5
Anaktuvuk Pass	1996–97	N/A	N/A	N/A	N/A	N/A	210	28,587	362	93	90.5
Anaktuvuk Pass	1998–99	N/A	N/A	N/A	N/A	N/A	500	68,000	756	220	91.3
Anaktuvuk Pass	1999–00	N/A	N/A	N/A	N/A	N/A	329	44,785	560	143	89.6
Anaktuvuk Pass	2000–01	N/A	N/A	N/A	N/A	N/A	732	99,579	1,071	353	90.8
Anaktuvuk Pass	2001–02	N/A	N/A	N/A	N/A	N/A	271	36,910	415	122	78.2
Anaktuvuk Pass	2002–03	N/A	N/A	N/A	N/A	N/A	436	59,310	666	193	92.2
Anaktuvuk Pass	2006–07	92	61	53	47	63	696	81,490	1,000	299	N/A

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Anaktuvuk Pass	2011	95	63	53	52	73	616	77,706	914	251	79.2
Anaktuvuk Pass	2014	89	45	40	47	68	770	104,664	1,057	330	84.2
Anaktuvuk Pass	Average	92	61	49	49	68	514	65,678	784	222	86.2
Atqasuk	1994	N/A	N/A	N/A	N/A	N/A	282	38,352	685	167	61.7
Atqasuk	1996	N/A	N/A	N/A	N/A	N/A	398	54,182	860	241	65.0
Atqasuk	1997	N/A	N/A	N/A	N/A	N/A	266	36,176	613	152	65.3
Atqasuk	2003	93	66	61	66	66	189	N/A	N/A	N/A	N/A
Atqasuk	2004	100	79	79	69	74	314	N/A	N/A	N/A	N/A
Atqasuk	2005	96	70	59	74	63	203	N/A	N/A	N/A	N/A
Atqasuk	2006	95	67	60	76	57	170	N/A	N/A	N/A	N/A
Atqasuk	Average	96	70	65	71	65	260	42,903	719	187	64.0
Bettles	1982	N/A	N/A	0	N/A	0	14	1,788	72	28	10.6
Bettles	1983	N/A	N/A	10	N/A	N/A	5	644	25	8	4.4
Bettles	1984	N/A	N/A	6	N/A	N/A	3	451	12	5	4.4
Bettles	1998	60	40	40	60	20	25	3,276	364	107	N/A
Bettles	1999	67	44	44	33	33	21	2,773	173	52	N/A
Bettles	2002	58	8	0	12	58	0	0	0	0	N/A
Bettles	2011	63	25	25	25	50	6	780	98	65	37.1
Bettles	Average	62	29	18	32	32	11	1,387	106	38	14.1
Brevig Mission	1984	18	N/A	0	7	18	N/A	N/A	N/A	N/A	N/A
Brevig Mission	1989	27	0	0	0	27	0	0	0	0	0.0
Brevig Mission	2000	85	24	20	29	71	76	10,369	153	35	N/A
Brevig Mission	2005	16	15	15	13	8	43	5,835	83	18	N/A
Brevig Mission	2015–16	92	29	19	31	78	65	8,840	136	45	N/A
Brevig Mission	Average	47	17	11	16	40	46	6,261	93	24	0.0
Buckland	2003	86	61	58	54	48	637	86,660	985	212	38.3
Buckland	2009	67	67	64	46	44	535	72,797	818	168	N/A
Buckland	2005	99	86	83	72	81	693	94,217	942	179	N/A

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Buckland	Average	84	71	68	57	58	622	84,558	915	186	38.3
Deering	1994	78	57	54	43	57	142	19,246	437	131	19.4
Deering	2007	87	55	45	55	74	182	24,743	526	162	N/A
Deering	2013	100	44	38	56	72	404	54,978	1,250	430	64.8
Deering	Average	88	52	46	51	68	243	32,989	738	241	42.1
Elim	1999	96	70	66	60	81	227	30,817	380	99	N/A
Elim	2005	96	79	58	65	85	150	20,421	319	77	N/A
Elim	2010	85	39	28	42	66	83	11,294	128	35	N/A
Elim	Average	92	63	51	56	77	153	20,844	276	70	N/A
Galena	1985	34	10	7	7	28	40	8,383	40	12	1.5
Galena	1996	12	10	10	8	4	40	5,224	29	10	N/A
Galena	1997	16	7	6	8	12	39	5,008	27	9	N/A
Galena	1998	15	4	3	4	12	7	936	5	2	N/A
Galena	1999	9	2	2	2	8	8	999	5	2	N/A
Galena	2001	5	0	0	0	5	0	0	0	0	N/A
Galena	2002	6	2	2	2	4	8	1,091	5	2	N/A
Galena	2010	8	3	1	1	6	6	770	5	2	0.7
Galena	Average	13	5	4	4	10	18	2,801	15	5	1.1
Hughes	1982	N/A	N/A	0	N/A	21	0	0	0	0	0.0
Hughes	2014	31	27	12	4	15	21	2,720	80	30	8.4
Hughes	Average	31	27	6	4	18	10	1,360	40	15	4.2
Huslia	1983	N/A	N/A	25	23	18	53	6,880	121	36	3.3
Huslia	1997	47	21	16	14	31	56	7,343	94	34	N/A
Huslia	1998	97	65	58	42	40	264	34,320	429	140	N/A
Huslia	1999	81	33	30	18	51	78	10,152	124	40	N/A
Huslia	2002	75	42	35	19	50	82	10,703	141	49	N/A
Huslia	Average	75	40	33	23	38	107	13,880	182	60	3.3
Kaltag	1996	30	17	11	13	23	16	2,095	34	9	N/A

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Kaltag	1997	20	4	4	7	18	8	1,075	17	4	N/A
Kaltag	1998	19	10	9	7	10	6	807	13	4	N/A
Kaltag	2001	2	0	0	0	2	0	0	0	0	N/A
Kaltag	2002	0	0	0	0	0	0	0	0	0	N/A
Kaltag	Average	14	6	5	5	10	6	795	13	3	N/A
Kiana	1999	97	68	65	52	75	488	66,316	691	174	N/A
Kiana	2006	94	62	57	N/A	N/A	306	41,612	438	109	31.2
Kiana	2009	77	80	75	54	55	414	56,337	547	149	N/A
Kiana	Average	89	70	66	53	65	403	54,755	559	144	31.2
Kivalina	1964	N/A	N/A	N/A	N/A	N/A	256	36,338	1,398	209	15.6
Kivalina	1965	N/A	N/A	N/A	N/A	N/A	1010	144,434	5,555	830	53.6
Kivalina	1982	N/A	N/A	N/A	N/A	N/A	346	48,202	1,026	179	22.9
Kivalina	1983	N/A	N/A	N/A	N/A	N/A	564	76,652	1,631	284	30.2
Kivalina	1992	97	77	74	53	68	351	47,539	660	138	18.2
Kivalina	2007	93	64	64	67	69	268	36,458	450	85	13.9
Kivalina	2010	79	67	29	51	73	86	11,657	130	32	N/A
Kivalina	Average	90	69	56	57	70	412	57,326	1,550	251	25.7
Kobuk	2004	89	82	61	46	64	134	18,224	651	148	N/A
Kobuk	2009	86	86	82	68	50	210	28,531	865	194	N/A
Kobuk	2012	93	67	57	57	73	119	16,173	449	98	31.8
Kobuk	Average	89	78	66	57	63	154	20,976	655	147	31.8
Kotlik	1980	N/A	N/A	7	N/A	N/A	8	1,600	29	4	N/A
Kotlik	Average	N/A	N/A	7	N/A	N/A	8	1,600	29	4	N/A
Kotzebue	1986	88	50	45	40	58	1917	260,645	341	97	24.4
Kotzebue	1991	93	70	63	59	62	3782	514,362	636	141	23.8
Kotzebue	2012	82	44	39	49	59	1804	245,287	301	80	N/A
Kotzebue	2013	84	43	34	42	71	1680	228,438	274	75	N/A
Kotzebue	2014	84	39	29	47	72	1286	174,823	212	59	28.8

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Kotzebue	Average	86	49	42	47	64	2094	284,711	353	90	25.7
Koyuk	1998	97	66	59	53	64	263	35,799	484	129	N/A
Koyuk	2004	97	77	72	72	72	425	57,737	671	153	N/A
Koyuk	2005	89	51	46	36	67	143	19,424	221	58	N/A
Koyuk	2006	N/A	N/A	N/A	N/A	N/A	447	60,759	683	168	40.0
Koyuk	2010	95	72	47	48	53	184	24,990	312	84	N/A
Koyuk	Average	94	66	56	52	64	292	39,742	474	118	40.0
Noatak	1994	84	84	91	71	50	615	996	83,664	221	47.8
Noatak	1999	95.6	74.4	72	61.1	62.2	683	92,902	938	224	N/A
Noatak	2002	91	76	71	61	64	410	55,733	552	120	N/A
Noatak	2007	97	73	66	78	88	442	60,061	505	114	31.4
Noatak	2010	56	21	21	4	45	66	8,937	78	16	N/A
Noatak	2010–1	95	62	50	51	78	360	48,918	391	90	N/A
Noatak	2016–17	96	70	51	56	84	337	45,783	358	80	N/A
Noatak	Average	88	66	60	54	67	416	44,761	12,355	124	39.6
Noorvik	2002	95	72	71	60	59	988	134,373	873	182	N/A
Noorvik	2008	94	70	70	37	56	767	104,289	724	174	N/A
Noorvik	2012	95	60	59	47	65	851	115,758	857	198	32.8
Noorvik	Average	95	67	67	48	60	869	118,140	818	184	32.8
Nuiqsut	1985	98	90	90	80	60	513	60,021	790	150	37.5
Nuiqsut	1992	N/A	81	N/A	N/A	N/A	278	32,551	N/A	N/A	21.7
Nuiqsut	1993	98	74	74	79	79	672	82,169	903	228	30.7
Nuiqsut	1994–95	N/A	N/A	N/A	N/A	N/A	258	30,186	N/A	N/A	36.3
Nuiqsut	1995–96	N/A	N/A	N/A	N/A	N/A	362	42,354	N/A	N/A	23.1
Nuiqsut	2000–01	N/A	N/A	N/A	N/A	N/A	496	57,985	N/A	N/A	31.6
Nuiqsut	2002–03	95	47	45	49	80	397	N/A	N/A	118	N/A
Nuiqsut	2003–04	97	74	70	81	81	564	N/A	N/A	157	N/A

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Nuiqsut	2004–05	99	62	61	81	96	546	N/A	N/A	147	N/A
Nuiqsut	2005–06	100	60	59	97	96	363	N/A	N/A	102	N/A
Nuiqsut	2006–07	97	77	74	66	69	475	N/A	N/A	143	N/A
Nuiqsut	2010	94	86	76	N/A	N/A	471	55,107	593	N/A	N/A
Nuiqsut	2011	92	70	56	49	58	498	58,226	619	134	N/A
Nuiqsut	2012	99	68	62	65	79	501	58,617	598	147	N/A
Nuiqsut	2013	95	79	63	62	75	586	68,534	692	166	N/A
Nuiqsut	2014	90	66	64	67	59	774	105,193	974	253	N/A
Nuiqsut	2015	96	84	78	74	72	628	73,527	728	180	N/A
Nuiqsut	2016	96	76	67	79	81	481	56,277	592	132	N/A
Nuiqsut	2014	90	66	64	59	67	774	105,193	974	253	28.3
Nuiqsut	Average	96	72	67	71	75	507	63,281	746	165	29.9
Nulato	1996	7	5	5	5	4	13	1,642	18	5	N/A
Nulato	1997	6	4	2	2	4	3	407	5	1	N/A
Nulato	1998	9	8	6	5	6	5	711	10	3	N/A
Nulato	2001	1	0	0	0	1	0	0	0	0	N/A
Nulato	2010	2	0	0	0	2	0	0	0	0	0.0
Nulato	Average	5	3	3	2	3	4	552	7	2	0.0
Point Hope	2014	91	53	30	51	80	185	25,156	143	34	7.6
Point Hope	2015	N/A	56	N/A	N/A	N/A	422	49,374	N/A	N/A	N/A
Point Hope	Average	91	53	30	51	80	185	25,156	143	34	7.6
Point Lay	1987	94	72	72	63	73	157	18,418	428	153	17.2
Point Lay	1994	N/A	N/A	N/A	N/A	N/A	223	30,260	522	171	31.3
Point Lay	2002	N/A	N/A	N/A	N/A	N/A	154	20,944	322	85	22.1
Point Lay	2012	93	64	60	71	76	356	48,380	705	186	31.3
Point Lay	2015	N/A	63	N/A	N/A	N/A	224	N/A	N/A	N/A	N/A
Point Lay	Average	94	66	66	67	75	223	29,501	494	149	25.5

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Selawik	1999	97	61	61	75	84	1289	175,335	1,124	249	N/A
Selawik	2006	N/A	65	63	N/A	N/A	934	127,120	757	165	N/A
Selawik	2011	97	70	54	59	80	683	92,947	550	109	20.4
Selawik	Average	97	65	59	67	82	969	131,801	810	174	20.4
Shaktoolik	1998	94	59	53	51	88	167	22,699	405	97	N/A
Shaktoolik	1999	94	47	45	29	78	125	16,992	288	73	N/A
Shaktoolik	2003	98	58	58	56	77	198	26,991	450	122	N/A
Shaktoolik	2009	51	51	47	35	25	133	18,100	302	81	N/A
Shaktoolik	Average	84	54	51	43	67	156	21,196	361	93	N/A
Shishmaref	1982	N/A	12	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shishmaref	1989	48	19	19	19	38	197	26,747	227	57	N/A
Shishmaref	1995	78	33	31	56	67	342	46,542	332	83	10.5
Shishmaref	2000	85	39	34	36	69	299	40,651	271	73	N/A
Shishmaref	2009	72	72	65	55	52	339	46,049	374	81	N/A
Shishmaref	2014	92	51	47	57	69	487	66,197	473	107	17.0
Shishmaref	Average	75	38	35	44	59	333	45,237	335	80	13.7
St. Michael	2003	68	29	18	16	57	48	6,460	68	16	N/A
St. Michael	2006	N/A	N/A	N/A	N/A	N/A	17	2,366	25	5	N/A
St. Michael	Average	68	29	18	16	57	33	4,413	47	10	N/A
Stebbins	2013	9	3	3	3	6	26	3,482	26	6	1.8
Stebbins	2006	N/A	N/A	N/A	N/A	N/A	0	0	0	0	N/A
Stebbins	2002	5	6	0	0	5	0	0	0	0	N/A
Stebbins	1980	N/A	N/A	0	N/A	N/A	0	0	0	0	0.0
Stebbins	Average	7	5	1	2	5	9	1,161	9	2	0.9
Teller	2000	59	8	6	6	54	21	2,823	40	12	N/A
Teller	2005	9	0	0	0	9	0	N/A	0	0	N/A
Teller	2006	N/A	N/A	N/A	N/A	N/A	0	0	0	0	N/A

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Teller	2015–16	47	18	17	13	39	29	3,944	51	16	N/A
Teller	Average	34	4	3	3	32	11	2,823	20	6	N/A
Unalakleet	2002	78	20	15	15	66	167	22,741	96	30	N/A
Unalakleet	2004	88	63	59	50	62	723	98,348	477	140	N/A
Unalakleet	2006	N/A	N/A	N/A	N/A	N/A	554	75,314	378	108	N/A
Unalakleet	Average	83	42	37	32	64	481	65,468	317	93	N/A
Utqiagvik	1987	N/A	N/A	26	N/A	N/A	1595	186,669	199	62	30.1
Utqiagvik	1988	N/A	N/A	27	N/A	N/A	1533	179,314	191	59	29.2
Utqiagvik	1989	N/A	N/A	39	N/A	N/A	1656	193,744	207	64	22.2
Utqiagvik	1992	N/A	46	N/A	N/A	N/A	1993	233,206	N/A	N/A	17.1
Utqiagvik	1995–96	N/A	N/A	N/A	N/A	N/A	2155	293,094	N/A	N/A	24.5
Utqiagvik	1996–97	N/A	N/A	N/A	N/A	N/A	1158	157,420	N/A	N/A	13.3
Utqiagvik	2000	N/A	N/A	N/A	N/A	N/A	3359	456,851	N/A	N/A	29.3
Utqiagvik	2001	N/A	N/A	N/A	N/A	N/A	1820	247,520	N/A	N/A	22.9
Utqiagvik	2002–03	92	61	55	80	78	5641	659,997	N/A	123	N/A
Utqiagvik	2003	N/A	N/A	N/A	N/A	N/A	2092	284,444	N/A	N/A	22.8
Utqiagvik	2003–04	87	52	45	73	69	3548	415,116	N/A	82	N/A
Utqiagvik	2004–05	85	51	48	62	64	4338	507,546	N/A	94	N/A
Utqiagvik	2005–06	90	50	47	81	78	4535	530,595	N/A	103	N/A
Utqiagvik	2006–07	92	65	59	65	70	5380	629,460	N/A	111	N/A
Utqiagvik	2014	70	38	33	38	52	4323	587,897	371	111	30.6
Utqiagvik	Average	86	52	42	67	68	3008	370,858	242	90	24.2
Wainwright	1989	N/A	N/A	66	N/A	N/A	711	83,187	699	178	23.7
Wainwright	2009	97	64	61	62	84	1231	167,356	1,073	284	41.7
Wainwright	Average	97	64	64	62	84	971	125,271	886	231	32.7
Wales	1993	24	7	2	5	21	4	486	10	3	0.4
Wales	2000	21	2	0	7	23	0	0	0	0	N/A

Study community	Study year	% of HH using	% of HH trying	% of HH harvesting	% of HH giving	% of HH receiving	Estimated number harvested	Estimated total pounds	Estimated mean HH pounds	Estimated per capita pounds	% of total harvest
Wales	2010	13	0	0	3	13	0	0	0	0	N/A
Wales	Average	19	3	1	5	19	1	162	3	1	0.4
White Mountain	1999	65	36	33	29	42	93	12,654	183	60	N/A
White Mountain	2006	N/A	N/A	N/A	N/A	N/A	50	6,825	112	34	8.1
White Mountain	2008	85	46	33	34	70	99	13,477	207	69	N/A
White Mountain	2015-16	92	29	19	31	78	65	8,840	136	45	N/A
White Mountain	Average	75	41	33	32	56	81	10,985	168	54	8.1
Wiseman	1991	N/A	N/A	N/A	N/A	N/A	10	1,260	N/A	N/A	28.2
Wiseman	2011	80	80	60	60	20	4	520	104	40	13.6
Wiseman	Average	80	80	60	60	20	7	890	104	40	20.9
All Communities	Average	72	46	38	39	53	352	47,201	703	98	26.5

Source: See Table 2
Notes: HH = Households; N/A = Not available
Harvest data not available for Livengood, Fairbanks, and Koyukuk.

Anaktuvuk Pass and Nuiqsut, rely more heavily on other caribou herds such as the Teshekpuk Herd (TH) and Central Arctic Herd (CAH). While harvest data are only available for a limited number of study years for each community and therefore may not capture wide variations in annual harvests, review of individual study years suggest declining caribou harvests in several study communities. These include Elim, Kivalina, Kobuk, Kotzebue, Noatak, Selawik, and Shungnak. Thus, a number of study communities in the western portion of the project area may have experienced declines in caribou harvests in recent years. In contrast, several communities have seen a recent increase in caribou harvests in recent years, including Allakaket, Ambler, Deering, Hughes (based on two data points), Shishmaref, and Wainwright (based on two data points).

6. Potential Impacts of Proposed Project to Subsistence Uses

6.1. Impact Methods

The potential impacts of the AMDIAR to subsistence uses are discussed under two primary headings: 1) Road Impacts and 2) Other Indirect and Cumulative Impacts/Indirect and Cumulative Impacts of Growth. The first section, Road Impacts, discusses the direct and indirect impacts of construction and operation of the Ambler Road. This section does not address potential impacts from development and activities that will result from operation of the road. The second section, Other Indirect and Cumulative Impacts/Indirect and Cumulative Impacts of Growth, addresses potential impacts associated with future mining development scenarios (facilitating access to the Ambler Mining District is a primary purpose of the road), in combination with other past, present, and reasonably foreseeable actions in the region.

The proposed subsistence impact analysis approach is organized as follows:

- Identify Potential Impact Categories
- Identify Impact Indicators
- Analyze Potential Impacts of the Road on Subsistence Uses
- Summarize Impact Indicators
- Discuss Other Indirect and Cumulative Impacts/Indirect and Cumulative Impacts of Growth

6.2. Impact Categories

Under both Construction and Operation headings, impacts are discussed under the following three subsistence impact categories:

1. Resource Abundance – Successful subsistence harvests depend on an adequate number of animals being available for harvest within a reasonable distance from one's community. While overall population levels within a region may appear stable, if a resource experiences a decline within a community's harvesting area (e.g., within a specific stream used commonly by the community) due to direct mortality or decreased egg or calf survival rates in the area, this would indicate a decrease in resource abundance for that community for that resource. While this section references the conclusions of the wildlife chapters in regards to potential population-level effects, more localized effects from a biological perspective may still affect resource abundance for an individual subsistence community.

2. Resource Availability - Successful subsistence harvests depend on continued availability of resources, of adequate quality and health, in traditional use areas. Subsistence availability can be affected by changes in resource health, resource displacement from traditional harvest locations due to altered distribution or migration, or resource contamination (including actual and/or perceived contamination of resources and habitat or habituation of resources to development activities). Similar to resource abundance, while this section references the conclusions of the wildlife chapters in regards to disturbance or displacement of subsistence resources, impacts which may be minimal from a biological perspective may have larger effects on individual subsistence users, and these impacts are also discussed under Resource Availability.
3. User Access (User Access) - Successful subsistence harvests depend on continued access to subsistence resources and use areas without physical, regulatory, or social barriers. Avoidance of an area due to development activities, infrastructure, concerns over contamination and other project related reasons is also an impact to user access. Access could be negatively affected or enhanced by a project.

Competition, Costs and Time, and Culture are also categories of impacts and often occur as a result of changes in the above three categories of abundance, availability, or access. For example, changes in access can result in changes in harvester competition for resources. Increased access to an area may result in more competition for resources from outsiders and/or from community or nearby community residents who did not previously use the area. Other aspects of a project may result in increased or decreased competition between communities, within a community, or between local hunters and outsiders. Displacement of resources, resource population decline, competition, and economic changes (e.g., income changes, changes in employment levels) can also affect costs and effort associated with subsistence harvest activities. Harvest activity costs are often directly related to distance traveled, in addition to other factors (e.g., gas prices, time spent away from home). Indirect effects of increased travel distances or time required to locate and harvest subsistence resources include increased safety risks. Finally, disruption of harvest activities can also disrupt learning and transmission of subsistence skills, which are key components of Alaska Native cultural identity. Harvesting activities, including distribution and processing of harvest products, foster and maintain social ties that are also important to overall wellbeing. Disruption of harvest activities can weaken those social ties by reducing social interactions. In addition, satisfaction that comes from eating traditional foods is also important to overall wellbeing, and disruptions to harvests of resources can affect the ability to consume subsistence foods. Other potential impacts to culture include avoidance of traditional use areas, loss of the integrity of a culturally significant place, and decreased autonomy (i.e., control over traditional lands, tribal government, development activities). Impacts to competition, costs and time, and culture are identified under the abundance, availability, and user access headings where applicable, and summarized in a separate section following the discussions of impacts to resource abundance, resource availability, and user access.

6.3. Impact Indicators

The study team identified two primary impact indicators that could be quantitatively measured for the subsistence study communities. These indicators are 1) Resource Importance (discussed above under Section 4.3) and 2) Subsistence Use Areas. These impact indicators are based on NEPA guidance, which requires consideration of both context and intensity when assessing significant impacts (40 CFR 1508.27). By understanding the relative importance of each subsistence resource (i.e., Resource Importance) and the location of where these uses occur (i.e., Subsistence Use Areas), the study team can better analyze the context and intensity of impacts and which subsistence resources and activities are more vulnerable to impacts from the proposed Project.

This analysis assumes that if a project impact were to affect a resource of higher importance, then that effect would be of a greater intensity to a community compared to a similar effect to a resource of lesser importance. The rationale is based on the fact that resources of higher importance have a greater number of subsistence users who participate in the harvests of that resource, share the resource, or for which the resource contributes a higher amount to the overall subsistence diet.

Furthermore, communities whose use areas are located along the project alternative or whose use areas are bisected (e.g., intersecting in or near the middle of the use area) by the proposed Project would likely experience greater impacts versus those communities that are located farther away or only have a small portion of their use areas intersected by the proposed Project. The rationale that the intensity of an impact would be greater when the proposed Project bisects a community's use area (versus on the periphery of a community's use area) is based on an analysis of subsistence use area mapping studies that record the number of harvesters by use area (SRB&A 2013a, 2009b, a, 2007). These studies have shown that areas closest to the communities are generally used by more people than areas located farther from the community., Other studies have termed this use of an intensively used core area as a "central-based use area" pattern in which a core area surrounding the community supports most of the food production with larger, less frequently used subsistence use areas extending beyond the intensively-used core (Wolfe and Fischer 2003). The analysis for this report acknowledges exceptions can occur if the outer edge of a community's use area is close to the community and limited by a regulatory boundary (e.g., community's use along a National Park) or prominent natural feature (e.g., coastline or mountain range).

The goal of this approach to use key impact indicators (i.e., resource importance, subsistence use areas) is to rely on systematically collected quantitative data to reduce subjective impact assessments, to avoid broad generalities in those analyses in the final assessment, and to allow for replication of the findings in both the baseline and impact assessment analyses. This impact analysis is the product of years of SRB&A research and development of systematic, quantitative, and replicable impact assessment methods. Other examples of quantitative data that have been collected in other subsistence studies around the state, and which could be used as impact indicators in order to provide a more specific and focused impact assessment, include travel methods by use area (to inform user access impacts), overlapping subsistence use areas (to inform the number of subsistence users potentially affected and where), and timing of subsistence activities by use areas (to inform likelihood for potential direct impacts at same time and place). However, these data are not available or were not systematically documented in a quantitative method during past studies in the subsistence study communities in order for the study team to incorporate them into the impact analysis as impact indicators. Where applicable, they are discussed in qualitative terms.

6.4. Road Impacts

6.4.1 Impacts Common to All Alternatives

The following sections describe the potential impacts of the proposed Ambler Road which are common to all alternatives. Table 42 through Table 45 provides impact indicators and shows the number of communities whose subsistence use areas are crossed by one or more of the project alternatives, by subsistence resource. The table also shows the relative importance of each subsistence resource to each community, in terms of selected measures of material and cultural importance (see Resource Importance sections above). The project alternatives cross subsistence use areas for 16 of the 27 subsistence study communities. Subsistence use areas are most commonly crossed for small land mammals (15 communities), caribou/moose (12 communities each), and non-salmon fish/vegetation (10 communities each) (Table 45). Most of these resources (moose, caribou, vegetation, and non-salmon fish) are of high importance to a majority of potentially affected communities. In the case of small land mammals, these resources are generally of low to moderate resource importance to the study communities (see Table 42 through Table 44); while trapping and hunting of furbearers and small land mammals remains culturally important, these activities occur among a smaller subset of community harvesters and provide a minimal amount in terms of subsistence foods. The study communities with the highest numbers of resource uses crossed by the proposed project alternatives are Hughes, Kobuk, Shungnak, Allakaket, Ambler, Bettles, and Evansville (eight or more resources each out of 14 resource categories) (Table 42 through Table 44).

Table 42. Use areas crossing project corridor and resource importance, by community, Alternative A

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Alatna	H[a]	M[a]	L[a]	L[a]	I[c]	M[b]	H[c]	H[b]	H[b]	I[c]	H[b]	M[b]	I[c]	H[b]	4
Allakaket	H[a]	H[a]	L[a]	L[a]	L[c]	M[b]	H[c]	M[b]	M[b]	I[c]	H[b]	H[b]	L[c]	H[b]	4
Ambler	M[a]	H[a]	L[b]	L[a]	L[c]	M[a]	H[b]	M[a]	M[b]	L[c]	H[a]	H[a]	L[c]	H[b]	7
Anaktuvuk Pass	M[b]	H[a]	M[b]	L[b]	L[c]	L[a]	H[c]	L[b]	L[b]	I[c]	M[b]	H[b]	I[c]	H[b]	2
Beaver	H[b]	L[b]	I[c]	M[b]	I[c]	H[b]	L[c]	H[b]	M[b]	L[b]	H[b]	M[b]	I[c]	H[b]	0
Bettles	H[a]	M[a]	L[a]	L[b]	I[c]	M[a]	I[c]	L[b]	L[a]	I[c]	M[a]	H[a]	I[c]	H[a]	8
Buckland	M[b]	H[b]	I[c]	L[b]	M[c]	L[b]	H[b]	M[b]	I[c]	M[b]	H[b]	H[b]	L[b]	H[b]	0
Coldfoot	L[a]	H[b]	I[b]	I[b]	I[c]	I[a]	I[c]	I[a]	L[a]	I[a]	L[b]	I[b]	I[c]	H[a]	6
Evansville	H[a]	H[a]	M[a]	L[b]	I[c]	L[a]	L[c]	L[a]	M[a]	I[c]	H[b]	H[a]	L[b]	H[a]	8
Galena	H[b]	L[c]	I[c]	L[c]	L[c]	M[b]	L[c]	M[b]	M[b]	I[c]	H[b]	H[b]	L[c]	H[b]	0
Hughes	H[b]	M[b]	I[a]	L[b]	I[c]	M[b]	M[c]	M[b]	M[b]	I[c]	H[b]	H[b]	I[c]	H[b]	1
Huslia	H[b]	M[b]	I[b]	L[b]	I[c]	M[b]	I[c]	M[b]	L[b]	I[c]	H[b]	H[b]	I[c]	L[b]	0
Kiana	M[b]	H[c]	L[b]	I[b]	I[c]	L[b]	M[b]	M[b]	L[c]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Kobuk	M[a]	H[a]	I[b]	L[a]	I[c]	L[a]	H[b]	M[a]	M[b]	I[c]	H[b]	H[b]	I[c]	H[a]	6
Kotzebue	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[b]	H[b]	0
Livengood	I[c]	I[c]	I[c]	I[b]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	0
Manley Hot Springs	M[b]	L[c]	I[c]	L[b]	I[c]	L[b]	I[c]	L[b]	M[b]	L[c]	H[b]	M[b]	L[c]	H[c]	0
Minto	H[b]	L[b]	L[c]	L[b]	I[c]	M[b]	I[c]	H[b]	M[b]	L[b]	H[b]	M[b]	L[c]	H[b]	0
Nenana	H[b]	L[b]	L[b]	I[b]	I[c]	L[b]	I[c]	I[b]	H[b]	I[b]	H[b]	H[b]	I[b]	I[c]	0
Noatak	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	L[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Noorvik	M[b]	H[b]	L[b]	L[b]	L[c]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Rampart	H[b]	L[b]	I[c]	I[b]	I[c]	M[b]	M[c]	M[b]	L[b]	I[c]	H[b]	H[b]	I[c]	H[b]	0
Selawik	M[b]	H[a]	I[c]	L[b]	I[c]	L[b]	H[b]	M[b]	M[b]	L[b]	M[b]	H[b]	L[c]	H[b]	1
Shungnak	M[a]	H[a]	L[a]	L[a]	I[c]	M[a]	H[b]	H[a]	L[b]	L[c]	H[a]	H[b]	L[c]	H[a]	8

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Stevens Village	H[b]	L[c]	I[c]	L[b]	I[c]	M[b]	M[c]	H[b]	L[b]	I[c]	H[b]	M[b]	I[c]	H[b]	0
Tanana	H[b]	L[b]	I[c]	L[b]	I[c]	H[b]	I[c]	M[b]	H[b]	I[b]	H[b]	M[b]	I[b]	H[b]	0
Wiseman	H[a]	H[c]	H[b]	I[b]	L[c]	M[a]	I[c]	M[a]	H[a]	I[a]	H[b]	H[b]	I[c]	H[a]	6

Source: Source: see Map 2 through Map 27; Table 2
Notes: DS = Dall sheep; H = Resource of high importance; I = Resource of indeterminate importance (no community harvest data); L = Resource of low importance; LLM = Large land mammal; M = Resource of moderate importance; MB = Migratory bird; MM = Marine mammal; MI = Marine invertebrates; NSF = Non-salmon fish; SML = Small land mammal; UGB = Upland game bird; V = vegetation
[a]Project Crosses Community Subsistence Use Area Data.
[b]Project Does Not Cross Community Subsistence Use Area Data
[c]No community subsistence use area defined, so project impact or lack of impact cannot be determined.

Table 43. Use areas crossing project corridor and resource importance, by community, Alternative B

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Alatna	H[a]	M[a]	L[a]	L[a]	I[c]	M[a]	H[c]	H[b]	H[b]	I[c]	H[b]	M[b]	I[c]	H[b]	5
Allakaket	H[a]	H[a]	L[a]	L[a]	L[c]	M[b]	H[c]	M[b]	M[b]	I[c]	H[b]	H[b]	L[c]	H[b]	4
Ambler	M[a]	H[a]	L[b]	L[a]	L[c]	M[a]	H[b]	M[b]	M[b]	L[c]	H[a]	H[a]	L[c]	H[a]	7
Anaktuvuk Pass	M[b]	H[a]	M[b]	L[b]	L[c]	L[a]	H[c]	L[b]	L[b]	I[c]	M[b]	H[b]	I[c]	H[b]	2
Beaver	H[b]	L[b]	I[c]	M[b]	I[c]	H[b]	L[c]	H[b]	M[b]	L[b]	H[b]	M[b]	I[c]	H[b]	0
Bettles	H[a]	M[a]	L[a]	L[b]	I[c]	M[a]	I[c]	L[b]	L[a]	I[c]	M[a]	H[a]	I[c]	H[a]	8
Buckland	M[b]	H[b]	I[c]	L[b]	M[c]	L[b]	H[b]	M[b]	I[c]	M[b]	H[b]	H[b]	L[b]	H[b]	0
Coldfoot	L[a]	H[b]	I[b]	I[b]	I[c]	I[a]	I[c]	I[a]	L[a]	I[a]	L[b]	I[b]	I[c]	H[a]	6
Evansville	H[a]	H[a]	M[a]	L[b]	I[c]	L[a]	L[c]	L[a]	M[a]	I[c]	H[b]	H[a]	L[b]	H[a]	8
Galena	H[b]	L[c]	I[c]	L[c]	L[c]	M[b]	L[c]	M[b]	M[b]	I[c]	H[b]	H[b]	L[c]	H[b]	0
Hughes	H[b]	M[b]	I[a]	L[b]	I[c]	M[b]	M[c]	M[b]	M[b]	I[c]	H[b]	H[b]	I[c]	H[b]	1

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Huslia	H[b]	M[b]	I[b]	L[b]	I[c]	M[b]	I[c]	M[b]	L[b]	I[c]	H[b]	H[b]	I[c]	L[b]	0
Kiana	M[b]	H[b]	L[b]	I[b]	I[c]	L[b]	M[b]	M[b]	L[c]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Kobuk	M[a]	H[a]	I[b]	L[a]	I[c]	L[a]	H[b]	M[a]	M[b]	I[c]	H[b]	H[b]	I[c]	H[a]	6
Kotzebue	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[b]	H[b]	0
Livengood	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	0
Manley Hot Springs	M[b]	L[c]	I[c]	L[b]	I[c]	L[b]	I[c]	L[b]	M[b]	L[c]	H[b]	M[b]	L[c]	H[b]	0
Minto	H[b]	L[b]	L[c]	L[b]	I[c]	M[b]	I[c]	H[b]	M[b]	L[b]	H[b]	M[b]	L[c]	H[b]	0
Nenana	H[b]	L[b]	L[b]	I[b]	I[c]	L[b]	I[c]	I[b]	H[b]	I[b]	H[b]	H[b]	I[b]	I[b]	0
Noatak	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	L[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Noorvik	M[b]	H[b]	L[b]	L[b]	L[c]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Rampart	H[b]	L[b]	I[c]	I[b]	I[c]	M[b]	M[c]	M[b]	L[b]	I[c]	H[b]	H[b]	I[c]	H[b]	0
Selawik	M[b]	H[a]	I[c]	L[b]	I[c]	L[b]	H[b]	M[b]	M[b]	L[b]	M[b]	H[b]	L[c]	H[b]	1
Shungnak	M[a]	H[a]	L[a]	L[a]	I[c]	M[a]	H[b]	H[a]	L[b]	L[c]	H[a]	H[b]	L[c]	H[a]	8
Stevens Village	H[b]	L[c]	I[c]	L[b]	I[c]	M[b]	M[c]	H[b]	L[b]	I[c]	H[b]	M[b]	I[c]	H[b]	0
Tanana	H[b]	L[b]	I[c]	L[b]	I[c]	H[b]	I[c]	M[b]	H[b]	I[b]	H[b]	M[b]	I[b]	H[b]	0
Wiseman	H[a]	H[b]	H[b]	I[b]	L[c]	M[a]	I[c]	M[a]	H[a]	I[a]	H[b]	H[b]	I[c]	H[a]	6

Source: see Map 2 through Map 27; Table 2
Notes: DS = Dall sheep; H = Resource of high importance; I = Resource of indeterminate importance (no community harvest data); L = Resource of low importance; LLM = Large land mammal; M = Resource of moderate importance; MB = Migratory bird; MM = Marine mammal; MI = Marine invertebrates; NSF = Non-salmon fish; SML = Small land mammal; UGB = Upland game bird; V = vegetation
[a]Project Crosses Community Subsistence Use Area Data.
[b]Project Does Not Cross Community Subsistence Use Area Data
[c]No community subsistence use area defined, so project impact or lack of impact cannot be determined.

Table 44. Use areas crossing project corridor and resource importance, by community, Alternative C

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Alatna	H[a]	M[a]	L[b]	L[a]	I[c]	M[a]	H[c]	H[b]	H[b]	I[c]	H[b]	M[a]	I[c]	H[b]	5
Allakaket	H[a]	H[a]	L[a]	L[a]	L[c]	M[a]	H[c]	M[a]	M[a]	I[c]	H[b]	H[a]	L[c]	H[a]	9
Ambler	M[a]	H[a]	L[b]	L[a]	L[c]	M[a]	H[b]	M[a]	M	L[c]	H[a]	H[a]	L[c]	H[a]	8
Anaktuvuk Pass	M[b]	H[a]	M[b]	L[b]	L[c]	L[a]	H[c]	L[b]	L[b]	I[c]	M[b]	H[b]	I[c]	H[b]	2
Beaver	H[b]	L[b]	I[c]	M[b]	I[c]	H[b]	L[b]	H[b]	M[b]	L[b]	H[b]	M[b]	I[c]	H[b]	0
Bettles	H[b]	M[b]	L[b]	L[b]	I[c]	M[b]	I[c]	L[b]	L[b]	I[c]	M[b]	H[b]	I[c]	H[b]	0
Buckland	M[b]	H[b]	I[c]	L[b]	M[c]	L[b]	H[b]	M[b]	I[c]	M[b]	H[b]	H[b]	L[b]	H[b]	0
Coldfoot	L[b]	H[b]	I[b]	I[b]	I[c]	I[b]	I[c]	I[b]	L[b]	I[b]	L[b]	I[b]	I[c]	H[b]	0
Evansville	H[b]	H[b]	M[b]	L[b]	I[c]	L[b]	L[c]	L[b]	M[b]	I[c]	H[b]	H[b]	L[b]	H[b]	0
Galena	H[b]	L[c]	I[c]	L[c]	L[c]	M[b]	L[c]	M[b]	M[b]	I[c]	H[b]	H[b]	L[c]	H[b]	0
Hughes	H[a]	M[a]	I[a]	L[a]	I[c]	M[a]	M[b]	M[a]	M[b]	I[c]	H[a]	H[a]	I[c]	H[a]	9
Huslia	H[b]	M[a]	I[b]	L[b]	I[c]	M[a]	I[c]	M[b]	L[b]	I[c]	H[a]	H[b]	I[c]	L[b]	3
Kiana	M[b]	H[b]	L[b]	I[b]	I[c]	L[b]	M[b]	M[b]	L[c]	L[b]	H[b]	H[a]	L[c]	H[b]	1
Kobuk	M[a]	H[a]	I[b]	L[a]	I[c]	L[a]	H[b]	M[a]	M[a]	I[c]	H[a]	H[a]	I[c]	H[a]	9
Kotzebue	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[b]	H[b]	0
Livengood	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	0
Manley Hot Springs	M[b]	L[c]	I[c]	L[b]	I[c]	L[b]	I[c]	L[b]	M[b]	L[c]	H[b]	M[b]	L[c]	H[b]	0
Minto	H[b]	L[b]	L[c]	L[b]	I[c]	M[b]	I[c]	H[b]	M[b]	L[b]	H[b]	M[b]	L[c]	H[b]	0
Nenana	H[b]	L[b]	L[b]	I[b]	I[c]	L[b]	I[c]	I[b]	H[b]	I[b]	H[b]	H[b]	I[b]	I[b]	0
Noatak	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	L[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Noorvik	M[b]	H[b]	L[b]	L[b]	L[c]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Rampart	H[b]	L[b]	I[c]	I[b]	I[c]	M[b]	M[c]	M[b]	L[b]	I[c]	H[b]	H[b]	I[c]	H[b]	0
Selawik	M[b]	H[a]	I[c]	L[b]	I[c]	L[a]	H[b]	M[b]	M[b]	L[b]	M[b]	H[b]	L[c]	H[b]	2
Shungnak	M[a]	H[a]	L[a]	L[a]	I[c]	M[a]	H[b]	H[a]	L[b]	L[c]	H[a]	H[a]	L[c]	H[a]	9

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Stevens Village	H[a]	L[c]	I[c]	L[a]	I[c]	M[a]	M[c]	H[a]	L[a]	I[c]	H[b]	M[a]	I[c]	H[a]	7
Tanana	H[a]	L[a]	I[c]	L[a]	I[c]	H[a]	I[c]	M[b]	H[b]	I[b]	H[b]	M[b]	I[b]	H[b]	4
Wiseman	H[b]	H[b]	H[b]	I[b]	L[c]	M[b]	I[c]	M[b]	H[b]	I[b]	H[b]	H[b]	I[c]	H[b]	0

Source: see Map 2 through Map 27; Table 2
Notes: DS = Dall sheep; H = Resource of high importance; I = Resource of indeterminate importance (no community harvest data); L = Resource of low importance; LLM = Large land mammal; M = Resource of moderate importance; MB = Migratory bird; MM = Marine mammal; MI = Marine invertebrates; NSF = Non-salmon fish; SML = Small land mammal; UGB = Upland game bird; V = vegetation
[a]Project Crosses Community Subsistence Use Area Data.
[b]Project Does Not Cross Community Subsistence Use Area Data
[c]No community subsistence use area defined, so project impact or lack of impact cannot be determined.

Table 45. Use areas crossing project corridor and resource importance, by community, any alternative

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Alatna	H[a]	M[a]	L[a]	L[a]	I[c]	M[a]	H[c]	H[b]	H[c]	I[c]	H[b]	M[a]	I[c]	H[b]	6
Allakaket	H[a]	H[a]	L[b]	L[a]	L[c]	M[a]	H[c]	M[a]	M[a]	I[c]	H[b]	H[a]	L[c]	H[a]	9
Ambler	M[a]	H[a]	L[b]	L[a]	L[c]	M[a]	H[b]	M[a]	M[b]	L[c]	H[a]	H[a]	L[c]	H[a]	8
Anaktuvuk Pass	M[b]	H[a]	M[b]	L[b]	L[c]	L[a]	H[b]	L[b]	L[b]	I[c]	M[b]	H[b]	I[c]	H[b]	2
Beaver	H[b]	L[b]	I[c]	M[b]	I[c]	H[b]	L[c]	H[b]	M[b]	L[b]	H[b]	M[b]	I[c]	H[b]	0
Bettles	H[a]	M[a]	L[a]	L[b]	I[c]	M[a]	I[c]	L[b]	L[a]	I[c]	M[a]	H[a]	I[c]	H[a]	8
Buckland	M[b]	H[b]	I[c]	L[b]	M[a]	L[b]	H[b]	M[b]	I[c]	M[b]	H[b]	H[b]	L[b]	H[b]	0
Coldfoot	L[a]	H[b]	I[b]	I[b]	I[c]	I[a]	I[c]	I[a]	L[a]	I[a]	L[b]	I[b]	I[c]	H[a]	6
Evansville	H[a]	H[a]	M[a]	L[b]	I[c]	L[a]	L[b]	L[a]	M[a]	I[c]	H[b]	H[a]	L[b]	H[a]	8
Galena	H[b]	L[c]	I[c]	L[c]	L[c]	M[b]	L[c]	M[b]	M[b]	I[c]	H[b]	H[b]	L[c]	H[b]	0
Hughes	H[a]	M[a]	I[a]	L[a]	I[c]	M[a]	M	M[a]	M[b]	I[c]	H[a]	H[a]	I[c]	H[a]	9
Huslia	H[b]	M[a]	I[b]	L[b]	I[c]	M[a]	I[c]	M[b]	L[b]	I[c]	H[a]	H[b]	I[c]	L[b]	3
Kiana	M[b]	H[b]	L[b]	I[b]	I[c]	L[b]	M[b]	M[b]	L[c]	L[b]	H[b]	H[a]	L[c]	H[b]	1
Kobuk	M[a]	H[a]	I[b]	L[a]	I[c]	L[a]	H[b]	M[a]	M[a]	I[c]	H[a]	H[a]	I[c]	H[a]	9
Kotzebue	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[b]	H[b]	0
Livengood	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	I[c]	0
Manley Hot Springs	M[b]	L[c]	I[c]	L[b]	I[c]	L[b]	I[c]	L[b]	M[b]	L[c]	H[b]	M[b]	L[c]	H[b]	0
Minto	H[b]	L[b]	L	L[b]	I[c]	M[b]	I[c]	H[b]	M[b]	L[b]	H[b]	M[b]	L[c]	H[b]	0
Nenana	H[b]	L[b]	L[b]	I[b]	I[c]	L[b]	I[c]	I[b]	H[b]	I[b]	H[b]	H[b]	I[b]	I[b]	0
Noatak	M[b]	H[b]	L[b]	L[b]	L[b]	L[b]	H[b]	M[b]	L[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Noorvik	M[b]	H[b]	L[b]	L[b]	L[c]	L[b]	H[b]	M[b]	M[b]	L[b]	H[b]	H[b]	L[c]	H[b]	0
Rampart	H[b]	L[b]	I[c]	I[b]	I[c]	M[b]	M	M[b]	L[c]	I[c]	H[b]	H[b]	I[c]	H[b]	0
Selawik	M[b]	H[a]	I[c]	L[b]	I[c]	L[a]	H[b]	M[b]	M[c]	L[c]	M[b]	H[b]	L[c]	H[b]	2

Study community	Moose	Caribou	DS	Bear	Other LLM	SLM	MM	MB	UGB	Eggs	Salmon	NSF	MI	V	Number of known resource use areas crossed
Shungnak	M[a]	H[a]	L[a]	L[a]	I[c]	M[a]	H[b]	H[a]	L[b]	L[c]	H[a]	H[a]	L[c]	H[a]	9
Stevens Village	H[a]	L	I[c]	L[a]	I[c]	M[a]	M	H[a]	L[a]	I[c]	H[b]	M[a]	I[c]	H[a]	7
Tanana	H[a]	L[a]	I[c]	L[b]	I[c]	H[a]	I[c]	M[b]	H[b]	I[b]	H[b]	M[b]	I[b]	H[b]	3
Wiseman	H[a]	H[b]	H[b]	I[b]	L[c]	M[a]	I[c]	M[a]	H[a]	I[a]	H[b]	H[b]	I[c]	H[a]	6

Source: see Map 2 through Map 27; Table 2
Notes: DS = Dall sheep; H = Resource of high importance; I = Resource of indeterminate importance (no community harvest data); L = Resource of low importance; LLM = Large land mammal; M = Resource of moderate importance; MB = Migratory bird; MM = Marine mammal; MI = Marine invertebrates; NSF = Non-salmon fish; SML = Small land mammal; UGB = Upland game bird; V = vegetation
[a]Project Crosses Community Subsistence Use Area Data.
[b]Project Does Not Cross Community Subsistence Use Area Data
[c]No community subsistence use area defined, so project impact or lack of impact cannot be determined.

Table 46. Number of communities with use areas crossing the project, by alternative and resource

Resource	Number of communities crossing Alternative A	Number of communities crossing Alternative B	Number of communities crossing Alternative C	Number of communities crossing any Alternative	Affecting greatest number of communities
Moose	9	9	8	12	A/B
Caribou	9	9	10	12	C
Dall sheep	6	6	3	6	A/B
Bear	5	5	7	7	C
Other large land mammals	0	0	0	0	N/A
Small land mammals	8	9	11	15	C
Marine mammals	0	0	0	0	N/A
Migratory birds	6	5	6	9	A/C
Upland game birds	4	4	3	7	A/B
Eggs	2	2	0	2	A/B
Salmon	3	3	5	6	C
Non-salmon fish	3	3	8	10	C

Resource	Number of communities crossing Alternative A	Number of communities crossing Alternative B	Number of communities crossing Alternative C	Number of communities crossing any Alternative	Affecting greatest number of communities
Marine invertebrates	0	0	0	0	N/A
Vegetation	6	7	6	10	B
Total Number of Communities Crossed	**12**	**12**	**12**	**16**	**N/A**

Source: see Map 2 through Map 27; Table 2
Notes: A = Alternative A; B = Alternative B; C = Alternative C; N/A = Not applicable; No. = Number

During scoping, tribal, village, and corporation entities as well as Alaska Native resource co-management entities expressed concerns regarding potential road impacts. Based on the traditional knowledge of the individuals living in the Project area, the scoping meeting participants described potential impacts to resource abundance, resource availability, and user access as well as compounded impacts resulting from changes to resource abundance and availability and user access. The traditional knowledge observations and concerns are discussed below under the various impact headings.

Resource Abundance

Construction

Whereas many large-scale projects in Alaska have distinct construction and operation phases, the AMDIAR will undergo several periods of construction (lasting approximately two years each) interspersed with longer periods of operation/exploration. Construction impacts will be greatest during Phase 1 when the majority of construction (e.g., culvert and bridge installation, primary placement of gravel) will occur. Construction activities which could affect resource abundance through removal or disturbance of habitat include blasting/mining, operation of construction equipment, excavation, placement of gravel, construction noise, human presence, water withdrawal, installation of bridges and culverts, and air and ground traffic. Construction activities may also cause direct mortality to individual animals, including caribou, moose, fish, and waterfowl through vehicle and aircraft collisions, pile driving, and blasting.

The AMDIAR could cause direct mortality to caribou resulting from construction vehicle strikes, particularly if the caribou use the road as a movement corridor or insect relief area. Individual caribou may become ill through ingestion of chemicals used during construction or mining. Alteration and fragmentation of caribou habitat may also affect resource abundance in the long-term; these impacts are discussed below under “Operation.” Fish may experience direct mortality through driving of bridge pile, and certain activities such as pile driving, construction sedimentation, and stream diversions, may alter or degrade fish habitat thereby reducing egg survival downstream. Water withdrawal may kill individual fish but would likely not have population-level effects.

During the scoping period, the traditional knowledge provided by the Native Village of Kotzebue indicated that silt and contaminants as well as changes to water flows in the Kobuk River region watersheds may lead to decreased health and abundance of sheefish, salmon, whitefish, and Dolly Varden char populations. The Native Village commented that these resources are essential to the livelihood of the community of Kotzebue, particularly due to the fact that they are inexpensive to harvest and are available throughout the year:

> Healthy and abundant sheefish and salmon require pristine watersheds free from silt and contaminants, in addition to sufficient water flows and unfettered access to the most remote parts of the Kobuk River for their annual spawning runs. Salmon are critical to our members, representing a major source of income and subsistence resources necessary for their continued quality of life and livelihood. Sheefish are a major part of the annual cycle of subsistence for our members as they are commonly harvested near Kotzebue for the majority of the year. They somewhat uniquely represent an egalitarian resource, in that they are easily harvested for much of the year by the entire community because of their proximity and without requiring scarce, or expensive, methods and means. Whitefish that feed in the summer in coastal lagoons of Kotzebue Sound and continue to be harvested as a treasured food by our members, also use the Kobuk River and its tributaries for spawning and overwintering purposes, as do Dolly Varden char. (Native Village of Kotzebue 2018)

Waterfowl nesting and feeding near the road corridor or gravel sites may also experience direct habitat loss or may ingest chemicals associated with construction activities and dust deposition. Some individual mortalities of waterfowl would likely occur as a result of increased air traffic in the region. Direct loss of vegetation resulting from gravel mining, gravel placement, and fugitive dust would cause decreased abundance of vegetation (e.g., berries, wild greens) along the road corridor. In addition, clearing and grading along the road ROW could cause an increase in wildlife mortality (e.g., destruction of dens, clearing of habitat), particularly for resources such as small land mammals.

Operation

Operation activities which could affect resource abundance include the presence of roads and bridges (e.g., habitat fragmentation), the presence of other infrastructure such as communications towers and culverts, fuel or other contaminant spills, dust deposition, road and air traffic, and human activity. The presence of the road in addition to related culverts, bridges, and gravel infrastructure would alter and degrade fish habitat both upstream and downstream from the road, which could affect fish abundance for subsistence users in certain waterways crossed by the road corridor. It is not possible to predict the location and magnitude of such changes, although key sheefish spawning areas in the Kobuk River drainage and whitefish spawning in the Alatna River may be particularly vulnerable to population-level impacts.

Habitat fragmentation resulting from sustained disturbances to caribou along the road could result in decreased abundance of certain resources over time. In the case of caribou, other Alaskan herds such as the Central Arctic Herd have maintained habitat connectivity and general migration patterns despite being intersected by highways and roads. Fragmentation of the WAH and RMH range resulting from a road may be more pronounced because the WAH and RMH ranges have less development and therefore have had less opportunity to habituate to human activity. The likelihood of longer term impacts on resource abundance vary by resource and are discussed below under the individual alternatives, under Indirect and Cumulative Impacts, and in individual biological resources discussions.

As with construction, some direct mortalities may occur as a result of collisions with vehicles, aircraft, or infrastructure during operations, particularly if animals such as moose are attracted to the road ROW as a movement corridor. Ingestion of contaminated water or vegetation as a result of spills could also cause illness in individual animals; larger spills into waterways would have larger effects on fish abundance, particularly in spawning streams.

Concerns about potential contamination of sheefish and chum salmon spawning grounds have already been voiced in the study communities (Watson 2014). The Kobuk River supports the largest population of spawning sheefish in Alaska, and the Alatna River is the only spawning habitat for sheefish in the upper Koyukuk River drainage. In addition, sheefish spawning grounds are particularly sensitive to changes in water velocity, temperature, pH, and other factors. Thus, any impacts to sheefish spawning grounds along the Alatna and Kobuk rivers could have much larger effects on the abundance of sheefish within the Kobuk and Koyukuk river drainages.

Over time, fugitive dust along road corridors may increase the affected area of vegetation which could in turn affect caribou, waterfowl, and other animals feeding in the vicinity of the road. Illegal use of the road by hunters may result in increased mortality of moose and caribou along the road corridor, although likely not to the level of reducing overall population numbers.

Ingestion of contaminated water or vegetation as a result of spills could also cause illness in individual animals; larger spills into waterways would have larger effects on fish habitat and abundance, particularly if spills occur in sheefish, whitefish, or salmon spawning streams, and could have population-level effects.

Resource Availability

Many of the subsistence study communities have high unemployment rates, incomes below the poverty line, and high food insecurity (Guettabi, Greenberg, Little, and Joly 2016). Despite these factors, community populations are stable. Subsistence activities and harvests are a key component in maintaining residents' ability to remain in their communities (Guettabi et al. 2016). Because of the importance of subsistence to maintaining the stability of the mixed economy and resilience of the study communities, these communities are also particularly vulnerable to impacts on subsistence harvests and subsistence resource availability. Furthermore, many of the subsistence study communities do not currently have road access and have majority Alaska Native populations which have specific cultural, social, and spiritual identities and needs that are inextricably linked to subsistence, which adds to their vulnerability associated with change introduced through an industrial road. These communities would be most vulnerable to potential impacts subsistence resource availability resulting from the project.

Construction

Construction activities that may affect resource availability for subsistence users include excavation, blasting, mining, ROW clearing, gravel placement, operation of construction equipment, general construction noise, human activity, vehicle and air traffic, sedimentation from construction activity, and fuel or other contaminant spills. Infrastructure such as the pioneer road, material sites, culverts, and bridge piles may also pose as physical obstructions for terrestrial mammals and fish. The 16 communities who have use areas overlapped by the project alternatives would experience direct impacts to resource availability; larger impacts to resource behavior, migration, or distribution could result in indirect impacts to resource availability for all 27 subsistence study communities, and in the case of caribou, the 42 caribou study communities.

In the short term, blasting may displace or divert resources such as large land mammals, small land mammals, and waterfowl, due to the noise associated with such activities (Section 3.2.6). Blasting also destroys vegetation and surrounding habitat for resources such as caribou, moose, and waterfowl. Clearing of trees and brush for the ROW and stripping of topsoil and organic material may alter or degrade resource habitat, particularly for herbivores that depend on surface vegetation or for fish in streams or rivers affected by erosion and sedimentation. In addition, these activities would remove berry, wild plant, and wood harvesting areas for study communities along the road corridor. Habitat alteration can affect resource distribution, thereby reducing the availability of those resources to subsistence users in traditional hunting or harvesting areas. Resource movement, particularly for migratory animals such as caribou, may be diverted due to increased human and material presence, air and ground traffic, noise, and/or contamination and dust from construction activities (see detailed discussion below, under "Caribou"). This general disturbance of wildlife could result in subsistence resources being unavailable at the time and place that subsistence users are accustomed to finding them.

Noise from construction equipment, gravel placement, blasting, mining, vehicle traffic, aircraft and helicopters, and human activity, would likely displace or divert certain resources (Section 3.2.6). Traffic itself causes a physical barrier for migratory animals, particularly caribou, and can also displace or divert resources when herds are separated (Vistnes and Nellemann 2007). Some animals, such as certain species of small land mammals and caribou, can become habituated to certain development activities over time; however, this habituation can result in changes to resource distribution and may also cause increased mortalities due to vehicle strikes. During the construction years, estimated air traffic volumes are 5 to 9 fixed wing aircraft trips each week, and one helicopter trip per week. Ground traffic would increase over the three phases of the AMDIAR but would be less during the construction phases.

Potential effects of construction activities on resource availability also include contamination resulting from fuel and other chemical spills, dust deposition, sedimentation due to erosion along river and stream banks, and increased emissions. Construction activity may lead to concerns by local residents about contamination of subsistence resources, particularly plants and berries, which are of high importance to nearly all potentially affected communities (see Resource Importance sections) and which could be directly affected by fugitive dust along the road corridors. This concern would be especially elevated in areas where naturally occurring asbestos is exposed during construction or contained in the gravel fills used for the project. Fuel spills and erosion may also result in contamination of waterways, affecting fish and other animals who ingest contaminated water. Contamination or perceived contamination can have indirect effects on subsistence, as subsistence users may reduce their consumption of a resource if there is a fear of contamination; thus, resources perceived as unhealthy or contaminated are considered unavailable to local residents.

The influx of workers during the multi-year construction period would also cause a substantial increase in human disturbance and activity within the region, which would likely result in decreased availability of certain resources in the vicinity of construction areas The potential for impacts to resource availability resulting from hunting or fishing by temporary construction workers is a key concern which has been raised by the study communities. This analysis assumes that no road users authorized by AIDEA (including construction workers) will be allowed to also hunt or fish from the road. In other words, construction workers or truck drivers will not be allowed to stop and hunt or fish using the road for access. However, it is possible that workers may choose to return to the area after construction is complete to engage in harvesting activities within the area, which could increase the number of hunters in the area over time and reduce resource availability for local residents.

The following sections provide a more in-depth discussion of potential impacts to the resources which are most commonly harvested by the study communities along the proposed road corridors and which are of high importance to a majority of those study communities. These resources include caribou, moose, fish, and vegetation.

Caribou

As noted above, the proposed road routes cross through community caribou hunting areas for 12 communities: Hughes, Kobuk, Shungnak, Allakaket, Ambler, Bettles, Evansville, Alatna, Huslia, Anaktuvuk Pass, Selawik, and Tanana. For seven of these communities, caribou are a resource a high importance (see Table 45), while for the remaining five communities, caribou are of moderate or low importance based on selected measures. In addition to the communities who have documented use of the proposed corridors, additional subsistence study communities and caribou study communities may experience impacts to caribou availability if the road causes larger impacts on caribou movement. The project area crosses through the winter, migratory (fall and spring), and peripheral range for the Western Arctic Herd (WAH); the total range, including calving grounds, for the Ray Mountain Herd (RMH); and the peripheral range of the Hodzana Hills caribou herd (HHH). The Native Village of Kotzebue commented on the supreme importance of caribou to their community and the profound cultural impacts that a decrease in the presence of the WAH would have on the community of Kotzebue. They commented that it is essential that the WAH be able to migrate freely:

> It is impossible to overstate the importance of caribou to our members. Their absence in the annual subsistence cycle would irreversibly change the character of the culture and impose major hardship on the people as it would be impossible to replace the quantity and quality of food that caribou currently provide. (Native Village of Kotzebue 2018)

The primary construction activities which may affect caribou availability to local communities include air and ground traffic, construction noise (e.g., blasting, machinery), the presence of linear infrastructure (e.g., pioneer road), and human activity. Air traffic has been a commonly reported and observed impact on caribou on the North Slope and in Northwest Alaska (SRB&A 2009b, 2018, Georgette and Loon 1988, Sullender 2017). Air traffic is observed to cause behavioral changes, skittish behavior, and delayed or diverted crossing behavior, which in turn has impacts on caribou hunting success for local hunters. These types of behaviors are most commonly observed in response to helicopter traffic, although fixed-wing aircraft have also been observed to elicit similar responses. In addition to changes in behavior, increased exposure to aircraft disturbance may also affected body condition through increased energy expenditures (e.g., more time fleeing versus feeding or resting) (Sullender 2017). Furthermore, increased energy expenditures may result in reduced foraging rates and, ultimately, decreased mating success/pregnancy rates.

Roads and road traffic are also believed to cause behavioral and migratory changes in caribou which can affect hunting success. Deflections or delays of caribou movement from roads and associated ground traffic and human activity have been documented in the traditional knowledge of harvesters (SRB&A 2009b, SRB&A 2014, SRB&A 2018) and during behavioral studies on caribou, particularly for maternal caribou (displacement of between 1.24 and 2.5 miles [2 and 4 km] from roads) (ABR and SRB&A 2014). In recent years, reports of ground traffic–related impacts on the North Slope caribou hunting, particularly in the vicinity of Nuiqsut, have increased with the construction of gravel roads in the area (SRB&A 2016, 2017, 2018). Impacts and road have also been observed by Noatak and Kivalina caribou hunters in regards to the Red Dog DMTS (SRB&A 2014). Residents have observed that some caribou will stop once they reach the DMTS, sometimes traveling alongside the road before crossing, and other times bypassing the road altogether. Such behavior has also been documented through radio collar observation. A study conducted by (Wilson, Parrett, Joly, and Dau 2016), found that the DMTS influenced the movements of approximately 30 percent of radio-collared WAH caribou, and of those individuals, the average delay in crossing was 33 days. Caribou from the Teshekpuk Herd (TH) were not similarly affected, which could be due to greater exposure of the TH to industrial development in the eastern portion of its range. In general, observed caribou behavior in response to the DMTS is variable: in some cases caribou cross seemingly without delay, while in other cases herds scatter and migration is delayed for multiple days (Wilson et al. 2016, ABR and SRB&A 2014). Responses to roads also seem to vary from year to year based on the context in which roads are encountered.

In addition to impacts to resource abundance, the Alaska Native entities present at the scoping meetings also described potential impacts to resource availability in traditional use areas. A majority of the traditional knowledge comments noted the potential for altered migration, particularly in regards to caribou as well as aquatic resources. The Western Interior Alaska Subsistence Regional Advisory Council noted that noise disturbances resulting from increased traffic will decrease availability of key terrestrial and aquatic resources within at least a 50 mile radius of the Project:

> The Council emphasizes that the impacts of developing the Ambler Road Project will have adverse and far reaching effects within at least 50 miles of each side of the road. These impacts include noise disturbance to terrestrial and aquatic wildlife resulting from increased motorized off-road vehicle traffic and boat use extending up the coast and into the Kobuk River Drainage. The increased motorized off-road vehicle traffic and boat use resulting from development of the Amber Road will also have significant adverse impacts up and down the Koyukuk River, John River, and Alatna River drainages. (Western Interior Alaska Subsistence Regional Advisory Council 2018)

The tendency for caribou to divert around areas of disturbance is evidenced by traditional hunting methods which are still observed today. According to the (WAHWG 2017), caribou hunting traditions ensure that caribou migratory paths are well established before hunting begins:

> Hunters in Kiana were instructed to wait two days after the first caribou passed through for the migration to be established. By waiting to harvest caribou, the community protected the migration for years to come.

Other traditions indicate that residents should camp and hunt on the south sides of rivers in the fall so that caribou cross these linear features before encountering hunters. This reduces the likelihood of further deflection away from the river and overall changes in migratory paths.

Large changes and delays in caribou movement could have substantial impacts to hunters waiting for the caribou migration. In the case of the proposed Ambler Road, WAH caribou typically migrate through the Kobuk River Valley area twice a year (fall and spring migration) and some WAH caribou winter in the area as well. The fall migration is the most intensive caribou hunting season for most communities, although residents may also hunt small groups of overwintering caribou or during their spring migration (Braem et al. 2015) Table 6). In general, the westernmost subsistence study communities have more access to the WAH, while communities on the periphery of the herd's range (e.g., Alatna, Allakaket) may be more vulnerable to smaller changes in the herd's annual movements (Guettabi et al. 2016). In 2017, residents from Allakaket noted that a poor snow year in combination with few caribou migrating near their village had resulted in low caribou hunting success rates that year (WAHWG 2017). Despite their greater proximity to the WAH migratory range, communities along the western end of the proposed road corridors (e.g., Ambler, Kobuk, and Shungnak) have indicated that the WAH has altered its migratory path farther west toward Buckland, which has caused community residents to shift their hunting focus to the west and south of their communities (Watson 2018). Thus, further changes to this migration could cause other shifts in the availability of caribou to these communities. In addition, larger changes to the migration of the WAH or reduced availability or large diversions in individual study years could affect resource availability to any of the 42 caribou study communities (see Section 5.6).

The Native Village of Kotzebue traditional knowledge comments during scoping emphasized the point that changes in resource availability will affect subsistence communities that are not located within the path of, or directly adjacent to, the Project. They noted that this is particularly true when considering the migratory nature of certain key species, particularly caribou which are essential to the health and wellbeing of the community of Kotzebue:

> While the area in question is only infrequently visited by our tribal members, sheefish, salmon and caribou - three of the most critical resources to the Tribe, are dependent on the continued health and wellbeing of this area.... Caribou which are the mainstay for Kotzebue cultural, nutritional and spiritual connection to the country use the entire Region at various times of the year. The migratory nature of these species should be taken into account so that communities not located directly adjacent to the proposed road (like Kotzebue), but who rely on the migratory resources using this area, are overtly acknowledged as directly impacted with a vested interest in this project and are included alongside the affected communities with closer proximity to the actual road for the purpose of impacts. (Native Village of Kotzebue 2018)

The Native Village of Kotzebue also provided their traditional knowledge on the ways in which a road corridor can affect caribou migration, noting that caribou are sensitive to noise and development and are able to see, hear, and feel development long before they reach a road or construction area. The Native Village used Red Dog Road (i.e., DMTS) as an example to illustrate the effects that development of roads has had on the WAH. They noted that while the Red Dog Road is shorter and therefore not directly comparable to the proposed Ambler Road, it can still be used as an example to demonstrate impacts to caribou including habitat fragmentation and disruption of migration paths.

> The major consideration with the road and the route selection would be to minimize the impact to their ability to freely migrate from the northern Brooks Range in the fall to their southern wintering habitat and back again in the spring and a road running east to west in the middle of this migratory route is a serious cause for concern. This type of migration impact has already been documented in regards to the much shorter Red Dog road. The related issue of habitat fragmentation is also detrimental to caribou and development and this road and the expected related spur roads, along with the increasing ability to develop future roads connected to this road in the future, is of serious concern for the long-term health of the western Arctic caribou herd. It has also to be kept in mind that even with the proactive approach taken along the relatively short Red Dog road in regards to stopping traffic while caribou are near the road there are still demonstrable impacts. It is unknown if such a strategy will, or even could, be put in place on the Ambler road, given the differing ownership and political affiliations of the mine developers in the Ambler District, in addition to the totally different logistical challenges in regards to the hauling season and distances that would be covered by the trucks. It also needs to be kept in mind that while it is practical to stop trucking on the Red Dog road due to its short length and nearby facilities on both ends, which would be totally different on the Ambler road, it also is exclusively tundra/willow habitat and herds of caribou can be relatively easily spotted at a distance. This will not be the case on the Ambler road, where both the topography and the spruce dominated areas will make it impossible in many places along the road to even observe caribou until they are right next to the road, but of course the caribou will still be able to smell, feel and hear the road and its associated traffic well before they reach it. (Native Village of Kotzebue 2018)

Effects on caribou movement are most likely to occur when linear structures are placed parallel to the herd's primary movement (Wilson et al. 2016). Perpendicular roads may also intercept caribou and cause delayed crossing (CPAI 2018, BLM 2018a). In the case of the proposed Ambler Road, Alternatives A and B are located perpendicular to the WAH's primary north-south movement and will thus likely cause deflections or delays in caribou movement at least during peak migratory periods. Alternative C would be less likely to intercept caribou because it is outside the main migratory range. While temporary disruptions to caribou movement in the WAH range have not been shown to alter overall migration patterns or reduce connectivity between seasonally-important ranges, the frequency and magnitude of caribou responses to roads would likely increase as the density of roads increases. In addition, even small changes in caribou distribution and movement from a biological perspective can have large impacts on hunter success.

Louden Tribal Council in Galena provided their traditional knowledge comments and summarized many of the above described impacts regarding the potential impacts of the Project on the migratory behavior and overall health of the WAH, noting that the ambient stress created by roads may cause migration route changes, avoidance, decreased populations, and habitat fragmentation. The Tribal Council also commented on the potential impacts that the road and road corridor may present including increased hunting pressure, increased predation, and increased mortality by traffic collisions:

> BLM needs to consider the full range of potentially serious impacts a project of this scale could have on the migratory behavior, habitat, and health of the Western Arctic

> Caribou Herd. The proposed road would cut east to west through a significant portion of the migratory range of the Western Arctic Caribou Herd, one of North America's largest existing wild caribou herds. Risks to caribou from roads include impeding migration routes, habitat fragmentation, and possibly local extinctions. Increased noise levels from road and air traffic in the region may lead to caribou avoidance of the road and displacement from their historical range. Roads create ambient stress in caribou, which results in less energy available for feeding, mating, and calving. Further, caribou may suffer direct mortality by traffic collisions, increased pressure from recreational hunting, and increased predation risk by wolves due to clear cutting in the road corridor and more efficient travel routes into caribou range. (Louden Tribal Council 2018)

Moose

The proposed road corridors cross moose hunting areas for 12 communities and are of high importance to eight of these communities. In some subsistence study communities located within the WAH's peripheral range (e.g., Alatna and Allakaket), moose has supplanted caribou as the primary large land mammal harvested, as caribou have become less available and moose have become more available in the region (Watson 2018).

Impacts to moose availability would generally be on a smaller geographic scale than for caribou, as moose have smaller ranges and residents do not rely on seasonal migratory movements when hunting them. Thus, impacts to moose hunting would occur primarily in the vicinity of the road where moose could exhibit avoidance or other behavioral changes. Because a majority of moose hunting in the region occurs along rivers during the fall months, impacts would be most likely to occur in areas where the road corridor crosses key moose hunting rivers such as the Koyukuk and Kobuk rivers and smaller drainages such as the Alatna, John, and Wild rivers. Residents may experience decreased success in these areas due to moose remaining farther from the riversides or in deeper brush. However, impacts to moose availability would be localized.

While moose may initially exhibit avoidance of the road corridor, they also tend to habituate relatively quickly to human activity (Section 3.3.4). Moose may also be attracted to the ROW as a movement corridor or because of the availability of new vegetation in maintained areas of the ROW (Section 3.3.4). This could increase their availability to hunters in those areas but could also result in higher rates of injury or mortality due to traffic collisions.

Fish

As noted above, the proposed road routes cross through community non-salmon fishing areas for 10 communities: Hughes, Kobuk, Shungnak, Allakaket, Ambler, Bettles, Evansville, Alatna, and Kiana. For eight of these 10 communities, non-salmon fish are a resource a high importance (see Table 45), while for the remaining two communities, non-salmon fish are of moderate importance based on selected measures. Key fish species for these study communities include chum salmon, sheefish, and humpback and broad whitefish and, to a lesser extent, cisco, northern pike, grayling, burbot, and trout. The AMDIAR crosses streams and rivers which support spawning habitat for both sheefish and chum salmon. In particular, the Kobuk and Alatna rivers are key spawning grounds for sheefish and are also important fishing areas for the subsistence study communities. Both of these drainages are crossed by proposed project corridors. In addition to the communities who have documented use of the rivers crossed by the project corridors, communities upstream and downstream from the project corridors could experience impacts on fish availability if larger impacts to fish movement or health occur.

Construction activities which may affect fish availability to subsistence communities include installation of bridges and culverts, related pile installation, stream diversions, and stream excavation, water withdrawal, blasting at material sites, and contamination. Fish could be temporarily diverted, displaced, or obstructed due to culvert placement, excavation, or stream diversion. While impacts to fish resulting from construction activities are expected to be localized, subsistence users often harvest fish in specific locations along rivers; thus, localized changes in fish distribution could have impacts on resource availability for individual harvesters. Construction activities in waterways could also increase stream turbidity that could affect downstream harvesting areas or make these areas less desirable for fishing in the short-term.

The introduction of invasive species (both fish and/or aquatic plants) could also impact fish habitat and/or productivity and impact fish availability to subsistence users. Unlike other construction impacts that are expected to be more short-term, the introduction of invasive species could become a long-term impact if their spread is uncontrolled, reducing fish availability for subsistence users along the AMDIAR. If fuel or other contaminant spills occur near fish bearing streams, subsistence harvesters along may avoid harvesting fish if they are perceived (or confirmed) to be contaminated or unhealthy. In the case of larger spills, contamination concerns and avoidance may extend to communities located downstream from the AMDIAR (e.g., Huslia, Noorvik, and Kiana).

Vegetation

The proposed road corridors cross vegetation harvesting areas for 10 communities (see Table 45) and are of high importance to all of these communities. Construction activities which may affect the availability of vegetation, including berries, wild plants, and wood, include clearing of the ROW, fugitive dust resulting from the road and ore concentrate trucks, and contamination from fuel spills.

AMDIAR construction will result in the removal of vegetation harvesting areas for local residents. In addition, a larger area surrounding the road will likely be removed from use for some individuals due to concerns about contamination. Impacts to vegetation harvest areas resulting from roads has been documented in relation to the Red Dog DMTS (SRB&A 2009b). Residents form Kivalina have reported observing dust on vegetation and changes in the taste or appearance of berries. In addition, some individuals have reported that they no longer use traditional vegetation harvesting areas along the DMTS due to concerns about contamination. Communities along the proposed road corridors may also experience reduced availability of vegetation in traditional harvesting areas during and after construction of the road. Because core harvesting areas for vegetation often occur in close proximity to communities, those communities in closest proximity to the road corridor would be most likely to experience impacts on their vegetation harvesting areas. Dust deposition could eliminate vegetation within 16 feet of roads and may cause avoidance of vegetation harvesting at greater distances (Section 3.3.1).

Operation

Disturbance, displacement, or contamination of subsistence resources during operations could result in these resources being unavailable at the time and place that local harvesters are accustomed to finding them. In general, impacts would be similar to the construction impacts (discussed above) pertaining to traffic, dust deposition, human activity, contamination, and infrastructure. However, the impacts would occur over a longer time frame and would occur with either greater or lesser frequency or intensity depending on the impact source. Under Phase 3, the final road would be larger and access roads and maintenance stations would be in place.

During operation, the availability of subsistence resources could be affected through human activity, air and ground traffic, and maintenance activities, resulting in skittish behavior, changes in local distribution of resources, and/or diversion from usual migration routes. In addition, road and other infrastructure may physically divert certain animals. Spills or other contamination could also affect the local distribution of resources such as fish and vegetation or may result in resources being considered unavailable to local harvesters due to concerns of contamination.

Sources of noise from maintenance and operation of the road would include vehicle traffic, small fixed-wing aircraft, helicopters, maintenance equipment and activities (grading, sanding, plowing, gravel placement), and human activity. Noise above ambient levels may displace or divert resources from traditional areas (see discussion above, under Construction) (Section 3.2.6). The frequency of truck traffic would increase over the three phases of the AMDIAR, and would be substantially higher once mine production began, with up to 200 trips per day at peak mine production. Increased traffic along the Dalton Highway may also displace caribou from the HHH thus affecting resource availability to users of that herd, although documented harvests from the HHH by local residents are relatively limited. While the road under Phase 2 would be a single-lane road and traffic would occur in one-way convoys, the road would be upgraded to a two-lane road under Phase 3 and traffic would not occur in convoys. Air traffic would decline slightly during operations, with an estimated two to six aircraft trips weekly (one to two to each maintenance station) and an additional helicopter trip per week. While overall ground traffic would be higher during mine production, human activity would be lower once construction is complete.

The cleared area within the ROW and road may create a travel corridor for large land mammals which could lead to a two-fold effect on resource availability. First, if the cleared area draws large land mammals to the corridor there could be a corresponding decline in large land mammals in areas they were previously found. Furthermore, a cleared area within the ROW with a high concentration of large land mammals could be a draw for local hunters traveling overland in the winter by snowmachine or by off-road vehicle during other times of the year. This could cause a reduction in the availability of certain resources in other traditional harvest areas. In addition, in the long-term, if the road facilitates access into the area after reclamation, the availability of moose in the area may decrease due to increased hunting.

During operations, the final two-lane road combined with an increase in traffic would likely increase the potential for deflection or delay of caribou movements, particularly during the fall migration south (see above under Construction). Over time, local caribou distribution may be altered to the extent that residents no longer find caribou within their usual hunting areas or experience reduced hunting success in those areas. Some industrial road projects in the state of Alaska provide for access to roads for local residents. In other communities where roads have been built, access to private roads has in some way offset some of the impacts to resource availability; however, lack of access to local hunters for the AMDIAR would introduce subsistence impacts with no offsetting subsistence benefit.

Stream and riverbeds may experience increased sedimentation or alteration over time due to the presence of culverts and bridge piers. If culverts and bridges are not properly maintained or if erosion control measures are not taken, fish migrations could be temporarily disrupted or blocked, which could reduce fish availability for subsistence users. The risk of contamination from dust deposition and fuel would continue through the life of the project and depending on the magnitude of spills could have far-reaching impacts on upstream and downstream subsistence users. Gravel mining and associated blasting will continue throughout operations for roadway maintenance, and thus some individual loss or displacement of fish will continue during operations.

User Access

Construction

Sixteen of the 27 subsistence study communities have subsistence use areas crossing one or more of the proposed road corridor alternatives (Table 45). These communities would be the most likely to experience direct impacts to user access resulting from the proposed road. Of these communities, five have use areas which are bisected by the road, meaning that access to a large portion of their hunting, fishing, and gathering areas would require crossing the road corridor (depending on the chosen alternative). These communities are Bettles, Evansville, Hughes, Kobuk, and Shungnak. Alatna, Allakaket, and Ambler are also bisected but to a lesser degree (i.e., the road crosses more on the periphery rather than through the center of their use areas) than the above five communities. As shown in Table 45 above, the subsistence activities which most commonly occur in the vicinity of the proposed corridors include hunting and trapping of small land mammals and furbearers, hunting of moose and caribou, vegetation harvesting, non-salmon fish harvesting, and migratory bird hunting. Other resource harvesting activities that could be affected include hunting of other large land mammals (Dall sheep and bear), hunting of upland game birds, salmon fishing, and to a lesser extent, egg harvesting.

Impacts to harvester access would occur within the vicinity of the road corridor, where harvesters could be faced with physical obstructions to access or by causing harvesters to avoid construction work areas. Construction infrastructure such as the pioneer road, construction laydown materials, and heavy equipment could present physical barriers to subsistence users. In addition, individuals traveling overland may have to divert around material sites and other areas which are unsafe for travel. Although the road will include crossing ramps for local residents to use when traveling overland, these likely will not be in place until Phase 2 or 3 of the project and therefore the road is more likely to pose an obstruction to overland travel during the construction phase; in addition, hunters may not be permitted to cross construction-phase roads until crossing areas are established, thus obstructing travel altogether for a period of time. Potential impacts of the physical road to user access are discussed in further detail under Operation.

Physical obstructions to access would be most common for residents traveling overland by snowmachine or off-road vehicle. Harvesters traveling overland to access use areas for caribou, furbearers, and geese may be diverted around construction areas if there are physical obstructions. In addition, there may be periods of time during construction where access along certain river drainages, which can serve as both winter and summer travel corridors, is obstructed due to bridge construction activities (e.g., installation of bridge pilings).

The degree of impacts from construction would depend on whether the timing of construction activities conflicts with subsistence use areas and activities for a community. Because construction would occur year-round, it is likely that there would be direct conflicts with construction activities for certain subsistence use areas. According to data collected for several communities whose use areas are bisected by the AMDIAR (Hughes, Bettles, and Evansville), in addition to several additional communities whose use areas overlap with portions of the AMDIAR (Alatna, Allakaket, and Wiseman/Coldfoot), residents of the region primarily use boats and snowmachines to access hunting and gathering areas, although road-connected communities (Wiseman/Coldfoot) also commonly use road vehicles to access harvesting areas (see travel method discussions above). Subsistence activities occur year-round, peaking in the fall (August and September) and again in the mid-winter and early spring (February through April) for most study communities with available data. The project corridors cross areas used for both riverine and overland travel, and construction activities would occur year-round; thus, residents may experience impacts to construction during all subsistence seasons and activities which are overlapped by the AMDIAR.

In addition to physical barriers to subsistence users during construction, residents may also experience reduced access due to security restrictions around construction work areas or general avoidance of development areas. Even if regulatory and physical barriers do not exist in certain areas of the project area, subsistence users may choose not to access nearby subsistence use areas any longer because construction-related sites, smells, lights, noises, and activities can disturb resources, reduce the potential for a successful harvest, and negatively affect the harvester's experience (Section 3.2.6). In addition, residents may avoid hunting in the vicinity of the road due to concerns about shooting near infrastructure and human activity, or because of a lack of knowledge regarding security protocols. Any incidences of spills or other forms of uncontrolled hazardous waste discharge that occur during construction could lead to harvester concerns of contamination (real or perceived) and result in users avoiding subsistence use areas near the contaminated areas, thereby reducing user access. Finally, subsistence users may avoid hunting near construction work areas due to a general discomfort with conducting traditional subsistence activities near non-local workers and industrial activity.

Avoidance of industrial areas by subsistence users has been documented on the North Slope of Alaska, particularly for the community of Nuiqsut. In a recent study monitoring the impacts of oil and gas development on Nuiqsut caribou hunters, between 51 percent and 61 percent of caribou harvesters reported avoidance of any subsistence use area during four years of the Nuiqsut Caribou Subsistence Monitoring Project, and between 33 percent and 46 percent did so for development reasons (CPAI 2018, SRB&A 2018). Residents have noted that avoidance of industrial areas varies from year to year depending on activity levels within a given area and other factors. Thus, it is likely that a proportion of hunters from the subsistence study communities will avoid certain areas of the proposed road corridor at some point during the life of the AMDIAR. Avoidance may be higher during construction due to the higher activity and noise levels.

<u>Operation</u>

As noted above, 16 of the 27 subsistence study communities have subsistence use areas crossing one or more of the proposed road corridor alternatives, and the road and other project related infrastructure will represent a direct loss of traditional subsistence hunting and harvesting areas for these communities. During AMDIAR operation, residents would continue to experience physical barriers to access resulting from infrastructure such as roads, although the presence of crossing ramps would help reduce those impacts. Harvesters traveling overland to access use areas for caribou, furbearers, and geese may be diverted around operational infrastructure if there are physical obstructions. Physical obstructions to harvesters traveling by boat along river channels would be unlikely during operation. In addition to physical obstructions, residents from the subsistence study communities will also experience reduced access resulting from road use policies, user avoidance, and contamination concerns throughout the life of the project.

Scoping comments shared concerns regarding user access to traditional subsistence use areas. They noted that user access may be decreased due to a tendency for subsistence hunters to avoid areas of development:

> Subsistence harvesters often avoid areas of development. As a result, avoidance areas will extend far beyond the immediate footprint of the road, causing the loss of subsistence use areas across a broad area. (Louden Tribal Council 2018)
>
> A proposed Ambler Mining Road that severs Evansville Incorporated's land base would create a physical encumbrance that would adversely impact management and enjoyment of the land. (Evansville Inc. 2017)

As noted above, the AMDIAR will not permit access to local residents for subsistence purposes but will allow for residents to cross the road at established crossing areas. AIDEA has indicated they will establish a committee which will help identify appropriate locations for crossings. The efficacy of crossing ramps to reduce access impacts for local hunters will depend on the location, design, and frequency of the ramps. Because subsistence users do not always use or follow established trails when pursuing resources overland, instead traveling in various directions based on environmental factors (e.g., weather, snow and ice conditions) and traditional knowledge of resource distribution and behavior, the presence of crossing ramps will not eliminate impacts to user access. Subsistence users may have to travel additional distances when pursuing resources in order to locate approved crossing areas, or they may take safety risks by crossing in areas not approved for crossing. In addition, despite the presence of crossing ramps, some individuals may still have difficulty using crossing ramps, especially when hauling sleds. Subsistence users in the community of Nuiqsut have reported difficulty under certain conditions when using crossing ramps on industrial roads near their community (SRB&A 2018).

While road access for local subsistence users will not be permitted, it is possible that residents from nearby study communities will use the cleared area within the ROW alongside the road as a travel corridor for overland (snowmachine or off-road vehicle) travel, particularly if resources such as moose concentrate in these corridors. Use of the ROW may facilitate access to hunting areas farther from the community as well as between communities. AIDEA indicates that ROW travel will be prohibited, and security will patrol the roads to prevent violations. Enforcement measures will reduce but not eliminate use of the ROW. Restrictions on use of the ROW, particularly by local residents when certain areas of the road will be crossable, may be difficult to enforce. Increased non-local access would be less likely but may affect subsistence uses for residents of the subsistence study communities by increasing human activity and competition in the area.

A potential for increased access by outside hunters is a primary concern which has been voiced by a number of subsistence study communities (Watson 2014). The likelihood of non-local hunters accessing the ROW would depend on policies regarding ROW use in addition to measures taken to prevent or limit access to the ROW (e.g., boulders, berms, or fencing near entry points). Preventative measures would help lessen the impact of increased use along the ROW but would likely not eliminate the impact, as some individuals would likely use the ROW regardless of use policies. While less likely, it is also possible that individual hunters, including local and non-local hunters, may trespass and use the road itself to access hunting areas during periods of low activity on the road. Security gates at the road entrance will reduce the likelihood of trespassing with road vehicles; however, trespassing with off-road vehicles may still occur. Several Alaska Native entities expressed similar concern regarding the potential for increased access to traditional subsistence use areas by non-local hunters. They indicated that increased competition and hunting pressure will decrease resource abundance and availability and negatively impact subsistence harvesting success by local residents. While the proposed Road will be commercial access only, scoping meeting participants highlighted the lack of specific information on how public access will be restricted and indicated that restricting all public access will be impossible.

> The potential for unauthorized use of the road and right-of-way, as well as possible future authorized public use of the road, presents additional concerns. For instance, unauthorized individuals could use the road to access areas that would not otherwise be accessible, and compete for subsistence resources traditionally used and relied on by residents of the local community. (Doyon Ltd. 2018)
>
> BLM should assume the public will be able to access the road, because there is no information on how public access will be restricted. Unrestricted access and illegal road use may lead to increased hunting pressure. Further, poaching by construction and mining workers should be considered. Even if road use is limited to industrial access and poaching is limited, the estimated 400 trucks per day on a long industrial road has the potential to greatly impact subsistence hunting and harvesting success. (Louden Tribal Council 2018)

During operations, harvester avoidance of the project area may be reduced from construction levels due to decreased noise and human activity disturbances, although avoidance responses would likely continue throughout the life of the project for certain individuals. In general, the total area of infrastructure would be greater under operations and would include a two-lane road, bridges, road maintenance stations, vehicle turnouts, material sites, water source access roads, road maintenance access roads, air strips, and communications towers. Thus, the area of infrastructure-related avoidance by local residents would be larger during operations. For some individuals, avoidance may extend to a larger area than the footprint if they perceive that resources are less available due to noise, traffic, and human activity associated with road operation. As with construction, any spills or other forms of uncontrolled hazardous waste discharge that occur during operations could lead to harvester concerns of contamination (real or perceived). These concerns could result in users avoiding subsistence use areas near contaminated areas, thereby reducing user access and also impacting resource availability.

Because the road corridor bisects subsistence use areas for a number for communities (Bettles, Evansville, Hughes, Kobuk, and Shungnak), residents from these communities may not have the option to avoid the road altogether in order to continue accessing traditional subsistence use areas. Thus, total avoidance of the AMDIAR area may be more likely for residents from communities whose use areas are on the periphery of the AMDIAR area.

Socio-Cultural Impacts

Impacts to resource abundance, resource availability, and user access would likely affect the costs and time associated with conducting subsistence activities and could have larger socio-cultural impacts on residents in the AMDIAR area. Decreased abundance or availability of resources may result in residents spending more time and effort in the pursuit of those resources, with greater risks to hunter safety. Some residents may reduce the time spent harvesting subsistence resources if the resources are unavailable in traditional harvesting areas and residents do not have the money to expend on traveling farther. Impacts related to resource availability, such as decreased community subsistence harvests, would likely have greater impacts to vulnerable low income, unconnected, and low-harvest households (Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016). Decreased harvests among the study communities could also have more wide-ranging effects due to the potential impacts on sharing networks within the region in addition to networks which extend to other regions (Kofinas et al. 2016). Sharing is a key value across the study region which is central to subsistence. Finally, if the road reduces the availability of key subsistence resources such as caribou, moose, or sheefish, communities may experience negative social effects (e.g., increased drug and alcohol use, increased depression) resulting from poor harvests of those resources in a given year, increased food insecurity, and perceived degradation of culturally or spiritually important places and resources.

Over time, decreased abundance and availability of resources, in combination with decreased access to or avoidance of traditional harvesting areas, may reduce overall participation rates in subsistence or harvest amounts. When subsistence users' opportunities to engage in subsistence activities are limited, then their opportunities to transmit knowledge about those activities, which are learned through participation, are also limited. If residents stop using portions of the project area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit traditional knowledge to younger generations about those traditional use areas would be diminished. While communities would likely maintain a cultural connection to these areas and acknowledge these areas as part of their traditional land use area, the loss of direct use of the land could lead to reduced knowledge among the younger generation of place names, stories, and traditional ecological knowledge associated with those areas. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of the community. Any changes to residents' ability to participate in subsistence activities, to harvest subsistence resources in traditional places at the appropriate times, and to consume subsistence foods could have long-term or permanent effects on the spiritual, cultural, and physical well-being of the study communities by diminishing social ties that are strengthened through harvesting, processing, and distributing subsistence resources, and by weakening overall community well-being.

6.4.2 Alternative A: AIDEA Proposed Route (GAAR North) to the Dalton Highway

Alternative A crosses use areas for 12 subsistence study communities, including Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Kobuk, Selawik, Shungnak, and Wiseman. Thus, these communities would likely experience direct impacts of the AMDIAR on their subsistence uses in terms of direct loss of subsistence use areas, impacts on user access, and direct impacts to resource availability (e.g., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAHWG study communities.

Communities with the highest number of resource uses crossed (five or more resources) include Bettles, Evansville, Shungnak, Ambler, Coldfoot, Kobuk, and Wiseman. Alternative A bisects community uses for Bettles, Evansville, Kobuk, and Shungnak, (i.e., community residents would need to cross or detour around the road in order to access a large portion of their subsistence use area), and therefore in terms of access these communities would be most heavily impacted by Alternative A. Bettles, Evansville, and Kobuk would be located closest to the road corridor and would therefore be more likely to experience benefits of the road related to lowered costs of subsistence supplies/equipment and other goods in the event that these communities can develop a way to create an access route from their community to the nearby corridor (Kobuk is the only community that will have direct access). Potential negative impacts of increased access to communities are often associated with the increased potential or ease of bringing drugs, alcohol, and other prohibited substances into communities and the negative sociocultural impacts that could ensue. The attending Alaska Native entities during scoping expressed concerns that increased access to subsistence use areas and increased access to and from communities may negatively impact the cultural wellbeing of many in the area. The Native Village of Allakaket discussed the potential effects of outside access to their community, noting that while road access to the community will likely not be of much benefit to residents, it may create opportunities for bootleggers and drug dealers to access the community:

> The road is too far north from our village to make it practical to bring in groceries and goods to reduce the cost of living, but it is not so far as to prevent those who want to make a great deal of money from drugs and alcohol from driving down the road and then by snowmachine or four-wheeler to Allakaket. Regardless of whether mining or trucking companies prohibit substance abuse, there will be individuals willing to bring it into Allakaket. We have seen no plans on the part of the state or federal government to provide a greater police presence to stop this. We in Allakaket do not even have a public safety officer to address this. (Allakaket Tribal Council 2018)
>
> [The Project] should take into account the potential for reduced subsistence diets and increases in access to alcohol and drugs. (Allakaket Tribal Council 2018)

Resources for which availability could be directly affected under Alternative A include caribou (nine communities), moose (nine communities), small land mammals (eight communities), migratory birds (six communities), Dall sheep (six communities), and vegetation (six communities) (Table 42). Of these resources, moose, caribou, and vegetation are resources of high importance to majority of the potentially affected study communities (see Table 42). For a smaller number of communities, harvests of salmon, non-salmon fish, bear, and eggs could be directly affected.

Alternative A crosses through key migratory range for the WAH and could therefore affect the availability of WAH caribou to the south (in the fall) and north (in the spring/summer) of the road. The road runs perpendicular to the primary direction of movement during migration, thus introducing an impact source that could lead to caribou being diverted and delayed during migration. Caribou cross the Alternative A corridor during both the fall and winter (Section 3.3, Mammals). Alternative A is to the north of a majority of the study communities whose caribou hunting activities peak in the fall. Large deflections of caribou to the north of these communities during the fall months could have substantial impacts on resource availability to subsistence harvesters. The likelihood of large deflections would vary annually based on environmental and development-related (e.g., traffic and noise levels) factors. The importance of maintaining the north-south migration is evident in traditional hunting methods which place hunting camps to the south of rivers and allow the first of the caribou herd to pass by before hunting them (WAHWG 2017). Direct impacts to caribou availability along the road corridor resulting from smaller-scale disruptions may occur for the communities of Bettles, Evansville, Shungnak, Ambler, Kobuk, Alatna, Allakaket, Anaktuvuk Pass, and Selawik. For Anaktuvuk Pass, the road corridor is on the periphery of their caribou hunting areas. Larger-scale disruptions may extend to other users of the WAH. Alternative A does not occur within the range of the RMH. Traffic increases on the Dalton Highway may affect the HHH and may affect subsistence activities near the Dalton Highway.

Under Alternative A, fish availability could be directly affected for four study communities: Bettles, Evansville, Shungnak (for salmon), and Ambler. Non-salmon fish are a resource of high importance to these communities. In particular, sheefish spawning grounds which are particularly sensitive to changes in environmental conditions, occur along the Alatna and Kobuk rivers, which are crossed by the Alternative A corridor. Any impacts from construction or operation of the road corridor which change water quality downstream could affect sheefish spawning grounds and could impact communities downstream from the corridor on the Koyukuk and Ambler River drainages, including Alatna, Allakaket, Hughes, Huslia, Ambler, Kobuk, Shungnak, Kiana, and Noorvik. These communities could experience indirect impacts if larger changes to fish health or availability occur. Alternative A has a greater potential to directly affect sheefish spawning grounds compared to Alternative C. In addition to sheefish spawning grounds, Alternative A also crosses streams in the Upper Koyukuk drainage which support spawning for Chinook, chum salmon, and whitefish, including the Alatna River, Henshaw Creek, North Fork Koyukuk River, Wild River, and John River. Impacts to these spawning grounds could also have larger effects to communities who harvest salmon downstream from the road corridor.

6.4.3 Alternative B: AIDEA Alternative Route (GAAR South) to the Dalton Highway

Alternative B is similar to Alternative A in terms of the communities which could be directly affected and the nature of the potential impacts. Alternative B crosses use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Kobuk, Selawik, Shungnak, and Wiseman (Table 43). Thus, these communities would likely experience direct impacts of the AMDIAR on their subsistence uses in terms of direct loss of subsistence use areas, impacts on user access, and direct impacts to resource availability (e.g., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). The primary difference between Alternatives A and B in terms of direct community impacts is that the route would not overlap with migratory bird hunting areas for Ambler but would overlap with vegetation harvest areas for that community. Alternative B would cross within about seven miles of sheefish spawning habitat on the Reed River and would therefore introduce higher potential for degradation and contamination of that habitat from spills (Section 3.3, Fish and Amphibians). For caribou, the effects would the same as under Alternative A (Section 3.3, Mammals). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAHWG study communities.

6.4.4 Alternative C: Diagonal Route to the Dalton Highway

Alternative C crosses use areas for 12 subsistence study communities (Table 46), including Alatna, Allakaket, Ambler, Anaktuvuk Pass, Hughes, Huslia, Kiana, Kobuk, Selawik, Shungnak, Stevens Village, and Tanana. These communities would likely experience direct impacts of the AMDIAR on their subsistence uses in terms of direct loss of subsistence use areas, impacts on user access, and direct impacts to resource availability (e.g., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAHWG study communities. However, larger migratory changes are less likely under Alternative C than Alternatives A and B (see discussion below).

Communities with the highest number of resource uses crossed (five or more resources) include Allakaket, Hughes, Kobuk, Shungnak, Ambler, Stevens Village, and Alatna. Alternative C bisects community uses for Hughes, Kobuk, and Shungnak (i.e., community residents would need to cross or detour around the road in order to access a large portion of their subsistence use area), and therefore in terms of access these communities would be most heavily impacted by Alternative C. These three communities would also be most likely to experience benefits of the road related to lowered costs of subsistence supplies/equipment and other goods in the event that these communities can develop a way to create an access route from their community to the nearby corridor. The community of Kobuk would be located directly along the Alternative C route.

Resources for which availability could be directly affected under Alternative C include small land mammals (11 communities), caribou (10 communities), non-salmon fish (eight communities), moose (eight communities), bear (seven communities), vegetation (six communities), migratory birds (six communities), and salmon (five communities) (Table 44). For a smaller portion of communities, harvests of Dall Sheep and upland game birds could be affected. For a majority of the study communities, caribou, moose, non-salmon fish, salmon, and vegetation are resources of high importance (Table 44). Alternative C would have greater noise impacts compared to Alternatives A and B as it will affect more previously undisturbed land than Alternatives A and B, and noise would spread wider under Alternative C due to terrain differences. Thus, impacts on resource availability and user avoidance related to noise may occur over a greater area under Alternative C (Section 3.2.6)

Alternative C does not cross through the primary migratory range for the WAH and does not intersect the primary north-south migratory movement of the herd. Therefore, the alternative would be less likely to affect migration routes and behavior for WAH caribou and less likely to have direct and indirect effects on resource availability to the caribou study communities. However, Alternative C does occur within the wintering grounds for the WAH and affects an overall greater amount of WAH habitat, and therefore direct impacts to caribou availability along the road corridor may occur for the communities of Allakaket, Hughes, Kobuk, Shungnak, Ambler, Alatna, Huslia, Anaktuvuk Pass, Selawik, and Tanana, all of whom have caribou hunting areas overlapped by the alternative. For Anaktuvuk Pass, the road corridor is on the periphery of their caribou hunting areas. Alternative C bisects the overall and summer ranges of the RMH; due to the small size of population and herd range, impacts to this herd could be more amplified; however, the RMH is difficult to access and hunted by the subsistence study communities only occasionally and therefore direct impacts to local hunters would be possible but unlikely. No impacts to the HHH would occur as a result of Alternative C.

Compared to Alternatives A and B, Alternative C crosses areas of higher value moose habitat and therefore could have greater impacts to moose availability in nearby communities. Impacts would be relatively localized along the road system and therefore would affect communities with moose hunting areas closest to the road corridor (e.g., Hughes, Kobuk, and Shungnak).

Compared to Alternatives A and B, under Alternative C, fish availability could be directly affected for a greater number of communities (eight communities versus four). Alternative C crosses Kobuk River directly downstream from sheefish spawning habitat. Thus, any changes to waterways which obstruct access to spawning grounds or affect water quality could have larger indirect impacts to communities who harvest sheefish upstream and downstream from the road corridor, including Alatna, Allakaket, Bettles, Evansville, Hughes, Kobuk, Shungnak, Ambler, Huslia, and Kiana. However, Alternative C would be less likely to have direct impacts on sheefish spawning grounds. In addition, while Alternative C would cross more fish streams than alternatives A and B, it would construct more bridges and fewer minor culverts which are more likely to obstruct fish passage. In addition to sheefish spawning grounds, Alternative C also crosses streams which support spawning for Chinook and chum salmon. Impacts to salmon spawning grounds could also have larger effects to communities who harvest salmon downstream from the road corridor along the Yukon and Koyukuk rivers.

6.5. Community Impact Indicator Summaries

This section presents a summary of impact indicators by community and alternative. Communities with the greatest number of resources of high importance and use areas bisected by the project (compared to having partial, peripheral, isolated, or no use areas crossed by the project) would likely experience the greatest intensity of effects related to the project. The following definitions are used in defining the level of project intersection with community use areas:

- Bisect – proposed project crosses through the center or large portions of a community’s use areas
- Partial – proposed project intersects a portion of use areas near the community
- Periphery – proposed project intersects use areas located on the outer edge of the community’s use areas
- Isolated – proposed project intersects community use areas in one specific, contained location
- None – proposed project does not intersect with the community’s use areas

In summary, for Alternatives A and B, Shungnak, Evansville, Bettles, and Kobuk would experience the greatest intensity of impacts due to the greater number of resources of high importance that are overlapped with the Project and that their subsistence use areas are bisected by the Project (Table 47, Table 48). Ambler, Allakaket, and Alatna could also experience a higher intensity of impacts due to greater numbers of resources of higher importance and larger portions of use areas potentially affected. Alternative C would be similar except Bettles and Evansville would be unlikely to experience effects and Hughes would be added to the list of communities that would experience greater impacts from the Project (Table 49). These tables do not account for the potential for larger indirect effects that could occur, particularly for resource availability impacts, which are more uncertain and for which the study team did not identify any systematic, quantifiable impact indicators.

Table 47. Alternative A impact indicator summary – resource importance and use areas

Community	Number of high resources crossed	Number of moderate resources crossed	Number of low resources crossed	Number of resource of indeterminate importance crossed	Level of project intersection with use areas
Shungnak	4	2	2	0	Bisect
Evansville	4	2	2	0	Bisect
Bettles	3	3	2	0	Bisect
Kobuk	2	2	2	0	Bisect
Ambler	3	3	1	0	Partial
Allakaket	2	0	2	0	Partial
Alatna	1	1	2	0	Partial
Wiseman	3	2	0	1	Periphery
Selawik	1	0	0	0	Periphery
Hughes	0	0	0	1	Periphery
Coldfoot	1	0	2	3	Isolated
Anaktuvuk Pass	1	0	1	0	Isolated
Beaver	0	0	0	0	None
Buckland	0	0	0	0	None
Galena	0	0	0	0	None
Huslia	0	0	0	0	None
Kiana	0	0	0	0	None
Kotzebue	0	0	0	0	None
Livengood	0	0	0	0	None
Manley Hot Springs	0	0	0	0	None
Minto	0	0	0	0	None
Nenana	0	0	0	0	None
Noatak	0	0	0	0	None
Noorvik	0	0	0	0	None
Rampart	0	0	0	0	None
Stevens Village	0	0	0	0	None
Tanana	0	0	0	0	None

Table 48. Alternative B impact indicator summary – resource importance and use areas

Community	Number of high resources crossed	Number of moderate resources crossed	Number of low resources crossed	Number of resource of indeterminate importance crossed	Level of project intersection with use areas
Evansville	4	2	2	0	Bisect
Shungnak	4	2	2	0	Bisect

Community	Number of high resources crossed	Number of moderate resources crossed	Number of low resources crossed	Number of resource of indeterminate importance crossed	Level of project intersection with use areas
Bettles	3	3	2	0	Bisect
Kobuk	2	2	2	0	Bisect
Ambler	4	2	1	0	Partial
Alatna	1	2	2	0	Partial
Allakaket	2	0	2	0	Partial
Wiseman	3	2	0	1	Periphery
Selawik	1	0	0	0	Periphery
Hughes	0	0	0	1	Periphery
Coldfoot	1	0	2	1	Isolated
Anaktuvuk Pass	1	0	1	0	Isolated
Beaver	0	0	0	0	None
Buckland	0	0	0	0	None
Galena	0	0	0	0	None
Huslia	0	0	0	0	None
Kiana	0	0	0	0	None
Kotzebue	0	0	0	0	None
Livengood	0	0	0	0	None
Manley Hot Springs	0	0	0	0	None
Minto	0	0	0	0	None
Nenana	0	0	0	0	None
Noatak	0	0	0	0	None
Noorvik	0	0	0	0	None
Rampart	0	0	0	0	None
Stevens Village	0	0	0	0	None
Tanana	0	0	0	0	None

Table 49. Alternative C impact indicator summary – resource importance and use areas

Community	Number of high resources crossed	Number of moderate resources crossed	Number of low resources crossed	Number of resource of indeterminate importance crossed	Level of project Intersection with Use Areas
Shungnak	**5**	**2**	**1**	0	Bisect
Kobuk	**4**	**3**	**2**	0	Bisect
Hughes	**4**	**3**	**1**	1	Bisect
Allakaket	**4**	**3**	**2**	0	Partial
Ambler	**4**	**3**	**1**	0	Partial

Community	Number of high resources crossed	Number of moderate resources crossed	Number of low resources crossed	Number of resource of indeterminate importance crossed	Level of project Intersection with Use Areas
Alatna	1	3	1	0	Partial
Stevens Village	3	2	2	0	Periphery
Tanana	2	0	1	0	Periphery
Huslia	1	2	0	0	Periphery
Selawik	1	0	1	0	Periphery
Anaktuvuk Pass	1	0	1	0	Isolated
Kiana	1	0	0	0	Isolated
Beaver	0	0	0	0	None
Bettles	0	0	0	0	None
Buckland	0	0	0	0	None
Coldfoot	0	0	0	0	None
Evansville	0	0	0	0	None
Galena	0	0	0	0	None
Kotzebue	0	0	0	0	None
Livengood	0	0	0	0	None
Manley Hot Springs	0	0	0	0	None
Minto	0	0	0	0	None
Nenana	0	0	0	0	None
Noatak	0	0	0	0	None
Noorvik	0	0	0	0	None
Rampart	0	0	0	0	None
Wiseman	0	0	0	0	None

6.6. Other Indirect and Cumulative Impacts/Indirect and Cumulative Impacts of Growth

This section discusses other indirect and cumulative impacts of the AMDIAR and associated growth in the region, including mining development and other road access. Past and present actions which have affected subsistence uses and resources within the study region include mining development (including the Red Dog Mine), infrastructure projects, scientific research, recreation and tourism, sport hunting and fishing, hunting and harvesting regulations, establishment of wildlife refuges and national parks, and environmental changes resulting from climate change. Construction of the TAPS and Dalton Highway have affected subsistence access and resource availability for communities in the eastern portion of the project area, with many residents believing that the highway and pipeline have resulted in changes to caribou migration across the region. The Red Dog Mine, including the DMTS and port site, has introduced contamination concerns for local residents, particularly Kivalina residents who are situated downstream from the mine, and have affected resource distribution and migration for resources such as caribou and marine mammals possibly resulting in decreased harvests of these resources over time (EPA

2009). Increased sport hunting and fishing in the region and associated air traffic have resulted in increased competition for local subsistence users in addition to disturbance and displacement of subsistence resources such as caribou. The establishment of Gates of the Arctic National Park and Preserve (GAAR) in the 1980s also affected access to and use of traditional harvesting areas for residents of nearby communities within the northeastern portion of the project area (Watson 2018). Impacts of climate change include changes in the predictability of weather conditions such as the timing of freeze-up and breakup, snowfall levels, storm and wind conditions, and ice conditions (e.g., ice thickness on rivers and lakes), all of which affect individuals' abilities to travel to subsistence use areas when resources are present in those areas. In addition, subsistence users may experience greater risks to safety when travel conditions are not ideal. Changes in resource abundance or distribution resulting from climate change can also affect the availability of those resources to subsistence users or may cause subsistence users to travel farther and spend more time and effort on subsistence activities (Brinkman 2016).

Construction and operation of the AMDIAR would likely result in changes to resource abundance, resource availability, and user access for many of the subsistence study communities. The project would introduce a large industrial road corridor into an area that was previously undeveloped and which was used primarily for subsistence and recreational purposes. Under any alternative, 12 communities have direct uses of the project corridor(s), and a majority of these communities are rural, low-income, non-road-connected communities who rely on subsistence to support their mixed economy. The AMDIAR would introduce impacts to resource abundance and resource availability for key resources such as sheefish, whitefish, salmon, and caribou, while also reducing (rather than facilitating) access to traditional harvesting areas. The road itself may increase access to and reduce costs of commercial goods for certain communities; however, few local jobs directly associated with the road (e.g., maintenance and operation) will be available after construction. Impacts to resource availability and user access will be most pronounced for communities who do not experience increased income associated with the road (i.e., road or mining jobs) and/or do not experience benefits of the road related to lowered costs of subsistence supplies/equipment, food, or other goods. These communities would have less opportunity to purchase or invest in fuel and equipment to adjust to changes in access and resource availability.

Reasonably foreseeable actions within the region that could contribute to subsistence impacts include development of the Ambler Mining District (Arctic, Bornite, Sun, and Smucker projects); use of the AMDIAR for commercial access; use of the AMDIAR for commercial use by local communities and Native Allotment owners. Secondary access roads connecting the AMDIAR to other mining areas and claims, Air Force lands, and local communities are also a potential. See Appendix H for details.

The AMDIAR will facilitate additional mining and other development throughout the study region, which will contribute to impacts on subsistence resource abundance, resource availability, and user access for subsistence users across the region. Mining development will result in the physical removal of traditional subsistence hunting and harvesting areas for the study communities in addition to decreased access to these areas through security/access restrictions and through user avoidance of development areas. The overall area available for subsistence use will likely shrink over time due to the increasing presence of infrastructure and human activity within traditional use areas.

Construction of additional access roads to mines, communities, and other locations will contribute to fragmentation of habitat for resources such as caribou and moose, which would remove usable habitat for these resources and in the case of caribou could cause substantial changes in range distribution. While the construction of roads would result in a net loss of current habitat areas, clearing and maintenance of ROWs may also create new movement corridors and feeding areas, particularly for moose. Impacts to migrating caribou increase with density of roads and infrastructure (see Section 3.3, Mammals). Mining activities would cause further disturbance to wildlife through the presence of mine pits and noise and disturbance from heavy machinery, blasting, and human activity. Mine development and additional road construction would also contribute to further contamination and alteration of waterways which may cause substantial degradation to spawning grounds and other habitat for non-salmon fish (sheefish and other whitefish) and salmon that are key subsistence species across the region. Mining and further road development could have population-levels effects on certain fish species, particularly if mine activities result in contamination or degradation of Kobuk River sheefish spawning grounds and Alatna River whitefish spawning grounds.

The potential for increased access into the project area resulting from local and non-local use of the project road and ROW (regardless of legality) may increase competition in the region for certain resources and decrease harvesting success for local hunters. Secondary access roads developed by communities would likely be used, at least by local residents, for subsistence harvesting activities and could create harvesting corridors and increase competition within those areas. Even if the road is reclaimed, the remaining cleared area within ROW would likely become accessible for local and non-local hunters traveling by snowmachine and off-road vehicles. If the road, ROW, or reclaimed ROW increases access into the region, state and federal regulators may respond by introducing stricter hunting and harvesting regulations as well, which would affect availability of resources to local communities. Increased competition and decreased resource availability may result in residents having to travel farther and spend more time, money, and effort to harvest resources such as moose and caribou.

The potential for increased access into the region was a key concern voiced by residents during both scoping and traditional knowledge studies associated with the AMDIAR (Watson 2014, BLM 2018b). Many residents do not believe that the road will remain private and point to previous roads which they believed to have restricted access which were eventually opened to the public (e.g., the Dalton Highway). The WAHWG cited the Dalton Highway as an example of how restricted access roads can easily be opened to the public due to political and public pressure:

> The WACH declined for much of the last two decades. Reduced population levels during that time led to harvest restrictions. Although the most recent caribou count indicates a population that is stabilizing or possibly starting to increase, concerns remain that increased access due to roads could greatly compound user conflict and limited availability of caribou. We recognize that the proposed road is currently specified as being commercial-only. However, history (e.g., with the Dalton Highway) suggests that once roads are established they eventually become used by the public. We are greatly concerned that the Ambler Road will not remain closed to public use given this history and the multiple jurisdictions (State, Federal and Native) that the proposed road would cross. (Western Arctic Caribou Herd Working Group 2018)

In addition, it is unclear whether the road would allow access to small mining claims; while large mines would likely have policies regarding hunting and fishing by workers, smaller mining outfits or individuals may allow these activities. According to Guettabi et al. (2016), increased access resulting from the road and/or ROW would likely reduce harvest success for local hunters, particularly for moose. Specifically, the study analyzed harvest rates by the number of hunters in game management units (GMUs) and found that the quantity of moose harvested was inversely related to the number of moose hunters within a GMU. The study estimated that for every one percent increase in the number of moose hunters in the project area, communities along the project corridor would harvest approximately 1.09 times less moose than if there were no additional access to the region. However, this conclusion is based on an assumption that the road will eventually be opened to public access, which BLM does not believe is reasonably foreseeable. Increased access of the area resulting solely from illegal trespass of restricted roads and/or ROWS would likely not have the same level of impacts on harvesting success. According to the WAHWG (2017), communities within the region have already experienced increased competition in traditional hunting areas, with greater numbers of hunters concentrated within smaller areas. Sport hunting is a key issue within the region for subsistence harvesters, and illegal access to the area via a road or ROW would contribute to these impacts.

If the AMDIAR results in reduced availability of subsistence resources such as moose, caribou, sheep, small land mammals, fish, waterfowl, or vegetation, or if it decreases access to traditional use areas, then residents from the study communities may have to spend greater amounts of time, effort, and money in order to locate and procure these resources. Residents may also have to travel farther to less familiar areas to find resources, with greater risks to health and safety. While some hunters respond to changes in resource availability by taking more trips and increasing costs in order to harvest what they need, others may choose to take fewer trips because of lack of funds or reduced success.

Communities in the study region currently have high levels of unemployment and low income with high costs of living; despite these factors, many of the study communities have remained stable and resilient through a mixed economy which revolves around subsistence hunting and harvesting (Guettabi et al. 2016). Construction of the AMDIAR and associated mining development would result in increased employment opportunities and income for residents of some of the subsistence study communities. Residents may invest the income from construction, operation, and mining jobs into supplies and equipment (e.g., snowmachines, outboards, fuel, ammunition) to support subsistence activities. In addition, the ability to use the road to transport commercial goods, including subsistence supplies and equipment, may also reduce certain costs associated with subsistence. However, at this time, there is no guarantee that this benefit is certain for any community. In addition, benefits associated with increased employment and income would be most likely to occur for NANA shareholders and communities due to agreements between mining companies on NANA lands regarding local hire policies. Thus, interior communities such as Alatna, Allakaket, Bettles, and Evansville may experience subsistence impacts (e.g., reduced resource availability and access to traditional harvesting areas) without the counter benefits of increased income and employment associated with mine development.

Those individuals who obtain long-term employment associated with the AMDIAR or associated mining developments may experience reduced time to engage in subsistence activities, although they may continue to invest monetarily in and support subsistence activities for others in the community. Those with mining jobs may move away from their communities, as some have done in association with the Red Dog Mine, to larger urban centers.

A shifting of subsistence roles may occur in certain cases, where particularly active harvesters (e.g., super-harvester households) may no longer have time to provide subsistence foods and may rely on others to fill the subsistence roles they once held. Subsistence roles within a community naturally change over time due to household circumstances (e.g., age and number of household members, employment levels) and communities can adapt to these changes. However, a sudden change in employment levels in the community may cause at least a temporary disruption in social ties and roles within the subsistence study communities, which could cause a decline in the distribution of subsistence foods for a period of time. Larger disruptions to subsistence ties could come with high costs to social, cultural, and economic well-being, particularly to the more vulnerable low income, unconnected, and low-harvest households (Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016). Over time, if communities in the region become road-connected, the availability of goods, increased income and employment opportunities, and decreased harvesting opportunities could result in an overall decrease in subsistence harvests among the study communities.

Ultimately, the cumulative impacts to subsistence resulting from the AMDIAR, other reasonably foreseeable developments, and climate change could result in reduced harvesting opportunities for local residents and alterations in subsistence harvesting patterns. A recent analysis comparing road-connected communities to non-road-connected communities showed that road-connected communities have substantially lower subsistence harvests than non-road-connected communities (Guettabi et al. 2016). This study analyzed socio-economic impacts of a road into the study region but was based on the assumption that the road would eventually become public, which BLM has determined is not reasonably foreseeable. The road-connected communities in its analysis were located on publicly-accessible roads in more densely populated areas. The currently proposed road is a private, industrial-access road but would also incrementally introduce elements of a commercially accessible road including increased access to and decreased costs of goods such as food and equipment. Thus, while the AMDIAR may not reduce subsistence harvests to levels seen along other road-connected communities in the state, the combination of reduced resource availability, decreased user access, increased income (for some communities), and increased access to commercial goods (for some communities), will likely alter subsistence harvesting patterns across the region and affect overall subsistence harvests for certain communities. Decreased harvests among the study communities could have wide-ranging effects due to the potential impacts on sharing networks within the region in addition to networks which extend to other regions (Kofinas et al. 2016). Sharing is a key value across the study region which is central to subsistence. Decreased harvests could disrupt existing sharing networks to other communities and regions if residents are unable to share as widely or frequently as they are accustomed.

Cumulative impacts of Alternative A and B related to resource abundance and availability would likely be greater than those under Alternative C, as they would be more likely to affect resource availability of migrating caribou to the subsistence study communities, particularly during the fall months, and are most likely to have population-level effects on sheefish and whitefish, all key subsistence species among the study communities. However, impacts related to user access and direct impacts on resource availability along the road corridors would be similar across all alternatives and would affect a similar number of study communities.

When subsistence users' opportunities to engage in subsistence activities are limited, then their opportunities to transmit knowledge about those activities, which are learned through participation, are also limited. If residents stop using portions of the project area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit traditional knowledge to younger generations about those traditional use areas would be diminished. While communities would likely maintain a cultural connection to these areas and acknowledge these areas as part of their traditional land use area, the loss of direct use of the land could lead to reduced knowledge among the younger generation of place names, stories, and traditional ecological knowledge associated with those areas. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of the community. Any changes to residents' ability to participate in subsistence activities, to harvest subsistence resources in traditional places at the appropriate times, and to consume subsistence foods could have long-term or permanent effects on the spiritual, cultural, and physical well-being of the study communities by diminishing social ties that are strengthened through harvesting, processing, and distributing subsistence resources, and by weakening overall community well-being.

7. References

ABR, and SRB&A. 2014. Assessment of the Potential Effects of an Elevated Pipeline Along the Red Dog Mine Haul Road on Caribou Distribution, Movements, and Crossing Success. Part One: Review of Literature and Expert Opinion. Prepared for Red Dog Operations. Anchorage, Alaska.

Adams, L. G., R. O. Stephenson, B. W. Dale, R. T. Ahgook, and D. J. Demma. 2008. Population Dynamics and Harvest Characteristics of Wolves in the Central Brooks Range, Alaska.

ADF&G (Alaska Department of Fish and Game). 2019. "Community Subsistence Information System: Csis. Harvest by Community.", Accessed May 2018. www.adfg.alaska.gov/sb/CSIS/index.cfm?ADFG=harvInfo.harvestCommSelComm.

Alaska Federation of Natives. 2012. First Peoples of Alaska. Proclamation to Achieve Subsistence Rights and Protection of Native Cultures.www.nativefederation.org/wp-content/uploads/2013/03/Subsistence-Proclamation-2012.pdf.

Allakaket Tribal Council. 2018. Comments on Ambler Road. Allakaket, Alaska.

Andersen, D. B., C. J. Utermohle, and L. Brown. 1998. The 1997-98 Harvest of Moose, Caribou, and Bear in Middle Yukon and Koyukuk River Communities, Alaska: Results of the 1998 Big Game Harvest Assessment Project. Technical Paper No. 245, Division of Subsistence, Alaska Department of Fish and Game, Juneau, Alaska.

Andersen, D. B., C. J. Utermohle, and G. Jennings. 2001. The 1999-2000 Harvest of Moose, Caribou, and Bear in Ten Middle Yukon River Communities: Results of the 2000 Big Game Harvest Assessment Project. Technical Paper No. 262, Division of Subsistence, Alaska Department of Fish and Game, Juneau Alaska.

Andersen, D., C. Brown, R. Walker, and K. Elkin. 2004a. Traditional Ecological Knowledge and Contemporary Subsistence Harvest of Non-Salmon Fish in the Koyukuk River Drainage, Alaska. Technical Paper No. 282. ADF&G, Division of Subsistence.

Andersen, David B., Caroline L. Brown, Robert J. Walker, and Gretchen Jennings. 2004b. The 2001-2002 Harvest of Moose, Caribou, and Bear in Middle Yukon and Koyukuk River Communities, Technical Paper. Juneau, Alaska: Division of Subsistence, Alaska Dept. of Fish and Game.

Andersen, David B., and Gretchen Jennings. 2001. The 2000 Harvest of Migratory Birds in Ten Upper Yukon River Communities, Alaska. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. www.subsistence.adfg.state.ak.us/TechPap/Tp268.pdf.

Andersen, David B., Charles J. Utermohle, and Louis A. Brown. 2000. The 1998-99 Harvest of Moose, Caribou, and Bear in Ten Middle Yukon and Koyukuk River Communities. Technical Paper No. 251. Division of Subsistence, Alaska Dept. of Fish and Game. Juneau, Alaska.

Anderson, Douglas D., Wanni Wibulswasdi Anderson, Ray Bane, Richard K. Nelson, and Nita Sheldon Towarak. 1998. Kuuvanmiit Subsistence: Traditional Eskimo Life in the Latter Twentieth Century. National Park Service, U.S. Dept. of the Interior. Washington, D.C.

Andrews, E. F. 1988. The Harvest of Fish and Wildlife for Subsistence by Residents of Minto, Alaska. Number of Technical Paper No. 137s vols. Vol. Technical Paper No. 137. Alaska Department of Fish and Game, Division of Subsistence. Juneau, Alaska.

Andrews, E. F., and R. K. Napoleon. 1985. Moose Hunting in the Minto Flats Management Area by Minto Permit Holders, 1984-1985. Number of Technical Paper No. 122s vols. Vol. Technical Paper No. 122. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska.

Bacon, J., T. Hepa, H. Jr. Brower, M. Pederson, T. Olemaun, J. George, and B. Corrigan. 2009. Esimtates of Subsistence Harvest for Villages on the North Slope of Alaska, 1994-2003. North Slope Borough, Department of Wildlife Management. Barrow, Alaska. www.north-slope.org/assets/images/uploads/MASTER%20SHDP%2094-03%20REPORT%20FINAL%20and%20%20Errata%20info%20(Sept%202012).pdf.

Betts, Martha F. 1997. Subsistence Harvest and Use Patterns for Rampart, Tanana, Stevens Village, Manley Hot Springs, Eureka, and Minto, Alaska: Eureka-Rampart Road Study Environmental Assessment. Northern Land Use Research, Inc. Fairbanks, Alaska.

BLM (U.S. Bureau of Land Management). 2018a. Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project - Final Supplemental Environmental Impact Statement. edited by (United States Department of the Interior) DOI.

_____. 2018b. Ambler Road Environmental Impact Statement Scoping Summary Report. April 2018.

Braem, Nicole M. 2012a. Subsistence Wildlife Harvests in Ambler, Buckland, Kiana, Kobuk, Shaktoolik, and Shishmaref, Alaska, 2009-2010. Special Publication No. SP2012-003. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. www.adfg.alaska.gov/specialpubs/SP2_SP2012-003.pdf.

_____. 2012b. Subsistence Wildlife Harvests in Noorvik, Shungnak, and White Mountain, Alaska, 2008-2009. Special Publication No. SP2011-003. Alaska Dept. of Fish and Game, Division of Subsistence,. Fairbanks, AK. library.state.ak.us/asp/edocs/2012/07/ocn798726160.pdf.

Braem, Nicole M., Patricia Fox, James S. Magdanz, and David Koster. 2013. Subsistence Harvests in Northwest Alaska: Selawik, 2010-2011. Technical Paper No. 389. Alaska Department of Fish and Game, Division of Subsistence,. Fairbanks, Alaska. www.adfg.alaska.gov/techpap/TP389.pdf.

Braem, Nicole M., Anna R. Godduhn, Elizabeth Mikow, Andrew R. Brenner, Alida Trainor, Seth J. Wilson, and Marylynne L. Kostick. 2018. Key Subsistence Fisheries in Northwest Alaska, 2012-2014. Technical Paper No. 433. Alaska Department of Fish and Game Division of Subsistence. Fairbanks, Alaska. www.arlis.org/docs/vol1/O/1062605181.pdf.

Braem, Nicole M., and Marylynne L. Kostick. 2014. Subsistence Wildlife Harvests in Elim, Golovin, Kivalina, Koyuk, Noatak, and Wales, Alaska, 2010-2011. Special Publication No. SP2012-04. Alaska Department of Fish and Game, Division of Subsistence,. Fairbanks, Alaska. www.adfg.alaska.gov/specialpubs/SP2_SP2012-004.pdf.

Braem, Nicole M., Elizabeth H. Mikow, Andrew R. Brenner, Anna R. Godduhn, Brittany Retherford, and Marylynne L. Kostick. 2017. Chukchi Sea and Norton Sound Observation Network: Harvest and Use of Wild Resources in 9 Communities in Arctic Alaska, 2012-2014. Technical Paper No. 403.

Alaska Department of Fish and Game, Division of Subsistence. www.adfg.alaska.gov/techpap/TP403.pdf.

Braem, Nicole M., Elizabeth Mikow, Seth J. Wilson, and Marylynne L. Kostick. 2015. Wild Food Harvests in 3 Upper Kobuk River Communities : Ambler, Shungnak, and Kobuk, 2012-2013. Technical Paper No. 402. Alaska Department of Fish and Game, Division of Subsistence,. Fairbanks, Alaska. www.adfg.alaska.gov/techpap/TP%20402.pdf.

Brinkman, T.J., W.D. Hansen, F. S. Chapin III, G. Kofinas, S. BurnSilver, T.S. Rupp. 2016. Arctic Communities Perceive Climate Impacts on Access as a Critical Challenge to Availability of Subsistence Resources. Climatic Change (2016) 139:413–427 DOI 10.1007/s10584-016-1819-6.

Brower, H. K., and R. T. Opie. 1996. North Slope Borough Subsistence Harvest Documentation Project: Data for Anaktuvuk Pass, Alaska for the Period July 1, 1994, to June 30, 1995. Department of Wildlife Management, North Slope Borough. Barrow, Alaska.

Brown, C., D. Koester, and P. Koontz. 2010. Traditional Ecological Knowledge and Harvest Survey of Nonsalmon Fish in the Middle Yukon River Region, Alaska, 2005-2008. Technical Paper No. 358, Alaska Department of Fish and Game, Division of Subsistence.

Brown, C., and M. L. Kostick. 2017. Harvest Use of Subsistence Resources in 4 Communities in the Nenana Basin. Technical Paper No. 429. Alaska Department of Fish and Game, Division of Subsistence.

Brown, Caroline L., Nicole M. Braem, Elizabeth H. Mikow, Alida Trainor, Lisa J. Slayton, David M. Runfola, Hiroko Ikuta, Marylynne L. Kostick, Christopher R. McDevitt, Jeff Park, and James J. Simon. 2016. Harvests and Uses of Wild Resources in 4 Interior Alaska Communities and 3 Arctic Alaska Communities, 2014. Technical Paper No. 426. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. www.adfg.alaska.gov/techpap/TP426.pdf.

Brown, Caroline L., Andrew R. Brenner, Hiroku Ikuta, Elizabeth Mikow, Brittany Retherford, Lisa J. Slayton, Alida Trainor, Jeff Park, David Koster, and Marylynne L. Kostick. 2015. The Harvest and Uses of Wild Resources in Mountain Village, Marshall, Nulato, Galena, and Ruby, Alaska, 2010. Technical Paper No 410. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. www.adfg.alaska.gov/techpap/TP%20410.pdf.

Brown, Caroline L., and Anna R. Godduhn. 2015. Socioeconomic Effects of Declining Salmon Runs on the Yukon River. Technical Paper No. 398. Fairbanks, Alaska. www.adfg.alaska.gov/techpap/TP398.pdf.

Brown, Caroline L., Lisa J. Slayton, Alida Trainor, David Koster, and Marylynne L. Kostick. 2014. Wild Resource Harvests and Uses, Land Use Patterns, and Subsistence Economies in Manley Hot Springs and Minto, Alaska, 2012. Technical Paper No. 400. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. www.adfg.alaska.gov/techpap/TP400.pdf.

Brown, Caroline L., Robert Walker, and Susan B. Vanek. 2004. The 2002-2003 Harvest of Moose, Caribou, Bear, and Wolves in the Lower-Middle Yukon River Communities of Grayling, Anvik, Shageluk, and Holy Cross. Technical Paper No. 281. Division of Subsistence, Alaska Dept. of Fish and Game. Juneau.www.subsistence.adfg.state.ak.us/TechPap/tp281.pdf.

Case, Martha, and Libby Halpin. 1990. Contemporary Wild Resource Use Patterns in Tanana, Alaska, 1987. Technical Paper No. 178. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. www.adfg.alaska.gov/techpap/tp178.pdf.

Clark, A.M., and D.W. Clark. 1978. "On the Edge of Today: Culture Change in a Northern Athapaskan Village During the 1960's." Anthropological Papers of the University of Alaska (1a(1):65-80).

CPAI (ConocoPhillips Alaska, Inc.). 2018. Eed Willow Master Development Plan Npr-a on Alaska's North Slope.

Darbyshire & Associates. 1990. Yukon Flats Region Community Profiles a Background for Planning. Aero Map U.S. Inc. and Honda Graphics under contract with the Alaska Department of Community and Regional Affairs.

Doyon Limited. 2018. Letter regarding Ambler Road Project. Fairbanks, Alaska.

EPA (United States Environmental Protection Agency). 2009. Red Dog Mine Extension Aqqaluk Project: Final Supplemental Environmental Impact Statement. Prepared by Tetra Tech. dnr.alaska.gov/mlw/mining/largemine/reddog/pdf/rdseis2009vol1.pdf.

Evansville Incorporated. 2017. Written Comments for Ambler Road Project, Scoping Phase. Fairbanks, Alaska.

Fuller, Alan S., and John C. George. 1999. Evaluation of Subsistence Harvest Data from the North Slope Borough 1993 Census for Eight North Slope Villages for the Calendar Year 1992. North Slope Borough, Department of Wildlife Management. Barrow, Alaska.www.north-slope.org/assets/images/uploads/Master%20Report%20(Fuller-George%2099).pdf.

Georgette, S., and H. Loon. 1988. The Noatak River: Fall Caribou Hunting and Airplane Use. Technical Paper No. 162, Division of Subsistence, Alaska Department of Fish and Game, Kotzebue, Alaska.

Georgette, Susan. 2000. Subsistence Use of Birds in the Northwest Arctic Region, Alaska. Technical Paper No. 260. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. www.subsistence.adfg.state.ak.us/TechPap/tp260.pdf.

Georgette, Susan, and Hannah Loon. 1993. Subsistence Use of Fish and Wildlife in Kotzebue, a Northwest Alaska Regional Center. Technical Paper No 167. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. www.subsistence.adfg.state.ak.us/TechPap/tp167.pdf.

Godduhn, A. R., N. M. Braem, and M. L. Kostick. 2014. Subsistence Wildlife Harvests in Kotzebue, Alaska, 2012-2013. Special Publication No. SP2014-03, Alaska Department of Fish and game, Division of Subsistence.

Gonzalez, D., E. H. Mikow, and M. L. Kostick. 2018. Subsistence Wildlife Resources in Buckland, Koyukuk, and Noatak, Alaska, 2016-2017. Alaska Department of Fish and Game, Division of Subsistence, Special Publication No.-003.

Guettabi, M., J. Greenberg, J. Little, and K. Joly. 2016. Evaluating Differences in Household Subsistence Harvest Patterns between the Ambler Project and Non-Project Zones. Natural Resource Report NPS/GAAR/NRR—2016/1280. U.S. Department of the Interior National Park Service Natural Resource Stewardship and Science. Fort Collins, Colorado.

Holen, Davin, Sarah M. Hazell, and David S. Koster. 2012. Subsistence Harvests and Uses of Wild Resources by Communities in the Eastern Interior of Alaska, 2011. Technical Paper No. 372. Alaska Department of Fish and Game. Division of Subsistence. Anchorage, Alaska. www.arlis.org/docs/vol1/AlaskaGas/Article/Article_ADFGSubsistence_2012_SubsistHarvestsUsesWild.pdf.

Jones, Eliza, Wendy Arundale, Johnson Moses, Oscar Nictune, Lee Simon, Susie Williams, William William, Moses Henzie, Henry William, Alice Ambrose, Lavine Williams, and Joe Beetus. 1997. Allakaket-Alatna Native Place Names. University of Alaska, Fairbanks, the Elmer E. Rasmuson Library Archives. Fairbanks, Alaska.

Kevin Waring Associates. 1992. Hope Basin Socioeconomic Baseline Study Volume I. Minerals Management Service, Anchorage, AK.

Kofinas, G., S. B. BurnSilver, J. Magdanz, R. Stotts, and M. Okada. 2016. Subsistence Sharing Networks and Cooperation: Kaktovik, Wainwright, and Venetie, Alaska. BOEM Report 2015-023 DOI; AFES Report MP 2015-02. School of Natural Resources and Extension, University of Alaska Fairbanks.

Koskey, M., and K. Mull. 2011. Traditional Ecological Knowledge and Biological Sampling of Nonsalmon Fish Species in the Yukon Flats Region, Alaska. Technical paper No. 632, Alaska Department of Fish and Game, Division of Subsistence.

Louden Tribal Council. 2018. Scoping Comments Regarding the Proposed Environmental Impact Statement for the Ambler Mining District Industrial Access Project. Galena, Alaska.

Magdanz, J., S. Georgette, and J. Evak. 1995. "Chapter Xix: Kotzebue." In An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska, edited by J. A. Fall and C. J. Utermohle, XIX-1-XIX-72. Anchorage, Alaska: Division of Subsistence, Alaska Department of Fish and Game.

Magdanz, J., H. Smith, N. Braem, and D. S. Koster. 2011a. Patterns and Trends in Subsistence Fish Harvests, Northwest Alaska, 1994-2004. Technical Paper No. 366. Alaska Dept. of Fish and Game, Division of Subsistence, Kotzebue, AK.

Magdanz, James S., Nicole M. Braem, Brad C. Robbins, and David Koster. 2010. "Subsistence Harvests in Northwest Alaska, Kivalina and Noatak, 2007." Alaska Dept. of Fish and Game, Division of Subsistence, Accessed Technical Paper No. 354. http://www.adfg.alaska.gov/techpap/TP354.pdf.

Magdanz, James S., David Koster, Liliana Naves, and Patricia Fox. 2011b. Subsistence Harvests in Northwest Alaska, Buckland and Kiana, 2003 and 2006. Technical Paper No. 363. Alaska Dept. of Fish and Game, Division of Subsistence. Kotzebue, Alaska.

Magdanz, James S., Robert J. Walker, and Ronald R. Paciorek. 2004. The Subsistence Harvests of Wild Foods by Residents of Shungnak, Alaska, 2002. Technical Paper No. 279. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. www.arlis.org/docs/vol1/A/57016852.pdf.

Marcotte, J. R. 1988. Subsistence Harvest of Fish and Wildlife by Residents of Galena, Alaska, 1985-86. Technical Paper No. 155, Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska.

Marcotte, James R. 1986. Contemporary Resource Use Patterns in Huslia, Alaska, 1983. Technical paper. Technical Paper No. 133. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska.www.adfg.alaska.gov/techpap/tp133.pdf.

Marcotte, James R., and Terry L. Haynes. 1985. Contemporary Resource Use Patterns in the Upper Koyukuk Region, Alaska. Technical Paper No. 93. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. www.subsistence.adfg.state.ak.us/TechPap/tp093.pdf.

Mikow, E., N. M. Braem, and M. Kostick. 2014. Subsistence Wildlife Harvests in Brevig Mission, Deering, Noatak, and Teller, Alaska, 2011-2012. Special Publication No. 2014-02. Alaska Department of Fish and Game, Division of Subsistence.

Mikow, E. H., and M. L. Kostick. 2016. Subsistence Wildlife Harvests in Kotzebue, Alaska, 2013-2014. Special Publication No. 2016-02, Alaska Department of Fish and Game, Division of Subsistence.

Naves, L. C., and N. M. Braem. 2014. Alaska Subsistence Harvest of Birds and Eggs, 2012, Alaska Migratory Bird Co-Management Council. Technical Paper No. 397, Alaska Department of Fish and Game. Division of Subsistence and Alaska Migratory Bird Co-Management Council.

Native Village of Kotzebue. 2018. Scoping Comments Bureau of Land Management Ambler Road Environmental Impact Statement. Kotzebue, Alaska.

Noorvik Native Community. 2018. Letter regarding Ambler Road Environmental Impact Statement. Noorvik, Alaska.

Pedersen, S., and C. Hugo. 2005. Anaktuvuk Pass Subsistence Fishery Harvest Assessment: October 2001 through September 2003. Number of Final Report for FIS Study 02-50s vols. Vol. Final Report for FIS Study 02-50. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Management Program.

Pedersen, S., and J. Nageak. 2009. Documentation of Caribou Harvest Levels in Anaktuvuk Pass, June 2006-May 2007. ADF&G, Division of Subsistence. Fairbanks, Alaska.

Pedersen, S., and T. Opie. 1991. Community Subsistence Caribou Harvest Survey: Anaktuvuk Pass 1990-1991. Alaska Department of Fish and Game, Division of Subsistence in Cooperation with City of Anaktuvuk Pass, Nunamiut Corporation, NPS, and NSB. Fairbanks, Alaska.

_____. 1992. Documentation of Caribou Harvest Levels in Anaktuvuk Pass, 1991-92. Division of Subsistence, Alaska Department of Fish and Game and Department of Wildlife Management, North Slope Borough, Barrow. Fairbanks, Alaska.

_____. 1994. Documentation of Caribou Harvest Levels in Anaktuvuk Pass, 1993-94. Alaska Department of Fish and Game, and Department of Wildlife Management, North Slope Borough, Barrow. Fairbanks, Alaska.

Pedersen, Sverre. 1979. Regional Subsistence Land Use, North Slope Borough, Alaska. Occasional Paper No. 21. Anthropology and Historic Preservation, Cooperative Park Studies Unit, University of Alaska, Fairbanks, Alaska. Conservation and Environmental Protection, North Slope Borough, Barrow, Alaska.

Ristroph, Elizaveta, Allakaket Tribal Council, and Alatna Tribal Council. 2019. Allakaket-Alatna Subsistence Areas and Important Places. Prepared by Ristroph Law, Planning, and Research. Fairbanks, Alaska.

Robert, M., and E. Andrews. 1984. Trapping Patterns in the Vicinity of the Kaiyuh Flats, West Central Alaska. Technical Paper Number 84, Alaska Department of Fish and Game, Division of Subsistence, Fairbanks, Alaska.

Satterthwaite-Phillips, Damien, Christopher Krenz, Glenn Gray, and Liz Dodd. 2016. IñuuniałiQput Iḷiḷugu Nunaŋŋuanun: Documenting Our Way of Life through Maps. Northwest Arctic Borough, Subsistence Mapping Project. Kotzebue, Alaska.

Schroeder, Robert, D. Anderson, and G. Hildreth. 1987. Subsistence Use Area Map Atlas for Ten Kotzebue Sound Communities. Alaska Department of Fish and Game, Division of Subsistence. Juneau, Alaska. www.adfg.alaska.gov/techpap/tp130.pdf.

Scott, C. 1998. Invitation to Dialogue: Land and Renewable Resource Use over Time in Wiseman, Alaska. Technical Report NPS/CCSOUW/NRTR-98-03, NPS D-31. University of Washington, College of Forest Resources, Field Station for Protected Area Research, Seattle, Washington.

Shinkwin, A., and M. Case. 1984. Modern Foragers: Wild Resource Use in Nenana Village, Alaska.

Spearman, G., S. Pedersen, and W. Brown. 1979. "Anaktuvuk Pass Synopsis." In Native Livelihood & Dependence: A Study of Land Use Values through Time, edited by North Slope Borough Contract Staff, 121-140. Anchorage, Alaska: Report prepared for National Petroleum Reserve in Alaska, Work Group 1, Field Study 1. U.S. Department of the Interior National Petroleum Reserve Alaska, 105(C) Land Use Study.

SRB&A (Stephen R. Braund & Associates). 2007. Yukon Flats Land Exchange Environmental Impact Statement Supplemental Baseline Study, Subsistence Use Areas and Traditional Knowledge Study for Beaver, Birch Creek, and Fort Yukon, Alaska. U.S. Department of the Interior, Fish and Wildlife Service. Anchorage, Alaska.

_____. 2009a. Impacts and Benefits of Oil and Gas Development to Barrow, Nuiqsut, Wainwright, and Atqasuk Harvesters. Prepared for North Slope Borough, Department of Wildlife Management. Anchorage, Alaska.

_____. 2009b. Subsistence Use Areas and Traditional Knowledge Study for Kivalina and Noatak, Alaska: Red Dog Mine Extension Aqqaluk Project, Supplemental Baseline Report. Tetra Tech, Tech Alaska Inc., and U.S. Environmental Protection Agency. Anchorage, Alaska.

_____. 2013a. Subsistence Use Area and Traditional Knowledge Studies: Anaktuvuk Pass Appendix. Foothills West Transportation Access Environmental Studies. Alaska Department of Transportation and Public Facilities.

_____. 2013b. Subsistence Use Area and Traditional Knowledge Studies: Anaktuvuk Pass, Barrow, and Nuiqsut. Foothills West Transportation Access Environmental Studies. Prepared for Three Parameters Plus, Inc. and Alaska Department of Transportation and Public Facilities. Anchorage, Alaska.

_____. 2014. Assessment of the Potential Effects of an Elevated Pipeline Along the Red Dog Mine Haul Road on Caribou Distribution, Movements, and Crossing Success. Part Two: Traditional Knowledge Workshops, Kivalina and Noatak. Prepared for Abr, Inc. Anchorage, Alaska.

_____. 2016. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 7 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2017. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 8 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2018. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 9 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. Unpublished. Subsistence Mapping and Traditional Knowledge Studies. Surveys Conducted between 2015-2017 in Association with the Alaska Lng Project Environmental Baseline Studies.

Stevens, Carrie, and Bryan Karonhiakta'tie Maracle. n.d. Subsistence Harvest of Land Mammals, Yukon Flats, Alaska: March 2010-February 2011. Council of Athabascan Tribal Governments.

Sullender, B. 2017. Ecological Impacts of Road- and Aircraft-Based Access to Oil Infrastructure. Edited by Audubon Alaska.

Sumida, V. A. 1988. Land and Resource Use Patterns in Stevens Village, Alaska. Number of Technical Paper No. 129s vols. Vol. Technical Paper No. 129. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska.

_____. 1989. Patterns of Fish and Wildlife Harvest and Use in Beaver, Alaska. Number of Technical Paper No. 140s vols. Vol. Technical Paper No. 140. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska.

Sumida, V., and C. Alexander. 1985. Moose Hunting by Residents of Beaver, Birch Creek, Fort Yukon, and Stevens's Village in the Western Gmu 25 (D) Permit Moose Hunt Area, 1984-1985. Alaska Department of Fish and Game, Division of Subsistence. Juneau, Alaska.

Van Lanen, James M., Carrie Stevens, C. Brown, Bryan Karonhiakta'tie Maracle, and D. Koster. 2012. Subsistence and Mammal Harvests and Uses, Yukon Flats, Alaska: 2008-2010 Harvest Report and Ethnographic Update. Alaska Department of Fish and Game, Division of Subsistence. Anchorage.

Vistnes, Ingunn, and Christian Nellemann. 2007. The Matter of Spatial and Temporal Scales: A Review of Reindeer and Caribou Response to Human Activity. Vol. 31.

WAHWG (Western Arctic Caribou Herd Working Group). 2017. "Protecting the Migration through Safe Hunting." Caribou Trails Summer 2017 (17):3.

Walker, Robert J., and Robert J. Wolfe. 1987. Subsistence Economies in Alaska: Productivity, Geography, and Development Impacts. Vol. 24, Arctic Anthropology. Juneau, Alaska: Alaska Department of Fish and Game, Division of Subsistence.

Watson, Annette. 2014. "Preliminary Traditional and Local Ecological Knowledge (Tek/Lek) Study of the Impacts by the Proposed Road to Ambler on the Communities of Allakaket and Alatna." Ph.D., College of Charleston.

_____. 2018. Ethnographic Overview and Assessment of Gates of the Arctic National Park and Preserve: Subsistence Land Use across the Kobuk Preserve. Cultural Resource Report NPS/GAAR/CRR-2018/001. Fairbanks, Alaska: National Park Service Fairbanks Administrative Center.

Webb, D. D. 1999. Subsistence Waterfowl Harvest Survey Galena, Huslia, Nulato, Kaltag, Hughes, Ruby, 1998, Progress Report (Koyukuk/Nowitna Refuge Complex (U.S.); 99-02. Galena, Alaska: Koyukuk/Nowitna National Wildlife Refuge Complex (1999).

Webb, Deborah D., and Koyukuk/Nowitna Refuge Complex (U.S.). 2000. Subsistence Waterfowl Harvest Survey Galena, Huslia, Nulato, Koyukuk, Kaltag, Hughes, Ruby, 1998 and 1999, Final Report. Galena, Alaska: Koyukuk/Nowitna National Wildlife Refuge Complex.

Western Arctic Caribou Herd Working Group. 2018. Comments Regarding the Ambler Road Environmental Impact Statement. Nome, Alaska.

Western Interior Alaska Subsistence Regional Advisory Council. 2018. Written Comments for Ambler Road Project, Scoping Phase. Anchorage, Alaska.

Whiting, A. 2006. Native Village of Kotzebue, Harvest Survey Program, 2002-2003-2004: Results of Three Consecutive Years Cooperating with the Qikiqtagrugmiut to Understand Their Annual Catch of Selected Fish and Wildlife.

Wilson, R. R., L. S. Parrett, K. Joly, and J. R. Dau. 2016. "Effects of Roads on Individual Caribou Movements During Migration." Biological Conservation 195:2-8.

Wilson, Seth J., and Marylynne L. Kostick. 2016. Harvest and Use of Wild Resources in Hughes, Alaska, 2014. Technical Paper No. 424. Alaska Department of Fish and Game, Division of Subsistence. www.adfg.alaska.gov/techpap/TP%20424.pdf.

Wolfe, R. 2000. Subsistence in Alaska: A Year 2000 Update. Juneau, Alaska.

Wolfe, R. J., and A. W. Paige. 1995. The Subsistence Harvest of Black Brant, Emperor Geese, and Eider Ducks in Alaska. Prepared for the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Subsistence Division, Juneau, Alaska.

Wolfe, Robert J., and Victor Fischer. 2003. Methods for Rural/Non-Rural Determinations for Federal Subsistence Management in Alaska: Final Report, Analysis and Recommended Methodology. Institute of Social and Economic Research, University of Alaska Anchorage. Anchorage, Alaska. http://www.iser.uaa.alaska.edu/Publications/Rural%20Final%20Report2.pdf.

Wolfe, Robert James, and Amy W. Paige. 2002. Subsistence Harvest of Black Brant, Emperor Geese and Eider Ducks in Alaska. Technical Paper No. 234. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. www.arlis.org/docs/vol1/A/50419619.pdf.

Wolfe, Robert James, and Cheryl Scott. 2010. Continuity and Change in Salmon Harvest Patterns, Yukon River Drainage, Alaska. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program. Anchorage, Alaska.

YRDFA (Yukon River Drainage Fisheries Association). 2008. Middle Koyukuk River of Alaska: An Atlas of Fishing Places and Traditional Place Names. Anchorage, Alaska.

Appendix M:

ANILCA Section 810 Preliminary Evaluation

This page is intentionally left blank.

Table of Contents

A. ANILCA Section 810 Preliminary Evaluation

This analysis of subsistence impacts is prepared for the Ambler Road Draft Environmental Impact Statement (DEIS) that analyzes the environmental consequences of a proposed road to the Ambler Mining District (District). The U.S. Bureau of Land Management (BLM) has prepared this analysis, on behalf of the Department of Interior, to fulfill the departmental requirements pursuant to Section 810 of Alaska National Interest Lands Conservation Act (ANILCA), as part of the DEIS to address a right-of-way (ROW) application filed by the Alaska Industrial Development and Export Authority (AIDEA). AIDEA proposes to construct, operate, and remove a 211-mile, all-season, industrial access road from the existing Dalton Highway at milepost (MP) 161 westerly to the District, located within the Northwest Arctic Borough (NAB) in the southern foothills of the Brooks Range of north-central Alaska. Under AIDEA's proposal, approximately 25 miles of the 211 miles of road would cross BLM-managed lands and approximately 26 miles would cross NPS-managed lands. According to AIDEA, the road would provide access for mineral exploration, mine development, and mining operations in the District as well as commercial commerce to communities if spur access roads are developed in the future. The proposed road would not be open to public access. There is currently no road or other surface access to the District from the existing transportation network. The District has long been recognized as containing a variety of mineral deposits, which have been explored or evaluated for more than a century (AIDEA 2016; Grybeck 1977). There are more than 1,300 active mining claims in the District vicinity (ADNR 2018). A 2015 economic analysis identified 4 major mineral deposits, with Trilogy Metals Inc.'s Arctic and Bornite deposits the most active (Cardno 2015), which would benefit from an industrial access road to develop the deposits and improve economics.

The DEIS provides detailed analysis of the following three road alternatives and a no-action alternative:

- No Action Alternative: The No Action Alternative evaluates what would occur if the BLM does not grant a road ROW to AIDEA. The No Action Alternatives provides a baseline for comparison to the other alternatives and it is a potential outcome of the DEIS.
- Alternative A: Alternative A is AIDEA's proposed alternative. It starts at MP 161 of the Dalton Highway and is 211 miles long with 3,498 acres of DOI-managed lands. The distance from Fairbanks to the road terminus would be 456 miles.
- Alternative B: Alternative B is an alternate route proposed by AIDEA across NPS lands in GAAR. It is a variation on Alternative A, with the same beginning point (MP161) and termini. It is 228 miles long with 3,083 acres of Department of Interior (DOI)-managed lands. The distance from Fairbanks to the road terminus would be 473 miles.
- Alternative C: Alternative C grew out of scoping comments. The route begins at MP 59.5 of the Dalton Highway and is 332 miles long with 19,090 acres of DOI-managed land. The distance from Fairbanks to the road terminus would be 476 miles.

A.1 Subsistence Evaluation Factors

Section 810(a) of (ANILCA), 16 United States Code (USC) 3120(a), requires that an evaluation of subsistence uses and needs be completed for any federal determination to "withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands." As such, an evaluation of potential impacts on subsistence under ANILCA Section 810(a) must be completed for the Ambler Road Draft Environmental Impact Statement (DEIS). ANILCA requires that this evaluation include findings on three specific issues, as follows:

- The effect of use, occupancy, or disposition of public lands on subsistence uses and needs

- The availability of other lands for the purposes sought to be achieved
- Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes

Per Bureau of Land Management (BLM) Instruction Memorandum No. AK-2011-008 (BLM 2011), three factors are considered when determining if a significant restriction of subsistence uses and needs may result from the proposed action, alternatives, or in the cumulative case, as follows:

- Reduction in the abundance of harvestable resources used for subsistence purposes
- Reduction in the availability of resources used for subsistence caused by alteration of their distribution, migration patterns, or location
- Legal or physical limitations on access of subsistence users to harvestable resources

Each alternative must be analyzed according to these criteria. ANILCA Section 810 also requires that cumulative impacts be analyzed. This approach helps the reader separate subsistence restrictions that could be caused by activities proposed under the four alternatives, including the no action alternative, from those that could be caused by past, present, or future activities that have occurred or could occur in the surrounding area.

An alternative would be considered to significantly restrict subsistence uses if, after consideration of protection measures, such as lease stipulations or required operating procedures, it can be expected to substantially reduce the opportunity to use subsistence resources (BLM 2011). Substantial reductions are generally caused by large reductions in resource abundance, a major redistribution of resources, extensive interference with access, or major increases in the use of those resources by non-subsistence users.

If the analysis determines that the proposed action, alternatives, or the cumulative case may significantly restrict subsistence uses, the head of Federal agency having jurisdiction over the federal public lands in question is required to notify the State of Alaska and appropriate regional and local subsistence committees. It also must conduct ANILCA Section 810 hearings in potentially affected communities.

It is possible that the finding may be revised to "will not significantly restrict subsistence uses" based on changes to alternatives, new information, or new mitigation measures resulting from the hearings. If the significant restriction remains, the head of the Federal agency having jurisdiction may prohibit the action or finalize the evaluation by making the following determinations:

- A significant restriction of subsistence uses would be necessary, consistent with sound management principles for the use of public lands
- The proposed activity would involve the minimal amount of public land necessary to accomplish the purpose of the use, occupancy, or other disposition
- Reasonable steps would be taken to minimize adverse effects on subsistence uses and resources resulting from such actions (Section 810(a)(3))

The head of the Federal agency having jurisdiction can then authorize use of the public lands.

B. ANILCA Section 810(A) Evaluations and Findings for All Alternatives and the Cumulative Case

Chapter 2 of the DEIS includes a detailed description of the sequencing of construction, operation and maintenance and decommissioning of the road. Road construction includes procurement and use of gravel resources, timing of construction, construction equipment and uses, personnel camps and support logistics, including air traffic support for personnel and material. Construction of the road would be in three separate phases, projected to span 10 years. Operations and maintenance includes mine operations, material and ore transport, transport of fuel and chemicals, maintenance of material sites and facilities and communications. Decommissioning includes the proposed decommissioning of the project and reclamation. The evaluation and findings following this introductory section include short summaries of the alternatives descriptions otherwise described in detail in the DEIS.

Chapter 3 of the Ambler Road DEIS describes the current environmental status of the project area and potential effects of the alternatives to subsistence and subsistence resources. Appendix H of the Ambler Road DEIS: Indirect and Cumulative Impacts Associated with the Ambler Road of the DEIS addresses the indirect and cumulative impacts of the road and Appendix L of the Ambler Road DEIS: Subsistence Technical Report assesses information regarding subsistence use in the project area. This analysis uses the above information from the DEIS to evaluate potential impacts to subsistence pursuant to Section 810(a) of ANILCA and as directed in BLM instruction memorandum (BLM IM AK-2011-008).

The evaluation of potential impacts to subsistence resources was conducted by identifying impact indicators and analyzing potential impacts of the proposed road and its alternatives on subsistence uses. These impacts were compared to the three subsistence impact categories according to Section 810 of ANILCA: resource abundance, resource availability and user access. Two impact indicators were identified that could be quantitatively measured for the subsistence communities: resource importance and subsistence use areas. Resource importance is measured in three categories: high, moderate and low. Resource importance is established by analyzing historical harvests from the potentially affected communities. Subsistence use areas were quantified from years of subsistence use data collected primarily by ADF&G. A detailed discussion of this methodology is available in Appendix L of the Ambler Road DEIS: Subsistence Technical Report Section 5.

These impact indicators are based on NEPA guidance, which requires consideration of both context and intensity when assessing significant impacts (40 CFR 1508.27). By understanding the relative importance of each subsistence resource and the location of where these subsistence resources are used, as well as the context and intensity of impacts to subsistence resources and activities, vulnerable impacts from the proposed project can be better analyzed.

Subsistence uses and resources are discussed in detail in the Ambler Road DEIS Section 3.4.7. Tables 42-45 in Appendix L of the Ambler Road DEIS: Subsistence Technical Report Section 6.4 illustrates the resource importance to each community whose subsistence use area would potentially be affected by the proposed road. Tables 47- 49 of the technical report quantifies the categories of resource importance by community. Each alternative of the proposed road is evaluated for the availability, abundance and access to subsistence resources of vital importance to communities: caribou, moose, fish (salmon and non-salmon), vegetation and other resources (large land mammals, marine mammals, migratory birds, etc.)

B.1 Evaluation and Findings for No Action Alternative

Under the No Action Alternative, the BLM would not grant a ROW. The No Action Alternative provides a baseline against which impacts under other alternatives can be evaluated.

B.1.1 Evaluation of the Effect of Use, Occupancy or Disposition on Subsistence Use and Need

Under the No Action Alternative, there would be no reduction in the abundance of harvestable resources (caribou, moose, salmon, non-salmon fish, vegetation and other) used for subsistence purposes. There would be no adverse impacts on wildlife habitats, direct impacts on subsistence resources, or increased harvest and increased competition from non-subsistence users. There would be no reduction in the availability of subsistence resources caused by an alteration in their distribution, migration, or location. There would be no limitation on the access of subsistence users to harvestable resources, including physical and legal barriers.

B.1.2 Evaluation of the Availability of Other Lands

Under the No Action Alternative, construction and operation of the road would not occur on federally managed public lands. Therefore, there would be no need to evaluate other lands for the access road.

B.1.3 Evaluation of Other Alternatives That Would Reduce or Eliminate the Use, Occupancy or Disposition of Public Lands Needed for Subsistence Purposes

Under the No Action Alternative, construction and operation of the road would not occur. Therefore, there would be no need to evaluate other ways to accommodate the proposed action.

B.1.4 Findings

The No Action Alternative would not result in a significant restriction of subsistence uses. A positive determination pursuant to ANILCA Section 810 is not required.

B.2 Evaluation and Findings for Alternative A (AIDEA Proposed Route (GAAR North) to the Dalton Highway)

Alternative A is a 211-mile alignment, accessing the District from the east, with its eastern terminus at MP 161 of the Dalton Highway. It is a total length of 456 miles to Fairbanks. It runs almost directly west to the District across primarily state-managed, BLM-managed, and NPS-managed lands. The ROW would traverse the south side of the Brooks Range, following a series of stream and river valleys oriented roughly east-west, separating the Schwatka Mountains from a series of smaller mountain ranges and foothills, including the Ninemile Hills, Jack White Range, Alatna Hills, Helpmejack Hills, Akoliakruich Hills, Angayucham Mountains, and Cosmos Hills. This route crosses GAAR farther north than Alternative B. See Ambler Road DEIS, Appendix A, Map 2-3.

B.2.1 Evaluation of the Effect of Use, Occupancy or Disposition on Subsistence Use and Need

B.2.1.1 Caribou

Abundance

Caribou, of the large land mammals, is the most depended upon natural resource available to potentially affected communities (DEIS Section 3.3.4 Mammals). In this region of Alaska caribou is the primary resource harvested, making up 32 percent of the total poundage of consumable resources (Appendix L, Section 5.1.2).

In 18 of the 27 communities involved in this study, caribou are of high or moderate importance (Appendix L, Table 42). Of these communities, nine would see a direct impact by the proposed action: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Beetles, Evansville, Kobuk, Selawik and Shungnak. Bettles, Evansville, Kobuk and Shungnak all have subsistence use areas that would be bisected by the proposed road. Evansville, Kobuk and Shungnak are considered in the high value resource category for caribou. These communities would be impacted most by the ROW. Alatna, Allakaket and Ambler subsistence use areas would be partially bisected by the proposed action. Allakaket and Ambler are both ranked in the high category for caribou use, with Alatna ranked moderate. Anaktuvuk Pass and Selawik are located on the periphery of the project. Both of these communities are in the high dependence category for caribou use. All other communities in the subsistence study, whether they are ranked as having a high, moderate or low dependence on caribou, have subsistence use areas outside of the project area and likely wouldn't see an impact on their subsistence use.

The project area passes through the winter, migratory and peripheral range of the WAH and the peripheral range of the Hodzana Hills Herd (HHH). Construction and operation activities as described in the proposed road DEIS Section 3.4.7 could affect abundance by:

- causing direct mortalities
- loss and fragmentation of habitat
- behavioral changes

Direct mortalities could occur if traffic is at expected use of 168 trips per day, with the chance for a caribou- vehicle strike. While this may occur, the significance of an individual collision on the herd population would be minor. Caribou may also see the road as a physical barrier that may alter their behavior or shift their migratory patterns. This may lead to a change in body condition due to expenditure of energy (Sullender 2017). Increased energy expenditures may result in reduced foraging rates and, ultimately, decreased mating success/pregnancy rates. Caribou migration may be altered to the point where calving success and winter survival are affected. These would both have major impacts on the herd population. These changes could lead to a higher mortality rate in caribou affecting the overall population.

Availability

Bettles, Evansville, Kobuk and Shungnak subsistence use areas would all be bisected by the proposed road alignment. Caribou is a high value resource to Shungnak, Evansville and Kobuk and a moderate resource to Bettles. These communities would experience the greatest impact from the road being built. The project would intersect a portion of the subsistence use areas of Allakaket, Alatna and Ambler. Allakaket and Ambler are ranked as high value for caribou, with Alatna ranked as moderate. Wiseman and Selawik subsistence use areas are both on the periphery of the proposed project and are ranked as high value for caribou. Hughes is also on the periphery of the area but is ranked as moderate value on caribou. Impacts to these communities could be realized as subsistence users having to travel farther and longer to harvest caribou than they previously did. It could also cause less overall hunter success, meaning subsistence users would have to turn to non-traditional food sources.

The primary construction and operation activities which may affect caribou availability to local communities include:

- air and ground traffic
- construction noise (e.g., blasting, machinery)
- presence of linear infrastructure (e.g., road)
- human activity

Air traffic has been a commonly reported and observed impact on caribou on the North Slope and in Northwest Alaska (SRB&A 2009, 2018, Georgette and Loon 1988, Sullender 2017). Air traffic is observed to cause behavioral changes, skittish behavior, and delayed or diverted crossing behavior, which in turn has impacts on caribou hunting success. These types of behaviors are most commonly observed in response to helicopter traffic, although fixed-wing aircraft have also been observed to elicit similar responses. In addition to changes in behavior, increased exposure to aircraft disturbance may also affected body condition through increased energy expenditures (Sullender 2017). Furthermore, increased energy expenditures may result in reduced foraging rates and, ultimately, decreased mating success/pregnancy rates. This would have significant impacts on the herd population.

Roads, road traffic and construction are also believed to cause behavioral and migratory changes in caribou which can affect hunting success. Deflections or delays of caribou movement from roads and associated ground traffic and human activity has been documented in the traditional knowledge of harvesters (SRB&A 2009, 2014, 2018) and during behavioral studies on caribou, particularly for maternal caribou (ABR and SRB&A 2014). In recent years, reports of ground traffic–related impacts on the North Slope caribou hunting, particularly in the vicinity of Nuiqsut, have increased with the construction of gravel roads in the area (SRB&A 2016, 2017, 2018). Impacts of roads have also been observed by Noatak and Kivalina caribou hunters in regards to the Red Dog Delong Mountain Transportation System (DMTS) (SRB&A 2014). Residents have observed that some caribou may stop once they reach the DMTS, sometimes traveling alongside the road before crossing, and other times bypassing the road altogether. Such behavior has also been documented through radio collar observation. A study conducted by (Wilson et.al. 2016), found that the DMTS influenced the movements of approximately 30 percent of radio-collared WAH caribou, and the average delay in crossing was 33 days. Caribou from the Teshekpuk Herd (TH) were not similarly affected, which could be due to greater exposure of the TH to industrial development in the eastern portion of its range. In general, observed caribou behavior in response to the DMTS is variable: in some cases caribou cross seemingly without delay, while in other cases herds scatter and migration is delayed for multiple days (Wilson et al. 2016, ABR and SRB&A 2014). Responses to roads also seem to vary from year to year based on the context in which roads are encountered.

Access

Alatna, Allakaket, Ambler, Anaktuvuk Pass, Beetles, Evansville, Kobuk, Selawik and Shungnak would all see their subsistence hunting areas intersected by the proposed ROW (Appendix L: Tables 42 and 47). Bettles, Evansville, Kobuk and Shungnak would have their hunting areas bisected by the project. Allakaket, Alatna and Ambler would have their subsistence hunting area partially intersected, while Selawik would be on the periphery of the project. The communities that would have their use areas wholly or partially bisected would see the largest impact on their subsistence activities.

Impacts to harvester access would occur within the vicinity of the road corridor, where harvesters could be faced with physical obstructions to access or by removal of usable area (e.g. avoidance of work areas).

- physical barriers: road, construction laydown materials, pilings and heavy equipment
- diversion: avoidance of material sites and other areas which are unsafe for travel
- crossing ramps: not in place until Phase 2 or 3 of the project, hunters may not be permitted to cross construction-phase roads until crossing areas are established

The degree of impacts from construction and operation would depend on whether the timing of construction activities conflicts with subsistence use areas and activities for a community. Because construction would occur year-round, it is likely that there would be direct conflicts with construction activities for certain subsistence use areas. Subsistence activities occur year-round, peaking in the fall (August and September) and again in the mid-winter and early spring (February through April) for most study communities with available data (Appendix L: Section 5). The project corridors cross areas used for both riverine and overland travel, and construction activities would occur year-round; thus, residents may experience significant impacts during all subsistence seasons and activities which are overlapped by the proposed ROW.

The proposed ROW would not permit access to local residents for subsistence purposes but would allow residents to cross the road at established crossing areas. The efficacy of crossing ramps to reduce access impacts for local hunters would depend on the location, design, and frequency of the ramps along the ROW. Subsistence users do not always use or follow established trails when pursuing resources overland;

instead traveling in various directions based on environmental factors (e.g., weather, snow and ice conditions) and traditional knowledge of resource distribution and behavior. Therefore, the presence of crossing ramps would not eliminate significant impacts to user access. Subsistence users may have to travel additional distances when pursuing resources in order to locate approved crossing areas, or they may take safety risks by crossing in areas not approved for crossing. In addition, despite the presence of crossing ramps, some individuals may still have difficulty using crossing ramps, especially when hauling sleds. Subsistence users in the community of Nuiqsut have reported difficulty under certain conditions when using crossing ramps on industrial roads near their community (SRB&A 2018).

B.2.1.2 Moose

Abundance

The proposed road corridor crosses subsistence moose hunting areas for nine communities. Moose is considered a resource of high importance for five of the communities (Alatna, Allakaket, Bettles, Evansville and Wiseman), and of moderate importance for three communities (Ambler, Kobuk, and Shungnak) (Appendix L, Table 42).

Construction and operation activities as described in the proposed road DEIS Section 3.4.7 could affect abundance by:

- causing direct mortalities
- loss and fragmentation of habitat
- behavioral changes

Direct mortalities could occur during construction and operation both from vehicle-moose collisions. An estimated 168 trips on the road daily would substantially increase the probability of a collision. This probability would be the same all year long. Construction would affect moose through removal or disturbance of habitat. Since moose have smaller ranges than caribou and do not migrate, impacts would be more localized to the immediate vicinity of the road.

Availability

Impacts to moose availability would generally be on a smaller geographic scale than for caribou, as moose have smaller ranges and residents do not rely on seasonal migratory movements when hunting them. Thus, impacts to moose hunting from construction and operation of the road would occur primarily in the vicinity of the road where moose could exhibit avoidance or other behavioral changes. Because a majority of moose hunting in the region occurs along rivers during the fall months, impacts would be most likely to occur in areas where the road corridor crosses key moose hunting rivers such as the Koyukuk and Kobuk rivers, and smaller drainages such as the Alatna, John, and Wild rivers. Residents may experience decreased success in these areas due to moose remaining in deeper brush (Appendix L: Section 6.4.1). Because intersections with the road are a very small portion of the rivers, this would not have a significant effect on overall hunter success.

Aside from the temporary disturbance during construction and of traffic during operation, moose availability would not be significantly impacted by the proposed ROW. Moose may actually use the road as a travel corridor, especially in winter. Moose may still be available to harvest by subsistence users at current levels.

Access

While road access for local subsistence users would not be permitted, it is possible that residents from local communities would use the cleared area of the ROW alongside the road as a travel corridor; particularly if game such as moose concentrate in these corridors. Use of the ROW may facilitate access to hunting areas farther from the community as well as between communities. AIDEA indicates that ROW travel would be prohibited, and security would patrol the roads to prevent violations. Enforcement measures would reduce but not eliminate use of the ROW. Restrictions on use of the ROW, particularly by local residents when certain areas of the road would be crossable, may be difficult to enforce.

B.2.1.3 Fish

Abundance

The proposed ROW would cross subsistence fishing areas for four communities: Shungnak, Ambler, Bettles and Evansville. Fish is considered a resource of high importance for these communities (Appendix L, Table 42). Key fish species for these communities include chum salmon, sheefish, humpback and broad whitefish and, to a lesser extent, cisco, northern pike, grayling, burbot, and trout. In addition to the above communities who have documented use of the rivers crossed by the proposed project corridor, communities downstream that rely on sheefish (Buckland, Kobuk, Kiana, Noorvik, Selawik, Noatak and Kotzebue) could experience consequences to harvest if larger impacts to fish movement, reproductive success or health occur (DEIS Section 3.3.2, 3-43 and 3-52).

Impacts to fish under Alternative A could include:

- spawning habitat loss
- increased turbidity from construction sedimentation
- contamination from accidental spills
- introduction of invasive species

The proposed ROW would construct bridges across known Koyukuk River Chinook and chum salmon spawning habitat and install culverts in more than 1,000 perennial streams assumed to support anadromous and/or resident fish. Bridges and culverts would eliminate and alter fish habitat (DEIS Section 3.3.2, Fish and Amphibians). Culverts would eliminate portions of natural stream channels by routing flow underneath the roadway embankment. Replacing natural habitat with culverts and confining flow through culverts and bridges would reduce habitat complexity, increase sedimentation and scour potential, and degrade habitat quality both upstream and downstream throughout the life of the road.

The Kobuk and Alatna rivers are key spawning grounds for sheefish and are also important fishing areas. The upper Kobuk River supports the largest spawning concentration of sheefish in Alaska. The Kobuk is well known for its world-class sheefish trophy fishing. The Alatna River is the most important spawning area for sheefish and other whitefish species in the upper Koyukuk River drainage (DEIS Section 3.3.2). The ROW would cross both of these drainages under Alternative A. If construction removed suitable spawning habitat directly, the loss would equate to a significant decrease to spawning success.

Sedimentation, especially when increased over naturally occurring levels, adversely affects habitat quality and function. Increased fine sediments can smother incubating eggs, decrease fry emergence, reduce the amount of suitable habitat for juvenile fish, and decrease benthic community production (Limpinsel et al. 2017). Elevated turbidity from suspended solids diminishes habitat quality, and may decrease primary production, elevate water temperatures, and affect feeding behavior; large plumes can damage gills and impair organ function (Limpinsel et al. 2017). If sedimentation increased in any of the spawning areas, there would be a significant impact to spawning success.

Spills have the potential to substantially degrade habitat quality and affect the long-term health of individual fish and fish populations. Habitat located in the vicinity of road crossing sites, which includes spawning, rearing, feeding, wintering and migratory habitat, would be most susceptible to contamination from potential spills. Such a spill, particularly if near a stream, would substantially alter water chemistry, cause fish mortality, substantially degrade habitat quality and function, and cause population-level effects.

The introduction of invasive species could also impact fish habitat and/or productivity. Unlike other ROW impacts that are expected to be more short-term, the introduction of invasive species could become a long-term impact if their spread is uncontrolled. This would cause a significant effect because of the long term nature of the impact.

Availability

Construction activities which may affect fish availability to subsistence communities include:

- installation of bridges, culverts and related pile installation
- stream diversion and excavation
- gravel mining
- loss of harvest area

Fish could be diverted, displaced, or obstructed due to culvert placement, excavation, or stream diversion. While impacts to fish resulting from construction activities are expected to be localized, subsistence users often harvest fish in specific locations along rivers; thus, localized changes in fish distribution could have impacts on resource availability for individual harvesters.

Removing gravel from a stream channel changes the structure of its natural habitat for aquatic species, sediment transport dynamics and flow processes; degrades quality and habitat function upstream and downstream of mined areas; and alters fish and invertebrate communities (Brown et al. 1998). Removing streambed gravel from relic channels in the floodplain would degrade habitat quality by reducing habitat complexity and altering dynamics, which may affect survival rates of incubating eggs (Kondolf et al. 2002). Adverse impacts to fish may be fairly localized during the activity, although the full magnitude of effects is difficult to quantify given the lack of specific gravel extraction methods and plans. Studies have shown that attempts to mitigate or restore streams impacted by gravel mining may be ineffective because impacts often extend kilometers upstream and downstream of mined sites (Brown et al. 1998). Gravel mining near sheefish and other whitefish spawning areas would have especially negative consequences to fish populations, since these fish have specific spawning requirements and large numbers of fish spawn in relatively small, distinct areas.

While impacts to fish resulting from construction activities are expected to be localized, subsistence users often harvest fish in specific locations along rivers; thus, localized changes in fish distribution could have impacts on resource availability for individual harvesters. In addition to the communities who have documented use of the rivers crossed by the project corridors, communities upstream and downstream from the project corridors could experience impacts on fish availability if larger impacts to fish movement or health occur. An impact on this scale would be quite significant.

Access

There may be periods of time during construction where access along certain river drainages is obstructed due to bridge construction activities. It is anticipated that bridges would be designed with adequate clearance. However, it is possible that bridges may also obstruct boat travel along certain smaller waterways; the likelihood of this impact depends on individual bridge height and design.

B.2.1.4 Vegetation

Abundance

Vegetation is a high value resource to all communities except Livengood and Nenana in the project area Bettles, Evansville, Kobuk and Shungnak subsistence use areas would be bisected by the ROW. The Wiseman subsistence use area is located on the periphery of the project area.

Construction and operation activities which may affect the abundance of vegetation, including berries, wild plants, and wood include:

- clearing of the ROW
- fugitive dust
- contamination from accidental spills

ROW construction would result in the removal of vegetation harvesting areas for local residents. Communities along the proposed road corridors may also experience reduced availability of vegetation in traditional harvesting areas during and after construction of the road. This may lead to an overall decline in the abundance of harvestable vegetation.

In addition, a larger area surrounding the road would likely be removed from use for some individuals due to concerns about contamination. Impacts to vegetation harvest areas resulting from roads has been documented in relation to the Red Dog DMTS (SRB&A 2009b). Residents form Kivalina have reported observing dust on vegetation and changes in the taste or appearance of berries. In addition, some individuals have reported that they no longer use traditional vegetation harvesting areas along the DMTS due to concerns about contamination.

Spills have the potential to substantially degrade vegetation. Vegetation located in the vicinity of road would be most susceptible to contamination from potential spills. Introduction of toxicants from petroleum products associated with vehicle use and road run-off has the ability to impact vegetation (DEIS Section 3.3.1). Accidental spills along the ROW may significantly restrict harvestable vegetation in the direct vicinity of the road.

Availability

Construction and operation activities which may affect the availability of vegetation would include:

- clearing of the ROW
- fugitive dust
- contamination from accidental spills

Availability of vegetation in the direct route of the road may be directly impacted due to construction activity. Construction activity may lead to concerns by local residents about contamination of subsistence resources, particularly plants and berries. This concern would be especially elevated in areas where naturally occurring asbestos is exposed during construction or contained in the gravel fills used for the project. Spills or other contamination could also affect the local distribution of vegetation or may result in resources being considered unavailable to local harvesters due to concerns of contamination.

Permanent loss of native vegetation would occur from construction of the main road, landing strips, material and rip-rap sources, and construction access roads, due to vegetation clearing and the placement of gravel fill. Loss of vegetation through an undisturbed landscape would result in a number of effects to the surrounding environment, including alteration of adjacent vegetation community composition and loss or alteration of fish and wildlife habitat. Removal of native vegetation in this area, particularly in boreal forest, could take decades to recover (DEIS Section 3.3.1).

Access

Impacts to harvester access would occur along the ROW, where harvesters could be faced with physical obstructions to access or by removal of usable area.

- physical barriers: road, construction laydown materials, pilings and heavy equipment
- diversion: avoidance of material sites and other areas which are unsafe for travel
- crossing ramps: not in place until Phase 2 or 3 of the project, individuals may not be permitted to cross construction-phase roads until crossing areas are established

The degree of impacts from construction and operation would depend on whether the timing of construction activities conflicts with harvest. Because construction would occur year-round, it is likely that there would be direct conflicts with vegetation harvest. Subsistence harvest activities occur year-round, peaking in the summer for most communities (Appendix L: Section 5). The project corridor crosses areas used for both riverine and overland travel; thus, residents may experience significant impacts during all activities which are overlapped by the proposed ROW. While access would be hindered more for some communities than others, the proposed ROW may significantly restrict current levels of access for all involved communities.

B.2.1.5 Other

Abundance

Other subsistence resources such as Dall sheep, bear, muskoxen, small land mammals, marine mammals, migratory birds, upland game birds and eggs are considered of moderate or low importance or have fewer communities depending on them for subsistence (DEIS Section 3.4.7). Impacts from construction and operation could occur, but would not significantly impact the abundance of these resources available for subsistence use.

Availability

Availability of all other subsistence resources would vary from season to season and resource to resource. Construction can impact hunting for land mammals (large and small), birds (waterfowl and upland), and gathering eggs. Construction activities that may affect resource availability for subsistence users include:

- construction activity
- physical obstructions from infrastructure vehicle and air traffic
- accidental fuel or other contaminant spills

In the short term, construction activity may displace or divert resources such as large land mammals, small land mammals, and waterfowl, due to associated activity. Construction may also destroy vegetation and surrounding habitat for resources. Clearing of trees and brush for the ROW and stripping of topsoil and organic material may alter or degrade resource habitat, particularly for herbivores that depend on surface vegetation. Habitat alteration can affect resource distribution, thereby reducing the availability of those resources to subsistence users in traditional hunting or harvesting areas. Equipment, material storage sites and related infrastructure associated with construction, may act as a physical barrier to wildlife. This general disturbance of wildlife could result in subsistence resources being unavailable at the time and place that subsistence users are accustomed to finding them.

During construction and operation, the availability of subsistence resources would be affected through air and ground traffic, resulting in changes in behavior, changes in local distribution of resources, and/or avoidance of the ROW.

Accidental spills may degrade habitat along the ROW. This may alter the behavior of wildlife dependent upon the habitat, causing avoidance of the ROW. This would not significantly affect resources in this category. Wildlife in this group do not migrate as the caribou do, and therefore would not experience a large scale affect. Effects from the road would be more localized to the general vicinity of the ROW.

Access

Impacts to harvester access would occur within the vicinity of the road corridor, where harvesters could be faced with physical obstructions to access or by causing harvesters to avoid construction work areas. Construction infrastructure such as the road, construction laydown materials, and heavy equipment could present physical barriers to subsistence users. In addition, individuals traveling overland may have to divert around material sites and other areas which are unsafe for travel. Although the road would include crossing ramps for local residents to use when traveling overland, these likely would not be in place until Phase 2 or 3 of the project and therefore the road is more likely to pose an obstruction to overland travel during the construction phase; in addition, hunters may not be permitted to cross construction-phase roads until crossing areas are established, thus obstructing travel altogether for a period of time.

B.2.2 Evaluation of the Availability of Other Lands

Alternative A and B are both similar in the amount of federal land used by the ROW. The only variation in public land between the alternatives would occur within GAAR. The remainder of the two routes would be located on State and Native Corporation land. Alternative C proposes to use BLM managed land for the majority of the route, with Native Corporation land and State of Alaska land managing less. Other DOT&PF previously identified alternative corridors considered include the Original Brooks East, Kanuti Flats, Elliot Highway, Parks Highway Railroad, DMTS Port, Cape Blossom, Selawik Flats and Cape Darby. These routes did not meet screening criteria and were not considered further (see DEIS Appendix G for further discussion).

Of the feasible alternatives carried forward for evaluation, the proposed route was designed and engineered to optimize many environmental and economic considerations. Alternative A is the most economically feasible route and while it crosses more waterbodies requiring culverts or bridges, it has a smaller overall footprint than the other proposed routes. While Alternative C crosses the subsistence use area of 12 communities, A and B both cross only subsistence use areas of 11 communities[1]. Alternatives A and B both have the largest project area in the WAH habitat (4,161 and 4,775 acres respectively), while Alternative C has an area of 4,120 total acres.

The purpose of constructing and operating the proposed road would be to access the District. As such, there is no other feasible terminus for the road. Therefore, the only options are the starting point and the route the road would follow.

[1] Note: For alternatives A and B the only resource used by Hughes that could be affected would be Dall sheep. The importance of Dall sheep to the community of Hughes is not known. Only high and moderate valued resources were analyzed in detail for in this Section 810 Analysis.

B.2.3 Evaluation of Other Alternatives That Would Reduce or Eliminate the Use, Occupancy or Disposition of Public Lands Needed for Subsistence Purposes

AIDEA and DOT&PF considered numerous transportation modes and route alternatives for accessing the District. Their screening process eliminated many of those options as either not physically or economically feasible. Consideration was given to the environment as air travel only was an option; a rail system was another. Using existing infrastructure, such as the DMTS, for part of the route was considered. These options did not meet the criteria established for this project. Only physically and economically feasible alternatives were carried through for analysis in the DEIS.

B.2.4 Findings

Alternative A would not result in a significant restriction to subsistence uses for Beaver, Galena, Hughes, Huslia, Livengood, Manley Hot Springs, Minto, Nenana, Rampart, Stevens Village and Tanana.

Alternative A may result in a significant restriction to subsistence uses for Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Coldfoot, Evansville, Kiana, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, Shungnak and Wiseman due to a decrease in abundance and availability of caribou, fish and vegetation.

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required at the draft stage and hearings must be held with subsistence users before final determinations can be made.

All communities may not experience impacts equally to all resources. But, the proposed road project may significantly impact at least one resource for all above communities.

The proposed road may deflect or delay the migration of caribou of the WAH by up to 33 days (Appendix L Section 6.4.1). This may lead to a decrease in overwinter survival and lower reproductive success. A reduction of population of the herd may also lead to caribou not being available when and where subsistence users are accustomed to harvesting them. The proposed road may also limit or divert subsistence users in their harvest of caribou.

Construction of the proposed road requires many bridges, culverts and bank modifications to be completed. This can affect the population of fish indirectly by loss of habitat and lower spawning success. Lower abundance may lead to a lower availability of both salmon and non-salmon fish in historical subsistence use areas.

Construction of the proposed road would remove suitable vegetation harvest areas and hinder access to more. While this area is very small in comparison to the overall harvest areas, vegetation harvesting is a high value resource to nearly all communities in the study area. Considering the importance of vegetation, altered availability of vegetation may result in a significant reduction in subsistence uses.

B.3 Evaluation and Findings for Alternative B (AIDEA Alternative Route (GAAR South) to the Dalton Highway)

Alternative B is similar to Alternative A, but it differs in the route through GAAR. It is 228 miles long with a total distance to Fairbanks of 473 miles. This routes crosses GAAR further south than Alternative A.

B.3.1 Evaluation of the Effect of Use, Occupancy or Disposition on Subsistence Use and Need

B.3.1.1 Caribou

Because Alternative B is very similar to Alternative A, there would be no quantifiable differences between the analyses for caribou. See Section B.2.1.1 of this evaluation.

B.3.1.2 Moose

Because Alternative B is very similar to Alternative A, there would be no quantifiable differences between the analyses for c moose. See Section B.2.1.2 of this evaluation.

B.3.1.3 Fish

The majority of the analysis of Alternative A would apply similarly to Alternative B. See Section B.2.1.3 of this evaluation. Noticeable differences will be discussed below.

The route chosen through GAAR for Alternative B would place a river crossing 7 miles from sheefish spawning habitat on the Reed River and closer to it than Alternative A. This may increase the likelihood of impact to the resource. Moving a crossing closer to sheefish spawning habitat, especially with the concentrated spawning area located there would increasing sediment from construction and erosion and potential degradation and contamination of the habitat from accidental spills. This may impact reproductive success of sheefish in the Kobuk River. As stated in B.2.1.3 of this evaluation, this particular stretch of the Kobuk river has the highest concentration of sheefish spawning habitat in Alaska. Any effect on spawning success here may affect a large portion of the sheefish population.

B.3.1.4 Vegetation

Alternatives B differs from Alternative A in that the ROW would overlap Ambler's vegetation harvest area. This may lead to a direct impact by removal of harvestable vegetation or contamination (real or perceived) to harvestable vegetation by fugitive dust and accidental spills (see Section B.2.1.4). This may significantly restrict harvest by the community of Ambler. The direct loss of harvestable vegetation by construction of the road would last for the life of the project. Even after reclamation of the road, vegetation can take decades to recover.

B.3.1.5 Other

Because Alternative B is very similar to Alternative A, there will be no quantifiable differences between the analyses for other resources. See Section B.2.1.5 of this evaluation.

B.3.2 Evaluation of the Availability of Other Lands

See Section B.2.2 of this evaluation.

B.3.3 Evaluation of Other Alternatives That Would Reduce or Eliminate the Use, Occupancy or Disposition of Public Lands Needed for Subsistence Purposes

See Section B.2.3 of this evaluation.

B.3.4 Findings

Alternative B would not result in a significant restriction to subsistence uses for Beaver, Galena, Hughes, Huslia, Livengood, Manley Hot Springs, Minto, Nenana, Rampart, Stevens Village and Tanana.

Alternative B may result in a significant restriction to subsistence uses for Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Coldfoot, Evansville, Kiana, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, Shungnak and Wiseman due to a decrease in abundance and availability of caribou, fish and vegetation.

A positive determination pursuant to ANILCA Section 810 is required at the draft stage and hearings must be held with subsistence users before final determinations can be made.

See Section B.2.4 of this evaluation for discussion.

B.4 Evaluation and Findings for Alternative C (Diagonal Route to the Dalton Highway)

The BLM developed this alternative based on scoping comments. The 332-mile route is longer than the other alternatives but has a similar driving length (476 miles) to Fairbanks. This alternative would have a logical terminus connecting into the road and rail network to provide year-round access to existing port facilities.

B.4.1 Evaluation of the Effect of Use, Occupancy or Disposition on Subsistence Use and Need

B.4.1.1 Caribou

Abundance

Impacts of the road to caribou would generally be the same between Alternative C and Alternative A/B[2]. The route change would affect different communities which will be discussed here. Any variation in impact on resource between the two alternatives will be discussed here as well. Similar impacts of the road are discussed in Section B.2.1.1 of this evaluation.

Ten communities would experience a direct impact on caribou from Alternative C; Alatna, Allakaket, Ambler, Anaktuvuk Pass, Hughes, Huslia, Kobuk, Selawik, Shungnak and Tanana. Six of these communities consider caribou of high importance, Allakaket, Ambler, Anaktuvuk Pass, Kobuk, Selawik and Shungnak (Appendix L: Table 44). Tanana is in the low resource category, with the remaining communities in the moderate category. Hughes, Kobuk and Shungnak would have their subsistence hunting areas bisected by the proposed road. Alatna, Allakaket and Ambler subsistence hunting areas would be partially intersected by the proposed ROW. The proposed ROW would be located on the periphery of Selawik and Tanana's subsistence hunting areas. Anaktuvuk Pass would see an impact in an isolated portion of their subsistence use area. All other communities in the subsistence study, whether they are ranked as having a high, moderate or low dependence on caribou, have subsistence use areas outside of the project area and likely wouldn't see an impact on their subsistence use.

Alternative C places the ROW through the middle of the entire RMH range; it bypasses the HHH range and passes through the peripheral and winter range of the WAH. This alternative intercepts only a small portion of the migratory area of the WAH. The RMH may experience a direct impact from this alternative. Because the RMH is a smaller herd (812 as of last census), access to it is limited and it has a relatively short season, subsistence harvest is low (DEIS Section 3.3.4). Alternative C crosses more WAH habitat than the other alternatives. But, may have a lesser impact on their fall and spring migrations because it only intercepts a small portion of their migratory range.

---

[2] Note, while Alternative C would affect more habitat than Alternatives A and B, the impacts to subsistence users would be localized to subsistence use areas. Any alteration of resource availability, abundance, or access would be felt the same by subsistence users, it's just different communities that would experience the impact.

Availability

Impacts of the road to caribou would be the same between Alternative C and Alternatives A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.1 of this evaluation.

Access

Impacts of the road to caribou would be the same between Alternative C and Alternative A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.1 of this evaluation.

B.4.1.2 Moose

Abundance

Impacts of the road to moose would be the same between Alternative C and Alternative A/B. The route change would affect different communities which will be discussed here. For impacts of the road see Section B.2.1.2 of this evaluation.

The proposed ROW crosses subsistence moose hunting areas for eight communities, Alatna, Allakaket, Ambler, Hughes, Kobuk, Shungnak, Stevens Village and Tanana. Moose is considered a resource of high importance for five of the communities (Alatna, Allakaket, Hughes, Stevens Village and Tanana), and of moderate importance for the rest (Appendix L, Table 44).

Availability

Impacts of the road to moose would be the same between Alternative C and Alternative A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.2 of this evaluation.

Access

Impacts of the road to moose would be the same between Alternative C and Alternative A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.2 of this evaluation.

B.4.1.3 Fish

Abundance

Impacts of the road to fish would generally be the same between Alternative C and Alternative A/B. The route change would affect different communities which will be discussed here. Any variation in impact on resource between the two alternatives will be discussed here as well. Similar impacts of the road are discussed in Section B.2.1.1 of this evaluation.

The proposed ROW crosses subsistence fishing areas for nine communities: Alatna, Allakaket, Ambler, Hughes, Huslia, Kiana, Kobuk, Shungnak and Stevens Village. This alternative affects more community fishing resources than the other two alternatives. For all of these communities except Alatna and Stevens Village, fish are categorized as a resource a high importance (Appendix L, Table 44). Hughes, Kobuk and Shungnak would see their subsistence fishing areas bisected by the proposed ROW. Alatna, Allakaket and Ambler use areas would be partially intersected by the ROW. The ROW would fall on the periphery of the Hughes and Huslia fishing use areas. These communities would have direct impacts to their subsistence use areas from the proposed project. Other communities not directly impacted by the road could also see an effect in terms of spawning habitat loss, increased turbidity and loss of harvest area.

Alternative C crosses the Kobuk River directly downstream from Kobuk River sheefish spawning habitat. Thus, any changes to waterways which obstruct access to spawning grounds could have larger indirect impacts to communities who harvest sheefish upstream and downstream from the road corridor. However, Alternative C would be less likely to have direct impacts on sheefish spawning grounds due to sediment and turbidity. But, Alternative C would require a crossing on the Koyukuk River near Hughes in the middle of known sheefish spawning habitat. In addition, while Alternative C would cross more fish streams than alternatives A and B, it would construct more bridges and fewer minor culverts which are more likely to obstruct fish passage. In addition to sheefish spawning grounds, Alternative C also crosses streams which support spawning for Chinook and chum salmon. Impacts to salmon spawning grounds could also have larger effects to communities who harvest salmon downstream from the road corridor along the Yukon and Koyukuk rivers.

Availability

Impacts of the road to fish would be the same between Alternative C and Alternative A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.3 of this evaluation.

Access

Impacts of the road to fish would be the same between Alternative C and Alternative A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.3 of this evaluation.

B.4.1.4 Vegetation

Abundance

Impacts of the road to vegetation would be the same between Alternative C and Alternative A/B. The route change would affect different communities which will be discussed here. For impacts of the road see Section B.2.1.4 of this evaluation.

Vegetation is a resource of high importance to almost each community in the project area. Allakaket, Ambler, Hughes, Kobuk, Shungnak and Stevens Village are in the high value category for vegetation. Shungnak and Kobuk subsistence use areas would be bisected by the proposed ROW. Allakaket and Ambler would see their subsistence use areas partly intersected, and Stevens Village's use area is on the periphery of the project.

Availability

Impacts of the road to vegetation would be the same between Alternative C and Alternative A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.4 of this evaluation.

Access

Impacts of the road to vegetation would be the same between Alternative C and Alternative A/B. The route change would affect different communities which are discussed in the previous section. For impacts of the road see Section B.2.1.4 of this evaluation.

B.4.1.5 Other

Abundance

Impacts of the road to other resources would be the same between Alternative C and Alternative A/B. The route change would affect different communities which will be discussed here. For impacts of the road see Section B.2.1.5 of this evaluation.

Other resources are of low or moderate importance to almost each community in the project area. Alatna, Allakaket, Ambler, Anaktuvuk Pass, Hughes, Huslia, Kobuk, Selawik, Shungnak, Stevens Village and Tanana all use at least one other resource that may be impacted by the proposed ROW.

Availability

Impacts of the road to other resources would be the same between Alternative C and Alternative A/B. The route change would affect different communities which will be discussed in the previous section. For impacts of the road see Section B.2.1.5 of this evaluation.

Access

Impacts of the road to other resources would be the same between Alternative C and Alternative A/B. The route change would affect different communities which will be discussed in the previous section. For impacts of the road see Section B.2.1.5 of this evaluation.

B.4.2 Evaluation of the Availability of Other Lands

See Section B.2.2 of this evaluation.

B.4.3 Evaluation of Other Alternatives That Would Reduce or Eliminate the Use, Occupancy or Disposition of Public Lands Needed for Subsistence Purposes

See Section B.2.3 of this evaluation.

B.4.4 Findings

Alternative C would not result in a significant restriction to subsistence uses for Beaver, Bettles, Buckland, Coldfoot, Evansville, Galena, Kotzebue, Livengood, Manley Hot Springs, Minto, Nenana, Noatak, Noorvik, Rampart and Wiseman.

Alternative C may result in a significant restriction to subsistence uses for Alatna, Allakaket, Ambler, Anaktuvuk Pass, Hughes, Huslia, Kiana, Kobuk, Selawik, Shungnak, Stevens Village and Tanana due to decrease of abundance and availability of caribou, fish and vegetation.

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required at the draft stage and hearings must be held with subsistence users before final determinations can be made.

All communities may not experience impacts equally to all resources. But, the proposed road project may significantly impact at least one resource for all above communities.

Alternative C may not affect the migration of WAH caribou as much as the other two alternatives. But, there is still a portion of the road that extends into the WAH migratory area and this alternative crosses more total range of the WAH, so an impact may occur (Appendix A: Map 3-22). Approximately 20 percent of the WAH cross this area in the winter. This may significantly divert the herd on their winter range making availability to subsistence users a concern.

Construction of the proposed road requires many water crossings to be installed. This is concerning because of the proximity to sheefish spawning habitat. If any detrimental impact stems from these installations a majority of the sheefish population in Northwest Alaska may be significantly impacted.

Construction of the proposed road would remove suitable vegetation harvest areas and hinder access to more. While this area is very small in comparison to the overall harvest areas, vegetation harvesting is a high value resource to nearly all communities in the study area. Considering the importance of vegetation, altered availability of vegetation may result in a significant reduction in subsistence uses.

B.5 Evaluation and Findings for the Cumulative Case

The goal of the cumulative case analysis presented in Appendix H is to evaluate the incremental impact of the actions considered in the EIS, in conjunction with all past, present, and reasonably foreseeable future activities in or near the Ambler Road. Past and present actions which have affected subsistence uses and resources within the study region include mineral development, infrastructure projects, scientific research, recreation and tourism, sport hunting and fishing, hunting and harvesting regulations, establishment of wildlife refuges, national parks and preserves, and environmental changes resulting from climate change.

Actions included in the cumulative case analysis are listed in Appendix H Section 2. Past and present actions that have affected subsistence and resources are:

- oil exploration and extraction, including Trans-Alaska Pipeline System (TAPS) and the Dalton Highway
- Red Dog Mine, including the DMTS and port site
- sport hunting and fishing
- passage of ANILCA
- impacts of climate change
- Reasonably foreseeable future actions are:
- development of mineral prospects within the District
- use of the proposed road for commercial access
- use of the proposed road for commercial use by local communities and Native Allotment owners

B.5.1 Evaluation of the Effect of Use, Occupancy or Disposition on Subsistence Use and Need

B.5.1.1 Oil Exploration and Extraction

Oil and gas exploration, development, and production is ongoing and planned within the onshore North Slope, State and Federal waters in the Beaufort Sea, and in the Western Canadian Arctic. These activities include exploration work, infrastructure development, construction, and maintenance, gravel mining, and production associated with existing wells. These activities are expected to continue under all alternatives.

Construction of the TAPS and Dalton Highway have affected subsistence access and resource availability for communities in the eastern portion of the project area, with many residents believing that the highway and pipeline have resulted in changes to caribou migration across the region. Impacts to vegetation within this area include construction of the Dalton Highway and other roads and airports in rural Alaska communities, which has resulted in loss within the footprints, alteration beyond the footprints, and the spread and establishment of non-native invasive species (NNIS) near developments.

B.5.1.2 Red Dog Mine

The Red Dog Mine, including the DMTS and port site, has introduced contamination concerns for local residents, particularly Kivalina residents who are situated downstream from the mine, and have affected resource distribution and migration for resources such as caribou and marine mammals possibly resulting in decreased harvests of these resources over time (EPA 2009). Residents have observed that some caribou would stop once they reach the DMTS, sometimes traveling alongside the road before crossing, and other times bypassing the road altogether. Such behavior has also been documented through radio collar observation.

B.5.1.3 Sport Hunting and Fishing

Increased sport hunting and fishing in the region and associated air traffic have resulted in increased competition for local subsistence users in addition to disturbance and displacement of subsistence resources such as caribou.

B.5.1.4 ANILCA

The establishment of Gates of the Arctic National Park and Preserve (GAAR) in the 1980s also affected access to and use of traditional harvesting areas for residents of nearby communities within the northeastern portion of the project area (Watson 2018).

B.5.1.5 Climate Change

Climate change is an ongoing factor considered in cumulative effects analyses of the Ambler Road. Climate change could affect the habitat, behavior, distribution, and populations of fish and wildlife within the program area. Impacts of climate change include changes in the predictability of weather conditions such as the timing of freeze-up and breakup, snowfall levels, storm and wind conditions, and ice conditions (e.g., ice thickness on rivers and lakes), all of which affect individuals' abilities to travel to subsistence use areas when resources are present in those areas. In addition, subsistence users may experience greater risks to safety when travel conditions are not ideal. Changes in resource abundance or distribution resulting from climate change can also affect the availability of those resources to subsistence users or may cause subsistence users to travel farther and spend more time and effort on subsistence activities (Brinkman 2016).

B.5.1.6 Reasonably Foreseeable Future Actions

Reasonably foreseeable actions within the region that could contribute to subsistence impacts include development of the Ambler Mining District (Arctic, Bornite, Sun, and Smucker projects); use of the AMDIAR for commercial access; use of the AMDIAR for commercial use by local communities and Native Allotment owners

The development of mines within the District and secondary access roads would result in habitat loss, alteration, and fragmentation of WAH caribou migratory and winter range. The mines, mining roads, and secondary access roads would increase habitat fragmentation exponentially. The fragmentation of habitat would further remove usable habitat for caribou during migration and winter, which could force substantial range shifts, increased competition for resources, or increased predation (NCASI 2008). Alternative's A and B, both place the ROW in more migratory habitat than Alternative C, which may spatially alter WAH migration away from subsistence use areas of Alatna, Allakaket, Ambler, Bettles, Evansville, Hughes, Kobuk, Shungnak, Selawik and Wiseman. But, Alternative C places the ROW more in the winter range of the WAH. This may alter the WAH use of winter range and impact Alatna, Allakaket, Ambler, Hughes, Huslia, Kobuk, Selawik, Tanana and Shungnak. In addition, it is unclear whether the road would allow access to small mining claims; while large mines would likely have policies regarding hunting and fishing by workers, smaller mining outfits or individuals may allow these activities. According to the Western Arctic Herd Working Group (WAHWG 2017), communities within the region have already experienced increased competition in traditional hunting areas, with greater numbers of hunters concentrated within smaller areas. Sport hunting is a key issue within the region for subsistence harvesters, and public access to the area via a road or ROW would contribute to these impacts.

Reasonably foreseeable future actions that would impact fish include the advanced mining development and indirect road access. Direct and indirect chemical stressors such as mining-related pollution, acid mine drainage, and the release of toxic materials have the potential to significantly impact aquatic life health and the survival of fish populations (Limpinsel et al. 2017). Toxic metals that bioaccumulate in fish tissue can lead to fish mortality, increased susceptibility to disease, reduced growth rates, and pose health risks to human consumers (Hughes et al. 2016). Given the proximity of the 4 most advanced mine projects to the Kobuk River sheefish spawning grounds and the large numbers of sheefish that spawn in this habitat, sheefish may be especially vulnerable to population-level effects (Appendix H Section 3.4.2).

Mining and its associated activities have the potential to cause the greatest impacts to vegetation. Open pit and underground mining would result in loss of vegetation within the project area and alteration of vegetation beyond project areas from disturbance of surface and groundwater flow, lowering of the water table from dewatering activities, and fugitive dust from heavy metals and accessory roads. As has been shown at Red Dog Mine, fugitive dust from heavy metals can travel thousands of feet to several kilometers in distance, particularly if strict mitigation measures are not employed or practiced. This can result in increased or complete loss of lichen and moss (Neitlich et al. 2017). Heavy metal dust can persist in the soil for many decades (Neitlich et al. 2017), resulting in adverse impacts to the surrounding vegetation and habitat. Although the exact number of acres of vegetation that would be lost or altered is unknown, the potential magnitude of loss and alteration is expected to be at least in the thousands of acres, not including accessory roads. In addition, hundreds of thousands of acres of mining claims exist in the advanced mining scenario, which could result in more loss and alteration than initially predicted if more claims are developed.

B.5.2 Evaluation of the Availability of Other Lands

See Section B.2.2 of this evaluation.

B.5.3 Evaluation of Other Alternatives That Would Reduce or Eliminate the Use, Occupancy or Disposition of Public Lands Needed for Subsistence Purposes

See Section B.2.3 of this evaluation.

B.5.4 Findings

The cumulative case, when taken in conjunction with Alternatives A, B, and C, would not result in a significant restriction to subsistence uses for the communities of Beaver, Galena, Livengood, Manley Hot Springs, Minto, Nenana, Rampart and Stevens Village.

The cumulative case, when taken in conjunction with Alternatives A, B, and C, may result in a significant restriction to subsistence uses for the communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Coldfoot, Evansville, Hughes, Huslia, Kiana, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, Shungnak, Stevens Village, Tanana, and Wiseman, due to a potential decrease in abundance and availability of caribou, fish and vegetation.

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required at the draft stage and hearings must be held with subsistence users before final determinations can be made.

All communities may not experience impacts equally to all resources. But, the proposed road project may impact at least one resource for all above communities.

Cumulative impacts of Alternatives A and B related to resource abundance and availability would likely be greater than those under Alternative C, as they would be more likely to affect resource availability of migrating caribou to the subsistence study communities, particularly during the fall months, and are most likely to have population-level effects on sheefish and whitefish, all key subsistence species among the study communities. However, impacts related to user access and direct impacts on resource availability along the road corridors would be similar across all alternatives and would affect a similar number of study communities.

The proposed road in conjunction with discussed cumulative effects may divert or delay the migration of caribou of the WAH by up to 33 days (Appendix L Section 6.4.1). This may lead to a decrease in overwinter survival and lower reproductive success. A reduction of population of the herd may also lead to caribou not being available when and where subsistence users are accustomed to harvesting them. The proposed road and cumulative impacts may also limit or divert subsistence users in their harvest of caribou.

Construction of the proposed road and addition of numerous open pit mining operations requires much infrastructure to be completed. This can affect the population of fish indirectly by loss of habitat and lower spawning success. Lower abundance may lead to a lower availability of both salmon and non-salmon fish in historical subsistence use areas.

Construction of the proposed road in conjunction with discussed cumulative effects would remove suitable vegetation harvest areas and hinder access to more. While this area is very small in comparison to the overall harvest areas, vegetation harvesting is a high value resource to nearly all communities in the study area. Considering the importance of vegetation, altered availability of vegetation may result in a significant reduction in subsistence uses.

C. Notice and Hearings

ANILCA Section 810(a) provides that no "withdrawal, reservation, lease, permit, or other use, occupancy or disposition of the public lands which would significantly restrict subsistence uses shall be effected" until the federal agency gives the required notice and holds a hearing in accordance with ANILCA Section 810(a) (1) and (2). The BLM will provide notice in the Federal Register that it made positive findings pursuant to ANILCA Section 810 that the Alternatives A, B, and C and cumulative case presented in the Ambler Road DEIS, met the "may significantly restrict" threshold. As a result, public hearings will be held in the potentially affected communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Coldfoot, Evansville, Kiana, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, Shungnak and Wiseman. Notice of these hearings will be provided in the Federal Register and by way of the local media. Meeting dates and times will also be posted on BLM's website at eplanning.blm.gov.

D. Subsistence Determinations under ANILCA Section 810(a)(3)

ANILCA Section 810(a) provides that no "withdrawal, reservation, lease, permit, or other use, occupancy or disposition of the public lands which would significantly restrict subsistence uses shall be effected" until the federal agency gives the required notice and holds a hearing in accordance with ANILCA Section 810(a)(1) and (2), and makes the three determinations required by ANILCA Section 810(a)(3). The three determinations that must be made are: 1) that such a significant restriction of subsistence use is necessary, consistent with sound management principles for the utilization of the public lands; 2) that the proposed activity will involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other such disposition; and, 3) that reasonable steps will be taken to minimize adverse impacts to subsistence uses and resources resulting from such actions [16 U.S.C. 3120(a)(3)(A), (B), and (C)].

The BLM has found in this preliminary subsistence evaluation that Alternatives A, B, C and the cumulative case considered in this DEIS may significantly restrict subsistence uses. Therefore, the BLM will undertake the notice and hearing procedures required by ANILCA Section 810 (a)(1) and (2) in conjunction with release of the Ambler Road DEIS in order to solicit public comment from the potentially affected communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Coldfoot, Evansville, Kiana, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, Shungnak and Wiseman.

The determination that the requirements of the ANILCA Section 810(a)(3)(A), (B), and (C) have been met will be analyzed in the Final ANILCA Section 810 Evaluation. The Final Evaluation will integrate input voiced during the hearings by residents of potentially affected communities.

E. References

ABR, Inc. (ABR, Inc. – Environmental Research & Services, Inc.). 2007. SD F3: Revegetation Plan for the Red Dog Mine. Prepared for Teck Cominco Alaska Inc. Anchorage, Alaska. June 2007.

ABR, and SRB&A. 2014. Assessment of the Potential Effects of an Elevated Pipeline along the Red Dog Mine Haul Road on Caribou Distribution, Movements, and Crossing Success. Part One: Review of Literature and Expert Opinion. Prepared for Red Dog Operations. Anchorage, Alaska.

ADNR. 2018. Alaska Mining Claims Mapper. Available at: akmining.info/ Accessed March 15, 2018.

AIDEA. 2016. Standard Form 200 ROW Application. Form and associated narrative submitted to BLM and other federal agencies. June 20, 2016. On file with BLM Central Yukon Field Office.

Belisle, M., and C.C. St. Clair. 2001. Cumulative effects of barriers on the movements of forest birds. *Conservation Ecology* 5(2):9. Available at: www.researchgate.net/publication/262013684_Cumulative_Effects_of_Barriers_on_the_Movements_of_Forest_Birds

BLM. 2016. *Central Yukon Resource Management Plan, Analysis of Management Situation*. Prepared by the BLM Central Yukon Field Office, April 2016. Available at: eplanning.blm.gov/epl- front-office/projects/lup/35315/72940/80089/CYRMP_AMS_all_April_2016_Final.pdf

BLM. 2018. *Ambler Road Environmental Impact Statement Scoping Summary Report.* April 2018. Available at: eplanning.blm.gov/epl-front-office/projects/nepa/57323/143515/176591/20180430_Ambler_EIS_SSR.pdf

BLM. 2019. BLM-Alaska Special Status Plant and Animal Species List – 2019. Available at: www.blm.gov/program

Brinkman, T.J., W.D. Hansen, F. S. Chapin III, G. Kofinas, S. BurnSilver, T.S. Rupp. 2016. Arctic Communities Perceive Climate Impacts on Access as a Critical Challenge to Availability of Subsistence Resources. Climatic Change (2016) 139:413–427 DOI 10.1007/s10584-016-1819-6.

Brown, A.V., M.M. Lyttle, and K.B. Brown. 1998. Impacts of Gravel Mining on Gravel Bed Streams. Transactions of the American Fisheries Society 127:979-994, 1998.

Brown, R.J. 2009. *Distribution and Demographics of Whitefish Species in the Upper Koyukuk River Drainage, Alaska, with an Emphasis on Seasonal Migrations and Important Habitats of Broad Whitefish and Humpback Whitefish*. Alaska Fisheries Technical Report Number 104. August 2009. Fairbanks Fish and Wildlife Field Office. Fairbanks, Alaska.

Cardno. 2015. *Ambler Mining Region Economic Impact Analysis*. Prepared for AIDEA. Project Number E514004900. January 16, 2015. Available at: www.aidea.org/Portals/0/PDF%20Files/CARDNOAmblerEconomicImpactAnalysis.pdf

Eck, E. M. Norton, C. Kantner, S. Shindler, and P. Schaeffer. No Date. *Sheefish In The Northwest Arctic*. The Fish Themselves.

EPA. 2009. *Red Dog Mine Extension, Aqqaluk Project, Final Supplemental Environmental Impact Statement.* Prepared by Tetra Tech, Inc., October 2009.

Georgette, Susan, and Hannah Loon. 1993. Subsistence Use of Fish and Wildlife in Kotzebue, a Northwest Alaska Regional Center. Technical Paper No 167. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. Available at: www.subsistence.adfg.state.ak.us/TechPap/tp167.pdf

Grybeck, Donald. 1977. *Known Mineral Deposits of the Brooks Range, Alaska.* USGS Open-file report 77-166C. Available at: ftp.ambleraccess.org/Reports/Mineral_Studies/DOI-Geological-Survey-1977.pdf

Guettabi, M., J. Greenberg, J. Little, and K. Joly. 2016. *Evaluating Differences in Household Subsistence Harvest Patterns Between the Ambler Project and Non-project Zones.* Natural Resource Report NPS/GAAR/NRR-2016/1280. Available at: www.iser.uaa.alaska.edu/Publications/2016_08-EvaluatingDifferencesInHouseholdSubsistence.pdf

Hughes, R.M, F. Amezcua, D.M. Chambers, W.M. Daniel, J.S. Franks, W. Fanzin, D. MacDonald, E. Merriam, G. Neall, P. dos Santos Pompeu, L. Reynolds, L. Roulson, and C.A. Woody. 2016. Position paper and American Fisheries Society Statement on Mining and Fossil Fuel Extraction.

Joly, K., R.R. Jandt, C.R. Meyers, and M.J. Cole. 2007. Changes in vegetative cover on Western Arctic Herd winter range from 1981 to 2005: potential effects of grazing and climate change. *Rangifer*, Special Issue No. 17:199–207.

Kondolf, G.M., M. Smeltzer, and L. Kimball. 2002. Freshwater Gravel Mining and Dredging Issues – White Paper. Prepared for the Washington Department of Fish and Wildlife, Department of Ecology, and Department of Transportation. Published April 4, 2002. Available at: wdfw.wa.gov/publications/00056

Limpinsel, D. E., Eagleton, M. P., and Hanson, J. L., 2017. Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska. EFH 5 Year Review: 2010 through 2015. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/AKR-14, 229p.

NCASI (National Council for Air and Stream Improvement, Inc.). 2008. Fragmentation in the boreal forest and possible effects on terrestrial wildlife. Technical Bulletin No. 959. Research Triangle Park, N.C.: National Council for Air and Stream Improvement, Inc. Available at: www.ncasi.org/wp-content/uploads/2019/02/tb959.pdf

Neitlich, P.N., J.M. Ver Hoef, S.D. Berryman, A. Mines, L.H. Geiser, L.M Hasselbach, and A.E. Shiel. 2017. Trends in spatial patterns of heavy metal deposition on National Park Service lands along the Red Dog Mine haul road, Alaska, 2001–2006. PLOS One. 12(5): e0177936. Available at: doi.org/10.1371/journal.pone.0177936

SRB&A. 2009. Subsistence Use Areas and Traditional Knowledge Study for Kivalina and Noatak, Alaska: Red Dog Mine Extension Aqqaluk Project, Supplemental Baseline Report. Tetra Tech, Tech Alaska Inc., and U.S. Environmental Protection Agency. Anchorage, Alaska.

SRB&A. 2014. Assessment of the Potential Effects of an Elevated Pipeline Along the Red Dog Mine Haul Road on Caribou Distribution, Movements, and Crossing Success. Part Two: Traditional Knowledge Workshops, Kivalina and Noatak. Prepared for Abr, Inc. Anchorage, Alaska.

SRB&A. 2016. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 7 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A. 2017. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 8 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A. 2018. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 9 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A. Unpublished. Subsistence Mapping and Traditional Knowledge Studies. Surveys Conducted Between 2015 and 2017 in Association with the Alaska LNG Project Environmental Baseline Studies.

Sullender, B. 2017. Ecological Impacts of Road- and Aircraft-Based Access to Oil Infrastructure. Edited by Audubon Alaska.

Vistnes, Ingunn, and Christian Nellemann. 2007. The Matter of Spatial and Temporal Scales: A Review of Reindeer and Caribou Response to Human Activity. Vol. 31.

WAHWG. 2015. Draft 2015 Meeting Summary. December 16-17, 2015.

WAHWG. 2016. Draft 2016 Meeting Summary. December 14-15, 2016.

WAHWG, Western Arctic Caribou Herd Working Group. 2017. "Protecting the Migration through Safe Hunting." *Caribou Trails* Summer 2017 (17):3.

Watson, Annette. 2014. "Preliminary Traditional and Local Ecological Knowledge (Tek/Lek) Study of the Impacts by the Proposed Road to Ambler on the Communities of Allakaket and Alatna." Ph.D., College of Charleston.

Watson, Annette. 2018. *Ethnographic Overview and Assessment of Gates of the Arctic National Park and Preserve: Subsistence Land Use across the Kobuk Preserve*. Cultural Resource Report NPS/GAAR/CRR-2018/001. Fairbanks, Alaska: National Park Service Fairbanks Administrative Center.

Wilson, R. R., L. S. Parrett, K. Joly, and J. R. Dau. 2016. "Effects of Roads on Individual Caribou Movements During Migration." *Biological Conservation* 195:2-8.

Woody, C. A., R. M. Hughes, E. J. Wagner, T. P. Quinn, L. H. Roulson, L. M. Martin, and K. Griswold. 2010. The mining law of 1872: Change is overdue. *Fisheries* 7:321-331.

Name and Title **Date**

Appendix N

Project Design Features, Best Management Practices, and Potential Mitigation

This page is intentionally left blank.

Table of Contents

Attachment

Attachment A: BLM Mineral Materials Mining and Reclamation Plan Proposal Form

Acronyms

AAC	Alaska Administrative Code
ACEC	Area of Critical Environmental Concern
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AGL	above ground level
AIDEA	Alaska Industrial Development and Export Authority
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
AS	Alaska Statute
BLM	U.S. Bureau of Land Management
BMP	best management practice
CFR	Code of Federal Regulations
CRMP	Cultural Resources Management Plan
dBA	A-weighted decibels
District	Ambler Mining District
DOT&PF	Alaska Department of Transportation and Public Facilities
EDRR	Early Detection Rapid Response
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
GAAR	Gates of the Arctic National Park and Preserve
ISPMP	Invasive Species Prevention and Management Plan
MBTA	Migratory Bird Treaty Act
mph	mile per hour
NAD83	North American Datum of 1983
NAGPRA	Native American Graves Protection and Repatriation Act

NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NNIS	Non-native Invasive Species
NOA	naturally occurring asbestos
NPS	National Park Service
NTP	Notice to Proceed
PA	Programmatic Agreement
POD	Plan of Development
POL	Petroleum, Oils and Lubricants
ROD	Record of Decision
ROW	right-of-way
SPCCP	Spill Prevention Control and Countermeasure Plan
UAF	University of Alaska Fairbanks
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service

1. Introduction and General Provisions

This document is intended to present a holistic list of design features, best management practices (BMPs), and potential mitigation measures the U.S. Bureau of Land Management (BLM), and all regulatory agencies with jurisdiction, could require as part of their authorizations for the Ambler Road Project. The BLM may authorize portions of the project under separate permits, such as an authorization for the road right-of-way (ROW) and separate authorization for material extraction and sales. BLM has the authority only to enforce mitigation on BLM-managed lands. For purposes of the National Environmental Policy Act (NEPA) and this Environmental Impact Statement (EIS), this list is intended to be applicable to the range of activities the Alaska Industrial Development and Export Authority (AIDEA) has proposed. However, not every requirement listed would be applicable to every activity/permit. This appendix is generally organized in the same order as the EIS, with Section 1 providing general background and overall stipulations, Section 2 providing general stipulations related to design and construction features of any alternative, and Section 3 providing requirements applicable to specific resource categories addressed in the EIS.

The following are measures that have arisen from law, regulation, and plan policy; have been proposed by AIDEA or by other agencies; or have arisen as the BLM has worked through the analysis in the EIS. These are measures that appear likely to apply and are presented as listings for consideration. No decision will be made until the Record of Decision (ROD) is issued. Each agency may select measures such as these for inclusion in decisions related to their own jurisdictions. Measures may be added, dropped, or refined before the Final EIS and ROD based on public and agency comment and further project analysis. The list of measures includes:

1. **Design features proposed by AIDEA.** Items proposed by the applicant and assumed to be design features that would be implemented and applied throughout the length of the selected alternative. These are identified as a "design feature proposed by AIDEA." Primarily, these were proposed by AIDEA in their ROW application, but they may have been modified for clarity or enforceability during development of the EIS.

2. **Potential BLM Mitigation Measure or Standard Stipulations.** Other BLM standard permit stipulations that typically apply to such projects, measures proposed by other agencies, and specific measures that grew out of the impact analysis. These are identified as "Potential BLM Mitigation Measure." The BLM has the authority to enforce measures from this second group only on its own lands. Other landowners (e.g., State of Alaska, Alaska Native corporations, National Park Service [NPS]) and issuers of permits (e.g., U.S. Army Corps of Engineers, Alaska Department of Fish and Game [ADF&G]) would need to decide which of the measures would be required on other parts of the road.

1.1. General

1. **Potential BLM Mitigation Measure:** AIDEA would conduct all activities associated with the initiation, construction, operation, and termination of the grant within the authorized limits of the ROW area.

2. **Potential BLM Mitigation Measure:** Any activities on the Ambler Road ROW beyond those analyzed in the EIS and specified in the ROW grant must have prior written approval of the Authorized Officer.

3. **Potential BLM Mitigation Measure:** AIDEA would ensure that the facilities to be constructed, used, and operated would limit or prevent damage to scenic, esthetic, cultural, and environmental values (including damage to fish and wildlife habitat), damage to federal property, and hazards to public health and safety.

4. **Potential BLM Mitigation Measure:** If the Ambler Road ROW is no longer being used, AIDEA must notify the Authorized Officer in writing within 30 days of termination to initiate closure and reclamation.

5. **Potential BLM Mitigation Measure:** AIDEA would comply with all federal, state, and local laws and regulations applicable to the premise.

6. **Potential BLM Mitigation Measure:** AIDEA would ensure that the facilities to be constructed, used, and operated on the granted location are maintained and operated in a manner consistent with the grant.

7. **Potential BLM Mitigation Measure:** Except as specified in the grant, AIDEA would not disturb or destroy pipelines, fuel gas lines, roads, trails, work pads, survey monuments or ROW markers, cathodic protection devices, monitoring rods, drainage/erosion control structures, or any other facilities or properties existing on public lands. Any disturbance of these facilities or properties by AIDEA in the conduct or operations under this ROW would be reported to the Authorized Officer and would be restored to the satisfaction of the Authorized Officer

8. **Potential BLM Mitigation Measure:** Except for authorized road/traffic signs, no signs or advertising devices would be placed on the ROW or on adjacent public lands, except those posted by or at the direction of the Authorized Officer.

9. **Potential BLM Mitigation Measure:** AIDEA would comply with state standards for public health and safety, environmental protection and siting, construction, operation, and maintenance when those standards are more stringent than federal standards.

10. **Potential BLM Mitigation Measure:** AIDEA would not block or obstruct the ingress or egress along any permanent existing roads or trails, including perennial winter trails. See also Section 3.4.2, Transportation and Access.

11. **Potential BLM Mitigation Measure:** To ensure monument preservation and aid in the management of federal lands, the points where the road enters, on which the road is located, and where it leaves f federal interest lands would be documented. This would be accomplished by locating and measuring to the nearest monuments on either side of the as-built centerline of the road. When on federal lands, if the road centerline falls within 1,320 feet of an existing monument, its position would also be measured and its relationship shown relative to the centerline. These steps would ensure both objectives and monument preservation and would assist in the federal land manager's ability to identify where the road is on federal lands.

12. **Potential BLM Mitigation Measure:** AIDEA would conduct an environmental briefing with all employees, contractors, and subcontractors so they are familiar with the stipulations. A copy of the stipulations would be posted in a conspicuous place in any crew quarters and office associated with road operations (e.g., gatehouses, offices at maintenance camps).

13. **Potential BLM Mitigation Measure:** AIDEA would develop and provide safety and environmental briefings/trainings for all field personnel, including contractors and subcontractors, and their employees, and for all drivers of the Ambler Road. The briefings/trainings would communicate, at a

minimum, grant and environmental permit requirements. AIDEA would maintain records of participant names and dates of these briefings.

14. **Potential BLM Mitigation Measure:** AIDEA would ensure that copies of project stipulations, and all other applicable permits from other state or federal agencies, are available for reference by the road construction and maintenance operators and drivers on the road, and that such materials are available for review by the BLM at any time. AIDEA would maintain records demonstrating that each person working on the project acknowledged training regarding the stipulations and receipt of a stipulations summary.

15. **Potential BLM Mitigation Measure:** AIDEA would develop and submit a monitoring plan for approval by the Authorized Officer. It would be designed to demonstrate compliance with the approved plan of operations and other federal and state environmental laws and regulations, provide early detection of potential problems, and supply information that would assist in directing corrective actions should they become necessary. Examples of monitoring programs that may be relevant include water quality, air quality (dust control), slope stability, revegetation progress (during reclamation), noise levels, and wildlife mortality. Monitoring plans may incorporate existing state and federal monitoring requirements to avoid duplication. However, the submitted monitoring plan needs to include copies of and clearly reference these other plans.

16. **Potential BLM Mitigation Measure:** AIDEA would ensure that copies of all relevant monitoring plan records are available on-site for review by the BLM at any time personnel are working on-site.

17. **Potential BLM Mitigation Measure:** AIDEA activities in connection with the grant would not violate applicable air and water quality standards or related facility siting standards established by or pursuant to applicable federal or state laws.

1.2. Reporting Requirements

1. **Potential BLM Mitigation Measure:** Signatures from all employees, contractors, and subcontractors would be obtained indicating that they have been informed of the stipulations in the environmental briefing or road training. A copy of these signatures must be faxed (907-474-2282) or emailed to the Authorized Officer within 1 week of initiation of work. Any new employees, contractors, or subcontractors hired after the initial briefing would be subject to the same process, briefing, signature, and submittal to the Authorized Officer within 1 day of work.

2. **Potential BLM Mitigation Measure:** AIDEA would submit documentation of consultation with affected subsistence communities to the BLM within 90 days of approving 90 percent road design at each phase of construction and annually by the end of the calendar year for 2 years following completion of construction of each phase, and at minimum every 5 years thereafter for the life of the project. Reporting would include a list of issues raised during consultation and results of road use monitoring.

3. **Potential BLM Mitigation Measure:** AIDEA would monitor road use and keep records of numbers of vehicles by vehicle class and trip purpose. AIDEA would include in its monitoring and record keeping any unauthorized use of the road.

4. **Potential BLM Mitigation Measure:** AIDEA would provide the BLM with as-built drawings of the road within 90 days of completion of each construction phase. Data would be in the form of an ESRI shape file(s) referencing the North American Datum of 1983 (NAD83).

1.3. General Responsibilities and Plan of Development

1. **Potential BLM Mitigation Measure:** AIDEA would refine, based on the NEPA analysis, the Plan of Development (POD) provided with the Standard Form 299 (SF299) ROW grant application, and the POD would be reviewed and approved by the BLM and made part of the ROW grant to AIDEA. AIDEA would construct, operate, and maintain the Ambler Road and Related Facilities within the ROW in strict conformity with the POD. Any relocation, additional construction, or use that is not in accord with the approved plans would not be initiated without the prior written approval of the Authorized Officer.

2. **Potential BLM Mitigation Measure:** ADIEA's proposed design features, industry BMPs, and BLM adopted mitigation measures listed in the BLM ROD for the Ambler Road Final EIS would be incorporated by reference into the AIDEA's POD and compliance program. Selected design features, BMPs, and mitigation measures would be refined and clarified in the pending subsequent ROW grant stipulations.

1.4. General Completion of Use (Restoration/Reclamation)

See also Section 3.3.1, Vegetation and Wetlands.

1. **Potential BLM Mitigation Measure:** Upon completion of use of all, or a very substantial part, of the ROW, AIDEA would promptly remove all improvements and equipment, except as otherwise approved by the Authorized Officer, and would restore the ROW to a condition that is approved in writing by the Authorized Officer or, at the option of AIDEA, pay the cost of removal and restoration.

2. **Potential BLM Mitigation Measure:** AIDEA would submit a final summary report to the Authorized Officer within 30 days of completion or cessation of operations. This report would include:

    a. Written statement of program completion with completion date.
    b. Summary of incidents and accidents that includes location, date, nature of incident or accident, whether any administrative or enforcement action was initiated, actions taken by AIDEA in response, and status of response completion. At a minimum, the types of incidents and accidents must include fuel, oil, or hazardous material spills; overturned vehicles or equipment; incidents that resulted in exceeding state water quality standards; incidents that altered stream banks, resulting in the stream leaving its normal channel (i.e., stream blowouts); wildlife injuries or fatalities; and fish kills.
    c. A comprehensive map showing locations of camp locations and dates utilized, fuel storage locations and dates utilized, routes used for off-highway fuel hauls and dates utilized, storage locations for any hazardous materials with dates utilized, and types of materials.

2. Alternatives

This section presents general requirements related to construction of any alternative. Specific design and construction measures are also listed in Section 3, Affected Environment and Environmental Consequences, for protection of individual resources.

1. **Potential BLM Mitigation Measure:** Before BLM would issue a Notice to Proceed (NTP) for a construction segment or project, AIDEA would, in a manner acceptable to the Authorized Officer,

locate and clearly mark on the ground the exterior boundaries of the ROW and the location of all related facilities proposed to be constructed as part of that specific construction segment or project.

2. **Potential BLM Mitigation Measure:** AIDEA would furnish a bond, acceptable to the Authorized Officer, prior to commencement of construction activities at a date acceptable to the Authorized Officer. The Authorized Officer would determine the amount of this bond. This bond must be maintained in effect until the Authorized Officer accepts removal of improvements and restoration of the ROW. AIDEA agrees that all monies deposited with the Authorized Officer as security for AIDEA's performance of the terms and conditions of this ROW grant may, upon failure on AIDEA's part to fulfill any of the requirements herein set forth or made a part hereof, be retained by the United States to be applied as far as may be needed to the satisfaction of AIDEA’s obligations assumed hereunder, without prejudice whatsoever to any other rights and remedies of the United States.
3. **Potential BLM Mitigation Measure:** AIDEA would submit a plan for use of explosives on federal land, including but not limited to blasting techniques, to the Authorized Officer.
4. **Potential BLM Mitigation Measure:** All construction and operations activities would be conducted with due regard for good resource management and in such a manner as not to block any stream or drainage system; change the character or course of a stream; cause the pollution of any stream, lake, wetland, or land area; or cause pollution of the air.
5. **Potential BLM Mitigation Measure:** During construction phases, vehicles would not be operated more than 10 feet outside the cut-fill construction footprint and not outside the limits of planned temporary maintenance camps and construction work areas specified in construction plans. During operations, vehicles would not be operated off the standard operating surfaces: road surface, open material sites needed for operations, communications sites, maintenance stations, and airstrips. There is an exception for specific road maintenance tasks that require work on the road embankment slopes, but no vehicles would be operated outside the project footprint without written permission of the Authorized Officer.

3. Affected Environment and Environmental Consequences

3.1. Introduction

This section reflects the Affected Environment and Environmental Consequences chapter of the EIS and presents mitigation measures and design features in the same order the topics are addressed in the EIS. Note that there is substantial crossover between some sections, such as water, wetlands, and soils/erosion control. Cross references are provided where possible.

3.2. Physical Environment

3.2.1 Geology and Soils

1. **Design feature proposed by AIDEA:** Geotechnical field studies and detailed thermal modeling would be completed, and specific measures to be incorporated in specific areas would be identified during final design after the alignment has received approval from the appropriate federal and state agencies to control permafrost thawing. Design features related to this mitigation would be

determined during the design/permitting phase and would be incorporated into ROW authorization and the permit.

2. **Design feature proposed by AIDEA:** Cut slopes exposing ice-rich permafrost are particularly susceptible to erosion and would be stabilized using a mat of riprap or porous, granular material placed on a geotextile fabric. The porous rock material and geotextile fabric would be used to cover the exposed ice-rich soils and would extend to the toe of the embankment slope, allowing water to flow through the subsurface soils beneath the roadway embankment. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

3. **Design feature proposed by AIDEA:** Embankment thicknesses would be increased where permafrost is likely, and cut sections would be avoided to the greatest extent practical to minimize permafrost exposure. Since permafrost degradation typically begins at the toe of the fill slope and spreads under the embankment, fill slopes should be ideally as flat as possible (constructing benched berms alongside the embankment is a common approach). During Phases 1 and 2, fill slopes at culverts would be flattened to provide sufficient burial cover over the culverts to protect the pipes. The flatter fill slopes and more gradual transition from the roadway embankment to existing ground would also help reduce permafrost degradation at the stream crossings. Flattening the fill slopes would be weighed against the increased footprint of the roadway. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

4. **Design feature proposed by AIDEA:** Provisions for reducing permafrost degradation would be included in project design. Potential methods for addressing permafrost concerns include embankment insulation, air convention embankment, thermosyphons, sunsheds, snowsheds, or air ducts. For example, 6 inches of rigid insulation board could be installed under culvert bedding material for increased insulation. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

5. **Design feature proposed by AIDEA:** Snow would be plowed off the road shoulders and embankment slopes to facilitate dissipation of heat out of the roadway embankment and reduce the likelihood of permafrost degradation. The operations and maintenance BMPs covering snow plowing would be incorporated into the stipulations of the ROW authorization and carried through into AIDEA's contract requirements for any road operator hired by AIDEA.

6. **Potential BLM Mitigation Measure:** Each installation of artificial erosion control media would remain in place and be inspected and maintained weekly during the growing season until sufficient vegetation is established to achieve natural erosion control.

7. **Design feature proposed by AIDEA:** Additional soil stability and erosion measures, such as riprap armoring and installation of erosion control matting, would be incorporated in the design where conditions suggest erosion may be an issue. Geotextile fabric would be placed beneath the riprap as appropriate to prevent migration of fines out of the underlying soils into surface water flows. Design features related to this mitigation would be determined during the design/permitting phase and incorporated into permit stipulations.

8. **Potential BLM Mitigation Measure:** AIDEA would make provisions for permafrost monitoring and proactive maintenance as necessary, following construction, where permafrost thawing and fill

subsistence appear to be a risk. This applies to all project components, including fill for the main road, spur roads to materials sites, landing strips, and building pads.

9. **Potential BLM Mitigation Measure:** Geotechnical investigations would include corrosion testing to identify areas of potential acid rock drainage and avoid and minimize cuts to these areas. Sampling and testing procedures for NOA are identified under Section 3.2.7, Air Quality and Climate.

3.2.2 Sand and Gravel Resources

The majority of the proposed mitigation in this section applies to operation of mineral material sites (i.e., gravel pits). However, some apply to placement and management of mineral materials for road and ancillary facility construction and operation.

1. **Potential BLM Mitigation Measure:** Gravel and other construction materials would not be taken from streambeds, riverbeds, active floodplains, lakeshores, or outlet of lakes unless the taking is approved by the Authorized Officer.

2. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would provide a detailed mineral materials (e.g., gravel) mining and reclamation plan to BLM for approval at least 90 days prior to beginning any mining operations. The mining and reclamation plan would address all applicable items in the attached Mineral Materials Mining and Reclamation Plan Proposal form (Attachment A).

3. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would notify BLM at the beginning and end of active mining operations.

4. **Potential BLM Mitigation Measure:** Excavated materials would not be stockpiled in rivers, streams, 100-year floodplains, or wetlands unless approved by the Authorized Officer.

5. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that the site is developed sequentially in cells. A disturbed cell would be reclaimed prior to opening a new area. Exceptions to allow for thawing of permafrost may be granted at the discretion of the Authorized Officer

6. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that a 100-foot undisturbed buffer is maintained along any lakes or creeks that flow through upland material mining pits. Any approved access roads that bisect the buffer area would be rehabilitated at the close of mining by revegetating the crossing with plant species and densities similar to those in the undisturbed buffer for at least 100 feet from the bank-full elevation. Access roads in buffers originally void of vegetation would be scarified to a minimum depth of 8 inches during final reclamation.

7. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that buffer zones are not disturbed, except by designated crossings. Operation of equipment, placement of overburden or mined material, or storage/placement of any equipment and supplies would not be allowed in any buffer zones identified in the mining and reclamation plan, specified in the Decision Record for this authorization, or required in these stipulations.

8. **BLM Standard Stipulation for Mineral Material Mining:** Unless separately authorized, AIDEA would ensure that no material site is used for storage of materials and supplies not related to production of mineral from that site. Unless separately authorized AIDEA would ensure that mineral materials sites are not used for secondary or value-added production processes not related to production of mineral materials.

9. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that no minerals originating outside the permit area are imported to the permit area, except as may be authorized in approved project plans.

10. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that overburden, topsoil, and vegetation are stockpiled separately in a manner that prevents loss through erosion, preserves them for use in reclamation, and does not impede access to usable mineral materials.

11. **BLM Standard Stipulation for Mineral Material Mining::** AIDEA would ensure that work pit sides are sloped to prevent erosion and provide for the safety of humans and animals. Slopes along pit sides and inactive faces would be no greater than 3:1 (horizontal:vertical).

12. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that site stabilization measures and measures to control erosion, sedimentation, and storm water are maintained in proper working order throughout the term of the authorization, including during periods of temporary closure or inactivity.

13. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that BMPs for dust abatement (e.g., graveling, watering) are utilized when deemed necessary by AIDEA, their contractor, or subcontractor, or when directed by a BLM representative.

14. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would meet with BLM staff at the end of the life cycle of the material site mine, prior to final reclamation, to define final configuration of the mine.

15. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that reclamation is conducted in accordance with the approved reclamation plan. Deviations or modifications to the approved reclamation plan must be approved in writing by the Authorized Officer prior to execution.

3.2.3 Hazardous Waste

1. **Potential BLM Mitigation Measure:** AIDEA or its designee would prepare and implement a comprehensive waste management plan. This plan would be drafted in consultation with federal, state, and borough agencies as appropriate, and would be submitted to the Authorized Officer for approval. Management decisions affecting waste generation would be addressed in the following order of priority: (1) prevention and reduction, (2) recycling, (3) treatment, and (4) disposal. The plan would include:

    a. Precautions taken to avoid attracting wildlife to food and garbage, including use of bear-resistant containers for all waste materials and classes.
    b. Protocols for the incineration, backhaul, or composting of all putrescible waste in a manner approved by the Authorized Officer; burial of waste is not permitted. All solid waste, including incinerator ash, would be disposed of in an approved waste-disposal facility in accordance with U.S. Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC) regulations and procedures.
    c. Procedures for the disposal of wastewater and domestic wastewater. The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by a National Pollutant Discharge Elimination System or state permit.

2. **Potential BLM Mitigation Measure:** Construction camps and permanent facilities for maintenance and operations would meet ADEC standards for handling and disposal of solid waste, human waste,

gray water, and kitchen sanitation. ADEC approved plans would be provided to the Authorized Officer.

3. **Potential BLM Mitigation Measure:** AIDEA would remove all waste generated by road activities, and dispose of waste according to applicable local, state, and federal laws. Prompt removal of discarded or unneeded material, equipment, and debris is required.

4. **Potential BLM Mitigation Measure:** Temporary construction camps, permanent maintenance and operations stations, and all facilities would be maintained in a sanitary manner. Solid waste would be collected in bear-proof containers until hauled away for proper disposal.

5. **Potential BLM Mitigation Measure:** AIDEA would transport, store, transfer, and dispose of hazardous waste, hazardous materials, and hazardous material containers in a way that meets legal requirements and prevents release to the environment.

6. **Potential BLM Mitigation Measure:** Hazardous material containment liner material would be compatible with the stored product and capable of remaining impermeable during typical weather extremes expected throughout the storage period.

7. **BLM Standard Stipulation for Mineral Material Mining:** AIDEA would ensure that all solid waste and garbage, including incinerated ash, is removed from public lands and disposed of in an ADEC-approved waste disposal facility. No solid waste is to remain on site for more than 90 days.

8. **Potential BLM Mitigation Measure:** AIDEA would ensure that portable toilets are used for human waste disposal, and are regularly maintained anywhere construction or maintenance activity is concentrated, such as at material sites. The disposal of human waste is not authorized on public land.

Spill Prevention and Response

1. **Potential BLM Mitigation Measure:** For construction phases, including material site operation, and for operations and maintenance of the road, a Spill Prevention Control and Countermeasure Plan (SPCCP) would be written. The plan would be submitted to the Authorized Officer prior to the storage of petroleum products greater than 1,320 gallons. AIDEA would follow the approved plan and update it as necessary throughout the term of Road Activities.

2. **Design feature proposed by AIDEA:** Sufficient oil-spill-cleanup materials (e.g., absorbents, containment devices) would be carried by field crews on all project maintenance and security vehicles.

3. **Potential BLM Mitigation Measure:** All spills would be contained and cleaned up as soon as the release has been identified. Appropriate spill response equipment and supplies must be on hand when hazardous materials are used. Field crews must have access to these materials and they must be available at each refueling point. The release of Petroleum, Oils, and Lubricants (POLs) or hazardous substances other than POLs to any water body is to be reported to ADEC as soon as the person has knowledge of the release. All other releases would be reported in accordance with ADEC spill reporting guidelines (in Fairbanks 907-457-2121, or 1-800-478-9300 outside normal business hours).

4. **Potential BLM Mitigation Measure:** Notice of any reportable spill (as required by 40 CFR 300.125 and 18 Alaska Administrative Code [AAC] 75.300) would be given to the Authorized Officer as soon as possible, but no later than 24 hours after occurrence.

5. **Potential BLM Mitigation Measure:** ADEC-approved oil spill cleanup materials (absorbents) would be carried by trucks transporting fuel or hazardous fluids on the road and would be available at

all fueling points. The absorbents would be appropriate to the hazardous substances that are used throughout the project.

6. **Potential BLM Mitigation Measure:** AIDEA agrees to indemnify the United States against any liability arising from the release of any hazardous substance or hazardous waste (as these terms are defined in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S. Code [USC] 9601, et. seq. or the Resource Conservation and Recovery Act, 42 USC 6901, et. seq.) on the authorization (unless the release or threatened release is wholly unrelated to the authorization permittee/AIDEA/permittee's activity on the authorization). This agreement applies without regard to whether a release is caused by AIDEA, its agent, or an unrelated third party.

7. **Potential BLM Mitigation Measure:** During construction and operation, "duck ponds" would be placed beneath all parked vehicles at all times. An over pack drum with fuel spill kits would be kept on site wherever equipment is working.

8. **Potential BLM Mitigation Measure:** AIDEA would ensure that all spill containment devices, including "duck ponds," liners, and vehicle drip pans, are maintained in good working condition at all times. Spill containment devices that are punctured, torn, or worn beyond serviceability would be replaced within 24 hours of discovery of the unserviceable condition.

9. **Potential BLM Mitigation Measure:** Equipment that has been identified as having fluid leaks would have a drip basin under the leak area to ensure no release to the surrounding environment occurs.

Fuel Handling and Storage

1. **Potential BLM Mitigation Measure:** Transportation and storage of hazardous materials would be handled in a manner to minimize the potential impacts to the environment and human health.

2. **Potential BLM Mitigation Measure:** AIDEA would ensure that all hazardous materials containers, including POL containers, are stored within secondary containment.

    a. Double-walled tanks would meet secondary containment requirements.
    b. When containment other than double-walled tanks is used, the containment area would be lined with an impermeable liner composed of material compatible with the substance(s) to be contained. The liner would be free of cracks or gaps and sufficiently impervious to contain leaks or spills.
    c. If the containment is completely under cover of a roof, then the containment volume must be large enough to contain the capacity of the largest container stored within.
    d. If the containment is not completely under cover of a roof, then the containment volume must be large enough to contain the capacity of the largest container stored, plus water from a 5-year, 24-hour storm event. The amount of precipitation from a 5-year, 24-hour storm event for a given location can be found at hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_ak.html.

3. **Potential BLM Mitigation Measure:** Transfer of POLS to equipment would be completed in a secure manner to minimize the possibility of contamination of the surrounding environment. At a minimum, secondary containment would be placed under the location to catch overflow and assist the operator in containing a spill, if one occurs.

4. **Potential BLM Mitigation Measure:** Any equipment needing repair that can be moved would be repaired at a designated maintenance station. Equipment repair that has the potential to release fluids would be completed over an impermeable liner to ensure fluid migration to the environment does not occur.

5. **Potential BLM Mitigation Measure:** Containers with a total capacity larger than 55 gallons that contain fuel or hazardous substances would not be stored within 100 feet of a water body.

6. **BLM Land Use Plan requirement:** No fuel storage or refueling of equipment would be allowed within the 100-year floodplain of a river or lake.

7. **BLM Land Use Plan requirement:** Fuel barrels and tanks, propane tanks, and all other hazardous substance storage containers must be labeled with the following information: AIDEA name, contents of the container (name of the product put in the container, if not in the original container from the manufacturer), and date the product was purchased/put in the container (e.g., Smith [UAF], Gasoline, September 2008). Fuel handling would be in compliance with all state and federal regulations.

3.2.4 Paleontological Resources

1. **Potential BLM Mitigation Measure:** AIDEA would develop a plan addressing inadvertent discovery of paleontological resources as part of its Plan of Development, to be submitted for approval.

3.2.5 Water Resources

See also related stipulations under Sections 3.2.1, Geology and Soils (permafrost); 3.2.3, Hazardous Waste; 3.3.1, Vegetation and Wetlands; and 3.3.2, Fish and Amphibians.

Water – General

1. **Potential BLM Mitigation Measure:** AIDEA would obtain an individual permit from the appropriate office of the U.S. Army Corps of Engineers and provide the Authorized Officer with a copy of the same. Failure to comply with this requirement would be cause for suspension or termination of the ROW authorization.

2. **Design feature proposed by AIDEA:** Project design features that mitigate impacts to permafrost and hydrology would be incorporated based on geologic and hydrologic studies to freely convey surface water across the road surface and minimize impacts on groundwater flows. Design features related to this mitigation would be refined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations. See also Section 3.2.1, Geology and Soils, for further information about permafrost soils.

3. **Design feature proposed by AIDEA:** The planned construction of the road would use fill techniques with minimal cutting of native soils to the maximum extent practical. Cut areas would be examined further during future design phases to evaluate the risk of intercepting groundwater flows. High-risk areas would be mitigated by adjusting the roadway profile to reduce or eliminate the required cut or by incorporating appropriate drainage measures to collect and convey the exposed water. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

4. **Design feature proposed by AIDEA:** Bridges and culverts would be installed at all identified drainage crossings, including rills and ephemeral channels, to maintain hydrologic connectivity, minimize changes to watershed basin areas, and reduce the likelihood of water impoundment degrading permafrost. An adequate number of culverts and/or bridges would be installed to maintain hydrologic continuity and existing drainage patterns within wetland complexes, ephemeral channels, and perennial stream channels. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

5. **Design feature proposed by AIDEA:** The collection of upstream runoff in ditches would be minimized to reduce the effects of diverting surface waters to adjacent drainage ways, maintain existing flow patterns and quantities, and reduce the potential for permafrost degradation. Roadside ditches would only be used in limited cut areas where permafrost presence is unlikely. The elevated (fill) aspect of the road is expected to avoid impacts to shallow groundwater sources; if there are site-specific concerns about damming shallow groundwater or wetting of the embankment, coarse materials would be placed at the lowest levels of the embankment to facilitate groundwater movement across the system (see also Section 3.2.1, Geology and Soils). Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

6. **Design feature proposed by AIDEA:** Culverts and bridges would be sized to adequately span (at a minimum) the bank full width of the natural channel to minimize changes to stream flow velocities during base and flood flows and to maintain natural channel functions, such as sediment/debris transport and wildlife passage. Stream banks would be stabilized at road crossings to minimize the potential for erosion and downstream sedimentation. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

7. **Design feature proposed by AIDEA:** All culverts determined by resource agencies as necessary to maintain hydrologic connectivity during full build-out of the project (Phase 3) would be installed during construction of Phase 1. Length of culverts installed during Phase 1 would be as needed for Phase 2. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

8. **Design feature proposed by AIDEA:** Design techniques would be employed during design phases to facilitate shallow groundwater flow beneath the road embankment. Installation of multiple culverts in parallel, t a subsurface layer of porous, rocky substrate, and subsurface drains/pipe are potential options. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

9. **Potential BLM Mitigation Measure:** All crossings would be based on site-specific information, such as fish species presence, seasonal in-stream flows and peak discharge, and floodplain regime (50- to 100-year flood events). See also Section 3.3.2, Fish and Amphibians, regarding fish passage culverts.

10. **Potential BLM Mitigation Measure:** Mobile ground equipment would not be operated in or on lakes, streams, or rivers on BLM-managed land except when ice thickness is adequate to support the equipment without altering the stream bed or displacing water outside the stream channel, unless specifically approved by the Authorized Officer.

11. **Potential BLM Mitigation Measure:** Following completion of use of ice bridges at stream crossings, and before breakup occurs, AIDEA would breach or weaken ice bridges constructed during road construction and maintenance activities.

12. **Design feature proposed by AIDEA:** Riprap would be placed around the culvert ends at all phases of construction to protect and stabilize the slope of the embankment, reducing erosion of embankment material and minimizing the risk of embankment failure at the crossing during flood events. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

13. **Potential BLM Mitigation Measure:** AIDEA would ensure that the temperature of natural surface water or groundwater would not be changed by the Ambler Road or by any Ambler Road activities to affect the natural surface water or groundwater, unless approved by the Authorized Officer.

14. **Potential BLM Mitigation Measure:** To comply with Executive Order 11988, and Department Manual 520, disturbance in floodplains would be avoided where practicable. When avoidance is not practicable, floodplain disturbance would be minimized and floodplain function restored to the extent practicable.

    a. New road construction within 100-year floodplains would be avoided unless no practicable alternative exists. Where new road construction is undertaken in the 100-year floodplain, AIDEA would provide written documentation to the BLM of the alternative locations considered and rationale for why the alternatives are not practicable.
    b. Roads through floodplains would cross riparian areas perpendicular to the main channel to the extent practicable.
    c. Throughout the ROW, structural and vegetative treatments in riparian areas would contribute to the maintenance or restoration of proper functioning condition.
    d. When riparian vegetation is cleared, riparian vegetation diversity and density would be re-established to the extent practicable.

15. **Design feature proposed by AIDEA:** Design and construction of large bridges would employ measures to minimize effects on water flow and fish migration. Specific design features related to this mitigation would be determined during the design/permitting phase, and would include measures such as:

    a. Use of clean temporary diversion structures (e.g., Super Sack containers).
    b. Working in low-water conditions when the need for diversion and dewatering requirements are lessened.
    c. Minimizing use of riprap by exploring bioengineering alternatives for bank protection and stabilization.
    d. Placing pilings to allow for unimpeded river traffic.
    e. Restricting in-water construction during critical migration and spawning movements.

Water Quality

1. **Design feature proposed by AIDEA:** A stormwater pollution prevention plan would be developed for construction and would identify BMPs to be implemented to reduce the potential for water quality impacts. BMPs also would be incorporated for road operation and maintenance activities to minimize potential impacts on water quality. Measures would include barriers to capture and filter stormwater at construction area boundaries, stabilization of disturbed areas as quickly as feasible, designation of specific areas for fueling, and maintaining equipment to reduce the potential for unintentional releases. The operating and maintenance BMPs would be incorporated into the stipulations of the ROW permit and carried through into AIDEA's contract requirements of any road operator hired by AIDEA.

2. **Potential BLM Mitigation Measure:** The applicant would employ BMPs for storm water, sediment, and erosion control per the Alaska Storm Water Guide (dec.alaska.gov/water/wnpspc/stormwater/Guidance.html), with particular attention to considerations for linear projects. Failure to employ relevant BMPs would constitute a violation of the ROW authorization stipulations and may be grounds for an immediate suspension of operations.

3. **Design feature proposed by AIDEA:** Trucks hauling concentrate from the Ambler Mining District (District) to the Dalton Highway would be required to use covered, sealed containers to prevent ore concentrate from escaping the haul trucks and minimize the potential for impacts on streams from concentrate transport. The operating requirement would be incorporated into the stipulations of the ROW permit and carried through into AIDEA's permit requirements of any road user.

4. **Design feature proposed by AIDEA:** A spill prevention and response plan would be developed to guide construction and operation activities. The plan would identify measures to reduce the potential for fuel spills, locations of spill response materials, and training of construction and maintenance staff on spill response. AIDEA would also develop a concentrate recovery plan similar to that developed at the Red Dog Mine to address concentrate spills. Details of the plans would be incorporated into the stipulations of the ROW permit and carried through into AIDEA's contract requirements of any road operator hired by AIDEA.

5. **Potential BLM Mitigation Measure:** Snow ramps or snow bridges and ice thickening used during construction at watercourse crossings would be substantially free of soil and/or debris. The ramps and/or bridges would be breached upon completion of the winter construction season before spring snowmelt begins.

Floodplains

1. **Design feature proposed by AIDEA:** All bridges would be designed to adequately convey at a minimum the 100-year peak flood without damage to the roadway embankment or adjacent channel reaches. Scour characteristics of rivers at bridge crossings would be evaluated to minimize long-term risk to bridge abutments and piers. Culverts would be designed to convey at a minimum the 50- or 100-year peak flood depending on site characteristics and perceived risk, as determined on a case-by-case basis. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

2. **Design feature proposed by AIDEA:** During design, culvert widths and bridge spans would be increased as needed, and/or overflow culverts would be installed to improve floodplain connectivity and accommodate stream characteristics to reduce the likelihood of damming or erosion. Overflow culverts, typically set at higher elevations relative to the primary culvert, would be considered at stream crossings where aufeis formation is probable. The overflow culverts would greatly improve the ability to keep water flowing across the roadway and prevent erosion and damming should flow through the primary culvert become impeded or blocked by ice. Overflow culverts also would be considered at stream crossings where there is a high likelihood of large woody debris (e.g., fallen trees) blocking culverts, based on the prevalence of timbered banks and active stream erosion upstream of the crossing. Overflow culverts also would be considered at broad, active floodplains, especially where the main stream channel is poorly defined, to better accommodate hydrologic connectivity across the floodplain. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into ROW authorization and permit stipulations.

3.2.6 Acoustical Environment (Noise)

1. **Potential BLM Mitigation Measure:** Methods for reducing the truck traffic noise along the road would be employed. As part of the plan of development, AIDEA would provide a Noise Management Plan subject to land manager approval.

2. **Design feature proposed by AIDEA:** During construction, AIDEA has proposed requiring contractors to use the following techniques to reduce construction noise:

a. Place stationary noise sources away from noise-sensitive locations.
b. Turn idling equipment off.
c. Drive equipment forward instead of backward, lift instead of drag materials, and avoid scraping or banging activities.
d. Use quieter equipment with properly sized and maintained mufflers, engine intake silencers, less obtrusive backup alarms (e.g., manually adjustable, self-adjusting, or broadband sound alarms instead of traditional “beep-beep-beep” alarms), engine enclosures, or noise blankets.
e. Purchase and use new equipment rather than using older equipment. New equipment tends to be quieter than older equipment due to new technology, improvements in mechanical efficiency, improved casing and enclosures, and other innovations.

3. **Potential BLM Mitigation Measure:** AIDEA would work with land managers to develop stipulations that would be required of construction contracts for the project. Noise reduction features related to this mitigation would be determined during the design/permitting phase, incorporated into ROW authorization and permit stipulations, and incorporated into construction contracts.

3.2.7 Air Quality and Climate

1. **Design feature proposed by AIDEA:** Dust palliatives would be applied to the gravel road to reduce the potential for dust. The University of Alaska Fairbanks (UAF) Alaska University Transportation Center has been studying dust palliatives for several years, and this project would incorporate the latest technologies for dust minimization and mitigation based on UAF studies. Details of the plans would be incorporated into the stipulations of the ROW permit and carried through into AIDEA's contract requirements of any road operator hired by AIDEA.

2. **Design feature proposed by AIDEA:** Construction emissions would be minimized through use of standard BMPs related to dust suppression, equipment maintenance, and other factors.

3. **Design feature proposed by AIDEA:** The use of naturally occurring asbestos (NOA) materials as construction materials would be avoided unless no other suitable materials are available. In the event NOA materials are the only feasible option for road construction, AIDEA would comply with the Alaska Department of Transportation and Public Facilities’ (DOT&PF’s) Interim Guidance and Standards for Naturally Occurring Asbestos (NOA) Material Use, July 17, 2012. AIDEA would be required to provide to the BLM and DOT&PF a Site Specific Plan, including a Sampling and Analysis Plan, an Asbestos Compliance Plan, Dust Control Plan, and an Operations and Maintenance Plan, along with plans, specifications, materials quantity estimates, and description of the project. (Compliance would provide the immunity provided by House Bill 258, signed into Alaska law in 2012.)
4. **Potential BLM Mitigation Measure:** In connection with the Ambler Road, AIDEA would use and operate all facilities and devices to avoid or minimize air pollution and ice fog, as required by ADEC.

5. **Potential BLM Mitigation Measure:** Naturally Occurring Asbestos:

   a) AIDEA would sample for NOA any native material (e.g., gravels) located in surficial deposits or in areas noted as having a “high” or “medium” potential to contain asbestos, if materials may be moved or used for construction of any project components. Investigations of asbestos content of soils, rocks, and gravel would include both analysis that does not involve grinding/milling of the soils, such as the ASTM 7521 method, and a milling sample preparation technique, such as the draft CARB 435 method. The highest concentration found for each type of analysis would be used as the “result” for that sample.

b) Where "cut and fill" techniques are used on materials located in surficial deposits or areas noted as having a "high" or "medium" potential to contain asbestos that have not been tested to determine their asbestos content, and when there is not sufficient time to test those materials for asbestos, AIDEA would ensure that all construction activities assume that those materials contain more than 0.25 percent asbestos, and would take all required precautions as noted above under a).

c) Unless the Authorized Officer grants an exception for good cause, AIDEA would ensure no use of NOA materials with more than 0.25 percent asbestos within 6 inches of the road surface, within 4 inches of embankment slope surfaces, within 12 inches of embankment ramps (for allowed road crossings for summer or winter cross-country travel routes or trails used for local travel), or anywhere in the roadbed within 4 feet of any culvert installation.

d) During construction, AIDEA would ensure that contractors clearly document where NOA materials (either materials greater than, or less than 0.25 percent asbestos) are placed, either in subgrade or in capping materials. If any materials with more than 0.25 percent asbestos are used in capping materials (exposed road bed), signs along the side of the road would be placed to alert travelers of its presence.

6. **Potential BLM Mitigation Measure:** All vehicles and equipment that burn diesel fuels must use ultra-low sulfur diesel as defined by the ADEC Division of Air Quality.

3.3. Biological Resources

3.3.1 Vegetation and Wetlands

See also Section 3.2.1, Geology and Soils, for erosion control measures.

Vegetation – General

1. **Potential BLM Mitigation Measure:** AIDEA would conduct baseline surveys to identify non-native invasive, as well as rare plants, prior to construction to avoid impacts to rare plants species. If a non-native invasive species or rare plant species is found, AIDEA would consult with the relevant land manager to determine appropriate response measures.

2. **Design feature proposed by AIDEA:** Stabilization and restoration of sites disturbed during construction activities would occur in a timely manner within the post-disturbance growing season as work is completed. Disturbed soils would be stabilized and revegetated with native plant materials to reduce visual impacts and the potential for soil erosion and sediment discharge. AIDEA would work with the Alaska Plant Materials Center and the relevant land manager to develop a plan for obtaining native plant seed and/or cuttings to be used for restoration and reclamation needs. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into permit stipulations.

3. **Potential BLM Mitigation Measure:** All restoration and revegetation activities would be performed in accordance with AIDEA's Revegetation Plan, as approved by the Authorized Officer. Use of topsoil with live native vegetation is preferred with planting and reseeding as secondary options.

4. **Potential BLM Mitigation Measure:** While loss of native vegetation types that occur within both the cut and fill footprints would be unavoidable and permanent, measures would be implemented to mitigate for the loss of vegetation within the 10-foot temporary construction zone and therefore vegetation loss within this zone would be considered temporary. Mitigation measures include revegetation within the 10-foot temporary construction zone and along the fill slope of the roads. Revegetation would be accomplished by planting native vegetation and reseeding with certified weed-free native seed.

5. **Potential BLM Mitigation Measure:** Vehicles would not be operated more than 10 feet outside cut-fill project footprint; see Section 2, Alternatives. To mitigate impacts after construction in areas that would not be developed, stabilization and restoration of areas disturbed during construction activities would occur as work is completed. Disturbed soils would be stabilized and revegetated with native plant materials to reduce the potential for soil erosion and sediment discharge. AIDEA would work with the Alaska Plant Material Center and the landowners to develop a plan for obtaining native plant seed and/or cuttings to be used for restoration and reclamation needs.

6. **Potential BLM Mitigation Measure:** AIDEA would employ mitigation measures to reduce contamination of roadside vegetation. Methods would include suppressing fugitive dust on roads and rinsing trucks transporting ore, including wheels and undercarriage, before they enter the road. Vehicles repeatedly using the road would be inspected regularly to ensure that hydraulic seals are working properly. Contaminant monitoring would continue throughout the life of the project, and adaptive management would be employed to modify mitigation measures to reduce contamination.

7. **Potential BLM Mitigation Measure:** At temporary construction camps, permanent maintenance camps, turnouts, or other places of common intended or unintended pedestrian traffic, boardwalks would be built, used, and properly maintained in areas where repeated trampling would create visible trails or water tracks or would otherwise impede vegetation growth, or the route would be closed and closure enforced.

8. **Design feature proposed by AIDEA:** Reclamation of the industrial access road and support facilities would be undertaken at the end of the 50-year term of the ROW authorization, unless the BLM approves an extension for good cause, or once material exploration and mine operations in the District are completed and when a surface transportation corridor to the region is no longer necessary. A detailed reclamation plan is subject to land manager approval and would be developed prior to the issuance of the ROW permit. Reclamation measures would include removal of embankments, culverts, and bridges; regrading the roadway to establish more natural ground contours and drainage patterns; and revegetation of the area through seeding or planting of native vegetation. Appropriate native plant materials would be identified in consultation with the Alaska Plant Materials Center and each landowner. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into permit stipulations.

Wetlands

See also Section 3.2.5, Water Resources.

1. **Design feature proposed by AIDEA:** In areas where the proposed roadway footprint requires the fill of wetlands and does not contain a defined channel, minor culverts (less than 3-foot diameter) would be installed at approximately 150-foot spacing to maintain hydrologic connectivity between bisected wetlands. Culvert spacing and sizing would ultimately be determined during permitting based on additional design information. Design features related to this mitigation would be determined during the design/permitting phase and incorporated into permit stipulations.

2. **Design feature proposed by AIDEA:** Measures to avoid wetland loss would include design efforts to minimize impacts to wetlands and streams such as traversing upland habitats with less than 10 percent longitudinal grades; avoiding sloughs, ponds, and lakes, typically by a minimum of 50 feet; locating river crossings at straight sections; avoiding braided or multiple channels; and crossing rivers at the narrowest point feasible. Other design minimization measures would include shifting the alignment to impact lower-value wetlands and following existing roads or trails where possible.

3. **Potential BLM Mitigation Measure:** The following mitigation measures would be incorporated to reduce impacts to wetlands and wetland functions by helping to maintain hydrologic connectivity between bisected wetlands and waterbodies. Design measures would be based on geologic and hydrologic studies to freely convey surface water across the road surface.

    a. Bridges and culverts would be installed at all identified drainage crossings, including rills and ephemeral channels, to help maintain hydrologic connectivity, minimize changes to watershed basin areas, and reduce likelihood of water impoundment degrading permafrost. An adequate number of culverts and/or bridges would maintain hydrologic continuity and existing drainage patterns within wetland complexes, ephemeral channels, and perennial streams.
    b. Roadside ditches would only be used in limited cut areas where permafrost presence is unlikely. These efforts could help to maintain hydrologic connectivity between bisected wetlands and reduce the effects of diverting surface water flow to minimize impacts.

4. **Potential BLM Mitigation Measure:** In wetlands and other particularly sensitive areas, tundra mats or other appropriate types of ground protection would be used to minimize disturbance of ground vegetative cover outside the cut-fill footprint during non-winter construction, unless otherwise authorized by the Authorized Officer.

Non-native Invasive Species

1. **Potential BLM Mitigation Measure:** AIDEA would prepare an Invasive Species Prevention and Management Plan (ISPMP) to prevent the introduction and spread of non-native invasive species. The ISPMP would incorporate a landscape management approach across landowner boundaries, BMPs, Early Detection Rapid Response (EDRR), and reporting requirements to land managers. The ISPMP must be approved by the jurisdictional land manager prior to authorization of road construction and operations.

2. **Potential BLM Mitigation Measure:** The ISPMP would address methods of Non-Native Invasive Species (NNIS) prevention and infestation management. The plan could include multiple methods of control and eradication depending on the size, density, location, and species present within the infestation. Methods of control and eradication could include manual, mechanical, or chemical treatment, or disposal of invasive plants and infested soil.

3. **Potential BLM Mitigation Measure:** As part of the ISPMP, AIDEA would conduct a baseline and periodic NNIS surveys.

4. **Potential BLM Mitigation Measure:** Additional guidance and BMPs include:

    a. BLM – Alaska Invasive Species Management 2010 Policy, available at:
    b. eplanning.blm.gov/epl-front-office/projects/nepa/37008/44249/47684/AK_BLM_Invasive_Species_Management_Policy_2010.pdf
    c. AIDEA would employ the EDRR approach to invasive plant control (recognizing and controlling invasive species promptly). More information on EDRR is available at: www.doi.gov/sites/doi.gov/files/National%20EDRR%20Framework.pdf
    d. BLM Alaska has identified 36 NNIS of Concern as those currently of highest concern; all detections of these species must be reported to the Authorized Officer within 30 days of observation. All detections of NNIS of Concern (equivalent to list in BLM Alaska Invasive Species Management 2010 Policy; BLM to provide then-current list) must be reported to the Authorized Officer within 30 days. All reports of invasive species presence would include, at a minimum, a detailed description of the location and a photograph of the plant(s).

e. AIDEA would certify that all equipment and vehicles used for construction of the road are weed-free prior to use on the project/prior to leaving the existing road system. BMPs for minimizing the spread of NNIS would include washing/brushing of vehicles, including tires and undercarriage; equipment; and personal items, such as shoes, and clothes, which would be performed before entering the road. As part of a vehicle inspection protocol, equipment and vehicles using the Ambler Road for any purpose would be inspected for weeds and cleaned.
f. AIDEA would not use aircraft, vehicles/equipment, or materials for project purposes that have traveled to, parked in, or been staged in areas infested with invasive plants.
g. During operations, vehicles/drivers authorized to use the road would be trained in invasive species awareness and abatement.
h. Vehicles and equipment would be required to be cleaned prior to entering or leaving the Ambler Road system.
i. Permitted activities, including road and snow maintenance activities, would commence from areas known to not be infested with invasive plants and move toward known infested areas.
j. Invasive species prevention and management would include ongoing adaptive management and monitoring to mitigate the introduction and spread of NNIS, including *Elodea*.

5. **Potential BLM Mitigation Measure:** No mineral materials (sand and gravel) originating from material sources in the Dalton Highway corridor would be used unless it is inspected and certified weed-free.

Forestry, Timber, and Fire

1. **Potential BLM Mitigation Measure:** Prior to initiating clearing operations on federal land, AIDEA would provide the Authorized Officer with an estimate of the amount of merchantable timber, if any, expected to be cut, removed, or destroyed, and would pay the BLM in advance of such construction or maintenance activity, such sum of money as the Authorized Officer determines to be the full stumpage value of the timber to be cut, removed, or destroyed. Prior to any operations, the Holder, if required, would enter into a timber sale contract with the BLM for timber designated for cutting on the ROW.

2. **Potential BLM Mitigation Measure:** AIDEA would prepare and submit for approval by the Authorized Officer a Timber Clearing, Salvage, and Utilization Plan prior to any clearing activity. All timber clearing would be performed in accordance with the approved plan.

3. **Potential BLM Mitigation Measure:** Except as authorized for construction of project facilities, AIDEA would not cut live trees or other vegetation.

4. **Potential BLM Mitigation Measure:** Use of open fires in connection with Ambler Road activities is prohibited on BLM-managed land unless approved by the Authorized Officer and performed in accordance with federal law, except that incineration of solid waste combustibles may be conducted in accordance with these stipulations. AIDEA would require all employees, contractors, subcontractors, and authorized drivers to build no fires except in designated fire rings designed for the purpose.

5. **Potential BLM Mitigation Measure:** The federal government would not be held responsible for protection of the AIDEA's structures or their personal property from wildfire.

6. **Potential BLM Mitigation Measure:** AIDEA would be held financially responsible for any actions or activity that results in a wildfire. Costs associated with wildfires include, but are not limited to, damage to natural resources and costs associated with any suppression action taken on the fire.

7. **Potential BLM Mitigation Measure:** AIDEA would employ measures from Firewise Alaska (forestry.alaska.gov/Assets/pdfs/home/firewise09.pdf) to prevent wildfires from overtaking maintenance stations and communication towers.

8. **Potential BLM Mitigation Measure:** AIDEA would promptly notify the Authorized Officer of any fires that occur on or near lands subject to the ROW grant. AIDEA would comply with the instructions and directions of the Authorized Officer concerning the use, prevention, and suppression of fires on BLM-managed land.

9. **Potential BLM Mitigation Measure:** The BLM, through the Authorized Officer, reserves the right to impose restrictions on Ambler Road activities in any area to prevent the cause or spread of wildfire and ensure public safety during periods when fire danger is severe.

10. **Potential BLM Mitigation Measure:** AIDEA would be held financially responsible for AIDEA's actions or activities that result in a wildfire. Costs associated with wildfires include, but are not limited to, damage to natural resources and costs associated with any suppression action taken on the fire.

3.3.2 Fish and Amphibians

See also Section 3.2.5, Water Resources, for related stipulations.

1. **Potential BLM Mitigation Measure:** AIDEA would provide prior notification and obtain permit approval from the ADF&G Division of Habitat, before altering or affecting "the natural flow or bed" of a specified waterbody, or fish stream, per the Anadromous Fish Act (Alaska Statute [AS] 16.05.871–16.05.901). All activities within or across a specified anadromous waterbody require approval from ADF&G, including construction; road crossings; gravel removal; mining; water withdrawals; the use of vehicles or equipment in the waterway; stream realignment or diversion; bank stabilization; blasting; and the placement, excavation, deposition, or removal of any material.

2. **Potential BLM Mitigation Measure:** AIDEA would be required to notify and obtain authorization from the ADF&G for activities within or across a stream used by fish if it is determined that such uses or activities could represent an impediment to the efficient passage of resident or anadromous fish, in accordance with the Fishway (or Fish Passage) Act (AS 16.05.841). ADF&G would determine timing windows during which in-water work would be authorized to minimize potential impacts to sensitive fish life stages such as spawning and/or migration periods.

3. **Potential BLM Mitigation Measure:** AIDEA would conduct all road and construction activities to ensure free passage and movement of fish consistent with regulatory requirements of the ADF&G. Regulated blockages of fish passage and movement, if necessitated by in-stream activities, would meet ADF&G requirements and be approved by ADF&G as required.

4. **Design feature proposed by AIDEA:** For waterways to be crossed with culverts and which are deemed to be fish-bearing, the design would comply with ADF&G fish passage standards, which require prescribed velocities and capacities among other design factors, to minimize and/or mitigate impacts to fish habitat from construction activities and operations. Design features of each fish stream crossing structure would be determined through coordination with the ADF&G during the design/permitting phase and incorporated into permit stipulations to ensure structures are designed to maintain fish passage per the Fish Passage Act (AS 16.05.841).

5. **Potential BLM Mitigation Measure:** AIDEA would submit culvert and bridge inspection and maintenance plans to the Authorized Officer for approval prior to construction.

6. **Potential BLM Mitigation Measure:** AIDEA would employ properly installed erosion and sedimentation measures during construction to minimize sedimentation impacts to fish habitat. AIDEA would also stabilize disturbed areas and install silt curtains or other measures at construction sites to direct storm water away from fish-bearing waters.

7. **Potential BLM Mitigation Measure:** Stream bed structures would be constructed such that the combination of structure height and subsequent water velocity allows all occurring fish species free movement within the water body.

8. **Design feature proposed by AIDEA:** All perennial rivers and streams and well-established ephemeral channels are assumed to provide fish habitat, and crossings of them would be designed to provide fish passage. Culverts would be designed and installed using stream simulation principles with embedded culverts filled with substrate to replicate natural channel characteristics and function. Fish passage crossings would be designed to convey the 100-year peak flood (1 percent exceedance probability). See Section 3.2.5 (Water Resources), Water – General, for additional culvert information. Design features related to this mitigation would be determined during the design/permitting phase and incorporated into permit stipulations.

9. **Potential BLM Mitigation Measure:** Bridges and culverts span waterways would be designed to not restrict adequate fish passage and to retain full access to spawning areas where streams are braided.

10. **Potential BLM Mitigation Measure:** AIDEA would protect Fish Spawning Beds, Fish Rearing Areas, and Overwintering Areas from sediment where soil material is expected to be suspended in water as a result of Ambler Road activities. Settling basins or other sediment control structures would be constructed and maintained to intercept sediment before it reaches rivers, streams, or lakes. Where disturbances cannot be avoided, proposed modifications and appropriate mitigation measures would be designed by AIDEA and approved by the Authorized Officer.

11. **Potential BLM Mitigation Measure:** ADF&G would apply Blasting Standards stipulations where blasting operations may affect anadromous and/or resident fish, as required by AS 16. AIDEA would submit detailed blasting plans to the ADF&G and Authorized Officer for review and approval.

12. **Potential BLM Mitigation Measure:** No blasting would be done under water or within 0.25 mile of streams or lakes with identified sensitive wildlife habitat without the approval of the Authorized Officer.

13. **Potential BLM Mitigation Measure:** AIDEA would obtain fish habitat permit and temporary water use authorizations from ADF&G and Alaska Department of Natural Resources (ADNR), respectively, for each water withdrawal source and comply with permit stipulations therein. Permit stipulations limit the amount of water that can be removed, require screens be used on water intakes, set intake velocity limits to minimize impacts to fish, and require pump intake screens be checked periodically during operations to ensure proper function.

14. **Potential BLM Mitigation Measure:** AIDEA would notify the BLM within 48 hours of any observation of dead or injured fish on water source intake screens or in holes used for pumping water. AIDEA would temporarily cease pumping from that hole until additional preventative measures are taken to avoid further impacts to fish.

15. **Potential BLM Mitigation Measure:** During periods of fish spawning, rearing, and migration, AIDEA's activities on federal land may be restricted by the Authorized Officer with written notice.

As needed, the Authorized Officer may furnish AIDEA a list of areas where such actions may be required, together with anticipated dates of restriction.

16. **Potential BLM Mitigation Measure:** AIDEA would be required to obtain authorization from ADF&G prior to removing gravel from below ordinary high water of any fish bearing water. While upland sources are preferred, ADF&G may issue a Fish Habitat Permit for work below ordinary high water when few alternatives exist. AIDEA would need to provide gravel extraction plans during permitting.

3.3.3 Birds

1. **Potential BLM Mitigation Measure:** AIDEA, its employees, and its contractors would comply with the Migratory Bird Treaty Act (MBTA) in the execution of all activities under this permit. AIDEA would ensure all associated operations are conducted in such a manner as to avoid or minimize impacts to migratory birds. The primary mechanism to avoid and minimize impacts is to conduct work that may impact migratory birds outside of the nesting season (May1–July 15). The U.S. Fish and Wildlife Service (USFWS) provides guidance for MBTA compliance in Alaska, including dates to avoid vegetation clearing available at: www.fws.gov/alaska/fisheries/fieldoffice/anchorage/pdf/vegetation_clearing_2017.pdf. If AIDEA/permittee chooses not to follow these USFWS guidelines, then AIDEA/permittee would have a qualified biologist survey any area where vegetation would be damaged by the project or associated activities no longer than 48 hours prior to vegetation disturbance. If an active nest is located, an appropriate avoidance area (as determined by the qualified biologist) would be marked and avoided during all operations. Results of the survey(s), including findings, sufficient coordinates to describe a boundary around the survey area, site photographs, and photographs of any marked avoidance areas, would be provided to the BLM within 7 business days of the survey. This measure is similar to a measure proposed by AIDEA.

2. **Potential BLM Mitigation Measure:** AIDEA would ensure that their employees, contractors, and subcontractors do not harass or feed birds. The threshold for harassment is intentionally causing an animal to alter its behavior. This would be part of training for drivers authorized to use the Ambler Road.

3. **Potential BLM Mitigation Measure:** AIDEA would ensure that no vertical or near-vertical faces that may encourage bank swallow nesting are left on any slope, including on stockpiles. If bank swallows establish nests, AIDEA would ensure that the face is not disturbed until after young are fledged or the nests are naturally vacated.

3.3.4 Mammals

1. **Potential BLM Mitigation Measure:** AIDEA would notify the Authorized Officer within 30 days if an animal is killed in defense of life or property.

2. **Potential BLM Mitigation Measure:** AIDEA would ensure that food, garbage, and other potential wildlife attractants are kept secured while awaiting their use, removal, or incineration.

3. **Potential BLM Mitigation Measure:** AIDEA would ensure that their employees, contractors, and subcontractors do not harass or feed wildlife. The threshold for harassment is intentionally causing an animal to alter its behavior. This would be part of training for drivers authorized to use the Ambler Road.

4. **Potential BLM Mitigation Measure:** During periods of wildlife breeding, lambing, or calving activity, and during major migrations of wildlife, AIDEA's activities on BLM-managed land may be restricted by the Authorized Officer with written notice. From time to time, the Authorized Officer may furnish AIDEA a list of areas where such actions may be required, together with anticipated dates of restriction.

5. **Design feature proposed by AIDEA:** AIDEA would incorporate the abatement and wildlife interaction protocols used on the Delong Mountain Transportation System into construction and operation of the Ambler Road. Details of the operating plan would be carried through into AIDEA's permit requirements of any road user.

6. **Potential BLM Mitigation Measure:** All wildlife would have the right of way on the Ambler Road. Vehicles would be required to slow down or stop and wait to permit the free and unrestricted movement of wildlife across the road at any location. During known caribou migration, the Authorized Officer may require temporary cessation of traffic.

7. **Design feature proposed by AIDEA:** AIDEA communications protocol for road users would include coordination and notification to drivers of currently observed animal patterns, including migration patterns, to increase awareness of potential animal and vehicle conflicts. AIDEA would develop communication protocols in conjunction with wildlife managers. The communication protocols would be carried through into AIDEA's permit requirements of any road user.

8. **Potential BLM Mitigation Measure:** AIDEA would work with land managers and wildlife agencies to identify construction timing windows to protect wildlife. Timing design features related to this mitigation would be determined during the design/permitting phase.

9. **Potential BLM Mitigation Measure:** All field crews, construction workers, maintenance workers, and drivers on the road would follow a wildlife interaction plan prepared by AIDEA or a designee detailing how they are to manage wildlife attractants (food and non-food materials) and respond to human-wildlife interactions. This would be included with the training for authorized drivers of the Ambler Road.

10. **Potential BLM Mitigation Measure:** In areas and times of known caribou distribution and occurrence during snow season, snow bank height would be minimized to allow caribou passage.

11. **Potential BLM Mitigation Measure:** Construction, maintenance, and operations would be conducted in a manner that minimizes disturbance of fish, wildlife, and habitat resources. Intentionally disturbing, harassing, or feeding wildlife is prohibited (5 AAC 92.230).

12. **Potential BLM Mitigation Measure:** During survey and construction, cross-country activity is prohibited within 1/2 mile of occupied grizzly bear dens identified by the ADF&G unless alternative protective measures are approved by the Authorized Officer in consultation with the ADF&G. During maintenance and operations, cross-country activity originating from the Ambler Road is prohibited entirely.

13. **Design feature proposed by AIDEA:** AIDEA would adopt a caribou policy that AIDEA and all contractors and road users would make every effort to ensure caribou are not disturbed in their efforts to cross the road. The operating policy would prevent the free-flow of traffic on the Ambler Road whenever caribou are crossing or are in the area. During times of caribou herd seasonal migration, the policy would allow for the closure of the road for several consecutive days. During such herd movements, AIDEA would monitor caribou movement and maintain a log of herd movement based

on location and numbers of animals. Records would be maintained and shared annually with ADF&G and the Authorized Officer.

14. **Potential BLM Mitigation Measure:** Within the Areas of Critical Environmental Concern (ACECs), aircraft associated with Ambler Road activities would be required to fly a minimum of 2,000 feet above ground level (AGL) from May 1 to August 31, unless doing so would endanger human life or be an unsafe flying practice.

15. **Potential BLM Mitigation Measure:** Operators would prohibit their employees, agents as well as contractors, subcontractors, and their employees, while on duty or living at any camp or mobile camp, from feeding wild animals or birds or leaving garbage or other potentially edible items that would attract wild animals or birds. Garbage would be kept in bear proof containers.

16. **Potential BLM Mitigation Measure:** The Fish and Wildlife protection plan would include measures to maximize opportunities for unfettered wildlife movement and minimize habitat fragmentation. This includes design features such as:

    a. Burying infrastructure or facilities that may deter wildlife movement;
    b. Creating wildlife escapement design features in excavations;
    c. Siting and orienting infrastructure and facilities to allow maximum opportunities for unfettered wildlife movement;
    d. Using vegetation to provide screened and unfragmented movement corridors around infrastructure and facilities; and
    e. Following measures to minimize or eliminate visual or soundscape impacts that may deter wildlife movement.

17. **Potential BLM Mitigation Measure:** Prior to starting activities, AIDEA would obtain the locations of known brown bear dens from the ADF&G for the purpose of avoiding both human/bear interactions and disturbance of bear dens.

18. **Potential BLM Mitigation Measure:** Camps are to be used only in support of authorized activities. Support of non-commercial activities at construction camps on BLM-managed lands is not authorized. Other uses, including use by hunters, fishers, tourists, researchers, or employee's friends or family members, is not authorized. This does not preclude providing appropriate emergency assistance to anyone in distress, or providing assistance and support to law enforcement or search and rescue personnel if requested.

19. **Potential BLM Mitigation Measure:** To minimize wildlife entanglement and plastic debris pollution, erosion and sediment control products would be plastic-free, such as netting manufactured from 100 percent biodegradable, nonplastic materials like jute, sisal, or coir fiber.

3.4. Social Systems

3.4.1 Land Ownership, Use, Management, and Special Designations

For wild and scenic river crossings, see Sections 3.2.5, Water Resources, and 3.4.2, Transportation and Access.

3.4.2 Transportation and Access

1. **Design feature proposed by AIDEA:** AIDEA would operate the Ambler Road as an industrial access road not open to the general public and would maintain a staffed gate at the Dalton Highway

end of the road to regulate access only to authorized drivers. A similar gate would be established near the western end, near the boundary of the District. The road would not be open to general public use for any purpose or any means, including vehicles, on foot, or by bicycle, except for crossing the road at designated and safe locations.

2. **Potential BLM Mitigation Measure:** AIDEA would design and implement an authorization (permit) program for drivers authorized to use the road. The program would include education about ROW stipulations that apply to drivers. No drivers would be allowed to use the road without such authorization.

3. **Potential BLM Mitigation Measure:** In keeping with operation of the Ambler Road as an industrial access road not generally open to the public, AIDEA would operate project airstrips for Ambler Road activities only, except for emergency landings. Public access to airstrips for recreation, hunting, or other general uses would not be allowed.

4. **Potential BLM Mitigation Measure:** AIDEA would prepare and submit a Public Access Plan inclusive of construction and operational periods to the Authorized Officer for review and approval.

5. **Design feature proposed by AIDEA:** AIDEA would make provisions for suitable permanent crossings of the ROW for the public where the ROW crosses existing roads, foot trails, winter trails, RS2477 trails, easements (including Alaska Native Claims Settlement Act [ANCSA] 17b public easements), or other ROWs or known routes identified through AIDEA coordination with subsistence communities in the region and land managers.

6. **Potential BLM Mitigation Measure:** BLM would have access to the road for inspection of the project in the area authorized by the ROW grant. BLM drivers would be allowed entry in authorized driver training and would be authorized to drive the road for project administration and inspection purposes.

7. **Design feature proposed by AIDEA:** Bridges would be designed to minimize impacts on river flow and allow continued navigation on the river by watercraft that use each particular river, typically rafts, canoes, kayaks, and small motorized vessels. Where commercial/industrial barges are possible, the bridges would be designed for passage of tugs and barges.

8. **Potential BLM Mitigation Measure:** A highway use agreement for project use of existing highways would be in place prior to construction, and would be an agreement between the AIDEA and DOT&PF regarding how impact to existing infrastructure caused by construction and operation would be mitigated.

9. **Potential BLM Mitigation Measure:** Terms and conditions are applicable to locations where the proposed project area crosses state or federally owned land. Note: the state ROW lease applies to state lands, except Mental Health Trust, University, and Alaska Railroad land; the federal grant applies to federal land except Gates of the Arctic National Park and Preserve (GAAR) land and trust land (allotments). The grant would be prepared by the BLM Central Yukon Field Office and approved by the Authorized Officer.

10. **Potential BLM Mitigation Measure:** Areas of approved restricted public access would be easily identifiable on the ground. AIDEA would provide appropriate signs, flagging, barricades, and other safety measures when regulating or prohibiting public access.

11. **Potential BLM Mitigation Measure:** All Ambler Road activities would be confined to the authorized ROW. AIDEA would not operate mobile ground equipment off the ROW and authorized

areas specifically requested by AIDEA or off existing public roads and highways, unless approved by the Authorized Officer.

3.4.3 Recreation and Tourism

See Section 3.4.2, Transportation and Access, regarding river passage and crossing of the road. Also see Sections 3.4.4, Visual Resources, and 3.2.6, Acoustical Environment.

1. **Potential BLM Mitigation Measure:** AIDEA would prohibit its agents, employees, contractors, and their employees while on duty or living at a camp from hunting, fishing, shooting, trapping, or camping.

2. **Potential BLM Mitigation Measure:** AIDEA's agents, employees, contractors, and their employees would not use project equipment, including transportation to and from the job site, for the purpose of hunting, fishing, shooting, and trapping.

3.4.4 Visual Resources

1. **Potential BLM Mitigation Measure:** AIDEA would submit a plan to reduce and minimize impacts from light fixtures and facilities during construction, operations, and maintenance phases of road activities to the BLM for review and approval.

2. **Potential BLM Mitigation Measure:** For temporary and long-term facilities, designs would use the minimum lighting intensity necessary to ensure safety; use localized task lighting; and incorporate measures such as diffusers, lenses, and shielding to reduce nighttime glare, light radiation, and backscatter into the sky.

3. **Design feature proposed by AIDEA:** Revegetation of fill slopes with native seed, trees, and/or shrubs on topsoil could be used as a mitigation technique to reduce the contrast between the gravel road and the existing forest. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into permit stipulations.

4. **Potential BLM Mitigation Measure:** Structure designs and equipment at temporary construction camps and permanent maintenance and operations facilities would use color, form, line, or texture to reduce contrast with background features. Reflectivity would be minimized.

5. **Potential BLM Mitigation Measure:** The exterior of structures associated with temporary construction camps and long-term maintenance and operations facilities would be colored covert green, shadow gray, or a similar color unless another color is specified in the project-specific stipulations as depicted on the BLM's Visual Resource Management Standard Environmental Colors Chart. For more information visit: www.blm.gov/wo/st/en/prog/Recreation/recreation_national/RMS.html

6. **Potential BLM Mitigation Measure:** Non-enclosed steel structures (e.g., poles, fences, towers) would be powder coated and have a dull galvanized metal finish. Tall structures would be minimized and constructed in locations not conspicuous on the horizon, to the greatest extent possible.

7. **Potential BLM Mitigation Measure:** Other visual impact mitigation measures, subject to consistency with vegetation BMPs, would include:

    a. Restore the construction zone in a manner that facilitates reestablishment of the adjacent natural vegetation.

b. Use root balls, salvaged native plant materials, and the surface layer removed from the construction footprint for redistribution on disturbed areas where feasible.
c. Maintain a screening of existing natural vegetation between the Ambler Road and its facilities and the Dalton Highway, to the extent possible.
d. Minimize locating Ambler Road facilities, new material sites, and construction material stockpiling that would be visible to the public in places with special visual resource values.
e. Blend the Ambler Road facilities into the natural setting to the extent practicable when crossing or passing near places with high visual resource value, including GAAR, ACECs, the Dalton Highway corridor, existing communities, and streams used for recreation and transportation.
f. Use revegetation species that are appropriate for the general area. See also Section 3.3.1, Vegetation and Wetlands.
g. Regrade construction disturbances to a condition that blends with the surrounding terrain and surface drainage patterns.
h. Monitor reclaimed, disturbed construction areas and take remedial action where expected revegetation success is not achieved.

3.4.5 Socioeconomics and Communities

1. **Potential BLM Mitigation Measure:** AIDEA would implement the following mitigation measures to address effects on socioeconomics:

    a. Time construction activities as much as possible to minimize impact to high-use tourist and recreation seasons (e.g., river floating, wildlife viewing, hunting, snow machining, dog mushing).
    b. Time construction activities to minimize impacts to local lodges and other businesses (i.e., minimize summer and fall construction in recreational and tourist areas).
    c. Identify and promote work opportunities for local residents.
    d. Develop training programs for local residents so that they could be employed during construction and operations.

2. **Potential BLM Mitigation Measure:** Avoid locating construction support and operations/maintenance facilities (e.g., construction camps) in places with special visual resource values that would be observable to the general public or that would reduce the visual values of private properties.

Public Health

1. **Potential BLM Mitigation Measure:** AIDEA would use only non-persistent and immobile types of pesticides, herbicides, preservatives, and other chemicals. Each chemical to be used and its application constraint would be approved by the BLM prior to use. AIDEA would avoid and minimize construction and operations activities related to chemical applications during sensitive periods in life cycles such as calving, denning, nesting, and migration. The use of pesticides and herbicides is regulated by ADEC’s Environmental Health Division through 18 AAC 90 and may require a permit.

3.4.6 Environmental Justice

None identified.

3.4.7 Subsistence Uses and Resources

1. **Potential BLM Mitigation Measure:** Operations would not impede qualified rural residents from pursuing subsistence activities (Alaska National Interest Lands Conservation Act [ANILCA], Public Law 96-487).

2. **AIDEA proposed design feature.** AIDEA would form a subsistence working group for communication and knowledge sharing.

3. **Potential BLM Mitigation Measure:** AIDEA would consult directly and regularly with affected subsistence communities on an ongoing basis, using the following guidelines:

    a. AIDEA would consult with directly affected subsistence communities to discuss the siting, timing, and methods of road construction and operations to help discover local traditional and scientific knowledge, including locations needed to cross the Ambler Road, resulting in measures that minimize impacts to subsistence uses, potentially to include ramps for road crossing locations (see also Section 3.4.2, Transportation and Access).
    b. During this consultation, AIDEA would share the results of road use monitoring (both permitted and unpermitted).
    c. AIDEA would make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that road construction and operations and maintenance activities do not result in unreasonable interference with subsistence activities. In the event that no agreement is reached between the parties, the Authorized Officer would determine which road activities would occur, including the timeframes.
    d. AIDEA would designate a project liaison dedicated to receiving feedback from potentially affected communities.

4. **Potential BLM Mitigation Measure:** AIDEA would notify workers and road users when subsistence activities are ongoing in the area and direct them to refrain from actions that may affect the activities (e.g., not removing trapline markers).

5. **Potential BLM Mitigation Measure:** Subsistence Activity Impact mitigation would also include:

    a. Identify locations and times when subsistence activities occur, and minimize work during these times and in these areas to the maximum extent practicable.
    b. Schedule work (e.g., blasting) to avoid conflict with subsistence activities when possible.

3.4.8 Cultural Resources

1. **Potential BLM Mitigation Measure:** Mitigation measures for historic properties are listed in a Programmatic Agreement (PA; Appendix J of the Ambler Road EIS). AIDEA would agree to the terms of the PA, which is an agreement with the BLM, U.S. Army Corps of Engineers, NPS, U.S. Coast Guard, ADNR, Alaska State Historic Preservation Officer, and Advisory Council on Historic Preservation related to implementation of Section 106 of the National Historic Preservation Act (NHPA; 16 USC 470 et seq.). A Cultural Resources Management Plan (CRMP) would be implemented and agreed to as part of the PA (Appendix J, Attachment E). The PA is prepared in accordance with Section 106 of the NHPA.

4. References

Limpinsel, D.E., M.P. Eagleton, and J.L. Hanson. 2017. Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska. EFH 5 Year Review: 2010 through 2015. U.S. Department of Commerce, NOAA Technical Memo. NMFS-F/AKR-14, 229p.

NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

This page is intentionally left blank.

Attachment A:

BLM Mineral Materials Mining and Reclamation Plan Proposal Form

This page is intentionally left blank.

Attachment A:

BLM Mineral Materials Mining and Reclamation Plan Proposal Form

While there is no requirement to use this form to apply for a mineral material mining authorization, all of the relevant information identified here is required for a mining plan to be determined complete.

NOTE 1: Applicants should contact BLM to request separate authorization for the following activities, which are outside the scope of activities authorized under a mineral material mining plan:

- Establishment and operation of camps on public lands for commercial purposes.
- Storage of materials or supplies not related to the production of mineral materials, including culverts, bridge railings, calcium chloride, or other road maintenance supplies.
- Secondary or value-added production processes, including operation of hot-batch plants, asphalt production, cement production, fabrication of components for off-site use, and similar activities not related to the production of mineral materials.

NOTE 2: Applicants would be required to provide a copy of the following documentation prior to beginning operations.

- The relevant approved Storm Water Pollution Prevention Plan (SWPPP)
- A certified Spill Prevention, Control, and Countermeasure Plan (SPCCP) if required by 40 CFR 112, or a Spill Contingency Plan (SPC) subject to BLM approval.

Providing those, even in draft form, as part of this mining plan would help expedite the analysis and approval.

Applicants would also be **required** to provide a copy of any other permits required by applicable State or Federal regulation (e.g., a Clean Water Act Section 404 permit, an Alaska Department of Fish and Game Fish Habitat Permit, etc.) **prior to** beginning operations. Thus, they are encouraged to pursue those with the relevant agency concurrently with this application.

MINING PLAN

- ☐ Project Name
- ☐ Prepared By
- ☐ Date

Operator Information

- ☐ Operator Name
- ☐ Mailing Address
- ☐ Phone Numbers (Office, Cell, and FAX)
- ☐ Point of contact

Permittee Information (if different than operator information)

- ☐ Permittee(s) Name
- ☐ Mailing Address
- ☐ Phone Numbers (Office, Cell, and FAX)
- ☐ Point of contact

General Plan Information

- ☐ Mineral Material type(s) to be mined
- ☐ Quantity per Year to be mined (cubic yards)
- ☐ Total quantity to be mined

General Schedule of Operations from Start through Closure

- ☐ Proposed date for mobilization to site
- ☐ Proposed date for start of mining
- ☐ Estimated date for end of mining
- ☐ Estimated date for beginning of reclamation
- ☐ Estimated date for completion of reclamation
- ☐ Estimated date(s) for period(s) of temporary or seasonal closure
- ☐ Other relevant milestone date estimates (e.g., planned change of mining method, etc.)

DESCRIPTION OF OPERATIONS

Location

- ☐ Legal Description: (Township, Range, section(s), quarter section(s))
- ☐ Highway milepost
- ☐ Site name (if known)
- ☐ Are non-native invasive plant species present at the site? (if known).

Equipment and Devices

- ☐ Provide a list or description of all equipment and devices that would be used in the operations and the purpose/use for each

Operating Practices

- ☐ Type of action/operation proposed (open pit, quarry, etc.)
- ☐ Mining methods or techniques proposed (dozer scraping, excavator, drag line, blasting, etc.)
- ☐ Estimated dimensions of excavation/workings (length, width, depth)
- ☐ Description of processing/washing/crushing/sorting to be conducted on site
- ☐ If water-based processes are proposed (washing), a detailed description of the water management plan, including water source, flow control, settling, and discharge rates and locations.
- ☐ Estimated average daily production (cubic yards)
- ☐ Estimated depth of overburden above usable materials
- ☐ Estimated maximum volume of material stockpiles
- ☐ Estimated volume of material stockpiles at completion of mining
- ☐ Estimated total surface disturbance (acres); include mining area, access, berms, stockpiles, fuel yards, sanitation facilities, etc.
- ☐ Description of overburden stockpiling (location, methods to prevent loss from erosion)
- ☐ Description of dust control practices
- ☐ Proposed daily hours of operation

Reclamation Plan

- ☐ Description of proposed reclamation practices and methods
    - o Regrading and reshaping to conform with adjacent landforms
    - o Placement of growth medium and establishment of self-sustaining revegetation
    - o Measures to control erosion, landslides, and water runoff
- ☐ General reclamation schedule, from start to finish
- ☐ Description of final pit configuration (reference diagrams)
- ☐ Reclamation practices for roads/access features
- ☐ Post-reclamation disposition of access features (reclaimed, left for future access to the pit, etc.)

Monitoring Plan

A monitoring plan must be designed to demonstrate compliance with the approved plan of operations and other Federal and State environmental laws and regulations, provide early detection of potential problems, and supply information that would assist in directing corrective actions should they become necessary. Examples of monitoring programs which may be relevant to a given operation include water quality, air quality (dust control), slope stability, revegetation progress (during reclamation), noise levels (if near visitor services facilities), and wildlife mortality. Monitoring plans may incorporate existing State and/or other Federal monitoring requirements to avoid duplication. However, the submitted monitoring plan needs to include copies of and clearly reference these other plans.

Where applicable, the monitoring plan must include details on:

- ☐ Type and location of monitoring devices
- ☐ Sampling parameters and frequency
- ☐ Analytical methods
- ☐ Reporting procedures
- ☐ Procedures to respond to adverse monitoring results

Interim Management Plan

The interim management plan describes management of the project area during periods of temporary and seasonal closures to prevent unnecessary or undue degradation.

The interim management plan must include, where applicable, the following:

- ☐ Measures to stabilize excavations and workings
- ☐ Measures to isolate or control toxic or deleterious materials (e.g., if hazardous materials, including POLs, are left on site)
- ☐ Provisions for the secure storage or removal of equipment, supplies and structures
- ☐ Measures to maintain the project area in a safe and clean condition
- ☐ Plans for monitoring site conditions during periods of non-operation
- ☐ Schedule of anticipated periods of temporary closure during which you would implement the interim management plan

Description of Support Facilities

- ☐ Office and administrative facilities
    - o Description of structures and locations (reference project maps)
- ☐ Sanitation needs
    - o Human waste management methods (port-a-john, etc.)
    - o Cleaning and maintenance schedule
- ☐ Public safety considerations
    - o Proposed fencing, barriers, or barricades and the need/purpose for each
    - o Proposed signage and the need/purpose for each
    - o Description of any other proposed public safety features or devices
- ☐ Trash and solid waste management
    - o Methods for interim secure storage of garbage generated on site
    - o Schedule for incineration of solid waste combustibles
    - o Schedule for backhaul of non-combustible waste
    - o Description of burning/incineration facilities
- ☐ SWPPP or other water management plans
    - o Proposed means of storm water diversion around workings
    - o Diversion ditches and discharge locations in case water is produced during mining operations
    - o Sediment and erosion control methods and devices
    - o Schedule for inspection and maintenance of sediment and erosion control devices
    - o Location of any planned water discharge
    - o Water needs and uses
    - o Water sources, including and methods and rates of water extraction or transfer
- ☐ Access
    - o Location(s) of each proposed road (reference project maps)

- Road type for each proposed road (haul, light vehicle, access, etc.)
- Road maintenance methods and schedules
- Proposed upgrades to existing roads
- The location of reasonable public passage or access routes through or around the area to adjacent public lands

☐ Hazardous materials, including, but not limited to, POLs and explosives

- SPCCP or SCP, as applicable
- Location of all hazardous materials storage (reference project maps)
- Location of refueling areas
- Blasting plan, if applicable

Project Maps and Diagrams

☐ Maps must be at an appropriate scale and of sufficient detail for BLM to discern the locations of:

- Excavation boundaries
- Types and location of material stockpiles
- Phasing plan (see attached example)
- Processing facilities
- Overburden areas
- Administrative facilities (office structures, etc.)
- Equipment storage areas
- Maintenance facilities and/or location
- Refueling areas
- Fuel storage
- All water bodies within the intended disturbance area
- Access features
- Public safety devices, including proposed fences, barricades, and signage

☐ Diagrams

- Pre-mining cross sections
- Post mining cross sections
- Post-reclamation cross sections

The BLM may require additional, site-specific information when resource status or conditions warrant.

This page is intentionally left blank.

Attachment A:

BLM Mineral Materials Mining and Reclamation Plan Proposal Form

This page is intentionally left blank.

Attachment A:

BLM Mineral Materials Mining and Reclamation Plan Proposal Form

While there is no requirement to use this form to apply for a mineral material mining authorization, all of the relevant information identified here is required for a mining plan to be determined complete.

NOTE 1: Applicants should contact BLM to request separate authorization for the following activities, which are outside the scope of activities authorized under a mineral material mining plan:

- Establishment and operation of camps on public lands for commercial purposes.
- Storage of materials or supplies not related to the production of mineral materials, including culverts, bridge railings, calcium chloride, or other road maintenance supplies.
- Secondary or value-added production processes, including operation of hot-batch plants, asphalt production, cement production, fabrication of components for off-site use, and similar activities not related to the production of mineral materials.

NOTE 2: Applicants would be required to provide a copy of the following documentation prior to beginning operations.

- The relevant approved Storm Water Pollution Prevention Plan (SWPPP)
- A certified Spill Prevention, Control, and Countermeasure Plan (SPCCP) if required by 40 CFR 112, or a Spill Contingency Plan (SPC) subject to BLM approval.

Providing those, even in draft form, as part of this mining plan would help expedite the analysis and approval.

Applicants would also be **required** to provide a copy of any other permits required by applicable State or Federal regulation (e.g., a Clean Water Act Section 404 permit, an Alaska Department of Fish and Game Fish Habitat Permit, etc.) **prior to** beginning operations. Thus, they are encouraged to pursue those with the relevant agency concurrently with this application.

MINING PLAN

- ☐ Project Name
- ☐ Prepared By
- ☐ Date

Operator Information

- ☐ Operator Name
- ☐ Mailing Address
- ☐ Phone Numbers (Office, Cell, and FAX)
- ☐ Point of contact

Permittee Information (if different than operator information)

- ☐ Permittee(s) Name
- ☐ Mailing Address
- ☐ Phone Numbers (Office, Cell, and FAX)
- ☐ Point of contact

General Plan Information

- ☐ Mineral Material type(s) to be mined
- ☐ Quantity per Year to be mined (cubic yards)
- ☐ Total quantity to be mined

General Schedule of Operations from Start through Closure

- ☐ Proposed date for mobilization to site
- ☐ Proposed date for start of mining
- ☐ Estimated date for end of mining
- ☐ Estimated date for beginning of reclamation
- ☐ Estimated date for completion of reclamation
- ☐ Estimated date(s) for period(s) of temporary or seasonal closure
- ☐ Other relevant milestone date estimates (e.g., planned change of mining method, etc.)

DESCRIPTION OF OPERATIONS

Location

- ☐ Legal Description: (Township, Range, section(s), quarter section(s))
- ☐ Highway milepost
- ☐ Site name (if known)
- ☐ Are non-native invasive plant species present at the site? (if known).

Equipment and Devices

- ☐ Provide a list or description of all equipment and devices that would be used in the operations and the purpose/use for each

Operating Practices

- ☐ Type of action/operation proposed (open pit, quarry, etc.)
- ☐ Mining methods or techniques proposed (dozer scraping, excavator, drag line, blasting, etc.)
- ☐ Estimated dimensions of excavation/workings (length, width, depth)
- ☐ Description of processing/washing/crushing/sorting to be conducted on site
- ☐ If water-based processes are proposed (washing), a detailed description of the water management plan, including water source, flow control, settling, and discharge rates and locations.
- ☐ Estimated average daily production (cubic yards)
- ☐ Estimated depth of overburden above usable materials
- ☐ Estimated maximum volume of material stockpiles
- ☐ Estimated volume of material stockpiles at completion of mining
- ☐ Estimated total surface disturbance (acres); include mining area, access, berms, stockpiles, fuel yards, sanitation facilities, etc.
- ☐ Description of overburden stockpiling (location, methods to prevent loss from erosion)
- ☐ Description of dust control practices
- ☐ Proposed daily hours of operation

Reclamation Plan

- ☐ Description of proposed reclamation practices and methods
    - Regrading and reshaping to conform with adjacent landforms
    - Placement of growth medium and establishment of self-sustaining revegetation
    - Measures to control erosion, landslides, and water runoff
- ☐ General reclamation schedule, from start to finish
- ☐ Description of final pit configuration (reference diagrams)
- ☐ Reclamation practices for roads/access features
- ☐ Post-reclamation disposition of access features (reclaimed, left for future access to the pit, etc.)

Monitoring Plan

A monitoring plan must be designed to demonstrate compliance with the approved plan of operations and other Federal and State environmental laws and regulations, provide early detection of potential problems, and supply information that would assist in directing corrective actions should they become necessary. Examples of monitoring programs which may be relevant to a given operation include water quality, air quality (dust control), slope stability, revegetation progress (during reclamation), noise levels (if near visitor services facilities), and wildlife mortality. Monitoring plans may incorporate existing State and/or other Federal monitoring requirements to avoid duplication. However, the submitted monitoring plan needs to include copies of and clearly reference these other plans.

Where applicable, the monitoring plan must include details on:

- ☐ Type and location of monitoring devices
- ☐ Sampling parameters and frequency
- ☐ Analytical methods
- ☐ Reporting procedures
- ☐ Procedures to respond to adverse monitoring results

Interim Management Plan

The interim management plan describes management of the project area during periods of temporary and seasonal closures to prevent unnecessary or undue degradation.

The interim management plan must include, where applicable, the following:

- ☐ Measures to stabilize excavations and workings
- ☐ Measures to isolate or control toxic or deleterious materials (e.g., if hazardous materials, including POLs, are left on site)
- ☐ Provisions for the secure storage or removal of equipment, supplies and structures
- ☐ Measures to maintain the project area in a safe and clean condition
- ☐ Plans for monitoring site conditions during periods of non-operation
- ☐ Schedule of anticipated periods of temporary closure during which you would implement the interim management plan

Description of Support Facilities

- ☐ Office and administrative facilities
    - Description of structures and locations (reference project maps)
- ☐ Sanitation needs
    - Human waste management methods (port-a-john, etc.)
    - Cleaning and maintenance schedule
- ☐ Public safety considerations
    - Proposed fencing, barriers, or barricades and the need/purpose for each
    - Proposed signage and the need/purpose for each
    - Description of any other proposed public safety features or devices
- ☐ Trash and solid waste management
    - Methods for interim secure storage of garbage generated on site
    - Schedule for incineration of solid waste combustibles
    - Schedule for backhaul of non-combustible waste
    - Description of burning/incineration facilities
- ☐ SWPPP or other water management plans
    - Proposed means of storm water diversion around workings
    - Diversion ditches and discharge locations in case water is produced during mining operations
    - Sediment and erosion control methods and devices
    - Schedule for inspection and maintenance of sediment and erosion control devices
    - Location of any planned water discharge
    - Water needs and uses
    - Water sources, including and methods and rates of water extraction or transfer
- ☐ Access
    - Location(s) of each proposed road (reference project maps)

- Road type for each proposed road (haul, light vehicle, access, etc.)
- Road maintenance methods and schedules
- Proposed upgrades to existing roads
- The location of reasonable public passage or access routes through or around the area to adjacent public lands

☐ Hazardous materials, including, but not limited to, POLs and explosives

- SPCCP or SCP, as applicable
- Location of all hazardous materials storage (reference project maps)
- Location of refueling areas
- Blasting plan, if applicable

Project Maps and Diagrams

☐ Maps must be at an appropriate scale and of sufficient detail for BLM to discern the locations of:

- Excavation boundaries
- Types and location of material stockpiles
- Phasing plan (see attached example)
- Processing facilities
- Overburden areas
- Administrative facilities (office structures, etc.)
- Equipment storage areas
- Maintenance facilities and/or location
- Refueling areas
- Fuel storage
- All water bodies within the intended disturbance area
- Access features
- Public safety devices, including proposed fences, barricades, and signage

☐ Diagrams

- Pre-mining cross sections
- Post mining cross sections
- Post-reclamation cross sections

The BLM may require additional, site-specific information when resource status or conditions warrant.

This page is intentionally left blank.

Appendix O

References

This page is intentionally left blank.

References

ABR. 2014. *Stream habitat surveys of proposed bridge crossing sites on the Brooks East corridor*. Prepared for DOWL HKM by ABR, Inc. – Environmental Research & Services, October 2014.

ABR. 2015. *A Survey of Fish Assemblages in the South Fork Koyokuk River*. Prepared by ABR, Inc. – Environmental Research & Services, March 2015.

ABR. 2017. *Assessment of Potential Changes in Wetland and Riverine Functions for the Proposed Ambler Mining District Industrial Access Project in Gates of the Arctic National Park*. Prepared for AIDEA, Anchorage, Alaska.

ACCS, UAA. 2019a. ACCS Rare Plant Data. Obtained February 2019.

ACCS, UAA. 2019b. Wildlife Data Portal (Beta). Available at: aknhp.uaa.alaska.edu/apps/wildlife/ Accessed February 25, 2019.

Adams, L.G., T.J. Meier, P. Owen, and G.H. Roffler. 2006. Interrelationships of Denali's large mammal community. *Alaska Park Science* 5:36–40.

Adamczewski, J.Z., C.C. Gates, B.M. Soutar, and R.J. Hudson. 1988. Limiting effects of snow on seasonal habitat use and diets of caribou *(Rangifer tarandus groenlandicus)* on Coats Island, Northwest Territories, Canada. *Canadian Journal of Zoology* 66:1986–1996.

ADEC (Alaska Department of Environmental Conservation). 2016. State of Alaska 2015 Ambient Air Quality Network Assessment. Air Quality Division & Quality Assurance Program.

ADEC. 2019. Welcome to SWIMS. Available at: dec.alaska.gov/Applications/EH/SWIMS/Default.aspx. Accessed February 27, 2019.

ADF&G (Alaska Department of Fish and Game), Division of Subsistence. No Date. Alaska's Economies and Subsistence. Juneau, Alaska.

ADF&G. 1973. Alaska's Wildlife and Habitat. Available at: www.adfg.alaska.gov/static-sf/GIS/AHMGB/AHMG_Alaskas_Wildlife_And_Habitat.pdf

ADF&G. 2006. *Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife and Fish Resources*. ADF&G. Juneau, Alaska.

ADF&G. 2015. Alaska Wildlife Action Plan. Juneau, Alaska.

ADF&G. 2016. Nelchina Caribou Herd Bulletin. July 2016. Available at: www.adfg.alaska.gov/static/hunting/caribouhunting/pdfs/nelchina_caribou_herd_bulletin_july_2016.pdf

ADF&G. 2017. Seasonal ranges of 33 caribou herds in Alaska. GIS Shapefile.

ADF&G. 2019. Alaska Freshwater Fish Inventory database. ADF&G, Division of Sport Fish. Available at: adfg.maps.arcgis.com/apps/webappviewer/index.html?id=f5aac9a8e4bb4bf49dc39db33f950bbd. Accessed March 5, 2019.

ADNR (Alaska Department of Natural Resources), Division of Mining, Land, and Water. No Date. RS2477 Project. Available at: www.dnr.state.ak.us/mlw/trails/rs2477/index.cfm

ADNR, Division of Mining, Land, and Water. 2008. *Northwest Area Plan for State Lands*. Available at: dnr.alaska.gov/mlw/planning/areaplans/northwest/pdf/nwap_2008_complete.pdf

ADNR. 2014. *Yukon Tanana Area Plan*. Available at: dnr.alaska.gov/mlw/planning/areaplans/ytap/pdf/ytap_2014_web/ytap_2014_complete.pdf

ADNR. 2018. Alaska Mining Claims Mapper. Available at: akmining.info/ Accessed March 15, 2018.

ADNR, Division of Agriculture. 2019. *Elodea*. Available at: dnr.alaska.gov/ag/ag_Elodea.htm

ADNR, Office of History and Archaeology. 2019. Alaska Heritage Resources Survey Online Database. Available at: dnr.alaska.gov/parks/oha/ahrs/ahrs.htm

ADOLWD (Alaska Department of Labor and Workforce Development). 2019. *Northwest Arctic Borough and Yukon-Koyukon Census Area Annual Average Resident Employment by Industry, 2014-2016*.

AICC (Alaska Interagency Coordination Center). 2019. Alaska Interagency Wildland Fire Management Plan 2016. March 2019 Review. Available at: fire.ak.blm.gov/content/aicc/Alaska%20Statewide%20Master%20Agreement/4.%20Alaska%20Interagency%20WIldland%20Fire%20Managment%20Plan%20(AIWFMP)/2018%20AIWFMP.pdf Accessed April 24, 2019.

AIDEA. 2019. Investing in Alaskans: Partnership, Stewardship, Integrity. Available at: www.aidea.org/Portals/0/PDF%20Files/2019AIDEAInformationBrochure.pdf

AKEPIC (Alaska Exotic Plants Information Clearinghouse), ANHP (Alaska Natural Heritage Program), UAA (University of Alaska Anchorage), ACCS (Alaska Center for Conservation Science). 2019. Alaska Exotic Plant Information Clearinghouse database. Alaska Center for Conservation Science, University of Alaska Anchorage. Available at: aknhp.uaa.alaska.edu/apps/akepic/ Accessed February 2019.

Akpoveta, O.V., and Osakwe, S.A. 2014. Determination of Heavy Metal Contents in Refined Petroleum Products. e-ISSN: 2278-5736. *IOSR Journal of Applied Chemistry* Volume 7, Issue 6, Ver. 1:1–2. June 2014.

Alaska Federal Health Care Partnership. 2016. Alaska Challenges. Anchorage, Alaska.

Alt, K. 1994. Whitefish Species – Alaska Department of Fish and Game.

Altman, B., and R. Sallabanks. 2012. Olive-sided Flycatcher (Contopus cooperi), Version 2.0. In *The Birds of North America* (A. F. Poole, editor). Cornell Lab of Ornithology, Ithaca, New York. Available at: doi.org/10.2173/bna.502

Andersen, R. 1991. Habitat changes in moose ranges: effects on migratory behavior, site fidelity, and size of summer home range. *Alces* 27:85–92.

Anderson, D.B. 2007. Local and Traditional Knowledge of Whitefish in the Upper Koyukuk River Drainage, Alaska. Draft Final Report for FIS Project 04-269. TEK Component.

Anderson, D.B., C.L. Brown, R.J. Walker, and K. Elkin. 2004. *Traditional Ecological Knowledge and Contemporary Subsistence Harvest of Non-salmon Fish in the Koyukuk River Drainage, Alaska*. ADF&G, Division of Subsistence. Technical Paper No. 282.

Anderson, David B., Caroline Brown, Robert Walker, and Gretchen Jennings. 2004. *The 2001-2002 Harvest of Moose, Caribou, and Bear in Middle Yukon and Koyukuk River Communities*. ADF&G, Division of Subsistence, Technical Paper No. 278.

Andrews, E.F. 1977. *Report on Cultural Resources of the Doyon Region, Central Alaska*. Occasional Paper No. 5, Anthropology and Historic Preservation Cooperative Park Studies Unit. University of Alaska, Fairbanks.

Armstrong, Robert H. 1994. *Alaska Blackfish*. Prepared by ADF&G. Available at: www.adfg.alaska.gov/static/education/wns/alaska_blackfish.pdf

Armstrong, H. 2010. Alaska Potential Fossil Yield Classification (PFYC) List. On file, BLM Alaska and Colorado State Offices.

ASTM (American Society for Testing and Materials). 1999. Standard Guide for Assessment of Wetland Functions. ASTM Subcommittee E50.05.

ATSDR. 2019. Agency for Toxic Substances and Disease Registry. Available at: www.atsdr.cdc.gov/

Auerbach, N.A., M.D. Walker, and D.A. Walker. 1997. Effects of Roadside Disturbance on Substrate and Vegetation Properties in Arctic Tundra. *Ecological Applications* 7(1):218–235.

Avery, M.L. 2013. Rusty Blackbird (Euphagus carolinus), Version 2.0. In *The Birds of North America* (A. F. Poole, editor). Cornell Lab of Ornithology, Ithaca, New York. Available at: birdsna.org/Species-Account/bna/species/rusbla/introduction

Ballard, W.B., L.A. Ayres, P.R. Krausman, D.J. Reed, and S.G. Fancy. 1997. Ecology of wolves in relation to a migratory caribou herd in northwest Alaska. *Wildlife Monographs* 135:1–47.

Ballard, W.B., M. Edwards, S.G. Fancy, S. Boe, and P.R. Krausman. 1998. Comparison of VHF and satellite telemetry for estimating sizes of wolf territories in northwest Alaska. *Wildlife Society Bulletin* 26(4):823–829.

Barber, J.R., K.R. Crooks, and K.M. Fistrup. 2010. The costs of chronic noise exposure for terrestrial organisms. *Trends in Ecology and Evolution* 25(3):180–189.

Barnes, D. and B. Conner. 2014. Managing Dust on Unpaved Roads and Airports. INE/AUTC 14.14. Alaska DOT&PF, Alaska University Transportation Center. Report No. 4000096. October 2014.

Barr, J. F., C. Eberl, and J.W. McIntyre. 2000. Red-throated Loon (Gavia stellata), Version 2.0. In *The Birds of North America* (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, New York. Available at: birdsna.org/Species-Account/bna/species/retloo/introduction

Bartzke, G.S., R. May, E.J. Solberg, C.M. Rolandsen, and E. Roskaft. 2015. Differential barrier and corridor effects of power lines, roads, and rivers on moose (*Alces alces*) movements. *Ecosphere* 6(4):67.

Bayne, E.M., L. Habib, and S. Boutin. 2008. Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. *Conservation Biology* 22(5):1186–1193.

Berland, A., T. Nelson, G. Stenhouse, K. Graham, and J. Cranston. 2008. The impact of landscape disturbance on grizzly bear habitat use in the Foothills Model Forest, Alberta, Canada. *Forest Ecology and Management* 256(11):1875–1883.

Betchkal, D. 2015. Acoustic Monitoring Report, Noatak National Preserve – 2013 and 2014. Natural Resource Data Series NPS/NOAT/NRR–2015/787. DOI, NPS. Fort Collins, Colorado.

Betchkal, D. 2019. Gates of the Arctic National Park and Preserve – acoustic inventory report, 2013 and 2014. Natural Resource Report NPS/GAAR/NRR—2019/1892. DOI, NPS. Fort Collins, Colorado.

Betts, M.F. 1997. *Subsistence Harvest and Use Patterns for Rampart, Tanana, Stevens Village, Manley Hot Springs, Eureka, and Minto, Alaska: Eureka-Rampart Road Study Environmental Assessment*. Northern Land Use Research, Inc. Fairbanks, Alaska.

Blanchard, Morgan R., Richard O. Stern, Jason Rogers, David Guilfoyle, Peter M. Bowers, Roberta Gordaoff, Hayley Brown, Gayle Neufeld, and Michaela Phillips. 2014a. *Cultural Resources Overview and Data Gap Analysis, Ambler Mining District Industrial Access Road Project (AMDIAR)*. Prepared for DOWL HKM by Northern Land Use Research Alaska, LLC. Anchorage, Alaska.

Blanchard, Morgan, David Guilfoyle, and Gerad Smith. 2014b. *Level 1 Cultural Resources Survey - 2013 Ambler Mining District Industrial Access Road Project*. Prepared for DOWL HKM by Northern Land Use Research Alaska, LLC. Anchorage, Alaska.

Blanchard, Morgan, Sarah McGowan, Karin Olmedo, Gerad Smith, Patrick Hall, and Roberta Gordaoff. 2015. *Cultural Resources Survey of the Ambler Mining District Industrial Access Road (AMDIAR) Project Within Gates of the Arctic National Preserve, Alaska*. Prepared for DOWL HKM by Northern Land Use Research Alaska, LLC. Anchorage, Alaska

BLM (U.S. Bureau of Land Management). 1986. *Resource Management Plan and Record of Decision for the Central Yukon Planning Area*. Prepared by BLM Fairbanks District Office. Available at: eplanning.blm.gov/epl-front-office/projects/lup/35315/43914/47265/CYRMP_ROD_small-web.pdf

BLM. 1989. *Utility Corridor Proposed Resource Management Plan and Environmental Impact Statement*. Prepared by BLM Arctic District Office. Fairbanks, Alaska.

BLM. 1991a. *Utility Corridor Resource Management Plan/Environmental Impact Statement Record of Decision*. Available at: eplanning.blm.gov/epl-front-office/projects/lup/35315/43921/47272/UtilityRMP_ROD_web.pdf

BLM. 1991b. *Recreation Area Management Plan: Dalton Highway*. November 1991. Prepared by BLM Arctic District Office. Fairbanks, Alaska. Available at: archive.org/details/recreationmanage6051unit

BLM. 2004. Alaska Statewide Land Health Standards and Guidelines. Instruction Memorandum No. AK 2004-023. Available at: eplanning.blm.gov/epl-front-office/projects/lup/66967/84130/100730/Statewide_land_health_standards.pdf

BLM. 2006. *Kobuk Seward Peninsula Resource Management Plan, Draft EIS*. Available at: eplanning.blm.gov/epl-front-office/eplanning/docset_view.do?projectId=66967&currentPageId=96799&documentId=132953

BLM. 2008a. National Environmental Policy Act Handbook H-1790-1. January 2008. NEPA Handbook H-1790 508. Available at: www.ntc.blm.gov/krc/uploads/366/NEPAHandbook_H-1790_508.pdf

BLM. 2008b. Manual 6840 Special Status Species Management. Form 1221-2, Release 6-125. Available at: www.blm.gov/sites/blm.gov/files/uploads/mediacenter_blmpolicymanual6840.pdf

BLM. 2013a. National Petroleum Reserve-Alaska Integrated Activity Plan Record of Decision. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska. Available at: eplanning.blm.gov/epl-front-office/projects/nepa/5251/42462/45213/NPR-A_FINAL_ROD_2-21-13.pdf

BLM. 2013b. TES C Geothermal Springs In: CYR geodatabase. Accessed February 2019.

BLM. 2013c. Invasive Species In: CYR geodatabase. Accessed February 2019.

BLM. 2013d. Non-native Plants 5th Level Hydrologic Units. In: CYR geodatabase. Accessed February 2019.

BLM. 2013e. *Elodea* Susceptible Rivers In: CYR geodatabase. Accessed February 2019.

BLM. 2013f. Infestation Vulnerability. In: CYR geodatabase. Accessed February 2019.

BLM. 2015. *Central Yukon Resource Management Plan: Areas of Critical Environmental Concern*. Prepared in advance of a RMP revision, November 2015. Prepared by BLM Central Yukon Field Office. Fairbanks, Alaska. Available at: eplanning.blm.gov/epl-front-office/projects/lup/35315/66005/71748/2015-11-24_CYRMP_ACEC-Rpt_final_508_reduced.pdf

BLM. 2016a. *Central Yukon Resource Management Plan, Analysis of Management Situation*. Prepared by the BLM Central Yukon Field Office, April 2016. Available at: eplanning.blm.gov/epl-front-office/projects/lup/35315/72940/80089/CYRMP_AMS_all_April_2016_Final.pdf

BLM. 2016b. BLM Alaska ANCSA 17b Easements Brochure. Available at: www.blm.gov/documents/alaska/public-room/brochure/ancsa-17b-easements-brochure

BLM. 2018a. *Ambler Road Environmental Impact Statement Scoping Summary Report*. April 2018. Available at: eplanning.blm.gov/epl-front-office/projects/nepa/57323/143515/176591/20180430_Ambler_EIS_SSR.pdf

BLM. 2018b. *Mineral Occurrence and Development Potential Report – Leasable, Central Yukon Resources Management Plan*. BLM/AK/PL-18/009+9128+FO200

BLM. 2018c. *Visual Resource Inventory: Central Yukon Resource Management Plan*. Inventory prepared in advance of planned resource management plan, June 2018. BLM Central Yukon Field Office. Fairbanks, Alaska. Available at: eplanning.blm.gov/epl-front-office/projects/lup/35315/154298/191364/Visual_Resource_Inventory.pdf

BLM. 2019. BLM-Alaska Special Status Plant and Animal Species List – 2019. Available at: www.blm.gov/programs/fish-and-wildlife/threatened-and-endangered/state-te-data/alaska Accessed February 14, 2019.

Boertje, R.D., C.L. Gardner, K.A. Kellie, and B.D. Taras. 2012. Fortymile caribou herd: increasing numbers, declining nutrition, and expanding range. Wildlife Technical Bulletin 14, ADF&G/DWC/WTB-2012-14.

Boggs, K., T.V. Boucher, T.T. Kuo, D. Fehringer, and S. Guyer. 2012. Vegetation map and classification: Northern, Western and Interior Alaska. Alaska Natural Heritage Program, University of Alaska Anchorage. Anchorage, Alaska.

Bolger, D.T., W.D. Newmark, T.A. Morrison, and D.F. Doak. 2008. The need for integrative approaches to understand and conserve migratory ungulates. *Ecology Letters* (2008) 11:63–77.

Boucher, T.V., J.R. Fulkerson, B. Bernard, L. Flagstad, T. Nawrocki, M. Carlson, and N. Fresco. 2016. Section G. Terrestrial Coarse-filter Conservation Elements. In: *Central Yukon Rapid Ecoregional Assessment*. Prepared for the U.S. Department of the Interior (Trammel, E.J, T. Boucher, M.L. Carlson, N. Fresco, J.R. Fulkerson, M.L. McTeague, J. Reimer, and J. Schmidt, editors). DOI, BLM. Anchorage, Alaska.

Braem, N.M., E.H. Mikow, S.J. Wilson, and M.L. Kostick. 2015. *Wild Food Harvests in 3 Upper Kobuk River Communities: Ambler, Shungnak, and Kobuk, 2012–2013*. Technical Paper No. 402. February 2015. ADF&G, Division of Subsistence. Fairbanks, Alaska. Available at: www.adfg.alaska.gov/techpap/TP%20402.pdf

Brown, A.V., M.M. Lyttle, and K.B. Brown. 1998. Impacts of Gravel Mining on Gravel Bed Streams. *Transactions of the American Fisheries Society* 127:979–994.

Brown, C.L., J.S. Magdanz, D.S. Koster, and N.M. Braem. 2012. *Subsistence Harvests in 8 Communities in the Central Kuskokwim River Drainage, 2009*. Technical Paper No. 365. ADF&G, Division of Subsistence, Fairbanks, Alaska. Available at: library.state.ak.us/asp/edocs/2012/03/ocn781787334.pdf

Brown, R.J. 2009. *Distribution and Demographics of Whitefish Species in the Upper Koyukuk River Drainage, Alaska, with an Emphasis on Seasonal Migrations and Important Habitats of Broad Whitefish and Humpback Whitefish*. Alaska Fisheries Technical Report Number 104. August 2009. Fairbanks Fish and Wildlife Field Office. Fairbanks, Alaska.

Brown, R.J., and J.M. Burr. 2012. *A Radiotelemetry Investigation of the Spawning Origins of Innoko River Inconnu (Sheefish)*. ADF&G, Fishery Data Series No. 12-54. Anchorage, Alaska.

Brown, W.E. 2007. T*he History of the Central Brooks Range: Gaunt Beauty – Tenuous Life*. University of Alaska Press. Fairbanks, Alaska.

Burch, E.S. 1998. *The Inupiaq Eskimo Nations of Northwest Alaska*. University of Alaska Press. Fairbanks, Alaska.

Burch, E.S. Jr. 2012. *Caribou herds of northwest Alaska 1850–2000*. University of Alaska Press. Fairbanks, Alaska.

Burford Jr., D.D. 2005. An Assessment of Culverts of Fish Passage Barriers in a Montana Drainage using a Multi-tiered Approach. A thesis submitted in partial fulfillment of the requirements for the degree Masters of Science in Fish and Wildlife Management. Montana State University. Bozeman, Montana. April 2005. Available at: scholarworks.montana.edu/xmlui/bitstream/handle/1/1013/BurfordD0505.pdf?sequence

Burson III, S.L., J.L. Belant, K.A. Fortier, and W.C. Tomkiewicz III. 2000. The effect of vehicle traffic on wildlife in Denali National Park. *Arctic* 53(2): 146-151.

Cameron, R.D., D.J. Reed, J.R. Dau, W.T. Smith. 1992. Redistribution of calving caribou in response to oil field development on the Arctic slope of Alaska. *Arctic* 45(4):338–342.

Cameron, R. D., W. T. Smith, R. D. White, and B. Griffith. 2005. Central arctic caribou and petroleum development: distribution, nutritional and reproductive implications. *Arctic* 58:1–9.

Cardno. 2015. *Ambler Mining Region Economic Impact Analysis*. Prepared for AIDEA. Project Number E514004900. January 16, 2015. Available at: www.aidea.org/Portals/0/PDF%20Files/CARDNOAmblerEconomicImpactAnalysis.pdf

Carls, M. and J. Meador. 2009. A Perspective on the Toxicity of Petrogenic PAHs to Developing Fish Embryos Related to Environmental Chemistry. Human and Ecological Risk Assessment - HUM ECOL RISK ASSESSMENT. 15. 1084-1098. 10.1080/10807030903304708.

Carlson, M. L., I. Lapina, M. Shephard, J.S. Conn, R. Densmore, P. Spencer, J. Heys, J. Riley, and J. Nielsen. 2008. *Invasiveness Ranking System for Non-native Plants of Alaska*.

Carlson, M.L., M. Aisu, E.J. Trammell, J. R. Fulkerson, D. Merrigan, and T. Nawrocki. 2016. Section D. Biotic Change Agents. In . *Central Yukon Rapid Ecoregional Assessment* (Trammell, E.J., T. Boucher, M.L. McTeague, J. Reimer, and J. Schmidt, editors). Prepared for the DOI, BLM. Anchorage, Alaska.

CEQ and ACHP (Council on Environmental Quality and Advisory Council on Historic Places). 2013. NEPA and NHPA: A Handbook for Integrating NEPA and Section 106. Council on Environmental Quality, Executive Office of the President and Advisory Council on Historic Places. Washington, D.C.

Cheek, J. 2008. How Arctic engineers are facing the challenges of a changing climate. Science Poles interview. Available at: www.sciencepoles.org/interview/how-arctic-engineers-are-facing-challenges-of-changing-climate

Chen, W., S.G. Leblanc, H.P. White, C. Prevost, B. Milakovic, C. Rock, G. Sharam, H. O'Keefe, L. Corey, B. Croft, A. Gunn, S. van der Wielen, A. Football, V. Tracz, .S. Pellissey, and J. Boulanger. 2017. Does Dust from Arctic Mines Affect Caribou Forage? *Journal of Environmental Protection* 8:258–276.

Cho, R. 2018. Why thawing permafrost matters. Republished courtesy of Earth Institute, Columbia University. PhyOrg. January 12, 2018. Available at: phys.org/news/2018-01-permafrost.html

Colpern, M., and J.L. Nelson. 2011. A Digital Atlas for the Northern Cordillera: Major Geologic Terranes. Available at: www.geology.gov.yk.ca Accessed March 7, 2019.

Cook, J.A., and S.O. MacDonald. 2006. *Mammal Inventory of Alaska's National Parks and Preserves: Arctic Network Inventory & Monitoring Program.* NPS, Alaska Region, Inventory and Monitoring Program Final Report 2006.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M. van den Belt. 1997. The Value of the World's Ecosystem Services and Natural Capital. *Nature,* Vol. 387. May 15, 1997.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. USFWS, Office of Biological Services. Washington, D.C.

Craig, T., and L. Dillard. 2012. *Aerial Raptor Stick Nest Survey – Fall 2012*. Kanuti NWR, USFWS.

Craig, T., and L. Dillard. 2013. *Aerial Raptor Stick Nest Survey – Spring 2013*. Kanuti NWR. USFWS.

Creamer, P.A. 2019. Culvert Hydraulics: Basic Principles. CONTECH Engineers Solutions. Available at: www.conteches.com/knowledge-center/pdh-article-series/culvert-hydraulics-basic-principles

Cronin, M.A., W.B. Ballard, J. Truett, and R. Pollard. 1994. Mitigation of the effects of oil field development and transportation corridors on caribou. Final Report to the Alaska Caribou Steering Committee. LGL Alaska Research Associates, Inc. Anchorage, Alaska.

Curatolo, J.A. and S.M. Murphy. 1986. The Effects of Pipelines, Roads, and Traffic on the Movements of Caribou, *Rangifer tarandus*. *Canadian Field-Naturalist* 100(2):2018–224.

Cuyler, C., R.R. White, K. Lewis, C. Soulliere, A. Gunn, D.E. Russell, and C. Daniel. 2010. Are warbles and bots related to reproductive status in West Greenland caribou? *Rangifer*, Special Issue No. 20:243–257.

Daigle, P. 2010. A summary of the environmental impacts of roads, management responses, and research gaps: A literature review. *BC Journal of Ecosystems and Management* 10(3):65–89.

Dale, B.W., L.G. Adams, and R.T. Bowyer. 1994. Functional response of wolves preying on barren-ground caribou in a multiple-prey ecosystem. *Journal of Animal Ecology* 63:644–652.

Danahy, Anne. 2013. Suppression of naturally occurring blazes may increase wildfire risk. *Penn State News*. Available at: news.psu.edu/story/270206/2013/03/26/research/suppression-naturally-occurring-blazes-may-increase-wildfire-risk

Darrow, M., D. Fortier, R. Daanen, J. Zottola, I. De Grandpré, S. Veuille, and M. Sliger. 2013. Impacts of groundwater flow on permafrost degradation and transportation infrastructure stability. Alaska University Transportation Center Report 13.08.

Dau, J. 2005. Two caribou mortality events in Northwest Alaska: possible causes and management implications. *Rangifer*, Special Issue No. 16:37–50.

Dau, J. 2013. Units 21D, 22A, 22B, 22C, 22D, 22E, 23, 24 and 26A. Pp. 201–280 in *Caribou management report of survey and inventory activities 1 July 2010–30 June 2012* (P. Harper, editor). ADF&G, Species Management Report ADF&G/DWC/SMR-2013-3. Juneau, Alaska.

Dau, J. 2015. Units 21D, 22B, 22C, 22E, 23, 24 AND 26A. Chapter 14, Pp. 14-1 – 14-89 In: *Caribou management report of survey and inventory activities 1 July 2012 – 30 June 2014* (P. Harper and L.A. McCarthy, editors). ADF&G, Species Management Report ADF&G/DWC/SM-2015-4. Juneau, Alaska.

Davis, M. 2019. Letter from AIDEA Mark Davis (AIDEA Chief Infrastructure Development Officer) to BLM Timothy J. La Marr (BLM Field Manager – Central Yukon Field Office. Personal communication, April 16, 2019.

DeGroot, K.A., and J. McMillan. 2012. *Landbird monitoring in the Arctic Network: Gates of the Arctic National Park and Preserve and Noatak National Preserve (2010 report)*. Natural Resource Report NPS/ARCN/NRDS-2012/315. NPS. Fort Collins, Colorado.

DFO. 2000. Effects of sediment on fish and their habitat. DFO Pacific Region Habitat Status Report 2000/01.

DOI (United States Department of the Interior). 2017. 7 Burning Questions: Wildfires & Public Lands. Available at: www.doi.gov/blog/7-burning-questions-wildfires-public-lands

DOT&PF (Alaska Department of Transportation and Public Facilities). 2009a. *Naturally Occurring Asbestos in Alaska and Experience and Policy of Other States Regarding its Use*. Statewide Research Office. Juneau, Alaska.

DOT&PF. 2012a. Naturally Occurring Asbestos (NOA) Material Use Interim Guidance and Standards. July 12, 2012. Available at: www.dot.state.ak.us/stwddes/desmaterials/assets/pdf/asbestos/noa_interim_guidance.pdf

DOT&PF. 2017. 2017 Annual average daily traffic (AADT) GIS Map. Available at: dot.alaska.gov/stwdplng/transdata/traffic_AADT_map.shtml Accessed on May 10, 2019.

DOT&PF. 2019. Unpublished Dalton Highway crash data for 2013–2016 provided by DOT&PF to HDR. Anchorage, Alaska.

DOWL. 2011a. *Ambler Mining District Access Geotechnical Memorandum*. September 2011. Report prepared for DOT&PF Northern Region. Fairbanks, Alaska.

DOWL. 2011b. *Ambler Mining District Access, Environmental Overview Memorandum.* AKSAS 63812. Prepared for DOT&PF, Fairbanks, Alaska. Prepared by DOWL HKM, Anchorage, Alaska. September 2011.

DOWL. 2014a. *Preliminary Wetland Delineation and Functions and Values Assessment Ambler Mining District Access Road*. Prepared for AIDEA. May 2014. Anchorage, Alaska.

DOWL. 2015. *Ambler Mining District Industrial Access Road Preliminary Terrain Unit Map Report*. Prepared for AIDEA. Anchorage, Alaska.

DOWL. 2016a. *Ambler Mining District Industrial Access Project Corridor SF299 Supplemental Narrative*. Prepared for Alaska Industrial Development and Export Authority. Anchorage, Alaska. Available at: eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=111130

DOWL. 2016b. Desktop Wetland Delineation Ambler Mining District Industrial Access Project. Prepared for AIDEA. June 2016. Anchorage, Alaska.

DOWL. 2019a. Ambler Mining District Industrial Access Project SF299 Application Communications Amendment. April 2019. Prepared for AIDEA by DOWL. Anchorage, Alaska.

DOWL. 2019b. Unpublished data. DOWL mapping under preparation.

Doyon Limited. 2019. Natural Resource Development. Available at www.doyon.com/our-companies/natural-resource-development/ Accessed February 23, 2019.

Duchesne, M., S. D. Cote, and C. Barnette. 2000. Responses of woodland caribou to winter ecotourism in the Charlevoix Biosphere Reserve, Canada. *Biological Conservation* 96:311–317.

Dyer, S.J., J. P. O'Neill, S.M. Wasel, and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in northeastern Alberta. *Canadian Journal of Zoology* 80:839–845.

Eagan, R.M. 1995. Units 20A, 20B, 20C, 20F, and 25C brown bear. Pp. 192–212 In: Brown bear management report of survey and inventory activities (M.V. Hicks, editor). Study 4.0. ADF&G. Juneau, Alaska.

Eastland, W.G., R.T. Bowyer, and S.G. Fancy. 1989. Effects of snow cover on selection of calving sites by caribou. *Journal of Mammalogy* 70(4):824–828.

Edmonds, E. J. 1987. Population status, distribution, and movements of woodland caribou in west central Alberta. *Canadian Journal of Zoology* 66:817–826.

Egger, K. 2019. BLM recreation subject matter expert, personal communication to John Wolfe, HDR recreation subject matter expert.

EPA (U.S. Environmental Protection Agency). 2009. *Red Dog Mine Extension, Aqqaluk Project, Final Supplemental Environmental Impact Statement*. Prepared by Tetra Tech, Inc., October 2009.

EPA. 2016. NAAQS Table. Available at: www.epa.gov/criteria-air-pollutants/naaqs-table

EPA. 2019. NPDES Stormwater Program. Available at: www.epa.gov/npdes/npdes-stormwater-program

Erickson, W.P., G.D. Johnson, and D.P. Young, Jr. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. USDA Forest Service Technical Report PSW-GTR-191.

Esse, D.A., and C.F. Kretsinger. 2009. Abundance and run timing of adult salmon in Clear Creek, Hogatza River, Alaska, 2000–2005. Program Report DIFR BLM/AK/F0300-65/FY09/1120/07. BLM, Central Yukon Field Office. Fairbanks, Alaska.

Evengard, B., J. Berner, M. Brubaker, G. Mulvad, and B. Revich. 2011. Climate change and water security with a focus on the Arctic. Global Health Action 2011; 4:10.3402/gha.v4i0.8449. Available at: www.ncbi.nlm.nih.gov/pmc/articles/PMC3204919/

Faille, G., C. Dussault, J. Ouellet, D. Fortin, R. Courtois, M. St-Laurent, C. Dussault. 2010. Range fidelity: the missing link between caribou decline and habitat alteration? *Biological Conservation* 143:2840–2850.

Fay, G., A. Meléndez, and T. Schwörer. 2012. *Power Cost Equalization Funding Formula Review*. Prepared for National Renewable Energy Laboratory. Golden, Colorado.

Ferguson, M.A.D., and F. Messier. 2000. Mass emigration of Arctic tundra caribou from a traditional winter range: population dynamics and physical condition. *Journal of Wildlife Management* 64 (1):168–178.

Forman, R.T.T. and L.E. Alexander. 1998. Roads and their Major Ecological Effects. *Annual Review of Ecology and Sytematics* 29(1998):207–231. Available at: www.jstor.org/stable/221707

Foster, M., and S. Goldsmith. 2008. *Replacement Cost for Public Infrastructure in Alaska: An Update*. Institute for Social and Economic Research, University of Alaska Anchorage. Anchorage, Alaska.

Fresco, N., A. Floyd, M. Lindgren, A. Bennett, L. Krutikov, and S. Marchenko. 2016. Section C: Abiotic Change Agents. In: *Central Yukon Rapid Ecoregional Assessment* (Trammel, E.J, T. Boucher, M.L. Carlson, N. Fresco, J.R. Fulkerson, M.L. McTeague, J. Reimer, and J. Schmidt, editors). Prepared for the DOI, BLM. Anchorage, Alaska.

Fried, N. 2018. The Cost of Living in Alaska. *Alaska Economic Trends* 38 (7):4–13.

Friedman, Sam. 2018. CDLs Fly South for Shift Work. Alaska Business Magazine. July 24, 2018. Available at: www.akbizmag.com/industry/transportation/cdls-fly-south-for-shift-work/

Fulkerson, J., E.J. Trammel, M.L. Carlson, and M. McTeague. 2016. Section B. Introduction to the Final Report. In: *Central Yukon Rapid Ecoregional Assessment* (Trammell, E.J., T. Boucher, M.L. Carlson, N. Fresco, J.R. Fulkerson, M.L. McTeague, J. Reimer, and J. Schmidt, editors). Prepared for the DOI, BLM. Anchorage, Alaska.

Fullman, T.J., K. Joly, and A. Ackerman. 2017. Effects of environmental features and sport hunting on caribou migration in northwestern Alaska. *Movement Ecology* 5:4–15.

Gardner, C.L., J.P. Lawler, J.M. Ver Hoef, A.J. Magoun, and K.A. Kellie. 2010. Coarse-scale distribution surveys and occurrence probability modeling for wolverine in interior Alaska. *The Journal of Wildlife Management* 74(8):1894–1903.

Gardner, C.L., N.J. Pamperin, and J.F. Benson. 2014. Movement patterns and space use of maternal grizzly bears influence cub survival in interior Alaska. *Ursus* 25(2):121–138.

Gerken, J.D. 2009. Identification and Characterization of Inconnu Spawning Habitat in the Sulukna River, Alaska. December 2009.

Goldsmith, S. 2010. *The Alaska Permanent Fund Dividend: A Case Study in Implementation of a Basic Income Guarantee*. Institute for Social and Economic Research, University of Alaska, Anchorage. Anchorage, Alaska.

Grybeck, Donald. 1977. *Known Mineral Deposits of the Brooks Range, Alaska*. USGS Open-file report 77-166C. Available at: dggs.alaska.gov/pubs/id/12337

Grybeck, D.J., S.W. Nelson, J.B. Cathrall, J.W. Cady, and J.R. Le Compte. 1996. Mineral resource potential map of the Survey Pass Quadrangle, Brooks Range, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map 1176-I, 16 p., 1 sheet, scale 1:250,000.

Guettabi, M., J. Greenberg, J. Little, and K. Joly. 2016. *Evaluating Differences in Household Subsistence Harvest Patterns Between the Ambler Project and Non-project Zones*. Natural Resource Report NPS/GAAR/NRR-2016/1280. Available at: www.iser.uaa.alaska.edu/Publications/2016_08-EvaluatingDifferencesInHouseholdSubsistence.pdf

Hall, J.V., W.E. Frayer, and B.O. Wilen. 1994. Status of Alaska Wetlands. Available at: www.fws.gov/wetlands/documents/status-of-alaska-wetlands.pdf

Hancock, P.J. 2002. Human Impacts on the Stream–Groundwater Exchange Zone. Environmental Management 29(6):763–781.

Harris, G., R.M. Nielson, T. Rinaldi, and T. Lohuis. 2014. Effects of winter recreation on northern ungulates with focus on moose (*Alces alces*) and snowmobiles. *European Journal of Wildlife Resources* 60:45–58.

Harwood, C. 2014. Kanuti NWR Trip Report June 2014, Kanuti Canyon and Kanuti Lake BBSs. USFWS, Kanuti NWR. Bettles, Alaska.

Hasselbach, L., J.M. Ver Hoef, J. Ford, P. Neitlich, E. Crecelius, S. Berryman, B. Wolk, and T. Bohle. 2005. Spatial patterns of cadmium and lead deposition on and adjacent to National Park Service lands in the vicinity of Red Dog Mine, Alaska. U.S. National Park Service Publications and Papers 12. Available at: digitalcommons.unl.edu/natlpark/12

Hastings, M.C. and A.N. Popper. 2005. Effects of Sound on Fish. January 28, 2005; Revised Appendix B August 23, 2005.

Hawkins, A. 2005. Assessing the impact of pile driving upon fish. UC Davis Road Ecology Center. Available at: escholarship.org/uc/item/28n858z1#main

HDR (HDR Alaska, Inc.). 2018. *Yukon River Reconnaissance Study: Existing Conditions and Initial Needs Assessment Report*. March 2018. Prepared by HDR for DOT&PF. Anchorage, Alaska.

Hilderbrand, G.V., K. Joly, M.S. Sorum, M.D. Cameron, and D.D. Gustine. 2019. Brown bear (*Ursus arctos*) body size, condition, and productivity in the Arctic, 1977–2016.

Hintz, W.D. and R.A. Relyea. 2017. Impacts of road deicing salts on the early-life growth and development of a stream salmonid: Salt type matters. *Environmental Pollution* 223:409–415. April 2017.

Hinzman, L.D., N.D. Bettez, W.R. Bolton, F.S. Chapin, M.B. Dyurgerov, C.L. Fastie, B. Griffith, R.D. Hollister, A. Hope, H.P. Huntington, A.M. Jensen, G.J. Jia, T. Jorgenson, D.L. Kane, D.R. Klein, G. Kofinas, A.H. Lynch, A.H. Lloyd, A.D. McGuire, F.E. Nelson, W.C. Oechel, T.E. Osterkamp, C.H. Racine, V.E. Romanovsky, R.S. Stone, D.A. Stow, M. Sturm, C.E. Tweedie, G.L. Vourlitis, M.D. Walker, D.A. Walker, P.J. Webber, J.M. Welker, K.S. Winker, and K. Yoshikawa. 2005. Evidence and Implications of Recent Climate Change in Northern Alaska and Other Arctic Regions. *Climate Change* (2005) 72:251–298. DOI: 10.1007/s10584-005-5352-2.

Hollis, A.L. 2007. Units 20F, 21B, 21C, 21D and 24 caribou. Pp. 158–173 in *Caribou management report of survey and inventory activities 1 July 2004- 30 June 2006* (P. Harper, editor). ADF&G. Project 3.0. Juneau, Alaska.

Hong, E., R. Perkins, and S. Trainor. 2014. Thaw Settlement Hazard of Permafrost Related to Climate Warming in Alaska. *Arctic* 67 (1):93–103. Available at: pubs.aina.ucalgary.ca/arctic/Arctic67-1-93.pdf

Horne, J.S., T. Craig, K. Joly, G.W. Stout, M.R. Cebrian, and E.O. Garton. 2014. Population characteristics, space use, and habitat selection of two non-migratory caribou herds in central Alaska, 1994–2009. *Rangifer* 34(1):1–20.

Hotchkiss, R.H. and C.M. Frei. 2007. Design for fish passage at roadway-stream crossings: synthesis report. FHWA-HIF-07-033. June 2007.

Hughes, J., S.D. Albon, R.J. Irvine, and S. Woodin. 2009. The cost of parasites to caribou. *Parasitology* 136:253–265.

Hughes, R.M, F. Amezcua, D.M. Chambers, W.M. Daniel, J.S. Franks, W. Fanzin, D. MacDonald, E. Merriam, G. Neall, P. dos Santos Pompeu, L. Reynolds, L. Roulson, and C.A. Woody. 2016. Position Paper and American Fisheries Society Statement on Mining and Fossil Fuel Extraction.

Hughes Traditional Council. 2013. Hughes Long Range Transportation Plan.

Incardona, J.P., T.K. Collier, and N.L. Scholz. 2004. Defects in cardiac function precede morphological abnormalities in fish embryos exposed to polycyclic aromatic hydrocarbons. *Toxicology and Applied Pharmacology* 196(2):191–205. April 15, 2004. Available at: www.sciencedirect.com/science/article/pii/S0041008X04000110

Incardona, J., M. Carls, L. Holland, T. Linbo, D.H. Baldwin, M. Myers, K.A. Peck, M. Tagal, S.D. Rice, and N. Scholz. 2015. Very low embryonic crude oil exposures cause lasting cardiac defects in salmon and herring. Scientific Reports. 5. 13499. 10.1038/srep13499.

Iniakuk Wilderness Lodge. 2019. Iniakuk Wilderness Lodge. Available at: gofarnorth.com/

IPCC (International Panel on Climate Change). 2007. *Climate Change 2007: Synthesis Report*. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, Pachauri, R.K and A. Reisinger, editors). IPCC, Geneva, Switzerland. Available at: www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf

IUCN (International Union for Conservation of Nature). 2019. The IUCN Red List of Threatened Species. Version 2019-1. Available at: www.iucnredlist.org Accessed March 22, 2019.

Jandt, R.R. 1998. *Ray Mountains Caribou: distribution, movements and seasonal use areas, 1994–1997*. BLM Alaska Open File Report 69. U.S. Department of the Interior, Bureau of Land Management, Alaska State Office. Anchorage, Alaska.

Jandt, R.R., C.R. Meyers, and M.J. Cole. 2003. *Western Arctic Caribou Herd Winter Habitat Monitoring and Utilization, 1995-1996*. BLM-Alaska Open File Report 88, January 2003.

Jandt, R.R., K. Joly, C.R. Meyers, and C. Racine. 2008. Slow recovery of lichen on burned caribou winter range in Alaska tundra: potential influences of climate warming and other disturbance factors. *Arctic, Antarctic, and Alpine Research* 40:89–95.

Jensen, D.W., E. Ashley Steel, A.H. Fullerton, and G.R. Pess. 2009. Impact to Fine Sediment on Egg-to-Fry Survival of Pacific Salmon: A Meta-Analysis of Published Studies. Northwest Fisheries Science Center, NOAA Fisheries. Seattle, Washington.

Jensen, D.W., E.A. Steel, A.H. Fullerton, and G.R. Pess. 2009. Impact of Fine Sediment on Egg-to-Fry Survival of Pacific Salmon: A Meta-Analysis of Published Studies. *Reviews in Fisheries Science* 17(3):348–359.

Johnson, I., T. Brinkman, B. Lake, C. Brown. 2017. Winter hunting behavior and habitat selection of wolves in a low-density prey system. *Wildlife Biology* 2017. Available at: bioone.org/journals/wildlife-biology/volume-2017/issue-4/wlb.00290/Winter-hunting-behavior-and-habitat-selection-of-wolves-in-a/10.2981/wlb.00290.full

Johnson, J., and B. Blossom. 2017a. *Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes - Interior Region, Effective June 1, 2017.* ADF&G Special Publication No. 17-02, Anchorage. AWC online mapper available at: adfg.maps.arcgis.com/apps/webappviewer/index.html?id=f5aac9a8e4bb4bf49dc39db33f950bbd

Johnson, J., and B. Blossom. 2017b. *Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes – Arctic Region, Effective June 1, 2017.* ADF&G Special Publication No. 17-01, Anchorage. AWC online mapper available at: adfg.maps.arcgis.com/apps/webappviewer/index.html?id=f5aac9a8e4bb4bf49dc39db33f950bbd

Johnson, J., and B. Blossom. 2018a. C*atalog of waters important for spawning, rearing, or migration of anadromous fishes - Interior Region, Effective June 1, 2018*. ADF&G, Special Publication No. 18-03. Anchorage, Alaska.

Johnson, J., and B. Blossom. 2018b. *Catalog of waters important for spawning, rearing, or migration of anadromous fishes - Arctic Region, Effective June 1, 2018*. ADF&G, Special Publication No. 18-02. Anchorage, Alaska.

Johnson, C.B. and B.E. Lawhead. 1989. Distribution, movements, and behavior of caribou in the Kuparuk Oilfield, summer 1988. Prepared for ARCO Alaska, Inc., and Kuparuk River Unit by Alaska Biological Research, Inc. Fairbanks, Alaska.

Joly, K. 2011. Modeling influences on winter distribution of caribou in northwestern Alaska through use of satellite telemetry. *Rangifer*, Special Issue 19:75–85.

Joly, K. 2019. NPS caribou subject matter expert, personal communication to Nathan Jones, HDR mammal subject matter expert.

Joly, K., and D.R. Klein. 2011. Complexity of caribou population dynamics in a changing climate. *Alaska Park Science* 10:26–31.

Joly, K., F.S. Chapin III, and D.R. Klein. 2010. Winter habitat selection by caribou in relation to lichen abundance, wildfires, graving, and landscape characteristics in northwest Alaska. *Ecoscience* 17(3):321–333.

Joly, K., and M.D. Cameron. 2015. *Caribou vital sign annual report for the Arctic Network Inventory and Monitoring Program: September 2014-August 2015*. Natural Resource Report NPS/ARCN/NRR-2015/1090. NPS. Fort Collins, Colorado.

Joly, K., and M.D. Cameron. 2017. *Caribou Vital Sign Annual Report for the Arctic Network Inventory and Monitoring Program: September 2015–August 2016.* Natural Resource Report NPS/ARCN/NRR—2017/1398. NPS. Fort Collins, Colorado.

Joly, K., and M.D. Cameron. 2018a. Early fall and late winter diets of migratory caribou in northwestern Alaska. *Rangifer* 38(1):27–38.

Joly, K., and M.D. Cameron. 2018b. Caribou vital sign annual report for the Arctic Network Inventory and Monitoring Program: September 2017-August 2018. Natural Resource Report NPS/ARCN/NRR—2018/1834. NPS. Fort Collins, Colorado.

Joly, K., M.D. Cameron, and M.S. Sorum. 2016. Caribou, grizzly bear, and moose activity along proposed routes to the Ambler Mining District, Alaska. Natural Resource Report NPS/GAAR/NRR-2016/1283. NPS. Fort Collins, Colorado.

Joly, K., F.S. Chapin III, and D.R. Klein. 2010. Winter habitat selection by caribou in relation to lichen abundance, wildfires, graving, and landscape characteristics in northwest Alaska. *Ecoscience* 17(3):321–333.

Joly, K., P.A. Duffy, and T.S. Rupp. 2012. Simulating the effects of climate change on fire regimes in Artic biomes: implications for caribou and moose habitat. *Ecosphere* 3(5):36. Available at: dx.doi.org/10.1890/ES12-00012.1

Joly, K., R.R. Jandt, C.R. Meyers, and M.J. Cole. 2007. Changes in vegetative cover on Western Arctic Herd winter range from 1981 to 2005: potential effects of grazing and climate change. *Rangifer*, Special Issue No. 17:199–207.

Joly, K., R.R. Jandt, and D.R. Klein. 2009. Decrease of lichens in Arctic ecosystems: the role of wildfire, caribou, reindeer, competition and climate in north-western Alaska. *Polar Research* 28:433–442.

Joly, K., S.K. Wasser, and R. Booth. 2015. Non-invasive assessment of the interrelationships of diet, pregnancy rate, group composition, and physiological and nutritional stress of barren-ground caribou in late winter. *PLoS ONE* 10(6): e0127586.

Joly, K., T. Craig, M.D. Cameron, A.E. Gall, and M.S. Sorum. 2017. Lying in wait: limiting factors on a low-density ungulate population and the latent traits that can facilitate escape from them. *Acta Oecologica* 85:174–183.

Joly, K., C. Nellemann, and I. Vistnes. 2006. A Reevaluation of Caribou Distribution Near an Oilfield Road on Alaska's North Slope. *Wildlife Society Bulletin* 34(3):866–869.

Joly, K., J. Rasic, R. Mason, and M. Lukin. 2018. History, purpose, and status of caribou movements in northwest Alaska. *Alaska Park Science* 17(1).

Jones, E. 1986. *Koyukon Ethnogeography*. Alaska Historical Commission Studies in History, No. 171. Alaska Historical Commission. Anchorage, Alaska.

Jorgenson, M.T., M. Kanevskiy, Y. Shur, J. Grunblatt, C. Ping, and G. Michaelson. 2015. Permafrost database development, characterization, and mapping for northern Alaska. Final Report. Prepared for USFWS, Arctic Landscape Conservation Cooperative. Anchorage, Alaska. Available at: arcticlcc.org/assets/products/ALCC2012-10/reports/Permafrost_Characterization_and_Mapping_Final_Report.pdf

Jorgenson, T., K. Yoshikawa, M. Kanevskiy, and Y. Shur. 2008. *Permafrost Characteristics of Alaska*. University of Alaska Fairbanks, Institute of Northern Engineering. Fairbanks, Alaska.

Jorgenson, T.M., C.H. Racine, J.C. Walters, and T.E. Osterkamp. 2001. Permafrost Degradation and Ecological Changes Associated with a Warming Climate in Central Alaska.

Kane, D.L., K. Yoshikawa, and J.P. McNamara. 2013. Regional groundwater flow in an area mapped as continuous permafrost, NE Alaska (USA). *Hydrogeology Journal* 21:41–52.

Kane, D.L., E.K. Youcha, S.L. Stuefer, H. Toniolo, J.W. Homan, W.E. Schnabel, R.E. Gieck, E. Lamb, T. Tschetter, and G. Myerchin-Tape. 2015. *Environmental Studies of Ambler Transportation*

Corridor, Alaska. Final Report. University of Alaska Fairbanks, Water and Environmental Research Center, INE/WERC 15.14. December 2015. Fairbanks, Alaska.

Kelleyhouse, R.A. 2001. *Calving ground selection and fidelity: Teshekpuk Lake and Western Arctic caribou herds*. MS Thesis, University of Alaska Fairbanks.

Knapman, L.N. 1989. *Watershed Activity Plan, Tozitna River Watershed Area of Critical Environmental Concern*. BLM-AK-PT-89-050-7200-070. September 1989.

Kociolek, A., C. Grilo, S. Jaconson. 2015. Chapter 33. Flight doesn't solve everything: mitigation of road impacts on birds. Pp. 281–289 In: Handbook of Road Ecology (Van Der Ree, R., D.J. Smith, C. Grilo, editors). First Edition. John Wiley & Sons, Ltd.

Kofinas, G., S.B. BurnSilver, J. Magdanz, R. Stotts, and M. Okada. 2016. Subsistence Sharing Networks and Cooperation: Kaktovik, Wainwright, and Venetie, Alaska. BOEM Report 2015-023 DOI; AFES Report MP 2015-02. School of Natural Resources and Extension, University of Alaska Fairbanks.

Kolden, K. and C. Aimone-Martin. 2013. Blasting Effects on Salmonids. Prepared for ADF&G, Division of Habitat. June 2013.

Kondolf, G.M., M. Smeltzer, and L. Kimball. 2002. Freshwater Gravel Mining and Dredging Issues – White Paper. Prepared for the Washington Department of Fish and Wildlife, Department of Ecology, and Department of Transportation. Published April 4, 2002. Available at: wdfw.wa.gov/publications/00056

Kreiger, R., S. Whitney, and S. Dapcevich. 2019. Nonresidents Working in Alaska: 2017. Alaska Department of Labor and Workforce Development. Juneau, Alaska.

Kretsinger, C.F., and S.M. Will. 1995. *Indian River ACEC Aquatic Habitat Management Plan*. BLM-Alaska ACEC HMP BLM/AK/ST-94/019/+7200+070. May 1995.

Kretsinger, C.F., S.M. Will, D.R. Hunt, and M.I. Mahran. 1994. *Hogatza River ACEC Aquatic Habitat Management Plan*. BLM-Alaska ACEC HMP BLM/AK/ST-94/014/+6700+070. May 1994.

Kuipers, J.R., A.S. Maest, K.A. MacHardy, and G. Lawson. 2006. Comparison of Predicted and Actual Water Quality at Hardrock Mines: The Reliability of Predictions in Environmental Impact Statements.

Kuropat, P.J. 1984. *Foraging behavior of caribou on a calving ground in northwestern Alaska*. Thesis, University of Alaska Fairbanks.

Kusler, J. 2006. Common Questions: Definitions of the Terms Wetland "Function" and "Value." June 26, 2006. ASWM, Inc. (Association of State Wetland Managers, Inc.) in cooperation with The International Institute for Wetland Science and Public Policy.

Lawhead, B.E., and S.M. Murphy. 1988. 1987 Endicott Environmental Monitoring Program Draft Report: Caribou. Envirosphere Company. Anchorage, Alaska.

Lawhead, B.E., L.C. Byrne, and C.B. Johnson. 1993. 1990 Endicott Environmental Monitoring Program Final Report. Volume V Meteorology, River Discharge, Caribou, Caribou Synthesis: Caribou Synthesis 1987–1990. Prepared for USACE, Alaska District, Anchorage, Alaska by Science Applications International Corporation. Bellevue, Washington, and Anchorage, Alaska.

Lawler, J.P. 2003. Distribution of muskoxen determined by incidental observations and aerial surveys in Gates of the Arctic National Park and Preserve, Alaska: 1999–2002. Resource Report, NPS/AR/NR/NRTR-2003-41. DOI, NPS, Alaska Region. Fairbanks, Alaska.

Lawler, J.P., and J. Dau. 2006. *2006 Aerial moose survey in the upper Kobuk drainage, Alaska*. Natural Resource Technical Report NPS/AR/NRTR – 2006-057. NPS. Anchorage, Alaska.

Leblond, M., C. Dussault, J.P. Ouellet. 2013. Avoidance of roads by large herbivores and its relation to disturbance intensity. *Journal of Zoology* 289:32–40.

Leblond, M., J. Frair, D. Fortin, C. Dussault, J. Ouellet, and R. Courtois. 2011. Assessing the influence of resource covariates at multiple spatial scales: an application to forest-dwelling caribou faced with intensive human activity. *Landscape Ecology* 26:1433–1466.

Limpinsel, D.E., M.P. Eagleton, and J.L. Hanson. 2017. Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska. EFH 5 Year Review: 2010 through 2015. U.S. Department of Commerce, NOAA Technical Memo. NMFS-F/AKR-14.

Lindsey, K.D. 1986. *Paleontological Inventory and Assessment of Public Lands Administered by Bureau of Land Management, State of Alaska*. Report on file at BLM, Fairbanks District Office. Fairbanks, Alaska.

Longson, S. 2019. Summer 2018 GMH/WMH/RMH/HHH Caribou Survey Results. Confidential memorandum from Sara Longson, Galena Assistant Area Biologist, to Doreen Parker McNeil and Glenn Stout. ADF&G, Division of Wildlife Conservation. Fairbanks, Alaska. January 8, 2018.

Loss, S.R., T. Will, and P.P. Marra. 2014. Estimation of bird-vehicle collision mortality on U.S. roads. *The Journal of Wildlife Management* 78:763–771.

Loss, S.R., T. Will, and P.P. Marra. 2015. Direct mortality of birds from anthropogenic causes. *Annual Review of Ecology, Evolution, and Systematics* 46:99–120.

MacDonald, S.O., and J.A. Cook. 2009. *Recent Mammals of Alaska*. University of Alaska Press. Fairbanks, Alaska.

Maest, A.S., Kuipers, J.R., Travers, C.L. and Atkins, D.A. 2005. *Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the-Art.*

Maier, J.A.K., J.M. Ver Hoef, A.D. McGuire, R.T. Bowyer, L. Saperstein, and H.A. Maier. 2005. Distribution and density of moose in relation to landscape characteristics: effects of scale. *Canadian Journal of Forestry Research* 35:2233–2243.

Maier, J.A.K., S.M. Murphy, R.G. White, and M.D. Smith. 1998. Responses of Caribou to Overflights by Low-altitude Jet Aircraft. *The Journal of Wildlife Management* 62(2):752–766.

Maitland, B.M., M. Poesch, A.E. Anderson, and S.N. Pandit. 2016. Industrial road crossings drive changes in community structure and instream habitat for freshwater fish in the boreal forest. *Freshwater Biology* (2016) 61:1–18.

Mallat, J. 1985. Fish gill structural changes induced by toxicants and other irritants: a statistical review. *Canadian Journal of Fisheries and Aquatic Science* 42:630–648.

Marcotte, J.R., and T.L. Haynes. 1985. *Contemporary Resource Use Patterns in the Upper Koyukuk Region, Alaska*. Technical Paper No. 93. ADF&G, Division of Subsistence. Fairbanks, Alaska. Available at www.subsistence.adfg.state.ak.us/TechPap/tp093.pdf

May, R., A. Landa, J. Van Dijk, J.D.C. Linnell, and R. Andersen. 2006. Impact of infrastructure on habitat selection of wolverines *Gulo gulo*. *Wildlife Biology* 12(3):285–295.

McCloskey, S., E. Jones, S. Paskvan, C. Moncrieff, K. Bodony, R. Toohey, and B.M. Jones. 2014. *Mapping Traditional Place Names Along the Koyukuk River—Koyukuk, Huslia, and Hughes, Western Interior Alaska.* U.S. Geological Survey Fact Sheet 2014-3105. Available at: dx.doi.org/10.3133/fs20143105

McGanahan, D.A., A.L.M. Daigh, C. Whippo, G.A. Goreham, J.K. Ransom, J. Spiess, and B. Poling. 2017. Fugitive dust impacts on land and landowner/citizen perceptions of Bakken development. Final Report, February 2017.

McKenna, B. 2015. *Abundance and Run Timing of Adult Salmon in Henshaw Creek, Kanuti National Wildlife Refuge, Alaska, 2014*. Tanana Chiefs Conference, Fisheries Program, FRMP 14-209.

Mecklenburg, C.W., T.A. Mecklenburg, and L.K. Thorsteinson. 2002. *Fishes of Alaska*. American Fisheries Society. Bethesda, Maryland.

Meyer, M.E., and R.G. Sullivan. 2016. *Enjoy the View – Visual Resources Inventory Report: Gates of the Arctic National Park and Preserve*. Natural Resource Report NPS/GAAR/NRR-2016/1295. DOI, NPS. Fort Collins, Colorado.

Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-Being: Wetlands and Water. Synthesis. World Resources Institute. Washington, D.C.

mindat.org. 2019. Definition of a mining district. Available at: www.mindat.org/glossary/mining_district Accessed March 13, 2019.

Modafferi, R.D. 1991. Train moose-kill in Alaska: characteristics and relationship with snowpack depth and moose distribution in lower Susitna Valley. *Alces* 27:193–207.

Moore, K., M. Furniss, S. Firor, and M. Love. 1999. Fish passage through culverts: an annotated bibliography. Updated November 5, 1999. Six Rivers National Forest Watershed Interactions Team. Eureka, California.

Moquin, P.A. and F.J. Wrona. 2015. Effects of permafrost degradation on water and sediment quality and heterotrophic bacterial production of Arctic tundra lakes: An experimental approach. Liminnology and Oceanography. Doi: 10.1002/Ino.10110. Water and Climate Research Center, Environment Canada, University of Victoria, Victoria, British Columbia V8P 5C2, Canada. April 16, 2015. Available at: aslopubs.onlinelibrary.wiley.com/doi/pdf/10.1002/lno.10110

Morrow, J.E. 1980. *The freshwater fishes of Alaska*. Alaska Northwest Publishing Company. Anchorage, Alaska.

Mowat, G., and D.C. Heard. 2006. Major components of grizzly bear diet across North America. *Canadian Journal of Zoology* 84:473–489.

Murphy, S.M., and B.E. Lawhead. 2000. Chapter 4 Caribou. Pp. 59–84 In: The Natural History of an Arctic Oilfield: Development and Biota (J.C. Truett and S.R. Johnson, editors). Academic Press. San Diego, California.

Myers-Smith, I.H., B.K. Arnesen, R.M. Thompson, and F.S. Chapin III. 2006. Cumulative impacts on Alaskan arctic tundra of a quarter century of road dust.

NAB (Northwest Arctic Borough). 2010. Northwest Arctic Winter Trails & Shelter Cabins 2010. Available at: www.nwabor.org/wp-content/uploads/trailwaypoints.pdf

Nawaz, M.F., G. Bourrie, and F. Trolard. 2012. Soil Compaction Impacts and Modelling, A Review. January 31, 2012.

Nawrocki, T., J. Fulkerson, and M. Carlson. 2013. *Alaska Rare Plant Field Guide*. Alaska Natural Heritage Program, University of Alaska Anchorage. Anchorage, Alaska.

NCHRP (National Cooperative Highway Research Program). 2019. Environmental Stewardship Practices, Procedures, and Policies for Highway Construction and Maintenance. Available at: environment.transportation.org/environmental_issues/construct_maint_prac/compendium/manual/

Neitlich, P.N., J.M. Ver Hoef, S.D. Berryman, A. Mines, L.H. Geiser, L.M Hasselbach, and A.E. Shiel. 2017. Trends in spatial patterns of heavy metal deposition on National Park Service lands along the Red Dog Mine haul road, Alaska, 2001–2006. *PLoS One* 12(5): e0177936. Available at: journals.plos.org/plosone/article?id=10.1371/journal.pone.0177936

Nellemann, C., I. Vistnes, P. Jordhøy, O. Strand, and A. Newton. 2003. Progressive impact of piecemeal infrastructure on wild reindeer. *Biological Conservation* 113:307–317.

NewFields. 2019. Ambler Road Health Impact Assessment.

Nicholson, K.L., S.M. Arthur, J.S. Horne, E.O. Garton, and P. A. Del Vecchio. 2016. Modeling caribou movements: seasonal ranges and migration routes of the Central Arctic Herd. *PLoS ONE* 11(4):e0150333.

Nixon, H. and J. Saphores. 2007. Impacts of Motor Vehicle Operation on Water Quality: Clean-up Costs and Policies. Transportation Research Part D 12(8). doi:10.1016/j.trd.2007.08.002. Available at: escholarship.org/content/qt8tn1w17s/qt8tn1w17s.pdf

NMFS (National Marine Fisheries Service). 2005. Final National Marine Fisheries Service National Gravel Extraction Guidance. June 10, 2005.

NOAA (National Oceanic and Atmospheric Administration), Fisheries. No Date. Culverts. Available at: www.westcoast.fisheries.noaa.gov/fish_passage/solutions/Culverts.html

Nowacki, G., P. Spencer, M. Fleming, T. Brock, and T. Jorgenson. 2001. *Unified Ecoregions of Alaska: 2001*. U.S. Geological Survey Open-File Report 2002–297.

NPFMC (North Pacific Fisheries Management Council). 2012. *Fishery management plan for the Salmon Fisheries in the EEZ off Alaska*. Prepared by the NPFMC, NMFS Alaska Region, and ADF&G. June 2012. Anchorage, Alaska.

NPS (National Park Service). 2000a. Director's Order #47. Soundscape Preservation and Noise Management. DOI, NPS. Washington, D.C.

NPS. 2006a. Management Policy 4.9: Soundscape Management. In Management Policies 2006. DOI, NPS. Washington, D.C.

NPS. 2006b. Management Policy 8.2.3: Use of Motorized Equipment. In Management Policies 2006. DOI, NPS. Washington, D.C.

NPS. 2019. NPSpecies – The National Park Service biodiversity database. IRMA Portal version. Available at: irma.nps.gov/npspecies Accessed March 22, 2019.

NRC (Natural Research Council). 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope.

NRC. 2005. Assessing and Managing the Ecological Impacts of Paved Roads. Committee on Ecological Impacts of Road Density, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies, Transportation Research Board. The National Academies Press. Washington, D.C. Available at: www.nap.edu/read/11535/chapter/1

O'Donnell, J.A., C.E. Zimmerman, M.P. Carey, and J.C. Koch. 2017. Potential Effects of Permafrost Thaw on Arctic River Ecosystems. DOI, NPS. Available at: www.nps.gov/articles/aps-16-1-10.htm

Oswalt, W.H. 1967. *Alaskan Eskimos*. Chandler Publishing Co. Scranton, Pennsylvania.

Pamperin, N.J. 2015. Units 20F, 21B, 21C, 21D, 24A, 24B, and 25D caribou. Chapter 13, Pp. 13-1 – 13-15 In: *Caribou management report of survey and inventory activities 1 July 2012–30 June 2014* (P. Harper and L. A. McCarthy, editors). ADF&G, Species Management Report ADF&G/DWC/SMR-2015-4. Juneau, Alaska.

Pardieck, K.L., D.J. Ziolkowski Jr., M. Lutmerding and M.A.R. Hudson. 2018. North American Breeding Bird Survey Dataset 1966–2017, version 2017.0. USGS, Patuxent Wildlife Research Center. Available at: doi.org/10.5066/F76972V8

Parker, D.I., B.E. Lawhead, and J.A. Cook. 1997. Distributional limits of bats in Alaska. *Arctic* 50(3):256–265.

Parrett, L. 2019. ADF&G caribou subject matter expert, personal communication to Nathan Jones, HDR mammal subject matter expert.

Passioura, J.B. 2002. Soil conditions and plant growth. *Plant, Cell and Environment* 25:311–318.

Peace of Selby Wilderness Lodge. 2019. Discover Peace of Selby Wilderness. Available at: www.alaskawilderness.net/

Pearson, Clark. 2016. Mining Districts: A Short Review of Legal Authorities. June 2016. *ICMJ's Prospecting and Mining Journal*. Available at: www.icmj.com/magazine/article/mining-districts-a-short-review-of-legal-authorities-3460/ Accessed March 13, 2019.

Person, B.T., A.K. Prichard, G.M. Carroll, D.A. Yokel, R.S. Suydam, and J.C. George. 2007. Distribution and movements of the Teshekpuk caribou herd 1990–2005: prior to oil and gas development. *Arctic* 60(3):238–250.

Platte, R., and R. Stehn. 2011. *Aerial survey of waterbirds on Kanuti National Wildlife Refuge and adjacent wetlands*. Field Report 8 April 2011. USFWS, Migratory Bird Management. Anchorage, Alaska.

Price, M.H.H. 2014. Sub-lethal metal toxicity concerns for salmonids from Seabridge Gold's proposed KSM tailings impoundment. January 24, 2014.

Pyare, S., and T. Gotthardt. 2007. Alaska Herp Database. Alaska Natural Heritage Program, University of Alaska Anchorage. Anchorage, Alaska.

Quinn, T.P. 2005. *The Behavior and Ecology of Pacific Salmon and Trout*. 1st Edition. American Fisheries Society.

Reeves, M.K. 2008. Batrachochytrium dendrobatidis in wood frogs (Rana sylvantica) from three National Wildlife Refuges in Alaska, USA. *Herpetological Review* 39(1):68–70.

Reeves, M.K., and D.E. Green. 2006. Rana sylvatica wood frog chytridiomycosis. *Herpetol* Rev. 37:450.

Reeves, M.K., C.L. Dolph, H. Zimmer. R.S. Tjeerdema, and K.A. Trust. 2008. Road proximity increases risk of skeletal abnormalities in wood frogs from National Wildlife Refuges in Alaska. *Environmental Health Perspectives* 116(8):1009–1014.

Reger, R.D., D.S.P. Stevens, and R.L. Smith. 2003a. Survey of Geology, Geologic Materials, and Geologic Hazards in Proposed Access Corridors in the Candle Quadrangle, Alaska. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 57, 5 sheets, scale 1:250,000. Available at: doi.org/10.14509/3248

Reger, R.D., D.S.P. Stevens, and R.L. Smith. 2003b. Survey of Geology, Geologic Materials, and Geologic Hazards in Proposed Access Corridors in the Hughes Quadrangle, Alaska. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 75, 5 sheets, scale 1:250,000. Available at: doi.org/10.14509/2929

Reger, R.D., D.S.P. Stevens, and R.L. Smith. 2003c. Survey of Geology, Geologic Materials, and Geologic Hazards in Proposed Access Corridors in the Melozitna Quadrangle, Alaska. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 91, 5 sheets, scale 1:250,000. Available at: doi.org/10.14509/2938

Reger, R.D., D.S.P. Stevens, and R.L. Smith. 2003d. Survey of Geology, Geologic Materials, and Geologic Hazards in Proposed Access Corridors in the Shungnak Quadrangle, Alaska. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 108, 5 sheets, scale 1:250,000. Available at: doi.org/10.14509/3293

Reger, R.D., D.S.P. Stevens, and R.L. Smith. 2003e. Survey of Geology, Geologic Materials, and Geologic Hazards in Proposed Access Corridors in the Solomon Quadrangle, Alaska. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 110, 5 sheets, scale 1:250,000. Available at: doi.org/10.14509/3301

Reger, R.D., D.S.P. Stevens, G.R. Cruse, and H.R. Livingston. 2003f. Survey of Geology, Geologic Materials, and Geologic Hazards in Proposed Access Corridors in Selected Quadrangles, Alaska. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 129, 72 p. Available at: dggs.alaska.gov/pubs/id/2946

Reger, R.D., G.R. Cruse, D.S.P. Stevens, and R.L. Smith. 2003g. Survey of Geology, Geologic Materials, and Geologic Hazards in Proposed Access Corridors in the Bendeleben Quadrangle, Alaska. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 51, 5 sheets, scale 1:250,000. Available at: doi.org/10.14509/2962

Reimer, J.P., T. Nawrocki, M. Aisu, and T. Gotthardt. 2016. Chapter H. Terrestrial Fine-filter Conservation Elements. In: *Central Yukon Rapid Ecoregional Assessment* (Trammell, E.J., T. Boucher, M.L. Carlson, N. Fresco, J.R. Fulkerson, M.L. McTeague, J. Reimer, and J. Schmidt, editors). Prepared for the DOI, BLM. Anchorage, Alaska.

Reimers, E. and J.E. Colman. 2006. Reindeer and caribou (*Rangifer tarandus*) response towards human activities. *Rangifer* 26(2):55–71.

Reynaud, S. and P. Deschaux. 2006. The effects of polycyclic aromatic hydrocarbons on the immune system of fish: a review. *Aquatic Toxicology* 77(2):229–238. May 2006. Available at: www.sciencedirect.com/science/article/pii/S0166445X05003978

Reynolds, H.V., and G.W. Garner. 1987. Patterns of grizzly bear predation on caribou in northern Alaska. Pp. 59–67 In: Bears – Their Biology and Management: Proceedings of the 7th International Conference on Bear Research and Management, Williamsburg, Va., 21–26 February 1986, and Plitvice Lakes, Yugoslavia, 2–5 March 1986 (P. Zager, editor). International Association for Bear Research and Management, Washington, D.C. [Available from Terry D. White, Department of Forestry, Wildlife, and Fisheries, The University of Tennessee, P.O. Box 1071, Knoxville, TN 37901-1071, USA.]

Reynolds, P.E., H.V. Reynolds, and E.H. Follman. 1983. Responses of grizzly bears to seismic surveys in northern Alaska. *International Association of Bear Research and Management* 6:169–175.

Ritchie, B. 2013. *Raptor surveys along the proposed Brooks East Corridor, Ambler Mining District Access Project, Alaska, 2013*. Field Report. Prepared by ABR, Inc. – Environmental Research & Services, Fairbanks, Alaska. Prepared for DOWL KLM. October 2013. Anchorage, Alaska.

Robinson, D. 2009. The Unemployment Rate. *Alaska Economic Trends* 29(10):4–7.

Romanoff, K (editor). 2018. Caribou Trails. Summer 2018, Issue 18. Western Arctic Caribou Herd Working Group.

Rowland, J.C., C.E. Jones, G. Altmann, R. Bryan, B.T. Crosby, G.L. Geernaert, L.D. Hinzman, D.L. Kane, D.M. Lawrence, A. Mancino, P. Marsh, J.P. McNamara, V.E. Romanovsky, H. Toniolo, B.J. Travis, E. Trochim, and C.J. Wilson. 2010. Arctic Landscapes in Transition: Responses to Thawing Permafrost. *EOS* (EOS, Transactions, American Geophysical Union) 91(26):229–236. June 29, 2010.

Ruggiero, L.F., K.B. Aubry, S.W. Bushkirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires. 1999. Ecology and conservation of lynx in the United States. U.S. Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-30WWW. October 1999.

Rupp, T.S., and A. Springsteen. 2009. *Projected Climate Change Scenarios for the Bureau of Land Management Eastern Interior Management Area, Alaska, 2001–2099*. University of Alaska Fairbanks Report. Prepared for DOI, BLM.

Saito, B. 2014. Unit 23 moose management report. Pp. 32-1 – 32-21 In: *Moose management report of survey and inventory activities 1 July 2011–30 June 2013* (P. Harper and L.A. McCarthy, editors). ADF&G, Species Management Report ADF&G/DWC/SMR-2014-6. Juneau, Alaska.

Satterthwaite-Phillips, D., C. Krenz, G. Gray, and L. Dodd. 2016. *IñuuniałiQput Iḷiḷugu Nunaŋŋuanun*: Documenting Our Way of Life through Maps. Northwest Arctic Borough, Subsistence Mapping Project. Kotzebue, Alaska.

Savereide, J.W. 2019. ADF&G fish subject matter expert, email communication to Erin Cunningham, HDR fish subject matter expert.

Savereide, J.W., and J. Huang. 2016. *Spawning Location, Run Timing, and Spawning Frequency of Kobuk River Sheefish, 2008-2014*. 2015 Final Report for Study 12-103 USFWS Office of Subsistence Management Fishery Information Service Division. ADF&G Fishery Data Series No. 16-31.

Scanlon, B. 2009. Fishery Management Report for Sport Fisheries in the Northwest/North Slope Management Area, 2008. Fishery Management Report No. 09-48. ADF&G, Division of Sport Fish and Commercial Fisheries. December 2009. Available at: www.adfg.alaska.gov/FedAidpdfs/FMR09-48.pdf

Scannell, H.L. 2015. *Fisheries and Aquatic Inventory of The Koyukuk, John, and Wild Rivers, 2014*. Ambler Mining District Industrial Access Road. Prepared by the ADF&G, Division of Habitat Fairbanks for AIDEA.

Schaefer, J.A., and S.P. Mahoney. 2007. Effects of progressive clearcut logging on Newfoundland caribou. *Journal of Wildlife Management* 71.

Schoenfeld, E. 2013. Medevacs face more competition, sicker patients. *KRBD*. December 23, 2013.

Shanks, A. 2009. Northwest Arctic Borough. *Alaska Economic Trends* 29(8):12–16.

Shanks, A. 2013. Yukon-Koyukuk Census Area. *Alaska Economic Trends* 33(3):8–11.

Shideler, R.T., M.H. Robus, J.F. Winters, and M. Kuwada. 1986. Impacts of human developments and land use on caribou: a literature review. Volume I: A Worldwide Perspective. Technical Report 86-2. ADF&G, Habitat and Restoration Division. Juneau, Alaska.

Simeone, W.E. 1985. *A History of Alaskan Athapaskans*. Alaska Pacific University. Anchorage, Alaska.

Sisinyak, N. 2006. *The Alaska Blackfish.* Fish and Wildlife News, ADF&G, April 2006.

Solie, D.N., and J.E. Athey. 2015. *Preliminary Evaluation of Bedrock Potential for Naturally Occurring Asbestos in Alaska*. Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 157, 15 p., 21 sheets, scale 1:500,000. Available at: doi.org/10.14509/29447

Sorum, M.S., K. Joly, and M.D. Cameron. 2015. *Aerial Moose Survey Within and Around Gates of the Arctic National Park and Preserve, March 2015*. Natural Resource Report NPS/GAAR/NRR—2015/967. DOI, NPS. Fort Collins, Colorado.

Spindler, M. 2016. Ice road to Bettles a lifeline for residents. *News-Miner*. Available at: www.newsminer.com/news/local_news/ice-road-to-bettles-a-lifeline-for-residents/article_5bcb30d8-ef35-11e5-b18a-3f60261acb29.html Accessed February 22, 2019.

SRB&A (Stephen R. Braund & Associates). No Date. Subsistence Mapping and Traditional Knowledge Studies. Surveys Conducted Between 2015 and 2017 in Association with the Alaska LNG Project Environmental Baseline Studies.

SRB&A. 2018. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 9 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

Stadler, J.H. 2003. The Adverse Effects to Fishes of Pile-driving – the Implications for ESA and EFH Consultations in the Pacific Northwest. UC Davis John Muir Institute of the Environment. Available at: escholarship.org/uc/item/7bx541gm

Steel, Z.L., H.D. Safford, and J.H. Viers. 2015. The fire frequency-severity relationship and the legacy of fire suppression in California forests. *Ecosphere* 6(1):1–23. Available at: esajournals.onlinelibrary.wiley.com/doi/full/10.1890/ES14-00224.1

Stephenson, R.O. 1979. Chapter 2: Caribou distribution, population characteristics and mortality patterns in Northwest Alaska, 1977–1978. In: Studies of selected wildlife and fish and their use of habitats on and adjacent to the National Petroleum Reserve in Alaska 1977–1978. Prepared by National Petroleum Reserve in Alaska, U.S. Department of the Interior, 105(c) Land Use Study. May 1979. Anchorage, Alaska.

Stout, G.W. 2018. Moose management report and plan, Game Management Unit 24: Report period 1 July 2010–30 June 2015, and plan period 1 July 2015–30 June 2020. ADF&G, Species Management Report and Plan ADF&G/DWC/SMR&P-2018-19. Juneau, Alaska.

Stout. R.G., and T.S. Al-Niemi. 2002. Heat-tolerant flowering plants of active geothermal areas in Yellowstone National Park. *Annals of Botany* 90(2):259–267.

Sullender, B. 2017. Ecological impacts of road- and aircraft-based access to oil infrastructure.

Sweeney, M.A. and L.J. Simmons. 2019. Cultural Resources Sensitivity Model for the Ambler Mining District Industrial Access Project. Prepared for DOWL and AIDEA. May 2019.

Taube, T.T. and K. Wuttig. 1998. Abundance and Composition of Sheefish in the Kobuk River, 1997. Fishery Manuscript Report No. 98-3. ADF&G, Division of Sport Fish. December 1998.

Teck (Teck Resources, Inc.). 2018. Response by Catherine Suda (Manager, U.S. Lands and Assets) to comments from National Parks Service (October 22, 2018) and Arctic Caribou Herd Working Group (October 23, 2018) on Phase I Plan of Operations to conduct exploration in the Lisburne Mining District at the Anarraaq/Aktigiruq deposit (F20l89339).

Teck Cominco AK, Inc. 2007. Red Dog Mine Total Suspended Particulates, Lead and Zinc Concentrations – Jan 1, 2006 to Dec 31, 2006. Red Dog Mine Site, May 2007.

Thomas, D.C. and J. Edmonds. 1983. Rumen Contents and Habitat Selection of Peary Caribou in Winter, Canadian Arctic Archipelago. *Arctic and Alpine Research* 15(1):97–105.

Tibbitts, T.L., D.R. Ruthrauff, R.E. Gill, Jr., and C.M. Handel. 2005. *Inventory of Montane-nesting birds in the Arctic Network of National Park, Alaska*. Arctic Network Inventory and Monitoring Program, NPS. NPS/AKARCN/NRTR-2006/02. Fairbanks, Alaska.

Timothy, J. 2013. Alaska blasting standard for the proper protection of fish. ADF&G, Technical Report No. 13-03. Douglas, Alaska.

Trammell, E.J., T. Boucher, M.L. Carlson, N. Fresco, J.R. Fulkerson, M.L. McTeague, J. Reimer, and J. Schmidt, eds. 2016. *Central Yukon Rapid Ecoregional Assessment*. Prepared for DOI, BLM. Anchorage, Alaska.

Trombulak, S.C. and C.A. Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. *Conservation Biology*, February 2000.

Trumbull, N. and C. Bae. 2000. Transportation and Water Pollution. Available at: courses.washington.edu/gmforum/topics/trans_water/trans_water.htm

UA (University of Alaska Center for Economic Development). 2019. Economic Impacts of Ambler Mining District Industrial Access Project and Mine Development. Prepared for AIDEA. July 2019.

USACE (U.S. Army Corp of Engineers), Alaska District. 1995. Navigable Waters. Issued October 19, 1995.

USACE. 2012. *Point Thomson Project Final Environmental Impact Statement.* Alaska District, Alaska Regulatory Division. Available at: www.arlis.org/docs/vol1/AlaskaGas/Report3/Report_PtThom_FEIS/v1.pdf

USACE. 2018. *Donlin Gold Project: Final Environmental Impact Statement*. Available at: dnr.alaska.gov/mlw/mining/largemine/donlin/pdf/eis/FinalEIS.pdf

U.S. Census Bureau. 2019. American FactFinder: American Community Survey. Available at: factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml Accessed February 23, 2019.

USFWS (U.S. Fish and Wildlife Service). No Date. Plan Your Visit. Selawik National Wildlife Refuge – Alaska. Available at: www.fws.gov/refuge/Selawik/visit/plan_your_visit.html Accessed March 2019.

USFWS. 2008. Birds of Conservation Concern 2008. USFWS, Division of Migratory Bird Management. Arlington, Virginia. Available at: www.fws.gov/migratorybirds/pdf/grants/BirdsofConservationConcern2008.pdf

USFWS. 2019. Environmental Conservation Online System. Updated February 13, 2015. Available at: ecos.fws.gov Accessed February 20, 2019.

USGS (U.S. Geological Survey). No Date. USGS topographic and route alignment layers of Ambler Viewer.

U.S. Global Change Research Program. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II (Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart, eds.). U.S. Global Change Research Program, Washington, D.C. doi: 10.7930/NCA4.2018.

Viereck, L.A. and L.A. Schandelmeier. 1980. Effects of Fire in Alaska and Adjacent Canada: a Literature Review. BLM-Alaska Technical Report 6 BLM/AK/ST-97/013+9218+380. November 1980 (Reprinted February 1997). DOI, BLM, Alaska State Office. Anchorage, Alaska.

Vistnes, I. and C. Nellemann. 2007. The Matter of Spatial and Temporal Scales: A Review of Reindeer and Caribou Response to Human Activity. Volume 31.

Vonk, J.E., S.E. Tank, W.B. Bowden, I. Laurion, W.F. Vincent, P. Alekseychik, M. Amyot, M.F. Billet, J. Canario, R.M. Cory, B.N. Deshpande, M. Helbig, M. Jammet, J. Karlsson, J. Larouche, G. MacMillan, M. Rautio, K.M. Walter Anthony, and K.P. Wickland. 2015. Reviews and syntheses: Effects of permafrost thaw on Arctic aquatic ecosystems. Biogeosciences. Published December 8, 2015.

Vors, L.S., J.A. Schaefer, B.A. Pond, A.R. Rodgers, and B.R. Patterson. 2007. Woodland caribou extirpation and anthropogenic landscape disturbance in Ontario. *Journal of Wildlife Management* 71(4):1249–1256.

VTPI (Victoria Transport Policy Institute). 2015. Transportation Cost and Benefit Analysis II – Water Pollution. Available at: www.vtpi.org/tca/tca0515.pdf

WAH WG (Western Arctic Caribou Herd Working Group). 2011. Western Arctic Caribou Herd Cooperative Management Plan. Revised December 2011. Nome, Alaska. Available at: westernarcticcaribounet.files.wordpress.com/2016/11/wah-managementplan_final_2011_reduced.pdf

WAH WG. 2015. Draft 2015 Meeting Summary. December 16–17, 2015.

WAH WG. 2016. Draft 2016 Meeting Summary. December 14–15, 2016.

WAH WG. 2017. "Protecting the Migration through Safe Hunting." Caribou Trails Summer 2017 (17):3.

Walker, D.A. and K.R. Everett. 1987. Road Dust and its Environmental Impact on Alaskan Taiga and Tundra. *Arctic and Alpine Research* 19(4):479–489.

Warhaftig, C. 1965. *Physiographic Divisions of Alaska.* U.S. Geological Survey Professional Paper 482, 52 p., 6 sheets, scale 1:2,500,000.

Warnock, N. 2017a. *Alaska Watchlist: 2017 Red List of Declining Bird Populations*.

Warnock, N. 2017b. *The Alaska WatchList 2017 (yellow list – vulnerable species)*. Audubon Alaska. Anchorage, Alaska.

Watson, Annette. 2018. *Ethnographic Overview and Assessment of Gates of the Arctic National Park and Preserve: Subsistence Land Use across the Kobuk Preserve*. Cultural Resource Report NPS/GAAR/CRR-2018/001. NPS, Fairbanks Administrative Center. Fairbanks, Alaska.

Werner, R.A., 1996. Forest Health in Boreal Ecosystems of Alaska. *The Forestry Chronicle* 72(1), January 1996.

Wesson, R.L., A.D. Frankel, C.S. Mueller, and S.C. Harmsen. 1999. USGS Seismic-Hazard Maps for Alaska and the Aleutian Islands. Available at: pubs.usgs.gov/imap/i-2679/i2679-2.pdf Accessed March 14, 2019.

West, R.L, and H.E. Metsker. 1983. Asbestos Investigations in Fish and Wildlife in the Upper Yukon River Region, Alaska 1977-1982, Summary.

WHO (World Health Organization). 2003. Asbestos in Drinking-Water: Background document for development of WHO Guidelines for Drinking-water Quality. Available at: www.who.int/water_sanitation_health/dwq/asbestos.pdf Accessed June 19, 2019.

Wilkins, G., H.W. Stoyko, H. Ghaffari, J. DiMarchi, J. Huang, M. Silva, M.F. O'Brien, M. Chin, and S.A. Hafez. 2013. *Preliminary Economic Assessment Report on the Arctic Project, Ambler Mining District, Northwest Alaska*. Report prepared by Tetra Tech for Nova Copper, effective September 12, 2013.

Wilson, M., B. Saylor, N. Szymoniak, S. Colt, and G. Fay. 2008. *Components of Delivered Fuel Prices in Alaska*. Prepared for Alaska Energy Authority. Anchorage, Alaska.

Wilson, R.R., D.D. Gustine, and K. Joly. 2014. Evaluating Potential Effects of an Industrial Road on Winter Habitat of Caribou in North-central Alaska. *Arctic* 67(4): 472-482. Available at: www.researchgate.net/publication/269111893_Evaluating_Potential_Effects_of_an_Industrial_Road_on_Winter_Habitat_of_Caribou_in_North-Central_Alaska

Wilson, R.R., L.S. Parrett, K. Joly, and J.R. Dau. 2016. Effects of Roads on Individual Caribou Movements During Migration. *Biological Conservation* 195:2–8.

Wolfe, R.J., and R.J. Walker. 1987. Subsistence Economies in Alaska: Productivity, Geography, and Development Impacts. *Arctic Anthropology* 24(2):56–81.

Wood, C.M. 2001. Toxic responses on the gill. Pp. 1–87 In: *Target organ toxicity in marine and freshwater Teleost* (W.H. Benson and D.W. Schlenk, editors). Taylor et Francis. Washington.

Woody, C. A., R. M. Hughes, E. J. Wagner, T. P. Quinn, L. H. Roulson, L. M. Martin, and K. Griswold. 2010. The mining law of 1872: Change is overdue. *Fisheries* 7:321–331.

Woodward, R. T. and Y. Wui. 2001. The Economic Value of Wetland Services: A Meta-Analysis. *Ecological Economics*, 37:257–270.

Wuttig, K.G., M.L. Albert, A.E. Behr, and J.W. Savereide. 2015. *Fishery Investigations along the Proposed Ambler Road Corridor, 2014*. Fishery Data Series No. 15-37. ADF&G, Divisions of Sport Fish and Commercial Fisheries. November 2015.

Yom-Tov, Y., S. Yom-Tov, D. MacDonald, and E. Yom-Tov. 2007. Population cycles and changes in body size of the lynx in Alaska. *Oecologia* 152:239.

Young Jr., D.D. 2015. Chapter 19: Units 20A, 20B, 20C, 20F, and 25C brown bear. Pp 19-1 – 19-19 In: *Brown bear management report of survey and inventory activities 1 July 2012–30 June 2014* (P. Harper and L. A. McCarthy, editors). ADF&G, Species Management Report ADF&G/DWC/SMR-2015-1. Juneau, Alaska.

Yoshikawa, K., W.R. Bolton, V.E. Romanovsky, M. Fukuda, and L.D. Hinzman. 2002. Impacts of wildfire on the permafrost in the boreal forests of Interior Alaska. December 18, 2002.

Yoshikawa. K., L.D. Hinzman, and D.L. Kane. 2007. Spring and aufeis (icing) hydrology in Brooks Range, Alaska. *Journal of Geophysical Research*, Vol. 112. G04S43, doi:10.1029/2006JG000294.

YRDFA (Yukon River Drainage Fisheries Association). 2008. *Middle Koyukuk River of Alaska: An Atlas of Fishing Places and Traditional Place Names*. Anchorage, Alaska.

Zedler, J.B. 2000. Progress in wetland restoration ecology. *Trends in Ecology and Evolution* 15:402–407.

Zender Environmental Health and Research Group. 2015. Regional Waste Backhaul in Rural Alaska. Anchorage, Alaska.

This page is intentionally left blank.

Appendix P

Glossary

This page is intentionally left blank.

Glossary

Active floodplain: The flat area along a water body where sediments are deposited by seasonal or annual flooding; generally demarcated by a visible high water mark.

Aerial: Consisting of, moving through, found in, or suspended in the air.

Affect: To bring about a change. As a verb, affect is most commonly used in the sense "to influence" or "impact." The adjective "affected" means acted upon or influenced by.

Alluvial: Sedimentary material consisting mainly of coarse sand and gravel; made up of or found in the materials that are left by the water of rivers, floods, etc.

Alternatives: The different means by which objectives or goals can be attained. One of several policies, plans, or projects proposed for decision making. BLM is directed by the National Environmental Policy Act (NEPA) to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.…" (40 Code of Federal Regulations [CFR] 1507.2, Section102(2)E)

Ambient: Used to describe the environment as it exists at the point of measurement and against which changes (impacts) are measured.

Ambient air quality standard: Air pollutant concentrations of the surrounding outside environment that cannot legally be exceeded during fixed time intervals and in a specific geographic area.

Anadromous: Fish that mature in the sea and swim up freshwater rivers and streams to spawn (e.g., salmon, Dolly Varden, Arctic cisco).

Aquatic: Growing, living in, frequenting, or taking place in water; used to indicate habitat, vegetation, and wildlife in freshwater.

Archaeological resource: Places where remnants, such as artifacts or features, of a past culture survive in a physical context that allows for their interpretation. Archaeological resources can be districts, sites, buildings, structures, or objects and can be prehistoric or historic.

Aufeis: Thick ice that builds up as a result of repeated overflow.

Biological Assessment (BA): A document prepared by or under the direction of a federal agency; addresses listed and proposed species and designated and proposed critical habitat that may be in the action area and evaluates the potential effects of the action on such species and habitat.

Bureau of Land Management (BLM): An agency of the United States government, under the U.S. Department of the Interior, responsible for administering certain public lands of the United States.

Calving area: A large area where large mammals, particularly ungulates such as caribou, congregate to give birth to their young.

Capital expenses: The money spent to purchase or upgrade physical assets (e.g., buildings, roads, machinery).

Caribou Study Community: Any community that is in game management subunits that overlap caribou herd ranges, and which have Federal Subsistence Board customary and traditional use determinations for those herds.

Cubic feet per second (cfs): 1 cfs equals 448.33 gallons per minute.

Class I air quality area: Areas such as national parks over 6,000 acres, wilderness areas over 5,000 acres, national memorial parks over 5,000 acres, and international parks that were in existence as of August 1977, where air quality should be given special protection. Federal Class I areas are subject to maximum limits on air quality degradation called air quality increments (often referred to as prevention of significant deterioration [PSD] increments). All areas of the United States not designated as Class I are Class II areas. The air quality standards in Class I areas are more stringent than national ambient air quality standards.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the *Federal Register* (FR) by the executive departments and agencies of the federal government.

Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA): Authorizes funds administered by the U.S. Environmental Protection Agency (EPA) to identify and clean up hazardous waste sites; also known as Superfund.

Connected action: Connected actions are: a) actions (other than unconnected single actions) that may be: (1) connected actions, which means that they are closely related and therefore should be discussed in the same impact statement. Actions are connected if they: (i) automatically trigger other actions that may require environmental impact statements; (ii) cannot or will not proceed unless other actions are taken previously or simultaneously; (iii) are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR 1508.25(a)(i-iii)).

Conservation system unit: Any unit in Alaska of the National Park System, National Wildlife Refuge System, National Wild and Scenic Rivers System, National Trails System, National Wilderness Preservation System, or a National Forest Monument, including additions and expansions to these systems in the future (Section 102(4) of the Alaska National Interest Lands Conservation Act).

Consultation: Exchange of information and interactive discussion; consultation can be mandated by statute or regulation that has prescribed parties, procedures, and timelines, such as under NEPA, Section 7 of the Endangered Species Act (ESA), or Section 106 of the National Historic Preservation Act (NHPA).

Cooperating agency: Assists the lead federal agency in developing an Environmental Impact Statement (EIS). A cooperating agency may be any agency that has special jurisdiction by law or special expertise for proposals covered by NEPA (40 CFR 1501.6). Any federal, state, tribal, or local government jurisdiction with such qualifications may become a cooperating agency by agreement with the lead agency.

Council on Environmental Quality (CEQ): An advisory council to the president, established by NEPA. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the president on environmental matters.

Criteria air pollutants: The 6 most common air pollutants in the United States: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (both PM_{10} and $PM_{2.5}$ inhalable and respirable particulates), and sulfur dioxide (SO_2). Congress has focused regulatory attention on these 6 pollutants because they endanger public health and the environment, are widespread throughout the

United States, and come from a variety of sources. Criteria air pollutants are typically emitted from many sources in industry, mining, transportation, electricity generation, energy production, and agriculture.

Cultural resources: The remains of sites, structures, or objects used by humans in the past, historic or prehistoric.

Cumulative action: Proposed actions, which, when viewed with the proposed action, potentially have cumulatively significant impacts related to 1 or more identified issues. Cumulative actions “should be discussed” in the same NEPA document (40 CFR 1508.25(a)(2)).

Cumulative effect/impact: The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions (40 CFR 1508.7, 1508.25). Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Decision maker: The BLM official (also termed authorized official, authorized officer, responsible official, and responsible manager) who has been delegated authority to approve an action and is responsible for issuing a decision to implement a proposed action.

Density: The number of individuals per a given unit area.

Deposit: A natural accumulation, including precious metals, minerals, coal, gas, and oil, that may be pursued for its intrinsic value, such as a gold deposit.

Design features: Measures or procedures incorporated into the proposed action or an alternative, including measures or procedures that could reduce or avoid adverse impacts. Because these features are built into the proposed action or an alternative, design features are not considered mitigation.

Development: The phase of mining operations that occurs after exploration has proven successful and before full-scale production.

Direct effect/impact: “...those effects which are caused by the action and occur at the same time and place” (40 CFR 1508.8(a)).

Draft Environmental Impact Statement (Draft EIS): The draft statement of the environmental effects of a major federal action, which is required under Section 102 of NEPA and released to the public and other agencies for comment and review.

Effect: Environmental change resulting from a proposed action. Effects can be both beneficial and detrimental. Direct effects are caused by the action and occur at the same time and place, while indirect effects are caused by the action but are later in time or farther removed in distance, although still reasonably foreseeable. Indirect effects may include growth-inducing and other effects related to induced changes in the pattern of land use, population density, or growth rate and related effects on air and water and other natural systems, including ecosystems. Effect and impact are synonymous, and both are used in this document.

Employment: Labor input into a production process, measured in the number of person-years or jobs; the number of jobs required to produce the output of each sector. A person-year is approximately 2,000 working hours by 1 person working the whole year or by several persons working seasonally. A job may be 1 week, 1 month, or 1 year.

Endangered species: Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range; plant or animal species identified by the Secretary of the Interior as endangered in accordance with the ESA.

Environment: The physical conditions that exist in an area, such as the area that would be affected by a proposed project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance; the sum of all external conditions that affect an organism or community to influence its development or existence.

Environmental Impact Statement (EIS): An analytical document prepared under NEPA that portrays the potential impacts on the environment of a proposed action and its possible alternatives. An ElS is developed for use by decision makers to weigh the environmental consequences of a potential decision.

Environmental justice: The fair treatment and meaningful involvement of all people, regardless of natural origin or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order (EO) 12898 directs federal agencies to achieve environmental justice as part of their missions by identifying and addressing disproportionately high adverse effects of agency programs, policies, and activities, on minority and low-income populations.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geologic agents, including gravitation creep.

Essential fish habitat (EFH): As defined by the Magnuson-Stevens Fishery Conservation and Management Act, "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." In Alaska, there are 6 federal Fisheries Management Plans that identify EFH for fish species managed under a fishery management unit. For the purpose of interpreting the definition of EFH habitat, "waters" include aquatic areas and their associated physical, chemical, and biological properties; "substrate" includes sediment underlying the waters; "necessary" refers to the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" includes all habitat types that a species uses throughout its life cycle.

Ethnographic: Of or pertaining to the descriptive and analytical study of the culture of particular self-defined groups or communities.

Exception: A 1-time exemption to a lease stipulation, determined on a case-by-case basis.

Exploration: The search for economic deposits of minerals, gas, oil, or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking, and mapping.

Exploratory unit: A prospective area delineated on the basis of geological or geophysical inference and permit the most efficient and cost-effective means of developing underlying resources.

Federal action: A BLM proposal is a federal action when: (1) the proposal is at a stage in development where the BLM has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal (40 CFR 1508.23); (2) the proposed action and effects are subject to BLM control and responsibility (40 CFR 1508.18); (3) the action has effects that can be meaningfully evaluated

(40 CFR 1508.23); and (4) effects of the proposed action are related to the natural and physical environment, and the relationship of people with that environment (40 CFR 1508.8, 40 CFR 1508.14).

***Federal Register* (FR):** the official daily publication for rules, proposed rules, and notices of federal agencies and organizations, as well as EOs and other presidential documents. The FR is published by the Office of the Federal Register, National Archives and Records Administration (NARA).

Final Environmental Impact Statement (Final EIS): A revision of the Draft EIS that addresses public and agency comments on the draft.

Fisheries habitat: Streams, lakes, and reservoirs that support fish populations.

Fishery: The act, process, occupation, or season of taking an aquatic species.

Floodplain: The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year.

Fossil: Evidence or remnant of a plant or animal preserved in the earth's crust, such as a skeleton, footprint, or leaf print.

Frequency: The number of samples in which a plant or animal species occurs, divided by the total number of samples.

Fugitive dust: Particles suspended randomly in the air, usually from road travel, excavation, or rock loading operations.

Game Management Unit (GMU): A geographic division made by the Alaska Department of Fish and Game (ADF&G) for the management of fish and wildlife in the state. Different GMUs have different hunting and fishing seasons, bag limits, and other harvest rules.

Geology: The scientific study of the origin, history, and structure of the earth; the structure of a specific region of the earth's surface.

Geomorphic: Pertaining to the structure, origin, and development of the topographical features of the earth's crust.

Global warming: An increase over time of the average temperature of the earth's atmosphere and oceans. It is generally used to describe the temperature rise over the past century or so and the effects of humans on the temperature rise.

Greenhouse effect: A process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases (GHG) and is reradiated in all directions. Since part of this reradiation is toward the earth's surface and the lower atmosphere, it elevates the average surface temperature above what it would be in the absence of the gases.

Greenhouse gas (GHG): A gas that absorbs and emits thermal radiation in the lowest layers of the atmosphere. This process is the fundamental cause of the greenhouse effect. The primary GHGs that are considered air pollutants are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons (CFCs).

Groundwater: Water found beneath the land surface in the zone of saturation below the water table.

Habitat: The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions. The place where an organism lives.

Hazardous air pollutants (HAPs): Also known as toxic air pollutants, those that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The EPA is required to control 187 HAPs. Examples of HAPs are benzene (found in gasoline), perchloroethlyene (emitted from dry cleaning facilities), and methylene chloride (used as a solvent).

Hazardous waste: As defined by the EPA, a waste that exhibits 1 or more of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. Hazardous wastes are listed in 40 CFR 261.3 and 171.8.

Historic property: Historic properties are defined in the National Historic Preservation Act (NHPA; 54 United States Code [USC] 300308) as any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places [NRHP], including artifacts, records, and material remains related to such a property or resource."

Human environment: Includes the natural and physical environment and the relationship of people with that environment. When economic or social effects and natural or physical environmental effects are interrelated, then the analysis must discuss all of these effects on the human environment (40 CFR 1508.14).

Hydrocarbon: A naturally occurring organic compound composed of hydrogen and carbon. Hydrocarbons can occur in molecules as simple as methane (1 carbon atom with 4 hydrogen atoms), but also as highly complex molecules, and can occur as gases, liquids, or solids. The molecules can have the shape of chains, branching chains, rings, or other structures. Petroleum is a complex mixture of hydrocarbons.

Hydrologic system: The combination of all physical factors such as precipitation, stream flow, snowmelt, and groundwater that affect the hydrology of a specific area.

Hyporheic zone: Where surface and groundwater interact beneath and adjacent to streams; it is critical for salmon spawning and egg incubation and regulates biological activity that affects stream health (see Hancock 2002 for more information).

Impact: see "effect."

Impermeable: Not permitting passage of fluids through its mass.

Impoundment: The collection and confinement, usually of water (in the case of mining, tailings materials), in a reservoir or other storage area.

Indirect effect/impact: Impact caused by an action but later in time or farther removed in distance, although still reasonably foreseeable. Effects that "…are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on water and air and other natural systems, including ecosystems" (40 CFR 1508.8(b)).

Infrastructure: The underlying foundation or basic framework; substructure of a community's built environment, such as schools, police and fire stations, hospitals, roads, airports, and water and sewer systems.

Insect-relief area: An area with relatively low numbers of insects that caribou use for relief from insects.

Irretrievable: Applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the wildlife forage production from an area is irretrievably lost during the time an area is used as an oil or gas development site. If the use changes, forage production can be resumed. The production lost is irretrievable, but the act is not irreversible.

Irreversible: A term that applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Jurisdictional wetland: A wetland area delineated and identified by specific technical criteria, field indicators, and other information, for the purposes of public agency jurisdiction. The U.S. Army Corps of Engineers (USACE) regulates "dredging and filling" activities associated with jurisdictional wetlands. Other federal agencies that can become involved with matters that concern jurisdictional wetlands include the U.S. Fish and Wildlife Service (USFWS), EPA, and the Natural Resource Conservation Service.

Landform: Any physical, recognizable form or feature on the earth's surface having a characteristic shape that is produced by natural causes. Landforms provide an empirical description of similar portions of the earth's surface.

Landscape: The sum total of the characteristics that distinguish a certain area on the earth's surface from other areas; these characteristics are a result not only of natural forces, but also of human occupancy and use of the land. An area composed of interacting and interconnected patterns of habitats (ecosystems), which are repeated because of geology, landforms, soils, climate, biota, and human influences throughout the area.

Land management: The intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions.

Land status: The ownership or management status of lands.

Land use allocation: The assignment of a management emphasis to particular land areas with the purpose of achieving the goals and objectives of some specified use(s) such as campgrounds, wilderness, logging, and mining.

Land use plan: a set of decisions that establish management direction for land within an administrative area, as prescribed under the planning provisions of the Federal Land Policy and Management Act; an assimilation of land-use-plan level decisions developed through the planning process outlined in 43 CFR 1600, regardless of the scale at which the decisions were developed. The term includes both Resource Management Plans and Management Framework Plans.

Listed species: Species that are listed as threatened or endangered under the ESA.

Long-term impacts: Impacts that normally result in permanent changes to the environment such as the loss of habitat due to development of a gravel pit. For each resource, the definition of long term may vary.

Management area: An area delineated on the basis of management objective prescriptions.

Marine: Of, found in, or produced by the sea.

Migratory: Moving from place to place, daily or seasonally.

Mining District: The term "Mining District" applies traditionally to geographic areas described by miners and are often governed under bylaws drawn up by miners. The Ambler Mining District is an informal descriptive term applied to the approximate area mapped in this EIS and has no formal or legal standing. In contrast, the many individual mining claims and mining agreements that exist within the mapped area do have legal rights and responsibilities under state and federal law.

Mitigation: Steps taken to: (1) avoid an impact altogether by not taking a certain action or parts of an action; (2) minimize an impact by limiting the degree or magnitude of the action and its implementation; (3) rectify an impact by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate an impact over time by preserving and maintaining operations during the life of the action; and (5) compensate for an impact by replacing or providing substitute resources or environments (40 CFR 1508.20).

National Environmental Policy Act (NEPA): An act declaring a national policy to encourage productive and enjoyable harmony between humankind and the environment; promote efforts to prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity; enrich the understanding of the ecological systems and natural resources important to the nation; and establish a CEQ.

National Pollutant Discharge Elimination System (NPDES): A program authorized by Sections 318, 402, and 405 of the Clean Water Act (CWA), and implemented by 40 CFR 122. The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

Notice of Availability (NOA): The FR notice that an EIS (draft or final) or Record of Decision (ROD) is available. Publication of a notice of filing of an EIS by the EPA formally begins the public comment period.

Notice of Intent (NOI): This FR notice announces that an EIS will be prepared. Publication of this notice formally starts the scoping process.

Particulates: Small particles suspended in the air, generally considered pollutants.

Per capita income: Total income divided by the total population.

Permafrost: Permanently frozen ground.

Plant community: A vegetation complex, unique in its combination of plants, that occurs in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site (e.g., soils, temperature, elevation, solar radiation, slope aspect, precipitation).

Pollution: Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment that produce undesired effects.

Preferred alternative: The alternative the BLM believes would reasonably accomplish the purpose and need for the proposed action while fulfilling its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors. This alternative may or may not be the same as the BLM or proponent's proposed action.

Proposed action: A proposal for the BLM to authorize, recommend, or implement an action to address a clear purpose and need. A proposal may be generated internally or externally.

Public scoping: A process whereby the public is given the opportunity to provide oral or written comments about the influence of a project on an individual, the community, and/or the environment.

Raptor: Bird of prey such as eagles, hawks, falcons, and owls.

Reasonably foreseeable action: Actions for which there are existing decisions, funding, formal proposals, or which are highly probable, based on known opportunities or trends.

Record of Decision (ROD): A document separate from, but associated with, an EIS that states the decision, identifies alternatives (specifying which were environmentally preferable), and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and, if not, why (40 CFR 1505.2).

Regulated air pollutants: Pollutants first set forth in the Clean Air Act of 1970 and are the basis upon which the federal government and state regulatory agencies have established emission thresholds and regulations. Regulated air pollutants include criteria air pollutants, HAPs, volatile organic compounds (VOCs), and GHGs. The same pollutant may be regulated under more than 1 regulatory standard.

Regulation: An official rule. Within the federal government, certain administrative agencies (such as the BLM) have a narrow authority to control conduct within their areas of responsibility. A rule (also called a regulation or rulemaking) is a statement published in the FR to implement or interpret law or policy (see Administrative Procedure Act, 5 USC 551(4) ["'rule' means the whole or a part of an agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy or describing the organization, procedure, or practice requirements of an agency…"]). A rule is generally published as a proposed rule and then as a final rule. Once a rule is published in final, it is codified in the CFR and remains in effect until it is modified by publication of another rule.

Resident: A species that is found in a particular habitat for a particular time period, such as winter or summer resident, as opposed to a species found only when passing through during migration.

Resource management plan (also known as Land Use Plan or Management Framework Plan): A set of decisions that establish management direction for land within an administrative area, as prescribed under the planning provisions of the Federal Land Policy and Management Act of 1976, as amended, Public Law 94-579, 90 Statute 2743; an assimilation of land use plan-level decisions developed through the planning process outlined in 43 CFR 1600, regardless of the scale at which the decisions were developed.

Right-of-way: Public lands that the BLM authorizes a holder to use or occupy under a grant (e.g., roads, pipelines, power lines, fiber optic lines).

Riparian: Occurring adjacent to streams and rivers and directly influenced by water. A riparian community is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Scenic River: River designation, under the Federal Wild and Scenic Rivers Program, on the basis of undisturbed and scenic character. Scenic rivers are given special management criteria by federal agencies.

Scoping (internal and external): The process by which the BLM solicits internal and external input on the issues and effects that will be addressed, as well as the degree to which those issues and effects will be analyzed in the NEPA document. Scoping is a form of public involvement in the NEPA process. Scoping occurs early in the NEPA process and generally extends through the development of alternatives (the public comment periods for EIS review are not scoping). Internal scoping is simply the use of BLM staff to decide what needs to be analyzed in a NEPA document. External scoping, also known as formal scoping, involves notification and opportunities for feedback from other agencies, organizations, and the public.

Scoping process: A part of the NEPA process; early and open activities used to determine the scope and significance of the issues, and the range of actions, alternatives, and impacts to be considered in an EIS (40 CFR 1501.7).

Sediments: Unweathered geologic materials generally laid down by or within waterbodies; the rocks, sand, mud, silt, and clay at the bottom and along the edge of lakes, streams, and oceans.

Sensitive species: Plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations; species that have appeared in the FR as proposed for classification or are under consideration for official listing as endangered or threatened species.

Short-term impacts: Impacts occurring during project construction and operation, and normally ceasing upon project closure and reclamation. For each resource, the definition of short term may vary.

Significant: The description of an impact that exceeds a certain threshold level. Requires consideration of both context and intensity. The significance of an action must be analyzed in several contexts, such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts, which should be weighted along with the likelihood of its occurrence. The CEQ regulations at 40 CFR 1508.27(b) include 10 considerations for evaluating intensity.

Sociocultural: Of, relating to, or involving a combination of social and cultural factors.

Socioeconomic: Pertaining to or signifying the combination or interaction of social and economic factors.

Soil horizon: A layer of soil material approximately parallel to the land surface that differs from adjacent genetically related layers in physical, chemical, and biological properties.

Solid waste: Includes garbage and/or refuse.

Spawning: Production, deposition, and fertilization of eggs by fish.

Subsistence: Harvesting of plants and wildlife for food, clothing, and shelter. The attainment of most of one's material needs, such as food and clothing materials, from wild animals and plants.

Substantive comment: A comment that does 1 or more of the following: questions, with reasonable basis, the accuracy of information in the EIS; questions, with reasonable basis or facts, the adequacy of, methodology for, or assumptions used for the environmental analysis; presents reasonable alternatives other than those presented in the EIS; or prompts the BLM to consider changes or revisions in 1 or more of the alternatives.

Terrestrial: Of or relating to the earth, soil, or land; inhabiting the earth or land.

Thermokarst: Depressions and uneven ground settlements resulting from the thawing and melting of permafrost.

Third-party contracting: Contracting for the preparation of NEPA documents that is funded by the non-BLM proponent of an action. The BLM must still approve this analysis.

Threatened species: A plant or animal species likely to become an endangered species throughout all or a significant portion of its range within the foreseeable future.

Traditional knowledge: An intimate understanding by indigenous peoples of their environment, which is grounded in a long-term relationship with the surrounding land, ocean, rivers, ice, and resources. This understanding includes knowledge of the anatomy, biology, and distribution of resources; animal behavior; seasons, weather, and climate; hydrology, sea ice, and currents; ecosystem function; and relationship between the environment and the local culture.

Waterbody: A jurisdictional water of the United States (see 33 CFR 328.4). Examples of “waterbodies” include streams, rivers, lakes, ponds, and wetlands.

Water quality: The interaction between various parameters that determines the usability or non-usability of water for onsite and downstream uses. Major parameters that affect water quality include temperature, turbidity, suspended sediment, conductivity, dissolved oxygen, pH, specific ions, discharge, and fecal coliform.

Wetlands (biological wetlands): Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstance support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include habitats such as swamps, marshes, and bogs (see jurisdictional wetlands).

Wild and Scenic Rivers: Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Wilderness: A wilderness, in contrast with those areas where humans and their works dominate the landscape, is recognized as an area where the earth and its community of life are untrammeled by humans, where humans are visitors who do not remain. An area of wilderness also means an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of human’s work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

References

Hancock, P.J. 2002. Human Impacts on the Stream–Groundwater Exchange Zone. *Environmental Management* 29(6):763-781.

This page is intentionally left blank.