5. BIOLOGICAL RESOURCES

This chapter describes the biological environment and potential impacts due to construction and operation of the proposed Northern Rail Extension (NRE). The analysis focuses on four primary biological resources: (1) vegetation, (2) fisheries, (3) game mammals, and (4) game and protected birds. Analyses were focused on these resources because of their importance in providing habitat (vegetation cover), human use (fisheries, game mammals and birds), and regulatory compliance (protected migratory birds). During consultations with Federal and State of Alaska resource agencies, no Federal or state protected threatened, endangered or candidate plants or animals were identified as occurring within the project area (see Appendix B). Section 5.7 addresses Bureau of Land Management (BLM)-designated special status species identified as occurring within the project area. The analysis of wetlands impacts is presented in Chapter 4, Water Resources. Subsistence uses of biological resources are discussed in Chapter 7, Subsistence.

Appendix F describes the regional and site-specific conditions for biological resources, assessment methods, and the results of quantitative impact analyses for the proposed alternative segments based on spatial analyses, field surveys, and literature reviews. Appendix G presents the results of the Essential Fish Habitat (EFH) Assessment as specified by the National Marine Fisheries Service (NMFS).

5.1 Applicable Regulations

Project construction activities that have a potential to affect vegetation, fisheries, game animals, migratory birds, endangered species or their habitats are regulated by various Federal and state agencies. Table 5-1 lists and describes specific regulations for the protection of biological resources that are applicable to and must be complied with during construction of the NRE.

These Federal and State of Alaska regulations and associated permits provide the framework for agencies to review design, construction, and operation of the NRE to ensure that significant impacts on biological communities and resources within the project area are avoided, reduced, or mitigated.

5.2 Project Area Overview

The proposed NRE lies within the Tanana-Kuskokwim Lowlands eco-region, bordered to the north by the Yukon-Tanana Uplands and to the south by the Alaska Range eco-regions (Figure 5-1). A broad outwash plain slopes down from the Alaska Range, with numerous rivers radiating from the mountains of the Alaska Range to the south and the Yukon-Tanana Uplands to the north, which drain into the Tanana River (Nowacki *et al.*, 2001). The Yukon-Tanana Uplands are characterized by rounded mountains and hills between the Yukon and Tanana rivers. Rivers cut deep, narrow, V-shaped valleys into these uplands with small lakes occurring in valleys where drainage has been blocked (Nowacki *et al.*, 2001).

Table 5-1
Applicable Federal and State Permitting Activities

Permit/Activity	Authority	Description
FEDERAL		
National Oceanic & Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS)		
Essential Fish Habitat Consultation	Magnuson-Stevens Fishery Management and Conservation Act (M-SFMCA) (16 U.S.C. § 1801-1883)	Provides for the management of fish and other species in designated Exclusive Economic Zones (EEZ).
Fish & Wildlife Coordination Act Consultation	Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. § 661 *et seq.*)	Requires evaluation of the impacts to fish and wildlife and development of mitigation for proposed development projects, including involvement of NMFS and state fish and wildlife management agencies.
U S Fish and Wildlife Service (USFWS)		
Bald and Golden Eagle Protection Act Clearance	Bald and Golden Eagle Protection Act (16 U.S.C. § 668)	Provides for the protection of bald and golden eagles, their nests, or their eggs from harm or disturbance.
Migratory Bird Protection Act Consultation	Migratory Bird Treaty Act (16 U.S.C. § 703)	Provides for protection of birds that migrate between the United States and Canada, Mexico, Japan, or Russia.
Fish & Wildlife Coordination Act Consultation	Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. § 661 *et seq.*)	Requires evaluation of the impacts to fish and wildlife and development of mitigation for proposed development projects, including involvement of the U.S. Fish and Wildlife Service (USFWS) and state fish and wildlife management agencies.
Endangered Species Act Consultation	Endangered Species Act (ESA) (16 U.S.C. § 1531)	Provides for the protection of wildlife, fish, and plants that have been identified as in danger of becoming extinct including habitats that have been identified as critical to their survival. No federally protected wildlife fish or plants or designated critical habitats occur within the project area.
Department of Defense(DoD), U.S. Army Alaska (USARAK)		
Sikes Act Improvement Act	Sikes Act Improvement Act of 1997 (16 U.S.C. § 670a *et seq.*)	Promotes the planning, development, maintenance, and coordination of fish and game conservation and rehabilitation on military reservations.
Natural Resources – Land, Forest, and Wildlife Management	Natural Resources – Land, Forest, and Wildlife Management (Army Regulation (AR) 200-3)	Establishes the policy and procedures for management of natural resources to ensure the support of military mission and to ensure conservation, restoration, and appropriate use of renewable resources.
Enforcement of Hunting, Trapping and Fishing on Army Lands in Alaska	Enforcement of Hunting, Trapping and Fishing on Army Lands in Alaska (AR 190-13)	Requires civilians and DoD personnel to comply with fish and game laws established by the Alaska Department of Fish and Game (ADF&G) (*i.e.*, hunting seasons, bag limits, weapons restrictions, closed areas).
Environmental Conservation Program	Department of Defense (DoD) Directive 4715.3	Implements policy, assigns responsibilities, and prescribes procedures for the integrated management of natural and cultural resources on property under DoD control.

Table 5-1
Applicable Federal and State Permitting Activities (continued)

Permit/Activity	Authority	Description
STATE		
Alaska Department of Natural Resources (ADNR)		
Alaska Forest Resources Practice Act	Division of Forestry, Alaska Resources and Practice Act, Alaska Statute (AS) 41.17	Manages the state's forests, providing technical advice to the divisions of lands on sound forest practices necessary to ensure the continuous growing and harvesting of commercial forest species on other state land. Regulates the operations on private forest land and provides public information and assistance regarding forest practices and timber management.
Prohibited and restricted noxious weeds	Division of Agriculture, 11 Alaska Administrative Code (AAC) 34.020	Provides for the regulation and identification of prohibited noxious weeds and establishes the maximum allowable tolerances for restricted noxious weeds.
Alaska Department of Fish & Game (ADF&G)		
Fish Habitat (Title 16) Application	Habitat Division, AS 16.05.841 or 16.05.871	Requires environmental review for any activity conducted within fish-bearing waters, such as bridges, culvert installation, fords and crossings (both winter and summer), material sites, tailings facilities, and water-withdrawal structures.
Fish Passage Evaluation	Habitat Division, AS 16.05.841	Requires notification and authorization for activities within or across streams used by fish if such uses or activities may cause an impediment to passage of fish as determined by ADF&G. Culvert installation; stream realignment or diversions; dams; low-water crossings; and construction, placement, deposition, or removal of any material or structure below ordinary high water all require fish passage evaluation.
Anadromous Fish Evaluation	Habitat Division, AS 16.05.871	Requires notification and approval "to construct a hydraulic project or use, divert, obstruct, pollute, or change the natural flow or bed" or "to use wheeled, tracked, or excavating equipment or log-dragging equipment in the bed" of an anadromous waterbody from fish habitat biologists. All activities within or across streams and all instream activities including construction; road crossings; gravel removal; placer mining; water withdrawals; the use of vehicles or equipment in the waterway; stream realignment or diversion; bank stabilization; blasting; and the placement, excavation, deposition, disposal, or removal of any material potentially affecting an anadromous waterbody apply.
Conservation and Protection of Alaska Fish & Game	AS 16.20	Provides for the protection and preservation of the state's natural habitat and game populations.
Fish & Game (Title 5)	5 AAC 1 – 5 AAC 99	Establishes the framework for the regulation of subsistence/personal use, recreational, and commercial fishing.
Fish Resources Permit Application	Division of Sport Fish and the Division of Commercial Fisheries (5 AAC 41)	Provides for the regulation of the transportation, possession, or release of live fish for scientific or educational purposes.

Table 5-1
Applicable Federal and State Permitting Activities (continued)

Permit/Activity	Authority	Description
Fish, Game, Aquatic Plant Resources	Title 16, AS 16.05.020 (2)	Provides for the regulation of hunting and trapping and for the management of game populations within the state.
Determining Endangered Species	AS 16.20.190	Establishes the framework and criteria for determining endangered fish and wildlife species or subspecies in Alaska.
Regulation and Management of Game and Fish Resources	Alaska Statutes: Title 16, Chapter 5	Provides for the regulation of hunting and management of game populations within the state. Provides for the regulation of fishing and management of fisheries within the state.

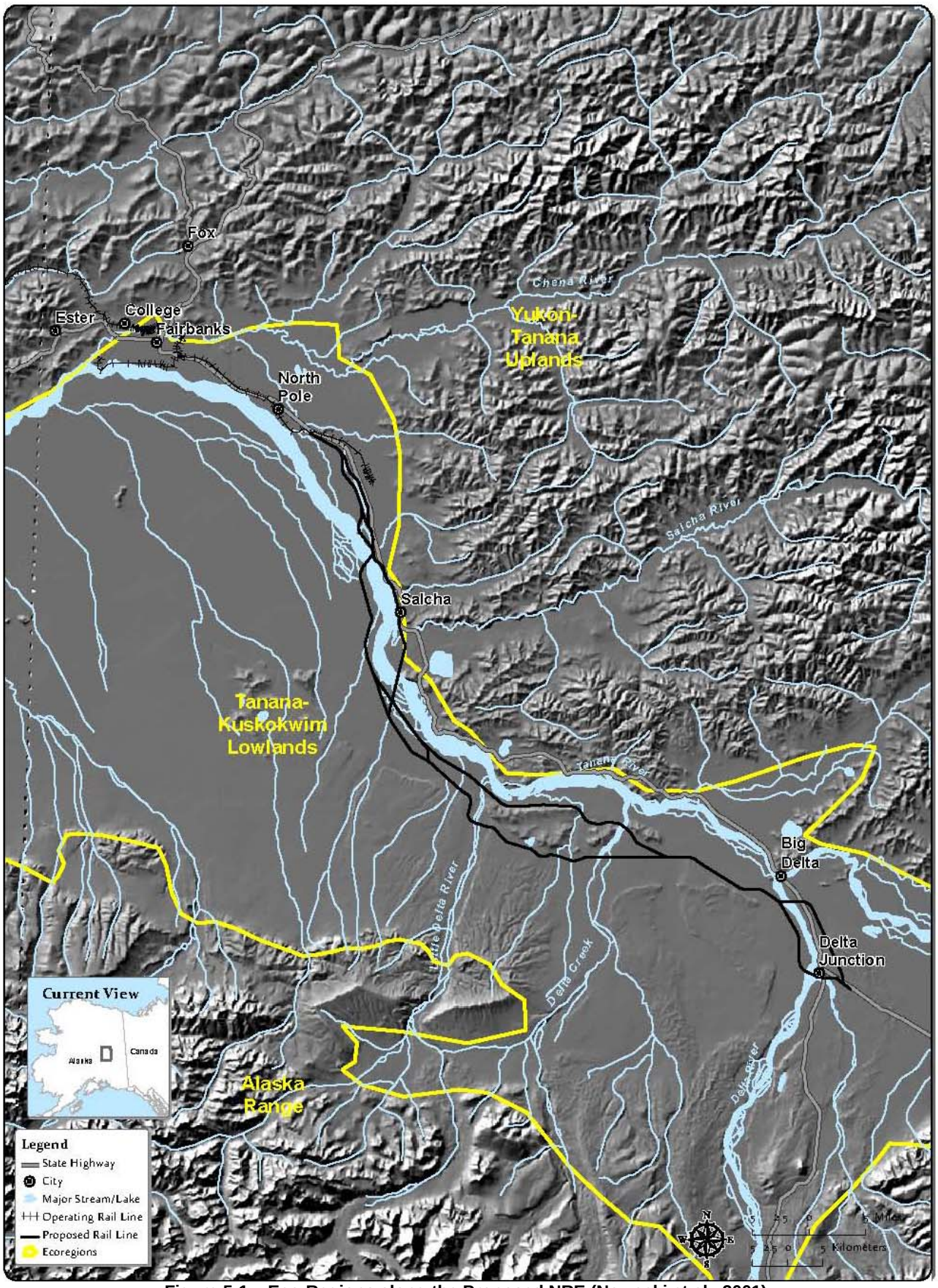

Figure 5-1 – Eco-Regions along the Proposed NRE (Nowacki et al., 2001)

This region provides prime habitat for animals using aquatic and riparian habitats such as mink, marten, muskrat, beaver, and river otter. Clear headwater streams are important spawning areas for Chinook (king), coho (silver), and chum salmon. Northern pike, whitefish, and burbot are common in the larger lakes and rivers, and arctic grayling are common in smaller streams (ADF&G, 2006). Groundwater-charged seeps and springs are common and support salmon and grayling eggs and developing embryos through the dark frozen winters.

Boreal forests dominate the landscape with black spruce in bogs, white spruce and balsam poplar along rivers; and tall willow, resin birch, and alder shrub communities scattered throughout (Nowacki *et al.*, 2001). The coldest, wettest areas of permafrost flats support birch-heath shrubs and sedge tussocks (Nowacki *et al.*, 2001). Black spruce favors the north-facing slopes underlain with permafrost; and black spruce also occurs with sedge tussocks. White spruce, birch, and aspen dominate south-facing slopes. Summer lightning storms are frequent in the foothills and mountains, so forest fires are common (ADF&G, 2006). This mosaic of boreal forest, riparian and aquatic habitats is home to moose, black bears, beavers, porcupines, red squirrels, grouse, ptarmigan, and ravens. Moose and caribou are the primary game mammals and their predators include wolves, black bears, and brown bears. Wolverine, marten, mink, short-tailed weasel, and lynx prey upon hares, red squirrels, and rodents throughout the forests. Open, mixed broadleaf-needleleaf forests support a large variety of resident birds, including black-capped and boreal chickadees, common redpolls, gray jays, common ravens, black-backed and three-toed woodpeckers, northern flickers, northern hawk owls, boreal owls and great horned owls, ptarmigan, and grouse.

Many migrant waterbirds and landbirds pass though this area on their way to and from nesting habitats to the north. Some waterbirds remain to nest; mallards, American wigeon, bufflehead, northern pintail, northern shoveler, scaup, and trumpeter swans breed on or near the lakes and wetlands (Platte, 2003). Mew gulls nest on river bars. Floodplain forests of large cottonwoods and white spruce combine with salmon runs to create bald eagle nesting habitat along the Tanana River (Ritchie and Prichard, 2007). Cliffs next to the river provide nesting habitats for peregrine falcons (Ritchie and Prichard, 2007). Common migratory landbirds nesting in the floodplain and boreal forests include savannah sparrow, dark-eyed junco, Wilson's warbler, Swainson's thrush, yellow-rumped warbler, white-crowned sparrow and orange-crowned warbler (Anderson *et al.*, 2000; Benson, 1999).

5.3 Vegetation Resources

This section describes the existing vegetation conditions in the project area and potential impacts resulting from the proposed NRE (Figure 5-2).

5.3.1 Affected Environment

Existing conditions for vegetation were based on Gallant *et al.* (1995); TAPSO, (2001); Magoun and Dean, (2000); Viereck *et al.*, (1992); and ANHP *et al.*, (2006). Quantification of vegetation and habitat types within the area were based on the Tanana Flats Land Cover Classification (BLM *et al.*, 2002) for an area within 5 miles of all proposed alternative segments. Table 5-2 indicates the relative abundance as a proportion of cover within the project area for vegetation

Table 5-2
Vegetation Cover Classes Within 5 Miles of the Proposed NRE[a]

Project Area Cover (%)[b]	Class Name	Project Area Cover (%)	Class Name
12	Closed Needleleaf Forest	<1	Aquatic Bed
28	Open Needleleaf Forest	2	Clear Water
8	Closed Broadleaf Forest	5	Turbid Water
5	Open Broadleaf Forest	<1	Ice
14	Closed Mixed Broadleaf/Needleleaf Forest	<1	Sparse Vegetation
3	Tall Shrub	1	Gravel/Rock
10	Low Shrub	3	Mud/Silt/Sand
<1	Dwarf Shrub	1	Urban
2	Graminoid[c]	3	Agriculture
<1	Bryoid/Lichen	3	Other

[a] Source: BLM *et al.*, 2002.
[b] < means less than.
[c] Grasses and grasslike plants.

cover classes. Figure 5-2 indicates the vegetation surrounding the area. Additional information on vegetation resources can be found in Appendix F.

Vegetation cover in the project area is primarily controlled by flooding and fire, although forestry, military activity, agriculture, gravel mining, urban development, insect infestations, moose browsing, and the spread of invasive and noxious plants have also affected vegetation within the project area. Development of vegetation communities is influenced by slope, aspect, elevation, parent material (the primary material from which soil is formed), and succession subsequent to flooding and fire. Frequent flooding across the active floodplains of the Tanana River, Little Delta River, Delta River, Delta Creek, and Jarvis Creek results in active erosion and the formation of new alluvial bars. Fires are common within the project area, ranging in size from less than 2 acres to 800,000 acres, and averaging about 5,600 acres. Fires occur naturally in Alaskan boreal forests at estimated periodicities of 50 to 200 years (VanCleve *et al.*, 1991). Fire season generally lasts from June through the beginning of August (Gallant *et al.*, 1995). See Appendix F for additional information about the fire history in the project area.

Riparian areas scoured by floodwater generally follow a sequence from bare alluvium, alluvium with scattered willows and herbs, open willow shrub, closed alder and willow shrub, open balsam poplar forest with a dense alder understory, closed balsam poplar forest with alder understory, mixed balsam poplar-white spruce forest, to closed white spruce forest (Viereck *et al.*, 1993). Development from the closed alder willow shrub to mature balsam poplar forest occurs over a period of 75 to 90 years, and the transition from mixed balsam poplar-white spruce forest to white spruce dominant forests occurs gradually over the span of nearly 100 years (Magoun and Dean, 2000).

Recently burned areas typically revegetate with herbaceous communities often dominated by fireweed, followed by graminoid communities dominated with bluejoint reedgrass and willow scrub. Broadleaf forests follow willow communities in uplands on south-facing slopes or on well-drained river terraces; while paper birch forests develop on east, west and some north-facing slopes and in flat areas. Mixed forests develop as spruce becomes established within the broadleaf forests; followed by spruce forests in some locations.

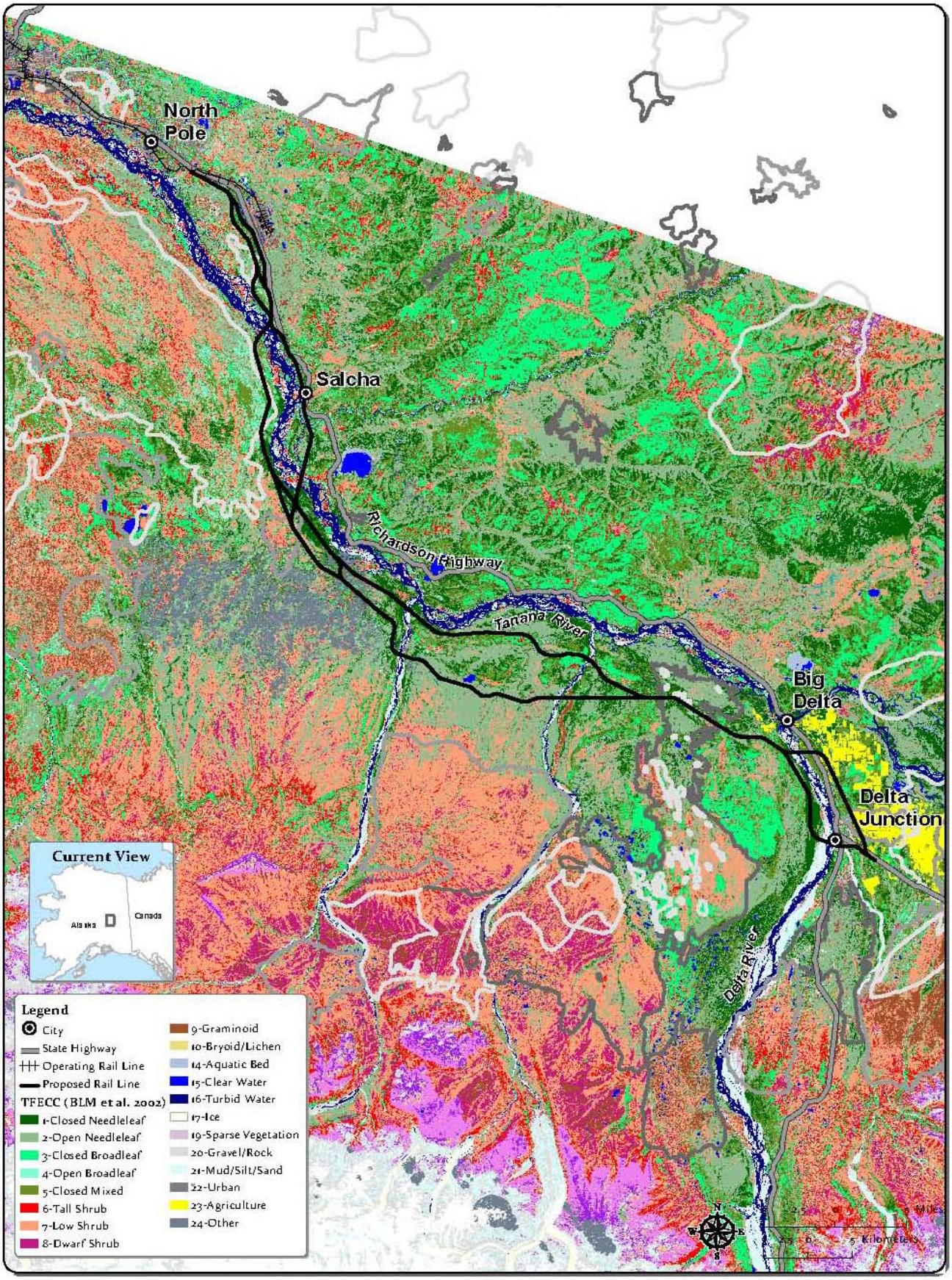

Figure 5-2 – Vegetation along the Proposed NRE

Forest communities cover two-thirds of the area. Needleleaf forests are dominated by white spruce, black spruce, or a combination of the two. Closed stands of white spruce occupy young river terraces where soil drainage is good, while closed stands of black spruce occur on poorly drained floodplain soils. Mixed closed stands with both white spruce and black spruce may have tall shrub understories of alder and willow. Colder, wetter soils support black spruce woodlands, where the tall shrub understory is a much more important component of the ecosystem than in the closed forest stands. Black spruce woodlands are part of the open needleleaf forest vegetation class, but are described as needleleaf scrub in wetland classifications (see Chapter 4). Broadleaf forests consist of open or closed stands of balsam poplar, paper birch or quaking aspen. Mixed forests consist of paper birch or quaking aspen with black spruce and/or white spruce, or where white spruce co-dominates with balsam poplar.

Tall shrub communities found on floodplains in the project area are typically dominated by willow or alder. Low shrub is characterized by open, low mixed shrubs and tussock-forming sedges. Resin birch, Labrador-tea, bog blueberry, low-bush cranberry, and sedge tussocks are common. Wetland communities, discussed in more detail in Chapter 4, are associated with the wettest locations, such as low and dwarf shrub bogs, graminoid meadows, and aquatic bed communities. Graminoid meadows are typically dominated by sedges or bluejoint reedgrass. Aquatic bed communities include herbaceous marshes with an open cover of emergent wetland plants. Horsetail typically dominates in aquatic bed communities, although buckbean and marsh fivefinger can be common; grasses and sedges may also be present as well as aquatic mosses.

Invasive and Noxious Plants

Alaska has remained relatively free from large-scale habitat changes resulting from non-native invasive plant species, primarily because Alaska has a small human population and relatively few areas of anthropogenic disturbance. Forty-four species of non-native plants occur within the project area (ANHP *et al.*, 2006). The most common non-native plants in the project area include common dandelion (*Taraxacum officinale*), foxtail barley (*Hordeum jubatum*), and annual hawksbeard (*Crepis tectorum*). These plants are considered to be highly invasive weeds. The Richardson Highway, from Delta Junction to Fairbanks, has some of the highest weed diversity of any transportation alignment in Interior Alaska (Lapina *et al.*, 2007). Seven to 19 different non-native plants were found at each of ten sites along this section of the Richardson Highway (Lapina *et al.*, 2007). Three weeds classified as prohibited noxious weeds and five weeds classified as restricted noxious weeds under Title 3 of the Alaska State Statute (11AAC 34.020) occur within the project area (Table 5-3, Figure 5-3; ANHP *et al.*, 2006).

Table 5-3
Occurrence of Prohibited and Restricted Noxious Weeds Within the Project Area[a]

Common Name	Species	Occurrence
Prohibited Noxious Weeds		
Field Bindweed	*Convolvulus arvensis*	2 sites
Hempnettle	*Galeopsis tetrahit*	8 sites
Perennial Sowthistle	*Sonchus arvensis*	29 sites
Restricted Noxious Weeds		
Yellow Toadflax	*Linaria vulgaris*	8 sites
Plantain	*Plantago* sp	34 sites
Annual Bluegrass	*Poa annua*	5 sites
Wild Buckwheat	*Polygonum convovulus*	4 sites
Tufted Vetch	*Vicia cracca*	32 sites

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

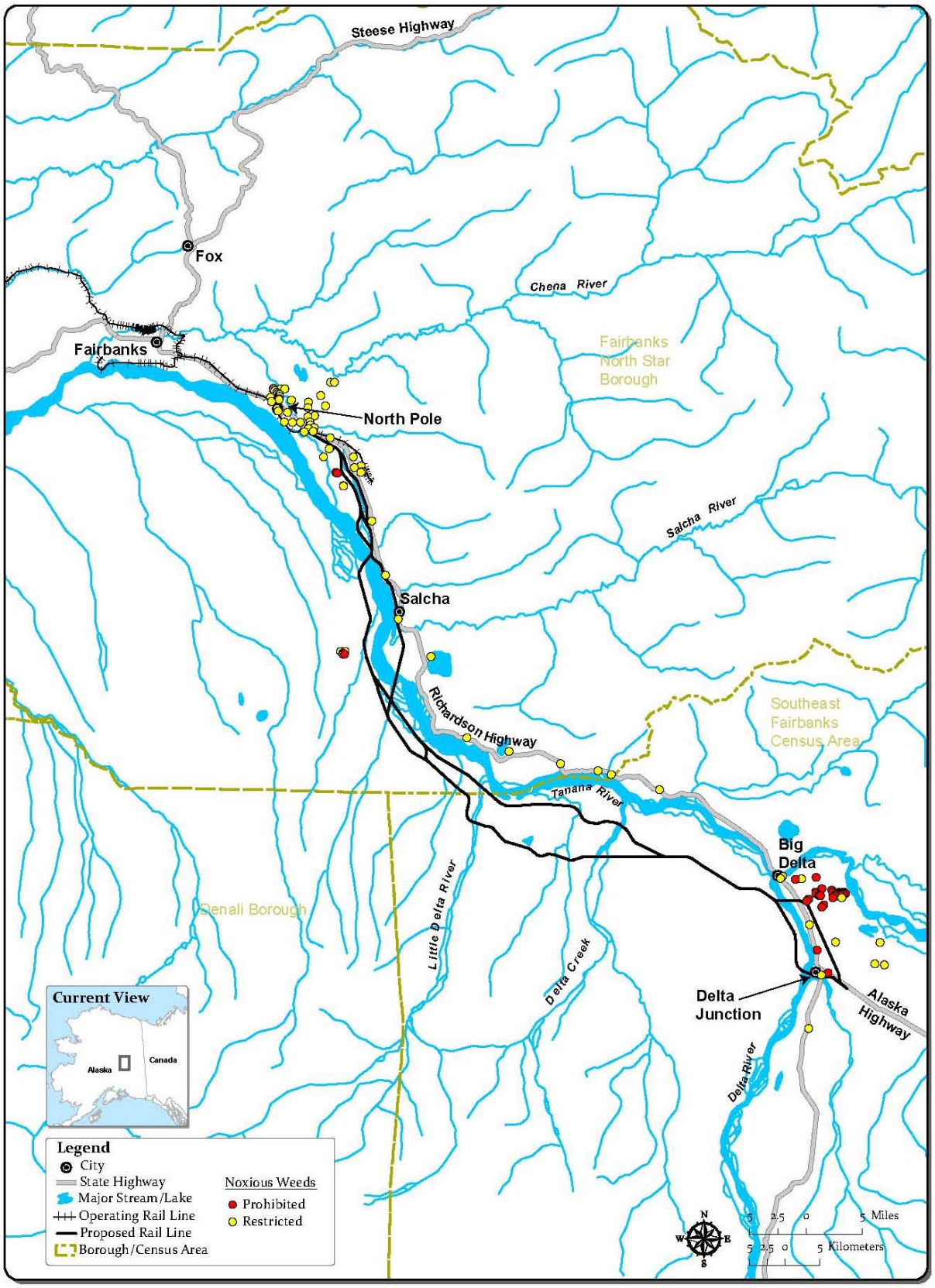

Figure 5-3 – Distribution of Prohibited and Restricted Noxious Weeds along the Proposed NRE (ANHP *et al.*, 2006)

5.3.2 Environmental Consequences

This section discusses the potential impacts on vegetation resulting from the proposed NRE. Chapter 20 identifies proposed mitigation for impacts to biology.

The effects of construction and operation of the proposed NRE on vegetation would be influenced by the vegetation type, soil conditions, and extent of topographic modification required for construction. The primary impacts from construction and operation of the project would be similar across vegetation types – vegetation would be removed and soil structures would be altered. No Federal or state 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 (Lipkin, 2007; Racine *et al.*, 2001; Tande *et al.*, 1996), and one rare willow, *Salix setchelliana*, was identified during field investigations for wetlands along Delta Alternative Segment 2 (HDR, 2007a).

Methodology

Analysis of effects to vegetation from the construction and operation of the proposed NRE was based on GIS analysis of the BLM *et al.* (2002) Tanana Flats Earth Cover Map. Analysis included a summary of vegetation cover within the 200-foot right-of-way (ROW) and ancillary facilities outside of the 200-foot ROW.

Construction Impacts

Impacts on vegetation would occur through direct clearing for construction of the rail line, access roads, and other support facilities. The following describes construction-related impacts that would be common to all the alternative segments.

- **Vegetation Clearing and Fill Placement**. Direct clearing of vegetation would result in plant death, adversely affecting plant community composition and structure. Some vegetation regrowth would be expected in the short term, although plant communities would be temporarily or permanently altered. Direct placement of fill to support the rail line and access roads would result in permanent vegetation loss. Vegetation loss would be short term in the areas at the edges of road and rail embankments which could be allowed to revegetate by natural succession. However, this natural process could be hindered by mechanical vegetation management in some locations. Some areas would be restored after construction. Forested areas stripped of vegetation would require from 70 to 200 years for regeneration and would be considered a long-term habitat loss, even with restoration. Restoration of graminoid or shrub habitats may occur within 5 to 20 years, and would be considered a short-term habitat loss. Forest communities would be replaced, in part, by either native early successional-stage vegetation or invasive plants.

- **Soil Compaction and Erosion**. Heavy equipment transiting areas within and outside the project footprint would affect plant communities by causing soil compaction. Compaction of soils inhibits germination of some seeds in the upper soil surface, inhibits infiltration of precipitation, inhibits root penetration, and could favor the development of bare soil areas or establishment of invasive plants. Removal of vegetation cover exacerbates erosion, and construction of the rail line would increase erosion rates throughout the project area. Soil

erosion and sedimentation would occur in areas where a moderate amount of excavation or fill placement has been completed.

- **Spread of Invasive Plants.** Construction of the rail line, access roads, and other support facilities would likely increase the spread of invasive plants by allowing entry through the following pathways (1) construction equipment used on the site could carry seeds or propagative plant parts from other construction projects or infested portions of this construction project, (2) removal of overburden and cut materials to offsite locations could spread invasive species, and placement of fill from borrow sites may introduce invasive plants and (3) seed mixtures used in revegetation of slopes and exposed soils may contain invasive plant seeds. Native vegetation next to the rail line, access roads, and other areas cleared for the project would likely experience competition from invasive plants. The highest concentrations of invasive species within the project area are found in the more highly disturbed areas of North Pole and Delta Junction. Construction of alternative segments near these areas would have an increased potential to spread invasive plants.

- **Dust Deposition**. Wind-blown dust from gravel roads and railbeds could damage or eliminate plants by direct cover with mineral fines, which inhibit photosynthesis and respiration. More tolerant invasive species often replace native species in areas exposed to dust. The magnitude and duration of dust exposure would determine the intensity of the impact and vegetation response (Everett, 1980). Dust would have minimal to moderate impacts within approximately 1,000 feet (300 meters) from the ROW (Everett, 1980).

- **Fragmentation**. Fragmentation of vegetation communities from construction of the rail line would alter plant communities along the alignment edges and facilitate the spread and establishment of invasive non-native plants (Hansen and Clevenger, 2005). Permanent rail facilities would replace vegetation coverage resulting in the linear separation of the landscapes (Meffe *et al.*, 1997). Linear construction projects, such as a road or rail line, divide vegetation communities, converting interior communities into edge communities (Watson, 2005).

- **Wildland Fires**. Clearing of the ROW would fragment fuels, potentially creating a fire break such that a fire starting on one side of the ROW might be unable to cross the cleared alignment to the opposite side of the ROW. This would potentially change the natural cycle of fire, leading to decreased biodiversity from ecological succession. The separated vegetation communities could then experience different rates of ecological succession. A fuel break along the Tanana River Valley could also be beneficial in the protection of late-succession riparian forests and private property.

Operations Impacts

The following describes operations-related impacts that would be common to all the alternative segments.

- **Maintenance Clearing**. Continued vegetation and soil disturbance would include ongoing mechanical clearing and trimming of vegetation within the ROW to ensure the safety of the rail line (Appendix F). Other methods of vegetation maintenance may include thermal removal, steam or hot water removal, fire removal, smothering vegetation with impenetrable plastic layers along the base of the embankment; or manual removal with axes, machetes and

chain saws (Torstensson, 2001). These activities would disturb successional vegetation cover, providing an opportunity for the introduction of invasive species. Any vegetation removal by burning could increase the risk of fire spreading beyond the vegetation management target area and could result in the unintentional destruction of forest resources (ARRC, 1984). The alteration of vegetation cover from ROW clearing and maintenance would be considered minor, but permanent.

- **Chemical Spills**. Vegetation remaining in the ROW after construction could be affected in the unlikely event of a release of hazardous materials from a train derailment or collision. The level of impact would depend on the type and quantity of spill. However, the likelihood of a release is low as ARRC anticipates few shipments of hazardous materials, and railcars used for transportation of hazardous materials are designed to withstand various types of impacts. The extent of degradation of vegetation would depend on factors such as the specific pollutant discharged, runoff type, and vegetation community affected. Chemical spills along the rail line are expected to be infrequent and, therefore, have minimal impact. A discussion of hazardous materials transportation safety is provided in Chapter 11 of the EIS.

- **Runoff and Sedimentation**. Precipitation runoff from road and rail embankments and across dust deposits during operation of the proposed NRE could result in changes in soil chemistry depending on the site-specific pH of the soil resulting in reduced nutrient levels, altered organic horizon depth, higher soil bulk density, and lower soil moisture. These changes could cause reduced vegetation biomass and diversity especially in areas with acidic soils, such as the needleleaf forest habitats (Auerbach *et al.*, 1997). Sedimentation of barren river bars and riverine willow communities could occur in slackwater areas behind erosion control structures constructed in floodplains. In most cases this sedimentation would lead to a decrease in plant species richness (Klinger *et al.*, 1983; Walker *et al.*, 1987).

- **Wildland Fire and Fire Management**. Sparks from rail operation could increase the potential for fires (DeWilde and Chapin, 2006). Wide-scale changes in fire management for the area surrounding the rail line would be unlikely. Fire management and fire history for the project area and alternatives are presented in Appendix F.

Impacts by Alternative Segment

Permanent vegetation removal would occur through direct clearing for the rail line and other support facilities. The level of impact is based on the size of the area to be cleared during construction and operation of the rail line. The following describes the vegetation types and areas of vegetation that would be removed within the 200-foot ROW and for support facilities associated with each alternative segment. The construction and operations impacts for alternative segments are presented and discussed when differences occur between alternative segments or when impacts are notable.

Common Support Facilities

Vegetation would be cleared for 33 borrow areas (17 acres each), two additional construction staging areas, one materials staging area, and three new communication towers. These common facilities are not dependent on the alternative segments selected. The exact locations for the borrow areas have not been determined. Borrow areas would occur at approximately two- to three-mile intervals along the ROW probably within non-aquatic habitats. Vegetation impacts

are estimated based on the distribution of vegetation classes within the project area. Borrow areas would be converted to ponds. An estimated 534 acres of vegetation cover would be removed for construction of the borrow areas – 438 acres of forests, 84 acres of shrubs, 11 acres of graminoid vegetation, and 1 acre of bryoid/lichen (Table 5-4).

Table 5-4
Estimated Vegetation Clearing for Common Support Facilities[a]

Class Name	Borrow Pit Areas[b] (acres)	Extra Construction Staging Areas and Rock Staging[c] (acres)	Total[d] (acres)
Closed Needleleaf Forest	76.1	4.9	80.9
Open Needleleaf Forest	185.5	7.4	192.9
Closed Broadleaf Forest	54.2	21.5	75.8
Open Broadleaf Forest	30.1	5.0	35.1
Closed Mixed Needleaf/ Broadleaf Forest	92.2	34.6	126.8
Tall Shrub	15.9	62.2	78.1
Low Shrub	66.4	50.9	117.3
Dwarf Shrub	1.7	0.4	2.0
Graminoid	10.9	0.9	11.9
Bryoid/Lichen	0.9		0.9
Sparse Vegetation	2.5	0.0	2.5
Gravel/Rock	3.4		3.4
Mud/Silt/Sand	20.2	2.9	23.1
Urban	-	1.4	1.4
Total Area[d]	**560.0**	**192.1**	**752.0**

[a] Source: BLM *et al.*, 2002.
[b] Approximately 33 borrow areas at 17 acres per borrow area.
[c] Two construction staging areas (140 and 40 acres) and a rock staging area (12.1 acres).
[d] Column and row totals may not sum exactly due to rounding.

The two additional staging areas cleared for construction could be restored after construction has been completed. About 188 acres of vegetation would be removed for the construction staging areas – 73 acres of forests, 114 acres of shrubs, and 1 acre of graminoid vegetation. The final vegetation after restoration would depend on the type of vegetation cleared, soil conditions, and surrounding vegetation. Most restoration efforts would be initiated with establishment of an initial graminoid and herbaceous ground cover to prevent excess erosion and spread of invasive weeds. Shrubs would require 5 to 20 years to return to their original community composition and height (ADF&G, 2001a). Early succession forests would require up to 70 years to reach their original coverage and late succession forest would require up to 200 years to become established (ADF&G, 2001a).

Additional construction staging areas, access roads, Richardson Highway relocations, the Salcha School relocation, and passenger terminals are specific to the alternative segment selected for construction. These facilities would be constructed outside of the 200-foot ROW. The impacts to vegetation from these alternative segment-associated facilities are evaluated in conjunction with the ROW impacts for the alternative segments.

North Common Segment

Construction of the North Common Segment would clear about 62 acres of vegetation, including 36 acres of forests, 18 acres of shrubs, 7 acres of graminoid vegetation, and 1 acre of bryoid/lichen (Table 5-5). Most of the segment appears to be undisturbed forest and shrub communities (Figure 5-4). The highest concentrations of invasive species within the project area are found in the more highly disturbed areas of North Pole, and Delta Junction, but invasive plants are common along the Richardson Highway. Construction and operation of the North Common Segment would have a high potential to spread invasive plants.

Table 5-5
Vegetation Cover Within the 200-foot ROW for the North Common Segment[a]

Vegetation Class	Area (acres)	ROW Area (%)
Closed Needleleaf Forest	1.0	1
Open Needleleaf Forest	7.2	11
Closed Broadleaf Forest	7.5	12
Open Broadleaf Forest	6.1	10
Closed Mixed Needleleaf/ Broadleaf Forest	14.3	22
Tall Shrub	6.0	9
Low Shrub	11.8	18
Dwarf Shrub	0.4	1
Graminoid	6.7	10
Bryoid/Lichen	0.8	1
Urban	2.2	3
Total Area	**64.0**	

[a] Source: BLM *et al.*, 2002.

Eielson Alternative Segments

Construction of the Eielson alternative segments would clear about 246 acres of vegetation for Eielson Alternative Segment 1, 241 acres for Eielson Alternative Segment 2, and 238 acres for Eielson Alternative Segment 3 (Figure 5-4 and Table 5-6). The Eielson alternative segments cross predominantly open needleleaf and closed mixed forests. Construction of Eielson Alternative Segment 1 would clear 235 acres of forests, 10 acres of shrubs, and 1 acre of graminoid vegetation. Construction of Eielson Alternative Segment 2 would clear 221 acres of forests, 10 acres of shrubs, and 10 acres of graminoid vegetation. Construction of Eielson Alternative Segment 3 would clear 210 acres of forests, 17 acres of shrubs, and 11 acres of graminoid vegetation. The high proportions of closed-canopy forests crossed by the Eielson alternative segments indicate that this area has been undisturbed by extensive flooding or fire. The most extensive area of closed forest vegetation would be cleared for Eielson Alternative Segment 1 (133 acres), followed by Eielson Alternative Segment 3 (109 acres) and Eielson Alternative Segment 2 (98 acres).

All three Eielson alternative segments are located near sources of invasive plants, which could result in the spread of invasive plant species within the ROW. The three alternative segments

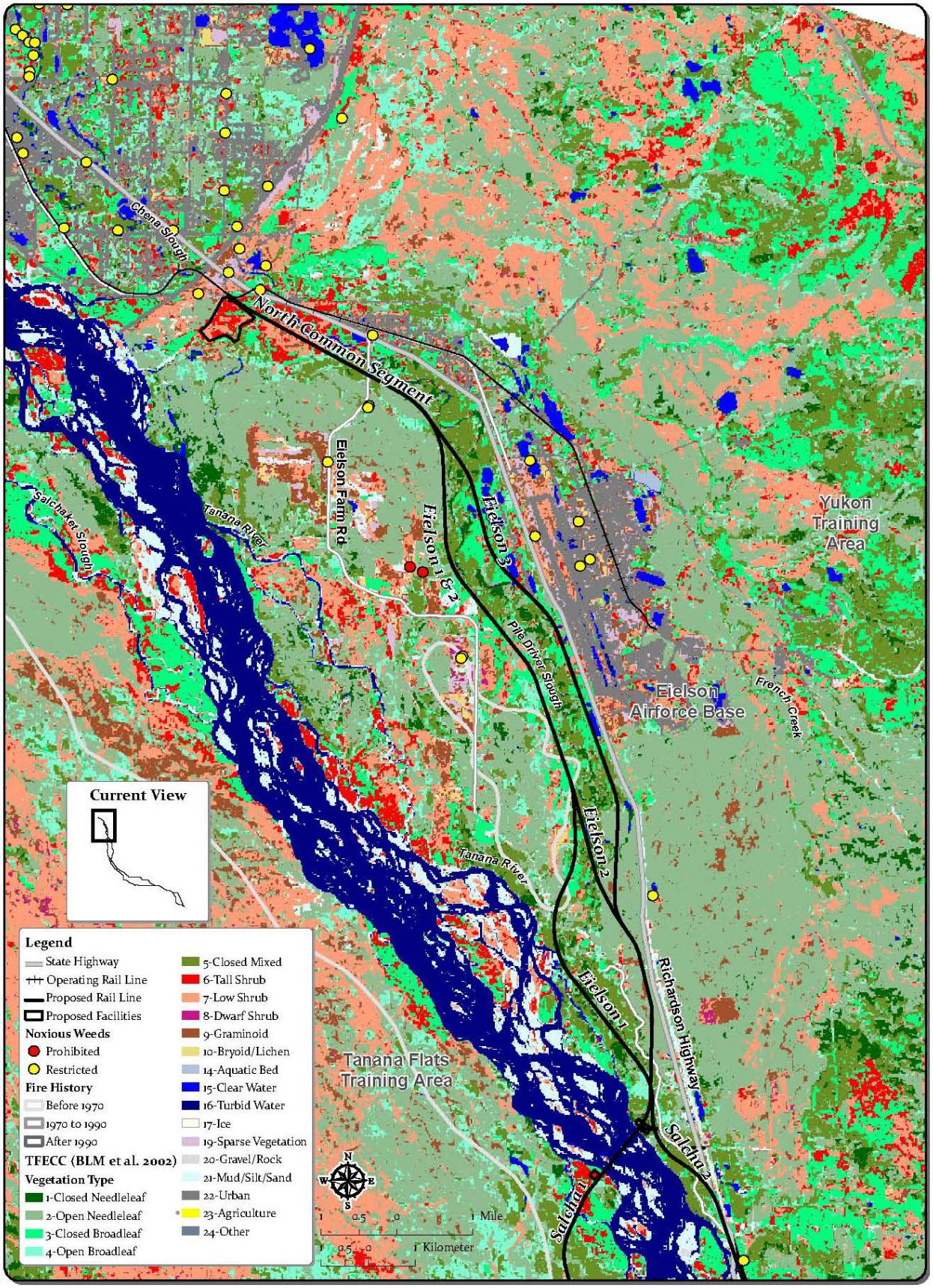

Figure 5-4 – Vegetation along the North Common and Eielson Alternative Segments

Table 5-6
Vegetation Cover Within the 200-foot ROW for Eielson Alternative Segments[a]

	Eielson 1		Eielson 2		Eielson 3	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Closed Needleleaf Forest	20.6	8	13.7	6	11.8	5
Open Needleleaf Forest	72.0	29	104.9	43	91.4	38
Closed Broadleaf Forest	38.6	16	30.5	13	43.5	18
Open Broadleaf Forest	30.2	12	18.1	7	10.2	4
Closed Mixed Needleleaf/Broadleaf Forest	73.6	30	54.0	22	53.5	22
Tall Shrub	2.2	1	1.7	1	11.5	5
Low Shrub	8.2	3	8.3	3	5.5	2
Graminoid	1.0	0	9.7	4	11.0	5
Clear Water	-	0	0.1	0	2.8	1
Sparse Vegetation	-	0	-	0	0.5	0
Mud/Silt/Sand	0.8	0	0.2	0	0.2	0
Urban	-	0	-	0	1.3	1
Total Area	**247.2**		**241.2**		**243.2**	

[a] Source: BLM *et al.*, 2002.

parallel the Richardson Highway, and Eielson Alternative Segment 3 may contain previously disturbed vegetation communities within the urban area crossed by the segment. Alternative segments near previously disturbed areas with sources of invasive plants have a higher potential for spreading invasive plants.

Salcha Alternatives

Construction of the Salcha alternative segments would result in the clearing of about 435 acres of vegetation for Salcha Alternative Segment 1 and 537 for Salcha Alternative Segment 2 (Tables 5-7 and 5-8). The Salcha alternative segments cross predominately forest and riparian habitats (Figure 5-5). Construction of Salcha Alternative Segment 1 would clear 381 acres of forests, 53 acres of shrubs, and 1 acre of graminoid vegetation. Construction of Salcha Alternative Segment 2 would clear 471 acres of forests, 61 acres of shrubs, and 3 acres of graminoid vegetation.

Salcha Alternative Segment 1 crosses the Tanana River and continues along the west side of the Tanana River in a largely undisturbed landscape where few invasive plants would be expected and the potential to spread invasive plants would be low. The Salcha Alternative Segment 2 parallels portions of the Richardson Highway ROW, where existing sources of invasive plants would likely be spread throughout the rail ROW during construction. Salcha Alternative Segment 1 crosses 258 acres of closed forest and Salcha Alternative Segment 2 crosses 343 acres. Construction of Salcha Alternative Segment 1 and the eastern end of Salcha Alternative Segment 2 would fragment stands of closed needleleaf and closed mixed forests along the southern bank of the Tanana River.

Fire management differs between the Salcha alternative segments. Salcha Alternative Segment 2 approaches the Town of Salcha and runs along the Richardson Highway where fire protection is either critical or full; Salcha Alternative Segment 1 crosses primarily undeveloped lands where fire management is limited (See Appendix F for definitions of fire protection levels). About 4

Table 5-7
Vegetation Cover Within the 200-foot ROW for the Salcha Alternative Segments[a]

	Salcha 1		Salcha 2	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Closed Needleleaf Forest	40.7	14	67.7	25
Open Needleleaf Forest	23.6	8	48.1	14
Closed Broadleaf Forest	27.9	10	44.7	13
Open Broadleaf Forest	64.6	23	17.7	5
Closed Mixed Needleleaf/ Broadleaf Forest	94.4	33	84.4	25
Tall Shrub	8.1	3	11.9	4
Low Shrub	4.7	2	8.7	3
Graminoid	1.0	0	1.6	0
Bryoid/Lichen	-	-	0.4	0
Clear Water	0.8	0	5.7	2
Turbid Water	14.3	5	17.2	5
Ice	-	-	0.2	0
Sparse Vegetation	-	-	1.3	0
Gravel/Rock	-	-	0.3	0
Mud/Silt/Sand	3.9	1	23.1	7
Total Area	**284.0**		**333.0**	

[a] Source: BLM *et al.*, 2002.

Table 5-8
Vegetation Cover Within Access Roads, Bridge Staging Areas, Revetments, Levees, Richardson Highway Relocations and the Salcha School Relocation for Salcha Alternative Segments[a]

	Salcha 1		Salcha 2	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Closed Needleleaf Forest	9.3	4	99.2	32
Open Needleleaf Forest	17.6	7	52.5	17
Closed Broadleaf Forest	24.9	10	20.0	7
Open Broadleaf Forest	18.1	7	10.5	3
Closed Mixed Needleleaf/ Broadleaf Forest	60.3	24	26.5	9
Tall Shrub	36.8	15	22.7	7
Low Shrub	2.6	1	17.4	6
Dwarf Shrub	-	-	0.3	0
Graminoid	0.2	0	1.3	0
Bryoid/Lichen	-	-	1.1	0
Clear Water	12.9	5	10.5	3
Turbid Water	57.0	23	25.1	8
Sparse Vegetation	-	-	0.1	0
Gravel/Rock	0.4	0	2.2	1
Mud/Silt/Sand	8.4	3	17.6	6
Total Area	**248.5**		**307.0**	

[a] Source: BLM *et al.*, 2002.

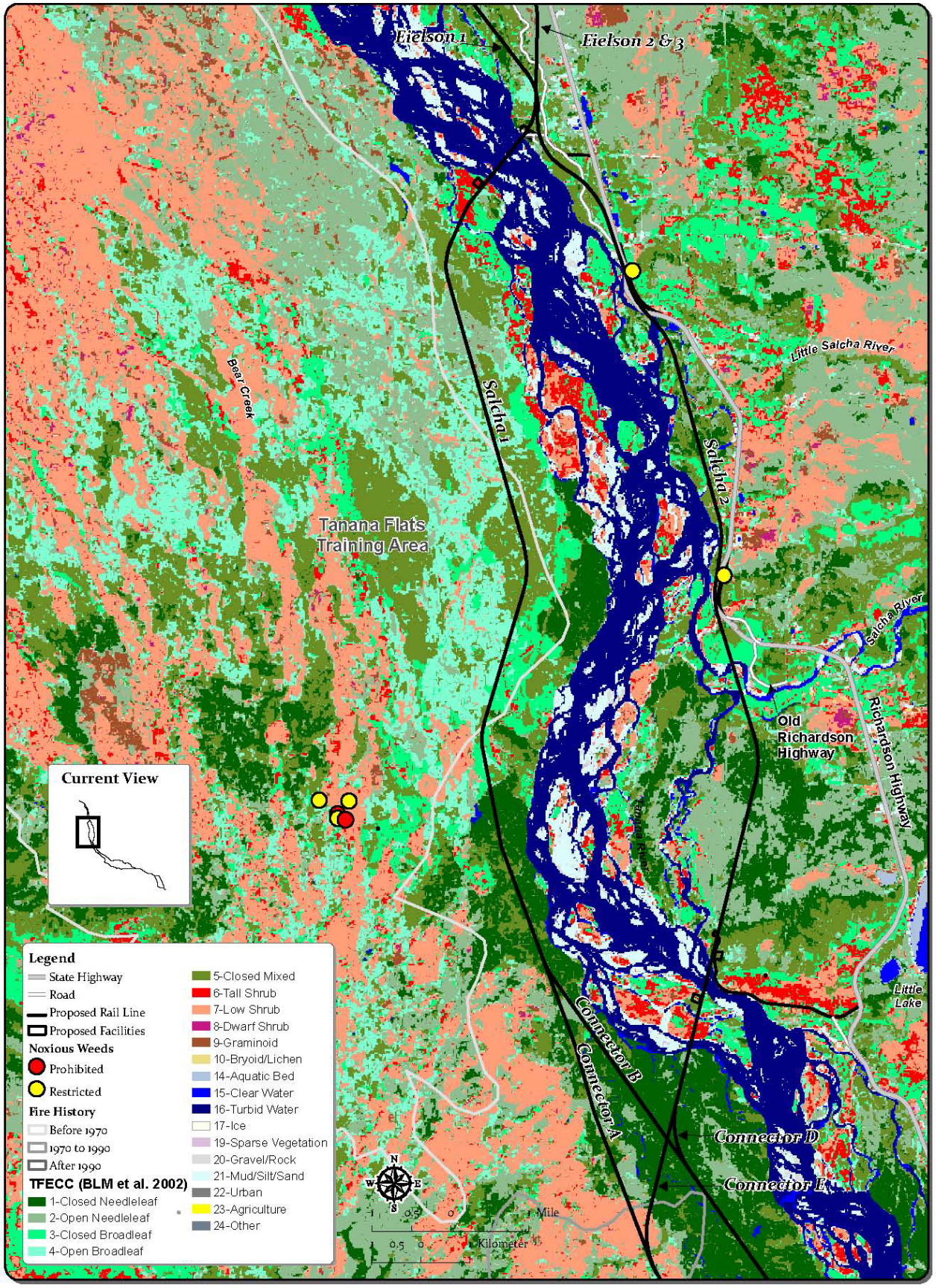

Figure 5-5 – Vegetation along the Salcha Alternative Segments

miles of Salcha Alternative Segment 1 was burned during 1957, while none of the Salcha Alternative Segment 2 has been burned since the 1950s.

Central Alternative Segments and Connectors

Construction of the Central alternative segments and connectors would result in the clearing of primarily forest and low shrub vegetation (Table 5-9 and Table 5-10). Much of Central Alternative Segment 1, Connector A, and Connector F cross open needleleaf forests, which appear to consist primarily of black spruce; while much of Central Alternative Segment 2, Connector B, Connector C, and Connector D cross closed needleleaf and mixed forests, which appear to consist primarily of white spruce and balsam poplar forests (Figure 5-6).

The Central alternative segments and Connectors extend along the west side of the Tanana River, where little disturbed vegetation exists and few invasive plants would be expected. The southern ends of Central Alternative Segment 1 and Central Alternative Segment 2 and all of Connector F fall within an area designated for full fire protection. The northern ends of Central Alternative Segment 1, Central Alternative Segment 2 and all of Connectors A, B, C, and D fall within an area designated for limited fire protection. Fire burned across about a mile of Central Alternative Segment 1, Connector A, and Connector C during 1981.

Table 5-9
Vegetation Cover Within 200-foot NRE ROW for Central Alternative Segments[a]

Vegetation Class	Central 1		Central 2	
	Area (acres)	ROW Area (%)	Area (acres)	ROW Area (%)
Closed Needleleaf Forest	16.5	13	64.7	74
Open Needleleaf Forest	40.0	33	7.8	9
Closed Broadleaf Forest	1.8	1	-	-
Open Broadleaf Forest	9.2	7	-	-
Closed Mixed Needleleaf/ Broadleaf Forest	21.1	17	11.8	14
Tall Shrub	0.4	0	-	-
Low Shrub	17.0	14	-	-
Graminoid	0.2	0	-	-
Clear Water	-	-	-	-
Mud/Silt/Sand	0.2	0	2.0	2
Other	16.5	13	0.6	1
Total Area	**122.9**		**86.9**	

[a] Source: BLM *et al.*, 2002.

Table 5-10
Vegetation Cover Within 200-foot NRE ROW for Central Connectors[a]

Vegetation Class	Connector A		Connector B		Connector C		Connector D		Connector E	
	Area (acres)	ROW Area (%)	Area (acres)	ROW Area (%)	Area (acres)	ROW Area (%)	Area (acres)	ROW Area (%)	Area (acres)	ROW Area (%)
Closed Needleleaf Forest	29.4	28	56.6	71	30.6	55	19.4	92	8.2	14
Open Needleleaf Forest	30.7	29	12.2	15	8.6	15	0.4	2	8.0	14
Closed Broadleaf Forest	0.4	0	-	-	0.1	0	-	-	1.3	2
Open Broadleaf Forest	3.6	3	0.2	0	2.0	4	-	-	0.1	0
Closed Mixed Forest	26.2	25	9.6	12	3.6	6	1.4	7	6.8	12
Tall Shrub	0.8	1	-	-	0.4	1	-	-	0.2	0
Low Shrub	14.2	13	-	-	10.1	18	-	-	-	-
Graminoid	0.5	0	-	-	0.2	0	-	-	-	-
Clear Water	-	-	0.8	1	0.4	1	-	-	-	-
Mud/Silt/Sand	-	-	-	-	-	-	-	-	0.3	0
Other	-	-	-	-	-	-	-	-	33.6	58
Total Area	**105.8**		**79.4**		**56.0**		**21.2**		**58.5**	

[a] Source: BLM *et al.*, 2002.

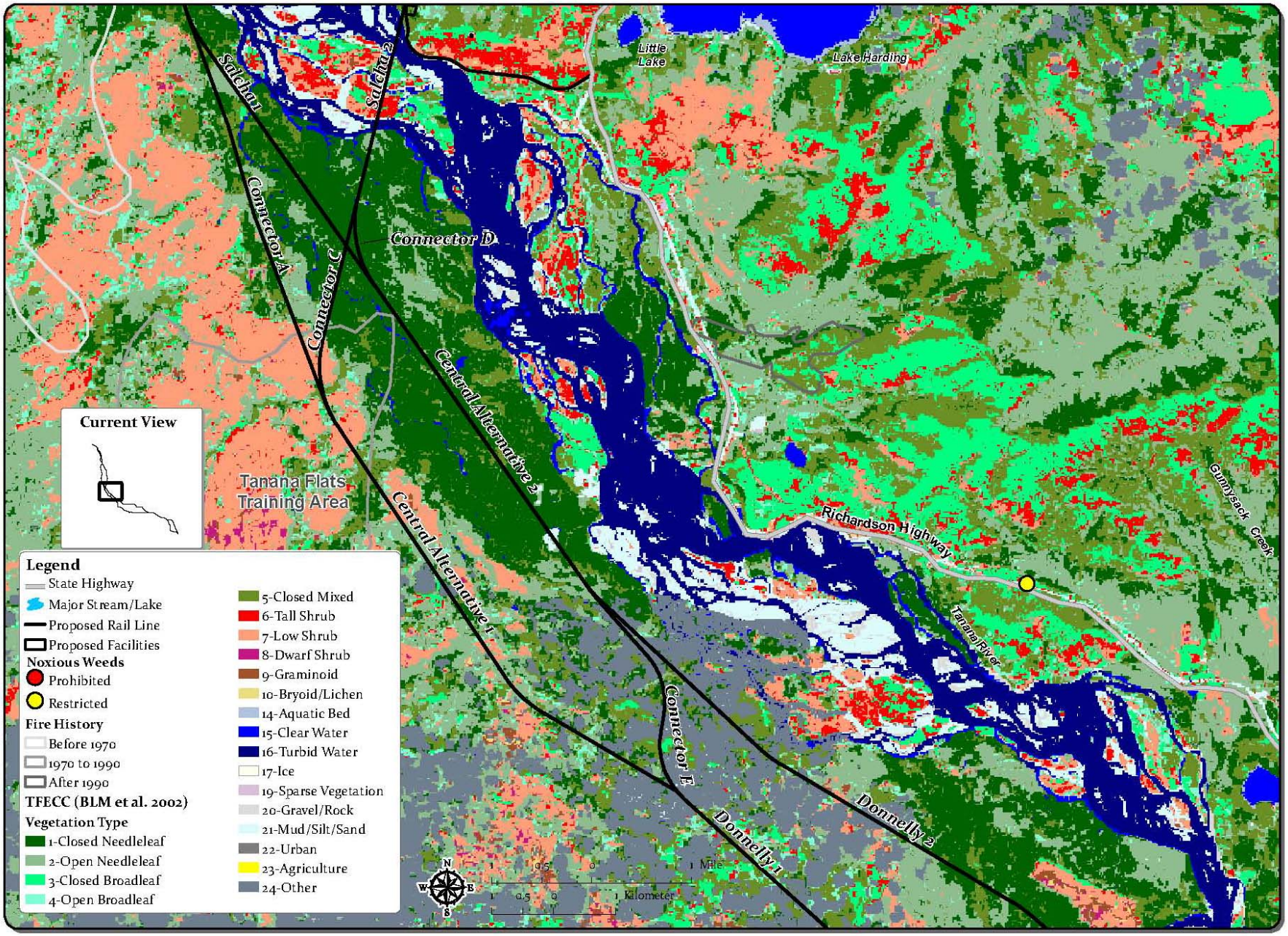

Figure 5-6 – Vegetation along the Central Alternative Segments and Connectors

Donnelly Alternative Segments

Construction of the Donnelly alternative segments would result in the clearing of primarily forest and low shrub vegetation (Table 5-11, Table 5-12, and Figure 5-7). Construction of the Donnelly alternative segments would clear about 628 acres for Donnelly Alternative Segment 1 and 636 acres for Donnelly Alternative Segment 2 (Table 5-11 and Table 5-12). Construction of Donnelly Alternative Segment 1 would clear 590 acres of forests, 27 acres of shrubs, and 11 acres of graminoid vegetation. Construction of Donnelly Alternative Segment 2 would clear 617 acres of forests, 16 acres of shrubs, and 3 acres of graminoid vegetation. The Donnelly Alternative Segment 2 crosses nearly twice the area of closed canopy white spruce, balsam poplar, paper birch and quaking aspen mixed forest (403 acres) as the Donnelly Alternative Segment 1 (206 acres), which primarily crosses open needleleaf black spruce forest.

Both alternative segments cross largely undisturbed boreal forest along the west side of the Tanana River, where few existing invasive plants would be expected. Fire management for both of the Donnelly alternative segments is primarily full suppression because of the cabins associated with the Richardson Clearwater River. Neither alternative segment area has been affected by fire since the 1950s. Construction of the rail- and roadbeds could increase the potential for interruption of the natural fire and succession pattern, especially for the Donnelly Alternative Segment 1, which crosses primarily black spruce forests.

Table 5-11
Vegetation Cover Within 200-foot NRE ROW for the Donnelly Alternative Segments[a]

	Donnelly 1		Donnelly 2	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Closed Needleleaf Forest	109.8	18	197.1	31
Open Needleleaf Forest	323.1	52	147.6	23
Closed Broadleaf Forest	6.9	1	35.7	6
Open Broadleaf Forest	16.9	3	7.7	1
Closed Mixed Needleleaf/ Broadleaf Forest	66.6	11	154.2	24
Tall Shrub	3.2	1	3.8	1
Low Shrub	22.6	4	9.8	2
Dwarf Shrub	0.6	0	-	0
Graminoid	11.0	2	2.7	0
Clear Water	2.0	0	2.1	0
Turbid Water	5.5	1	5.7	1
Gravel/Rock	2.3	0	3.5	1
Mud/Silt/Sand	7.4	1	4.4	1
Other[b]	43.0	7	56.1	9
Total Area	**620.9**		**630.4**	

[a] Source: BLM *et al.*, 2002.
[b] Portions of the areas crossed by these alternatives were obscured by clouds. These areas are primarily forest covered.

Table 5-12
Vegetation Cover Within Large Bridge Staging Areas and River Gravel Mine Sites for the Donnelly Alternative Segments[a]

	Donnelly 1		Donnelly 2	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Closed Needleleaf Forest	13.2	21	12.3	20
Open Needleleaf Forest	0.9	1	2.1	3
Closed Broadleaf Forest	0.3	0	0.4	1
Open Broadleaf Forest	0.1	0	0.7	1
Closed Mixed Needleleaf/ Broadleaf Forest	8.7	14	3.3	5
Low Shrub	0.4	1	2.9	5
Graminoid	0.2	0	-	-
Clear Water	0.9	1	-	-
Turbid Water	16.5	26	15.7	25
Sparse Vegetation	-	-	0.4	1
Gravel/Rock	6.8	11	8.2	13
Mud/Silt/Sand	14.8	24	16.6	27
Total Area	**62.8**		**62.6**	

[a] Source: BLM *et al.*, 2002.

South Common Segment

Construction of the South Common Segment would result in clearing of about 251 acres of vegetation (Table 5-13 and Figure 5-8). Vegetation within this alignment was 97 percent forest prior to a fire that occurred during 1998, as reflected in Table 5-13. Construction of the South Common Segment would clear 251 acres of vegetation including: 150 acres of forests, 91 acres of shrub, and 10 acres of graminoid vegetation (Table 5-13). The fire reset succession across 94 acres crossed by the segment, leaving 59 percent of the alignment in forest cover. Forested habitats within the burn area were replaced with low shrub/graminoid habitats, which are usually the first communities to regrow in burn areas. Due to the remoteness of the South Common Segment, few invasive plants would be expected to occur and the potential to spread invasive plants would be expected to be low.

Table 5-13
Pre- and Post-Fire Vegetation Cover Within 200-foot NRE ROW for the South Common Segment[a]

Vegetation Class	Pre-Fire Area (acres)	Post-Fire Area (acres)
Closed Needleleaf Forest	57.8	25.5
Open Needleleaf Forest	99.1	51.5
Closed Broadleaf Forest	18.7	18.2
Open Broadleaf Forest	8.5	3.8
Closed Mixed Needleaf/ Broadleaf Forest	60.1	51.3
Low Shrub	6.1	90.6
Graminoid	0.9	10.3
Clear Water	1.5	1.5
Totals	**252.7**	**252.7**

[a] Sources: BLM *et al.*, 2002; BLM AFS, 2007.

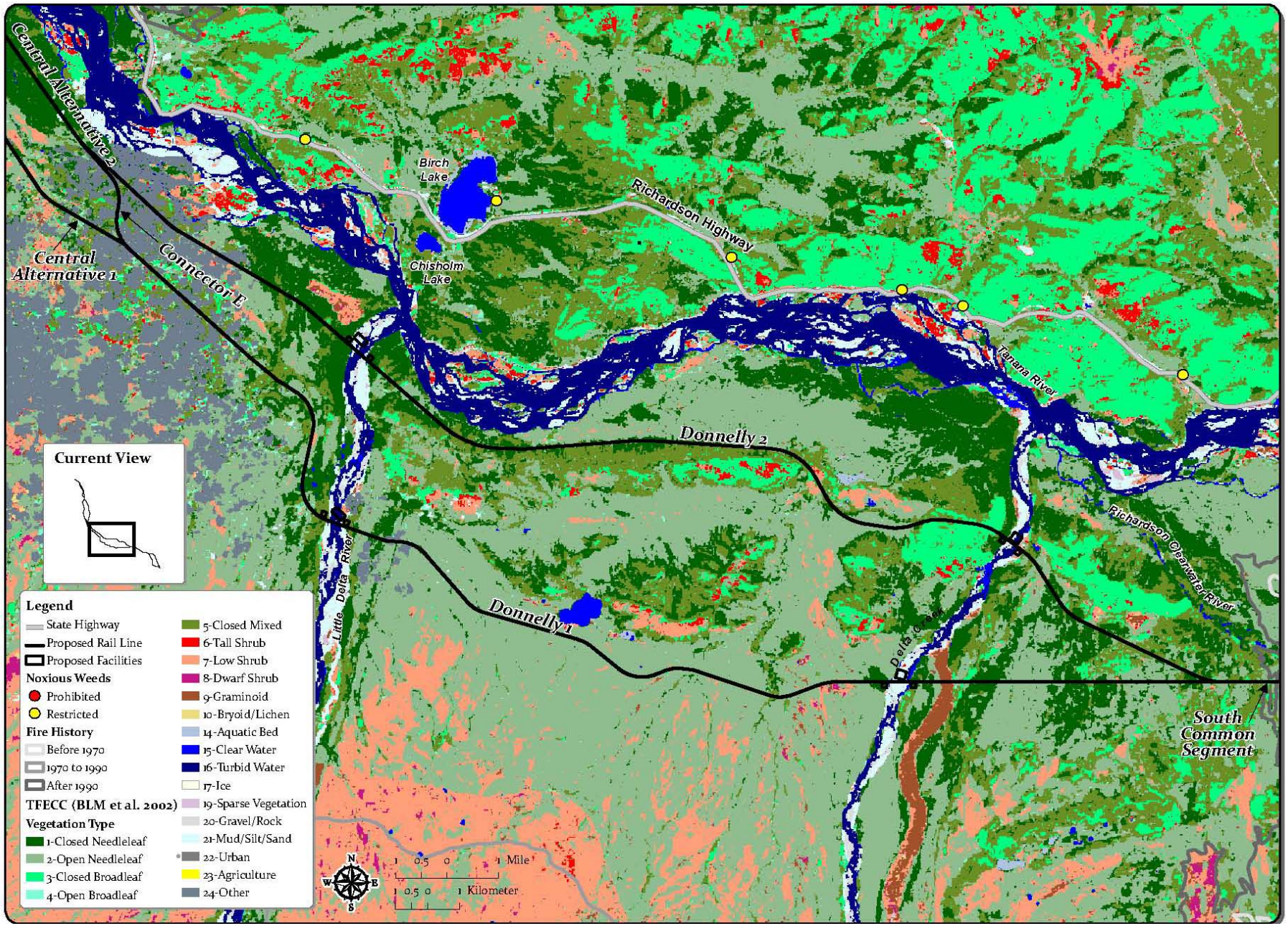

Figure 5-7 – Vegetation along the Donnelly Alternative Segments

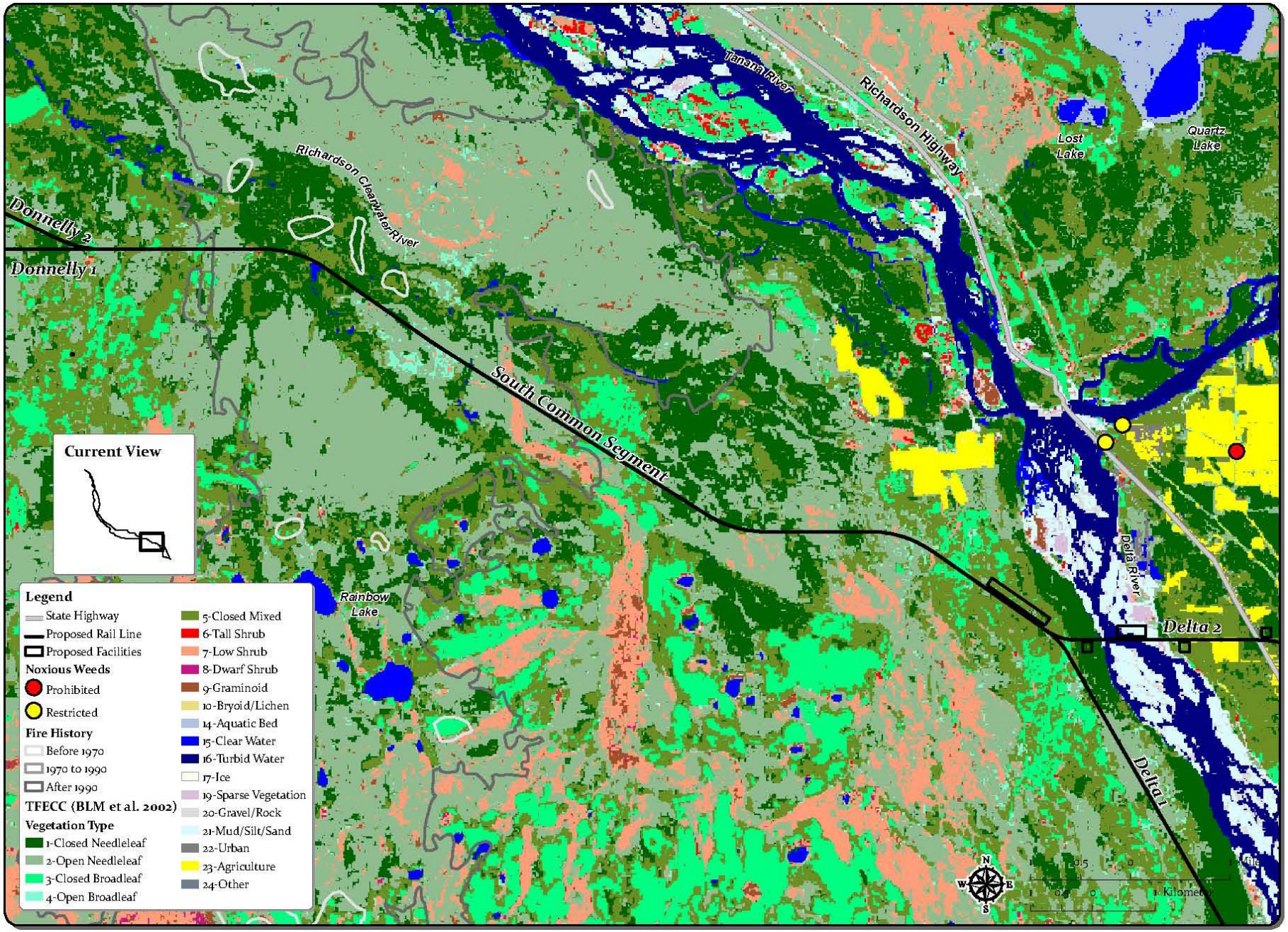

Figure 5-8 – Vegetation along the South Common Segment

Delta Alternative Segments

Construction of Delta Alternative Segment 1 would clear about 261 acres of vegetation, while Delta Alternative Segment 2 would clear about 281 acres (Table 5-14 and Table 5-15). Delta Alternative Segment 1 would result in clearing of primarily forest vegetation classes, while Delta Alternative Segment 2 would result in clearing of forests and agricultural vegetation (Figure 5-9). Delta Alternative Segment 2 would have a higher potential for invasive plant infestation because of its proximity to sources of invasive plants near the Richardson Highway and agricultural lands. A rare willow, *Salix setchelliana*, was reported to occur on Delta Alternative Segment 2 (HDR, 2007a). Delta Alternative Segment 1 would occupy primarily undeveloped and undisturbed boreal forests where a lower potential for invasive plants would be expected.

Table 5-14
Vegetation Cover Within 200-foot NRE ROW for the Delta Alternative Segments[a]

	Delta 1		Delta 2	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Closed Needleleaf	121.5	44	35.9	13
Open Needleleaf	60.6	22	52.1	19
Closed Broadleaf	9.0	3	20.5	7
Open Broadleaf	3.9	1	6.0	2
Closed Mixed	41.7	15	72.9	26
Tall Shrub	0.7	0	2.1	1
Low Shrub	3.1	1	2.3	1
Dwarf Shrub	0.0	0	-	-
Graminoid	2.3	1	-	-
Bryoid/Lichen	0.6	0	-	-
Clear Water	-	-	0.3	0
Turbid Water	6.0	2	8.1	3
Sparse Vegetation	3.6	1	1.2	0
Gravel/Rock	5.1	2	0.8	0
Mud/Silt/Sand	15.6	6	5.0	2
Urban	0.8	0	2.6	1
Agriculture	3.7	1	66.9	24
Totals	**278.2**		**276.7**	

[a] Source: BLM *et al.*, 2002.

Table 5-15
Vegetation Cover Within Bridge Staging, River Gravel Mine Sites, Overpass Staging, Passenger Terminal, and Access Roads for the Delta Alternative Segments[a]

	Delta 1		Delta 2	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Closed Needleleaf	2.8	7	8.9	21
Open Needleleaf	3.2	8	1.0	2
Closed Broadleaf	-	-	1.1	2
Open Broadleaf	1.4	4	0.6	1
Closed Mixed	2.3	6	8.0	19
Tall Shrub	0.4	1	-	-
Low Shrub	1.6	4	-	-
Graminoid	1.9	5	-	-
Clear Water	0.5	1	-	-
Turbid Water	0.4	1	4.3	10
Ice	-	-	-	-

Table 5-15
Vegetation Cover Within Bridge Staging, River Gravel Mine Sites, Overpass Staging, Passenger Terminal, and Access Roads for the Delta Alternative Segments[a] (continued)

	Delta 1		Delta 2	
Vegetation Class	**Area (acres)**	**ROW Area (%)**	**Area (acres)**	**ROW Area (%)**
Sparse Vegetation	3.0	7	0.2	1
Gravel/Rock	1.9	5	3.0	7
Mud/Silt/Sand	20.3	50	12.6	30
Urban	-	-	0.2	0
Agriculture	0.9	2	2.9	7
Total Area	**40.6**		**42.8**	

[a] Source: BLM *et al.*, 2002.

No-Action Alternative

Under the No-Action Alternative, there would be no impacts from rail line construction or operations activities. Vegetation within the alternative segment alignments would continue to be influenced by urban and agricultural development, permafrost distribution, and the natural processes of flooding and fire that initiate ecological succession in the boreal forest.

5.3.3 Summary of Impacts to Vegetation

The primary impacts to vegetation from construction and operation of the proposed NRE would be loss of the existing vegetation cover and spread of invasive plants. A summary of the results of the quantitative analysis of vegetation clearing impacts for the NRE alternative segments is presented in Table 5-16. Estimates are maximums based on clearing of the entire 200-foot ROW.

Construction of the proposed NRE would result in surface disturbance of an estimated 3,071 acres, including a permanent loss of 2,364 acres of forests, 324 acres of shrubs, 47 acres of grass/sedge and 84 acres of other vegetation habitats for a total loss of an estimated 2,819 acres of vegetation cover (Table 5-16). The minimum and maximum range of construction impacts would result in surface disturbance of an estimated 3,021 to 3,137 acres, including 2,325 to 2,424 acres of forests, 305 to 354 acres of shrubs, 33 to 40 acres of grass/sedge, and 128 to 68 acres of other vegetation, for a total loss of an estimated 2,791 to 2,885 acres of vegetation cover (Table 5-16). Vegetation cover losses represent a small total area compared to the vegetation cover surrounding the project alternatives because of the primarily undeveloped nature of the project area. Loss of vegetation cover, soil disturbance, and the use of fill materials and seed sources contaminated with invasive plant seeds would contribute to the spread of weed species. Some cleared areas would likely be restored after construction; other areas would be covered by fill.

Vegetation clearing would be considered a long-term impact for forest communities even with restoration, especially for late-succession forests. Vegetation clearing would be considered a short-term impact on shrub and graminoid communities, if appropriate restoration was completed.

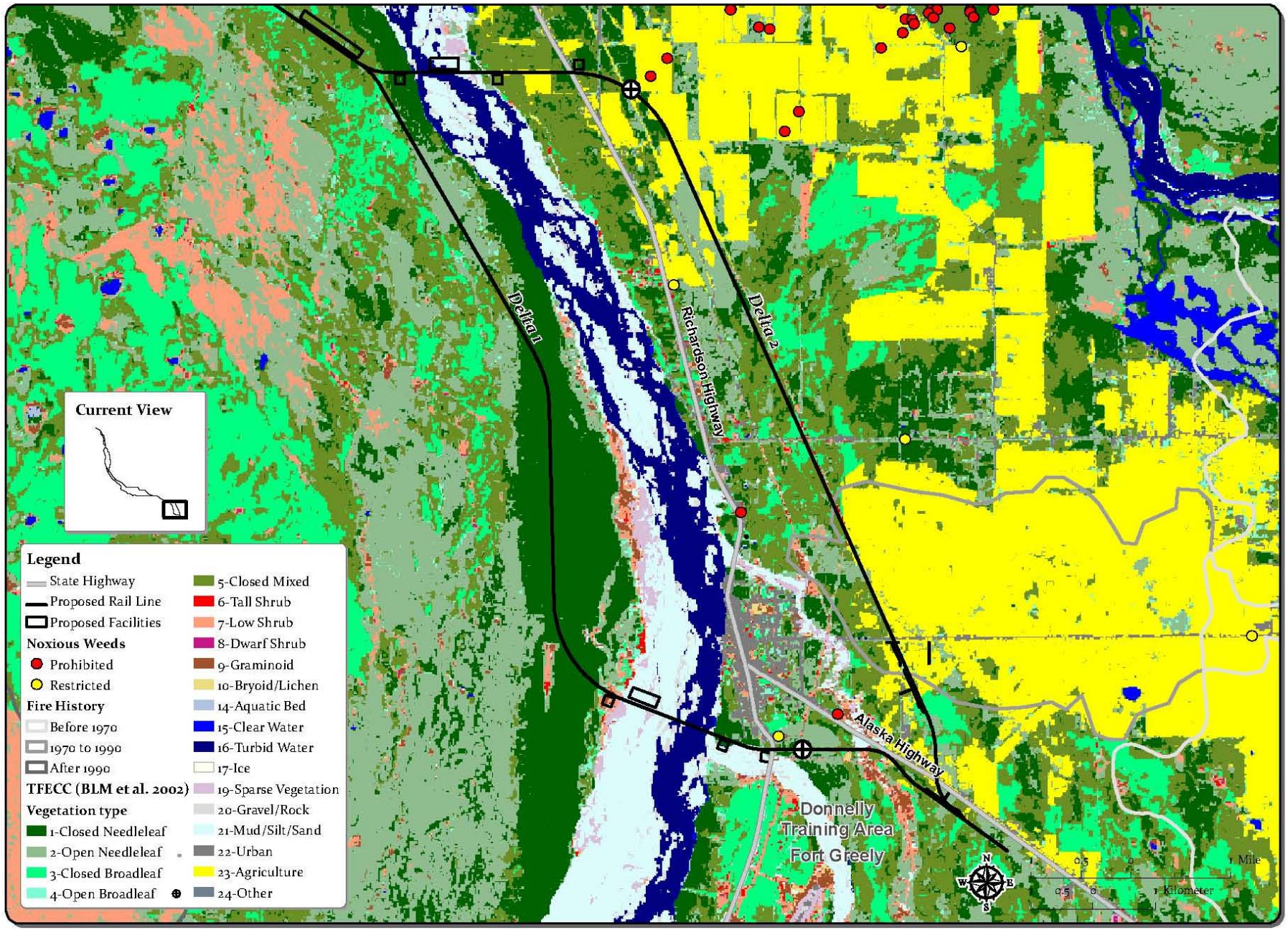

Figure 5-9 – Vegetation along the Delta Alternative Segments

Table 5-16
Summary of Vegetation Impacts (acres) by Alternative Segment[a]

Alternative or Segment	Closed NL Forest	Open NL Forest	Closed BL forest	Open BL Forest	Closed NL/BL Forest	All Forests	All Shrubs	Gramin -oid	Other Vege-tated	Total Vege-tated Area	Non-vege-tated	*Total Area*[b]
Common Facilities	80.9	192.9	75.8	35.1	126.8	511.4	197.4	11.9	0.9	721.6	30.4	752.0
North Common	1.0	7.2	7.5	6.1	14.3	36.1	18.2	6.7	0.8	61.6	2.2	63.8
Eielson 1	20.6	72.0	38.6	30.2	73.6	235.0	10.4	1.0	0.0	246.4	0.8	247.3
Eielson 2	13.7	104.9	30.5	18.1	54.0	221.2	10.1	9.7	0.0	241.0	0.4	241.4
Eielson 3	11.8	91.4	43.5	10.2	53.5	210.5	17.0	11.0	0.0	238.5	4.8	243.4
Salcha 1 + Extra	50.0	41.1	52.8	82.7	154.7	381.4	52.3	1.3	0.0	434.9	97.6	532.5
Salcha 2 + Extra	167.0	100.6	64.8	28.2	110.9	471.4	61.0	3.0	1.5	536.8	103.3	640.2
Central 1	16.5	40.0	1.8	9.2	21.1	88.6	17.4	0.2	16.5	122.6	0.2	122.8
Central 2	64.7	7.8	-	-	11.8	84.3	0.0	-	0.6	84.9	2.1	86.9
Connector A	29.4	30.7	0.4	3.6	26.2	90.2	15.0	0.5	0.0	105.7	0.0	105.7
Connector B	56.6	12.2	-	0.2	9.6	78.5	0.0	-	0.0	78.5	0.8	79.4
Connector C	30.6	8.6	0.1	2.0	3.6	44.9	10.5	0.2	0.0	55.6	0.4	55.9
Connector D	19.4	0.4	-	-	1.4	21.2	0.0	-	0.0	21.2	0.0	21.2
Connector E	8.2	8.0	1.3	0.1	6.8	24.3	0.2	-	33.6	58.2	0.3	58.4
Donnelly 1 + Extra	123.0	324.1	7.1	17.1	75.3	546.5	26.8	11.2	43.0	627.5	56.2	683.7
Donnelly 2 + Extra	209.4	149.7	36.1	8.4	157.4	561.0	16.5	2.7	56.1	636.4	56.7	693.1
South Common	57.8	99.1	18.7	8.5	60.1	244.2	6.1	0.9	0.0	251.2	1.5	252.7
Delta 1 + Extra	124.3	63.8	9.0	5.3	44.0	246.4	5.9	4.2	5.2	261.7	57.3	318.9
Delta 2 + Extra	44.8	53.1	21.5	6.6	80.8	206.9	4.5	0.0	69.7	281.1	38.4	319.5
Proposed Action[c]	578.3	847.6	215.6	165.3	556.9	2363.6	323.8	47.1	84.1	2818.6	253.1	3071.7
Minimum Area Alternative[d]	578.8	668.1	242.8	165.7	669.6	2325.0	305.0	33.2	128.1	2791.3	230.0	3021.3
Maximum Area Alternative[e]	621.7	908.2	223.2	141.6	529.7	2424.4	353.6	39.1	67.8	2885.0	252.3	3137.2

[a] Source: BLM *et al.*, 2002.
[b] Totals may not sum exactly due to rounding, column subtotal for all forest cover is sum of the five forest cover types.
[c] Proposed Action includes North Common, Eielson 3, Salcha 1, Connector B, Central 2, Connector E, Donnelly 1, South Common, and Delta 1.
[d] Minimum Project Area includes North Common, Eielson 2, Salcha 1, Connector B, Central 2, Donnelly 2, South Common, and Delta 2.
[e] Maximum Project Area includes North Common, Eielson 1, Salcha 2, Connector C, Central 1, Donnelly 1, South Common, and Delta 1.

5.4 Fisheries Resources

This section describes the existing conditions of fisheries in the project and potential impacts from the proposed NRE.

5.4.1 Affected Environment

Important fish resources and habitats occurring in the project area include waters supporting recreational, commercial and subsistence/personal use fisheries for trout, char, whitefish and salmon. Table 5-17 lists fish species identified by Federal and state agencies as potentially occurring in or downstream of proposed NRE stream crossings. Fish resources in the project area include resident (life cycle does not include extended migration), fresh water migratory (life cycle includes seasonal migrations within fresh waters) and anadromous (life cycle includes migrations to marine waters) species. Many freshwater fish in Interior Alaska make extensive seasonal movements within and between drainages. Some fish species have resident populations, freshwater migratory populations and anadromous populations within the project area. Additional supporting information on fisheries resources in the mid-Tanana River Basin can be found in Appendix F.

Table 5-17
Fish Occurring in the Mid-Tanana River Basin[a]

Common Name[b]	Species	Potential Use[c]	Anadromy (Y/N)	Conservation Concern[d] (Y/N)
Alaska Blackfish	*Dallia pectoralis*	--	N	Y
Alaskan Brook Lamprey	*Lampetra alaskense*	--	N	Y
Arctic Char (I)	*Salvelinus alpinus*	R	N	N
Arctic Lamprey	*Lampetra japonica*	--	Y	Y
Broad Whitefish	*Coregonus nasus*	R,S	Y	Y
Burbot	*Lota lota*	R,S	N	N
Chinook (King) Salmon	*Oncorhynchus tshawytscha*	C,R,S	Y	N
Chum (Dog) salmon	*Oncorhynchus keta*	C,R,S	Y	N
Coho (Silver) Salmon	*Oncorhynchus kisutch*	C,R,S	Y	N
Dolly Varden	*Salvelinus malma*	R	Y/N	N
Arctic Grayling	*Thymallus arcticus*	R,S	N	N
Humpback Whitefish	*Coregonus oidschian*	R,S	Y/N	N
Lake Trout	*Salvelinus namaycush*	R	N	N
Least Cisco	*Coregonus said*	S	Y/N	N
Longnose Sucker	*Catostomus catostomus*	S	N	N
Northern Pike	*Esox lucius*	R,S	N	N
Rainbow Trout (I)	*Oncorhynchus mykiss*	R	N	N
Round Whitefish	*Prosopium cylindraceum*	R	N	N
Inconnu (Sheefish)	*Stenodus leucichthys*	R,S	N	N
Trout Perch	*Percopsis omiscomaycus*	--	N	Y

[a] Sources: Parker, 2006; ADF&G, 2007a and 2007b.
[b] I = introduced.
[c] Potential Use Codes: C = commercial, R = recreational, S = subsistence/personal use (as reported in Busher *et al.*, 2007).
[d] Species of Conservation Concern are listed in the Alaska Comprehensive Wildlife Conservation Strategy.

Perennial and intermittent streams that connect to major tributaries along proposed rail alternative segments may contain fish or habitats suitable for fish use during portions of the year.

These streams may support spawning, foraging, rearing, refuge, and migratory use by resident and anadromous fish species. The proposed NRE would require a minimum of 19 crossings and a maximum of 35 crossings of streams that have been documented to contain either fish or fish habitat. The combination of alternatives and segments that has the least number of stream crossings documented to contain either fish or fish habitat is the North Common Segment, Eielson Alternative Segment 1, Salcha Alternative Segment 1, Connector A, Donnelly Alternative Segment 1, South Common Segment, and Delta Alternative Segment 1. The maximum number of crossings would include the North Common Segment, Eielson Alternative Segment 3, Salcha Alternative Segment 2, Central Alternative Segment 1, Connector C, Donnelly Alternative Segment 1, South Common Segment, and Delta Alternative Segment 1. All alternative segments could affect three fisheries protected by the Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Act (Public Law 104-297)—the Chinook, coho, and chum salmon fisheries. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Figure 5-10 shows major streams supporting EFH protected fisheries in the project area (Johnson and Weiss, 2007). Not all streams crossed by the alternative segments have been documented to contain EFH fisheries or other anadromous fishes. Some of these waters may contain undocumented EFH-protected species and most streams are likely to contain other common resident or anadromous fishes as listed in Table 5-17. For additional information on fish habitat, site-specific habitat conditions and documented fish species use for proposed stream crossings, and for an analysis of project construction and operation affects on EFH, please refer to Appendices F and G.

5.4.2 Environmental Consequences

This section discusses the potential impacts on fisheries resulting from the proposed NRE. Supporting descriptions of environmental consequences, results of quantitative analyses and illustrations are presented in Appendices F and G.

The NRE would require multiple stream crossings at locations likely to contain fish or fish habitat. The magnitude of effects of construction and operation of the project on fisheries would be influenced by the stream type, conveyance structure, type of fish and habitat occurring within the stream, and timing of construction. The primary impacts of crossing structures to fish and fish habitat are loss and degradation of instream habitats due to placement of structures, alteration of stream hydrology and blockage of movements. Alterations of stream hydrology caused by conveyance structures are discussed in Chapter 4. The primary impact of instream gravel removal would be temporary or permanent habitat alteration depending on the amount of gravel removed and the gravel recharge rate. Most effects from the construction and operation of the project would include increased erosion and sedimentation from removal of riparian vegetation, and loss or alteration of stream and riparian habitats. Impacts to fisheries would vary with type of stream, quality of fish habitat, and timing of fish use of the habitat.

Each stream crossing would have site-specific impacts on aquatic and riparian habitats. The extent and duration of these impacts would depend on the specific characteristics of conveyance type and design and the fish community present. Impacts would occur during rail line construction and operations. To minimize and offset potential impacts to fish resources, all fish habitat and water quality permit conditions would be incorporated into the design phase and construction of the project stream crossings.

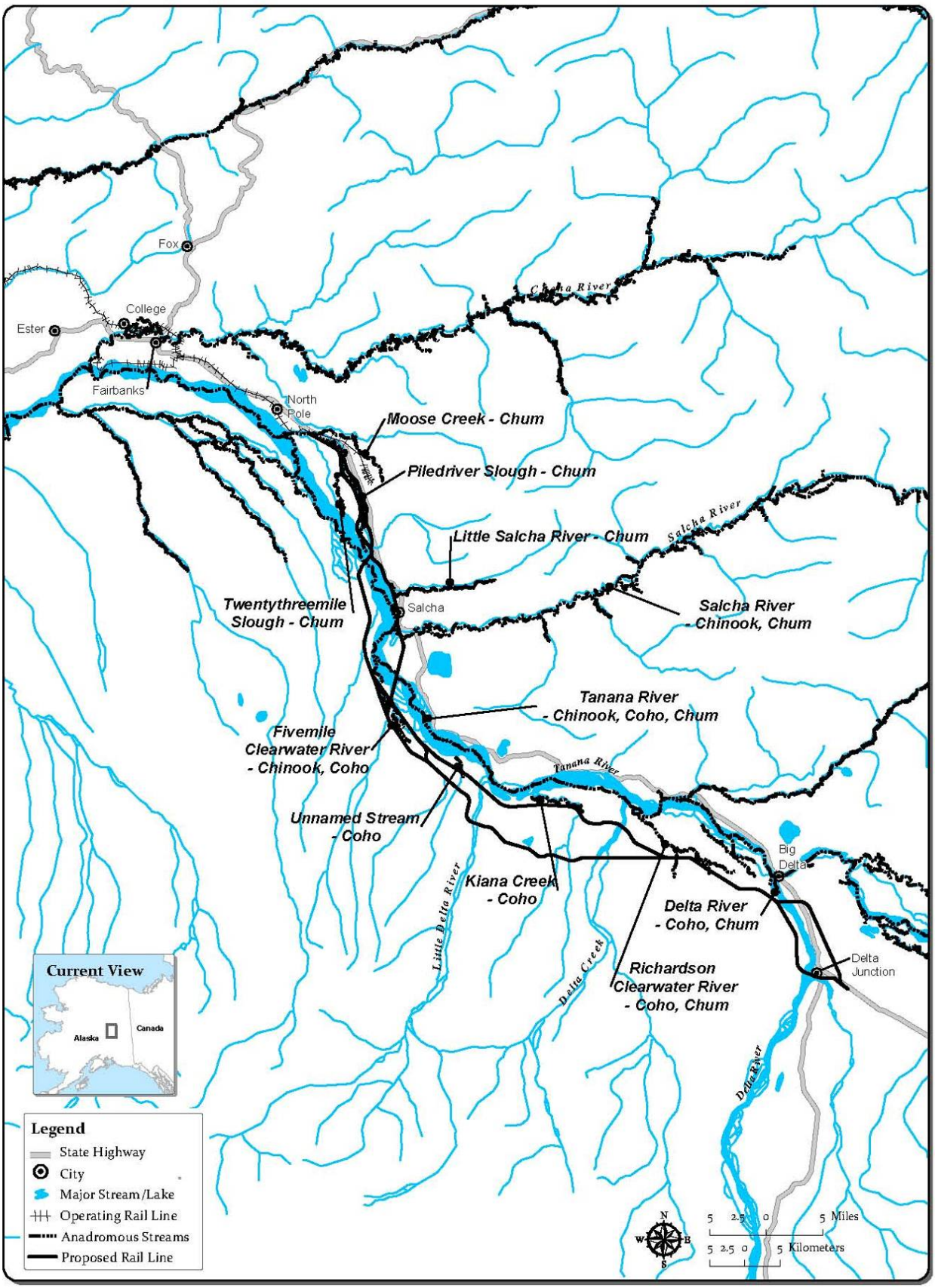

Figure 5-10 – Waters Documented as Important for Chinook, Coho and Chum Salmon under Alaska Statute 16.15.871(a) in the Project Area (Johnson and Weiss, 2007)

Methodology

Effects to fisheries from the construction and operation of the proposed NRE were evaluated based on habitat use, habitat requirement, and seasonal movement of fish within the project area. Habitat analysis was based on a review 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 from 2005 to 2007 (Noel, 2007a).

Construction Impacts

Construction of the rail line would result in short-term disturbance and long-term habitat modification along the approximately 80-mile rail line. The following discussion describes the types of potential construction-related impacts on fish and fish habitats that would be applicable to all of the alternative segments proposed for the NRE.

- **Loss or Alteration of Instream and Riparian Habitats.** Installation of bridge pilings, bank armoring, and culverts would permanently remove streambed area that would otherwise be available for fish use. Loss of gravel bottoms, sandy shoal areas, stands of emergent vegetation, and other habitat would impact rearing, foraging, and spawning. Temporary loss of instream habitat would also occur if water is diverted from the channel to facilitate installation of bridge pilings, bank armoring, or culverts. Removal of gravel from glacial river beds would also cause a temporary alteration in the river bed. The pit formed for gravel removal would generally be refilled with gravel during the following spring breakup periods by bed load migration and would generally not result in permanent fish habitat loss or alteration.

  Riparian vegetation would be removed as a result of bridge, culvert, and access road construction. Trees and other woody vegetation provide protection to fish habitat by filtering runoff, shading the stream, providing large woody debris (LWD) and other organic matter to the stream. Riparian clearing would also eliminate important streambank habitats such as undercut banks. Removal of riparian vegetation and disturbance to streambanks could result in erosion, sediment loading and turbidity, elevated water temperatures, reduced productivity, and a reduction in habitat complexity.

- **Mortality from Instream Construction.** Instream construction activities could cause direct mortality of fish when equipment or materials are placed in the stream bed. Small, larval or juvenile fish may become stranded in pools created when equipment is driven through the stream. Pools could then subsequently drain or dry resulting in desiccation of the fish. Fry are particularly vulnerable because they are weak swimmers and are susceptible to stranding by wave action created as equipment is driven through or along the stream bed. Large fish would be expected to avoid vehicle wheels and ruts. Redds, eggs, and fry within or downstream of the construction site could be impacted by sedimentation, excessive vibration, and scour (Banner and Hyatt, 1973; Crisp, 1990). Water diversions and temporary dewatering could also impact fish embryos and pre-emergent fry (Becker *et al.*, 1982; Holland, 1987) through desiccation and/or freezing.

- **Blockage of Fish Movement.** In-stream construction activities would impact fish movements during construction where water diversions create temporary physical barriers to fish passage or alter stream flows sufficiently to create either high water or low water

conditions that would prevent fish passage. Water diversions and culverts could physically restrict access to spawning habitat, and turbidity created during construction could also trigger avoidance behavior which would lead to a behavioral blockage of movements (Bisson and Bilby, 1982; Warren and Pardew, 1998). These impacts would be expected to be temporary during bridge construction. Ice bridge stream-crossings can alter spring breakup timing and create ice jams with high flows that restrict movements of resident fish and out-migrating salmon.

Improperly installed conveyance structures could impede fish passage by increasing the velocity or decreasing the depth of water flowing through the structure. Culverts could pose a physical barrier (as with a hung culvert) if not installed properly. Conveyance structures blocking or impeding fish passage could result in a loss of access to spawning and rearing habitat which could reduce fish productivity. Water diversions could also create temporary physical barriers to fish passage or alter stream flows sufficiently to create either high-water or low-water conditions that would prevent fish passage, potentially restricting access to rearing and spawning habitat.

Bridges and culverts can also create choke points where the downstream movement of ice is restricted. Culverts often freeze solid and are very slow to melt due to the insulation of road or rail embankments. Fish that migrate to upstream spawning or foraging areas in the spring can be blocked by frozen culverts.

- **Degradation of Water Quality**. Clearing of the ROW, grading and placement of conveyance structures, and construction of new access roads would expose soil to erosive forces of wind, rain, and surface runoff during construction. Such erosion would deliver sediment into streams which would degrade water quality and fish habitat. Increased turbidity from suspended sediment would degrade spawning and rearing habitat for a variety of species (Wood, 2004; Grieg *et al.*, 2005). Sedimentation (infiltration of fine particles into substrate interstices) can smother eggs and newly-hatched fry, reducing survival (Wood, 2004; Grieg *et al.*, 2005). High turbidity could also trigger avoidance behavior, affect foraging success in fish that rely on sight for feeding (Barret *et al.*, 1992), and clog gills.

  Small fuel or oil leaks from construction equipment could contribute to water quality degradation during construction. Spills and leaks could enter the water either directly as equipment crosses the stream or indirectly with runoff from the bridge or adjacent road- or railbed.

- **Alteration of Stream Hydrology and Breakup**. Construction activities would cause changes in flow patterns through the hyporheic zone by dislodging fine sediments during excavation and vegetation clearing which can infiltrate the hyporheic zone and clog interstitial spaces; and by vibrations from construction equipment which can cause substrates to settle and become compacted (Sear, 1995; Huggenberger *et al.*, 1998). The hyporheic zone is a region beneath a stream bed where there is mixing of shallow groundwater and surface water. Hyporheic flow and warm groundwater upwelling are important factors in salmonid egg development, and provide a warm water refuge for overwintering fishes (Brown and Mackay, 1995; Baxter and McPhail, 1999). Permanent alterations in subsurface flows could result from the changes in permafrost distribution, bank and substrate armoring, instream support structures and changes in channel morphology associated with bridges and culverts (Sear, 1995; Hanrahan, 2006). Sub-surface structures that stabilize bridges can alter

flow patterns within the hyporheic zone. Warm water upwelling can also prevent a stream from freezing, thus allowing fish to overwinter in areas that would otherwise be unavailable.

Ice bridges used during winter construction of conveyance structures could alter spring breakup timing and create ice jams that redirect flows. Fish species moving upstream or downstream could have difficulty passing areas where ice bridges have been constructed. In extreme cases, this can lead to the formation of ice dams that limit flow downstream of the bridge. Downstream habitat can be dewatered, which can be particularly problematic for anadromous salmonids whose eggs and fry over-winter in glacial streams such as the Tanana River. Water tends to back up behind ice dams that can result from stream constriction at bridges and culverts, and once the ice dam is breached a large volume of water can be released over a short period of time. This sudden flush of water can scour downstream substrates, radically altering channel morphology, eliminating redds, and causing high mortality in overwintering sac-fry.

- **Noise and Vibration Impacts**. Noise and vibrations caused by pile driving and culvert installation during bridge construction could impact egg mortality and hatch timing in areas at and near stream crossings. Vibrations could be of sufficient magnitude to negatively impact the development of salmonid eggs in redds near bridges and culverts. Vibration could disrupt egg membranes leading to egg death. Salmonid eggs are especially susceptible to disruption just after laying and fertilization prior to hardening. Exposure to vibration could affect fish by disrupting their sense of hearing and the function of the lateral line, a sensory organ that detects vibration (Hastings *et al.*, 1996; McCauley *et al.*, 2003). Noise and vibration from winter construction activities could also trigger avoidance behavior, displacing fish from overwintering habitat, especially near the Tanana River bridge crossings.

Operations Impacts

The following are types of potential impacts that would be expected during project operations.

Maintenance activities such as clearing drainage ditches and management of vegetation in the ROW could cause some increase in sedimentation and turbidity over background levels in streams. Water quality could be negatively affected in the unlikely event of a release of hazardous materials from a train derailment or collision. However, the likelihood of a release is low because ARRC anticipates few shipments of hazardous materials, and railcars used to transport hazardous materials are designed to withstand various types of impacts.

Impacts by Alternative Segment

All alternative segments cross streams or waterbodies with fish resources and would potentially cause impacts as discussed above. Notable site-specific impacts on fish and fish habitats for alternative segments are summarized below. Appendix F presents additional supporting information on fish and fish habitats for each alternative.

North Common Segment

The North Common Segment crosses Piledriver Slough, which seasonally supports resident fish populations and some spawning of chum salmon, and an un-named slough, which supports

resident fish (Table 5-18, Figure 5-11). Blockage of fish migration at Piledriver Slough would be of consequence to in-migrant adult chum salmon and arctic grayling headed to spawning habitats and out-migrant chum salmon fry headed to marine rearing habitats that would pass beneath the bridge. Out-migration of chum salmon fry would coincide with spring breakup during April to May and could be hindered by ice jams that could result from channel constriction at the proposed bridge site. The crossing of the un-named slough by two ten-foot culverts would alter instream habitats and would potentially block movements of resident fish.

Piledriver Slough is generally blocked from receiving direct flow from the Tanana River, although during flood conditions flushing flows occur. During most of the year, stream flows are maintained by precipitation and surface water/groundwater exchange. Flushing flows through Piledriver and Twentythreemile Sloughs reduce beaver dams. Any changes in the local hydrology could have corresponding impacts on spawning or overwintering habitat within this reach. Chum salmon and arctic grayling spawning have been documented near this crossing site (Crossing 1; Noel, 2007a, Record 1).

Eielson Alternative Segments

Fish and fish habitats at the 12 crossings of fish-bearing clearwater sloughs that would be affected by construction are listed in Table 5-19 and shown in Figure 5-11. Each of the Eielson alternative segments crosses Piledriver Slough, although crossings are in different locations for each alternative segment. Eielson Alternative Segment 3 crosses Piledriver Slough nearest the outflow of the slough where it receives flow from Moose Creek and rejoins the Tanana River. Eielson Alternative Segment 2 crosses Piledriver Slough before its confluence with Twentythreemile Slough. Eielson Alternative Segment 1 crosses Piledriver Slough just north of where it previously connected to the Tanana River; the channel is currently blocked by fill materials (see Appendix F for a history of alterations to Piledriver Slough). Of these crossings, the crossings further downstream have the largest flows from groundwater exchange and would have the largest affect on instream resident and anadromous fish habitats. Eielson Alternative Segment 1 and Eielson Alternative Segment 2 cross Twentythreemile Slough near where it flows into Piledriver Slough. Twentythreemile Slough supports resident fish and chum salmon.

Eielson Alternative Segment 3 crosses a meandering, un-named slough five times. This slough supports resident fish for rearing and summer forage. Construction across these meanders would likely lead to loss of fish habitat at stream margins, increased erosion and sedimentation associated with disturbance of the riparian buffer zone. Because the crossings would be primarily culverts, there would also be a potential for limiting fish movements during low-flow periods. Groundwater upwelling could be affected by changes in channel morphology related to the installation of multiple culverts. Eielson Alternative Segment 2 and Eielson Alternative Segment 3 cross another un-named slough that contains pool and riffle habitats suitable for rearing, migration and spawning habitats for resident fish.

Salcha Alternative Segments

Fish and fish habitats at the 12 crossings of fish-bearing waterbodies crossed by the Salcha alternative segments are listed in Table 5-20 and shown in Figure 5-12. The Salcha alternative segments would both cross the Tanana River, which provides year-round habitat for resident and anadromous fish. A bridge crossing the Tanana River would include bank armoring, rock revetments and levee construction upstream of the bridge and channel plugs for side channels on

Table 5-18
Fish-bearing Streams Crossed by the North Common Segment

Alternative or Segment	Crossing Number ID	Stream Name	Waterbody Type	Fish Use	Channel Width (feet)	Crossing Type	Crossing Size (feet)	Spawning Habitat	Rearing Habitat	Migration Habitat	Over-winter Habitat
North Common	1	Piledriver Slough	Slough	Anadromous	65	Bridge	100	√	√	√	√
North Common	105	Unnamed	Slough	Resident	20	Culvert	2 x 10	√	√		

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.

Table 5-19
Fish-bearing Streams Crossed by the Eielson Alternative Segments

Alternative or Segment	Crossing Number ID	Stream Name	Waterbody Type	Fish Use	Channel Width (feet)	Crossing Type	Crossing Size (feet)	Spawning Habitat	Rearing Habitat	Migration Habitat	Over-winter Habitat
Eielson 1	3	Twentythreemile Slough	Slough	Anadromous	100	Bridge	100	√	√	√	√
Eielson 1	10	Piledriver Slough	Slough	Anadromous	30	Culvert	3 x10	√	√	√	√
Eielson 2	3	Twentythreemile Slough	Slough	Anadromous	100	Bridge	100	√	√	√	√
Eielson 2	314	Piledriver Slough	Slough	Anadromous	105	Bridge	330	√	√	√	√
Eielson 2	13	Un-named	Slough	Resident	80	Bridge	60		√		
Eielson 3	113	Piledriver Slough	Slough	Anadromous	80	Bridge	300	√	√	√	√
Eielson 3	111	Unnamed	Slough	Resident	30	Culvert	3 x10		√		
Eielson 3	110	Unnamed	Slough	Resident	20	Culvert	3 x10		√		
Eielson 3	129	Unnamed	Slough	Resident	20	Culvert	3 x10		√		
Eielson 3	131	Unnamed	Slough	Resident	20	Culvert	3 x10		√		
Eielson 3	5	Unnamed	Slough	Resident	25	Bridge	130		√		
Eielson 3	13	Unnamed	Slough	Resident	80	Bridge	60		√		

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.

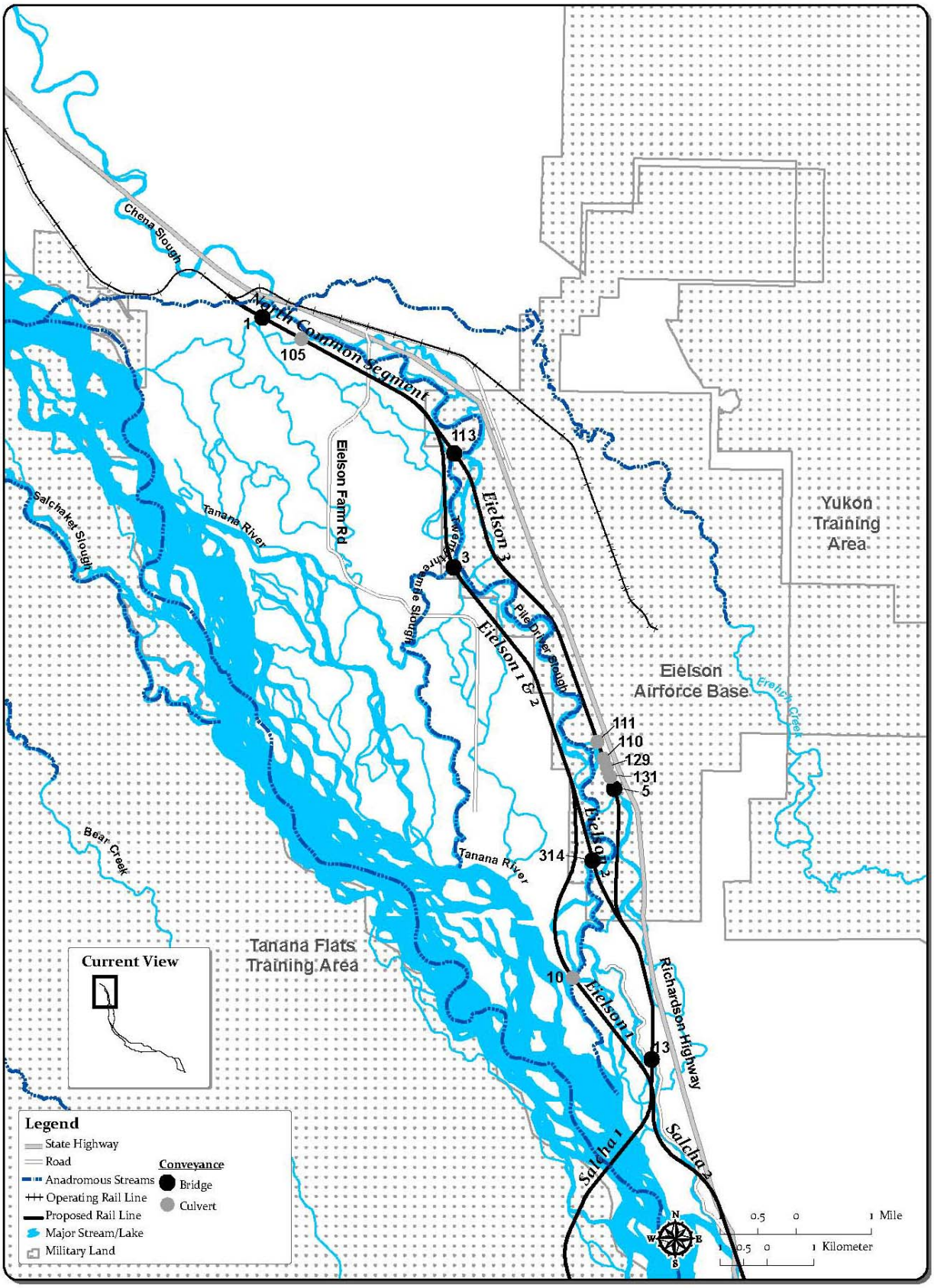

Figure 5-11 – Fish-bearing Streams Crossed by the North Common Segment and Eielson Alternative Segments (ADF&G, 2005; Johnson and Weiss, 2007; Noel, 2007a)

Table 5-20
Fish-bearing Streams Crossed by the Salcha Alternative Segments

Alternative or Segment	Crossing Number ID	Stream Name	Waterbody Type	Fish Use	Channel Width (feet)	Crossing Type	Crossing Size (feet)	Spawning Habitat	Rearing Habitat	Migration Habitat	Over-winter Habitat
Salcha 1		Tanana River	Stream	Anadromous	3,800	Bridge	3,600	√	√	√	√
Salcha 1	89	Un-named	Slough	Resident	34	Culvert	3 x 10[a]	√	√	√	√
Salcha 1	295	Un-named	Stream	Resident	125	Culvert	125		√	√	√
Salcha 2	16	Little Salcha River	Stream	Anadromous	65	Bridge	160	√	√	√	√
Salcha 2	17	Unnamed	Overflow	Probable	20	Culvert	3 x 10	√	√		
Salcha 2	18	Unnamed	Slough	Anadromous	15	Bridge	390	√	√	√	√
Salcha 2		Salcha River	Stream	Anadromous	195	Bridge	2,500[a]	√	√	√	√
Salcha 2		Tanana River	Stream	Anadromous	1,500	Bridge	4,000	√	√	√	√
Salcha 2	22	Unnamed	Slough	Anadromous	130	Bridge	4,000	√	√		
Salcha 2	23	Unnamed	Slough	Anadromous	150	Culvert	3 x 10[a]	√	√		
Salcha 2	340	Unnamed	Stream	Probable	10	Culvert	10		√	√	√
Salcha 2	341	Unnamed	Stream	Anadromous	20	Culvert	2 x 10		√	√	√

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.
[a] The conveyance size is a SEA estimate based on proposed lengths of similar crossings. The final conveyance distance would be determined during final design.

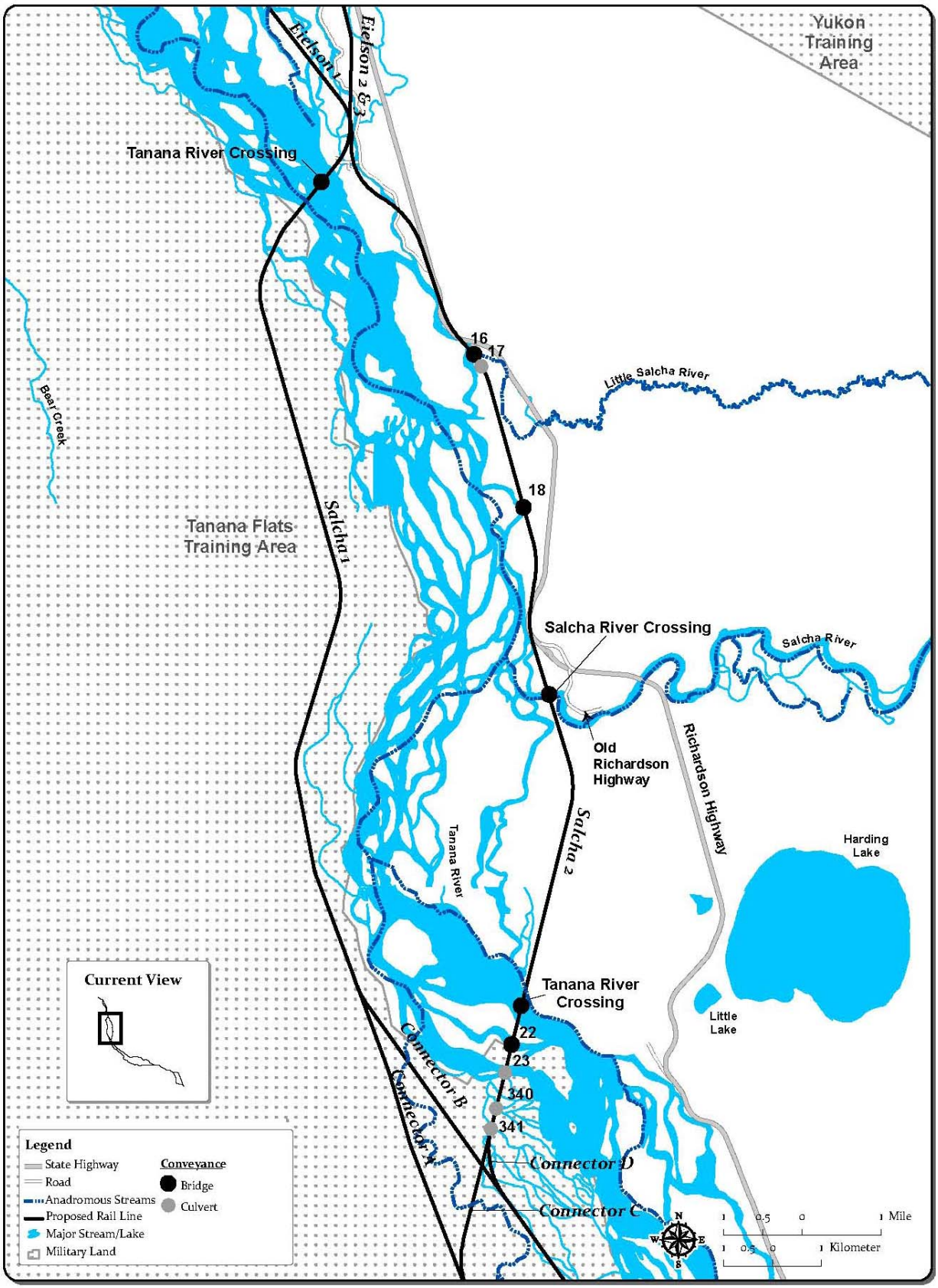

Figure 5-12 – Fish-bearing Streams Crossed by the Salcha Alternative Segments (ADF&G, 2005; Johnson and Weiss, 2007; Noel, 2007a)

the east and west banks of the Tanana River. Revetments change the local hydrology, and though riprap may provide some habitat for juvenile salmonids along the stream reaches that have been severely degraded, riprap does not provide the habitat required for multiple age classes of salmonids or for resident fishes equivalent to that provided by naturally vegetated banks (Schmetterling *et al.*, 2001; Fischenich, 2003). Fall run chum salmon spawn in the numerous side channels of the Tanana River upstream and downstream of both Salcha alternative segments (Barton, 1992; Driscoll, 2008). Bridge abutments, levees, and revetments alter hydraulic patterns resulting in locally altered sediment transport, deposition patterns, and scour, creating unstable depositional features that impact fish habitats, and could limit the delivery of coarse sediments to downstream habitats.

Salcha Alternative Segment 1 includes two additional waterbody crossings (Table 5-20), including one side channel of the Tanana River that provides spawning, summer foraging and rearing habitats for resident fish. A shot-rock revetment and channel plug would be placed across the upstream connection of this side channel; which would result in the creation of a groundwater-fed, clear water slough. Passage of river flow is critical for anadromous fish use of side-channel habitats. Blockage or filling of side-channels and sloughs would cause significant habitat alteration, resulting in the eventual loss of salmon spawning. Flushing flows, which prevent the establishment of beaver dams in side channels and sloughs, would be blocked by revetments and channel plugs. 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. Salcha Alternative Segment 1 also crosses a small perennial stream that drains a large wetland complex that provides high quality spawning and rearing habitat for arctic grayling.

Salcha Alternative Segment 2 would include eight additional waterbody crossings including the Little Salcha River, the Salcha River, two un-named streams, three un-named sloughs, and one overflow channel. Six of these crossings are documented as anadromous fish streams, while two have probable fish occurrence (Table 5-20). Salcha Alternative Segment 2 would include running the railbed through a side channel of the Tanana River at the confluence of the Little Salcha River. This Tanana River side channel has been identified as fall chum salmon spawning habitat (Barton, 1992; Driscoll, 2008). The channel modification illustrated at the Tanana River crossing for the Salcha Alternative Segment 2 in Figure 2-17, would result in the creation of a major new channel, redirecting all the flow from the existing side channel and likely leading 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. The Little Salcha River supports chum salmon spawning (Johnson and Weiss, 2007). Salcha Alternative Segment 2 crosses the Salcha River about a mile above the confluence with the Tanana River across potential spawning habitats for fall-run chum salmon and migration habitat for Chinook salmon.

Central Alternative Segments and Connectors

Fish and fish habitats at the 17 crossings of fish-bearing waterbodies crossed by the Central alternative segments and Connectors that would be affected by construction are listed in Table 5-21 and shown in Figure 5-13. Central Alternative Segment 1 crosses one un-named stream which provides spawning and rearing habitat for resident fish. Central Alternative Segment 2 crosses an un-named slough with possible salmon habitat (Table 5-21). This slough periodically receives flow from the Tanana River, which would allow it to provide temporary fish refuge 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 would support seasonal use by resident fish.

Connectors B, C, and E cross the Fivemile Clearwater River, which provides migration and rearing habitat for Chinook and coho salmon and as spawning, migration and foraging habitats for resident fish. The Connectors are widely variable in length and number of stream crossing.

Table 5-21
Fish-bearing Streams Crossed by the Central Alternative and Connector Segments

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

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.

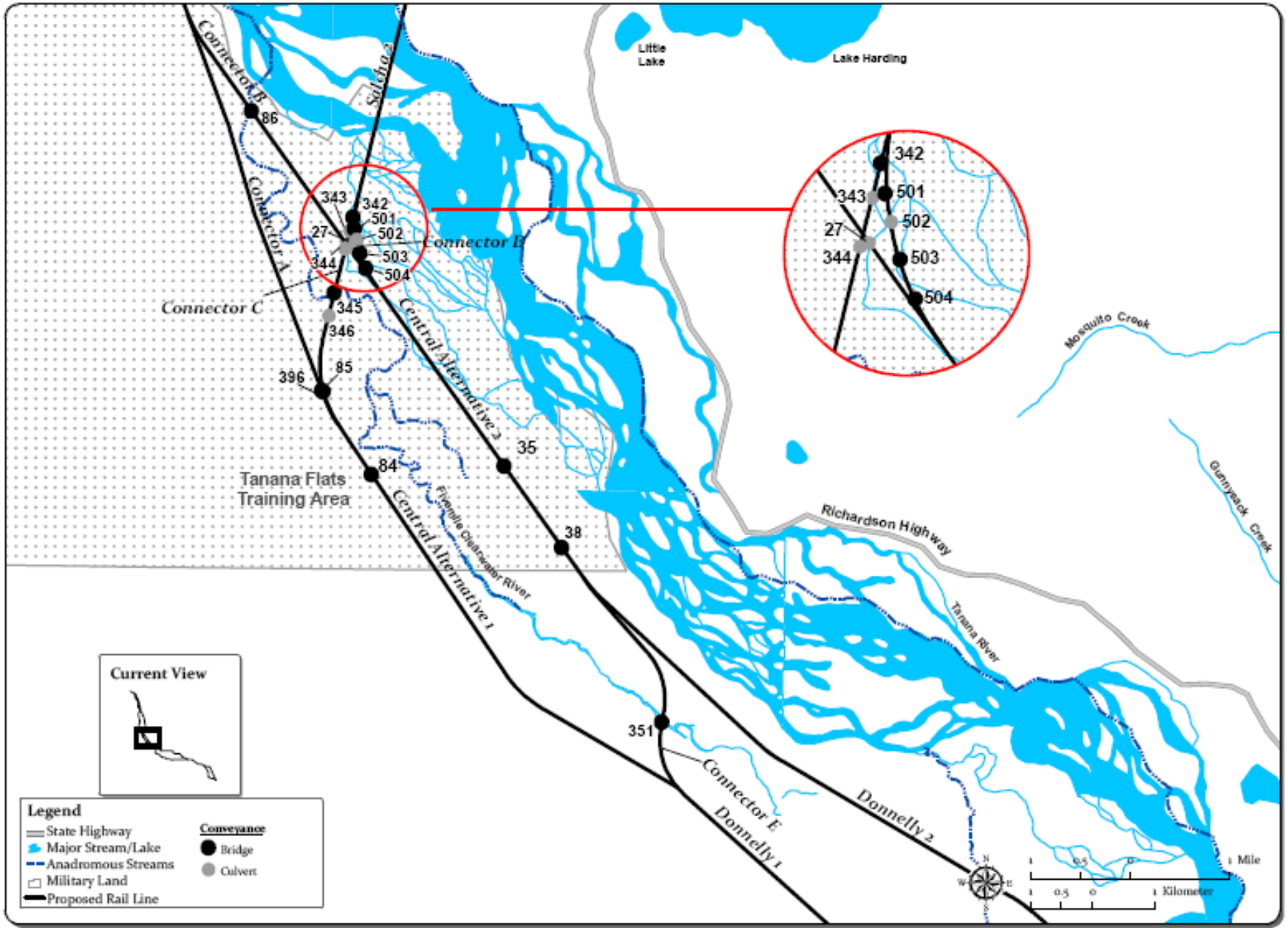

Figure 5-13 - Fish-bearing Streams Crossed by the Central Alternative Segments and Connectors (ADF&G, 2005; Johnson and Weiss, 2007; Noel, 2007a)

Donnelly Alternative Segments

Fish and fish habitats at the 14 crossings of fish-bearing streams crossed by the Donnelly alternative segments are listed in Table 5-22 and shown in Figure 5-14. The Donnelly alternative segments both cross the Little Delta River, Kiana Creek and Delta Creek.

The six streams crossed by Donnelly Alternative Segment 1 provide primarily resident rearing and migration habitats. Donnelly Alternative Segment 1 crossings of the Little Delta River and Delta Creek could be less likely to contain fish habitats than Donnelly Alternative Segment 2 crossings because they are farther from the Tanana River. Resident fish likely use both of these glacial rivers to move between summer foraging habitats and over-wintering habitats in the Tanana River.

Donnelly Alternative Segment 2 crosses the Kiana Creek drainage in the lower reaches compared to Donnelly Alternative Segment 1. The lower portions of the Kiana Creek drainage support coho salmon rearing; and spawning habitats for coho salmon spawning and arctic grayling likely occur in the upper reaches of the watershed, but have not yet been identified. Donnelly Alternative Segment 2 crosses two narrow clearwater streams that flow into a beaver complex, which supports adult arctic grayling and potential spawning habitat for long-nose suckers. These streams appear to be primarily groundwater fed, with the ridges blocking subsurface flows forcing them to the surface, and 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.

South Common Segment

Fish and fish habitats at the three crossings of fish-bearing streams crossed by the South Common Segment are listed in Table 5-23 and shown in Figure 5-15. The South Common Segment crosses several tributaries of the Richardson Clearwater River; which support coho spawning and rearing. Construction of road and rail line bridges at these three crossings would lead to the removal of some of the few remaining trees that line these streams.

Delta Alternative Segments

Fish and fish habitats at the two crossings of fish-bearing streams crossed by the Delta alternative segments are listed in Table 5-24 and shown in Figure 5-16. Both of the Delta alternative segments cross the Delta River, which supports resident fish especially during seasonal movements. The lower 2 miles of the Delta River provides fall chum and coho spawning habitat where upwelling cleans gravels of glacial silts and maintains sufficient flows to remain unfrozen during the winter. Delta Alternative Segment 1 crosses the Delta River near the confluence of Jarvis Creek; which supports resident fish populations especially during seasonal movements to and from upstream foraging, rearing and spawning habitats.

Table 5-22
Fish-bearing Streams Crossed by the Donnelly Alternative Segments

Alternative or Segment	Crossing Number ID	Stream Name	Waterbody Type	Fish Use	Channel Width (ft)	Crossing Type	Crossing Size (ft)	Spawning Habitat	Rearing Habitat	Migration Habitat	Over-winter Habitat
Donnelly 1	137	Unnamed	Stream	Resident	10	Bridge	40		√	√	
Donnelly 1		Little Delta River	Stream	Resident	30	Bridge	800		√	√	
Donnelly 1	279	Unnamed	Stream	Resident	6	Culvert	2 x 10		√		
Donnelly 1	76	West Kiana Creek	Stream	Resident	3	Bridge	40		√		
Donnelly 1	74	Kiana Creek	Stream	Resident	55	Bridge	65		√	√	
Donnelly 1		Delta Creek	Stream	Resident	200	Bridge	700		√	√	
Donnelly 2	40	Un-named	Stream	Anadromous	75	Culvert	3 x 10	√	√	√	√
Donnelly 2	41	Un-named	Stream	Anadromous	18	Bridge	40	√	√	√	√
Donnelly 2		Little Delta River	Stream	Resident	240	Bridge	900		√	√	
Donnelly 2	252	Un-named	Wetland	Probable	85	Culvert	4		√		
Donnelly 2	100	Kiana Creek	Stream	Anadromous	35	Bridge	80	√	√	√	√
Donnelly 2		Delta Creek	Stream	Resident	160	Bridge	700		√	√	
Donnelly 2	101	Unnamed	Stream	Resident	10	Culvert	2 x 10		√		
Donnelly 2	102	Unnamed	Stream	Resident	5	Culvert	10		√		

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.

Table 5-23
Fish-bearing Streams Crossed by the South Common Segment

Alternative or Segment	Crossing Number ID	Stream Name	Waterbody Type	Fish Use	Channel Width (feet)	Crossing Type	Crossing Size (feet)	Spawning Habitat	Rearing Habitat	Migration Habitat	Over-winter Habitat
South Common	136	Un-named	Stream	Anadromous	10	Bridge	50		√	√	
South Common	103	Un-named	Stream	Probable	35	Bridge	65	√	√	√	√
South Common	104	Un-named	Stream	Anadromous	15	Bridge	40	√	√	√	√

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.

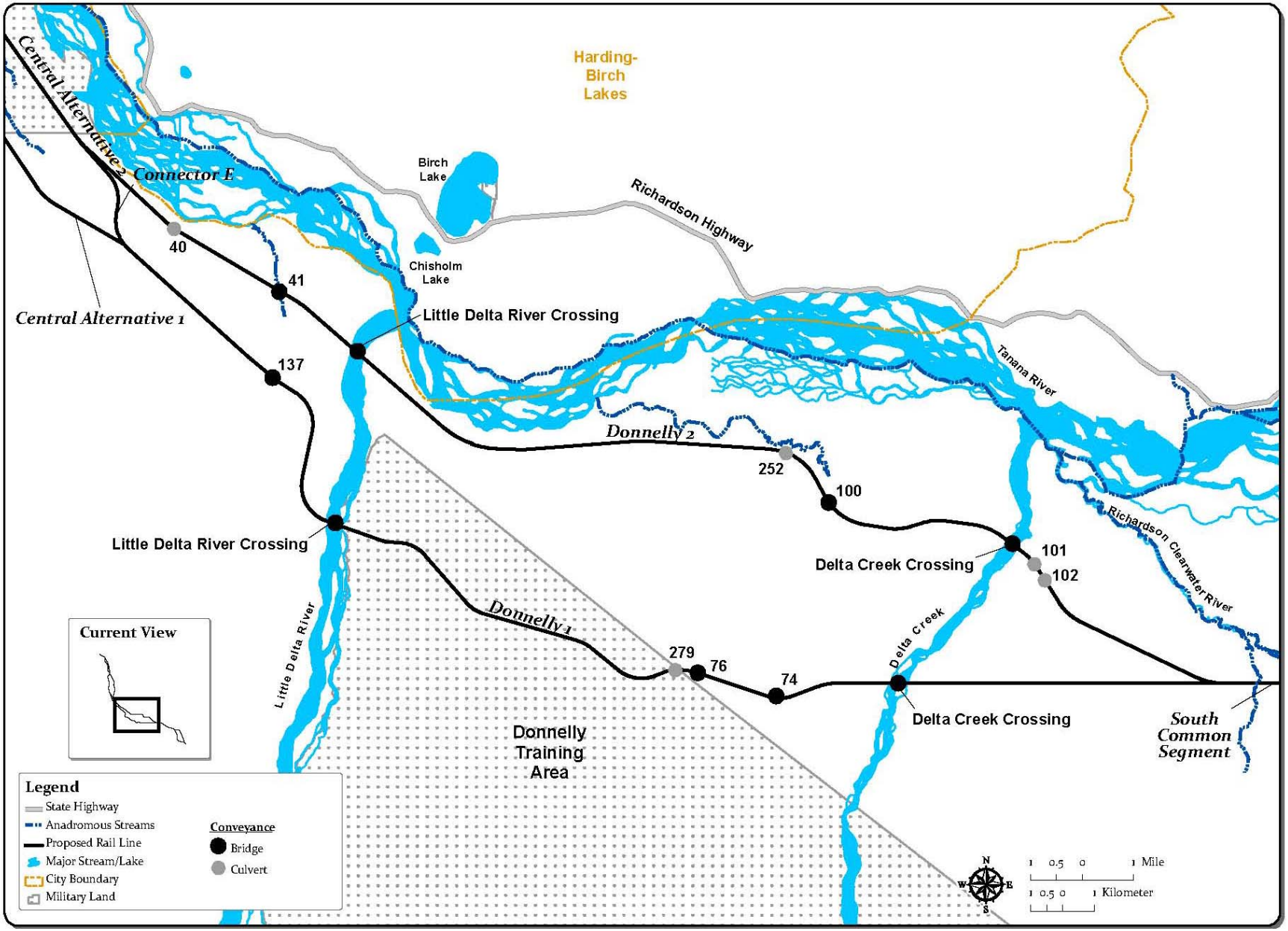

Figure 5-14 – Fish-bearing Streams Crossed by the Donnelly Alternative Segments (ADF&G, 2005; Johnson and Weiss, 2007; Noel, 2007a)

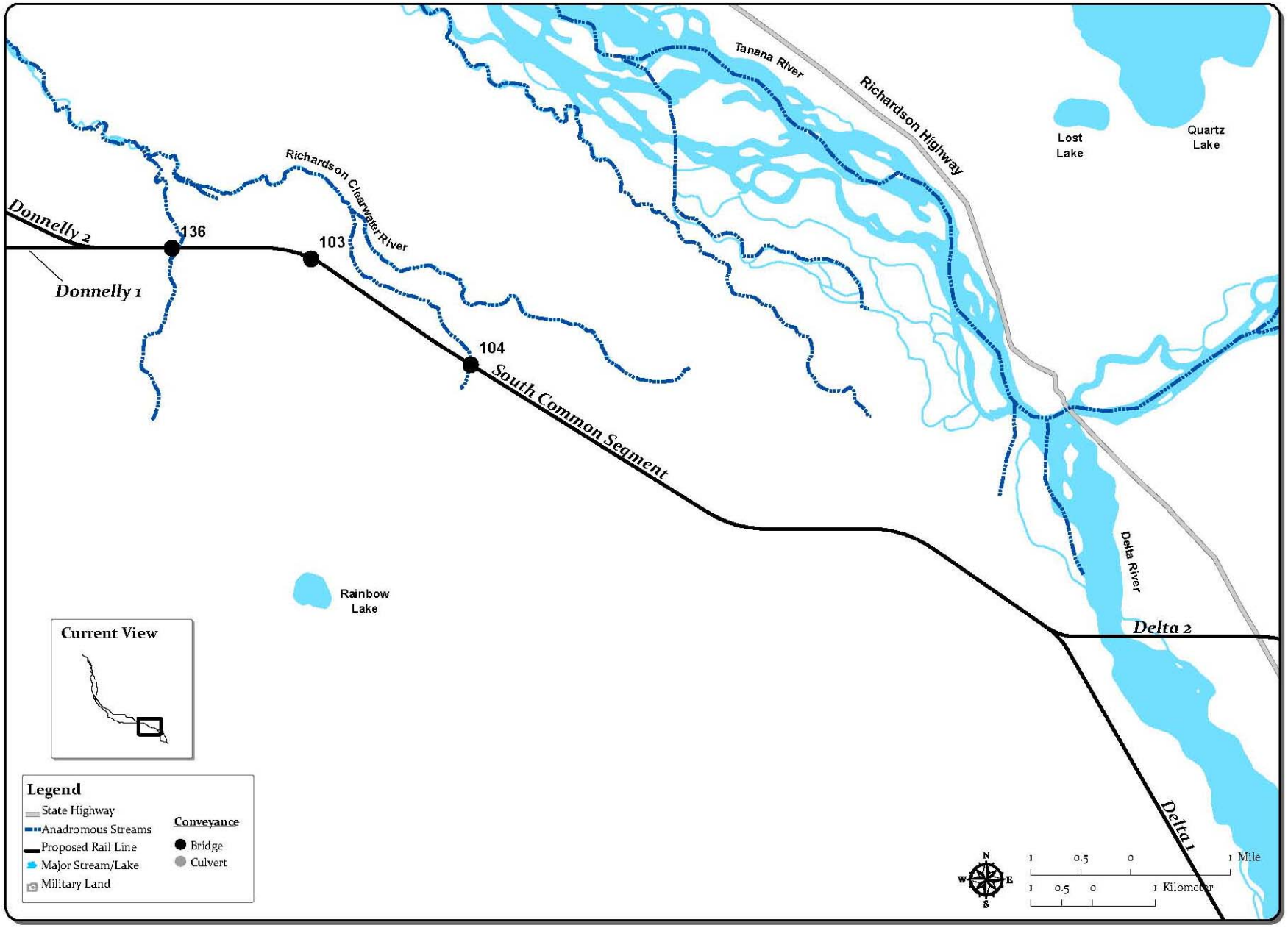

Figure 5-15 - Fish-bearing Streams Crossed by the South Common Segment (ADF&G, 2005; Johnson and Weiss, 2007; Noel, 2007a)

Table 5-24
Fish-bearing Streams Crossed by the Delta Alternative Segments

Alternative or Segment	Crossing Number ID	Stream Name	Waterbody Type	Fish Use	Channel Width (feet)	Crossing Type	Crossing Size (feet)	Spawning Habitat	Rearing Habitat	Migration Habitat	Over-winter Habitat
Delta 1		Delta River	Stream	Resident	630	Bridge	2000		√	√	
Delta 2		Delta River	Stream	Resident	290	Bridge	2000		√	√	√

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.

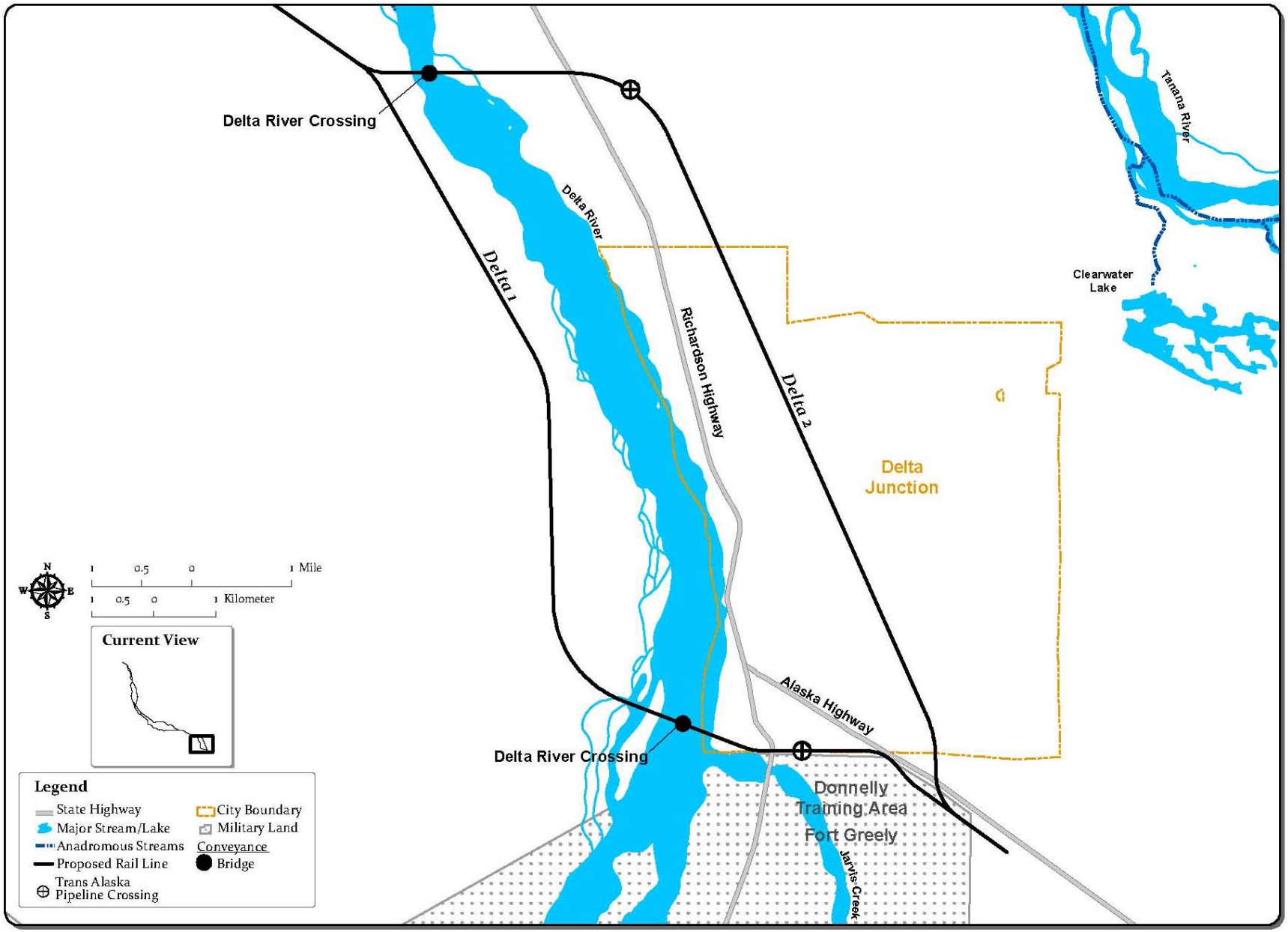

Figure 5-16 – Fish-bearing Streams Crossed by or Near the Delta Alternative Segments (ADF&G, 2005; Johnson and Weiss, 2007; Noel, 2007a)

No-Action Alternative

Under the No-Action Alternative, impacts on fisheries resources from rail line construction and operations activities would not occur.

5.4.3 Summary of Impacts to Fisheries

The primary impacts to fisheries from construction and operation of the proposed NRE would be loss and degradation of instream and riparian habitats due to placement of structures, alteration of stream hydrology and blockage of movements. Alterations of stream hydrology caused by conveyance structures are discussed in Chapter 4. The primary impact of instream gravel removal would be temporary or permanent habitat alteration depending on the amount of gravel removed and the gravel recharge rate. Most effects from the construction and operation of the project would include increased erosion and sedimentation from removal of riparian vegetation, and loss or alteration of stream and riparian habitats. All stream crossings would result in some loss and degradation of instream and riparian habitats as discussed in Chapter 4. Bridged crossings would normally result in a smaller area of instream habitat loss compared to closed bottom culverts. In general, clear-span bridges (those without instream bridge pilings) would have less potential to create conditions that would cause blockage of fish movements. Most alternatives would cross previously identified anadromous fish streams with bridges. The proposed action would require 27 fish-stream crossings, including eight crossings of anadromous fish streams, 18 crossings of resident fish streams, and one crossing of a stream containing fish habitat (Table 5-25). In addition to these crossings, Salcha Alternative Segment 2 would result in filling and alteration of a Tanana River side channel near the outflow of the Little Salcha River, and Delta Alternative Segment 1 would run next to Jarvis Creek, a resident fish stream. Construction and operation of the Tanana River bridge and river training structures in the river channels associated with Salcha Alternative Segment 1 and Salcha Alternative Segment 2 would have direct adverse effects on anadromous and resident fish habitats in the vicinity of the structures. The minimum number of fish-bearing stream crossings that would be required for NRE would be 19 (74 percent bridges, 63 percent resident fish streams), and the maximum number would be 35 (63 percent bridges, 46 percent resident fish streams). Most (67 percent) fish-stream crossings for the proposed action would use bridges, and would cross primarily (67 percent) resident fish streams (Table 5-25). Construction of the NRE would have moderate impacts to resident and anadromous fisheries resources in the project area.

5.5 Game Mammal Resources

This section discusses the existing game mammal conditions in the project area as well as potential impacts resulting from the project.

Table 5-25
Summary of Fish-bearing Streams Crossed by the NRE Alternative Segments

Alternative or Segment	Anadromous Fishes	Probable Fish Habitat	Resident Fishes	Total Crossings	Spawning Habitat	Rearing Habitat	Migration Habitat	Over-winter Habitat	Bridges	Culverts
North Common Segment	1		1	2	2	2	1	1	1	1
Eielson 1	2			2	2	2	2	2	1	1
Eielson 2	2		1	3	2	3	2	2	3	
Eielson 3	1		6	7	1	7	1	1	3	4
Salcha 1	1		2	3	2	3	3	3	1	2
Salcha 2	7	2		9	7	9	6	6	5	4
Central 1			1	1	1	1			1	
Central 2		1	1	2		2	2		2	
Connector A	1			1		1	1	1	1	
Connector B	2			2	1	2	2	1	1	1
Connector C	5	1		6	1	6	6	3	3	3
Connector D	4			4		4	4		3	1
Connector E	1			1	1	1	1		1	
Donnelly 1			6	6		6	4		5	1
Donnelly 2	3	1	4	8	3	8	5	3	4	4
South Common Segment	2	1		3	2	3	3	2	3	
Delta 1			1	1		1	1		1	
Delta 2			1	1		1	1	1	1	
Proposed Action[a]	8	1	18	27	9	27	18	8	18	9
Minimum Crossings Alternative[c]	7	0	12	19	9	19	15	10	14	5
Maximum Crossings Alternative[b]	16	3	16	35	15	35	22	13	22	13

Note: Spawning, rearing, migration, or over-winter habitats for either or both anadromous and resident fish species.
[a] Proposed action includes North Common, Eielson 3, Salcha 1, Connector B, Central 2, Connector E, Donnelly 1, South Common, and Delta 1.
[b] Minimum crossings includes North Common, Eielson 1, Salcha 1, Connector A, Central 1, Donnelly 1, South Common, and Delta 1.
[c] Maximum crossings includes North Common, Eielson 3, Salcha 2, Central 1, Connector C, Donnelly 1, South Common, and Delta 1.

5.5.1 Affected Environment

The proposed NRE would be located within ADF&G's Game Management Unit (GMU) 20 (50,397 square miles); and more specifically, crossing through subunits 20A (6,796 square miles), 20B (9,114 square miles), and 20D (5,637 square miles) (Figure 5-17). Moose and black bears are the primary big game mammals occurring within the project area, which is defined as the area within 5 miles of the proposed alternatives. The eastern end of the proposed rail line is home to the Delta bison herd. Trappers primarily harvest marten, beaver, red fox, lynx, mink, and wolves in the project area. 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.

Bison

Plains bison were introduced to Alaska in 1928 to the Delta River, near the mouth of Jarvis Creek, from the National Bison Range in Montana. The free-ranging Delta bison herd has been maintained by hunting at approximately 450 animals since the 1990s (DuBois, 2004a). Fire suppression in the range of the reintroduced bison led to an increase in forested habitats. The increase in forested areas reduced foraging habitat for the plains bison, which feeds on graminoid vegetation such as sedges and grasses.

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 90,000-acre Delta Junction State Bison Range (Figure 5-17). 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 over growth of the native bluejoint reedgrass.

Bears

Black and brown (grizzly) bears are common in GMU 20. During spring, black bears use moist lowlands where early growing vegetation, especially horsetail (*Equisetum* spp.), comprises the bulk of their diet. Black bears also eat carrion moose calves, and salmon when available. During fall, black bears primarily feed on berries, especially blueberries, in open meadows or alpine areas. Black bears selectively use black spruce-tamarack forests with abundant low-bush cranberries and blueberries in the fall and broadleaf forests with horsetails in the spring (Smith, 1994). Brown bears feed on a variety of plants and animals; using their long claws to expose ground squirrels in burrows and dig roots. Brown bears feed on berries, grasses, sedges, horsetails, cow parsnips, fish, roots, and various mammals including ground squirrels, and moose and caribou calves.

Black bears mate during June and July. Brown bears mate during May through July. As food becomes scarce and temperatures drop in the fall, both black and brown bears go into hibernation in dens generally excavated into small mounds, hillsides or river terraces. Bears may remain dormant in winter dens as long as 7 to 8 months. Sows give birth to their young while in their

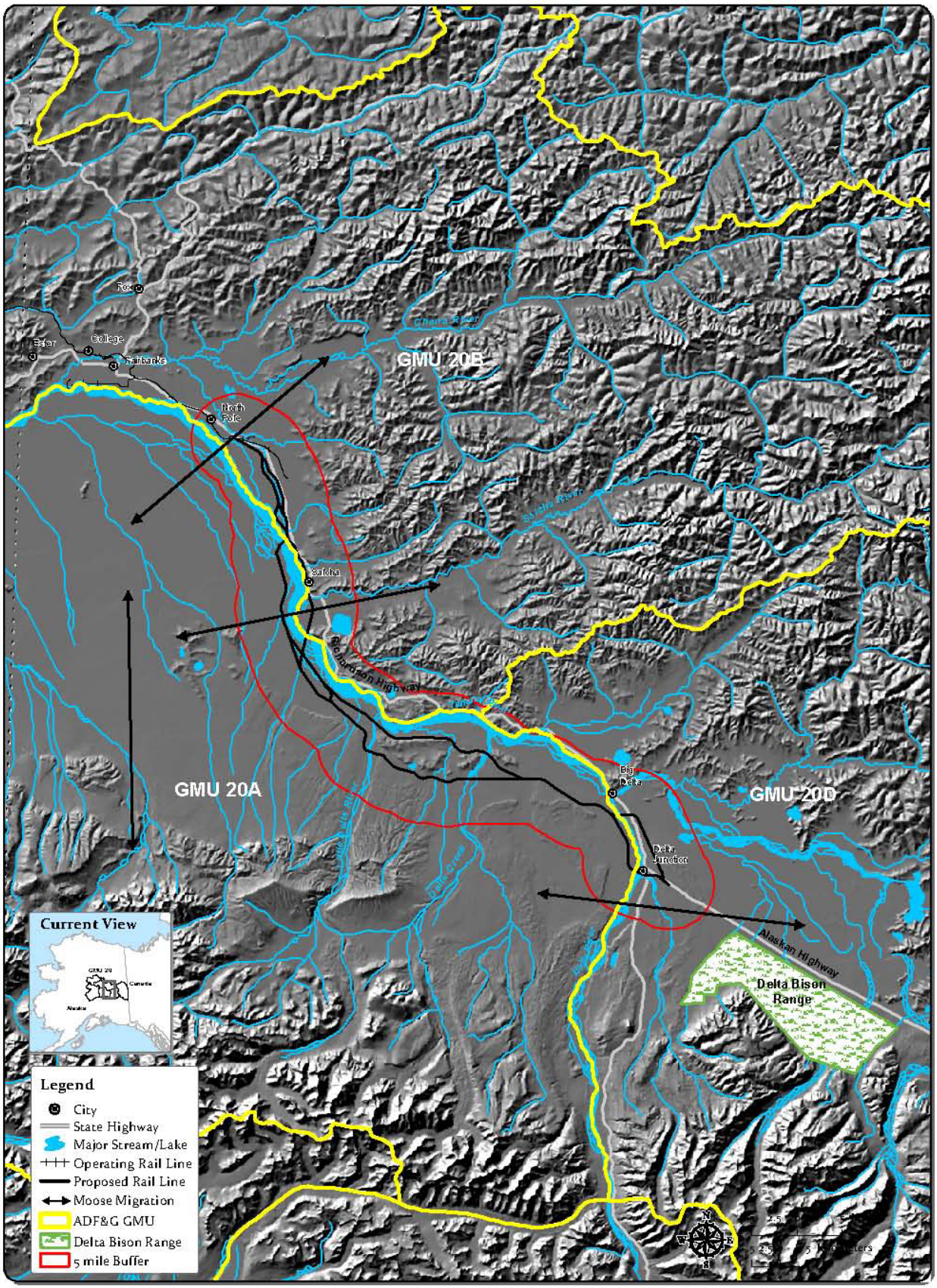

Figure 5-17 – Alaska Department of Fish and Game's Game Management Units, Moose Migration Directions, and the Delta Bison Range

winter dens and emerge with their young in May. Black bear cubs remain with the female for 1 or 2 years, while brown bear cubs remain with the female for 2 to 3 and up to 5 years.

An average of 222 black bears per year was harvested by hunters in GMUs 20A, 20B and 20D from 2001 to 2003. Most black bears are harvested during May and June by local resident hunters as bears emerge from their dens. Harvest is generally concentrated in areas where road systems facilitate access and transport of baits for bait stations. An average of 34 brown bears was harvested annually by hunters in GMUs 20A, 20B, and 20D from 2000 to 2004, mostly in the fall.

Caribou

Two caribou herds may occur within the project area. The Delta caribou herd ranges in the northern foothills of the central Alaska Range between the Parks and Richardson highways, and the Macomb caribou herd ranges in the northern foothills of the eastern Alaska Range between the Richardson Highway and the Robertson River. Caribou from the Delta and Macomb herds are most likely to occur within the project area during the late fall and winter, but would generally not be common in this section of the Tanana River Valley.

Moose

Moose are distributed throughout Alaska and are the primary large mammal harvested within the Tanana River Valley. The moose population in central GMU 20A have been the subject of intensive research and management for decades. Moose in central GMU 20A have been maintained at a high population density and nutritional studies of the area indicate that the population is nutritionally stressed (Boertje *et al.*, 2007). The moose population in GMU 20A appears to have peaked about 2002 at nearly 15,000 individuals, followed by a declining trend in 2004 and 2005 to around 13,000 individuals (ADF&G, 2008a; Young, 2004a and 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 was numbered at approximately 14,000 individuals in 2005 supporting an average harvest of about 650 moose per year (Young, 2006b). The moose population in GMU 20D has also been increasing since the mid 1990s to approximately 5,500 individuals in 2005, although population and harvest management objectives have not been met (DuBois, 2006b). In all three game management subunits, vehicle collisions continue to be a source of mortality, as is mortality due to collisions with trains in GMU 20A and 20B (see Appendix F for discussion of collision-related moose mortality). Primary predators of moose calves in this region are wolves, black bears and grizzly bears (Boertje *et al.*, 2000). Moose in this region include both migratory and non-migratory populations (Gasaway *et al.*, 1983). Migratory moose ranges may be 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. During calving in mid-May to June, cow moose generally select habitats with heavy cover such as dense tall shrub or closed needleleaf forests. Moose forage on sedges, horsetail, pondweeds and grasses during the spring, and vegetation in shallow ponds, forbs and the leaves of birch, willow and aspen during the summer. Aquatic habitats provide aquatic and emergent vegetation, insect relief, drinking water and water for cooling to assist with thermoregulation. Moose mate during September to October, selecting more open habitats

during the rut. During the fall, moose transition from a leafy to a woody diet, feeding on willow, birch, and aspen twigs during the winter. Moose generally use open areas with abundant shrub forage during winter. Moose are well adapted to traveling across snow, but depth of more than 28 inches can affect moose movements and habitat use. Moose may seek closed canopy needleleaf forests, which generally have lower snow depths, as snowpack reaches more than 38 inches (Peek, 1997).

Wolves

Wolves are common throughout the Tanana River Valley. Wolves are social animals that live in packs of 2 to 12 animals; which usually include parents and pups with larger packs of multiple females and two or three litters of pups. Wolves breed in February and March, and litters are born in May or early June, averaging four to seven pups. Pups are born in a den excavated in well drained soil. Wolves center their activities around their den sites, traveling as far as 20 miles in search of food to bring back to the den. Pups are weaned during mid-summer, and pups are usually moved away from the den in mid to late-summer.

Wolf populations in GMUs 20A, 20B, and 20D are managed to provide for compatible human uses including hunting, trapping, photography, viewing, listening, scientific and educational purposes (Young, 2006c; DuBois, 2006c). Management of wolves focuses on providing sustained, diverse uses (Young, 2006c). Most harvested wolves are taken by trappers using snares and traps although some are shot by hunters, with an average annual harvest of 78 wolves per year in GMU 20A; 79 wolves per year in GMU 20B; and 29 wolves per year in GMU 20D (Young, 2006c; DuBois, 2006c).

The primary foods of wolves in GMU 20 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 been used periodically 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. Fall wolf populations within these three subunits appear to have remained fairly stable, at around 500 individuals, from 1998 to 2005 (Young, 2003 and 2006c; DuBois, 2003 and 2006c).

Furbearers

There are no comprehensive surveys throughout the project area for furbearers to indicate density or abundance. Common furbearers harvested in the project area are listed in Table 5-26. The primary species targeted by trappers in this area are marten, wolf, wolverine, and lynx (Blejwas, 2006). Wolverine are also harvested by hunting. Harvest data give an indication of abundance and are used by wildlife managers. However, as access into remote areas is increased by the creation of transportation alignments, harvest data can give a false impression of species abundance as new areas are opened and local populations are reduced through harvest. Most trappers in Interior Alaska use traps or snares to harvest furbearers and run their traplines using snow machines and highway vehicles (Blejwas, 2006). Wildlife managers request that trappers

Table 5-26
Estimated Abundance, Population Trends, and Harvest of Furbearer for GMUs 20A, 20B, and 20D Within the Project Area

Common Name	Species	Relative Abundance	Trend	20A Harvest Estimate	20B Harvest Estimate	20C Harvest Estimate	*Totals*
Beaver	*Castor canadensis*	abundant	none	153	871	24	1,048
Coyote	*Canis latrans*	common	none	94	141	29	264
Short-tailed Weasel (Ermine)	*Mustela erminea*	common	none	47	165	6	218
Lynx	*Lynx canandensis*	scarce	none	371	33	29	433
Marten	*Martes americana*	common	none	1,024	1,671	306	3,001
Mink	*Neovison vison*	common	none	365	35	12	412
Muskrat	*Ondatra zibethicus*	scarce	none	0	0	41	41
Red Fox	*Vulpes vulpes*	common	none	406	141	141	688
Red Squirrel	*Tamiasciurus hudsonicus*	abundant	none	94	141	29	264
River Otter	*Lontra canadensis*	scarce	none	9	9	0	18
Wolf	*Canis lupus*	common	decline	75	69	69	213
Wolverine	*Gulo gulo*	scarce	none	16	5	11	32
All Furbearers				2,654	3,281	697	6,632
Prey Species							
Hare	*Lepus americanus*	common	increase	(Abundance peaked during 2006; ADF&G 2008c)			
Grouse		common	none	(Abundance peaked during 2005; ADF&G 2008c)			
Ptarmigan	*Lagopus* spp.	scarce	none	(Abundance peaked during 2006; ADF&G 2008c)			
Mice/Rodents		abundant	increase				

Notes: Harvest estimates are for the 2004-2005 season based on the ADF&G's Trapper Questionnaire (Blejwas, 2006). Questionnaire totals were adjusted by percent of sealed furs using either the reported percentages or the average percentage for Region 3 – Interior Alaska (Blejwas, 2006).

qualitatively evaluate furbearer abundance to indicate if populations appear to be increasing or decreasing; these qualitative trends are reported in Table 5-26 (Blejwas, 2006).

Furbearers are quite varied in ecology and habitat use. Beaver, mink, muskrat and river otter all depend on aquatic habitats, but only beaver and muskrat forage on vegetation. Ermine and mink prefer riparian woodlands and feed on small warm-blooded mammals, but will eat birds, eggs, frogs, fish and insects. Wolverine, a weasel relative, are habitat generalists which can be expected to use available forested and riparian habitats within the project area. They are solitary animals that are primarily scavengers, although they will also prey on small mammals.

The canids—red fox, coyote and wolf—range widely using many habitat types with home range size increasing with the increasing size of the species. Foxes, coyote, and wolves are susceptible to rabies, distemper, and other diseases which may cause periodic declines in populations; although rabies has not been demonstrated to cause declines in Interior Alaska populations. These three species compete for smaller prey and will exclude the smaller species from their range such that, foxes are less abundant where coyote are common, and coyote are absent or scarce where wolves are abundant.

Lynx also have a wide range; the size of their range is dependent on prey availability. Lynx populations are particularly influenced by hare populations, which in turn are regulated through vegetation following an 8 to 10-year cycle. All furbearers use some type of nest, den, or burrow for reproduction and some species use these structures year-round. Some species rely on delayed implantation to separate and regulate the breeding and birthing periods.

5.5.2 Environmental Consequences

The magnitude of environmental consequences of construction and operation of the NRE on game mammals would be influenced by the animal's dependence on specific habitats, the availability of preferred and used habitats, the amount of preferred habitat affected by the project, ecology and life history, and past and current population trends. Because game mammal populations are managed for sustainable human harvest, project-related effects on population abundance, distribution, available habitat, and predator-prey relationships would also affect management of these game mammals. Supporting descriptions of environmental consequences, results of quantitative analyses and illustrations are presented in Appendix F.

Impacts common to all alternative segments are presented first, followed by a discussion of these impacts as they apply to the common game mammals. Most effects from construction and operation of the NRE would be similar for game mammals regardless of the specific alternative segment selected for construction and are discussed under common impacts. In a few cases, construction or operation impacts for game mammals from individual alternative segments could differ and these are discussed under the specific alternative segments. Some game mammal resources are limited in distribution within the project area and affects of construction and operation of the NRE on these resources are discussed under the specific alternative. Proposed mitigation for impacts to game mammals is presented in Chapter 20 of the EIS.

Methodology

Effects on game mammals from the construction and operation of the proposed NRE were evaluated based on habitat use, habitat requirements, and seasonal movements of game mammals within the project area. Habitat analysis for game mammals was based on the vegetation analyses presented in the EIS, and the reported density of animals expected within the project area.

Habitat fragmentation due to roads and trails was evaluated by comparing the existing density of roads and trails (miles per square mile) within 9.5-square-mile (25–square-kilometer) blocks established to summarize aerial transect survey data. Original road and trail density was calculated, as was the density after including the proposed NRE. The difference between the existing road and trail density within the analysis block, the increase in density as a result of construction of the NRE, and the final post-construction density were compared. The NRE was treated as a single alignment, even though it includes adjacent rail and road alignments within the 200-foot ROW along most of the route.

Fragmentation of riparian areas was based on GIS data that includes 25-foot buffers (50 feet total width) for riparian areas of minor rivers and 100-foot buffer (200 feet total width) for riparian areas of major rivers. Spatial analyses were completed using ArcGIS and hydrology data taken from U.S. Geological Survey 1:63360-scale mapping for water. Major rivers were defined as the Tanana River, Salcha River, Richardson Clearwater River, Fivemile Clearwater River, Delta Creek, Little Delta River and Delta River.

Potential fragmentation of large contiguous habitat areas, referred to as core areas or habitats, was evaluated by visual comparison and consideration of spatial statistics generated using the Patch Analyst extension for ArcGIS. Core habitats were created from the existing landcover map (BLM *et al.*, 2002) by aggregating polygons constructed from the raster image by landcover

class within the 5-mile area surrounding the alternative segments. Core areas were constructed using a 100-foot buffer, based on the 98-foot (30-meter) pixel size for the landcover map. Core habitats that would be crossed by the alternative segments were then identified and spatial statistics were computed. A buffer of the proposed NRE was then created and used to produce fragmented core habitats. The fragmented core habitats were then compared to the original core habitats both visually and using spatial statistics.

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, 2007b).

Common Construction Impacts

This section describes the common types of environmental consequences that construction-related activities could have on game mammals. In situations where certain game mammals are more susceptible to a construction action, the impact is explained in detail under the type of mammal. Construction would include clearing the ROW and laying the new rail line, installing communication towers and power lines, operation of work camps and construction staging areas as well as potential borrow area sites. Some impacts would be initiated during construction but would continue through operations, such as habitat modification and impacts from power lines and communication towers.

- **Habitat loss, alteration, and fragmentation**. Construction of the rail line and additional facilities would result in short-term disturbance and long-term habitat loss and modification within the ADF&G's GMUs 20A, 20B and 20D. The NRE would require removal of about 2,800 to 3,000 acres of mainly undisturbed native vegetation across the Tanana River Valley. For all cover types, the maximum area of impact would represent less than one percent of habitats available within 5 miles of the proposed alternatives. Review and analysis of land cover mapping (BLM *et al.*, 2002) indicates that the rail alignment would contribute to habitat fragmentation of forested and riparian habitats. Habitat fragmentation-related issues relevant for game mammals include barriers to movement, creation of edge effects, reductions in core areas of available habitats, facilitation of predator movements, intrusion of invasive species, and intrusion of humans (Jalkotzy *et al.*, 1997). Much of the habitat that would be crossed by the proposed rail line has not been previously fragmented by improved transportation alignments; however, an extensive network of trails can be found in the area.

- **Direct mortality from construction.** Construction-related traffic along the access and maintenance roads would involve many gravel haul truck trips as well as other traffic. Game mammals could be hit and killed by construction vehicles traveling back and forth, especially in areas or weather conditions with poor visibility coincident with high traffic levels. Game mammals in hibernation or in dens with young that are unable to move during construction could be killed during clearing and excavation. Food- conditioned bears investigating worksites or construction camps may end up as Defense of Life or Property mortalities. Additional hunting mortality could occur if workers are allowed to hunt from work camps.

- **Reduced survival from exposure to construction noise and from increased human activity**. Construction noise and human activity could cause mammals to flee from

hibernation sites or abandon young. Abandoned young could die and energy expended fleeing could cause reduced survival over harsh winter months. Game mammals that reuse den or nest sites could be forced to abandon them due to proximity to the project. This would require extra energy and could reduce survival. Bears and moose may be intentionally harassed by hazing to protect workers and equipment.

- **Loss of breeding success from exposure to construction noise and from increased human activity**. Construction during individual breeding seasons of game mammals could lead to loss of breeding success especially if mammals are differentially displaced because of sex or age. Construction in favored breeding habitats could result in energy spent finding more suitable habitats thus limiting survival of offspring or adults.

- **Reduced survival or mortality due to spills and leaks of toxic materials.** Game mammals could be exposed to leaks of fuels, oils, antifreeze and other toxic substances used to operate and maintain equipment used during construction. Many game mammals are curious and could experience fatalities if toxic substances were ingested either directly or through self cleaning of oiled fur or hair. Canids and bears are both attracted by antifreeze.

Bears

The proposed action and alternatives would have similar effects on black and brown (grizzly) bears. Based on the reported densities, an estimated 118 to 177 black bears and three to eight brown bears would occur within 5 miles of the proposed NRE. Aerial transect surveys during the spring and fall identified brown bears near proposed alternative segments during fall surveys only (Noel, 2006a).

Black and brown bear foraging habitat that would be affected by construction of the proposed NRE are summarized in Appendix F. The proposed project would affect less than 1 percent of available habitat within 5 miles of the proposed alternatives. This level of habitat loss or alteration would likely be of no consequence to existing black and brown bear populations.

Habitat fragmentation may be of more consequence to black and brown bears than direct habitat loss or alteration. It is likely that most bears would be displaced from habitats within as much as 0.3 mile from roads, especially during spring (Waller and Servheen, 2005) by heavy construction-related traffic. In some areas, the existing road densities are sufficient to displace black bears (2 miles per square mile) and brown bears (0.5 mile per square mile) (Jalkotzy *et al.*, 1997). The NRE would increase area road densities sufficient to displace black bears from the current value of 9 percent to a predicted value of 12 percent, and would increase area road densities sufficient to displace brown bears from the current value of 36 percent to a predicted value of 52 percent of the 316-square-mile area analyzed. Displacement of bears, however, would be of unknown consequence because differential habitat values for the surrounding region are not quantified.

The access road and rail line could act as a fire break leading to decreased incidence of wildland fires spreading across the rail alignment. Fire could be beneficial to bears by increasing plant growth and berry crops leading to increased forage and prey animals. It could also be detrimental to bears by clearing large areas of forest, thus reducing black bear numbers, or adversely affecting salmon streams, thus reducing prey.

Bears use riparian corridors for travel and forage. Fragmentation of riparian habitats would occur due to construction of the proposed 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 bears to cross beneath them. If construction of bridges and bridge approaches for streams with salmon spawning runs occurred coincident with these runs during the summer into early winter, bears could be temporarily displaced from these foraging habitats.

The proposed action and alternatives could coincide with den sites. Because some of these sites would be reused (18 percent), destruction of an unoccupied den site could reduce survival of the individual attempting to reuse the site (Smith, 1994). Several black bear dens were located on bars in the Tanana (Smith, 1994). Fall and winter vegetation clearing activities and excavation would potentially affect approximately one black bear den based on the minimum and maximum project areas and the estimated density of black bears in the project. While effects to a few individuals could occur, effects to the population would be minor. No brown bears would be expected to den within the project area.

Food-conditioned bears could be attracted to the worksites if foods and garbage create odors. If bears investigating worksites or construction camps gain access to foods or garbage, they would not avoid these areas and would likely end up as Defense of Life or Property mortalities. Sows which become food-conditioned teach their cubs to also associate humans with food, which can eventually lead to the destruction of entire family groups. Between 2001 and 2005, six black bears and six brown bears were killed in Defense of Life or Property in GMUs 20A, 20B and 20D (ADF&G, 2005b).

Caribou

Caribou from the Delta and Macomb herds are most likely to occur within the project area during the late fall and winter, but would generally not be common along the rail line. If the Fortymile Caribou herd were to increase in size and range, these animals could also winter near the NRE. Within the project area, needleleaf forests, open broadleaf forest, graminoid and bryoid/lichen habitats would contain plants and lichens preferred by caribou as winter forage. Direct habitat loss would affect less than one percent of habitats available within 5 miles of preferred alternatives.

Winter construction would have the greatest potential to disrupt caribou within the region. A few caribou could be hit by construction vehicles. Construction activities could displace caribou from winter foraging habitats which could increase their energy expenditure leading to reduced survival. However, few caribou would be expected within the region and any mortality due to collisions, or reduced survival or reproduction due to disturbance and displacement would be expected to be negligible.

Moose

Preferred moose habitats include riparian willow, poorly drained meadows, and early succession forests. Direct habitat loss would affect less than one percent of habitats available within 5 miles of the proposed alternatives. Based on fall moose densities, adjusted by proportion of the project area within each GMU, habitat used by an estimated 12 moose would be lost or substantially altered by construction of the project.

Moose reproduction parameters, population size, and trend and browse condition within the region indicate that availability of high quality forage may be inadequate for the size of the moose population within the GMU 20A portion of the project area (Boertje *et al.*, 2007). Some of the most valuable browse for moose—broadleaf forests and tall shrub habitats—are not abundant within the project area. These habitats account for about 15 percent of habitats within 5 miles of the proposed action and alternatives and total acres removed would be less than one percent of habitats available within 5 miles of the proposed alternatives. The area of vegetation removed, however, may underestimate the total habitat impact if moose avoid roadways (Rolley and Keith, 1980). Snow conditions and migratory behaviors could negate avoidance, however, and because moose use a variety of habitats, and readily cross transportation alignments during most of the year, habitat loss and fragmentation by the rail line would generally be of minor consequence to moose.

Wolves

Wolves sometimes den in areas such as the low rise south of the Tanana River and also have seasonal den sites in diverse habitat. Therefore, construction of the proposed project could directly affect the natal and seasonal den sites of the estimated four wolf packs in the project area. Noise from construction activities would affect a greater area than the direct footprint of the project and could result in displacement of a few individual wolves away from the immediate area. If construction activities occurred in early spring shortly after pups are born, disturbance near an active den site could lead to abandonment of the den and loss of the pups, but could also result in movement of the pups to a new den site by the adult wolves.

In portions of the project area the existing road densities are sufficient to displace wolves (1.5 miles per square mile) (Jalkotzy *et al.*, 1997). The addition of NRE would increase area road densities to more than 1.5 miles per square mile within 3 percent of the project area. Although the rail line would not be open to public access, hunters and trappers could trespass on the alignment. Road and trail densities sufficient to limit wolf numbers due to access by hunters and trappers, estimated at 1 to 1.3 miles per square mile (Jalkotzy *et al.*, 1997), would increase within 6 percent of the project area. This level of increased road density would be unlikely to affect wolf populations within the project area, even if hunters and trappers trespassed on the alignment.

Wolves are habitat generalists, and would not likely be directly affected by habitat loss due to construction of the proposed alternatives, but could be indirectly affected by habitat loss if changes in potential prey species resulted.

Furbearers

Appendix F describes habitat use, breeding season, den type and use and home range size estimates and estimated habitat impact area for furbearers. Forested and riparian habitats would be the primary habitats used by the diverse assemblage of furbearing animals within the region. Minimum and maximum impacts to habitats used by each furbearing animal are quantified in Appendix F. Direct habitat loss would affect less than 1 percent of habitats available within 5 miles of the proposed alternatives. A few furbearers would be expected to be hit and killed by construction vehicles.

Common Operations Impacts

This section describes the common types of environmental consequences that operation-related activities would have on game mammals. In situations where certain game mammals are more susceptible to a project operation, the impact is explained in detail under the type of mammal. Project operation would include running five round trip trains per day (ten one-way trains) over the rail line and maintaining the ROW. Some impacts would be initiated during construction but would continue through operation such as habitat modification and impacts from power lines and communication towers.

- **Mortality due to collision with trains**. Train traffic on the rail line would result in mammal fatalities, especially in areas or weather conditions with poor visibility and in areas with concentrated use by specific game mammals.

- **Reduced survival due to habitat alteration – attraction/ displacement**. Game mammals displaced from or attracted to the rail line may have increased or reduced survival. For example, increased availability of carcasses from animals colliding with the train would benefit predators such as wolves and coyotes, which may change their distribution as a result of the transportation alignment through the region. Increases in predators along the rail line could, however, be negated if trapping increases by unauthorized use of the maintenance road. Changes in the natural fire regime which maintains the boreal forest ecosystem could result from the addition of the rail line through this region.

- **Reduced breeding success due to disturbance from trains or humans**. Train operation during individual breeding seasons of game mammals could lead to loss of breeding success especially if mammals are differentially displaced because of sex or age. ARRC regulations prohibit access to rail ROW; however, the cleared rail ROW and maintenance road could make remote regions of the project area more accessible to unauthorized users. This would affect the pattern of hunter and trapper harvest activities within the project area by facilitating access to existing trail systems or to previously remote, roadless areas.

- **Reduced or enhanced survival due to disruption of predator-prey relationships.** Any alteration of predator survival (especially for wolves and bears; the primary predators of moose in the region), due to increased nutrition from rail-killed moose or other large game mammals would have the potential to disrupt predator-prey relations within the region. Increased trapping or hunting facilitated by unauthorized access to remote locations from new roads would also have the potential to disrupt predator-prey relations within the region.

- **Reduced survival or mortality due to exposure to spilled toxic materials.** In the unlikely event of a fuel spill or leak caused by derailment or chronic leaks from engines and tank cars during operation, game mammals would be exposed to contamination. Oiled mammals ingest contaminants during grooming or through consumption of oiled prey, leading to toxicity. Fur provides insulation which is lost upon contact with petroleum-based products, such as diesel fuel and oil, leading to hypothermia especially for mammals tied to aquatic environments such as beavers and otters. Spills could also lead to reduced food abundance.

Bears

Few bears would be expected to be hit by trains, as no bears have been reported killed by rail lines within the project area or along the Richardson Highway. Bears would generally be expected to avoid the rail line, although some bears may be attracted to the rail line if grains or animal feeds such as wheat, barley, oats or dog foods were spilled and not effectively removed. Bears could also be attracted to the rail line by rail-killed carrion during their active periods – spring through fall. The five round trip trains per day and periodic summer maintenance work would cause minor displacement of a few bears from the rail line. All but very small cubs would be expected to successfully cross the rail line.

Moose

Based on early-winter densities, an estimated 2,300 moose would occur within 5 miles of the proposed project alternatives, including about 1,400 seasonal migrants that would move across the proposed rail line at least twice a year. The existing 58 miles of rail line through GMU 20B averages an annual moose-train collision mortality of 0.35 moose/mile or about 20 moose per year (annual range 0.16 to 1.05 moose per mile) (Young, 2004b; 2006b). Assuming that the frequency of trains for the NRE would be roughly 40 percent higher than the frequency of trains on the existing 58-mile rail line at the western end of the project area, the increase in moose-train collision mortality from operation of the proposed 81.5-mile NRE would average 40 moose per year, ranging from 18 to 120 collision mortalities per year. If the frequency of trains is also increased on the existing rail line because of operation of the NRE, the number of moose-train collision mortalities would be expected to increase on the existing line.

These mortalities would primarily occur during November, December and January and would likely be concentrated along specific rail alternatives (discussed in alternative sections below). Moose-train collision mortalities resulting from operation of the NRE could range higher than the estimated values during years with snow depths greater than 30 inches, or if a greater proportion of seasonal moose movements occur across the NRE than occur across the existing 58-mile rail line west of the project area.

Indirect effects of the NRE on moose habitat, movements, survival and reproduction related to disturbance would be minor compared to the direct loss of moose due to moose-train collision mortality. All moose would be expected to successfully cross the rail line, unless hit by a train or work vehicle. The five round trip trains per day and periodic summer maintenance work would cause minor displacement of moose from the rail line. Harvest pressure on moose is directly related to the ease of hunter access and road development into moose range (Timmerman and Buss, 1997).

Wolves

Wolf packs may travel as much as 10 to 30 miles a day during winter, and dispersing wolves may travel 100 to 700 miles from their original pack range. The estimated 36 wolves residing within the project area would likely be attracted to and travel along the rail line. Wolves hunt daily traveling in areas that provide the best passage, such as rivers, ridges, creeks, trails, and little-used roads. Few wolves would be expected to be hit by trains, because no wolves were reported as killed by vehicles on the section of the Richardson Highway that crosses through the project area (ADF&G, 2005b).

Indirect effects due to disturbance may cause some additional displacement of wolves from the vicinity of the NRE alignment. Wolves could also be attracted to the rail line by the increased availability of animal carcasses from moose-train collisions and bird-powerline collisions. During winter, wolves attracted by carcasses to the rail line could experience reduced survival because of facilitated unauthorized access for hunters and trappers to remote areas south of the Tanana River (Jalkotzy *et al.*, 1997).

Furbearers

Several train collision mortalities could be expected each year due to operation of the NRE. Habitat loss effects on furbearer populations in the project area would likely be negligible, although changes in access, if hunters and trappers trespass on the new ROW, could increase furbearer harvest in remote locations south of the Tanana River.

Impacts by Alternative Segment

This section describes the environmental consequences of the common and alternative segments of the proposed NRE to game mammals where these are notable or apply to specific species only.

North Common Segment

Moose and furbearers are expected to occur within this portion of the NRE. Current access for hunting and trapping, along with residential and agricultural development reduce the occurrence of wolves, bears and some furbearing animals within this area.

Eielson Alternative Segments

Impacts for the Eielson alternative segments would be the same as the impacts discussed for North Common Segment.

Salcha Alternative Segments

All game mammals are expected to occur within this portion of the project area, although densities are expected to be higher in Salcha Alternative Segment 1 than in Salcha Alternative Segment 2 because of the remoteness of the Salcha Alternative Segment 1 habitats. In Salcha Alternative Segment 2, current residential and agricultural development could reduce the occurrence of wolves, bears and some furbearing animals.

Both alternative segments cross the Tanana River and areas of riparian habitats, potentially used by moose, bears, and furbearers for forage and travel upstream from these crossings would be altered by bank armament. All furbearers would be expected to be abundant within the extensive riparian habitats in this area, although hunting and trapping may have reduced abundance in the vicinity of the Salcha Alternative Segment 2.

The Salcha Alternative Segment 1 is within a region that is considered prime moose calving habitat. Construction within this area during the calving period would likely displace some calving moose. Displacement from and disturbance within calving habitats may alter reproductive success, primarily thorough changes in predation rates.

Central Alternative Segments and Connectors

The areas of the Central alternative segments and Connectors currently provide riparian habitats for bears, moose, and furbearers. Furbearers would be expected to be abundant due to the remoteness of this area. Moose would be expected to be abundant within this portion of the project area.

Construction of Central Alternative Segment 2, and Central Connectors B, C, and D would contribute to fragmentation of large areas of closed needleleaf forest core habitats (Figure 5-18). Fragmentation of these core forested habitats would have mixed effects on game mammals. Openings created in the closed needleleaf forest would benefit moose, but would be detrimental for furbearers that require dense forests for cover. However, increased edge habitat created by construction of Central Alternative Segment 2 would benefit some furbearers by opening up habitats for prey species such as voles, hares and grouse. Fragmentation of needleleaf forested core habitats would likely be detrimental for red squirrels.

Donnelly Alternative Segments

Both Donnelly alternative segments cross primarily forested habitats. Donnelly Alternative Segment 1 ROW is 77 percent forested and Donnelly Alternative Segment 2 is 81 percent forested. Black bears, moose, wolves, and furbearers would be expected to be common along both Donnelly alternative segments, primarily because of their remoteness, although there are several trails that coincide with Donnelly Alternative Segment 1. Furbearers would be expected to be more common along Donnelly Alternative Segment 2 because of its proximity to riparian habitats of the Tanana River and Kiana Creek and their tributaries.

Habitat fragmentation would be of greater consequence for the closed canopy forests crossed by the Donnelly alternative segments than for the large areas of open canopy forests, which by definition contain breaks with open habitats. Construction of Donnelly Alternative Segment 1 would contribute to fragmentation of core areas of open and closed needleleaf forest habitats (Figure 5-19). Construction of Donnelly Alternative Segment 2 would contribute to fragmentation of core areas of closed needleleaf and closed broadleaf forest habitats (Figure 5-20). Fragmentation of these forested habitats would have mixed effects on game mammals. Openings in closed needleleaf forest would benefit moose, but could be detrimental for furbearers that require conifer forests for cover. Openings in open needleleaf forests would be of less consequence because these habitats have openings in the canopy. While openings in closed broadleaf forests would benefit moose, effects on other game mammals would be varied. Increased edge habitat created by construction of the Donnelly alternative segments could benefit some furbearers by opening up habitats for prey species such as voles, hares and grouse. Fragmentation of closed needleleaf forest would likely be detrimental to red squirrels.

South Common Segment

Black bears, brown bears, moose and wolves would be expected to be common within this portion of the project area based on the relative remoteness of the area, proximity to salmonid streams, an extensive recent burn habitat, and moose observations.

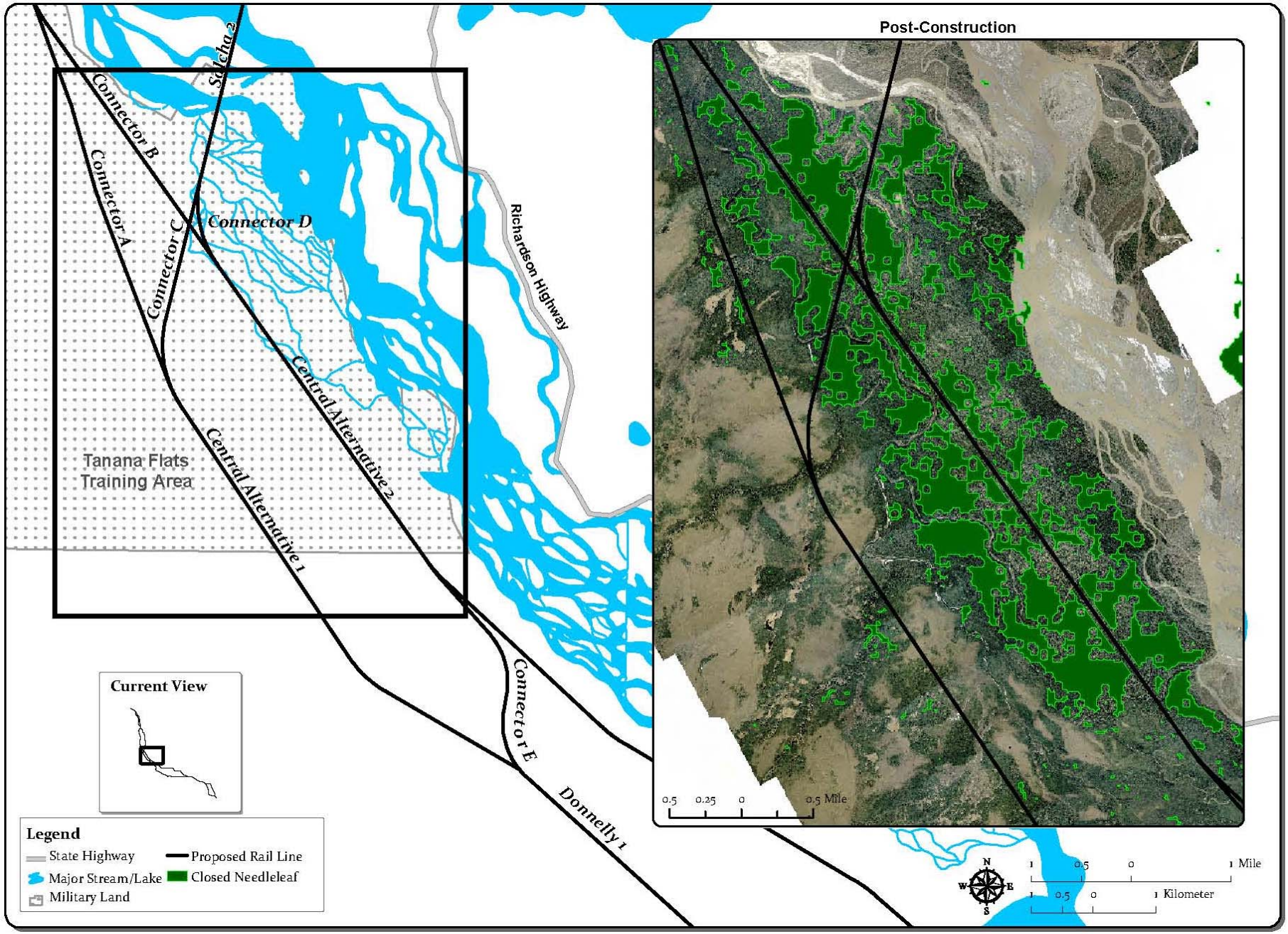

Figure 5-18 – Fragmentation of Core Closed Canopy Needleleaf Forest Habitats Crossed by Central Alternative Segment 2 (BLM *et al.*, 2002)

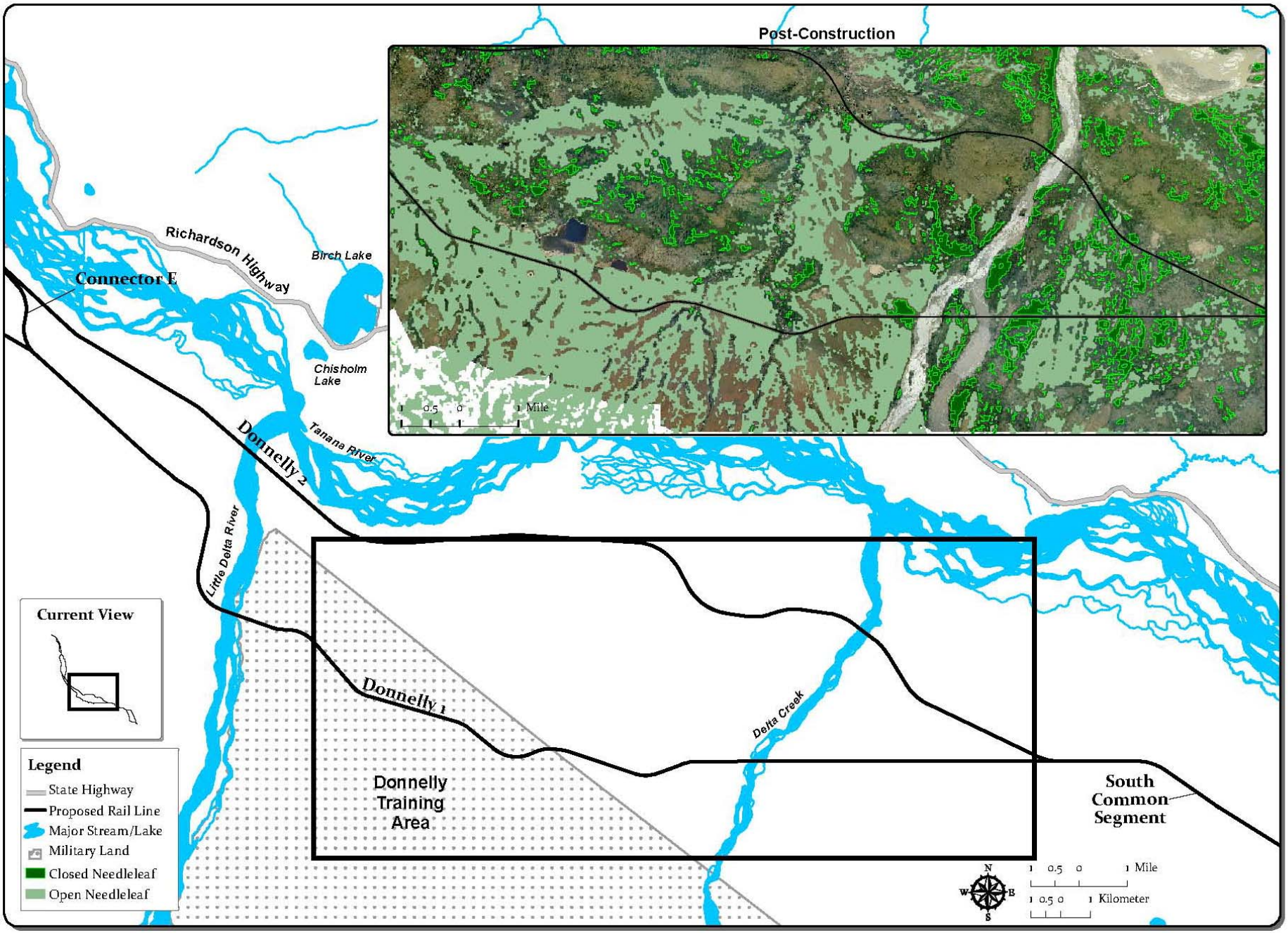

Figure 5-19 – Fragmentation of Core Forest Habitats Crossed by Donnelly Alternative Segment 1 (BLM *et al.*, 2002)

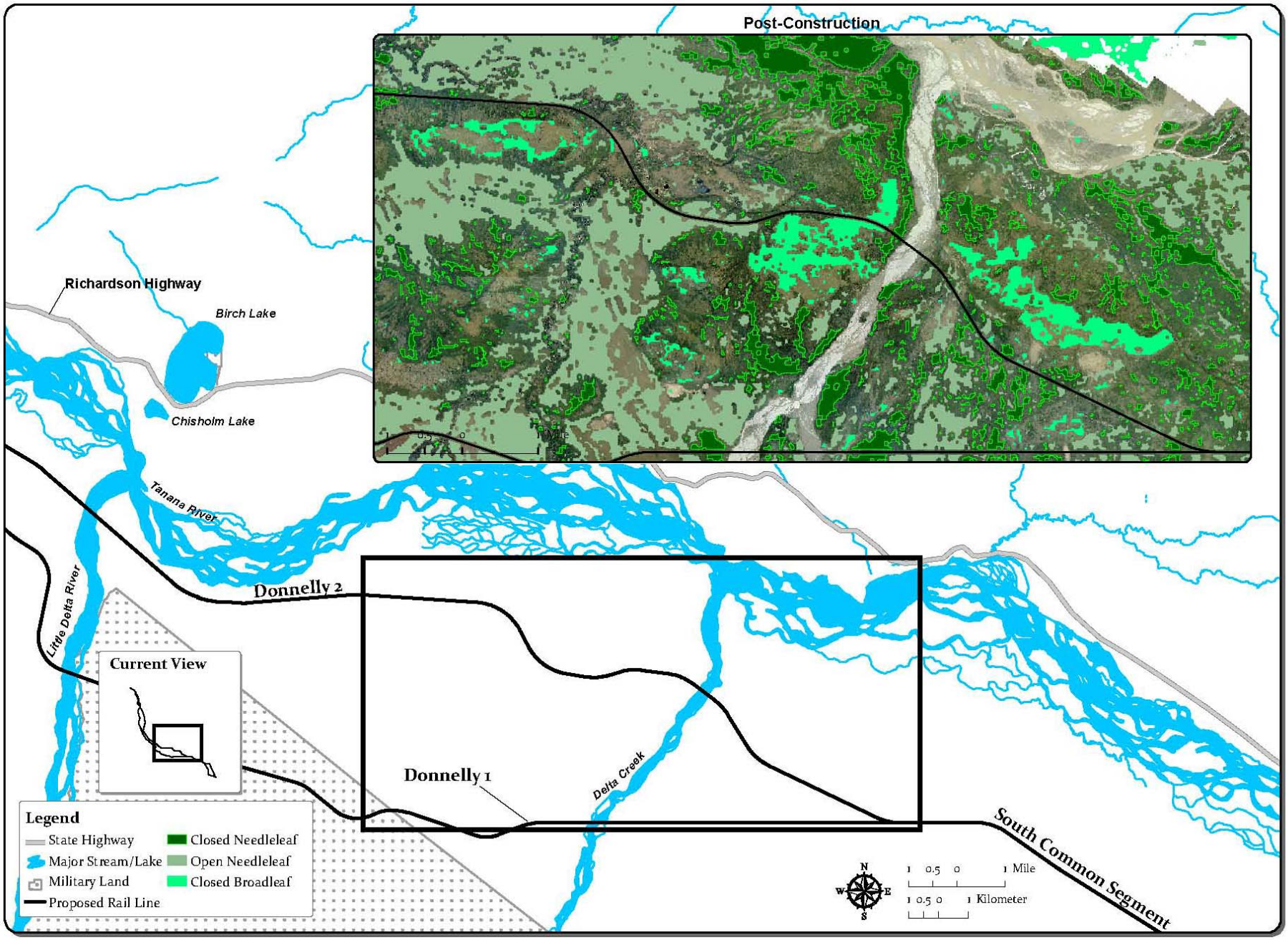

Figure 5-20 – Fragmentation of Core Forest Habitats Crossed by Donnelly Alternative Segment 2 (BLM *et al.*, 2002)

Delta Alternative Segments

Bison, black bear, brown bear, moose, wolves and furbearers would be expected to occur within this portion of the project area. All game mammals except bison would be expected to be more common along Delta Alternative Segment 1 than Delta Alternative Segment 2 because of the extent of residential, commercial, and agricultural development within Delta Alternative Segment 2.

The Delta bison herd is intensively managed to maintain the current population size and distribution; it is unlikely that many bison would occur within the proposed rail line. Delta Alternative Segment 2 would affect more area of habitat preferred by bison for forage than Delta Alternative Segment 1. Neither alternative segment would cause substantial fragmentation to graminoid habitats preferred by bison. Based on the rate of 0.4 bison per year for bison-vehicle collisions, anticipated bison-train collision mortality would be expected to occur at a rate of less than one every 10 years. Bison-train collisions would be more likely to occur in Delta Alternative Segment 2 than in Delta Alternative Segment 1, based on habitat and historic distributions. This mortality rate would be of no consequence to the Delta bison herd or its harvest management.

Delta Alternative Segment 1 would contribute to fragmentation of a large closed needleleaf forest patch (Figure 5-21). Fragmentation of this forested habitat would have mixed effects on game mammals. Openings in closed needleleaf forest would benefit moose, but could be detrimental for furbearers that require coniferous forests for cover. However, increased edge habitat created by construction of Delta Alternative Segment 1 would be beneficial for some furbearers, by creating early successional habitats for prey species such as voles, hares and grouse. Fragmentation of closed needleleaf forest would likely be detrimental for red squirrels.

No-Action Alternative

The No-Action Alternative would not affect game mammal populations or game mammal management within the project area.

5.5.3 Summary of Impacts to Game Mammals

The primary consequences of construction of the rail line through the project area are train-moose collision mortality and potential changes in access to the remote areas south of the Tanana River facilitated by the maintenance road along the rail line and roads to communication towers. ARRC regulations prohibit access to rail ROW, however, the cleared rail ROW and maintenance road could make remote regions of the project area more accessible to unauthorized users. Both increased moose mortality and changes in hunter and trapper access would potentially require changes in the management of game mammals within the portions of GMU 20A, 20B, and 20D crossed by the alternative segments. These impacts are unrelated to the individual alternative segments selected for construction. Small changes in the loss and alteration due to habitat fragmentation for habitats used by game mammals would benefit some game mammals and would be detrimental to others. Habitat impacts for alternative segments are presented in

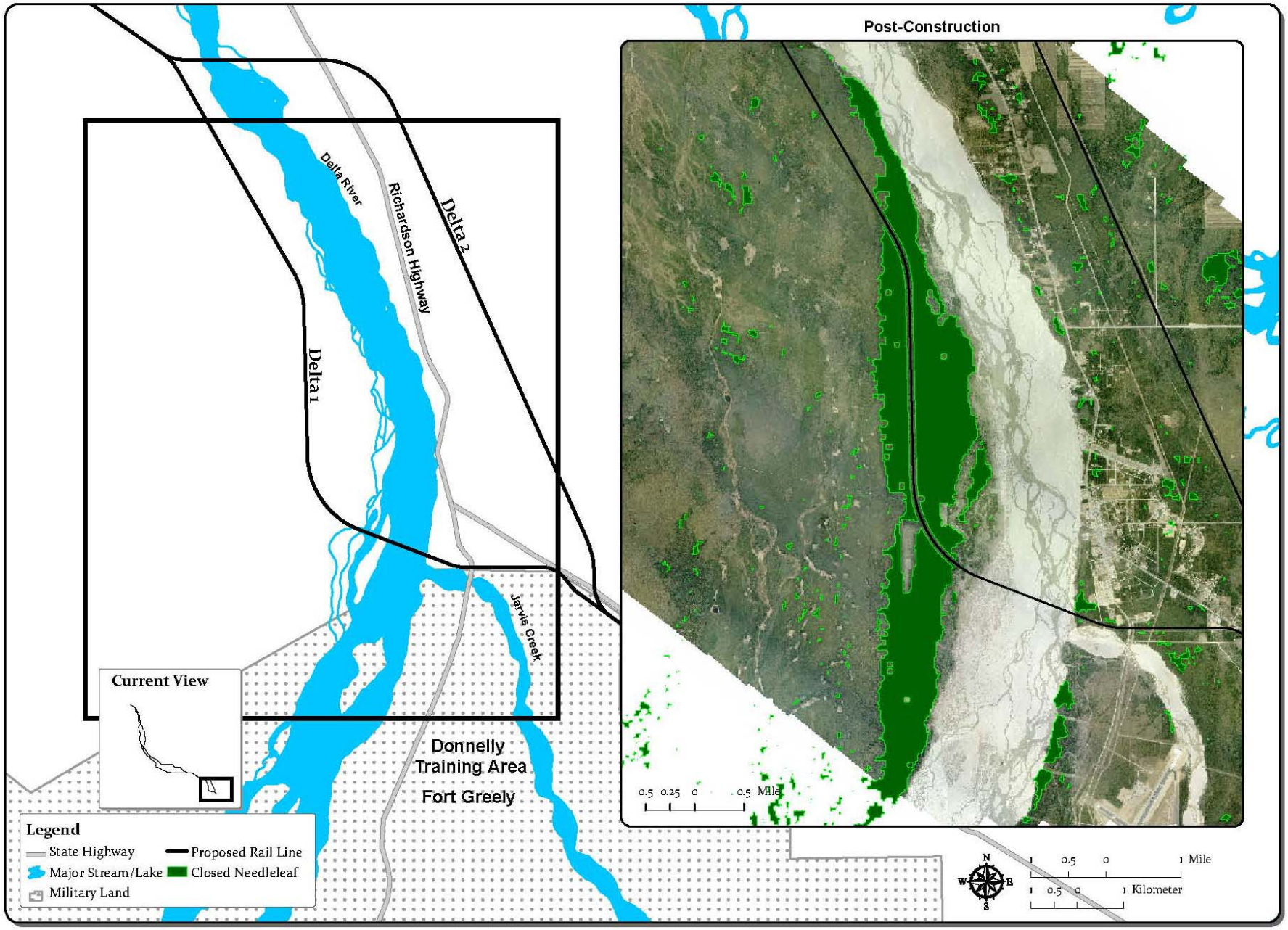

Figure 5-21 – Fragmentation of Core Closed Needleleaf Forest Habitat Crossed by Delta Alternative Segment 1 (BLM *et al.*, 2002)

Appendix F and are summarized in Table 5-27. Riparian habitats impacts for alternative segments are presented in Table 5-28. In general the NRE would affect a small proportion of the available habitat and a small proportion of the game mammal populations within the project area.

Table 5-27
Direct Loss of Habitats used by Game Mammals[a] (acres)

Alternative Segment	Bison[b]	Bears[c]	Caribou[d]	Moose[e]	Wolves[f]	Furbearers[g]
Common Facilities	-	718.8	321.7	718.8	750.7	589.6
North Common	-	60.5	21.7	60.5	61.6	42.0
Eielson 1	-	246.4	123.8	246.4	247.3	237.2
Eielson 2	-	241.0	146.4	241.0	241.2	222.9
Eielson 3	-	238.5	124.5	238.5	239.3	222.0
Salcha 1	-	434.9	175.2	434.9	447.6	426.4
Salcha 2	-	535.1	299.1	536.2	580.4	506.0
Central 1	-	122.6	65.9	122.6	122.8	88.9
Central 2	-	84.9	72.5	84.9	86.9	84.3
Connector A	-	105.7	64.1	105.7	105.7	91.0
Connector B	-	78.5	68.9	78.5	78.5	78.5
Connector C	-	55.6	41.4	55.6	55.6	45.3
Connector D	-	21.2	19.7	21.2	21.2	21.2
Connector E	-	58.2	16.3	58.2	58.4	24.5
Donnelly 1	-	626.9	475.3	626.9	658.8	549.8
Donnelly 2	-	636.4	370.2	636.4	669.7	564.9
South Common	-	251.2	166.3	251.2	251.2	244.2
Delta 1	14.6	256.4	198.2	256.4	311.2	247.5
Delta 2	74.2	211.4	104.6	211.4	304.0	209.0
Proposed Action[h]	14.6	2,808.7	1,640.5	2,808.7	2,944.3	2,508.8
Minimum Area Alternative[i]	74.2	2,717.6	1,447.5	2,717.6	2,891.5	2,461.8
Maximum Area Alternative[j]	14.6	2,873.4	1,713.3	2,874.7	3,039.6	2,550.5

[a] Source: (BLM *et al.*, 2002).
[b] Habitats summed for bison include Tall Shrub, Low Shrub, Graminoid, Other, and Agricultural categories for Delta Alternatives only.
[c] Habitats summed for bears include All Forests, Tall Shrub, Low Shrub, Other, and Graminoid categories.
[d] Habitats summed for caribou include Needleleaf Forests, Open Broadleaf Forest, Graminoid, and Bryoid/Lichen categories.
[e] Habitats summed for moose include All Forests, Tall Shrub, Low Shrub, Graminoid, Aquatic Bed and Other categories.
[f] Habitats summed for wolves include All categories except Aquatic Bed, Water and Urban
[g] Habitats summed for furbearers include All Forests, and Tall Shrub.
[h] Estimate based on footprint area for the proposed action includes North Common, Eielson 3, Salcha 1, Connector B, Central 2, Connector E, Donnelly 1, South Common, Delta 1 and associated facilities.
[i] Estimate based on minimum area alternative includes North Common, Eielson 2, Salcha 1, Central 2, Connector B, Donnelly 2, South Common, Delta 2 and associated facilities.
[j] Estimate based on maximum area alternative includes North Common, Eielson 1, Salcha 2, Central 1, Connector C, Donnelly 1, South Common, Delta 1 and associated facilities.

Table 5-28
Riparian Habitat Crossed by Alternative Segments

Alternative Segment	Riparian Area for Major Rivers[a] (acres)	Riparian Area for Minor Rivers[b] (acres)	Total Riparian Area (acres)
North Common	-	1.6	1.6
Eielson 1	-	11.0	11.0
Eielson 2	-	8.6	8.6
Eielson 3	-	8.7	8.7
Salcha 1	19.0	4.5	23.5
Salcha 2	39.4	5.7	45.1
Central 1	-	1.2	1.2
Central 2	-	4.2	4.2
Connector A	-	1.4	1.4
Connector B	2.3	0.9	3.3
Connector C	1.4	2.5	4.0
Connector D	-	2.3	2.3
Connector E	2.8	0.9	3.6
Donnelly 1	15.4	7.6	23.0
Donnelly 2	14.2	2.4	16.5
South Common	2.1	-	2.1
Delta 1	-	1.6	1.6
Delta 2	-	0.9	0.9
Proposed Action[c]	41.6	30.0	71.6
Minimum Area Alternative[d]	37.6	23.1	60.8
Maximum Area Alternative[e]	58.4	31.2	89.6

[a] Major Rivers include Tanana River, Salcha River, Richardson Clearwater River, Fivemile Clearwater River, Delta Creek, and Little Delta River
[b] Minor Rivers include all other streams mapped at 1:63,360 scale resolution.
[c] Estimate based on footprint area for the proposed action includes North Common, Eielson 3, Salcha 1, Connector B, Central 2, Connector E, Donnelly 1, South Common, Delta 1 and associated facilities.
[d] Estimate based on minimum area alternative includes North Common, Eielson 2, Salcha 1, Central 2, Connector B, Donnelly 2, South Common, Delta 2 and associated facilities.
[e] Estimate based on maximum area alternative includes North Common, Eielson 1, Salcha 2, Central 1, Connector C, Donnelly 1, South Common, Delta 1 and associated facilities.

5.6 Bird Resources

This section discusses the existing birds in the project area as well as potential impacts resulting from the NRE.

5.6.1 Affected Environment

A suite of resident birds occur within the project area including owls, ptarmigan and grouse, ravens and jays, woodpeckers, chickadees, and finches. Many 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. All migratory birds are protected by the Migratory Bird Treaty Act; eagles are also protected by the Bald and Golden Eagle Act. Migratory waterfowl and resident upland game birds are hunted. Waterfowl are harvested primarily during the fall migration from September to December, while upland game birds are harvested during late summer through March.

Waterfowl and Waterbirds

Waterfowl and waterbirds occurring within the project area are considered migratory. The most common species include: American wigeon, bufflehead, mallard, northern pintail, northern shoveler, scaup and trumpeter swans. Many geese, ducks and sandhill cranes stage in and migrate through the Tanana River Basin during spring and fall. A few loons and grebes occur within the project area as do gulls and shorebirds. Nesting season densities within the region crossed by the proposed NRE are presented in Appendix F. Ducks, geese, swans, loons, grebes and gulls generally nest near aquatic habitats. Shorebirds and cranes generally nest in wetland habitats, although shorebirds also nest in upland habitats. Hunters harvest ducks, geese, snipe and sandhill cranes from ponds, lakes, wetlands, agricultural fields, and rivers during fall migrations.

Raptors

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). Approximately 20 active bald eagle nests were identified within the project area during 2005 to 2007; representing about 20 reproducing pairs and their associated territories (Prichard and Ritchie, 2007). Bald eagle nests within the areas crossed by the proposed alternative segments during 2005-2007 were primarily associated with habitats along the Tanana River; occurring in balsam poplar trees (77 percent), and spruce trees (20 percent) (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. 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). Limited band recoveries suggest that Tanana River bald eagles migrate through inland areas and overwinter in western North America including Washington and northwestern Wyoming (Ritchie and Ambrose, 1996).

Approximately 13 peregrine falcon nests were identified within the project area from 2005 to 2007 (Prichard and Ritchie, 2007). Peregrine falcons nest on cliffs and four of these nests were located within about a half mile of the proposed NRE. Five species of owls commonly occur within the project area. The two largest of these owls, the great gray owl and the great horned owl, nest in white spruce trees within closed canopy forests (Prichard and Ritchie, 2007; BLM *et al.*, 2002). Six of the seven identified nests of large owls were associated with clear-water, anadromous-fish streams.

Upland Game Birds and Landbirds

Ptarmigan and grouse are the primary upland game birds found throughout in the project area. Ptarmigan are harvested from 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 carrion. Many birds; however, feed primarily on insects which are not available during the winter and these birds remain in Interior Alaska only during the summer breeding season when insects are abundant.

Birds of Conservation Concern

The 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). While there are no federally listed threatened or endangered birds occurring in the project area, various agencies have identified birds of conservation concern within Interior Alaska beginning with the Boreal Partners in Flight (a working group made up of government representatives and individuals) listing for landbirds in 1999 (revised in 2004), USFWS listing of birds of conservation concern (USFWS, 2002), and the ADF&G's Comprehensive Wildlife Conservation Plan (ADF&G, 2006). Birds of conservation concern that have been documented within the project area during the breeding season are listed in Table 5-29. The State of Alaska also maintains a Species of Special Concern listing which includes the American peregrine falcon, northern goshawk, olive-sided flycatcher, gray-cheeked thrush, Townsend's warbler and blackpoll warbler (ADF&G, 1998).

5.6.2 Environmental Consequences

Impacts to birds were analyzed for short-term and long-term effects of construction and operation of the proposed NRE. The primary mechanisms for impacts to birds from construction and operation of the proposed NRE are habitat loss, alteration and fragmentation and collision mortality with power lines on poles, and communication towers. The nature of impacts from the project to birds would vary based on the phase of the project and the type of bird. Construction of the rail line and additional facilities would result in short-term disturbance and long-term habitat modification along the approximately 80-mile alignment. Following construction, operation of the rail line would result in disturbance due to train movement. Common impacts based on project phase are discussed below, followed by a comparison of the impacts specific to alternative segments is provided where appropriate. Supporting descriptions of environmental consequences, results of quantitative analyses and illustrations are presented in Appendix F. Proposed mitigation for impacts to birds is presented in Chapter 20 of the EIS.

Methodology

Effects to game and protected birds from the construction and operation of the proposed NRE were evaluated based on habitat use, habitat requirements, and seasonal movements of birds within the project area. Analysis of habitat impacts for birds is based on the vegetation analysis presented in the EIS, combined with the reported density of breeding birds within the project area. Analysis of habitat impacts for eagles and other raptors is based on raptor survey data collected for the proposed NRE combined with vegetation cover data. Examples of collision mortality for sandhill cranes due to contact with power lines within the rail alignment is based on reported habitat use, and spring and fall sandhill crane survey data (Noel, 2006q).

Common Construction Impacts

This section describes the common types of environmental consequences that construction-related activities would have for all of the alternative segments. Construction would include clearing the ROW and access roads of vegetation, excavation of gravel fill, building gravel rail and roadbeds, laying the new rail line, installing communication towers and power lines, and operating work camps and construction staging areas.

Table 5-29
Priority Bird Species Documented During the Breeding Seasons Within the Project Area[a]

Species (Migration)[b]	Status[c]	Global Rank[d]	Alaska Rank[e]	Alaska Abundance	Alaska Trend[f]	Rationale
American Three-toed Woodpecker (R)	ADF&G	G5	S4	200,000	+6.5%	Sensitive to forest management - cavity nester
American golden plover (L)	BCC	G5	S4B	200,000[g]		Small declining population
Bald Eagle (S)	PIF	G5	S4B/S4N	20,000	+	Sensitive to changes in forests
Belted Kingfisher (S)	ADF&G	G5	S5	140,000	-2.5%	Widespread long-term population declines
Blackpoll Warbler (L)	PIF	G5	S3B	4,000,000	-3.8%	In decline (sensitive to changes in riparian habitats)
Boreal Chickadee (R)	ADF&G	G5	S5	1,100,000	-0.5%	Sensitive to forest management - cavity nester
Dark-eyed Junco (S)	ADF&G	G5	S3N/S5B	40,000,000	-1.1%	Widespread long-term population declines
Gray-cheeked Thrush (L)	SOC	G5	S3B	2,000,000	unknown	Long-term declines, sensitive to removal of riparian shrubs
Hairy Woodpecker (R)	ADF&G	G5	S4	120,000	+6.8%	Sensitive to forest management - cavity nester
Hermit Thrush (S)	ADF&G	G5	S4B	1,300,000	-1.8%	Long-term declines
Northern Flicker (S)	ADF&G	G5	S5B	180,000	+0.2%	Sensitive to forest management - cavity nester
Northern Goshawk (R)	PIF	G5	S4	13,000	unknown	Breeding sensitivity to forest changes
Olive-sided Flycatcher (L)	PIF & ADF&G	G4	S3/S4B	200,000	-3.3%	In decline (sensitive to forest management - canopy nester)
Peregrine Falcon (L)	BCC & PIF	G4	S3B	1,100	+	Recently delisted - sensitive to changes on cliffs, rocks, etc. & vulnerable to contaminants
Pine Siskin (S)	ADF&G	G5	S5	500,000	+5.5%	Sensitive to forest management - canopy nester
Ruffed Grouse (R)	PIF	G5	SNR	200,000	unknown	Sensitive to changes in forests
Rusty Blackbird (S)	PIF	G4	S4B	400,000	-5.8%	In decline (sensitive to climate and riparian habitat changes)
Short-eared Owl (L)	PIF	G5	S4/S5B	18,000	unknown	Declining population
Smith's Longspur (S)	PIF	G5	S3/S4B	unknown	unknown	Small population, restricted distribution
Townsend's Warbler (L)	PIF & ADF&G	G5	S3B	1,500,000	+0.2%	Sensitive to forest management - canopy nester
Varied Thrush (S)	PIF & ADF&G	G5	S5	6,000,000	-0.1%	Sensitive to forest management - canopy nester
Whimbrel (L)	BCC	G5	S3/S4B	26,000 *	stable	Declining population trend, small population
White-crowned Sparrow (L)	ADF&G	G5	S3N/S5B	13,000,000	-1.9%	Long-term declines
White-winged Crossbill (R)	ADF&G	G5	S5	2,000,000	+4.3%	Sensitive to forest management - canopy nester
Wilson's Warbler (L)	PIF & ADF&G	G5	S3B	7,000,000	+1.0%	Sensitive to changes in riparian habitats

[a] Sources: Rosenberg, 2004; ADF&G, 2006; Prichard and Ritchie, 2007; Benson, 1999; Anderson *et al.*, 2000; Harding and Sharbaugh 2005.
[b] (R) = Resident, (S) = Short-distance migrant, (L) = Long-distance migrant.
[c] Status: BCC – USFWS, 2002; PIF – Rosenberg, 2004; ADF&G - ADF&G, 2006; SOC - ADF&G, 1998.
[d] Rankings: G5 = Globally secure, G4 = Globally apparently secure, S5 = State secure, S4 = State apparently secure, S3 = State vulnerable, SNR = State not ranked, N = Non-breeding, B = Breeding.
[e] Average annual long-term population trend in Alaska portion of the Boreal Partners in Flight Bird Conservation Region 4 (Rosenberg, 2004; ADF&G, 2006).
[f] – Represents declining trend of unknown magnitude; + represents increasing trend of unknown magnitude.
[g] Morrison *et al.* 2006.

- **Habitat loss, alteration, and fragmentation.** Construction of the approximately 80-mile NRE rail line would require a minimum project area of about 3,020 acres and a maximum project area of 3,140 acres of primarily undisturbed native vegetation along the Tanana River Valley. All birds would experience nesting, foraging and staging habitat loss or alteration due to construction of the linear alignment. After construction, some of the vegetation would be restored to its natural condition along the ROW. Loss of forest communities would generally be considered long-term even with restoration. It would require 5 to 20 years or more to reestablish trees and shrub habitat for cover, perching, and nesting for most raptors and landbirds; 50 to 100 years for trees large enough to support eagle and large owl nests; and over 50 years to grow the snags to support cavity nesting landbirds.

- Construction of rail and roadbeds across wetlands would alter the suitability of habitats near these structures for ground nesting waterbirds and waterfowl due to changes in water abundance and distribution. Construction of the large bridge crossings on the Tanana River, Little Delta River, Delta Creek and Delta River could lead to channel constriction, altering the stream channels, scour of woody vegetation and bar formation within these river segments leading to loss of habitat and reduction in habitat suitability for roosting cranes and swans (Folk and Tacha, 1990; Currier, 1997). Habitat loss and altered suitability indirectly affects bird survival and reproductive potential. Tree nesting raptors and cavity nesting landbirds reuse nest structures and loss of nest trees could lead to reduced or lost reproduction in subsequent years from energy spent establishing new nests. These increased energetic costs would have a large consequence for long-distance migrant landbirds.

- Habitat fragmentation issues that are relevant for birds include creation of edge effects, reduction in patch size of available habitats, facilitation of predator movements, intrusion of invasive species, and intrusion of humans. Habitat fragmentation caused by loss and changes in vegetation cover within the ROW through large areas of core forest habitats would have the greatest effect on resident and migrant landbirds (Hinkle *et al.*, 2002). Forest-nesting landbird abundance, diversity, and reproduction rates all become depressed as a result of fragmentation associated with linear developments (Jalkotzy *et al.*, 1997). Linear alignments increase landbird nest predation and nest parasitism by fragmenting forest habitats facilitating access of edge-loving landbirds and predators.

- **Loss of breeding success and reduced survival from exposure to construction noise and from increased human activity.** Disturbance by vehicles or people on foot to nesting birds causes incubating birds to flush from their nests leaving the nest vulnerable to mammalian and avian predators. For ground nesting birds, flushing of birds from nests alerts nearby mammalian and avian predators to the location of the nest which leads to nest depredation resulting in lost reproduction. Ducks, geese, sandhill cranes and swans stage, remaining within an area to congregate and feed on their way to and from breeding and wintering habitats, within the project area during spring and fall migrations. Many landbirds migrate through Interior Alaska on their way to and from nesting grounds in western and arctic Alaska. Disturbance of migrant birds in staging habitats could inhibit the birds' capacity to acquire the fat stores necessary to continue migration, and could reduce reproductive outputs of migrant birds headed to nesting grounds in the spring, or reduce survival of migrants while headed to wintering grounds in the fall.

- **Loss of individuals and habitats due to construction equipment fuel spills.** In the unlikely event of fuel spills and leaks during construction, birds could be exposed to contamination. Oiled birds ingest contaminants during preening, leading to toxicity. Feathers of birds provide insulation and buoyancy which is lost upon contact with petroleum-based products such as diesel fuel and oil, leading to hypothermia and an inability to float for waterbirds and waterfowl. Spills could lead to a reduction in available food as it kills forage such as insects and small mammals. Raptors could ingest oiled prey leading to toxicity.

- **Collision or electrocution mortality from power lines and communication towers.** Power lines on poles associated with the rail line and three new communication towers would increase the collision potential for birds. Factors influencing collision risk are related to the type of bird, environmental factors, location, and the configuration of the lines and towers. Power line poles and communication towers provide perches for raptors and other predatory birds which facilitate predation on ground-nesting waterfowl, waterbirds, gamebirds and landbirds leading to reduced productivity of birds nesting in proximity to these structures. Heavy-bodied, less-agile birds and birds within large flocks such as cranes, swans and geese are more likely to experience fatalities from power lines and communication towers as they may lack the ability to quickly negotiate obstacles. The power poles associated with the project could result in fatalities from electrocution for opportunistic raptors using them for nesting sites, vantages for territorial defense, or vantages for hunting. Raptors are particularly susceptible to electrocution by poorly designed power poles, especially when these are placed near nesting territories or foraging habitats.

- **Direct mortality from project construction.** Collisions with construction equipment and fatalities of birds present within the construction ROW could occur. Active nests present within the ROW during construction would also be destroyed by equipment during vegetation clearing and gravel deposition resulting in the loss of nests, eggs, or young.

Common Operations Impacts

This section describes the common types of environmental consequences that operation-related activities would have on birds. Project operation would include running five round trip trains per day (ten one-way trains) over the rail line and maintaining the ROW. Some impacts would be initiated during construction but would continue through operation such as habitat modification and impacts from power lines and communication towers discussed above.

- **Reduced survival because of stress or avoidance of feeding due to exposure to disturbance.** Birds that nest near the tracks would be flushed from their nest when trains pass leaving the nest vulnerable to predators and disrupting incubation. Train movement could disturb migrating waterfowl and waterbirds in staging habitats and could inhibit the birds' capacity to acquire the fat stores necessary to continue migration. Train movement could also disrupt migrating landbirds passing through the project area. This could reduce reproductive outputs of migrant birds headed to nesting grounds in the spring, or reduce survival while headed to wintering grounds in the fall.

- **Loss of individuals and habitats due to exposure to toxic materials, or fuel spills.** In the unlikely event of a fuel spill or leak caused by derailment or collision during operations, birds would be exposed to contamination. Oiled birds ingest contaminants during preening, leading to toxicity. Feathers of birds provide insulation and buoyancy which is lost upon

contact with petroleum-based products such as diesel fuel and oil, leading to hypothermia and an inability to float for waterbirds and waterfowl. Spills could lead to a reduction in available food as it kills forage such as insects and small mammals. Raptors could ingest oiled prey leading to toxicity.

- **Direct mortality from collisions with trains.** Large, less-agile birds would be most noticeable when they collide with trains; however, all sizes of birds occurring within the project area would be vulnerable to train collision mortality. Birds that feed on carrion from previous collisions with trains and birds attracted to gravels along the road and railbeds would likely have an increased incidence of collision mortality.

Impacts by Alternative Segment

The following section describes impacts which would occur from construction and operation of each alternative segment to waterbirds and waterfowl, raptors, upland game birds, landbirds, and birds of conservation concern where differences between alternative segments were identified, or where potential impacts were notable. With the exception of tree and cliff nesting raptor surveys (Prichard and Ritchie, 2007) and spring and fall sandhill crane migration surveys (Noel, 2006a), project specific bird data were not available for analyses; so analyses were based on regional data using the minimum, maximum and proposed project impacts. Additional descriptions of the existing data and analyses used in estimating impacts are found in Appendix F.

North Common Segment and Eielson Alternative Segments

Construction during bird migration periods in this portion of the project would disturb and displace aggregations of sandhill cranes, swans, and ducks associated with wetlands and ponds near the alternatives. The power lines and communication tower associated with the North Common and Eielson alternative segments could increase the collision risk to staging birds including sandhill cranes and migratory flocks of ducks. Construction of Eielson Alternative Segment 1 and Eielson Alternative Segment 2 would result in destruction or disturbance of one bald eagle nest and one red-tailed hawk nest. Construction of the North Common and Eielson alternative segments would contribute to fragmentation of some remaining open needleleaf and closed broadleaf forested core habitats contributing to habitat degradation for raptors, owls and landbirds within this portion of the project area. The powerline and communication tower would also increase collision and electrocution hazards for the bald eagle nest site and the red-tailed hawk nest site along these alternatives.

Salcha Alternative Segments

Construction of Salcha Alternative Segments 1 and 2 would result in degradation of Tanana River roosting habitats used by sandhill cranes. Construction of Salcha Alternative Segment 1 would result in destruction or disturbance of one nesting pair of bald eagles, one great horned owl nest, as well as contribute to fragmentation of core areas of closed needleleaf, closed broadleaf, and closed mixed forest habitats especially for tree nesting raptors and landbirds. Construction of Salcha Alternative Segment 2 would result in the destruction or disturbance and degradation of foraging habitat for two nesting pairs of bald eagles and three nest structures, as well as three nesting pairs of peregrine falcons. The power lines associated with Salcha Alternative Segment 2 would further degrade foraging habitat at the Salcha River crossing creating an additional hazard for the bald eagles that use that area. The power line and

communication tower associated with Salcha Alternative Segment 1 would increase collision risk for forest nesting raptors and landbirds in the area.

Central Alternative Segments and Connectors

Construction of Central Alternative Segment 2 would result in destruction or disturbance of one nesting pair of bald eagles, and construction of Connector A or B would result in the destruction or disturbance of one nesting pair of great horned owls. Construction of Central Alternative Segment 2, and Connectors B, C, and D would contribute to fragmentation of large areas of closed needleleaf forest core habitat, contributing to habitat degradation for tree nesting raptors and landbirds. The power lines associated with Central Alternative Segment 2, and Connectors B, C, and D would be located through an area of undisturbed closed needleleaf forest, which would increase collision risk for forest nesting birds and reduce habitat suitability.

Donnelly Alternative Segments

Construction of Donnelly Alternative Segment 2 would result in the destruction or disturbance of one bald eagle nest structure and disturbance to one nesting pair of peregrine falcons as well as would contribute to fragmentation of core areas of closed needleleaf and closed broadleaf forest habitats. Construction of Donnelly Alternative Segment 1 would result in the destruction or disturbance of one northern goshawk nest structure and would contribute to fragmentation of core areas of open and closed needleleaf forest habitats. The power line and communication tower associated with these alternative segments would contribute to increased risk of collision mortalities for sandhill cranes and peregrine falcons.

South Common Alternative

Construction of the South Common Segment would result in destruction or disturbance of two red-tailed hawk nests, two great gray owl nests, and one great horned owl nest. Construction of this segment would contribute to some fragmentation of the few small patches of forest habitats remaining along streams after the 1998 fire. The power lines associated with this segment would contribute to increased risk of collision mortality for sandhill cranes flying between foraging and roosting habitats.

Delta Alternative Segments

Construction of the Delta alternative segments would result in destruction or disturbance of three northern goshawk nest structures. Construction of Delta Alternative Segment 1 would contribute to fragmentation of large patches of closed needleleaf forest habitats, contributing to habitat degradation for forest nesting birds. The power line associated with Delta Alternative Segment 1 would contribute to increased risk of collision mortality for sandhill cranes flying between foraging and roosting habitats and for forest nesting landbirds.

No-Action Alternative

Under the No-Action Alternative, impacts from construction or operations activities would not occur. Bird populations residing or migrating through the project area would remain unaffected.

5.6.3 Summary of Impacts to Birds

Construction of the proposed action would reduce the acreage of available habitat, primarily (75 percent) forested habitats, for an estimated 3,148 nesting birds within the Tanana River Valley (Table 5-30). The minimum area alternative would alter nesting habitat for an estimated 3,144 birds and the maximum area alternative would alter nesting habitat for an estimated 3,225 birds, primarily landbirds (Table 5-30). Alternative segments passing through late-succession forest habitats would have the greatest potential impact on forest nesting landbirds by fragmenting large patches of forest and creating edge habitat that decreases reproductive potential for forest nesting landbirds. Power lines on poles and communication towers built to support the rail line would increase collision mortality for all birds, but would have the greatest potential for damage where lines and towers lie between wetland or agricultural foraging habitats and riverine roosting habitats used by sandhill cranes, geese, swans, and ducks during migration; or when lines and towers are near raptor nest and foraging sites. Twenty-five bird species of conservation concern have been documented in the project area and would be affected by a loss of habitat and reduction in habitat suitability due to construction of the rail line. Estimated habitat impacts for nesting birds based on regional and averaged project area densities and project footprint requirements are listed in Table 5-30. In general the NRE would affect a small proportion of the available habitat and a small proportion of the total avian population within the project area, with the greatest potential for moderate impacts to forest nesting owls and landbirds.

Table 5-30
Estimated Bird Impacts Due to Nesting Habitat Loss or Alteration from the Proposed NRE Based on Regional and Averaged Local Area Density During the Nesting Season[a]

Bird Type	Individuals Displaced			
Bird Type	**Estimated Project Area Population[b]**	**ARRC Proposed Action[c]**	**Minimum Project Area[d]**	**Maximum Project Area[e]**
Waterbirds	480	2	2	2
Geese & Swans	310	2	2	2
Ducks	4,300	21	21	21
Raptors and Owls	11,600	76	74	91
Upland Game Birds	8,900	43	43	44
Landbirds	618,800	3,004	3,002	3,065
Resident	89,600	435	435	444
Long-Distance Migrant	366,600	1,779	1,778	1,815
Short-Distance Migrant	162,700	790	790	806
Birds of Conservation Concern[f]	230,920	1,127	1,124	1,167
Total Individuals[g]	644,390	3,148	3,144	3,225

Table 5-30
Estimated Bird Impacts Due to Nesting Habitat Loss or Alteration from the Proposed NRE Based on Regional and Averaged Local Area Density During the Nesting Season[a]
(continued)

[a] Source: USFWS, 2008; Anderson *et al.,* 2000; Benson 1999; Prichard and Ritchie, 2007, Appendix F4).
[b] Estimate based on regional or average project area densities multiplied by area within 5 miles of all proposed alternative segments.
[c] Estimate based on footprint area for all proposed alternative segments and all associated facilities. Estimate based on footprint area for the proposed action includes: North Common, Eielson 3, Salcha 1, Connector B, Central 2, Connector E, Donnelly 1, South Common, Delta 1 and associated facilities.
[d] Estimate based on minimum area alternative includes: North Common, Eielson 2, Salcha 1, Central 2, Connector B, Donnelly 2, South Common, Delta 2 and associated facilities.
[e] Estimate based on maximum area alternative includes: North Common, Eielson 1, Salcha 2, Central 1, Connector C, Donnelly 1, South Common, Delta 1 and associated facilities.
[f] Estimate based only on species for which an abundance within the project area could be calculated. Estimate includes species with widely divergent populations and totals do no reflect the condition for individual species of conservation concern (see Appendix F).
[g] Total includes waterbirds, geese and swans, ducks, raptors and owls, upland game birds and landbirds. Landbird categorized by migration are subcategories of landbirds and totals for birds of conservation concern are included within the appropriate category above.

5.7 BLM Alaska Special Status Species

BLM's Alaska State Office maintains a list of Special Status Species (SSS) with objectives to conserve listed species and the ecosystems they depend on, and ensure that BLM actions do not contribute to the need to list or perpetuate listings under the Federal Endangered Species Act or BLM's SSS policies. Seven birds and one mammal from the Alaska SSS list are known to occur in the project area. There are no Alaska SSS fish or plants in the project area. A summary of potential project impacts to these eight SSS species is provided in Table 5-31. Analysis and discussion of these species are provided in Sections 5.5.3 and 5.6.3, and Appendix F.

Table 5-31
Summary of Assessment of Impacts from the NRE to BLM Alaska Special Status Species[a]

Species (Migration)[b]	Rationale[c]	Estimated Project Area Population[d]	Habitat Impact Description[e]	Estimated Proposed Project Impact[f] (number of birds)	Estimated Minimum Project Impact[g] (number of birds)	Estimated Maximum Project Impact[h] (number of birds)
Federally Delisted Species						
American Peregrine Falcon (L)	Delisted in 1999 - Sensitive to changes on cliffs, rocks, etc. & vulnerable to contaminants	26	Disturbance during nesting and foraging, power line, communication tower collision mortality	0	0 pair	8
BLM Alaska Sensitive Birds						
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, power line, communication tower collision mortality	119	119	122
Gray-cheeked Thrush (L)	Long-term declines, sensitive to removal of riparian shrubs	Unknown	300 acres shrub habitats, 70 acres riparian habitats removed fragmented, power line, communication tower collision mortality	√	√	√
Long-tailed Duck (S)	Sea ducks have experienced significant declines	8	Disturbance during nesting, brood-rearing, habitat loss, degradation, power line collision morality	0	0	0
Olive-sided Flycatcher (L)	In decline (Sensitive to forest management - Canopy nester)	1,718	1,900 acres needleleaf/mixed forested habitats removed, fragmented, power line, communication tower collision mortality	8	8	9
Surf Scoter (S)	Sea duck populations in decline (Scoter data combined for all three species)	149	Disturbance during nesting, brood-rearing, habitat loss, degradation, power line, communication tower collision mortality	1	1	1
Townsend's Warbler (L)	Sensitive to forest management - Canopy nester	Unknown	1,900 acres needleleaf/mixed forested habitats removed, fragmented	√	√	√
Trumpeter Swan (S)	NA	203	Disturbance during spring/fall migration, nesting, brood-rearing, habitat loss, degradation, power line collision morality	1	1	1

Table 5-31
Summary of Assessment of Impacts from the NRE to BLM Alaska Special Status Species[a] (continued)

Species (Migration)[b]	Rationale[c]	Estimated Project Area Population[d]	Habitat Impact Description[e]	Estimated Proposed Project Impact[f] (number of birds)	Estimated Minimum Project Impact[g] (number of birds)	Estimated Maximum Project Impact[h] (number of birds)
BLM Alaska Sensitive Mammals						
Canada Lynx	NA	Unknown/ Scarce	Disturbance, habitat loss and alteration, 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	√	√	√

[a] Sources: Anderson *et al.*, 2000; Benson, 1999; Benson, 2001; Harding and Sharbaugh, 2005; Prichard and Ritchie, 2007; ADF&Gs Alaska Wildlife Notebook, NatureServe, Animal Diversity Web; Blejwas, 2006.
[b] (S) = Short-distance migrant, (L) = Long-distance migrant. √ indicates the species has been documented in the project area and impacts would occur but data are insufficient to estimate the scale of impact.
[c] Rationale for inclusion in Alaska's comprehensive wildlife Conservation Strategy (ADF&G, 2006), NA = not applicable (species not listed in Conservation Strategy)
[d] Estimates generated only for species with an abundance estimate within the project area.
[e] 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.
[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 Connector B, Central 2, Donnelly 2, South Common, Delta 2 and associated facilities.
[h] Maximum Project Area includes North Common, Eielson 1, Salcha 2, Central Connector C, Central 1, Donnelly 1, South Common, Delta 1 and associated facilities.