4. WATER RESOURCES

This chapter analyzes potential direct and indirect impacts to water resources due proposed Northern Rail Extension (NRE) construction and operations. The NRE would be in predominately undeveloped areas within the Tanana River Valley. This chapter describes applicable regulations (Section 4.1), and the affected environment and potential environmental consequences to surface water (Section 4.2), groundwater (Section 4.3), water quality (Section 4.4), wetlands (Section 4.5), and floodplains (Section 4.6).

4.1 Applicable Regulations

Various Federal and State of Alaska agencies regulate project construction activities that could impact water resources, as described in Sections 4.1.1 and 4.1.2.

4.1.1 Federal Agency Regulations

U.S. Environmental Protection Agency (USEPA):

- Section 402 of the Clean Water Act (CWA) (33 U.S.C. [United States Code] 1251 *et seq*.) – National Pollutant Discharge Elimination System (NPDES): Point Source and Stormwater Discharges.

- Section 404 of the CWA – Discharge of Fill Material to Waters of the U.S. USEPA reviews and comments on U.S. Army Corps of Engineers (USACE) Section 404 permit applications for compliance with the Section 404(b)(1) guidelines and other statutes and authorities within its jurisdiction (40 Code of Federal Regulations [CFR] Part 230).

U.S. Army Corps of Engineers:

- Section 10 of the Rivers and Harbors Act (33 U.S.C. 403) – Navigable Waters of U.S. Dredge and Fill Permit.

- Section 404 of the CWA – Discharge of Fill Material to Waters of the U.S.

- Executive Order 11990, *Protection of Wetlands* (24 May 1977).

- Executive Order 11988, *Floodplain Management* (24 May 1977).

4.1.2 State Agency Regulations

Alaska Department of Natural Resources (ADNR):

- Alaska Statute (AS) 46.15, Alaska Water Use Act, and 11 Alaska Administrative Code (AAC) 93 – Under the Alaska Constitution, all surface and subsurface waters reserved for common use, except mineral and medicinal waters, are subject to appropriation under state law. Any withdrawal, diversion (including dewatering of an area or gravel pit) or impoundment of a significant volume of water requires a permit or certificate under state

law. ADNR is the exclusive regulatory authority to approve water withdrawals from surface and subsurface waterbodies in Alaska. This authority is based on the common law doctrine of Public Trust, which is embedded in the Alaska Constitution, Article VIII, Section 3, and entitled Common Use. A significant amount of water is defined in 11 AAC 93.970 (14) as:

> The use of more than 5,000 gallons of water in a single day from a single water source; or, The regular daily or recurring seasonal use of more than 500 gallons of water per day for ten days or more per year from a single water source; or The non-consumptive use of more than 30,000 gallons of water per day from a single water source; or, Any water use that might adversely affect the water rights of other appropriators or the public interest.

- Division of Forestry, Alaska Forest Resources Practices Act (FRPA, AS 41.17) – Protect fish habitat, water quality, reforestation, timber health, fire protection.

Alaska Department of Environmental Conservation:

- Section 401 of the CWA – Section 401 Certification.
- Sections 402 and 404 of the CWA – Certificate of Reasonable Assurance for 402 and 404 Permits.
- Section 402 of the CWA – NPDES: Point Source and Stormwater Discharges.

Alaska Department of Fish and Game (ADF&G):

- Title 16, AS 16.05.020(2) – Fish, Game, Aquatic Plant Resources (management, protection, maintenance, improvement, and extension).
- AS 16.05.841 (Fishway Act) and AS 16.05.871 (Anadromous Fish Act) Fish Habitat Permits issued by ADF&G Division of Habitat.

4.1.3 Local Regulations/Plans

- Fairbanks North Star Borough (FNSB) – Title 21, Stormwater Management Ordinance, requires a site development permit for any land-disturbing activity of 1 acre or more that has potential for eroded soil to enter waters of the United States.

4.2 Surface Water

This section describes existing surface-water conditions of the Tanana River Valley in proximity to the proposed NRE (Figure 4-1). SEA collected data in the project area during field investigations in 2005, 2006, and 2007. Appendix E describes the methodologies employed and data collected. Appendix E also describes and summarizes data the U.S. Geological Survey and the State of Alaska collected in the project area.

4.2.1 Affected Environment

The Tanana River Basin occupies approximately 44,000 square miles extending from the river's headwaters in Canada to its confluence with the Yukon River (Brabets *et al.*, 2000). The Tanana

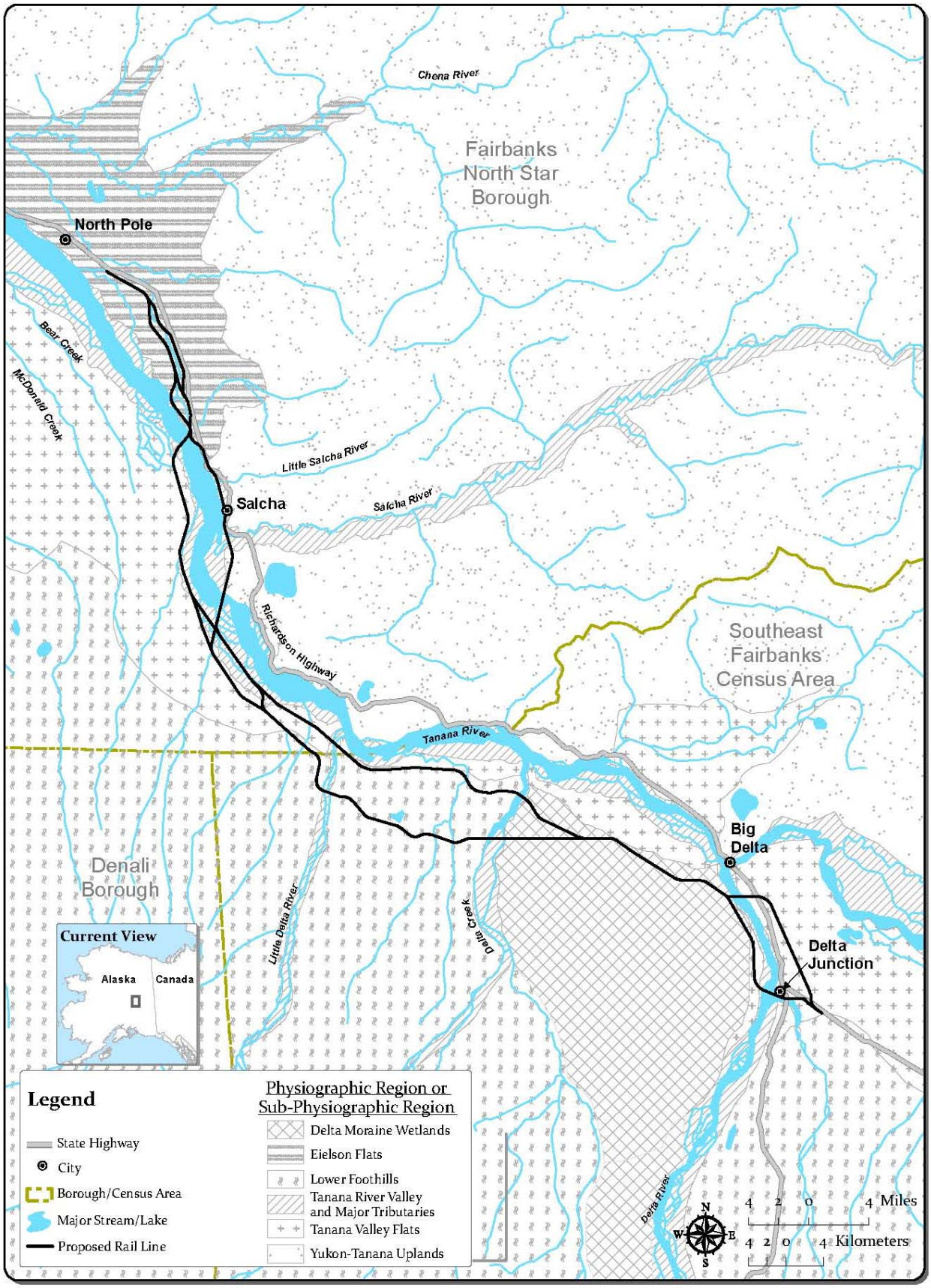

Figure 4-1 – Physiographic and Sub-Physiographic Regions

River is part of the larger Yukon River Basin, and is the largest tributary of the Yukon River. The Tanana River flows north-northeast from the base of the Alaska Range and through several physiographic regions (Wahrhaftig, 1965). A physiographic region is an area that has similar features or land forms that differ significantly from that of adjacent areas. Often, there are sub-areas within a region. These sub-areas are referred to as sub-physiographic regions. Table 4-1 summarizes the characteristics of major streams and rivers in the NRE project area. The project area lies along the border of the Yukon-Tanana Uplands and Tanana Lowlands physiographic regions, but mostly within the Tanana Lowlands region following the path of the river. The Tanana Lowlands are further divided into sub-physiographic regions that have distinct hydrologic and geomorphic characteristics, including Eielson Flats, Delta Moraine Wetlands, Lower Foothills, Tanana Valley Flats, and the Tanana River Valley and Major Tributaries.

Table 4-1
Summary Characteristics of Major Streams and Rivers in the NRE Project Area

Major Streams and Rivers	Drainage Area (square miles)[a]	Sub-Physiographic Region	Dominant Discharge Regime[b]
Tanana Lowlands Physiographic Region			
Tanana River	19,850	Tanana River Valley and Major Tributaries	Glacier
Piledriver Slough	ND[c]	Eielson Flats	Groundwater Breakup-
Moose Creek	ND	Eielson Flats	Groundwater
Twentythreemile Slough	ND	Eielson Flats	Breakup-Rainfall-Groundwater
Fivemile Clearwater River	188	Tanana Valley Flats	Groundwater
Little Delta River	691	Lower Foothills	Glacier
Kiana Creek	115	Lower Foothills	Breakup-Rainfall-Groundwater
Delta Creek	641	Lower Foothills	Glacier
Richardson Clearwater River	182	Tanana Valley Flats	Groundwater
Providence Creek	ND	Tanana Valley Flats	Groundwater
Delta River	1,642	Tanana Valley Flats - Delta Moraine Wetlands - Lower Foothills	Glacier
Jarvis Creek	ND	Tanana Valley Flats - Lower Foothills	Glacier-Rainfall
Yukon-Tanana Uplands Physiographic Region			
Little Salcha River	65[a]	N/A [d]	Rainfall-Groundwater
Salcha River at Richardson Highway	2,170	N/A	Breakup-Rainfall

[a] Drainage areas computed at proposed crossing location.
[b] Discharge regimes are described in Appendix E.
[c] ND = no data available.
[d] N/A = no sub-physiographic regions were identified in the project area.

There are 11 major watercourses that discharge to the Tanana River within the project area. Three of the larger rivers (Delta River, Delta Creek, and Little Delta River) have headwaters in

glaciated regions of the Alaska Range and flow northward toward the Tanana River. Two rivers on the northern side of the Tanana River (Salcha River and Little Salcha River) flow south-southwest from the Yukon-Tanana Uplands. Five streams that are primarily groundwater-fed (Richardson Clearwater, Fivemile Clearwater, Providence Creek, Twentythreemile Slough, and Piledriver Slough) flow parallel to the Tanana River along the south and north sides of the river before discharging to the river. Kiana Creek flows north and drains a large area in the Lower Foothills between Delta Creek and Little Delta River, until it reaches the Tanana Valley Flats, where it turns westward and is fed by a major groundwater upwelling complex. Kiana Creek joins the Tanana River approximately 4.5 miles upstream of the Little Delta River. In addition to the 11 major drainages within the project area, numerous smaller drainages in the valley are derived from local groundwater seeps or small side branches of the Tanana River, or are snowmelt/runoff drainage pathways.

In the project area, lakes were either formed naturally or excavated by humans. Naturally formed lakes and ponds are a result of floodplain processes, spring discharge, natural depressions below the groundwater table, relic moraine features associated with rapid downwasting of the 'Delta' Glaciers, or are located at the base of closed basins. Lakes and ponds are found throughout the study area, but in general have not been used for to supply water. Excavated lakes have been created to supply water for construction, development, or agriculture, or resulted from gravel mining and borrow areas dug below the groundwater table. Excavated lakes are common in the rural populated areas of Eielson Flatlands.

The Tanana River floodplain (Figure 4-2) exhibits many small pond-like features with a relatively permanent water supply that sustains them for most of the year. These smaller ponds are lenticularly shaped oxbows (*e.g.*, ponds formed within old river meander scars or channels) once occupied by the Tanana River. The ponded water is lower in elevation or is located in small depressions that fill with water when the underlying water table is high. Over time, these depressions fill in with organics and sediment and no longer contain standing water. These features are common throughout the Tanana River floodplain, and less so within the Eielson Flatlands and Tanana Valley Flats.

4.2.2 Environmental Consequences

This section describes potential impacts to surface water as a result of the proposed NRE. Appendix E describes in detail the methodology for assessing impacts. Appendix E also provides detailed water-resource tables, which list specific water resources and their characteristics. This section first describes common impacts associated with the proposed rail line, and then describes specific impacts associated with each alternative segment. The impacts descriptions include both proposed rail line construction and operations. In some cases, there would be no operations impacts. Chapter 20 describes proposed mitigation measures for impacts to surface water.

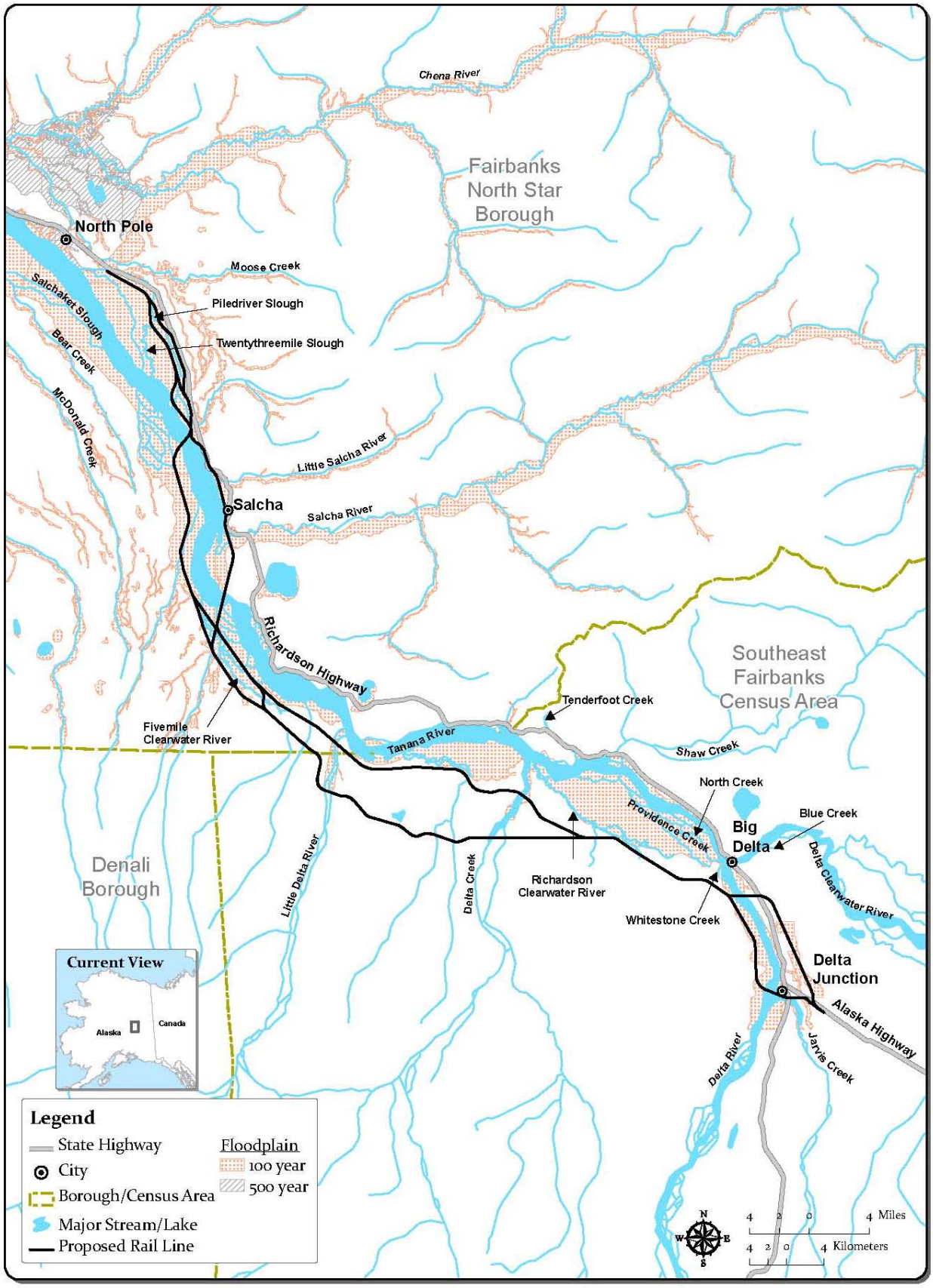

Figure 4-2 – Floodplain Area

Methodology

As part of this analysis, impacts are defined as low, moderate, high, or no impact (see Table 4-2). These impact descriptions provide a general guideline for understanding the effects of the proposed NRE, because the location and/or design characteristics of some temporary construction facilities and rail line structures would only be developed during the final design and permitting process. See Chapter 2 for a description of this process. The impact determinations for these preliminary facilities and structures represent the Surface Transportation Board Section of Environmental Analysis (SEA) conservative best estimates of the potential effects that could result from these types of facilities and structures in the project area.

Table 4-2
Impact Assessment Definitions

Description	Definition
No Impact	The activity/structure would not come in contact with the listed resource.
Low Impact	The activity/structure could have contact, but has little to no effect.
Moderate Impact	The activity/structure could cause negative impacts, but typically only under adverse or extreme conditions (*i.e.*, extreme flooding or weather events).
High Impact	The activity/structure would most likely cause negative impacts under normal construction or operational activities (*e.g.*, when fill is placed and occupies approximately half or more of a channel width).

Common Impacts to Surface Water

Common impacts are construction and operations-related impacts that could occur throughout the project area. These potential impacts are not associated with any specific alternative segment.

Common Construction Impacts to Surface Water

Construction-related impacts could result from the construction of unpaved access roads, construction of the rail line foundation, excavation of borrow areas, construction of bridges and culverts, use of ice roads and ice bridges, water supply extraction, and staging areas.

Unpaved Access Roads

In general, the construction of access roads would have low impacts to rivers and streams, except in areas where the road would be near or adjacent to waterbodies and wetland flow-way areas. In these cases, flood and/or wetland flow-way hydraulics could be altered, potentially creating new wetland areas or causing the loss of wetland areas by cutting off water sources. In addition, unpaved access roads could increase sediment availability, which could lead to sediment loading and turbidity in nearby streams. The construction of access roads (or the railbed) could affect sheet surface water flow if adequate cross drainage is not provided or if fill materials capture surface or subsurface flows and redirect them. In porous floodplain systems, there is the potential for fills associated with access roads to alter subsurface flows and upwellings important for fish habitat. The impacts from access road-related bridges and culverts are discussed below.

Excavation of Borrow Areas

Large man-made reservoirs could result from the excavation of materials used to supply subballast. In addition, borrow areas in discontinuous permafrost terrain could lead to thermal erosion (the erosion of permafrost by the combined thermal and mechanical action of moving water) and subsequent transport of fine-grained sediments during flooding or ice breakup to nearby waterbodies. Thermal erosion can occur anywhere ice-rich permafrost thaws, not just near streams. Section 4.4 provides more information about erosion and sedimentation.

There would also be several large (approximately 20 acres each) borrow areas in the active channels of the large braided glacial streams (Tanana River, Little Delta River, Delta Creek, and Delta River). The exact location of these borrow areas within the active channels has not been identified, and the timing and duration of borrow activity has not been described, so it is plausible that without knowledge of annual and seasonal variation of flood stage and hydraulics of these rivers at the borrow areas, there could be adverse consequences. These consequences could include flooding and subsequent erosion and/or aggradation of the borrow area and loss of equipment and work days.

Excavation of materials from wetlands could cause loss of aquatic habitat, loss of the ability to slow surface water flow, and decreased filtration capacity, as described in Section 4.5. Local shallow water areas (former borrow areas) could be targeted areas for further gravel extraction. The excavation of borrow areas could affect sheet surface water flow by capturing surface or subsurface flows. In some cases, these man-made reservoirs have established recreational or habitat value, which could be disrupted by the removal of material from the gravel pits, including sediment disturbance, an increase in turbidity, and an overall degradation of water quality within the pit pond. Also, large man-made reservoirs (approximately 17 acres each) would be left as a result of the material excavations.

Construction and Installation of Bridges and Culverts

Bridges would be constructed as single- or multiple-span segments that would either completely or only partially span (or clear) the channel. Depending on design and the need to work in the channel (*i.e.*, geotechnical drilling for design work, constructing piers and footings) or along the stream banks (*i.e.*, constructing abutments), filling or excavating materials from streams and/or wetlands, impacts could be low to high, and could include:

- Blockage, convergence, or changes to the natural drainage during and after (short and long-term) constructing/working in the channel;
- Sloughing and erosion of the streambank;
- Thermal erosion of cuts made into permafrost soils;
- Geotechnical boreholes providing direct communication between surface water and groundwater;
- Increased stages and velocities of floodwater (due to temporary constrictions) possibly concurrent with increased backwater flooding; and
- increased channel scour, bank erosion and downstream sedimentation.

The installation of bridge piers or abutments could result in the exposure of supra-permafrost (the layer of ground above permafrost) layers. Alteration of these areas could also affect the stability of the piers if thawing was not abated.

The construction of single culverts and battery culverts (multiple culverts at one crossing), however, would likely result in localized disturbance of the streambank to gain access to the channel, and disturbance of the channel bed during culvert installation. Culvert installation would likely have a low impact to supra-permafrost locations. The placement of culverts would typically be within existing channel beds and banks, limiting the extent of permafrost disturbances.

Construction and Use of Ice Roads and Ice Bridges

Although the Alaska Railroad Corporation (ARRC or the Application) has not proposed specific ice roads or bridges, wintertime construction might require ice roads and ice bridges to cross rivers and streams. In some cases, the building of an ice bridge would entail thickening of ice at the crossing. Thickening ice at a crossing could increase freeze-depth in the stream bed and banks, leading to increased overflow or icing in the channel, and diverting flows from downstream reaches. In spring, the thicker zone of ice could take longer to thaw/melt during breakup and cause local flooding (similar to an ice jam). Disturbance along these areas from construction activities could lead to river or stream bank collapse and erosion. Ice bridges can also cause effects during winter, because under-ice flows are restricted and overflow icing increases due to restriction of the channel cross section by thickening ice.

Water Supply Extraction for Potable Water and Construction Use

Rivers, streams, lakes, and ponds could supply fresh water for the construction of ice bridges and ice roads during winter construction seasons and for potable and construction water at construction camps and staging facilities. The Applicant has not estimated proposed project water needs (rates and volumes), but SEA anticipates that these activities could have low short-term (seasonal) impacts on the stage (water level) of smaller streams but would have a lesser effect on larger watercourses.

Major rivers, lakes, and ponds could be used to supply fresh water for the construction of ice bridges and ice roads during the winter construction season and for potable and construction water at construction camps and staging facilities. Impacts to rivers, lakes, and ponds would depend on the total cumulative water withdrawal by all users from a single source. The ADNR would manage water withdrawal to ensure that water appropriation would not impact fish or fish overwintering habitats or prior appropriators.

If the cumulative withdrawal rate by all users exceeded the natural recharge rate for that aquifer (during intermittent or sustained periods), water extractions from wells could (1) temporarily reduce local groundwater levels and (2) affect the rate and volume of groundwater discharge to rivers and streams. This effect would be greater in certain areas where there is a reasonably high level of hydraulic connectivity between the surface water and groundwater systems.

ADNR would authorize the withdrawal, impoundment, or diversion of water only if the withdrawal, impoundment, or diversion would be in the public interest and would not adversely affect the supply of water to lawful appropriators of record. Public interest criteria include the

effect of water withdrawal, diversion, or impoundment on fish and game resources and on public recreational opportunities.

Use of River Channels or Floodplains as Transport and Staging Areas

Although construction staging areas and camps are not typically allowed on floodplains due to the inherent flooding risks and the associated difficulty in containing hazardous materials spills, there might not be feasible alternatives. Because locations have not been finalized (regarding proximity to waterbodies and floodplains), SEA has conservatively assumed that there is a possibility staging areas and camps could be located on floodplains.

The use of floodplains as staging areas or camps could affect sheet surface water flow if adequate cross drainage was not provided or if fill materials captured surface or subsurface flows and redirected them. In porous floodplain systems, there is the potential for fills associated with access roads to alter subsurface flows and upwellings important for fish habitat.

Natural drainage patterns could be disrupted if construction activities (*e.g.*, in staging areas) occur during flooding episodes of major streams, during high runoff periods along seasonal drainages, or along shallow overland flow paths. Blockages or diversions to areas with insufficient flow capacity could result in seasonal or semi-permanent impoundments. Also, redirected surface flows could increase stream velocities at isolated locations, where increased bank scour or overbanking could occur.

There is discontinuous permafrost throughout the project area and compaction or ground disturbance to the area adjacent to streambanks would likely occur as a result of the construction and use of staging areas and camps. As a result of the potentially large areas that would be occupied, there would be a possibility of affecting areas of permafrost, which could catalyze thermal erosion near streambanks. In addition, removal or compaction of shallow surface soils could enlarge or eliminate supra-permafrost areas. Construction pads could temporarily affect shallow surface water zones and could temporarily change the thickness and vertical location of the active thaw zone. This could lead to entrainment and transport of fine-grained sediments to nearby waterbodies during rainstorms or subsequent breakups.

Common Operations Impacts to Surface Water

Section 4.4 describes operations impacts to surface water.

Impacts to Surface Water by Alternative Segment

Construction Impacts

North Common Segment

There are two potential crossings along this segment—one bridge and one culvert. The 140-acre Eielson Construction Camp and Staging Area and one 17-acre borrow area would be part of this segment. Figure 4-3 shows the proposed stream crossings and Table 4-3 provides additional details on the two crossings. Appendix E provides information on controlling factors and other crossing characteristics, and summarizes potential impacts for North Common Segment (see Tables E-15 through E-16b).

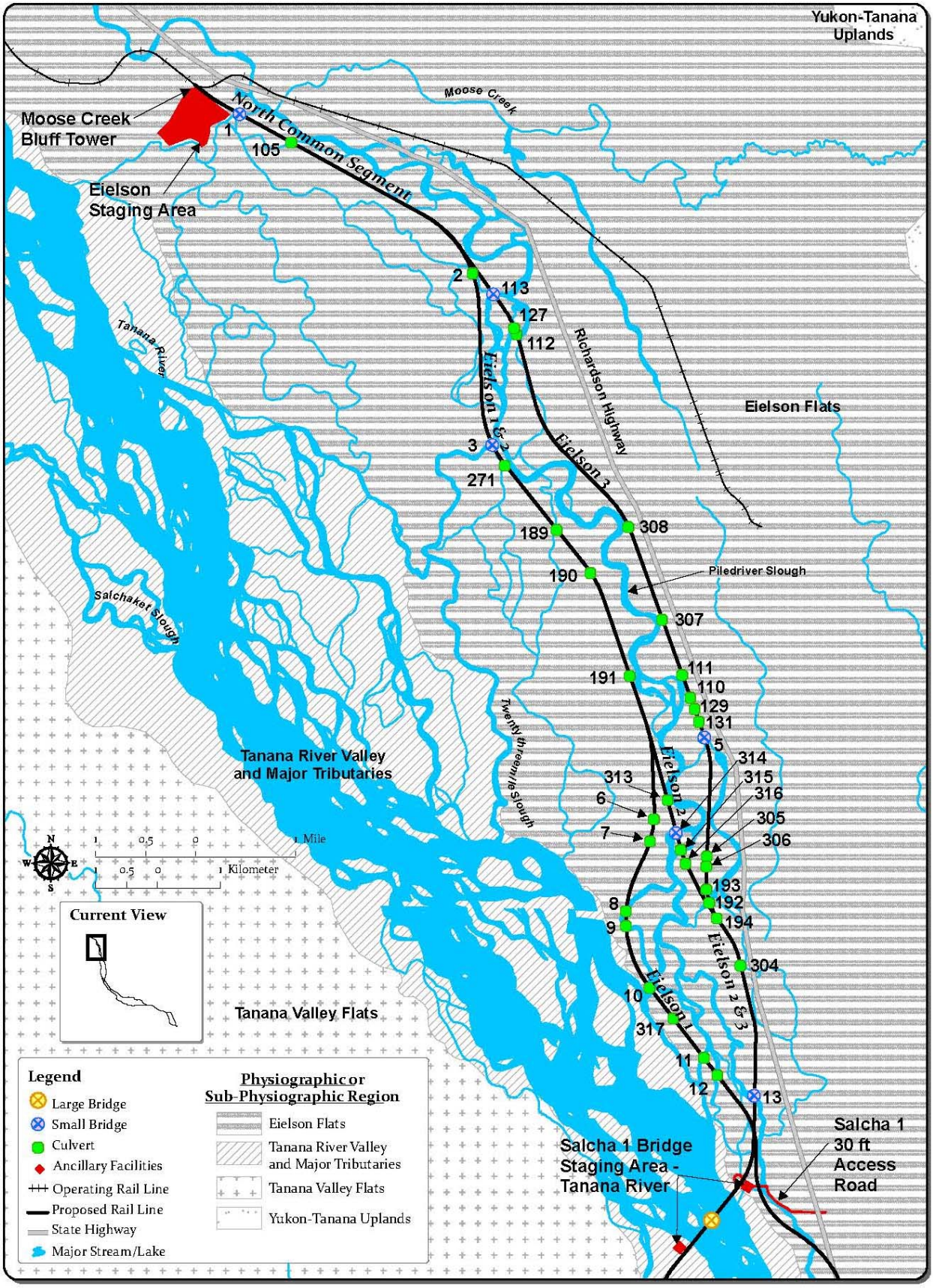

Figure 4-3 – North Common and Eielson Alternative Segments Stream Crossings

Table 4-3
Summary of Crossing Environment for North Common Segment

Number of Crossings	
	2
Type of Waterbody	
Drainageway	–
Floodplain Slough	1
Overflow Channel	–
Seep	–
Stream	1
Wetland Flow-way[a]	–
Physiographic Division	
Eielson Flats	2
Delta Moraine Wetlands	–
Lower Foothills	–
Tanana River Valley and Major Tributaries	–
Tanana Valley Flats	–
Yukon-Tanana Uplands	–
Type of Crossing	
Small Bridge	1
Culvert	1
Channel Stability	
High	–
Moderate	2
Low	–
Within 100-Year Floodplain	
Yes	2
No	–

[a] Not defined as wetlands per the National Wetlands Inventory.

The relevant activities or structures that would be placed along the 2.7-mile-long North Common Segment would result in low impacts. Most of the activities would not be located along the margins of any waterbodies along this reach and would not affect the rivers and streams.

The approximately 100-foot-long proposed bridge across the Piledriver Slough would be a single-span bridge and no structures would be placed directly in the channel, resulting in minimal disturbance to the river channel. There would be low to moderate disturbances to the streambanks during construction of the bridge approaches and abutments. Impacts associated with potential bridge construction over Piledriver Slough would be low.

Construction of the culvert crossing (two 10-foot-diameter culverts) would likely result in localized disturbance of the streambank when gaining access to the channel and disturbance of the channel bed when installing the culvert. Impacts associated with potential culvert battery construction would be moderate.

The 140-acre Eielson Construction Camp and Construction Staging Area would likely be located along this segment, but its relative proximity to waterbodies is not known. Compaction and/or ground disturbance adjacent to streambanks in areas of permafrost could occur as a result of constructing the staging area and camp in proximity to streams. As a result of the potentially

large area being occupied, there would likely be a moderate impact to local areas of permafrost, which could catalyze thermal erosion near streambanks.

Well-water extraction would also be required for potable water use in the camp and for construction water in the staging area. The estimated water use (rates and volumes) would be determined during final design and permitting. Based on the following general effects that could result from water use, there could be impacts on natural water balances in the local area. Water extractions from wells could reduce local groundwater levels and, due to a reasonably high level of hydraulic connectivity between the surface water and groundwater systems, the rate and volume of groundwater discharge to waterbodies could be reduced intermittently during sustained pumping periods (*i.e.*, the withdrawal rate could exceed the natural recharge rate). The level of impact would depend on site conditions and water withdrawal rates.

The construction of gravel access roads near adjacent waterbodies would result in low impacts because there would be a number of existing roads in the area that could be used when feasible. Therefore, the construction of new roads would be minimal.

One approximately 17-acre borrow area to supply subballast material would likely be located along this segment. While there is discontinuous permafrost throughout this area, borrow areas would not likely be situated in permafrost (because the finer-grained nature of these soils would be less desirable), which would minimize the potential for thermal erosion and reduced gravel pond quality. Therefore, it is anticipated that this borrow area would result in a low impact.

Further, due to the shallow groundwater in the area it could be difficult to reach the assumed excavation depth of 20 feet, even with the use of a dragline, as described in Section 2.3.3. Thus, the borrow area might need to be larger than the assumed 17 acres. A large groundwater-fed pond would be left as a result of the subballast excavation.

The bridge across Piledriver Slough would span the entire width of the channel and would be designed to pass the 100-year flood and provide passage for navigation of small boats. These design criteria would also make the potential for ice and debris jams low. Thus, the proposed bridge across Piledriver Slough would result in a low impact.

The proposed battery culvert would cause some constriction at the crossing site because the bankfull width of the channel would be reduced from 35 feet to less than 20 feet by the use of two 10-foot-diameter culverts (see Table E-15 in Appendix E). During high flows, this constriction could cause backwaters to form upstream, which would increase the potential for flooding and sediment deposition upstream, and/or channel scour downstream. The culvert also would increase the potential for debris to become trapped, which could result in overbank flooding. The installation of the culvert would result in high impacts, because it could (1) alter flood hydraulics upstream and downstream of the crossing, (2) increase the potential for overbank flooding and ice and debris jams upstream of the culverts, (3) increase scour and bank erosion downstream of the culverts, and (4) increase channel aggradation in certain reaches both upstream and downstream of the culverts.

The remainder of activities or structures along North Common Segment would likely result in low impacts.

Eielson Alternative Segments

There are three proposed Eielson alternative segments, though the segments have common routes over part of the project area. Depending upon the alternative, four or five 17-acre borrow areas are proposed at 3 to 5-mile intervals. Staging areas surrounding the bridge crossings are only proposed for Eielson Alternative Segments 2 and 3.

Table 4-4 lists and Figure 4-3 shows the types of waterbodies and proposed stream crossings along these alternative segments. Appendix E provides information on controlling factors and other stream crossing characteristics for the Eielson alternative segments (see Tables E-17 through E-22c).

Table 4-4
Summary of Crossing Environment for Eielson Alternative Segments

	Eielson 1	Eielson 2	Eielson 3
Number of Crossings			
	14	13	17
Type of Waterbody			
Drainageway	–	–	1
Floodplain Slough	1	3	7
Overflow Channel	6	4	2
Seep	–	–	–
Stream	–	1	–
Wetland Flow-way[a]	7	5	7
Physiographic Division			
Eielson Flats	14	13	17
Delta Moraine Wetlands	–	–	–
Lower Foothills	–	–	–
Tanana River Valley and Major Tributaries	–	–	–
Tanana Valley Flats	–	–	–
Yukon-Tanana Uplands	–	–	–
Type of Crossing			
Small Bridges	1	3	3
Rail Large Bridges	–	–	–
Culvert	13	10	14
Channel Stability			
High	6	3	10
Moderate	7	9	6
Low	1	1	1
100 Year Floodplain			
Yes	14	13	17
No	–	–	–

[a] Not defined as wetlands per the National Wetlands Inventory.

Eielson Alternative Segment 1

This segment would be 10.3 miles long and would include 14 total crossings (13 culverts and 1 bridge), 6 of them common with Eielson Alternative Segment 2. The approximately 100-foot-long proposed bridge across Twentythreemile Slough would likely be a single-span bridge similar to the one across Piledriver Slough as part of North Common Segment. The bridge would be designed to pass the 100-year flood and provide passage for navigation of small boats.

These design criteria would also make the potential for ice and debris jams low. Thus, the proposed bridge over Twentythreemile Slough would result in a low impact.

Seven of the culverts would be used to maintain hydraulic continuity in a wetland flow-way and would be 4 or 10 feet in diameter. Fill would be used across most of the cross-sectional width of the wetland flow-ways. Culvert batteries (multiple culverts at a single crossing) sized to convey flows up to the 100-year flood would be used at four other culvert crossings. The remaining two culverts would also be sized to convey the 100-year flood flow. In all but two of the cases, fill would be required to cross at least half the width of the channels, resulting in disturbance of the streambanks and a narrow strip (but sufficiently wide to build the rail line) across the channels. These local activities would result in high impacts during construction. The timeframe for construction would depend on funding, and construction would likely be staged. However, under a full construction scenario, ARRC anticipates that the project would be completed within 3 to 4 years. Most of the other activities or structures along Eielson Alternative Segment 1 would not be located along the margins of any waterbodies. Therefore, they would not affect the rivers and streams and would result In low impacts. Refer to the Common Impacts and North Common Segment discussions above for activities relating to culverts, gravel access roads and borrow extraction.

Culvert batteries and single culverts would be used in the overflow crossings for the purpose of conveying 100-year flood flows. Although some of these culverts would be relatively large, the overflow channels would still be substantially constricted, thereby potentially increasing flow velocities during high flows through this section. These crossings (both single and battery culverts) would result in high impacts for (1) altered flood hydraulics, (2) increased potential for overbank flooding and ice or debris jams, and (3) increased scour, bank erosion, and channel aggradation. Refer to the section entitled Common Impacts to Surface Water for discussions of these potential impacts.

The remainder of the activities or structures proposed along Eielson Alternative Segment 1 would likely result in low impacts.

Eielson Alternative Segment 2

This segment would be 10.0 miles long and would include 13 total crossings (3 bridges and 10 culverts), 6 of them common along 5.7 miles of Eielson Alternative Segment 1 and 3 crossings common with the last 2.2 miles of the Eielson Alternative Segment 3.

The approximately 100-foot-long proposed bridge across Twentythreemile Slough would likely be a single-span bridge similar to the one across Piledriver Slough as part of North Common Segment. The bridge would be designed to pass the 100-year flood and provide passage for navigation of small boats. These design criteria would also make the potential for ice and debris jams low. Thus, the proposed bridge over Twentythreemile Slough would result in a low impact.

The Piledriver Slough bridge crossing (#314 on Figure 4-3) would be approximately 330 feet long and would likely have at least two mid-channel piers to accommodate three bridge sections. The third bridge would be shorter (60 feet) and would cross an 80-foot-wide channel. Construction activities for these two bridges would have a greater chance of disturbing the channel and banks, so potential impacts would be moderate.

Five of the culverts would be used to maintain hydraulic continuity in a wetland flow-way; three would be 4 feet in diameter and two would be 10 feet in diameter. In all cases, the culvert diameters would be a small proportion of the crossing width, so fill would be used across most of the cross-sectional width of the wetland flow-way. Culverts would be used at the other five crossings to convey flows up to the 100-year flood, and in one case to convey a small stream. Two of the five culverts used to maintain hydraulic conductivity would be 4 feet in diameter; only one of these would be a culvert battery (four 10-foot-diameter culverts). In all but two cases (#190 and #191 on Figure 4-3), fill would be used in more than half of the channel width. These crossings (both single and battery culverts) would result in high impacts for (1) altered flood hydraulics, (2) increased potential for overbank flooding and ice or debris jams, and (3) increased scour, bank erosion, and channel aggradation. Refer to the section entitled Common Impacts to Surface Water for discussions of these potential impacts.

The other activities or structures proposed along Eielson Alternative Segment 3 would likely result in low impacts.

Eielson Alternative Segment 3

This alternative segment would be 10.1 miles long, with the last 2.2 miles the same as Eielson Alternative Segment 2. There are 17 proposed crossings that include 3 bridges, 6 culvert batteries, and 8 single culverts. Two of the bridge crossings, one across Piledriver Slough and the other across an unnamed slough, would likely be multiple span bridges, which would require mid-channel piers; the third would be a 60-foot crossing in an 80-foot-wide channel. Potential impacts associated with these bridge crossings would be moderate due to the required work in the channel and along the banks. Refer to the section entitled Common Impacts to Surface Water for a discussion of these impacts. The same high impacts listed above for Eielson Alternative Segment 1 would apply to the culvert placements.

Most of the activities proposed along Eielson Alternative Segment 3 would likely result in low impacts. Refer to the Common Impacts and North Common Segment subsections for discussions of the construction of culverts and gravel access roads, and material extraction from borrow areas.

Salcha Alternative Segments

Both Salcha alternative segments would include Tanana River crossings, and one would cross both the Tanana and Salcha Rivers. Depending on the alternative segment, there would be three to five 17-acre borrow areas at 3- to 5-mile intervals. Staging areas surrounding the bridge crossings are proposed along both segments. Ice roads and bridges would be used along these segments to cross the Tanana River during winter to transport material and equipment to the west side of the Tanana River.

Figure 4-4 shows and Table 4-5 lists the types of waterbodies these alternative segments would cross and the proposed stream crossings. Appendix E provides information on controlling factors and other stream crossing characteristics (see Tables E-23 through E-26d).

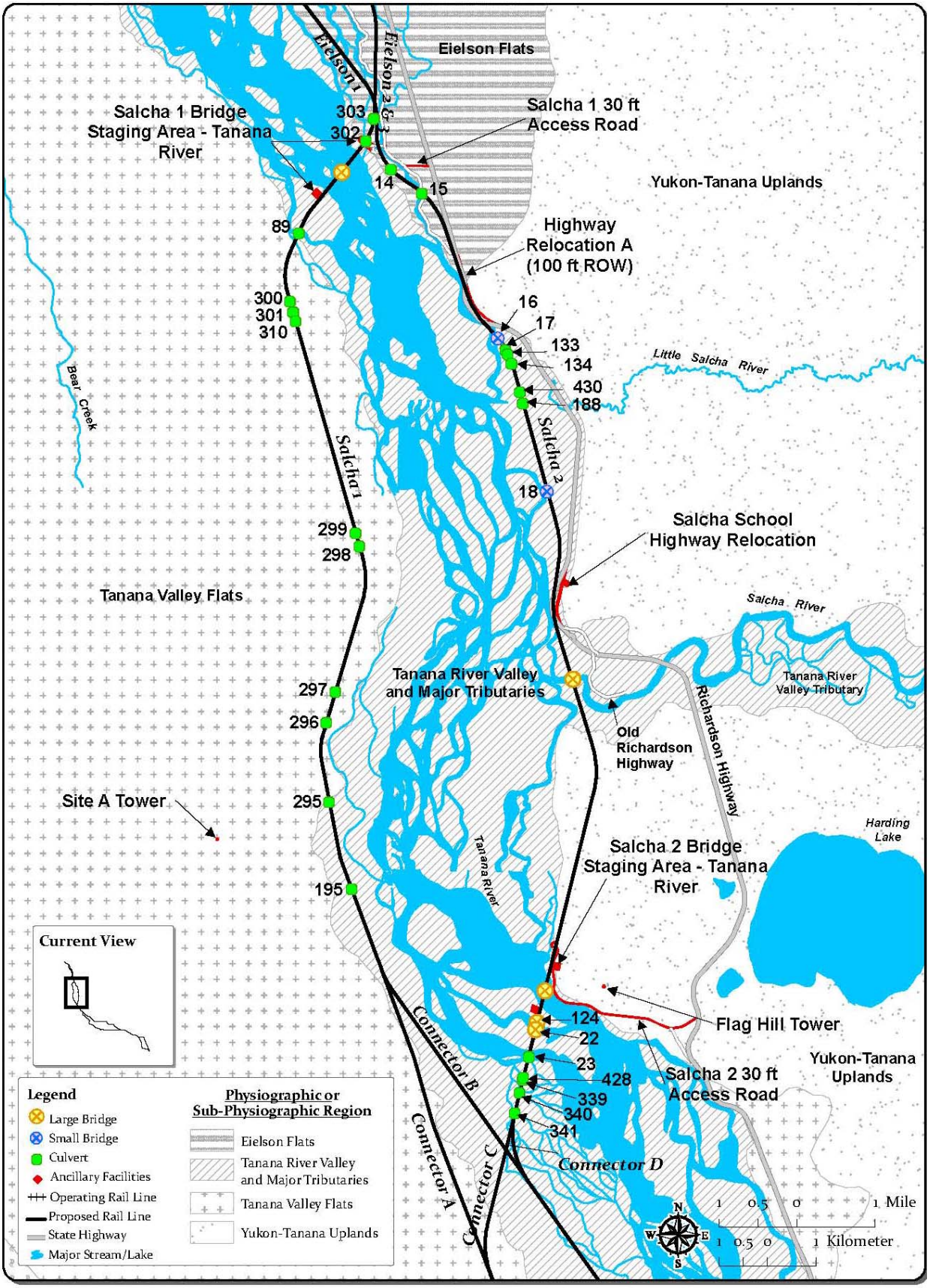

Figure 4-4 – Salcha and Connector Alternative Segments Stream Crossings

Table 4-5
Summary of Crossing Environment for Salcha Alternative Segments

	Salcha 1	Salcha 2
Number of Crossings		
	13	18
Type of Waterbody		
Drainageway	4	–
Floodplain Slough	1	8
Overflow Channel	–	3
Seep	–	–
Stream	2	5
Wetland Flow-way[a]	6	2
Physiographic Division		
Eielson Flats	2	2
Delta Moraine Wetlands	–	–
Lower Foothills	–	–
Tanana River Valley and Major Tributaries	4	16
Tanana Valley Flats	7	–
Yukon-Tanana Uplands	–	–
Type of Crossing		
Small Bridges	-	2
Rail Large Bridges	1	4
Culvert	12	12
Channel Stability		
High	11	3
Moderate	2	15
Low	–	–
Within 100-Year Floodplain		
Yes	13	18
No	–	–

[a] Not defined as wetlands per the National Wetlands Inventory.

Salcha Alternative Segment 1

This segment would be approximately 11.8 miles long and would run primarily along the west side of the Tanana River. Thirteen crossings are proposed along this segment, including one major crossing of the Tanana River (approximately 3,000 feet wide), and 12 culvert crossings. The bridge crossing of the Tanana River would require a dual-modal bridge ranging from 2,400 to 3,600 feet in length. Due to the size of the crossing, there would be construction activities in the middle of the channel to place the bridge piers. Construction activities could cause increased scour or bank erosion while accessing the channel. This impact would be moderate.

The large-bridge crossing at the Tanana River would be designed to pass the 100-year flood and be navigable for a maximum boat size (depending on U.S. Guard [USCG] criteria). Further, the piers placed within the channel would alter flood hydraulics, causing increased scour surrounding the piers, which would result in downstream aggradation and increase the potential for overbank flooding and ice or debris jams. Detailed analyses of the Tanana River crossing has been conducted on only a preliminary level and effects to flood hydraulics during high-flow events are unknown. Thus, conservatively, this structure could result in high impacts.

The Applicant would need to construct gravel roads along the west side of the Tanana River, and has proposed a 24-foot-wide road. Road crossings of streams would be adjacent to the rail line and have the same type of bridge and culvert crossings as the railbed and would have similar impacts as the railbed crossings. While localized disturbances to the stream banks would likely occur during construction, impacts would be low.

Ice roads and bridges would be constructed to cross the Tanana River in winter for transport of people and construction material. Ice roads and bridges would result in moderate impacts, as follows: (1) altered flood hydraulics, (2) increased potential for overbank flooding and ice or debris jams, and (3) stresses on natural water balances. These effects would occur during spring breakup when the ice roads and bridges began to melt. The ice roads and bridges would be the last to break up because of the increased thickness of the ice in the river and could cause ice jams, which could back up the river and cause flooding upstream.

Most of the other activities or structures along Salcha Alternative Segment 1 would be located away from major waterbodies; therefore, impacts would likely be low. Refer to the Common Impacts to Surface Water and North Common Segment subsections for discussions of activities relating to staging areas, culverts, and borrow extraction.

Salcha Alternative Segment 2

This segment would be approximately 13.8 miles long and would run primarily along the east side of the Tanana River. Eighteen crossings are proposed along this segment, including two major river crossings of the Salcha and Tanana rivers (one Tanana River bridge crossing the main and two side channels), two additional smaller bridge crossings, and 12 culvert crossings (including six culvert batteries).

The bridge crossing at the Tanana River is near Flag Hill and would require a dual-modal bridge approximately 4,000 feet long. Due to the size of the crossing, there would be construction activities along the banks while building the abutments, and in the middle of the channel while placing the bridge piers. The bridge would cross the main channel of the Tanana River and two side channels approximately 280 and 150 feet wide. This crossing would also include placement of a natural bottom culvert in an additional side channel.

The large bridge crossing of the Salcha River would also require multiple spans. Construction activities for all these bridges could cause increased bank erosion when accessing the channel and while the bridge approaches and abutments were constructed. This impact would be moderate.

The large bridge crossing at the Tanana River would be designed to pass the 100-year flood and be navigable for a maximum boat size (depending on USCG criteria). Further, the piers placed within the channel would alter flood hydraulics, would cause increased scour surrounding the piers, resulting in downstream aggradation, and increase the potential for overbank flooding and ice or debris jams. Detailed analyses of the Tanana River crossing has been conducted on only a preliminary level and effects to flood hydraulics during high-flow events are unknown. Thus, conservatively, this structure could result in high impacts.

Six culvert batteries (three batteries with two 10-foot-diameter culverts and three batteries with three 10-foot-diameter culverts) are proposed for three overflow channels (one of which includes

flow from the Little Salcha River), one small stream, and two small sloughs. In all but one case, the combined width of the proposed culvert batteries and single culverts would be small compared to the total crossing widths. Thus, considerable fill would be required, and much of the channel and banks would be disturbed. Overall, there would be minimal to moderate disturbances to the streambanks and channels due to the short construction window. Impacts associated with culvert construction would be high.

Ice roads and bridges would result in moderate impacts, as follows: (1) altered flood hydraulics, (2) increased potential for overbank flooding and ice or debris jams, and (3) stresses on natural water balances. These effects would occur during spring breakup when the ice roads and bridges began to melt. The ice roads and bridges would be the last to break up because of the increased thickness of the ice in the river and could cause ice jams, which could back up the river and cause flooding upstream.

Most of the other activities or structures along this segment would be located away from major waterbodies; therefore, the impacts would likely be low. Refer to the section entitled Common Impacts to Surface Water and the section entitled North Common Segment for discussions of activities relating to staging areas, small culverts, and borrow extraction.

Central Alternative Segments

The two Central alternative segments would include crossings of wetland flow-ways, streams, seeps, overflow channels, and a drainageway (Figure 4-5). Both alternative segments would require unpaved access roads, borrow areas, a construction camp, water-supply extraction, and transportation and staging areas. Ice roads and bridges might be used along Central Alternative Segment 2 to cross waterbodies during winter to transport material and equipment. Appendix E provides information on controlling factors and other crossing characteristics for the two Central alternative segments (see Tables E-27 through E-29d).

Central Alternative Segment 1

The Applicant proposes ten stream crossings along Central Alternative Segment 1—one bridge crossing and nine culvert crossings. In addition, a 40-acre Tanana/Donnelly Construction Camp and one or two borrow areas are proposed for this segment. Ice roads and bridges would not likely be used for this segment. Table 4-6 lists the types of waterbodies and proposed stream crossings for Central Alternative Segment 1.

The bridge would cross a relatively small tributary stream of the Tanana River and would likely be a single-span bridge; therefore, no structures would be placed in the channel. There would be minimal to moderate disturbances to the streambanks if the bridge approach and abutments were constructed. Impacts associated with bridge construction would be low.

All nine culvert crossings would require relatively small single culverts (*i.e.*, 4 feet or 10 feet in diameter) that would provide conveyance for a stream, a drainageway, seeps, or hydraulic continuity for wetland flow-ways. Most of these single culverts would occupy only a small portion of the channel, with the remaining width covered in fill. Short-term streambank and channel disturbance during construction would result in high impacts.

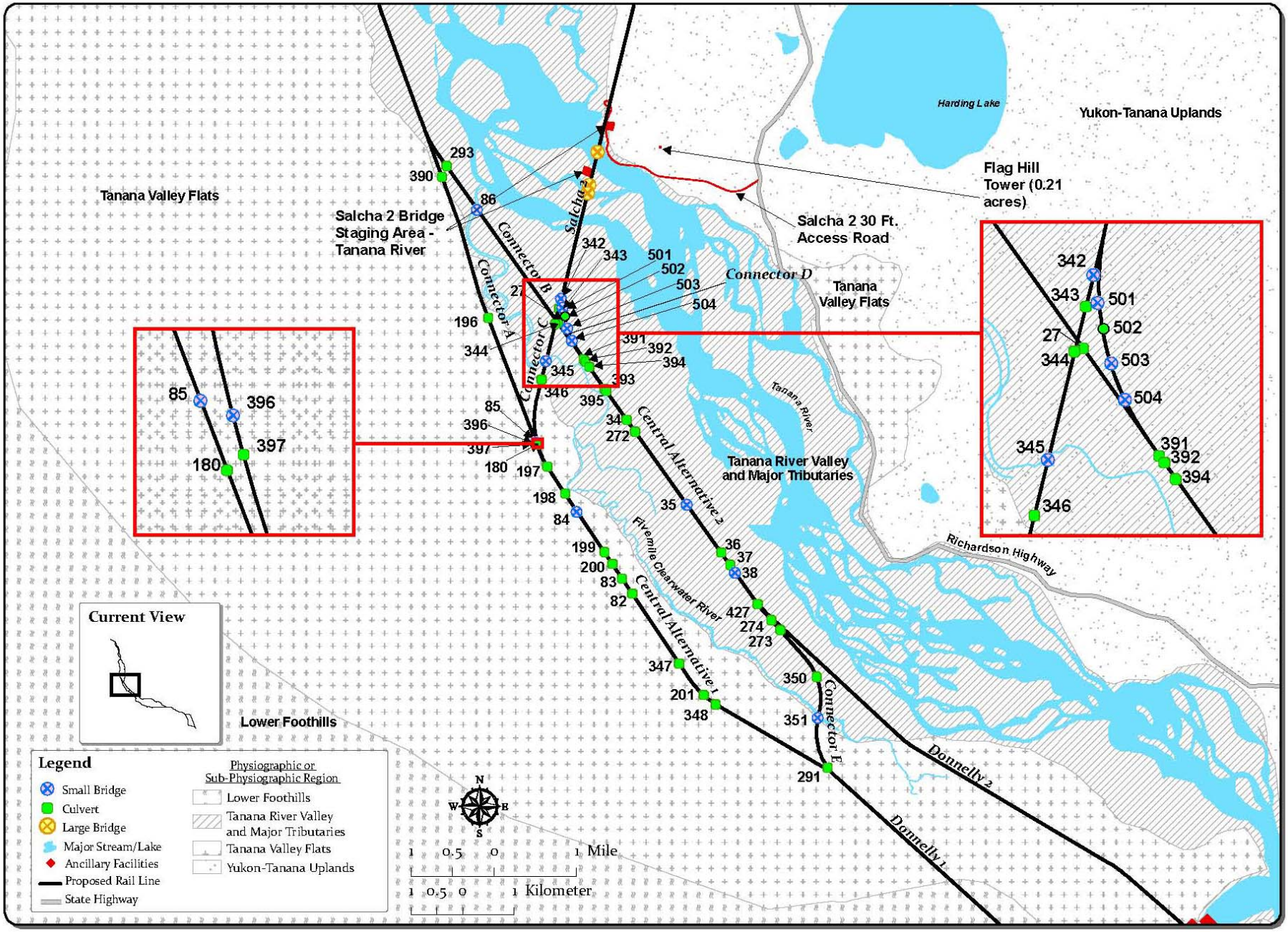

Figure 4-5 – Central Alternative Segments and Connectors Stream Crossings

Table 4-6
Summary of Crossing Environment for Central Alternative Segments 1 and 2

	Central Alternative 1	Central Alternative 2
Number of Crossings		
	10	11
Type of Waterbody		
Drainageway	1	–
Floodplain Slough	–	–
Overflow Channel	–	9
Seep	3	–
Stream	2	–
Wetland Flow-way[a]	4	2
Physiographic Division		
Eielson Flats	–	–
Delta Moraine Wetlands	–	–
Lower Foothills	–	–
Tanana River Valley and Major Tributaries	–	11
Tanana Valley Flats	10	–
Yukon-Tanana Uplands	–	–
Type of Crossing		
Small Bridges	1	2
Rail Large Bridges	–	–
Culvert	9	9
Channel Stability		
High	9	9
Moderate	1	2
Low	–	–
Within 100-Year Floodplain		
Yes	–	11
No	10	–

[a] Not defined as wetlands per the National Wetlands Inventory.

Other activities or structures placed along the 5.1-mile-long Central Alternative Segment 1 would result in low impacts. Similar to the other segments, most of the construction activities would not be along the margins of any waterbodies and, therefore would not affect the rivers and streams.

The 40-acre Tanana/Donnelly Construction Camp could be located along this segment, but its relative proximity to waterbodies is not known. There is discontinuous permafrost throughout this area and compaction and ground disturbance to the area adjacent to the streambanks could occur as a result of the staging area and camp. As a result of the potentially large area that would be occupied, and its unknown location, the potential impacts could be moderate to areas of permafrost, which could catalyze thermal erosion near streambanks.

Well-water extraction would also be required for potable water use in the camp and construction water in the staging area. The estimated water use (rates and volumes) would be determined during final design and permitting. Based on the following general effects that could result from water use, there could be impacts on natural water balances in the local area. Water extractions from wells could reduce local groundwater levels and, due to a reasonably high level of hydraulic connectivity between the surface water and groundwater systems, the rate and volume

of groundwater discharge to waterbodies could be reduced intermittently during sustained pumping periods (*i.e.*, the withdrawal rate could exceed the natural recharge rate). The level of impact would depend on site conditions and water withdrawal rates.

Central Alternative Segment 2

The Applicant proposes 11 stream crossings along Central Alternative Segment 2—two bridge crossings and nine culvert crossings. In addition, a 40-acre Tanana/Donnelly Construction Camp and one or two borrow areas are planned for this segment. Ice roads and bridges would not likely be used for this segment. Table 4-6 lists the types of waterbodies and proposed stream crossings for Central Alternative Segment 2.

The two bridges would cross relatively small overflow channels of the Tanana River and would likely be single-span bridges; therefore, no structures would be placed in the channel. There would be minimal to moderate disturbances to the streambanks if the bridge approaches and abutments were constructed. Impacts associated with bridge construction along Central Alternative Segment 2 would be low.

The nine culvert crossings would be relatively small, single culverts (*i.e.*, 4 feet or 10 feet in diameter) that would provide conveyance for flows up to the 100-year flood or hydraulic continuity for wetland flow-ways. Most of these single culverts would occupy only a small portion of the channel, with the remaining width covered in fill. Short-term streambank and channel disturbance during construction would result in high impacts.

Other activities or structures placed along Central Alternative Segment 2 would result in low impacts. Similar to other segments, most of the activities or structures would not be located along the margins of any waterbodies, and therefore would not affect the rivers and streams.

The 40-acre Tanana/Donnelly Construction Camp could be located along this segment, but its relative proximity to waterbodies is not known. There is discontinuous permafrost throughout this area and there could be compaction and ground disturbance to the area adjacent to the streambanks as a result of the staging area and camp. Because of the potentially large area the camp would occupy and its unknown location, potential impacts could be moderate to areas of permafrost, which could catalyze thermal erosion near streambanks.

Well-water extraction would also be required for potable water use in the camp and construction water in the staging area. The estimated water use (rates and volumes) would be determined during final design and permitting. Based on the following general effects that could result from water use, there could be impacts on natural water balances in the local area. Water extractions from wells could reduce local groundwater levels and, due to a reasonably high level of hydraulic connectivity between the surface water and groundwater systems, the rate and volume of groundwater discharge to waterbodies could be reduced intermittently during sustained pumping periods (*i.e.*, the withdrawal rate could exceed the natural recharge rate). The level of impact would depend on site conditions and water withdrawal rates.

Connector Segments A through E

There would be 24 stream crossings along the proposed connector segments—nine small bridge crossings and 15 culvert crossings (Figure 4-5). There would likely be one or two borrow areas

along the connectors; ice roads and bridges would not be likely. Table 4-7 lists the types of waterbodies and proposed stream crossings along the connector segments. Appendix E provides information on controlling factors and other crossing characteristics for the connector segments (see Tables E-30 through E-39b).

Table 4-7
Summary of Crossing Environment for Connector Segments A through E

	Connector A	Connector B	Connector C	Connector D	Connector E
Number of Crossings					
	4	3	7	4	6
Type of Waterbody					
Drainageway	1	1	–	–	1
Floodplain Slough	–	1	1	–	–
Overflow Channel	–	–	1	–	–
Seep	–	–	–	–	–
Stream	1	1	4	4	1
Wetland Flow-way[a]	2	–	1	–	4
Physiographic Division					
Eielson Flats	–	–	–	–	–
Delta Moraine Wetlands	–	–	–	–	–
Lower Foothills	–	–	–	–	–
Tanana River Valley and Major Tributaries	1	3	5	4	5
Tanana Valley Flats	3	–	2	–	1
Yukon-Tanana Uplands	–	–	–	–	–
Type of Crossing					
Small Bridges	1	1	3	3	1
Rail Large Bridges	–	–	–	–	–
Culvert	3	2	4	1	5
Channel Stability					
High	4	2	4	1	5
Moderate	–	1	3	3	1
Low	–	–	–	–	–
Within 100-Year Floodplain					
Yes	–	3	7	4	3
No	4	–	–	–	3

[a] Not defined as wetlands per the National Wetlands Inventory.

The nine bridge crossings would include relatively small streams and would likely be single-span bridges; therefore, no structures would be placed in the channel. Connector Segments B, C, and E would cross Fivemile Clearwater River. There would be low to moderate disturbances to the streambanks if the bridge approaches and abutments were constructed. Impacts associated with bridge construction along the connector segments would be low.

Five culvert batteries (four batteries with two and one with three 10-foot-diameter culverts) and ten single culverts (six 4 feet and four 10 feet in diameter) would provide conveyance for flows up to the 100-year flood, or hydraulic continuity for wetland flow-ways. Most of these culverts would occupy only a small portion of the channel, with the remaining width covered in fill. Short-term streambank and channel disturbance during construction would result in high impacts.

Other activities or structures placed along the connector segments would likely result in low impacts. Similar to the other segments, most of the activities would not be located along the margins of any waterbodies, and therefore would not affect the rivers and streams.

Donnelly Alternative Segments

There are two proposed Donnelly alternative segments. The 28-mile-long Donnelly Alternative Segment 1 would have 37 total crossings, including four small bridges, two large bridges, four culvert batteries, and 27 single culverts. The 26.2-mile-long Donnelly Alternative Segment 2 would have 48 total crossings with four bridges (two large and two small), two culvert batteries, and 42 single culverts (Figure 4-6). Both segments would require relatively large multiple-span bridges to cross the wide glacially fed and braided Little Delta River and Delta Creek. Smaller full-span bridges would be necessary to cross two unnamed streams (one for each Donnelly alternative segment), and small full-span bridge is proposed for Kiana Creek (40 feet long for Donnelly Alternative Segment 1 or 80 feet long for Donnelly Alternative Segment 2).

Donnelly Alternative Segment 1 would require culverts and culvert batteries to maintain flow for 17 small streams and drainageways, and hydraulic continuity for 14 wetland flow-ways. Donnelly Alternative Segment 2 would pass along the boundary of the Lower Foothills and Tanana Valley Flats, where there are numerous seeps and springs. Thirteen culvert crossings would be required to maintain flow for 13 seeps, 7 wetland flow-way crossings, 24 small streams, drainageways, and overflow channels.

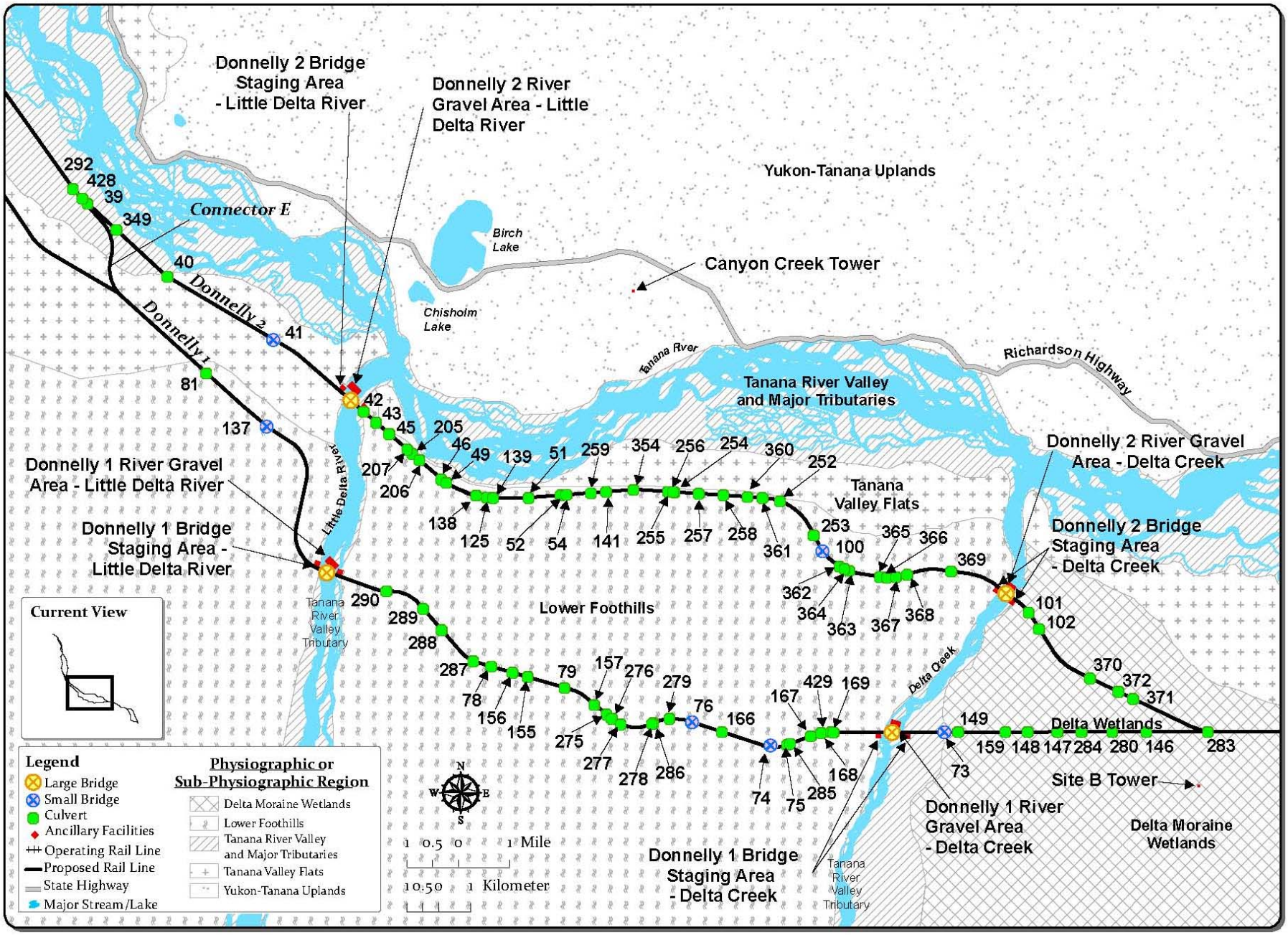

Figure 4-6 – Donnelly Alternative Segments Stream Crossings

Depending on segment, there could be up to eight 17-acre borrow areas planned at 3- to 5-mile intervals. Staging areas surrounding the bridge crossings are proposed along both segments. Ice roads and bridges would be used along these segments to cross the larger rivers during winter to transport material and equipment along the selected segment. The Tanana/Donnelly Construction Camp could also be used for either segment. Table 4-8 lists the types of waterbodies and proposed stream crossings proposed for each Donnelly alternative segment. Appendix E provides information on controlling factors and other stream crossing characteristics (see Tables E-40 through 43f).

Table 4-8
Summary of Crossing Environment for Donnelly Alternative Segments

	Donnelly 1	Donnelly 2
Number of Crossings		
	37	48
Type of Waterbody		
Drainageway	14	14
Floodplain Slough	–	–
Overflow Channel	1	4
Seep	–	13
Stream	8	10
Wetland Flow-way[a]	14	7
Physiographic Division		
Eielson Flats	–	–
Delta Moraine Wetlands	8	5
Lower Foothills	26	34
Tanana River Valley and Major Tributaries	3	7
Tanana Valley Flats	–	2
Yukon-Tanana Uplands	–	–
Type of Crossing		
Small Bridges	4	2
Rail Large Bridges	2	2
Culvert	31	44
Channel Stability		
High	27	37
Moderate	10	8
Low	–	3
Within 100-Year Floodplain		
Yes	4	7
No	33	41

[a] Not defined as wetlands per the National Wetlands Inventory.

Donnelly Alternative Segment 1

There are 37 proposed crossings that encompass three physiographic regions along this segment that would require bridges or culverts. The larger crossings would be associated with the Little Delta River, Delta Creek, West Kiana Creek, Kiana Creek, and two unnamed streams. The smaller crossings would include drainageways, wetland flow-ways, and streams.

The bridge crossings over one of the unnamed streams, West Kiana Creek, and Kiana Creek would all be relatively short, single-span bridges. The proposed crossings of West Kiana Creek

and Kiana Creek would likely have minimal impact on the channel; the bridge over the unnamed stream would only partially span the waterway (40 feet to 50 feet). Bank disturbance would occur with all three of these crossings. In particular, field observations of Kiana Creek noted over-steepened channel banks and active bank erosion. Construction of bridge abutments along the channel banks could cause additional disturbance of the bank sediments, thus increasing bank erosion. Due to the sensitive nature of these streams, construction activities associated with these proposed crossings would result in high impacts because of the potential to increase bank erosion and cause channel aggradation downstream.

Long, multiple-pier, partial-span bridges are proposed to cross over Delta Creek and the Little Delta River. Due to the size of these crossings, there would be construction activities along the banks and in the middle of the channels while building the abutments and the bridge approaches. Construction activities for these bridges could cause increased bank erosion when accessing the channel and while the bridge approaches and abutments were constructed. This impact would be moderate.

The large bridge crossings of the Little Delta River and Delta Creek would be designed to pass the 100-year flood and be navigable for a maximum boat size (depending on USCG criteria). Further, the piers placed within the channel would alter flood hydraulics, cause increased scour surrounding the piers (resulting in downstream aggradation), and increase the potential for overbank flooding and debris jams. Analyses of the Little Delta River and Delta Creek crossings have been conducted on only a very preliminary level, and the effects to flood hydraulics during high-flow events are unknown. Thus, conservatively, it is expected that these structures could result in high impacts.

The sixth Donnelly Alternative Segment 1 bridge, a partial-span, multiple-pier structure, is proposed to cross a 1,050-foot overflow channel of the Tanana River. There would be significant work in the channel, which could lead to increased erosion and downstream sediment transport. This impact would be moderate.

Twenty seven of the culvert crossings would be relatively small single culverts (*i.e.*, 4 feet or 10 feet in diameter), three would be small culvert batteries (two 4-foot-diameter culverts), and one would be larger (three 10-foot-diameter culverts). These structures would provide conveyance for streams and drainageways, or hydraulic continuity for wetland flow-ways. Most of these single culverts would occupy only a small portion of the channels, with the remaining width covered in fill. Short-term and localized streambank and channel disturbance during construction would result in high impacts.

Ice roads and bridges across the Little Delta River and Delta Creek could be required during construction. However, these streams are relatively shallow, especially in winter where most of the channel is not occupied by river ice. Due to the natural high sediment transport of these streams, the effect of ice roads and bridges would not likely be detectable; therefore, impacts from the ice bridges would be low.

The 40-acre Tanana/Donnelly Construction Camp could be located along this segment, but its relative proximity to waterbodies is not known. There is discontinuous permafrost throughout this area and there could be compaction and ground disturbance to the area adjacent to the streambanks as a result of the staging area and camp. Because of the potentially large area the

camp would occupy and its unknown location, potential impacts could be moderate to areas of permafrost, which could catalyze thermal erosion near streambanks.

Well-water extraction would also be required for potable water use in the camp and construction water in the staging area. The estimated water use (rates and volumes) would be determined during final design and permitting. Based on the following general effects that could result from water use, there could be impacts on natural water balances in the local area. Water extractions from wells could reduce local groundwater levels and, due to a reasonably high level of hydraulic connectivity between the surface water and groundwater systems, the rate and volume of groundwater discharge to waterbodies could be reduced intermittently during sustained pumping periods (*i.e.*, the withdrawal rate could exceed the natural recharge rate). The level of impact would depend on site conditions and water withdrawal rates.

Most other activities or structures placed along the 28-mile long Donnelly Alternative Segment 1 would likely result in low impacts. Similar to North Common Segment, Salcha Alternative Segment 1, and the Central alternative segments, most of the activities would not be located along the margins of any waterbodies and would not affect the rivers and streams.

Donnelly Alternative Segment 2

There would be 48 crossings encompassing four physiographic regions along this segment. The Little Delta River and Delta Creek would require larger crossings; drainageways, wetland flow-ways, streams, overflow channels, and seeps would require smaller crossings.

Crossings over an unnamed stream and Kiana Creek would require relatively short, single, full-span bridges; therefore, minimal impacts to either channel would be expected. There would be bank disturbance with both of these crossings. In particular, field observations of Kiana Creek noted over-steepened channel banks and active bank erosion. Construction of the bridge abutments along the channel banks could disturb the bank sediments, thus increasing bank erosion. Due to the sensitive nature of these streams, construction activities associated with these potential crossings would result in moderate impacts because of the potential to increase bank erosion.

The Applicant proposes long, multiple-pier, partial-span bridges to cross over Delta Creek and the Little Delta River. Due to the size of these crossings, there would be construction activities along the banks and in the middle of the channels while building the abutments and the bridge approaches. Construction activities for these bridges could cause increased bank erosion when accessing the channel and while the bridge approaches and abutments were constructed. This impact would be moderate.

The large bridge crossings of the Little Delta River and Delta Creek would be designed to pass the 100-year flood and be navigable for a maximum boat size (depending on USCG criteria). Further, the piers placed within the channel would alter flood hydraulics, cause increased scour surrounding the piers (resulting in downstream aggradation), and increase the potential for overbank flooding and debris jams. Analyses of the Little Delta River and Delta Creek crossings have been conducted on only a very preliminary level, and the effects to flood hydraulics during high-flow events are unknown. Thus, conservatively, these structures could result in high impacts.

Forty-two of the culvert crossings would be relatively small single culverts (*i.e.*, 4 feet or 10 feet in diameter); two would be culvert batteries (one battery with three 10-foot-diameter culverts and one with two 10-foot-diameter culverts). These structures would provide conveyance for high 100-year flood flows in drainageways, seeps, and streams, or hydraulic continuity for wetland flow-ways. Most of these single culverts would occupy only a small portion of the channels, with the remaining width covered in fill. Short-term and localized streambank and channel disturbance during construction would result in high impacts.

Ice roads and bridges across the Little Delta River and Delta Creek could be required during construction. However, these streams are relatively shallow, especially in winter where most of the channel is not occupied by river ice. Due to the natural high sediment transport of these streams, the effect of ice roads and bridges would not likely be detectable; therefore, impacts from the ice bridges would be low.

The 40-acre Tanana/Donnelly Construction Camp could be located along this segment, but its relative proximity to waterbodies is not known. There is discontinuous permafrost throughout this area and there could be compaction and ground disturbance to the area adjacent to the streambanks as a result of the staging area and camp. Because of the potentially large area the camp would occupy and its unknown location, potential impacts could be moderate to areas of permafrost, which could catalyze thermal erosion near streambanks.

Well-water extraction would also be required for potable water use in the camp and construction water in the staging area. The estimated water use (rates and volumes) would be determined during final design and permitting. Based on the following general effects that could result from water use, there could be impacts on natural water balances in the local area. Water extractions from wells could reduce local groundwater levels and, due to a reasonably high level of hydraulic connectivity between the surface water and groundwater systems, the rate and volume of groundwater discharge to waterbodies could be reduced intermittently during sustained pumping periods (*i.e.*, the withdrawal rate could exceed the natural recharge rate). The level of impact would depend on site conditions and water withdrawal rates.

Most activities or structures placed along the proposed 26.2-mile-long Donnelly Alternative Segment 2 would likely result in low impacts. Similar to the North Common Segment, Salcha Alternative Segment 1, and Central alternative segments, most of the activities would not be located along the margins of any waterbodies and would not impact the rivers and streams.

South Common Segment

There would be 14 crossings along South Common Segment (Figure 4-7). In addition, the 40-acre Big Delta Construction Camp and Staging Area and two or three 17-acre borrow areas are proposed for this segment. Ice roads and bridges are not proposed for this segment. Table 4-9 lists the types of waterbody and stream crossings along this segment. Appendix E provides information on controlling factors and other crossing characteristics (see Tables E-44 though E-45c).

Crossings along this 10.5-mile segment would include three bridges over headwaters of the Richardson Clearwater River and several smaller drainages, and would include culverts to cross drainageways and wetland flow-ways.

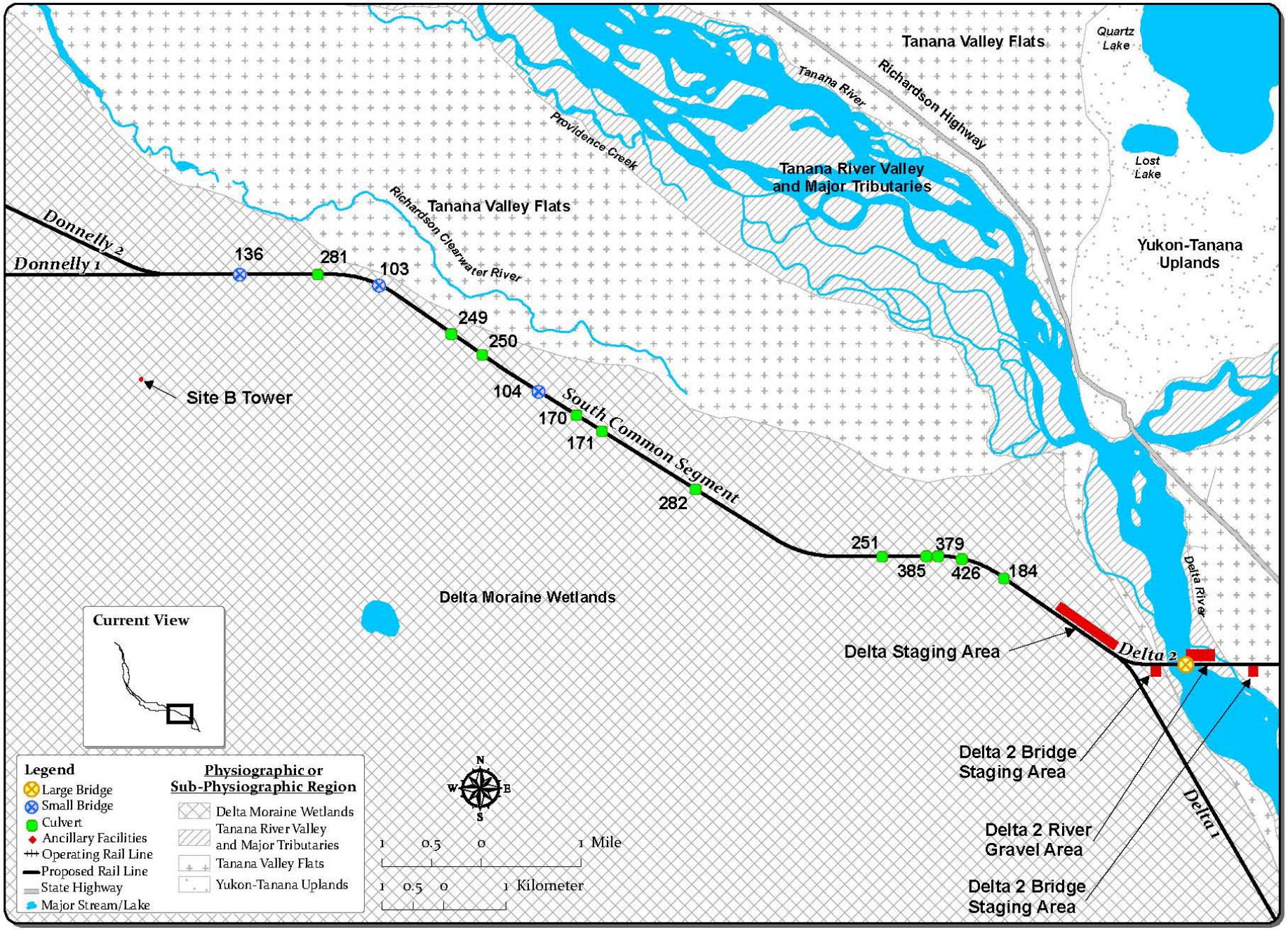

Figure 4-7 – South Common Segment Stream Crossings

Table 4-9
Summary of Crossing Environment for the South Common Segment

Number of Crossings	
	14
Type of Waterbody	
Drainageway	2
Floodplain Slough	–
Overflow Channel	–
Seep	–
Stream	3
Wetland Flow-way[a]	9
Physiographic Division	
Eielson Flats	–
Delta Moraine Wetlands	14
Lower Foothills	–
Tanana River Valley and Major Tributaries	–
Tanana Valley Flats	–
Yukon-Tanana Uplands	–
Type of Crossing	
Small Bridges	3
Rail Large Bridges	–
Culvert	11
Channel Stability	
High	14
Moderate	–
Low	–
Within 100-Year Floodplain	
Yes	–
No	14

[a] Not defined as wetlands per the National Wetlands Inventory.

Most of the other activities or structures proposed along this segment would not be located along the margins of waterbodies, thereby minimizing potential impacts to rivers and streams. Therefore, impacts would likely be low.

The three proposed bridge crossings at headwaters of the Richardson Clearwater River include single-span bridges ranging from 40 to 65 feet in length. In two cases, the spans would be longer than the channel width. Bridges longer than the channel width would minimize opportunities to affect the bank areas. There would be minimal disturbances to the streambanks while the bridge approaches and abutments were constructed. Impacts associated with construction of these bridges would be low.

Construction and installation of the culverts (4-foot and 10-foot diameter single culverts) would require moderate disturbances to facilitate access to the channels. Fill would be necessary to cross a portion of these channels. The slower velocity flows associated with the wetland flow-ways and low-flow or possible dry drainageway channels would minimize impacts to the channel bed and banks during operations. Impacts associated with culvert installation would be high.

The large Big Delta Construction Camp and Staging Area would be located along this segment. Impacts to discontinuous permafrost and water-well extraction would be similar to those described in the section entitled Common Impacts to Surface Water for large camps and staging areas. This activity would likely result in moderate impacts for the reasons previously discussed.

In addition, the construction and installation of wide gravel roads would have impacts similar to those described for Salcha Alternative Segments 1 and 2 along the west side of the Tanana River.

Delta Alternative Segments

Delta Alternative Segments 1 and 2 would have different crossing locations for the Delta River (Figure 4-8). Depending on the alternative segment, there would be one or two 17-acre borrow areas at 3- to 5-mile intervals, in addition to gravel extraction within the Delta River. There would be staging areas surrounding the bridge crossing along either alternative segment. Ice roads and bridges would also be used to cross the Delta River during winter months.

Table 4-10 lists the types of waterbody and proposed stream crossings. Appendix E provides information on controlling factors and other stream crossing characteristics (see Tables E-46 through E-49b).

Delta Alternative Segment 1

There are only two proposed waterbody crossings along this segment—a larger bridge crossing associated with the Delta River and a smaller crossing for a drainageway. Impacts associated with the proposed crossing of the Delta River would be similar to those of the large crossings of the Salcha alternative segments (Tanana River) and the Donnelly alternative segments (Delta Creek and Little Delta River); refer to those sections for descriptions of impacts.

Most construction activities would likely result in low impacts to rivers and streams due to the small number of proposed crossings. Refer to the section entitled Common Impacts to Surface Water for a description of those impacts.

The location of the proposed bridge crossing along the east side of the Delta River is near the confluence of Jarvis Creek and Delta River. Field observations indicate that the downstream end of the confluence has steepened banks, and active erosion of the river bank is occurring. Impacts associated with this bridge construction would include blockages or changes to the channel's shape, which would result in moderate impacts, and the potential for increased scour, bank erosion, and channel aggradation. Overall, the impacts would be high.

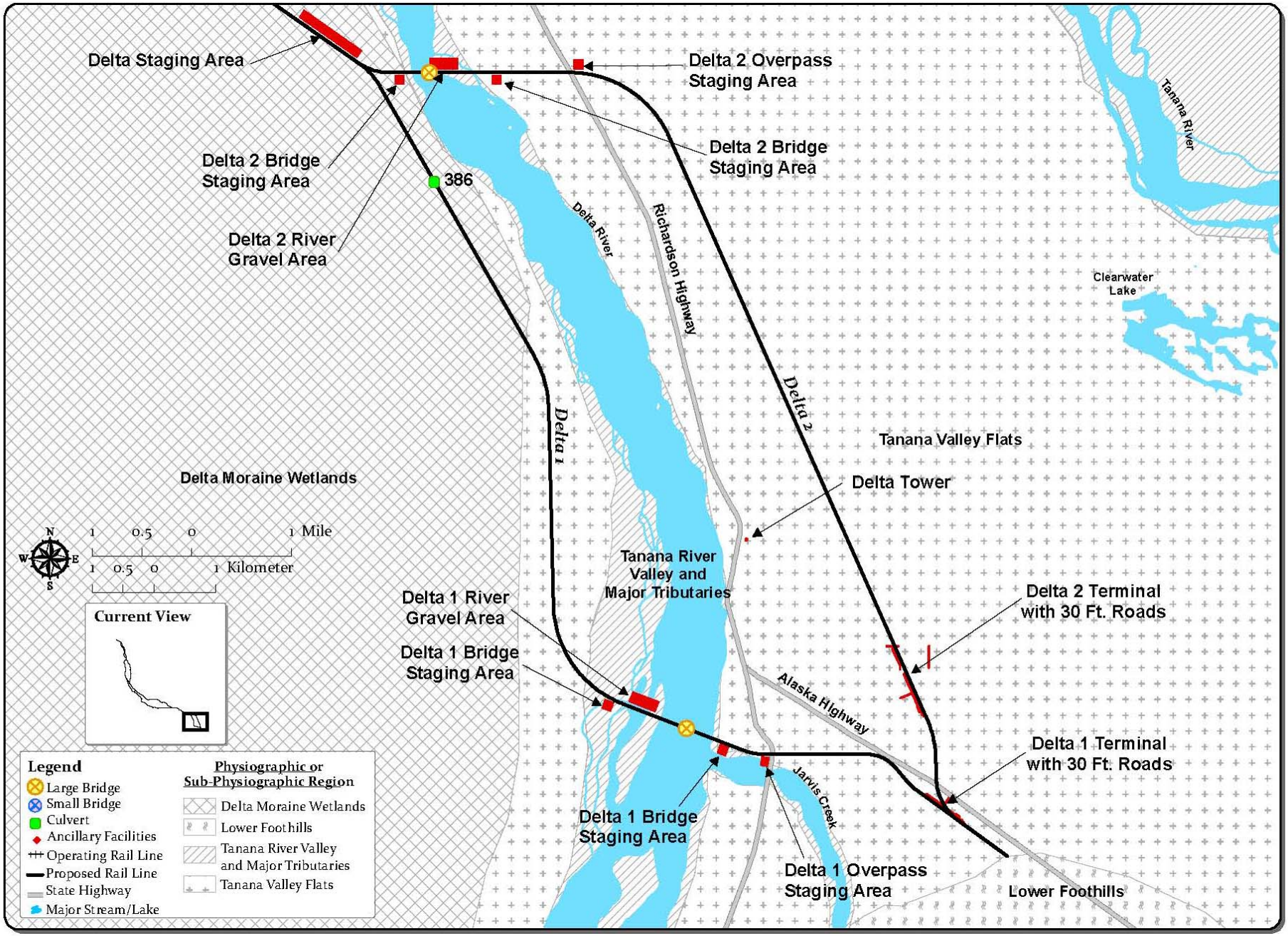

Figure 4-8 – Delta Alternative Segments Stream Crossings

Table 4-10
Summary of Crossing Environment for Delta Alternative Segments

	Delta 1	Delta 2
Number of Crossings		
	2	1
Type of Waterbody		
Drainageway	1	–
Floodplain Slough	–	–
Overflow Channel	–	–
Seep	–	–
Stream	1	1
Wetland Flow-way[a]	–	–
Physiographic Division		
Eielson Flats	–	–
Delta Moraine Wetlands	1	–
Lower Foothills	–	–
Tanana River Valley and Major Tributaries	1	1
Tanana Valley Flats	–	–
Yukon-Tanana Uplands	–	–
Type of Crossing		
Small Bridges	–	–
Rail Large Bridges	1	1
Culvert	1	–
Channel Stability		
High	1	–
Moderate	–	–
Low	1	1
Within 100-Year Floodplain		
Yes	2	1
No	–	–

[a] Not defined as wetlands per the National Wetlands Inventory.

Ice roads and bridges across the Delta River would be constructed in winter. Ice roads and bridges would result in low impacts, similar to the impacts described for Donnelly Alternative Segments 1 and 2. Borrow and gravel extraction is proposed at several locations along Delta Alternative Segment 1 and within the Delta River. Gravel extraction activities within the Delta River could cause blockage of the low-flow channels where gravel or spill piles were placed within the river. Also, blockages from construction activities would likely occur. Extraction impacts would likely be moderate.

Delta Alternative Segment 2

The only crossing along Delta Alternative Segment 2 would be a bridge over the Delta River. The impacts associated with this crossing are described above for Delta Alternative Segment 1 and the Salcha and Donnelly alternative segments.

Construction of gravel access roads near waterbodies would result in low impacts because most of the segment would be located adjacent to a number of existing roads in the area. The impacts associated with construction of new roads would be minimal. Impacts associated with borrow

and gravel extraction would be the same as described above for Delta Alternative Segment 1. These impacts would likely be moderate.

Operations Impacts to Surface Water

Section 4.4 describes operations impacts to surface water.

No-Action Alternative

Under the No-Action Alternative the proposed rail line would not be built and there would be no impacts to surface water.

4.3 Groundwater

This section describes the current groundwater conditions of the Tanana River Valley in the vicinity of the proposed NRE. Data were collected in the project area during field investigations conducted in 2005, 2006, and 2007. Appendix E describes the methodologies employed and data collected. Appendix E also describes and summarizes data the USGS and the State of Alaska collected in the project area.

4.3.1 Affected Environment

Groundwater in the Tanana River Basin occurs under artesian or unconfined conditions. Artesian conditions are found in the lower slopes where permeable beds are confined by less permeable sediments, sedimentary rocks, or permafrost. Artesian conditions are common within the Tanana Valley Flats and along the northern border of the Lower Foothills, especially from the flatlands east of the Delta River to west of the Little Delta River, and provide the headwater sources for the Richardson Clearwater River, Providence and Whitestone Creeks, the Fivemile Clearwater River, and other smaller unnamed creeks. Unconfined conditions prevail in unconsolidated alluvium throughout the study area and form significant aquifers in Eielson Flats and Tanana Valley Flats.

Seepage from streams provides an important source of groundwater for much of the study area south of the Tanana River, especially the large braided streams flowing north across alluvial fans from the Alaska Range. These streams provide a steady source of recharge throughout each year. Direct infiltration of precipitation, especially snowmelt, is also significant in many areas; however, this input is minimal in areas underlain by permafrost or bedrock, which are prone to quick runoff.

Regional groundwater generally flows parallel to surface drainage. The water table slope has less relief and is generally less than the land-surface slope; however, groundwater mounds can form under stream channels. Fluctuations in groundwater level are related mainly to seasonal changes in recharge and discharge and range from a few inches per year to more than 50 feet per year, depending on location and proximity to recharge and discharge zones. Shallow groundwater areas, such as floodplains and low terraces, fluctuate with stream stage as the stream alternates between gaining and losing flow. Fluctuations in water levels in bedrock respond to snowmelt and precipitation recharge, but typically the changes are smaller than in the floodplains and terraces.

Permafrost affects both surface water and groundwater flow because its relative impermeability restricts recharge, discharge, groundwater movement, storage capacity, and confining pressures that might lead to artesian conditions. The impermeable permafrost prevents infiltration from runoff and creates ponds and swamps. Permafrost also holds a significant amount of water in storage as ice.

4.3.2 Environmental Consequences

This section describes potential impacts to groundwater as a result of the proposed project. Section 4.2.2 describes the methodology for assessing impacts. Appendix E includes detailed water-resource tables, which list the specific water resources and their characteristics.

Common impacts associated with the proposed project are presented first, followed by discussion of specific impacts associated with each alternative segment where appropriate. Construction and operation impacts are presented, except where these types of impacts are not expected. Proposed mitigation measures for impacts to groundwater are addressed in Chapter 20.

Common Impacts to Groundwater

Common construction and operations impacts are those that could occur throughout the project area. Common impacts are not associated with any specific alternative segment.

Common Construction Impacts to Groundwater

Construction-related impacts could result from the construction of unpaved access roads, excavation of borrow areas, construction of bridges and culverts, use of ice roads and ice bridges, water supply extraction, and transportation and staging areas.

Construction of Unpaved Access Roads, Staging Areas, and Camps

Construction of access roads, staging areas, and camps would alter infiltration and recharge characteristics and, in most cases, permanently reduce or impede infiltration due to surface-soil compaction and the creation of impenetrable surfaces (*e.g.*, buildings, tanks, and other structures). These effects would be limited to the footprint of the access roads, areas, and facilities.

Presence of Bridges and Culverts

The presence of culverts, bridge pilings, or other permanent maintenance structures would have minimal to no effect on groundwater infiltration because activities would not remove large volumes of surface soils or have an impact on infiltration processes. The location of bridges or culverts near or over springs and seeps could disrupt groundwater discharge processes and create instability concerns that would need to be addressed in structure design. However, during the investigation and design phase, geotechnical boreholes would be necessary to characterize the subsurface. These boreholes could provide direct communication between surface water and groundwater, and between shallow and deep aquifers; therefore, they would have to be properly abandoned following state regulations.

Excavation of Borrow Areas

Extraction of gravel from borrow areas could affect the local hydrogeologic regime (and water balance) by the removal of saturated materials and the creation of large man-made reservoirs. Depending on the hydraulic transmissivity of the soils in the borrow areas, over time, the man-made reservoirs would likely become groundwater fed. The water levels in the man-made reservoirs would fluctuate with the water table, and would be a source of groundwater discharge through evaporation during summer and changing to a source of groundwater recharge during ice breakup and major rainstorms.

There could be dewatering of aquifers or reservoirs of local, shallow, thawed, water-bearing zones during construction and operation of any borrow area. However, dewatering of a shallow aquifer would not be permitted if it would adversely affect the right of a prior water-rights appropriator or would not be in the public interest. In some cases, borrow areas could be in supra-permafrost zones, which could be enlarged or eliminated by the removal of shallow surface soils, blasting, and excavation of gravel. In general, construction of the rail line could temporarily affect shallow subsurface saturated zones that exist as thaw bulbs around lakes and streams and could temporarily change the thickness and vertical location of the active thaw zone.

Water-Supply Extraction for Potable Water and Construction Use

Water demands during construction could temporarily affect local water balances if the cumulative withdrawal rate by all users exceeded the natural recharge rate for that aquifer. Withdrawal of water from groundwater sources or surface water could deplete groundwater recharge of the surrounding aquifer, thereby lowering water tables and reducing discharge to streams. Further, to allow a dry work environment, temporary dewatering of a shallow groundwater aquifer could be required. The level of impact would depend on site conditions and water withdrawal rates. The ADNR would only authorize withdrawal of water if the withdrawal would be in the public interest and would not adversely affect the supply of water to lawful appropriators of record. Public interest criteria include the effect of water withdrawal, the effect of diversion or impoundment on fish and game resources, and the effect on public recreational opportunities.

Groundwater could supply fresh water for the construction of ice roads during winter construction seasons and for potable water at temporary construction camps and staging facilities. Although water-use demands have not been estimated, these activities would likely have minor short-term (seasonal) impacts on groundwater levels. Long-term effects on groundwater levels are not expected because natural annual recharge processes are sufficient to recharge to pre-pumping levels following the construction year.

Common Operations Impacts to Groundwater

Section 4.4 describes operations impacts to groundwater.

Impacts to Groundwater by Alternative Segment

Construction Impacts

North Common Segment

The extraction of gravel from the 17-acre borrow area along this segment would result in moderate impacts to the local hydrogeologic regime and water balance through the removal of saturated materials and the creation of a large pond. Due to the anticipated relatively high hydraulic transmissivity of the soils in Eielson Flats, the pond would become a groundwater pond over a relatively short period. Water levels in the pond would fluctuate with the water table, being a source of groundwater discharge through evaporation during the summer and changing to a source of groundwater recharge during snowmelt or rainstorms.

The 140-acre Eielson Construction Camp and Staging Area along this segment would impede groundwater infiltration due to surface soil compaction and impenetrable surfaces such as buildings and other structures. Also, staging areas for bridge construction would compact the ground surface and could locally alter surface infiltration. These activities would result in moderate impacts.

Construction and installation of the proposed bridge across Piledriver Slough and the culvert along this segment would have a low impact on groundwater because construction would not require the removal of large volumes of surface soils or affect infiltration processes.

Construction of gravel access roads would have a low impact because existing roads would be used when feasible and the construction of new roads would be minimal, resulting in few changes to existing conditions.

Long-term impacts to the hydrogeologic regime would include changes in recharge potential (infiltration rates) in the camp and staging area and the changed hydrologic balance of the newly created pond. Both these impacts would likely be low due to the minimal sizes of the affected areas. The remainder of activities or structures would likely result in low impacts for reasons described above.

Eielson Alternative Segments

Groundwater impacts would be the same for all Eielson alternative segments.

The extraction of subballast from the borrow area on the selected Eielson alternative segment would have a moderate impact on the local hydrogeologic regime. Refer to the section entitled Common Impacts to Groundwater for a detailed description of the potential impacts to groundwater from proposed subballast extraction.

The remainder of activities or structures would likely result in low impacts. Refer to the section entitled Common Impacts to Groundwater and the section entitled North Common Segment for a description of these impacts.

The borrow areas proposed along these segments could have long-term impacts to local hydrogeologic regimes and include changes in the recharge potential and hydrologic water balance. The borrow area along any of the Eielson alternative segments would result in a low impact, provided the impacts were mitigated as described in Chapter 20.

Salcha Alternative Segments

Groundwater impacts would be the same for both Salcha alternative segments.

The extraction of subballast from borrow areas along these segments would likely have a moderate impact to the local hydrogeologic regime. Refer to the section entitled Common Impacts to Groundwater and the section entitled North Common Segment for a detailed description of potential impacts.

Disruption and change in surface material (from natural soils to gravels) as a result of road construction could lead to compaction of underlying soils and result in localized changes in groundwater infiltration and recharge surrounding the road. This would likely result in a low impact.

The borrow areas proposed along the Salcha alternative segments could have long-term impacts to local hydrogeologic regime and could include changes in the recharge potential and hydrologic water balance. The borrow areas would result in a low impact, provided the impacts were mitigated as described in Chapter 20.

Central Alternative Segments

Groundwater impacts would be the same for both Central alternative segments.

Construction impacts to groundwater would generally be the same as described in the section entitled Common Impacts to Groundwater and the section entitled North Common Segment. The following activities or structures would result in moderate impacts:

- During extraction of materials from the borrow areas, there could be changes in local hydrogeologic regime due to the removal of saturated materials and the creation of a large pond.

- The Tanana/Donnelly Construction Camp would impede groundwater infiltration due to surface soil compaction and impenetrable surfaces such as buildings and other structures.

The remainder of activities or structures would have low impacts for the reasons described in the section entitled North Common Segment.

Gravel roads along these segments would need to be constructed. Disruption and change in surface material (natural soils to gravels) and compaction of underlying soils could result in localized changes in groundwater infiltration and recharge surrounding the road, but would likely result in low impacts.

Long-term impacts to the hydrogeologic regime would include changes in recharge potential (infiltration rates) of the staging/camp area and the changed hydrologic balance of the newly created gravel pond. These impacts would be low, provided the impacts are mitigated as described in Chapter 20.

The remainder of activities or structures was determined to have low impacts for the reasons described above.

Connector Segments A through E

Groundwater impacts would be the same for all the connector segments.

Construction impacts to groundwater would generally be the same as described in the section entitled Common Impacts to Groundwater and the section entitled North Common Segment. The following activities or structures would likely result in moderate impacts:

- During the extraction of materials from the borrow areas, changes in local hydrogeologic regime could occur due to the removal or saturated materials and the creation of a large pond.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled North Common Segment.

Gravel roads along these segments would need to be constructed. Disruption and change in surface material (natural soils to gravels) and compaction of underlying soils could result in localized changes in groundwater infiltration and recharge surrounding the roads, but would likely result in low impacts.

Long-term impacts to the hydrogeologic regime would include the changed hydrologic balance of any newly created pond. The borrow areas would result in a low impact, provided the impacts are mitigated as described in Chapter 20.

The remainder of activities or structures would likely result in low impacts for the reasons described above.

Donnelly Alternative Segments

Groundwater impacts would be the same for both Donnelly alternative segments.

Construction impacts to groundwater would be the same as those described in the section entitled Common Impacts to Groundwater. The following activities or structures would likely result in moderate impacts:

- During the extraction of materials from the borrow areas, changes in local hydrogeologic regime could occur due to the removal or saturated materials and the creation of a large pond.

- The Tanana/Donnelly Construction Camp would impede groundwater infiltration due to surface soil compaction and impenetrable surfaces such as buildings and other structures.

The remainder of activities or structures would likely result in low impacts for the reasons described in the Common Impacts subsection.

Gravel roads along these segments would need to be constructed. Disruption and change in surface material (natural soils to gravels) and compaction of underlying soils could result in localized changes in groundwater infiltration and recharge surrounding the road, but would likely result in low impacts.

Long-term impacts to the hydrogeologic regime would include changes in recharge potential (infiltration rates) of the construction camp area and the changed hydrologic balance of the newly created gravel pond. Both of these impacts would be low because of the minimal sizes of the affected areas.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled Common Impacts to Groundwater.

South Common Segment

Construction impacts to groundwater would be the same as described in the section entitled Common Impacts to Groundwater. The following activities or structures would likely result in moderate impacts**:**

- During the extraction of materials from the borrow areas, changes in local hydrogeologic regime could occur due to the removal of saturated materials and the creation of a large pond.
- The Big Delta Construction Camp and Staging Area would impede groundwater infiltration due to surface soil compaction and impenetrable surfaces such as buildings and other structures.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled Common Impacts to Groundwater.

Gravel roads along these segments would need to be constructed. Disruption and change in surface material (natural soils to gravels) and compaction of underlying soils could result in localized changes in groundwater infiltration and recharge surrounding the road, but would likely result in low impacts.

Long-term impacts to the hydrogeologic regime would include changes in recharge potential (infiltration rates) of the construction camp and staging area and the changed hydrologic balance of the newly created gravel pond. These impacts would likely be low because of the minimal sizes of the affected areas.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled Common Impacts to Groundwater.

Delta Alternative Segments

Delta Alternative Segment 1

Construction impacts to groundwater would be the same as described in the section entitled Common Impacts to Groundwater and the section entitled Donnelly Alternative Segments. The following activities or structures would likely result in moderate impacts:

- During the extraction of materials from the borrow areas, changes in local hydrogeologic regime could occur due to the removal of saturated materials and the creation of a large pond.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled Common Impacts to Groundwater.

Gravel roads along these segments would need to be constructed. Disruption and change in surface material (natural soils to gravels) and compaction of underlying soils could result in localized changes in groundwater infiltration and recharge surrounding the road, but would likely result in low impacts.

The long-term impact to the hydrogeologic regime would be the changed hydrologic balance of the newly created gravel pond. The impact would likely be low because of the minimal size of the affected area.

Operations Impacts to Groundwater

Section 4.4 describes operations impacts to groundwater.

No-Action Alternative

Under the No-Action Alternative, the proposed rail line would not be built and there would be no impacts to groundwater.

4.4 Water Quality

This section describes the current water quality conditions of the Tanana River Valley in the vicinity of the proposed NRE. SEA collected data in the project area during field investigations in 2005, 2006, and 2007. Appendix E describes the methodologies employed and data collected. Appendix E also describes and summarizes data the USGS and the State of Alaska collected in the project area.

4.4.1 Affected Environment

Except for several large streams, data on surface water quality is generally unavailable for most streams within the project area. From 1949 to 1981, the USGS collected data on surface water quality for some of the larger streams, including the Tanana River at Big Delta, near Harding Lake, and near Fairbanks; the Salcha River near Salchaket; the Delta River; and Jarvis Creek. Samples were collected from these stations at intervals varying from monthly to annually; there were also single-event samples. In most cases, the samples were analyzed for a full chemical suite of parameters. Appendix E summarizes the sampling data. Burrows and Harrold (1983) conducted a detailed sediment load (total suspended and bed loads) study of the Tanana River in 1980 and 1981. In 1983, the State of Alaska conducted a water quality study on Richardson Clearwater Creek and its tributaries (Maurer, 1999). There is no current water quality information available from established USGS sites within the project area. The most current water quality information was acquired at 68 potential stream crossing locations throughout the project area in 2005, 2006, and 2007 by SEA. The information collected was limited to *in-situ* sampling procedures using a Horiba U22 series hand-held water quality meter. No laboratory analyses were conducted. Appendix E summarizes this field data.

In general, the available water quality data indicate that the chemical composition of surface water within the project area is highly variable due to spatial differences in geology, soils, the extent of permafrost, and specific watershed processes such as glaciated basins.

4.4.2 Environmental Consequences

This section describes potential impacts to water quality as a result of the proposed project. Section 4.2.2 describes the methodology for assessing impacts. Appendix E provides detailed water-resource tables, which list specific water resources and their characteristics.

This section first describes common impacts to water quality for the entire project area, and follows with specific impacts associated with each alternative segment. Chapter 20 provides proposed mitigation measures for potential impacts to water quality.

Common Impacts to Water Quality

Common construction and operations impacts are those that could occur throughout the project area. Common impacts are not associated with any specific alternative segment.

Common Construction Impacts to Water Quality

Construction-related impacts could result from the construction of unpaved access roads, excavation of borrow areas, construction of bridges and culverts, use of ice roads and ice bridges, water supply extraction, and transportation and staging areas.

Construction of Unpaved Access Roads

Unpaved access roads would, in most cases, follow the rail line, except where necessary to gain access to borrow areas, staging areas, and camps or to gain access to a nearby established road. If access roads were required to be near or adjacent to rivers or streams (*i.e.*, roads would need to cross watercourses), the potential consequences to water quality could include:

- Increased sediment transport to watercourses during ice breakup, snowmelt or rainstorms.
- Nutrient loading associated with sediments could contribute to water quality changes.
- Disturbance and degradation of permafrost, leading to increased sediment load to watercourses.

In general, construction of access roads would have negligible impacts to rivers and streams except in those areas where the road would be near or adjacent to waterbodies.

Excavation of Borrow Areas

Local shallow water areas could be affected during the construction and operation of borrow areas. Disruption and movement of material from the borrow areas would stir up sediment and degrade water quality within the pond.

While there is discontinuous permafrost throughout the project area, it is assumed that borrow extraction would not be situated in permafrost (because the finer-grained nature of these soils would be less desirable), thus minimizing the potential for thermal erosion and reduced gravel pond quality. If sediment were disturbed and entrained, the effect would likely be short term and would last only during the construction and extraction period. Turbidity levels would return to background conditions once the fine material settled. No long-term impacts would be expected.

Construction and Installation of Bridges and Culverts

During construction activities, surface disturbance of the banks and riparian areas in the immediate vicinity of waterbodies being crossed could lead to localized sloughing, erosion, and sheet rilling. This could lead to increased erosion rates and sediment loads to the channel during

high-water events or runoff from snow melt and rainstorms. In addition, disturbed banks along water crossings could increase sediment loads and turbidity during construction periods, even during low-water periods.

Construction and installation of culverts could cause increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom. Bed and bank disruption could lead to increased sediment load downstream of the crossing. This impact, however, would generally be short in duration and conditions would return to background levels once construction finished.

Construction and installation of the proposed bridges could have negligible to moderate effects on water quality, depending on whether the proposed bridge is a full or partial span and on the amount of in-channel work necessary for construction of piers and abutments. Depending on the direction (direct or oblique) and type of bridge construction (single partial span, single clear span, multiple pier partial span, multiple pier clear span), abutments, and/or in-channel piers, the length of affected streambank and channel width could be quite large. Therefore, the degree of bank and channel disturbances could vary substantially and could effectively alter bank erosion and sedimentation processes.

Construction and Use of Ice Roads and Ice Bridges

The construction and use of ice roads and bridges would leave a residual effect (*i.e.*, disturbed surface and exposed soils) that would be observed after breakup. In some cases, these disturbed areas would be point sources of increased sediment loads and/or turbidity levels.

Use of Rail Line and Unpaved Access Roads

In general, the use of the rail line and unpaved access roads would have negligible impacts to rivers and streams except in those areas where they would be in proximity to waterbodies. When near or adjacent to waterbodies, consequences to water quality could include:

- Increased transport of fine-grained sediments to watercourses during ice breakup, snowmelt, or rainstorms, and
- Unmitigated thermal degradation of permafrost, leading to increased sediment load to watercourses.

The relative degree of water quality degradation associated with increased turbidity and/or sediment loads would vary dependent on stream type, location and habitat value. In general, the clearwater streams (*i.e.*, many of those fed by groundwater) would have the greatest risk due to their low existing turbidities and sediment loads.

Use of Bridges and Culverts

With the changes in channel hydraulics due to a culvert or bridge, channel scour and erosion processes (*i.e.*, lateral migration, avulsion [the sudden change in the course of a stream], bank undercutting) can increase, which could lead to an increase in sediment transfer loads and downstream sedimentation. Unmitigated thermal erosion of fine-grained permafrost along streambanks would also contribute to an increase in sediment load and turbidity.

The presence of bridges could have negligible to moderate effects on water quality, depending on the number of in-channel piers used to support the bridge and on whether the proposed bridge is a full or partial span. The approach direction (direct or oblique), type of bridge construction (single partial span, single clear span, multiple pier partial span, multiple pier clear span), placement of abutments and/or in-channel piers, and the length of affected streambank and channel width would vary by structure. Therefore, the degree of bank and channel infringement could also vary substantially, as would the extent of erosion and sedimentation.

Common Operations Impacts to Water Quality

The use of gravel roads could result in a moderate impact**.** The presence of gravel roads would provide a constant source of sediment to the river if the sediment was transported by surface runoff.

Impacts to Water Quality by Alternative Segment

Construction Impacts to Water Quality

North Common Segment

Construction and installation of the only proposed culvert on this segment could cause increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom. This activity would result in a moderate impact. Bed and bank disruption could lead to increased sediment load downstream of the crossing. However, this impact would be short in duration and conditions would return to background levels once construction was completed and any disturbed areas reclaimed.

During extraction of materials from the borrow areas, surface water runoff could transport fines and petroleum-hydrocarbons from disturbed ground surfaces into nearby waterbodies. This would likely result in a low impact to water quality in local areas.

The proposed location of the Eielson Construction Camp and Staging Area is along this segment. Surface water runoff could transport metals and other miscellaneous chemicals used and stored at the camp to the surface waters, resulting in a moderate impact**.**

Construction and installation of the only proposed bridge along this segment would result in a low impact to water quality because the bridge would span the entire width of Piledriver Slough and construction activities would not occur in the channel. Activities that could affect water quality (*i.e.*, bridge abutment and foundation work) would likely be isolated by temporary berms or dams, so impacts would be low.

Impacts from the construction of gravel roads would also likely result in a low impa**ct** because existing roads would be used when feasible and the construction of new roads would be minimal, resulting in few changes to existing conditions.

Eielson Alternative Segments

Water quality impacts would be the same for all Eielson alternative segments.

Construction and installation of culverts along all three segments could cause increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom. These activities would result in moderate impacts**.** Bed and bank disruption could lead to increased sediment load downstream of the crossings. However, this impact would be short in duration, and conditions would return to background levels once construction was completed.

During extraction of materials from the borrow areas, surface water runoff could transport fines from disturbed ground surfaces into nearby waterbodies. This would likely result in low impacts to water quality.

The remaining impacts to water quality would likely be **low**, as described under the section entitled Common Impacts to Water Quality.

Salcha Alternative Segments

Water quality impacts would be the same for both Salcha alternative segments.

The construction of new and wide gravel roads along these segments would have a moderate potential to increase sediment and turbidity loads in surface waters because some of the roads would be in proximity to watercourses. This would likely result in a moderate impact. In some cases, existing roads would be utilized along the eastern edge of the Tanana River, thereby minimizing the need to construct new gravel roads. In these instances, there would likely be low impacts along this segment.

The substantial amount of channel and bank work that would occur from either of the Tanana River crossings would likely disturb sediments and create increased sediment loads and downstream sedimentation. However, the effects might not be discernible due to the already high sediment loads carried during ice breakup and during peak summer flow season. Thus, the impacts would likely be low.

Ice roads and bridges would result in moderate impacts due to increases in turbidity. Sediment could be trapped in the ice, and when the sediment was released during breakup, turbidity levels in the water would increase immediately downstream. This would be less detectable for the glacial-type streams, and more problematic for the clearer streams (for example, at proposed crossings #340 and #341), where extra precautions would be necessary.

Construction and installation of the culverts along either of these two segments could cause increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom. Bed and bank disruption could lead to increased sediment load downstream of crossings. Although this activity would be short in duration and conditions would return to background levels once construction is finished, these activities would result in moderate impacts**.**

During extraction of materials from the borrow areas, surface water runoff could transport fines from disturbed ground surfaces into nearby waterbodies. Following best management practices would likely minimize this impact. This activity would likely have a low impact on water quality.

The remaining potential impacts to water quality would likely be low, as described in the section entitled Common Impacts to Water Quality.

The permanent gravel roads would likely result in a moderate impact when they were located in proximity to watercourses. These roads would provide a constant source of sediment to the river when it is transported by surface runoff.

The remaining activities or structures would likely result in low impacts to water quality the long-term. Refer to the section entitled Common Impacts to Water Quality for more detailed discussions.

Central Alternative Segments

Water quality impacts would be the same for both Central alternative segments.

Construction impacts to water quality would generally be the same as described in the section entitled Common Impacts to Water Quality and the section entitled North Common Segment. The following activities or structures would likely result in moderate impacts:

- Increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom.
- Gravel roads along these segments would need to be constructed. Surface runoff could transport the gravel to surrounding waterbodies.
- During the extraction of materials from the borrow areas, surface water runoff could transport fines from disturbed ground surfaces into nearby waterbodies.
- Surface water runoff from the proposed Tanana/Donnelly Construction Camp could transport metals and/or other miscellaneous chemicals being used and stored at the camp to the surface waters.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled North Common Segment.

The permanent gravel roads could result in moderate impacts. These roads would provide a constant source of sediment to the river when transported by surface runoff.

Connector Segments A through E

Water quality impacts would be the same for all connector segments.

Construction impacts to water quality would generally be the same as described in the section entitled Common Impacts to Water Quality and the section entitled North Common Segment. The following activities or structures would likely result in moderate impacts:

- Increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom.

- Gravel roads along these segments would need to be constructed. Surface runoff could transport the gravel to surrounding waterbodies.

- During the extraction of materials from the borrow area, surface water runoff could transport fines from disturbed ground surfaces into nearby waterbodies.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled North Common Segment.

The permanent gravel roads could result in moderate impacts. These roads would provide a constant source of sediment to the river when the sediment was transported by surface runoff.

Donnelly Alternative Segments

Water quality impacts would be the same for both Donnelly alternative segments.

The substantial amount of channel and bank work that would occur for the Little Delta River and Delta Creek crossings would likely disturb sediments and create increased sediment loads and downstream sedimentation. However, the effects would not be discernible due to the already high sediment loads carried during ice breakup and during the peak summer flow season. Thus, there would be low impacts.

Construction impacts are generally the same as described in the section entitled Common Impacts to Water Quality and sections addressing other segments. The following impacts would likely be moderate:

- Increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom during culvert installation. It is assumed that culvert installation would occur during ice-free periods and during low-flow periods. During low-flow periods, some waterbodies might have little or no flow at crossings (drainageways or overflow channels), reducing impacts to low.

- Gravel roads along these segments would need to be constructed. Due to the high abundance of waterbody crossings, surface runoff could transport gravel to nearby waterbodies.

- Sediment could be trapped within ice roads and bridges, and when the sediment was released during ice breakup, turbidity levels in the water would increase immediately downstream.

- Surface water runoff from the proposed Tanana/Donnelly Construction Camp could transport metals and other miscellaneous chemicals being used and stored at the camp to the surface waters.

During the extraction of materials from the borrow areas, surface water runoff could transport fines from disturbed ground surfaces into nearby waterbodies. In addition, gravel from the Little Delta River and Delta Creek would be extracted for construction material. Disruption of the channel bed would increase downstream turbidity, resulting in moderate impacts.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled North Common Segment.

The permanent gravel roads would likely result in a moderate impact. These roads would provide a constant source of sediment to the river when the sediment was transported by surface runoff.

South Common Segment

Construction impacts would be the same as described in the entitled Common Impacts to Water Quality. The following would likely result in moderate impacts**:**

- Increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom during culvert installation. It is assumed that culvert installation would occur during ice-free periods and during low-flow periods.
- During the extraction of materials from the borrow areas, surface water runoff could transport fines from disturbed ground surfaces into nearby waterbodies.
- Gravel roads along this segment would need to be constructed. Due to the wide road, surface runoff could transport gravel to nearby waterbodies.
- Surface water runoff from the Big Delta Construction Camp and Staging Area could transport metals and other miscellaneous chemicals being used and stored at the camp to the surface waters.

The remainder of activities or structures would likely result in low impacts for the reasons described in the section entitled North Common Segment.

The permanent gravel roads would result in a moderate impact**.** The gravel roads would provide a constant source of sediment to the river when the sediment was transported by surface runoff.

Delta Alternative Segments

Water quality impacts would be the same for the both Delta alternative segments.

Construction impacts would be the same as described for the Donnelly alternative segments. The following would likely result in moderate impacts**:**

- Increases in turbidity and sediment loads associated with disturbances of the streambank and channel bottom during culvert installation. It is assumed that culvert installation would occur during ice-free periods and during low-flow periods (Delta Alternative Segment 1 only).
- During the extraction of materials from the borrow areas, surface water runoff could transport fines from disturbed ground surfaces into nearby waterbodies. Gravel extraction is also proposed within the main channel of the Delta River, and the disturbance of the channel bed would release fine sediments downstream.
- Gravel roads along these segments would need to be constructed. Due to the wide road, surface runoff could transport gravel to nearby waterbodies (Delta Alternative Segment 1 only).

The remainder of activities or structures would likely result in low impacts **f**or reasons described in the section entitled Common Impacts to Water Quality.

Operations Impacts to Water Quality

The section entitled Common Operations Impacts to Water Quality describes impacts to water quality from rail line operations.

No-Action Alternative

Under the No-Action Alternative, there would be no impacts to water quality from proposed rail line construction and operations.

4.5 Wetlands

This section describes the current wetlands conditions of the Tanana River Valley in the vicinity of the proposed NRE. SEA collected data in the project area during field investigations in 2005, 2006, and 2007. Appendix E describes the methodologies employed and data collected. Appendix E also describes and summarizes data the USGS and the State of Alaska collected in the project area.

4.5.1 Affected Environment

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR Part 328.3(b)). By regulatory definition, wetlands must support hydrophytic vegetation, show signs of wetland hydrology, and contain hydric soils. Wetlands and other waters of the United States are subject to the USACE jurisdiction under authority of Section 404 of Clean Water Act of 1972 or Section 10 of the Rivers and Harbors Act of 1899. To comply with these laws, it is necessary to avoid project impacts to wetlands wherever practicable, minimize impact where impact is unavoidable, and compensate for the impact in some cases. An estimated 5 percent of the wetlands in the project area did not appear to have surface connections to waterways or other wetlands. These wetlands could be isolated and might not fall under USACE jurisdiction.

Wetlands improve water quality, recharge water supplies, reduce flood risks, and provide fish and wildlife habitat. Wetlands act as natural sponges by trapping and slowly releasing surface water, rain, snowmelt, groundwater, and floodwaters. Trees, root mats, and other wetland vegetation slow floodwaters and distribute water over the floodplain. These combined water storage and braking functions can lower floodwater elevations and reduce erosion (USEPA, 1995). Wetlands also provide recreational opportunities, aesthetic benefits, sites for research and education, and habitats for sport and commercial fishery species and other wildlife (USEPA, 2001a).

Appendix E describes wetland communities within 500 feet of the proposed alternative segments or project area (HDR, 2007a). The description of wetlands within the project area was based on field investigations and interpretations of aerial photographs (HDR, 2007a). Two wetland types predominate in the project area, forested wetlands and scrub/shrub wetlands; emergent wetlands are less common (Table 4-11). Forested wetlands include broadleaf, needleleaf, and mixed broadleaf/needleleaf forest communities. Scrub/shrub wetlands include broadleaf, needleleaf, and mixed shrub communities. Emergent wetlands are dominated by graminoid species—sedges

and grasses with scattered willow shrubs. Other waters and riverine habitats in the project area include ponds (with and without aquatic bed vegetation such as lilypads, horsetails, and pondweed), and perennial and intermittent streams.

Table 4-11
Summary of Wetland Types Within 500 Feet of the Proposed Alternative Segments[a]

Proportion (percent) of Wetland Area by Category[b]	Wetland Type (NWI Code[c])	Number of Wetland Regions[d]	Wetland Area (acres)
1	Broadleaf Forest Wetlands (PFO1)	28	18.1
96	Needleleaf Forest Wetlands (PFO4)	576	2,061.7
3	Mixed Forest Wetlands (PFO#/#)	27	66.2
30	**Subtotal Forest Wetlands (PFO)**	**631**	**2,145.9**
26	Broadleaf Scrub/Shrub Wetlands (PSS1)	584	779.9
24	Needleleaf Scrub/Shrub Wetlands (PSS4)	274	729.7
50	Mixed and Other Scrub/Shrub Wetlands (PSS#/#)	343	1,532.4
43	**Subtotal Scrub/Shrub Wetlands (PSS)**	**1,201**	**3,042.0**
9	Emergent Wetlands (PEM)	430	160.9
3	Palustrine Waters (P)	60	63.6
42	Riverine Waters (R)	435	787.9
46	Other Waters	495	851.5
27	**Subtotal All Other Wetlands and Waters**	**1,420**	**1,863.9**
	All Wetlands and Waters	**3,252**	**7,051.8**

[a] Source: HDR, 2007a.
[b] Proportion of wetland area for broader wetland types (PFO, PSS, and Other Wetlands and Waters) are in bold. Proportion of wetland areas within each wetland type are listed for Forested Wetlands (PFO1,PFO4, PFO#/#), Scrub/Shrub Wetlands (PSS1, PSS4, PSS#/#), and Other Wetlands and Waters (PEM, P, R, Other Waters).
[c] National Wetland Inventory (NWI) Codes as defined by Classification of Wetlands and Deepwater Habitats (Cowardin *et al.*, 1979):
PFO – Palustrine Forested
PSS – Palustrine Scrub/Shrub
PEM – Palustrine Emergent
R – Riverine
[d] Regions are individual contiguous wetland areas as mapped by HDR (2007a).

Unique or Sensitive Wetlands

There are large areas of herbaceous floating mat wetlands, or fens, between the Alaska Range and the Tanana River at the northwestern corner of the Tanana Flats (Racine and Walters, 1994). Fen systems play an important role in regulating hydrology, nutrient availability, thermal

stability, water table levels, and succession (Hogg and Wein, 1988). This habitat type is rare because it is not found on the edges of ponds and lakes as are most fens; the absence of mosses; physiographic position; presumed origin (groundwater discharge); and because of its large extent (Racine and Walters, 1994). A field investigation in 1997 discovered the presence of floating mat fens in the northern range of the Tanana Flats, although no fens appear to be present within the project area (Racine *et al.*, 1998; HDR, 2007a).

Wetland Functions and Values

Wetlands provide multiple benefits to the environment that are unique and vital to ecological resources. Benefits are defined as functions and values where the wetlands serve specific functions for the environment, such as controlling erosion, or supply humans a benefit, such as providing recreation areas. Wetland functions (and values) for project area wetlands that were identified and evaluated include surface-water storage (flood control), stream-flow maintenance (maintaining aquatic habitat and aesthetic appreciation opportunities), groundwater recharge/discharge (replenishing water supplies), sediment removal and nutrient cycling (water quality protection and nutrient export), and contributions to the abundance and diversity of wetland vegetation and wildlife (maintaining aquatic habitat and fish and wildlife harvest opportunities) (USEPA, 2001a; HDR, 2007b).

An assessment of the functional capacity of wetlands in the project area indicates (Magee and Holland, 1998; HDR, 2007b):

- Wetlands in the study area have a high functional capacity to modify water quality, contribute to the abundance and diversity of wetland vegetation, and contribute to the abundance and diversity of wetland fauna.
- Permanently and semi-permanently flooded emergent wetlands have a high functional capacity to perform groundwater discharge.
- Wetlands with an outlet have a high functional capacity to export detritus and a moderate functional capacity to store stormwaters and floodwaters and modify stream flow.
- Wetlands without an outlet have a high functional capacity to store stormwaters and floodwaters and a low functional capacity to modify stream flow and export detritus.

4.5.2 Environmental Consequences

This section describes potential impacts to wetlands as a result of the proposed project. Appendix E provides detailed wetland tables that list the individual wetland classes and their characteristics. Chapter 20 describes proposed mitigation measures for impacts to wetlands.

Wetland types and areas within 500 feet of the proposed segments were identified through implementation of the USACE wetlands jurisdictional determination methodology from August 23 through 31, 2005; July 20 through 27, 2006; and August 14 through 20, 2006 (HDR, 2007a; HDR, 2007b). The methodology for establishing wetland boundaries and types is contained in the USACE Wetlands Delineation Manual (Environmental Laboratory, 1987) and the Interim Regional Supplement to the USACE Wetland Delineation Manual Alaska Region (USACE, 2007a). The aerial extent of wetlands that would be directly affected by the proposed rail line

was calculated using geographic information system (GIS) analysis of delineated wetland areas within the 200-foot-wide rail line right-of-way (ROW). Areas outside the 200-foot ROW, which have been proposed for staging areas, communications towers, access roads, highway relocations, river gravel areas, and passenger terminals, were also analyzed. Wetland types and areas for these ancillary facilities were estimated from National Wetland Inventory data in instances where their locations were not included within the areas delineated.

Functions and values of wetlands in the vicinity of the proposed project were analyzed through application of *A Rapid Procedure for Assessing Wetland Functional Capacity* (Magee and Hollands, 1998; HDR, 2007b). The wetlands functional assessment was the basis for describing qualitative wetland impacts that would result from proposed rail line construction and operations. Appendix E includes a summary of wetland functional values by wetland class.

Wetland Analysis

In compliance with Executive Order 11990, *Protection of Wetlands and Floodplains*, this section provides the results of an impact analysis on those areas within 500 feet of the alternative segments that are considered to be wetlands, as described above. Approximately 33 percent of the area within 500 feet of the proposed alternative segments would be considered wetlands, according to the USACE established criteria for determining wetlands (Environmental Laboratory, 1987; USACE, 2007a). Construction of the rail line project would directly affect wetlands that are situated within the 200-foot rail line ROW and could indirectly affect wetlands that are within 500 feet of the construction footprint. Construction of the proposed project would require the placement of fill material in wetlands. The placement of fill would cause a permanent loss of wetland functions within the fill areas and could result in additional indirect impacts to adjacent wetland areas. Appendix F provides detailed wetlands data for each alternative segment.

Common Impacts to Wetlands

Common Construction Impacts to Wetlands

Construction activities would affect wetland functions or values, either short term or long term, including:

- Fish, wildlife, and plant habitats—Fill placed in wetlands would result in permanent direct loss of habitat. Hydrophilic plants would lose available habitat area, although some wetland types, such as black spruce wetlands are ubiquitous throughout the project area (Post, 1996).

- Water quality improvement—Reduction in total wetland area and alteration of wetland hydrology would reduce the capacity of regional wetlands to provide the function of water quality improvement.

- Flood storage—Removal of wetland vegetation would destroy the wetlands' capacity to impede and redistribute floodwaters (USEPA, 2001a).

- Shoreline erosion protection—Removal of riparian vegetation with roots and root wads that reinforce soil structure by increasing its shear strength would decrease bank stability and result in increased bank erosion (Gray and MacDonald, 1989).

- Aesthetic appreciation—Loss and interruption of wetlands due to construction of the rail line would diminish the undeveloped character of the project area, which is parallel to the scenic Richardson Highway.

Construction of the rail line would require that the 200-foot ROW be cleared of surface vegetation. Wetlands would be both excavated and filled within the railbed and access road footprints. Construction activities resulting in the direct loss of wetlands, through excavation or fill placement, would affect predominantly the most common wetland types within the area: forested and scrub/shrub wetlands. Loss or alteration of wetlands would eliminate or minimize wetland function. Fill or drainage of wetlands prevents surface water storage and reduces wetland water quality enhancement functions, while accelerating the flow of water downstream and potentially causing increased flood damage. Wetlands act as natural sponges by trapping and slowly releasing surface water, rain, snow melt, groundwater, and floodwaters. Trees, root mats, and other wetland vegetation slow floodwaters and redistribute waters over the floodplain. These combined water storage and braking functions can lower floodwater elevations and reduce erosion (USEPA, 1995).

The direct loss of wetland vegetation due to construction activities would also affect adjacent riparian vegetation. Riparian habitats are located adjacent to waterbodies and provide a mechanism through which energy, materials, and water passes. They are the transition areas between terrestrial and aquatic ecosystems (NRC, 2002) and are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, their biodiversity, and their influence on aquatic ecosystems. Riparian zones act as natural filters, protecting aquatic environments from excessive sedimentation, polluted surface runoff, and erosion (Nakasone *et al.*, 2003). They supply shelter and food for many aquatic animals and shade that is an important part of stream temperature regulation. Research shows riparian zones are instrumental in water quality improvement for both surface runoff and water flowing into streams through subsurface or groundwater flow (Mengis *et al.*, 1999).

Impacts to wetland soils would result from filling, excavating, or clearing for construction of the railbed and associated facilities, resulting in the permanent loss of some hydric soils that sustain wetlands. Soil stability depends on vegetative cover, and when vegetation is disturbed, soil can become unstable. The peat cover common in many black spruce wetlands insulates the wetland from summer heating and encourages permafrost aggradation, creating a feedback that results in a shallow frost table. This shallow active layer (the layer above permafrost that seasonally melts) reduces the wetlands moisture storage capacity and is easily saturated (Woo and Young, 2005; Post, 1996). Black spruce lowland wetlands (generally falling under the needleleaf forested and scrub-shrub wetland types) are abundant in the project area (Hall *et al.*, 1994).

Rail line and bridge construction activities would cause increased sediment loading to wetlands (Childers and Gosselink, 1990) by exposing mineral soils to erosion from the removal of wetland and riparian vegetation. Channelization caused by culverts and bridges would change wetland hydrology by increasing the velocity of water moving into and through wetlands. Patterns of sediment deposition would be changed and wetland functions and values that depend on low velocity flows through the wetland would be reduced. High sediment loads entering wetlands through channels and drainage ditches can smother aquatic vegetation and benthic invertebrates, fill in riffles and pools, and increase water turbidity (USEPA, 1993). Channel modifications would change instream water temperatures and could diminish habitat suitability for fish and wildlife (USEPA, 1993). Borrow areas next to wetlands would also degrade water quality

through sedimentation and increased turbidity in the wetland (Irwin, 1992). Silts and fines precipitate from still waters, leading to sedimentation, which reduces water storage capacity, smothers vegetation, reduces light penetration, and reduces oxygen concentrations, which ultimately affects wetland richness, diversity, and productivity.

Disturbances in wetland hydrology, such as interruption of surface flow or creation of outlets, could create surface impoundments or increase outflow. When the water table of a wetland drops because of decreased inflow or increased outflow, changes in vegetation and degradation of the peat layer can occur; these changes can ultimately result in degradation of the wetland and reduction or elimination of its functions. Normal sheet flow through wetlands is inhibited by road embankments, leading to the creation of surface impoundments that decrease water circulation and lead to water stagnation. Decreased water circulation also results in increased water temperature, lower dissolved oxygen levels, changes in salinity and potential of hydrogen (pH), the prevention of nutrient outflow, and increased sedimentation (USEPA, 1993).

Railbeds and roadbeds could create impoundments even with installation of properly placed and maintained culverts. Once installed, culverts can become ice traps because of a culvert's location within an embankment exposes the culvert to maximum cooling conditions. Metal culverts have very high thermal conductivity. Culverts are usually designed to have an air space at the top. As cold air circulates through the pipe, cooling it and the surrounding embankment, small culverts often freeze solid as over-ice melt waters flow into the culvert and freeze during spring break up (Freitag and McFadden, 1997). Such inadvertent impoundment and hydrologic alteration can change the functions of the wetland (Winter, 1981).

During construction, fugitive dust generated by excavation and grading would cause short-term, local increases in levels of air-borne particulates. Fugitive dust would also be generated by loose soil blowing from haul truck beds and by traffic in vehicle access and construction staging areas. Dust deposited in wetlands would affect plant growth by changing soil productivity and permeability and reducing water quality, which could result in reduced wetland plant diversity next to the roadways.

Common Impacts of Facilities

Two construction staging areas and a rock staging area have been proposed that would likely be used regardless of which segment might be authorized for construction. These staging areas are near the beginning of the project (Eielson Construction Staging Area; see Chapter 2) and near the end of the project (Delta Construction Staging Area; see Chapter 2) and would affect about 19 acres of wetlands, primarily scrub/shrub and mixed forest wetlands (Table 4-12). Three new communications towers would also be constructed for the rail line. These towers would affect approximately 0.2 acre each and would likely occur within forested upland habitats and would not affect wetlands. New access roads to these tower locations would cross wetlands, contributing additional minor affects to wetlands similar to those described for the rail line.

Table 4-12
Wetlands within the Eielson and Delta Construction Staging Areas and Rock Staging Area[a]

NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)
PFO#/#	Mixed Forest Wetlands	5.6	30
PSS1	Broadleaf Scrub/Shrub Wetlands	12.9	70
Wetland Total		**18.5**	
Upland		173.5	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

Approximately 560 acres would be required for borrow areas, with an approximate spacing of one 17-acre pit every 2.5 miles and a total of 33 borrow areas. A total of 33 percent of the project area is wetlands, and avoidance of all wetland impacts in the excavation of borrow areas would be unlikely. With no avoidance of wetlands, an estimated 185 acres of wetlands would be affected by borrow area excavation based on the 33 percent wetland proportion (see Table 4-13) (HDR, 2007a). Specific borrow area locations have not yet been finalized, but would presumably be sited to minimize impacts to wetland, making the 185-acre figure an estimate of the maximum impact.

Table 4-13
Estimated Borrow Area Wetlands for 33 Borrow Areas at 2.5-Mile Intervals Based on the Proportional Distribution of Wetland Types in the Project Area[a]

NWI Code[b]	Definition	Estimated Area (acres)	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	-	-
PFO4	Needleleaf Forest Wetlands	60.4	33
PFO#/#	Mixed Forest Wetlands	1.9	1
PFO	**Subtotal Forest Wetlands**	**62.3**	**34**
PSS1	Broadleaf Scrub/Shrub Wetlands	18.5	10
PSS4	Needleleaf Scrub/Shrub Wetlands	23.7	13
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	48.0	26
PSS	**Subtotal Scrub/Shrub Wetlands**	**90.2**	**49**
PEM	Emergent Wetlands	4.0	2
P/RA	Aquatic Bed	-	-
P/R	Other Waters	28.3	15
	All Wetlands and Waters	**184.8**	**33**
Upland		375.2	67

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

Operations Impacts to Wetlands

Most direct effects to wetlands within the ROW would occur during construction, while many indirect effects would occur during rail line operations. Railroad maintenance would include repairing the tracks and associated structures (maintenance roads, ditches, bridges, and culverts) and cleaning out ditches and culverts. These activities would be infrequent and of short duration. The maintenance and use of access roads could include the use of rock salt for deicing or sand for increasing traction that could damage or kill vegetation and aquatic life (Campbell *et al.*,

1994). Herbicides, soil stabilizers, and dust palliatives used along roadways could damage wetland plants (USEPA, 1993). Bridge maintenance activities could cause deposition of lead, iron (rust), and toxins from paint, solvents, abrasives, and cleaners directly into the wetlands below, resulting in injury to wetland plants and contamination of wetland soils. Toxic substances adhering to sediments could accumulate in impoundments as a result of decreased water circulation, leading to bioaccumulation of contaminants by wetland biota. Bioaccumulation of toxins occurs at higher trophic levels, which could ultimately cause toxicity.

Stormwater discharges from railbed drainage ditches would convey stormwater and low concentrations of pollutants to wetlands along the receiving waterways and drainage channels, potentially altering soil chemistry and soil pH and affecting vegetation adjacent to the rail line. Runoff from bridges could increase loadings of hydrocarbons, heavy metals, toxic substances, and deicing chemicals directly into wetlands (USEPA, 1993). Moreover, precipitation runoff could have a similar affect on the pH of wetlands, depending on the parent materials for the railbed. The primary pollutants that would cause degradation are sediment, nutrients, pesticides, salt, heavy metals, and selenium. Other factors could include low dissolved oxygen and pH (NCSU, 2008; USEPA, 1993).

Fugitive dust generated by vehicles using gravel access and maintenance roads could affect wetlands next to the access roads by covering vegetation with fine dust particles, inhibiting photosynthesis. Train operations could produce insignificant amounts of fugitive dust. Fugitive dust settling in wetlands along the rail line ROW could affect soil pH, surface hydrology, and sheet flow (DNRP, 2004).

Impacts to Wetlands by Alternative Segment

Construction Impacts to Wetlands

North Common Segment

Construction of North Common Segment would result in the loss of 3.5 acres of wetlands (Table 4-14) within the 200-foot ROW (Figure 4-9). Wetland impacts would result from excavation and filling associated with the construction of the rail line, access roads, and staging areas. Impacts from construction activities would be permanent and would eliminate or limit most wetland functions. Most affected wetlands would be broadleaf scrub/shrub communities that are not unique to the region (SWS, 2008). Broadleaf scrub/shrub wetlands have high functional capacities for water quality improvement, nutrient export, and contributions to the abundance and diversity of wetland flora and fauna (HDR, 2007b).

Table 4-14
Wetlands within 200-foot ROW for North Common Segment[a]

NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	-	-
PFO4	Needleleaf Forest Wetlands	-	-
PFO#/#	Mixed Forest Wetlands	-	-
PFO	**Forest Wetlands**	**-**	-
PSS1	Broadleaf Scrub/Shrub Wetlands	2.6	75
PSS4	Needleleaf Scrub/Shrub Wetlands	-	-

Table 4-14
Wetlands within 200-foot ROW for North Common Segment[a] (continued)

NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	-	-
PSS	**Scrub/Shrub Wetlands**	**2.6**	
PEM	**Emergent Wetlands**	**0.3**	9
P/RA	**Aquatic Bed**	**-**	-
P/R	**Other Waters**	**0.6**	16
	All Wetlands and Waters	**3.5**	
Upland		60.3	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

Eielson Alternative Segments

Wetland communities within the 200-foot ROW for the Eielson alternative segments would be directly affected through the loss of 17 to 100 acres (depending on alternative) of wetlands through excavation, filling, or other construction activities, including the development of access roads, staging areas, and support facilities necessary for rail line operations and maintenance (Figure 4-9 and Table 4-15). The affected wetland communities are not unique in the region. In some locations, the direct loss of wetlands to construction activities would eliminate adjacent riparian zones. Within the 200-foot rail line ROW, Eielson Alternative Segment 1 would affect about 17 acres of wetlands; Eielson Alternative Segment 2 would affect about 71 acres of wetlands; and Eielson Alternative Segment 3 would affect approximately 100 acres of wetlands. Affected wetlands differ in proportions with the various alternative segments but include predominantly scrub/shrub and forested wetland communities.

Eielson Alternative Segments 2 and 3 have the potential to affect the greatest wetland acreages near their southern terminus. Eielson Alternative Segments 2 and 3 would affect a higher proportion and acreage of scrub/shrub wetlands, predominately mixed needleleaf/broadleaf scrub/shrub and broadleaf scrub/shrub wetland communities (Table 4-15). These scrub/shrub wetland communities have high functional capacities for water quality improvement, nutrient export, and contributions to the abundance and diversity of wetland flora and fauna (HDR, 2007b). Eielson Alternative Segments 2 and 3 would also affect a lower proportion but higher total acreage of forested wetlands than Eielson Alternative Segment 1 (Table 4-15). Forested wetland communities affected by construction would be primarily needleleaf forested wetlands which have high functional capacities for water quality improvement, nutrient export and contributions to the abundance and diversity of wetland flora and fauna. Eielson Alternative Segment 1 would cross fewer wetland communities, although Eielson Alternative Segment 1 would come closest to the Tanana River (approximately 500 feet), which could affect water quality, not only of wetlands within the ROW, but within the riparian communities next to the Tanana River.

Table 4-15
Wetlands Within the 200-foot ROW for the Eielson Alternative Segments[a]

		Eielson 1		Eielson 2		Eielson 3	
NWI[b] Code	**Description**	**Area (acres)**	**Wetland Proportion (percent)**	**Area (acres)**	**Wetland Proportion (percent)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1	Broadleaf Forest Wetlands	-	-	-	-	-	-
PFO4	Needleleaf Forest Wetlands	6.9	41	23.3	33	36.6	36
PFO#/#	Mixed Forest Wetlands	-	-	-	-	0.1	-
PFO	**Forest Wetlands**	**6.9**	**41**	**23.3**	**33**	**36.7**	**36**
PSS1	Broadleaf Scrub/Shrub Wetlands	6.2	37	16.2	23	16.8	17
PSS4	Needleleaf Scrub/Shrub Wetlands	0.2	1	3.4	5	6.4	6
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	0.7	4	23.5	33	25.4	25
PSS	**Scrub/Shrub Wetlands**	**7.1**	**42**	**43.1**	**61**	**48.6**	**48**
PEM	**Emergent Wetlands**	**1.5**	**9**	**3.5**	**5**	**5.7**	**6**
P/RA	**Aquatic Bed**	**-**	**-**	**-**	**-**	**0.7**	**1**
P/R	**Other Waters**	**1.3**	**8**	**0.9**	**1**	**8.6**	**9**
	All Wetlands and Waters	**16.8**		**70.8**		**100.3**	
Upland		230.5		170.6		143.1	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

Salcha Alternative Segments

Construction of Salcha Alternative Segment 1 or Salcha Alternative Segment 2 would directly affect 180 acres and 262 acres of wetlands and waters, respectively (Tables 4-16 and 4-17). Wetlands that would be affected by construction in the Salcha Alternative Segment 1 ROW are dominated by scrub/shrub communities (Table 4-16); and construction within the Salcha Alternative Segment 2 ROW would affect predominately forested wetland communities (Figure 4-10 and Table 4-16). The wetlands communities that would be affected are common within the region (SWS, 2008). Scrub/shrub wetland communities within Salcha Alternative Segment 1 ROW are predominately mixed needleleaf/broadleaf and needleleaf communities, which have high functional capacities for water quality improvement, nutrient export, and contributions to the diversity and abundance of wetland flora and fauna (HDR, 2007b). Forested wetland communities along Salcha Alternative Segment 2 are predominately needleleaf communities, which have high functional capacities for water quality improvement, nutrient export, and contributions to the diversity and abundance of wetland flora and fauna (HDR, 2007b).

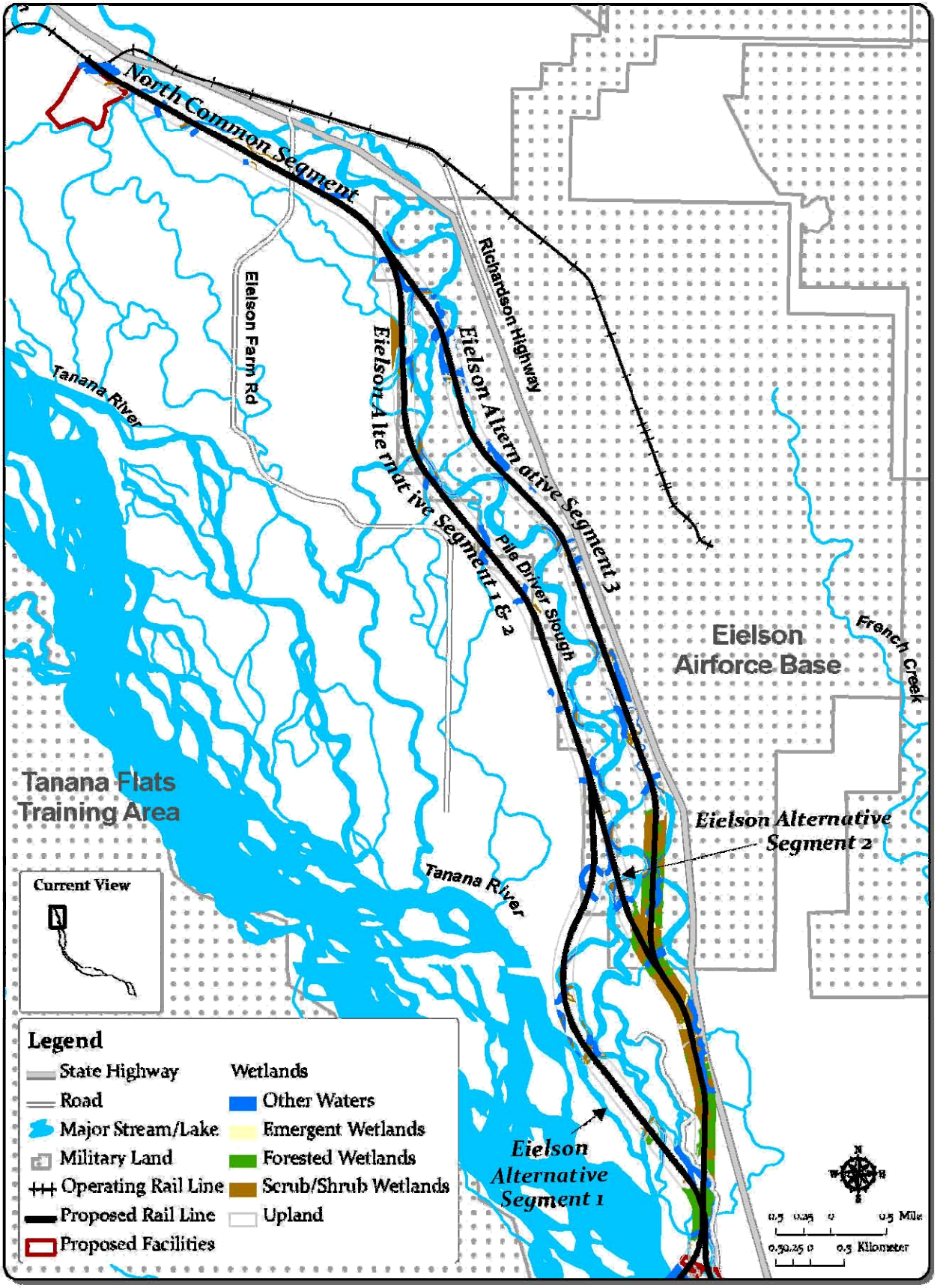

Figure 4-9 – Wetlands along North Common and the Eielson Alternative Segments (HDR, 2007a)

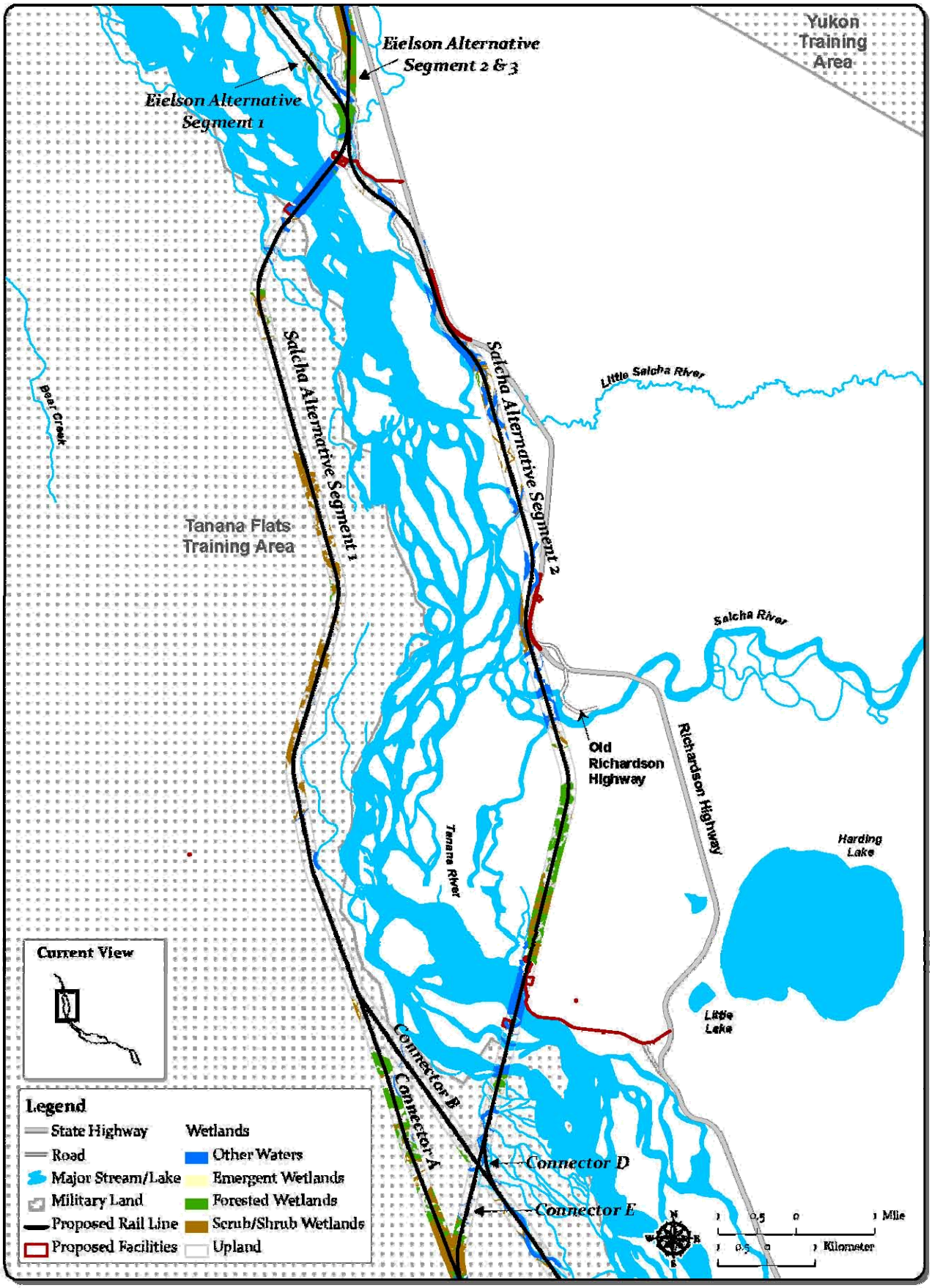

Figure 4-10 – Wetlands along the Salcha Alternative Segments (HDR, 2007a)

Table 4-16
Wetlands within 200-foot ROW for the Salcha Alternative Segments[a]

		Salcha 1		Salcha 2	
NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)	Area (acres)	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	-	-	-	-
PFO4	Needleleaf Forest Wetlands	7.2	11	47.3	43
PFO#/#	Mixed Forest Wetlands	-	-	-	-
PFO	**Forest Wetlands**	**7.2**	**11**	**47.3**	**43**
PSS1	Broadleaf Scrub/Shrub Wetlands	2.8	4	18.9	17
PSS4	Needleleaf Scrub/Shrub Wetlands	12.4	18	8.1	7
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	24.2	36	2.1	2
PSS	**Scrub/Shrub Wetlands**	**39.4**	**58**	**29.1**	**26**
PEM	**Emergent Wetlands**	**0.2**	**0**	**2.9**	**3**
P/RA	**Aquatic Bed**	**-**	**-**	**0.1**	**0**
P/R	**Other Waters**	**21.2**	**31**	**31.5**	**28**
	All Wetlands and Waters	**68.0**		**110.9**	
Upland		215.7		222.1	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

Table 4-17
Wetlands within Salcha Alternative Segments 1 and 2 Bridge Staging Areas, Levees, Riprap Areas, Gravel Extraction Sites, Access Roads, and Highway Relocations[a]

		Salcha 1		Salcha 2	
NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)	Area (acres)[c]	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	-	-	11.2	7
PFO4	Needleleaf Forest Wetlands	25.0	22	-	-
PFO#/#	Mixed Forest Wetlands	-	-	-	-
PFO	**Forest Wetlands**	**25.0**	**22**	**11.2**	**7**
PSS1	Broadleaf Scrub/Shrub Wetlands	17.3	16	34.2	23
PSS4	Needleleaf Scrub/Shrub Wetlands	-	-	<0.1	0
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	-	-	56.8	38
PSS	**Scrub/Shrub Wetlands**	**17.3**	**16**	**91.0**	**61**
PEM	**Emergent Wetlands**	**-**	**-**	**-**	**-**
P/RA	**Aquatic Bed**	**-**	**-**	**-**	**-**
P/R	**Other Waters**	**69.6**	**62**	**49.2**	**32**
	All Wetlands and Waters	**111.9**		**151.4**	
Upland		136.9		155.8	

[a] Source: USFWS, 2005.
[b] NWI = National Wetland Inventory.
[c] < means less than.

Either alternative segment would include a crossing of the Tanana River and its adjacent wetlands and riparian zones. Table 4-17 lists wetlands within the Salcha alternative segments 1

and 2 bridge staging areas, levees, riprap areas, borrow sites, access roads, and highway relocation areas. Wetlands would be affected by construction of the river crossings through excavation, filling, or other construction activities, including the development of shoreline protection structures, flood protection structures, access roads, staging areas, and support facilities necessary for the rail line operations and maintenance (Table 4-17).

During construction, riprap would be added to the upstream side of the proposed Tanana River Bridge, resulting in affects on wetlands and riparian areas. Direct impacts would occur from placement of riprap material in wetlands. Riprap would also add substrate that is substantially different from the parent material of the shoreline, resulting in substantial changes to the habitat condition. In general, riprap would be placed on top of a barrier that would prevent the growth of riparian shrubs. Secondary habitat changes in riverine habitats would include changes in flow, sediment distribution, and vegetation, which would result in changes to the surrounding riparian wetlands.

Salcha Alternative Segment 1 would directly affect fewer wetland acres than Salcha Alternative Segment 2, and would not travel as close to the Tanana River as would Salcha Alternative Segment 2, potentially minimizing the impact of construction-related damages to water quality, wetlands, and riparian habitats adjacent to the Tanana River. Salcha Alternative Segment 2 would occupy the north bank of the Tanana River in several locations, potentially increasing the severity of the impacts to riverine wetlands, water quality, and riparian habitats due to proximity to the river channel.

Central Alternative Segments and Connectors

Construction of the Central alternative segments would affect 51 acres of wetland communities for Central Alternative Segment 1 and 6.5 acres for Central Alternative Segment 2 (Table 4-18). Impacts on wetland communities within the 200-foot ROW would include excavation and filling. Figure 4-11 shows wetlands the Central alternative segments and connector segments would cross. Wetlands affected by the Central Alternative Segment 1 are dominated by needleleaf forested wetlands and broadleaf scrub/shrub wetland communities, which comprise almost half of the wetland habitats within the project area. The dominant wetland community affected by Central Alternative Segment 2 would be scrub/shrub. Needleleaf forest wetlands have functional capacities for water quality improvement, nutrient export, and contribution to the abundance and diversity of wetland fauna. Needleleaf scrub/shrub and mixed needleleaf/broadleaf scrub/shrub wetland communities have functional capacities for water quality improvement, nutrient export, and contribution to the abundance and diversity of wetland fauna. The seasonally flooded needleleaf scrub/shrub communities have a lower functional capacity for contribution to the abundance and diversity of wetland flora than do the saturated mixed scrub/shrub wetland communities (HDR, 2007b).

Table 4-18
Wetlands within the 200-foot ROW for the Central Alternative Segments[a]

		Central 1		Central 2	
NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)	Area (acres)[c]	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	-	-	-	-
PFO4	Needleleaf Forest Wetlands	22.5	44	-	0
PFO#/#	Mixed Forest Wetlands	-	-	-	-
PFO	**Forest Wetlands**	**22.5**	**44**	**-**	**-**
PSS1	Broadleaf Scrub/Shrub Wetlands	17.6	35	3.7	57
PSS4	Needleleaf Scrub/Shrub Wetlands	0.6	1	<0.1	0
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	5.9	12	2.8	43
PSS	**Scrub/Shrub Wetlands**	**24.1**	**48**	**6.5**	**100**
PEM	**Emergent Wetlands**	**4.2**	**8**	**-**	**-**
P/RA	**Aquatic Bed**	**-**	**-**	**-**	**-**
P/R	**Other Waters**	**0.2**	**0**	**-**	**-**
	All Wetlands and Waters	**51.0**		**6.5**	
Upland		71.8		80.4	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.
[c] < means less than.

The five connector segments that could connect various alternative segments vary widely in length. Construction of the connector segments would affect between 1.6 and 56.2 acres of wetland communities (Figures 4-10 and 4-11, Table 4-19).

Donnelly Alternative Segments

Construction of the Donnelly alternative segments would affect 397 acres of wetland communities for Donnelly Alternative Segment 1 and 303 acres for Donnelly Alternative Segment 2 (Tables 4-20 and 4-21) by filling, excavation and construction, including large bridge staging areas, and river gravel sites. Within the 200-foot ROW, Donnelly Alternative Segment 1 would affect about 356 acres of wetlands and Donnelly Alternative Segment 2 would affect about 257 acres of wetlands. Wetlands affected would be predominantly scrub/shrub and forested wetland communities for Donnelly Alternative Segment 1 and predominately forested wetlands and scrub/shrub wetland communities for Donnelly Alternative Segment 2 (Figure 4-12). Wetland communities affected by the Donnelly alternative segments are common within the proposed project area (see Table 4-11) (SWS, 2008). The scrub/shrub wetlands affected by construction of the Donnelly alternative segments would include predominately mixed and other scrub/shrub wetland communities, while forested wetlands would include predominately needleleaf forests. Both alternatives would affect 55 to 60 acres of riverine habitats, which while not unique to the region, would generally be considered sensitive and highly susceptible to impacts on water quality or habitat (USEPA, 2001a). The glacial nature of the Little Delta River and Delta Creek, however, could negate most water quality or habitat impacts because of the higher turbidity and suspended sediment loads already present in the stream.

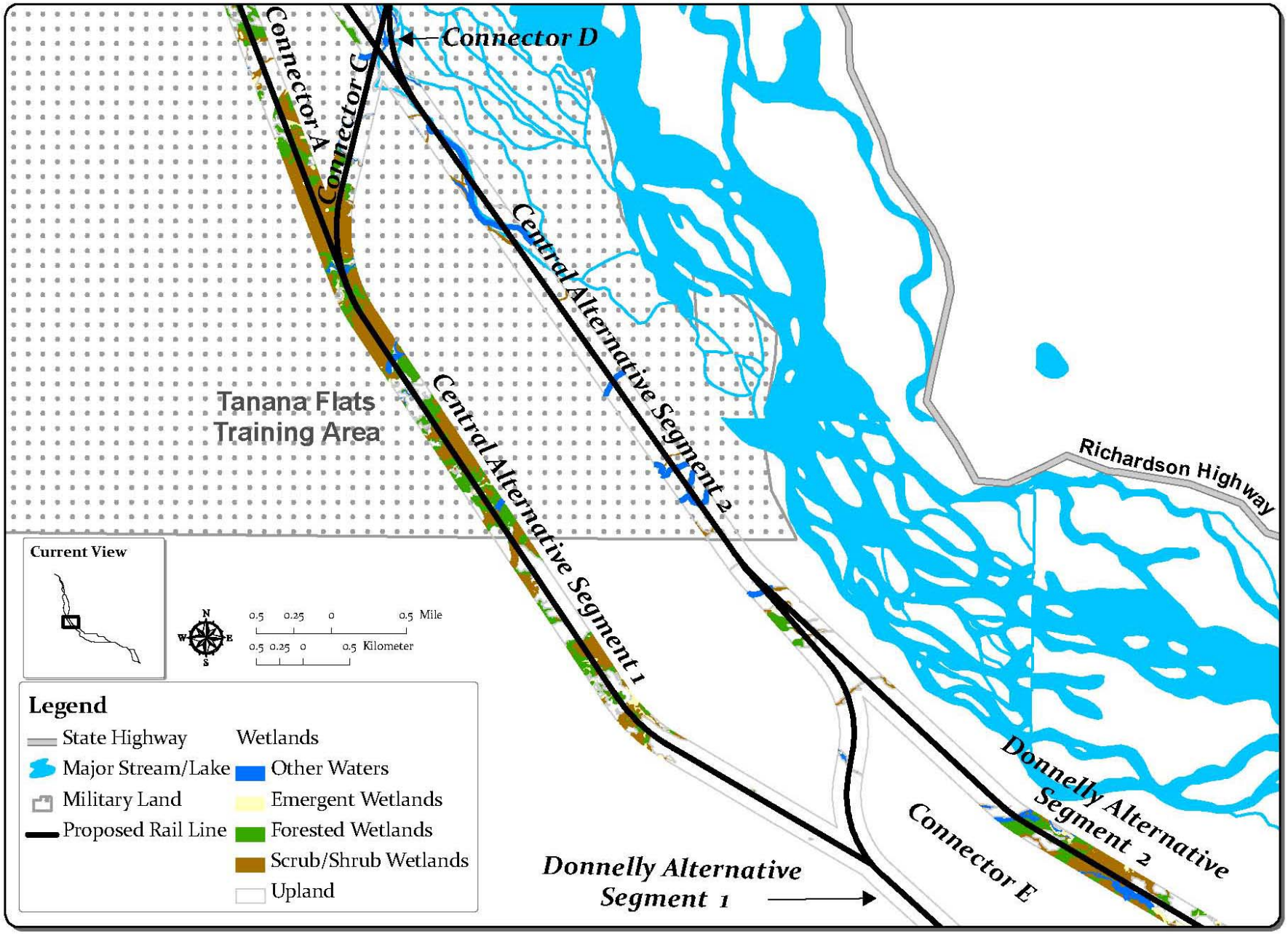

Figure 4-11 – Wetlands along the Central Alternative Segments (HDR, 2007a)

Table 4-19
Wetlands within the 200-foot ROW for the Connector Segments[a]

		Connector A		Connector B		Connector C		Connector D		Connector E	
NWI[b] Code	**Description**	**Area (acres)**	**Wetland Proportion (percent)**	**Area (acres)**	**Wetland Proportion (percent)**	**Area (acres)[c]**	**Wetland Proportion (percent)**	**Area (acres)**	**Wetland Proportion (percent)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1	Broadleaf Forest Wetlands	0.1	0	-	-	-	-	-	-	-	-
PFO4	Needleleaf Forest Wetlands	30.3	54	0.3	18	10.4	40	-	-	0.7	22
PFO#/#	Mixed Forest Wetlands	1.5	3	-	-	-	-	-	-	-	-
PFO	**Forest Wetlands**	**31.9**	**57**	**0.3**	**18**	**10.4**	**40**	**-**	**-**	**0.7**	**22**
PSS1	Broadleaf Scrub/Shrub Wetlands	14.5	26	0.4	24	7.9	30	1.5	51	0.1	3
PSS4	Needleleaf Scrub/Shrub Wetlands	0.2	0	-	-	-	-	-	-	-	-
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	8.3	15	-	-	5.3	20	-	-	2.0	56
PSS	**Scrub/Shrub Wetlands**	**23.0**	**41**	**0.4**	**24**	**13.2**	**50**	**1.5**	**51**	**2.1**	**59**
PEM	**Emergent Wetlands**	**1.1**	**2**	**0.2**	**13**	**1.3**	**5**	**0.2**	**6**	**0.3**	**7**
P/RA	**Aquatic Bed**	**-**	**-**	**-**	**-**	**<0.1**	**0**	**-**	**-**	**-**	**-**
P/R	**Other Waters**	**0.2**	**0**	**0.7**	**45**	**1.4**	**5**	**1.2**	**43**	**0.4**	**12**
	All Wetlands and Waters	**56.2**		**1.6**		**26.3**		**2.9**		**3.5**	
Upland		49.5		77.8		29.6		18.3		54.9	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.
[c] < means less than.

Table 4-20
Wetlands within 200-foot ROW for the Donnelly Alternative Segments[a]

		Donnelly 1		Donnelly 2	
NWI[b] Code	**Description**	**Area (acres)**	**Wetland Proportion (percent)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1	Broadleaf Forest Wetlands	0.2	0	1.5	1
PFO4	Needleleaf Forest Wetlands	123.1	35	128.0	50
PFO#/#	Mixed Forest Wetlands	0.4	0	10.6	4
PFO	**Forest Wetlands**	**123.7**	**35**	**140.1**	**55**
PSS1	Broadleaf Scrub/Shrub Wetlands	3.6	1	20.9	8
PSS4	Needleleaf Scrub/Shrub Wetlands	87.4	24	8.8	3
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	117.9	33	67.6	26
PSS	**Scrub/Shrub Wetlands**	**208.9**	**58**	**97.3**	**37**
PEM	**Emergent Wetlands**	**2.0**	**1**	**4.2**	**2**
P/RA	**Aquatic Bed**	**0.2**	**0**	**-**	**-**
P/R	**Other Waters**	**21.3**	**6**	**15.4**	**6**
	All Wetlands and Waters	**356.1**		**257.0**	
Upland		264.8		373.3	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

Table 4-21
Wetlands within the Donnelly Alternative Segments 1 and 2 Little Delta River and Delta Creek Large Bridge Staging Areas and Instream Gravel Sites[a]

		Donnelly 1		Donnelly 2	
NWI[b] Code	**Description**	**Area (acres)**	**Wetland Proportion (percent)**	**Area (acres)**	**Wetland Proportion (percent)**
PFO1	Broadleaf Forest Wetlands	2.1	5	4.0	9
PFO4	Needleleaf Forest Wetlands	-	-	-	-
PFO#/#	Mixed Forest Wetlands	-	-	-	-
PFO	**Forest Wetlands**	**2.1**	**5**	**4.0**	**9**
PSS1	Broadleaf Scrub/Shrub Wetlands	-	-	-	-
PSS4	Needleleaf Scrub/Shrub Wetlands	-	-	-	-
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	5.1	13	1.7	4
PSS	**Scrub/Shrub Wetlands**	**5.1**	**13**	**1.7**	**4**
PEM	**Emergent Wetlands**	**-**	**-**	**-**	**-**
P/RA	**Aquatic Bed**	**-**	**-**	**-**	**-**
P/R	**Other Waters**	**33.7**	**82**	**39.8**	**87**
	All Wetlands and Waters	**40.9**		**45.5**	
Upland		21.9		17.3	

[a] Source: USFWS, 2005.
[b] NWI = National Wetland Inventory.

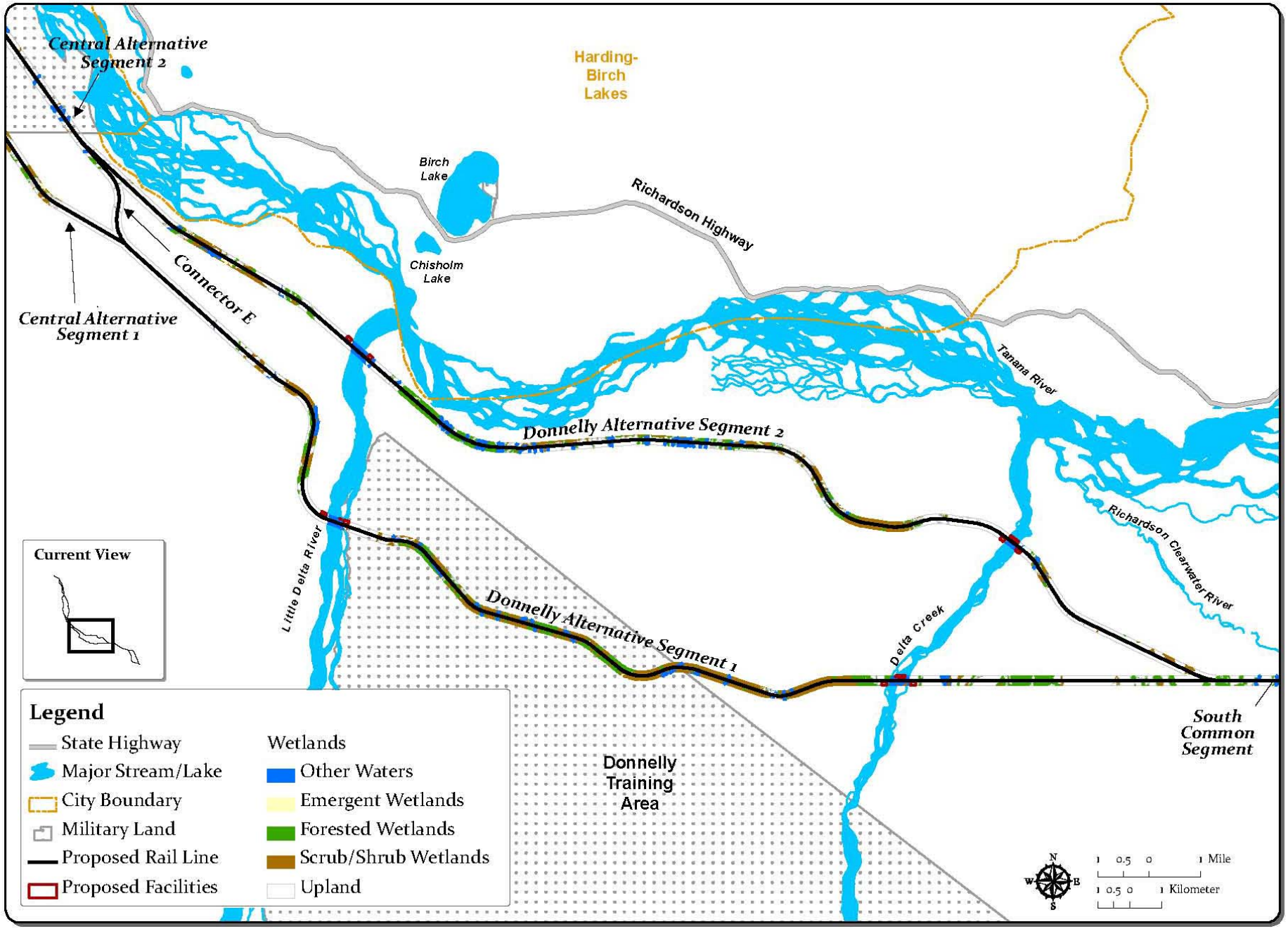

Figure 4-12 – Wetlands along the Donnelly Alternative Segments (HDR, 2007a)

The forested wetlands affected by construction of the Donnelly alternative segments would be primarily saturated needleleaf forests, which have a high functional capacity to improve water quality, export nutrients, and contribute to the abundance and diversity of wetland flora and fauna (HDR, 2007b). Donnelly Alternative Segment 2 would affect more broadleaf scrub/shrub habitats (21 acres) than Donnelly Alternative Segment 1 (4 acres). Broadleaf scrub/shrub habitats generally provide slightly higher functional capacities for contributions to the abundance and diversity of wetland flora and fauna than needleleaf scrub/shrub habitats (HDR, 2007b).

Donnelly Alternative Segment 1 and Donnelly Alternative Segment 2 would cross the Little Delta River and Delta Creek, tributaries of the Tanana River. Donnelly Alternative Segment 1 would be farther from the Tanana River than Donnelly Alternative Segment 2, which could reduce the impact of construction activities on water quality, wetlands, and the riparian zone next to the Tanana River. Donnelly Alternative Segment 2 would approach the southern bank of the Tanana River in several locations; potentially increasing the severity of impacts to wetlands, water quality, and the riparian zone (Figure 4-12). Construction of the large bridge crossings for the Little Delta River and Delta Creek would contribute to bank erosion that could be characterized as impacts to sensitive habitat (USEPA, 2001a).

South Common Segment

Construction within the 200-foot ROW of South Common Segment would result in the loss of about 56 acres of wetlands composed primarily of scrub/shrub wetland communities and forested communities (Table 4-22). The direct loss of wetlands would occur as a result of excavation, filling, or other construction activities. Figure 4-13 shows wetlands types. Most scrub/shrub wetlands affected would be seasonally flooded broadleaf communities (see Appendix E) with high functional capacities for water quality improvement, nutrient export, and contribution to the abundance and diversity of wetland flora and fauna (HDR, 2007b). Most affected forested wetlands would be saturated needleleaf forests (see Appendix E) with high functional capacities for water quality improvement, nutrient export, and contributions to abundance and diversity of wetland flora and fauna (HDR, 2007b).

Delta Alternative Segments

Construction of the Delta alternative segments would result in the loss of about 95 acres of wetlands for Delta Alternative Segment 1 and 60 acres of wetlands for Delta Alternative Segment 2 (Tables 4-23 and 4-24) through excavation, filling, or other construction activities, including the development of highway overpass staging areas, access roads, and a passenger terminal. Affected wetlands would be predominantly scrub/shrub and riverine communities within the Delta Alternative Segments 1 and 2 ROWs (Table 4-23; Appendix E). Riverine communities are considered sensitive habitats (SWS, 2008). Delta Alternative Segment 1 would affect more forested wetlands than Delta Alternative Segment 2 (Tables 4-23 and 4-24). Figure 4-14 shows wetland types for Delta Alternative Segments 1 and 2. Either alternative segment would require bridge crossings of the Delta River and adjacent riparian areas. Delta Alternative

Table 4-22
Wetlands within the 200-foot ROW for South Common Segment[a]

NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	0.1	0
PFO4	Needleleaf Forest Wetlands	11.0	20
PFO#/#	Mixed Forest Wetlands	0.2	0
PFO	**Forest Wetlands**	**11.3**	**20**
PSS1	Broadleaf Scrub/Shrub Wetlands	32.7	59
PSS4	Needleleaf Scrub/Shrub Wetlands	6.9	12
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	3.8	7
PSS	**Scrub/Shrub Wetlands**	**43.4**	**78**
PEM	**Emergent Wetlands**	**0.8**	**1**
P/RA	**Aquatic Bed**	–	–
P/R	**Other Waters**	**0.3**	**1**
	All Wetlands and Waters	**55.8**	
Upland		196.9	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

Table 4-23
Wetlands within 200-foot ROW for the Delta Alternative Segments[a]

		Delta 1		Delta 2	
NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)	Area (acres)	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	–	–	–	–
PFO4	Needleleaf Forest Wetlands	11.6	17	0.6	2
PFO#/#	Mixed Forest Wetlands	–	–	–	–
PFO	**Forest Wetlands**	**11.6**	**17**	**0.6**	**2**
PSS1	Broadleaf Scrub/Shrub Wetlands	0.9	1	6.3	18
PSS4	Needleleaf Scrub/Shrub Wetlands	0.7	1	0.7	2
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	31.3	45	12.0	33
PSS	**Scrub/Shrub Wetlands**	**32.9**	**47**	**19.0**	**53**
PEM	**Emergent Wetlands**	**0.1**	**0**	**1.1**	**3**
P/RA	**Aquatic Bed**	–	–	–	–
P/R	**Other Waters**	**24.9**	**36**	**15.1**	**42**
	All Wetlands and Waters	**69.5**		**35.8**	
Upland		208.8		241.1	

[a] Source: HDR, 2007a.
[b] NWI = National Wetland Inventory.

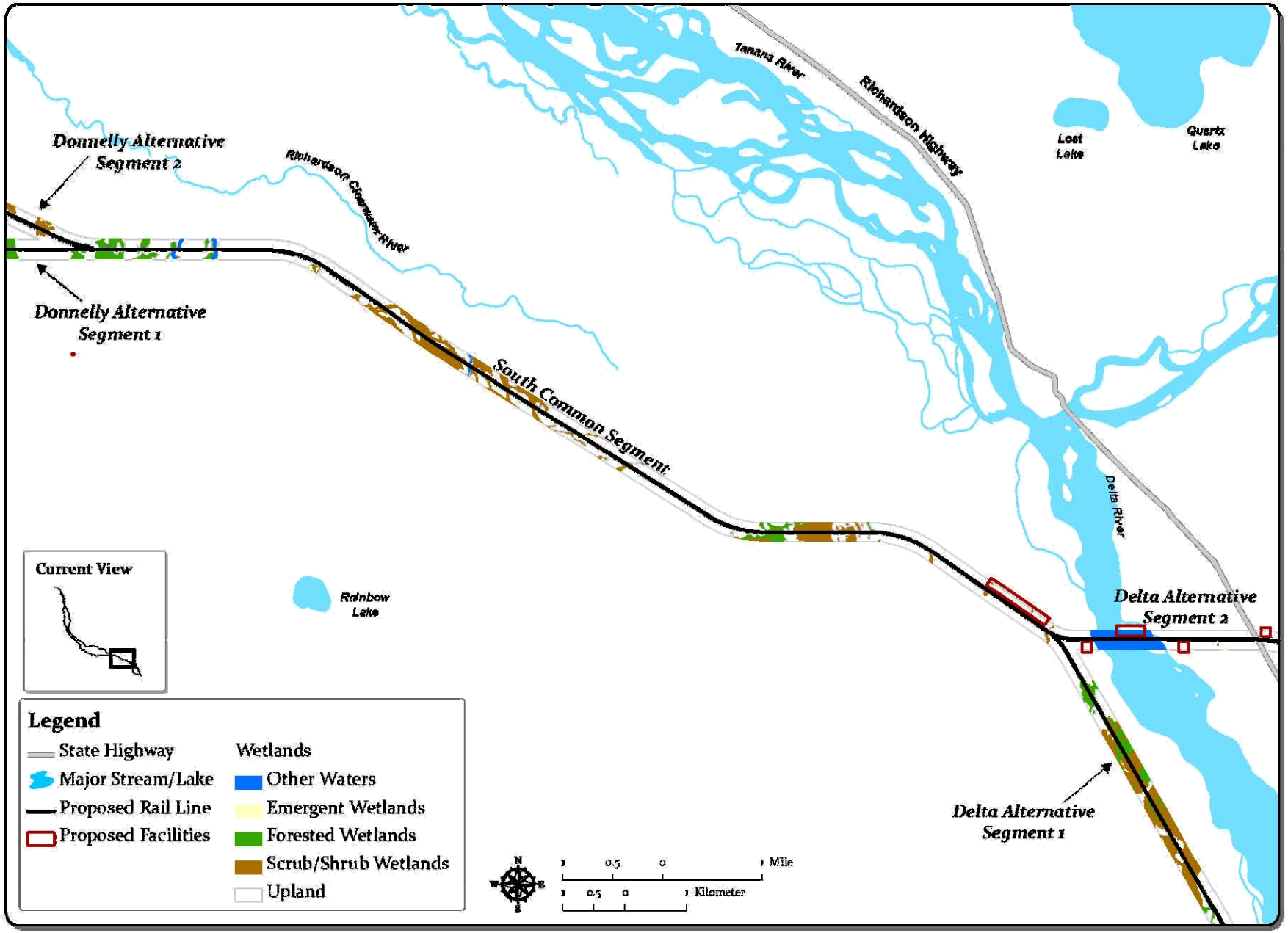

Figure 4-13 – Wetlands along South Common Segment (HDR, 2007a)

Table 4-24
Wetlands within Delta Alternative Segments 1 and 2 Large Bridge Staging areas, Instream Gravel Sites, Overpass Staging Areas, Access Roads, and Passenger Terminal[a]

		Delta 1		Delta 2	
NWI[b] Code	Description	Area (acres)	Wetland Proportion (percent)	Area (acres)	Wetland Proportion (percent)
PFO1	Broadleaf Forest Wetlands	2.4	9	–	–
PFO4	Needleleaf Forest Wetlands	–	–	–	–
PFO#/#	Mixed Forest Wetlands	–	–	3.6	15
PFO	**Forest Wetlands**	**2.4**	**9**	**3.6**	**15**
PSS1	Broadleaf Scrub/Shrub Wetlands	1.1	5	0.6	3
PSS4	Needleleaf Scrub/Shrub Wetlands	–	–	–	–
PSS#/#	Mixed and Other Scrub/Shrub Wetlands	–	–	–	–
PSS	**Scrub/Shrub Wetlands**	**1.1**	**5**	**0.6**	**3**
PEM	**Emergent Wetlands**	–	–	–	–
P/RA	**Aquatic Bed**	–	–	–	–
P/R	**Other Waters**	**21.9**	**86**	**19.9**	**82**
	All Wetlands and Waters	**25.4**		**24.1**	
Upland		15.2		18.5	

[a] Source: USFWS, 2005.
[b] NWI = National Wetland Inventory.

Segment 1 would cross riparian habitats next to Jarvis Creek, which would likely contribute to increased riverbank erosion in this actively eroding area.

Scrub/shrub wetlands that would be affected by construction of the Delta alternative segments would be primarily mixed needleleaf/broadleaf wetland communities, which have high functional capacities for water quality improvement, nutrient export, and contributions to the diversity and abundance of wetland flora and fauna. Needleleaf forested wetlands affected by construction of the Delta alternative segments have high functional capacities for water quality improvement, nutrient export, and contributions to the abundance and diversity of wetland flora and fauna.

Operations Impacts

Section 4.4 describes operations impacts to wetlands.

Summary of Impacts to Wetlands

The primary impacts to wetlands from Proposed NRE construction and operations would be loss of the existing wetland vegetation cover and alteration of wetland hydrology. Table 4-25 summarizes the results of the quantitative analysis of wetland impacts for the NRE alternative segments. Estimates are maximums based on clearing of the entire 200-foot ROW and no avoidance of wetlands for materials excavation sites. Construction of the proposed project would result in surface disturbance of an estimated 814 acres of wetlands including loss of 289 acres of forested wetlands, 511 acres of scrub/shrub wetlands, and 14 acres of emergent wetlands (Table 4-25). Construction of the minimum and maximum area projects would result in disturbance of an estimated 672 to 896 acres of wetlands including 283 to 377 acres of forested wetlands, 374 to 562 acres of scrub/shrub wetlands, and 14 to 17 acres of emergent wetlands (Table 4-25). Impacts to wetlands would represent 15 percent of the wetlands within 500 feet of

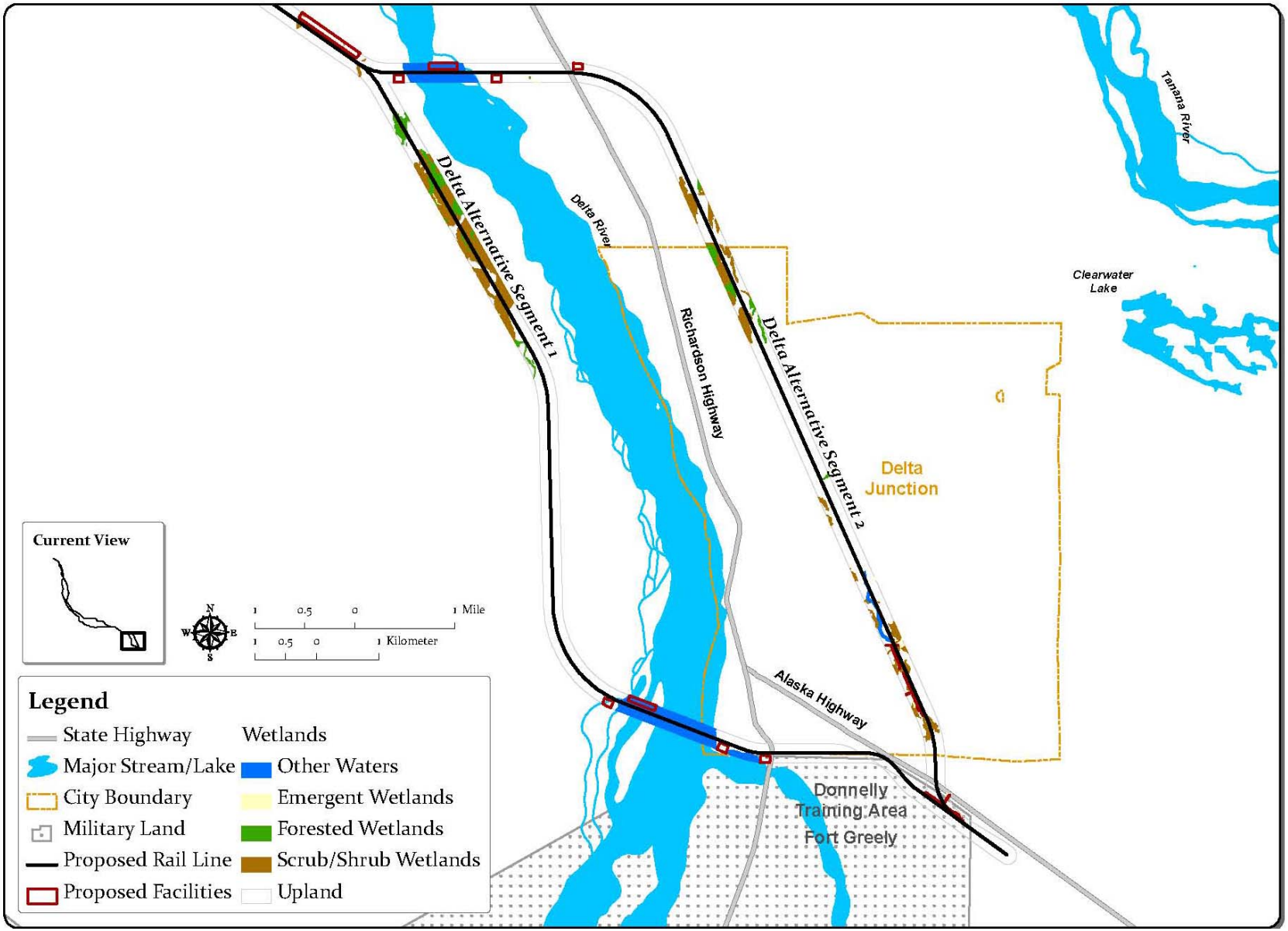

Figure 4-14 – Wetlands along the Delta Alternative Segments (HDR, 2007a)

Table 4-25
Summary of Impacts to Wetlands by Alternative Segment[a]

	Forested Wetlands (acres)	Scrub/Shrub Wetlands (acres)	Emergent and Aquatic Bed Wetlands (acres)	Total Wetlands (acres)	Other Waters (acres)	Total[b] Wetlands and Waters (acres)	Total[b] Uplands (acres)	Vegetated Wetland Proportion (percent)
Common Facilities	67.9	103.1	4.0	175.0	28.3	203.3	548.7	24
North Common	–	2.6	0.3	2.9	0.6	3.5	60.3	5
Eielson 1	6.9	7.1	1.5	15.5	1.3	16.8	230.5	6
Eielson 2	23.3	43.1	3.5	69.9	0.9	70.8	170.6	29
Eielson 3	36.7	48.6	5.7	91.0	9.3	100.3	143.1	37
Salcha 1 + Extra	32.2	56.7	0.2	89.1	90.8	179.9	352.6	17
Salcha 2 + Extra	58.5	120.1	3.0	181.6	80.7	262.3	377.8	28
Central 1	22.5	24.1	4.2	50.8	0.2	51.0	71.8	41
Central 2	–	6.5	–	6.5	–	6.5	80.4	7
Central Connector A	31.9	23.0	1.1	56.0	0.2	56.2	49.5	53
Central Connector B	0.3	0.4	0.2	0.9	0.7	1.6	77.8	1
Central Connector C	10.4	13.2	1.3	24.9	1.4	26.3	29.6	45
Central Connector D	–	1.5	0.2	1.7	1.2	2.9	18.3	8
Central Connector E	0.7	2.1	0.3	3.1	0.4	3.5	54.9	5
Donnelly 1 + Extra	125.8	214.0	2.2	342.0	55.0	397.0	286.7	50
Donnelly 2 + Extra	144.1	99.0	4.2	247.3	55.2	302.5	390.6	36
South Common	11.3	43.4	0.8	55.5	0.3	55.8	196.9	22
Delta 1 + Extra	14.0	34.0	0.1	48.1	46.8	94.9	224.0	15
Delta 2 + Extra	4.2	19.6	1.1	24.9	35.0	60.0	259.6	8

Table 4-25
Summary of Impacts to Wetlands by Alternative Segment[a] (continued)

	Forested Wetlands (acres)	Scrub/Shrub Wetlands (acres)	Emergent and Aquatic Bed Wetlands (acres)	Total Wetlands (acres)	Other Waters (acres)	Total[b] Wetlands and Waters (acres)	Total[b] Uplands (acres)	Vegetated Wetland Proportion (percent)
Proposed Action[b,c]	**288.9**	**511.4**	**13.8**	**814.1**	**232.2**	**1,046.3**	**2,025.4**	**26**
Minimum Area Alternative[b,d]	283.3	374.4	14.3	672.0	211.8	883.9	2,137.4	22
Maximum Area Alternative[b,e]	317.3	561.6	17.4	896.3	214.6	1,110.9	2,026.4	29

[a] Sources: HDR, 2007a; USFWS, 2005.
[b] column and row totals might not equal sums of values due to rounding.
[c] Proposed action (the Applicant's preferred segments) 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.

the proposed project alternatives, ranging from 13 to 17 percent for the minimum and maximum project area alternatives (Tables 4-11 and 4-25). Loss of wetland vegetation, disturbance of hydric soils and alteration of wetland hydrology would contribute to the alteration or loss of wetland functions for affected wetlands. Within the project area most forested, scrub/shrub, and emergent wetlands have high functional capacities for water quality improvement, nutrient export, and contributions to the abundance and diversity of wetland flora and fauna. Some cleared areas would likely be restored after construction; other areas would be covered by fill. Clearing of wetland vegetation would be considered long-term or permanent impacts to forest wetlands, even with restoration, especially for late-succession riparian forests. Clearing of wetland vegetation would be considered a short-term impact on scrub/shrub and emergent communities, provided appropriate restoration was completed. Wetland habitats could be created with appropriate restoration of material sites.

No-Action Alternative

Under the No-Action Alternative, there would be no impacts to wetlands from proposed rail line construction and operations.

4.6 Floodplain Resources

This section describes the current floodplain conditions of the Tanana River Valley in the vicinity of the proposed NRE. SEA collected data in the project area during field investigations in 2005, 2006, and 2007. Appendix E describes the methodologies employed and data collected. Appendix E also describes and summarizes data the USGS and the State of Alaska collected in the project area.

4.6.1 Affected Environment

Flooding in the Tanana River Basin can be broken down into several categories, including rainfall runoff, snowmelt, groundwater, or ice jam/log jam floods. The largest floods on record resulted from ice jams or runoff following large rainfalls. The largest flood on record for Fairbanks occurred in mid-August 1967. It was the result of widespread rainfall totaling 10 inches on the middle and lower Tanana River near the City of Fairbanks. There was large-scale flooding on rivers in the area, including the Salcha River, where the maximum discharge was almost twice the peak for the 100-year recurrence interval flood. At the peak of the 1967 flood, approximately 95 percent of Fairbanks was under water. The flood was estimated as a 333-year recurrence interval flood (Collins, 1990).

Present damageable property in the study area consists of residences, scattered cabins, highways, bridges, and culverts. The Chena River Flood Control project has reduced the likelihood of a severe flood within the City of Fairbanks; however, those flood control measures are downstream of the study area and provide no flood protection for the Eielson Flatlands. Since 1969, the Fairbanks North Star Borough (FNSB) has participated in the National Flood Insurance Program, a pre-disaster flood mitigation and insurance program designed to reduce the exorbitant cost of disasters. The National Flood Insurance Program is a voluntary program and provides a *quid pro quo* approach to floodplain management. It makes federally backed flood insurance available to residents and business owners in communities that agree to adopt and adhere to sound flood mitigation measures that guide development in floodplains.

Within the project area, the Tanana River has the largest floodplain footprint, which extends up to 5 miles from the main channel. The Tanana River floodplain consists of flat, low-lying areas with several sloughs or overflow channels extending from the main stem of the river. Other larger rivers in the project area include the Little Delta River, Delta River, Delta Creek, Little Salcha River, and Salcha River. The 100-year floodplains of these rivers are smaller (approximately 0.5 to 2.0 miles wide) and can be defined by the extent of their valley walls or the presence of resistant bedrock outcrops.

FNSB and HDR, Inc., mapped floodplains were mapped for the project area. The FNSB floodplains are categorized in three ways—those within the 100-year floodplain, which has a 26 percent chance of flooding in 30 years; those within the 100- to 500-year floodplain; and those within the greater-than-500-year floodplain. Outside the FNSB, HDR, Inc., mapped the extent of the 100-year floodplain for the remainder of the project area. Figure 4-2 shows the composite 100-year floodplain for the study area. The project area and many of the proposed rail segments within the FNSB lie within the 100-year floodplain, while the proposed rail segments within the Southeast Fairbanks Borough are primarily outside the 100-year floodplain, except near Delta Junction.

4.6.2 Environmental Consequences

This section describes potential impacts to floodplains as a result of the proposed project. Section 4.2.2 describes the methodology for assessing impacts to floodplains. Appendix E provides detailed water-resource tables, which list specific water resources and their characteristics. Chapter 20 describes proposed mitigation measures to address impacts to floodplains.

In general, almost all of the crossing sites in the Eielson Flats and Tanana River Valley physiographic regions are within the 100-year floodplain, while crossing sites in the other regions are generally outside the 100-year floodplain. The railbed within the 100-year floodplain would be constructed above the 100-year flood elevation.

Common Impacts to Floodplains

Common Construction Impacts to Floodplains

This section describes potential construction impacts to floodplains that could occur throughout the project area if the proposed rail line was constructed.

Access roads, staging areas, and camps would likely be placed within the 100-year floodplain. The affected areas would be small compared to the total floodplain storage available; thus, effects on floodplain storage would be minimal. Nevertheless, access roads are linear features, and as such they can inhibit the flow of floodwaters to portions of the floodplain.

Borrow areas located in the floodplain and in proximity to the river or stream could alter the hydraulics and conveyance of the watercourse during flood stage, which could lead to a short-term increase in flood storage (*e.g.*, while the borrow area is filling with water during a flood) and/or the long-term change in channel planform (through the development of meander cutoffs) and a change in sinuosity of the affected reaches. This effect would be more likely in streams crossing broad shallow floodplains and not likely for entrenched streams. In any case, the short-

and long-term effects would likely not be significant unless critical habitat was lost or changed, or the flooding dynamics affected the integrity of rural developments.

Common Operations Impacts to Floodplains

SEA does not anticipate impacts to floodplains from rail line operations.

Impacts by Alternative Segment

North Common Segment

The Eielson Construction Staging Area and Eielson Construction Camps would be located along this segment, which is entirely within the 100-year floodplain (Figure 4-2). Although the affected area would be approximately 140 acres, this area is small compared to the total floodplain storage available. This impact would likely be low.

All other activities or structures located along this segment would likely result in low impacts to floodplains.

Eielson Alternative Segments

All of the Eielson alternative segments would be within the 100-year floodplain, and the elevated rail line and access roads could inhibit the flow of floodwaters to portions of the floodplain. Depending on proximity and bed elevation of the rail line and access roads, these activities or structures could have a moderate impact. All other activities or structures would likely result in low impacts for reasons described in the section entitled Common Impacts to Floodplains

Salcha Alternative Segments

Most of Salcha alternative segments 1 and 2 would be with the 100-year floodplain. Proposed bridge crossings would include considerable lengths of river training works and channel plugs (in the overflow channels) to stabilize the river from lateral migrations and/or avulsions. River training works and channel plugs are structures placed in the river to direct the flow of water. Construction of the training works and plugs would require work in the active channel and would disturb banks and alter their physical conditions. Further, the bridge crossings would require staging areas on either side of the crossing. The approximate size of the staging areas would be 1 acre; however, the Tanana River staging areas would be approximately 5.7 acres. All of the proposed staging areas would be within the 100-year floodplain and the staging areas and associated construction facilities and structures could be inundated during an extreme flood event. While the affected areas would be large, the reduction in floodplain area would be small. This impact would likely be low due to the low risk of inundation and the relatively small area affected.

During spring breakup of ice, the ice roads and bridges could be the last to melt due to the increased thickness of the ice at these locations. As a result, ice jams or backups could occur, resulting in flooding upstream. This impact would be low.

Central Alternative Segments

Central Alternative Segment 1 would be outside the 100-year floodplain and, if constructed, would not impact floodplains. All of Central Alternative Segment 2 would be within the 100-year floodplain of the Tanana River.

The proposed location for the Tanana/Donnelly Construction Camp along Central Alternative Segment 2 would be entirely within the 100-year floodplain (Figure 4-2). Although the exact location of the camp is not known, the size of the camp in relation to the entire floodplain area would be small. Thus, the impact would be low.

Elevated rail lines and access roads along Central Alternative Segment 2 could inhibit the flow of floodwaters to portions of the floodplain, thereby reducing floodplain storage. Depending on proximity and bed elevation of the rail line and access roads, these activities or structures could have a moderate impact. All other activities or structures would result in low impacts for reasons described in the section entitled Common Impacts to Floodplains.

Connectors Segments A through E

All of Connector Segment A and half of Connector Segments C and E would be outside the 100-year floodplain, all of Connector Segments B and D would be within the 100-year floodplain, and about half the crossings for Connector Segment E would be within the 100-year floodplain. For segments in the 100-year floodplain, the elevated rail line and access roads could inhibit the flow of floodwaters to portions of the floodplain, thereby reducing floodplain storage. Depending on proximity and bed elevation of the rail line and access roads, these activities or structures could have a moderate impact. All other activities or structures would likely result in low impacts for the reasons described in the section entitled Common Impacts to Floodplains.

Donnelly Alternative Segments

Only a small portion (approximately less than 10 percent) of Donnelly Alternative Segments 1 and 2 would be within the 100-year floodplain. Thus, the built up roadbeds for the rail line and access road would have minimal effect on flood hydraulics and floodplain storage. These activities or structures would result in low impacts for the reasons described in the section entitled Common Impacts to Floodplains.

The proposed bridge crossings along these alternative segments would require staging areas on either side of the crossings. The approximate size of each staging area is 1 acre; however, the Little Delta River and Delta Creek staging areas would be approximately 5.7 acres. The proposed staging areas would be adjacent to or just inside the 100-year floodplain. While the affected areas would large, the reduction in floodplain area would be relatively small. This impact would likely be low**.**

South Common Segment

The entire footprint of South Common Segment would be outside the 100-year floodplain. The activities or structures located along this segment would result in low impacts to floodplains.

Delta Alternative Segments

Portions of Delta Alternative Segments 1 and 2 would be within the 100-year floodplain. The proposed bridge crossings along these segments would require staging areas on either side of the crossings. The approximate size of the staging areas would be 1 acre; however, the Delta River staging areas would be approximately 5.7 acres. While the affected areas would large, the reduction in floodplain area would be relatively small. This impact would likely be low**.**

Changes in floodplain hydraulics and floodplain storage would likely occur due to the bridge crossings and raised roadbeds for the rail line and access roads. Long-term operations activities or structures would result in moderate impacts**.**

No-Action Alternative

Under the No-Action Alternative, there would be no impacts to floodplains from proposed rail line construction and operations.