Documenting anadromous headwaters in the Tanana Flats of interior Alaska, in response to proposed road development

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Abstract - There is immediate interest in road development within the Blair Lakes region of the Tanana Flats, originating at the Tanana River railroad bridge, near Salcha, Alaska. However, there are several anadromous and potentially anadromous streams that extend into this area that may be affected by development. The objectives of this project were to study these streams and inventory fish species. More specifically, we sought to further document life stage distribution and add new findings to the State of Alaska Anadromous Waters Catalog. From 2013-2014, we sampled Clear, Bear, Fivemile, Dry, and Willow Creeks as well as Blair Lakes, Wood River, and Wood River tributaries. We employed a repeat sampling design across two sampling occasions and captured fish with baited minnow traps, backpack electrofishing, minnow seines, long-handled dipnets, angling, and direct observation. Overall, we documented 40 kilometers of newfound salmon habitat. New findings for Clear Creek include juvenile Chinook salmon (*Oncorhynchus tschawytscha*) found 38 km further upstream and spawning adults found 31 km further upstream with the first documentation of chum salmon (*O. keta*) spawning in this creek. New findings for Bear Creek include chum salmon spawning 9 km further upstream and the first observation of coho salmon (*O. kisutch*) in this creek. Lastly, we found further indication that Wood River may be anadromous by documenting juvenile Chinook salmon 1 kilometer upstream from the Tanana River. These novel findings will yield a more complete knowledge of species and life stage distribution that will provide permitting agencies with information important for project placement and insight into appropriate mitigation measures. Ultimately, the results from this study will be used to advise development in the Tanana River drainage with respect to the conservation of salmon and habitat critical to their survival.

Introduction - Alterations to sensitive hydrologic regimes, soil chemistry, and fish habitats have occurred in the past by military training activities (Thurow et al. 1995, Quist et al. 2003, Bhat et al. 2006). Soil erosion from land-use activities can cause increased sedimentation in streams that is not consistent with high quality fish habitat, particularly in basins with headwater streams (Schlosser 1991). The establishment of permanent and semi-permanent road corridors that cross wetland habitats and stream

features can result in altered flow and increases in total suspended solids (Forman and Alexander 1998, Sample et al. 1998). Military training such as mechanized infantry exercises has in some cases caused the sedimentation of water resources and a shift of the fish communities to more silt-intolerant species (Quist et al. 2003). Higher intensity military training such as tracked vehicle use has been well documented in different ecoregions due to negative impacts such as soil compaction, increased interrill erosion, and decreased infiltration rates (Thurow et al. 1995, Anderson et al. 2005). For Alaska, changes to the landscape from activities such as military training, recreation, and development may be amplified due to the sensitivity of permafrost systems.

Increases in U.S. Army (Army) military training are proposed for interior Alaska through the Joint Pacific Alaska Range Complex (JPARC) Modernization and Enhancement effort. There is immediate interest in road development in the Tanana Flats, originating with the Tanana River railroad bridge (JPARC EIS 2013). The JPARC project states that the Army will investigate multiple 'roadway access alignments' that connect the highway system to military training grounds using the Alaska Railroad Northern Rail Extension Tanana River Crossing (JPARC EIS 2013). Permanent development and associated increases in military training may affect the streams and lakes of the Tanana Flats and, consequently, fish habitats. Of particular concern are salmon, which have high commercial, cultural, and recreational value and exhibit very specific habitat requirements, returning annually to natal streams and spawning grounds (Healey 1991). More specifically, interest in Yukon River Chinook salmon life history has increased exponentially due to their populations experiencing drastic population declines since 1989 (JTC 2014).

Yukon River salmon exhibit a stream-type life history with extensive offshore migrations to reach spawning grounds resulting in greater residence time (Healey 1983, 1991). Juvenile Chinook salmon typically spend one year in freshwater habitats, overwintering in natal areas or downstream rearing habitat (Bradford et al. 2001, Daum and Flannery 2012), then migrate to the ocean (Bradford et al. 2008). After three to seven years at sea, adults pass Pilot Point sonar in western Alaska after ice out in May or June (Beacham et al. 1989, JTC 2014), returning to Tanana River tributaries in early July (Savereide 2012).

Two lineages of chum salmon run during summer (July) and fall (November, Seeb and Crane 1999). Juvenile chum smolt immediately (Bradford et al. 2008) and spend 2-5 years at sea before returning to freshwater habitats (Salo 1991). Coho salmon move into the Tanana River in late September and are on spawning grounds from October to November. They spend 1-5 years in freshwater and around 18 months at sea before returning to spawn (Sandercock 1991).

The Tanana River represents an important component of U.S. Chinook salmon stock composition (Eiler et al. 2004). The majority of Tanana River Chinook salmon return to the Salcha, Chena, and Goodpaster rivers, respectively, followed by lower returns to the Kantishna and Tolovana Rivers (Eiler et. al 2004). Chinook also return to unknown areas along the Tanana River mainstem (Eiler et. al 2004), such as Clear Creek just south of Salchaket Slough, though it is unknown how many might return to this stream. Of the majority of Chinook returning to U.S. reaches, the Tanana River and its tributaries represent the largest proportion of stock composition. Accordingly, new investigations, such as those initiated by impending development, into use of the more unknown tributaries and mainstem habitats could represent significant additions to the understanding of Yukon River Chinook salmon spawning resources in this region.

Prospective development has spurred several surveys for anadromous waters in the Tanana Flats. An Essential Fish Habitat assessment (MSA; 16 U.S.C. § 3: "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity") was conducted for the Northern Rail Extension Environmental Impact Statement from 2005-2007 (ARRC EIS 2009). In eastern Tanana Flats, Fivemile Clear Creek and several Tanana River sloughs were surveyed as part of this EIS and were found to contain anadromous fish. Clear Creek, Willow Creek, and Wood River were recently surveyed for anadromous fish (Hander and Legere 2012). These waters were sampled 2-3 times and covered 49, 10, and 86 river kilometers, respectively. On Clear Creek, a total of 18 sites were sampled with 3 juvenile Chinook salmon captured at 1 site and 3 adult Chinook salmon carcasses observed at 2 sites. For Willow Creek, 9 sites were sampled and no salmon were captured or observed; however, the anadromous humpback whitefish (*Coregonus pidschian*; n=2) was captured in gillnets near the mouth of Willow

Creek. No anadromous fish were captured or observed on the Wood River though lake chub (*Couesius plumbeus*) was frequently captured by minnow trap (n=313). While only three salmon were caught on Clear Creek at one site, it is possible that occupied juvenile rearing habitat extends further upstream from this site (Hander and Legere 2012) and in clearer waters.

Apart from the impetus of prospective development, there have been multiple surveys for anadromous fish in the Tanana River with respect to their ecology and distribution (Mecum 1984, Barton 1992, Hemming and Morris 1997, Ott et al. 1998, Durst 2001, Seitz and Bradley 2012, Wirth et al. 2012). These ecological works have resulted in approved nominations to the Alaska Department of Fish and Game (ADFG) *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes* (AWC; Johnson and Coleman 2014) an up-to-date inventory of fish distribution. Fish distribution and species richness is fundamental to the conservation and management of fishes (Patton et al. 2000). For Alaska, continuing these investigations is very important because less than 50% of anadromous waters have been documented (Johnson and Coleman 2014) and the pace of resource development is rapid and large-scale (Chance and Andreeva 1995). Under Alaska state law [AS 16.05.871(a)], anadromous waters are afforded higher levels of protections than non-anadromous waters. This law mandates the cooperation of the state in directing road corridor placement and appropriate conveyances for protected waters.

The modernization and enhancement of JPARC, specifically Tanana Flats roadway access, is the source of our obligation to document anadromous waters in the Tanana Flats. To address this circumstance of impending development and expand the knowledge of important Tanana River mainstream habitats and tributaries, we began a study in 2013 to further document anadromous waters. While the remote lowlands of the Tanana Flats have hampered and confined fish investigations to navigable waters, they have also sequestered upstream areas in relative isolation and protection. More information is needed regarding the entire water course, particularly where headwaters intersect with areas of interest to development, to understand how pristine populations of fish and their habitats may be affected by new roads and unprecedented access.

Study Area - In interior Alaska, the Tanana Flats is a large glacial river floodplain and alluvial fan complex located on the northern slopes of the Alaska Range (Figure 1, Wahrhaftig 1965, Walters et al. 1998). This boreal forest ecosystem has tightly meandering tributaries that flow into the Tanana River. These tributaries contain important habitat for anadromous and resident fish species such as salmon (*Oncorhynchus tshawytscha, O. kisutch, O. keta*), whitefish (*Prosopium cylindraceum, Coregonus pidschian*), Arctic grayling (*Thymallus arcticus),* Arctic lamprey (*Lampetra camptschatica*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus catostomus*), northern pike (*Esox lucius*), burbot (*Lota lota*), and slimy sculpin (*Cottus cognatus*). A remote and roadless area, the greater Tanana Flats ecoregion is approximately 7000 km^2 in size, of which 2628.7 km^2 is military land. The major water bodies in the Tanana Flats on military land are as follows: Tanana River, Wood River, Blair Lakes and Ann Lake, Clear Creek, McDonald Creek, Bear Creek, Fivemile Clear Creek, Crooked Creek, Willow Creek, and Dry Creek. The streams of the Tanana Flats are typically clear water streams that flow north and westerly into the Tanana River or its connecting sloughs.

The vegetation of the Tanana Flats is in an array of successional stages due to floodplain dynamics, frequent wildfire, and permafrost degradation. White (*Picea glauca*) and black spruce (*P. mariana*) forests are interspersed with paper birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), and balsam poplar (*P. balsamifera*) forests across areas of discontinuous permafrost. Alder (*Alnus* spp.) and willow (*Salix* spp.) communities occupy areas of early succession following alluvial deposition and wildfires. Groundwater discharge fens are oriented from southeast to northwest, paralleling the flow of surface and subsurface waters while lowland sedge meadows and bogs are common across the landscape. Significant wildfires that have occurred since 2000 were the Dry Creek Fire (2012, 190.83 km^2), Bonnifield #1 Fire (2011, 34.77 km^2), Willow Creek Fire (2010, 55.71 km^2), Wood River Fire (2009, 507.4 km^2), Willow Creek Fire (2004, 28.01 km^2), and 2001 Survey Line Fire (2001, 453.68 km^2).

Clear Creek – The first order upper perennial Clear Creek, 89.48 kilometers, is ground-water fed and located in the Blair Lakes region with outlet into Salchaket Slough, Tanana River (Figure 2). At the origin there is significant beaver activity with multiple active dams, lodges, and ponds. The clear headwaters of Clear Creek form two distinct channels that confluence 20 kilometers downstream. It is highly sinuous and dominated by a pool and riffle flow regime with variable depth (0.3-1.07 m, Tab. A1-2, Appendix 1) and a well-developed riparian zone. Large woody debris is scattered throughout the creek creating scoured pools and variable water flow. The substrate composition is cobble, gravel, and sand with a heavy riparian zone consisting of river alder (*Alnus crispa*), black spruce and paper birch. Shrubs including prickly rose (*Rosa acicularis*), high-bush cranberry (*Viburnum opulus*), red-osier dogwood (*Cornus stolonifera*), and felt-leaf willow (*Salix alaxensis*).

Bear Creek- The first order upper perennial Bear Creek, 26.33 kilometers, originates on the eastern edge of the Tanana Flats. It is groundwater fed, clear, and flows north into McDonald Creek, which flows into Salchaket Slough of the Tanana River (Figure 3). Bear Creek is a meandering stream dominated by a run sequence flow regime, with depths ranging from shallow (<1 meter) to moderate depth (up to 2 meters, Tab. A2-2, Appendix 2), and substrate composed of cobble and mud with submerged vegetation. The riparian zone surrounding the creek is comprised of grasses (*Graminoid* spp.), black spruce, and river alder. Multiple stretches lining Bear Creek were recently burned by the Dry Creek Fire in 2012 (19,082 ha) and regrowth includes fireweed (*Epilobium angustifolium*) and Bebb's willow (*Salix bebbiana*).

Fivemile Clear Creek – The first order upper perennial Fivemile Clear Creek, 21.62 kilometers, is located near the southeastern edge of the military land boundary, originating on borough land (Figure 4). It is groundwater fed and primarily clear; however, there are several small intermittent tributaries to the east of the creek that are cloudy and stagnant during late summer. The flow regime of main channel Fivemile Clear Creek is dominated by riffle and run sequences, it has minimal large woody debris in the channel, and depth ranges from >1m to over 2 meters. The substrate composition is cobble and mud with

submerged vegetation. The majority of the riparian vegetation surrounding the stream channel is black spruce, white spruce, and river alder.

Dry Creek – The first order intermittent Dry Creek, 119.10 kilometers, originates in the high mountains of the Alaska Range and flows north to the Tanana Flats, draining a basin lying just east of Wood River (Figure 5). In the foothills the stream has a large volume of water, but much of its water is disappears after reaching the Tanana Flats (Capps 1911). Dry Creek is composed mainly of riffle and run sequences, the substrate is sand and silt, and the water depth is shallow (<1 m), resulting in turbid water clarity (Tab. A4-1, Appendix 4). There is a wide channel with gravel sandbars and vegetation only present outside of the gravel channel, indicating periods of high and swift water. The riparian zone surrounding the stream corridor is mainly felt-leaf willow, river alder, and quaking aspen.

Blair Lakes Region – There are three main lakes in the Blair Lakes region (Figure 6). The named Blair Lakes consist of two water bodies: one slightly larger (2.38 km^2) in which the depth ranges from shallow, sandy shoreline to a vegetated depth of nearly 15 meters. The smaller (1.03 km^2), more northerly lake was very shallow with the benthos solidly vegetated from all shorelines and only reaching a maximum depth of 4 m. A third water body in the area, Ann Lake, is eutrophic and solidly vegetated with depths reaching a maximum of 2 meters and an area of 1.39 km^2.

Willow Creek – The first order lower perennial Willow Creek, approximately 53.27 kilometers, runs across the center of the Tanana Flats originating west of Blair Lakes and flowing to the Tanana River (Figure 7). It is ground-water fed and clear with several branches that are intermittent across years and appear based upon flood stage. Water depth is less than 1 meter with channel width between 4-7 meters (Tab. A6-1, Appendix 6) Dense vegetation lines the creek, including river alder, marsh cinquefoil (*Potentilla palustris*), grasses, willows, and black spruce. Frequent large and small woody debris is present in the creek creating scoured pools and riffle and run sequences on gravel and sand substrate, rendering it impassable to boating traffic.

Wood River – The second order upper perennial Wood River, 172.75 kilometers, is located on the western edge of the Tanana Flats (Figure 8). The Wood River is fed by the Yanert Glacier in the Alaska Range and flows into the Tanana River southwest of Fairbanks. It is highly sinuous with large gravel bars and at times shallow water. The substrate consists of sand and silt while the water is turbid with no clarity. Water depth ranges from less than one meter to 3 meters with channel width between 4-30 meters (Tab. A7-1, Appendix 7). Several clear water creeks enter the river far upstream: Bonniefield Creek, Gold King Creek, St. George Creek, and Fish Creek. Lower reaches riparian habitat consists of river alder, black spruce and paper birch, as well as shrubs including prickly rose, high-bush cranberry, common cattail, and felt-leaf willow.

Fish Creek – The first order lower perennial Fish Creek, 28.36 kilometers, originates in the Alaska Range and opens in the Wood River, 68 kilometers upstream from the Tanana River (Figure 9). The creek is groundwater and glacially fed with a mixture of riffles, runs, and pools with channel width around 8 meters (Table A7-1, Appendix 7). The substrate and riparian habitat of Fish Creek is similar to other Wood River tributaries and is composed of sand, gravel, and boulders lined by grasses, river alder, black spruce, and felt-leaf willow.

St. George Creek – The first order upper perennial St. George Creek, 44.53 kilometers, is a clear water tributary that originates in the Alaska Range and flows into the Wood River, 75 kilometers upstream from the Tanana River (Figure 9). The creek is groundwater and glacially fed with a mixture of riffles, runs, and pools throughout its length. Water depth is less than one meter with channel width between 4-12 meters (Table A7-1, Appendix 7). The substrate and riparian habitat of St. George Creek is a mixture of sands, gravels, and boulders lined with grasses, river alder, black spruce, and felt-leaf willow.

Gold King Creek – The first order upper perennial Gold King Creek, 51.46 kilometers, is a clear water tributary that originates in the Alaska Range and flows into the Wood River, 81 kilometers upstream from the Tanana River (Figure 9). This creek is groundwater and glacially fed with water depth less than one

meter and channel width between 4-5 meters (Tab. A7-1, Appendix 7). The substrate is composed of gravel, sand, and large boulders while the channel contains runs, riffles, pools, and occasional large woody debris. The riparian zone is a thick mix of river alder, black spruce, Bebb's willow, paper birch, prickly rose, and grasses.

Methods

Stream selection - We selected Clear Creek, Bear Creek, Fivemile Clear Creek, Dry Creek, Blair Lakes and Ann Lake, Willow Creek, and Wood River to survey for anadromous fish because these waters are in the Tanana Flats roadway access development area in the Blair Lakes region (Figure 1). In addition, relatively little information was known about the upper reaches of these streams, excepting Fivemile Clear Creek. We also surveyed the upper reaches of the Wood River; e.g., tributaries, because they approach the area of interest for development. Wood River has been a long-suspected but never confirmed anadromous waterway and shares an extensive boundary with military land so its anadromous classification has implications for military training and infrastructure development. We sampled Tanana Flats waterbodies during two sampling occasions to target various life history strategies and migration timing of anadromous fish (Healey 1991). The first sampling period occurred during early summer from June 15-July 31 while the second was during late summer from August 1 to September 30.

Sampling Techniques - We used a variety of sampling techniques to capture fish depending upon the hydrography and topographic features of the individual streams, rivers, and lakes. For wadeable waters, these techniques included minnow traps baited with salmon roe, minnow seines, backpack electrofishing, dipnetting, angling, and direct observation.

Minnow traps (23 x 45 cm, 0.6 cm wire mesh, with 2.5 cm diameter openings) baited with salmon roe were principally used to capture juvenile salmon. Sites that were deemed high-quality in terms of juvenile rearing habitat determined the placement of minnow traps such as shoreline areas with woody debris, undercut banks, slower moving water with deeper pools, and riparian overhang (Mossop and Bradford 2004). We typically soaked minnow traps overnight and fished them the following day.

We used single pass electrofishing not only for its adequacy in assessing species richness (Lyons 1992, Patton et al. 2000) and if necessary estimating relative abundance (Kruse et al. 1998) but also to minimize impacts to fish (Snyder 2003). Electrofishing was used conservatively at sites only along Clear Creek to capture fish; and this technique was not used in the presence of adult salmon (per FRP: #SF2013-128). For each site, the electrofisher (Smith-Root® LR-24) calculated stream conductivity; in conjunction, we adjusted power settings to the least amount necessary to capture fish with rapid recovery times. We observed fish over an acclimation period in a still water reserve and released after full recovery (usually < 30s).

For a less invasive technique, we used long-handled dip nets to capture juvenile salmon opportunistically. We infrequently used minnow seines (9.0 x 1.2 m with 0.64 cm ace mesh) due to few suitable sites. Lastly, angling was used to maximize encounters with adult fish such as Arctic grayling and northern pike, particularly in lentic systems. We flew aerial stream surveys, via rotary aircraft, on several creeks to attempt to identify locations for spawning salmon.

Once fish were captured, they were identified to life stage and species. We measured and photographed at least the first capture of each species at a site. When convenient, a Photarium© was used to photograph fish, which allowed better observation of diagnostic features. Fish were measured to fork length and total length for most species except slimy sculpin, which were only measured to total length. To distinguish between juvenile Chinook and coho, we used the collective diagnostic features: anal fin shape, distance between parr marks, adipose fin window, and fin color. In addition we photographed almost all juvenile salmon captured for further clarification and had these photos examined by multiple fisheries biologists who regularly work with juvenile salmon.

We conducted aquatic habitat assessments at most sites where we deployed minnow traps as well as stream reaches where we used electrofishing, except where time was limited. We took measurements of pH, dissolved oxygen, specific conductivity, and temperature using a Hach® HQ40d portable water meter. We classified streams generally according to order, permanence, and flow. We identified the five major plant species at each location and determined stream type, substrate type, and water clarity. We

also measured water depth, stream width, high water mark, and elevation. Finally, four photographs were taken at each site in cardinal directions.

Clear Creek – During 2013, we sampled Clear Creek during both sampling occasions on three separate trips: June 24-30, July 9-12, and August 19-25. We used minnow traps, electrofishing, dipnetting, and direct observation to capture fish and document fish for 4.5 river kilometers along the east and west forks of Clear Creek and north of the confluence in Clear Creek. To examine the detection of juvenile salmon in Clear Creek, we first delineated a stream reach with multiple sites of juvenile salmon rearing habitat. Traveling upstream we identified potential rearing sites visually then checked to confirm whether or not juvenile salmon were present (Tab. A1-3, App. 1). We conducted transects on both the east (1.8 km) and west (1.6 km) forks of Clear Creek to identify suitable rearing habitat. On the east fork, we identified 53 sites while on the west fork we selected 28 sites (Tab. A1-3, App. 1). We repeat sampled these sites several days later to see what proportion of the population may not have been detected in each sample. In 2014, we attempted to repeat sample 2013 sites in the same sampling occasions but were inhibited by high waters. From August 26-29, we used minnow traps to sample 0.87 stream km on the west fork and 0.08 stream km on the east fork. Direct observation of Clear Creek was conducted during aerial field transportation and while deploying minnow traps in more remote locations on July 21-22 and August 18-19. Lastly from September 15-16, we deployed minnow traps in the furthest upstream headwater sites that we accessed by hiking in from Blair Lakes.

Bear Creek – During 2013, we sampled Bear Creek during both sampling occasions on three separate trips: June 24-26, August 17-19, and September 17-19. We used minnow trapping and direct observation to capture and document fish along 8.5 river kilometers, accessed by helicopter. We attempted to characterize juvenile salmon rearing habitat by walking upstream and documenting available habitat but encountered non-wadeable and swift waters. During 2014, we attempted to float sample Bear Creek from June 24-28, but our sampling was hampered by heavy rains and swift waters, commensurate with record rainfall across the Fairbanks area. Minnow traps were deployed along 2.57 km of the creek and direct

observation was employed by floating the remainder of Bear Creek to Salchaket Slough. We used a helicopter to deploy a few minnow traps from July 21-22.

Fivemile Clear Creek - We sampled Fivemile Clear Creek only during 2013 for one sampling occasion, August 18-19. We deployed minnow traps at five sites along 3.7 river kilometers, accessed by helicopter.

Dry Creek – During 2013, we sampled Dry Creek in two sampling occasions: 26-27 July and 17-18 September. A total of 16 sites along 10.35 river kilometers of Dry Creek were surveyed. We attempted to use the minnow seine but were unsuccessful in drawing it to close due to a high stream stage. During 2014, we deployed a few minnow traps along 0.01 km of the creek from July 29-30 and accessed an area further upstream from July 21-22 to deploy a minnow trap via helicopter.

Blair Lakes – We sampled Blair Lakes four times during two sampling occasions: July 22-28, 2013; September 19-25, 2013; July 9, 2014; and July 31, 2014. We primarily used angling from a canoe to sample south Blair Lake and Ann Lake but also deployed minnow traps.

Willow Creek – We sampled Willow Creek during 2014 via helicopter from June 23-24, July 21-22, and August 18-19. We sampled two different forks of Willow Creek that cross a winter trail from Clear Creek Assault Strip to Blair Lakes Air Force Range.

Wood River – During 2014, we attempted to access upstream river sites from the Tanana River; however, a large log jam 2.8 km upstream prevented access further upriver. We deployed minnow traps along a 2 kilometer stretch of river below the log jam from August 12-14.

Wood River Tributaries – We sampled Fish Creek, St. George Creek, and Gold King Creek during 2014. We accessed sites along these tributaries via helicopter and deployed minnow traps in both sampling occasions, though early summer efforts were probably influenced by high waters. Sampling on Fish Creek took place from June 23-24; St. George Creek from June 23-24, July 21-22, August 18-19; and Gold King Creek from June 23-24 and August 18-19.

Permitting - Prior to commencing fieldwork, we acquired the requisite state of Alaska fisheries resource permits (FRP: #SF2013-128, #SF2014-095). We also had the project proposal reviewed and approved by

the Colorado State University Institutional Assurance Care and Use Committee (IACUC #13-4243A, Identification and inventory of anadromous and resident fish species in the Tanana Flats, Alaska).

Results

Clear Creek – During 2013, we captured eight species of fish at study sites along Clear Creek (Table 1C). Slimy sculpin was captured most frequently, followed by juvenile Chinook salmon then adult Arctic grayling. We did not capture burbot or humpback whitefish, which we had expected based on Hander and Legere (2012, Tab. 1A). For our study on detection of juvenile salmon the detection rate for age-0 juvenile salmon was 1.00 , between the first and second visits (9 Jul - 11 Jul, Tab. A1-3, Appendix 1), indicating that if we correctly identified rearing habitat the probability of detecting juvenile age-0 salmon, given that they were present, was 100%. At our second sampling occasion later in the season (August 20), we did not detect any juvenile salmon at these sites - most likely representing a migration event for these age-0 salmon. Flood stage waters in 2014 prevented early summer sampling; however, during the second occasion we captured three fish species: Chinook salmon, slimy sculpin, and northern pike (Tabs. 1B, 1C).

Bear Creek – In 2013, we captured four species of fish at study sites along Bear Creek (Tabs. 2A, 2C). Juvenile coho salmon were captured most frequently followed by slimy sculpin and Alaska blackfish. During late August we documented spawning adult chum salmon near the origin of Bear Creek. During 2014, we only captured slimy sculpin (Tabs. 2B, 2C).

Fivemile Clear Creek – We detected one fish species at study sites along Fivemile Clear Creek in 2013. Juvenile coho salmon were captured in minnow traps (Tabs. 3A, 3B). We did not repeat sample Fivemile Clear Creek in 2014, due to the incumbent classification as an anadromous water and our aerial determination that there were no significant clear water western tributaries to this creek.

Dry Creek – In 2013, we captured one fish species at study sites along Dry Creek (Tabs. 4A, 4C). A single slimy sculpin was caught by minnow trap and another flash of silver fell through minnow trap

mesh before being identified. Due to the lack of anadromous and other fish seen within this system during 2014 (Tabs. 4B, 4C), we found this observation to be inconclusive.

Blair Lakes Region – We captured one fish species in Blair Lakes and Ann Lake. Northern pike were caught only in the southern Blair Lake and at a rate of 1.76 fish per hour during 2013 (Tab. 5A) and 4.035 per hour during 2014 (Tab. 5B). We did not capture any fish in the northern Blair Lake or Ann Lake (Tab 5C). However, multiple waterfowl species, invertebrates, and molluscs reside in these lentic systems with regular use by moose consuming the emergent vegetation.

Willow Creek – We captured slimy sculpin at a rate of 0.005 per hour (Tab. 6A, 6B).

Wood River – In order of abundance, we captured adult lake chub, longnose sucker, juvenile Chinook salmon, and slimy sculpin in the Wood River (Tab. 7A, 7C). Lake chub were caught at a rate of 0.15 per hour while the remainder of the fish species were caught less than 0.03 per hour.

Wood River Tributaries – No fish were caught on Fish Creek (Tab. 7B, 7C), while slimy sculpin was caught on St. George Creek (0.01 fish per hour) and Gold King Creek (0.04 fish per hour).

Discussion - Our results fill this knowledge gap concerning headwaters and show that anadromous waters in the Tanana Flats are more extensive than previously known. For Clear Creek, we documented juvenile salmon 38 river kilometers upstream from the last approved *Anadromous Waters Catalog* nomination for juvenile Chinook salmon and suspect that their distribution extends even further upstream than our sampling sites. We documented spawning Chinook salmon 31 kilometers upstream from previously known. Due to our sampling sites being greater than 73 river kilometers upstream from the Tanana River and finding age-0 juvenile salmon at this time and location, we suspect that the headwater portion of Clear Creek is a natal area for these fishes, which was confirmed by our finding of spawning adult Chinook salmon.

We believe that we detected more juvenile salmon than Hander and Legere (2012) because this portion of Clear Creek was actually clear in water color and large woody debris was frequent, creating suitable

rearing habitat (Mossop and Bradford 2004). Our aquatic habitat assessments differed from Hander and Legere though stream width did not appear to differ between studies, as confirmed visually by air. The reason for these differences appears to originate within a particular stream reach around N 64.59364, W 147.72905 and up to the intersection of Dry Creek. In early season aerial reconnaissance efforts to find passable stream reaches on Clear Creek, we found that the water color north of this location was very cloudy, consistent with what Hander and Legere found in their aquatic habitat assessments (humic, ferric, muddy, and rarely clear). However, south and upstream of this point water color was extremely clear. The divergence in water color appears to be a component of stream influx where the Dry Creek stream bed opens into Clear Creek and was persistent in later season flights into our study sites. This location is probably of note because it represents an abrupt transition to higher quality juvenile rearing habitat, which may be the reason why we documented more juvenile salmon.

For Bear Creek, we extended the classification for anadromous waters 9 river kilometers further upstream and found a new spawning location for chum salmon. We also documented the first incidence of coho salmon for this creek. Our finding of juvenile age 1 coho supports the hypothesis that the winter flow of Bear Creek is not adequate to support incubation of coho eggs or survival of newly hatched fry (Ott et al. 1998). However, there are large portions of Bear Creek that remain open during the winter due to a permanent groundwater source, which may support these life stages of coho salmon.

We did not intensively sample Fivemile Clear Creek due to its previous classification as anadromous waters for coho salmon. We were primarily interested in whether or not several tributaries to the west of the creek, originating on military land and within the proposed area of interest for road devopment, contained essential fish habitat. We did not find any suitable habitat to deploy minnow traps in these western tributaries but did deploy minnow traps in mainstem habitats. The capture of coho salmon in the main channel confirmed that fish were present within the system but probably not entering the tributaries due to stagnant water. Consequently, we are reasonable certain that these muddy waters do not contain rearing or spawning habitat for anadromous fish.

Dry Creek was not dry during either sampling occasion and while water appears to be seasonally available, we only captured one fish. Fast moving and extremely turbid water probably contributed to our inability to capture fish; however, we are not sure that Dry Creek is a permanent source of essential fish habitat. Our conclusions were supported by aerial stream surveys during August that discovered the waters of Dry Creek going subterranean before reaching Clear Creek (Figure 5). There is a possibility that Dry Creek contains more fish than we were able to sample or that it is temporarily used; i.e., lower reaches may serve as a conduit to more permanent headwaters, which upstream investigations could confirm.

We were also interested in discovering if either Dry Creek runoff or the headwaters of Clear Creek intersect with Blair Lakes. Early season stream surveys did not map these streams to any lakes which our fish sampling supports because we did not capture any native fish species. The shallow depths of the northern Blair Lake and Ann Lake appear to limit fish populations through a winter kill mechanism or through the eutrophic nature of these systems.

Across the Tanana Flats we did not capture burbot or humpback whitefish. Lyons (1992) and Patton et al. (2000) show that our efforts should have been more than sufficient to detect these species if they had been present in the system (~35x the average stream width at normal flow conditions or three pool-riffle sequences and for streams 2-11 m, four 50 m long units). However, our focus on headwater areas may not have appropriate for some species such as burbot that are typically found in mainstem channel turbid waters (Mecum 1984, Breeser et al. 1988, Seitz et al. 2011).

For Clear Creek, Bear Creek, and Wood River our new findings were made into official submissions for the state of Alaska *Anadromous Waters Catalog* and the resident Fish Distribution Database, submitted September 30, 2014. While our findings for the other waterways may not contribute to the state databases, they advance of our understanding of how these systems function, which is germane due to the convergence of several proposed road corridors near Blair Lakes and Dry Creek. Ultimately, this process of documenting aquatic resources in the Tanana Flats prior to development will offer protection under Alaska state law by requiring the appropriate conveyance structures, construction during less

sensitive windows of time, and high standards for keeping stream habitats pristine. Importantly, it will also allow natural resource managers to measure the effect that increases in military training associated with development have on essential fish habitat.

While negative impacts to natural resources have transpired on account of military training there have also been positive benefits to maintaining vast amounts of land as open-space reserves. The significant amount of DOD lands, approximately 20 million acres total with 15% in Alaska (Gorte et al. 2012), has necessitated formal ecosystem management plans that consider the effects of military training such as vehicle traffic, live fire, and land development on wildlife, soils, water, vegetation, and access options (U.S. Army 2012, Quist et al. 2003). Despite varied perceptions about how this ecosystem management is practiced (Warren et al. 1994, Jacobson and Marynowski 1997, Benton et al. 2008), collectively these resources are usually more pristine due to the absence of industrial agriculture, logging, and mineral extraction (Boice 1997, Benton et al. 2008). Further, military lands often contain higher levels of biodiversity due to the heterogeneous direction of training activities upon the landscape which results in a mosaic of disturbance-averse and disturbance-dependent species (Warren et al. 2007, Stein et al. 2008). Therefore military lands offer an unparalleled example to study the effects of military training, recreation, and open space initiatives upon the landscape. Due to this lack of large-scale anthropogenic disturbances (Cohn 1996), military lands can offer refugia for threatened or endangered species (Warren et al. 2007) and serve as biological reserves for land and water.

In the special case of the Tanana Flats in Interior Alaska, we found this to be true for Yukon River salmon. For example, we discovered previously unidentified Chinook salmon rearing and spawning grounds on Clear Creek. This is particularly important when viewed in the larger theater of a declining Yukon River Chinook salmon population (JTC 2013, 2014) where these previously unknown habitats could factor as areas of larger significance and refugia due to the restricted nature of military lands.

Future Research – We do not know how many Chinook salmon are spawning in Clear Creek. Because this circumstance has only recently been discovered by our efforts, as well as those of Hander and Legere (2012), we do not expect there to be a run of considerable size. More research is needed to identify the extent of spawning habitat and number of spawners.

We know that there are significant ground-water sources in the Tanana Flats and that several areas along Bear and McDonald Creeks, remain open through the winter. For this reason, portions of Bear and McDonald Creeks probably represent overwintering habitat with good aerobic conditions. It is important know if there is there is any overwintering habitat on Clear Creek. In late-winter flights over Clear Creek, we did not detect any open-water sources. However, our summer 2013 investigations on Clear Creek revealed that there were frequent incidences of deep water >1.5m and active beaver habitat. These are areas that might not freeze and those that definitely do not in order to support beavers and could be winter habitat for juvenile salmon (Cunjak 1996). During February 2014, we followed up on this speculation and were able to core ice in several spots along Clear Creek and found flowing water beneath 50-86 cm of ice. In combination with dissolved oxygen (7.58-8.3 mg/dL) and conductivity (282-387 µS/cm) measurements, this portion of Clear Creek has high potential for wintering juvenile salmon. However, more work is needed to determine if juvenile salmon are actually present at this time, which could have implications for ice bridges that are associated with road development.

Our investigations, though successful, revealed much more to learn about anadromous fish in the Tanana Flats. Based on our work, we believe that the following suggestions would be most renumerative in terms of protections and scientific knowledge gained. 1.) Aerial surveys on Clear Creek during mid-July to determine the number of spawners and extent of spawning habitat. 2.) Winter fish habitat investigations on McDonald Creek, Bear Creek, and Clear Creek. 3.) Clear Creek juvenile salmon investigations. 4.) Identification and inventory of anadromous fish along the Wood River system including tributary streams. 5.) Aerial surveys during October for coho salmon in clear water tributaries of the Wood River. 6.) A Before-After-Control-Impact study to evaluate the effect of development on Clear Creek.

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Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

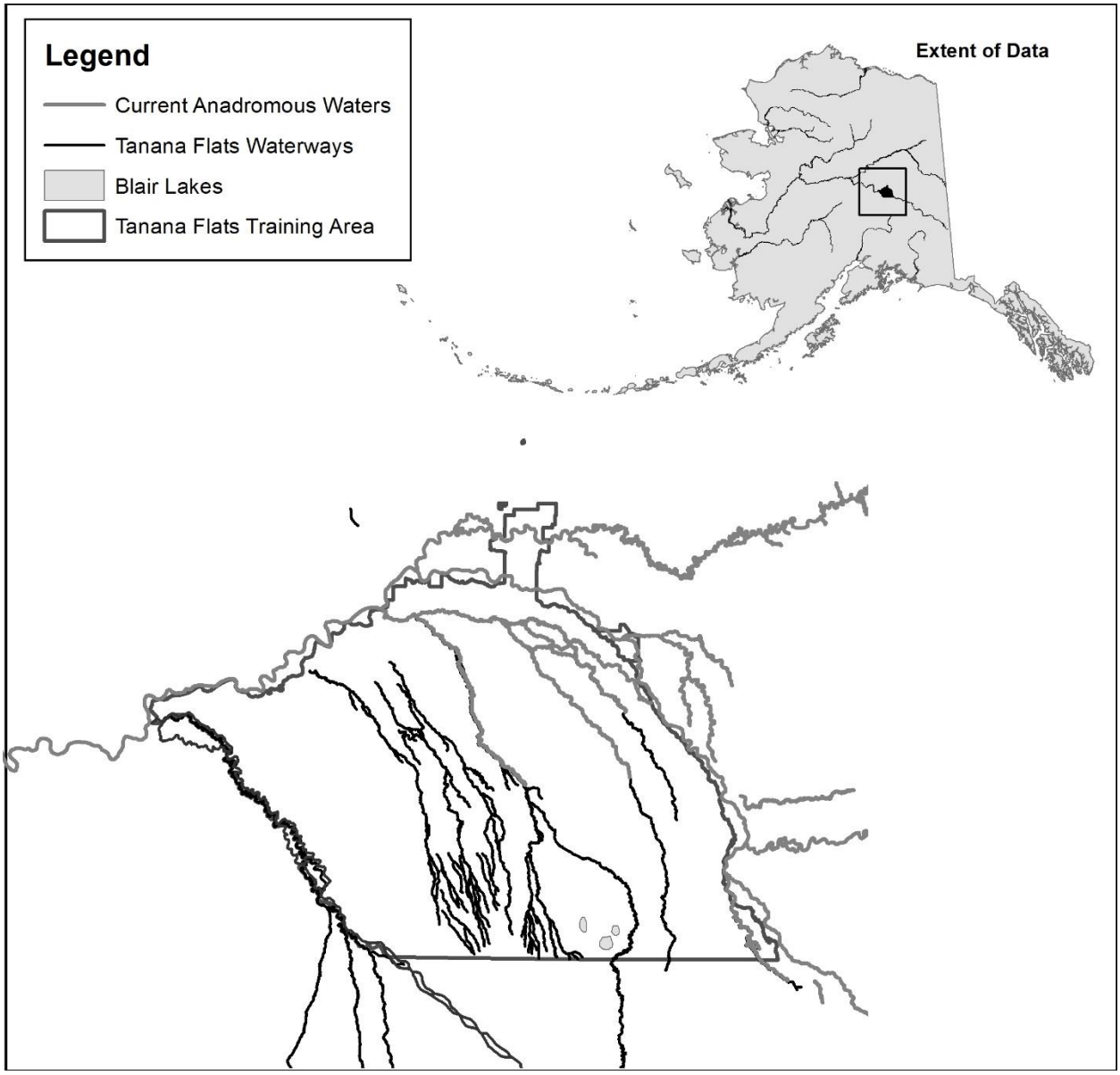

Figure 1. Streams of the Tanana Flats including anadromous waters for fisheries investigations under the Tanana Flats Training Area Roadway Access project, Fort Wainwright, Alaska, USA, 2013-2014.

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

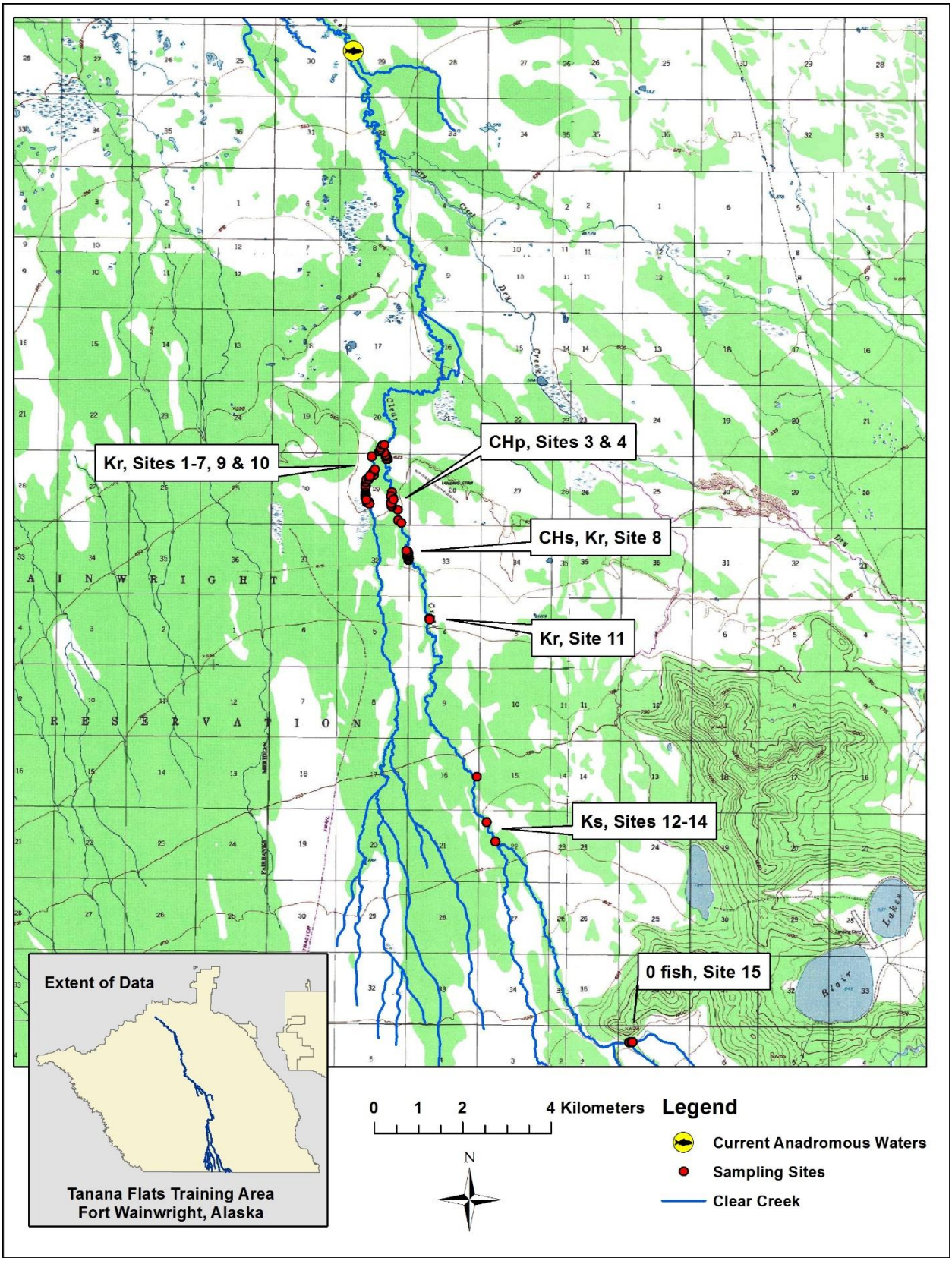

Figure 2. Clear Creek sampling sites including furthest upstream documentation of anadromous fish, Tanana Flats, Alaska, USA, 2013-2014.

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

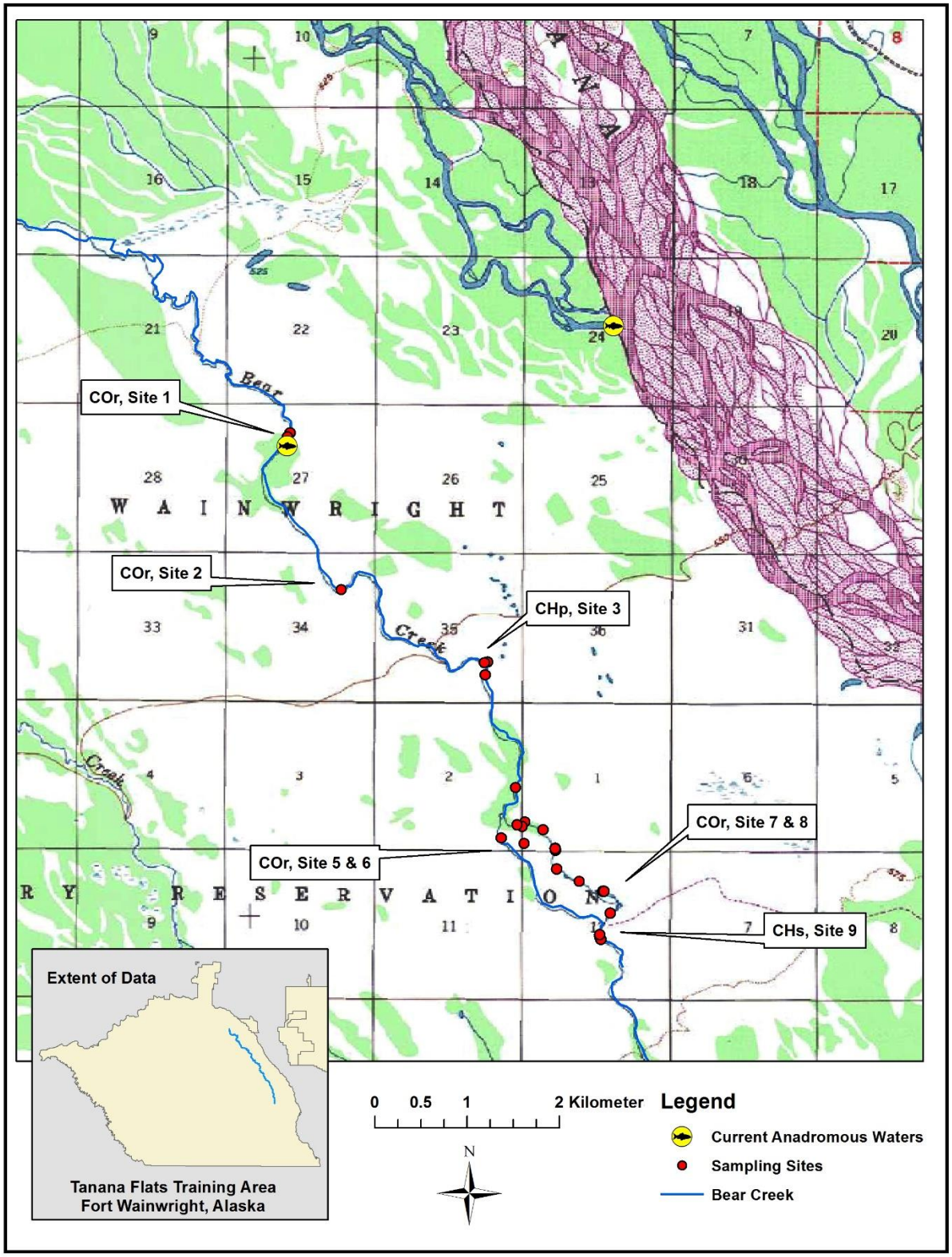

Figure 3. Bear Creek sampling sites including furthest upstream documentation of anadromous fish, Tanana Flats, Alaska, USA, 2013-2014

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

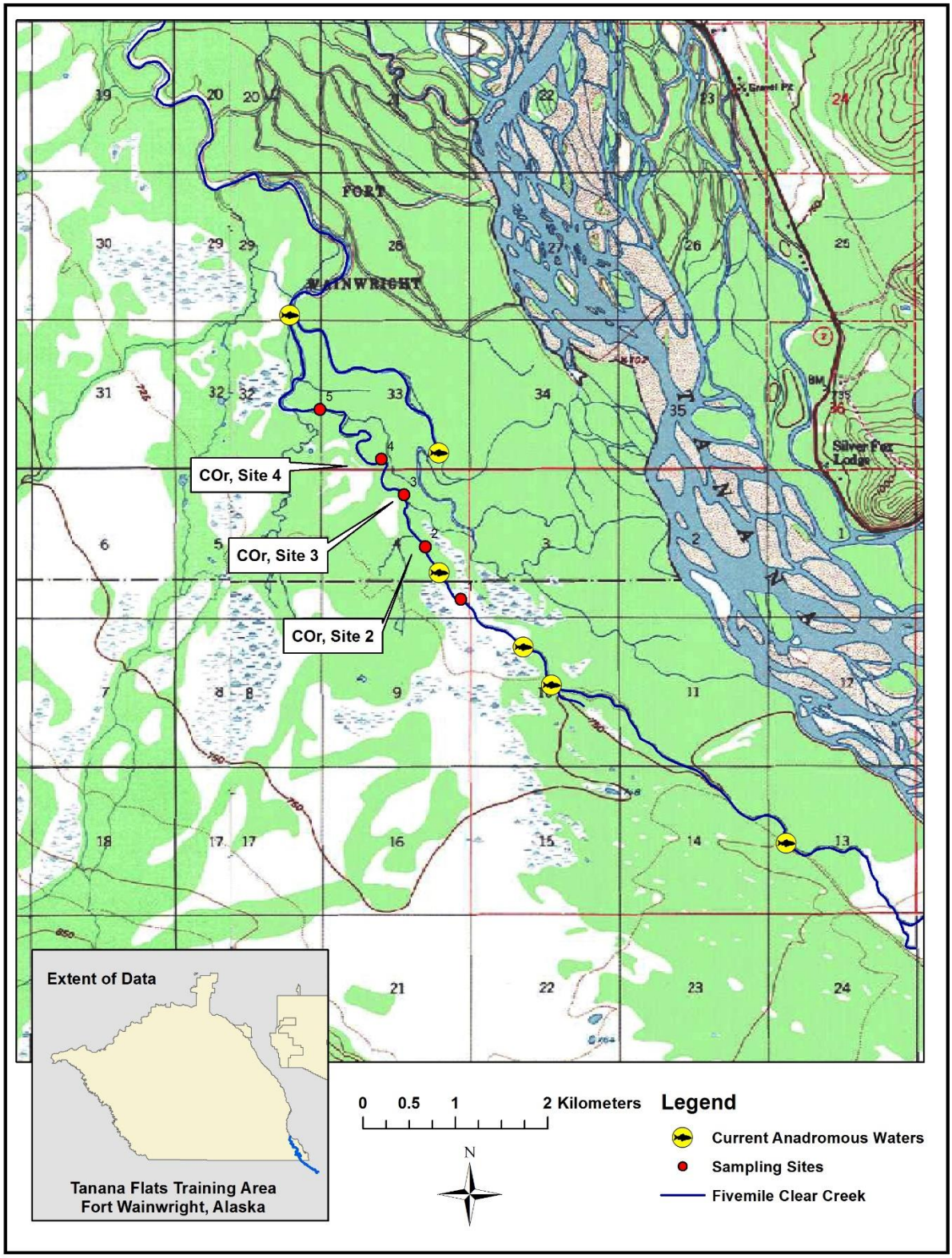

Figure 4. Fivemile Clear Creek sampling sites including furthest upstream documentation of anadromous fish, Tanana Flats, Alaska, USA, 2013-2014.

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

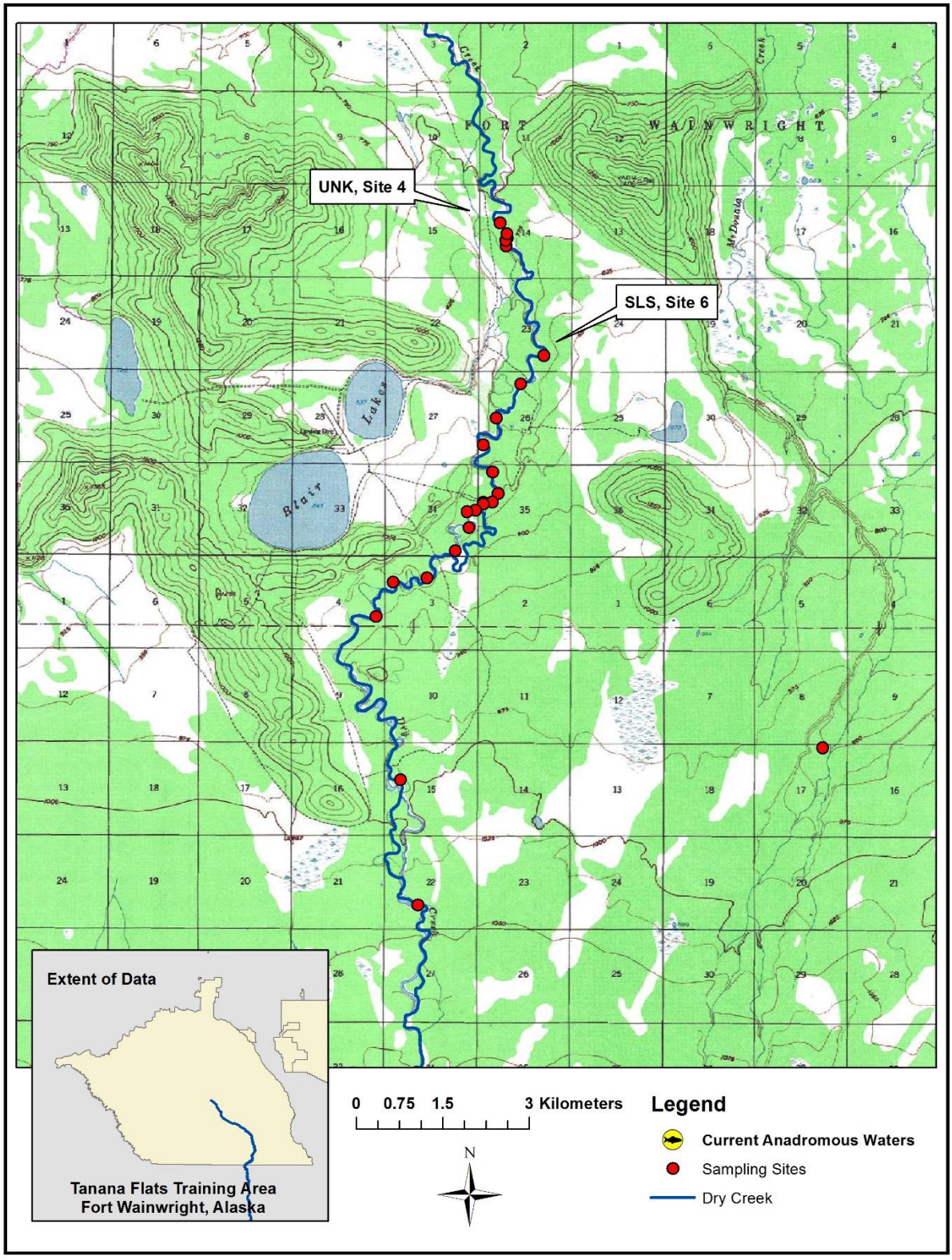

Figure 5. Dry Creek sampling sites for anadromous fish, Tanana Flats, Alaska, USA, 2013-2014.

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

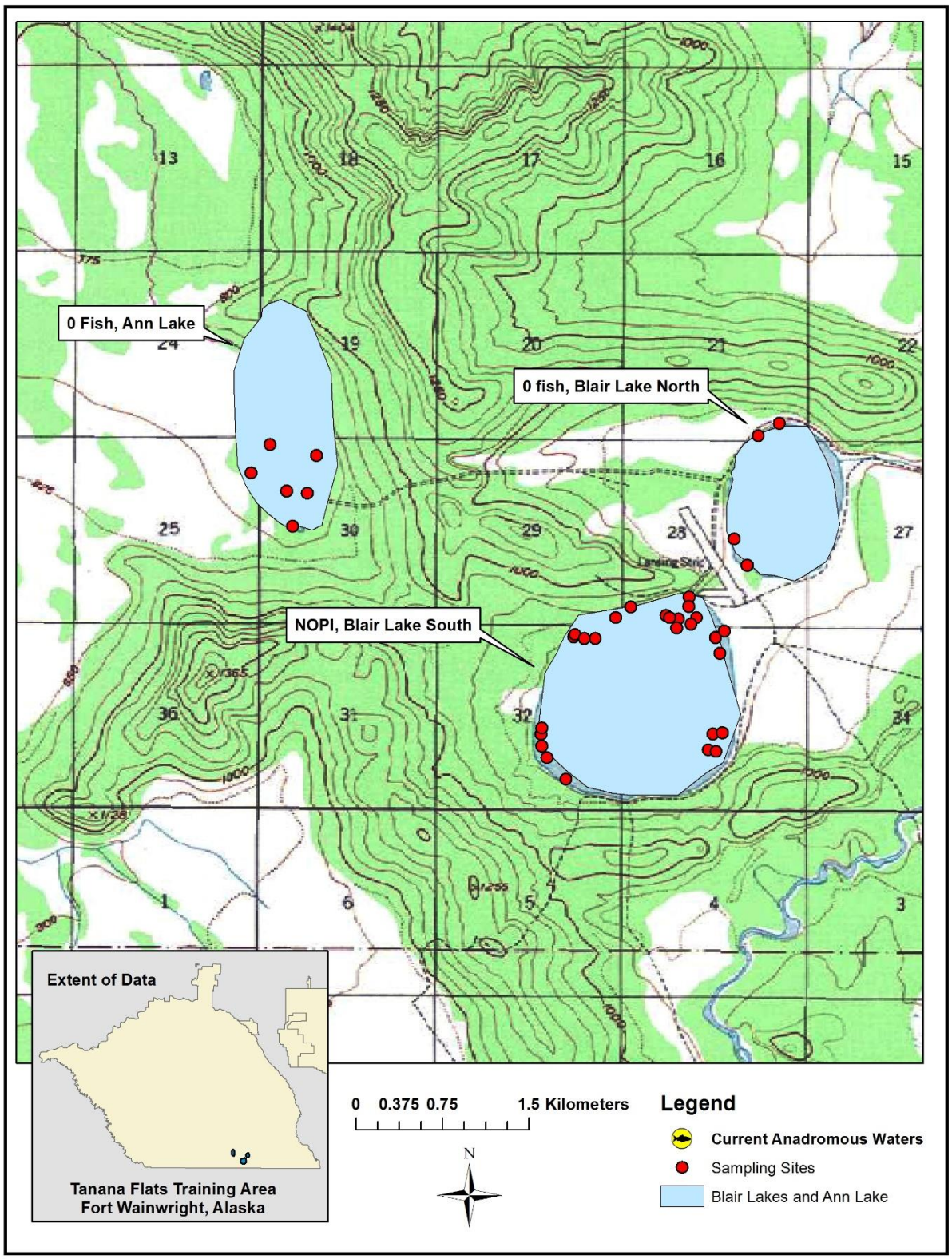

Figure 6. Blair Lakes and Ann Lake sampling sites for native resident fish, Tanana Flats, Alaska, USA, 2013-2014.

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

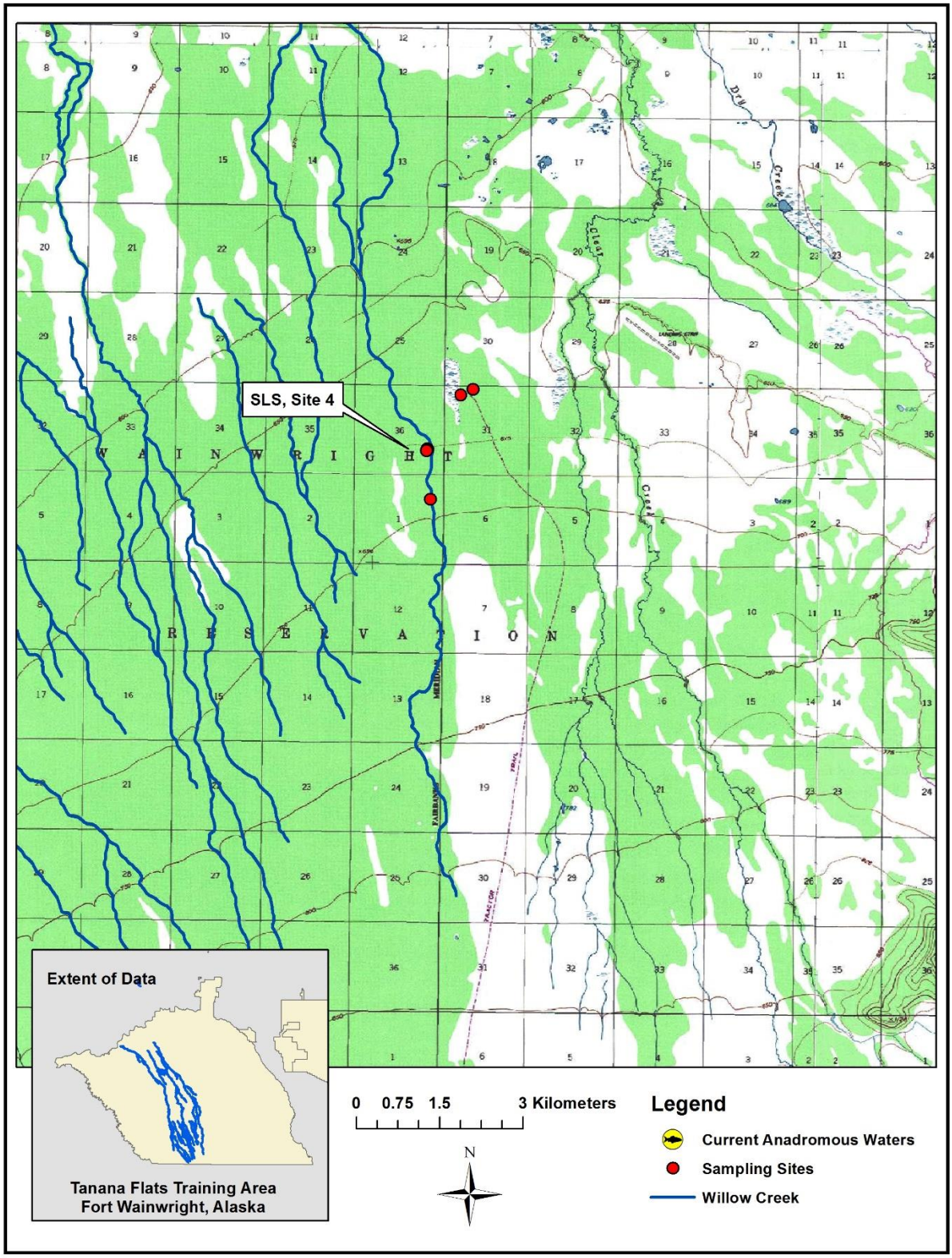

Figure 7. Willow Creek sampling locations for anadromous fish in the Tanana Flats, Alaska, USA, 2013-2014.

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

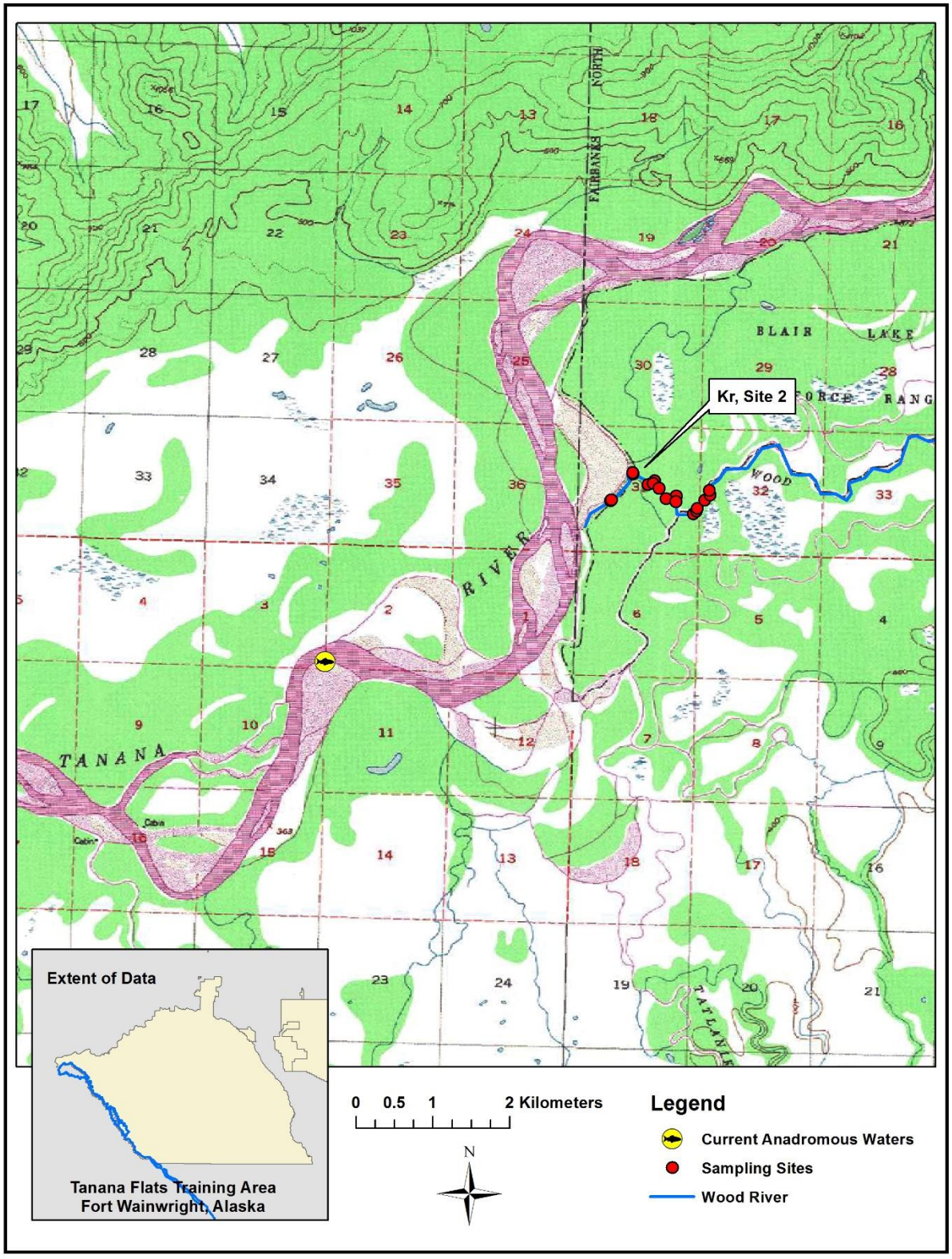

Figure 8. Wood River sampling sites for anadromous fish, Tanana Flats, Alaska, USA, 2013-2014.

Figures: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

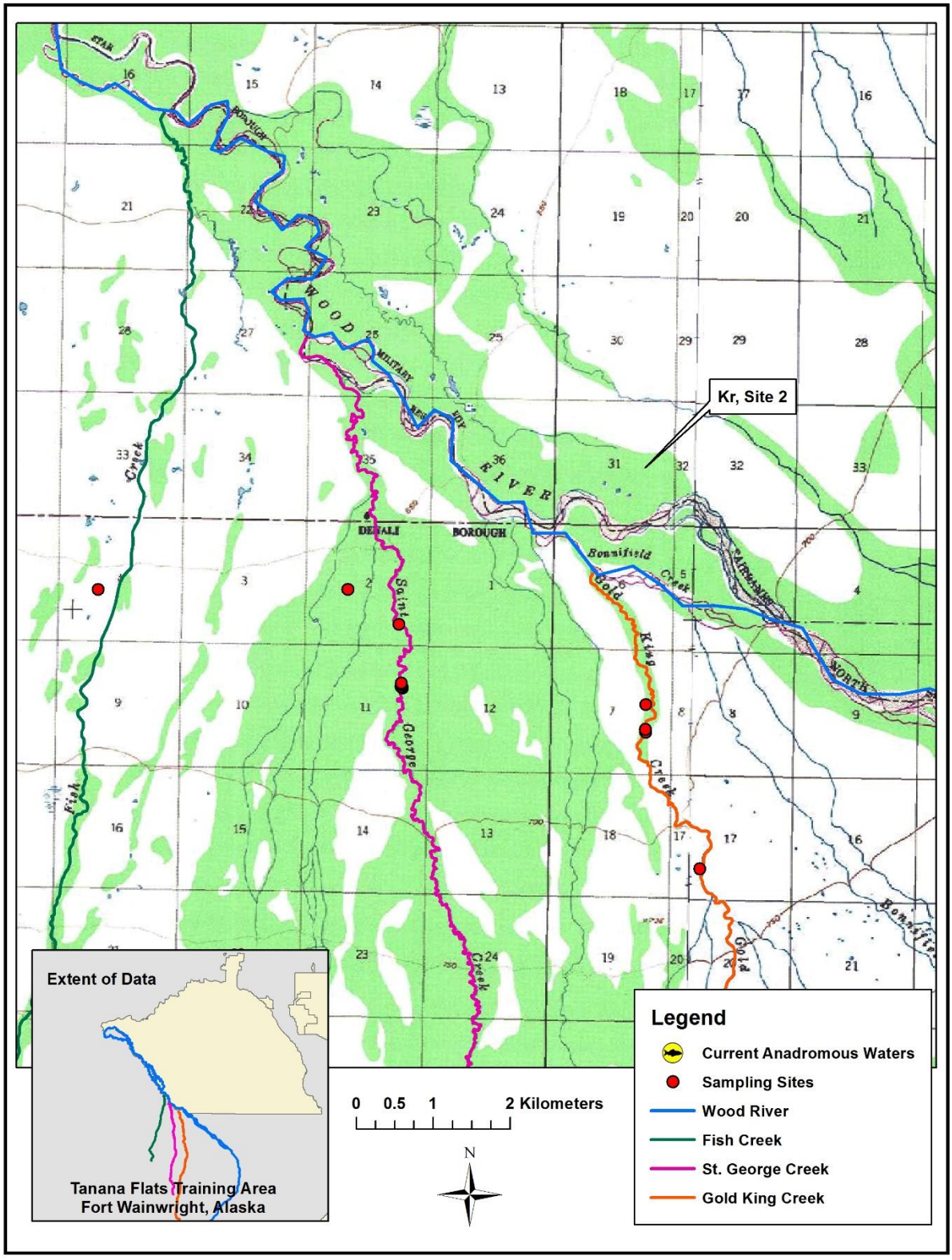

Figure 9. Wood River tributaries sampling sites for anadromous fish, Tanana Flats, Alaska, USA, 2013-2014.

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 1A. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in Clear Creek, Tanana Flats, Alaska, 2013.

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Arctic grayling	*Thymallus arcticus*	A/J	43	Electrofisher	37	0.00107
				Dipnet	5	0.62500
				Angling	1	2.00000
Arctic lamprey	*Lampetra camtschatica*	A	1	Minnow Trap	1	0.00043
Chinook salmon	*Oncorhynchus tshawytscha*	J	85	Minnow Trap	30	0.01300
				Dipnet	52	6.50000
				Electrofisher	3	0.00009
Chum salmon	*Oncorhynchus keta*	A	8	Dipnet	2	0.25000
				Direct Observation	6	0.75000
Longnose sucker	*Catostomus catostomus*	A	1	Electrofisher	1	0.00003
Northern pike	*Esox lucius*	J	2	Minnow Trap	2	0.00090
Round whitefish	*Prosopium cylindraceum*	A	12	Electrofisher	12	0.00030
Slimy sculpin	*Cottus cognatus*	A/J	88	Electrofisher	21	0.00060
				Minnow Trap	67	0.02910

Notes: *= 2013 capture effort for the Clear Creek system is electrofishing = 34,560.00 seconds, minnow trapping = 2,304.78 hours, dipnetting =8.00 hours, and angling=1 hour.

Table 1B. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in Clear Creek, Tanana Flats, Alaska, 2014.

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Chinook salmon	*Oncorhynchus tshawytscha*	J	286	Minnow Trap	279	0.32537
		A		Aerial	7	3.13043
Northern pike	*Esox lucius*	J	1	Minnow Trap	1	0.00244
Slimy sculpin	*Cottus cognatus*	A	6	Minnow Trap	6	0.00733

Notes*= 2014 capture effort for the Clear Creek system is minnow trapping = 817.53 hours and aerial surveys=1.92 hours.

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 1C. Clear Creek fish totals and length measurements by site, occasion, and sampling technique, Tanana Flats, Alaska 2013-2014.

Location	Site[1]	Occasion[2]	Gear[3]	Year	Fish[4]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB	Median Length of Fish[5]
CC	1	1	E	2013	14	0	0	0	7	6	1	0	0	0	0	0	**59, 154, 276**
CC	1	1	N	2013	28	28	0	0	0	0	0	0	0	0	0	0	**43.5**
CC	1	1	MT	2013	16	0	0	0	16	0	0	0	0	0	0	0	**66.5**
CC	1	2	MT	2013	2	1	0	0	1	0	0	0	0	0	0	0	**76, 71**
CC	1	1	MT	2014	5	5	0	0	0	0	0	0	0	0	0	0	**60**
CC	2	1	E	2013	2	0	0	0	0	1	1	0	0	0	0	0	**289, 206**
CC	2	1	N	2013	3	2	0	0	0	1	0	0	0	0	0	0	**68.5, 29**
CC	2	1	MT	2013	5	0	0	0	5	0	0	0	0	0	0	0	**75**
CC	2	2	MT	2013	10	8	0	0	1	0	0	0	0	1	0	0	**92, 75, 172**
CC	2	2	MT	2014	84	82	0	0	2	0	0	0	0	0	0	0	**71, 69.5**
CC	3	1	E	2013	7	3	0	0	0	3	0	1	0	0	0	0	**45, 243, 202**
CC	3	1	N	2013	7	6	0	0	0	1	0	0	0	0	0	0	**53, 105**
CC	3	1	MT	2013	21	1	0	0	20	0	0	0	0	0	0	0	**45, 70.5**
CC	3	2	MT	2013	3	2	0	0	1	0	0	0	0	0	0	0	**87, 72**
CC	3	2	DO	2013	2	0	0	2	0	0	0	0	0	0	0	0	**MNT***
CC	3	2	MT	2014	12	12	0	0	0	0	0	0	0	0	0	0	**75**
CC	4	1	N	2013	3	0	0	0	0	3	0	0	0	0	0	0	**28**
CC	4	1	MT	2013	11	1	0	0	10	0	0	0	0	0	0	0	**62, 74.5**
CC	4	2	MT	2013	9	9	0	0	0	0	0	0	0	0	0	0	**92**
CC	4	2	DO	2013	4	0	0	4	0	0	0	0	0	0	0	0	**653.5**
CC	4	2	MT	2014	145	144	0	0	0	0	0	0	0	1	0	0	**74, 80**
CC	5	1	E	2013	13	0	0	0	11	0	2	0	0	0	0	0	**60, 257.5**
CC	5	1	N	2013	8	8	0	0	0	0	0	0	0	0	0	0	**42.5**
CC	6	1	E	2013	13	0	0	0	0	12	1	0	0	0	0	0	**267, 286**
CC	7	1	E	2013	4	0	0	0	2	2	0	0	0	0	0	0	**54.5, 231**
CC	7	1	N	2013	1	1	0	0	0	0	0	0	0	0	0	0	**43**
CC	8	1	E	2013	22	0	0	0	1	14	7	0	0	0	0	0	**66, 257, 346**
CC	8	1	N	2013	6	6	0	0	0	0	0	0	0	0	0	0	**47.5**
CC	8	1	MT	2013	9	0	0	0	9	0	0	0	0	0	0	0	**70**
CC	8	2	N	2013	2	0	0	2	0	0	0	0	0	0	0	0	**589**
CC	8	2	MT	2013	6	5	0	0	1	0	0	0	0	0	0	0	**75, 60**
CC	9	1	MT	2013	4	0	0	0	3	0	0	0	1	0	0	0	**72, 175**
CC	9	2	MT	2013	1	1	0	0	0	0	0	0	0	0	0	0	**86**
CC	10	2	MT	2013	4	3	0	0	0	0	0	0	0	1	0	0	**112, 114**
CC	11	2	MT	2014	41	37	0	0	4	0	0	0	0	0	0	0	**71, 75**
CC	12	1	A	2014	4	4	0	0	0	0	0	0	0	0	0	0	**MNT**
CC	13	1	A	2014	1	1	0	0	0	0	0	0	0	0	0	0	**MNT**
CC	14	1	A	2014	1	1	0	0	0	0	0	0	0	0	0	0	**MNT**
CC	15	2	MT	2014	0	0	0	0	0	0	0	0	0	0	0	0	**-**
Total					**533**	**371**	**0**	**8**	**94**	**43**	**12**	**1**	**1**	**3**	**0**	**0**	**-**

Notes. [1] Site: site number is cumulative for mapping purposes only – each row represents an several sites. [2] Occasion: 1=June 15 to July 31, 2=August 1-September 30. [3] Gear Type: E=Electrofish, N=dip net, A=aerial observation, DO=direct observation ground), MT=minnow trap. [4] Fish: total number of fish sampled at each site. Fish species are as follows: K=King/chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*). [5] Median Fish Length=Medians are respective following fish order. MNT*=Measurement not taken.

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 2A. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in Bear Creek, Tanana Flats, Alaska, 2013.

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Alaska blackfish	*Dallia pectoralis*	A	1	Minnow Trap	1	0.001
Coho salmon	*Oncorhynchus kisutch*	J	10	Minnow Trap	10	0.014
Chum salmon	*Oncorhynchus keta*	A	5	Direct Observation	5	0.625
Slimy sculpin	*Cottus cognatus*	A	5	Minnow Trap	5	0.007

*= 2013 capture effort for the Bear Creek system is minnow trapping = 717.76 hours and direct observation =8.00 hours.

Table 2B. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in Bear Creek, Tanana Flats, Alaska, 2014.

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Slimy sculpin	*Cottus cognatus*	A	3	Minnow Trap	3	0.01041

*= 2014 capture effort for the Bear Creek system is minnow trapping = 288.19 hours.

Table 2C. Bear Creek fish totals and length measurements by site, occasion, and sampling technique, Tanana Flats, Alaska 2013-2014.

Location	Site[1]	Occasion[2]	Gear[3]	Easting	Northing	Latitude	Longitude	Fish[4]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB	Median Fish Length[5] (mm)
BC	1	1	MT	484324	7167201	64.62947	-147.32790	2	0	0	0	2	0	0	0	0	0	0	0	**51.5**
BC	2	1	MT	484906	7165548	64.61466	-147.31555	1	0	0	0	1	0	0	0	0	0	0	0	**50**
BC	6	1	MT	487230	7162728	64.58945	-147.26671	1	0	0	0	1	0	0	0	0	0	0	0	**89**
BC	6	2	MT	487224	7162746	64.58962	-147.26683	1	0	1	0	0	0	0	0	0	0	0	0	**98**
BC	8	2	MT	487720	7161758	64.58077	-147.25639	1	0	1	0	0	0	0	0	0	0	0	0	**99**
BC	3	2	DO	486457	7164753	64.60759	-147.28304	1	0	0	1	0	0	0	0	0	0	0	0	**DNC***
BC	9	2	DO	487707	7161790	64.58105	-147.25668	4	0	0	4	0	0	0	0	0	0	0	0	**DNC**
BC	1	2	MT	484324	7167200	64.62947	-147.32790	2	0	2	0	0	0	0	0	0	0	0	0	**85**
BC	6	2	MT	487230	7162727	64.58945	-147.26671	1	0	1	0	0	0	0	0	0	0	0	0	**96**
BC	8	2	MT	487708	7161801	64.58116	-147.25665	4	0	3	0	0	0	0	0	0	0	0	1	**99, 71**
BC	7	2	MT	487739	7162283	64.58548	-147.25604	1	0	1	0	0	0	0	0	0	0	0	0	**114**
BC	5	2	MT	486672	7162798	64.59006	-147.27383	1	0	1	0	0	0	0	0	0	0	0	0	**117**
BC	1	2	MT	484324	7167199	64.62947	-147.32790	1	0	0	0	1	0	0	0	0	0	0	0	**67**
BC	10	1	MT	487825	7162053	64.58334	-147.25429	3	0	0	0	3	0	0	0	0	0	0	0	**60**
Total			**Gear**2					**24**	**0**	**10**	**5**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	

Notes. [1] Site: site number is cumulative for mapping purposes only – each row represents several sites. [2] Occasion: 1=June 15 to July 31, 2=August 1-September 30. [3] Gear Type: E=Electrofish, N=dip net, A=aerial observation, DO=direct observation ground), MT=minnow trap. [3] Fish: total number of fish sampled at each site. Fish species are as follows: K=King/chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*). [5] Median Fish Length=Medians are respective following fish order. *DNC=Did not capture.

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 3A. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in Fivemile Clear Creek, Tanana Flats, Alaska, 2013.

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Coho salmon	*Oncorhynchus kisutch*	J	14	Minnow Trap	14	0.12

*= 2013 capture effort for the Fivemile Clear Creek system is minnow trapping = 119.98 hours and direct observation =4.00 hours.

Table 3B. Fivemile Clear Creek fish totals and length measurements by site and sampling technique for Tanana Flats, Alaska 2013-2014.

Location	Site #	Gear[1]	Date	Easting	Northing	Latitude	Longitude	Fish[2]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB	Median Fish Length (mm)
5MCC	1	MT	8/18/2013	502375	7133921	64.33118	-146.95085	0	0	0	0	0	0	0	0	0	0	0	0	-
5MCC	2	MT	8/18/2013	501992	7134490	64.33630	-146.95877	7	0	7	0	0	0	0	0	0	0	0	0	**70**
5MCC	3	MT	8/18/2013	501762	7135051	64.34133	-146.96352	5	0	5	0	0	0	0	0	0	0	0	0	**71**
5MCC	4	MT	8/18/2013	501518	7135436	64.34479	-146.96857	1	0	1	0	0	0	0	0	0	0	0	0	**100**
5MCC	5	MT	8/18/2013	500851	7135975	64.34962	-146.98238	1	0	1	0	0	0	0	0	0	0	0	0	**55**
Total								**14**	**0**	**14**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

[1] Gear: MT=minnow trap. [2] Fish: total number of fish sampled at each site. Fish species are as follows: K=king/Chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*).

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 4A. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in Dry Creek area, Tanana Flats, Alaska, 2013.

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Slimy sculpin	*Cottus cognatus*	A	1	Dip Net	1	2.000
Unknown**	***Unknown***	J	1	Minnow Trap	1	0.166

*= 2013 capture effort for the Dry Creek system is minnow trapping = 6 hours, direct observation = 12.00 hours, and dip-netting=0.50 hours. ** Unknown spp. was a small fish that slipped through the minnow trap. Technicians described it as as flash of silver.

Table 4B. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in Dry Creek area, Tanana Flats, Alaska, 2014.

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
-	-	-	0	Minnow Trap	0	0.000

*= 2014 capture effort for the Dry Creek system is minnow trapping = 168.39 hours.

Table 4C. Dry Creek area fish totals and length measurements by site, occasion, and sampling technique, Tanana Flats, Alaska 2013-2014.

Location	Site	Gear[1]	Date	Easting	Northing	Latitude	Longitude	Fish[2]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB	UNK	Median Fish Length (mm)
DC	1	MT	7/26/2013	485401	7140880	64.39333	-147.30272	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	2	MT	7/26/2013	485380	7140745	64.39211	-147.30315	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	3	MT	7/26/2013	485371	7140839	64.39296	-147.30336	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	4	MT	7/26/2013	485391	7140956	64.39401	-147.30296	1	0	0	0	0	0	0	0	0	0	0	0	1	**MNT***
DC	5	MT	7/26/2013	485273	7141146	64.39571	-147.30542	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	6	N	9/18/2013	486031	7138847	64.37511	-147.28949	1	0	0	0	1	0	0	0	0	0	0	0	0	**29.5**
DC	7	N	9/18/2013	485632	7138353	64.37066	-147.29771	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	8	N	9/18/2013	485199	7137762	64.36534	-147.30659	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	9	N	9/18/2013	484979	7137305	64.36123	-147.31113	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	10	N	9/18/2013	485145	7136828	64.35696	-147.30764	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	11	N	9/18/2013	484983	7136311	64.35231	-147.31095	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	12	N	9/18/2013	483124	7134331	64.33446	-147.34921	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	13	N	9/18/2013	483419	7134927	64.33982	-147.34317	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	14	N	9/18/2013	484005	7135003	64.34053	-147.33105	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	15	N	9/18/2013	484495	7135468	64.34472	-147.32095	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	16	N	9/18/2013	484739	7135865	64.34830	-147.31595	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	17	MT	7/21/2014	483554	7131503	64.30910	-147.34001	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	18	MT	7/21/2014	483849	7129339	64.28970	-147.33366	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	19	MT	7/29/2014	485243	7136461	64.35366	-147.30569	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	20	MT	7/29/2014	485132	7136317	64.35238	-147.30783	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	21	MT	7/29/2014	484974	7136270	64.35206	-147.31105	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	22	MT	7/29/2014	484836	7136169	64.35107	-147.31381	0	0	0	0	0	0	0	0	0	0	0	0	0	
DC	23	MT	7/29/2014	484699	7136148	64.35082	-147.31670	0	0	0	0	0	0	0	0	0	0	0	0	0	
MC	1	MT	7/21/2014	491005	7132057	64.31435	-147.18899	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total								**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	

Notes: [1] Gear: MT=minnow trap, N=dipnet. [2] Fish: total number of fish sampled at each site. Fish species are as follows: K=King/chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*). MNT*=Measurement not taken.

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Table 5A. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in the Blair Lakes region, Tanana Flats, Alaska, 2013.

Location	Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Blair Lake South	**Northern pike**	*Esox lucius*	A	19	Angling	19	1.76

Notes: *= 2013 capture effort for the Blair Lakes system is minnow trapping = 66.00 hours and angling 10.77 hours

Table 5B. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in the Blair Lakes region, Tanana Flats, Alaska, 2014.

Location	Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Blair Lake South	**Northern pike**	*Esox lucius*	A	14	Angling	14	4.035

Notes: *= 2014 capture effort for the Blair Lakes system is minnow trapping = 96.69 hours and angling 3.47 hours

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 5C. Blair Lakes region fish totals and length measurements by site, occasion, and sampling technique, Tanana Flats, Alaska 2013-2014.

Location	Site	Gear[1]	Date	Easting	Northing	Latitude	Longitude	Fish[2]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB	Median Fish Length (mm)
BLS	1	A	7/23/2013	MNT	MNT	MNT	MNT	1	0	0	0	0	0	0	0	0	1	0	0	**584**
BLS	2	A	7/23/2013	482426	7135908	64.34858	-147.36383	1	0	0	0	0	0	0	0	0	1	0	0	**602**
BLS	3	A	7/23/2013	482495	7135895	64.34846	-147.36241	1	0	0	0	0	0	0	0	0	1	0	0	**580**
BLS	4	A	7/23/2013	482466	7136048	64.34984	-147.36302	1	0	0	0	0	0	0	0	0	1	0	0	**636**
BLS	5	A	7/23/2013	482325	7137055	64.35886	-147.36606	1	0	0	0	0	0	0	0	0	1	0	0	**545**
BLS	6	A	7/23/2013	482062	7137073	64.35901	-147.37151	1	0	0	0	0	0	0	0	0	1	0	0	**550**
BLS	7	A	7/23/2013	482164	7137044	64.35876	-147.36938	1	0	0	0	0	0	0	0	0	1	0	0	**460**
BLS	8	A	7/23/2013	482278	7136998	64.35835	-147.36703	1	0	0	0	0	0	0	0	0	1	0	0	**565**
BLS	9	A	7/23/2013	482091	7137053	64.35883	-147.37093	1	0	0	0	0	0	0	0	0	1	0	0	**605**
BLS	10	A	7/23/2013	482154	7136966	64.35806	-147.36960	1	0	0	0	0	0	0	0	0	1	0	0	**520**
BLS	11	A	7/23/2013	482527	7136747	64.35610	-147.36183	1	0	0	0	0	0	0	0	0	1	0	0	**625**
BLS	12	A	7/23/2013	482489	7136884	64.35734	-147.36264	1	0	0	0	0	0	0	0	0	1	0	0	**530**
BLS	13	A	7/23/2013	482490	7136881	64.35731	-147.36263	1	0	0	0	0	0	0	0	0	1	0	0	**440**
BLS	20	MT	7/25/2013	482765	7137509	64.36295	-147.35701	0	0	0	0	0	0	0	0	0	0	0	0	
BLS	21	MT	7/25/2013	482260	7137230	64.36044	-147.36745	0	0	0	0	0	0	0	0	0	0	0	0	
BLS	22	MT	7/25/2013	481757	7137148	64.35966	-147.37784	0	0	0	0	0	0	0	0	0	0	0	0	
BLS	14	A	9/17/2013	482549	7136056	64.34991	-147.36131	1	0	0	0	0	0	0	0	0	1	0	0	**603**
BLS	15	A	9/18/2013	481194	7135655	64.34624	-147.38931	1	0	0	0	0	0	0	0	0	1	0	0	**560**
BLS	16	A	9/19/2013	481026	7135841	64.34790	-147.39281	1	0	0	0	0	0	0	0	0	1	0	0	**445**
BLS	17	A	9/20/2013	480985	7135942	64.34880	-147.39368	1	0	0	0	0	0	0	0	0	1	0	0	**550**
BLS	18	A	9/21/2013	480978	7136046	64.34973	-147.39383	1	0	0	0	0	0	0	0	0	1	0	0	**530**
BLS	19	A	9/22/2013	480982	7136096	64.35019	-147.39375	1	0	0	0	0	0	0	0	0	1	0	0	**651**
AL	1	MT	9/20/2013	478823	7137847	64.36577	-147.43871	0	0	0	0	0	0	0	0	0	0	0	0	
AL	2	MT	9/20/2013	478462	7138308	64.36988	-147.44626	0	0	0	0	0	0	0	0	0	0	0	0	
BLS	23	A	7/9/2014	481262	7136888	64.35731	-147.38806	1	0	0	0	0	0	0	0	0	1	0	0	**580**
BLS	24	A	7/9/2014	481271	7136907	64.35748	-147.38788	1	0	0	0	0	0	0	0	0	1	0	0	**381**
BLS	25	A	7/9/2014	481448	7136873	64.35719	-147.38420	1	0	0	0	0	0	0	0	0	1	0	0	**519**
BLS	26	A	7/9/2014	481352	7136875	64.35719	-147.38620	1	0	0	0	0	0	0	0	0	1	0	0	**373**
BLS	27	A	7/9/2014	481625	7137053	64.35881	-147.38057	1	0	0	0	0	0	0	0	0	1	0	0	**545**
BLS	28	A	7/9/2014	482257	7137151	64.35972	-147.36749	8	0	0	0	0	0	0	0	0	8	0	0	**490**
BLS	29	A	7/31/2014	482565	7136937	64.35782	-147.36108	0	0	0	0	0	0	0	0	0	0	0	0	
BLN	1	MT	9/15/2014	482765	7137581	64.36293	-147.35704	0	0	0	0	0	0	0	0	0	0	0	0	
BLN	2	MT	9/15/2014	483044	7138736	64.37399	-147.35136	0	0	0	0	0	0	0	0	0	0	0	0	
BLN	3	MT	9/15/2014	482861	7138628	64.37301	-147.35515	0	0	0	0	0	0	0	0	0	0	0	0	
BLN	4	MT	9/15/2014	482649	7137734	64.36497	-147.35942	0	0	0	0	0	0	0	0	0	0	0	0	
AL	4	MT	9/16/2014	478949	7138131	64.36832	-147.43613	0	0	0	0	0	0	0	0	0	0	0	0	
AL	5	MT	9/16/2014	478770	7138151	64.36849	-147.43985	0	0	0	0	0	0	0	0	0	0	0	0	
AL	6	MT	9/16/2014	478628	7138554	64.3721	-147.44284	0	0	0	0	0	0	0	0	0	0	0	0	
AL	7	MT	9/16/2014	479031	7138549	64.37128	-147.43448	0	0	0	0	0	0	0	0	0	0	0	0	
Total								**32**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**32**	**0**	**0**	

Notes: [1]Gear: A=angling, MT=minnow trap. [2] Fish: total number of fish sampled at each site. Fish species are as follows: K=King/chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*).

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 6A. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique for Willow Creek, Tanana Flats, Alaska, 2014

Common Name	Latin Name	Life Stage	Detections	Capture Technique*	Number	CPUE
Slimy sculpin	*Cottus cognatus*	A	1	Minnow Trap	1	0.00519

Notes: *= 2014 capture effort for the Willow Creek system is minnow trapping = 192.5076 hours.

Table 6B. Willow Creek fish totals and length measurements by site, occasion, and sampling technique, Tanana Flats, Alaska, 2014.

Site	Gear[1]	Date	Easting	Northing	Latitude	Longitude	Fish[2]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB	Median Fish Length (mm)
1	MT	6/23/2014	469356	7146580	64.44341	-147.63662	0	0	0	0	0	0	0	0	0	0	0	0	
2	MT	6/23/2014	469572	7146679	64.44431	-147.63216	0	0	0	0	0	0	0	0	0	0	0	0	
3	MT	7/21/2014	468748	7145588	64.43446	-147.64905	0	0	0	0	0	0	0	0	0	0	0	0	
3	MT	7/21/2014	468809	7144696	64.42646	-147.64758	0	0	0	0	0	0	0	0	0	0	0	0	
4	MT	8/18/2014	468757	7145603	64.43459	-147.64886	1	0	0	0	1	0	0	0	0	0	0	0	**83**
4	MT	8/18/2014	468752	7145605	64.43461	-147.64897	0	0	0	0	0	0	0	0	0	0	0	0	
4	MT	8/18/2014	468744	7145591	64.43449	-147.64912	0	0	0	0	0	0	0	0	0	0	0	0	
4	MT	8/18/2014	468740	7145582	64.43440	-147.64922	0	0	0	0	0	0	0	0	0	0	0	0	
Total							**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes: [1] Gear: MT=Minnow Trap [2] Fish: total number of fish sampled at each site. Fish species are as follows: K=king/Chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*).

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 7A. Species richness, life stage, # of detections, and catch per unit effort by species and sampling technique for the Wood River, Tanana Flats, Alaska, 2014.

Common Name	Latin Name	Life Stage**	Detections	Capture Technique*	Number	CPUE
Chinook Salmon	*Oncorhynchus tshawytscha*	A	6	Minnow Trap	6	0.01381
Longnose Sucker	*Catostomus catostomus*	J	16	Minnow Trap	16	0.03682
Lake Chub	*Couesius plumbeus*	A	69	Minnow Trap	69	0.15878
Slimy Sculpin	*Cottus cognatus*	A	1	Minnow Trap	1	0.00230

Notes: *= 2014 capture effort for the Wood River is minnow trapping = 434.54 hours. ** = We considered adult life phase lake chub to be fish that were greater than 50 mm.

Table 7B. Wood River headwater streams species richness, life stage, # of detections, and catch per unit effort by species and sampling technique in the Tanana Flats, Alaska 2014.

Location	Common Name	Latin Name	Life Stage**	Detections	Capture Technique*	Number	CPUE
St. George Creek	Slimy sculpin	*Cottus cognatus*	A	2	Minnow Trap	2	0.01187
Gold King Creek	Slimy sculpin	*Cottus cognatus*	A	1	Minnow Trap	1	0.04162

Notes: *= 2014 capture effort for St. George Creek is minnow trapping = 168.46 hours and Gold King Creek is minnow trapping =24.02 hours.

Tables: Documenting anadromous waters in the Tanana Flats, Alaska, in response to proposed road development

Table 7C. Wood River and Wood River headwater streams (Fish, Gold King, and St. George Creeks) fish totals and length measurements by site, occasion, and sampling technique, Tanana Flats, Alaska, 2014.

Location[1]	Site	Gear Type[2]	Date	Easting	Northing	Latitude	Longitude	FISH[3]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB	Median Fish Length[5] (mm)
FC	1	MT	6/23/2014	443838	7134894	64.33531	-148.16222	0	0	0	0	0	0	0	0	0	0	0	0	-
GKC	1	MT	6/23/2014	450949	7133043	64.3198	-148.01446	0	0	0	0	0	0	0	0	0	0	0	0	-
GKC	2	MT	6/23/2014	451651	7131272	64.30401	-147.99939	0	0	0	0	0	0	0	0	0	0	0	0	-
SGC	1	MT	6/23/2014	447077	7134894	64.33583	-148.09520	0	0	0	0	0	0	0	0	0	0	0	0	-
SGC	2	MT	7/21/2014	447743	7134437	64.33184	-148.08127	1	0	0	0	1	0	0	0	0	0	0	0	**77**
SGC	3	MT	7/21/2014	447790	7133618	64.32450	-148.08000	1	0	0	0	1	0	0	0	0	0	0	0	**80**
WR	1	MT	8/12/2014	421869	7166316	64.61285	-148.63338	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	2	MT	8/12/2014	421867	7166332	64.61301	-148.63344	13	6	0	0	0	0	0	5	0	0	2	0	**79.5, 81, 85**
WR	3	MT	8/12/2014	421577	7165966	64.60966	-148.63930	8	0	0	0	0	0	0	4	0	0	4	0	**57.5, 76.5**
WR	4	MT	8/12/2014	421589	7165976	64.60974	-148.63905	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	5	MT	8/12/2014	422148	7166224	64.61210	-148.62750	24	0	0	0	0	0	0	4	0	0	20	0	**108, 85**
WR	6	MT	8/12/2014	422191	7166307	64.61210	-148.62750	30	0	0	0	0	0	0	2	0	0	28	0	**103, 95**
WR	7	MT	8/12/2014	422430	7166025	64.61037	-148.62151	2	0	0	0	1	0	0	1	0	0	0	0	**44, 84**
WR	8	MT	8/12/2014	422653	7165787	64.60836	-148.61667	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	9	MT	8/13/2014	422699	7165837	64.60874	-148.61591	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	10	MT	8/13/2014	422701	7165867	64.60900	-148.61565	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	11	MT	8/13/2014	422804	7165971	64.60999	-148.61368	13	0	0	0	0	0	0	0	0	0	13	0	**83**
WR	12	MT	8/13/2014	422871	7166044	64.61065	-148.61232	2	0	0	0	0	0	0	1	0	0	1	0	**65, 116**
WR	13	MT	8/13/2014	422863	7166098	64.61114	-148.61249	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	14	MT	8/14/2014	422064	7166172	64.61161	-148.62923	1	0	0	0	0	0	0	0	0	0	1	0	**63**
WR	15	MT	8/14/2014	422129	7166186	64.61176	-148.62787	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	16	MT	8/14/2014	422205	7166130	64.61127	-148.62627	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	17	MT	8/14/2014	422296	7165991	64.61005	-148.62427	0	0	0	0	0	0	0	0	0	0	0	0	-
WR	18	MT	8/14/2014	422424	7165953	64.60973	-148.62158	0	0	0	0	0	0	0	0	0	0	0	0	-
SGC	3	MT	8/18/2014	447776	7133628	64.32462	-148.08015	0	0	0	0	0	0	0	0	0	0	0	0	-
GKC	3	MT	8/18/2014	450943	7133077	64.32010	-148.01460	1	0	0	0	1	0	0	0	0	0	0	0	**77**
Total								**95**	**6**	**0**	**0**	**4**	**0**	**0**	**16**	**0**	**0**	**69**	**0**	-

Notes: [1] Location is WR=Wood River, SGC=St. George Creek, and GKC=Gold King Creek. [2] Gear: MT=Minnow Trap [3] Fish: total number of fish sampled at each site. Fish species are as follows: K=king/Chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*).). [5] Median Fish Length=Medians are respective following fish order.

Appendix 1. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Clear Creek

Table A1-1. Clear Creek sampling sites, Tanana Flats, Alaska, 2013-2014.

Location[1]	Site[2]	Gear[3]	Date	Easting	Northing	Latitude	Longitude	Fish[4]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB
CCE	1	E	6/24/2013	471823	7147301	64.45009	-147.58552	14	0	0	0	7	6	1	0	0	0	0	0
CCE	1	N	6/24/2013	471823	7147301	64.45009	-147.58552	28	28	0	0	0	0	0	0	0	0	0	0
CCE	3	E	6/24/2013	471816	7147311	64.45019	-147.58566	7	3	0	0	0	3	0	1	0	0	0	0
CCE	5	E	6/25/2013	471789	7147460	64.45152	-147.58625	13	0	0	0	11	0	2	0	0	0	0	0
CCE	5	N	6/25/2013	471789	7147460	64.45152	-147.58625	8	8	0	0	0	0	0	0	0	0	0	0
CCE	7	E	6/26/2013	471777	7147152	64.44875	-147.58644	4	0	0	0	2	2	0	0	0	0	0	0
CCE	7	N	6/26/2013	471777	7147152	64.44875	-147.58644	1	1	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	6/26/2013	471822	7147301	64.45010	-147.58554	3	0	0	0	3	0	0	0	0	0	0	0
CCE	3	MT	6/26/2013	471816	7147333	64.45038	-147.58566	1	0	0	0	1	0	0	0	0	0	0	0
CCE	3	MT	6/26/2013	471786	7147357	64.45060	-147.58631	1	1	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	6/26/2013	471771	7147363	64.45064	-147.58662	1	0	0	0	1	0	0	0	0	0	0	0
CCE	3	MT	6/26/2013	471775	7147371	64.45072	-147.58653	5	0	0	0	5	0	0	0	0	0	0	0
CCE	1	MT	6/26/2013	471807	7147277	64.44988	-147.58585	5	0	0	0	5	0	0	0	0	0	0	0
CCE	1	MT	6/26/2013	471793	7147257	64.44970	-147.58612	0	0	0	0	0	0	0	0	0	0	0	0
CCE	1	MT	6/26/2013	471770	7147236	64.44951	-147.58661	0	0	0	0	0	0	0	0	0	0	0	0
CCE	1	MT	6/26/2013	471787	7147197	64.44916	-147.58623	1	0	0	0	1	0	0	0	0	0	0	0
CCE	1	MT	6/26/2013	471775	7147205	64.44923	-147.58649	0	0	0	0	0	0	0	0	0	0	0	0
CCE	9	MT	6/26/2013	471699	7148207	64.45821	-147.58827	1	0	0	0	0	0	0	0	1	0	0	0
CCE	9	MT	6/26/2013	471696	7148205	64.45820	-147.58833	3	0	0	0	3	0	0	0	0	0	0	0
CCE	3	MT	6/27/2013	471822	7147301	64.45010	-147.58554	2	0	0	0	2	0	0	0	0	0	0	0
CCE	3	MT	6/27/2013	471816	7147333	64.45038	-147.58566	6	0	0	0	6	0	0	0	0	0	0	0
CCE	3	MT	6/27/2013	471786	7147357	64.45060	-147.58631	0	0	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	6/27/2013	471771	7147363	64.45064	-147.58662	1	0	0	0	1	0	0	0	0	0	0	0
CCE	3	MT	6/27/2013	471775	7147371	64.45072	-147.58653	1	0	0	0	1	0	0	0	0	0	0	0
CCE	1	MT	6/27/2013	471807	7147277	64.44988	-147.58585	1	0	0	0	1	0	0	0	0	0	0	0
CCE	1	MT	6/27/2013	471793	7147257	64.44970	-147.58612	3	0	0	0	3	0	0	0	0	0	0	0
CCE	1	MT	6/27/2013	471770	7147236	64.44951	-147.58661	3	0	0	0	3	0	0	0	0	0	0	0
CCE	1	MT	6/27/2013	471787	7147197	64.44916	-147.58623	3	0	0	0	3	0	0	0	0	0	0	0
CCE	1	MT	6/27/2013	471775	7147205	64.44923	-147.58649	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472168	7145965	64.43814	-147.57809	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472166	7145968	64.43816	-147.57814	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472158	7146000	64.43845	-147.57830	5	0	0	0	5	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472137	7146013	64.43856	-147.57875	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472152	7146051	64.43891	-147.57845	2	0	0	0	2	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472164	7146066	64.43904	-147.57820	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472155	7146080	64.43917	-147.57838	1	0	0	0	1	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472151	7146117	64.43950	-147.57848	1	0	0	0	1	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472146	7146112	64.43946	-147.57857	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	6/28/2013	472115	7146134	64.43965	-147.57922	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	E	6/28/2013	472161	7145936	64.43788	-147.57824	22	0	0	0	1	14	7	0	0	0	0	0
CCE	8	N	6/29/2013	472164	7146066	64.43904	-147.57820	6	6	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471195	7147454	64.45142	-147.59859	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471200	7147410	64.45102	-147.59849	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471203	7147392	64.45086	-147.59841	1	0	0	0	1	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471189	7147380	64.45075	-147.59870	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471193	7147363	64.45060	-147.59861	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471190	7147327	64.45027	-147.59866	1	0	0	0	1	0	0	0	0	0	0	0

Appendix 1. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Clear Creek

Location[1]	Site[2]	Gear[3]	Date	Easting	Northing	Latitude	Longitude	Fish[4]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB
CCW	2	MT	7/9/2013	471214	7147290	64.44995	-147.59817	1	0	0	0	1	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471220	7147235	64.44946	-147.59803	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471263	7147246	64.44956	-147.59714	2	0	0	0	2	0	0	0	0	0	0	0
CCW	2	MT	7/9/2013	471280	7147198	64.44912	-147.59678	0	0	0	0	0	0	0	0	0	0	0	0
CCE	3	R	7/10/2013	471925	7146866	64.44795	-147.58333	3	2	0	0	0	1	0	0	0	0	0	0
CCE	3	R	7/10/2013	471778	7147031	64.44942	-147.58642	1	1	0	0	0	0	0	0	0	0	0	0
CCE	3	R	7/10/2013	471791	7146951	64.44870	-147.58612	1	1	0	0	0	0	0	0	0	0	0	0
CCE	3	R	7/10/2013	471781	7146958	64.44876	-147.58634	2	2	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471201	7147697	64.45360	-147.59851	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471209	7147745	64.45403	-147.59836	1	0	0	0	1	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471262	7147759	64.45416	-147.59726	2	0	0	0	2	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471278	7147796	64.45449	-147.59695	1	1	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471294	7147822	64.45473	-147.59660	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471337	7147847	64.45495	-147.59573	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471377	7147855	64.45503	-147.59489	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471360	7147914	64.45556	-147.59525	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471384	7147944	64.45583	-147.59478	6	0	0	0	6	0	0	0	0	0	0	0
CCW	4	MT	7/10/2013	471404	7147980	64.45616	-147.59436	1	0	0	0	1	0	0	0	0	0	0	0
CCW	2	E	7/11/2013	471195	7147454	64.45142	-147.59859	2	0	0	0	0	1	1	0	0	0	0	0
CCW	4	N	7/11/2013	471201	7147697	64.45360	-147.59851	3	0	0	0	0	3	0	0	0	0	0	0
CCW	6	E	7/11/2013	471189	7147361	64.45058	-147.59869	13	0	0	0	0	12	1	0	0	0	0	0
CCW	2	N	7/11/2013	471193	7147220	64.45107	-147.59860	3	2	0	0	0	1	0	0	0	0	0	0
CCE	1	MT	8/19/2013	471807	7147277	64.44988	-147.58585	1	1	0	0	0	0	0	0	0	0	0	0
CCE	1	MT	8/19/2013	471793	7147257	64.44970	-147.58612	0	0	0	0	0	0	0	0	0	0	0	0
CCE	1	MT	8/19/2013	471770	7147236	64.44951	-147.58661	0	0	0	0	0	0	0	0	0	0	0	0
CCE	1	MT	8/19/2013	471787	7147197	64.44916	-147.58623	0	0	0	0	0	0	0	0	0	0	0	0
CCE	1	MT	8/19/2013	471775	7147205	64.44923	-147.58649	1	0	0	0	1	0	0	0	0	0	0	0
CCE	3	MT	8/19/2013	471822	7147301	64.45010	-147.58554	0	0	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/19/2013	471816	7147333	64.45038	-147.58566	3	2	0	0	1	0	0	0	0	0	0	0
CCE	3	MT	8/19/2013	471786	7147357	64.45060	-147.58631	0	0	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/19/2013	471771	7147363	64.45064	-147.58662	0	0	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/19/2013	471775	7147371	64.45072	-147.58653	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472168	7145965	64.43814	-147.57809	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472166	7145968	64.43816	-147.57814	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472158	7146000	64.43845	-147.57830	3	3	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472137	7146013	64.43856	-147.57875	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472152	7146051	64.43891	-147.57845	1	0	0	0	1	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472164	7146066	64.43904	-147.57820	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472155	7146080	64.43917	-147.57838	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472151	7146117	64.43950	-147.57848	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472146	7146112	64.43946	-147.57857	1	1	0	0	0	0	0	0	0	0	0	0
CCE	8	MT	8/20/2013	472115	7146134	64.43965	-147.57922	1	1	0	0	0	0	0	0	0	0	0	0
CCE	3	DO	8/20/2013	471929	7146831	64.44588	-147.58322	1	0	0	1	0	0	0	0	0	0	0	0
CCE	3	DO	8/20/2013	472007	7146766	64.44531	-147.58159	1	0	0	1	0	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471195	7147454	64.45142	-147.59859	3	2	0	0	1	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471200	7147410	64.45102	-147.59849	1	1	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471203	7147392	64.45086	-147.59841	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471189	7147380	64.45075	-147.59870	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471193	7147363	64.45060	-147.59861	2	2	0	0	0	0	0	0	0	0	0	0

Appendix 1. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Clear Creek

Location[1]	Site[2]	Gear[3]	Date	Easting	Northing	Latitude	Longitude	Fish[4]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB
CCW	2	MT	8/21/2013	471190	7147327	64.45027	-147.59866	0	0	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471214	7147290	64.44995	-147.59817	1	1	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471220	7147235	64.44946	-147.59803	1	0	0	0	0	0	0	0	0	1	0	0
CCW	2	MT	8/21/2013	471263	7147246	64.44956	-147.59714	2	2	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/21/2013	471280	7147198	64.44912	-147.59678	0	0	0	0	0	0	0	0	0	0	0	0
CCE	8	N	8/21/2013	471198	7147420	64.45286	-147.59854	2	0	0	2	0	0	0	0	0	0	0	0
CCE	9	MT	8/22/2013	471696	7148205	64.45820	-147.58833	0	0	0	0	0	0	0	0	0	0	0	0
CCE	9	MT	8/22/2013	471661	7148207	64.45821	-147.58907	0	0	0	0	0	0	0	0	0	0	0	0
CCE	9	MT	8/22/2013	471649	7148274	64.45881	-147.58932	0	0	0	0	0	0	0	0	0	0	0	0
CCE	9	MT	8/22/2013	471659	7148304	64.45908	-147.58912	0	0	0	0	0	0	0	0	0	0	0	0
CCE	9	MT	8/22/2013	471617	7148352	64.45951	-147.58999	1	1	0	0	0	0	0	0	0	0	0	0
CCM	10	MT	8/22/2013	471503	7148382	64.45977	-147.59236	0	0	0	0	0	0	0	0	0	0	0	0
CCM	10	MT	8/22/2013	471528	7148426	64.46017	-147.59187	2	1	0	0	0	0	0	0	0	1	0	0
CCM	10	MT	8/22/2013	471542	7148468	64.46054	-147.59160	1	1	0	0	0	0	0	0	0	0	0	0
CCM	10	MT	8/22/2013	471580	7148523	64.46104	-147.59082	1	1	0	0	0	0	0	0	0	0	0	0
CCM	10	MT	8/22/2013	471624	7148524	64.46106	-147.58989	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	DO	8/22/2013	471191	7147633	64.45302	-147.59871	1	0	0	1	0	0	0	0	0	0	0	0
CCW	4	DO	8/22/2013	471383	7147932	64.45572	-147.59477	1	0	0	1	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471201	7147697	64.45360	-147.59851	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471209	7147745	64.45403	-147.59836	1	1	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471262	7147759	64.45416	-147.59726	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471278	7147796	64.45449	-147.59695	1	1	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471294	7147822	64.45473	-147.59660	4	4	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471337	7147847	64.45495	-147.59573	1	1	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471377	7147855	64.45503	-147.59489	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471360	7147914	64.45556	-147.59525	1	1	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471384	7147944	64.45583	-147.59478	1	1	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/23/2013	471404	7147980	64.45616	-147.59436	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	DO	8/23/2013	471195	7147566	64.45242	-147.59862	1	0	0	1	0	0	0	0	0	0	0	0
CCW	4	DO	8/23/2013	471234	7147746	64.45404	-147.59785	1	0	0	1	0	0	0	0	0	0	0	0
CCE	12	A	7/11/2014	474125	7139580	64.38100	-147.53633	3	3	0	0	0	0	0	0	0	0	0	0
CCE	13	A	7/11/2014	473935	7140009	64.38483	-147.54033	1	1	0	0	0	0	0	0	0	0	0	0
CCE	14	A	7/11/2014	473711	7141033	64.39400	-147.54517	1	1	0	0	0	0	0	0	0	0	0	0
CCE	12	A	7/20/2014	474125	7139580	64.38100	-147.53633	1	1	0	0	0	0	0	0	0	0	0	0
CCE	1	MT	7/20/2014	471338	7148273	64.45878	-147.59578	5	5	0	0	0	0	0	0	0	0	0	0
CCE	11	MT	8/18/2014	472635	7144611	64.42603	-147.56815	35	31	0	0	4	0	0	0	0	0	0	0
CCE	11	MT	8/18/2014	472643	7144605	64.42597	-147.56798	4	4	0	0	0	0	0	0	0	0	0	0
CCE	11	MT	8/18/2014	472646	7144593	64.42587	-147.56792	2	2	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471201	7147697	64.45360	-147.59851	5	5	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471209	7147745	64.45403	-147.59836	29	29	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471262	7147759	64.45415	-147.59726	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471278	7147796	64.45449	-147.59694	6	5	0	0	0	0	0	0	0	1	0	0
CCW	4	MT	8/26/2014	471294	7147822	64.45473	-147.59660	15	15	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471337	7147855	64.45496	-147.59572	1	1	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471377	7147855	64.45503	-147.59489	0	0	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471360	7147914	64.45556	-147.59526	47	47	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471384	7147944	64.45583	-147.59476	34	34	0	0	0	0	0	0	0	0	0	0
CCW	4	MT	8/26/2014	471404	7147980	64.45615	-147.59436	8	8	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/27/2014	471194	7147458	64.45142	-147.59860	3	3	0	0	0	0	0	0	0	0	0	0

Appendix 1. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Clear Creek

Location[1]	Site[2]	Gear[3]	Date	Easting	Northing	Latitude	Longitude	Fish[4]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB
CCW	2	MT	8/27/2014	471200	7147410	64.45102	-147.59848	11	10	0	0	1	0	0	0	0	0	0	0
CCW	2	MT	8/27/2014	471203	7147392	64.45086	-147.59842	5	4	0	0	1	0	0	0	0	0	0	0
CCW	2	MT	8/27/2014	471189	7147380	64.45075	-147.59871	9	9	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/27/2014	471193	7147363	64.45060	-147.59862	7	7	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/27/2014	471190	7147327	64.45028	-147.59868	9	9	0	0	0	0	0	0	0	0	0	0
CCW	2	MT	8/27/2014	471214	7147290	64.44994	-147.59818	40	40	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/28/2014	471822	7147301	64.45010	-147.58554	3	3	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/28/2014	471816	7147333	64.45403	-147.59836	4	4	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/28/2014	471786	7147357	64.45415	-147.59726	2	2	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/28/2014	471771	7147363	64.45449	-147.59694	2	2	0	0	0	0	0	0	0	0	0	0
CCE	3	MT	8/28/2014	471775	7147371	64.45473	-147.59660	1	1	0	0	0	0	0	0	0	0	0	0
CC	15	MT	9/15/2014	477166	7135053	64.34059	-147.47260	0	0	0	0	0	0	0	0	0	0	0	0
CC	15	MT	9/15/2014	477148	7135045	64.34052	-147.47298	0	0	0	0	0	0	0	0	0	0	0	0
CC	15	MT	9/15/2014	477199	7135050	64.34057	-147.47192	0	0	0	0	0	0	0	0	0	0	0	0
CC	15	MT	9/15/2014	477212	7135045	64.34052	-147.47165	0	0	0	0	0	0	0	0	0	0	0	0
CC	15	MT	9/15/2014	477226	7135051	64.34058	-147.47136	0	0	0	0	0	0	0	0	0	0	0	0
Total								**533**	**371**	**0**	**8**	**94**	**43**	**12**	**1**	**1**	**3**	**0**	**0**

Notes: [1] Location: CCW=west stem of Clear Creek; CCE=east stem of Clear Creek; CCM=main stem of Clear Creek. [2] Site: site number is cumulative for mapping purposes only – each row represents an individual site. [3] Gear Type: E=Electrofish, N=dip net, A=aerial observation, DO=direct observation ground), MT=minnow trap. [4] Fish: total number of fish sampled at each site. Fish species are as follows: K=King/chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*).

Appendix 1. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Clear Creek

Table A1-2. Aquatic habitat measurements for fish sampling sites on Clear Creek in the Tanana Flats, Alaska, 2013-2014.

Site	Date	Conductivity (µS/cm)	pH	Temp (°C)	DO[1] (mg/dl)	Stream Stage	Water Color	Width of Channel (m)	Ordinary High Water[2] (m)	Water Depth (m)
8	6/28/2013	368.0	7.83	10.1	10.19	Average	Clear	5.05	1.17	0.41
7	6/29/2013	366.0	7.72	11.3	10.02	Average	Clear	6.25	0.97	MNT**
5	6/29/2013	363.0	7.80	11.9	9.85	Average	Clear	8.43	0.97	MNT
1	6/25/2013	357.0	7.63	13.8	9.44	Average	Clear	8.23	0.97	0.64
3	6/27/2013	364.0	7.83	12.0	9.51	Average	Clear	8.69	1.04	0.56
2	7/11/2013	336.0	7.70	9.8	10.47	Average	Clear	8.10	1.12	0.53
4	7/11/2013	326.0	6.83	8.5	10.60	Average	Clear	8.74	0.89	0.46
6	7/11/2013	334.0	7.21	10.0	10.17	Average	Clear	8.59	0.84	MNT
Confluence*	8/23/2013	350.0	7.28	9.2	10.48	High	Clear	7.93	0.61	0.99
CCW crossing	8/23/2013	331.0	7.82	6.7	11.17	High	Clear	5.49	0.91	0.79
CCE crossing	8/23/2013	355.0	8.00	6.7	10.96	High	Clear	6.10	0.91	0.33
1	7/21/2014	353.0	7.86	8.7	10.99	Average	Clear	6.10	MNT	0.51
11	8/18/2014	383.0	7.79	9.1	11.40	Average	Clear	13.05	0.94	0.33
4	8/26/2014	369.0	7.93	11.2	8.00	Average	Clear	3.35	0.61	0.61
4	8/26/2014	364.0	8.03	8.1	11.00	Average	Clear	4.57	0.61	0.61
4	8/26/2014	363.0	8.14	8.5	11.20	Average	Clear	4.57	0.61	0.61
2	8/27/2014	364.0	8.09	8.8	11.25	Average	Clear	6.40	0.51	0.51
2	8/27/2014	367.0	8.40	8.8	11.34	Average	Clear	9.27	0.61	0.61
3	8/28/2014	386.0	8.15	7.6	11.83	Average	Clear	4.32	0.91	0.91
3	8/28/2014	390.0	8.22	7.7	11.76	Average	Clear	6.53	1.07	1.07
15	9/15/2014	173.9	6.83	6.7	4.22	Average	Ferric	3.35	Wetland	0.15
15	9/15/2014	156.7	6.77	7.3	4.22	Average	Ferric	0.30	Wetland	0.25

Notes: [1]**DO**=Dissolved Oxygen. [2]**Ordinary High Water**=Bank full mark. ***Confluence**=confluence of east and west forks upstream from trail crossing. **CCW crossing**=Clear Creek Assault Strip trail crossing on west fork of Clear Creek. **CCE crossing**=Clear Creek Assault Strip trail crossing on east fork of Clear Creek. **MNT=measurement not taken.

Appendix 1. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Clear Creek

Table A1-3. Juvenile salmon rearing habitat sites for detection study in Clear Creek, Tanana Flats, Alaska, 2013.

Stream	Latitude(N)	Longitude(W)	Site	Visit 1 (7/9 to 7/10)	Visit 2 (7/10 to 7/11)	Visit 3 (8/20)
East Fork	64.45007	-147.58563	ER1	1*	1*	0*
	64.44988	-147.58581	ER2	1	1	0
	64.44968	-147.58653	ER3	1	1	0
	64.44966	-147.58664	ER4	1	1	0
	64.44941	-147.58642	ER5	1	1	0
	64.44926	-147.58651	ER6	1	1	0
	64.44920	-147.58658	ER7	1	1	0
	64.44910	-147.58657	ER8	1	1	1
	64.44899	-147.58667	ER9	1	1	0
	64.44886	-147.58655	ER10	1	1	0
	64.44876	-147.58634	ER11	1	1	0
	64.44869	-147.58611	ER12	1	1	0
	64.44852	-147.58616	ER13	1	1	0
	64.44839	-147.58608	ER14	1	1	0
	64.44822	-147.58578	ER15	0	0	0
	64.44819	-147.58544	ER16	0	0	0
	64.44832	-147.58510	ER17	1	1	0
	64.44823	-147.58462	ER18	1	1	0
	64.44813	-147.58444	ER19	1	1	0
	64.44789	-147.58418	ER20	1	1	0
	64.44787	-147.58385	ER21	1	1	0
	64.44794	-147.58333	ER22	1	1	0
	64.44798	-147.58280	ER23	1	1	0
	64.44772	-147.58268	ER24	1	1	0
	64.44758	-147.58307	ER25	1	1	0
	64.44731	-147.58312	ER26	1	1	0
	64.44751	-147.58212	ER27	1	1	0
	64.44715	-147.58220	ER28	1	1	0
	64.44697	-147.58227	ER29	0	0	0
	64.44654	-147.58258	ER30	0	0	0
	64.44626	-147.58317	ER31	1	1	0
	64.44613	-147.58350	ER32	0	0	0
	64.44577	-147.58384	ER33	1	1	0
	64.44563	-147.58345	ER34	1	1	0
	64.44561	-147.58267	ER35	0	0	0
	64.44545	-147.58233	ER36	1	1	0
	64.44532	-147.58114	ER37	1	1	0
	64.44479	-147.58104	ER38	1	1	0
	64.44450	-147.58096	ER39	0	0	0
	64.44365	-147.58109	ER40	1	1	0
	64.44354	-147.58094	ER41	1	1	0
	64.44327	-147.57993	ER42	1	1	0
	64.44288	-147.57816	ER43	0	0	0
	64.44241	-147.57800	ER44	1	1	0

Appendix 1. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Clear Creek

Stream	Latitude(N)	Longitude(W)	Site	Visit 1 (7/9 to 7/10)	Visit 2 (7/10 to 7/11)	Visit 3 (8/20)
	64.44204	-147.57736	ER45	1	1	0
	64.44175	-147.57773	ER46	1	1	0
	64.44134	-147.57882	ER47	0	0	0
	64.44098	-147.57739	ER48	1	1	0
	64.44076	-147.57804	ER49	1	1	0
	64.44061	-147.57845	ER50	1	1	0
	64.44069	-147.57916	ER51	1	1	0
	64.44034	-147.58003	ER52	1	1	0
	64.43982	-147.57924	ER53	0	0	0
West Fork	64.45125	-147.59833	WR1	0	0	0
	64.45106	-147.59860	WR2	0	0	0
	64.45078	-147.59855	WR3	0	0	0
	64.45042	-147.59867	WR4	0	0	0
	64.45014	-147.59875	WR5	0	0	0
	64.44942	-147.59771	WR6	0	0	0
	64.44934	-147.59690	WR7	0	0	0
	64.45175	-147.59869	WR8	0	0	0
	64.45229	-147.59930	WR9	0	0	0
	64.45239	-147.59892	WR10	0	0	0
	64.45284	-147.59847	WR11	1	1	0
	64.45299	-147.59875	WR12	0	0	0
	64.45374	-147.59871	WR13	0	0	0
	64.45402	-147.59775	WR14	1	1	0
	64.45437	-147.59717	WR15	0	0	0
	64.45479	-147.59610	WR16	0	0	0
	64.45493	-147.59552	WR17	0	0	0
	64.45523	-147.59489	WR18	0	0	0
	64.45594	-147.59472	WR19	0	0	0
	64.45660	-147.59424	WR20	0	0	0
	64.45675	-147.59462	WR21	0	0	0
	64.45695	-147.59412	WR22	0	0	0
	64.45748	-147.59448	WR23	0	0	0
	64.45795	-147.59526	WR24	0	0	0
	64.45836	-147.59594	WR25	0	0	0
	64.45860	-147.59441	WR26	0	0	0
	64.45915	-147.59344	WR27	0	0	0
	64.45960	-147.59246	WR28	0	0	0
Total			**81**			

Notes: * 1=Juvenile salmon detected (greater than or equal to one individual), 0=Juvenile salmon not detected (no individuals detected).

Appendix 2. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Bear Creek

Table A2-1. Bear Creek sites sampled during Tanana Flats fish surveys, Alaska, 2013-2014.

Location	Site	Gear[1]	Date	Easting	Northing	Latitude	Longitude	Fish[2]	KS	CO	CH	SLS	AG	RW	LNS	AL	NOPI	LKC	AB
BC	1	MT	6/26/2013	484324	7167201	64.62947	-147.32790	1	0	0	0	1	0	0	0	0	0	0	0
BC	1	MT	6/26/2013	484324	7167199	64.62947	-147.32790	1	0	0	0	1	0	0	0	0	0	0	0
BC	2	MT	6/26/2013	484906	7165548	64.61466	-147.31555	1	0	0	0	1	0	0	0	0	0	0	0
BC	3	MT	6/26/2013	486468	7164621	64.60641	-147.28281	0	0	0	0	0	0	0	0	0	0	0	0
BC	4	MT	6/26/2013	486796	7163402	64.59548	-147.27583	0	0	0	0	0	0	0	0	0	0	0	0
BC	5	MT	6/26/2013	486672	7162798	64.59006	-147.27383	0	0	0	0	0	0	0	0	0	0	0	0
BC	6	MT	6/26/2013	487230	7162728	64.58945	-147.26671	1	0	0	0	1	0	0	0	0	0	0	0
BC	7	MT	6/26/2013	487739	7162283	64.58548	-147.25604	0	0	0	0	0	0	0	0	0	0	0	0
BC	8	MT	6/26/2013	487708	7161802	64.58116	-147.25665	0	0	0	0	0	0	0	0	0	0	0	0
BC	1	MT	8/18/2013	484351	7167244	64.62986	-147.32733	0	0	0	0	0	0	0	0	0	0	0	0
BC	2	MT	8/18/2013	484908	7165546	64.61465	-147.31549	0	0	0	0	0	0	0	0	0	0	0	0
BC	4	MT	8/18/2013	486491	7164765	64.60770	-147.28233	0	0	0	0	0	0	0	0	0	0	0	0
BC	6	MT	8/18/2013	487224	7162746	64.58962	-147.26683	1	0	1	0	0	0	0	0	0	0	0	0
BC	8	MT	8/18/2013	487720	7161758	64.58077	-147.25639	1	0	1	0	0	0	0	0	0	0	0	0
BC	3	DO	8/18/2013	486457	7164753	64.60759	-147.28304	1	0	0	1	0	0	0	0	0	0	0	0
BC	9	DO	8/18/2013	487707	7161790	64.58105	-147.25668	4	0	0	4	0	0	0	0	0	0	0	0
BC	1	MT	9/18/2013	484324	7167200	64.62947	-147.32790	2	0	2	0	0	0	0	0	0	0	0	0
BC	2	MT	9/18/2013	484906	7165547	64.61466	-147.31555	0	0	0	0	0	0	0	0	0	0	0	0
BC	3	MT	9/18/2013	486468	7164620	64.60641	-147.28281	0	0	0	0	0	0	0	0	0	0	0	0
BC	4	MT	9/18/2013	486796	7163401	64.59548	-147.27583	0	0	0	0	0	0	0	0	0	0	0	0
BC	5	MT	9/18/2013	486672	7162797	64.59006	-147.27383	0	0	0	0	0	0	0	0	0	0	0	0
BC	6	MT	9/18/2013	487230	7162727	64.58945	-147.26671	1	0	1	0	0	0	0	0	0	0	0	0
BC	7	MT	9/18/2013	487739	7162282	64.58548	-147.25604	0	0	0	0	0	0	0	0	0	0	0	0
BC	8	MT	9/18/2013	487708	7161801	64.58116	-147.25665	4	0	3	0	0	0	0	0	0	0	0	1
BC	8	MT	9/19/2013	487708	7161802	64.58116	-147.25665	0	0	0	0	0	0	0	0	0	0	0	0
BC	7	MT	9/19/2013	487739	7162283	64.58548	-147.25604	1	0	1	0	0	0	0	0	0	0	0	0
BC	6	MT	9/19/2013	487230	7162728	64.58945	-147.26671	0	0	0	0	0	0	0	0	0	0	0	0
BC	5	MT	9/19/2013	486672	7162798	64.59006	-147.27383	1	0	1	0	0	0	0	0	0	0	0	0
BC	4	MT	9/19/2013	486796	7163402	64.59548	-147.27583	0	0	0	0	0	0	0	0	0	0	0	0
BC	3	MT	9/19/2013	486468	7164621	64.60641	-147.28281	0	0	0	0	0	0	0	0	0	0	0	0
BC	2	MT	9/19/2013	484906	7165548	64.61466	-147.31555	0	0	0	0	0	0	0	0	0	0	0	0
BC	1	MT	9/19/2013	484324	7167199	64.62947	-147.32790	1	0	0	0	1	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	487717	7161749	64.58076	-147.25639	0	0	0	0	0	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	487825	7162053	64.58334	-147.25429	1	0	0	0	1	0	0	0	0	0	0	0
BC	10	MT	6/23/2014	487751	7162285	64.58548	-147.25578	0	0	0	0	0	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	487488	7162387	64.58640	-147.26129	1	0	0	0	1	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	487237	7162525	64.58762	-147.26648	0	0	0	0	0	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	487205	7162754	64.58958	-147.26682	0	0	0	0	0	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	487073	7162956	64.59140	-147.26962	0	0	0	0	0	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	486899	7163031	64.59216	-147.27364	1	0	0	0	1	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	486868	7162985	64.59174	-147.27429	0	0	0	0	0	0	0	0	0	0	0	0
BC	10	MT	6/24/2014	486812	7163001	64.59188	-147.27545	0	0	0	0	0	0	0	0	0	0	0	0
BC	9	MT	7/21/2014	487708	7161810	64.58123	-147.25665	0	0	0	0	0	0	0	0	0	0	0	0
BC	5	MT	7/21/2014	486638	7162855	64.59057	-147.27910	0	0	0	0	0	0	0	0	0	0	0	0
Total								**24**	**0**	**10**	**5**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**1**

Notes. [1] Gear Type: E=Electrofish, N=dip net, A=aerial observation, DO=direct observation ground, MT=minnow trap. [2] Fish: total number of fish sampled at each site. Fish species are as follows: K=king/Chinook salmon (*Oncorhynchus tshawytscha*), CO=coho salmon (*Oncorhynchus kisutch*), CH=chum salmon (*Oncorhynchus keta*), SLS=slimy sculpin (*Cottus cognatus*), AG=arctic grayling (*Thymallus arcticus*), RW=round whitefish (*Prosopium cylindraceum*), LNS=longnose sucker (*Catostomus catostomus*), AL=arctic lamprey (*Lampetra camtschatica*), NOPI=northern pike (*Esox Lucius*), LKC=lake chub (*Couesius plumbeus*), and AB=Alaska blackfish (*Dallia pectoralis*).

Appendix 2. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Bear Creek

Table A2-2. Aquatic habitat measurements for fish sampling sites on Bear Creek in the Tanana Flats, Alaska, 2013-2014.

Site	Date	Conductivity (µS/cm)	pH	Temp (°C)	DO[1] (mg/dl)	Stream Stage	Water Color	Width Channel (m)	Ordinary High Water[2] (m)	Water Depth (m)
1	9/19/2013	250.0	8.15	1.3	8.35	Average	Clear	40	UTD	0.965
2	9/19/2913	286.0	8.00	1.3	9.96	Average	Clear	28	UTD	0.787
3	9/19/2013	287.0	7.96	1.6	9.61	Average	Clear	26	UTD	0.813
4	9/19/2013	288.0	8.25	2.2	9.53	Average	Clear	30	UTD	1.219
5	9/19/2013	291.0	7.95	1.2	9.05	Average	Clear	34	UTD	1.219
6	9/19/2013	289.0	7.97	2.3	9.51	Average	Clear	9	UTD	0.584
7	9/19/2013	287.0	7.75	1.1	9.1	Average	Clear	20	UTD	0.813
8	9/19/2013	298.0	7.02	1.5	9.53	Average	Clear	29	UTD	0.559
9	6/24/2014	304.0	7.20	5.3	8.12	Average	Clear	4.57	Wetland	0.51
10	6/24/2014	303.0	7.42	3.3	8.28	Average	Clear	3.05	Wetland	0.51
10	6/24/2014	289.0	7.32	3.6	7.98	Average	Clear	4.57	Wetland	0.33
10	6/24/2014	291.0	7.48	4.3	7.52	Average	Clear	7.32	Wetland	0.61
10	6/24/2014	292.0	7.27	4.1	7.94	Average	Clear	4.57	Wetland	1.01
10	6/24/2014	289.0	7.30	4.2	8.40	Average	Clear	6.10	Wetland	0.30
10	6/24/2014	291.0	7.36	4.0	8.53	Average	Clear	6.10	Wetland	0.61
10	6/24/2014	290.0	7.29	4.0	8.65	Average	Clear	4.57	Wetland	0.61
10	6/24/2014	289.0	7.34	3.9	8.75	Average	Clear	6.10	Wetland	0.51
10	6/24/2014	292.0	7.30	3.9	8.81	Average	Clear	7.32	Wetland	0.51
8	7/21/2014	306.0	6.82	4.2	8.86	Average	Clear	5.69	Wetland	0.30
5	7/21/2014	292.0	6.84	5.6	7.53	Average	Tannic	2.44	Wetland	0.30

Notes: [1]**DO=**Dissolved Oxygen. [2]**Ordinary High Water**=Bank full mark. *UTD=unable to determine from current circumstances.

Appendix 3. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Fivemile Clear Creek

Table A3-1. Aquatic habitat measurements for fish sampling sites on Fivemile Clear Creek in the Tanana Flats, Alaska, 2013.

Site	Date	Conductivity (µS/cm)	pH	Temp (°C)	DO[1] (mg/dl)	Stream Stage	Water Color	Width Channel (m)	Ordinary High Water[2] (m)	Water Depth (m)
1	8/18/13	MNT*	MNT	MNT	MNT	Average	Clear	MNT	MNT	MNT
2	8/18/13	MNT	MNT	MNT	MNT	Average	Clear	MNT	MNT	MNT
3	8/18/13	MNT	MNT	MNT	MNT	Average	Clear	MNT	MNT	MNT
4	8/18/13	MNT	MNT	MNT	MNT	Average	Clear	MNT	MNT	MNT
5	8/18/13	MNT	MNT	MNT	MNT	Average	Clear	MNT	MNT	MNT

Notes: [1]**DO=**Dissolved Oxygen. [2]**Ordinary High Water**=Bank full mark. *MNT = measurement not taken.

Appendix 4. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Dry Creek

Table A4-1. Aquatic habitat measurements for fish sampling sites on Dry Creek area in the Tanana Flats, Alaska, 2013-2014.

Location	Site	Date	Conductivity (µS/cm)	pH	Temp (°C)	DO[1] (mg/dl)	Stream Stage	Water Color	Width of Channel (m)	Substrate	Ordinary High Water[2] (m)	Water Depth (m)
DC	1	7/26/2013	467	8.05	15.70	9.16	High	Glacial	4.57	Cobble/Sand/Silt	1.167	MNT*
DC	6	9/17/2013	603	6.92	2.40	12.14	Average	Glacial	17.98	Cobble/Sand/Silt	UTD*	0.254
DC	7	9/17/2013	605	6.71	2.60	12.00	Average	Glacial	10.97	Cobble/Sand/Silt	UTD	0.152
DC	8	9/17/2013	619	6.88	3.40	11.62	Average	Glacial	14.94	Cobble/Sand/Silt	UTD	0.356
DC	9	9/17/2013	609	7.20	4.10	11.36	Average	Glacial	18.59	Cobble/Sand/Silt	UTD	0.178
DC	10	9/17/2013	618	7.04	4.80	11.34	Average	Glacial	20.42	Cobble/Sand/Silt	UTD	0.178
DC	11	9/17/2013	626	7.21	5.30	11.10	Average	Glacial	17.98	Cobble/Sand/Silt	UTD	0.203
DC	12	9/18/2013	669	6.93	2.90	12.15	Average	Glacial	30.48	Cobble/Sand/Silt	UTD	0.203
DC	13	9/18/2013	661	7.35	3.40	11.97	Average	Glacial	24.69	Cobble/Sand/Silt	UTD	0.279
DC	14	9/18/2013	650	7.58	4.50	11.55	Average	Glacial	30.78	Cobble/Sand/Silt	UTD	0.406
DC	15	9/18/2013	634	7.63	5.00	11.00	Average	Glacial	49.68	Cobble/Sand/Silt	UTD	0.203
DC	16	9/18/2013	636	7.99	5.10	11.45	Average	Glacial	20.42	Cobble/Sand/Silt	UTD	0.152
DC	17	7/21/2014	613	7.78	9.30	10.58	Average	Glacial	10.97	Cobble/Sand/Silt	UTD	0.660
DC	18	7/21/2014	604	6.95	9.30	11.00	Average	Glacial	9.75	Cobble/Sand/Silt	UTD	0.560
DC	19	7/29/2014	598	6.88	10.50	10.63	Average	Glacial	6.10	Cobble/Sand/Silt	UTD	0.330
DC	20	7/29/2014	606	7.61	10.70	10.60	Average	Glacial	9.14	Cobble/Sand/Silt	UTD	0.200
DC	21	7/29/2014	605	7.82	11.50	10.57	Average	Glacial	16.15	Cobble/Sand/Silt	UTD	0.200
DC	22	7/29/2014	605	7.55	11.50	10.45	Average	Glacial	2.13	Cobble/Sand/Silt	UTD	0.130
DC	23	7/29/2014	608	7.90	11.50	10.46	Average	Glacial	7.92	Cobble/Sand/Silt	UTD	0.100
MC	1	7/21/2014	202	7.21	5.20	11.58	Average	Clear	2.74	Silt	0.609	0.304

Notes: [1]**DO**=Dissolved Oxygen. [2]**Ordinary High Water**=Bank full mark. *MNT=measurement not taken. *UTD=unable to determine from current circumstances.

Appendix 5. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Blair Lakes and Ann Lake

Table A5-1. Aquatic habitat measurements for fish sampling sites for Blair Lakes and Ann Lake in the Tanana Flats, Alaska, 2013-2014

Location[1]	Site	Obs. ID	Date	Conductivity (µS/cm)	pH	Water Temp (°C)	DO[2] (mg/dl)	Stream Stage	Water Color	Type of Stream	Width of Channel (m)	Streambed substrate	Ordinary high water[3] (m)	Water Depth (m)
BLS	21	BL21MT1	7/25/2013	226.0	8.40	21.9	8.68	Average	Clear	Lake	na	Sand/Cobble	UTD*	MNT**
BLS	22	BL31MT2	7/25/2013	222.0	8.68	20.4	9.35	Average	Clear	Lake	na	Silt/Vegetation	UTD	MNT
BLS	20	BL11MT1	7/25/2013	208.7	7.60	20.4	3.12	Average	Tannic	Lake	na	Silt	UTD	MNT
AL	1	AL12MT1	9/20/2013	259.0	7.83	4.3	11.58	Average	Tannic	Lake	na	Vegetation	UTD	MNT
AL	2	AL22MT2	9/20/2013	258.0	8.53	6.4	11.29	Average	Tannic	Lake	na	Vegetation	UTD	MNT
BLN	1	NBL11MT1	9/15/2014	169.9	7.05	10.9	10.70	Average	Tannic	Lake	6.10	Vegetation	UTD	0.91
BLN	2	NBL11MT2	9/15/2014	169.9	7.05	10.9	10.70	Average	Tannic	Lake	na	Vegetation	UTD	0.61
BLN	3	NBL11MT3	9/15/2014	169.9	7.05	10.9	10.70	Average	Tannic	Lake	na	Vegetation	UTD	0.61
BLN	4	NBL11MT4	9/15/2014	169.9	7.05	10.9	10.70	Average	Tannic	Lake	na	Vegetation	UTD	0.30
AL	3	AL11MT1	9/16/2014	286.0	8.51	10.6	10.36	Average	Clear	Lake	na	Vegetation	UTD	1.22
AL	4	AL11MT2	9/16/2014	286.0	8.51	10.6	10.36	Average	Clear	Lake	na	Vegetation	UTD	1.22
AL	5	AL11MT3	9/16/2014	286.0	8.51	10.6	10.36	Average	Clear	Lake	na	Vegetation	UTD	1.22
AL	6	AL11MT4	9/16/2014	286.0	8.51	10.6	10.36	Average	Clear	Lake	na	Vegetation	UTD	1.22

Notes: [1]Location: BLS=Blair Lake South, BLN=Blair Lake North, AL=Ann Lake. [2]DO=Dissolved Oxygen. [3]Ordinary High Water=Bank full mark. *UTD=unable to determine from current circumstances. **MNT=measurement not taken.

Appendix 6. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Willow Creek

Table A6-1. Aquatic habitat measurements for fish sampling sites on Willow Creek in the Tanana Flats, Alaska, 2014.

Site	Date	Conductivity (µS/cm)	pH	Temp (°C)	DO[1] (mg/dl)	Stream Stage	Water Color	Width Channel (m)	Stream Substrate	Ordinary high water[2] (m)	Water Depth (m)
1	6/23/2014	285.0	7.41	10.9	8.85	Average	Tannic	6.10	Muck	1.07	UTD*
2	6/23/2014	302.0	7.45	12.0	4.46	Average	Tannic	7.62	Muck	0.46	UTD
3	7/21/2014	343.0	8.07	7.5	11.95	Average	Clear	4.57	Cobble/Silt	0.61	0.63
3	7/21/2014	344.0	7.95	7.5	11.64	Average	Clear	5.79	Cobble/Silt	0.30	0.30
4	8/18/2014	346.0	8.27	8.8	12.00	Average	Clear	6.10	Muck	0.76	0.46

Notes: [1]DO=Dissolved Oxygen. [2]Ordinary High Water=Bank full stage. *UTD=unable to determine from current circumstances.

Appendix 7. Tanana Flats Stream Sampled Areas and Aquatic Habitat Measurements – Wood River and Wood River Area Creeks

Table A7-1. Aquatic habitat measurements for fish sampling sites on Wood River and Wood River headwater streams in the Tanana Flats, Alaska, 2014.

Location[1]	Site	Date	Conductivity (µS/cm)	pH	Temp (°C)	DO[2] (mg/dl)	Stream Stage	Water Color	Width Channel (m)	Ordinary High Water[3] (m)	Water Depth (m)
WR	1	8/12/2014	551.0	7.06	11.4	6.28	Average	Glacial	0.61	0.46	0.91
WR	2	8/12/2014	551.0	7.06	11.4	6.28	Average	Glacial	0.61	0.46	0.91
WR	3	8/12/2014	501.0	7.98	14.4	9.84	Average	Glacial	21.34	0.61	0.46
WR	4	8/12/2014	501.0	7.98	14.4	9.84	Average	Glacial	21.34	0.61	0.46
WR	5	8/12/2014	444.0	7.20	18.6	6.86	Average	Glacial	1.22	0.61	0.46
WR	6	8/12/2014	444.0	7.20	18.6	6.86	Average	Glacial	1.22	0.61	0.46
WR	7	8/12/2014	390.0	7.60	21.1	8.52	Low	Tannic	3.05	MNT*	0.76
WR	8	8/13/2014	498.0	8.11	16.3	9.75	Average	Tannic	21.34	MNT	1.22
WR	9	8/13/2014	495.0	7.99	16.0	9.83	Average	Tannic	15.24	MNT	0.46
WR	10	8/13/2014	495.0	7.96	15.9	9.89	Average	Glacial	16.76	MNT	0.46
WR	11	8/13/2014	498.0	7.95	16.8	9.68	Average	Glacial	15.24	MNT	0.15
WR	12	8/13/2014	496.0	8.14	16.4	9.80	Average	Glacial	15.24	MNT	0.23
WR	13	8/13/2014	491.0	7.68	16.6	9.65	Average	Glacial	10.67	MNT	0.20
WR	14	8/14/2014	496.0	7.97	15.9	9.84	Average	Glacial	30.48	0.91	MNT
WR	15	8/14/2014	494.0	8.00	16.1	9.80	Average	Glacial	15.24	0.91	MNT
WR	16	8/14/2014	497.0	8.06	15.6	9.88	Average	Glacial	19.81	0.91	MNT
WR	17	8/14/2014	498.0	8.10	16.1	9.64	Average	Glacial	24.38	0.91	MNT
WR	18	8/14/2014	499.0	8.06	15.8	9.99	Average	Glacial	30.48	0.91	MNT
FC	1	6/23/2014	131.2	7.66	12.5	7.44	Average	Tannic	7.62	0.46	MNT
SGC	1	6/23/2014	83.8	7.31	10.7	8.29	High	Tannic	3.66	0.91	MNT
SGC	2	7/21/2014	149.8	7.29	8.1	11.40	Average	Clear	12.50	0.46	0.46
SGC	3	7/21/2014	150.6	7.30	7.7	11.50	Average	Clear	4.88	MNT	0.51
SGC	3	8/18/2014	155.4	7.95	8.1	11.81	Low	Clear	7.32	0.59	0.79
SGC	3	8/18/2014	155.4	7.95	8.1	11.81	Low	Clear	7.32	0.59	0.79
SGC	3	8/18/2014	155.4	7.95	8.1	11.81	Low	Clear	7.32	0.59	0.79
SGC	3	8/18/2014	155.4	7.95	8.1	11.81	Low	Clear	7.32	0.59	0.79
GKC	1	6/23/2014	132.8	7.50	9.3	9.66	Average	Humic	4.57	0.91	MNT
GKC	2	6/23/2014	150.0	7.61	10.0	10.75	Average	Humic	4.57	0.61	MNT
GKC	3	8/18/2014	192.7	7.83	8.0	11.77	Low	Tannic	5.64	1.35	0.79
GKC	3	8/18/2014	192.7	7.83	8.0	11.77	Low	Tannic	5.64	1.35	0.79

Notes: [1] Location is WR= Wood River, FC=Fish Creek, GKC=Gold King Creek, SGC=St. George Creek. [2]DO=Dissolved oxygen. [3]Ordinary High Water=Bank full mark. *MNT=Measurement not taken.