Appendix F –
Biological Resources

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F. BIOLOGICAL RESOURCES

This appendix provides additional background information and analyses in support of the assessments presented in Chapter 5 of the Northern Rail Extension (NRE) Environmental Impact Statement. Background information includes supporting information, additional descriptions, technical data, and results of quantitative analyses summarized in Chapter 5. The format and order of this appendix follows the general order of Chapter 5, that is, Vegetation Resources (F.1), Fisheries Resources (F.2), Game Mammal Resources (F.3), and Bird Resources (F.4).

F.1 Vegetation Resources

Existing conditions for vegetation types were based on Gallant *et al.*, 1995; Magoun and Dean, 2000; Viereck *et al.*, 1992; and ANHP *et al.*, 2006. Quantification of vegetation and habitat types within the NRE project area are based on the Tanana Flats Earth Cover Classification (TFECC; BLM *et al.*, 2002) for an area within 5 miles of all proposed alternatives (Table F-1). Table F-2 lists vegetation communities by landscape positions and vegetation types for the Tanana Flats Earth Cover Classification.

Table F-1
Vegetation Cover Classes Within 5 Miles of the Proposed NRE[a]

Grid Code	Class Name	Area (acres)	Proportion of Area (%)[b]
1	Closed Needleleaf Forest	73,637	12
2	Open Needleleaf Forest	179,600	28
3	Closed Broadleaf Forest	52,464	8
4	Open Broadleaf Forest	29,131	5
5	Closed Mixed Broadleaf/Needleleaf Forest	89,310	14
6	Tall Shrub	15,364	3
7	Low Shrub	64,289	10
8	Dwarf Shrub	1,615	<1
9	Graminoid	10,580	2
10	Bryoid/Lichen	862	<1
14	Aquatic Bed	1,169	<1
15	Clear Water	9,778	2
16	Turbid Water	32,843	5
17	Ice	26	<1
19	Sparse Vegetation	2,438	<1
20	Gravel/Rock	3,323	1
21	Mud/Silt/Sand	19,564	3
22	Urban	8,843	1
23	Agriculture	20,086	3
24	Other	18,688	3
Total		**633,610**	

[a] Source: BLM *et al.*, 2002.
[b] < means less than.

No Federal or State of Alaska protected threatened, endangered, or candidate plants occur within the project area. Twenty-seven rare plants have been reported to occur within the Donnelly and Tanana Flats training areas near the NRE (Table F-3), and one rare willow, *Salix setchelliana*, was identified during field investigations for wetlands along Delta Alternative Segment 2 (HDR, 2007).

Table F-2
Vegetation Communities[a] for Tanana Flats Earth Cover Classifications[b]

TFECC	Landscape Position	Vegetation Type	Common Plants
Closed Needleleaf (canopy 60 to 100%)	Well-drained hillsides or young river terraces	Closed white spruce forest	White spruce (*Picea glauca*), willows (*Salix* spp.), prickly rose (*Rosa acicularis*), lowbush cranberry (*Vaccinium vitis-idaea*), bluebell (*Mertensia paniculata*), woodland horsetail (*Equisetum sylvaticum*), Canada dogwood (*Cornus canadensis*), feathermoss (*Hylocomium splendens*)
	Poorly-drained silts on floodplain terraces or north-facing slopes	Closed black spruce forest	Black spruce (*Picea mariana*), green alder (*Alnus crispa*), Labrador tea (*Ledum groenlandica*), lowbush cranberry, polar grass (*Arctagrostis latifolia*), feathermoss
	Poorly-drained silts on floodplain terraces	Closed black spruce-white spruce forest	Black spruce, white spruce, green alder, Labrador tea, lowbush cranberry, feathermoss
	Wet lowlands, shallow permafrost	Closed black spruce-tamarack forest	Black spruce, tamarack (*Larix laricina*), Labrador tea, lowbush cranberry, lichens and mosses
Open Needleleaf (canopy 25 to 60%)	Well-drained hillsides or young river terraces	Open white spruce forest	White spruce, Bebb's willow (*Salix bebbiana*), Canada dogwood, highbush cranberry (*Viburnum edule*), prickly rose, twinflower (*Linnaea borealis*), feathermosses (*Hylocomium splendens*, *Rhytidiadelphus loreus* and others), common horsetail (*Equisetum arvense*)
	Poorly-drained silts on floodplain terraces	Open black spruce forest	Black spruce, prickly rose, willows, green alder, Labrador tea, lowbush cranberry, crowberry (*Empetrum nigrum*), grasses, feathermosses, Sphagnum mosses (*Sphagnum* spp.)
	Wet lowlands, shallow permafrost	Open black spruce-tamarack forest	Black spruce, tamarack, shrub birch, Labrador tea, mosses
	Very poorly-drained lowlands, shallow permafrost scrub	Open dwarf black spruce forest	Black spruce, Labrador tea, tussock forming cottongrasses (*Eriophorum brachyantherum or Eriophorum vaginatum*), feathermosses, Sphagnum mosses
Closed Broadleaf (canopy 60 to 100%)	Floodplain terraces	Closed balsam poplar forest	Balsam poplar (*Populus balsamifera*), white spruce, prickly rose, bluejoint reedgrass (*Calamagrostis canadensis*), common horsetail
	Upland loess soils	Closed paper birch forest	Paper birch (*Betula papyrifera*), green alder, prickly rose, highbush cranberry, Canada dogwood, common horsetail, bluejoint reedgrass, Labrador tea, lowbush cranberry
	Well-drained slopes, upland slopes, south-facing	Closed quaking aspen forest	Quaking aspen (*Populus tremuloides*), prickly rose, twinflower, soapberry (*Shepherdia canadensis*), bearberry (*Arctostaphylos uva-ursi*)
	Well-drained slopes	Closed paper birch-quaking aspen forest	Paper birch, quaking aspen, white spruce, green alder, prickly rose, soapberry, lowbush cranberry, grasses, clubmosses (*Lycopodium* spp.)
	Well-drained slopes, floodplain terraces	Closed quaking aspen-balsam popular forest	Quaking aspen, balsam poplar, prickly rose

Table F-2
Vegetation Communitiesa for Tanana Flats Earth Cover Classifications[b] (cont'd)

TFECC	Landscape Position	Vegetation Type	Common Plants
Open Broadleaf (canopy 25 to 60%)	Upland loess soils	Open paper birch forest	Paper birch, green alder, Labrador tea, bluejoint reedgrass, leaf litter
	Well-drained slopes, upland slopes, commonly south-facing	Open quaking aspen forest	Quaking aspen, willows, bearberry, fireweed (*Epilobium* spp.), bluejoint reedgrass, lichens
	Floodplain terraces	Open balsam poplar forest	Balsam poplar, willows, alder, bluejoint reedgrass, horsetail (*Equisetum* spp.)
Closed Mixed (canopy 60 to 100%	Well-drained slopes, poorly drained slopes, floodplain terraces	Closed spruce-paper birch forest	white spruce, paper birch, green alder, Bebb's willow, prickly rose, bluejoint reedgrass, common horsetail lowbush cranberry, feather mosses
	Well-drained slopes, upland slopes	Closed Quaking aspen-spruce forest	Quaking aspen, white spruce, Canada dogwood
	Floodplain terraces	Closed balsam poplar-white spruce	Balsam poplar, white spruce, thinleaf alder (*Alnus tenuifolia*), prickly rose, lowbush cranberry, common horsetail
Tall Shrub (less than 1.3 meters tall)	Active and young floodplains, river bars, and after fires	Tall willow scrub	Alaska willow (*Salix alaxensis*), sandbar willow (*Salix interior*), grayleaf willow (*Salix glauca*), Bebb's willow, littletree willow (*Salix arbusculoides*), bluejoint, fireweed, horsetail
	Along rivers and after fires, Upland drainageways, seepages	Tall alder scrub	Thinleaf alder, green alder, bluejoint reedgrass
	Active and young floodplains, river bars	Tall alder-willow scrub	Thinleaf alder, green alder, Alaska willow, bebb willow, common horsetail, in wet areas with water sedge (*Carex aquatilis*), bluejoint, marsh fivefinger (*Potentilla palustris*), swamp horsetail (*Equisetum fluviatile*)
Low Shrub (0.25 to 1.3 meters tall)	Non-patterned wetlands with thick organic mat	Low mixed shrub-sedge tussock bog	Resin birch (*Betula gladulosa*), willows, tussock forming cottongrasses, bog blueberry (*Vaccinium uliginosum*), thinleaf Labrador tea, Sphagnum mosses
	Non-patterned wetlands with thick organic mat	Ericaceous scrub bog	Leatherleaf (*Chamaedaphne calyculata*), willows, water sedge (*Carex* spp.)
	Non-patterned wetlands with thick organic mat	Shrub birch-willow scrub	Resin birch, diamondleaf willow (*Salix pulchra*), grayleaf willow
Dwarf Shrub (less than 0.25 meter tall)	Non-patterned wetlands with thick organic mat	Low scrub	Labrador tea, bog blueberry, willows, feathermosses
Graminoid	Poorly drained silty lowlands to well-drained upland slopes	Bluejoint meadow	Bluejoint reedgrass, sedge (*Carex rostrata*), cinquefoil (*Potentilla* spp.), fireweed
	Lake and pond margins, sloughs, silty or organic soils	Subarctic lowland sedge wet meadow	Water sedge (*Carex aquatilis*, *Carex rostrata),* narrow-leaf cottongrass (*Eriophorum angustifolium*), marsh fivefinger, swamp horsetail

Table F-2
Vegetation Communitiesa for Tanana Flats Earth Cover Classifications[b] (cont'd)

TFECC	Landscape Position	Vegetation Type	Common Plants
Sparse Vegetation	River bars (dry to mesic)	Seral herbs	Yellow dryas (*Dryas drummondii*), river beauty (*Epilobium latifolium*), fireweed (*Epilobium angustifolium*)
Aquatic Bed	Sloughs, oxbow lakes, lake margins, silty or organic soils, fens	Fresh herb marsh	Buckbean (*Menyanthes trifoliate*), swamp horsetail, water smartweed (*Polygonum amphibium*)
	Shallow Lakes and ponds	Aquatic bed	Yellow pondlilly (*Nuphar polysepalum*), pondweed (*Potamogeton* spp.), water milfoil (*Myriophyllum spicatum*)

[a] Sources: Viereck *et al.*, 1992; Jorgenson *et al.*, 1999, 2001; HDR, 2007.
[b] Source: TFECC; BLM *et al.*, 2002.

Table F-3
Rare Plants Reported Near and Within the NRE Project Area

Species[a] (Synonym[b])	Common Name/ Habitat[b]	Global Status[a,c]	State Status[a,c]	Donnelly Training Area[d,e]	Tanana Flats Training Area[e,f]	NRE Project Area[g]
Apocynum androsaemifolium	Dogbane / Woods, hot springs	G5	S2S3		√	
Artemisia laciniata	Siberian Wormwood / Open forests	G4?	S2	√	√	
Carex crawfordii	Crawford's Sedge / Dry grasslands, roadsides	G5	S3	√	√	
Carex deweyana	Dewey Sedge / Probably introduced	G5	S2?	√		
Carex eburnea	Bristleleaf sedge / Dry sand, rocky places	G5	S3	√		
Carex sychnocephala	Manyhead Sedge / Meadows, grassy slopes	G4	S1	√		
Ceratophyllum demersum	Hornwort / Quiet water	G5	S1		√	
Cicuta bulbifera	Water Hemlock / Marshes, bogs	G5	S2		√	
Cryptogramma stelleri	Fragile Rockbrake / Rock crevices	G5	S2S3	√	√	
Draba incerta	Yellowstone Draba / Rocky slopes	G5	S2S3	√		
Festuca lenensis (Festuca ovina)	Tundra Fescue / Alpine slopes	G4G5	S3		√	
Glyceria pulchella	MacKenzie Valley Mannagrass / Wet places	G5	S2S3	√	√	
Lycopus uniflorus	Northern Bugleweed / Wet places	G5	S3		√	
Minuartia yukonensis	Yukon Stitchwort / Dry places, scree slopes	G4?	S3		√	
Myriophyllum verticillatum	Water Milfoil / Shallow water	G5	S3		√	
Oxytropis tananensis (Oxytropis campestris)	Field Locoweed / Dry, sandy places	G2G3Q	S2S3		√	
Pedicularis macrodonta	Muskeg Lousewort / Swamps, muskeg	G4Q	S3		√	
Phlox hoodii	Carpet Phlox / Dry mountain slopes	G5	S1S2	√		
Phlox richardsonii ssp. *Richardsonii (Phlox siberica)*	Richardson's Phlox / Dry mountain slopes	G4T2T3 Q	S2?	√		

Table F-3
Rare Plants Reported Near and Within the NRE Project Area (cont'd)

Species[a] (Synonym[b])	Common Name/ Habitat[b]	Global Status[a,c]	State Status[a,c]	Donnelly Training Area[d,e]	Tanana Flats Training Area[e,f]	NRE Project Area[g]
Potamogeton obtusifolius	Bluntleaf Pondweed / Water	G5	S2S3	√		
Rorippa curvisiliqua	Yellowcress / Wet places	G5	S1		√	
Rosa woodsii var. *woodsii*	Woods' Rose / Dry slopes	G5T5	S1S2		√	
Salix setchelliana	Setchell's Willow / Gravel bars, shores	G4	S3	√		√
Saxifraga adscendens ssp. *oregonensis*	Small Saxifrage / Rock crevices, sandy places	G5T4T5	S2S3	√		
Sisyrinchium montanum	Blue-eyed Grass / Moist places	G5	S1	√		
Stellaria alaskana	Alaska Starwort / Stony slopes	G3	S3	√		
Viola selkirkii	Selkirk's violet / Woods	G5?	S3	√		

[a] Source: Lipkin, 2007.
[b] Source: Hultén, 1968.
[c] Global and State Ranks: G = Global, S = State, Q = Taxonomically questionable, T = Rank of species and rank of described variety or subspecies, ? = Inexact, 1 = Critically imperiled, 2 = Imperiled, 3 = Rare or uncommon, 4 = Apparently secure, but with cause for long-term concern, 5 = Demonstrably secure.
[d] Source: Racine *et al.*, 2001.
[e] Occurrence = √.
[f] Source: Tande *et al.*, 1996.
[g] Source: HDR, 2007.

F.1.1 Noxious Weeds

Prohibited and restricted noxious weeds are regulated by the State of Alaska. Federally designated noxious weeds are regulated by the U.S. Department of Agriculture, Animal and Plant Health Inspection Service. No federally designated noxious weeds are known to occur in Alaska. Noxious weeds are generally introduced through contaminated seed sources, equipment, vehicles, materials and supplies used in revegetation and they are typically spread by construction vehicles, water, and wind. Noxious weeds could also be introduced to the NRE during operation of the rail line through spills of contaminated grain or animal feeds (hay, pellets). The State of Alaska regulates 12 prohibited weed species and nine restricted weed species (Table F-4). Of these listed weeds, three prohibited weeds and eight restricted weeds have been reported within the NRE project area (ANHP *et al.*, 2006). Comprehensive surveys for invasive plants have not been completed for all alternatives. Data presented include surveys compiled by the Alaska Natural Heritage Program primarily for transportation corridors and municipalities (ANHP *et al.*, 2006). The highest concentrations of invasive plants within the project area are found in the more highly disturbed areas of North Pole and Delta Junction, although noxious weeds occur throughout the Richardson Highway alignment. Alternative segments near these source areas would have a greater probability of contributing to the spread of invasive plants.

Table F-4
Occurrence of Prohibited and Restricted Noxious Weeds Within the Project Area

Common Name	Species	Occurrence
Prohibited Noxious Weeds		
Quackgrass	*Agropyron repens*	No occurrence
Whitetops and its varieties	*Cardaria drabe, C. pubescens, Lepidium latifolium*	No occurrence
Knapweed, Russian	*Centaurea repens*	No occurrence
Thistle, Canada	*Cirsium arvense*	No occurrence
Field Bindweed	*Convolvulus arvensis*	2 sites
Spurge, leafy	*Euphorbia esula*	No occurrence
Galensoga	*Galensoga parviflora*	No occurrence
Hempnettle	*Galeopsis tetrahit*	8 sites
Lettuce, blue-flowering	*Lactuca puichella*	No occurrence
Fieldcress, Austrian	*Rorippa austriaca*	No occurrence
Horsenettle	*Solanum carolinense*	No occurrence
Sowthistle, Perennial	*Sonchus arvensis*	29 sites
Restricted Noxious Weeds		
Oats, Wild	*Avena fatua*	No occurrence
Mustard	*Brassica kaber, juncea*	No occurrence
Blue Burr	*Lappula echinatat*	No occurrence
Toadflax, Yellow	*Linaria vulgaris*	8 sites
Plantain, Buckhorn	*Plantago* sp	34 sites
Annual Bluegrass	*Poa annua*	5 sites
Wild Buckwheat	*Polygonum convovulus*	4 sites
Radish	*Raphanus raphanistrum*	No occurrence
Vetch, Tufted	*Vicia cracca*	32 sites

[a] Source: ANHP *et al.*, 2006.

F.1.2 Alaska Railroad Corporation Vegetation Management

The Alaska Railroad Corporation (ARRC) manages vegetation on railbeds and facilities to:

- Eliminate plants and roots that impede drainage, or obstruct or interfere with train movement;
- Allow track inspectors to visually inspect ties, track, and fasteners;
- Maintain sight lines at crossings, and visibility of track flags, mileposts, and other signage;
- Remove potential fuels that can cause wildland fires;
- Maintain safe walking areas; and
- Prevent spread of invasive and noxious weeds (ARRC, 2006a; 2006b).

ARRC has used mechanical and other non-chemical methods of vegetation management since 1983. Permission to use herbicides has been intermittently requested by ARRC to assist in management of vegetation, but issuance of a permit has been consistently denied under 18 Alaska Administrative Code 90.505 by the Alaska Department of Environmental Conservation (ADEC, 2007). Alternative vegetation management techniques used by ARRC have included: inmate hand clearing, hydro-ax brush cutting, modified ballast regulator, reballasting, hot water/steam, weed burning and infrared burning treatments, and have been largely ineffective at controlling vegetation within the track ballast section (Kemenosh, 1999). ARRC uses manual and mechanical vegetation control including brush-cutting the right-of-way (ROW) and manual and mechanical ballast clearing (Burnham *et al.*, 2003). The Federal Railroad Administration has cited ARRC under the Railroad Safety Statutes Title 49 Code of Federal Regulations, Part 213, Section 37, annually for failing to control vegetation (Kemenosh, 1999).

Plants that tend to dominate the railbed are common within the project area and are difficult to remove, including tree saplings (balsam poplar, birch, aspen); shrubs (alder, willow, raspberry [*Rubus idaeus*]); herbaceous plants (fireweed, bluejoint reedgrass, horsetail, yarrow [*Achillea borealis*]); and introduced weeds (dandelion [*Taraxacum officinale*], white sweetclover [*Melilotus alba*], red clover [*Trifolium pretense*]) (Table F-4; Kemenosh, 1999; Lapina *et al.*, 2007).

Mechanical removal of vegetation results in ground disturbance, which promotes erosion. Use of heavy equipment for spot-control of vegetation may result in removal of more vegetation than is necessary. Vegetation removal by hand-clearing would result in some soil disturbance if weeds are pulled. Use of chain saws or other hand-held power tools would reduce soil disturbance but the chance of small fuel spills would be increased. Removing excess vegetation by burning would increase the risk of fire spreading beyond the vegetation management target area and potentially result in the unintentional destruction of forest resources (ARRC, 1984).

F.1.3 Fire Management and Wildland Fire History

The NRE crosses four levels of fire protection—Limited, Modified, Full, and Critical—under the Alaska Fire Services 2007 fire management options (Table F-5; BLM AFS, 2007a). Of the area crossed by the alternatives, 58 percent falls within the full protection classification, followed by limited protection (17 percent), critical protection (11 percent), unplanned protection (10 percent), and modified protection (4 percent). Portions of the Eielson alternative segments cross military lands that are under the jurisdiction of Eielson Air Force Base (AFB); these areas are identified as unplanned for wildland fire protection by the Alaska Fire Service (BLM AFS, 2007a). Table F-5 lists fire protection classes for each alternative segment.

Table F-5
Fire Protection Classes for NRE Alternative Segments[a]

	Fire Management Options 2007					
Segment	**Critical (miles)**	**Full (miles**	**Modified (miles)**	**Limited (miles)**	**Unplanned (miles)**	**Total Length (miles)**
North Common	-	2.6	-	-	-	2.6
Eielson 1	-	6.2	-	-	4.1	10.3
Eielson 2	1.9	3.3	-	-	4.8	10.0
Eielson 3	1.9	0.8	-	-	7.4	10.1
Salcha 1	-	1.5	-	10.3	-	11.8
Salcha 2	1.0	12.1	-	0.7	-	13.8
Central 1	-	3.4	-	1.7	-	5.1
Central 2	-	0.2	-	3.5	-	3.7
Connector A	-	-	-	4.4	-	4.4
Connector B	-	-	-	3.3	-	3.3
Connector C	-	-	-	2.3	-	2.3
Connector D	-	-	-	0.9	-	0.9
Connector E	-	2.4	-	-	-	2.4
Donnelly 1	-	17.8	6.2	1.6	-	25.6
Donnelly 2	-	26.1	-	-	-	26.1
South Common	-	10.5	-	-	-	10.5
Delta 1	2.4	9.1	-	-	-	11.5
Delta 2	10.4	1.2	-	-	-	11.6
Total Length (miles)	**17.6**	**97.2**	**6.2**	**28.7**	**16.3**	**166.0**

[a] Source: BLM AFS, 2007a.

Definitions of fire protection levels, as defined by Todd and Jewkes, (2006) are:

- Critical – Areas where human life and settlements are at risk. These areas receive the highest priority and aggressive suppression efforts.
- Full – Areas that are uninhabited but contain valuable resources. These areas receive suppression priority second only to critically designated areas.
- Modified – Fires are suppressed during the peak fire season, but later are converted to a limited management option.
- Limited – Areas where fires are generally allowed to burn and only monitored. However, adjacent lands are considered so that a fire does not burn into a higher priority option.

Of the 166 miles of alternative segments, 13 miles, or 8 percent, have been burned by fires greater than 100 acres (1988 through 2006) or greater than 1,000 acres (1950 through 1987) since 1949 (Table F-6). The largest and most recent burn area (4.2 miles of South Common Segment burned in 1998) caused forested habitats to be replaced by primarily herbaceous and low shrub habitats. Interruption of wildland fires by the railbed and adjacent roadbed on the west side of the Tanana River in areas designated as limited protection would alter the natural pattern of wildland fire-generated succession and would potentially lead to increased fuel and increased risk for intense wildland fire in the area of Salcha Alternative Segment 1, and Central and Central Connector alternative segments where fire management is limited. A fuel break along the Tanana River Valley could also be beneficial in the protection of late-succession riparian forests and private property.

Table F-6
Post-1949 Fire History for NRE Alternative Segments[a]

Segment	Unburned Length (miles)	Burned Length (miles)	Fire Year	Total Length (miles)
North Common	2.6	-		2.6
Eielson 1	9.5	0.8	1950	10.3
Eielson 2	9.6	0.4	1950	10.0
Eielson 3	10.1	-		10.1
Salcha 1	8.1	3.6	1957	11.7
Salcha 2	13.8	-		13.8
Central 1	4.5	0.6	1981	5.1
Central 2	3.6	-		3.6
Connector A	3.4	1.0	1981	4.4
Connector B	3.3	-		3.3
Connector C	1.3	1.0	1981	2.3
Connector D	0.9	-		0.9
Connector E	2.4	-		2.4
Donnelly 1	25.7	-		25.7
Donnelly 2	26.1	-		26.1
South Common	6.3	4.2	1998	10.5
Delta 1	11.5	-		11.5
Delta 2	9.6	1.9	1971	11.5
Total Length (miles)	**152.3**	**13.5**		**165.8**

[a] Source: BLM AFS, 2007b.

F.2 Fisheries Resources

Analysis of affects to fisheries from the construction and operation of the proposed alternative segments were evaluated based on habitat use, habitat requirement, and seasonal movement of fish within the project area. Habitat analysis was based on analysis of stream crossings presented in Chapter 4, anadromous fish stream data, and fish occurrence and habitat data provided by the ADF&G (ADF&G, 2005a) and collected at or near proposed crossing sites during 2005 to 2007 (Noel, 2007b).

F.2.1 Recreational Fisheries

Recreational fisheries in the project area are managed by the Alaska Department of Fish and Game (ADF&G) Sport Fish Division; which divides the drainage into two management areas; the Lower Tanana Management Area or Fairbanks Management Area and the Upper Tanana Management Area or Delta Management Area. The Lower Tanana Management Area consists of the Tanana River and its tributaries downstream of the Fairbanks North Star Borough boundary. Waters in this area crossed by the project include Piledriver Slough, Twentythreemile Slough, the Tanana River, the Little Salcha River, the Salcha River, the Fivemile Clearwater River, Kiana Creek, Delta Creek, tributaries of the Richardson Clearwater River, and the Little Delta River. The Upper Tanana River Management Area consists of the Tanana River and its tributaries upstream of the Fairbanks North Star Borough boundary. Waters in this area crossed by the project include Delta Creek, the Delta River and Jarvis Creek (ADF&G, 2008a).

The Richardson Highway, secondary roads from North Pole to Delta Junction, navigable waters, and overland trail systems provide access to fisheries resources within the project area. Angling opportunity is available year-round. In summer, fishing occurs in all waters where game fish are present; however, most anglers concentrate on lakes, sloughs and clearwater tributaries of the mainstem Tanana River (ADF&G, 2007b; ADF&G, 2008a). During winter months, fishing occurs through the ice primarily on stocked lakes, although some fishing occurs on the Tanana River for burbot and northern pike (ADF&G, 2008a). In the project area most fishing effort and harvest has focused on the Salcha River, where arctic grayling and Chinook salmon dominated the harvest (Figure F-1). Many people practice catch-and-release fishing, especially for Chinook salmon, arctic grayling, and rainbow trout. Catch estimates could be as much as ten times higher than harvest estimates for these species in this region (Brase, 2008).

F.2.2 Commercial and Subsistence/Personal Use Fisheries

Commercial, subsistence and personal use fisheries are managed by the ADF&G Division of Commercial Fisheries. The project area lies in ADF&G's Commercial Fisheries Yukon Management Area. There are three commercially harvested salmon within the project area, which also support sport and subsistence/personal use fish harvest: Chinook (king) salmon, coho (silver) salmon and chum (dog) salmon. No commercial or federally regulated subsistence fishing occurs in the project area. The primary management concern for these salmon in the Tanana River drainage is maintenance of adequate returns of spawning adults to meet subsistence needs and provide for commercial and personal use fisheries.

All salmonids in the Tanana River are considered to be Yukon River stocks because the Tanana River is a major tributary of the Yukon River. Chinook salmon arrive in the Tanana River as far as Fairbanks and areas upstream in early July, and are known to spawn in the Salcha River (Table F-7; Eiler *et al.*, 2004). Chinook salmon from the Tanana River drainages comprise about 20 percent of the Yukon River Chinook salmon run (Eiler *et al.*, 2004). This run is one of the most productive Alaskan fisheries, and is an important commercial and subsistence resource for both Alaska and Western Canada (Eiler *et al.*, 2004; Woodby *et al.*, 2005). In the project area Chinook salmon spawn and rear in the Salcha River and occur in the Fivemile Clearwater River (Figure F-2; Johnson and Weiss, 2007).

Table F-7
Run Timing for Salmon that Move Through and/or Spawn in the Project Area[a,b]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook salmon							■	■				
Coho salmon									▒	■	■	
Chum salmon							■	▒	▒	▒	■	

[a] Source: ADF&G, 2008b.
[b] Shading indicates run timing; darkest shading indicates peak availability.

Coho or silver salmon spawn in clear water tributaries of the Tanana River including: the Fivemile Clearwater River, Kiana Creek, and unnamed tributaries to the Richardson Clearwater River (Figure F-2; Johnson and Weiss, 2007) during September through November (Table F-7). In addition to its importance as a commercial and subsistence resource, coho salmon is a popular sport fish. The Delta Clearwater River near Delta Junction is a popular sport fishing spot (Delta Junction CoC, 2008).

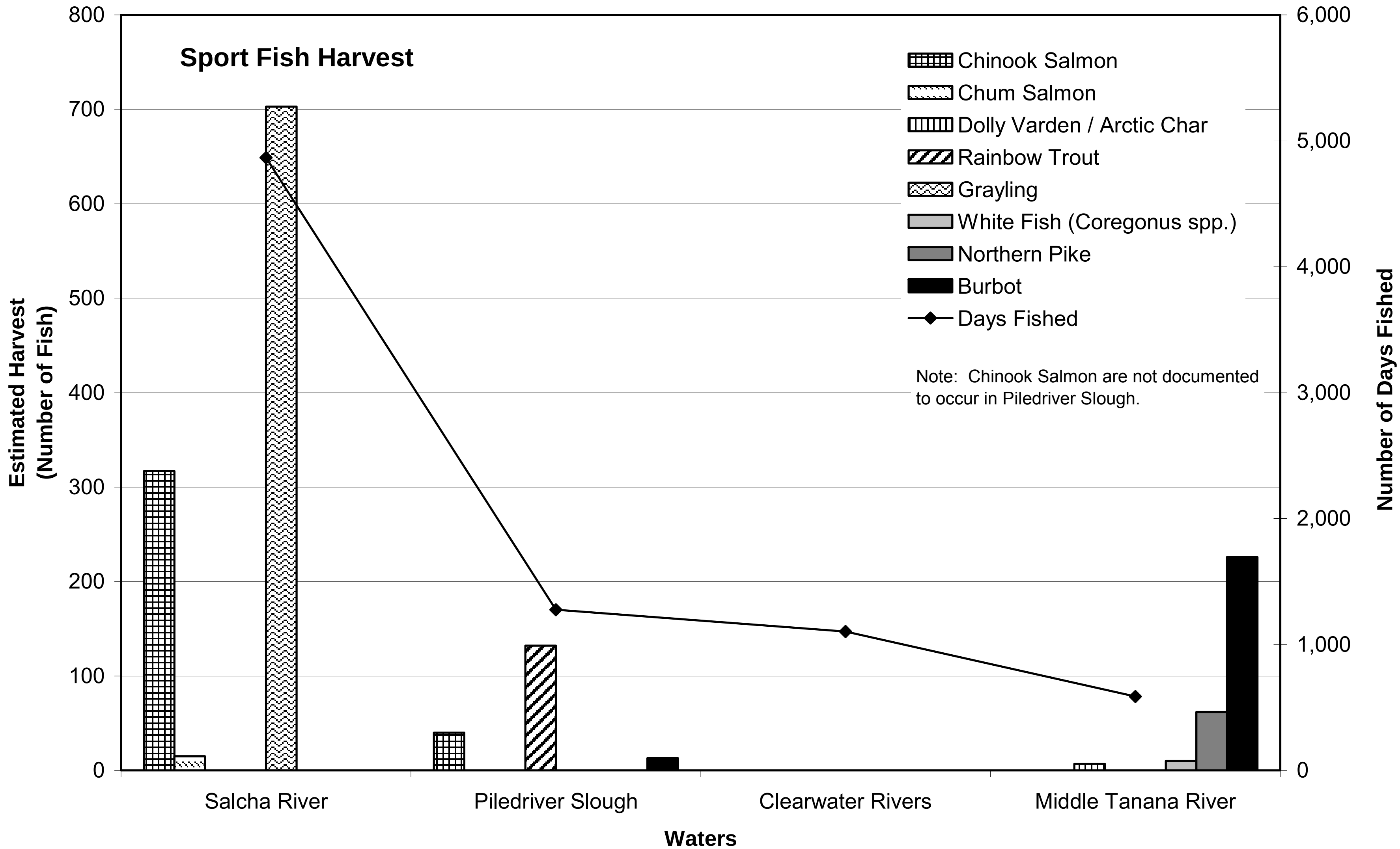

Figure F-1
Sport Fish Harvest and Angler Effort during 2006 for Waters in the Project Area Based on Angler Surveys (ADF&G, 2008a)

The summer run of chum salmon first arrives in the Fairbanks area in early July. The summer run of chum salmon generally uses north bank tributaries of the Tanana River such as Piledriver Slough, Moose Creek, Twentythreemile Slough, the Little Salcha River, and the Salcha River (Figure F-2). The fall run arrives during October through November (Table F-7) and generally uses the south bank tributaries such as the Richardson Clearwater River and the Delta River (Figure F-2). The Tanana River produces 30 percent of the Yukon fall chum salmon, an important resource to the people of the entire Yukon River. Many fall spawning chum salmon use the mainstem Tanana River as described by Barton (1992) and illustrated by recent telemetry data (Driscoll, 2008). Alaskan commercial, subsistence, personal use and sport harvests of Yukon River stocks of Chinook, coho and chum salmon during 1970 to 2007 are illustrated in Figure F-3.

Species commonly fished in this area, and their habitats and ecology, are listed in Table F-8.

F.2.3 Aquatic Animals of Conservation Concern

Aquatic animals that are of conservation concern are listed in the Alaska Comprehensive Wildlife Conservation Strategy (ADF&G, 2006). Five fish of conservation concern may occur in the project area, as well as one amphibian, one insect that has an aquatic larval stage, and one mollusk (Table F-9).

The Alaska blackfish is typically found in densely vegetated lowland swamps and ponds, and occasionally in larger rivers and lakes (Mecklenburg *et al.*, 2002; ADF&G, 2006). Alaska blackfish are relatively small (less than 8 inches) bottom-dwelling fish that primarily hunt small invertebrates. They spawn from May to August and the eggs adhere to vegetation, hatching within two weeks. Newly hatched larvae live off the yolk sac for about 10 days before beginning to feed and grow relatively quickly, reaching an average of 7 inches by age 4 in the interior (ADF&G, 2006). Alaska blackfish have a modified esophagus capable of gas absorption which allows them to live in small stagnant muskeg pools in which they can survive in damp mosses during dry periods. Alaska blackfish are found in densely vegetated lowland areas of the Tanana River Basin and may be locally abundant. Alaska blackfish may be used as a winter subsistence resource, although there are few data on the effect of take or population trends (ADF&G, 2006).

The Alaskan brook lamprey is a non-parasitic lamprey that lives in streams and lakes in the Tanana River Basin. The juvenile stage, or ammocoetes, burrows into sediment of pools and muddy backwaters where they feed on microorganisms, algae and other detritus. After 2 to 3 years, ammocoetes transform into adults (about 5 to 7 inches long) during the fall, and migrate downstream. Adults overwinter in lakes and sluggish pools of larger streams, and return to upstream spawning areas in spring and early summer. The adults die soon after spawning (Mecklenburg *et al.*, 2002). Abundance and trends for this lamprey are unknown, but they are considered to be rare. Populations occur in the Chena and Chatanika rivers and may occur farther upstream in the Tanana River Basin within the project area.

The Arctic lamprey is an anadromous lamprey that spends 3 to 7 years in fresh water and 1 to 4 years at sea (ADF&G, 2006). This lamprey spawns in the spring, digging redds in the gravel riffles and runs of cool, clear headwater streams. Eggs hatch 1 to 2 weeks later into ammocoetes, which burrow into mud, sand, or silt in streams or lakes where they feed on microorganisms, algae, and other detritus and grow to up to 4 inches in length (ADF&G, 2006; Mecklenburg *et al.*, 2002). After 3 to 7 years they develop adult features and migrate to the sea where they spend 4 to 7 years living parasitically on other fish or marine mammals before returning to freshwater

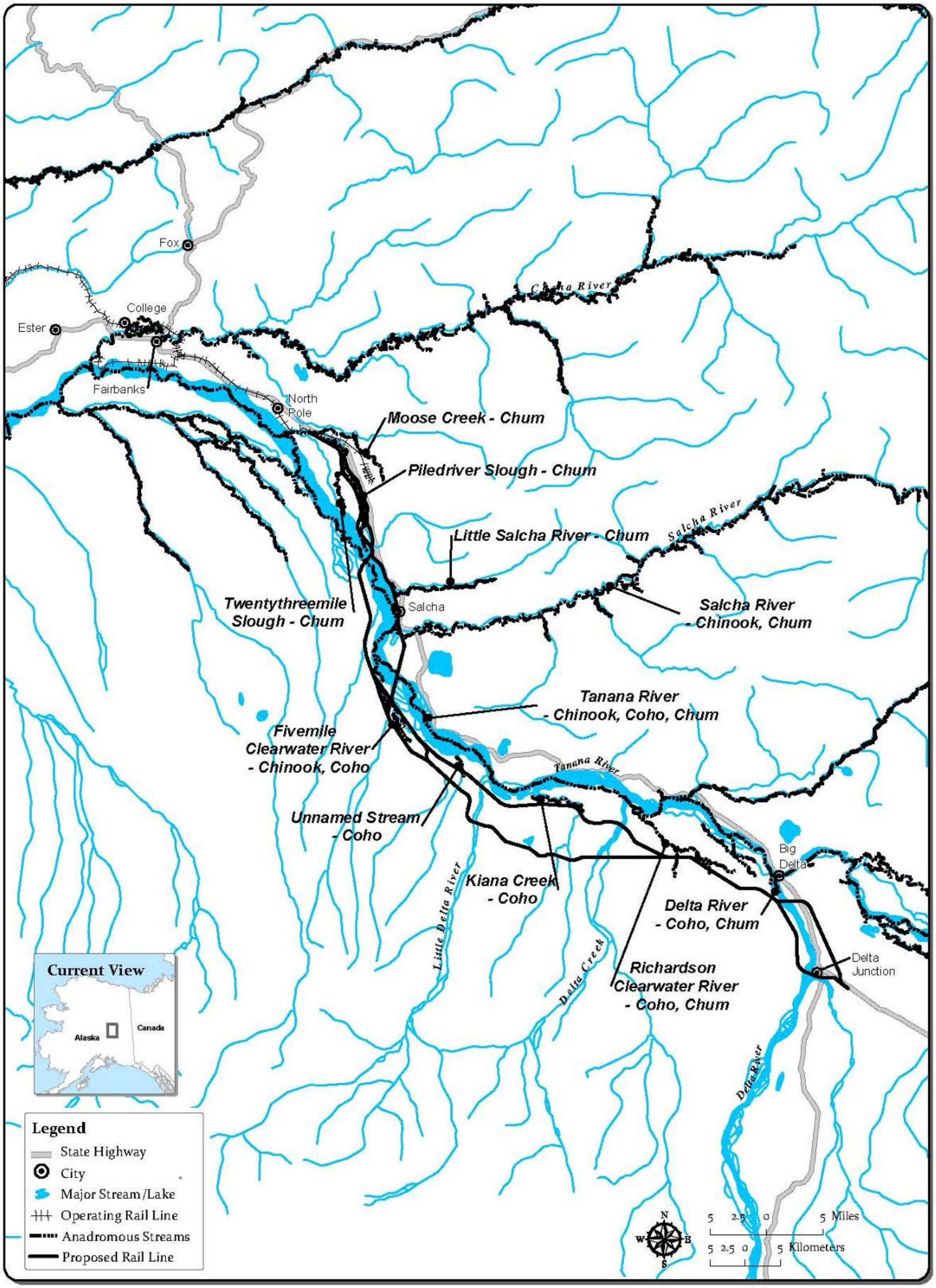

Figure F-2
Waters Documented as Important for Chinook, Coho, and Chum Salmon Under Alaska Statute 16.15.871(a) in the Project Area (Johnson and Weiss, 2007)

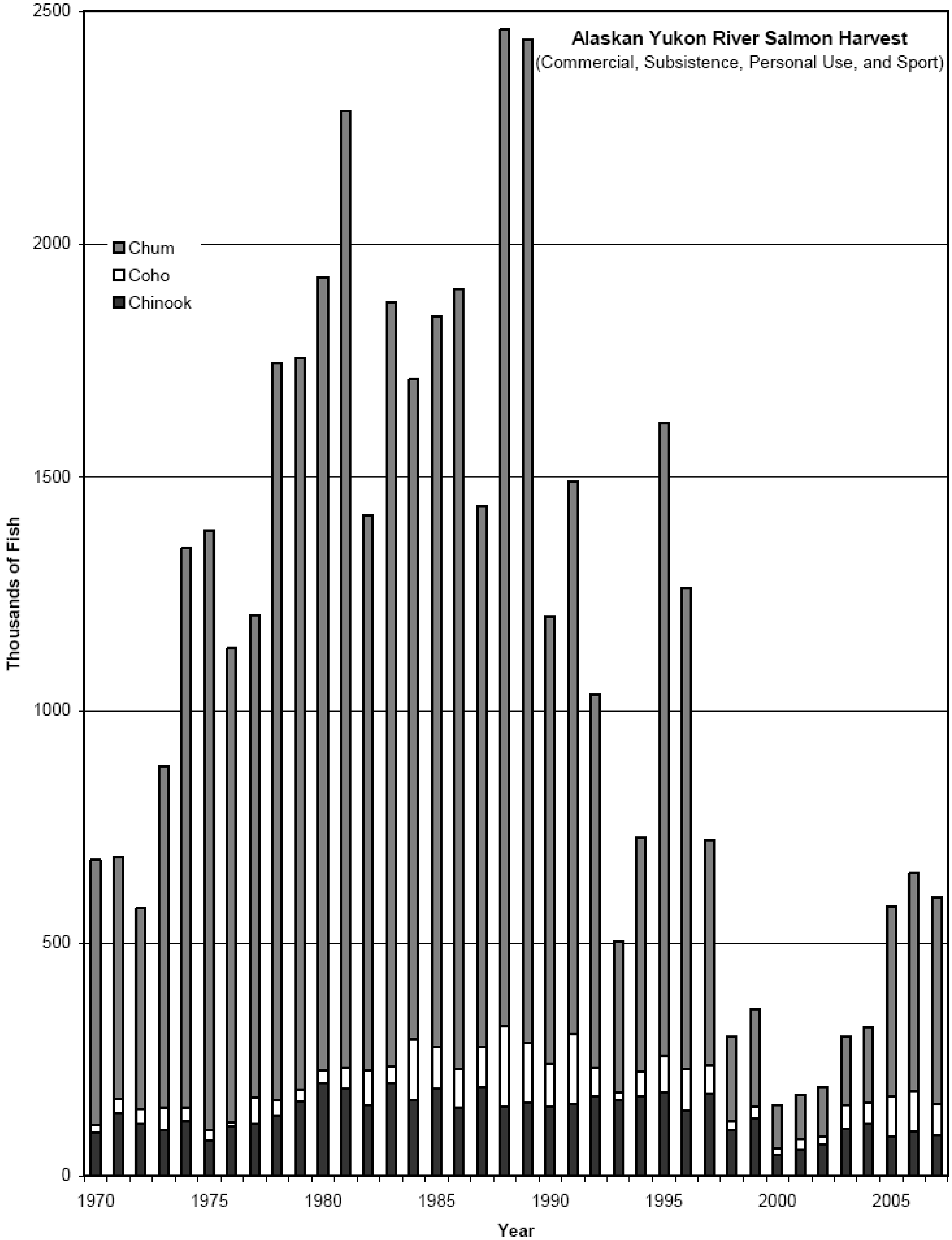

Figure F-3
Alaskan Harvest of Yukon River Chinook, Coho and Chum Salmon, 1970 to 2007 (JTC, 2008)

Table F-8
Habitat and Ecology of Important Commercial, Recreational and Subsistence/Personal Use Fish[a]

Common Name	Spawning Habitats/Rearing Habitats	Overwinter Habitats	Ecology
Burbot	Spawn under the ice in late winter in Tanana River. Young burbot feed on insects and other invertebrates, larger subadults and adults feed on fish.	Deep areas of rivers and lakes, uses Tanana River throughout their life history.	Nocturnal, long-lived and slow-growing, sexual maturity at 8 years, 18 inches. Extensive movements and interchange within the Tanana drainage, may colonize smaller lakes and gravel pits when the river overflows.
Chinook Salmon	Spawn in fast deep water over gravelly or rocky bottoms of non-glacial tributaries of glacial rivers where they can dig redds; fry and juveniles use sloughs, backwaters, tributaries, braids, channel edges, terraces and off-channel habitat, brush piles, beaver houses, shallows along gravel bars.	Overwinter as eggs or juveniles.	Juveniles smolt and outmigrate in the spring following hatching, and outmigration appears to occur soon after breakup peaking in mid to late May. Extensive movement within the river system in the first year of life, adults return to spawn after 4 to 5 years marine residence.
Chum Salmon	Spawn in small side channels, and areas of larger rivers with upwelling springs; fry emerge from the gravel in the spring and immediately outmigrate downriver, feeding on small insects and other detritus.	Overwinter as eggs.	Fry emerge from the gravel in early to mid April with peak outmigration occurring before the end of May. Adults return to spawn after 3 to 5 years marine residence.
Coho Salmon	Spawn in gravel areas of clearwater habitats-usually spring-fed; juveniles use ponds, lakes and pools in streams and rivers or stream margins, usually amongst submerged woody debris and in scour pools.	Juveniles overwinter near springs and in spring-fed streams, areas with upwelling are important for both egg and fry survival.	Spend 1 to 3 years in streams and may spend up to five winters in lakes before migrating to the sea, adults return after 18 months marine residence.
Dolly Varden	Spawn from mid-August to November in streams with gravel, may use braided reaches of glacial rivers; juveniles rear in streams remaining under rocks, logs or undercut banks feeding from the stream bottom.	Overwinter in lakes and large rivers, often found in shallow water and near areas of upwelling.	Anadromous and freshwater populations. Eggs hatch in March and fry emerge as late as June, maturity at 5 to 9 years, with three to four summers marine residence, about 16 to 24 inches.
Arctic Grayling	Cool, clear small headwater streams with gravelly substrate, may travel up to 100 miles, move little during the summer feeding season; feed on drifting aquatic insects, salmon eggs, outmigrating salmon smolts and terrestrial insects; juveniles and subadults move between overwintering grounds in the main Tanana and feeding grounds in the clearwater tributaries.	Overwinter in lakes, in the lower reaches and deeper pools of medium-sized rivers such as the Chena or in the main channel of the Tanana.	Highly migratory within a river system using different streams for spawning, juvenile rearing, summer feeding, and overwintering. May travel up to 100 miles to spawning streams, after breakup, migrating to summer feeding areas and spawning grounds. Spawn at about age 4 or 5, 11 to 12 inches long and generally return to the same spawning and feeding areas each year.

Table F-8
Habitat and Ecology of Important Commercial, Recreational and Subsistence/Personal Use Fish[a] (cont'd)

Common Name	Spawning Habitats/Rearing Habitats	Overwinter Habitats	Ecology
Humpback Whitefish	Gravel bottom upper reaches of river systems, braided reaches, of mainstem glacial reaches. Summer feeding areas seem to consist mainly of lakes and sloughs. Their diet consists mainly of clams, snails, crustaceans, insects and larvae.	Move downstream from spawning sites to overwinter but overwintering sites are unknown.	Some populations are anadromous. First spawning is at 4 or 5 years of age, upstream movement of spawning fish occurs at the end of the summer feeding period (August through September) and downstream movement probably occurs October through November.
Lake Trout	Shallow rocky shoals, clean, rocky lake bottom; feed on phytoplankton.	Overwinter in deep lakes.	Deep, oligotrophic mountain lakes, rarely found at the lower elevations of the Tanana River drainage, maturity and spawn for the first time at approximately 7 or 8 years of age and after that, spawn every other year or even less frequently, live to about 20 years of age but can live up to 40 years.
Least Cisco	Clear streams with gravel bottoms, sand and gravel substrate, such as braided reaches of mainstem glacial rivers; feed on plankton with river dwelling populations also feeding on terrestrial and aquatic insects.	Move downriver from spawning areas to overwinter but overwintering sites are largely unknown.	Migrate upstream in the fall to spawn. Found in a wide variety of habitats in freshwater: lakes, sloughs, large river and shallow tributary streams. Upstream migration shortly after breakup, moving into lakes and sloughs to feed. In late summer (August) the mature fish move further upstream and spawn.
Longnose Sucker	Spawn in lakes, ponds or they may travel to streams with gravel bottoms and cold water; juveniles prefer shallow silty backwaters, forms dense schools along the margins of lakes, sloughs, rivers, etc in early summer.	October they leave the spawning grounds and move downstream to deeper water or lakes to overwinter, overwinter in deep holes in the river or in lakes.	Spawn between May and July, often found in sloughs and backwaters where they move slowly along the bottom in search of invertebrates.
Northern Pike	Spawn in marshy, grassy banks with no little or no current; young pike emerge and begin to feed on insects and small crustaceans, quickly beginning to feed on smaller fish.	Believed to overwinter in the deep slow waters of larger rivers and in deeper lakes.	Not believed to travel long distances. Found in large and small lakes and in many sloughs and tributaries of the Tanana River, found in areas with high water clarity and cover; sight predators.
Inconnu	This species doesn't spawn or rear within the project area.	Overwinter in the lakes and deep rivers of the Minto Flats.	Do not normally ascend the Tanana much beyond Fairbanks.

[a] Sources: ADF&G, 2007a; ADF&G, 2007b; ADF&G, 2008c; Mecklenburg *et al.*, 2002.

Table F-9
Aquatic Animals of Conservation Concern Potentially Occurring in the Project Area[a]

Common Name	Species	Conservation Rank[b]	
		Global	State
Fish			
Alaska Blackfish	*Dallia pectoralis*	G5	S5
Alaskan Brook Lamprey	*Lampetra alaskense*	G3	S3
Arctic Lamprey	*Lampetra japonica*	G4	S4
Broad Whitefish	*Coregonus nasus*	G5	S4S5
Trout Perch	*Percopsis omiscomaycus*	G5	S3
Amphibians			
Wood Frog	*Rana sylvatica*	G5	S3S4
Insects			
Treeline Emerald	*Somatochlora sahlbergi*	G4	S3S4
Molluscs			
Yukon Floater	*Anodonta beringiana*	G4	S3S4

[a] Source: ADF&G, 2006.
[b] G5 = Globally secure, G5 = Globally secure, G4 = Globally apparently secure, G3 = Globally vulnerable, S5 = State secure, S4 = State apparently secure, S3 = State vulnerable, SNR = State not ranked.

to spawn. It is believed that some arctic lampreys may overwinter in the river system as non-feeding adults and spawn the following spring (ADF&G, 2006). Adults die shortly after spawning. Arctic lampreys are known to occur throughout the Tanana River drainage and are considered the most common lamprey in Alaska, though little is known about current population trends (ADF&G, 2006). Recent evidence indicates that the Alaskan brook lamprey and Artic lamprey may represent anadromous parasitic and fresh water non-parasitic populations, respectively, of a single species of lamprey.

Broad whitefish are widespread throughout Alaska and the Yukon River drainage. In fall, broad whitefish leave summer feeding areas and travel upstream to spawning grounds where they spawn in areas of gravel substrates such as braided reaches of mainstem glacial streams. In the Tanana River drainage they are common in the Minto Flats, lower Tolovana, Chatanika, and Tatalina Rivers (all outside the study area). Adults move downstream after spawning (probably in November) and overwinter in deeper water or in estuaries (Mecklenburg *et al.*, 2002). This species is considered abundant and population trends are reported to be stable; however subsistence users in the Yukon Flats area have recently noted lower harvest rates (ADF&G, 2006).

The trout perch is a small fish, with adults ranging in size from two to four inches that typically lives in lakes, but also lives in deep flowing pools over sandy substrates. By day, the trout perch remain in deep water, but they move into shallow waters to feed at night. The trout perch spawn in spring, often moving into shallow streams to spawn. It is considered an important prey item for many native fish and can be an important nutrient transporter in thermally stratified lakes due to the habit of feeding in shallow waters at night and moving to deeper waters during the day. In Alaska, this species is rare, but it is considered to be expanding its range within the Yukon River drainage (ADF&G, 2006).

The wood frog is common throughout North America. In Alaska, wood frogs are associated with interior forests. The wood frog is a generalist living in a diverse range of vegetation types, from grassy meadows to open forests and muskeg. Tadpoles occur in small fishless ponds, intermittent streams, ephemeral pools and emergent wetlands associated with forested floodplains. Adults hibernate under logs, rocks or in leaf litter during winter. Breeding occurs shortly after emergence from hibernation in early June, and adults may enter hibernation as early as late August in Interior Alaska. This species is widespread, relatively common and the population appears to be stable (ADF&G, 2006).

The treeline emerald is the most northerly breeding dragonfly occurring as far north as the Arctic latitudinal treeline. Dragonfly larvae are aquatic, living in pools, bogs, fens or lakes. Waterbodies in which the larvae are found are often lined with sedges, contain aquatic mosses such as sphagnum mosses and lie atop permafrost. Larvae of the treeline emerald have never been observed in moving water. Adults are terrestrial; however, they are always found in association with larval habitat. Abundance and population trends of this species are unknown. Most specimens of this dragonfly have been collected from the Delta Junction area (ADF&G, 2006).

The Yukon floater is one of four Alaska native freshwater mussels. Freshwater mussels are benthic filter feeders and the Yukon floater is most often found in lakes, ponds and slow moving streams with sand and gravel substrates. Freshwater mussels have a complex life history, with the larval stage (glochidium) parasitic on fish. Glochidia attach to fish fins or gills encysting until they transform and emerge as juveniles. Once the transformation is complete, juveniles drop off of their hosts and burrow into the substrate. The Yukon floater parasitize Chinook salmon, sockeye salmon and the three-spine stickleback (Nedeau *et al.*, undated), although there is some evidence that it may use a wider range of host species (ADF&G, 2006). Abundance and trends for the Yukon floater are unknown; however, significant declines in freshwater mussel populations across North America over the last 30 years in response to declining water quality and invasive exotic species such as the zebra mussel are causes for concern.

F.2.4 Fish-Bearing Stream Crossings along Each Alternative Segment

The following site-specific discussions are based primarily on Surface Transportation Board Section of Environmental Analysis (SEA) field surveys of proposed stream crossing locations (Noel, 2007b), published anadromous fish habitat use data (Johnson and Weiss, 2007), and unpublished fish distribution data (ADF&G, 2005a) supported by numerous other reports and publications.

North Common Segment

North Common Segment would cross Piledriver Slough (stream number 334-40-11000-2490-3315; Johnson and Weiss, 2007). Piledriver Slough was once part of Chena Slough, which flowed northwest through Fairbanks and then back into the Tanana River. Construction of the Moose Creek Dike in 1945 split Chena Slough into the current Chena Slough and Piledriver Slough (Ihlenfeldt, 2006). Construction of that project resulted in sloughs that are mostly groundwater-fed systems with low discharge and low sediment loads (Ihlenfeldt, 2006). Piledriver Slough is currently a clearwater stream that flows for some 21 miles parallel to and between Richardson Highway and the Tanana River adjacent to Eielson AFB.

Piledriver Slough seasonally supports populations of arctic grayling, round whitefish, humpback whitefish, least cisco, northern pike, burbot, longnose suckers, slimy sculpins, lake chubs, arctic lamprey, and a few sheefish. There is some spawning of chum salmon in the slough (Johnson and Weiss, 2007). ADF&G annually stocks Piledriver Slough with sterile rainbow trout (ADF&G, 2008a). The un-named slough (Crossing 105; Table F-10) contains rearing habitats for fish present in Piledriver Slough; and northern pike were observed near the crossing location (Noel, 2007b; Record 2, 11).

Table F-10
Fish-bearing streams North Common Segment Would Cross[a]

Crossing Number	Stream Name	Waterbody Type	Fish	Channel Width (feet)	Conveyance Type	Conveyance Size (feet)
1	Piledriver Slough	Slough	Anadromous	65	Bridge	100
105	Unnamed	Slough	Resident	20	Culvert	2 x 10

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Tables F-10 and F-11 list fish and fish habitats in the clearwater sloughs that North Common Segment would cross that would be affected by construction of the NRE. Piledriver Slough (Crossing 1; Table F-10) is an entrenched tributary of the mainstem Tanana River with pool and riffle habitat. The substrate of this clearwater stream is dominated by silt with sand and gravel (Noel, 2007b; Record 1). The unnamed slough crossing (Crossing 105) is over a pond-like tributary to Piledriver Slough that can freeze completely during winter. Northern Pike were observed near this crossing and habitats appeared suitable for other resident fish (Noel, 2007b; Record 2).

Table F-11
Fish Species, Life Stages, and Habitats That Could be Affected by Construction and Operation of North Common Segment[a]

	Life Stages				Habitat				
Fish Presence	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Over-wintering**	**Summer Foraging**	**Migratory**
Piledriver Slough (Crossing 1)									
Chum Salmon	X	X		X	X		X		X
Arctic Grayling	X	X	X	X	X	X	X	X	X
Burbot			X	X		X		X	X
Inconnu (Sheefish)				X				X	X
Lampreys		X	X	X		X	X		X
Northern Pike	X	X	X	X	X	X	X	X	X
Rainbow Trout			X	X			X	X	
Suckers	X	X	X	X	X	X	X	X	
Freshwater mussels			X	X	X	X	X	X	
Whitefish			X	X		X	X	X	X
Unnamed (Crossing 105)									
Northern Pike	X	X	X	X	X	X		X	
Suckers	X	X	X	X	X	X		X	

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Eielson Alternative Segments

Each of the Eielson alternative segments would cross Piledriver Slough. Eielson Alternative Segment 1 and Eielson Alternative Segment 2 would cross Twentythreemile Slough (stream number 334-40-11000-2490-4010; Johnson and Weiss, 2007) near where it flows into Piledriver Slough. Twentythreemile Slough flows for about 6 miles and is used by chum salmon (Johnson and Weiss, 2007) and arctic grayling.

Tables F-12 and F-13 list fish and fish habitats at the ten locations where the Eielson alternative segments would cross fish-bearing clearwater sloughs. Within the last several years, the quality and quantity of favorable fish spawning and rearing habitat in Piledriver Slough has declined. Fish passage has been restricted by undersized culverts, beaver dams, and filling in of gravel riffles/pools with sediment. Recent flooding in the Salcha area caused water to back up and block culverts, damage road crossings and deposited excess sediment in Piledriver Slough and tributary sloughs. These processes have had negative effects on local fish populations. The slough has become braided, increased its width/depth ratio, and is now reduced in the quantity and quality of habitat available for chum salmon, Arctic grayling, northern pike and burbot (Ihlenfeldt, 2006). The U.S. Fish and Wildlife Service (USFWS) have been working to improve fish habitat in Piledriver Slough by working to repair improperly placed culverts and to replace some culverts with bridges (Ihlenfeldt, 2006).

Table F-12
Fish-bearing Streams the Eielson Alternative Segments Would Cross[a]

Crossing Number	Stream Name	Waterbody Type	Fish	Channel Width (feet)	Conveyance Type	Conveyance Size (feet)
Eielson Alternative Segments 1 & 2						
3	Twentythreemile Slough	Slough	Anadromous	100	Bridge	100
Eielson Alternative Segment 1						
10	Piledriver Slough	Slough	Anadromous	30	Culvert	3 x 10
Eielson Alternative Segment 2						
314	Piledriver Slough	Slough	Anadromous	105	Bridge	330
Eielson Alternative Segment 3						
113	Piledriver Slough	Slough	Anadromous	80	Bridge	300
111	Unnamed	Slough	Resident	30	Culvert	3 x 10
110	Unnamed	Slough	Resident	20	Culvert	3 x 10
129	Unnamed	Slough	Resident	20	Culvert	3 x 10
131	Unnamed	Slough	Resident	20	Culvert	3 x 10
5	Unnamed	Slough	Resident	25	Bridge	130
Eielson Alternative Segments 2 & 3						
13	Unnamed	Slough	Resident	80	Bridge	60

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Each Eielson alternative segment would cross Piledriver Slough at a different location. Eielson Alternative Segment 3 would cross Piledriver Slough nearest the outflow of the slough where it receives flow from Moose Creek and rejoins the Tanana River (Crossing 113; Noel, 2007b; Record 117). Eielson Alternative Segment 2 would cross Piledriver Slough before its confluence with Twentythreemile Slough (Crossing 314; Noel, 2007b; Records 42 and 154). Eielson Alternative Segment 1 would cross Piledriver Slough just north of where it would connect to the Tanana River; connection is blocked by fill in the channel (Crossing 10; Noel, 2007b; Record 22). Of these crossings, the crossings farther downstream (Crossings 314 and 113) have the largest flows from groundwater exchange and would have the largest affect on instream resident and anadromous fish habitats. Riffles were dominated by gravel substrates, while stream margins and pools were primarily covered in organic debris. Emergent vegetation was abundant and juvenile and adult arctic grayling were collected (Noel, 2007b; Record 42, 117, 154). Groundwater upwelling was evident, and there was evidence of salmon and grayling spawning

Table F-13
Fish, Life Stages, and Habitats that Would be Affected by Construction and Operation of the Eielson Alternative Segments[a]

	Life Stages				Habitats				
Fish Presence	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Over-wintering**	**Summer Foraging**	**Migratory**
Twentythreemile Slough (Crossing 3)									
Chum salmon	X	X		X	X		X		X
Arctic Grayling	X	X	X	X	X	X		X	X
Lampreys		X	X	X		X		X	X
Suckers			X	X		X		X	X
Piledriver Slough (Crossings 10, 314, 113)									
Chum salmon	X	X		X	X		X		X
Arctic Grayling	X	X	X	X	X	X	X	X	X
Burbot			X	X		X		X	X
Lampreys		X	X	X		X	X		X
Northern Pike	X	X	X	X	X	X	X	X	X
Inconnu (Sheefish)				X				X	X
Northern Pike	X	X	X	X	X	X	X	X	X
Rainbow Trout			X	X			X	X	
Suckers	X	X	X	X	X	X	X	X	
Freshwater mussels			X	X	X	X	X	X	
Whitefish			X	X		X	X	X	X
Unnamed Sloughs (Crossings 111, 110, 129, 131, 5, 13)									
Lake Chub			X	X		X		X	
Suckers			X	X		X		X	

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Slough (Crossing 3; Noel, 2007b; Record 40). There was an inactive beaver dam that had been breached near the crossing at the confluence, resulting in substrates primarily composed of organic debris and silt at the crossing with a heavy vegetation mat (Noel, 2007b; Record 40). However, there are gravelly areas upstream where grayling redds were observed. Both grayling and juvenile salmonids were observed at the site.

Eielson Alternative Segment 3 would cross an unnamed slough that meanders east and west five times (Crossings 111, 110, 129, 131, and 5). This slough contained pool habitats used by resident fish (lake chub), likely for rearing and summer forage (Noel, 2007b; Record 118, 119, 153). The dominant substrates were silt, with organic debris making up the balance. Some emergent vegetation was present, and stream margins were covered with overhanging vegetation. Eielson Alternative Segment 2 and Eielson Alternative Segment 3 would cross another unnamed slough (Crossing 13), which is considered locally as Piledriver Slough, and contains pool and riffle habitats suitable for rearing, migration and spawning habitats for resident fish (Noel, 2007b; Record 26).

Salcha Alternative Segments

Both Salcha alternative segments would cross the Tanana River. Burbot occur primarily in the mainstem of the Tanana River; while Dolly Varden are found primarily in the upper reaches of tributaries of the Tanana River. Chinook, chum, and coho salmon are found in the Tanana River during migration and fall run chum salmon spawn in the mainstem Tanana River in the project area. The mainstem Tanana River is transitional habitat for resident fish migrating between seasonal feeding grounds and spawning habitat such as arctic grayling, round whitefish, humpback whitefish, least cisco, longnose suckers, slimy sculpins, lake chubs, arctic lamprey, and Alaska brook lamprey (ADF&G, 2008a). Many fish return to the Tanana River during the fall and winter as smaller tributaries and backwaters freeze.

Salcha Alternative Segment 2 would cross both the Little Salcha River and the Salcha River. The Salcha River (stream number 334-40-11000-2490-3329, Johnson and Weiss, 2007) supports Chinook salmon and a summer run of chum salmon. Salcha River salmon have traveled about 950 miles from the Bering Sea to the mouth of the Salcha River. By the time they reach the Salcha River, salmon are in full spawning colors and the flesh is beginning to deteriorate. To maintain a Chinook salmon run on the Salcha River, the ADF&G has set an escapement (the number of adult salmon allowed to return upstream to spawn) of between 3,300 and 6,500 fish. Resident fish in the Salcha River include arctic grayling, round whitefish, humpback whitefish, northern pike, burbot, longnose suckers, slimy sculpins, and arctic lamprey (ADF&G, 2008a). The Little Salcha River (stream number 334-40-11000-2490-3325, Johnson and Weiss, 2007) is a clear-water stream that flows into the Tanana River. About 6 miles of this river supports chum salmon.

Tables F-14 and F-15 list fish and fish habitats the Salcha alternative segments would cross.

Table F-14
Fish-bearing Streams Crossed by the Salcha Alternative Segments[a]

Crossing Number	Stream Name	Water-body Type	Fish	Channel Width (feet)	Conveyance Type	Conveyance Size (feet)
Salcha Alternative Segment 1						
	Tanana River	Stream	Anadromous	3,800	Bridge	3,600
89	Unnamed	Slough	Resident	34	Culvert	3 x 10[b]
295	Unnamed	Stream	Resident	125	Culvert	125
Salcha Alternative Segment 2						
16	Little Salcha River	Stream	Anadromous	65	Bridge	160
17	Unnamed	Overflow	Probable	20	Culvert	3 x 10
18	Unnamed	Slough	Anadromous	15	Bridge	390
	Salcha River	Stream	Anadromous	195	Bridge	2,500[b]
	Tanana River	Stream	Anadromous	1,500	Bridge	4,000
22	Unnamed	Slough	Anadromous	130	Bridge	4,000
23	Unnamed	Slough	Anadromous	150	Culvert	3 x 10[b]
340	Unnamed	Stream	Probable	10	Culvert	10
341	Unnamed	Stream	Anadromous	20	Culvert	2 x 10

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.
[b] The conveyance size is a SEA estimated based on proposed lengths of similar crossings. The final conveyance distance will be determined during final design.

Many fish use the Tanana River as a migratory route to upstream spawning grounds including Chinook, chum, and coho salmon and whitefish (Table F-15). Side channels of the Tanana River (Crossings 89, 16, 17, 18, 22, and 23) were dominated by gravel and cobble with groundwater upwelling at the channel margins. These areas provide summer foraging and rearing habitats for resident and anadromous fishes and spawning habitat for fall run chum salmon (Barton, 1992; Noel, 2007b; Record 48, 35, 36, 158, 159). Salcha Alternative Segment 1 at Crossing 295 is a

Table F-15
Fish, Life Stages, and Habitats That Would be Affected by Construction and Operation of the Salcha Alternative Segments

	Potential Life Stages				Potentially Affected Habitat				
Fish Presence	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Over-wintering**	**Summer Foraging**	**Migratory**
Tanana River and Side Channels (Crossings 89, 16, 17, 18, 22, 23)									
Chinook salmon			X	X		X		X	X
Chum salmon	X	X		X	X		X		X
Coho salmon				X					X
Burbot				X			X	X	X
Freshwater Mussels			X	X	X	X	X	X	
Arctic Grayling				X		X	X	X	
Inconnu (Sheefish)				X				X	
Lampreys		X	X	X		X	X		X
Suckers				X			X	X	X
Whitefish				X					X
Little Salcha River (Crossing 16)									
Chum salmon	X	X		X	X		X		X
Burbot			X	X			X		X
Arctic Grayling	X	X	X	X			X	X	X
Northern Pike		X	X	X		X	X	X	X
Lampreys		X	X	X			X	X	X
Suckers			X	X			X	X	X
Whitefish			X	X			X	X	X
Salcha River									
Chinook Salmon			X	X		X	X	X	X
Chum salmon	X	X		X	X		X		X
Burbot			X	X		X	X	X	X
Arctic Grayling	X	X	X	X		X	X	X	X
Lampreys		X	X	X			X		X
Suckers			X	X		X	X	X	X
Whitefish			X	X		X	X		X
Unnamed Streams and Sloughs (Crossings 295, 340, 341)									
Coho Salmon			X	X		X	X	X	X
Arctic Grayling	X	X	X	X			X	X	X
Suckers			X	X			X	X	X
Whitefish			X	X			X	X	X

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

small perennial stream that drains a large wetland complex and empties into the Tanana River (Noel, 2007b; Record 157). About 2 miles upstream from this crossing, high-quality spawning and rearing habitat for arctic grayling occurs (Noel, 2007b; Record 8, 9), and this reach likely serves as migratory habitat. The Salcha Alternative Segment 2 would have 11 fish-bearing stream crossings, including the Tanana River, the Little Salcha River and the Salcha River. Nine of these crossings are anadromous fish streams (Table F-14).

Salcha Alternative Segment 2 at Crossing 18 is a side channel of the Tanana River that connects to the Little Salcha River outflow. Flow into this channel is limited during low-flow periods due to the presence of a large gravel berm at the inflow of the channel. During periods of low flow the channel contains large clear pools, which contain juvenile salmonids in high densities (Noel, 2007b; Record 36). During high flows, the pools would be connected to the mainstem by a series of pools and riffles of gravel with some cobble and silt. Salcha Alternative Segment 2 would cross the Salcha River about 1 mile above its confluence with the Tanana River. The crossing would pass over a shallow glide in a meander bend of the river (Noel, 2007b; Record 47). There is potential for fall chum salmon spawning in this area, and Chinook salmon must pass through this crossing to reach upstream spawning habitats.

Passage of river flow is critical for anadromous fish use of side-channel Tanana River habitats such as at Crossings 89, 17, 18, 22, 23, 340, and 341. Blockage or filling of side-channels would cause significant habitat alteration resulting in the eventual loss of salmon spawning. Similarly modified side channels of the Tanana River near Fairbanks exhibit lower dissolved oxygen levels, reduced flows, substrates of finer particle size, and increased pH, hardness, water temperature, specific conductance, and cover (Mecum, 1984); conditions generally unsuitable for salmonids. These changes would reasonably be expected to alter fish use of affected channels by shifting habitats from a riverine to a more littoral character. The channel modification illustrated in Figure 2-17 would result in the creation of a major new channel. As a result, flow from the existing side channel would be directed and would likely lead to the destruction of the portions of the vegetated island that are not protected by the shot-rock revetment. The potential for instability of this channel alteration is high, given the highly permeable nature of the gravels supporting the Tanana River bars as discussed in Chapter 4.

Central Alternative Segments and Connectors

Central Alternative Segment 1 would cross an unnamed clearwater stream that provides habitat for resident fish (Tables F-16 and F-17).

Central Alternative Segment 2 would cross two unnamed sloughs (crossings 35 and 38), one used by resident fish and one that exhibits potential fish habitat (Tables F-16 and F-17). The channel at Crossing 35 appears to periodically receive flow from the Tanana River. This stream would likely serve as a temporary refuge for fish during high-flow events and as a route for resident and possibly anadromous fishes to and from habitats in the Fivemile Clearwater River and its tributaries. Both crossings periodically receive flow from the Tanana River, and seasonal use by resident fish would be expected.

Connector A would cross an unnamed stream (Crossing 85) that supports resident fishes.

Connector B would cross the Fivemile Clearwater River (Crossing 86), which serves as a migratory corridor for Chinook and coho salmon and resident fishes. The crossing site is a broad straight channel with heavily armored substrates; which are not likely suitable for salmonid spawning habitat (Noel, 2007b; Record 55).

Connector C would cross tributaries to the Fivemile Clearwater River (Crossings 345 and 346), which serves as a migratory corridor for Chinook and coho salmon and resident fishes.

Streams that would be crossed by Connector D (Crossings 501, 502, 503, and 504) provide habitat for the fall run of chum salmon.

Connector E would cross the upper reach of the Fivemile Clearwater River at Crossing 351, where substrates were sand and organic debris (Noel, 2007b; Record 85).

Table F-16
Fish-bearing Streams the Central Alternative Segments and Connectors Would Cross[a]

Crossing Number	Stream Name	Waterbody Type	Fish	Channel Width (feet)	Conveyance Type	Conveyance Size (feet)
Central 1						
84	Unnamed	Stream	Resident	40	Bridge	40
Central 2						
35	Unnamed	Overflow	Resident	50	Bridge	130
38	Unnamed	Overflow	Probable	30	Bridge	75
Connector A						
85	Unnamed	Stream	Anadromous	80	Bridge	40
Connector B						
27	Unnamed	Slough	Anadromous	90	Culvert	2 x 10
86	Fivemile Clearwater	Stream	Anadromous	105	Bridge	160
Connector C						
342	Unnamed	Stream	Anadromous	35	Bridge	90
343	Unnamed	Slough	Probable	20	Culvert	2 x 10
344	Unnamed	Overflow	Anadromous	90	Culvert	2 x 10
345	Fivemile Clearwater	Stream	Anadromous	135	Bridge	135
346	Unnamed	Stream	Anadromous	30	Culvert	3 x 10
396	Unnamed	Stream	Anadromous	80	Bridge	40
Connector D						
501	Unnamed	Stream	Anadromous	35	Bridge	90
502	Unnamed	Stream	Anadromous	4	Culvert	2 x 10
503	Unnamed	Stream	Anadromous	20	Bridge	90
504	Unnamed	Stream	Anadromous	20	Bridge	90
Connector E						
351	Fivemile Clearwater	Stream	Anadromous	65	Bridge	115

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Donnelly Alternative Segments

Both Donnelly alternative segments would cross the Little Delta River, Kiana Creek, and Delta Creek. The Little Delta River is a glacial tributary of the Tanana River that runs north for 24 miles before joining the Tanana River. There is little documentation of fish presence in reaches of this river that intersect the project area; however, portions of this stream and its tributaries are likely to support resident fish, such as burbot, near the confluence with the Tanana River. Resident fish may also use the Little Delta River for seasonal movements. Kiana Creek (stream number 334-40-11000-2490-3362; Johnson and Weiss, 2007) is a clearwater tributary of the Tanana River whose confluence lies approximately 4 miles upstream of the Little Delta River/Tanana River confluence. The first 7 miles of Kiana Creek support coho salmon during rearing (Johnson and Weiss, 2007) and it is likely that there are spawning areas upstream of the rearing areas. Based on SEA field surveys, additional coho rearing habitat has been documented east of the cataloged reach of Kiana Creek (Noel, 2007b; Record 68, 69). Larval arctic grayling also occurred upstream from the cataloged reach of this Tanana River tributary (Noel, 2007b; Record 179).

Table F-17
Fish Species, Life Stages, and Habitats That Could be Affected by Construction and Operation of the Central Alternative Segments and Connectors[a]

	Life Stages				Habitat				
Fish Presence	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Over-wintering**	**Summer Foraging**	**Migratory**
Unnamed Sloughs (Crossings 35, 38, 84, 85)									
Arctic Grayling			X	X		X		X	X
Burbot				X		X		X	X
Suckers	X	X	X	X	X	X	X	X	
Whitefish			X	X		X	X	X	
Fivemile Clearwater River (Crossing 86)									
Chinook Salmon			X	X		X	X	X	X
Coho Salmon			X	X		X	X	X	X
Burbot			X	X		X	X	X	X
Freshwater Mussels		X	X	X		X	X	X	
Arctic Grayling			X	X		X	X	X	X
Lampreys		X	X			X	X	X	X
Northern Pike		X	X	X		X	X	X	X
Suckers		X	X	X		X	X	X	X
Whitefish		X	X	X		X	X	X	X
Unnamed Streams and Sloughs (Crossings 27, 342, 343, 344, 345, 346, 396)									
Coho Salmon			X	X		X	X	X	X
Arctic Grayling	X	X	X	X			X	X	X
Suckers			X	X			X	X	X
Whitefish			X	X			X	X	X
Fivemile Clearwater River (Crossing 351)									
Coho Salmon			X	X		X		X	X
Arctic Grayling			X	X		X		X	X
Suckers	X	X	X	X	X	X	X	X	

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b

Delta Creek is a glacial tributary of the Tanana River whose confluence lies about 7 miles upstream from the mouth of Kiana Creek. Resident fish species have been documented near the mouth of Delta Creek, but no anadromous fish habitat is known to occur within this stream.

Tables F-18 and F-19 list fish and fish habitats at the 14 crossings of the Little Delta River, Kiana Creek and its tributaries, Delta Creek, and unnamed streams.

On Donnelly Alternative Segment 1, the stream reach at Crossing 137 is within a heavily forested area, but is likely the same anadromous stream as crossed by Donnelly Alternative Segment 2 at Crossing 41 (Noel, 2007b; Record 128), based on review of recent aerial photography. The stream at Crossing 137 was not evaluated during SEA field studies because it was inaccessible by helicopter. This stream has an abundance of large woody debris, and appeared to have some gravel substrates suitable for grayling spawning. The Donnelly Alternative Segment 1 crossings of the Little Delta River and Delta Creek may be less likely to contain fish habitats than the Donnelly Alternative Segment 2 crossings because they are farther

Table F-18
Fish-bearing Streams the Donnelly Alternative Segments Would Cross[a]

Crossing Number	Stream Name	Waterbody Type	Fish	Channel Width (feet)	Conveyance Type	Conveyance Size (feet)
Donnelly Alternative Segment 1						
137	Unnamed	Stream	Resident	10	Bridge	40
	Little Delta River	Stream	Resident	30	Bridge	800
279	Unnamed	Stream	Resident	6	Culvert	2 x 10
76	West Kiana Creek	Stream	Resident	3	Bridge	40
74	Kiana Creek	Stream	Resident	55	Bridge	65
	Delta Creek	Stream	Resident	200	Bridge	700
Donnelly Alternative Segment 2						
40	Unnamed	Stream	Anadromous	75	Culvert	3 x 10
41	Unnamed	Stream	Anadromous	18	Bridge	40
	Little Delta River	Stream	Resident	240	Bridge	900
252	Unnamed	Wetland	Probable	85	Culvert	4
100	Kiana Creek	Stream	Anadromous	35	Bridge	80
	Delta Creek	Stream	Resident	160	Bridge	700
101	Unnamed	Stream	Resident	10	Culvert	2 x 10
102	Unnamed	Stream	Resident	5	Culvert	10

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Table F-19
Fish, Life Stages, and Habitats That Could be Affected by Construction and Operation of the Donnelly Alternative Segments[a]

	Life Stages				Habitat				
Fish Presence	**Eggs**	**Fry/Larvae**	**Juveniles**	**Adults**	**Spawning**	**Rearing**	**Over-wintering**	**Summer Foraging**	**Migratory**
Unnamed Streams (Crossings 40, 41, 137)									
Coho Salmon			X	X		X		X	X
Arctic Grayling			X	X		X		X	X
Suckers	X	X	X	X	X	X	X	X	
Little Delta River									
Arctic Grayling			X	X		X		X	X
Suckers	X	X	X	X	X	X	X	X	
Kiana Creek and Tributaries (Crossings 76, 74, 100, 252, 279)									
Coho Salmon			X	X		X		X	X
Arctic Grayling			X	X		X		X	X
Suckers	X	X	X	X	X	X	X	X	
Delta Creek									
Arctic Grayling			X	X		X		X	X
Suckers	X	X	X	X	X	X	X	X	
Whitefish			X	X				X	X
Unnamed Streams (Crossings 101, 102)									
Arctic Grayling			X	X		X		X	X
Suckers	X	X	X	X	X	X	X	X	

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

from the Tanana River. Arctic grayling use both of these glacial rivers to move between summer foraging habitats and over-wintering habitats in the Tanana River; Delta Creek is also used by whitefish (Parker, 2006).

Both Donnelly Alternative Segment 1 (Crossing 74) and Donnelly Alternative Segment 2 (Crossing 100) would cross Kiana Creek, including tributary streams at Crossing 76 and 252. Donnelly Alternative Segment 2 would cross the Kiana Creek drainage in the lower reaches at Crossing 100; while Donnelly Alternative Segment 1 would cross Kiana Creek at Crossing 74 and an unnamed tributary at Crossing 76. A tributary draining a large wetland between the alternative segments also provides coho salmon rearing habitat (Noel, 2007b; Record 68, 69). Upper reaches of this watershed appear to depend on precipitation to maintain summer flows during at least a portion of the summer (Noel, 2007b; Record 168, 169, 179). The lower portions of the Kiana Creek drainage support coho salmon rearing, and coho salmon spawning and there likely are arctic grayling spawning habitats in the upper reaches of the watershed, but none have been identified.

Donnelly Alternative Segment 2 Crossings 101 and 102 would both occur at narrow clearwater streams that flow into a beaver complex at the base of a ridge (Noel, 2007b; Record 71, 138, 139). There are adult arctic grayling in this pond and a long-nose sucker with breeding tubercles was also found at the stream flowing from this beaver pond complex (Noel, 2007b; Record 138, 139). These streams appear to be primarily ground-water fed. It appears that ridges block subsurface flows and force them to the surface. Icings were observed throughout this area during late-winter and spring surveys, indicating that the area may provide thermal refuge for over-wintering fish or eggs. The outflow channel from this complex just down river from where Donnelly Alternative Segment 2 would cross Delta Creek may contain habitat suitable for fall spawning chum salmon.

South Common Segment

South Common Segment would cross several tributaries of the Richardson Clearwater River (stream number 331-40-11000-2490-3370; Johnson and Weiss, 2007), which is a clearwater stream that flows northwest for about 14 miles before joining the Tanana River. This stream supports populations of coho salmon, chum salmon, arctic grayling, round whitefish, and longnose suckers. Coho and chum salmon spawn and eggs overwinter in the stream. Juvenile coho salmon and other resident fish use it as a summer feeding ground (Ridder, 1983; Johnson and Weiss, 2007). The two unnamed tributaries of the Richardson Clearwater River that would be crossed by project alternatives (stream numbers 331-40-11000-2490-3370-4030 and 331-40-11000-2490-3370-4040; Johnson and Weiss, 2007) both support coho spawning and rearing.

Tables F-20 and F-21 list fish and fish habitats South Common Segment would cross. Although anadromous fish were not found during limited surveys of the area, it is likely that Crossing 103 provides habitat for coho salmon because spawning gravels were present (Noel, 2007b; Record 141).

South Common Segment Crossing 103 is a clearwater stream with gravel substrates, groundwater upwelling, and a mix of run riffle and pool habitat (Noel 2007b; Record 141). Spawning of summer run chum salmon and fall run coho salmon occur in the Richardson Clearwater River (Johnson and Weiss, 2007), into which this stream flows. The occurrence of suitable spawning habitat at this site, along with connection to a known anadromous stream, make it likely that coho salmon use this stream for spawning. Crossing 104 is similar to Crossing 103, and also contains gravels suitable for spawning.

Table F-20
Fish-bearing Streams South Common Segment Would Cross[a]

Crossing Number	Stream Name	Waterbody Type	Fish	Channel Width (feet)	Conveyance Type	Conveyance Size (feet)
136	Unnamed	Stream	Anadromous	10	Bridge	50
103	Unnamed	Stream	Probable	35	Bridge	65
104	Unnamed	Stream	Anadromous	15	Bridge	40

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Table F-21
Fish, Life Stages, and Habitats That Could be Affected by Construction and Operation of South Common Segment[a]

	Life Stages				Habitat				
Fish Presence	Eggs	Fry/Larvae	Juveniles	Adults	Spawning	Rearing	Over-wintering	Summer Foraging	Migratory
Richardson Clearwater River Tributaries (Crossings 136, 103, 104)									
Chum Salmon				X					X
Coho Salmon			X	X		X		X	X
Arctic Grayling			X	X		X		X	X
Suckers	X	X	X	X	X	X	X	X	
Whitefish			X	X		X	X	X	

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Delta Alternative Segments

The Delta River (stream number 331-10-11000-2490-3390; Johnson and Weiss, 2007) supports resident fish especially during seasonal movements. The lower 2 miles of this river also support fall chum and coho spawning. Upwelling in this area cleans gravels of glacial silts and maintains sufficient flows to remain unfrozen during the winter, providing overwinter incubation habitat for eggs and larvae of chum and coho salmon. Although alternatives would not cross that area, Delta Alternative Segment 1 would cross the Delta River near the confluence of Jarvis Creek. Jarvis Creek supports resident fish populations especially during seasonal movements to and from upstream foraging, rearing and spawning habitats. Jarvis Creek is not known to support anadromous fish.

Tables F-22 and F-23 list fish and fish habitats at Delta alternative segment crossings.

Table F-22
Fish-bearing Streams the Delta Alternative Segments Would Cross[a]

Crossing Number	Stream Name	Waterbody Type	Fish	Channel Width (feet)	Conveyance Type	Conveyance Size (feet)
Delta Alternative Segment 1						
	Delta River	Stream	Resident	630	Bridge	2,000
Delta Alternative Segment 2						
	Delta River	Stream	Resident	290	Bridge	2,000

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

Table F-23
Fish, Life Stages, and Habitats That Could be Affected by Construction and Operation of the Delta alternative Segments[a]

	Life Stages				Habitat				
Fish Presence	Eggs	Fry/Larvae	Juveniles	Adults	Spawning	Rearing	Over-wintering	Summer Foraging	Migratory
Delta River and Jarvis Creek (Crossings 35, 38)									
Arctic Grayling			X	X		X		X	X
Burbot			X	X		X		X	X
Suckers	X	X	X	X		X		X	X
Whitefish			X	X		X		X	X

[a] Sources: ADF&G, 2005a; Johnson and Weiss, 2007; Noel, 2007b.

F.3 Game Mammal Resources

This section presents additional information on game mammals within ADF&G's Game Management Units (GMUs) 20A, 20B, and 20D. The descriptions of abundance, distribution, harvest, and life histories developed for this section were compiled from various sources including ADF&G's GMU 20A, 20B, and 20D Management Reports; ADF&G's Wildlife Notebook Series; and NatureServe, Animal Diversity Web.

F.3.1 Affected Environment

Moose and black bear are the primary big game mammals occurring within the project area, defined as the area within 5 miles of the proposed alternative segments (Table F-24). The Delta bison herd ranges within the eastern end of the proposed rail project. Trappers harvest primarily marten, beaver, red fox, lynx, mink, and wolves. The following sections provide additional information on game mammal population trends and harvest levels within the sections of GMU 20 the NRE would cross.

Bison

Plains bison (*Bison bison bison*) were introduced to Alaska in 1928 to the Delta River area near the mouth of Jarvis Creek. The animals came from the National Bison Range in Montana. At the time of this introduction, biologists did not recognize the existence of the wood bison (*Bison bison athabascae*), which was the last bison subspecies to occur in Alaska. Plains bison are about 10 percent to 30 percent smaller and lighter in color than wood bison (ADF&G, 2008d).

The Delta bison herd grew to more than 500 animals during the 1950s, when hunting was initiated along with agricultural development and fire suppression (DuBois and Rogers, 2000). The free-ranging Delta bison herd has been maintained by hunting at around 450 animals since the 1990s (Figure F-4; DuBois, 2004). Fire suppression led to an increase in forested habitats that reduced foraging habitat for the plains bison, which feeds on graminoid vegetation such as sedges and grasses. With the development of agriculture in the Delta area, bison began to use hay crops and cereal grains during the fall and winter as farms were developed within the herd's traditional winter range. Conflict between bison and the agricultural community escalated with development of the Delta Agricultural Project in 1979; which lead to the establishment of the

Table F-24
Large Game Mammals Occurring Within the NRE Project Area

Game Mammal	Scientific Name	Generalized Hunting Seasons by GMU	Mean Annual Harvest 2001-2006 (GMU 20)[a]	Population Estimate (GMU 20)	Population Estimate (20A, 20B, 20D)	Project Area Density[b]
Bison (Delta Herd)	*Bison bison bison*	October to March	98 (22%)	450	450	
Black Bear	*Ursus americanus*	No closed season	262 (5%)	4,975	2,325	12 to 18 per 100 square miles
Brown Bear	*Ursus arctos*	September to May	57 (5%)	1,200	675	3 to 8 per 1,000 square miles
Caribou (Delta Herd)	*Rangifer tarandus*	August to September	37 (1%)	2,540		
Caribou (Macomb Herd)	*Rangifer tarandus*	August	24 (4%)	625		
Moose	*Alces alces*	September	1,885 (4%)	44,000	32,100	
		20A: Bulls - September Antlerless – August to February	775 (5%)		14,700	3.1 per square mile
		20B: September	660 (5%)		12,900	1.6 per square mile
		20D: September	310 (7%)		4,500	0.8 per square mile
Wolf	*Canis lupus*	August to May	250 (26%)	970	495 wolves 62 packs	36 wolves 4 packs

[a] Harvest percentage of estimated population appears in parentheses. Mean annual harvest of moose for subunits 20A, 20B, and 20D are listed on separate table lines. All harvested wolves are required to be sealed (registered and recorded). Wolf harvest records are reported from sealing files. No same day airborne hunting of wolves was in affect for GMU 20 during the reporting period. The National Research Council estimated sustainable harvest rates for wolves of from 30 percent up to 40 percent of early winter populations (NRC, 1997).

[b] Sources: Dubois 2006a, 2006b, 2006c, 2005a, 2005b, 2005c; Seaton 2005; Young 2006a, 2006b, 2006c, 2005a, 2005b.

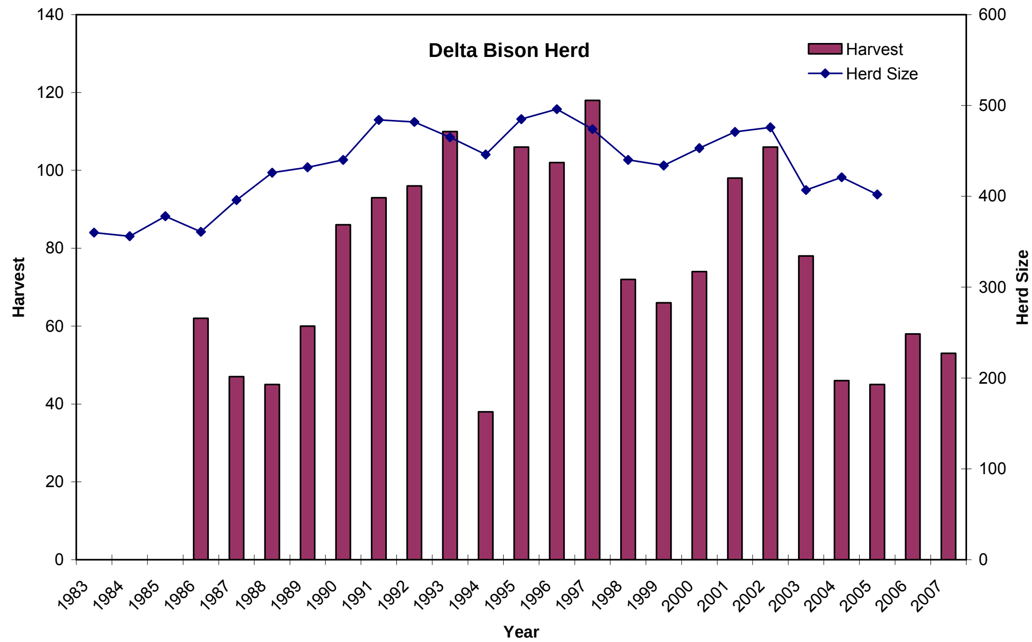

Figure F-4
Population and Harvest Trends for the Delta Bison Herd 1983 to 2007 (ADF&G, 2008d; DuBois, 2004; DuBois, 2006a)

90,000-acre Delta Junction State Bison Range (Figure F-5). The purpose of the bison range is to provide adequate winter range and to alter seasonal movements of bison to reduce damage to agriculture. Winter habitat development in the bison range includes annual fertilization of about 500 acres, forage management using controlled burns, and mowing and disking to control invasion of the native bluejoint reedgrass.

Bison may occur in the area the Delta alternative segments would cross at the eastern edge of the NRE project area. Bison feed on sedges and grasses, migrate to the Delta River during calving in May, and use riparian habitats along this river southwest of Delta Junction through the summer. In the fall, bison migrate from the Delta River toward Delta Junction, crossing the Alaska Highway. During the fall migration, bison leave the Delta River and move to the bison range instead of moving into agricultural lands (ADF&G, 2008d). Delta bison have established many traditional trails inside and outside of the bison range and they cross transportation corridors in many areas (Figure F-5; ADF&G, 2008d). Bison were hit by vehicles on the Alaska Highway near Delta Junction at the rate of two bison every 5 years during 2001 through 2005 (ADF&G, 2005b).

Bears

Hunters harvested an average of 222 black bears per year in GMUs 20A, 20B, and 20D from 2001 to 2003 (Figure F-6). Most black bears are harvested during May and June by local resident hunters at bait stations as bears emerge from their dens. Harvest is generally concentrated in areas where road systems facilitate access and transport of baits. Hunters harvested an average of 34 brown bears in GMUs 20A, 20B, and 20D from 2000 to 2004 (Figure F-7). Most brown bears are harvested during the fall, often in conjunction with moose hunts.

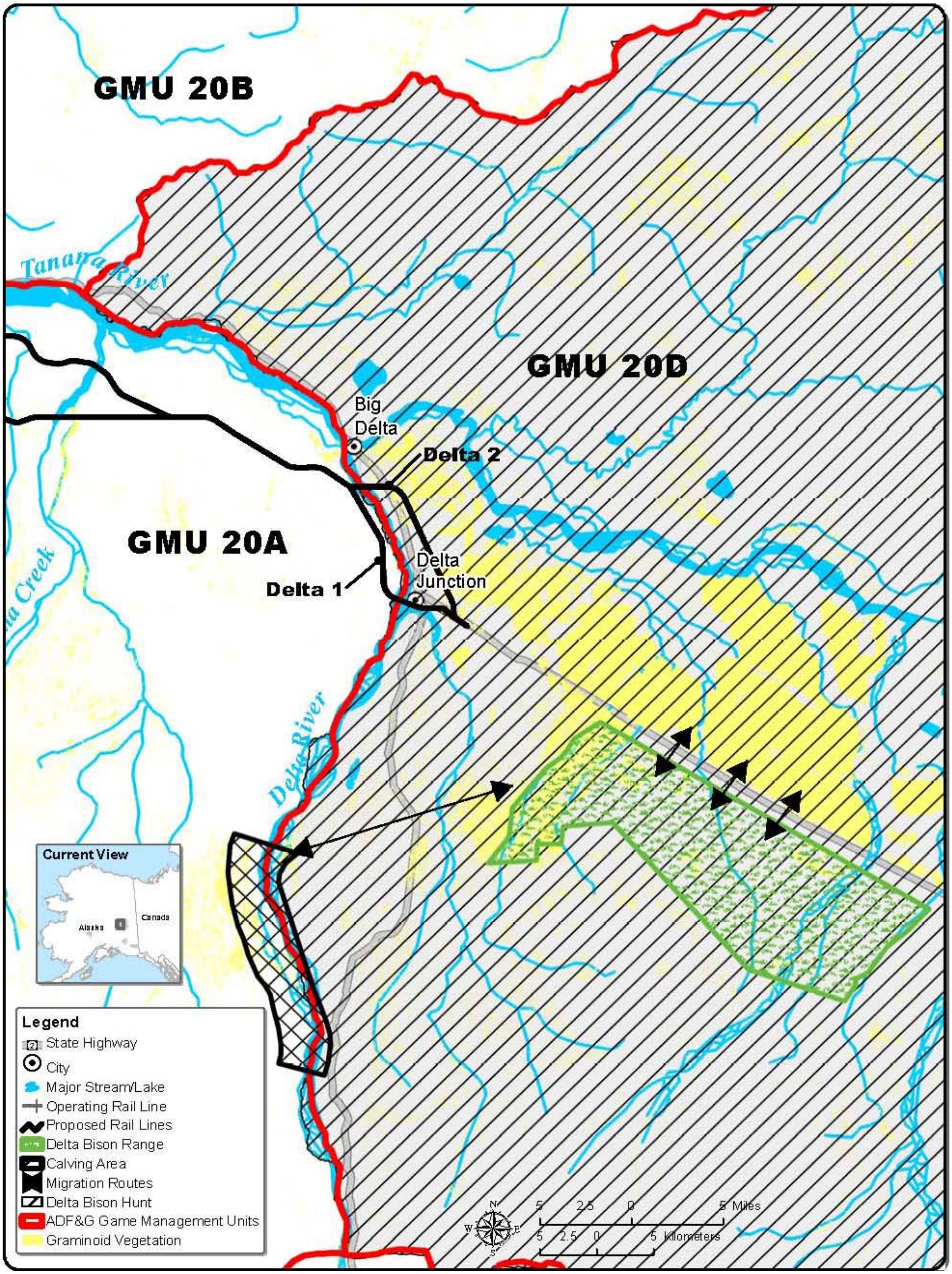

Figure F-5
Delta Bison Herd Range and Migration Routes in the Project Area (DuBois and Rogers, 2000)

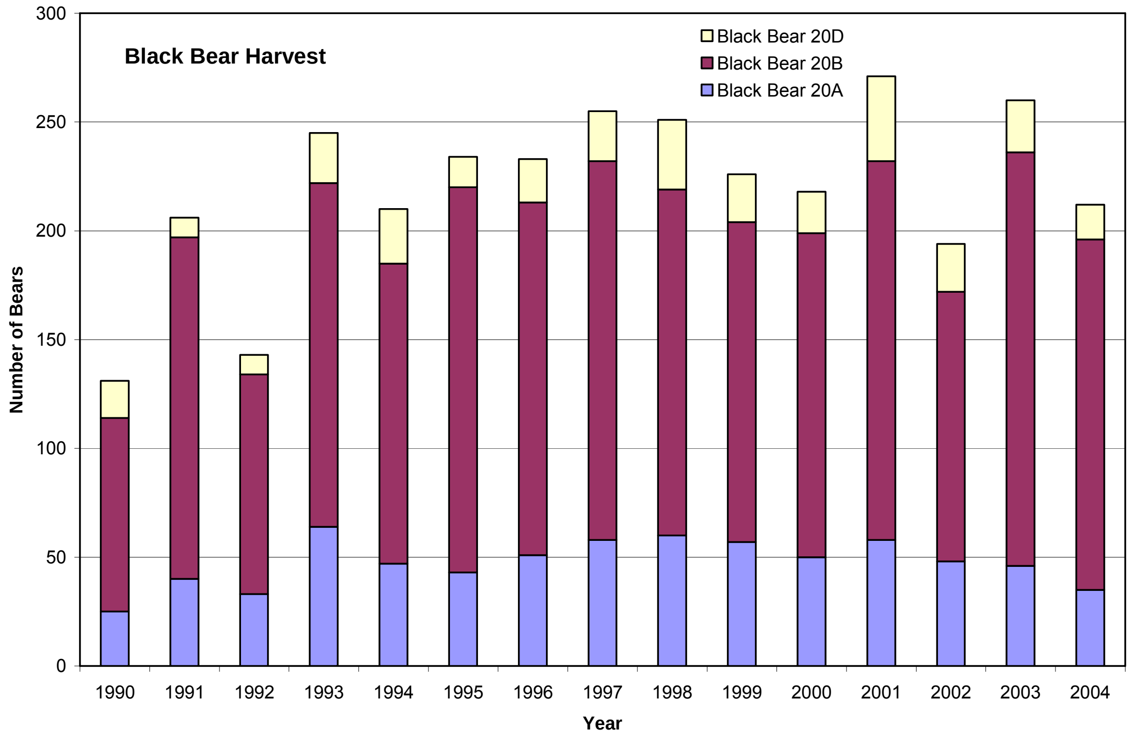

Figure F-6
Harvest Trends for Black Bears 1990 to 2004 (Seaton, 2005; DuBois, 2005b)

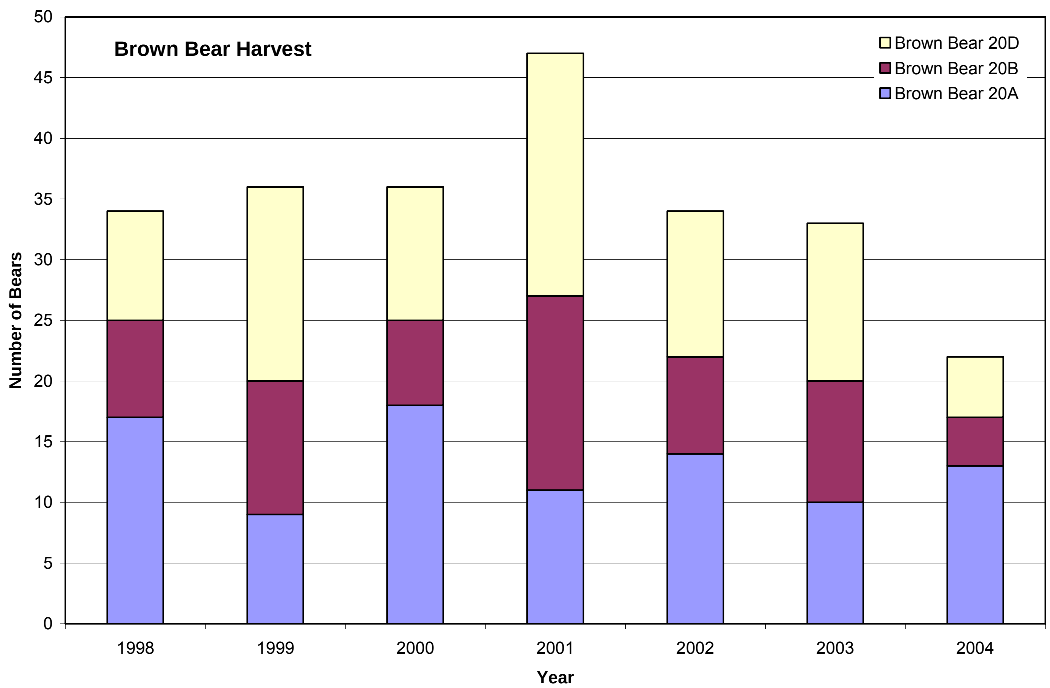

Figure F-7
Harvest Trends for Brown Bears 1998 to 2004 (Young, 2005b; DuBois, 2005c)

Both black and brown bears can become problems when they have learned to associate humans with food. Bears become conditioned to human food when they access improperly stored garbage, or human or animal foods. Bears have a keen sense of smell and habitually seek the same foods in the same places year after year. Because cubs learn about what and where to forage from their mothers, sows that are conditioned to human foods, condition their cubs to human foods. Once exposed to human foods and garbage, conditioned bears can become so problematic that they ultimately must be destroyed.

Caribou

Caribou herds that may occur within the project area include the Delta caribou herd that ranges in the northern foothills of the central Alaska Range between Parks and Richardson Highways, and the Macomb caribou herd that ranges in the northern foothills of the eastern Alaska Range between Richardson Highway and the Robertson River. If the Fortymile caribou herd were to increase in size and range, these animals would also winter along the Tanana River.

Human harvest affected the population dynamics of the Delta herd during 1969 to 1973, and again during 1981 to 1991. In other years, the hunting season was closed or restricted to permit drawing hunts primarily for bulls. Delta caribou herd harvest is managed through a bull-only special permit drawing in GMU 20A (ADF&G Hunt DC827; Figure F-8) with a mean annual harvest of 37 bulls (2000 to 2007). The Macomb caribou herd is managed as a subsistence and registration permit hunt (ADF&G Hunt RC835; Figure F-9) with a mean annual harvest of 23 bulls (2000 to 2007).

The Delta caribou herd historically ranges in the Alaska Range foothills north of the divide separating the Tanana and Susitna drainages in GMU 20A (Young, 2005a); to the south and outside of the project area. Recent range expansions include use of the upper Nenana and the Susitna drainages north of the Denali Highway. This herd was estimated at 1,500 to 2,500 animals in 1975 but by 1989 the Delta herd had grown to nearly 11,000 animals. The Delta herd declined from 11,000 animals in the early 1990s to 2,000 or fewer animals in the early 2000s (Figure F-8; Young, 2005a). After the initiation of a wolf-control program, the heard estimates were higher during 1994 and 1995; but the herd subsequently declined apparently because of high mortality of calves from birth through 16 months (Valkenberg *et al.*, 2002). Caribou generally calve during mid to late May.

Populations of caribou in Interior Alaska are primarily influenced by predation and weather; although population dynamics, nutrition, and body condition for the Delta caribou herd are also limited by shortages of winter food (Valkenburg *et al.*, 2002). Wolves are the primary predator of caribou calves, followed by grizzly bears, golden eagles, and lynx (Valkenburg *et al.*, 2002). Human harvest was a significant factor in the size of the Delta Caribou herd during the 1980s and early 1990s (Valkenburg *et al.*, 2002), but has not had a notable influence on herd size during the late 1990s to 2000s, averaging 37 caribou per year during 2000s.

The Macomb is a small caribou herd of about 500 to 600 caribou that ranges foothills of the Alaska Range generally south of the Alaska Highway, and primarily between the Robertson River and Richardson Highway. This herd was estimated at 350 to 400 caribou in 1972, and it received little sport harvest (Figure F-9). Hunting pressure increased on the Macomb herd during the early 1970s coincident with ADF&G imposing hunting restrictions on other nearby road-accessible caribou herds (DuBois, 2005a).

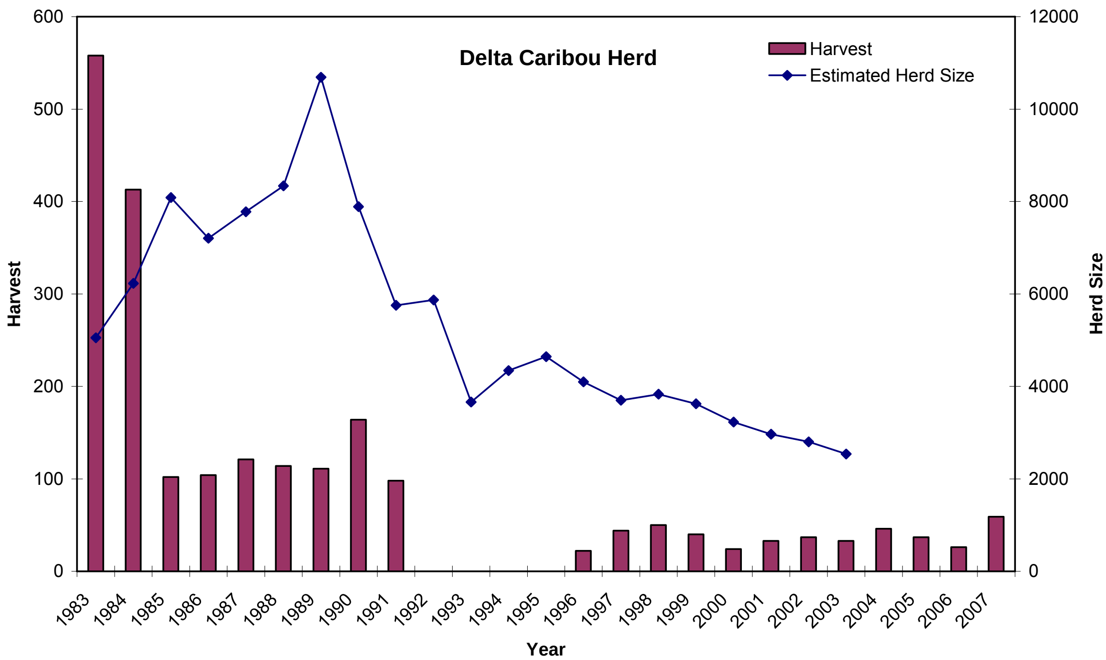

Figure F-8
Population and Harvest Trends for the Delta Caribou Herd 1983 to 2007 (ADF&G, 2008e; Young, 2005a)

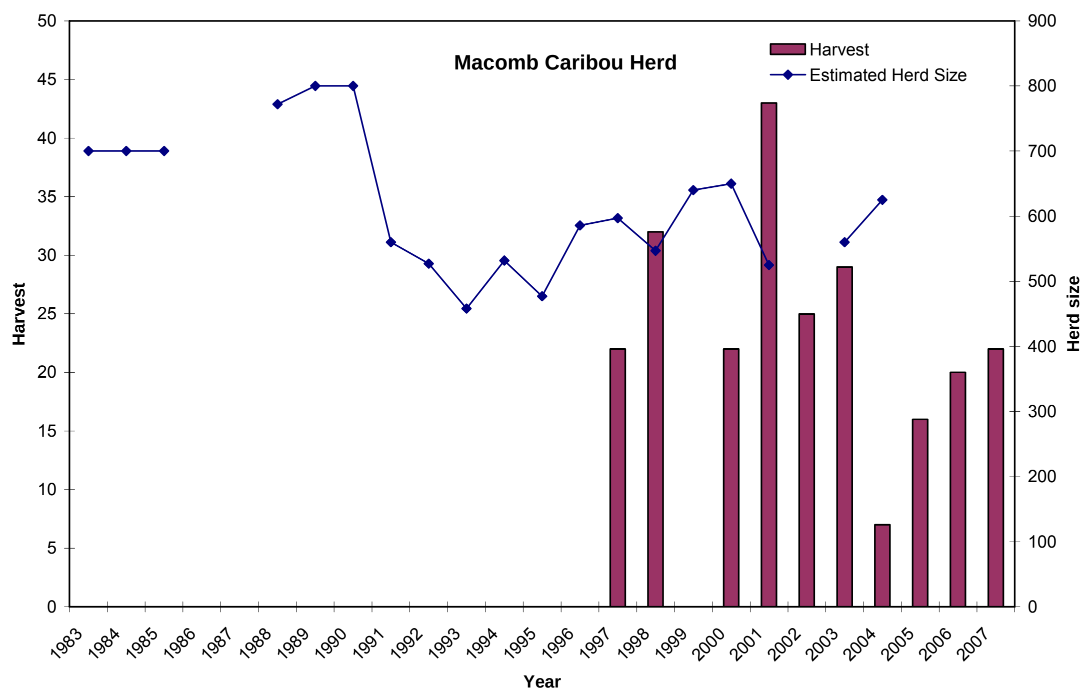

Figure F-9
Population and Harvest Trends for the Macomb Caribou Herd 1983 to 2007 (ADF&G, 2008e; DuBois, 2005a)

Moose

Moose are distributed throughout Alaska and are the primary large mammal harvested within the NRE project area in the Tanana River Valley. The moose population in the central GMU 20A has been the subject of intensive research and management for decades. Moose in central GMU 20A have been maintained at a high density and were considered to be increasing during 1997 to 2005 (Figure F-10; Boertje *et al.*, 2007). Review of the nutritional status of this population, including age at first reproduction, twinning rates, short-yearling mass, and indices of browse removal rates all indicate that this population is nutritionally stressed (Boertje *et al.*, 2007). Primary predators of moose calves in the region are wolves, black bears, and grizzly bears (Boertje *et al.*, 2000). Calf harvests were initiated in 2002 to help stabilize this high-density, food-stressed population and to compensate for the declining harvests of bulls (Young and Boertje, 2004). Many permit holders protested the calf hunt; with 61 percent not participating and only 30 percent of those who did participate harvesting a calf (Young and Boertje, 2004), contributing only marginally to the harvest mandate objective of 500 to 720 moose (Figure F-10). While acceptance of the calf hunt decreased, acceptance of cow hunts increased during 2002 to 2003 (Young and Boertje, 2004). The moose population in GMU 20A appears to have peaked in 2003, followed by a declining trend in 2004 and 2005 (Figure F-10). The population decline may be attributable to the increased antlerless harvests.

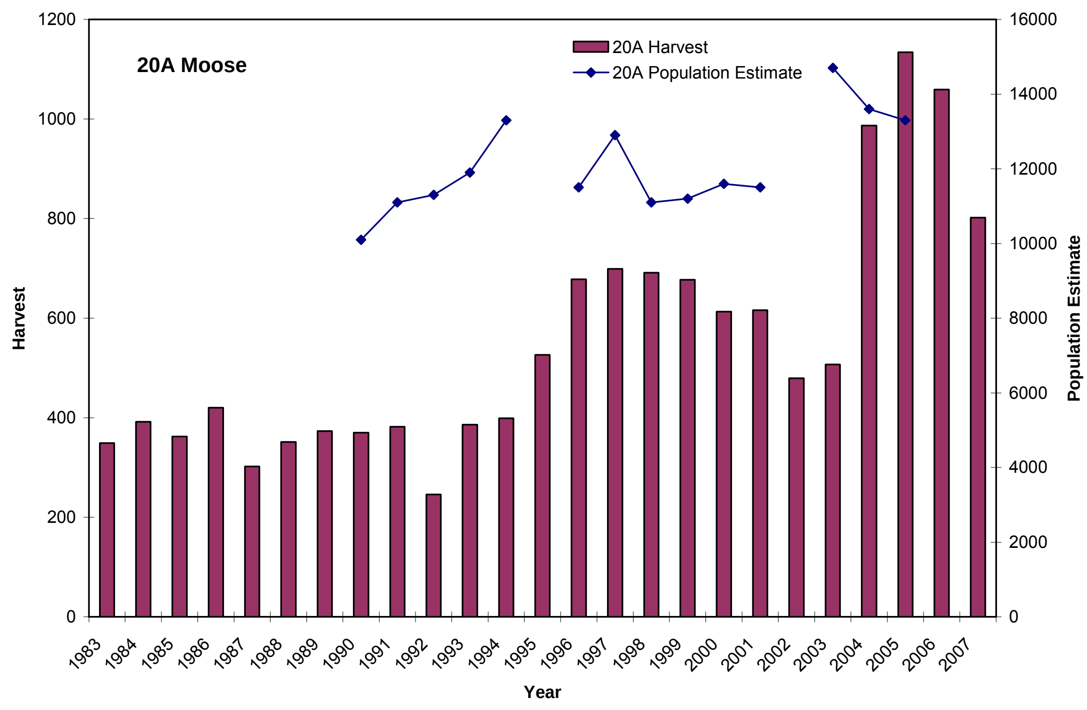

Figure F-10
Population and Harvest Trends for GMU 20A Moose 1983 to 2007 (ADF&G, 2008e; Young, 2004a; Young, 2006a)

The moose population in GMU 20B is also managed for high density because of high demand for moose hunting opportunities in this region, which is accessible by roads and waterways. This population appears to have increased since the early 1990s and supports an average harvest of about 650 moose per year (Figure F-11; Young, 2006b). The moose population in GMU 20D appears to have been increasing since the mid 1990s, although population and harvest management objectives have not been met (Figure F-12; DuBois, 2006b).

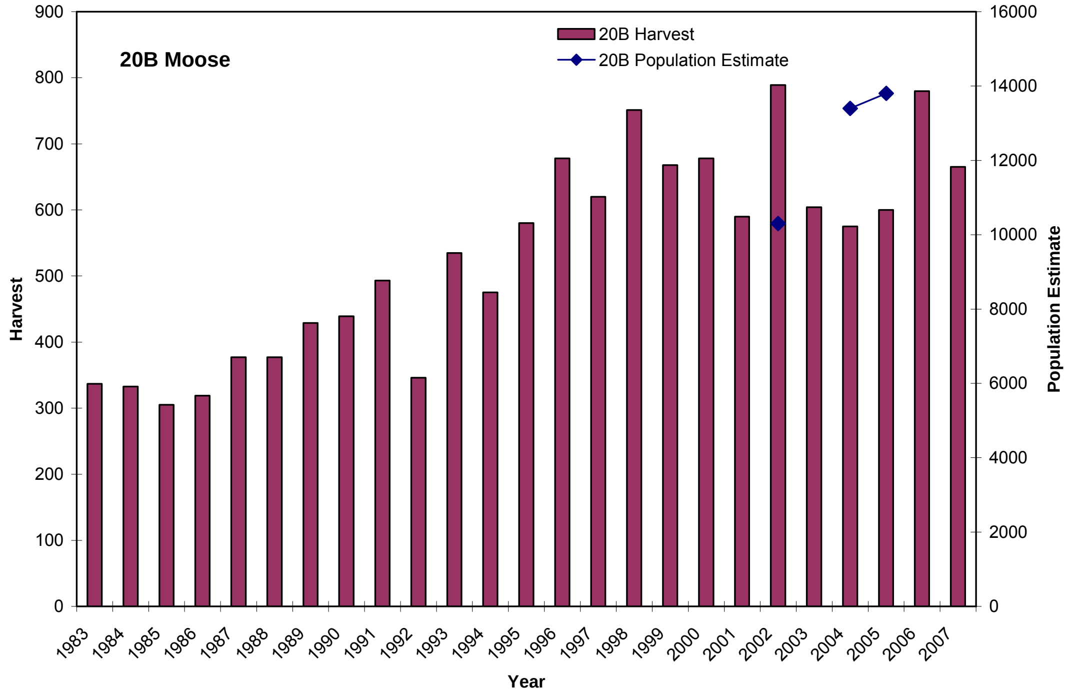

Figure F-11
Population and Harvest Trends for GMU 20B Moose 1983 to 2007 (ADF&G, 2008e; Young, 2004b; Young, 2006b)

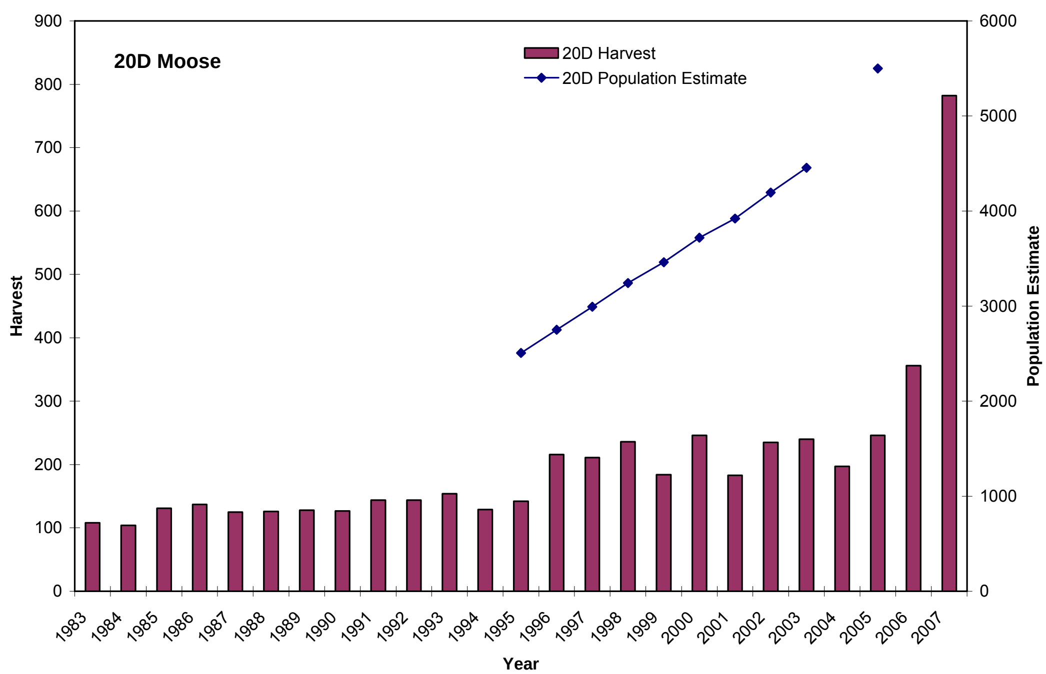

Figure F-12
Population and Harvest Trends for GMU 20D Moose 1983 to 2007 (ADF&G, 2008e; Young, 2004b; Young, 2006b)

Moose in this region include both migratory and non-migratory populations (Gasaway *et al.*, 1983). Migratory moose may range over 200 square miles, while non-migratory moose may range 100 square miles (Ballard *et al.*, 1991). Moose range size is influenced by the sex and age of the individual, the range characteristics of the cow, and habitat conditions. Most moose move to areas traditionally used for calving, rutting and wintering, thereby making use of different habitat types throughout the year. Moose movements within the project area follow general patterns, with movements from foothills areas of the Alaska Range and Yukon-Tanana Uplands toward the Tanana-Kuskokwim Lowlands during late winter to early spring and back to the foothills during late summer to early fall. Movement extent and timing during fall and winter from upland forested areas to lowlands, such as river valleys, is influenced primarily by snow depth. Moose are well adapted to traveling across snow, but depths of more than 28 inches can affect moose movements and habitat use. As snowpack reaches more than 38 inches moose may seek closed-canopy needleleaf forests, which generally have lower snow depths (Peek 1997). Moose wintering in the Salcha and Chena river drainages of GMU 20B and the Alaska Range foothills in GMU 20A move into the Tanana Flats in February to April where cows calve in central GMU 20A (Gasaway *et al.*, 1983). Migratory moose return to the Salcha and Chena river drainages or the Alaska Range foothills during August to October (Gasaway *et al.*, 1983). Moose from the western portion of GMU 20D make similar movements into the eastern portion of GMU 20A (Gasaway *et al.*, 1983). Moose tend to use traditional migratory routes and calves learn migratory behavior as they follow their mothers on annual migration routes (Hundertmark, 1997).

Based on early-winter densities presented in Table F-24, an estimated 2,300 moose would occur within 5 miles of the proposed project alternatives. Seasonal migrants increase the density of moose in the Tanana Flats from 1.8 to 2.0 times the early-winter density (Rodney Boertje, ADF&G, personal communication, February 14, 2008; Gasaway *et al.* 1983). If an estimated 30 percent of the moose in the project area are seasonal migrants from the foothills of GMU 20B and 20D, approximately 690 moose would be expected to move into and out of the proposed project area across the rail alignment twice a year, once during spring and once during fall.

About 200 moose-vehicle collisions were reported by Alaska State Troopers along the stretch of Richardson Highway paralleling the proposed NRE during 2001 to 2005 (ADF&G, 2005b), averaging 42 moose-vehicle kills per year. Collisions were most frequent at the west and east ends of the project area in the vicinity of Fairbanks, North Pole, and Delta Junction. Increased traffic near these communities was the most likely cause of the higher incidence of moose-vehicle collision reports in these areas. Moose-vehicle kills occurred most frequently during January and December, when only 4 to 5 hours of daylight may affect drivers’ ability to see moose on the highway, and during July to September, when more moose may be moving across the highway alignment (Figure F-13).

Wolves

Wolf populations in GMUs 20A, 20B, and 20D are managed to provide for compatible human uses including hunting, trapping, photography, viewing, listening, and scientific and educational purposes (Young, 2006c; DuBois, 2006c). Compatible uses include consumptive harvest of wolves for pelts as well as non-consumptive uses such as wildlife viewing and scientific research. Not all human uses are allowed in all areas or at all times. Management of wolves focuses on providing sustained, diverse uses as listed in the ADF&G’s Wolf Conservation and Management Policy for Alaska (for additional discussion of Alaska’s Wolf Control Programs,

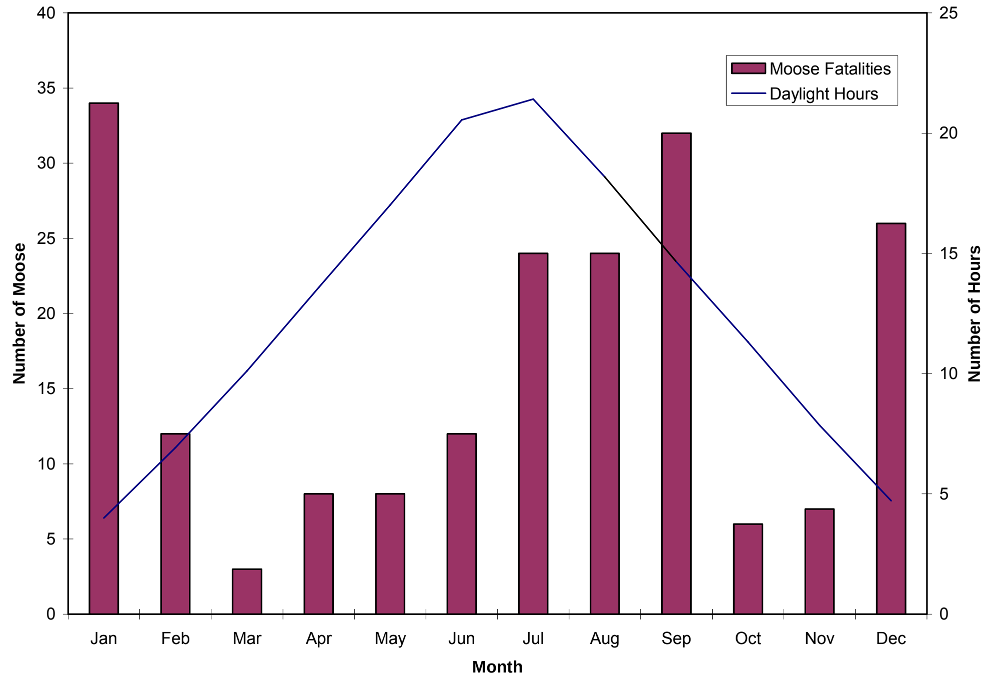

Figure F-13
Monthly Moose Collisions Mortalities During 2001 to 2005 Reported from Alaska State Troopers Logs for GMU 20B and 20D for Richardson Highway with Daylight Hours by Month (ADF&G, 2005b)

see http://www.wc.adfg.state.ak.us/index.cfm?adfg= wolf.main). Most harvested wolves are taken by trappers, although some are shot by hunters, with an average annual harvest of 78 wolves in GMU 20A; 79 wolves in GMU 20B; and 29 wolves in GMU 20D (Figure F-14; Young, 2006c; DuBois, 2006c).

Wolves are carnivorous and in GMU 20 their primary foods are moose and caribou. During winter a pack may kill a moose every few days. Wolf and prey populations can be affected by a number of factors including weather and food availability. Severe winters coupled with active wolf and bear predation can contribute to local big game scarcities. Within GMU 20, wolf numbers are primarily regulated by prey availability (Gasaway *et al.*, 1983; NRC, 1997), but wolf control programs have periodically been used to reduce wolf populations to enhance the harvestable surplus of moose and caribou. Because availability of moose and caribou for human consumption has been a dominant interest of GMU 20 residents, wolf-control measures were initiated within the GMU to reverse moose and caribou population declines. Wolf predation control programs occurred in Unit 20A (fall 1975 to spring 1982, and October 1993 to November 1994), Unit 20B (fall 1979 to spring 1986), and 20D (fall 1979 to spring 1983, July 1997 to July 2002). Fall wolf populations within these three subunits appear to have remained fairly stable during 1998 to 2005, remaining at around 500 individuals (Figure F-14; Young, 2003 and 2006c; DuBois, 2003 and 2006c).

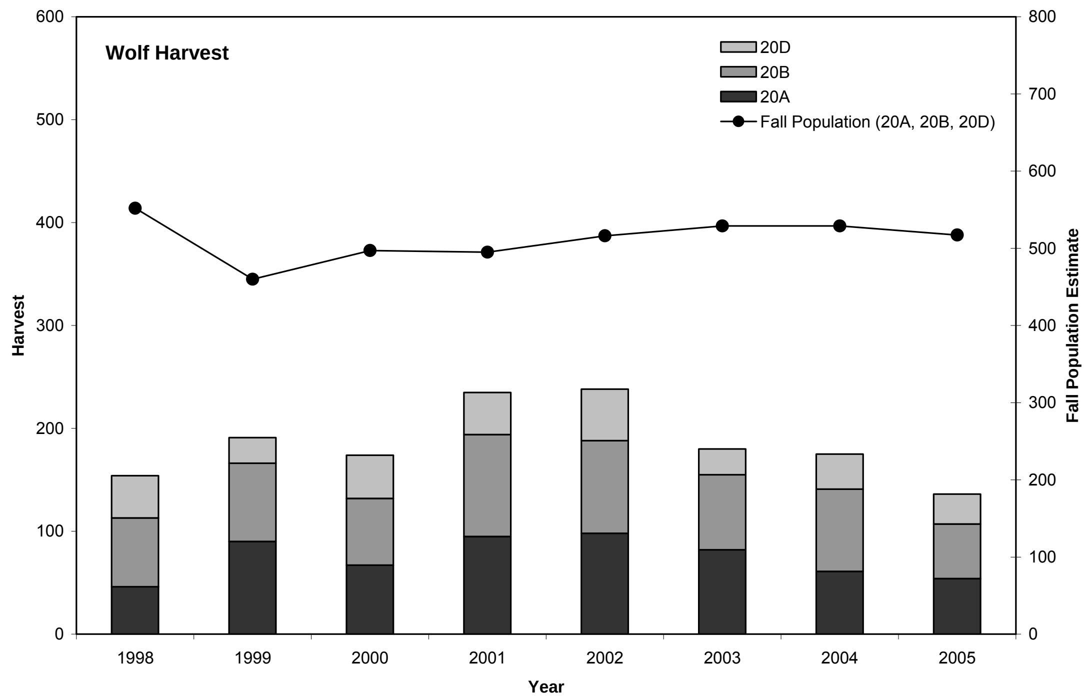

Figure F-14
Harvest Trends for Wolves 1998 to 2005 GMU 20A, 20B and 20D (Young, 2003 and 2006c; DuBois, 2003 and 2006c)

F.3.2 Environmental Consequences

Habitat Loss or Alteration

Habitat loss and alteration would result from construction of the proposed NRE. Loss and alteration within the project footprint as it relates to game mammals is summarized in Chapter 5. Habitat loss and level of game mammal use is further described below by game mammal for each alternative segment. As stated in Chapter 5, habitat loss for all vegetation cover types represents less than 1 percent of available habitats for all game mammals within 5 miles of the project area.

Habitats used by game mammals would be lost due to construction of the Eielson alternative segments (Table F-25). Eielson Alternative Segment 3 would affect the least amount of forested habitat, while Eielson Alternative Segment 1 would affect the greatest amount of forested habitat. Open broadleaf forest and tall shrub habitats would be the most valuable for moose forage within this area; Eielson Alternative Segment 1 would affect the largest area of these habitat types, while Eielson Alternative Segment 2 would affect the smallest area of these habitat types. Eielson Alternative Segment 2 would affect the largest area of needleleaf and mixed forest habitats, while Eielson Alternative Segment 3 would affect the smallest area of these habitat types.

Habitats used by game mammals would be lost due to construction of the Salcha alternative segments (Table F-26). Salcha Alternative Segment 1 would affect the smallest area of forested habitat. Salcha Alternative Segment 1 would affect a few more acres of open broadleaf and mixed forests and tall shrub habitat types than Salcha Alternative Segment 2.

Table F-25
Direct Loss of Habitats Used by Game Mammals Within the 200-foot ROW for the Eielson Alternative Segments[a,b]

		Alternative Segment			Level of Game Mammal Use[c]						
Grid Code	Class Name	Eielson 1 (acres)	Eielson 2 (acres)	Eielson 3 (acres)	Bison	Black Bear	Brown Bear	Caribou	Moose	Wolf	Fur-bearers
1	Closed Needleleaf	20.6	13.7	11.8	N	M	L	L	M	L	M
2	Open Needleleaf	72.0	104.9	91.4	N	M	L	L	H	L	L
3	Closed Broadleaf	38.6	30.5	43.5	N	M	L	L	H	L	M
4	Open Broadleaf	30.2	18.1	10.2	N	M	L	L	H	L	M
5	Closed Mixed	73.6	54.0	53.5	N	M	L	L	M	L	M
	Forested	*235.0*	*221.2*	*210.5*	N	M	L	L	M	L	M
6	Tall Shrub	2.2	1.7	11.5	N	M	L	N	H	L	M
7	Low Shrub	8.2	8.3	5.5	N	M	L	N	H	L	L
9	Graminoid	1.0	9.7	11.0	N	M	L	N	H	L	L
15	Clear Water	0.0	0.1	2.8	N	L	L	N	H	L	M
Total Area		**246.4**	**241.1**	**241.3**							

[a] Source: BLM *et al.*, 2002.
[b] Evaluations based on typical habitat use patterns, developed characteristics within the alternative area, and numbers of game mammals expected to occur within the alternative area.
[c] H = high, M = moderate, L = low, N = none.

Table F-26
Direct Loss of Habitats Used by Game Mammals Within the 200-foot ROW, Extra Staging Areas, and Access Roads for the Salcha Alternative Segments[a,b]

		Alternative Segment		Level of Game Mammal Use[c]						
Grid Code	Class Name	Salcha 1 (acres)	Salcha 2 (acres)	Bison	Black Bear	Brown Bear	Caribou	Moose	Wolf	Fur-bearers
1	Closed Needleleaf	50.0	167.0	N	H	L	L	M	M	H
2	Open Needleleaf	41.1	100.6	N	H	L	L	H	M	M
3	Closed Broadleaf	52.8	64.8	N	H	L	L	H	M	H
4	Open Broadleaf	82.7	28.2	N	H	L	L	H	M	H
5	Closed Mixed	154.7	110.9	N	H	L	L	H	M	H
	Forested	*381.3*	*471.4*	N	H	L	L	H	M	H
6	Tall Shrub	45.0	34.6	N	H	M	N	H	M	H
7	Low Shrub	7.3	26.1	N	H	M	N	H	M	M
9	Graminoid	1.3	3.0	N	H	L	N	H	M	M
15	Clear Water	13.7	16.2	N	H	M	N	H	M	H
16	Turbid Water	71.2	42.3	N	H	M	N	H	M	H
19	Sparse Vegetation	0.0	1.4	N	M	L	N	M	M	M
20	Gravel/Rock	0.4	2.4	N	M	L	N	M	M	M
21	Mud/Silt/Sand	12.3	40.8	N	M	L	N	M	M	M
Total Area		**532.5**	**638.3**							

[a] Source: BLM *et al.*, 2002.
[b] Evaluations based on typical habitat use patterns, developed characteristics within the alternative area, and numbers of game mammals expected to occur within the alternative area.
[c] H = high, M = moderate, L = low, N = none.

The Central alternative segments and Central Connectors would affect primarily forested habitats (Tables F-27 and F-28).

Table F-27
Direct Loss of Habitats Used by Game Mammals Within the 200-foot ROW for the Central Alternative Segments[a,b]

Grid Code	Class Name	Central 1 (acres)	Central 2 (acres)	Level of Game Mammal Use[c] Bison	Black Bear	Brown Bear	Caribou	Moose	Wolf	Fur-bearers
1	Closed Needleleaf	16.5	64.7	N	H	L	L	M	M	H
2	Open Needleleaf	40.0	7.8	N	H	L	L	H	M	M
3	Closed Broadleaf	1.8	0	N	H	L	L	H	M	H
4	Open Broadleaf	9.2	0	N	H	L	L	H	M	H
5	Closed Mixed	21.1	11.8	N	H	L	L	H	M	H
	Forested	*88.6*	*84.3*	N	H	L	L	H	M	H
6	Tall Shrub	0.4	0	N	H	M	N	H	M	H
7	Low Shrub	17.0	0	N	H	M	N	H	M	M
9	Graminoid	0.2	0	N	H	L	N	H	M	M
21	Mud/Silt/Sand	0.2	2.0	N	H	N	N	M	M	M
24	Other	16.5	0.6	N	H	M	L	M	M	M
Total Area		**122.9**	**86.9**							

[a] Source: BLM *et al.*, 2002.
[b] Evaluations based on typical habitat use patterns, developed characteristics within the alternative area, and numbers of game mammals expected to occur within the alternative area.
[c] H = high, M = moderate, L = low, N = none.

Table F-28
Direct Loss of Habitats Used by Game Mammals Within the 200-foot ROW for the Central Connector Segments[a,b]

		Alternative					Level of Game Mammal Use[c]						
Grid Code	**Class Name**	**Central Connector A (acres)**	**Central Connector B (acres)**	**Central Connector C (acres)**	**Central Connector D (acres)**	**Central Connector E (acres)**	**Bison**	**Black Bear**	**Brown Bear**	**Caribou**	**Moose**	**Wolf**	**Fur-bearers**
1	Closed Needleleaf	29.4	56.6	30.6	19.4	8.2	N	H	L	L	M	M	H
2	Open Needleleaf	30.7	12.2	8.6	0.4	8.0	N	H	L	L	H	M	M
3	Closed Broadleaf	0.4	-	0.1	-	1.3	N	H	L	L	H	M	H
4	Open Broadleaf	3.6	0.2	2.0	-	0.1	N	H	L	L	H	M	H
5	Closed Mixed	26.2	9.6	3.6	1.4	6.8	N	H	L	L	H	M	H
	Forested	*90.2*	*78.5*	*44.9*	*21.2*	*24.3*	N	H	L	L	H	M	H
6	Tall Shrub	0.8	-	0.4	-	0.2	N	H	M	N	H	M	H
7	Low Shrub	14.2	-	10.1	-	-	N	H	M	N	H	M	M
9	Graminoid	0.5	-	0.2	-	-	N	H	L	N	H	M	M
15	Clear Water	-	0.8	0.4	0.0	-	N	H	N	N	M	M	M
21	Mud/ Silts/ Sand	-	-	-	-	0.3	N	H	M	L	M	M	M
24	Other	-	-	-	-	33.6	N	H	L	L	M	M	M
Total Area		**105.8**	**79.4**	**56.0**	**21.2**	**58.5**							

[a] Source: BLM *et al.*, 2002.
[b] Evaluations based on typical habitat use patterns, developed characteristics within the alternative area, and numbers of game mammals expected to occur within the alternative area.
[c] H = high, M = moderate, L = low, N = none.

Habitats used by game mammals would be lost due to construction of the Donnelly alternative segments (Table F-29).

Table F-29
Direct Loss of Habitats Used by Game Mammals Within the 200-foot ROW, Extra Staging Areas, and Access Roads for the Donnelly Alternative Segments[a,b]

		Alternative Segment		Level of Game Mammal Use[c]						
Grid Code	**Class Name**	**Donnelly 1**	**Donnelly 2**	**Bison**	**Black Bear**	**Brown Bear**	**Caribou**	**Moose**	**Wolf**	**Fur-bearers**
1	Closed Needleleaf	123.0	209.4	N	H	L	L	M	M	H
2	Open Needleleaf	324.1	149.7	N	H	L	L	H	M	M
3	Closed Broadleaf	7.1	36.1	N	H	L	L	H	M	H
4	Open Broadleaf	17.1	8.4	N	H	L	L	H	M	H
5	Closed Mixed	75.3	157.4	N	H	L	L	H	M	H
	Forested	*546.6*	*561.0*	N	H	L	L	H	M	H
6	Tall Shrub	3.2	3.8	N	H	M	N	H	M	H
7	Low Shrub	22.9	12.7	N	H	M	N	H	M	M
8	Dwarf Shrub	0.6	0.0	N	H	M	N	H	M	M
9	Graminoid	11.2	2.7	N	H	L	N	H	M	M
15	Clear Water	2.9	2.1	N	H	M	N	H	M	H
16	Turbid Water	22.0	21.3	N	H	M	N	H	M	H
19	Sparse Vegetation	0.0	0.4	N	M	L	N	M	M	M
20	Gravel/Rock	9.1	11.8	N	M	L	N	M	M	M
21	Mud/Silt/Sand	22.2	21.0	N	M	L	N	M	M	M
24	Other	43.0	56.1	N	M	M	L	H	M	M
Total Area		**683.7**	**692.9**							

[a] Source: BLM *et al.*, 2002.
[b] Evaluations based on typical habitat use patterns, developed characteristics within the alternative area, and numbers of game mammals expected to occur within the alternative area.
[c] H = high, M = moderate, L = low, N = none.

South Common Segment would affect habitats used by game mammals (Table F-30). Habitat mapping (BLM *et al.*, 2002) for this segment is different than the current habitat type. An extensive wildland fire in 1998 reset the successional stage for this area. This large expanse is currently shrub habitat with scattered patches of forested habitats; and was used by moose during spring and late-summer prior to the fire (Noel, 2007a).

Construction of the Delta alternative segments would affect habitats used by game mammals (Table F-31).

Table F-30
Direct Loss of Habitats Used by Game Mammals Within the 200-foot ROW for South Common Segment[a,b]

			Level of Game Mammal Use[c]						
Grid Code	Class Name	South Common Segment (acres)	Bison	Black Bear	Brown Bear	Caribou	Moose	Wolf	Fur-bearers
1	Closed Needleleaf	57.8	N	H	M	L	M	M	H
2	Open Needleleaf	99.1	N	H	M	L	H	M	M
3	Closed Broadleaf	18.7	N	H	M	L	H	M	H
4	Open Broadleaf	8.5	N	H	M	L	H	M	H
	Forested	*244.2*	N	H	M	L	H	M	H
5	Closed Mixed	60.1	N	H	M	L	H	M	H
7	Low Shrub	6.1	N	H	M	N	M	M	M
9	Graminoid	0.9	N	H	M	N	H	M	M
15	Clear Water	1.5	N	H	M	N	H	M	H
Total Area		**252.7**							

[a] Source: BLM *et al.*, 2002.
[b] Evaluations based on typical habitat use patterns, developed characteristics within the alternative area, and numbers of game mammals expected to occur within the alternative area.
[c] H = high, M = moderate, L = low, N = none.

Table F-31
Direct Loss of Habitats Used by Game Mammals Within the 200-foot ROW, Extra Staging Areas, and Access Roads for the Delta Alternative Segments[a,b]

		Alternative Segment		Level of Game Mammal Use[c]						
Grid Code	Class Name	Delta 1	Delta 2	Bison	Black Bear	Brown Bear	Caribou	Moose	Wolf	Fur-bearers
1	Closed Needleleaf	124.3	44.8	N	H	L	L	M	L	M
2	Open Needleleaf	63.8	53.1	N	H	L	L	H	L	L
3	Closed Broadleaf	9.0	21.5	N	H	L	L	H	L	M
4	Open Broadleaf	5.3	6.6	N	H	L	L	H	L	M
5	Closed Mixed	44.0	80.8	N	H	L	L	H	L	M
	Forested	*246.4*	*206.9*	N	H	L	L	H	L	M
6	Tall Shrub	1.1	2.1	M	H	M	N	H	L	M
7	Low Shrub	4.7	2.3	M	H	M	N	H	L	L
9	Graminoid	4.2	0.0	H	H	L	N	H	L	L
15	Clear Water	0.5	0.3	L	H	M	N	H	L	M
16	Turbid Water	6.3	12.4	L	H	M	N	H	L	M
19	Sparse Vegetation	6.7	1.5	L	M	L	N	M	L	L
20	Gravel/Rock	6.9	3.8	L	M	L	N	M	L	L
21	Mud/Silt/Sand	36.0	17.7	L	M	L	N	M	L	L
23	Agriculture	4.6	69.7	H	M	M	L	H	L	L
Total Area		**317.4**	**316.6**							

[a] Source: BLM *et al.*, 2002.
[b] Evaluations based on typical habitat use patterns, developed characteristics within the alternative area, and numbers of game mammals expected to occur within the alternative area.
[c] H = high, M = moderate, L = low, N = none.

Because furbearers are such a diverse group, habitat use, breeding season, den type and use, and home range size estimates and estimated habitat impact area for common furbearers within the project area are further described in Table F-32. Forested and riparian habitats would be the primary habitats used by the diverse assemblage of furbearing animals within the project area. Minimum and maximum impacts to habitats used by each furbearing animal are quantified in Table F-32.

Habitat Fragmentation

Habitat fragmentation would result from construction of the proposed NRE and would have variable effects on game mammals, depending on the species considered. Fragmentation was reviewed by evaluating the location and distribution of core habitats, riparian habitats, and at a landscape scale using road and trail densities. Review and analysis of land cover mapping (BLM *et al.*, 2002) indicates that the rail line would contribute to habitat fragmentation of core forested habitats (Figure F-15). The rail line would also contribute to fragmentation of riparian habitats.

Bears, wolves, and other furbearers commonly use riparian corridors for travel and forage. Fragmentation of riparian habitats would occur due to construction of the rail line across rivers and streams, and by excavation of gravel sources within river beds. Most major rivers would be crossed by bridges, which generally would have sufficient height and span to allow for bears to cross beneath the bridge. Riparian corridors occupy 9 percent of the project area and various alternative segments contain less than 1 to 45 acres of riparian habitat.

The Salcha alternative segments, Central alternative segments and Central Connectors would primarily affect forested riparian habitats. These segments include the Tanana, Salcha, Little Salcha, and Fivemile Clearwater rivers, which provide riparian habitats for bears, moose, and furbearers. Furbearers would be expected to be more abundant in the area of Salcha Alternative Segment 1, Central alternative segments, and Central Connectors due to the remoteness of these areas. Moose would also be abundant within this portion of the project area.

Road and trail densities vary across the proposed rail line. Construction and operation of the proposed rail line would increase road densities by more than 0.4 mile per square mile within two blocks (6 percent of analysis blocks), and by more than 0.25 mile per square mile within 19 blocks (64 percent of analysis blocks; Figure F-16). During the winter, wolves attracted by carcasses to the rail line could experience reduced survival because of the facilitated access for hunters along the maintenance and tower access roads. Road densities of 1.0 to 1.3 miles per square mile have been found to provide sufficient access to hunters such that they can limit wolf population numbers by trapping or hunting (Jalkotzy *et al.*, 1997). Construction of the rail line would increase road density within analysis blocks between 0.02 to 0.50 mile per square mile throughout the project area and does not include communication tower access roads that would potentially be part of the project. Road density for two blocks (Figure F-16) would be increased to above the threshold of 1.0 mile per square mile.

Moose-Train Collision Mortality

Rail collision mortality for moose was estimated based on the reported annual mortality for moose from the existing 58 miles of rail line currently running through GMU 20B. Locations with suspected increased frequency of collisions were evaluated based on winter moose track survey data (Noel, 2006b), and moose distribution data collected during spring and fall aerial transect surveys (Noel, 2007a). Track surveys were flown during the winter along the NRE

Table F-32
Home Range Size Estimates and Habitats for Common Furbearers Within the NRE Project Area[a]

Furbearers	Home Range Size	General Habitat/Impact Summary[b]	Breeding and Den Habitat
Beaver	0.62-mile (1-kilometer) stream channel riparian habitat within 50 meters of water 43.5 acres (17.6 hectares) – solitary 19.0 acres (7.7 hectares) – families	Streams, ponds, backwaters (16 to 20 acres clear water); forage on shrubs and aquatic vegetation (101 to 107 acres tall shrub, 72 to 78 acres riparian habitat).	Breed January or February, young born late April to June. Bank den or lodge near dammed streams or on ponds – 2 feet x 3 feet x 3 feet – used year-round.
Coyote	2,471 to 24,710 acres (10 to 100 square kilometers)	Forests, grasslands, scrub/shrub, agricultural (2,544 to 2,606 acres); forage primarily on hares, rodents, carrion.	Breed February and March. Den in hills, floodplain terrace, aboveground or hollow logs, used only during whelping, may be occupied during March to July, may use more than one den, may use repeatedly.
Short-tailed Weasel (Ermine)	24.7 to 49.4 acres (10 to 20 hectares)	Forests, riparian woodlands and scrub/shrub (2,234 to 2,272 acres); forage primarily on small rodents and lemmings, but will eat birds, eggs, frogs, fish, insects.	Breed mid to late summer, young born early May through June. Den in rodent burrows, stumps, rock out crops, may remain June to August.
Lynx	5 to 100 square miles (3,200 to 64,000 acres), depending on food abundance	Spruce and hardwood forest habitats (2,127 to 2,171 acres), especially mosaic habitats caused by fire; forage primarily on hares, grouse, ptarmigan, squirrels, rodents.	Breed March and early April, kittens born May to June. Den in natural shelters such as windblown trees, hollow logs, log jams, rock crevices.
Marten	1 to 15 square miles (640 to 9,600 acres), depending on food abundance	Black spruce forests and bogs (633 to 786 acres); forage primarily on rodents, but also eat berries, small birds, eggs, vegetation, and carrion.	Breed July and August, young born in April or early May. Den in natural shelters such as hollow logs, windblown trees, standing snags/hollow trees.
Mink	Female, 20 to 50 acres Male, 1,900 acres	Riparian forests, marshes and scrub/shrub wetlands (461 to 513 acres); forage on fish, birds, eggs, rodents.	Breed March to April, most young born in June. Den in burrow or hollow log near a pond or stream, young remain in den through July.
Muskrat	2.5 to 4.9 acres (1 to 2 hectares) marshes 0.25 mile (411 meters) streams	Marshes, riparian areas, floodplains of large rivers, ponds (122 to 134 acres); forage on aquatic plants, lilies, sedges, grasses, mussels, small fish.	Breed during late April to mid May, two litters per year, first mid June, second mid July. Den vegetation piles 2 to 3 feet above water and 5 to 6 feet diameter; also may tunnel into banks used year-round.
Red Fox	Summer, 150 to 1,300 acres Winter, 3,104- to 49,658-acre (2- to 8-kilometer) radius	Mosaic habitats, lowland marshes (1,628 to 1,751 acres); forage on rodents, small mammals, birds, eggs, insects, vegetation, carrion.	Breeds February to March, young born April to May. Den 15 to 20 feet long, usually located on the side of a hill with several entrances; may use abandoned wolf dens.

Table F-32
Home Range Size Estimates and Habitats for Common Furbearers Within the NRE Project Areaa (cont'd)

Furbearers	Home Range Size	General Habitat/Impact Summary[b]	Breeding and Den Habitat
Red Squirrel	0.5 to 1.0 acre	Spruce forests (1,794 to 1,830 acres); forage on seeds, berries, buds, fungi, and occasionally insects and birds' eggs.	Breed February and March, young born April to May. Nest in hole in tree trunk or constructed mass of twigs, leaves, mosses and lichens, several nests maintained per territory, ground burrows or middens used primarily for food storage.
River Otter	1.2 to 48.5 miles (2 to 78 kilometers) waterway	Riparian habitats, rivers, lakes, marshes (122 to 134 acres); forage on fish, mussels, snails, birds, mammals, vegetation.	Breed in May, young born late January to June. Burrows in soil or uses fallen/hollow logs, overturned tree root wads; may use year-round.
Wolf	600 square miles (384,000 acres) per pack	Variable (2,676 to 2,739 acres); forages on moose, caribou, hares, rodents, birds.	Breed February and March, young born in May or early June. Den in well-drained soil up to 10 feet deep; young moved from den during mid to late summer.
Wolverine	Female, 50 to 100 square miles (32,000 to 64,000 acres) Male, 240 square miles (153,600 acres)	Variable, coniferous forests, riparian areas may be important winter habitat (1,901 to 1,932 acres); forages on moose and caribou carcasses, rodents, squirrels, hares, birds.	Breed May through August, young born January through April. Den made in snow; occupies dens in caves, under fallen trees or thickets when inactive.

[a] Compiled from various sources including ADF&Gs Alaska Wildlife Notebook, NatureServe, Animal Diversity Web.
[b] Numbers in parenthesis represent the range of potential impacts from the proposed NRE.

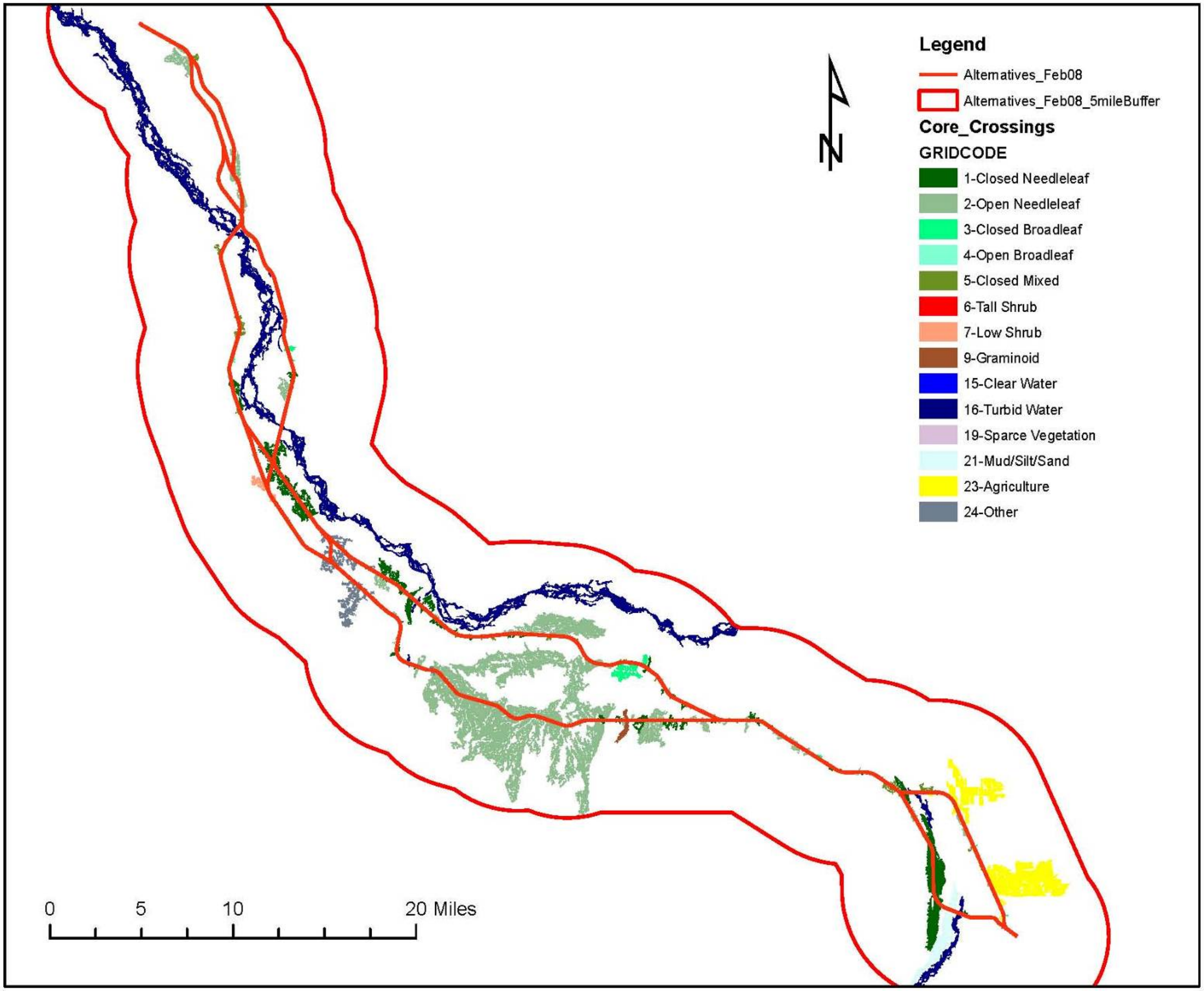

Figure F-15
Core Habitat Areas Crossed by NRE Alternatives (BLM *et al.*, 2002)

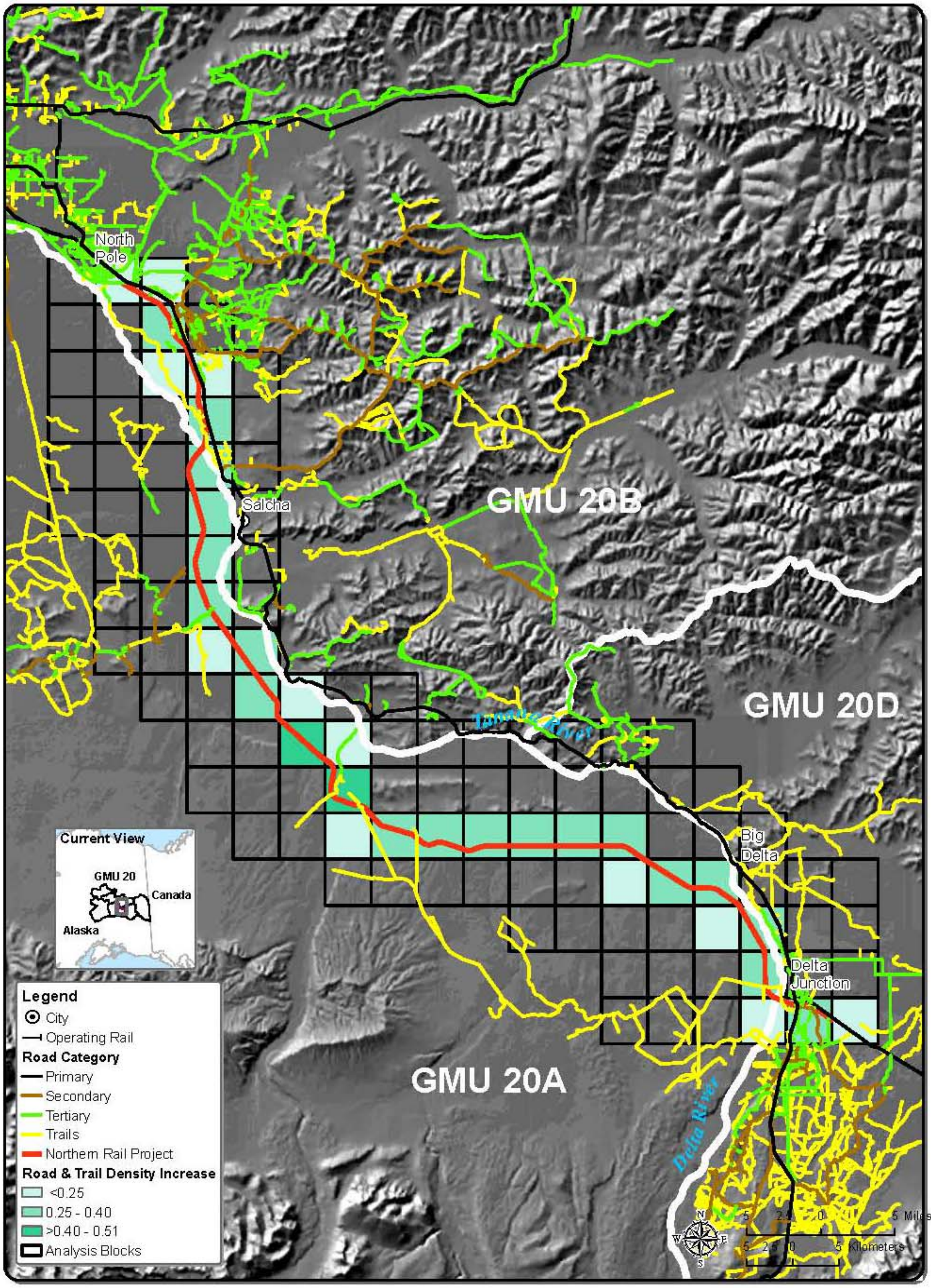

Figure F-16
Road and Trail Density Increases (miles per square miles) within Analysis Blocks Due to the NRE (Proposed Action)

alignments proposed at the time (Noel, 2006b). Spring and fall survey data for moose were collected during systematic north-south strip transect surveys of the project area (Noel, 2007a).

The existing rail line through GMU 20B averages annual moose-train collision mortalities of 0.35 moose per mile or about 20 moose per year (range 0.16 to 1.05 moose per mile) (Young, 2004b and 2006b). Assuming that the frequency of trains for the NRE would be roughly 40 percent higher than the frequency of trains on the existing rail line, the increase in moose-train collision mortality from operation of the approximately 80-mile NRE would average 40 moose per year, ranging from 18 to 120 collision mortalities per year. If the frequency of trains also increased on the existing rail line because of NRE operations, the number of moose-train collision mortalities would be expected to increase on the existing line.

During 2004-2005, most (63 percent) reported moose-train collisions on the existing rail line occurred during November, December and January (Figure F-17; ADF&G, 2005b). Collision mortality within this stretch of track appears to be influenced by February snow depth at the French Creek snow course (NRCS, 2008; Figure F-18). Collisions at this location occurred throughout the day. For those collisions that occurred before the solar noon, the time of the collisions averaged 4.4 hours (plus or minus 2.19 hours Standard Deviation (SD), range 2.2 to 9.4 hours) before sunrise. For those collisions that occurred after the solar noon, the time of collisions averaged 4.0 hours (plus or minus 2.63 hours SD, range 1.1 to 8.4 hours) after sunset (ADF&G, 2005b).

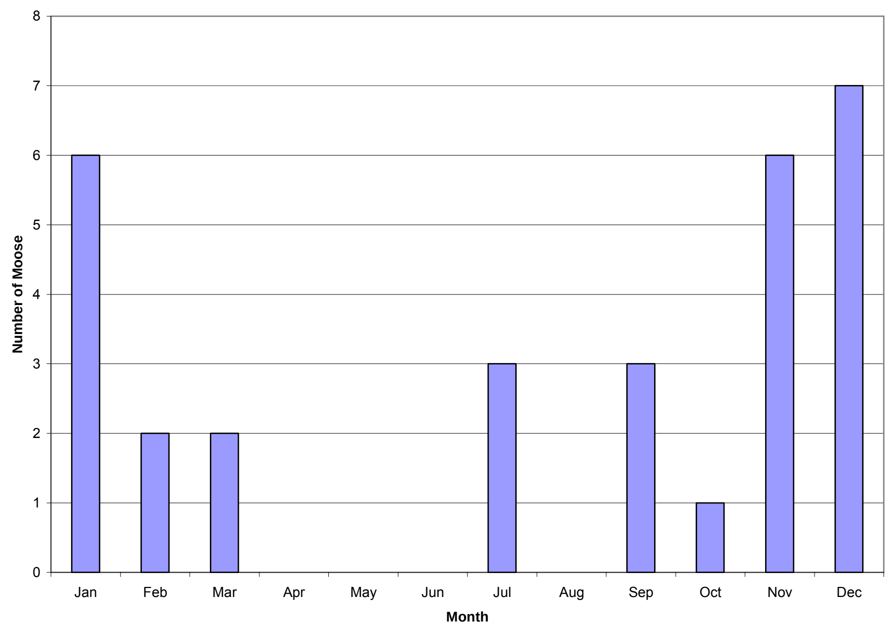

Figure F-17
Frequency of Moose-Train Collision Mortalities by Month Along 58 Miles of Existing Rail Line Within GMU 20B at the Western End of the NRE Project Area During 2004-2005 (ADF&G, 2005b)

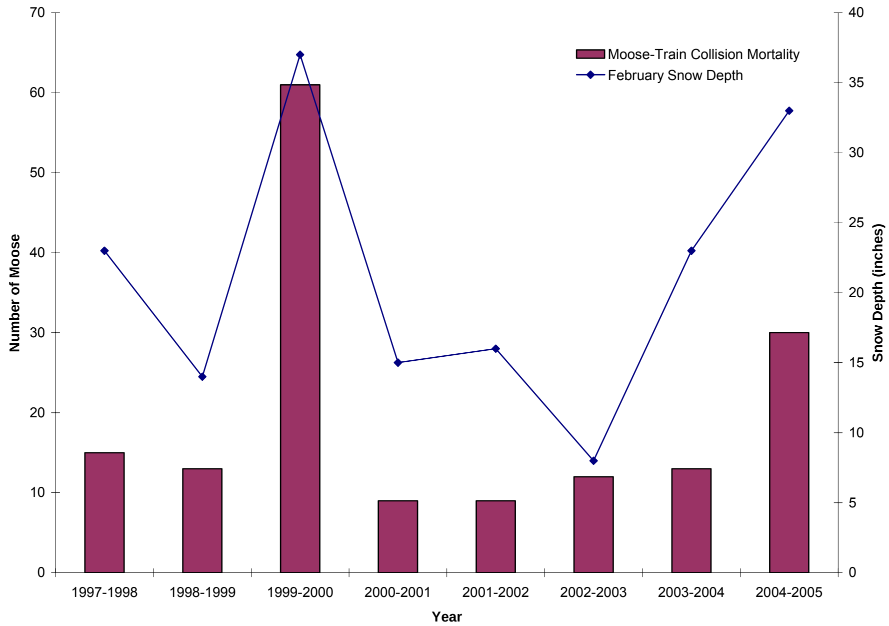

Figure F-18
Reported Annual Moose-Train Collision Mortality for 58 miles of Existing Rail Line Within GMU 20B at the Western End of the NRE Project Area with February Snow Depth at the French Creek Station (Young, 2004b and 2006b; NRCS, 2008)

The seasonality and distribution of existing moose-vehicle and moose-train collisions, winter moose-track survey data (Figure F-19), and spring and late-summer moose distribution data within the project area were reviewed (Figures F-20 and F-21). This review indicates that the estimated 40 (range 18 to 120) moose-train collision mortalities each year on the proposed rail line would most likely occur during November, December and January and would likely be concentrated along portions of Salcha Alternative Segment 1, Central Alternative Segment 1, Central Connectors A and B, Donnelly Alternative Segment 2, and South Common Segment. Mortalities would likely range higher during years with snow depths greater than 30 inches, or if a greater proportion of seasonal moose movements would occur across the proposed rail line than occur across the existing rail line.

F.4 Bird Resources

A suite of resident (designated R on tables) birds occur within the project area, including owls, ptarmigan and grouse, ravens and jays, woodpeckers, chickadees, and finches. Many other birds occurring within the project area are migratory, arriving or passing through in the spring beginning with raptors and waterfowl in April continuing with the arrivals of songbirds through May and passing through or leaving in late summer and fall (during July through October). Migratory birds fall into two classes, (1) long distance (L on tables) or Neotropical migrants (those that winter south of the Tropic of Cancer), and (2) short distance (S on tables) or Nearctic migrants (those that winter north of the Tropic of Cancer).

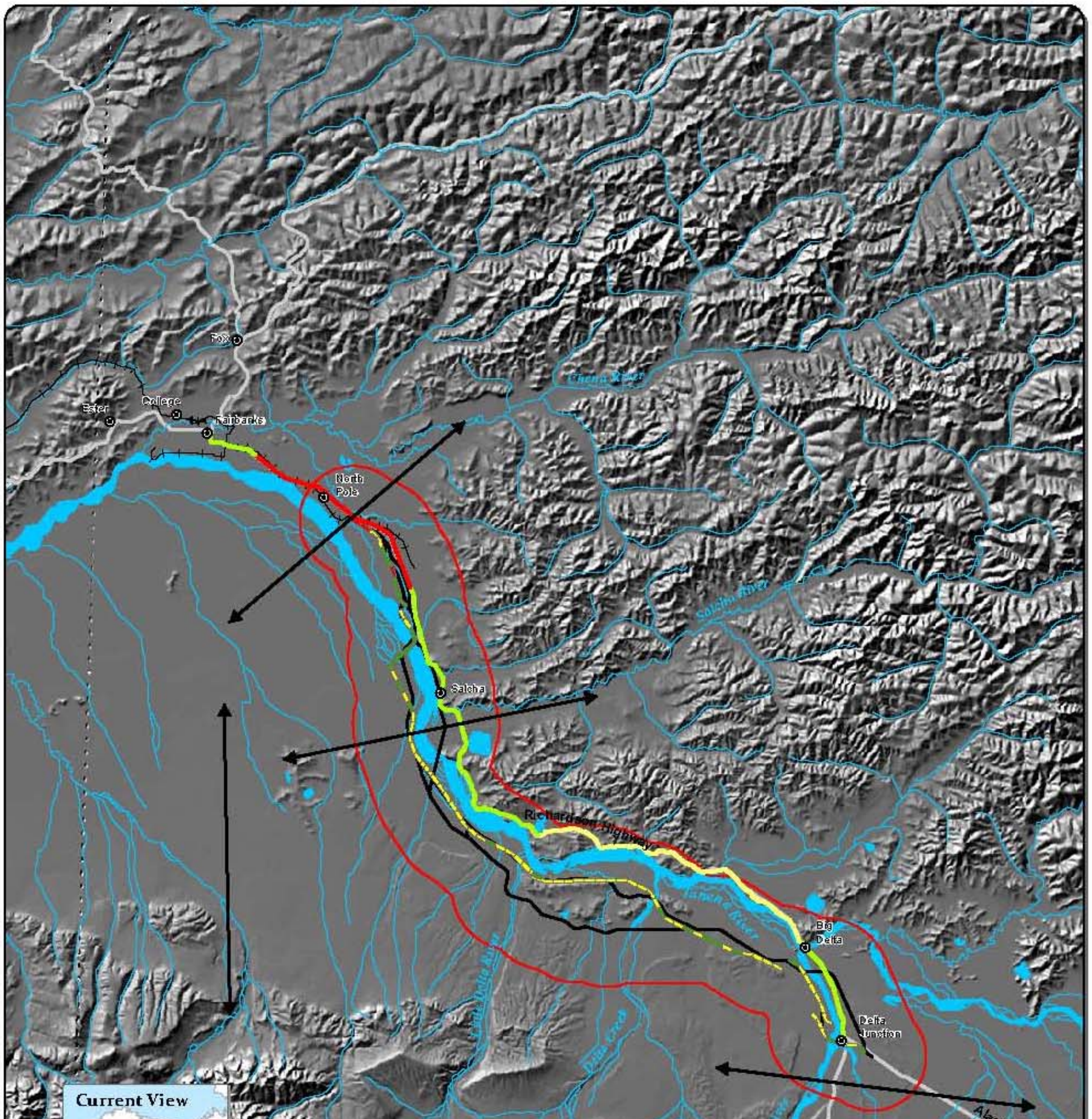

Figure F-19
Generalized Winter-Spring and Late-Summer Fall Moose Migration Directions (Gasaway *et al.*, 1983), Collision Mortality Along the Richardson Highway (ADF&G, 2005b), and Track Density Along and Near Portions of Proposed Alternative Segments (Noel, 2006b)

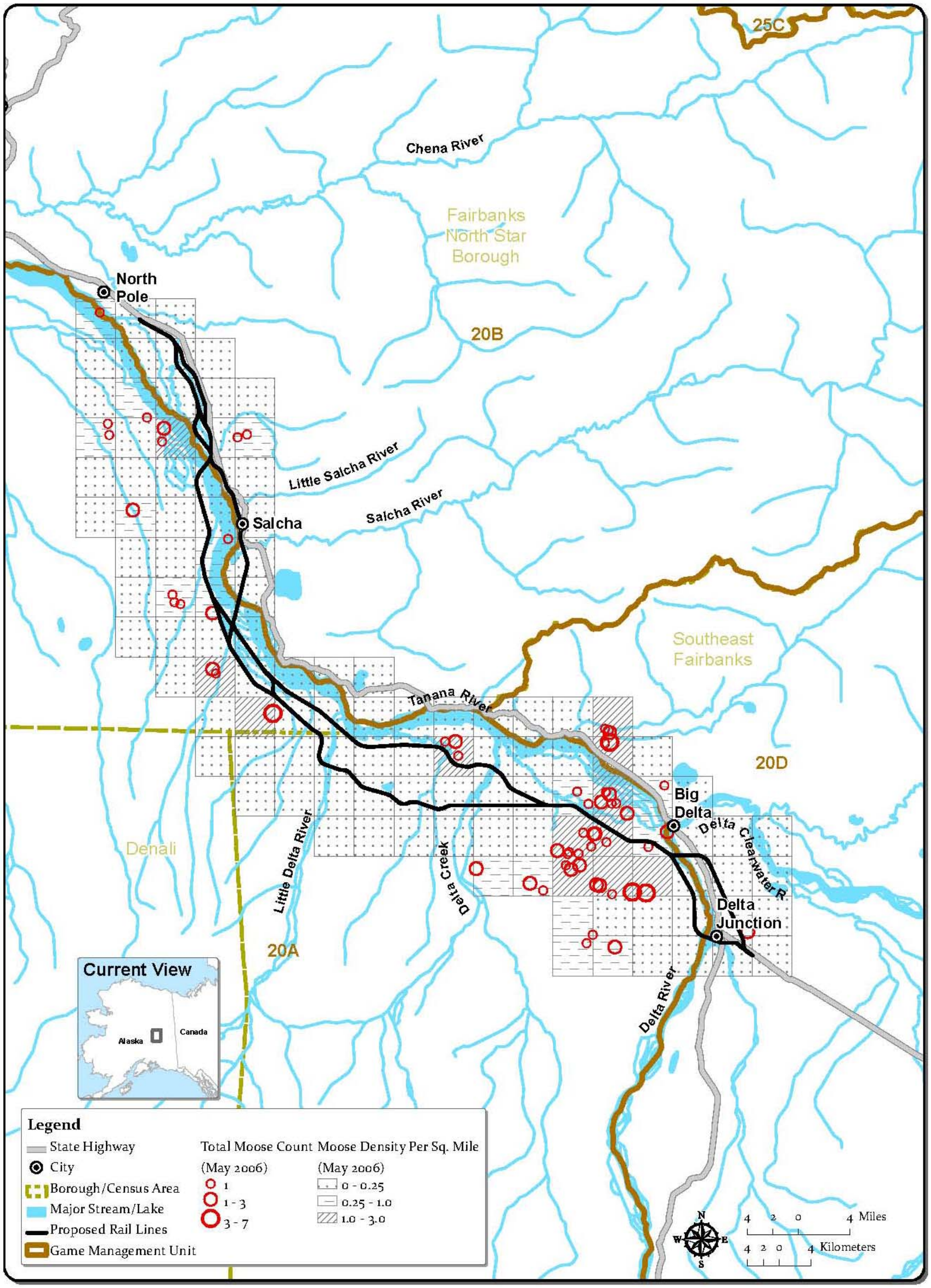

Figure F-20
Spring Moose Distribution and Densities Recorded During Aerial Transect Surveys Within the Project Area (Noel, 2007a)

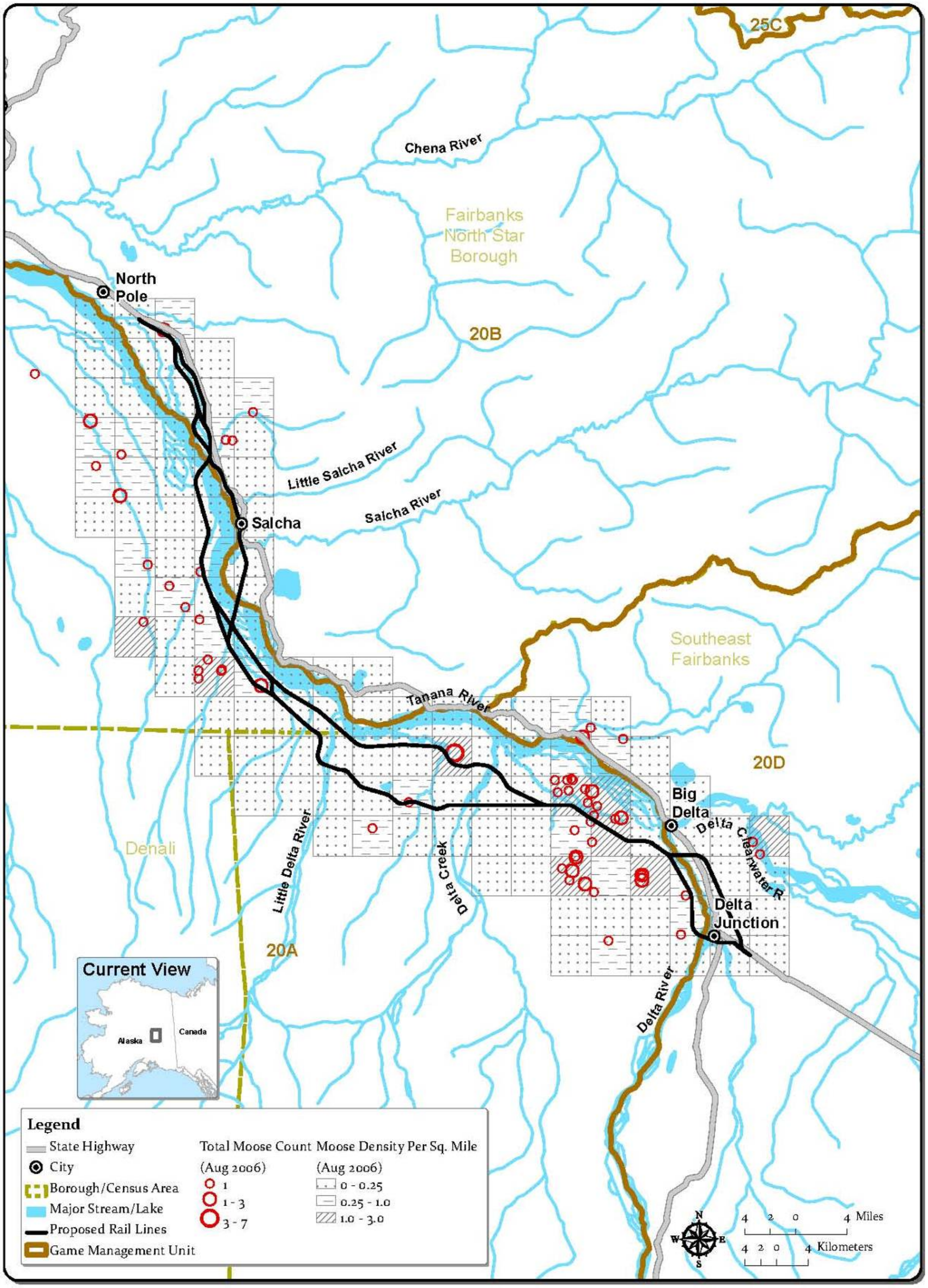

Figure F-21
Late-Summer Moose Distribution and Densities Recorded During Aerial Transect Surveys Within the Project Area (Noel, 2007a)

F.4.1 Waterfowl and Waterbirds

Waterfowl are hunted in Alaska and hunters harvested an average estimate of 70,000 ducks and 6,500 geese during 2005 and 2006 or less than 1 percent of the average estimated harvest of ducks and geese for the United States. Mallard, American wigeon, and American green-winged teal accounted for 74 percent of the duck harvest and Canada goose accounted for 71 percent of the goose harvest (USFWS, 2007). Alaska hunters harvested an average of 550 sandhill cranes during 2005 and 2006 (USFWS, 2007).

Table F-33 lists waterfowl and waterbirds that commonly occur within the project area based on aerial and ground-based surveys (Benson, 1999; Benson, 2001; Anderson *et al.*, 2000; Platte, 2003; Harding and Sharbaugh, 2005) and estimated numbers within 5 miles of the proposed NRE (990-square-mile area) based on regional USFWS aerial waterfowl surveys (USFWS, 2008). Some waterfowl and waterbirds nest within habitats crossed by the proposed rail line and many more waterfowl and waterbirds migrate through Interior Alaska on their way to and from nesting grounds in western and arctic Alaska. Most waterfowl and waterbirds nest on the ground near waterbodies. Herring and mew gulls nest on river bars in the Tanana River. Potential habitat loss due to construction of the NRE is listed in Table F-33. These potential losses are based on project area nest season densities.

Sandhill crane and swan use in the project area is shown in Figures F-22 and F-23. Based on SEA field surveys, sandhill cranes use exposed and submerged gravel bars in the Tanana River, the Little Delta River, Delta Creek and the Delta River for roosting (Figure F-22). Sandhill cranes roost in riverine areas surrounded by flowing water which afford protection from predators while the cranes sleep (Norling *et al.*, 1992). Some swans were also found on riverine habitats during dawn and dusk surveys (Figure F-22). During the day sandhill cranes forage in wetland habitats and grain fields, while swans generally remain on or near water (Figure F-23). Foraging habitats used by cranes were most closely associated with the Eielson alternative segments, Donnelly Alternative Segment 2 and Delta Alternative Segment 2 (Figure F-23). Cranes flying back and forth between riverine roosting habitats and foraging habitats (Currier, 1997; Morkill and Anderson, 1991) would potentially cross the NRE rail line several times a day while staging within the project area.

F.4.2 Raptors and Owls

Bald and golden eagles in Interior Alaska are primarily summer residents, arriving in late April and departing by freeze-up in mid-to-late September (Ritchie and Ambrose, 1996). Golden eagles migrate through the project area but are not known to rest in the vicinity of the NRE. Bald eagle nests within the project area during 2005-2007 were primarily associated with habitats along the Tanana River; occurring in balsam poplar trees (77 percent), and spruce trees (20 percent, presumably white spruce) (Prichard and Ritchie, 2007). Most nests on the Tanana River were within 300 feet of a shoreline (Ritchie and Ambrose, 1996) and clusters of nest structures may be associated with side channels with chum salmon spawning areas. Waterfowl are important in the diet of Tanana River nesting bald eagles, especially in the spring. Salmon are more important prey in late summer and fall (Ritchie and Ambrose, 1996). Bald eagles regularly occur on the lower Delta River during midwinter where they are found near open water associated with wintering waterfowl and fall spawning chum salmon (Ritchie and Ambrose, 1996). The few migration and winter band recoveries suggest that Tanana River bald eagles migrate through inland areas and overwinter in western North America including Washington

Table F-33
Waterbird Densities, Estimated Nesting Season Populations, and Estimated Number of Nesting Birds Affected[a] by the Proposed NRE

Common Name	Species	Donnelly Area[b]	Chena and Tanana Flats Area[c]	Tanana-Kuskokwim Lowlands Density (birds/square mile)[d]	Project Area Density (birds/square mile)[e]	Estimated Project Area Population[f]	Estimated Proposed Action Impact[g]	Estimated Minimum Project Area Impact[h]	Estimated Maximum Project Area Impact[i]
Waterbirds									
Common Loon	*Gavia immer*		√	0.052	0.013	13	0	0	0
Pacific Loon	*Gavia pacifica*	√		0.047	0.036	36	0	0	0
Horned Grebe	*Podiceps auritus*	√							
Red-necked Grebe	*Podiceps grisegena*	√	√	0.060	0.018	18	0	0	0
Sandhill Crane	*Grus Canadensis*			0.039	0.018	18	0	0	0
Large Shorebirds				0.026	0.031	31	0	0	0
Small Shorebirds				0.355	0.181	179	1	1	1
Herring Gull	*Larus argentatus*		√						
Mew Gull	*Larus canus*		√	0.220	0.161	159	1	1	1
Merganser	*Mergus* spp.	√		0.047	0.026	26	0	0	0
Geese & Swans									
Canada Goose	*Branta Canadensis*		√	0.104	0.114	113	1	1	1
Trumpeter Swan	*Cygnus buccinators*		√	0.254	0.205	203	1	1	1
Ducks									
American Green-winged Teal	*Anas crecca*	√		0.306	0.256	254	1	1	1
American Wigeon	*Anas americana*	√	√	0.622	0.430	426	2	2	2
Bufflehead	*Bucephala albeola*	√		0.443	0.344	341	2	2	2
Goldeneye	*Bucephala* spp.		√	0.414	0.293	290	1	1	1
Long-tailed Duck	*Clangula hyemalis*	√		0.060	0.008	8	0	0	0
Mallard	*Anas platyrhynchos*	√	√	0.596	0.487	482	2	2	2
Northern Pintail	*Anas acuta*	√		1.225	1.158	1,146	6	6	6
Northern Shoveler	*Anas clypeata*		√	0.277	0.298	295	1	1	1
Ring-necked Duck	*Athya collaris*	√		0.031	0.018	18	0	0	0
Scaup	*Aythya* spp.	√		1.329	0.860	851	4	4	4
Scoter	*Melanitta* spp.	√		0.492	0.150	149	1	1	1

Table F-33
Waterbird Densities, Estimated Nesting Season Populations, and Estimated Number of Nesting Birds Affected[a] by the NRE (cont'd)

[a] Number of nesting birds affected is based on the estimated project area nesting density multiplied by the area of footprint impact for the proposed action, the minimum area alternative, and the maximum area alternative.
[b] Source: Anderson *et al.*, 2000.
[c] Source: Benson, 1999; Harding and Sharbaugh 2005.
[d] Source: Platte, 2003.
[e] Source: USFWS, 2008.
[f] Estimate based on Project Area density (USFWS, 2008) and 5-mile area surrounding the proposed alternative segments (990 square miles)
[g] Proposed Action includes North Common, Eielson 3, Salcha 1, Central 2, Connectors B and E, Donnelly 1, South Common, and Delta 1.
[h] Minimum Project Area includes North Common, Eielson 2, Salcha 1, Central 2, Central Connector B, Donnelly 2, South Common, and Delta 2.
[i] Maximum Project Area includes North Common, Eielson 1, Salcha 2, Central 1, Connector C, Donnelly 1, South Common, and Delta 1.

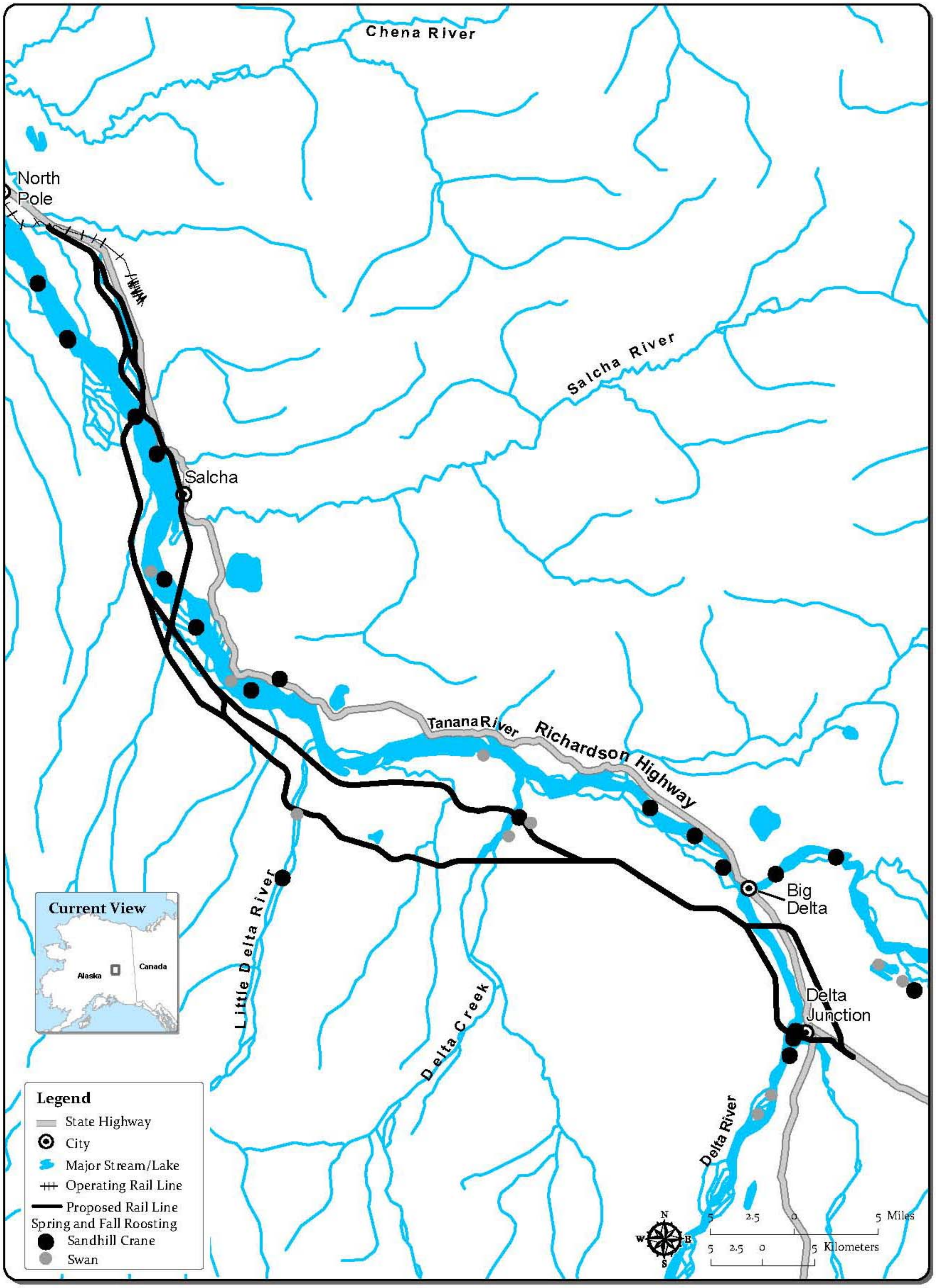

Figure F-22
Sandhill Crane and Swan Roosting Locations During Spring and Fall Migrations (Noel, 2006a)

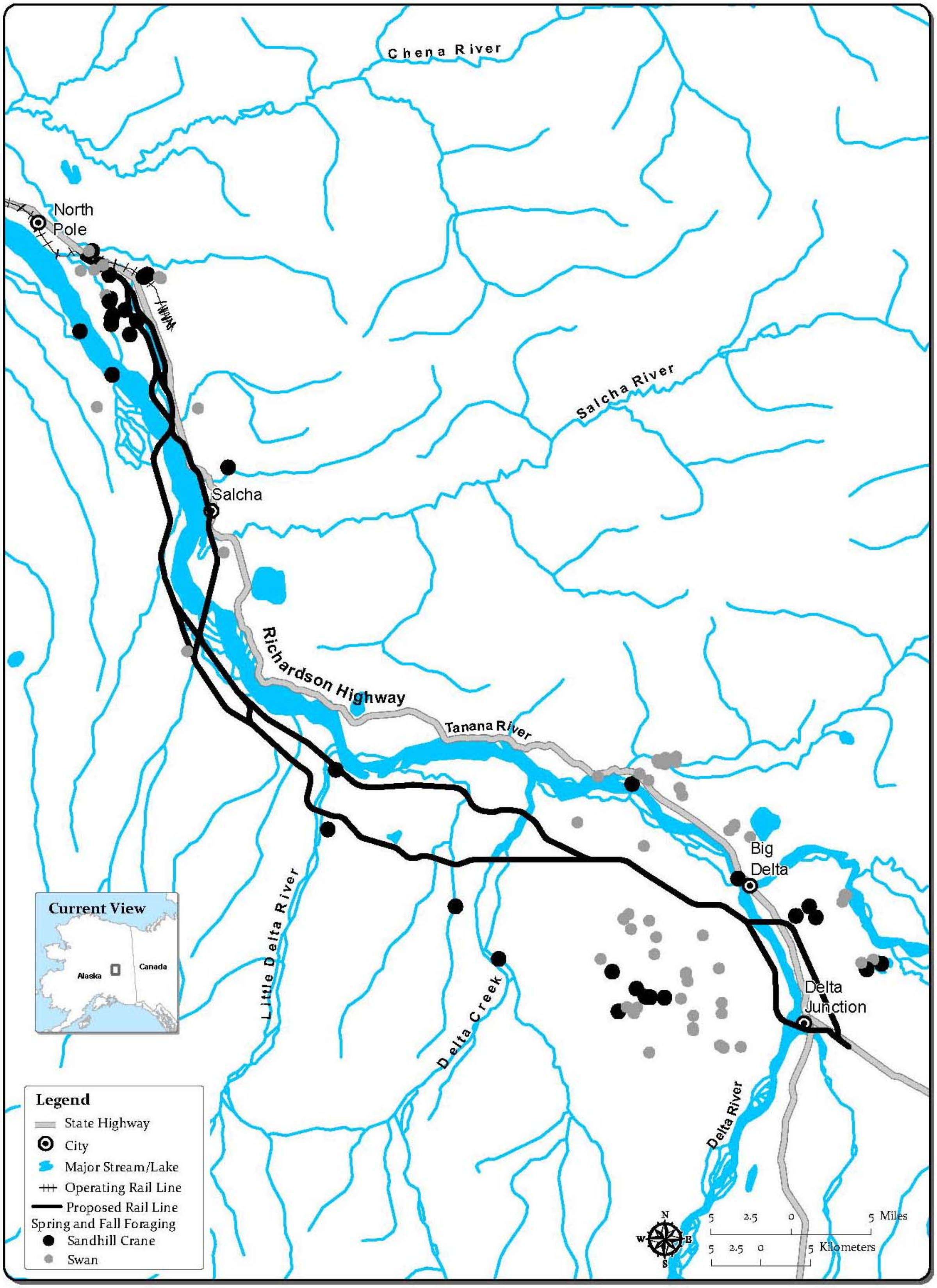

Figure F-23
Sandhill Crane and Swan Staging and Foraging Locations During Spring and Fall Migrations (Noel, 2006a)

and northwestern Wyoming (Ritchie and Ambrose, 1996). Table F-34 describes raptors and owls reportedly occurring in the project area, their population status, and estimates for project area and statewide populations and habitats.

There were approximately 20 active eagle nests in the project area during 2005 through 2007, representing about 20 reproducing pairs and their associated territories (Prichard and Ritchie, 2007; Figure F-24). This number appears consistent with the estimated 75 nesting pairs for the Tanana River Basin and represents about 25 percent of this population consistent with findings reported by Ritchie and Ambrose (1996). There were seven bald eagle nests within about 0.5 mile of the proposed NRE (Figure F-24). There were approximately 13 peregrine falcon nests in the project area during 2005 through 2007 (Prichard and Ritchie, 2007). Peregrine falcons nest on cliffs; four of these nests were within about 0.5 mile of the proposed NRE (Figure F-24).

Five species of owls commonly occur within the project area (Table F-34). The two largest of these owls, the great gray owl and the great horned owl, nest in white spruce trees within closed canopy forests (Table F-34; Prichard and Ritchie, 2007; BLM *et al.*, 2002). Six of the seven nests of large owls were associated with clear-water, anadromous-fish streams (Figure F-25). The two active great gray owl nests within the project area represent two breeding pairs of owls. Although the two nests were a little more than a mile apart, they are believed to be two separate breeding pairs because both nests were active in a single year (Prichard and Ritchie, 2007). Both of the great gray owl nests were located within about a half mile from the South Common Segment as was one of three great horned owl nests (Figure F-25). Two great horned owl nests were within about a half mile from Salcha Alternative Segment 1 (Figure F-25).

F.4.3 Upland Game Birds and Landbirds

Ptarmigan and grouse are the primary upland game birds in the project area (Table F-35). Ptarmigan are harvested during August to February and grouse are harvested August to March. Landbirds belong to many diverse groups and include both migrant and resident birds. Resident birds remain active during the winter. Resident ptarmigan, grouse, woodpeckers, chickadees, crossbills, and redpolls rely primarily on fruit and seed crops. Resident ravens and gray jays scavenge on winter or predator-killed carion. Ravens may associate with wolves in a beneficial relationship to both; as ravens assist packs in spotting prey and then scavenge the wolf-kill. Many landbirds, however, feed primarily on insects that are not available during the winter and these birds remain in Interior Alaska only during the summer breeding season when insects are abundant.

Upland game and landbirds nest within habitats crossed by the NRE and many more landbirds migrate through Interior Alaska on their way to and from nesting grounds in western and arctic Alaska. Upland gamebirds nest on the ground while most landbirds nest in trees or shrubs.

F.4.4 Birds of Conservation Concern

USFWS defines birds of conservation concern as species, subspecies, and populations that are not already federally listed as threatened or endangered but without additional conservation actions, are likely to become candidates for Federal listing (USFWS, 2002). Birds of conservation concern that have been reported to occur within the project area include 25 species, including two shorebirds, three raptors, one owl, one upland gamebird, and 18 landbirds (Table F-36). The 18 priority landbirds include four resident species, eight short-distance migrants, and six long-distance migrants (Table F-36).

Table F-34
Raptors and Owls Documented Within the Project Area and Estimated Impacts Due to Construction of the NRE[a,b]

Common Name (Migration and Annual Alaska Trend 1966-2005)[c]	Species	Primary Habitats (Nest Substrate)	Estimated Nests or Density in NRE Project Area	Estimated Alaska Population[d]	Estimated U.S. and Canada Population (Data Quality[e])	Estimated Project Area Population[f]	Estimated Proposed Action Impact[g] (No. of Birds)	Estimated Minimum ROW Impact[h] (No. of Birds)	Estimated Maximum ROW Impact[i] (No. of Birds)
Bald Eagle (S) (5.8%)	*Haliaeetus leucocephalus*	Closed or Open Broadleaf or Needleleaf Forests, Tall Shrub-65% (Poplar-75%)	22	50,000 to 70,000 (BCR4 – 22,000)	330,000 (3 A)	40	6	4	12
Northern Harrier (L) (7.4%)	*Circus cyaneus*	Riverine Tall Shrub, Upland Moist Low and Tall Scrub (Ground)	0	0	450,000 (3 A)	0	0	0	0
Northern Goshawk (R) (-6.1%)	*Accipiter gentilis*	Riverine Broadleaf Forest (Aspen-75%)	1	32,200 (BCR4 – 13,000)	240,000 (3 A)	2	0	0	2
Red-tailed Hawk (L) (-4.7%)	*Buteo jamaicensis*	Closed Broadleaf or Mixed Forest, Open Needleleaf Forest (Spruce-62%)	9	0	2,000,000 (4 A)	9	4	4	4
Golden Eagle (S) (5.9%)	*Aquila chrysaetos*	Low Wet Scrub (Cliffs or Trees)	0	0	80,000 (3 A)	0	0	0	0
Peregrine Falcon (L)	*Falco peregrinus*	Closed or Open Broadleaf or Needleleaf Forests-80% (Cliffs 100%)	13	2,900; 750 to 900 nesting pairs (BCR4 - 1,100)	28,000 (2)	26	0	0	8
Great Horned Owl (R) (9.4%)	*Bubo virginianus*	Closed Broadleaf or Mixed Forest, Lowland Wet Mixed Forest, Riverine Gravelly Dry Broadleaf Forest (Spruce 100%)	6	0	2,300,000 (3 A)	6	6	6	4
Northern Hawk Owl (R)	*Surnia ulula*	Lowland Needleleaf Forest, Fen Meadow (Black Spruce)	6.5 per square mile	0	65,000 (2 C)	6,410	31	31	32
Great Gray Owl* (R)	*Strix nebulosa*	Closed Needleleaf Forest - Lowland Forest (Spruce 100%)	2	0	32,000 (2 C)	4	4	4	4

Table F-34
Raptors and Owls Documented Within the Project Area and Estimated Impacts Due to Construction of the NRE [a,b] (cont'd)

Common Name (Migration and Annual Alaska Trend 1966-2005)[c]	Species	Primary Habitats (Nest Substrate)	Estimated Nests or Density in NRE Project Area	Estimated Alaska Population[d]	Estimated U.S. and Canada Population (Data Quality[e])	Estimated Project Area Population[f]	Estimated Proposed Action Impact[g] (No. of Birds)	Estimated Minimum ROW Impact[h] (No. of Birds)	Estimated Maximum ROW Impact[i] (No. of Birds)
Short-eared Owl (S, L) (7.7%)	*Asio flammeus*	Lowland Low Scrub, Slope Drainage Complex, Fen Meadow (Ground)	3.9 per square mile	150,000 (BCR4 – 18,000)	700,000 (2 A)	3,846	19	19	19
Boreal Owl* (R)	*Aegolius funereus*	Lowland Forest Thermokarst Complex (Black Spruce)	1.3 per square mile		600,000 (2)	1,282	6	6	6

[a] Sources: Prichard and Ritchie, 2007; Benson, 1999; Anderson *et al.*, 2000; Blancher *et al.*, 2007.
[b] Number of nesting birds impacted is based on the estimated project area nesting density multiplied by the area of footprint impact for the proposed action, the minimum area alternative, and the maximum area alternative. "Impact" refers to the nesting habitat loss based on nesting densities and total footprint of area of impact.
[c] (R) = Resident, (S) = Short-distance migrant, (L) = Long-distance migrant.
[d] Population estimate for the Alaska portion of the Partners in Flight Bird Conservation Region 4 (Blancher *et al.*, 2007).
[e] Data Quality Accuracy: 2 = Poor, 3 = Fair, 4 = Moderate; Precision: A = Very high, B = High, C = Good.
[f] Estimate based on survey data and regional densities within 5 miles of all proposed alternatives.
[g] Proposed Action includes North Common, Eielson 3, Salcha 1, Central 2, Connectors B and E, Donnelly 1, South Common, and Delta 1.
[h] Minimum Project Area includes North Common, Eielson 2, Salcha 1, Central 2, Connector B, Donnelly 2, South Common, and Delta 2.
[i] Maximum Project Area includes North Common, Eielson 1, Salcha 2, Central 1, Connector D, Donnelly 1, South Common, and Delta 1.

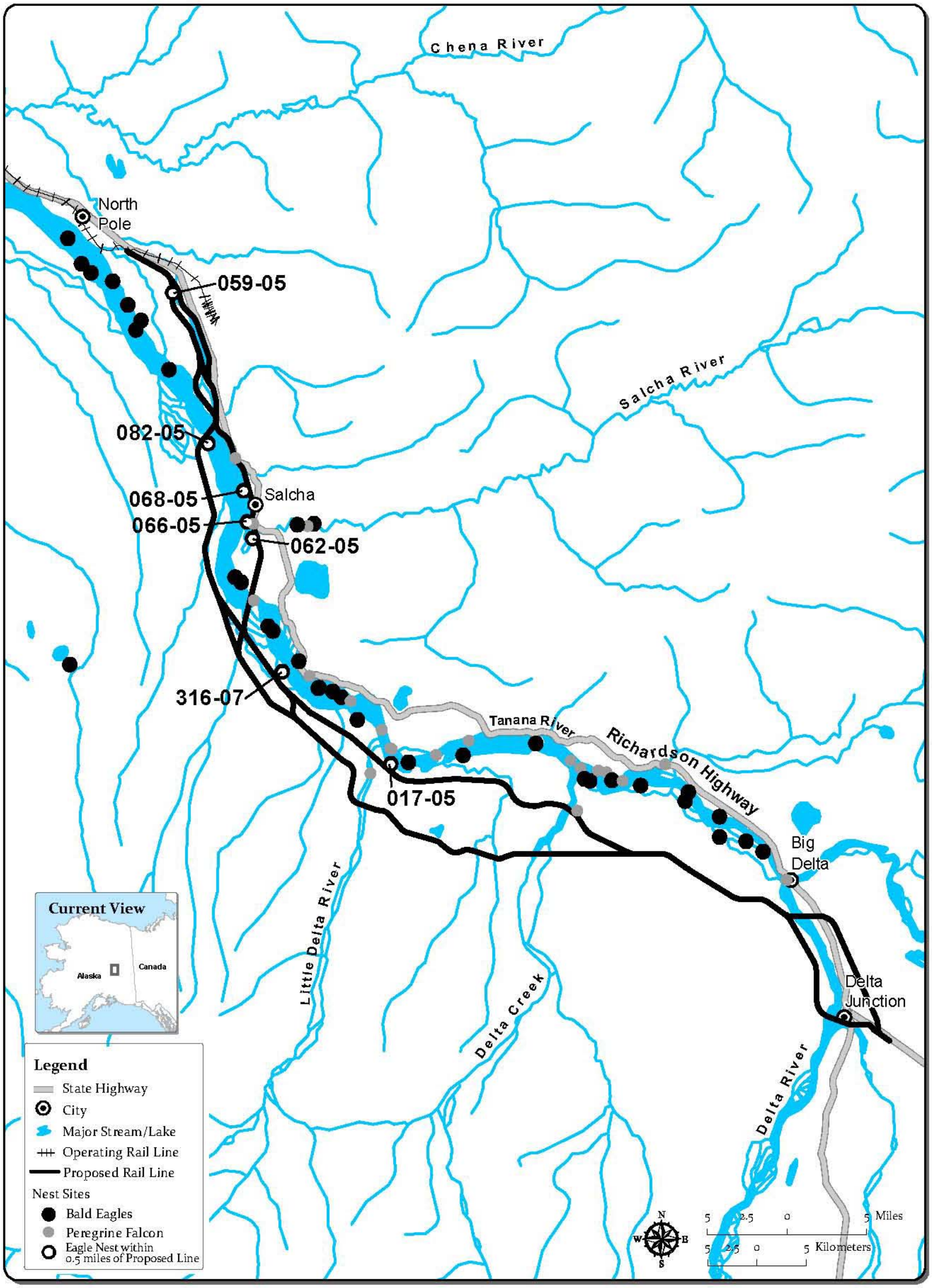

Figure F-24
Bald Eagle and Peregrine Falcon Nest Sites in the NRE Project Area (Prichard and Ritchie, 2007)

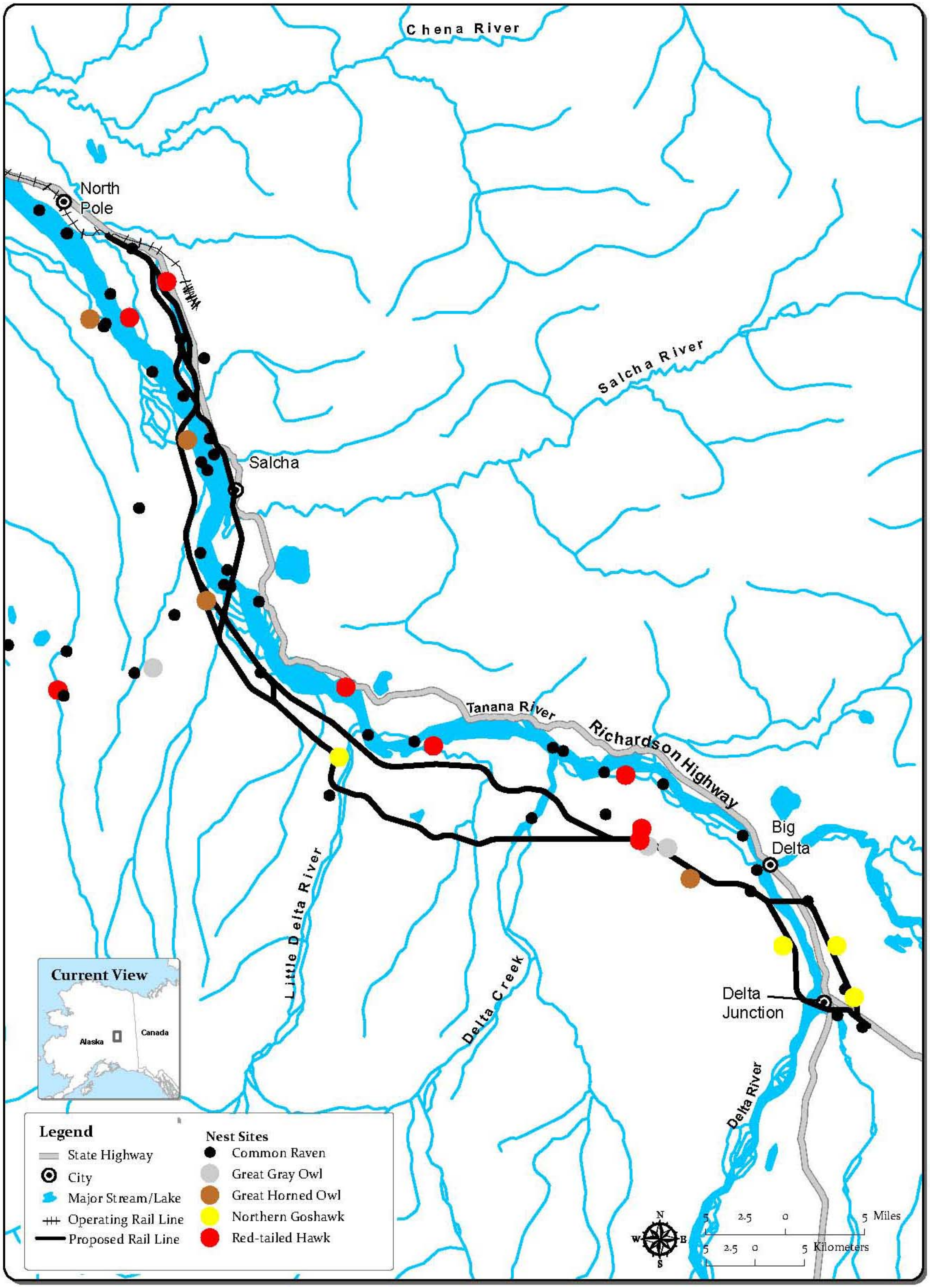

Figure F-25
Raptor and Raven Nest Sites in the NRE Project Area (Prichard and Ritchie, 2007)

Table F-35
Common Upland Game Birds and Landbirds Occurring During the Breeding Season and Estimated Impacts Due to Construction of the NRE[a]

Common Name[b]	Species	Primary Habitats	Project Region Density (birds/square mile)[c]	Alaska BCR 4 Population Size (annual trend, Data Quality)[d]	Estimated Project Area Population[e]	Estimated Proposed Action Impact (No. Birds)[f]	Estimated Minimum Project Area Impact (No. Birds)[g]	Estimated Maximum Project Area Impact (No. Birds)[h]
Upland Game Birds								
Spruce Grouse (R)	*Falcipennis Canadensis*	Needleleaf forest	6.41	40,000 (3 O)	6,344	31	31	31
Sharp-tailed Grouse (R)	*Tympanuchus phasianellus*	Willows, Open black spruce forest	2.56	5,000 (4 R)	2,539	12	12	13
Landbirds								
Belted Kingfisher (S)	*Ceryle alcyon*	Riparian shrub and forest	0	140,000 (-2.4%, 2 Y)	0	0	0	0
Hairy Woodpecker (R)	*Picoides villosus*	Needleleaf forest	1.28	120,000 (4.2%, 2 Y)	1,269	6	6	6
American Three-toed Woodpecker (R)	*Picoides dorsalis*	Needleleaf forest		200,000 (1.2%, 3 O)				
Northern Flicker (S)	*Colaptes auratus*	Needleleaf forest	1.47	180,000 (-0.7%, 2 Y)	1,454	7	7	7
Olive-sided Flycatcher (L)	*Contopus cooperi*	Needleleaf forest - black spruce	1.74	200,000 (-1.5%, 2 Y)	1,718	8	8	9
Western Wood-Peewee (L)	*Contopus sordidulus*	Riparian shrub - black spruce bogs/successional	0.85	200,000 (-4.0%, 2 Y)	846	4	4	4
Alder Flycatcher (L)	*Empidonax alnorum*	Shrub/successional	34.20	11,000,000 (-0.4%, 2 Y)	33,862	164	164	168
Hammond's Flycatcher (L)	*Empidonax hammondii*	Riparian needleleaf and mixed forest	5.95	1,300,000 (0.4%, 2 Y)	5,895	29	29	29
Gray Jay (R)	*Perisoreus canadensis*	Needleleaf and mixed forest	30.16	3,000,000 (2.2%, 2 Y)	29,857	145	145	148
Common Raven (R)	*Corvus corax*	Needleleaf forest	30 (nests)	60,000 (2.5%, 2 Y)				
Tree Swallow (L)	*Tachycineta bicolor*	Broadleaf and needleleaf forest	0.85	700,000 (3.8%, 2 Y)	846	4	4	4
Black-capped Chickadee (R)	*Poecile atricapillus*	Riparian broadleaf, and needleleaf forest	8.33	1,400,000 (1.9%, 2 Y)	8,249	40	40	41
Boreal Chickadee (R)	*Poecile hudsonia*	Needleleaf forest	10.77	1,100,000 (0.7%, 2 Y)	10,667	52	52	53
Ruby-crowned Kinglet (S)	*Regulus calendula*	Open needleleaf and mixed forests	12.79	6,000,000 (-0.2%, 2 Y)	12,662	61	61	63
Swainson's Thrush (L)	*Catharus ustulatus*	Riparian needleleaf and mixed forest	49.27	18,000,000 (0.0%, 2 Y)	48,783	237	237	242
Hermit Thrush (S)	*Catharus guttatus*	Riparian needleleaf forest and tall shrubs	5.46	1,300,000 (-1.1%, 2 Y)	5,405	26	26	27
American Robin (S)	*Turdus migratorius*	Forest and shrub	12.07	14,000,000 (1.6%, 2 Y)	11,946	58	58	59
Varied Thrush (S)	*Ixoreus naevius*	Forest and shrub	0.95	15,000,000 (0.1%, 2 Y)	938	5	5	5
Bohemian Waxwing (R)	*Bombycilla garrulus*	Needleleaf and mixed forest	7.45	300,000 (2 Y)	7,377	36	36	37

Table F-35
Common Upland Game Birds and Landbirds Occurring During the Breeding Season and Estimated Impacts Due to Construction of the NRE[a] (cont'd)

Common Name[b]	Species	Primary Habitats	Project Region Density (birds/square mile)[c]	Alaska BCR 4 Population Size (annual trend, Data Quality)[d]	Estimated Project Area Population[e]	Estimated Proposed Action Impact (No. Birds)[f]	Estimated Minimum Project Area Impact (No. Birds)[g]	Estimated Maximum Project Area Impact (No. Birds)[h]
Orange-crowned Warbler (L)	*Vermivora celata*	Low and tall shrub	45.77	13,000,000 (-0.3%, 2 Y)	45,309	220	220	224
Yellow Warbler (L)	*Dendroica petechia*	Needleleaf forest and shrub	4.89	1,600,000 (-0.7%, 2 Y)	4,839	23	23	24
Yellow-rumped Warbler (L)	*Dendroica coronata*	Needleleaf forest	50.79	16,000,000 (0.9%, 2 Y)	50,286	244	244	249
Townsend's Warbler (L)	*Dendroica townsendi*	Mature needleleaf forest	0	1,500,000 (0.9%, 3 O)	0	0	0	0
Blackpoll Warbler (L)	*Dendroica striata*	Riparian forest and shrub	24.79	4,000,000 (-2.7%, 2 Y)	24,544	119	119	122
Northern Waterthrush (L)	*Seiurus noveboracensis*	Black spruce forest	2.23	3,000,000 (7.8%, 2 Y)	2,208	11	11	11
Wilson's Warbler (L)	*Wilsonia pusilla*	Mixed forest and shrub	7.45	7,000,000 (1.1%, 2 Y)	7,375	36	36	37
American Tree Sparrow (S)	*Spizella arborea*	Low shrub	4.82	1,700,000 (2 Y)	4,772	23	23	24
Savannah Sparrow (L)	*Passerculus sandwichensis*	Low shrub and graminoid	36.30	2,000,000 (-0.2%, 2 Y)	35,937	174	174	178
Fox Sparrow (S)	*Passerella iliaca*	Low and tall shrub	5.98	2,000,000 (2.4%, 2 Y)	5,923	29	29	29
Lincoln's Sparrow (L)	*Melospiza lincolnii*	Low shrub and black spruce bog	70.17	2,000,000 (7.8%, 2 Y)	69,466	337	337	344
White-crowned Sparrow (L)	*Zonotrichia leucophrys*	Low shrub	26.50	13,000,000 (-1.3%, 2 Y)	26,236	127	127	130
Dark-eyed Junco (S)	*Junco hyemalis*	Mix and needleleaf forest and tall shrub	120.85	40,000,000 (-0.3%, 2 Y)	119,646	581	580	593
Red-winged Blackbird (L)	*Agelaius phoeniceus*	Wetland and graminoid	0.43	30,000 (-1.2%, 3 O)	423	2	2	2
Rusty Blackbird (L)	*Euphagus carolinus*	Needleleaf and mixed forest with wet graminoid	8.03	400,000 (6.3%, 2 Y)	7,954	39	39	39
White-winged Crossbill (R)	*Loxia leucoptera*	Mature needleleaf forest	20.00	2,000,000 (31.0%, 2 Y)	19,800	96	96	98
Common Redpoll (R)	*Carduelis flammea*	Needleleaf forest and shrub	12.49	5,000,000 (2 Y)	12,370	60	60	61
Pine Siskin (S)	*Carduelis pinus*	Needleleaf forest	0	500,000 (3.5%, 3 O)	0	0	0	0
Total Landbirds					**618,863**	**3,004**	**3,002**	**3,065**
Total Resident Landbirds					**89,589**	**435**	**435**	**444**
Total Long-Distance Migrants					**366,526**	**1,779**	**1,778**	**1,815**
Total Short-Distance Migrants					**162,747**	**790**	**790**	**806**

Table F-35
Common Upland Game Birds and Landbirds Occurring During the Breeding Season and Estimated Impacts Due to Construction of the NRE[a] (cont'd)

[a] Number of nesting birds impacted is based on the estimated project area nesting density multiplied by the area of footprint impact for the proposed action, the minimum area alternative, and the maximum area alternative.
[b] (R) = Resident, (S) = Short-distance migrant, (L) = Long-distance migrant.
[c] Derived from transect data within project area from Benson, 1999; Anderson *et al.*, 2000; Harding and Sharbaugh, 2005.
[d] Blancher *et al.*,2007; ADF&G, 2006: Estimate Accuracy 2 = Poor, 3 = Fair; Breeding Bird Survey Data Quality Y = yellow-10% or more of the range covered, O = orange-less than 10% of range covered.
[e] Estimates based on project region density and area within 5 miles of all proposed alternative segments (990 square miles) were generated only for species with an abundance estimate within the region.
[f] Proposed Action includes North Common, Eielson 3, Salcha 1, Connector B, Central 2, Connector E, Donnelly 1, South Common, Delta 1 and associated facilities.
[g] Minimum Project Area includes North Common, Eielson 2, Salcha 1, Central 2, Connector B, Donnelly 2, South Common, and Delta 2.
[h] Maximum Project Area includes North Common, Eielson 1, Salcha 2, Central 1, Connector C, Donnelly 1, South Common, Delta 1.

Table F-36
Estimated Priority Bird Nesting Habitat Loss Impacts from the NRE Based on Project Area Nesting Densities[a,b]

Species (Migration)[c]	Rationale	Estimated Project Area Population[d]	Habitat Impact Description	Estimated Proposed Action Impact (No. Birds)[e,f]	Estimated Minimum Project Area Impact (No. Birds)[f,g]	Estimated Maximum Project Area Impact (No. Birds)[f,h]
American Three-toed Woodpecker (R)	Sensitive to Forest Management - Cavity Nester	Unknown	1,900 acres needleleaf/mixed forested habitats removed, fragmented	√	√	√
American Golden Plover (L)	Small declining population	Unknown	Impacts unlikely	√	√	√
Bald Eagle (S)	Sensitive to changes in forests	40	Disturbance during nesting and foraging, potential removal of nest trees	6	4	12
Belted Kingfisher (S)	Widespread long-term population declines	Unknown	70 acres riparian habitat removed, fragmented 300 acres shrub habitat removed, fragmented	√	√	√
Blackpoll Warbler (L)	In Decline (Sensitive to changes in riparian habitats)	24,544	70 acres riparian habitat removed, fragmented 300 acres shrub habitat removed, fragmented	119	119	122
Boreal Chickadee (R)	Sensitive to Forest Management - Cavity Nester	10,667	1,900 acres needleleaf/mixed forested habitats removed, fragmented	52	52	53
Dark-eyed Junco (S)	Widespread long-term population declines	119,646	1,900 acres needleleaf/mixed forest and shrub habitats removed, fragmented	581	580	593
Gray-cheeked Thrush (L)	Long-term declines, sensitive to removal of riparian shrubs	Unknown	300 acres shrub habitats, 70 acres riparian habitats removed fragmented	√	√	√

Table F-36
Estimated Priority Bird Nesting Habitat Loss Impacts from the NRE Based on Project Area Nesting Densities [a,b] (cont'd)

Species (Migration)[c]	Rationale	Estimated Project Area Population[d]	Habitat Impact Description	Estimated Proposed Action Impact (No. Birds)[e,f]	Estimated Minimum Project Area Impact (No. Birds)[f,g]	Estimated Maximum Project Area Impact (No. Birds)[f,h]
Hairy Woodpecker (R)	Sensitive to Forest Management - Cavity Nester	1,269	1,400 acres needleleaf forested habitats removed, fragmented	6	6	6
Hermit Thrush (S)	Long-term declines	5,405	1,700 acres needleleaf forest, shrub habitats removed, fragmented	26	26	27
Northern Flicker (S)	Sensitive to Forest Management - Cavity Nester	1,454	1,900 acres needleleaf/mixed forested habitats removed, fragmented	7	7	7
Northern Goshawk (R)	Breeding sensitivity to forest changes	2	2,300 acres forested habitats removed, fragmented	0	0	2
Olive-sided Flycatcher (L)	In Decline (Sensitive to Forest Management - Canopy Nester)	1,718	1,900 acres needleleaf/mixed forested habitats removed, fragmented	8	8	9
Peregrine falcon (L)	Recently delisted - Sensitive to changes on cliffs, rocks, etc. & vulnerable to contaminants	26	Distrubance during nesting and foraging	0	0	8
Pine Siskin (S)	Sensitive to Forest Management - Canopy Nester	Unknown	1,900 acres needleleaf/mixed forested habitats removed, fragmented	√	√	√
Ruffed Grouse (R)	Sensitive to changes in forests	Unknown	2,300 acres forested habitats removed, fragmented	√	√	√
Rusty Blackbird (S)	In Decline (Sensitive to climate and riparian habitat changes)	7,954	1,900 acres needleleaf/mixed forest graminoid removed, fragmented	39	39	39
Short-eared Owl (L)	Declining population	3,846	200 acres low shrub and graminoid habitats removed, fragmented	19	19	19
Smith's Longspur (S)	Small population, restricted distribution	Unknown	Impacts unlikely	√	√	√
Townsend's Warbler (L)	Sensitive to Forest Management - Canopy Nester	Unknown	1,900 acres needleleaf/mixed forested habitats removed, fragmented	√	√	√
Varied Thrush (S)	Sensitive to Forest Management - Canopy Nester	938	2,300 acres forested habitats removed, fragmented	5	5	5
Whimbrel (L)	Declining population trend, small population	Unknown	Impacts unlikely	√	√	√
White-crowned Sparrow (L)	Long-term declines	26,236	200 acres low shrub and graminoid habitats removed, fragmented	127	127	130

Table F-36
Estimated Priority Bird Nesting Habitat Loss Impacts from the NRE Based on Project Area Nesting Densities [a,b] (cont'd)

Species (Migration)[c]	Rationale	Estimated Project Area Population[d]	Habitat Impact Description	Estimated Proposed Action Impact (No. Birds)[e,f]	Estimated Minimum Project Area Impact (No. Birds)[f,g]	Estimated Maximum Project Area Impact (No. Birds)[f,h]
White-winged Crossbill (R)	Sensitive to Forest Management - Canopy Nester	19,800	1,900 acres needleleaf/mixed forested habitats removed, fragmented	96	96	98
Wilson's Warbler (L)	Sensitive to changes in riparian habitats	7,375	870 acres mixed forest/shrub habitat removed, fragmented	36	36	37

[a] Sources: Anderson *et al.*, 2000; Benson, 1999; Benson, 2001; Harding and Sharbaugh, 2005; Prichard and Ritchie, 2006.
[b] Number of nesting birds impacted is based on the estimated project area nesting density multiplied by the area of footprint impact for the proposed action, the minimum area alternative, and the maximum area alternative.
[c] (R) = Resident, (S) = Short-distance migrant, (L) = Long-distance migrant.
[d] Estimates generated only for species with an abundance estimate within the project area.
[e] Proposed Action includes North Common, Eielson 3, Salcha 1, Connector B, Central 2, Connector E, Donnelly 1, South Common, and Delta 1.
[f] √ indicates the species has been documented in the project area and impacts would occur, but data are insufficient to estimate the scale of impact.
[g] Minimum Project Area includes North Common, Eielson 2, Salcha 1, Central 2, Connector B, Donnelly 2, South Common, and Delta 2.
[h] Maximum Project Area includes North Common, Eielson 1, Salcha 2, Central 1, Connector C, Donnelly 1, South Common, Delta 1.

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