APPENDIX 4-K

FISHERIES SURVEY REPORTS

- **Anadromous Fish Surveys Within the Brooks East Corridor Survey Area, Alaska (July 2013)**
- **Stream Habitat Surveys of Proposed Bridge Crossings on the Brooks East Corridor (July 2014)**
- **Fisheries and Aquatic Inventory of the Koyukuk, John and Wild Rivers (June 2015)**
- **Fisheries Investigations along the Proposed Ambler Road Corridor, 2014 (November 2015)**

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ANADROMOUS FISH SURVEYS WITHIN THE BROOKS EAST CORRIDOR SURVEY AREA, ALASKA

Prepared for

DOWL HKM
4041 B Street
Anchorage, AK 99503

by

Jena L. Lemke
Joel M. Gottschalk
Dorte Dissing
Robert M. Burgess
and
John C. Seigle

ABR, Inc.—Environmental Research & Services
P.O. Box 240268
Anchorage, AK 99524

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EXECUTIVE SUMMARY

- With the Ambler Mining District Access project, the State of Alaska proposes to identify, design, and construct an access and transportation corridor to the Ambler mineral belt.
- The Brooks East corridor, which extends east from the Ambler mineral belt through Bettles to the Dalton Highway, is being evaluated as a potential corridor. Empirical data documenting the distribution of anadromous fish species within the Brooks East Corridor survey area are limited.
- The objectives of the current survey were to: 1) document the distribution of anadromous fish species within Brooks East Corridor survey area; and 2) provide updated, spatially-explicit fish distribution data.
- Surveys to determine the presence of anadromous fish species within water bodies of the Brooks East Corridor survey area were conducted in July and September 2012. Field sampling was conducted 13–26 July 2012. Additional field sampling was conducted within Gates of the Arctic National Park and Preserve 4–9 September 2012.
- Along the proposed corridor route, 40 major stream or river crossings were identified. Another 3 crossings occurred along the northern option (through the Mauneluk River Valley) and 7 along the southern option (through the Gates of the Arctic National Park and Preserve) for a total of 50 potential major stream crossings. In some cases, the same water body crossed the proposed routes more than once. In July and September 2012, fish sampling or observations were recorded at 65 survey reaches associated with these major stream crossings.
- Anadromous adult or juvenile Pacific Salmon (Chinook, Coho, and Chum Salmon) were observed or sampled at 15 survey reaches associated with at least 9 majorstream crossings. Over all survey reaches, 178 km of anadromous stream will be nominated for inclusion in the AWC records for Pacific Salmon in the Brooks East Corridor project area.
- Dolly Varden were sampled at 15 survey reaches associated with at least8 major stream crossings. Over all survey reaches, 268 km of stream will be nominated for inclusion in the AFFI for Dolly Varden in the Brooks East Corridor project area.

- Spawning areas for Chum Salmon were documented in the Upper Kobuk River subbasin the Alatna River subbasinand in the Koyukuk Flats subbasin. Spawning Chinook salmon were observed in an unnamed tributary to the Alatna River in the Alatna River watershed.

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ACKNOWLEDGMENTS

DOWL HKM Environmental Specialist Jessica Christianson accompanied the ABR survey crew during the reconnaissance survey and field sampling trips. Her assistance with trip and survey logistics, permitting, and field sampling was greatly appreciated and contributed to the success of this survey. Pilot Karl Terry of the Bristow Group Inc. provided safe transport to and from the survey reaches for the majority of the field sampling. His knowledge of the survey area and assistance with survey logistics was also greatly appreciated and contributed to the success of this survey. Jay and Judy Jespersen of Brooks Range Aviation provided storage for field sampling gear while the crew was stationed in Bettles, Alaska. Accommodations were provided by the Bettles Lodge and the NOVAGOLD Dahl Creek Camp. ABR Biological Technicians Liz Miner and Matthew Apling assisted with the reconnaissance survey and field sampling.

INTRODUCTION

With the Ambler Mining District Access project, the State of Alaska proposes to identify, design, and construct an access and transportation corridor to the Ambler mineral belt. Of the 8 preliminary corridors that are being evaluated, one has been selected for field work in preparation for the future NEPA process. This corridor, referred to as Brooks East, extends east from the Ambler mineral belt through Bettles to the Dalton Highway.

Anadromous fish have been documented in portions of the Brooks East Corridor project area in the Anadromous Waters Catalog (AWC) maintained by the Alaska Department of Fish and Game (ADFG 2012a). A number of tributaries to these larger rivers are assumed to support anadromous fish species based on a GIS analysis of locations and stream gradients. However, limited data are available on the distribution of anadromous fish at proposed river crossings for the Brooks East Corridor.

DOWL HKM contracted ABR, Inc.—Environmental Research & Services (ABR) to conduct surveys to assess use of the Brooks East Corridor survey area by anadromous fish. The focus of this effort was to sample for the presence or absence of anadromous fish species in those streams that would be crossed by the proposed corridor. Field surveys were timed to coincide with the period when multiple species of Pacific Salmon were likely to be found on the spawning grounds and during which other facultatively anadromous species such as Dolly Varden Char (S*alvelinus malma*) were likely to be present in streams in the Brooks East Corridor survey area.

BACKGROUND

Salmon and other anadromous fish migrate from natal fresh waters to salt water and return to fresh waters to spawn. Anadromous fish import marine-derived nutrients and energy into fresh waters, frequently playing an important role in enriching otherwise unproductive aquatic and adjacent terrestrial ecosystems (Cederholm et al. 1999). The maintenance of properly functioning and connected aquatic habitats, along with proper management of harvests, is critical to preserving sustained yields of anadromous fish, as required by the Alaska Constitution. Consequently, in Alaska, habitats that are used by migrating, spawning, or rearing anadromous fish are protected under multiple administrative jurisdictions (Buckwalter 2010).

Alaska Statute (AS) 16.05.877 (the Anadromous Fish Act) affords special protection to waterbodies used by anadromous fish for migration, spawning, and/or rearing. The Alaska Department of Fish and Game (ADFG) records anadromous fish data in "The Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes," known as the Anadromous Waters Catalog (AWC) (ADFG 2012b).

The Magnuson-Stevens Fishery Conservation and Management Act is federal legislation designed to protect Essential Fish Habitat (EFH) for federally managed species, including freshwater habitats used by anadromous salmon. The responsible agency is the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service (NOAA Fisheries), which relies on the AWC to designate waterbodies in Alaska to be managed as EFH. It is critical that water bodies used by anadromous fish are listed in the AWC, as only these listed water bodies are afforded state and federal protected status with consequent permit requirements and related liabilities. The following survey was conducted with the notion that the state and federal permits necessary to proceed with the Ambler Mining District Access Project will require knowledge of potential impacts on any fish bearing waterbodies that may be traversed by the project corridor.

OBJECTIVES

Objective 1: Document the distribution of anadromous fish within Brooks East Corridor survey area

Objective 2: Provide updated, spatially-explicit fish distribution data

STUDY AREA

The Brooks East Corridor crosses 7 subbasins (subbasins are based on the 8th level Hydrological Unit Code (HUC) boundaries; USGS, NRCS, and EPA[http://nhd.usgs.gov/]): the Middle Kobuk River, Upper Kobuk River, Alatna River, Allakaket, Upper Koyukuk River, Koyukuk Flats and South Fork Koyukuk River subbasins (Table 1, Figure 1). The proposed corridor crosses 19 watersheds (watersheds are based on the 10th level HUC boundaries) (Table 1, Figure 1). Within the project corridor there are 2 proposed alternative routes: the Northern Road Alternative which passes entirely within the "Outlet Mauneluk River" watershed and the Southern Road Alternative which traverses the Beaver Creek, Reed River, Kobuk Canyon–

Kobuk River, Headwaters Hogatza River, Chebanika Creek–Alatna River and Helpmejack Creek–Alatna River watersheds (Figure 1).

METHODS

RECONNAISSANCE AND DESIGNATION OF SURVEY REACHES

A 5-day reconnaissance survey was conducted 8–12 June 2012. The primary goal of the reconnaissance survey was to identify stream and river crossing locations for sampling in July and September. ABR biologists were assisted by Environmental Specialist Jessica Christianson (DOWL HKM) and local Subsistence Advisor Allen A. Tickett. Helicopter support was provided by Bristow Group, Inc., through an arrangement with the State of Alaska. A Bell 407 helicopter was used for the majority of the survey. Potential stream and river crossing locations were systematically evaluated and fish survey reaches were established during the 5-day survey.

ABR and DOWL HKM staff met in Bettles, Alaska, on 7 June 2012. After reviewing maps and discussing logistics, it was determined that the initial survey should include a flight along the entire proposed corridor route. On 8 June 2012, the crew flew from the eastern edge of the project area near the Jim River, along the northernmost proposed route alternative, to the western edge of the project area near the Ambler River. During the flight, Jessica Christianson of DOWL HKM noted proposed major stream crossing locations, which ABR biologists recorded in booklets of 10 sequential aerial photo maps of the corridor that were provided by DOWL HKM (Appendix A). The major stream crossings had previously been documented by DOWL HKM officials as possible bridge crossings (DOWL HKM personal communication).

Major stream crossing locations were numbered 0–39 from west to east along the proposed route, N1 to N3 along the northern alternative through the Mauneluk River valley, and S1 to S7 along the southern alternative through Gates of the Arctic National Park and Preserve (Table 1; Figure 2). At each major stream crossing location, the most suitable survey reach was selected based on visual inspection of the stream or river from the air and the accessibility and proximity to a safe landing zone. These factors significantly affected the proximity of survey reaches to crossing locations. Once a survey reach was identified, its location was recorded electronically with a handheld GPS unit (Garmin 78s).

The survey team made every attempt to document physical habitat parameters at each survey reach. However, due to factors such as weather and helicopter duty-hour constraints this practice was omitted at some survey reaches (See Appendix Table B). The recorded habitat paramaters included wetted width, bankfull width, channel gradient, habitat unit composition (e.g., pools, glides, and/or riffles), and the dominant substrate. Water chemistry parameters were measured in each survey reach and included water temperature, dissolved oxygen saturation, dissolved oxygen concentration, conductivity, specific conductance, and pH (Appendix Table B). If the reach was near a tributary junction with a mainstem river, water chemistry parameters were measured in both the mainstem river and the tributary stream. Photographs of the survey reach also were taken, looking upstream and downstream from the water chemistry monitoring point.

During the June reconnaissance, helicopter landing permits had not yet been acquired and thus no landings were permitted in Gates of the Arctic National Park and Preserve. The survey team documented as much information as possible from the air at potential survey reaches located in the Park. This information included an assessment of the likelihood of fish communities being present in any given survey reach once the survey team returned during July or September. Data gathered during the reconnaissance survey, including antidotal information provided by Subsistence Advisors Allen A. Tickett and MacArthur L. Tickett, were used to prioritize survey reaches for field sampling in July and September 2012. The survey team agreed that the July field sampling effort would focus first on the northernmost proposed road route in areas where data on anadromous fish species were most limited, generally west of the Kobuk River.

FIELD SAMPLING

Fish surveys were conducted in waterbodies of the Brooks East Corridor survey area in July and September 2012. The initial survey effort concentrated on the northernmost proposed route. During these surveys a number of passive and active sampling methods were implemented and included minnow-trapping, backpack electrofishing surveys, small-handled dipnetting and visual observations from the ground and air.

Minnow traps were deployed in the majority of survey reaches. Each minnow trap was baited with raw salmon eggs in a clear, perforrated ziploc bag which was fastened to the inside of

the trap with twine. Raw salmon eggs were disinfected by soaking in a 1/100 Betadyne solution for 10 minutes prior to use. Once baited, the traps were deployed within various habitat types to ensure the highest probability of capture if juvenile fish were present (i.e., under cut banks, near larger woody debris, in deep pools, etc.). In most survey reaches, 3 minnow traps were deployed, but as many as 5 were deployed in larger streams and rivers. Minnow traps deployed within a survey reach were left to soak overnight. The following day, the survey crew relocated and checked each trap, removed any captured fish, and placed them in a holding bucket containing cool, well-oxygenated stream water. All sampled fish were identified to species, measured (salmonids: fork length; other species: total length), and released within the survey reach. In many cases, juvenile Coho Salmon (*Oncorhynchus kisutch*) and Chinook Salmon (*Oncorhynchus tshawytscha*) were difficult to differentiate due to the overlap in external morphological characteristics between the 2 species that may result in misidentification in the field. Such fish were documented in the field as undifferentiated juvenile Coho Salmon/Chinook Salmon, photographed and/or collected as a voucher specimen for later identification in the lab. These photographs and voucher specimens were later identified to species with the assistance of the USGS, Alaska Science Center.

Backpack electrofishing methods were based on those used by ADFG for inventory and cataloging of anadromous fish throughout Alaska (Buckwalter 2010). In reaches where backpack electrofishing was the primary sampling method, a survey reach was established with a length equivalent to 40 wetted channel widths or 150 m, whichever was greater (up to 300 m). This reach length ensured adequate sampling in both smaller and larger wadeable streams. The backpack electrofishing unit settings were adjusted prior to sampling based on the conductivity of water in each reach (Buckwalter 2010). The survey crew of either 2 or 3 people began the survey at the downstream end of the reach and proceeded upstream while electrofishing. The crew moved diagonally across the channel from bank to bank to sample all habitat types present. Fish were collected using dip nets and placed in a holding bucket containing cool, well-oxygenated stream water. The water in the holding bucket was refreshed periodically to reduce physiological stress caused by warm water temperatures or low dissolved oxygen saturation. All sampled fish were identified to species, enumerated, measured, and released live downstream of

the sampling location. Backpack electrofishing methods were not employed in stream reaches where adult fish were observed.

Voucher fish specimens were retained and preserved in 95% ethanol. Specimens were shipped to the ABR laboratory in Anchorage, AK, where they were transferred to 10% buffered formalin. Each fish specimen was verified to species and retained. Most specimens were <40 mm total length. Additionally, because anadromy cannot be assumed for Dolly Varden, particularly this far inland, in reaches where Dolly Varden were present, two specimens were retained to be made available to the National Park Service or other state or federal agencies for otolith analysis (to investigate anadromy), if required. For AWC nomination, ADFG requires supporting information to substantiate the contention that Dolly Varden are anadromous for any given nominated water body (e.g., otolith chemistry analysis) (Buckwalter 2010). For the purposes of this analysis, ABR treated Dolly Varden as potentially anadromous because they have the potential to go to marine waters. ABR made a distinction between salmonids by categorizing them as known anadromous Pacific Salmon or facultatively anadromous Dolly Varden. Dolly Varden bearing streams in this survey will be nominated to the Alaska Freshwater Fish Index (AFFI) which is managed along with the AWC by ADFG.

RESULTS

Water chemistry, habitat, and fish sampling data from all survey trips, including the June reconnaissance survey, are presented in Appendix B and C. During all sampling periods, water quality data were collected a total of 93 times at 62 distinct survey reaches (Appendix B). Fieldsampling was conducted 13–26 July 2012 at sites outside of Gates of the Arctic National Park and Preserve and 4–9 September 2012 at sites within the Park. During the 14-day field sampling period in July 2012, 56 survey reaches were sampled in 42 different waterbodies. During the 5-day field sampling period conducted in September 2012, 9 survey reaches were sampled in 7 different water bodies.

A total of 65 survey reaches were established during 2012 surveys (Figure 3). Fish were present in 56 of 65 survey reaches sampled in the project area (Table 1). A total of 8 species of fish were observed in the project area, including Coho Salmon, Chinook Salmon Chum Salmon (*Oncorhynchus keta*), Dolly Varden, Arctic Grayling (*Thymallus arcticus*), Northern Pike (*Esox*

lucius), Burbot (*Lota lota*), and Slimy Sculpin (*Cottus cognatus*) (Table 2). Pacific Salmon were observed in 14 of the 65 (22%) survey reaches sampled (Table 2; Figure 4). Dolly Varden were observed in 15 of 65 (23%) survey reaches sampled (Table 2; Figure 5). Slimy Sculpin was the most prevalent species observed during surveys, found in 38 of the 65 (58%) survey reaches Table 2; Figure 6). The next most prevalent species was Arctic Grayling, observed in 19 of the 65 (29%) survey reaches (Table 2; Figure 7). Small numbers of Burbot and Northern Pike were also found during surveys (Table 2: Figure 6).

CHUM SALMON

A total of 9 juvenile Chum Salmon were observed in 4 of 65 (6%) survey reaches (Table 2). The average fork length of 9 juvenile Chum Salmon was 47 mm (range 36–58 mm) (Appendix C). Juvenile Chum Salmon were observed in the Mauneluk River and an unnamed tributary of the Mauneluk River (UN29 and MN02), in the Reed River (RD03) and in an unnamed tributary to the Malamute Fork of the Alatna River (UN14) (Table 1; Figure 4). All individuals were sampled in low gradient (<1%) backwater habitats or in isolated pools within mid-channel gravel bars using either dipnets or backpack electrofishers. Adult Chum Salmon were observed in 5 of 65 survey reaches (8%) (Table 2). Adult chum salmon were observed in an unnamed tributary of the Alatna River (UN25a) and an unnamed tributary to the Mauneluk River (UN30), the Reed River (RD04), the Kobuk River (KB01) and the Hogatza River (HG01) (Table 1; Figure 4).

COHO SALMON

A total of 19 juvenile Coho Salmon were captured in 6 of 65 survey reaches (%)using a combination of electrofishers, minnow traps and dipnets (Tables 1 and 2; Appendix C). The average fork length of these 19 fish was 56 mm (range 46–69 mm) (Appendix C). Juvenile Coho Salmon were observed in unnamed tributaries of the Malamute Fork Alatna River (UN14 and UN15), Malamute Fork John River (UN17), and Jim River (UN19 and UN24) as well as in Tobuk Creek (TB01) (Table 1; Figure 4). No adult Coho Salmon were observed during 2012 surveys.

CHINOOK SALMON

Juvenile Chinook Salmon were electrofished in 2 of 65 survey reaches (3%) (Table 2). One individual was caught in Tobuk Creek and another in an unnamed tributary to the Jim River

(Table 1; Appendix C). Spawning adult Chinook Salmon were observed on the Alatna River (UN25b) (Figure 4).

DOLLY VARDEN

Dolly Varden were observed in 15 of the 65 survey reaches (23%) and 15 of 48 water bodies sampled (Table 2; Figure 5). The average fork length of the 80 Dolly Varden captured was 110 mm (range 69–168 mm) (Appendix C). Dolly Varden were observed in the western portion of the survey area; the easternmost extent of the observed distribution was in the Alatna River subbasin in an unnamed tributary to Helpmejack Creek (UN16) (Figure 5). Juvenile Dolly Varden were caught in minnow traps in 13 of the 15 survey reaches where Dolly Varden were observed, while backpack electrofishing methods were used to sample an additional 2 reaches (UN26 and UN31) (Table 1; Appendix C).

ANADROMOUS SPECIES IN SUBBASINS AND WATERSHEDS

MIDDLE KOBUK RIVER

The proposed Brooks East Corridor crosses the Outlet Ambler River and Shungnak River watersheds in the Middle Kobuk River subbasin (Figure 1). While sampling did occur in the Shungnak River watershed, no sampling occurred in the Outlet Ambler River watershed. Sampling did occurr in the Headwater Ambler River watershed nestled between those two watersheds to the north. Though this watershed is not crossed by the proposed road corridor, its waters are accessible to fish moving throughout all three watersheds. Previous AWC survey work found Chum Salmon, Dolly Varden and undifferentiated whitefish at locations on the Ambler River and its tributary, the Redstone River (Figures 4 and 8). No Pacific Salmon were observed at survey reaches associated with this subbasin during 2012 surveys. However, Dolly Varden were observed well upstream of crossing 0 on Ulaneak Creek (UL01) in the Headwater Ambler River watershed, an extension of the range recorded for Dolly Varden by the AFFI of 8 km (Table 3; Figure 5).

UPPER KOBUK RIVER

The Brooks East Corridor crosses 7 watersheds in the Upper Kobuk River subbasin; the Kogoluktuk River, Outlet Mauneluk River, Selby River, Beaver Creek, Reed River, Kobuk

Canyon–Kobuk River, and Headwaters Kobuk River watersheds (Figure 1). The proposed route has 19 major stream crossings within this subbasin (crossings 3–21), 12 of which were associated with nearby survey reaches (Table 1; Figure 2). Prior to the current survey, Chum Salmon, Dolly Varden and undifferentiated whitefish had been documented downstream of the proposed major road crossing on the mainstem of the Kogoluktuk River (crossing 4; AWC 331-00-10490-2307). Chum Salmon and undifferentiated whitefish were documented downstream of the proposed major crossing on the Mauneluk River (crossing 9; AWC 331-00-10490-2335). Chum Salmon were found south of the Selby River (crossing 11; AWC 331-00-10490-2387) and downstream of major crossings on Beaver Creek (crossing 13; AWC 331-00-10490-2437). Chum, King and Pink Salmon as well as Dolly Varden, Sheefish and undifferentiated whitefish have been documented on the mainstem Kobuk River (AWC 331-00-10490) (Figures 4 and 8).

During 2012 surveys, a total of 7 juvenile Chum Salmon were collected using electrofishing techniques in 3 survey reaches (MN02, RD03, UN29) in an unnamed tributary to the Mauneluk River as well as the Mauneluk River and the Reed River in the Upper Kobuk River subbasin. An additional 4 adult Chum Salmon spawning areas were observed in 3 survey reaches (KBO1, RD04, UN30) in the Kobuk River, Reed River and an unnamed tributary to the Mauneluk River (Plates 1–5) (Figure 4; Appendix C). In total, these observations fish add an additional 95 km of stream habitat to the AWC (Table 3). Salmon occurred at survey reaches associated with 3 crossings in the Upper Kobuk River subbasin (crossings 9, 16 and 19).

Dolly Varden were observed in 12 survey reaches (UN03, UN04, UN05, UN06, UN10, UN26, UN31, UN34, UN35, UN37, CN01 and RI01) associated with 6 proposed crossings (1, 5, 9, 11, 15 and S3) within the Upper Kobuk River subbasin (Table 1, Figure 5). The 68 Dolly Varden captured in this subbasin averaged 111 mm (range 69–168 mm). All Dolly Varden were caught with either minnow traps or electrofishing techniques. The majority of these fish (n = 47) were caught in survey reaches associated with unnamed tributaries to the Mauneluk River (Appendix C). These observations represent an additional 218.7 km of streams available to Dolly Varden to be added to the AFFI (Table 3).

KOYUKUK FLATS

The southern corridor option crosses only 1 watershed in the Koyukuk Flats subbasin, the Hogatza Hills-River watershed. Previously, Chum, Coho and Chinook Salmon as well as undifferentiated whitefish have been documented on the Hogatza River (AWC 334-40-11000-2125-3355), a considerable distance downstream of the 2012 survey area and just upstream of that point in an unnamed tributary (AWC 334-40-11000-2125-3355-4556). In 2012, adult spawning Chum Salmon were observed just downstream of the proposed major crossing S6 at a survey reach on the Hogatza River (HG01) (Figure 4; Plate 6). This point represents an addition of 27 km of salmon stream habitat to the AWC. No Dolly Varden were documented in the Koyukuk Flats subbasin during 2012 surveys.

ALATNA RIVER

The proposed corridor route crosses 4 watersheds in the Alatna River subbasin (Helpmejack Creek-Alatna River, Chebanika Creek-Alatna River, Tobuk Creek and Malamute Fork Alatna River) with 10 major stream crossings (22-30 and S7) (Figure 1). Survey reaches were located on streams associated with 3 major crossings in the Alatna River subbasin (S7, 24, 25) and included HelpmeJack Creek and its unnamed tributaries as well as the Alatna River, Koyukuk River, Malamute Fork Alatna River and Bedrock Creek (Figures 4 and 8). Chum and Chinook Salmon were previously documented at the confluence of the Alatna River and the Malamute Fork of the Alatna River (AWC 334-40-11000-2125-3661-4100) downstream of proposed crossing 24. Chum and Chinook Salmon were also documented at the confluence of Mettenpherg Creek and the Malamute Fork of the Alatna River (AWC Code 334-40-11000-2125-33661-5055) (Figures 4 and 8).

During 2012 surveys, juvenile Coho and Chum Salmon were captured using dipnets at a survey reach (UN14) in an unnamed tributary to the Malamute Fork Alatna River upstream of crossing 25 (Figure 4). These anadromous fish observations will add only a minor amount (>0.1 km) of stream habitat to the AWC but do serve to identify the outlet of this unnamed tributary as a potential starting point for future surveys. Juvenile Coho and Chinook Salmon were captured using electrofishers at survey reach TBO1, also upstream of crossing 25. An additional 1.8 km of stream habitat will be added to the AWC for anadromous salmon. Juvenile Coho Salmon were

collected in minnow traps on another unnamed tributary to the Malamute Fork Alatna River associated with crossing 25 (UN15) adding another 0.15 km to the AWC (Table 3).

Chum and Chinook salmon spawning areas were visually observed from the air during surveys of an unnamed tributary to the Alatna River (UN25a and UN25b) associated with crossing 24 (Figure 4). The Chum Salmon spawning (UN25a) area was located less than 1 km upstream of the confluence of the unnamed tributary with the mainstem Alatna River and extended approximately 100 m upstream (Figure 4; Plates 7 and 8). The Chinook Salmon spawning area was documented approximately 1.8 km upstream (UN25b) (Figure 4; Plates 9 and 10). In total, these two observations of salmon spawning will add another 53.7 km of stream habitat to the AWC (Table 3; Figure 4).

Juvenile Dolly Varden were collected with electrofishers and minnow traps in 2 survey reaches upstream of the S7 crossing and which ultimately flow into the Alatna River. These survey reaches were located in an unnamed tributary (UN16) to Helpmejack Creek as well as Helpmejack Creek itself (HJ01). Together, these observations will add 41.5 km of stream habitat to the AFFI for Dolly Varden (Table 3).

ALLAKAKET

The proposed route crosses two watersheds in the Allakaket subbasin (East Fork Henshaw Creek and Hawzerah Creek-Koyukuk River watersheds) (Figure 1). The proposed corridor route runs along the boundary between the northern portion of the Allakaket subbasin and the southern portion of the Upper Koyukuk River subbasin, occasionally reentering the Allakaket subbasin in the Hawzerah Creek-Koyukuk River watershed. However, no major stream crossings were identified on the Allakaket subbasin for the proposed corridor and thus only limited sampling occured in the subbasin (Table 1; Figure 1). Chum Salmon have previously been documented in East Fork Henshaw Creek (AWC 334-40-11000-2125-3701-4080) and Chum, Coho, Chinook and Sockeye Salmon as well as Sheefish and undifferentiated whitefish have been observed within the mainstem Koyukuk River in the Hawzerah Creek-Koyukuk River watershed (Figures 4 and 8). No Pacific Salmon or Dolly Varden were captured during limited 2012 sampling at the single survey reach (SZ01) in the East Fork Henshaw Creek watershed in East Fork Sozhekla Creek (Table 1; Appendix C).

UPPER KOYUKUK RIVER

The proposed route follows the southern boundary of the Upper Koyukuk River subbasin. Three major stream crossings were identified in the Upper Koyukuk River subbasin (32–34) (Figures 1 and 2). Although it crosses 3 watersheds, proposed major stream crossings only occur in 2, the Malemute Fork John River watershed and Timber Creek John River watershed. Minnow trapping and dipnetting were conducted at just one survey reach (UN17) and yielded juvenile Coho Salmon (Figure 4; Appendix C). The proposed major crossings of the Koyukuk River (33) and a side channel of the Koyukuk River (34) are the largest proposed crossings in the subbasin. Sampling reaches were not established in relation to these major crossings because anadromous fish presence had been previously documented upstream of each crossing on the Koyukuk River and most of its major tributaries (Figures 4 and 8).

SOUTH FORK KOYUKUK RIVER

At the east end of the Brooks East Corridor, the proposed road corridor enters the South Fork Koyukuk River subbasin, traversing portions of 3 different watersheds (Lower South Fork Koyukuk River, Middle South Fork Koyukuk River, and Jim River watersheds). The eastern terminus of the proposed corridor at the Dalton Highway lies just inside a fourth watershed, Prospect Creek. Five major stream crossings were identified in the South Fork Koyukuk River subbasin (35-39) and 4 crossings were associated with nearby survey reaches (survey reaches were not established near crossing 37 because AWC records document anadromous fish presence upstream at numerous locations. Prior to the current survey, the presence of anadromous salmon was documented upstream of proposed major stream crossing 39 on the mainstem of the Jim River (AWC 334-40-11000-2125-3740-4080). A total of 11 juvenile Coho Salmon and 1 juvenile Chinook Salmon were captured using electrofisers at 2 survey reaches (UN19 and UN24) on unnamed tributaries of the Jim River. Both survey reaches were upstream of locations previously recorded, adding 0.12 km to the AWC. No Dolly Varden were observed in this subbasin.

SUMMARY

Field surveys documenting the distribution of anadromous fish species within the Brooks East Corridor survey area has been limited to date. Stream surveys documented in this report represent only a small portion of available waters in the project area, but illustrate an efficient, practical method for sampling many waterbodies in a short period of time todocument anadromous fish bearing waters in large and remote areas of Alaska. These methods, largely developed by the Alaska Department of Fish and Game, have played an important role in managing fishery resources in Alaska.

Anadromous Pacific Salmon species were observed in 15 of the 65 survey reaches (23%) and 9 of 17 watersheds surveyed (53%) within the survey area, adding 178 km of stream stream habitat to the AWC (Table 3; Figure 8). These segments provide spawning, rearing, and/or migration habitats for anadromous salmon. Spawning areas were documented in 3 subbasins (Upper Kobuk River, Alatna River, and Koyukuk Flats subbasins) on unnamed tributaries to the Alatna River and the Mauneluk River and mainstem Reed River, Kobuk River, and Hogatza River. Spawing chum salmon occurred in all of these sites, while spawning Chinook salmon were observed only in an unnamed tributary to the Alatna River. Juvenile salmon were documented in the Mauneluk River and tributaries, the Reed River, unnamed tributaries to the Malamute Fork of the Alatna River the Koyukuk River, Tobuk Creek and unnamed tributaries to the Jim River. Dolly Varden occurred in 15 of the 65 survey reaches (23%), adding 268 km of stream to the AFFI. Dolly Varden were observed only in the Middle Kobuk River, Upper Kobuk River, and Alatna River subbasins.

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Buckwalter, J. D. 2010. Anadromous cataloging and fish inventory in the middle Kuskokwim and Unalakleet River drainages. Unpublished report by Alaska Department of Fish and Game, 136pp.

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Table 1. Waterbodies in 7 subbasins and 19 watersheds crossed by the proposed Brooks East Corridor, Alaska, and the presence or absence of fish species observed during summer 2012 sampling. Each survey reach is associated with a nearby stream crossing number along the proposed access corridor (see Figures 2 and 3).

SUBBASIN Watershed	Waterbody	Tributary to	Survey Reach	Crossing Number	Date	Latitude	Longitude	Pacific Salmon	Dolly Varden	Other Fish
ALATNA RIVER										
Helpmejack Creek-Alatna River	Helpmejack Creek	Alatna River	HJ01	S7	7/16/2012	67.05835	-153.79528	No	Yes	No
Helpmejack Creek-Alatna River	Helpmejack Creek	Alatna River	HJ02	S7	7/16/2012	67.04015	-153.66203	No	No	GRAY
Helpmejack Creek-Alatna River	Unnamed trib	Helpmejack Creek	UN16	S7	7/16/2012	67.04146	-153.66153	No	Yes	SLSC
Helpmejack Creek-Alatna River	Alatna River	Koyukuk River	AL01	24	7/23/2012	67.18136	-153.48386	No	No	SLSC
Helpmejack Creek-Alatna River	Unnamed trib	Alatna River	UN25a	24	7/23/2012	67.22524	-153.55644	CHUM	No	No
Helpmejack Creek-Alatna River	Unnamed trib	Alatna River	UN25b	24	7/23/2012	67.22868	-153.59320	KING	No	No
Malamute Fork Alatna River	Unnamed trib	Malamute Fork Alatna River	UN13	25	7/16/2012	67.06966	-153.11984	No	No	SLSC
Malamute Fork Alatna River	Unnamed trib	Malamute Fork Alatna River	UN14	25	7/16/2012	67.11074	-152.93070	COHO, CHUM	No	No
Malamute Fork Alatna River	Unnamed trib	Malamute Fork Alatna River	UN15	25	7/16/2012	67.10036	-152.74847	COHO	No	No
Malamute Fork Alatna River	Bedrock Creek	Malamute Fork Alatna River	BD01	25	7/17/2012	67.09796	-152.60043	No	No	No
Malamute Fork Alatna River	Unnamed trib	Bedrock Creek	UN18	25	7/17/2012	67.09319	-152.72504	No	No	No
Tobuk Creek	Tobuk Creek	Malamute Fork Alatna River	TB01	25	7/16/2012	67.07944	-153.18635	COHO, KING	No	No
ALLAKAKET										
East Fork Henshaw Creek	East Fork Sozhekla Creek	Sozhekla Creek	SZ01	31	7/17/2012	67.03600	-152.41211	No	No	GRAY
UPPER KOYUKUK RIVER										
Malamute Fork John River	Unnamed trib	Malamute Fork John River	UN17	32	7/17/2012	67.04867	-152.12669	COHO	No	No
SOUTH FORK KOYUKUK RIVER										
Jim River	Unnamed trib	Jim River	UN19	38	7/20/2012	66.78889	-150.85132	COHO, KING	No	SLSC, GRAY
Jim River	Unnamed trib	Jim River	UN24	39	7/23/2012	66.83560	-150.64531	COHO	No	SLSC
Lower South Fork Koyukuk River	Unnamed trib	South Fork Koyukuk River	UN20	35	7/20/2012	66.67128	-151.48851	No	No	SLSC
Middle South Fork Koyukuk River	Unnamed trib	South Fork Koyukuk River	UN21	36	7/20/2012	66.82559	-151.17087	No	No	SLSC, GRAY
KOYUKUK FLATS										
Headwaters Hogatza River	Hogatza River	Koyukuk River	HG01	S6	7/21/2012	66.82131	-153.99037	CHUM	No	SLSC
Headwaters Hogatza River	Unnamed trib	Hogatza River	UN22	S6	7/21/2012	66.86933	-154.04053	No	No	SLSC, BURB
Headwaters Hogatza River	Unnamed trib	Hogatza River	UN23	S5	7/21/2012	66.85331	-154.29780	No	No	GRAY
UPPER KOBUK RIVER										
Outlet Mauneluk River	Unnamed trib	Mauneluk River	UN03	9	7/13/2012	67.04256	-156.13206	No	Yes	SLSC
Outlet Mauneluk River	Unnamed trib	Mauneluk River	UN04	9	7/14/2012	67.12383	-156.00801	No	Yes	No
Outlet Mauneluk River	Unnamed trib	Mauneluk River	UN05	9	7/14/2012	67.05437	-155.81388	No	Yes	No
Outlet Mauneluk River	Unnamed trib	Mauneluk River	UN06	9	7/14/2012	67.02217	-155.84178	No	Yes	No
Outlet Mauneluk River	Mauneluk River	Kobuk River	MN02	9	7/25/2012	67.00295	-156.09182	CHUM	No	SLSC
Outlet Mauneluk River	Unnamed trib	Mauneluk River	UN29	9	7/25/2012	67.02696	-156.04826	CHUM	No	SLSC, PIKE
Outlet Mauneluk River	Unnamed trib	Mauneluk River	UN30	9	7/25/2012	67.03453	-156.03934	CHUM	No	GRAY

Table 1. Continued.

Watershed	Waterbody	Tributary to	Survey Reach	Crossing Number	Date	Latitude	Longitude	Pacific Salmon	Dolly Varden	Other Fish
SUBBASIN										
Beaver Creek	Beaver Creek	Kobuk River	BV01	13	7/15/2012	67.07523	-155.27667	No	No	SLSC, GRAY
Beaver Creek	Unnamed trib	Beaver Creek	UN08	15	7/15/2012	67.00270	-155.00900	No	No	No
Beaver Creek	Unnamed trib	Beaver Creek	UN10	11	7/15/2012	67.01060	-155.08077	No	Yes	No
Beaver Creek	Unnamed trib	Beaver Creek	UN12	13	7/15/2012	67.07503	-155.27765	No	No	No
Beaver Creek	Unnamed trib	Beaver Creek	UN26	15	7/24/2012	66.98333	-155.02530	No	Yes	SLSC
Beaver Creek	Unnamed trib	Beaver Creek	UN27	13	7/24/2012	67.12892	-155.19577	No	No	SLSC, BURB
Beaver Creek	Unnamed trib	Beaver Creek	UN28	13	7/24/2012	67.12244	-155.21069	No	No	SLSC
Headwaters Kobuk River	Unnamed trib	Kichaiakalea Creek	UN33	S3	9/4/2012	67.05337	-154.14697	No	No	SLSC
Headwaters Kobuk River	Unnamed trib	Kichaiakalea Creek	UN37	S3	9/7/2012	67.02964	-154.01124	No	Yes	SLSC
Headwaters Kobuk River	Unnamed trib	Mauneluk River	UN07	9	7/14/2012	67.11058	-155.63781	No	No	SLSC, GRAY
Headwaters Kobuk River	Mauneluk River	Kobuk River	MN01	9	7/14/2012	67.11119	-155.63925	No	No	No
Headwaters Kobuk River	Unnamed trib	Mauneluk River	UN31	9	7/26/2012	67.12433	-155.63481	No	Yes	SLSC
Kobuk Canyon-Kobuk River	Kobuk River	None	KB01	S3	9/4/2012	67.02165	-154.35763	CHUM	No	SLSC
Kobuk Canyon-Kobuk River	Unnamed trib	Kobuk River	UN32	S3	9/4/2012	66.89105	-154.47314	No	No	SLSC
Kobuk Canyon-Kobuk River	Unnamed trib	Kobuk River	UN34	S3	9/4/2012	67.01901	-154.44464	No	Yes	No
Kobuk Canyon-Kobuk River	Unnamed trib	Kobuk River	UN35	S3	9/4/2012	67.00066	-154.55439	No	Yes	SLSC
Kobuk Canyon-Kobuk River	Unnamed trib	Kobuk River	UN36	S3	9/5/2012	66.91783	-154.48701	No	No	No
Kobuk Canyon-Kobuk River	Unnamed trib	Kobuk River	UN38	S3	9/7/2012	66.99846	-154.54691	No	No	SLSC, GRAY
Kogoluktuk River	Canyon Creek	Kogoluktuk River	CN01	5	7/13/2012	67.02888	-156.66255	No	Yes	SLSC
Kogoluktuk River	Unnamed trib	Kogoluktuk River	UN01	4	7/13/2012	67.01672	-156.44185	No	No	No
Kogoluktuk River	Unnamed trib	Kogoluktuk River	UN02	4	7/13/2012	67.01543	-156.43502	No	No	SLSC, GRAY
Kogoluktuk River	Riley Creek	Kogoluktuk River	RI01	1	7/13/2012	67.05552	-156.70256	No	Yes	No
Kogoluktuk River	Kogoluktuk River	Kobuk River	KG01	4	7/26/2012	67.09536	-156.40128	No	No	SLSC, GRAY
Kogoluktuk River	Kogoluktuk River	Kobuk River	KG02	6	7/26/2012	67.01372	-156.68225	No	No	SLSC, GRAY
Reed River	Unnamed trib	Reed River	UN09	16	7/15/2012	67.19412	-154.88269	No	No	SLSC
Reed River	Reed River	Kobuk River	RD01	16	7/15/2012	67.19318	-154.88084	No	No	No
Reed River	Reed River	Kobuk River	RD02	16	7/21/2012	67.06531	-154.81343	No	No	SLSC, GRAY
Reed River	Reed River	Kobuk River	RD03	S2	7/21/2012	66.96365	-154.81606	CHUM	No	SLSC, GRAY, BURB
Reed River	Reed River	Kobuk River	RD04	S4	9/4/2012	66.88630	-154.83643	CHUM	No	No
Selby River	Unnamed trib	Narvak Lake	UN11	9	7/15/2012	66.99952	-155.61014	No	No	No
MIDDLE KOBUK RIVER										
Headwater Ambler River	Ulaneak Creek	Ambler River	UL01	0	7/13/2012	67.39883	-156.81866	No	Yes	SLSC
Shungnak River	Ruby Creek	Shungnak River	RU01	1	7/13/2012	67.09978	-156.92219	No	No	SLSC, GRAY
Shungnak River	Ruby Creek	Shungnak River	RU02	1	7/14/2012	67.11267	-156.91756	No	No	SLSC, GRAY
Shungnak River	Shungnak River	Kobuk River	SH01	1	7/14/2012	67.11272	-156.91808	No	No	SLSC
Shungnak River	Shungnak River	Kobuk River	SH02	1	7/21/2012	67.11806	-156.83575	No	No	SLSC, GRAY
Shungnak River	Shungnak River	Kobuk River	SH03	1	7/21/2012	67.08774	-157.14510	No	No	SLSC
Shungnak River	Shungnak River	Kobuk River	SH04	1	7/21/2012	66.98033	-157.30708	No	No	SLSC, GRAY

SLSC = Slimy Sculpin GRAY = Arctic Grayling BURB = Burbot PIKE = Northern Pike CHUM = Chum Salmon KING = Chinook Salmon COHO = Coho Salmon

Table 2. Number of reaches (and percent of total reaches overall and by month) in which each of 8 species of fish were observed in the Brooks East Corridor survey area, Alaska, July and September.

Common Name	Scientific Name	Life History Stage	# of Survey Reaches Observed	% of Survey Reaches Observed	# of Individuals Observed[a]	
					July	September
Chum Salmon	*Oncorhynchus keta*	Juvenile	4	6%	9 (1.3%)	–
		Adult	5	8%	4[b]	3[b]
Coho Salmon	*Oncorhynchus kisutch*	Juvenile	6	9%	19 (2.8%)	–
Chinook Salmon	*Oncorhynchus tshawytscha*	Juvenile	2	3%	2 (0.3%)	–
		Adult	1	2%	1[b]	–
Dolly Varden	*Salvelinus malma*	Any	15	23%	73 (10.7%)	7 (25.9%)
Arctic Grayling	*Thymallus arcticus*	Any	19	29%	46 (6.8%)	3 (11.1%)
Northern Pike	*Esox lucius*	Any	1	2%	2 (0.3%)	–
Burbot	*Lota lota*	Any	3	5%	4 (0.6%)	–
Slimy Sculpin	*Cottus cognatus*	Any	38	58%	525 (77.2%)	17 (63.0%)

[a] Value in parentheses represents percentage of total visually observed or captured fish of all species, exluding adult salmon.
[b] Represents the number of observations of groups of prespawning, spawning or post-spawning adults and is therefore not calculated as a percentage of total observed organisms.

Table 3. Survey reaches and the corresponding length of stream or river to be nominated for inclusion in the AWC/AFFI (based on GIS analysis) in the Brooks East Corridor survey area, Alaska.

Survey Reach	Waterbody	Tributary to	Nearest Crossing	Species	Life History Stage	Kilometers to be added to AWC/AFFI
TB01	Tobuk Creek	Malamute Fork Alatna River	25	Coho, Chinook Salmon	rearing, rearing	1.84
UN25a	Unnamed tributary	Alatna River	24	Chum Salmon	spawning	51.82
UN25b	Unnamed tributary	Alatna River	24	Chinook Salmon	spawning	1.84
RD04	Reed River	Kobuk River	S4	Chum Salmon	spawning	17.46
RD03	Reed River	Kobuk River	S2	Chum Salmon	rearing	12.82
HG01	Hogatza River	Koyukuk River	S6	Chum Salmon	spawning	26.99
UN29	Unnamed tributary	Mauneluk River	9	Chum Salmon	rearing	4.42
UN30	Unnamed tributary	Mauneluk River	9	Chum Salmon	spawning	1.11
MN02	Mauneluk River	Kobuk River	9	Chum Salmon	rearing	10.47
KB01	Kobuk River	None	S3	Chum Salmon	spawning	48.83
CN01	Canyon Creek	Kogoluktuk River	5	Dolly Varden	rearing	7.35
UN03	Unnamed tributary	Mauneluk River	9	Dolly Varden	rearing	10.67
UN04	Unnamed tributary	Mauneluk River	9	Dolly Varden	rearing	12.48
UN06	Unnamed tributary	Mauneluk River	9	Dolly Varden	rearing	19.81
UN05	Unnamed tributary	Mauneluk River	9	Dolly Varden	rearing	3.71
UN31	Unnamed tributary	Mauneluk River	9	Dolly Varden	rearing	30.28
UN35	Unnamed tributary	Kobuk River	S3	Dolly Varden	rearing	22.74
UN34	Unnamed tributary	Kobuk River	S3	Dolly Varden	rearing	18.50
UN37	Unnamed tributary	Kichaiakalea Creek	S3	Dolly Varden	rearing	29.87
UN38	Unnamed tributary	Kobuk River	S3			0.00
UL01	Ulaneak Creek	Ambler River	0	Dolly Varden	rearing	8.01
UN15	Unnamed tributary	Malamute Fork Alatna River	25	Coho Salmon	rearing	0.15
RI01	Riley Creek	Kogoluktuk River	1	Dolly Varden	rearing	6.64
UN10	Unnamed tributary	Beaver Creek	11	Dolly Varden	rearing	11.03
UN26	Unnamed tributary	Beaver Creek	15	Dolly Varden	rearing	45.57
HJ01	Helpmejack Creek	Alatna River	S7	Dolly Varden	rearing	12.41

Table 3. Continued.

Survey Reach	Waterbody	Tributary to	Nearest Crossing	Species	Life History Stage	Kilometers to be added to AWC/AFFI
UN16	Unnamed tributary	Helpmejack Creek	S7	Dolly Varden	rearing	29.12
UN19	Unnamed tributary	Jim River	38	Coho, Chinook Salmon	rearing, rearing	0.11
UN24	Unnamed tributary	Jim River	39	Coho Salmon	rearing	0.01
UN14	Unnamed tributary	Malamute Fork Alatna River	25	Coho, Chum salmon	rearing, rearing	0.1

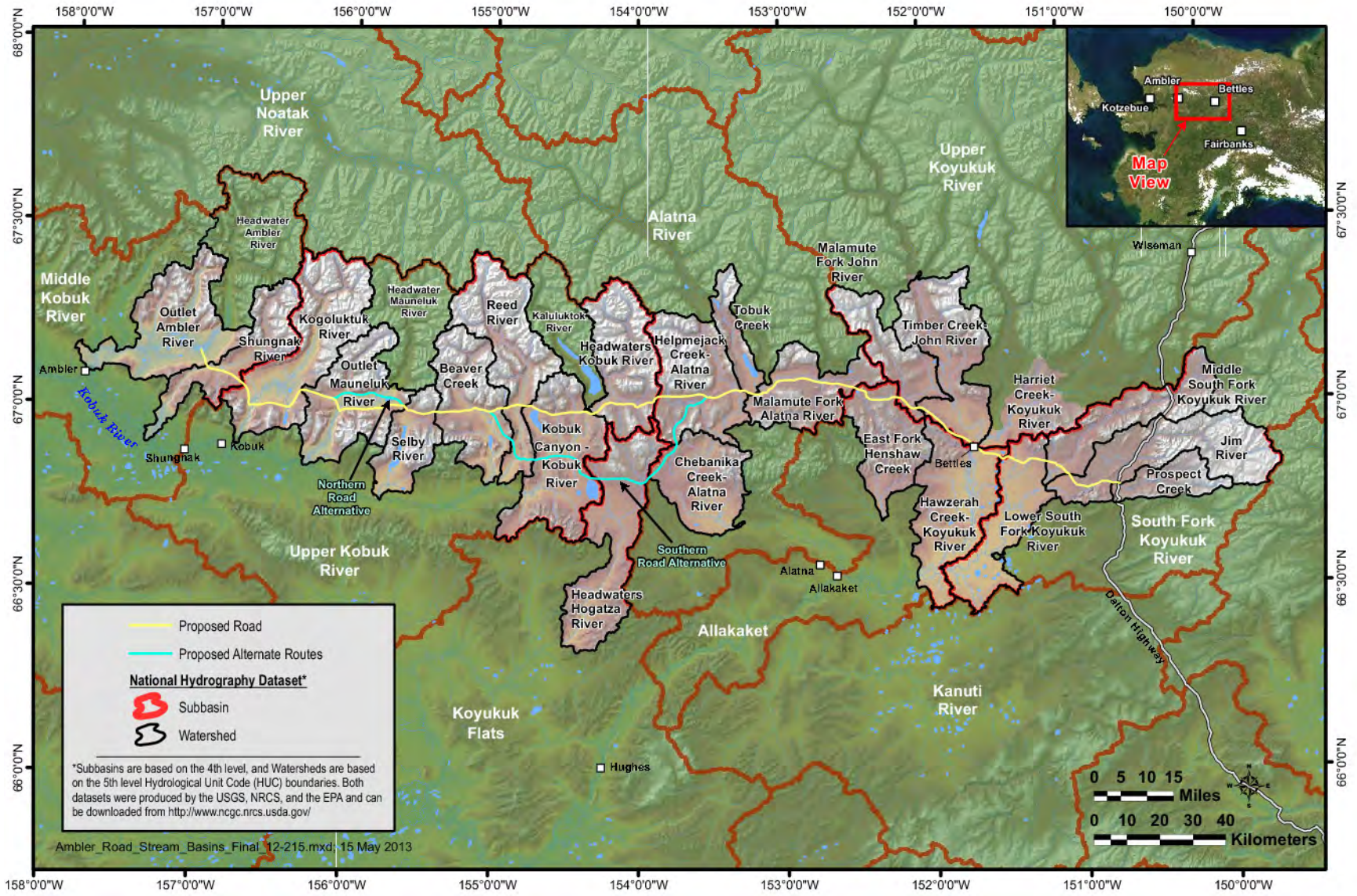


Figure 1. Subbasins and watersheds traversed by the proposed Brooks East Corridor, including the northern and southern options.

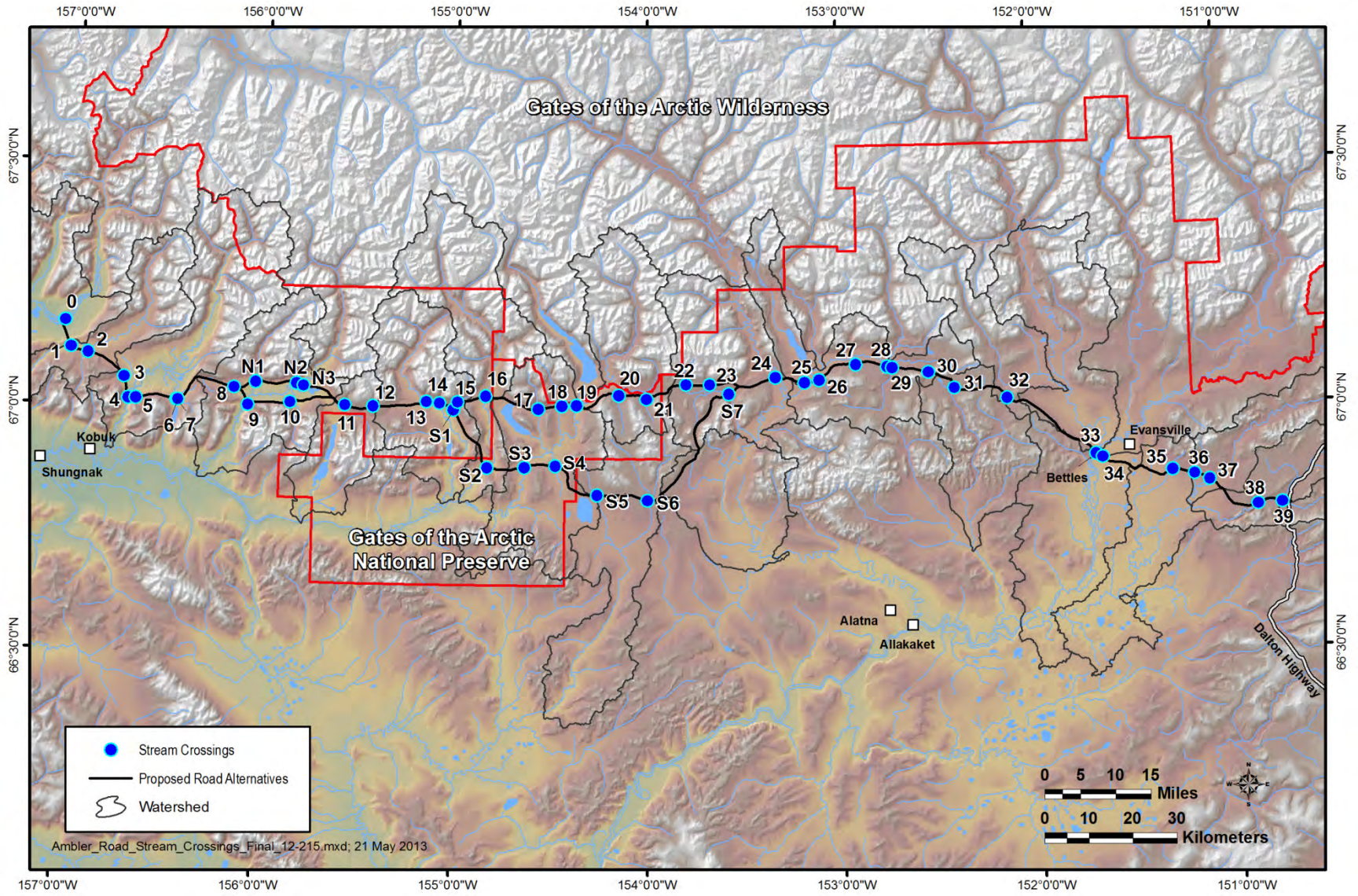


Figure 2. Major river and stream crossing locations identified in the Brooks East Corridor, including the northern and southern options.

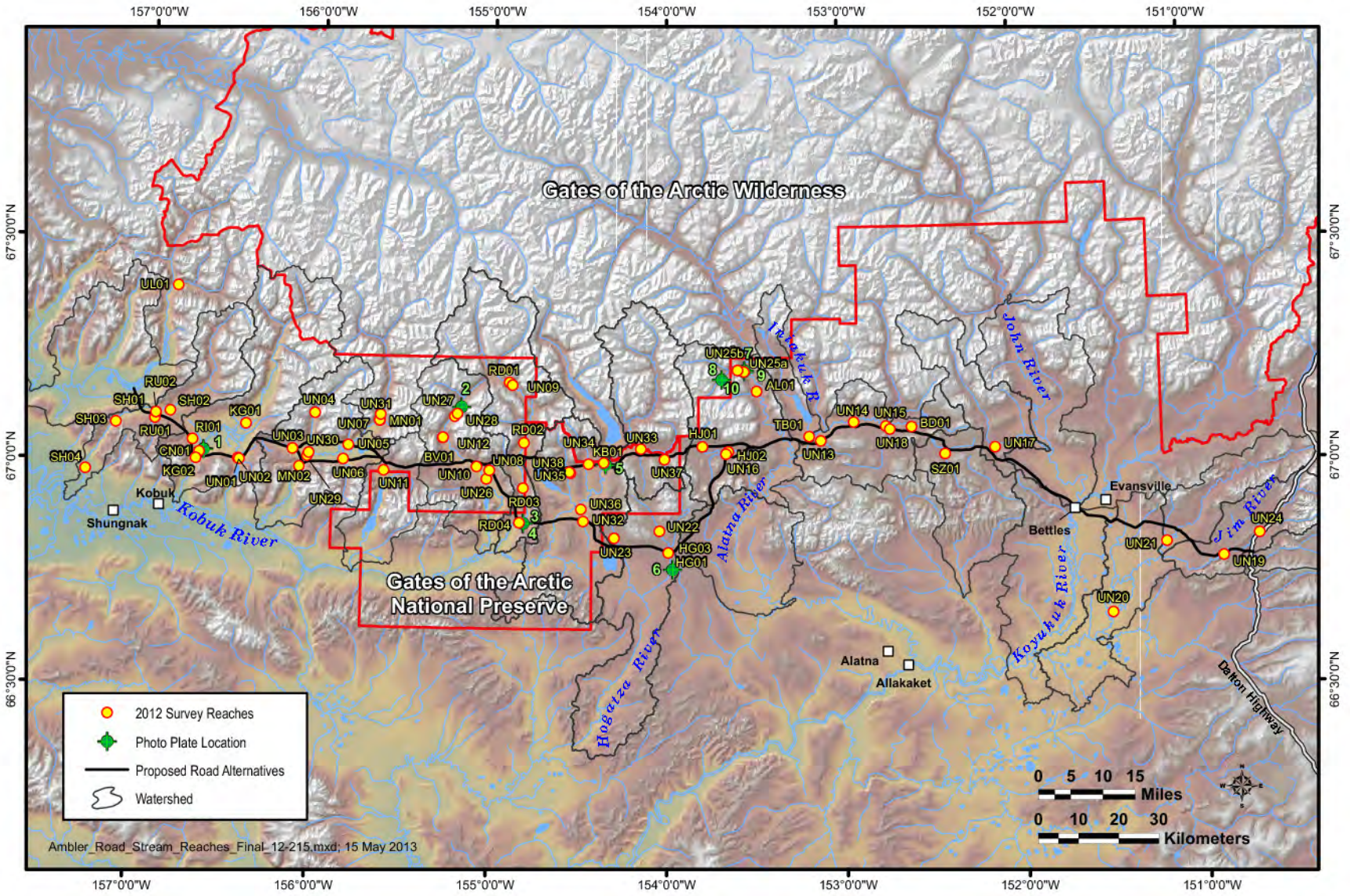


Figure 3. Survey reach locations in the Brooks East Corridor in July and September 2012.

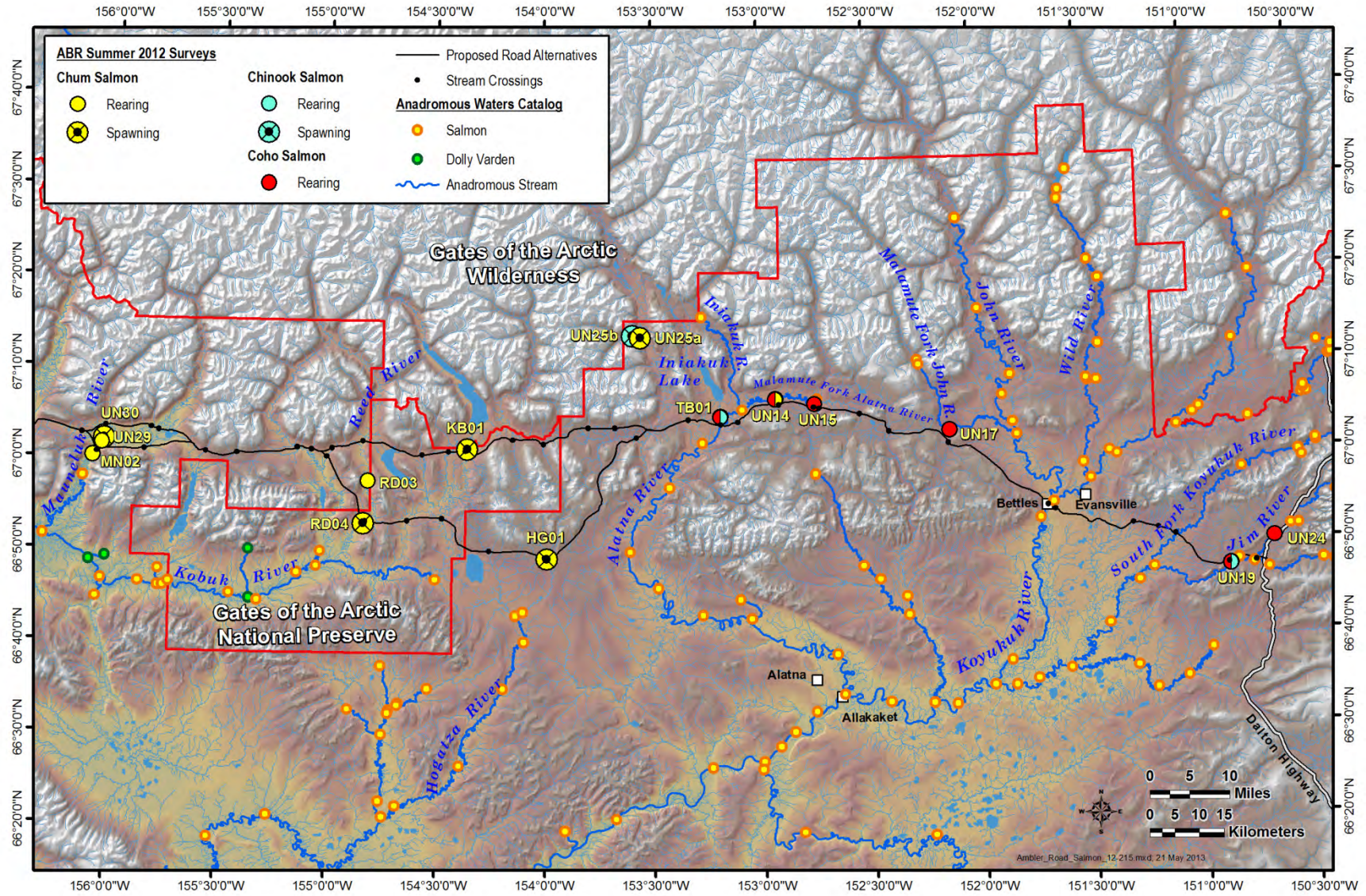


Figure 4. Survey reaches in the Brooks East Corridor where Pacific Salmon (*Oncorhynchus spp.*) were observed in July and September 2012.

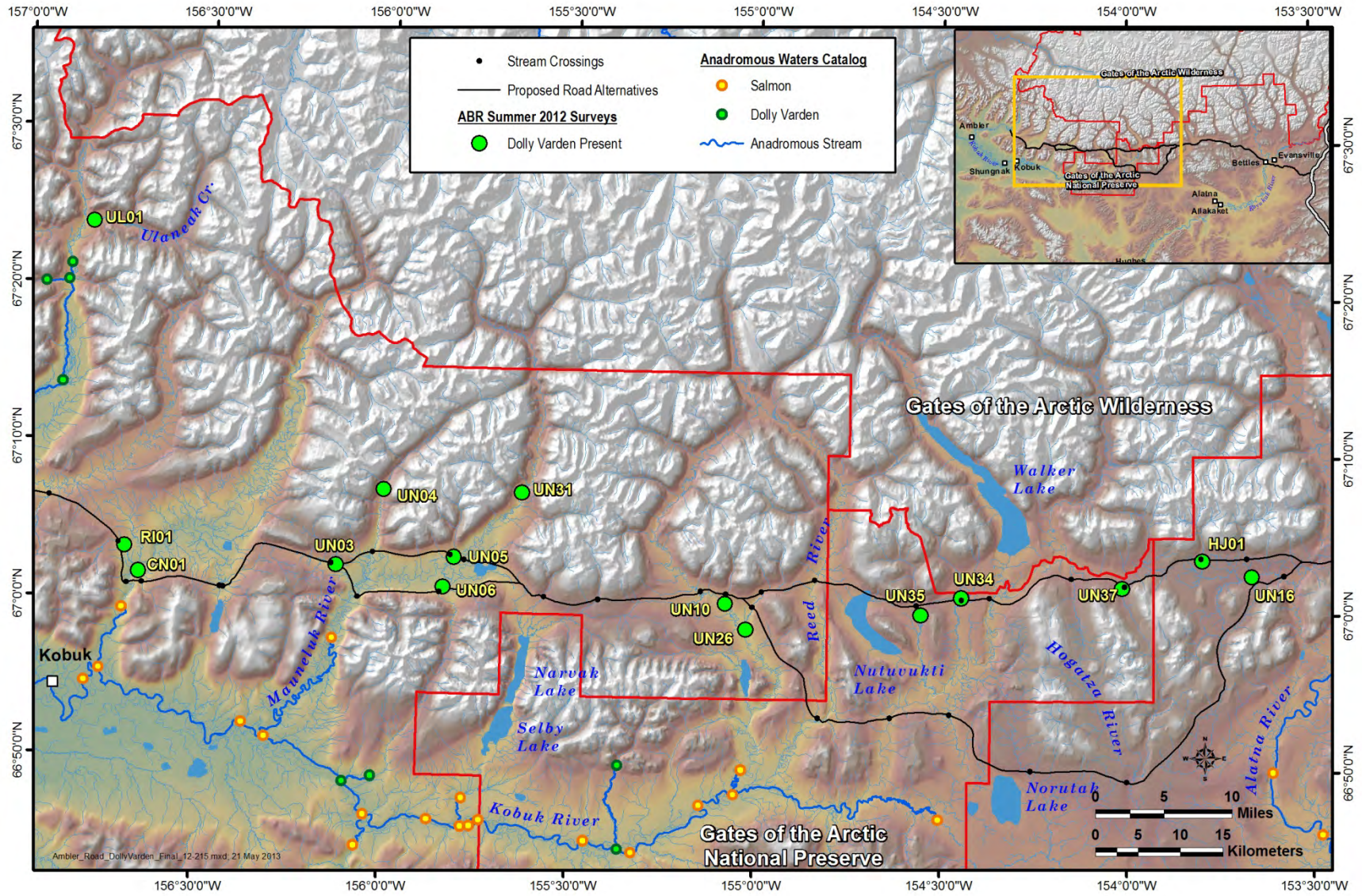


Figure 5. Survey reaches in the Brooks East Corridor where Dolly Varden (*Salvelinus malma*) were observed in July and September 2012.

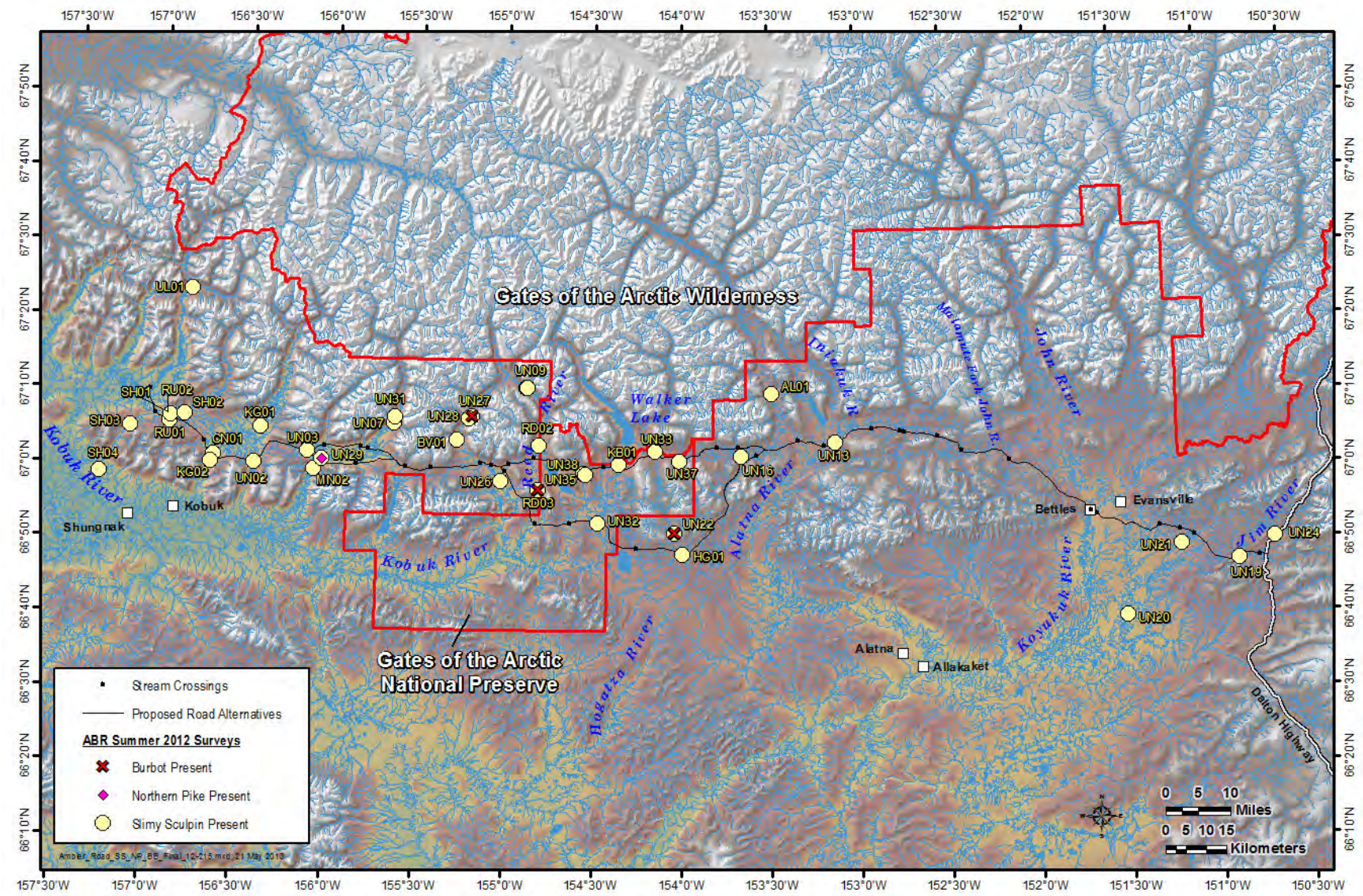


Figure 6. Survey reaches in the Brooks East Corridor where Burbot (*Lota lota*), Northern Pike (*Esox lucius*) and Slimy Sculpin (*Cottus cognatus*) were observed in July and September 2012.

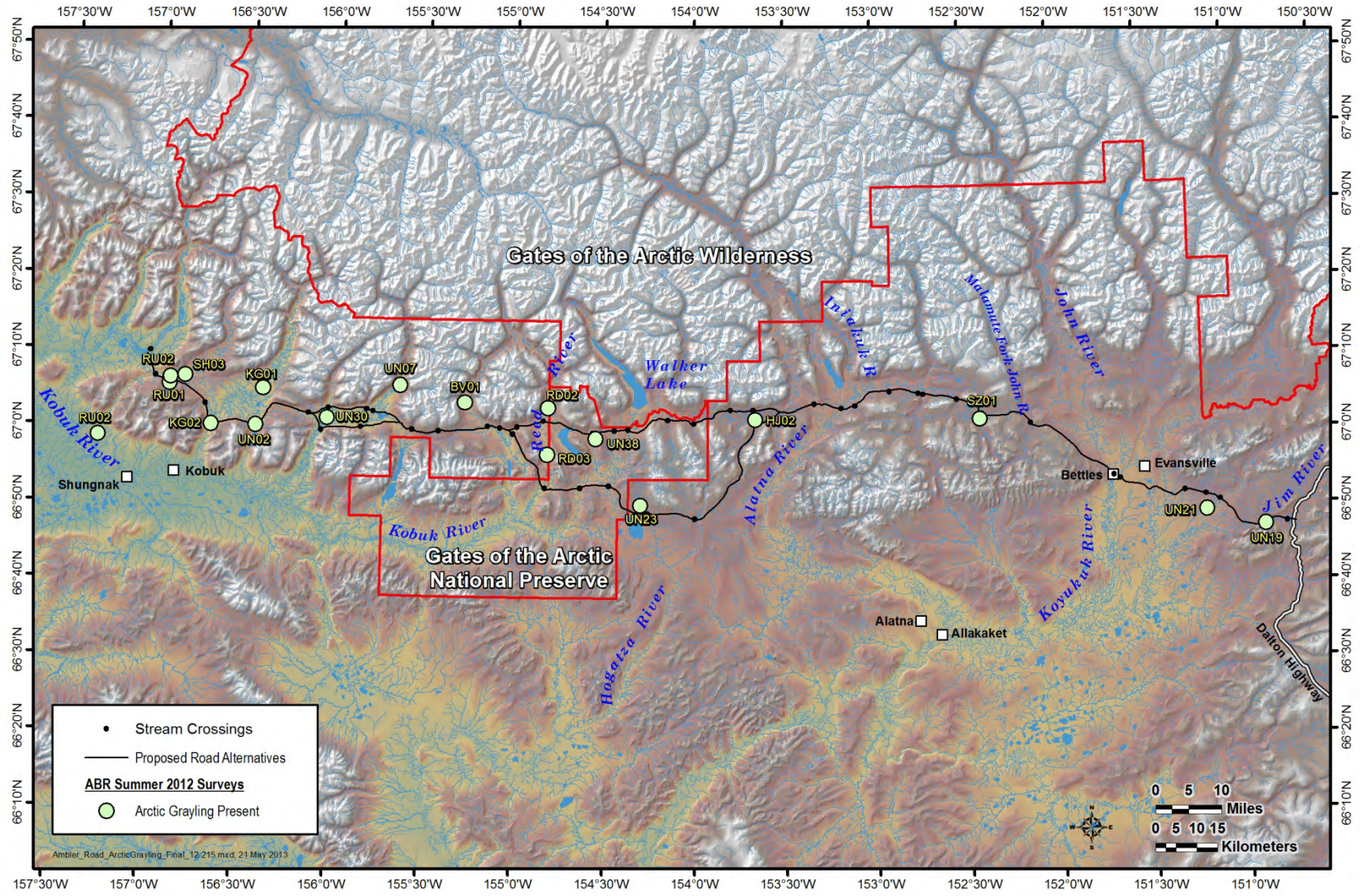


Figure 7. Survey reaches in the Brooks East Corridor where Arctic grayling (*Thymallus arcticus*) were observed in July and September 2012.

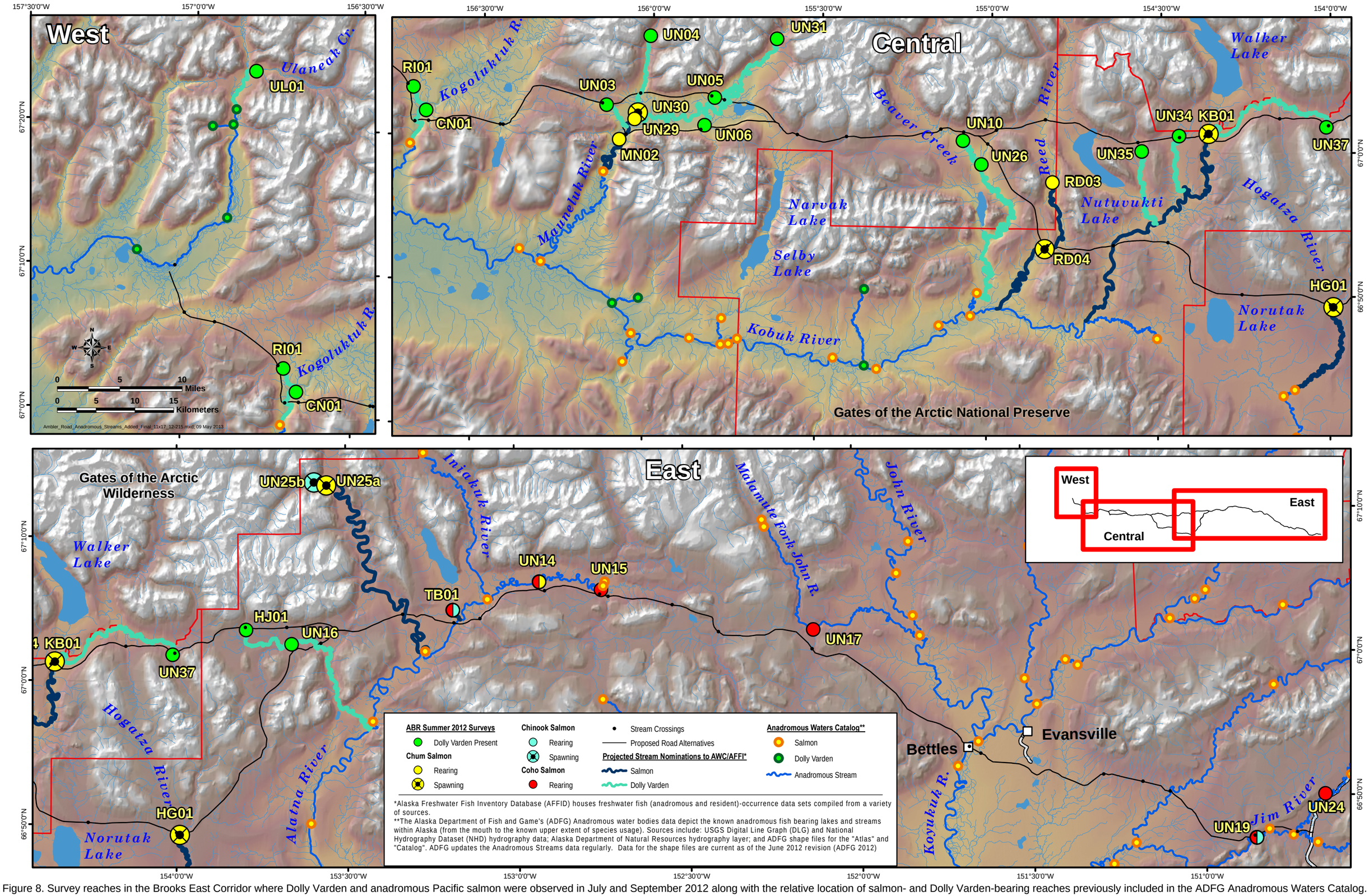


Figure 8. Survey reaches in the Brooks East Corridor where Dolly Varden and anadromous Pacific salmon were observed in July and September 2012 along with the relative location of salmon- and Dolly Varden-bearing reaches previously included in the ADFG Anadromous Waters Catalog.

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PLATES



Plate 1. Aerial view of the chum salmon spawning area documented within an unnamed tributary to the Mauneluk River, Alaska, July 2012.



Plate 2. Unidentified salmon carcass observed on a gravel point bar on Beaver Creek, Alaska, September 2012.



Plate 3. Chum salmon spawning area documented within the Reed River, Alaska, July 2012.



Plate 4. Chum salmon within the Reed River spawning area, Alaska, September 2012.



Plate 5. Female chum salmon carcass observed near a spawning area in the Kobuk River, Alaska, September 2012.



Plate 6. Chum salmon spawning area documented within the Hogatza River, Alaska, July 2012.



Plate 7. Aerial view of the chum salmon spawning area documented within an unnamed tributary to the Alatna River, Alaska, July 2012.



Plate 8. Chum salmon within the spawning area documented within an unnamed tributary to the Alatna River, Alaska, September 2012.



Plate 9. Aerial view of the Chinook salmon spawning area documented within an unnamed tributary to the Alatna River, Alaska, July 2012.

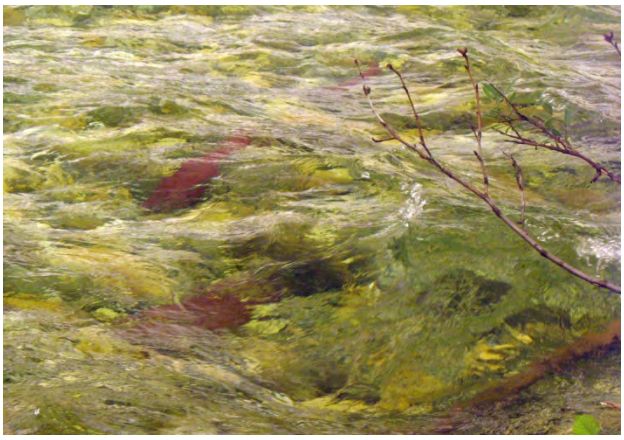


Plate 10. Chinook salmon within the spawning area documented within an unnamed tributary to the Alatna River, Alaska, September 2012.

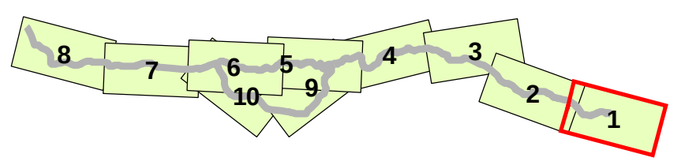
Appendix A. Field maps of the Brooks East Corridor route provided by DOWL HKM and used to locate and identify river crossings and sample reaches for the proposed Brooks Range East corridor, Alaska, 2012.

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Brooks East

MAP 1

2 Miles

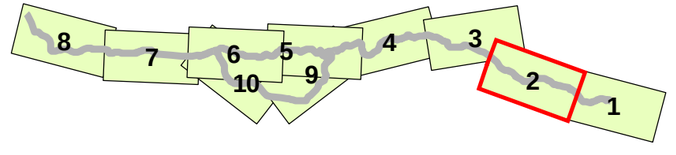


Brooks East

MAP 2

2

Miles

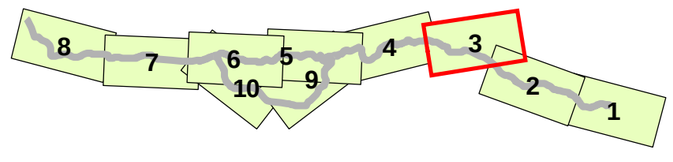


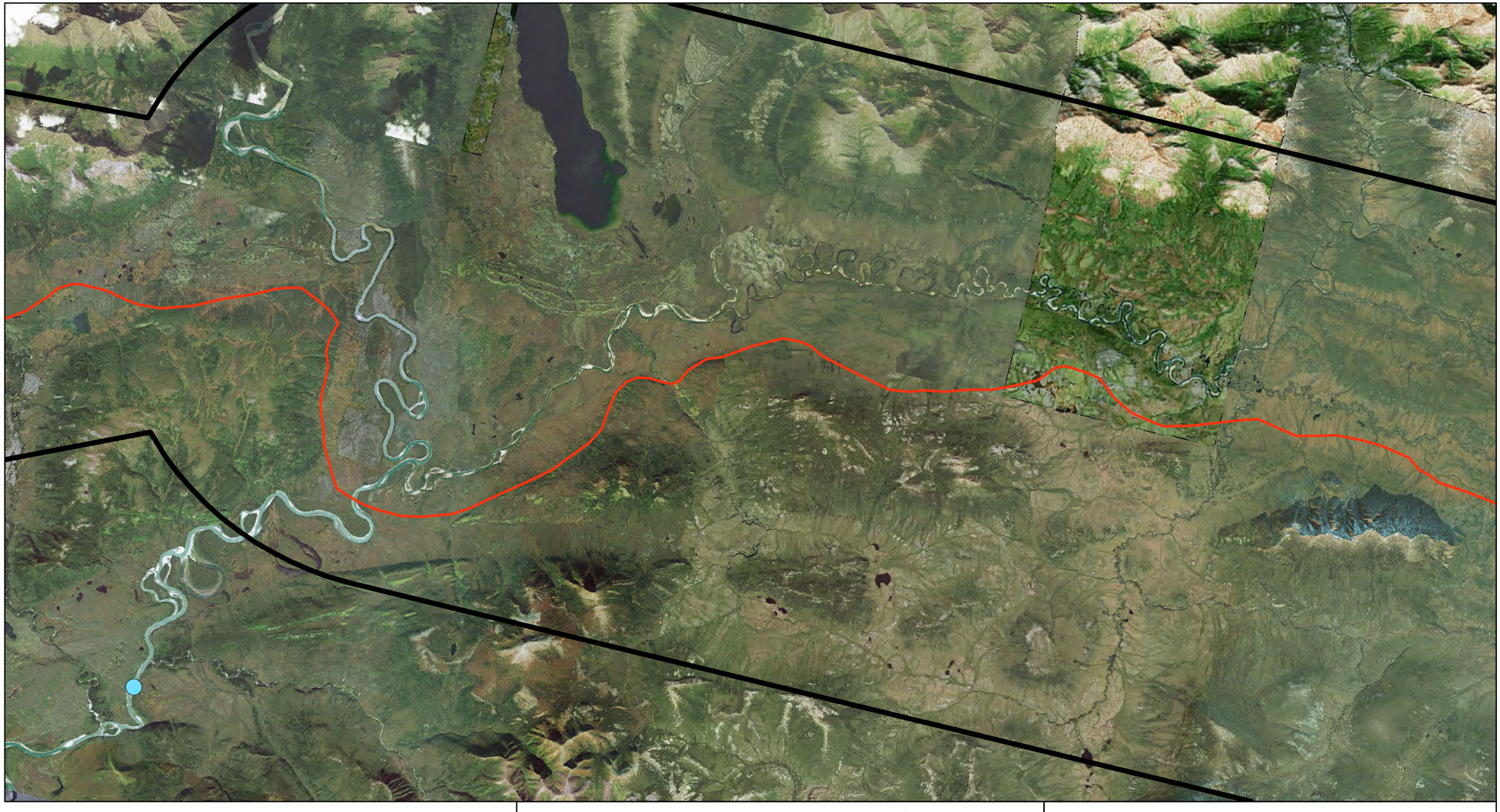
Brooks East

MAP 3

2

Miles

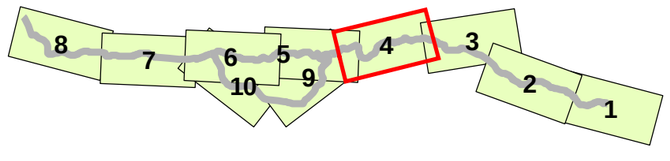




Brooks East

MAP 4

2 Miles

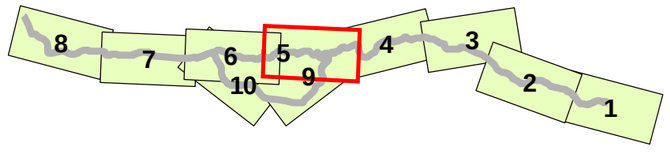


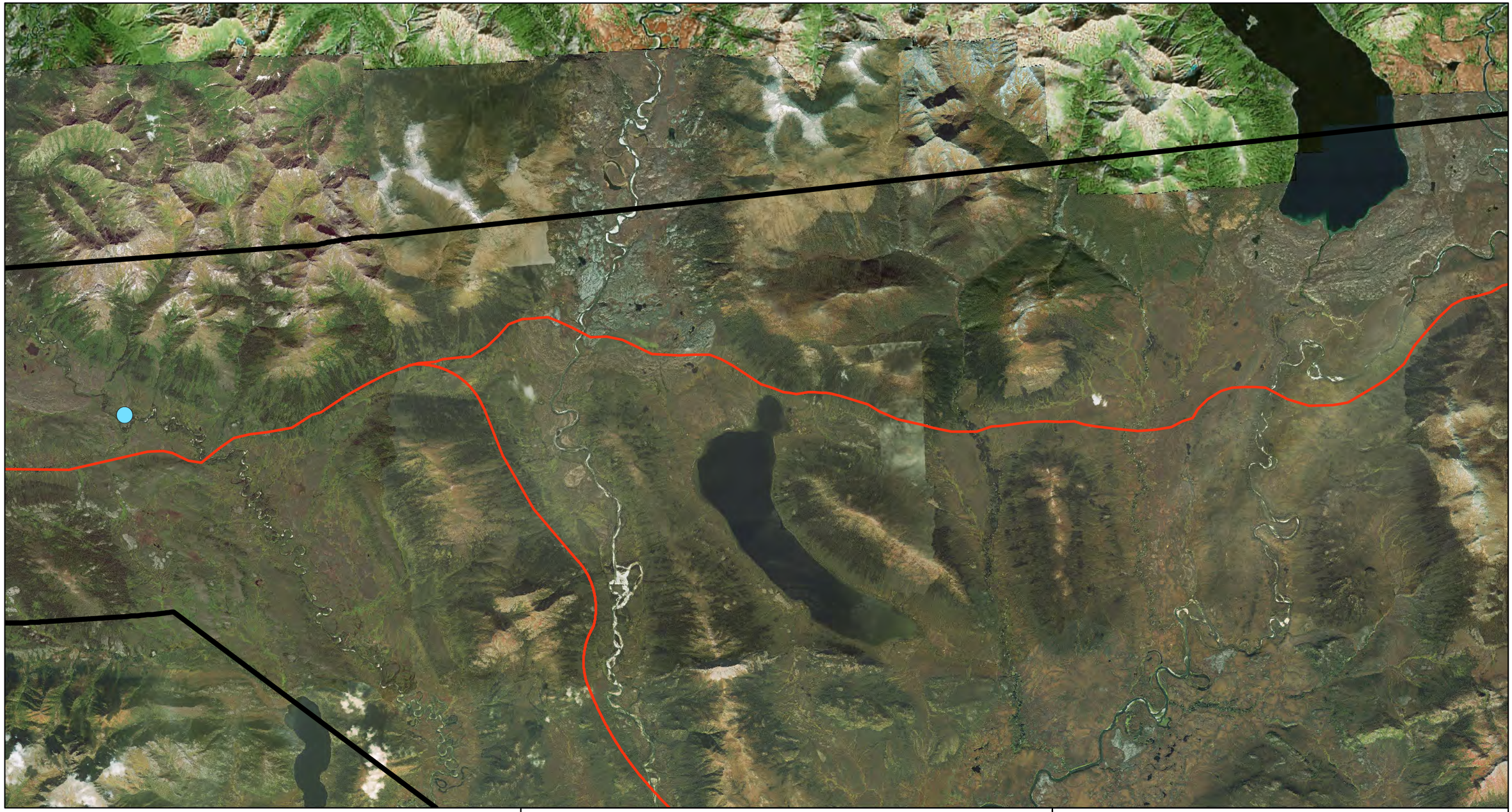
Brooks East

MAP 5

2

Miles



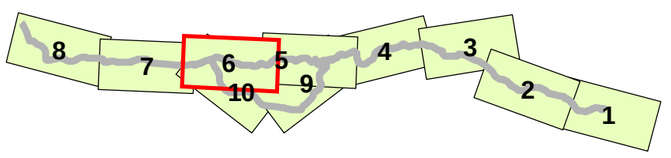


Brooks East

MAP 6

2

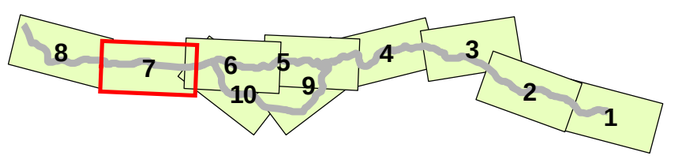
Miles



Brooks East

MAP 7

2 Miles

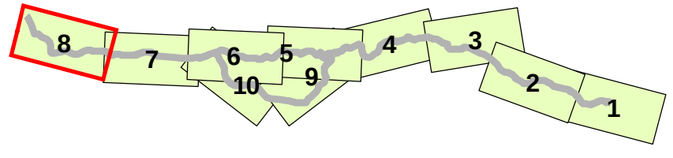


Brooks East

MAP 8

2

Miles

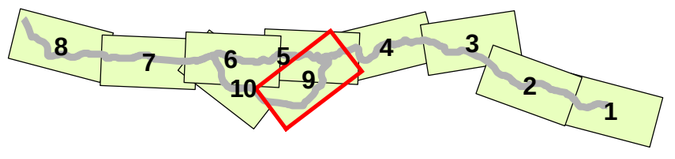


Brooks East

MAP 9

2

Miles

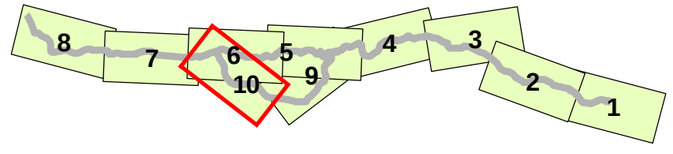


Brooks East

MAP 10

2

Miles



Appendix B. Water chemistry and physical habitat data from survey reaches associated with river and stream crossings in the proposed Brooks East Corridor, Alaska, 2012.

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Appendix B. Water chemistry and physical habitat data from survey reaches associated with river and stream crossings in the proposed Brooks East Corridor, Alaska, 2012.

Survey Reach	Nearest Crossing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Wetted Width (m)	Bankful Width (m)	Gradient (%)	Dominant Substrate[b]	Temperature °C	DO (%)	DO (mg/L)	Conductivity (µS/cm^{-1})	Specific Conductance (µS/cm^{-1})	pH
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	11.8	17.2	0.02	CB	9.5	109.2	12.25	115.6	164.2	*nm*
BD01	25	Bedrock Creek	Malamute Fork Alatna River	67.09796	-152.60043	6/11/2012	5.5	5.5	2.00	GC	8.0	93.8	10.75	105.3	155.7	6.77
BD01	25	Bedrock Creek	Malamute Fork Alatna River	67.09796	-152.60043	7/17/2012	4.8	6.3	1.25	GC	10.6	*nm*	*nm*	204.9	282.4	*nm*
BV01	13	Beaver Creek	Kobuk River	67.07523	-155.27667	7/15/2012	23.8	33.9	0.01	SA	10.3	51.9	5.76	138.2	191.9	*nm*
CN01	5	Canyon Creek	Kogoluktuk River	67.02889	-156.66256	6/8/2012	3.4	3.6	2.00	GC	7.3	106.7	12.52	136.8	206.4	7.51
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	3.4	3.6	1.50	*nm*	6.8	100.7	12.39	156.5	240.5	*nm*
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	15.7	15.8	1.50	CB	8.5	101.9	11.89	71.0	103.4	*nm*
HJ01	S7	Helpmejack Creek	Alatna River	67.05835	-153.79528	6/9/2012	16.3	18.1	2.00	CB	6.9	105.3	12.05	93.2	143.3	7.40
HJ01	S7	Helpmejack Creek	Alatna River	67.05835	-153.79528	7/16/2012	16.3	18.1	4.50	CB	8.1	91.9	10.87	157.9	233.4	*nm*
HJ02	S7	Helpmejack Creek	Alatna River	67.04015	-153.66203	6/9/2012	*nm*	*nm*	*nm*	*nm*	7.9	97.7	10.49	121.5	178.8	7.18
HJ02	S7	Helpmejack Creek	Alatna River	67.04015	-153.66203	7/16/2012	15.2	31.4	0.01	CB	12.0	92.4	9.96	165.5	220.4	*nm*
KB01	S3	Kobuk River	None	67.02165	-154.35763	9/4/2012	16.0	17.0	1.00	GC	10.1	104.1	11.68	112.9	158.1	*nm*
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	20.0	20+	0.50	CB	10.0	109.2	12.28	185.9	260.7	*nm*
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	20.0	20+	0.50	SA	12.2	105.3	11.26	75.7	99.9	*nm*
MN01	9	Mauneluk River	Kobuk River	67.11119	-155.63925	7/14/2012	*nm*	*nm*	*nm*	*nm*	11.9	106.8	11.24	160.4	213.7	*nm*
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	12.1	20.3	0.00	SA	4.5	97.1	12.49	69.9	115.2	*nm*
RD01	16	Reed River	Kobuk River	66.96365	-154.81606	6/10/2012	*nm*	*nm*	*nm*	*nm*	5.7	99.1	12.21	33.4	52.5	6.35
RD01	16	Reed River	Kobuk River	67.19318	-154.88084	7/15/2012	*nm*	*nm*	*nm*	*nm*	10.7	92.6	10.81	63.9	88.0	*nm*
RD01	16	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	20.0	20.0	1.25	CB	13.2	109.3	11.41	103.9	133.9	*nm*
RD02	16	Reed River	Kobuk River	67.06531	-154.81343	7/21/2012	20.0	20.0	0.50	CB	13.2	108.4	11.37	99.8	129.0	*nm*
RI01	1	Riley Creek	Kogoluktuk River	67.05552	-156.70256	6/8/2012	8.0	8.0	2.00	CB	7.0	104.5	12.12	122.3	184.8	7.62
RI01	1	Riley Creek	Kogoluktuk River	67.05552	-156.70256	7/13/2012	8.0	8.0	1.50	CB	6.0	105.7	12.94	138.5	218.0	*nm*
RU01	1	Ruby Creek	Shungnak River	67.09978	-156.92219	6/8/2012	7.3	11.9	2.00	GC	10.6	100.3	10.47	167.3	235.5	7.48
RU01	1	Ruby Creek	Shungnak River	67.09978	-156.92219	7/13/2012	7.3	11.9	1.25	GC	12.6	93.3	9.91	205.9	269.8	*nm*
RU02	1	Ruby Creek	Shungnak River	67.11267	-156.91756	7/14/2012	7.7	7.7	0.01	GF	13.5	101.5	10.56	208.0	266.2	*nm*
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	30.0	30.0	0.01	*nm*	13.6	96.8	9.95	148.2	188.9	*nm*
SH02	1	Shungnak River	Kobuk River	67.11806	-156.83575	7/21/2012	23.5	39.1	0.50	SA	13.6	110.0	11.42	125.2	160.0	*nm*
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	21.9	29.2	0.50	GC	15.0	110.4	11.13	134.9	166.8	*nm*
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	32.4	51.1	1.50	CB	15.2	106.7	10.70	144.0	177.4	*nm*
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	6/11/2012	2.6	4.6	2.00	GC	11.4	90.3	8.52	45.2	61.3	6.76
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	7/17/2012	2.6	4.6	0.50	GC	12.5	*nm*	*nm*	25.7	33.4	*nm*
TB01	25	Tobuk Creek	Malamute Fork Alatna River	67.07949	-153.18606	6/10/2012	18.2	18.2	2.00	CB	5.8	94.0	11.42	173.3	273.5	7.88
TB01	25	Tobuk Creek	Malamute Fork Alatna River	67.07944	-153.18635	7/16/2012	18.2	18.2	1.25	CB	17.0	95.5	9.23	255.6	301.9	*nm*
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	6/8/2012	17.5	20.0	2.00	CB	10.0	100.0	11.05	127.7	177.5	7.69
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	17.5	20.0	2.00	CB	10.1	98.2	11.03	207.5	288.6	*nm*
UN01	4	Unnamed trib	Kogoluktuk River	67.01671	-156.44184	6/8/2012	3.1	3.3	2.00	GF	17.5	91.6	8.56	32.9	35.7	6.55
UN01	4	Unnamed trib	Kogoluktuk River	67.01672	-156.44185	7/13/2012	3.1	3.3	0.01	GF	13.8	85.9	8.95	61.5	78.2	*nm*
UN02	4	Unnamed trib	Kogoluktuk River	67.01543	-156.43502	6/8/2012	4.7	4.9	2.00	GF	6.1	99.3	12.10	16.0	24.7	6.62

Survey Reach	Nearest Crossing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Wetted Width (m)	Bankful Width (m)	Gradient (%)	Dominant Substrate[b]	Temperature °C	DO (%)	DO (mg/L)	Conductivity (µS/cm^{-1})	Specific Conductance (µS/cm^{-1})	pH
UN02	4	Unnamed trib	Kogoluktuk River	67.01543	-156.43502	7/13/2012	4.7	4.9	0.01	GF	6.5	97.4	11.78	36.2	56.1	*nm*
UN03	9	Unnamed trib	Mauneluk River	67.04256	-156.13206	7/13/2012	16.3	16.3	0.02	CB	13.5	97.6	10.12	115.7	148.6	*nm*
UN04	9	Unnamed trib	Mauneluk River	67.12383	-156.00801	6/9/2012	23.2	23.5	2.00	CB	6.1	98.8	12.03	80.6	128.5	7.36
UN04	9	Unnamed trib	Mauneluk River	67.12383	-156.00801	7/14/2012	19.8	23.5	1.25	CB	11.2	103.2	11.25	152.3	206.9	*nm*
UN05	9	Unnamed trib	Mauneluk River	67.05437	-155.81388	6/9/2012	7.8	10.7	2.00	GC	5.6	108.4	13.17	64.4	101.8	6.93
UN05	9	Unnamed trib	Mauneluk River	67.05437	-155.81388	7/14/2012	7.8	10.7	1.25	GC	9.1	108.9	12.21	105.4	151.7	*nm*
UN06	9	Unnamed trib	Mauneluk River	67.02217	-155.84178	6/12/2012	7.8	16.6	2.00	GC	6.0	99.1	12.18	50.6	79.5	6.11
UN06	9	Unnamed trib	Mauneluk River	67.02217	-155.84178	7/14/2012	7.5	14.2	0.02	CB	10.3	109.4	12.09	86.7	121.1	*nm*
UN07	9	Unnamed trib	Mauneluk River	67.11058	- 155. 63781	6/9/2012	11.5	11.7	2.00	GC	5.6	110.0	13.28	114.3	180.4	6.76
UN07	9	Unnamed trib	Mauneluk River	67.11058	-155.63781	7/14/2012	6.1	7.3	0.02	CB	8.9	100.7	11.63	190.4	276.8	*nm*
UN08	15	Unnamed trib	Beaver Creek	67.00270	-155.00900	7/15/2012	5.8	7.3	1.50	CB	9.1	94.0	10.79	81.4	116.6	*nm*
UN09	16	Unnamed trib	Reed River	67.19412	-154.88269	7/15/2012	5.8	13.3	1.25	GC	9.4	95.1	11.12	136.1	194.0	*nm*
UN10	11	Unnamed trib	Beaver Creek	67.01060	-155.08077	6/9/2012	4.7	4.7	2.00	CB	6.3	107.2	12.55	87.9	133.0	6.93
UN10	11	Unnamed trib	Beaver Creek	67.01060	-155.08077	7/15/2012	4.7	7.7	0.01	CB	9.7	63.1	7.07	126.7	178.9	*nm*
UN11	9	Unnamed trib	Narvak Lake	66.99952	-155.61014	6/9/2012	5.4	5.6	2.00	GC	6.3	98.8	11.97	284.6	442.7	7.29
UN11	9	Unnamed trib	Narvak Lake	66.99952	-155.61014	7/15/2012	3.8	5.1	0.01	GC	6.0	104.6	12.79	323.3	508.0	*nm*
UN12	13	Unnamed trib	Beaver Creek	67.07488	-155.28398	6/9/2012	7.0	7.0	2.00	GC	4.3	101.4	12.91	60.7	97.2	6.86
UN12	13	Unnamed trib	Beaver Creek	67.07503	-155.27765	7/15/2012	5.8	6.8	0.01	GC	9.6	65.2	7.38	106.3	151.2	*nm*
UN13	25	Unnamed trib	Malamute Fork Alatna River	67.06966	-153.11984	6/10/2012	10.2	10.2	2.00	CB	9.2	99.4	11.11	114.4	164.5	7.45
UN13	25	Unnamed trib	Malamute Fork Alatna River	67.06966	-153.11984	7/16/2012	10.2	10.2	1.50	CB	12.4	93.0	9.86	202.0	265.7	*nm*
UN14	25	Unnamed trib	Malamute Fork Alatna River	67.11074	-152.93070	6/10/2012	3.0	3.1	2.00	GC	7.9	90.3	10.40	83.5	124.5	6.31
UN14	25	Unnamed trib	Malamute Fork Alatna River	67.11074	-152.93070	6/10/2012	*nm*	*nm*	*nm*	*nm*	9.9	100.5	11.04	139.2	195.7	7.57
UN14	25	Unnamed trib	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	3.0	3.0	0.50	GC	9.6	*nm*	*nm*	179.4	254.5	*nm*
UN15	25	Unnamed trib	Malamute Fork Alatna River	67.10036	-152.74847	6/10/2012	3.9	3.9	2.00	CB	11.8	97.6	10.21	88.1	118.0	6.85
UN15	25	Unnamed trib	Malamute Fork Alatna River	67.10036	-152.74847	7/16/2012	3.7	4.6	0-1%	CB	12.6	*nm*	*nm*	108.6	142.0	*nm*
UN16	S7	Unnamed trib	Helpmejack Creek	67.04146	-153.66153	6/9/2012	6.1	7.5	2.00	CB	7.3	96.5	11.22	121.7	182.0	7.70
UN16	S7	Unnamed trib	Helpmejack Creek	67.04146	-153.66153	7/16/2012	6.1	7.5	0.02	CB	8.4	96.0	11.20	141.0	208.7	*nm*
UN17	32	Unnamed trib	Malamute Fork John River	67.04867	-152.12670	6/11/2012	9.3	8.5	2.00	GC	9.0	92.1	10.27	36.2	52.1	6.41
UN17	32	Unnamed trib	Malamute Fork John River	67.04867	-152.12669	7/17/2012	7.1	7.2	0.50	GC	11.3	*nm*	*nm*	128.9	174.5	*nm*
UN18	25	Unnamed trib	Bedrock Creek	67.09319	-152.72504	6/10/2012	12.8	13.0	2.00	CB	12.0	94.5	9.91	64.5	85.7	7.05
UN18	25	Unnamed trib	Bedrock Creek	67.09319	-152.72504	7/17/2012	12.8	13.0	1.50	CB	13.4	*nm*	*nm*	118.3	151.9	*nm*
UN19	38	Unnamed trib	Jim River	66.78889	-150.85132	6/11/2012	4.1	4.3	2.00	GC	9.2	97.6	10.87	10.6	15.3	5.44
UN19	38	Unnamed trib	Jim River	66.78889	-150.85132	7/20/2012	3.2	4.3	1.00	GC	11.0	80.8	8.90	16.7	22.8	*nm*
UN20	35	Unnamed trib	South Fork Koyukuk River	66.67128	-151.48851	7/20/2012	23.3	25.5	0.50	GC	13.4	78.3	8.16	140.0	179.8	*nm*
UN21	36	Unnamed trib	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	3.6	5.0	0.50	GC	8.3	82.5	9.71	125.5	184.2	*nm*
UN22	S6	Unnamed trib	Hogatza River	66.86933	-154.04053	6/9/2012	8.8	16.4	2.00	GC	8.7	101.1	11.35	51.0	74.7	6.95
UN22	S6	Unnamed trib	Hogatza River	66.86933	-154.04053	7/21/2012	5.9	16.4	1.25	GC	8.1	82.1	9.79	69.7	104.5	*nm*
UN23	S5	Unnamed trib	Hogatza River	66.85331	-154.29780	6/9/2012	3.0	4.1	2.00	GC	13.4	85.7	8.62	94.1	122.2	6.82
UN23	S5	Unnamed trib	Hogatza River	66.85331	-154.29780	7/21/2012	3.2	3.5	0.50	*nm*	10.5	96.7	10.72	111.1	153.8	*nm*
UN24	39	Unnamed trib	Jim River	66.83560	-150.64531	7/23/2012	8.2	8.8	0.50	CB	12.9	96.2	10.19	63.1	82.0	*nm*
UN25a	24	Unnamed trib	Alatna River	67.22524	-153.55644	7/23/2012	22.5	22.5	0.01	CB	10.2	105.3	11.81	176.8	246.4	*nm*

Survey Reach	Nearest Crossing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Wetted Width (m)	Bankful Width (m)	Gradient (%)	Dominant Substrate[b]	Temperature °C	DO (%)	DO (mg/L)	Conductivity (µS/cm^{-1})	Specific Conductance (µS/cm^{-1})	pH
UN26	15	Unnamed trib	Beaver Creek	66.98333	-155.02530	7/24/2012	5.8	7.6	*nm*	GC	7.6	103.5	12.34	83.1	124.3	*nm*
UN27	13	Unnamed trib	Beaver Creek	67.12892	-155.19577	7/24/2012	7.2	8.0	0.50	GC	7.8	106.7	12.65	162.1	241.6	*nm*
UN28	13	Unnamed trib	Beaver Creek	67.12244	-155.21069	7/24/2012	9.0	10.8	0.03	CB	8.9	106.5	12.33	147.7	213.4	*nm*
UN29	9	Unnamed trib	Mauneluk River	67.02696	-156.04826	7/25/2012	9.8	10.9	0.50	SA	7.4	65.4	7.84	152.4	230.0	*nm*
UN30	9	Unnamed trib	Mauneluk River	67.03453	-156.03934	7/25/2012	20.0	20.0	1.00	CB	*nm*	*nm*	*nm*	*nm*	*nm*	*nm*
UN31	9	Unnamed trib	Mauneluk River	67.12433	-155.63481	7/26/2012	6.6	8.3	4.00	CB	8.5	107.6	12.58	108.4	158.2	*nm*
UN32	S3	Unnamed trib	Kobuk River	66.89105	-154.47314	9/4/2012	5.0	5.0	1.00	*nm*	6.8	91.5	11.16	45.8	70.2	*nm*
UN33	S3	Unnamed trib	Kichaiakalea Creek	67.05337	-154.14697	9/4/2012	5.0	5.0	1.00	GC	6.0	103.5	12.88	64.5	101.3	*nm*
UN34	S3	Unnamed trib	Kobuk River	67.01901	-154.44464	9/4/2012	*nm*	*nm*	1.00	GC	5.5	100.5	12.68	35.7	56.9	*nm*
UN35	S3	Unnamed trib	Kobuk River	67.00066	-154.55439	9/4/2012	3.0	3.0	0.00	FN	5.1	78.7	9.89	32.0	51.7	*nm*
UN36	S3	Unnamed trib	Kobuk River	66.91783	-154.48701	9/5/2012	25.0	12.0	0.50	*nm*	6.6	93.1	11.37	44.9	69.5	*nm*
UN37	S3	Unnamed trib	Kichaiakalea Creek	67.02964	-154.01124	9/7/2012	4.0	3.5	1.00	FN	4.7	101.1	12.99	105.6	172.3	*nm*
UN38	S3	Unnamed trib	Kobuk River	66.99846	-154.54691	9/7/2012	7.0	7.0	1.00	CB	5.1	100.6	12.80	25.6	41.3	*nm*

[a] Refer to Figure 2 for the location of crossing codes
[b] CB, cobble; GC, gravel coarse; GF, gravel fine; SA, sand; FN, fines
nm = not measured

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Appendix C. Fishing Results of fishing effort in streams within the proposed Brooks East Corridor survey area, Alaska, July and September 2012.

Appendix C. Results of fishing effort in streams within the proposed Brooks East Corridor survey area, Alaska, July and September 2012.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	76
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	112
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	109
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	108
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	109
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	124
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	87
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	83
UL01	0	Ulaneak Creek	Ambler River	67.39883	-156.81866	7/13/2012	Minnow Trap	Dolly Varden	juvenile	98
RI01	1	Riley Creek	Kogoluktuk River	67.05552	-156.70256	7/13/2012	Minnow Trap	Dolly Varden	juvenile	108
RI01	1	Riley Creek	Kogoluktuk River	67.05552	-156.70256	7/13/2012	Minnow Trap	Dolly Varden	juvenile	102
RI01	1	Riley Creek	Kogoluktuk River	67.05552	-156.70256	7/13/2012	Minnow Trap	Dolly Varden	juvenile	128
RI01	1	Riley Creek	Kogoluktuk River	67.05552	-156.70256	7/13/2012	Minnow Trap	NO FISH	–	–
RU01	1	Ruby Creek	Shungnak River	67.09978	-156.92219	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	20
RU01	1	Ruby Creek	Shungnak River	67.09978	-156.92219	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	60
RU01	1	Ruby Creek	Shungnak River	67.09978	-156.92219	7/13/2012	Minnow Trap	NO FISH	–	–
RU01	1	Ruby Creek	Shungnak River	67.09978	-156.92219	7/13/2012	Visual Observation	Arctic Grayling	adult	–
RU02	1	Ruby Creek	Shungnak River	67.11267	-156.91756	7/14/2012	Minnow Trap	NO FISH	–	–
RU02	1	Ruby Creek	Shungnak River	67.11267	-156.91756	7/14/2012	Minnow Trap	NO FISH	–	–
RU02	1	Ruby Creek	Shungnak River	67.11267	-156.91756	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	74
RU02	1	Ruby Creek	Shungnak River	67.11267	-156.91756	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	79
RU02	1	Ruby Creek	Shungnak River	67.11267	-156.91756	7/14/2012	Dipnet	Arctic Grayling	juvenile	85
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	71
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	61
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	74
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	70
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	70

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	56
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	NO FISH	–	–
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	37
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Dipnet	Arctic Grayling	juvenile	39
SH01	1	Shungnak River	Kobuk River	67.11272	-156.91808	7/14/2012	Dipnet	Arctic Grayling	juvenile	34
SH02	1	Shungnak River	Kobuk River	67.11806	-156.83575	7/21/2012	Minnow Trap	NO FISH	–	–
SH02	1	Shungnak River	Kobuk River	67.11806	-156.83575	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	66
SH02	1	Shungnak River	Kobuk River	67.11806	-156.83575	7/21/2012	Minnow Trap	NO FISH	–	–
SH02	1	Shungnak River	Kobuk River	67.11806	-156.83575	7/21/2012	Minnow Trap	NO FISH	–	–
SH02	1	Shungnak River	Kobuk River	67.11806	-156.83575	7/21/2012	Visual Observation	Arctic Grayling	adult	–
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Minnow Trap	NO FISH	–	–
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	52
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Minnow Trap	NO FISH	–	–
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Minnow Trap	NO FISH	–	–
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	44
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	44
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	73
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	39
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	39
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	39
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	44
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	39
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	33
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	39
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
SH03	1	Shungnak River	Kobuk River	67.08774	-157.14510	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	33
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Minnow Trap	NO FISH	–	–
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	61
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Minnow Trap	NO FISH	–	–
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Arctic Grayling	juvenile	57
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Arctic Grayling	juvenile	52
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Arctic Grayling	juvenile	55
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Arctic Grayling	juvenile	53
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Arctic Grayling	juvenile	51
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	64
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	39
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	38
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	29
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	34
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	38
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
SH04	1	Shungnak River	Kobuk River	66.98033	-157.30708	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
UN01	4	Unnamed tributary	Kogoluktuk River	67.01672	-156.44185	7/13/2012	Minnow Trap	NO FISH	–	–
UN01	4	Unnamed tributary	Kogoluktuk River	67.01672	-156.44185	7/13/2012	Minnow Trap	NO FISH	–	–
UN01	4	Unnamed tributary	Kogoluktuk River	67.01672	-156.44185	7/13/2012	Minnow Trap	NO FISH	–	–
UN02	4	Unnamed tributary	Kogoluktuk River	67.01543	-156.43502	7/13/2012	Minnow Trap	NO FISH	–	–
UN02	4	Unnamed tributary	Kogoluktuk River	67.01543	-156.43502	7/13/2012	Minnow Trap	NO FISH	–	–
UN02	4	Unnamed tributary	Kogoluktuk River	67.01543	-156.43502	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	70
UN02	4	Unnamed tributary	Kogoluktuk River	67.01543	-156.43502	7/13/2012	Visual Observation	Arctic Grayling	adult	–
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	39
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	33
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	34
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	32
KG01	4	Kogoluktuk River	Kobuk River	67.09536	-156.40128	7/26/2012	Visual Observation	Arctic Grayling	adult	–
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	79
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	61
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Dolly Varden	juvenile	111

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Dolly Varden	juvenile	114
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	67
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	56
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	57
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	63
CN01	5	Canyon Creek	Kogoluktuk River	67.02888	-156.66255	7/13/2012	Minnow Trap	NO FISH	–	–
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	80
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	81
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	79
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Arctic Grayling	juvenile	67
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Arctic Grayling	juvenile	61
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Arctic Grayling	juvenile	59
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	75
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	73
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	73
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	46
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	87
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	64
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
KG02	6	Kogoluktuk River	Kobuk River	67.01372	-156.68225	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
UN03	9	Unnamed tributary	Mauneluk River	67.04256	-156.13206	7/13/2012	Minnow Trap	Dolly Varden	juvenile	115
UN03	9	Unnamed tributary	Mauneluk River	67.04256	-156.13206	7/13/2012	Minnow Trap	Dolly Varden	juvenile	122
UN03	9	Unnamed tributary	Mauneluk River	67.04256	-156.13206	7/13/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	85
UN03	9	Unnamed tributary	Mauneluk River	67.04256	-156.13206	7/13/2012	Minnow Trap	Dolly Varden	juvenile	139
UN03	9	Unnamed tributary	Mauneluk River	67.04256	-156.13206	7/13/2012	Minnow Trap	Dolly Varden	juvenile	115
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	87
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	107
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	129
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	112
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	119
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	94
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	101
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	150
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	99

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	97
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	98
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	102
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	73
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	88
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	87
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	80
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	95
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	96
UN04	9	Unnamed tributary	Mauneluk River	67.12383	-156.00801	7/14/2012	Minnow Trap	Dolly Varden	juvenile	69
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	Dolly Varden	juvenile	95
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	Dolly Varden	juvenile	114
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	Dolly Varden	juvenile	104
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	Dolly Varden	juvenile	126
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	Dolly Varden	juvenile	117
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	Dolly Varden	juvenile	118
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	NO FISH	–	–
UN05	9	Unnamed tributary	Mauneluk River	67.05437	-155.81388	7/14/2012	Minnow Trap	NO FISH	–	–
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	71
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Minnow Trap	NO FISH	–	–
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Minnow Trap	NO FISH	–	–
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	70
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	64
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	73
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	46
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Arctic Grayling	juvenile	109
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	46
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	76
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Visual	Arctic Grayling	adult	>300

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
							Observation			
UN07	9	Unnamed tributary	Mauneluk River	67.11058	-155.63781	7/14/2012	Visual Observation	Arctic Grayling	adult	>300
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	110
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	129
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	118
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	111
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	135
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	102
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	100
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	100
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	123
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	117
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	97
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	99
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	125
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	113
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	123
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	114
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	168
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	128
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	122
UN06	9	Unnamed tributary	Mauneluk River	67.02217	-155.84178	7/14/2012	Minnow Trap	Dolly Varden	juvenile	78
MN01	9	Mauneluk River	Kobuk River	67.11119	-155.63925	7/14/2012	Minnow Trap	NO FISH	–	–
MN01	9	Mauneluk River	Kobuk River	67.11119	-155.63925	7/14/2012	Minnow Trap	NO FISH	–	–
MN01	9	Mauneluk River	Kobuk River	67.11119	-155.63925	7/14/2012	Minnow Trap	NO FISH	–	–
UN11	9	Unnamed tributary	Narvak Lake	66.99952	-155.61014	7/15/2012	Minnow Trap	NO FISH	–	–
UN11	9	Unnamed tributary	Narvak Lake	66.99952	-155.61014	7/15/2012	Minnow Trap	NO FISH	–	–
UN11	9	Unnamed tributary	Narvak Lake	66.99952	-155.61014	7/15/2012	Minnow Trap	NO FISH	–	–

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	82
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	73
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	70
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	44
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Chum Salmon	juvenile	55
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Chum Salmon	juvenile	57
MN02	9	Mauneluk River	Kobuk River	67.00295	-156.09182	7/25/2012	Electrofishing	Chum Salmon	juvenile	41
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Northern Pike	juvenile	193
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Northern Pike	juvenile	145
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	27
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Chum Salmon	juvenile	52
UN29	9	Unnamed tributary	Mauneluk River	67.02696	-156.04826	7/25/2012	Electrofishing	Chum Salmon	juvenile	58
UN30	9	Unnamed tributary	Mauneluk River	67.03453	-156.03934	7/25/2012	Visual Observation	Chum Salmon	adult	–
UN30	9	Unnamed tributary	Mauneluk River	67.03453	-156.03934	7/25/2012	Visual Observation	Arctic Grayling	adult	–
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	72
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	75
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Dolly Varden	juvenile	85
UN31	9	Unnamed tributary	Mauneluk River	67.12433	-155.63481	7/26/2012	Electrofishing	Dolly Varden	juvenile	127
UN10	11	Unnamed tributary	Beaver Creek	67.01060	-155.08077	7/15/2012	Minnow Trap	Dolly Varden	juvenile	83
UN10	11	Unnamed tributary	Beaver Creek	67.01060	-155.08077	7/15/2012	Minnow Trap	NO FISH	–	–
UN10	11	Unnamed tributary	Beaver Creek	67.01060	-155.08077	7/15/2012	Minnow Trap	Dolly Varden	juvenile	75
UN10	11	Unnamed tributary	Beaver Creek	67.01060	-155.08077	7/15/2012	Minnow Trap	Dolly Varden	juvenile	144
BV01	13	Beaver Creek	Kobuk River	67.07523	-155.27667	7/15/2012	Minnow Trap	NO FISH	–	–
BV01	13	Beaver Creek	Kobuk River	67.07523	-155.27667	7/15/2012	Minnow Trap	NO FISH	–	–
BV01	13	Beaver Creek	Kobuk River	67.07523	-155.27667	7/15/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	41
BV01	13	Beaver Creek	Kobuk River	67.07523	-155.27667	7/15/2012	Visual Observation	Arctic Grayling	adult	–
UN12	13	Unnamed tributary	Beaver Creek	67.07503	-155.27765	7/15/2012	Minnow Trap	NO FISH	–	–
UN12	13	Unnamed tributary	Beaver Creek	67.07503	-155.27765	7/15/2012	Minnow Trap	NO FISH	–	–

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN12	13	Unnamed tributary	Beaver Creek	67.07503	-155.27765	7/15/2012	Minnow Trap	NO FISH	–	–
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	44
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	46
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	64
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN27	13	Unnamed tributary	Beaver Creek	67.12892	-155.19577	7/24/2012	Electrofishing	Burbot	juvenile	111
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	44

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	70
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN28	13	Unnamed tributary	Beaver Creek	67.12244	-155.21069	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
UN08	15	Unnamed tributary	Beaver Creek	67.00270	-155.00900	7/15/2012	Minnow Trap	NO FISH	–	–
UN08	15	Unnamed tributary	Beaver Creek	67.00270	-155.00900	7/15/2012	Minnow Trap	NO FISH	–	–
UN08	15	Unnamed tributary	Beaver Creek	67.00270	-155.00900	7/15/2012	Minnow Trap	NO FISH	–	–
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	46
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	33
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	91
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	46
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	81
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	72
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	64
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	38
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	38
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	43
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	35
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	64
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	41
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Dolly Varden	juvenile	88
UN26	15	Unnamed tributary	Beaver Creek	66.98333	-155.02530	7/24/2012	Electrofishing	Dolly Varden	juvenile	98
UN09	16	Unnamed tributary	Reed River	67.19412	-154.88269	7/15/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	63
UN09	16	Unnamed tributary	Reed River	67.19412	-154.88269	7/15/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	63
UN09	16	Unnamed tributary	Reed River	67.19412	-154.88269	7/15/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	63
UN09	16	Unnamed tributary	Reed River	67.19412	-154.88269	7/15/2012	Minnow Trap	NO FISH	–	–
RD01	16	Reed River	Kobuk River	67.19318	-154.88084	7/15/2012	Minnow Trap	NO FISH	–	–
RD01	16	Reed River	Kobuk River	67.19318	-154.88084	7/15/2012	Minnow Trap	NO FISH	–	–
RD01	16	Reed River	Kobuk River	67.19318	-154.88084	7/15/2012	Minnow Trap	NO FISH	–	–
RD02	16	Reed River	Kobuk River	67.06531	-154.81343	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	47
RD02	16	Reed River	Kobuk River	67.06531	-154.81343	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	55
RD02	16	Reed River	Kobuk River	67.06531	-154.81343	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	49
RD02	16	Reed River	Kobuk River	67.06531	-154.81343	7/21/2012	Minnow Trap	NO FISH	–	–
RD02	16	Reed River	Kobuk River	67.06531	-154.81343	7/21/2012	Visual Observation	Arctic Grayling	juvenile/adult	–
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
AL01	24	Alatna River	Koyukuk River	67.18136	-153.48386	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
UN25a	24	Unnamed tributary	Alatna River	67.22524	-153.55644	7/23/2012	Visual Observation	Chum Salmon	adult	–
UN25b	24	Unnamed tributary	Alatna River	67.22868	-153.59320	7/23/2012	Visual Observation	Chinook Salmon	adult	–
UN13	25	Unnamed tributary	Malamute Fork Alatna River	67.06966	-153.11984	7/16/2012	Minnow Trap	NO FISH	–	–
UN13	25	Unnamed tributary	Malamute Fork Alatna River	67.06966	-153.11984	7/16/2012	Minnow Trap	NO FISH	–	–
UN13	25	Unnamed tributary	Malamute Fork Alatna River	67.06966	-153.11984	7/16/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	94
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Minnow Trap	NO FISH	–	–
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Minnow Trap	NO FISH	–	–
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Minnow Trap	NO FISH	–	–
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Dipnet	Coho Salmon	juvenile	46
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Dipnet	Coho Salmon	juvenile	48
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Dipnet	Chum Salmon	juvenile	38
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Dipnet	Chum Salmon	juvenile	44
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Dipnet	Coho Salmon	juvenile	47
UN14	25	Unnamed tributary	Malamute Fork Alatna River	67.11074	-152.93070	7/16/2012	Dipnet	Coho Salmon	juvenile	47
UN15	25	Unnamed tributary	Malamute Fork Alatna River	67.10036	-152.74847	7/16/2012	Minnow Trap	Coho Salmon	juvenile	58
UN15	25	Unnamed tributary	Malamute Fork Alatna River	67.10036	-152.74847	7/16/2012	Minnow Trap	Coho Salmon	juvenile	57
UN15	25	Unnamed tributary	Malamute Fork Alatna River	67.10036	-152.74847	7/16/2012	Minnow Trap	NO FISH	–	–
UN15	25	Unnamed tributary	Malamute Fork Alatna River	67.10036	-152.74847	7/16/2012	Minnow Trap	NO FISH	–	–
TB01	25	Tobuk Creek	Malamute Fork Alatna River	67.07944	-153.18635	7/16/2012	Minnow Trap	NO FISH	–	–

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
TB01	25	Tobuk Creek	Malamute Fork Alatna River	67.07944	-153.18635	7/16/2012	Minnow Trap	NO FISH	–	–
TB01	25	Tobuk Creek	Malamute Fork Alatna River	67.07944	-153.18635	7/16/2012	Minnow Trap	NO FISH	–	–
TB01	25	Tobuk Creek	Malamute Fork Alatna River	67.07944	-153.18635	7/16/2012	Electrofishing	Coho Salmon	juvenile	69
TB01	25	Tobuk Creek	Malamute Fork Alatna River	67.07944	-153.18635	7/16/2012	Electrofishing	Chinook Salmon	juvenile	74
BD01	25	Bedrock Creek	Malamute Fork Alatna River	67.09796	-152.60043	7/17/2012	Minnow Trap	NO FISH	–	–
BD01	25	Bedrock Creek	Malamute Fork Alatna River	67.09796	-152.60043	7/17/2012	Minnow Trap	NO FISH	–	–
BD01	25	Bedrock Creek	Malamute Fork Alatna River	67.09796	-152.60043	7/17/2012	Minnow Trap	NO FISH	–	–
UN18	25	Unnamed tributary	Bedrock Creek	67.09319	-152.72504	7/17/2012	Minnow Trap	NO FISH	–	–
UN18	25	Unnamed tributary	Bedrock Creek	67.09319	-152.72504	7/17/2012	Minnow Trap	NO FISH	–	–
UN18	25	Unnamed tributary	Bedrock Creek	67.09319	-152.72504	7/17/2012	Minnow Trap	NO FISH	–	–
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	7/17/2012	Minnow Trap	NO FISH	–	–
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	7/17/2012	Minnow Trap	NO FISH	–	–
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	7/17/2012	Minnow Trap	NO FISH	–	–
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	7/17/2012	Electrofishing	Arctic Grayling	juvenile	104
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	7/17/2012	Electrofishing	Arctic Grayling	juvenile	41
SZ01	31	East Fork Sozhekla Creek	Sozhekla Creek	67.03600	-152.41211	7/17/2012	Electrofishing	Arctic Grayling	juvenile	39
UN17	32	Unnamed tributary	Malamute Fork John River	67.04867	-152.12669	7/17/2012	Minnow Trap	NO FISH	–	–
UN17	32	Unnamed tributary	Malamute Fork John River	67.04867	-152.12669	7/17/2012	Minnow Trap	NO FISH	–	–
UN17	32	Unnamed tributary	Malamute Fork John River	67.04867	-152.12669	7/17/2012	Minnow Trap	NO FISH	–	–
UN17	32	Unnamed tributary	Malamute Fork John River	67.04867	-152.12669	7/17/2012	Dipnet	Coho Salmon	juvenile	59
UN20	35	Unnamed tributary	South Fork Koyukuk River	66.67128	-151.48851	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	39
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	29

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	35
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	32
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	33
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	30
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	31
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	29
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	34
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	29
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	26
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Arctic Grayling	juvenile	137
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	85
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	76
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	80
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	77
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	77
UN21	36	Unnamed tributary	South Fork Koyukuk River	66.82559	-151.17087	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	70
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	55
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	62
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	49
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	76
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	33
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	72
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	49
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	72
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	47
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Arctic Grayling	juvenile	97
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	55
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	66
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	55
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	52
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	61
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Coho Salmon	juvenile	55
UN19	38	Unnamed tributary	Jim River	66.78889	-150.85132	7/20/2012	Electrofishing	Chinook Salmon	juvenile	48
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	81
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	81
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	79
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	86
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	75
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	91
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	72
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	37
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	40
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	55
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	29
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	31
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Slimy Sculpin	juvenile/adult	31
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Coho Salmon	juvenile	62
UN24	39	Unnamed tributary	Jim River	66.83560	-150.64531	7/23/2012	Electrofishing	Coho Salmon	juvenile	61
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Minnow Trap	NO FISH	–	–
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Minnow Trap	NO FISH	–	–
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Minnow Trap	NO FISH	–	–
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Minnow Trap	NO FISH	–	–

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Arctic Grayling	juvenile	38
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Arctic Grayling	juvenile	41
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Arctic Grayling	juvenile	39
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Chum Salmon	juvenile	38
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Chum Salmon	juvenile	36
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	46
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
RD03	S2	Reed River	Kobuk River	66.96365	-154.81606	7/21/2012	Electrofishing	Burbot	juvenile	156
KB01	S3	Kobuk River	None	67.02165	-154.35763	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	78
KB01	S3	Kobuk River	None	67.02165	-154.35763	9/4/2012	Minnow Trap	NO FISH	–	–
KB01	S3	Kobuk River	None	67.02165	-154.35763	9/4/2012	Minnow Trap	NO FISH	–	–
KB01	S3	Kobuk River	None	67.02165	-154.35763	9/4/2012	Visual Observation	Chum Salmon	adult	–
KB01	S3	Kobuk River	None	67.02165	-154.35763	9/4/2012	Visual Observation	Chum Salmon	adult	–
UN32	S3	Unnamed tributary	Kobuk River	66.89105	-154.47314	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	101
UN32	S3	Unnamed tributary	Kobuk River	66.89105	-154.47314	9/4/2012	Minnow Trap	NO FISH	–	–
UN32	S3	Unnamed tributary	Kobuk River	66.89105	-154.47314	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	92
UN33	S3	Unnamed tributary	Kichaiakalea Creek	67.05337	-154.14697	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	56
UN33	S3	Unnamed tributary	Kichaiakalea Creek	67.05337	-154.14697	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	86
UN33	S3	Unnamed tributary	Kichaiakalea Creek	67.05337	-154.14697	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	87
UN33	S3	Unnamed tributary	Kichaiakalea Creek	67.05337	-154.14697	9/4/2012	Minnow Trap	NO FISH	–	–
UN34	S3	Unnamed tributary	Kobuk River	67.01901	-154.44464	9/4/2012	Minnow Trap	Dolly Varden	juvenile	128
UN34	S3	Unnamed tributary	Kobuk River	67.01901	-154.44464	9/4/2012	Minnow Trap	Dolly Varden	juvenile	130
UN34	S3	Unnamed tributary	Kobuk River	67.01901	-154.44464	9/4/2012	Minnow Trap	NO FISH	–	–
UN34	S3	Unnamed tributary	Kobuk River	67.01901	-154.44464	9/4/2012	Minnow Trap	NO FISH	–	–
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	101

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	96
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	65
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	87
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Dolly Varden	juvenile	146
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Dolly Varden	juvenile	116
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Dolly Varden	juvenile	131
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	68
UN35	S3	Unnamed tributary	Kobuk River	67.00066	-154.55439	9/4/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	95
UN36	S3	Unnamed tributary	Kobuk River	66.91783	-154.48701	9/5/2012	Minnow Trap	NO FISH	–	–
UN36	S3	Unnamed tributary	Kobuk River	66.91783	-154.48701	9/5/2012	Minnow Trap	NO FISH	–	–
UN36	S3	Unnamed tributary	Kobuk River	66.91783	-154.48701	9/5/2012	Minnow Trap	NO FISH	–	–
UN37	S3	Unnamed tributary	Kichaiakalea Creek	67.02964	-154.01124	9/7/2012	Minnow Trap	Dolly Varden	juvenile	128
UN37	S3	Unnamed tributary	Kichaiakalea Creek	67.02964	-154.01124	9/7/2012	Minnow Trap	Dolly Varden	juvenile	147
UN37	S3	Unnamed tributary	Kichaiakalea Creek	67.02964	-154.01124	9/7/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	79
UN37	S3	Unnamed tributary	Kichaiakalea Creek	67.02964	-154.01124	9/7/2012	Minnow Trap	NO FISH	–	–
UN37	S3	Unnamed tributary	Kichaiakalea Creek	67.02964	-154.01124	9/7/2012	Minnow Trap	NO FISH	–	–
UN37	S3	Unnamed tributary	Kichaiakalea Creek	67.02964	-154.01124	9/7/2012	Minnow Trap	NO FISH	–	–
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Minnow Trap	NO FISH	–	–
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Minnow Trap	NO FISH	–	–
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Minnow Trap	NO FISH	–	–
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Minnow Trap	NO FISH	–	–
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Electrofishing	Arctic Grayling	juvenile	122
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Electrofishing	Arctic Grayling	juvenile	123
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Electrofishing	Arctic Grayling	juvenile	115
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Electrofishing	Slimy Sculpin	juvenile/adult	73
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Electrofishing	Slimy Sculpin	juvenile/adult	34
UN38	S3	Unnamed tributary	Kobuk River	66.99846	-154.54691	9/7/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
RD04	S4	Reed River	Kobuk River	66.88630	-154.83643	9/4/2012	Visual	Chum Salmon	adult	–

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
							Observation			
UN23	S5	Unnamed tributary	Hogatza River	66.85331	-154.29780	7/21/2012	Electrofishing	Arctic Grayling	juvenile	121
UN23	S5	Unnamed tributary	Hogatza River	66.85331	-154.29780	7/21/2012	Electrofishing	Arctic Grayling	juvenile	55
UN23	S5	Unnamed tributary	Hogatza River	66.85331	-154.29780	7/21/2012	Electrofishing	Arctic Grayling	juvenile	51
UN23	S5	Unnamed tributary	Hogatza River	66.85331	-154.29780	7/21/2012	Electrofishing	Arctic Grayling	juvenile	57
UN23	S5	Unnamed tributary	Hogatza River	66.85331	-154.29780	7/21/2012	Electrofishing	Arctic Grayling	juvenile	63
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	46
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	69
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	72
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	77
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	56
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	66
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	61
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Visual Observation	Chum Salmon	adult	–
HG01	S6	Hogatza River	Koyukuk	66.82131	-153.99037	7/21/2012	Visual Observation	Chum Salmon	adult	–
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	78
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	70
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	72
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	89
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	54

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	59
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	52
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	36
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	38
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	32
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	29
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	64
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	78
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	51
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	53
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	66
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	84
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	85
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	42
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	58
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	57

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	48
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	56
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	45
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	63
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	77
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	67
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	44
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	87
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	81
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	87
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	69
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	70
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	73
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	78
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	75
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	61
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	72
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	62
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	50
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	71

Appendix C. Continued.

Survey Reach	Nearest Crosssing[a]	Waterbody	Tributary to	Latitude °N	Longitude °W	Date	Sampling Method	Species	Life History Stage	Length (mm)
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	74
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	60
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	68
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Slimy Sculpin	juvenile/adult	65
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Burbot	juvenile	115
UN22	S6	Unnamed tributary	Hogatza River	66.86933	-154.04053	7/21/2012	Electrofishing	Burbot	juvenile	119
HJ01	S7	Helpmejack Creek	Alatna River	67.05835	-153.79528	7/16/2012	Minnow Trap	NO FISH	–	–
HJ01	S7	Helpmejack Creek	Alatna River	67.05835	-153.79528	7/16/2012	Minnow Trap	Dolly Varden	juvenile	86
HJ01	S7	Helpmejack Creek	Alatna River	67.05835	-153.79528	7/16/2012	Minnow Trap	NO FISH	–	–
HJ01	S7	Helpmejack Creek	Alatna River	67.05835	-153.79528	7/16/2012	Electrofishing	Dolly Varden	juvenile	122
HJ02	S7	Helpmejack Creek	Alatna River	67.04015	-153.66203	7/16/2012	Minnow Trap	NO FISH	–	–
HJ02	S7	Helpmejack Creek	Alatna River	67.04015	-153.66203	7/16/2012	Minnow Trap	NO FISH	–	–
HJ02	S7	Helpmejack Creek	Alatna River	67.04015	-153.66203	7/16/2012	Minnow Trap	NO FISH	–	–
HJ02	S7	Helpmejack Creek	Alatna River	67.04015	-153.66203	7/16/2012	Visual Observation	Arctic Grayling	adult	–
UN16	S7	Unnamed tributary	Helpmejack Creek	67.04146	-153.66153	7/16/2012	Minnow Trap	NO FISH	–	–
UN16	S7	Unnamed tributary	Helpmejack Creek	67.04146	-153.66153	7/16/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	86
UN16	S7	Unnamed tributary	Helpmejack Creek	67.04146	-153.66153	7/16/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	81
UN16	S7	Unnamed tributary	Helpmejack Creek	67.04146	-153.66153	7/16/2012	Minnow Trap	Slimy Sculpin	juvenile/adult	57
UN16	S7	Unnamed tributary	Helpmejack Creek	67.04146	-153.66153	7/16/2012	Minnow Trap	Dolly Varden	juvenile	94
UN16	S7	Unnamed tributary	Helpmejack Creek	67.04146	-153.66153	7/16/2012	Minnow Trap	Dolly Varden	juvenile	85

[a] Refer to Figure 2 for the location of crossing codes

STREAM HABITAT SURVEYS OF PROPOSED BRIDGE CROSSINGS ON THE BROOKS EAST CORRIDOR

Prepared for

DOWL HKM
4041 B Street
Anchorage, AK 99503

by

ABR, Inc.—Environmental Research & Services
P.O. Box 240268
Anchorage, AK 99524

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INTRODUCTION

The Ambler Mining District Access Project is a State of Alaska undertaking with the objective of identifying, designing, and constructing an access and transportation corridor to the Ambler mineral belt. Of the several preliminary corridors that were initially evaluated for development potential, 1 has been selected for field work in preparation for regulatory requirements defined by the National Environmental Policy Act (NEPA) process. The proposed corridor, referred to as the Brooks East Corridor, extends east from the Ambler mineral belt to the Dalton Highway (Figure 1). DOWL HKM contracted ABR, Inc.—Environmental Research & Services (ABR) on behalf of the Alaska Industrial Development and Export Authority (AIDEA) to characterize fish and aquatic habitat resources along the Brooks East Corridor.

In 2012, ABR conducted field surveys to sample for the presence of resident and anadromous fish species in streams crossed by the proposed corridor (Lemke et al. 2013). Fish species not previously described in the area were reported to the Alaska Department of Fish & Game (ADFG) for inclusion in the "Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes," known as the Anadromous Waters Catalog (AWC; ADFG

2013). As a result of the 2012 surveys, 175.5 km of streams were identified for nomination to the AWC for Pacific salmon (Lemke et al. 2013). Furthermore, 272.6 km of stream were identified as potential Dolly Varden (*Salvelinus malma*) habitat for inclusion in the ADFG Alaska Freshwater Fish Index (AFFI) (Lemke et al. 2013). Official AWC nominations from the 2012 sampling occurred in September 2013 and the catalog will reflect these nominations in the spring of 2014 (Appendix A) (ADFG 2013).

In 2013, ABR's summer field survey efforts focused on stream and riparian habitat assessments at proposed bridge crossings along the corridor. Fish sampling was not conducted in 2013. This report summarizes the 2013 stream habitat surveys and integrates these results with data on known fish assemblages in those waterbodies.

BACKGROUND

The Magnuson-Stevens Fishery Conservation and Management Act is federal legislation mandating conservation and protection of fishery resources while optimizing harvests of commercial fish stocks. Among the Act's mandates is a requirement for the protection of Essential Fish Habitat (EFH) utilized by fish species, including Pacific salmon, which have been assigned a federal management plan. For anadromous salmon in Alaska, EFH includes both freshwater and marine habitats. Where Pacific salmon are present in Alaskan freshwaters, the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service (NOAA Fisheries) is the agency with primary management authority over the fish and their habitat.

In addition to federal management, the Alaska state constitution describes the state's mandate to maintain proper functioning and connectivity of aquatic habitats, along with proper management of harvests to preserve sustained yields of anadromous fish. Consequently, in Alaska, habitats that are used by migrating, spawning, or rearing anadromous fish are protected under multiple administrative jurisdictions, including the Alaska Statute (AS) 16.05.877 (the Anadromous Fish Act) (Buckwalter 2010). Furthermore, the ADFG AWC serves to designate these anadromous habitats in Alaska.

The following survey was conducted with the notion that the state and federal permits necessary to proceed with the Ambler Mining District Access Project will require knowledge of potential impacts to any fish habitat that may be traversed by the proposed road.

OBJECTIVES

- Objective 1: Document the stream habitat conditions in waterbodies associated with potential bridge crossings along the Brooks East Corridor
- Objective 2: Integrate stream habitat and fish presence data from the study area to determine potential impacts of bridge construction on stream habitat

STUDY AREA

The Brooks East Corridor crosses numerous rivers, large creeks, and smaller waterbodies along its ~200 mile length. As defined in the United States Geological Survey's National Hydrography Dataset (USGS NHD) (USGS 2013), the proposed Brooks East Corridor crosses 7 subbasins (NHD fourth level: the Middle Kobuk River, Upper Kobuk River, Alatna River, Allakaket, Upper Koyukuk River, Koyukuk Flats, and South Fork Koyukuk River) and 19 watersheds (NHD fifth level; Figure 2). The current corridor is described as a "preferred" route with alternative routes along 2 relatively short stretches: a 23-km "northern option" near the western end of the corridor which runs roughly parallel to, and north of the Manuleak River (the proposed route runs roughly parallel to, and south of the Manuleak River) and a 94-km "southern option" near the middle of the corridor where it passes through the Gates of the Arctic National Preserve (Figure 2). Survey locations for the 2013 sampling effort were preselected by DOWL HKM personnel at 18 bridge crossings that have been identified and studied to some degree by Project personnel between the Shungnak River and the Jim River, though additional potential bridge crossings undoubtedly will be identified going forward.

METHODS

Aquatic sampling surveys occurred during 12–23 August 2013 and coincided with a period of low river flow which facilitated the differentiation of habitat segments and allowed safe wading by Project personnel. The ABR survey team was composed of 3 aquatic biologists who were accompanied by a local subsistence advisor, Allen A. Tickett, courtesy of DOWL HKM, with special knowledge of the study area. The survey team accessed each sample location by Bell 407 helicopter operated by Bristow Group, Inc. Surveys were generally conducted from west to east in the Brooks East Corridor, starting at the Shungnak River and ending at the Jim

River (Figure 1). Sampling priority was given to bridge crossings along the preferred corridor, followed by the northern and southern road options.

ABR stream habitat surveys focused on the largest waterbodies along the corridor and occurred approximately 1,000 ft upstream and 1,000 ft downstream of each proposed bridge crossing unless ground or water conditions reduced accessibility and dictated a shorter survey segment. Upon arriving at sample locations, the survey team flew over the entire 2,000 ft river survey reach centered on the proposed bridge crossing from an altitude of ~50–100 ft. During flight, video footage of the waterbody was collected using a Lumix TS3 digital camera and a GoPro Hero 3. This fly-over allowed the survey team to make an initial assessment of stream and riparian habitat, select possible habitat transect locations, and locate helicopter landing zones. Once on the ground, survey team members walked as much of the 2,000 ft reach as feasible, sketching a rough map along the way. These sketches served to highlight instream substrate transition zones, run-riffle-pool sequences, riparian vegetation, and other stream features (e.g., exposed gravel bars). GPS coordinates were recorded using a DeLorme Earthmate PN-60 to demarcate transition zones and notable reach characteristics. Additional photo-documentation was completed to compliment stream sketches.

After the initial assessment of stream features, the survey team selected 1–3 instream cross-sectional habitat transects at various points along the stream reach. Reaches with uniform flow regimes and homogeneous substrate generally warranted a single habitat transect. Reaches with heterogeneous instream features warranted 2–3 transects. Once habitat transect locations were identified, survey team members recorded the date, time, and latitude and longitude (decimal degrees) of each transect. Next, ambient water quality measurements were collected using a YSI Professional Plus multiparameter meter. Variables measured were temperature (° C), pH, specific conductance (µS/cm), and dissolved oxygen (mg/L and %). A 250 ml water sample was collected for measurement of turbidity (in nephelometric turbidity units; NTU) using a Hach 2100P Turbidometer. The 48-hour precipitation level (low, medium, high), water color (clear, ferric, glacial-high turbidity, glacial-low turbidity, humic, muddy), and stream stage (dry, low, medium, high) were assessed qualitatively and recorded.

Instream channel characteristics along the habitat transect were recorded using a measuring tape, survey rod, and clinometer. Variables collected were wetted width (m), bankfull width (m),

thalweg depth (m), stream gradient (%), and bank angle (°). Instream substrate composition was recorded along the transect after walking from bank to bank. Substrate was recorded as a percentage of bedrock, boulder, cobble, gravel, sand, silt, and clay and totaled 100%. Depending on flow and turbidity, substrate photos were taken along each transect. Instream channel cover was assessed for the presence of filamentous algae and periphyton, macrophytes, large woody debris (diameter greater than 0.3 m), small woody debris (diameter less than 0.3 m), live tree roots, overhanging vegetation, undercut bank, boulders, and artificial structures. Each parameter was expressed as a qualitative percentage of the total stream cover within 10 m upstream and downstream of the habitat transect and noted as absent (0%), sparse (less than 10%), moderate (10–40%), moderately abundant (40–75%), and abundant (greater than 75%).

Riparian vegetation was described for the left and right bank (facing downstream) within 10 m of the water's edge width along the habitat transect. Riparian vegetation was categorized as ground cover (vegetation less than 0.5 m), understory (0.5–5 m), and canopy (greater than 5 m). Vegetation type (coniferous, deciduous, or mixed) and percent cover were recorded for ground cover, understory, and canopy using the same qualitative percentage scale as instream channel cover.

Flow (m/s) and depth (m) were measured at up to 10 equally spaced points along the transect using a Marsh McBirneyFlo-Mate 2000 portable flow meter and top-setting wading rod. Stream discharge (m^3/s) for each sample site was calculated from the cross sectional water velocities and depth data. At least 4 photos were taken from the middle of each stream transect of the surrounding habitat looking upstream, downstream, towards left bank, and towards right bank. Following completion of habitat surveys at any given sample location, additional high-definition video was recorded from the air between proposed bridge crossings along the road corridor.

RESULTS AND DISCUSSION

ABR surveyed a total of 28 instream habitat transects in 14 waterbodies over 11 days of sampling during August 2013 field studies on the Brooks East Corridor Project (Figure 1, Appendix B). The waterbodies surveyed in the Project corridor include or flow into 1 of 2 major drainages; the Kobuk River or the Koyukuk River. Most streams in the Project corridor follow a

general north to south flow before reaching the Kobuk River or Koyokuk River (Figure 1). Habitat results are first presented for stream crossings along the preferred option, followed by stream crossings along the northern option and then the southern option. Some streams are crossed by more than one potential proposed corridor option. Detailed photographic records were kept at each stream crossing (see Plates). Additionally, a total of 3 hours of video footage was recorded of the corridor, including stream crossings, and is included as a supplemental DVD attached to the final report. Recent aerial photography obtained by DOWL HKM in 2012 was juxtaposed with aerial imagery from the 1970s and 1980s for each stream crossing (Appendix C), allowing a comparison of habitat changes (or lack thereof) over time. Finally, ambient water chemistry parameters were sampled at each stream crossing and provide a snapshot of stream conditions during August 2013 surveys (Appendix D). The following is a summary of habitat survey findings for each of the 18 stream crossings.

PROPOSED ROUTE

SHUNGNAK RIVER

The westernmost significant river crossing of the Brooks East Corridor is the Shungnak River (Figure 1). The Shungnak River flows ~95 miles from its headwaters in the Brooks Range to its confluence with the Kobuk River near the village of Kobuk. During 2012 fish surveys (Lemke et al. 2013), Slimy Sculpin (*Cottus cognatus*) and Arctic Grayling (*Thymallus arcticus*) were caught on the main body of the Shungnak River. Slimy Sculpin and Arctic Grayling were also captured on nearby Ruby Creek, a tributary to the Shungnak River. No Pacific salmon were caught or observed during those surveys. During physical habitat surveys in 2013, survey crew members observed juvenile Arctic Grayling in the 2,000-ft reach. The AWC shows no record of Pacific salmon in the Shungnak River as of November 2013 (Table 1).

ABR mapped and characterized the stream crossing reach and performed 3 instream habitat transect surveys on 12 August 2013 (Figure 3, Appendix B) (Plates 1–3). Most of the 2,000-ft reach at the Shungnak River crossing is a shallow (less than 1 m) riffle-run flow regime composed of boulder, cobble, gravel, and sand substrate. However, Transect 1 (SH-T1-13) is representative of the slackwater pool habitat available in this reach and substrate composition was dominated by fine sediment (80% silt and clay) rendering most of this transect unwadeable

due to the soft bottom. Transects 2 (SH-T2-13) and 3 (SH-T2-13) were upstream in shallow riffle-run habitat and substrate was dominated by gravel (40%) and cobble (30–35%). The majority of the reach provides good fish spawning habitat in the form of mixed gravel and cobble substrate. The downstream portion in the area of Transect 1 provides more slow moving water and fish refuge habitat than most of the sampled reach. Average flow measured at 2 transects was ~10.5 m^3/s (Table 2).

Instream cover was sparse to moderately abundant. Transect 1 had moderate cover of macrophytes with sparse woody debris, filamentous algae, boulders, and overhanging vegetation. Transect 2 had sparse small woody debris, boulders, and overhanging vegetation. Transect 3 had moderate filamentous algae, overhanging vegetation, and undercut bank with sparse woody debris, live tree roots, and boulders. Most instream cover in this stream reach would provide refuge to smaller fish.

On all 3 transects, tall (greater than 5 m height) riparian canopy of black spruce (*Picea mariana*) occurred on one bank and no tall cover occurred on the opposite bank. Willow (*Salix* spp.) and tall grasses made up the majority of the understory (0.5–5 m in height), though a high percentage (30%) of understory at Transect 2 was composed of shrubs and berry plants. Ground cover vegetation (less than 0.5 m in height) varied by transect. Most of the stream margin shade was located in the middle portion of the reach. Bank stability appeared to be good as the channel has not changed markedly since 1978 (Appendix C).

KOGOLUKTUK RIVER

The next major river crossing on the Brooks East Corridor is the Kogoluktuk River, a ~98-mile-long river which flows into the Kobuk River east-northeast of the village of Kobuk (Figure 1). During 2012 fish surveys, ABR electrofished the mainstem of the river, capturing Slimy Sculpin. Juvenile Dolly Varden (*Salvelinus malma*) were captured in baited minnow traps on Riley Creek, a tributary to the Kogoluktuk River and Slimy Sculpin and Arctic Grayling also were observed on an unnamed tributary to Riley Creek (Table 1). In 2013, ABR observed several Arctic Grayling (*Thymallus arcticus*) in a side channel near a habitat survey transect and at least one adult Arctic Grayling was caught by the Project subsistence advisor using rod and reel. The AWC lists spawning Chum Salmon (*Oncorhynchus keta*), Dolly Varden, and whitefish

(*Coregonus* spp.) as present in the Kogoluktuk River. No Pacific salmon were observed by ABR during either 2012 or 2013 surveys.

ABR mapped and characterized the stream crossing reach and performed 2 instream habitat transect surveys on 13 August 2013 (Figure 4, Appendix B) (Plates 4–6). The segment of stream covered by the 2,000-ft reach was generally shallow, wadeable, and wide throughout (Appendix B). Both transects measured over 100 m bankfull width. The downstream end of the stream reach separated into a main and side channel. The main channel in this segment of stream was ~1 m deep but unwadeable due to high flow rates.

Instream substrate throughout the reach was relatively uniform, with a mixture of sand, gravel, and cobble. Transect 1 (KG-T1-13) crossed the main channel of the river, over a sand bar, and through side-channel habitat. The sand bar would be completely inundated at slightly higher water levels. Instream substrate on Transect 1 was composed of more sand (90%) than other parts of the 2,000-ft reach, perhaps because of its location downstream of a bend in the river where reduced water velocity allows sand to settle out. Transect 1 also crossed a side-channel where cobble and gravel made up ~45% of substrate (Table 2, Appendix B). The stream was relatively shallow in the area of Transect 2 (KG-T2-13) and the substrate was divided nearly evenly between cobble (30%), gravel (30%), and sand (40%). These mixed substrates may provide significant spawning habitat for fish. Furthermore, the run-pool flow regime of most of the 2,000-ft reach would provide abundant refuge habitat for fish. Average estimated discharge for the 2 transects was 23.86 m^3/s.

Instream cover was generally sparse or absent in both Transect 1 and Transect 2. Some small woody debris was present in both transects, and sparse boulders were present at Transect 1. At Transect 2, there was sparse overhanging vegetation but moderate amounts of filamentous algae. Most of the available instream cover at the Kogoluktuk River crossing would be suitable for smaller fishes (e.g., Slimy Sculpin) in the form of mixed cobble and gravel.

At Transect 1, there was no riparian tall canopy within 10 m of the river on the left bank, while riparian tall canopy covered 50% of the ground within 10 m of the river on the right bank. Understory cover on the left bank was minimal (10%) and consisted of willow and tall grasses. On the right bank, the understory was dominated by willow, alder, and tall grass/shrubs. Ground

cover was limited on the left bank with 75% of the ground bare. On the right bank, ground cover was 90% and composed of grasses and small shrubs. At Transect 2, tall riparian cover on the left and right bank of the river covered 10% of the ground. Understory cover was composed of willow, alder, and tall grasses and was complete on the left bank moderate on the right bank. Ground cover on the left and right banks was abundant with grasses, shrubs, and saplings (90–95%). During the summer months, shade refuge would be most available to fish in the middle portion of the reach along the right bank of the bend in the river (Figure 4). The channel in the crossing reach does not appear to have changed markedly between 1978 and 2012 (Appendix C).

MAUNELUK RIVER

The next Brooks East Corridor crossing is the Mauneluk River, a ~114-mile-long tributary that flows into the Kobuk River ~16 miles east of the village of Kobuk (Figure 1). During 2012 surveys of the Mauneluk River and its tributaries, Chum Salmon, Dolly Varden, Slimy Sculpin, Northern Pike (*Esox lucius*), and Arctic Grayling were observed. Past nominations to the AWC reference whitefish and Chum Salmon on the Mauneluk River. ABR submitted nominations to extend the known upstream presence of Chum Salmon on the Maneuluk River by 84.2 km based on 2012 survey results (Table 1, Appendix A). Numerous large Arctic Grayling were caught using rod and reel by the subsistence advisor during ABR habitat field surveys in 2013. Additionally, Chum Salmon were observed spawning at the downstream extent of the surveyed reach near a point where the river braids into 3 sections (Figure 5).

ABR performed partial habitat surveys at observation points on 13 August 2013 (Figure 5, Appendix B) (Plates 7–8). Transects could not be conducted from bank to bank due to unwadeable conditions on most of the 2,000-ft reach. Efforts to find a suitable crossing in the reach by floating the stream with a packraft were unsuccessful due to a combination of high water velocities or the presence of deep pools. Discharge was measured downstream at an area where the stream braids into 3 channels, though this area lies outside the survey reach. Discharge was estimated at 34.4 m^3/s (Table 2).

Within the 2,000-ft reach, downstream portions of the left bank were unwadeable due to deep pools while upstream portions of the right bank were unwadeable due to water velocity. Thus, 2 partial transects were completed at stream observation points. Instream substrate at the

upstream observation point (MN-T1-13), located in the middle to upper portion of the survey reach, was composed primarily of cobble and gravel (85%) with some sand (15%) and appeared typical of most of the rest of the reach. The second observation point (MN-T2-13) was located downstream of MN-T1-13 at a transition zone before the stream split into multiple channels. In this area of stream the channel widened and water velocities diminished somewhat allowing sand to settle. The percentage of sand increased to 40% and cobble and gravel decreased to 60% in this part of the reach (Table 2, Appendix B). Most of the reach provides excellent mixed gravels as spawning substrate for fish along with deep pools for resting or refuge.

Instream cover along the partial transects differed by location. MN-T1-13 had moderate cover of filamentous algae along with sparse big and small woody debris, live tree roots, and overhanging vegetation. This partial transect was representative of much of the reach, suggesting plentiful cover for fish and other stream organisms. MN-T2-13 had moderate cover by filamentous algae and overhanging vegetation with sparse cover by macrophytes and woody debris, but was less representative of the reach as a whole.

At MN-T1-13, riparian cover was almost completely absent within 10 m of shore on the right bank and it was clear that this area is submerged at higher flows. The left bank had limited spruce and alder (30%) canopy while the understory cover was 100% and consisted of willow, alder, and spruce. Ground cover of small grasses and saplings was almost 100%. The left bank of the proposed bridge crossing appears to have good stability due to vegetation and provides stream shade for fish. The proposed crossing passes through side-channel habitat where rearing fish likely are present (Figure 5). At the downstream extent of the reach, at MN-T2-13, there was no canopy on the right bank while spruce, alder, and birch made up 80% of canopy cover on the left bank. Willow and alder dominated the understory on both banks. There was little bare ground on either bank with small grass and herbaceous vegetation dominating both banks providing additional bank stability. The channel appears to have widened slightly in the upper and lower portions of the reach and sand bars appear to have grown somewhat in the period between 1981 and 2012 (Appendix C).

BEAVER CREEK

Beaver Creek is a ~84-mile stream that joins the Kobuk River between the confluences of the Mauneluk River and Reed River. Its confluence with the Kobuk River occurs just west of the Reed River, ~7 miles south of Lake Minakokosa (Figure 1). The area of the proposed bridge crossing occurs west of Sun Camp, a seasonal mining support encampment with an airstrip. In 2012, ABR biologists sampled Beaver Creek and several unnamed tributaries. Dolly Varden and Burbot (*Lota lota*) were captured in tributaries while Slimy Sculpin and Arctic Grayling were captured in Beaver Creek. No fish were observed during the 2013 physical habitat surveys. The AWC lists Chum Salmon as present in Beaver Creek (Table 1).

The stream reach was a roughly straight, shallow segment of stream with a riffle-run flow regime (Figure 6). Limited pool habitat available was available in the reach, with the most significant pool located near the inlet to an ephemeral side channel which had no water and was not sampled during our survey. The reach was shallow (less than 1 m deep) and water velocities slow enough that the stream was completely wadeable. Discharge estimates averaged 7.8 m^3/s. ABR performed 2 habitat transect surveys on 14 August 2013 (Figure 6, Appendix B) (Plates 9–10). Transect 1 (BV-T1-13) was located in a shallow run in which the substrate was composed of cobble (50%), gravel (25%), and boulder (15%). Transect 2 (BV-T2-13) was located upstream near a pool-riffle-run sequence with nearly equal parts boulder, cobble, gravel, and sand. With high quantities of boulder and cobble, the reach may not be ideal spawning habitat for salmon.

Instream cover was widely available in the stream reach. Abundant filamentous algae and periphyton were present at both habitat survey transects. Sparse macrophyte cover, small woody debris, and undercut banks with moderate overhanging vegetation and boulder cover were present at both habitat transects. Sparse live tree roots were present along the stream banks at Transect 2. The reach would provide good cover for fish throughout, particularly with the addition of side channel habitat at higher flows (Table 2, Figure 6).

Riparian cover varied by transect location. A low percentage of spruce canopy (10%) was present at both transects. There was significant understory cover (90%) at Transect 1 composed of willow, short spruce, tall grasses, and herbaceous vegetation. Understory cover was only 30% on Transect 2. There was very little ground cover in the riparian zone of either transect

(Appendix B). However, stream banks appear to be stable and the channel does not appear to have changed markedly since 1981 (Appendix C). High cliff banks were present throughout most of the middle portion of the reach on the right bank and in downstream portions of the reach on the left bank, providing additional stream shade.

REED RIVER

The Reed River is a ~96-mile stream located in the Gates of the Arctic National Park between Beaver Creek and Walker Lake. Its confluence with the Kobuk River occurs ~5 miles east of Lake Minakokosa (Figure 1). During 2012 fish survey, ABR observed Chum Salmon (juvenile and adult), Slimy Sculpin, Arctic Grayling, and Burbot. Spawning Chum Salmon were observed during August 2013 habitat surveys. The AWC does not currently list Chum Salmon in the Reed River (Table 1). A nomination form has been submitted for the Reed River to add 30.3 km of anadromous waters to the AWC (Appendix A).

ABR performed 1 transect survey during stream habitat characterization on 15 August 2013 (Figure 7, Appendix B) (Plate 11). Waters within the 2,000-ft reach were a riffle-run-pool flow regime with significant pools formed at the outside bends in the river. A packraft was used to make a general characterization of the stream and its habitat and to determine the best location for the survey transect. Most waters in this reach were less than 1 m deep but only 1 completely wadeable transect was found. Stream substrate was relatively uniform throughout the reach and was composed of gravel (35%), sand (35%), cobble (20%), and boulder (10%). Discharge was estimated to be 26.5 m^3/s. Substrates in large pools located at the outside of bends of the reach appeared to have a high composition of sand, suggesting lower stream velocities at those points the river (Table 2). In general, spawning habitat for fish was abundant as confirmed by observations of spawning Chum Salmon.

Instream cover was even throughout the crossing reach. Filamentous algae were present in moderate portions. Macrophytes, small woody debris, live tree roots, overhanging vegetation, and boulders were sparse. Thus, fish cover is somewhat limited in this stream. Waters were clear and visibility was excellent during surveys, confirming the uniform nature of instream habitat availability. Deep pools probably provide the best fish refuge in this section of the Reed River.

Riparian habitat varied by location in the reach. Most canopy occurred on the inside of the river bends and was composed of spruce. No canopy was observed within 10 m of shore on the left bank as water levels were low and exposed a significant sandbar. Beyond the sandbar, a large spruce stand was present. On the right bank, there was sparse spruce canopy. Willow, alder, and small spruce provided about 60% cover in the understory. The ground was ~30% bare. Several high banks along with some spruce provide shade cover for fish. The absence of significant riparian vegetation and steep banks might suggest some bank instability, though no major change in the channel occurred between 1981 and 2012 (Table 2, Appendices C and D).

KOBUK RIVER

The Kobuk River is a ~280-mile river whose headwaters begin high in the Brooks Range. The river flows generally north to south past the east shores of Walker Lake and eventually winds through the Project corridor before turning west and advancing to the Chukchi Sea. All streams located west of this crossing in the Brooks East Corridor eventually flow into the Kobuk River (Figure 1). During 2012 fish surveys, ABR observed or captured Chum Salmon (juvenile and adult), Slimy Sculpin, Dolly Varden, and Arctic Grayling near the proposed crossing of the Kobuk River. Arctic Grayling also were observed by ABR in 2013. The AWC currently lists Chum Salmon, Chinook Salmon (*Oncorhynchus tshawytscha*) , Dolly Varden, Sheefish, and whitefish in the Kobuk River (Table 1).

Due to deep waters, ABR was unable to conduct a thorough ground survey of instream substrate throughout the 2,000-ft reach on the Kobuk River. Instead, the stream reach was observed from a hovering helicopter before landing downstream of the reach where waters were shallow enough to perform a sampling transect. Although outside the reach, the transect location appeared representative of habitat upstream in the reach (Figure 8, Appendix B) (Plates 12–13). Waters within the crossing reach were a riffle-run flow regime and discharge was estimated as 29.7 m^3/s on 15 August 2013 (Table 2). Significant side-channel habitat would be available to fish at higher water levels but this habitat was dry during our visit. On Transect 1 (KB-T1-13), substrate was composed of cobble (35%), gravel (35%), sand (25%), and boulders (5%). While flying over the reach, boulders appeared evenly scattered throughout the stream and there was no

indication that substrate in the rest of the reach was different from that observed on Transect 1. The evenly mixed substrate in the stream reach appeared ideal for fish spawning.

In general, instream habitat available to fish in the reach was evenly distributed and sparse to moderately abundant. On Transect 1, instream cover of macrophytes, small woody debris, live tree roots, undercut banks, and boulders was sparse. Filamentous algae and overhanging vegetation were moderately abundant (Table 2).

Riparian vegetation cover was similar throughout the reach but differed from left to right bank at any given location. Transect 1 left bank canopy was limited to willow and alder (25%), while the right bank had a dense cover (70%) of spruce, birch, and alder. The left bank understory was composed of grasses, willow, and berries and provided 50% cover while the right bank understory provided 100% cover from willow, alder, and spruce. Ground cover was nearly complete with herbaceous material, grass, and willow on both banks as well as some moss. In general, there was significant shade provided by canopy throughout the reach and good bank stability. Despite the appearance of meandering side-channels, the channel experienced only slight changes between 1981 and 2012 (Appendix C).

ALATNA RIVER

The ~338-mile-long Alatna River is the western-most major stream crossing in the Brooks East Corridor that flows into the Koyukuk River. The Alatna River joins with the Koyukuk River near the village of Allakaket (Figure 1). During 2012 fish surveys, ABR observed only Slimy Sculpin in the Alatna River. On tributaries to the Alatna River, including Helpmejack Creek and 2 unnamed streams, ABR observed Dolly Varden, Chum Salmon, Chinook Salmon, and Arctic Grayling. The AWC currently lists Chum Salmon, Chinook Salmon, and whitefish in the Alatna River. ABR did not observe any fish during 2013 habitat surveys on the Alatna River (Table 2).

ABR conducted habitat surveys of the crossing reach on the Alatna River on 17 August 2013 but found that waters were unwadeable and too deep to conduct instream surveys. Data were collected during low-level flights over the reach, on the ground at 2 observation points (AL-T1-13 and AL-T1-13) on the right bank of the reach, and observations made from a packraft. These observations revealed a uniform run-pool flow regime which might alternatively be referred to as glide habitat (Figure 9, Appendix B) (Plates 14–15). Discharge was not

measured on the Alatna River. Substrate composition appeared to be uniform throughout the reach and was composed of sand (35%), cobble (25%), silt (20%), boulders (10%), and gravel (10%). Though the substrate was composed of ~55% sand and fine material, there appeared to be sufficient mixed gravel and cobble to provide good spawning habitat for salmon in the reach (Table 2).

Habitat evaluation during the packraft float revealed limited instream cover, although sparse small woody debris was present and boulders were moderately abundant. Several deep pools were also present, providing limited boulder and pool habitat for fish refuge.

Riparian vegetation within 10 m of shore was uniform throughout the reach (Figure 9, Appendix B). Steep, exposed banks on either side of the river composed much of the immediate riparian zone and thus canopy was non-existent. However, beyond bankfull width, both sides of the river were vegetated with a thick spruce canopy. Some small alder and grass understory was present along the stream banks throughout the reach, along with sparse grass cover. Between 60% and 80% of the 10-m riparian zone was bare ground. Nonetheless, bank stability appeared good as very little change in the stream channel is discernible between 1981 and 2012 imagery. Deep pools and boulders, along with shade provided by spruce beyond the high banks of the river, probably provide ample refuge and shade for fish in this stream section.

MALAMUTE FORK ALATNA RIVER

The Malamute Fork Alatna River is a 61-mile-long river which flows roughly east to west and parallel to the Brooks East Corridor before turning south and joining with the Alatna River near Helpmejack Creek (Figure 1). During 2012 surveys, ABR observed various combinations of Coho Salmon (*Oncorhynchus kisutch*), Chinook Salmon, and Chum Salmon on Tobuk Creek and 2 unnamed tributaries to the Malemute Fork Alatna River, but did not sample in the river itself. The AWC lists Chum Salmon and Chinook Salmon in the Malamute Fork Alatna River. ABR nominated an additional 2 km of stream to the AWC for tributaries to the Malamute Fork Alatna River in 2013 (Appendix A). In 2013, ABR observed Chum Salmon during habitat surveys in the Malamute Fork Alatna River (Table 2).

ABR mapped and characterized the stream crossing reach on 17 August 2013. Habitat in the reach was relatively uniform with a riffle-run flow regime and only a small amount of pool

habitat (Figure 10, Appendix B) (Plate 16). Waters were generally wadeable and discharge was estimated at ~12.3 m^3/s. A single habitat survey transect (MF-T1-13) revealed that stream substrate was composed of a nearly even mix of gravel (35%), sand (35%), and cobble (25%) with sparse boulders (5%). Substrate in the reach appears to be ideal salmon spawning habitat (Table 2).

Instream cover in the reach was limited but uniform throughout. Sparse amounts of filamentous algae, small woody debris, overhanging vegetation, undercut banks, and boulders were present. Thus, most available refuge habitat was appropriate for smaller fish. A small amount of pool habitat also would provide refuge (Figure 10).

Riparian vegetation cover was relatively uniform throughout the reach, with dense cover within 10 m of shore on the left bank and open canopy on the right bank, giving way to dense spruce habitat beyond. Tall cover on the left bank was primarily composed of alder (Appendix B). Most shade available to fish appeared to occur on the left bank. Understory cover on both banks was 70–75% and was composed of willow, alder, and tall grasses. Small grasses, willow and alder saplings, and herbaceous material made up 75–80% of ground cover. The stream channel appears to have changed very little between 1981 and 2012 (Appendix C).

UN18

UN18 is an unnamed tributary which flows ~22 miles to the Malamute Fork Alatna River near Bedrock Creek (Figure 1). UN18 was the smallest stream sampled by ABR in 2013. No previous records of fish have been recorded on this waterbody and ABR did not perform fish surveys in this stream in 2012. The AWC does not have a record of anadromous fish for this stream. ABR observed juvenile Northern Pike during habitat surveys in 2013 (Table 1).

ABR mapped and characterized stream habitat in UN18 on 16 August 2013. The stream is distinguished from other waterbodies surveyed in 2013 both in terms of its low average discharge (~0.5m^3/s) and its sinuosity (Figure 11, Appendix B) (Plates 17–18). ABR collected data at 2 habitat survey transects (UN18-T1 and UN18-T2-13) representative of the mostly riffle-run-pool flow regime. Transect 1 was located in a shallow (less than 35 cm deep) riffle with instream substrate composed of boulder (50%), cobble (30%), gravel (15%), and sparse sand (5%). The substrate at Transect 1 did not appear to be appropriate for spawning salmon. Transect

2 was located just beyond a riffle in a large pool and substrate was evenly composed of boulder (25%), cobble (25%), gravel (25%), and sand (25%) and appeared to be higher quality salmonid spawning habitat (Table 2).

Instream cover was generally abundant throughout the reach. Filamentous algae was moderate to abundant and cover by overhanging vegetation was moderate throughout the reach. Small woody debris, undercut banks, and live tree roots were sparse to moderately abundant. Depending on the section of river, boulders were sparse to abundant. Though no fish surveys have been conducted here, the presence of juvenile Northern Pike suggests that the stream is excellent habitat for rearing fish.

Tall riparian vegetation cover varied depending on location in the stream but ranged from sparse spruce trees to dense alder, spruce, and birch, with some willow. Understory cover ranged from moderate to abundant, comprising willow, alder, and spruce. Ground cover was generally abundant with grasses, moss, and herbaceous material, though there was a large amount of bare ground associated with a sand bar on the right bank just upstream of Transect 2. The generally dense vegetation provides good shade cover throughout the reach and would appear to provide channel stability. However, comparison of imagery between 1982 and 2012 indicates that there were notable changes in the stream channel in the area of the proposed bridge (Appendix C).

KOYUKUK RIVER

The Koyukuk River is a 425-mile tributary to the Yukon River; it is the last major tributary entering the Yukon River before it meets the Bering Sea. ABR did not sample the Koyukuk River during 2012 fish surveys (Lemke et al. 2013). No fish observations were made during physical habitat sampling in 2013 (Table 1). Sheefish, whitefish, and 4 species of Pacific salmon are listed in the AWC for the Koyukuk River (Table 1). The Brooks East Corridor has 2 proposed bridge crossings on the Koyukuk River, both near the former (old) site of the village of Bettles (Figure 1).

ABR mapped and characterized the stream crossing reach on 22 August 2013 but did not perform an instream habitat transect survey because the stream was unwadeable due to deep water and strong flow. The entire stream reach was a mix of run and glide flow regime. Instream substrate and riparian habitat were characterized at 3 observations points along the stream's left

bank (Figure 12, Appendix B) (Plate 19). ABR floated the reach in a packraft to determine if wadeable transects were present, but none were observed. At the most upstream observation point, at a downstream inside bend in the river, substrate visible from the bank was predominantly sand, as might be expected at such a location where velocity decreases and sand settles out of the water column. Significant gravel and cobble instream substrate could be observed from the left bank along with moderate amounts of large and small woody debris. The left bank in this reach was composed of a large sand bar with little vegetation. Riparian vegetation on the right bank was dense and composed mainly of spruce and willow. The substrate at the second observation point, downstream between 2 proposed bridge crossings was composed of mostly sand, but transitioned to cobble, gravel, and boulder shortly downstream. Between the first and second observations points, the right bank vegetation transitioned from spruce to alder. Substrate composition at the farthest downstream observation point appeared to be composed of primarily of cobble, gravel, and boulder. Overall, this reach likely provides plentiful spawning and refuge habitat to many fishes, including salmon. The channel in this reach appears to have changed slightly between 1981 and 2012, mostly in the form of growing sandbars in upper and lower portions of the stream reach (Appendix C).

SOUTH FORK KOYUKUK RIVER

The South Fork Koyukuk River is a large tributary to the Koyukuk River and joins with the main fork ~15 miles south of the village of Bettles (Figure 1). ABR did not sample the South Fork Koyukuk River during 2012 fish surveys (Lemke et al. 2013). Chum Salmon, Chinook Salmon, and whitefish species are known to inhabit the South Fork Koyukuk, according to the AWC (Table 1). In 2013, the ABR survey crew made one observation of a dead Burbot (Table 1).

ABR mapped and characterized the stream crossing reach and performed 1 stream habitat transect survey on 22 August 2013 (Figure 13, Appendix B) (Plates 20–21). The flow regime in the stream crossing reach was dominated by a mix of run and pool habitat, with run-riffle habitat in the mid-section of the reach. Flow was estimated to be 13.75 m^3/s (Table 2). Transect 1 (SF-T1-13) was located at the proposed bridge crossing. Substrate along the transect was composed of cobble (40%), gravel (30%), boulder (15%), and sand (15%). This transect appeared to be

representative of much of the reach which should provide excellent spawning substrate for salmon. Instream cover along the habitat transect was sparse with some small woody debris. Thus, only sparse amounts of cover were available and suitable mostly for smaller fish.

Large exposed sand banks were present on both right and left banks of the reach. The left bank provided very little riparian vegetation cover. The canopy was absent and the understory only provided 15% cover from willow, herbaceous material, and fireweed. Ground cover was composed of exposed cobble, gravel, and sand (90%) with small patches of fireweed and willow (10%). The right bank vegetation was heavily affected by the presence of a winter trail and canopy cover was only 10%, by spruce, birch, and willow. The understory was dense with poplar, fireweed, herbaceous material, tall grasses, and willow, which together provided 70% cover. Ground cover was 75%, comprising herbaceous vegetation, moss, and poplar saplings. Limited canopy shade was available to the stream due to the distance from water. Numerous pools probably provide most refuge for fish in the reach. The sample reach channel on the South Fork Koyukuk River appears to be less stable than the reaches assessed on most other streams in this study. The channel appears to have shifted slightly to the west in the area of the proposed bridge crossing between 1981 and 2013 (Appendix C).

JIM RIVER

The Jim River is the easternmost significant river crossing before the proposed Brooks East Corridor joins the Dalton Highway (Figure 1). ABR did not sample the Jim River during fish surveys in 2012 (Lemke et al. 2013). The AWC lists Chum Salmon as present in the Jim River (Table 1). During 2013 stream habitat surveys, the ABR survey team observed Chum Salmon and Arctic Grayling.

ABR mapped and characterized the stream crossing reach and performed 1 instream habitat transect survey on 22 August 2013 (Figure 14, Appendix B) (Plates 22–24). The reach had a diversity of stream flow habitat types including riffle-run-pool and run-glide sequences as well as side channel and backwater pool habitat. Transect 1 (JM-T1-13) was located immediately downstream of the proposed bridge crossing within a long run. The substrate was representative of much of the run and run-glide sequences and consisted of gravel (45%), cobble (35%), sand (15%), and boulder (5%) which should provide excellent fish spawning habitat. Instream cover

was sparse along the transect but consisted of filamentous algae, large and small woody debris, and boulders. However, abundant pool habitat would provide good refuge for fish. Discharge was among the lowest estimated for streams surveyed on this Project at 5.06 m^3/s (Table 2).

Canopy cover was absent from both the left and right banks of the habitat transect, because the stream channel bankfull width extended well beyond the wetted width at the low flows observed in August 2013. The understory varied and was composed of willow and fireweed on the right bank (15%) and willow, alder, birch, and fireweed (60%) on the left bank. Right bank ground cover primarily was composed of exposed gravel and cobble (90%) along with sparse fireweed and willow. Ground cover on the left bank was composed of moss, herbaceous vegetation, and woody shrubs (50%) with bare ground visible throughout (50%). Good shade cover appeared to be scattered evenly about the reach, but bare ground and numerous sand bars indicated significant potential for bank erosion. The channel in this reach appears to have changed more than most streams surveyed in this study since 1979 (Appendix C). However, the channel at the proposed bridge crossing appears to have changed little compared to the rest of the reach.

NORTHERN OPTION

UN30

UN30 is an unnamed tributary to the Mauneluk River which is crossed by the northern option of the Brooks East Corridor (Figure 1). Spawning Chum Salmon were observed on UN30 in 2012. Spawning Chum Salmon and Dolly Varden also were observed on several other unnamed tributaries to the Mauneluk River in 2012 (Table 1). Chum Salmon and whitefish are known to occur on the Mauneluk River according to the AWC (ADFG 2013). ABR nominated less than a mile of Chum Salmon habitat to the AWC in 2013 (Appendix A). The ABR survey team did not observe fish in UN30 during 2013 physical habitat sampling.

ABR mapped and characterized the stream reach and performed 1 instream habitat transect survey on 21 August 2013 (Figure 15, Appendix B) (Plates 25). The slightly sinuous stream reach was marked by predominance of run-riffle habitat with. Discharge was relatively low compared to other streams surveyed (3.85 m^3/s) (Table 2). Instream substrate at Transect 1 (UN30-T1-13n) was representative of the reach as a whole and was composed of boulder (50%),

cobble (35%), gravel (15%), and sand (5 %). This substrate provides good spawning habitat for salmon as evidenced by the observation of spawning Chum Salmon in 2012. Instream cover was generally abundant and relatively uniform within the reach, providing good habitat for rearing fish. Filamentous algae and overhanging vegetation were sparse while there was moderately abundant small woody debris, and abundant boulder habitat.

Riparian vegetation varied by bank but was consistent throughout the reach. The left bank was composed of a large sand bar and thus no tall cover was present. Paper birch, spruce, willow, and alder provided approximately 30% canopy cover on the right bank. The understory vegetation cover was dominated by willow on the left bank (30%) and a combination of willow, alder, spruce, and herbaceous vegetation (50%) on the right bank. On the left bank sand bar, ground cover was ~50% exposed soil, while the right bank had near complete ground cover of moss, small grasses, and woody shrubs (Appendix B). On the whole, stream shade was abundantly available in the sample reach on UN30. The stream channel appears to have changed little since 1981 (Appendix C).

MAUNELUK RIVER

The Mauneluk River has proposed bridge crossings at 2 locations, with the second crossing located on the northern option of the Brooks East Corridor (Figure 1). No fish observations were made during 2013 sampling on the Mauneluk River northern option (Table 1). However, ABR observed Chum Salmon, Slimy Sculpin, and Arctic Grayling during 2012 fish surveys and during 2013 habitat surveys on the Mauneluk River at the river crossing associated with the preferred option (see above). As stated previously, Chum Salmon and whitefish are listed in the AWC for the Mauneluk River (Table 1).

ABR mapped and characterized the stream crossing reach and performed 1 instream habitat transect survey on 21 August 2013 (Figure 16, Appendix B) (Plates 26–27). The flow regime of the reach was marked by almost uniform run-pool habitat with some riffle habitat in the downstream portion of the reach. Due to deep water (greater than 1 m) and what appeared to be uniform instream habitat, only 1 transect was surveyed in August 2013. Transect 1 (MN-T1-13n) was located in run-pool habitat representative of most of the reach. Discharge at the transect was 15.46 m^3/s (Table 2). Substrate along Transect 1 was composed of gravel (65%), cobble (15%),

sand (15%), and boulder (5%) and would appear to provide good spawning habitat for salmon. Instream cover was generally limited within the reach. Small woody debris, overhanging vegetation, undercut banks, and boulders were sparse and cover by filamentous algae was moderate. Most of the available instream cover for fish occurred as deep pools or as cobble and boulders suitable mainly for smaller fish.

Riparian canopy cover was absent from both the right and left banks for much of the reach. Understory vegetation cover (40%) was uniform throughout the reach. Throughout the stream reach, the riparian zone on one bank was composed of steep, bare sand bars with cobble, gravel and sand substrate and no understory while the opposite bank featured moderate understory composed of willow. Despite the abundance of bare ground on steep banks, the stream channel does not appear to have altered greatly since 1981 (Appendix C).

SOUTHERN OPTION

REED RIVER

The Reed River has proposed bridge crossings on both the preferred and southern options of the Brooks East Corridor (Figure 1). The ABR survey team observed Chum Salmon on the preferred bridge crossing during both 2012 and 2013 sampling events. No fish were observed in the downstream southern option in 2013 (Table 1). The AWC did not previously list Pacific salmon in the Reed River (Table 1). ABR nominated ~19 miles of Chum Salmon spawning and rearing habitat to the AWC in 2013 (Appendix A).

ABR mapped and characterized the stream crossing reach and performed 2 instream habitat transect surveys on 19 August 2013 (Figure 17, Appendix B) (Plates 28–30). The flow regime of the reach was composed of a long run which transitioned to a riffle at the downstream extent of the reach. Additional riffle and pool habitat were also present upstream in side channel habitat. Both Transects 1 (RD-T1-13s) and 2 (RD-T2-13s) were located in long run habitat. Transect 2 also traversed a small portion of side channel habitat. Instream substrate in Transect 1 was composed of cobble (40%), sand (30%), gravel (20%), and boulder (10%). Substrate in the main channel on Transect 2 was cobble (35%), gravel (30%), sand (30%), and boulder (5%). Side-channel substrate was composed of sand (60%), gravel (30%), and cobble (10%). The relatively

uniform main channel provides good fish spawning gravels, while the side channels provide better rearing habitat (Table 2).

Instream cover at both transects was minimal. Filamentous algae, small woody debris, and boulder cover were sparse on both transects. Sparse overhanging vegetation and undercut bank habitat were present on Transect 2. Discharge estimates averaged 22. 2 m^3/s. Side channel discharge was low (1.85 m^3/s) in Transect 2, providing refuge from higher flows for juvenile fish (Appendix B).

At Transect 1, birch and spruce provided 40% tall riparian cover on the left bank, while the right bank was devoid of canopy. The opposite was true at Transect 2, where primarily spruce canopy cover was 30% on the right bank with no canopy on the left bank. Ample shade habitat for fish was provided by tall canopy throughout the reach. Cover by understory vegetation at Transect 1 was 40% on the left bank and 70% on the right bank and was composed of willow, alder, and grasses. Understory cover was similar on Transect 2, but 65% on the left bank and 80% on the right bank. Ground cover also was similar on both banks at the 2 transects, with 20–50% bare ground and a mix of woody shrubs, grasses, moss, and herbaceous material. Despite the amount of side-channel habitat and exposed banks, the channel has changed little since 1979 (Appendix C).

KOBUK RIVER

The Kobuk River has proposed bridge crossings on both the preferred and southern options of the Brooks East Corridor (Figure 1). ABR observed spawning Chum Salmon upstream of both proposed crossings during 2012 fish surveys. The AWC lists Chum and Chinook salmon on the Kobuk River (Table 1). No fish were observed during 2013 physical habitat surveys on the southern option.

ABR mapped and characterized the stream crossing reach and performed 1 instream habitat transect survey on 19 August 2013 (Figure 18, Appendix B) (Plate 31). The reach had a relatively homogenous glide-run flow regime with minimal riffles. Discharge was estimated at 28.22 m^3/s. Transect 1 (KB-T1-13s) passed through both run and riffle habitat downstream of the proposed bridge crossing. Substrate was composed of gravel (50%), cobble (35%), sand (10%), and boulder (5%) and provides excellent mixed gravel salmon spawning habitat. Substrate in the

transect appeared representative of substrate throughout most of the reach. Instream cover was limited, with moderately abundant filamentous algae and sparse small woody debris and boulders (Table 2).

Vegetation cover measured in the transect appeared to be representative of the entire reach, particularly for the left bank. Riparian canopy cover on both banks was mostly absent within 10 m of shore but some spruce occurred in the middle portion of the reach on the left bank. Most shade cover is available for fish in this section of the reach. On the left bank, understory also was absent. On the right bank, understory cover was 50% and was composed of a combination of willow, spruce, fireweed, and blueberry (50%). Ground cover on the left bank was mostly absent with only small patches of herbaceous vegetation and grasses. Ground cover on the right bank was more dense (40%) and consisted of woody shrubs, herbaceous vegetation, and blueberry (Appendix B). The stream channel in this reach of stream has changed very little from 1979 to 2012 (Appendix C).

HOGATZA RIVER

The Hogatza River is a 120-mile tributary of the Koyukuk River that starts in the Gates of the Arctic National Park and Preserve and flows southwest to the Koyukuk River. The Hogatza River is crossed by the southern option of the Brooks East Corridor (Figure 1). The ABR survey team observed spawning Chum Salmon and Slimy Sculpin during 2012 fish surveys (Table 1). The ABR habitat crews observed Arctic Grayling in 2013. The AWC lists Chum Salmon, Sockeye Salmon (*Oncorhynchus nerka*), Chinook Salmon, Coho Salmon, and whitefish present in the Hogatza River.

ABR mapped and characterized the stream crossing reach and performed 2 instream habitat transect surveys on 20 August 2013 (Figure 19, Appendix B) (Plates 32–34). The Hogatza River is sinuous with a general run-riffle-pool flow regime and abundant side channel habitat. ABR measured an average discharge of 0.67 m^3/s during August sampling. Transect 1 (HG-T1-13) was located upstream of the proposed bridge crossing in a run-riffle transition zone. Transect 2 (HG-T2-13MCs and HG-T-13SCs) was split by an island complex and passed through main channel (MC) and side channel (SC) pool and riffle habitat. Instream substrate at Transect 1 was composed of a mix of cobble (40%), gravel (35%), sand (15%), and boulder (10%). Instream

substrate in the main channel at Transect 2 was very similar, with cobble (40%), gravel (40%), sand (15%), and boulder (5%). Instream substrate in the side channel on Transect 2 was gravel (50%), sand (25%), and cobble (20%) with little boulder (5%). Most of the substrate in the surveyed reach was ideal salmon spawning habitat. During sampling, numerous Arctic Grayling were seen resting in the pool at the Transect 2 side channel.

Instream cover at both transects included sparse live tree roots, undercut banks, and boulder cover as well as moderately abundant overhanging vegetation, filamentous algae, and small woody debris (Table 2). Sparse large woody debris also was observed at Transect 1. In general, the sample reach would provide good refuge habit for rearing juvenile fish, as well as sufficient pools for larger fish.

At Transect 1, tall canopy riparian cover was mostly absent on the right bank due to the presence of a large gravel bar, although understory cover on the bar was 15%, primarily willows. Ground cover also was sparse in the immediate riparian zone on the right bank at Transect 1. On the left bank of Transect 1, canopy cover was 20% and was composed of spruce which increased in density beyond 10 m from shore. The understory was dense on the left bank, with 80% cover from willows, alders, berries, and tall grasses, and ground cover was nearly complete in the form of short grasses.

Riparian cover was greater at Transect 2 than it was at Transect 1, but similarly comprised mostly understory and ground cover, with moderate canopy cover. Transect 1understory cover was primarily willow, alder, and tall grasses and ground cover (90% on the right bank and 10% on the left bank) was composed of grasses, herbaceous vegetation, and moss. Transect 2 understory cover ranged between 30–50% and was composed of willow, alder, and tall grasses. Bare ground at Transect 2 was minimal (10–30%) with cover from grasses, saplings, herbaceous vegetation, and moss. In general, there was good shade available from canopy and understory cover. However, the cover in the area of the proposed bridge crossing at Transect 1 provides little stream shade. Despite the sinuous nature of the stream channel in the crossing reach, very little channel alteration appears to have occurred since 1981.

HELPMEJACK CREEK

Helpmejack Creek, a ~37-mile tributary to the Alatna River, is the last significant waterbody crossed by the southern option of the Brooks East Corridor (Figure 1). ABR observed Dolly Varden and Arctic Grayling in Helpmejack Creek during 2012 fish surveys (Table 2). No fish observations were made during 2013 physical habitat surveys. Pacific salmon are not listed in the AWC for Helpmejack Creek (Table 1).

ABR mapped and characterized the stream crossing reach and performed 3 instream habitat transect surveys on 18 August 2013 (Figure 20, Appendix B) (Plates 35–38). Helpmejack Creek is a sinuous stream with a riffle-run-pool flow regime. Transect 1 (HJ-T1-13s) was representative of pool habitat in the reach and instream substrate was composed of sand (40%), cobble (30%), silt (25%), and boulder (5%). While this is good refuge habitat it would not provide good substrate for spawning salmon due to the high percentage of silt present. Transect 2 (HJ-T1-13s) was located in a run section of stream and represented better fish spawning habitat with substrate composed of cobble (40%), boulder (30%), gravel (20%), sand (5%), and silt (5%). Transect 3 was located in a mixed run-pool habitat and was representative of the reach as a whole with substrate composed of cobble (50%), gravel (20%), silt (20%), and boulders (10%). In general, we saw more silt and sand on Helpmejack Creek than at other sample reaches in the corridor and habitats appeared to be less than ideal for spawning salmon. Discharge averaged 1.87 m^3/s (Table 2).

Instream cover at the 3 transects was sparse to moderately abundant. Transect 1 had sparse cover of filamentous algae, large woody debris, overhanging vegetation, undercut banks, and boulders with moderate cover by small woody debris. Transect 2 had sparse filamentous algae, small woody debris, overhanging vegetation, and undercut banks with moderate boulder cover. Transect 3 had sparse overhanging vegetation, small woody debris, and undercut banks. Instream cover at Helpmejack Creek would provide good refuge for juvenile and small fishes as well as resting habitat in deep pools for larger Arctic Grayling and Dolly Varden.

Riparian canopy vegetation was limited and varied from bank to bank, typically providing no cover on one bank while the opposite bank had between 20% and 40% spruce canopy. The understory was composed of moderate to heavy alder, willow, and grass. The ground cover

varied greatly with between 5% and 80% of the ground being bare while grass, herbaceous vegetation, young willow, and moss provided between 20% and 95% cover. Stream shading was good in the crossing reach as a whole because of the small channel width, and despite the low abundance of tall ground cover (Appendix D). Bank stability appeared to be good as the stream channel has altered very little since 1982 (Appendix D).

SUMMARY

During the 11 days of stream and riparian zone habitat surveys at proposed bridge crossings on the Brooks East Corridor, ABR conducted 28 habitat transects at 18 stream crossing reaches on 14 waterbodies. Most stream reaches surveyed were in known fish bearing streams and provided habitat for at least a portion of the life history of several salmonid species. Salmonid spawning habitat was available to some degree at almost all of the waterbodies sampled. Streams visited during 2013 habitat surveys represent only a small portion of the total number of waterbodies crossed by the Brooks East Corridor and most were large river systems. However, the vast majority of additional waterbodies crossed by the Brooks East Corridor are small relative to the streams surveyed in 2013. These small streams would require culverts as opposed to bridges during construction of the proposed road. Finally, streams surveyed in 2013 showed remarkable channel stability over the last 30 years as evidenced from aerial imagery. Fish presence, stream flow regimes, spawning substrates, refuge habitat, and riparian zone vegetation are important considerations prior to permitting and construction of any road project. This information will ultimately allow resource managers to determine potential impacts on fish and fish habitat and allow for determination of proper protocols for impact avoidance during the construction phase of the Brooks East Corridor.

ACKNOWLEDGMENTS

ABR would like to thank DOWL HKM for their support on this project. Kristen Hansen, Erin Gora, Emily Creely, Dwight Stuller, and Jessica Christianson provided invaluable logistic, field, and office support. We thank Allen A. Tickett, our subsistence advisor, for providing local knowledge and expertise during physical habitat surveys. The ABR crew is grateful to Betty, Al, and Chelsea from the Sourdough Lodge as well as Jay and Judy Jepson from Brooks Range Aviation for their hospitality during our 8-day stay in Bettles, Alaska. We are very grateful for the support of everyone at the NOVAGOLD Dahl Creek Camp during our 5-day stay at their camp. We appreciate 2 weeks of safe helicopter flights with Brent from the Bristow Group.

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Plate 1. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SH-T1-13, Shungnak River, Brooks East Corridor, Alaska, August 2013.

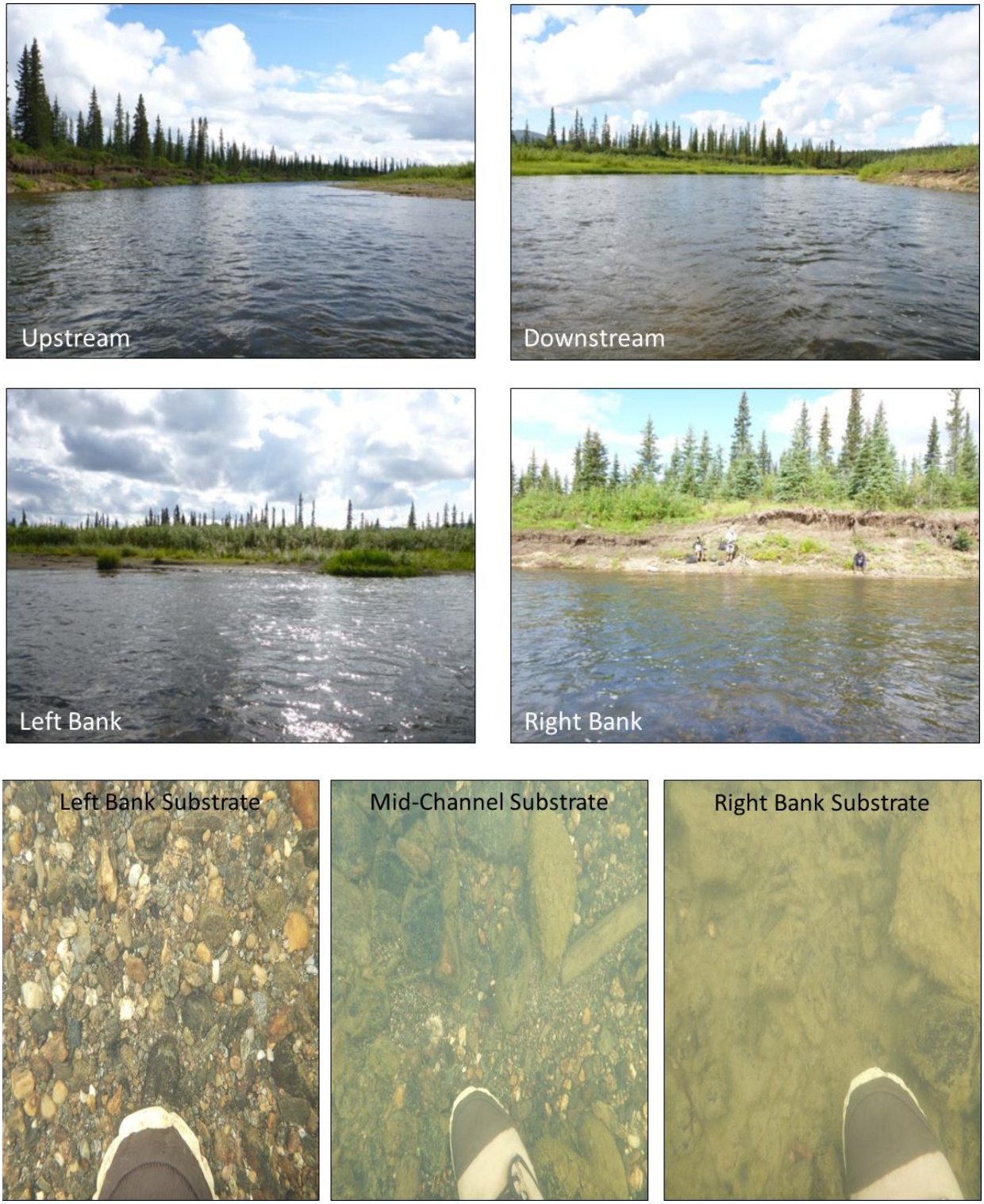


Plate 2. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SH-T2-13, Shungnak River, Brooks East Corridor, Alaska, August 2013.













Plate 3. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SH-T3-13, Shungnak River, Brooks East Corridor, Alaska, August 2013.









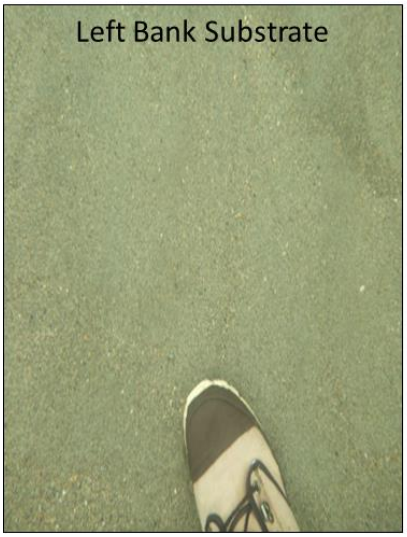






Plate 4. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KG-T1-13, Kogoluktuk River, Brooks East Corridor, Alaska, August 2013.









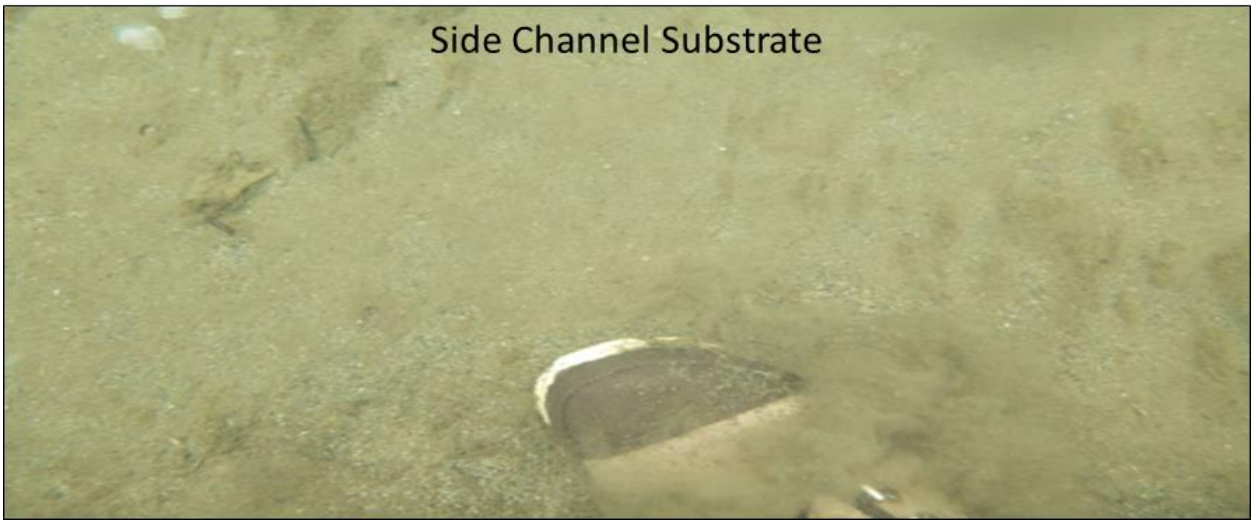


Plate 5. Stream channel characteristics, riparian habitat, and instream substrate composition of side-channel habitat at KG-T1-13, Kogoluktuk River, Brooks East Corridor, Alaska, August 2013.













Plate 6. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KG-T2-13, Kogoluktuk River, Brooks East Corridor, Alaska, August 2013.











Plate 7. Stream channel characteristics, riparian habitat, and instream substrate composition at partial transect (MN-T1-13) on the Mauneluk River, Brooks East Corridor, Alaska, August 2013.













Plate 8. Stream channel characteristics, riparian habitat, and instream substrate composition at partial transect (MN-T2-13) on the Mauneluk River, Brooks East Corridor, Alaska, August 2013.











Plate 9. Stream channel characteristics, riparian habitat, and instream substrate composition at transect BV-T1-13, Beaver Creek, Brooks East Corridor, Alaska, August 2013.

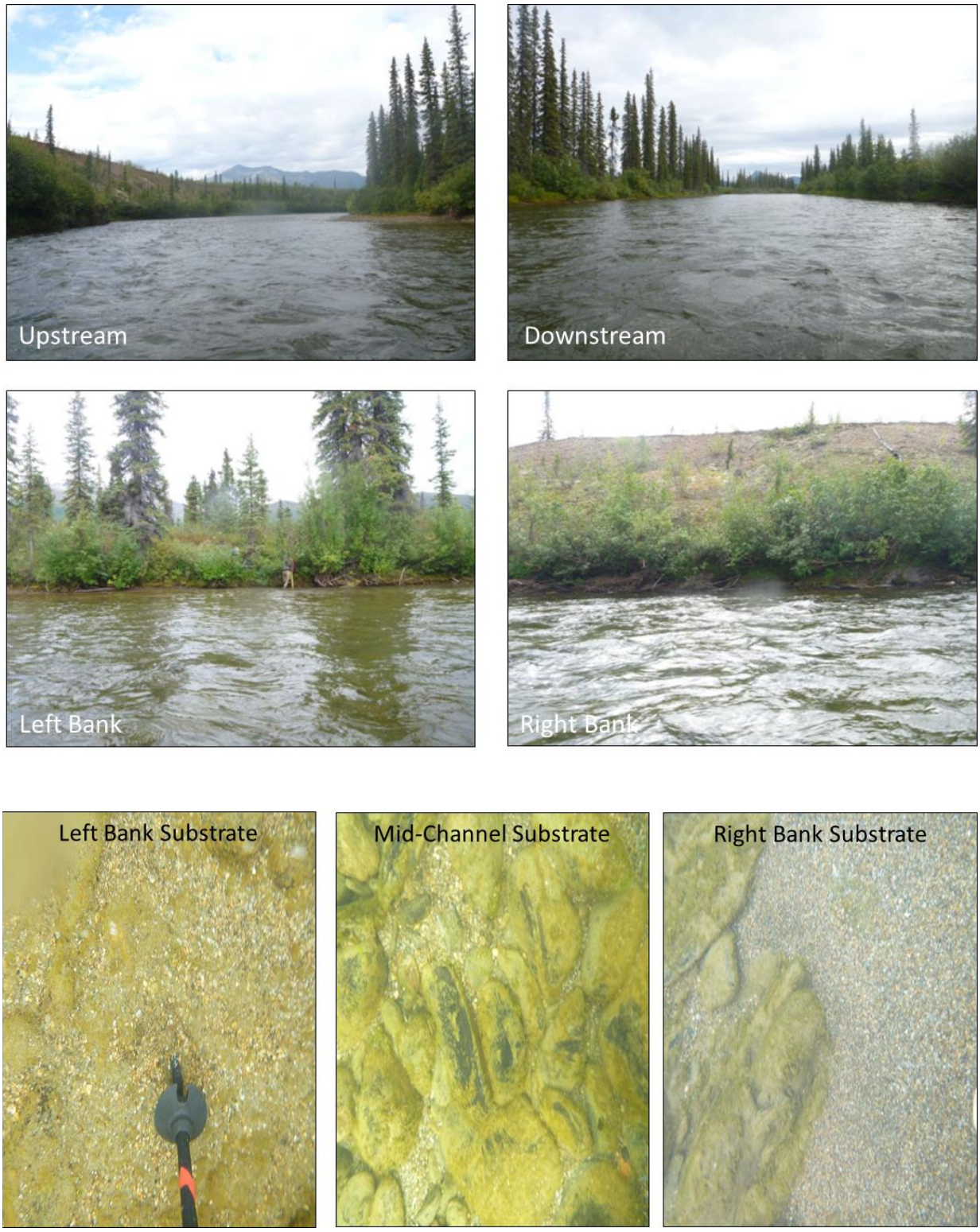


Plate 10. Stream channel characteristics, riparian habitat, and instream substrate composition at transect BV-T2-13, Beaver Creek, Brooks East Corridor, Alaska, August 2013.

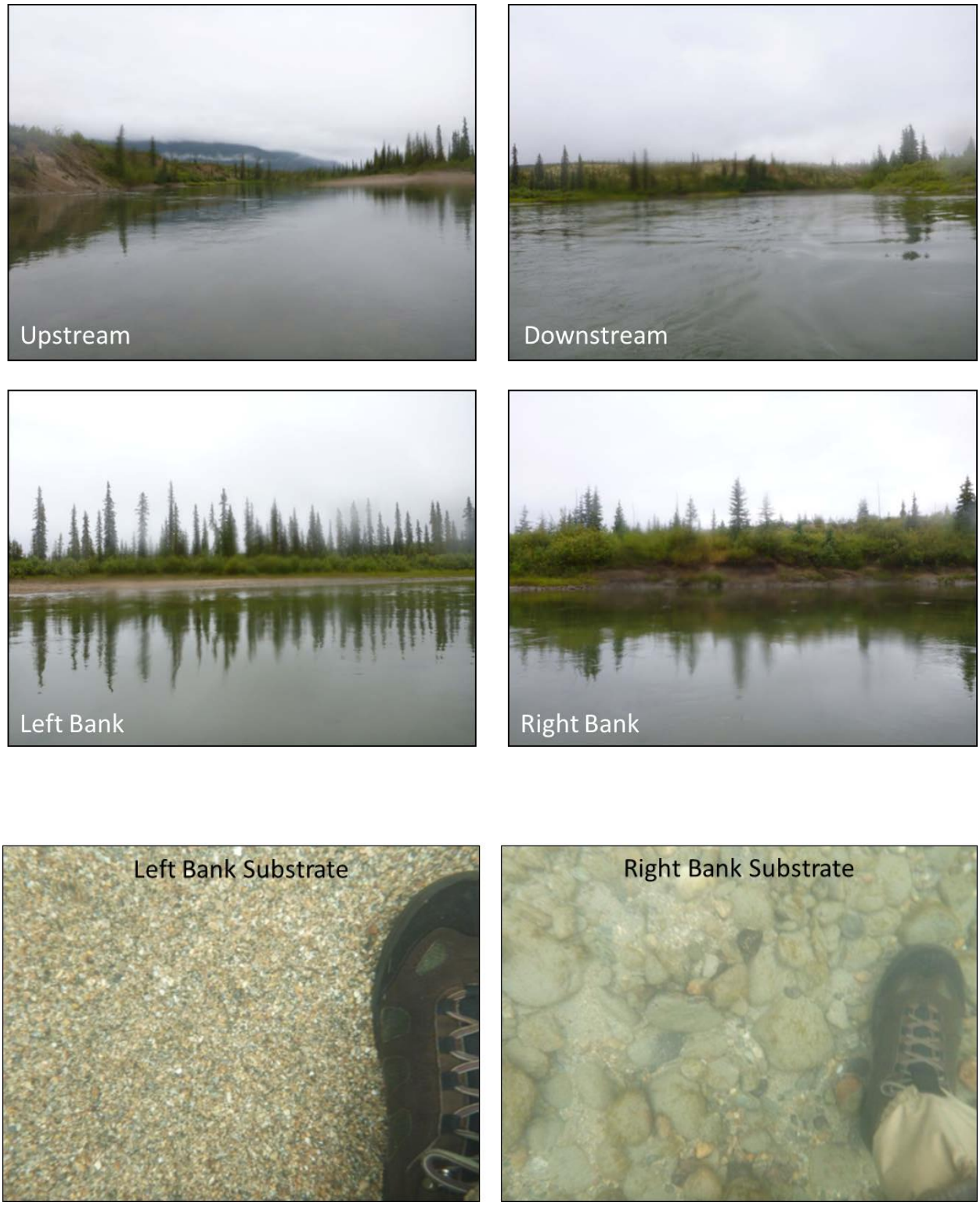
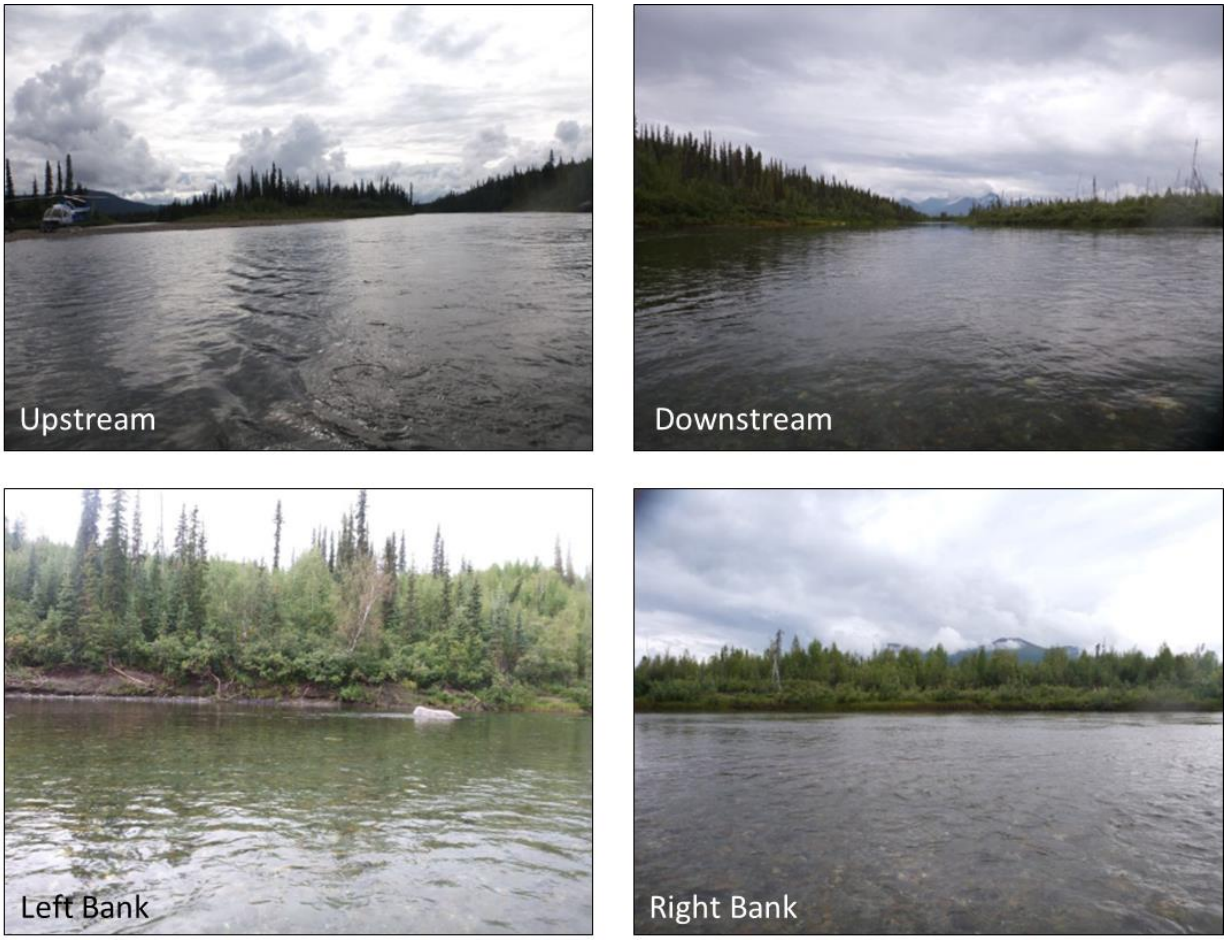


Plate 11. Stream channel characteristics, riparian habitat, and instream substrate composition at transect RD-T1-13, Reed River, Brooks East Corridor, Alaska, August 2013.



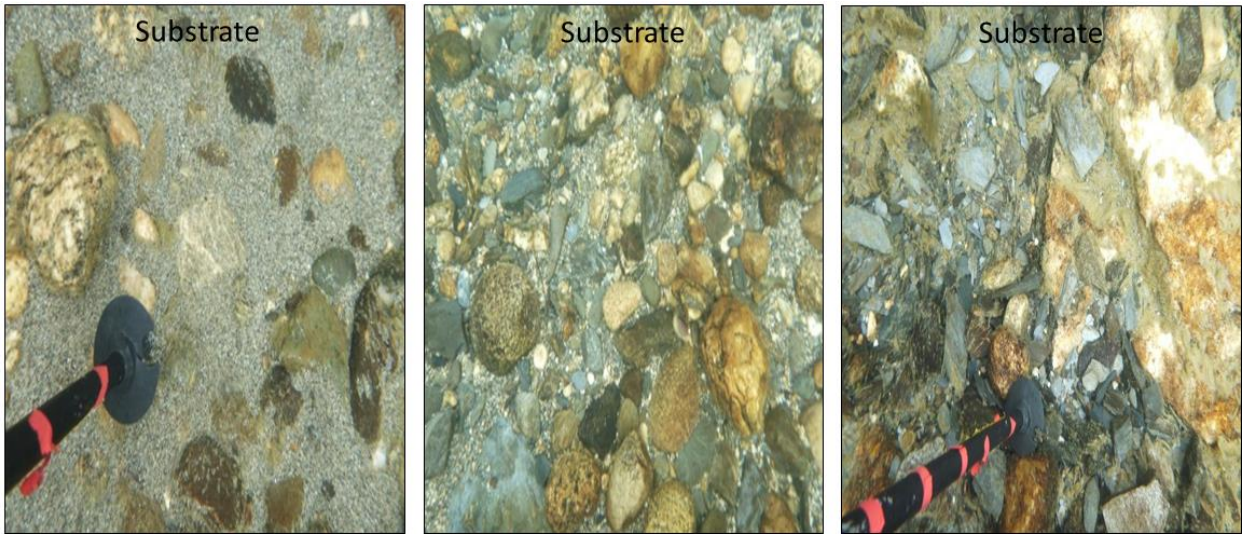


Plate 12. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KB-T1-13, Kobuk River, Brooks East Corridor, Alaska, August 2013.

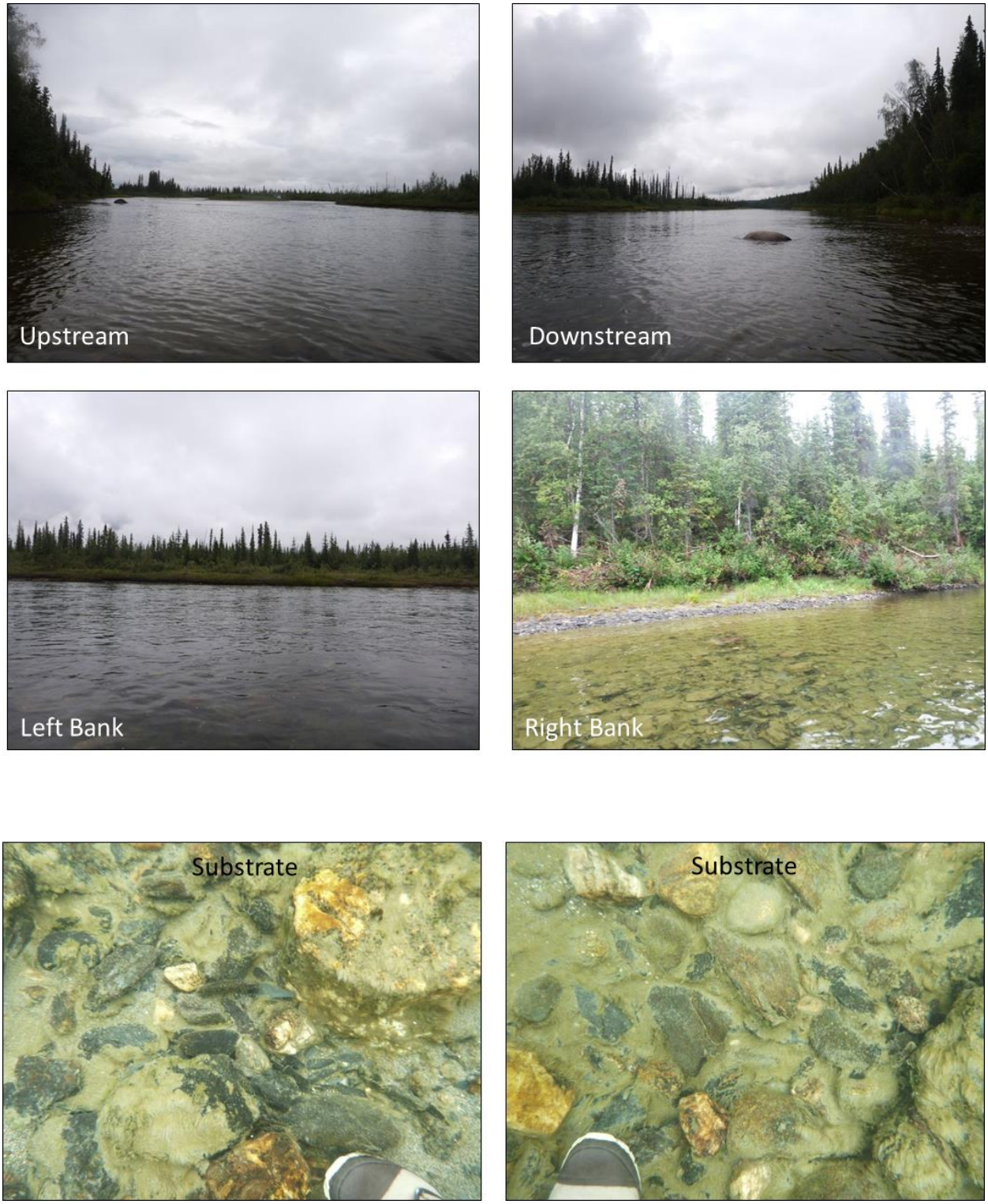


Plate 13. Stream channel characteristics, riparian habitat, and instream substrate composition at an observation point on the Kobuk River, Brooks East Corridor, Alaska, August 2013.



Plate 14. Stream channel characteristics and riparian habitat at observation point AL-T1-13 on the Alatna River, Brooks East Corridor, Alaska, August 2013.

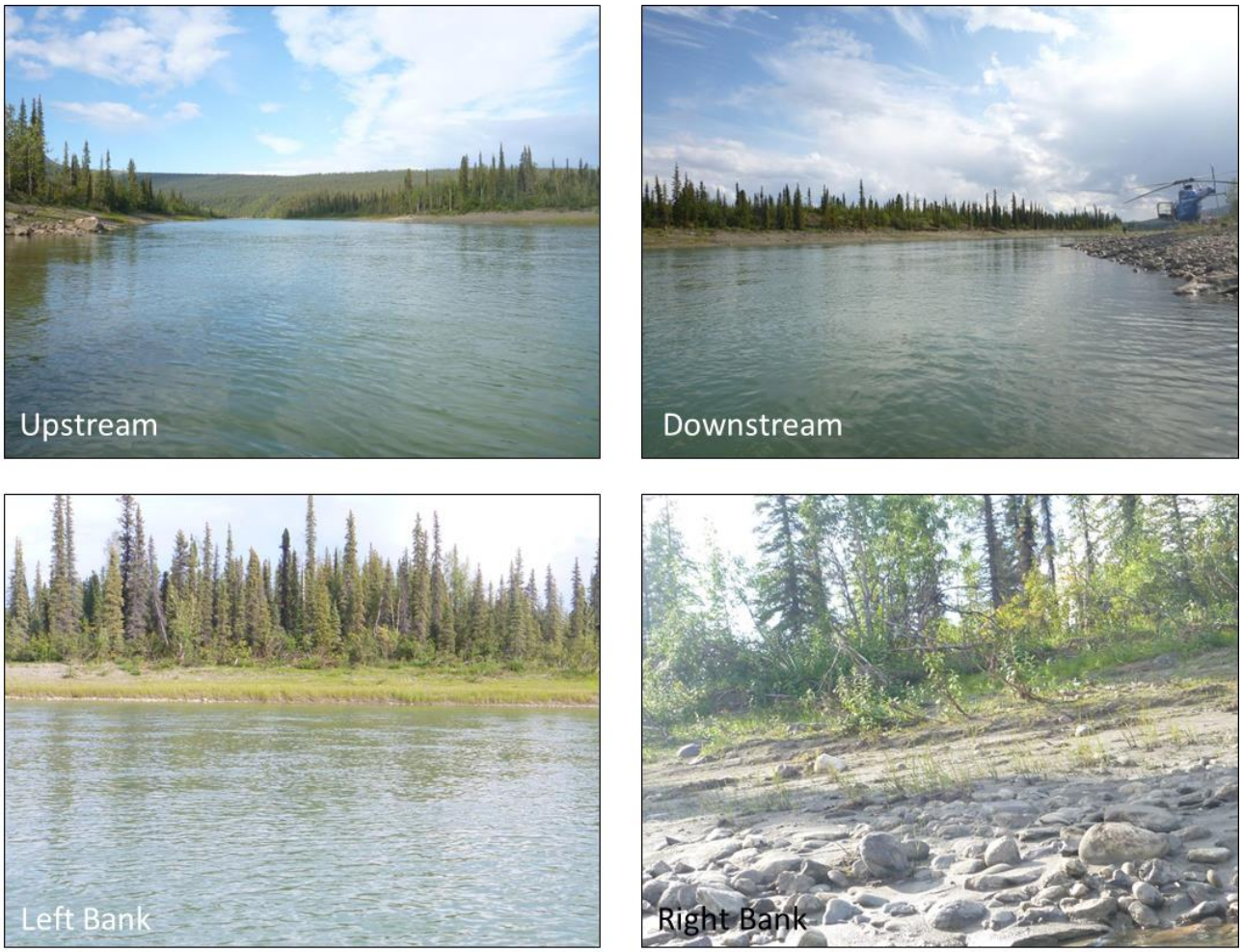


Plate 15. Stream channel characteristics and riparian habitat at observation point AL-T2-13, Alatna River, Brooks East Corridor, Alaska, August 2013.









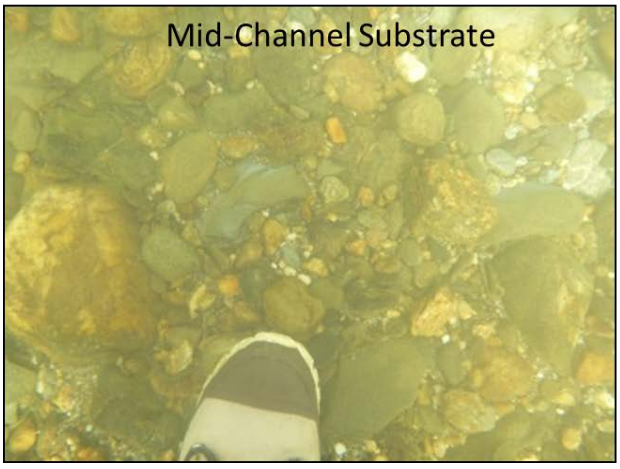




Plate 16. Stream channel characteristics, riparian habitat, and instream substrate composition at transect MF-T1-13, Malamute Fork Alatna River, Brooks East Corridor, Alaska, August 2013.













Plate 17. Stream channel characteristics, riparian habitat, and instream substrate composition at transect UN18-T1-13, unnamed tributary to the Malamute Fork Alatna River, Brooks East Corridor, Alaska, August 2013.

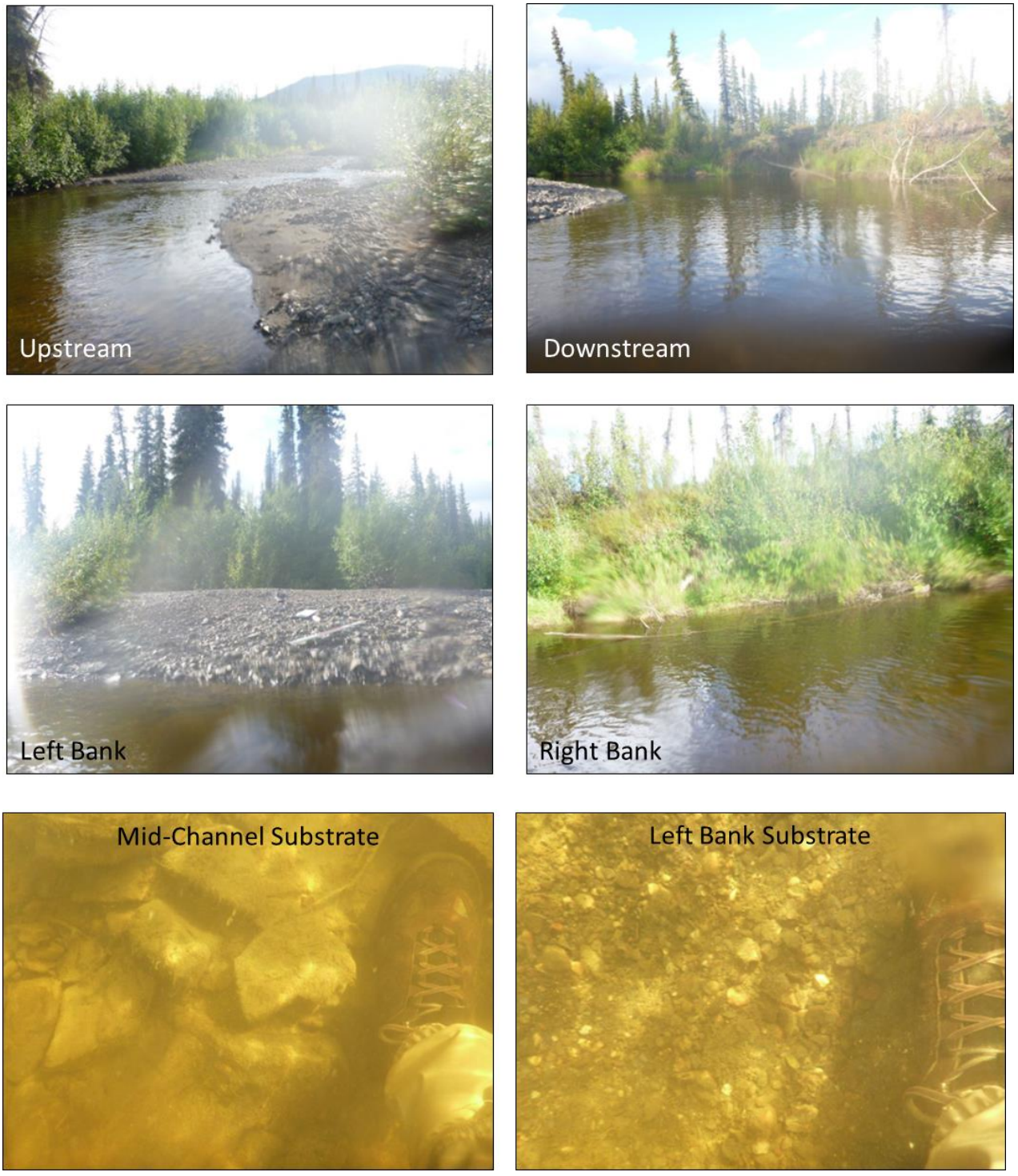


Plate 18. Stream channel characteristics, riparian habitat, and instream substrate composition at transect UN18-T2-13, unnamed tributary to the Malamute Fork Alatna River, Brooks East Corridor, Alaska, August 2013.



Plate 19. Stream channel characteristics, riparian habitat, and instream substrate composition at observation points on the Koyukuk River, Brooks East Corridor, Alaska, August 2013.

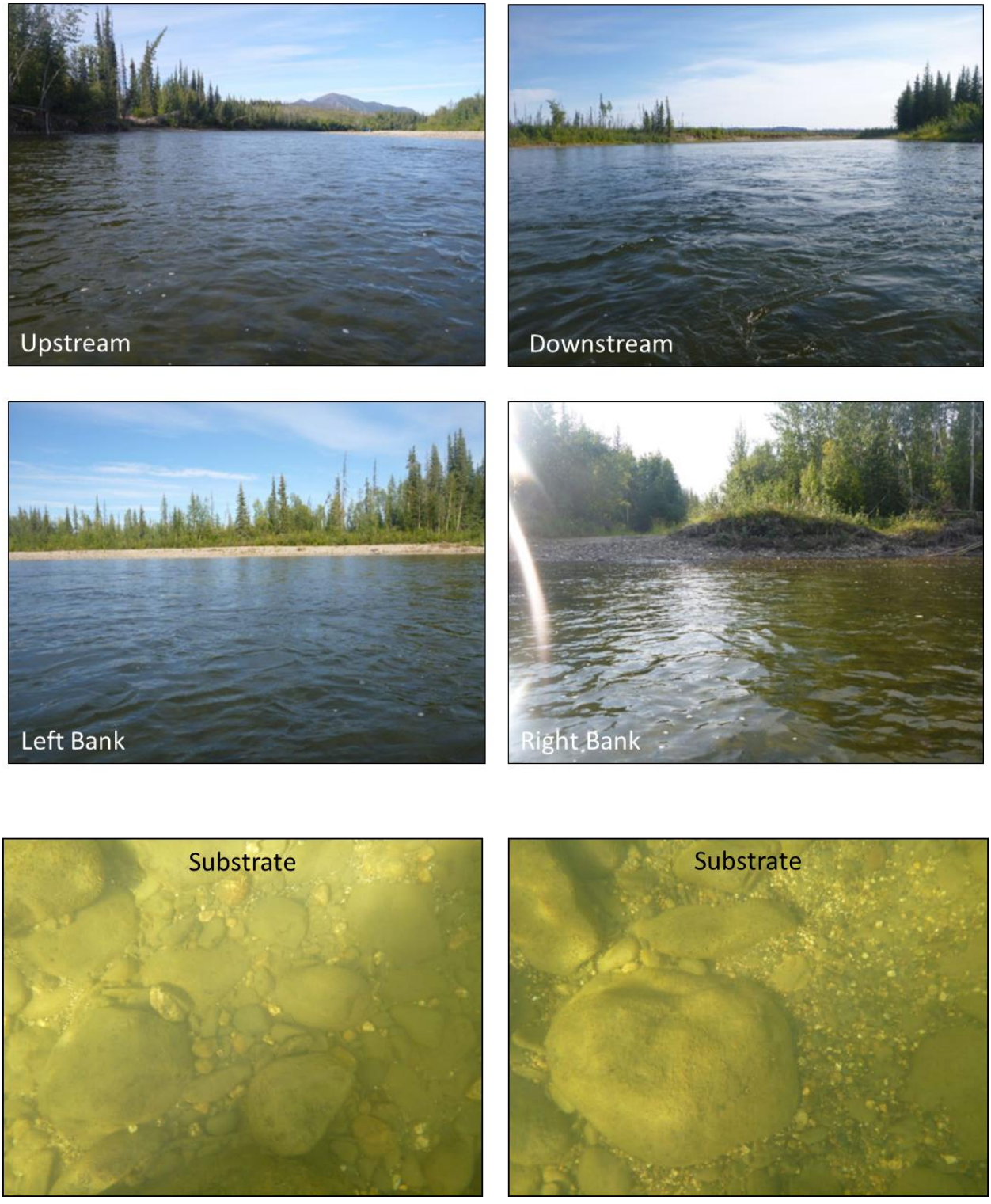


Plate 20. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SF-T1-13, South Fork Koyukuk River, Brooks East Corridor, Alaska, August 2013.



Plate 21. Stream channel characteristics and riparian habitat at observation points on the South Fork Koyukuk River, Brooks East Corridor, Alaska, August 2013.



Plate 22. Stream channel characteristics, riparian habitat, and instream substrate composition at transect JM-T1-13, Jim River, Brooks East Corridor, Alaska, August 2013.



Plate 23. Stream channel characteristics and riparian habitat at upstream observation points on the Jim River, Brooks East Corridor, Alaska, August 2013.

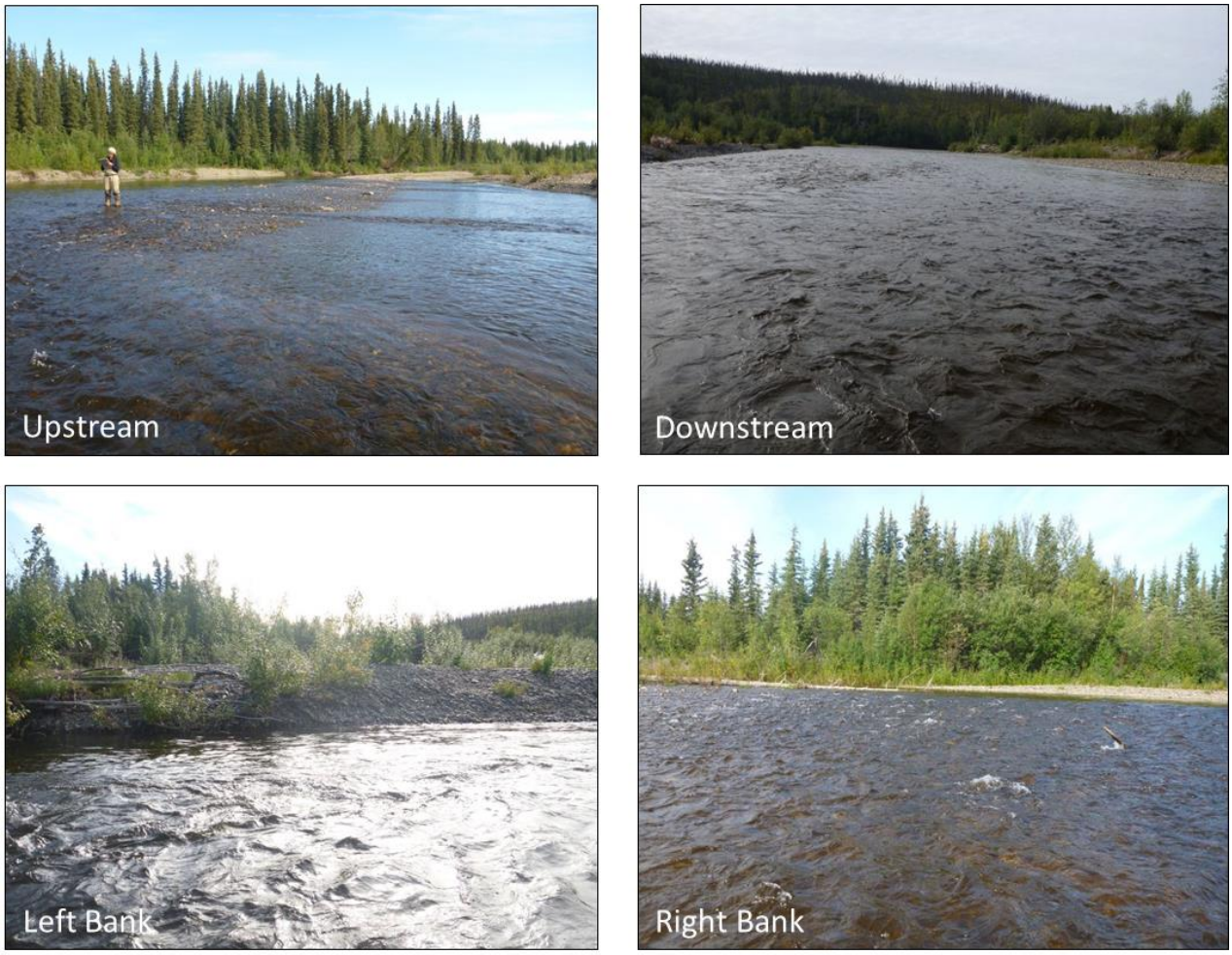


Plate 24. Stream channel characteristics and riparian habitat at downstream observation points on the Jim River, Brooks East Corridor, Alaska, August 2013.













Plate 25. Stream channel characteristics, riparian habitat, and instream substrate composition at transect UN30-T1-13n, unnamed tributary to the Mauneluk River, Brooks East Corridor, Alaska, August 2013.

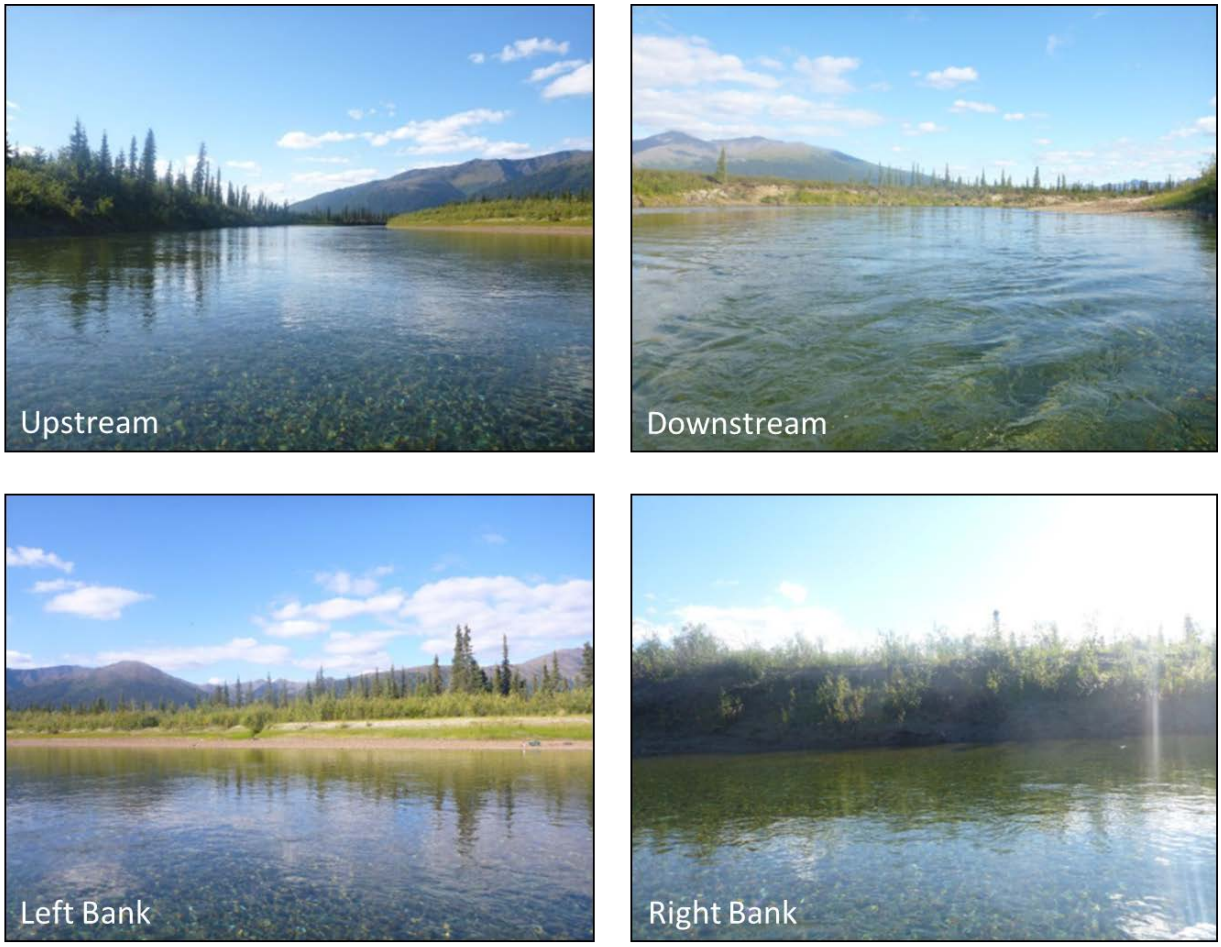


Plate 26. Stream channel characteristics, riparian habitat, and instream substrate composition at transect MN-T1-13n, Mauneluk River (northern option), Brooks East Corridor, Alaska, August 2013.







Plate 27. Stream channel characteristics and riparian habitat at observations points on the Mauneluk River (northern option), Brooks East Corridor, Alaska, August 2013.















Plate 28. Stream channel characteristics, riparian habitat, and instream substrate composition at transect RD-T1-13s, Reed River (southern option), Brooks East Corridor, Alaska, August 2013.











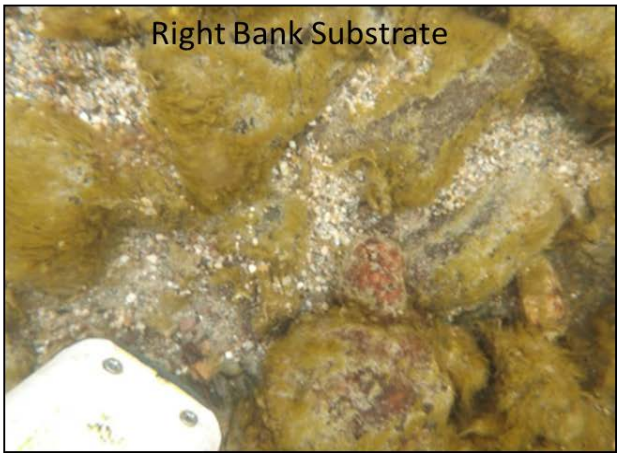


Plate 29. Stream channel characteristics, riparian habitat, and instream substrate composition at transect RD-T2-13s, Reed River (southern option), Brooks East Corridor, Alaska, August 2013.



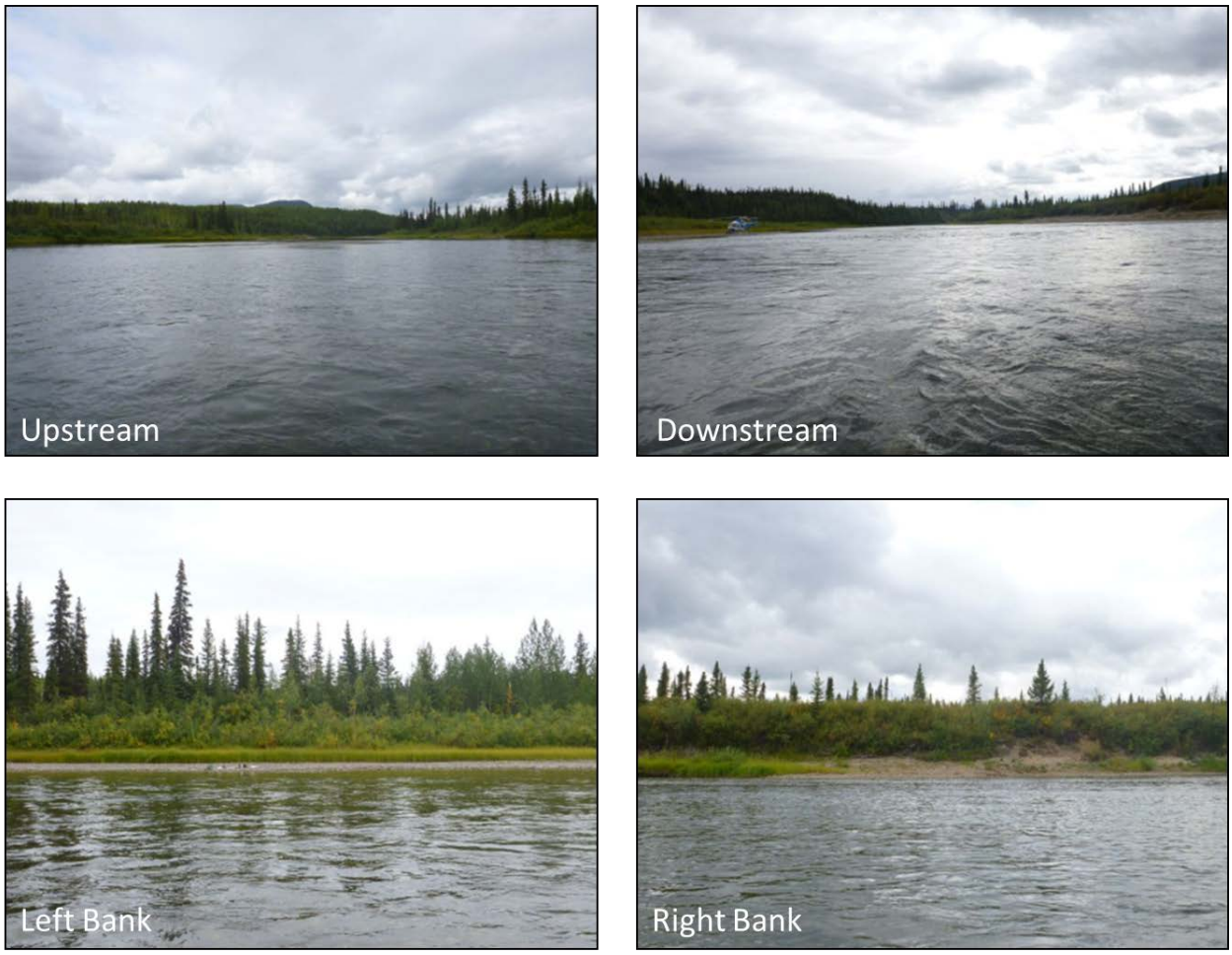








Plate 30. Stream channel characteristics, riparian habitat, and instream substrate composition of side-channel habitat at transect RD-T2-13s, Reed River (southern option), Brooks East Corridor, Alaska, August 2013.



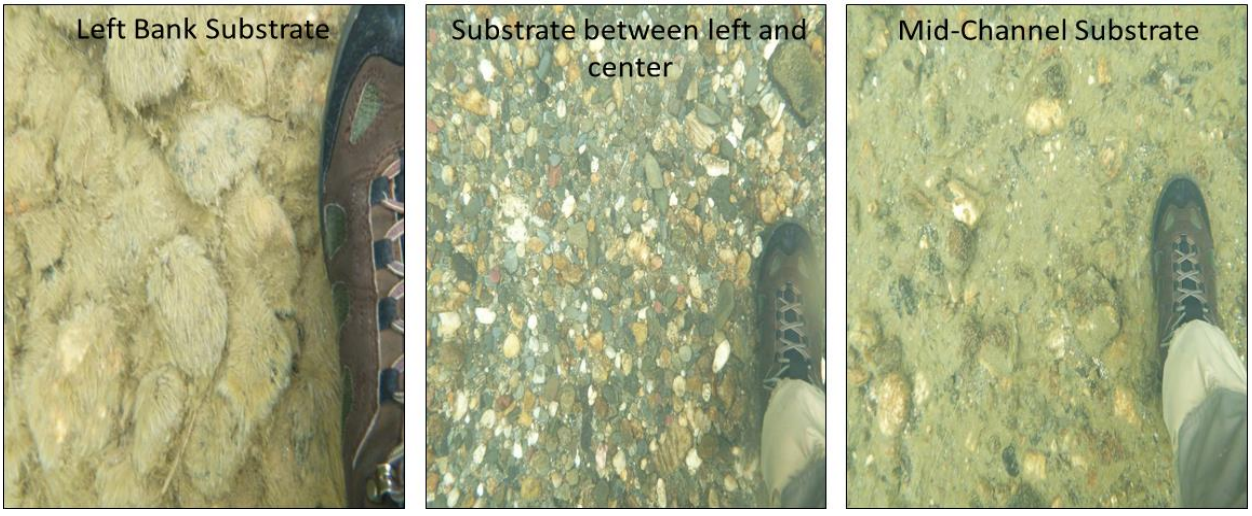


Plate 31. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KB-T1-13s, Kobuk River (southern option), Brooks East Corridor, Alaska, August 2013.

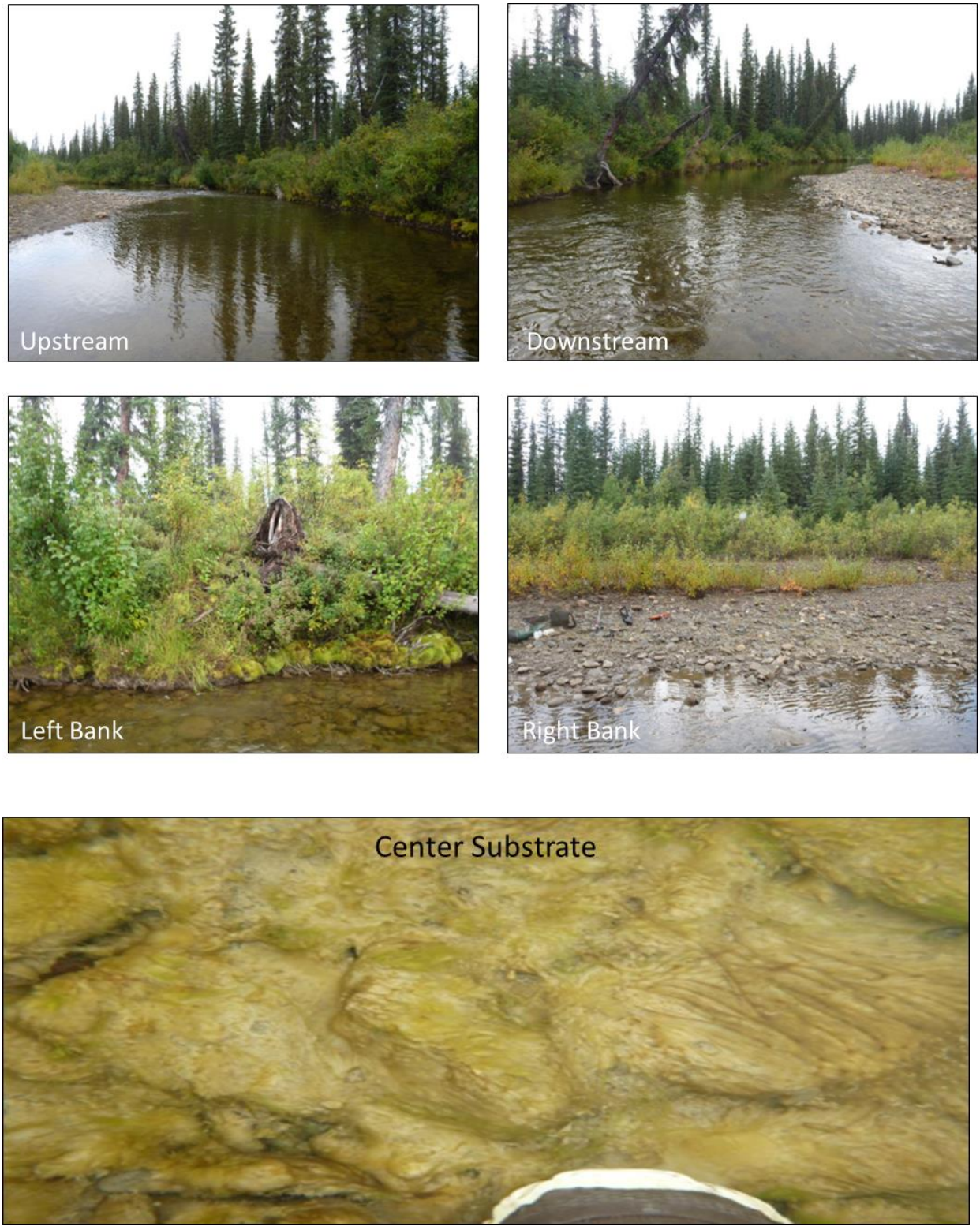


Plate 32. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HG-T1-13s, Hogatza River (southern option), Brooks East Corridor, Alaska, August 2013.

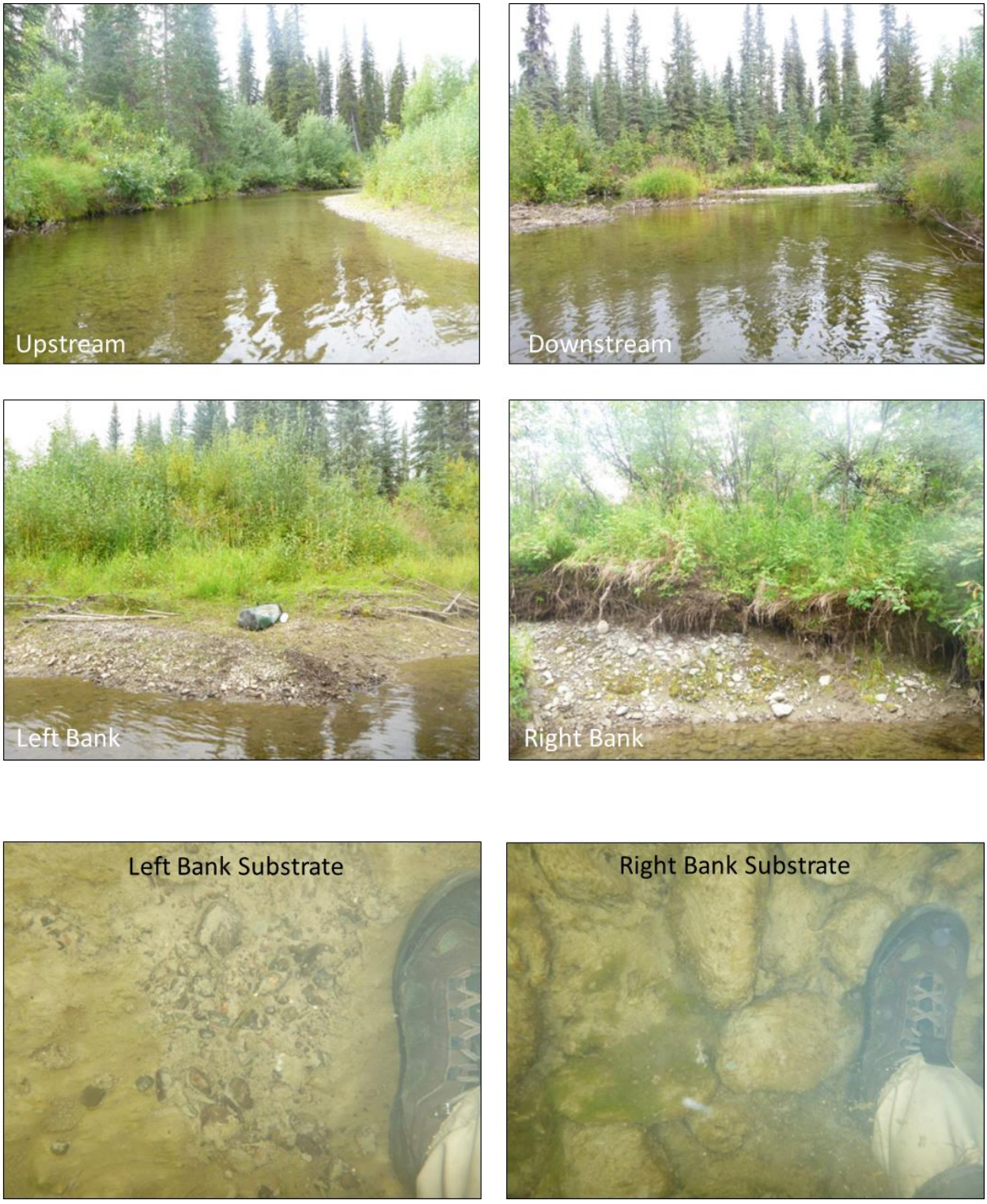


Plate 33. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HG-T2-13MCs, Hogatza River (southern option), Brooks East Corridor, Alaska, August 2013.



Plate 34. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HG-T2-13SCs, Hogatza River (southern option), Brooks East Corridor, Alaska, August 2013.











Plate 35. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HJ-T1-13s, Helpmejack Creek (southern option), Brooks East Corridor, Alaska, August 2013.











Plate 36. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HJ-T2-13s, Helpmejack Creek (southern option), Brooks East Corridor, Alaska, August 2013.



Plate 37. Stream channel characteristics and riparian habitat at transect HJ-T3-13s, Helpmejack Creek (southern option), Brooks East Corridor, Alaska, August 2013.



Plate 38. Stream channel characteristics, riparian habitat, and instream substrate composition at 3 observation points on Helpmejack Creek, Brooks East Corridor, Alaska, August 2013.

Table 1. Anadromous and freshwater fish species observed during surveys of the Brooks East Corridor, Alaska, 2012 and 2013, and current Alaska Department of Fish and Game Anadromous Waters Catalog (AWC) records.

Waterbody Name	Tributary to	Anadromous Fish Observations[a]		Freshwater Fish[a,b]		2013 AWC records[a]
		2012	2013	2012	2013	
Shungnak River	Kobuk River	–	–	SC, AG	AG	–
Ruby Creek	Shungnak River	–	ns	SC, AG	ns	–
Kogoluktuk River	Kobuk River	–	–	SC, AG	AG	CS, DV, WF
Unnamed tributary	Kogoluktuk River	–	ns	SC, AG	ns	–
Canyon Creek	Kogoluktuk River	–	ns	DV, SC	ns	–
Riley Creek	Kogoluktuk River	–	ns	DV	ns	–
Maunelak River	Kobuk River	CS	CS	SC	AG	CS, WF
Unnamed tributary	Mauneluk River	–	ns	DV, SC	ns	–
Unnamed tributary	Mauneluk River	–	ns	DV	ns	–
Unnamed tributary	Mauneluk River	–	ns	DV	ns	–
Unnamed tributary	Mauneluk River	–	ns	DV	ns	–
Unnamed tributary	Mauneluk River	CS	ns	SC, NP	ns	–
UN30	Mauneluk River	CS	ns	AG	ns	–
Unnamed tributary	Mauneluk River	–	ns	DV, SC	ns	–
Beaver Creek	Kobuk River	–	–	SC, AG	–	CS
Unnamed tributary	Beaver Creek	–	ns	DV	ns	–
Unnamed tributary	Beaver Creek	–	ns	DV, SC	ns	–
Unnamed tributary	Beaver Creek	–	ns	SC, BB	ns	–
Unnamed tributary	Beaver Creek	–	ns	SC	ns	–
Reed River	Kobuk River	CS	CS	SC, AG, BB	SC	–
Unnamed tributary	Reed River	–	ns	SC	ns	–
Kobuk River	None	CS	–	SC	AG	CS, KS, DV, SF, WF
Unnamed tributary	Kobuk River	–	ns	DV, SC	ns	–
Unnamed tributary	Kobuk River	–	ns	SC, AG	ns	–
Unnamed tributary	Kobuk River	–	ns	DV	ns	–
Unnamed tributary	Kobuk River	–	ns	SC	ns	–
Alatna River	Koyukuk River	–	–	SC	–	CS, KS
Unnamed tributary	Alatna River	CS	ns	–	ns	–
Unnamed tributary	Alatna River	KS	ns	–	ns	–
Malamute Fork Alatna River	Alatna River	ns	CS	ns	–	CS, KS
Tobuk Creek	Malamute Fork Alatna River	SS, KS	ns	–	ns	–

Table 1. Continued.

Waterbody Name	Tributary to	Anadromous Fish Observations[a]		Freshwater Fish[a,b]		2013 AWC records[a]
		2012	2013	2012	2013	
Unnamed tributary	Malamute Fork Alatna River	–	ns	SC	ns	–
Unnamed tributary	Malamute Fork Alatna River	SS	ns	–	ns	–
Unnamed tributary	Malamute Fork Alatna River	SS, CS	ns	–	ns	–
UN18	Bedrock Creek	–	–	–	NP	–
Koyukuk River	None	ns	–	ns	–	CS, SS, KS, RS, SF, WF
South Fork Koyukuk River	Koyukuk River	ns	–	ns	BB	CS, KS, WF
Unnamed tributary	Koyukuk River South Fork	–	ns	SC	ns	–
Unnamed tributary	Koyukuk River South Fork	–	ns	SC, AG	ns	–
Jim River	Koyukuk River	ns	CS	ns	AG	CS, KS
Unnamed tributary	Jim River	SS	ns	SC	ns	–
Unnamed tributary	Jim River	SS, KS	ns	AG, SC	ns	–
Hogatza River	Koyukuk River	CS	–	SC	AG	CS, SS, KS, WF
Unnamed tributary	Hogatza River	–	ns	SC, BB	ns	–
Unnamed tributary	Hogatza River	–	ns	AG	ns	–
Helpmejack Creek	Alatna River	–	–	DV, AG	ns	–
Unnamed tributary	Helpmejack Creek	–	–	DV, SC	ns	–

[a] DV = Dolly Varden; SS = Coho Salmon; KS = Chinook Salmon; SC = Slimy Sculpin; AG = Arctic Grayling; BB = Burbot; NP = Northern Pike; CS = Chum Salmon; RS = Sockeye Salmon; WF = Whitefish species; SF = Sheefish; ns=not sampled

[b] Dolly Varden observed during ABR surveys are treated as freshwater resident fish because it cannot be shown that they are anadromous without additional analysis

Table 2. Instream physical habitat parameters for waterbodies sampled in the Brooks East Corridor, Alaska, August 2013. Values in parentheses represent side-channel habitat.

Survey Transect	Waterbody	Date	Bankfull Width (m)	Wetted Width (m)	Thalweg Depth (m)	Stream Channel Substrate[a]	Discharge (m^3/s)	Instream Cover[b,c]
SH-T1-13	Shungnak River	8/12/2013	59	52	nm	40% SI, 40% CY, 5% BO, 5% CB, 5% GR, 5% SA	nm	FA1, MA2, SWD1, OV1, BO1
SH-T2-13	Shungnak River	8/12/2013	49	37	0.85	40% GR, 30% CB, 25% SA, 5% BO	10.00	SWD1, OV1, BO1
SH-T3-13	Shungnak River	8/12/2013	40	49	0.82	40% GR, 35% CB, 20% SA, 5% BO	11.06	FA2, SWD1, LTR1, OV2, UB2, BO1
KG-T1-13	Kogoluktuk River	8/13/2013	120	102	1.02	90% SA, 5% CB, 5% GR (50% SA, 25% GR, 20% CB, 5% BO)	24.88	SWD1, BO1
KG-T2-13	Kogoluktuk River	8/13/2013	131	124	0.89	40% SA, 30% CB, 30% GR	22.84	FA2, SWD1, OV1
MN-T1-13	Mauneluk River	8/13/2013	97	58	nm	50% GR, 35% CB, 15% SA	34.43[d]	FA2, LWD1, SWD1, LTR1, OV1
MN-T2-13	Mauneluk River	8/13/2013	nm	70	nm	40% CB, 40% SA, 20% GR	13.01	FA2, MA1, LWD1, SWD1, OV2
BV-T1-13	Beaver Creek	8/14/2013	34.2	31.5	0.66	50% CB, 25% GR, 15% BO, 5% SA, 5% CY	7.70	FA4, MA1, SWD1, OV2, UB1, BO2
BV-T2-13	Beaver Creek	8/14/2013	29.05	28	0.88	30% CB, 30% SA, 20% BO, 20% GR	7.86	FA4, MA1, SWD1, LTR1, OV2, UB1, BO2
RD-T1-13	Reed River	8/15/2013	79	56	0.98	35% GR, 35% SA, 20% CB, 10% BO	26.48	FA2, MA1, SWD1, LTR1, OV1, BO1
KB-T1-13	Kobuk River	8/15/2013	90	89	0.97	35% CB, 35% GR, 25% SA, 5% BO	29.67	FA2, MA1, SWD1, LTR1, OV2, UB1, BO1
AL-T2-13	Alatna River	8/17/2013	98.5	75.5	nm	35% SA, 25% CB, 20% SI, 10% BO, 10% GR	nm	SWD1, BO2
MF-T1-13	Malamute Fork Alatna River	8/17/2013	91	53.5	0.75	35% GR, 35% SA, 25% CB, 5% BO	12.28	FA1, SWD1, OV1, UB1, BO1
UN18-T1-13	Unnamed tributary to Malamute Fork Alatna River	8/16/2013	15.5	9.6	0.39	50% BO, 30% CB, 15% GR, 5% SA	0.60	FA2, SWD1, LTR1, OV2, UB1, BO3
UN18-T2-13	Unnamed tributary to Malamute Fork Alatna River	8/16/2013	19.5	7.3	1.08	25% BO, 25% CB, 25% GR, 25% SA	0.31	FA3, SWD2, LTR1, OV2, UB2, BO1
SF-T1-13	South Fork Koyukuk River	8/22/2013	85	56	1.04	40% CB, 30% GR, 15% BO, 15% SA	13.75	SWD1, AS2
JM-T1-13	Jim River	8/22/2013	65	23.5	0.71	45% GR, 35% CB, 15% SA, 5% BO	5.07	FA1, LWD1, SWD1, BO1
UN30-T1-13n	Unnamed tributary to Mauneluk River	8/21/2013	46	19.5	0.97	50% BO, 30% CB, 15% GR, 5% SA	3.85	FA1, SWD2, OV1, BO3
MN-T1-13n	Mauneluk River	8/21/2013	60	33.7	0.99	65% GR, 15% CB, 15% SA, 5% BO	15.46	FA2, SWD1, OV1, UB1, BO1
RD-T1-13s	Reed River	8/19/2013	65.5	57	0.93	40% CB, 30% SA, 20% GR, 10% BO	21.51	FA1, SWD1, BO1

Survey Transect	Waterbody	Date	Bankfull Width (m)	Wetted Width (m)	Thalweg Depth (m)	Stream Channel Substrate[a]	Discharge (m^3/s)	Instream Cover[b,c]
RD-T2-13s	Reed River	8/19/2013	80	46.5	0.81	35% CB, 30% GR, 30% SA, 5% BO (60% SA, 30% GR, 10% CB)	22.91	FA1, SWD1, OV1, UB1, BO1
KB-T1-13s	Kobuk River	8/19/2013	113	77	1.03	50% GR, 35% CB, 10% SA, 5% BO	28.22	FA2, SWD1, BO1
HG-T1-13s	Hogatza River	8/20/2013	27.5	9.2	0.42	40% CB, 35% GR, 15% SA, 10% BO	0.62	FA2, LWD1, SWD2, LTR1, OV2, UB1, BO1
HG-T2-13MCs	Hogatza River	8/20/2013	12.5	5.6	0.84	40% CB, 40% GR, 15% SA, 5% BO	0.59	FA1, SWD1, LTR1, OV2, UB1, BO1
HG-T2-13SCs	Hogatza River	8/20/2013	11.2	9.4	0.53	50% GR, 25% SA, 20% CB, 5% BO	0.12	FA2, SWD2, LTR1, OV2, UB2, BO1
HJ-T1-13s	Helpmejack Creek	8/18/2013	39.2	11.15	0.92	40% SA, 30% CB, 25% SI, 5% BO	1.75	FA1, LWD1, SWD2, OV1, UB1, BO1
HJ-T2-13s	Helpmejack Creek	8/18/2013	19.3	10.5	0.81	40% CB, 30% BO, 20% GR, 5% SA, 5% SI	1.62	FA1, SWD1, OV1, UB1, BO2
HJ-T3-13s	Helpmejack Creek	8/18/2013	24.2	10.9	0.69	50% CB, 20% GR, 20% SI, 10% BO	2.25	SWD1, OV1, BO1

[a] BO, boulder; CB, cobble; GR, gravel; SA, sand; SI, silt; CY, clay

[b] Each parameter was expressed as a qualitative percentage of the total stream cover within 10 m upstream and downstream of the water sampling site and was designated as 0=absent (0%), 1 = sparse (less than 10%), 2 = moderate (10–40%), 3 = moderately abundant (40–75%), or abundant (greater than 75%).

[c] FA = Filamentous Algae; MA = Macrophytes; LWD = Large woody debris (more than 0.3 m at diameter breast height); SWD = Small woody debris (less than 0.3 m at diameter breast height); LTR = Live Tree Roots; OV = Overhanging Vegetation; UB = Undercut Bank; AS = Artificial Structures

[d] Discharge measured downstream of transect at the end of the corridor because transect was unwadeable

nm=not measured

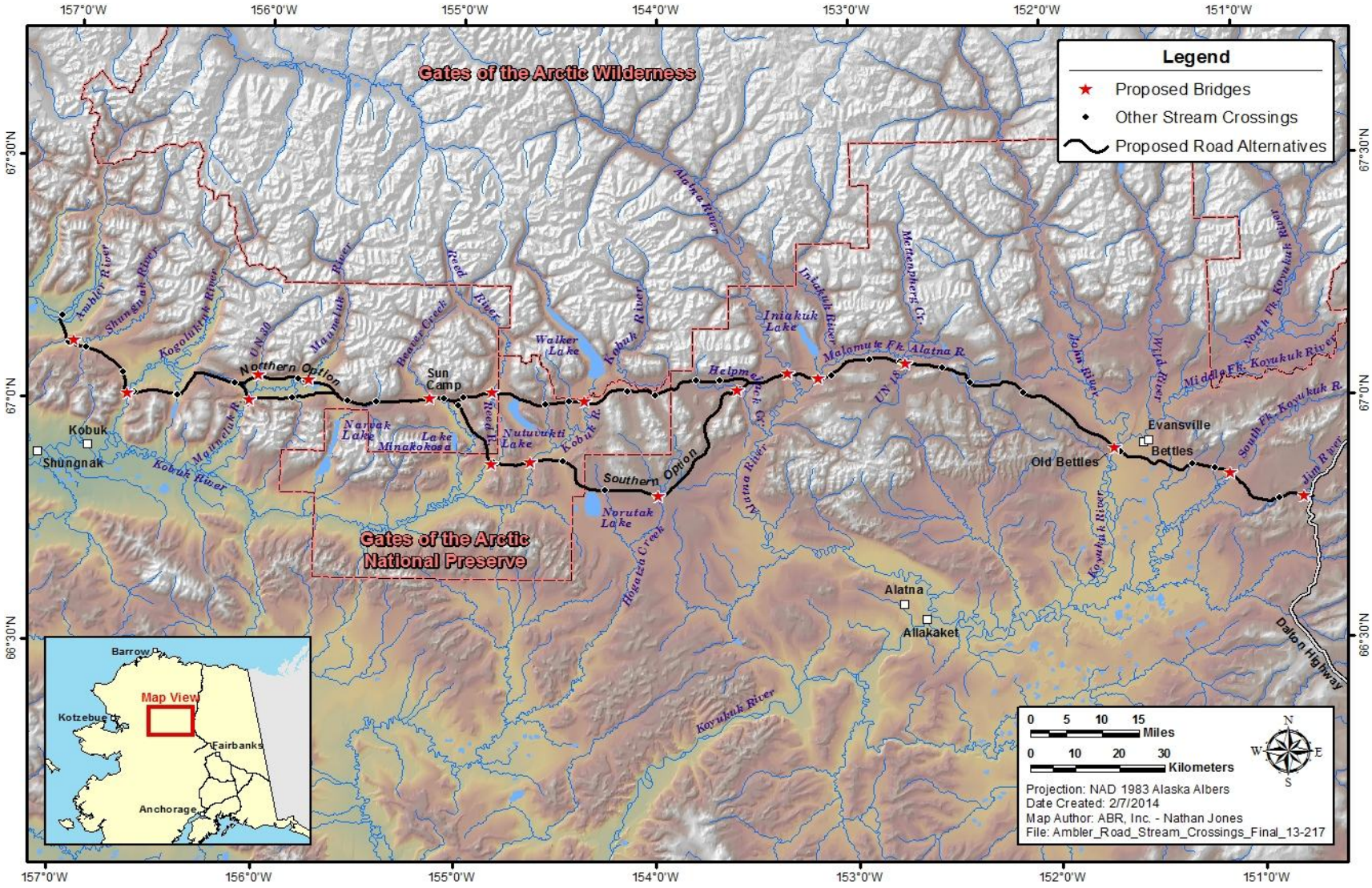


Figure 1. The Brooks East Corridor, including the northern and southern options, and proposed bridge crossings where stream habitat surveys were conducted in August 2013.

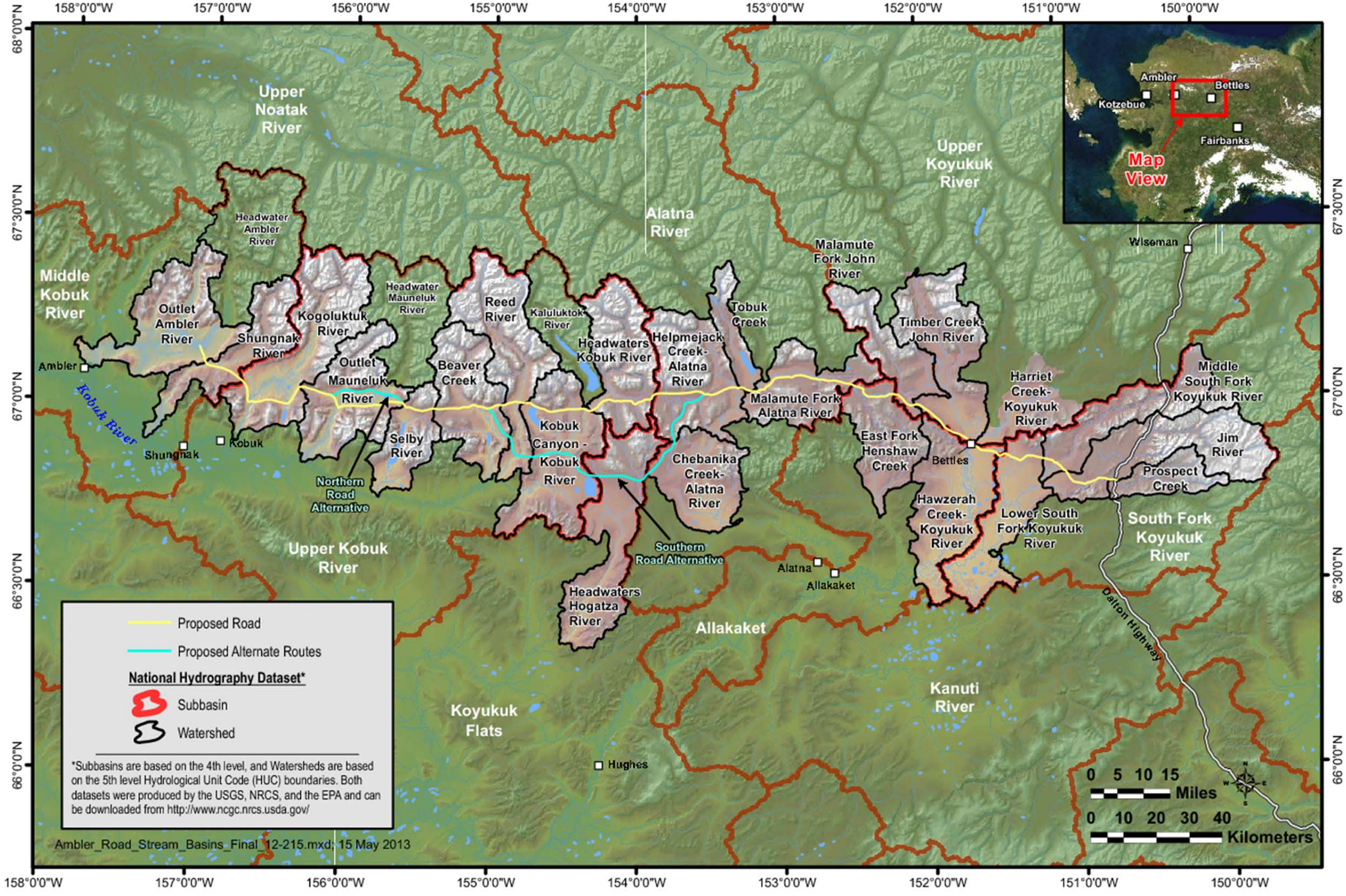


Figure 2. Subbasins and watersheds traversed by the proposed Brooks East Corridor, including the northern and southern options.

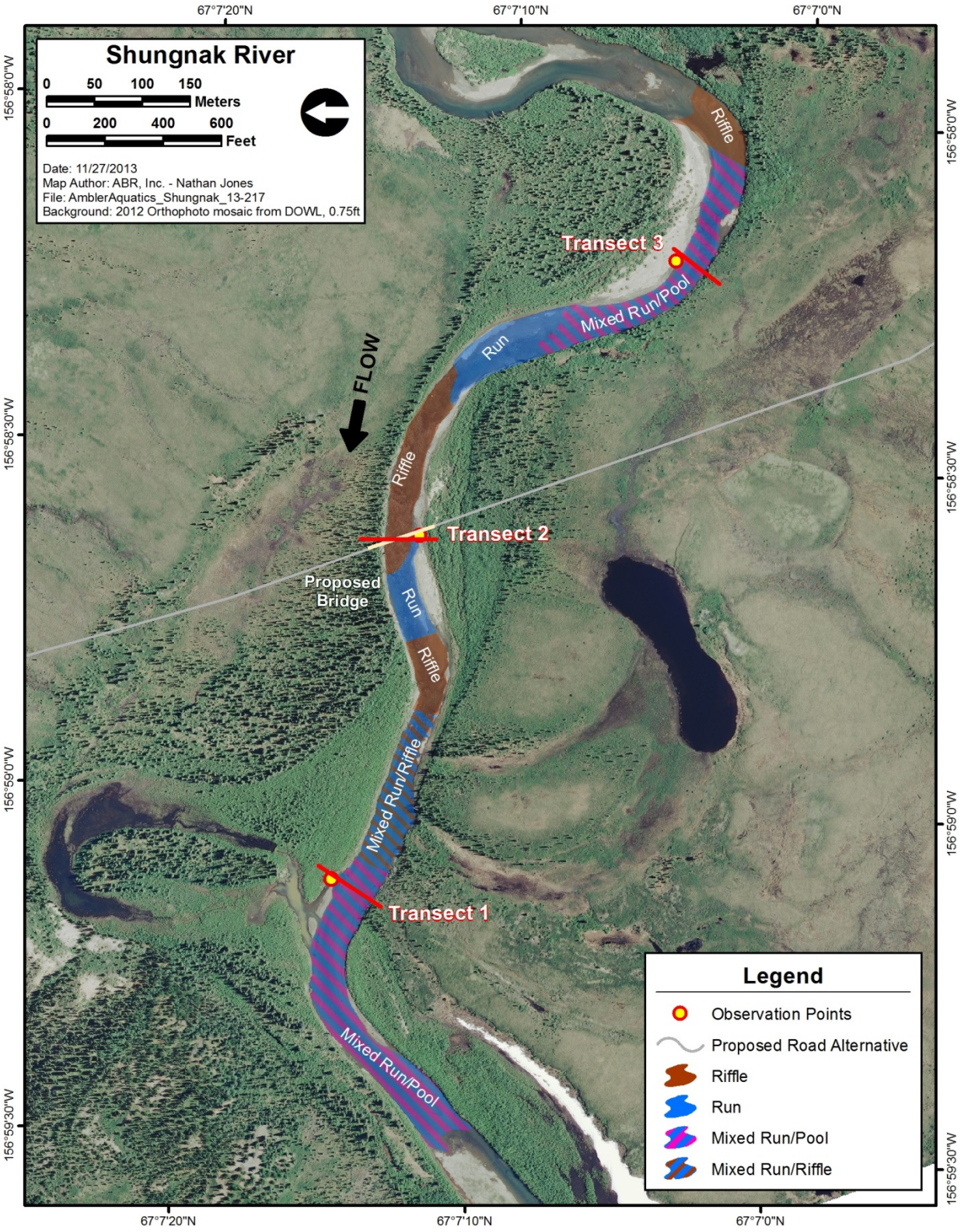


Figure 3. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Shungnak River, Alaska, August 2013.

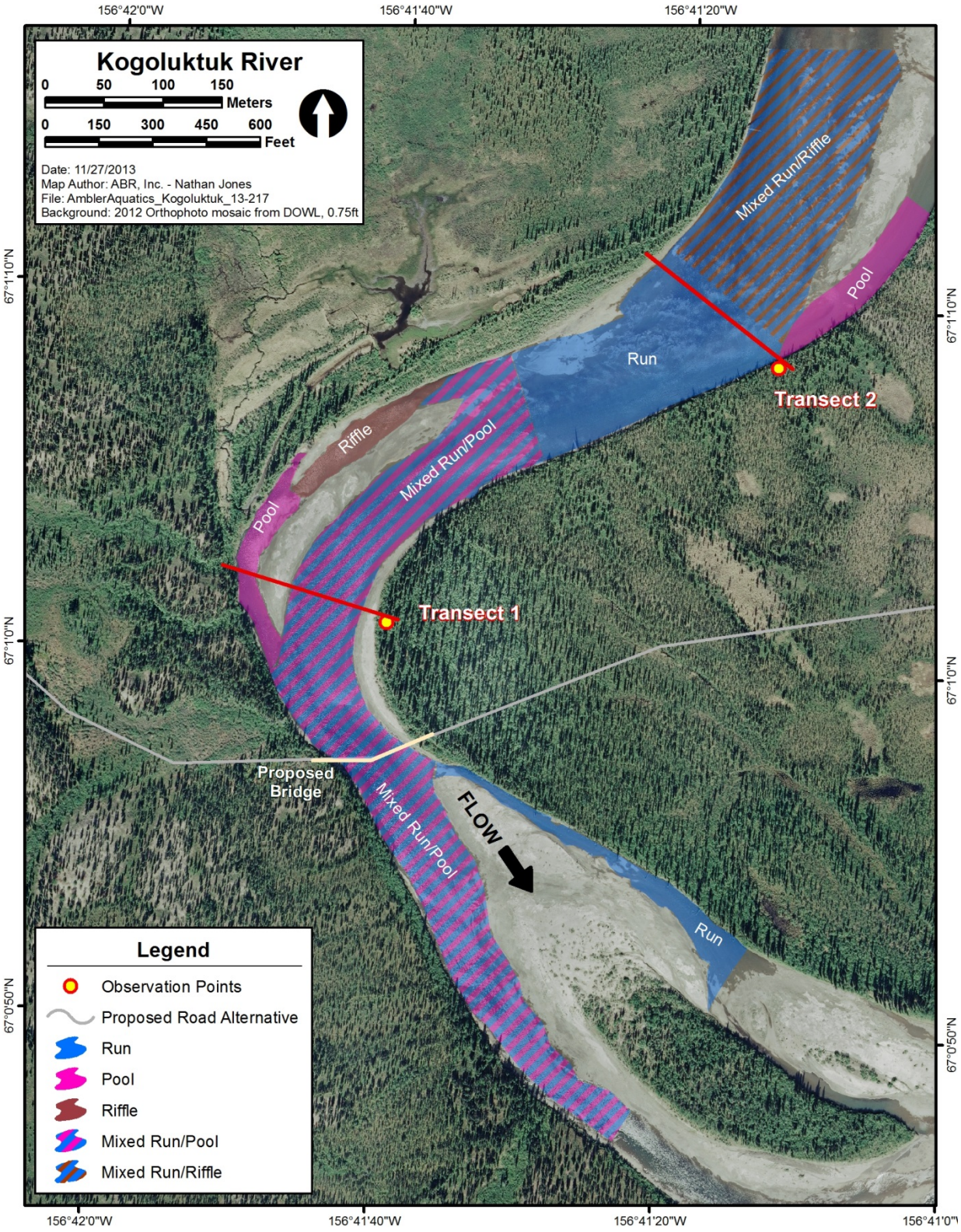


Figure 4. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Kogoluktuk River, Alaska, August 2013.

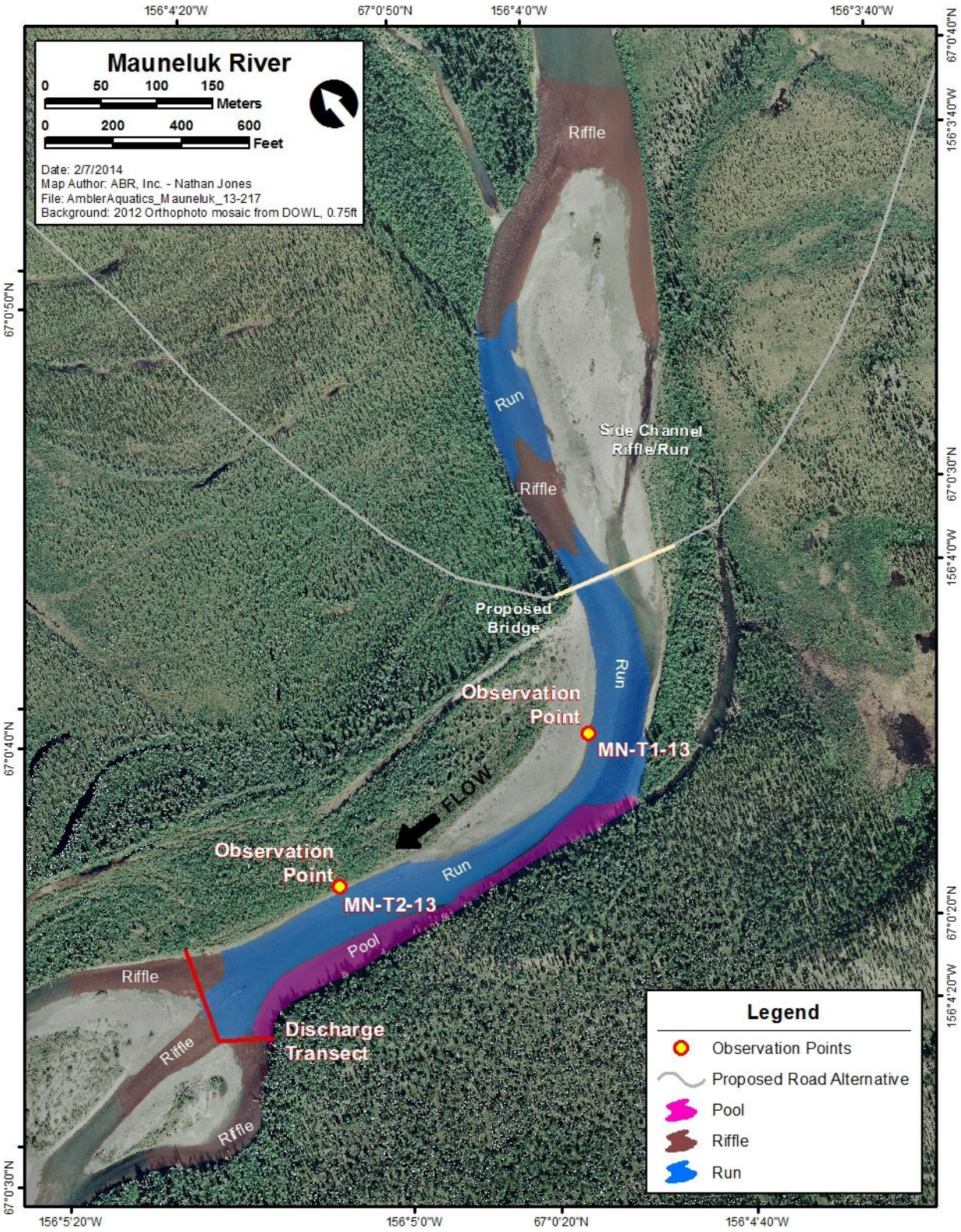


Figure 5. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Mauneluk River, Alaska, August 2013.

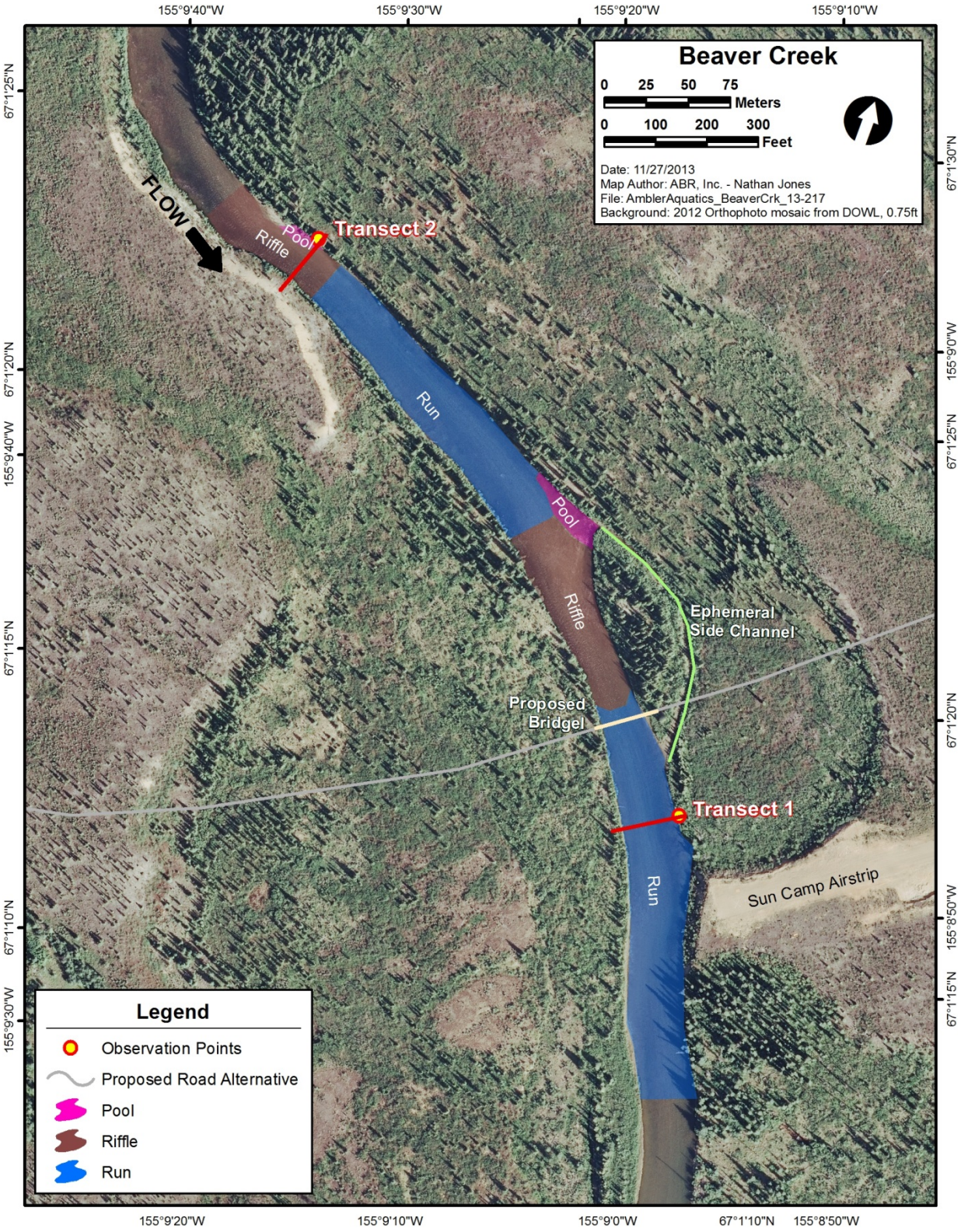


Figure 6. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Beaver Creek, Alaska, August 2013.

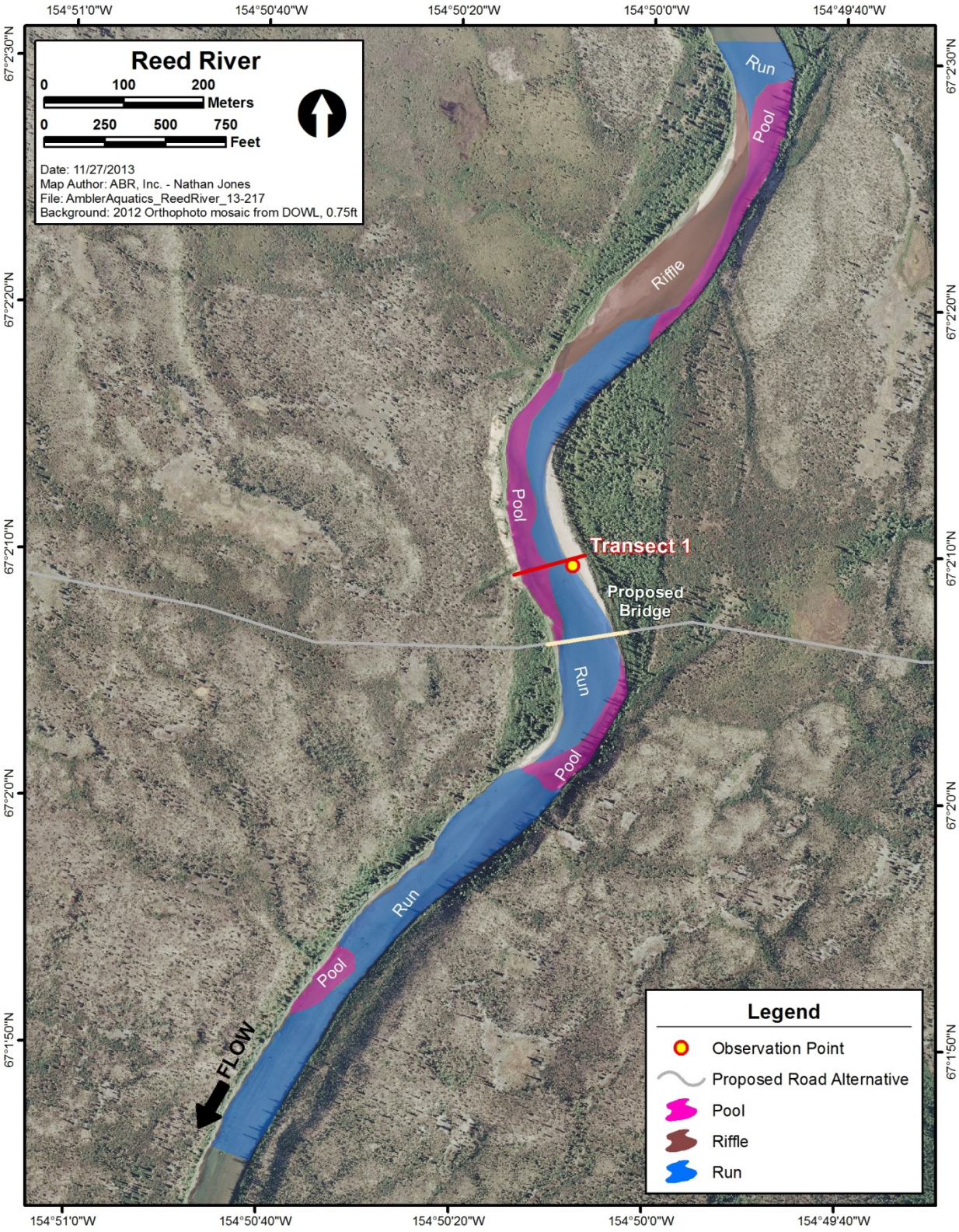


Figure 7. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Reed River, Alaska, August 2013.

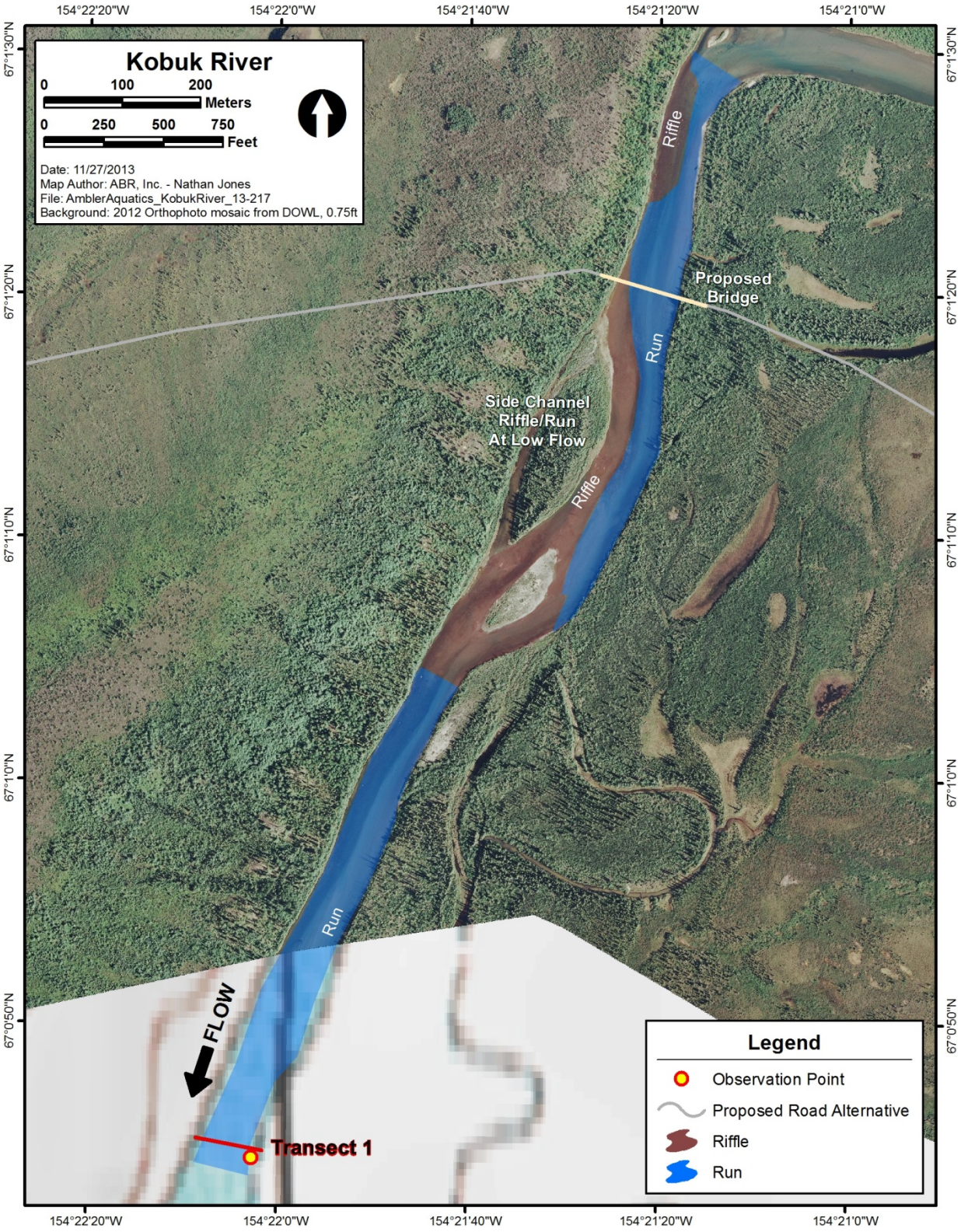


Figure 8. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Kobuk River, Alaska, August 2013.

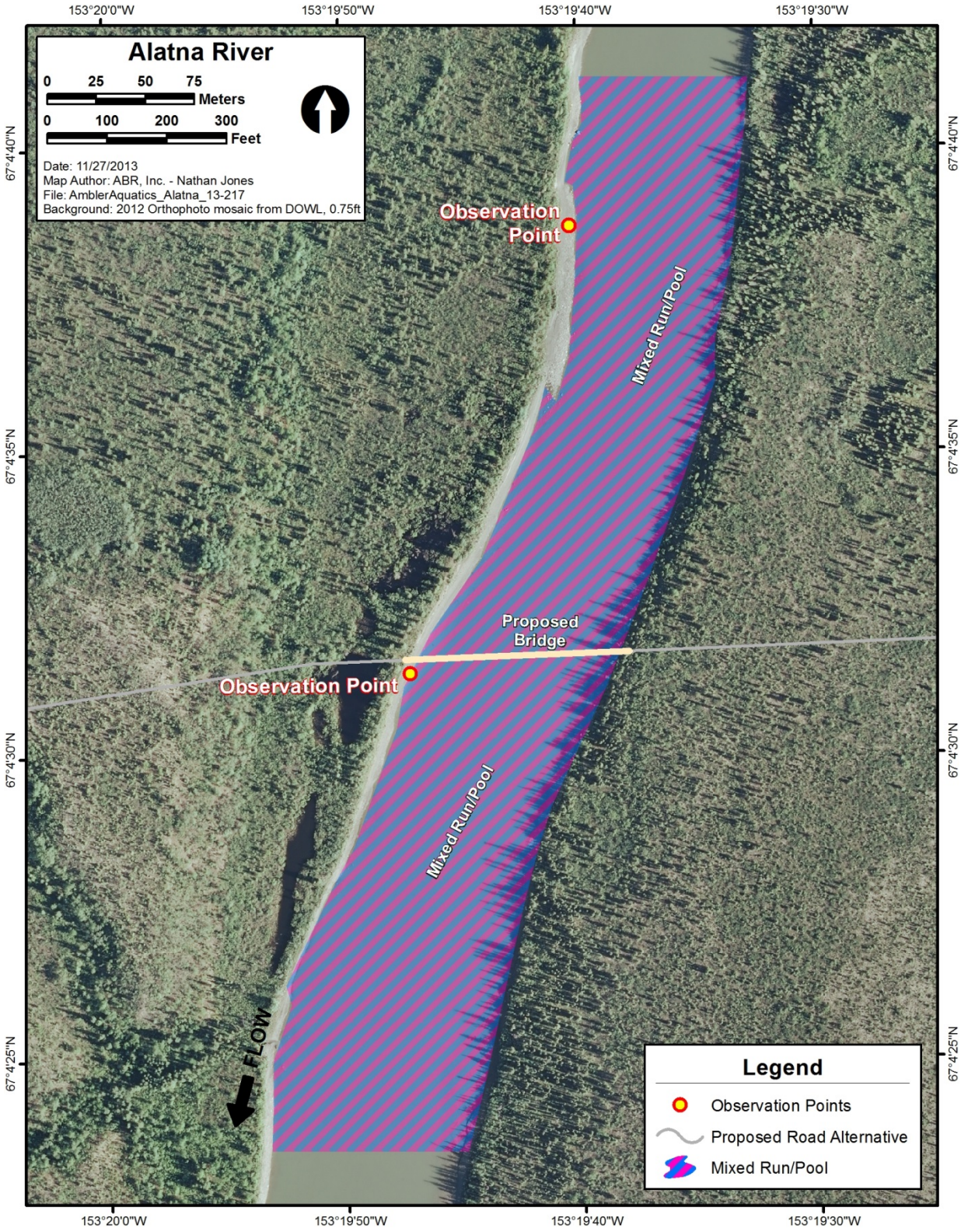


Figure 9. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Alatna River, Alaska, August 2013.

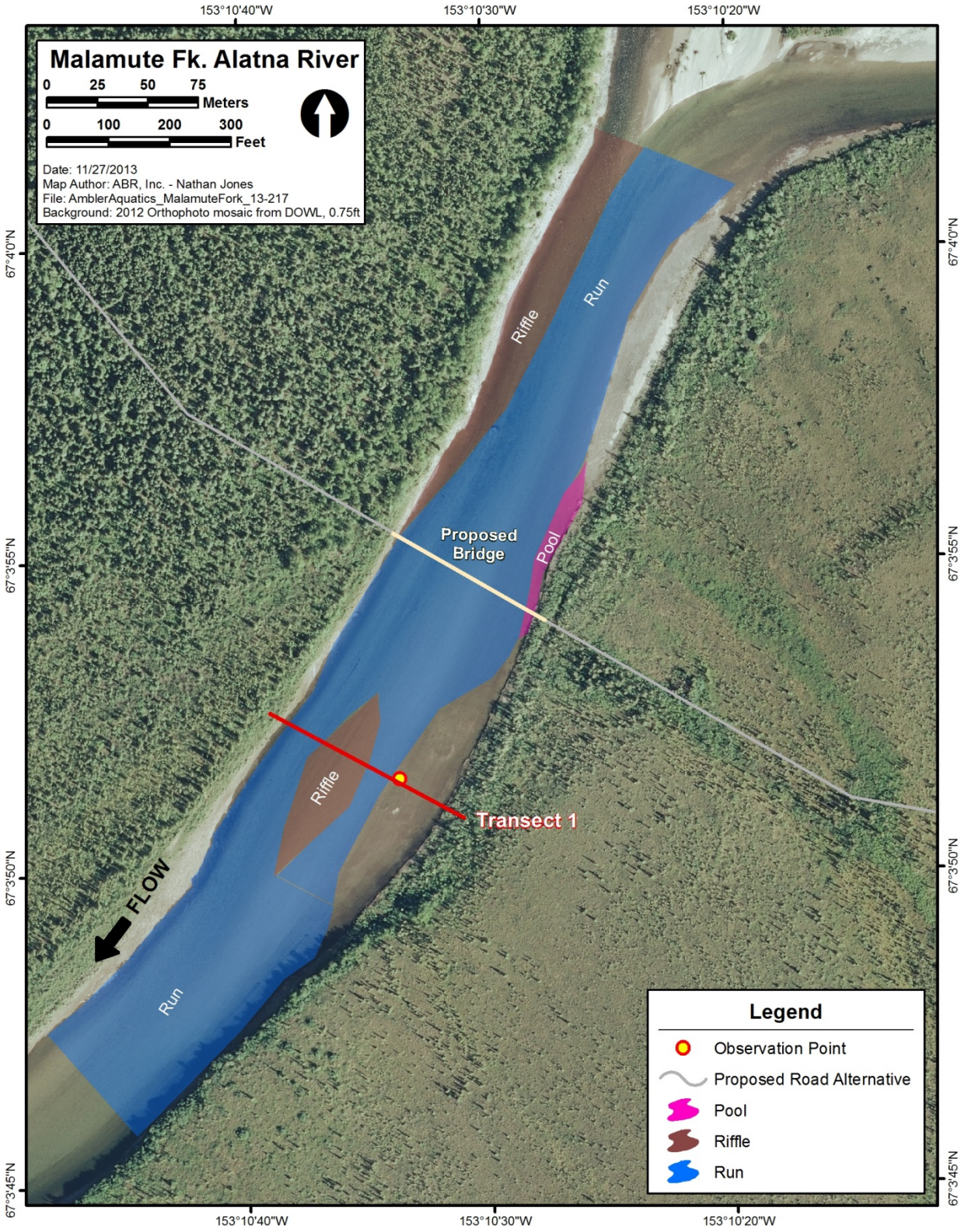


Figure 10. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Malamute Fork Alatna River, Alaska, August 2013.

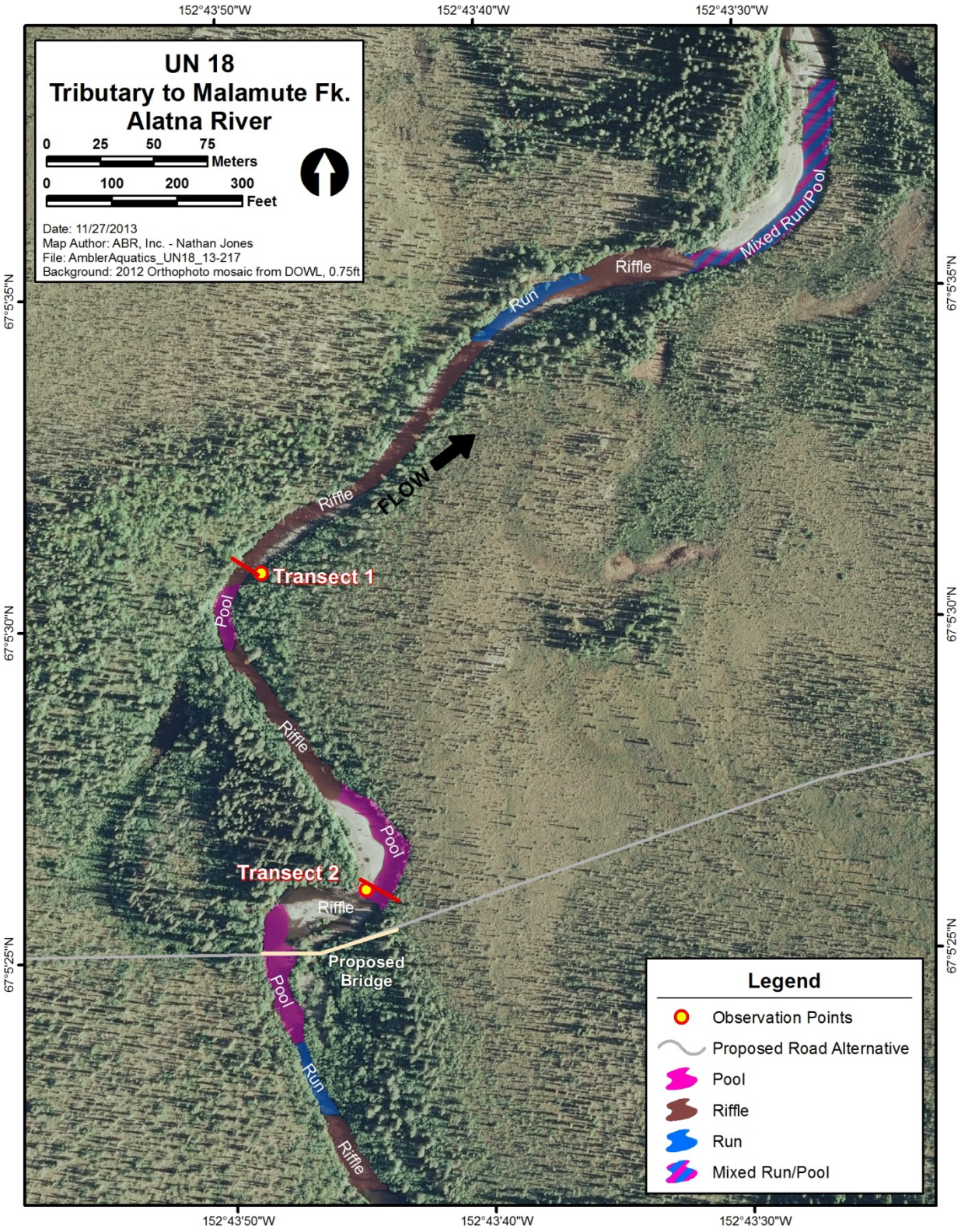


Figure 11. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of UN18, an unnamed tributary to the Malemute Fork Alatna River, Alaska, August 2013.

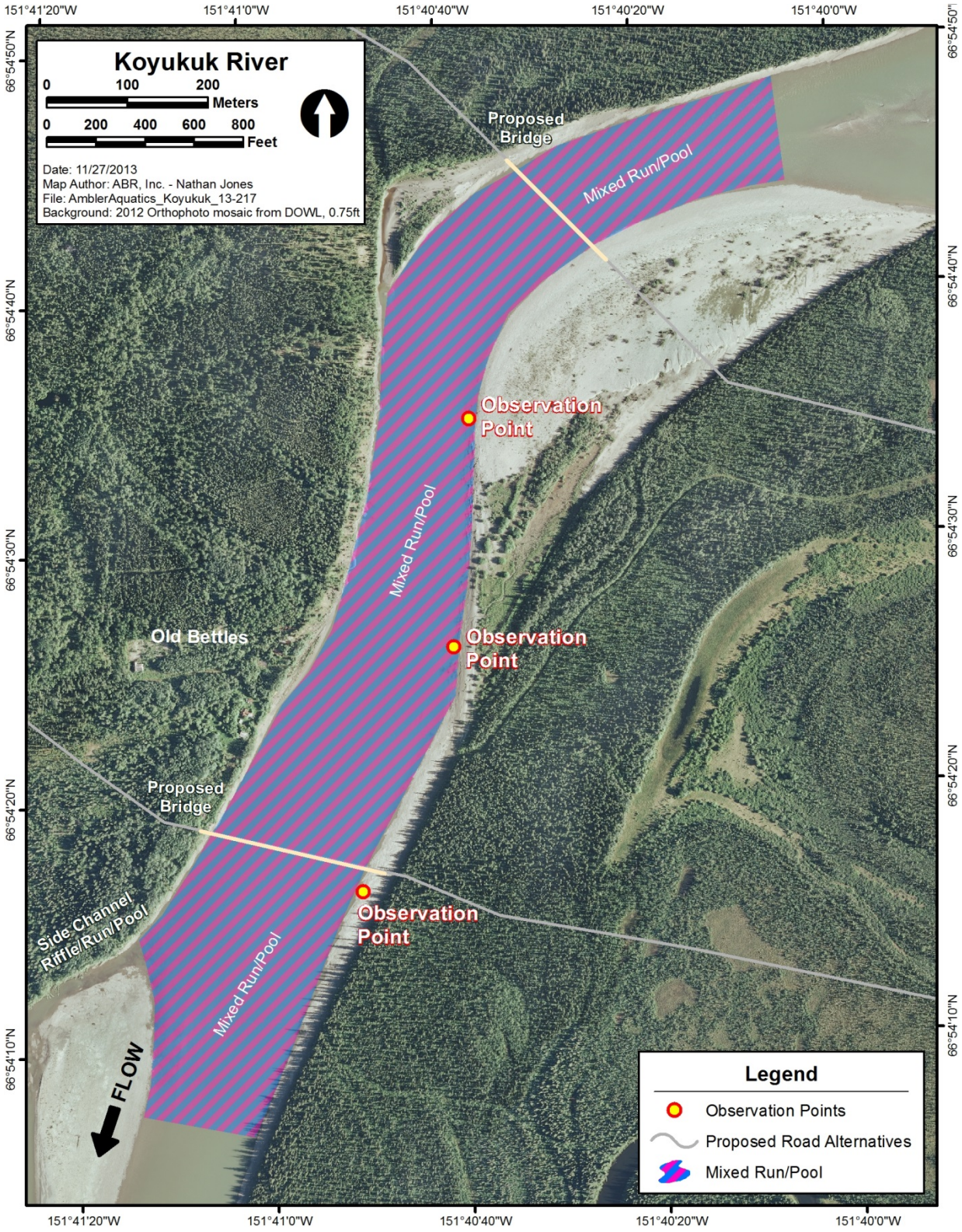


Figure 12. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Koyukuk River, Alaska, August 2013.

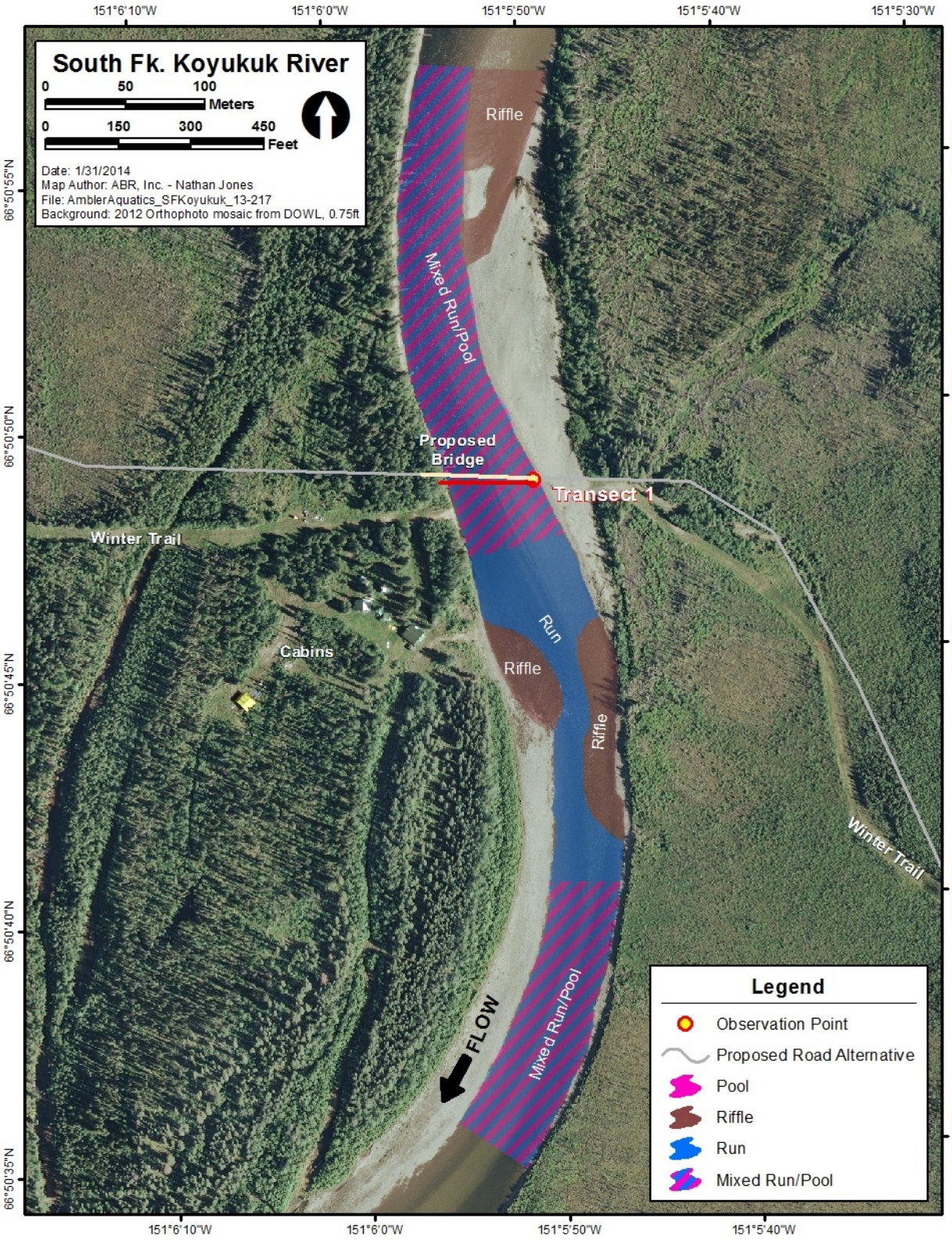


Figure 13. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the South Fork Koyukuk River, Alaska, August 2013.

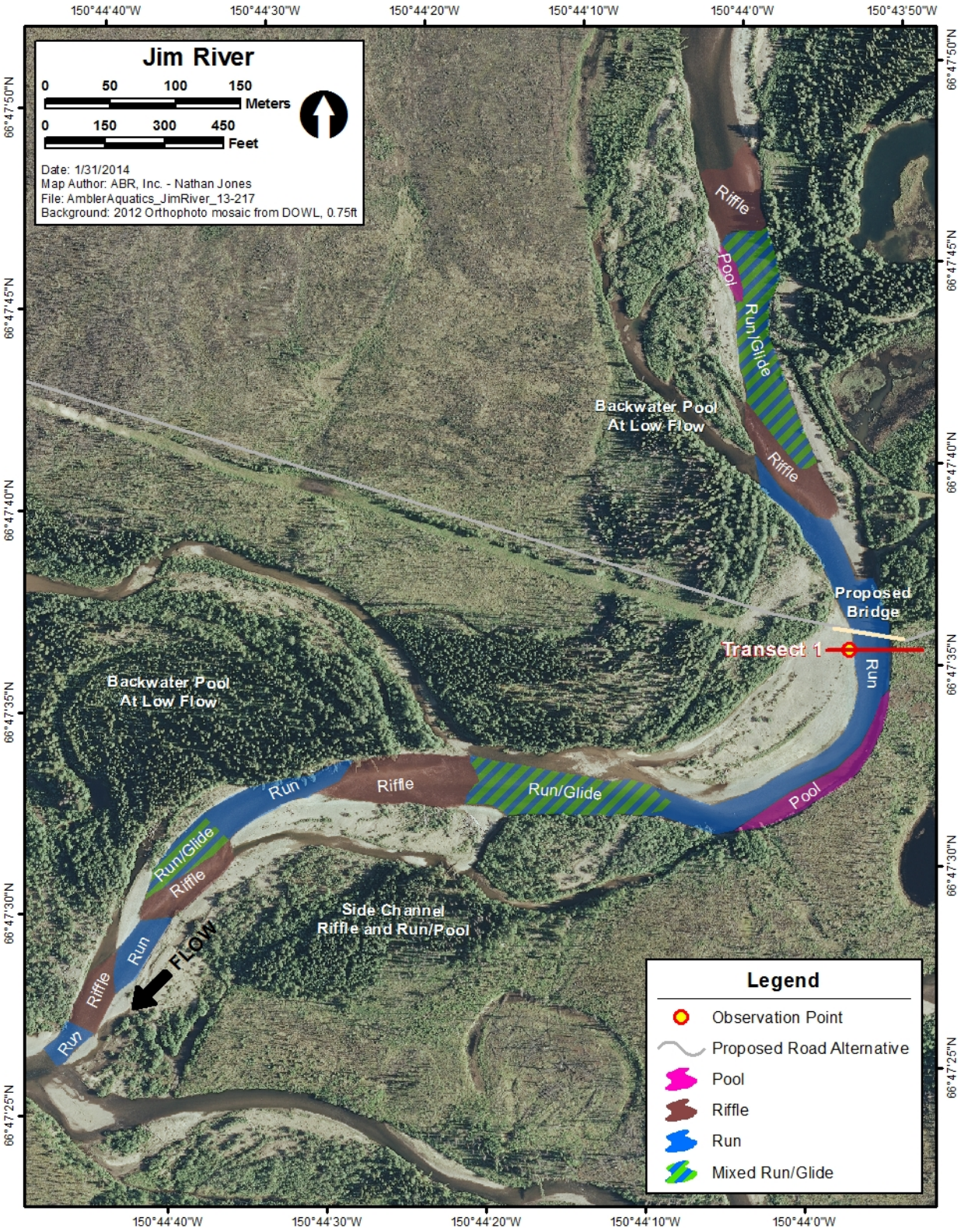


Figure 14. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the unnamed tributary to the Jim River, Alaska, August 2013.

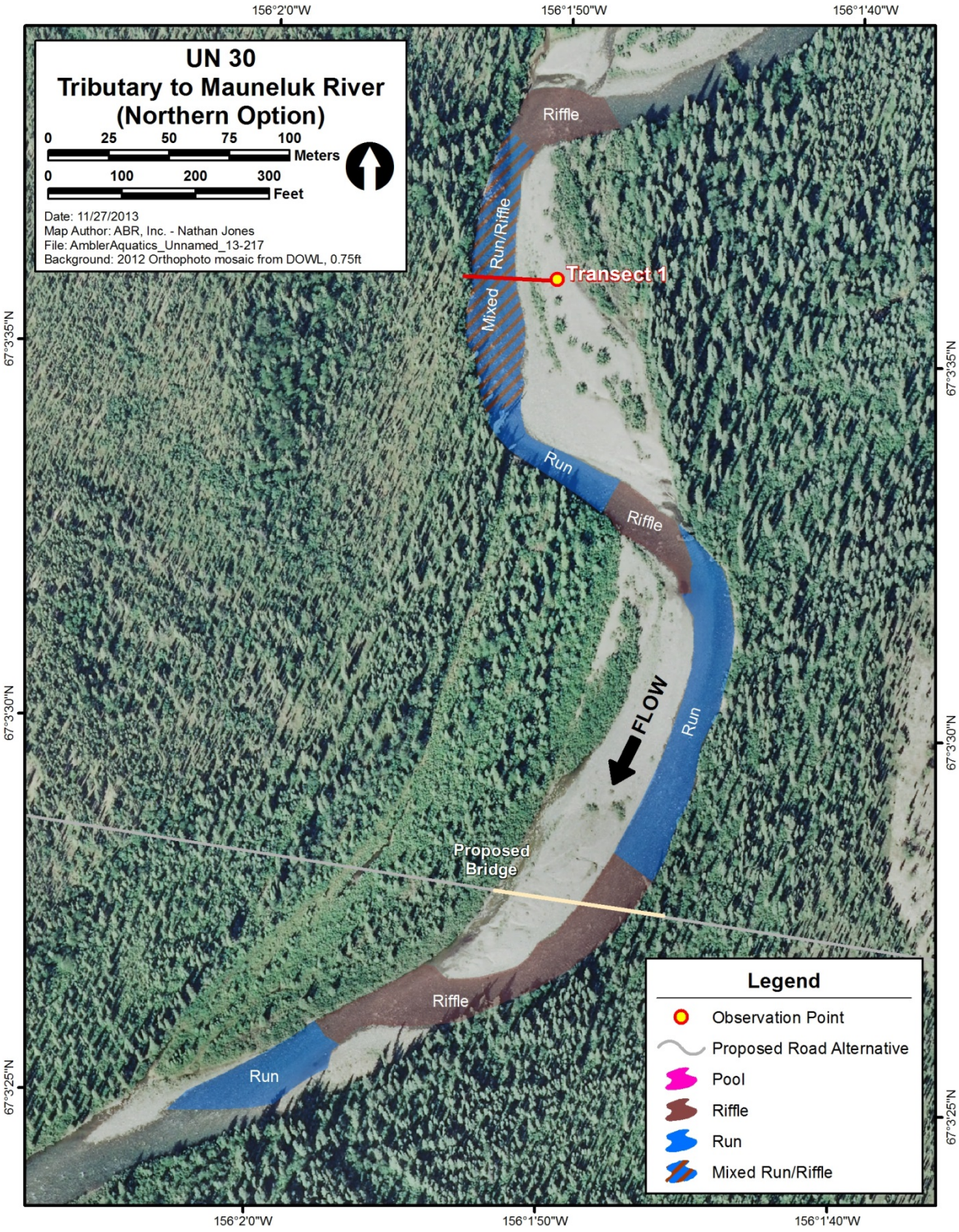


Figure 15. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of UN30, an unnamed tributary to the Mauneluk River on the northern road option, Alaska, August 2013.

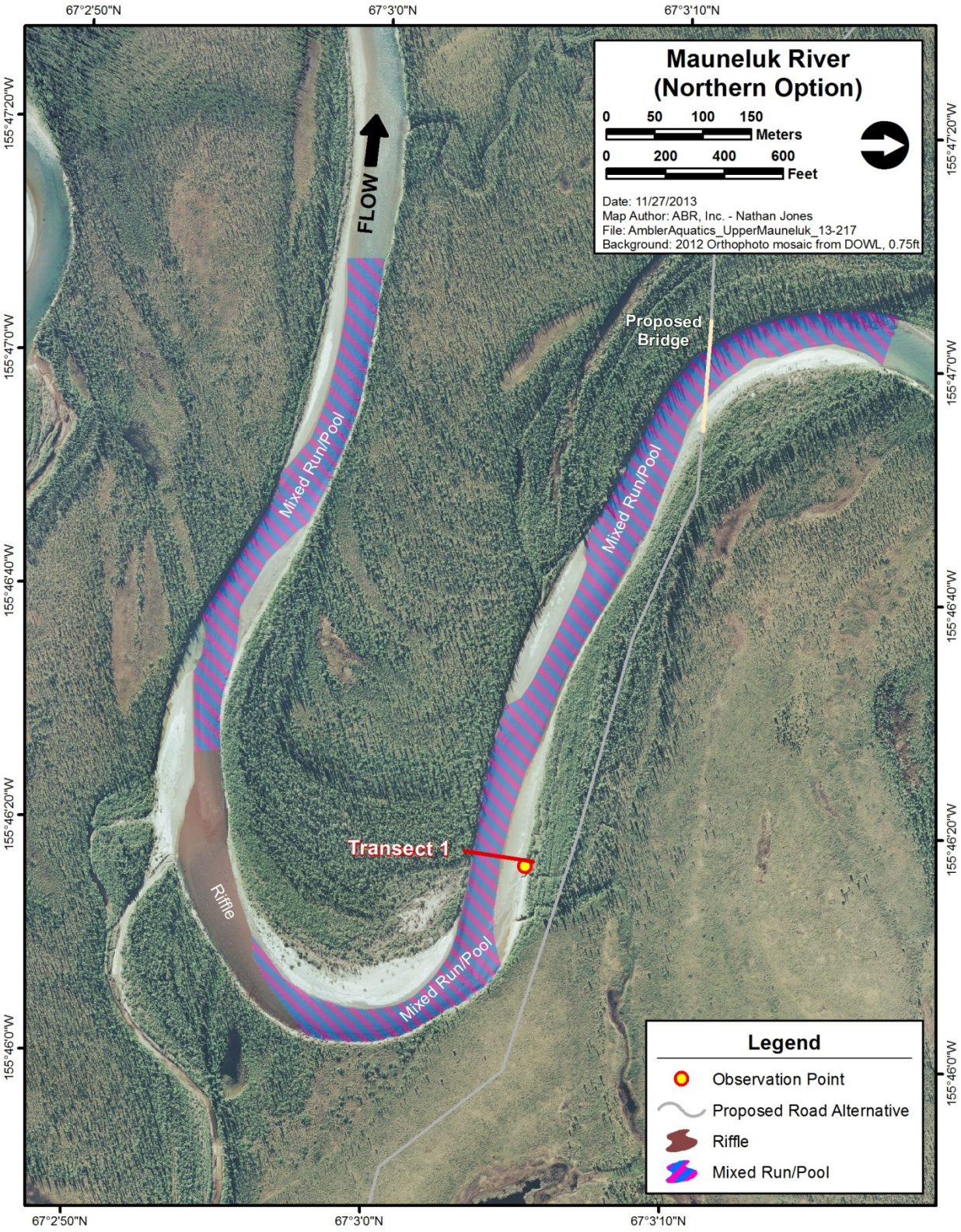


Figure 16. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Mauneluk River on the northern road option, Alaska, August 2013.

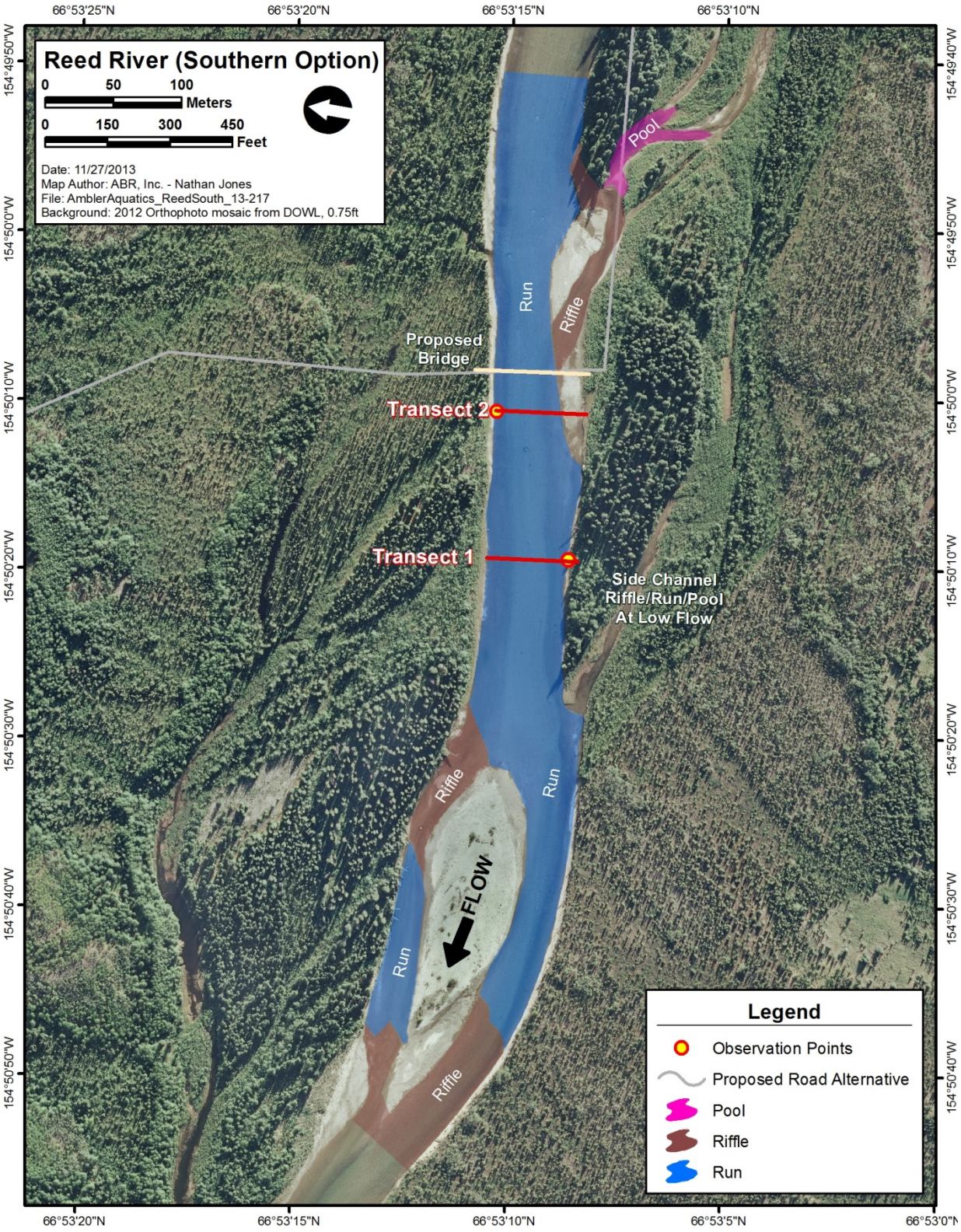


Figure 17. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Reed River on the southern road option, Alaska, August 2013.

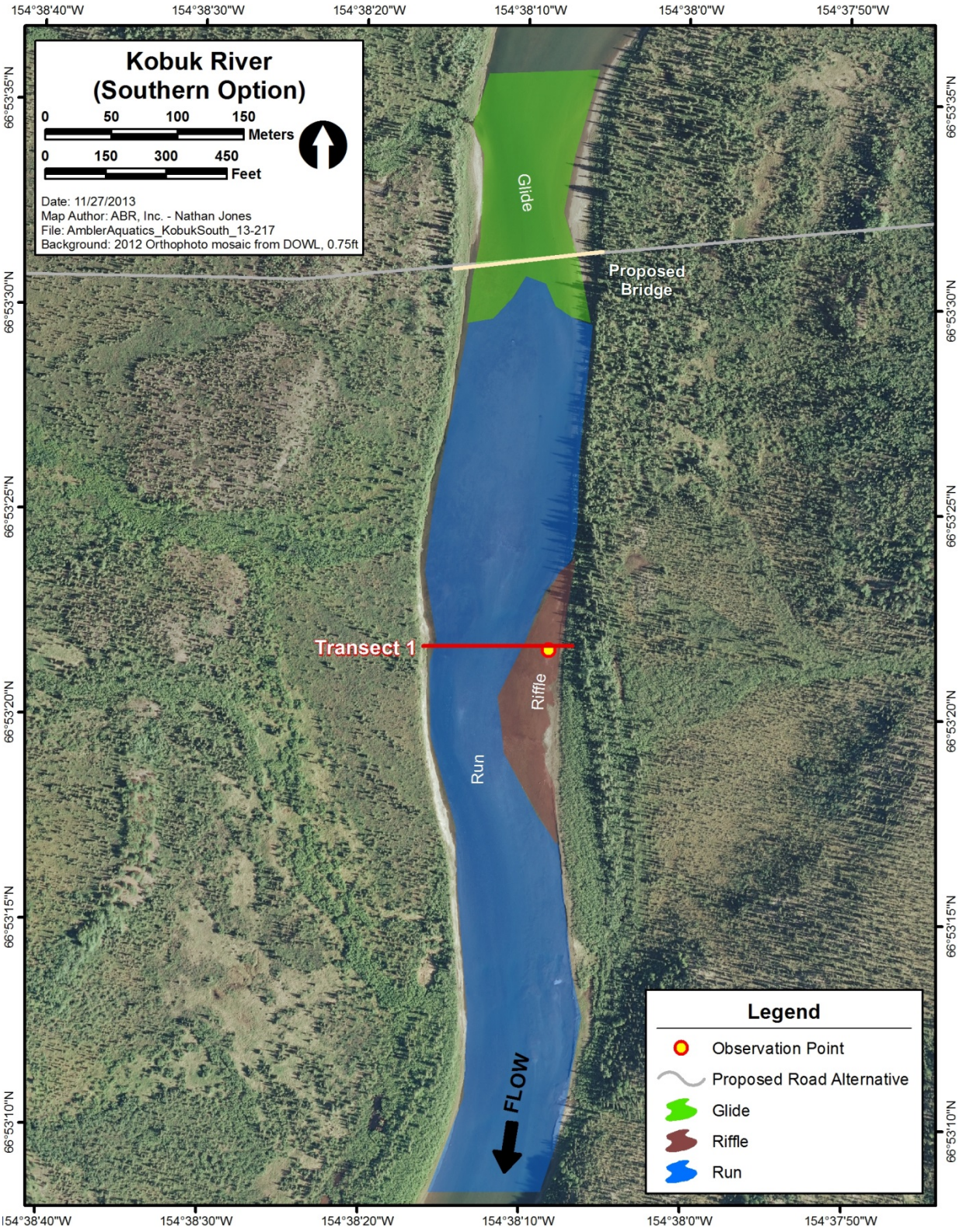


Figure 18. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Kobuk River on the southern road option, Alaska, August 2013.

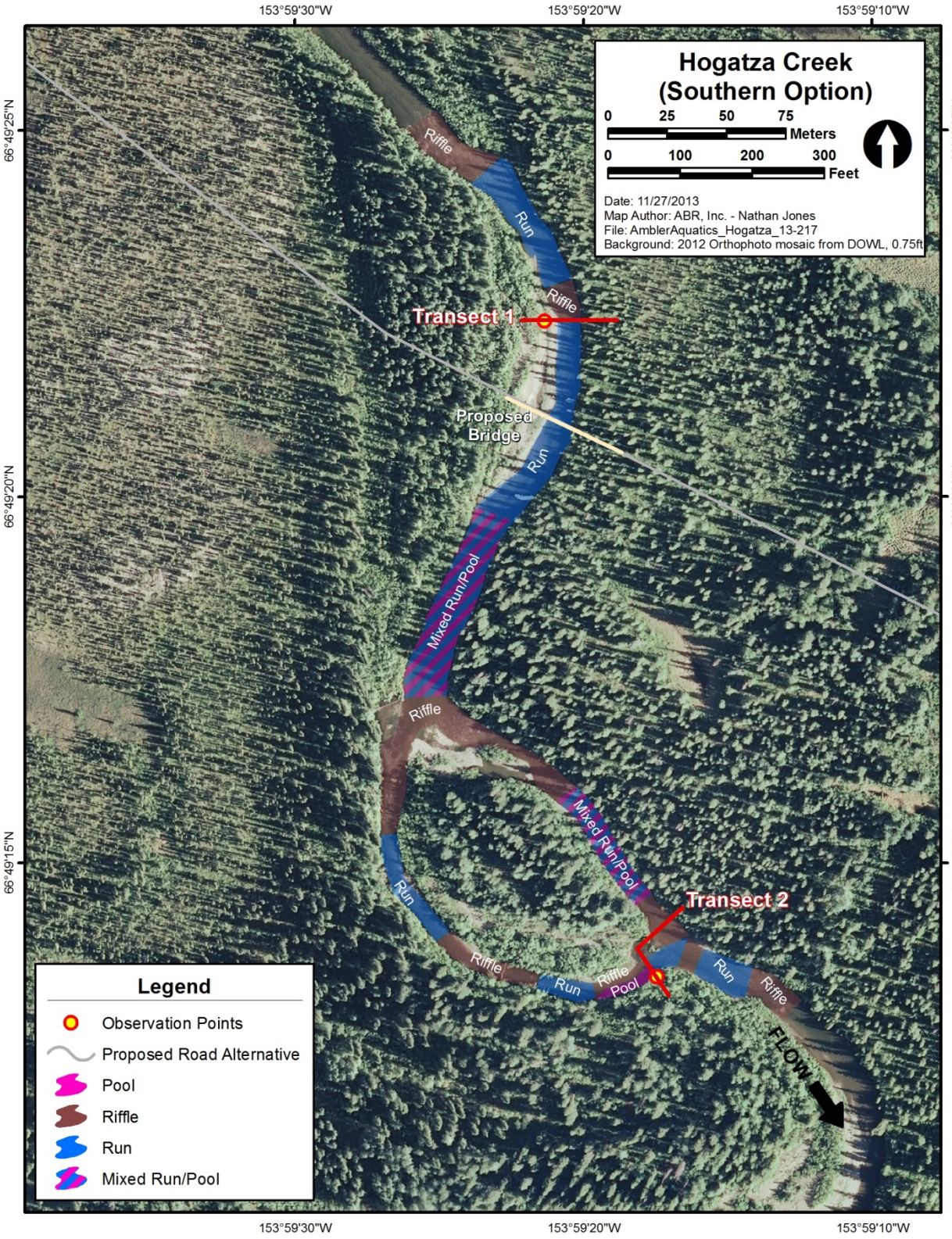


Figure 19. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of Hogatza Creek on the southern road option, Alaska, August 2013.

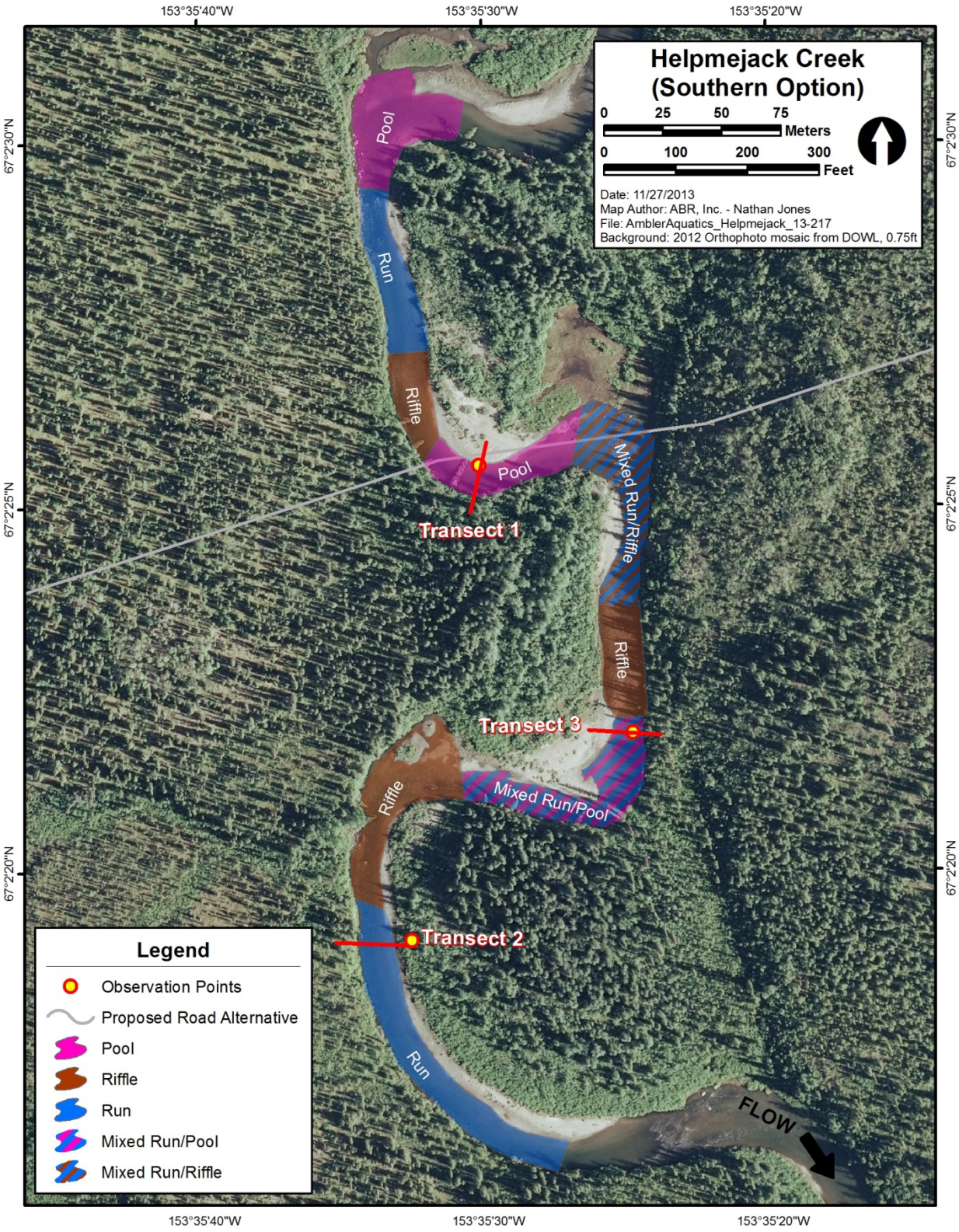


Figure 20. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of Helpmejack Creek on the southern road option, Alaska, August 2013.

Appendix A. Anadromous Waters Catalog (AWC) nomination forms for Pacific salmon observed by ABR during 2012 fish surveys in waterbodies traversed by the Brooks East Corridor, Alaska. Forms were submitted to the Alaska Department of Fish and Game (ADFG) in September 2013.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kogoluktuk River (331-00-10490-2307)

Name of Waterway: CANYON CREEK ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/13/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile Dolly Varden (111 and 114 mm) caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.02888, W156.66255. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Alatna River (334-40-11000-2125-3661)

Name of Waterway: HELPMEJACK CREEK ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/16/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile dolly varden caught at N 67.05835, W153.79528. one individual (FL=86mm) was caught using baited minnow traps. The other individual was caught by electrofishing (FL=122 mm). Fishers were Jena Lemke and Matthew Apling of ABR. See attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA
Signature: Sabrina Garcia Date: 09/12/2013
Agency: ABR, Inc.
Address: 1225 E. International Airport Rd. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): HUGHES D-2

Anadromous Waters Catalog Number of Waterway: 334-40-11000-2125-3355

Name of Waterway: HOGATZA RIVER ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	07/21/2012	✓		✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Visual observation of two adult spawning chum salmon by Jena Lemke and Matthew Apling of ABR, Inc. Observations occurred at N 66.82131, W153.99037. Please see Figure 4 and plate 6 in the attached report for maps and photos.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. Ste. 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-3

Anadromous Waters Catalog Number of Waterway: 331-00-10490

Name of Waterway: KOBUK RIVER ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	09/04/2012	✓		✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Visual observation of spawning adult chum salmon by Jena Lemke and Matthew Appling of ABR. Observation occurred at N 67.02165, W 154.35763. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: Mauneluk River (331-00-10490-2335)

Name of Waterway: Mauneluk River

☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	07/25/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Three juvenile Chum Salmon caught via electrofishing by Jena Lemke and Matthew Apling of ABR, Inc. The three individuals measured 41, 55, and 57 mm. Capture occurred at N 67.00295, W 156.09182. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): HUGHES D-4

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: REED RIVER

☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

Fisheries Scientist	Date
Habitat Operations Manager	Date
AWC Project Biologist	Date
Cartographer	Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	07/21/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile chum salmon captured via electrofishing by Jena Lemke and Matthew Apling of ABR, Inc. The individuals were 36 and 38mm long. Please see attached report for sampling methods and maps. Juveniles observed at N 66.96365, W 154.81606.

Name of Observer (please print): SABRINA GARCIA

Signature: [signature]

Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Ste. 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): HUGHES D-4

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: REED RIVER ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

Fisheries Scientist	Date
Habitat Operations Manager	Date
AWC Project Biologist	Date
Cartographer	Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	09 | 04 | 2012	✓		✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Visual observation of adult chum salmon spawning area by Jena Lemke and Matthew Apling of ABR, Inc.
Adult observed at N 66.88630, W 154.83643.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. Ste. 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kogoluktuk River (331-00-10490-2307

Name of Waterway: RILEY CREEK

☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/13/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Three juvenile Dolly Varden (102, 108, 128 mm) were captured in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for sampling methods and maps. Traps were set at N67.05552, W156.70256.

Name of Observer (please print): SABRINA GARCIA

Signature: [signature] Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-1

Anadromous Waters Catalog Number of Waterway: N/A, closest is AWC 334-40-11000-2125

Name of Waterway: TOBUK CREEK ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
COHO SALMON	07/16/2012		✓	✓	✓
CHINOOK SALMON	07/16/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Fishing was conducted via electrofishing. Matthew Apling and Jena Lemke with ABR, Inc. were the observers/fishers. Fishing took place at N 67.07944, W 153.18635. The Coho salmon was a juvenile measured at 69mm, Chinook was 74mm. Only one individual from each species was found. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia

Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER B-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Ambler River (331-00-10490-2205)

Name of Waterway: ULANEAK CREEK ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/13/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
8 juvenile Dolly Varden caught in minnow traps by Lena Lemke and Matthew Apling of ABR. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for sampling methods and maps. Traps were set at N 67.39883, W 156.81866.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia

Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____

Revision 02/08

Comments (cont.):

Dolly Varden FL (mm) were:

112
109
108
109
124
87
83
98

See Appendix C in attached report

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Alatna River (334-40-11000-2125-3661)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	07/23/2012	✓		✓	✓
CHINOOK SALMON	07/23/2012	✓		✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Visual observation by Jena Lemke and Matthew Apling of an adult chum salmon (67.22524, -153.55644) and an adult chinook salmon (67.22868, -153.59320). Both observations were made during aerial surveys. The chum salmon spawning area was located less than 1 km upstream of the confluence of the unnamed tributary with the mainstem Alatna River and extended (see back)

Name of Observer (please print): SABRINA GARCIA

Signature: Gabrielgarcia Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E International Airport Dr. Suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

Comments (cont.):
Approximately 100m upstream (see Figure 4; Plates 7 and 8 of the Report). The Chinook Salmon spawning area was documented approximately 1.8 km upstream (see Figure 6; Plates 9 and 10 of the attached report).

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): SURVEY PASS A-5

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Beaver Creek (331-00-10490-2437)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/15/2013		✓	✓	☑
					☐
					☐
					☐
					☐

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Three juvenile dolly varden (75, 83, 144mm) caught in minnow traps by Jena Lemke and Matthew Appling. Traps were set at N 67.01060, W 155.08077. Traps were baited with disinfected salmon eggs and soaked overnight. See attached report for maps and sampling methods.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Rd. Suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): HUGHES D-5

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Beaver Creek (331-00-10490-2437)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/24/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile Dolly Varden (88 and 98mm) were caught via electrofishing by Jena Lemke and Matthew Apling. Fishing occurred at N 66.98333, W155.02530. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA
Signature: Gabrielgarcia Date: 09/12/2013
Agency: ABR, Inc
Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): BETTLES D-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Jim River (334-40-11000-2125-3740-4080)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

Fisheries Scientist	Date
Habitat Operations Manager	Date
AWC Project Biologist	Date
Cartographer	Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
COHO SALMON	07/20/2012		✓	✓	✓
CHINOOK SALMON	07/20/2012		✓	✓	✓
					☐
					☐
					☐

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Nine coho salmon (55, 62, 49, 55, 66, 55, 52, 61, 55 mm) and one chinook salmon (48 mm) were caught during electrofishing surveys by Jena Lemke and Matthew Apling. Fishing occurred at N66.78089, W150.85132. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): BETTLES D-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Jim River (334-40-11000-2125-3740-4080)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

Fisheries Scientist	Date
Habitat Operations Manager	Date
AWC Project Biologist	Date
Cartographer	Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
COHO SALMON	07/23/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two coho salmon (FL = 61 and 62 mm) were caught during electrofishing surveys by Jena Lemke and Matthew Apling. Fishing occurred at N 66.83560, W150.64531. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-3

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kichaiakaleq Creek

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	09/07/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
2 juvenile Dolly Varden (128 and 147 mm) caught in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for sampling methods and maps. Traps were set at N67.02964, W154.01124.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-3

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	09/04/12		✓	✓	✓
					☐
					☐
					☐
					☐

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile Dolly varden (128 and 130 mm) caught in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. Traps were set at N 67.01901, W 154.44464.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-4

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination #: _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

_____ Fisheries Scientist	_____ Date
_____ Habitat Operations Manager	_____ Date
_____ AWC Project Biologist	_____ Date
_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	09/04/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
3 juvenile Dolly Varden (116, 131, 146mm) caught in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. Traps were set at N67.00066, W154.55439.

Name of Observer (please print): SABRINA GARCIA

Signature: Gabrielgarcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): WISEMAN A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Malamute Fork Alatna River (334-40-11000-2125-3661-4100)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
COHO SALMON	07/16/2013		✓	✓	✓
CHUM SALMON	07/16/2013		✓	✓	✓
					☐
					☐
					☐

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Four coho salmon (FL = 46, 48, 47, and 47 mm) and two chum salmon (FL = 38 and 44 mm) were caught using dipnets by Jena Lemke and Matthew Apling of ABR. Capture occurred at N 67.11074, W152.93070. See attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): WISEMAN A-6

Anadromous Waters Catalog Number of Waterway: 334-40-11000-2125-3661-4100

Name of Waterway: UNNAMED TRIB. TO MALAMUTE FORK ALATNA RIVER ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
COHO SALMON	07/16/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:

Two juvenile Coho Salmon (57 and 58mm) were captured in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for methods and maps. Traps were set at N 67.10036, W 152.74847

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99501

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Maunelu K River (331-00-10490-2335

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	07/25/2012		✓	✓	☑
					☐
					☐
					☐
					☐

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile chum salmon (52 and 55mm) caught via electrofishing by Jena Lemke and Matthew Apling. Fish were captured at N67.02696, W156.04826. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Gabriela Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Rd. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Maunelu River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/13/2013		✓	✓	✓
					☐
					☐
					☐
					☐

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Four juvenile Dolly Varden (115, 115, 122, 139 mm) caught in minnowtraps by Jena Lemke and Matthew Apling. Minnow traps were set at N 67.04256, W 156.13206. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, INC

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/14/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including number of fish and life stages observed, sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
20 juvenile Dolly Varden caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.02217, W155.84178. Traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. See back.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Comments (cont.):

Dolly Varden lengths were (for K length, mm):

110	100	123
129	123	114
118	117	168
111	97	128
135	99	122
102	125	78
100	113	

see Appendix C in attached report.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

_____ Fisheries Scientist	_____ Date
_____ Habitat Operations Manager	_____ Date
_____ AWC Project Biologist	_____ Date
_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/14/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
19 juvenile Dolly Varden caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.12383, W156.00801. Traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. See back.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Comments (cont.):

Dolly Varden lengths were (fork length, mm):

87	150	80
107	99	95
129	97	96
112	98	69
119	102	
94	73	
101	88	
	87	

See Appendix C in attached report.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS_A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY USGS Name Local Name

✓ Addition Deletion Correction Backup Information

For Office Use

Nomination #	Fisheries Scientist / Date
Revision Year:	Habitat Operations Manager / Date
Revision to: Atlas ____ Catalog ____ Both ____	AWC Project Biologist / Date
Revision Code:	Cartographer / Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/14/2013		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
6 juvenile Dolly Varden caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.05437, W155.81388. Traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. See back.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

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Comments (cont.):

Dolly Varden fork lengths (mm) were:

95

104

114

117

118

126

See Appendix C in attached report.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist _____ Date
Revision Year: _____	_____ Habitat Operations Manager _____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist _____ Date
Revision Code: _____	_____ Cartographer _____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
DOLLY VARDEN	07/26/2012		✓	✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile Dolly Varden (85 and 127 mm FL) caught via electrofishing by Jena Lemke and Matthew Apling. Fishing occurred at N67.12433, W155.63481. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____	_____ Fisheries Scientist	_____ Date
Revision Year: _____	_____ Habitat Operations Manager	_____ Date
Revision to: Atlas _____ Catalog _____ Both _____	_____ AWC Project Biologist	_____ Date
Revision Code: _____	_____ Cartographer	_____ Date

OBSERVATION INFORMATION

Species	Date(s) Observed	Spawning	Rearing	Present	Anadromous
CHUM SALMON	07/25/2012	✓		✓	✓

IMPORTANT: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Visual observation of adult chum salmon spawning area by Jena Lemke and Matthew Apling. Observation occurred at N 67.03453, W156.03934. Please see attached report for sampling methods and area maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Rd. suite 101
Anchorage, AK 99518

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Signature of Area Biologist: _____ Date: _____ Revision

02/08

Appendix B. Raw stream habitat data collected at survey transects on waterbodies traversed by the Brooks East Corridor, Alaska, August 2013.

Site Name	SH-T1-13	**Event Code**	
Date	12 August 2013	**Time**	10:43
Latitude N	67.120893	**Longitude W**	156.985129
Observers	JCS, MMA, SDG		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	9.5 °C	Bankfull Width	59 m
Dissolved Oxygen	100%	Wetted Width	52 m
Dissolved Oxygen	11.32 mg/L	Thalweg Depth	not measured (unwadeable)
Conductivity	115.3 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.164 mS/cm	Stream Gradient	< 1 %
pH	6.58	Stream Stage	Low
Turbidity	1.92 NTU	Water Color	Mostly clear/Humic

Bank Angle Sketches

LB Angle- Not measured (unwadeable)

RB Angle- 115°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	5
Gravel	2-64mm (0.1-2.5in)	5
Sand	0.06-2mm	5
Silt	0.06-2mm	40
Clay	0.004-0.06 mm	40

Flow

Crew was unable to take flow measurements because transect was unwadeable

Comments:

Flowing at 0.33 m/s at the surface, generally it is slow flowing.

Visual observation of approximately 5 inch juvenile fish

Photos:

US-0665

DS-0666

LB-0667

RB-0668

Substrate photos taken 15 August 2013-0823,0824

Site Name	SH-T1-13	**Event Code**	
Date	12 August 2013	**Time**	11:34
Latitude N	67.120893	**Longitude W**	156.985129
Observers	JCS, MMA, SDG		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	2
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Stream was unwadeable due to fines. Slack to slow flow. Low water level, potential rearing fish habitat.
Bacterial foam flowing at the surface.
Islands present now due to low flow- likely submerged at high water.

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
30% cover by black spruce, the only tree greater than 5 m. More dense upstream, less dense downstream.	No canopy 10+ m from the bank.
Understory (0.5 - 5 m)	
Mixed coniferous and deciduous (higher willow density). 75-80% willow cover, grasses next highest density	Dominated by willow and tall grasses.
Ground (< 0.5 m)	
Low percentage of open, bare ground. Mostly grasses. Low percentage of down wood, mostly within bankfull width.	Not much barren ground, less than 5%. Mostly grasses.

Site Name	SH-T2-13	**Event Code**	
Date	12 August 2013	**Time**	12:20
Latitude N	67.120226	**Longitude W**	156.979087
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	9.9°C	Bankfull Width	37 m
Dissolved Oxygen	102.10%	Wetted Width	49 m
Dissolved Oxygen	11.51 mg/L	Thalweg Depth	0.85 m
Conductivity	115.7 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.162 mS/cm	Stream Gradient	1%
pH	7.95	Stream Stage	Low
Turbidity	1.71 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle - 175°

RB Angle-165°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	30
Gravel	2-64mm (0.1-2.5in)	40
Sand	0.06-2mm	25
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	1.85	36	0.25
	2	5.55	58	0.85
	3	9.25	83	0.79
	4	12.95	65	1.07
	5	16.65	27	0.98
	6	20.35	47	0.65
	7	24.05	29	0.47
	8	27.75	20	0.31
	9	31.45	17	0.19
LB	10	35.15	13	0.09

Comments:

Right bank is higher than left. Area of transect is typical of most of 2,000 ft corridor, a shallow (< 2 ft) long run composed of cobble, boulder, gravel, sand. Returned to get flow measurements on 13 Aug.

Substrate photos taken 15 August 2013- 0819,0820,0821,0822

Photos: 0669 (US), 0671 (DS), 0670 (LB), 0672 (RB)

Site Name	SH-T2-13	**Event Code**	
Date	12 August 2013	**Time**	12:20
Latitude N	67.120226	**Longitude W**	156.979087
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	0
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Mostly cobble and gravel with a few boulders on right bank, lots of sand on left bank. Figured out flowmeter had dead batteries (returned Aug 13).

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
None.	5% Black Spruce.
Understory (0.5 - 5 m)	
Grasses, 5-10% Willow, 10-20%	Grasses, 10% Small spruce, 10% Willow, 50% Berries/shrubs, 30% (High/Low Cran, Blueberry, Salmonberry)
Ground (< 0.5 m)	
Short grass, 25% Small willow, 5% Bare ground, 50% minimum	Fireweed, 5% Bare ground, 20% Grass, 50% Willow, 25%

Site Name	SH-T3-13	**Event Code**	
Date	12 August 2013	**Time**	15:19
Latitude N	67.117791	**Longitude W**	156.968715
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	10.5 °C	Bankfull Width	49 m
Dissolved Oxygen	106.90%	Wetted Width	40 m
Dissolved Oxygen	11.92 mg/L	Thalweg Depth	0.82 m
Conductivity	116.7 uS/cm	48 hr. Precipita	Low
Sp. Cond.	0.161 mS/cm	Stream Gradier	0.50%
pH	7.57	Stream Stage	Low
Turbidity	1.79 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 115°

RB Angle- 175°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	35
Gravel	2-64mm (0.1-2.5in)	40
Sand	0.06-2mm	20
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	2	2	0.1
	2	6	33	0.44
	3	10	34	0.73
	4	14	45	0.9
	5	18	65	0.78
	6	22	62	0.87
	7	26	60	0.86
	8	30	35	0.38
	9	34	55	0.38
LB	10	38	39	0.16

Comments:

Flow was measured 8/13 because of dead batteries 8/12.

Photos: 0677 (US), 0678 (DS), 0680 (LB), 0681 (RB)

8 inch Arctic Grayling caught by Brett using rod and reel

Substrate photos taken 15 August 2013-0815,0816,0817

Site Name	SH-T3-13	**Event Code**	
Date	12 August 2013	**Time**	15:19
Latitude N	67.117791	**Longitude W**	156.968715
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	2
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Left bank angles variable (low angles, up to 90 degrees, and undercut in some places)

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Canopy dominated by black spruce- 10% cover.	No canopy 10 m from bank.
Understory (0.5 - 5 m)	
Mostly willow, other woody shrubs, possibly alder (up to 50% cover). Tall grasses (up to 25%)	5-10% mostly willow <5% grasses
Ground (< 0.5 m)	
Bare, 25% Small saplings and grasses	80% bare with gravel and sand 10% saplings 10% grasses

Site Name	KG-T1-13	**Event Code**	
Date	13 August 2013	**Time**	12:16
Latitude N	67.016932	**Longitude W**	156.694493
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	11.3 °C	Bankfull Width	120 m
Dissolved Oxygen	103.90%	Wetted Width	102 m
Dissolved Oxygen	11.35 mg/L	Thalweg Depth	1.02 m
Conductivity	195.2 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.264 mS/cm	Stream Gradient	<1 %
pH	7.83	Stream Stage	Low
Turbidity	0.99 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 175°

RB Angle- 160°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**	
		Main Channel	**Side Channel**
Bedrock		0	0
Boulder	>256mm (10in)	0	5
Cobble	64-256mm (2.5-10in)	5	20
Gravel	2-64mm (0.1-2.5in)	5	25
Sand	0.06-2mm	90	50
Silt	0.06-2mm	0	0
Clay	0.004-0.06 mm	0	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)	Channel
LB	1	5	40	0.27	Main
	2	15	81	0.53	Main
	3	25	79	0.54	Main
	4	35	63	0.45	Main
	5	45	65	0.48	Main
	6	55	86	0.39	Main
RB	7	60	43	0.3	Main
LB	8	81	20	0.03	Side
	9	85	38	0.11	Side
	10	89	63	0.25	Side
	11	93	75	0.27	Side
	12	97	112	0.24	Side
RB	13	99	101	0.07	Side

Comments: Photos: 0690 (Side channel RB), 0691(SC US), 0692(SC LB), 0693(SC DS), 0694(Main Channel RB), 0695(MC US), 0696(MC DS), 069 (MC LB). Last MC flow was taken 5 m from the sandbar. Sandbar was 14.05 m across at the transect. The thalweg was at 53.9 m from LB. Main channel 10 m from sandbar 50% SA, 50% GR and CO. Visual observation of approximately 50 cm Arctic Grayling. Substrate photos taken 15 August 2013: 0795-0799

Site Name	KG-T1-13	**Event Code**	
Date	13 August 2013	**Time**	12:16
Latitude N	67.016932	**Longitude W**	156.694493
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	0
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	50% Spruce/Alder
Understory (0.5 - 5 m)	
Willow, fireweed, grass all combined- 10% cover	Willow-15% Alder-25% Tall grass/shrubs-15%
Ground (< 0.5 m)	
Willow/grass- 25% cover Bare- 75%	Bare-10% Grass/shrubs-90%

Site Name	KG-T2-13	**Event Code**	
Date	13 August 2013	**Time**	14:05
Latitude N	67.018092	**Longitude W**	156.687062
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	12.3 °C	Bankfull Width	131 m
Dissolved Oxygen	106.10%	Wetted Width	124 m
Dissolved Oxygen	11.35 mg/L	Thalweg Depth	0.89 m
Conductivity	200.7 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.265 mS/cm	Stream Gradient	<1 %
pH	8.11	Stream Stage	Low
Turbidity	0.89 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 155°

RB Angle- 160°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	0
Cobble	64-256mm (2.5-10in)	30
Gravel	2-64mm (0.1-2.5in)	30
Sand	0.06-2mm	40
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	2	59	0.47
	2	14	75	0.57
	3	26	26	0.54
	4	38	33	0.48
	5	50	34	0.73
	6	62	43	0.61
	7	74	49	0.53
	8	86	25	0.65
	9	98	20	0.62
	10	110	13	0.57
RB	11	122	8	0.15

Comments:

Photos: 0703 (US), 0704 (DS), 0705 (LB), 0706 (RB)

More photos of substrate taken 15 August 2013-0804-0810

Site Name	KG-T2-13	**Event Code**	
Date	13 August 2013	**Time**	14:05
Latitude N	67.018092	**Longitude W**	156.687062
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	0
Boulders	0
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Spruce-10% cover	Spruce less than 10%
Understory (0.5 - 5 m)	
Alder and willow close to 100% cover	Willow/Alder- 20% cover Grass- 50% cover
Ground (< 0.5 m)	
Bare-10% Grass/shrub close to 100%	Grass-75% cover Rose-5% cover Alder-5% cover

Site Name	MN-T1-13	**Event Code**	
Date	13 August 2013	**Time**	15:50
Latitude N	67.008356	**Longitude W**	156.074302
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	11.1 °C	Bankfull Width	97 m
Dissolved Oxygen	110.30%	Wetted Width	58 m
Dissolved Oxygen	12.07 mg/L	Thalweg Depth	not measured-unwadeable
Conductivity	151.6 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.206 mS/cm	Stream Gradient	<1 %
pH	7.73	Stream Stage	Low
Turbidity	1.14 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- unmeasurable RB Angle- 175°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	0
Cobble	64-256mm (2.5-10in)	35
Gravel	2-64mm (0.1-2.5in)	50
Sand	0.06-2mm	15
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

Crew was unable to take flow measurements because transect was unwadeable

Comments:

Photos:

0707- US

0708-DS

0709-LB

0710-RB

0711-Substrate

Lots of fine gravel

Brett (helicopter pilot) caught numerous Arctic Grayling

Corridor section from lower end to bridge is consistent in terms of substrate

Site Name MN-T1-13 **Event Code**

Date 13 August 2013 **Time** 15:50

Latitude N 67.008356 **Longitude W** 156.074302

Observers JCS, SDG, MMA

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	1
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	1
Overhanging Vegetation	1
Undercut Bank	0
Boulders	0
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Woody debris on left bank

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Black spruce/Alder-30% cover	No canopy
Understory (0.5 - 5 m)	
Dominated by willow, alder, spruce (total cover)	No understory
Ground (< 0.5 m)	
Bare-5% Small grasses, fireweed,saplings	Bare-90% Fireweed and small grasses-10%

Site Name	MN-T2-13	**Event Code**	
Date	13 August 2013	**Time**	17:29
Latitude N	67.016628	**Longitude W**	156.054698
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	11.9 °C	Bankfull Width	nm
Dissolved Oxygen	110.40%	Wetted Width	70 m
Dissolved Oxygen	11.90 mg/L	Thalweg Depth	not measured-unwadeable
Conductivity	155.9 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.208 mS/cm	Stream Gradient	nm
pH	7.71	Stream Stage	Low
Turbidity	0.95 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- unmeasurable

RB Angle- 160°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	0
Cobble	64-256mm (2.5-10in)	40
Gravel	2-64mm (0.1-2.5in)	20
Sand	0.06-2mm	40
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	3.5	34	0.24
	2	8.5	52	0.25
	3	13.5	62	0.43
	4	18.5	82	0.52
	5	23.5	82	0.53
	6	28.5	95	0.65
LB	7	33.5	103	0.65

Comments:

Half of stream unwadeable

Visual observation of 5 salmon

JCS saw Chum Salmon

Turbidity sample taken near helicopter LZ, approximately 100 m downstream from transect

Site Name	MN-T2-13	**Event Code**	
Date	13 August 2013	**Time**	17:29
Latitude N	67.016628	**Longitude W**	156.054698
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	1
Woody Debris (Big) >0.3m	1
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	2
Undercut Bank	0
Boulders	0
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Spruce, alder, and birch provide about 80% cover	No canopy
Understory (0.5 - 5 m)	
Almost 100% cover by willow, alder, and other shrubs Not much grasss	Willow and alder-75% cover Grasses
Ground (< 0.5 m)	
Grass and other herbaceous vegetation up to 75% cover Very little bare ground	Bare-10% Small grasses-50% cover

Site Name	BV-T1-13	**Event Code**	
Date	14 August 2013	**Time**	12:40
Latitude N	67.021206	**Longitude W**	155.150792
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	8.7 °C	Bankfull Width	34.2 m
Dissolved Oxygen	100.50%	Wetted Width	31.5 m
Dissolved Oxygen	11.66 mg/L	Thalweg Depth	0.66 m
Conductivity	126.9 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.184 mS/cm	Stream Gradient	<1 %
pH	7.86	Stream Stage	Low
Turbidity	0.86 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 163°

RB Angle- 160°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**
Bedrock		0
Boulder	>256mm (10in)	15
Cobble	64-256mm (2.5-10in)	50
Gravel	2-64mm (0.1-2.5in)	25
Sand	0.06-2mm	5
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	5

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	1.6	9	0.06
	2	4.8	21	0.19
	3	8	39	0.53
	4	11.2	53	0.79
	5	14.4	66	0.56
	6	17.6	62	0.75
	7	20.8	57	0.55
	8	24	48	0.71
	9	27.2	34	0.53
RB	10	30.4	20	0.34

Comments:

Photos: 0728-US, 0719-DS, 0730-LB, 0731-RB, 0732-Substrate at thalweg

0733- Substrate at thalweg

Thalweg at 14.4 meters from left bank

Site Name	BV-T1-13	**Event Code**	
Date	14 August 2013	**Time**	12:40
Latitude N	67.021206	**Longitude W**	155.150792
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	4
Macrophytes	1
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	2
Undercut Bank	1
Boulders	2
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Periphyton-very heavy cover

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Spruce-10% cover	Spruce-20%
Understory (0.5 - 5 m)	
Willow, tall grass, spruce combined is 90% coverage	Willow, tall grass, and herbaceous vegetation is 65% coverage
Ground (< 0.5 m)	
Grass, herbaceous vegetation-100% cover	Bare ground-15% Grass and herbaceous vegetation-85%

Site Name	BV-T2-13	**Event Code**	
Date	14 August 2013	**Time**	14:10
Latitude N	67.023342	**Longitude W**	155.158002
Observers	JCS, SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	9.1 °C	Bankfull Width	29.05 m
Dissolved Oxygen	102.70%	Wetted Width	28 m
Dissolved Oxygen	11.78 mg/L	Thalweg Depth	0.88 m
Conductivity	128.6 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.184 mS/cm	Stream Gradient	<1%
pH	7.79	Stream Stage	Low
Turbidity	0.74 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 73°

RB Angle- 115°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	20
Cobble	64-256mm (2.5-10in)	30
Gravel	2-64mm (0.1-2.5in)	20
Sand	0.06-2mm	30
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	1.4	30	0.13
	2	4.2	24	0.22
	3	7	35	0.39
	4	9.8	49	0.49
	5	12.6	65	0.59
	6	15.4	88	0.78
	7	18.2	85	0.56
	8	21	74	0.73
	9	23.8	72	0.36
RB	10	26.6	39	0.03

Comments:

0735-Right bank substrate, 0736-RB moving towards left bank substrate, 0737- RB moving towards LB substrate with JCS foot for scale, 0739- Center channel substrate, ski pole for scale, 0740-US 0741- DS, 0742-LB, 0743-RB, 0744-LB substrate

Site Name	BV-T2-13	**Event Code**	
Date	14 August 2013	**Time**	14:10
Latitude N	67.023342	**Longitude W**	155.158002
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	4
Macrophytes	1
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	1
Boulders	2
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Periphyon very heavy on all substrate

LB heavy sand, center heavy cobble, right bank heavy boudler

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Spruce-10% cover	No canopy
Understory (0.5 - 5 m)	
Willow, alder, berries, spruce- 30% cover	Willow, alder, herbaceous vegetation, and spruce- 30% cover
Ground (< 0.5 m)	
Moss, lichen, small herb, and grass- 90% cover Bare due to game trail -10% cover	Moss, lichen, small herb, grass- almost 100% cover

Site Name	RD-T1-13	**Event Code**	
Date	15 August 2013	**Time**	9:57
Latitude N	67.035785	**Longitude W**	154.835141
Observers	SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	8.1 °C	Bankfull Width	79 m
Dissolved Oxygen	103.0%	Wetted Width	56 m
Dissolved Oxygen	12.13 mg/L	Thalweg Depth	0.98 m
Conductivity	81.1 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.120 mS/cm	Stream Gradient	<1 %
pH	6.72	Stream Stage	Low
Turbidity	1.13 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 169°

RB Angle- 170°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**
Bedrock		0
Boulder	>256mm (10in)	10
Cobble	64-256mm (2.5-10in)	20
Gravel	2-64mm (0.1-2.5in)	35
Sand	0.06-2mm	35
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	2.8	37	0.48
	2	8.4	45	0.62
	3	14	59	0.58
	4	19.6	89	0.67
	5	25.2	92	0.81
	6	30.8	87	0.77
	7	36.4	86	0.8
	8	42	67	0.65
	9	47.6	81	0.61
RB	10	53.2	61	0.64

Comments:

Thalweg 18.5 m from left bank. RB has cut bank at bankfull (photo taken). Periphyton cover heavy from RB to center of transect. Photos: 0763- JCS in pack raft, 0764- Cut bank at bankfull, right bank 0765- Substrate at RB, 0766-US, 0767-DS, 0768-LB, 0769-RB, 0771-Substrate at LB

Site Name	RD-T1-13	**Event Code**	
Date	15 August 2013	**Time**	9:57
Latitude N	67.035785	**Longitude W**	154.835141
Observers	SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	1
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	1
Overhanging Vegetation	1
Undercut Bank	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	Spruce-less than 10%
Understory (0.5 - 5 m)	
No understory	Willow, small spruce, alder-60% cover
Ground (< 0.5 m)	
100% sand and gravel cover	Bare (fine sediment)-30% Small grasses, saplings, berries, moss, and lichen-50%

Site Name KB-T1-13 **Event Code**

Date 15 August 2013 **Time** 13:18

Latitude N 67.012346 **Longitude W** 154.367417

Observers JCS, SDG, MMA

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	10.6 °C	Bankfull Width	90 m
Dissolved Oxygen	106.50%	Wetted Width	89 m
Dissolved Oxygen	11.84 mg/L	Thalweg Depth	0.97 m
Conductivity	142.2 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.196 mS/cm	Stream Gradient	<1 %
pH	7.45	Stream Stage	Low
Turbidity	0.68 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 95° RB Angle- 160°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	35
Gravel	2-64mm (0.1-2.5in)	35
Sand	0.06-2mm	25
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

#	Width (m)	Depth (cm)	Flow (m/s)	#	Width (m)	Depth (cm)	Flow (m/s)
LB-1	2.3	42	0.64	11	46.8	36	0.52
2	6.75	47	0.67	12	51.25	50	0.73
3	11.2	41	0.66	13	55.7	50	0.63
4	15.65	32	0.62	14	60.15	72	0.65
5	20.1	25	0.42	15	64.6	97	0.82
6	24.55	12	0.13	16	69.05	92	1.02
7	29	11	0.23	17	73.5	82	0.93
8	33.45	14	0.31	18	77.95	65	0.98
9	37.9	19	0.47	19	82.4	71	0.84
10	42.35	24	0.53	RB-20	86.85	44	0.62

Comments:

Brett caught an Arctic Grayling 100 m downstream of transect

Site Name	KB-T1-13	**Event Code**	
Date	15 August 2013	**Time**	13:18
Latitude N	67.012346	**Longitude W**	154.367417
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	1
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	1
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Periphyton cover heavy at banks only

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Willow, alder-25%	Spruce, birch, alder-70%
Understory (0.5 - 5 m)	
Tall grass, willow, berries-50%	Spruce, alder (dominant), willow-almost 100% cover
Ground (< 0.5 m)	
Grass, willow, herb-100%	Moss, herb, grass, and willow-90% Bare-10%

Site Name	AL-T2-13	**Event Code**	
Date	17 August 2013	**Time**	16:25
Latitude N	67.077422	**Longitude W**	153.327899
Observers	JCS,SDG		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	12.5 °C	Bankfull Width	98.5 m
Dissolved Oxygen	103.10%	Wetted Width	75.5 m
Dissolved Oxygen	10.97 mg/L	Thalweg Depth	not measurable
Conductivity	355.8 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.467 mS/cm	Stream Gradient	<1%
pH	7.83	Stream Stage	Low
Turbidity	5.47 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- not measured

RB Angle- 175°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	10
Cobble	64-256mm (2.5-10in)	25
Gravel	2-64mm (0.1-2.5in)	10
Sand	0.06-2mm	35
Silt	0.06-2mm	20
Clay	0.004-0.06 mm	0

Flow

Crew was unable to take flow measurements because transect was unwadeable

Comments:

Flow was unmeasurable because river was unwadeable

Photos:

0867-US

0868-DS

0869-LB

0870-RB

0871- Substrate at RB

0872- Substrate at RB

Transect 1 doesn't have a full habitat assessment (photos taken)

Associated sonar saved as chart 1, sonar completed 8/18

Site Name	AL-T2-13	**Event Code**	
Date	17 August 2013	**Time**	16:25
Latitude N	67.077422	**Longitude W**	153.327899
Observers	JCS,SDG		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	0
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	0
Undercut Bank	0
Boulders	2
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Cover based on what was visible from the bank
Very heavy periphyton cover mixed with silt
Boulders on exposed banks

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	No canopy
Understory (0.5 - 5 m)	
Alder-10% Grasses-50%	Alder-10% cover
Ground (< 0.5 m)	
Bare-60% Small grass-10%	Bare ground-80% Herbaceous grasses-10%

Above bankfull on both banks heavy black spruce cover

Site Name	MF-T1-13	**Event Code**	
Date	17 August 2013	**Time**	14:20
Latitude N	67.064310	**Longitude W**	153.176053
Observers	JCS,SDG		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	12.6 °C	Bankfull Width	91 m
Dissolved Oxygen	108.10%	Wetted Width	53.5 m
Dissolved Oxygen	11.4 mg/L	Thalweg Depth	0.75 m
Conductivity	273.2 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.357 mS/cm	Stream Gradient	<1%
pH	8.3	Stream Stage	Low
Turbidity	0.98 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 100° RB Angle- 115°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	25
Gravel	2-64mm (0.1-2.5in)	35
Sand	0.06-2mm	35
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	**Width (m)**	**Depth (cm)**	**Flow (m/s)**
LB	*1	2.7	3	n/a
	2	8.05	9	0.14
	3	13.4	14	0.22
	4	18.75	41	0.47
	5	24.1	52	0.64
	6	29.45	52	0.61
	7	34.8	62	0.69
	8	40.15	69	0.73
	9	45.5	55	0.67
RB	10	50.85	42	0.26

Comments:

* too shallow to measure flow. Thalweg was between flow measurements 7 and 8. Increment for flow was 5.35 m. Malamute Fork previously named UN15. Transect cut across gravel/cobble island and side channel. Side channel not flowing-mostly isolated pools.

Wetted width taken along main channel (side channel included in bankfull width)

Visual observation of spawning chum salmon upstream of transect (at top of corridor)

Photos: 0853-Substrate at RB, 0854-Center substrate, 0855 (US), 0856 (DS), 0857 (RB), 0858 (LB)

Site Name	MF-T1-13	**Event Code**	
Date	17 August 2013	**Time**	14:20
Latitude N	67.064310	**Longitude W**	153.176053

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	1
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Filamentous Algae on left and right bank
Heavy periphyton cover
Small woody debris on right bank
Transect is indicative of corridor reach

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Alder-25% cover Spruce behind the 10 meter mark	No canopy
Understory (0.5 - 5 m)	
Willow, alder, tall grasses along bank-75% cover	Willow, alder, and grasses-70%
Ground (< 0.5 m)	
Bare ground-20% Small grass, herbaceous vegetation-80%	Bare ground-25% Small grasses and saplings-75%

Site Name	UN18-T1-13	**Event Code**	
Date	16 August 2013	**Time**	16:37
Latitude N	67.091882	**Longitude W**	152.730167
Observers	JCS,SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	12.2 °C	Bankfull Width	15.5 m
Dissolved Oxygen	102.30%	Wetted Width	9.6 m
Dissolved Oxygen	10.96 mg/L	Thalweg Depth	0.39 m
Conductivity	116.5 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.154 mS/cm	Stream Gradient	1%
pH	7.33	Stream Stage	Low
Turbidity	1.63 NTU	Water Color	Mostly Clear

Bank Angle Sketches

LB Angle- 145°

RB Angle- 170°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	50
Cobble	64-256mm (2.5-10in)	30
Gravel	2-64mm (0.1-2.5in)	15
Sand	0.06-2mm	5
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	0.48	2	0
	*2	1.44	10	0.02
	3	2.4	23	0.6
	4	3.36	21	0.21
	5	4.32	23	0.53
	*6	5.28	30	0.07
	7	6.24	20	0.46
	8	7.2	22	0.07
	9	8.16	24	0.35
LB	10	9.12	34	0.3

Comments:

* Flow measurements number 2 and 6 were behind a boulder

JCS took approximately 20 minute long video upstream of transect 1 on GoPro

Photos: 0838-Right bank substrate, 0839-Center substrate, 0840-Left bank substrate, 0841 (US), 0842 (DS), 0843 (LB), 0844 (RB). Corridor map needs to be drawn from GPS (too sinuous).

Visual observation of Northern Pike

Site Name	UN18-T1-13	**Event Code**	
Date	16 August 2013	**Time**	16:37
Latitude N	67.091882	**Longitude W**	152.730167
Observers	JCS,SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	1
Boulders	3

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Small woody debris along left bank

Filamentous algae is zero, measurement of 2 accounts for periphyton cover

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Alder, spruce, birch - 75% cover	Spruce, alder, willow-10%
Understory (0.5 - 5 m)	
Almost 100% cover Mainly alder, some spruce, some willow	Willow and alder-50% cover
Ground (< 0.5 m)	
Bare-15% Grass and moss-85%	Herb, grass, moss-50% Bare ground (cobble, gravel, boulder)-50%

Site Name	UN18-T2-13	**Event Code**	
Date	16 August 2013	**Time**	17:30
Latitude N	67.090632	**Longitude W**	152.728927
Observers	JCS,SDG, MMA		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	12.5 °C	Bankfull Width	19.5 m
Dissolved Oxygen	100.60%	Wetted Width	7.3 m
Dissolved Oxygen	10.76 mg/L	Thalweg Depth	1.08 m
Conductivity	117.1 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.154 mS/cm	Stream Gradient	1%
pH	7.47	Stream Stage	Low
Turbidity	1.92 NTU	Water Color	Mostly Clear

Bank Angle Sketches

LB Angle- 165°

RB Angle- 150°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	25
Cobble	64-256mm (2.5-10in)	25
Gravel	2-64mm (0.1-2.5in)	25
Sand	0.06-2mm	25
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	0.36	6	0.01
	2	1.10	35	0.05
	3	1.83	52	0.1
	4	2.56	61	0.13
	5	3.29	72	0.12
	6	4.02	78	0.06
	7	4.75	96	0.08
	8	5.48	94	0.05
RB	9	6.21	50	0.03

Comments:

Photos:

0845-Right bank substrate, 0846- Center substrate, 0847- Left bank substrate,

0848 (US), 0849 (DS), 0850 (LB), 0851 (RB), 0852 (US)

Not mapped, needs to be mapped with GPS due to sinuousity

Site Name	UN18-T2-13	**Event Code**	
Date	16 August 2013	**Time**	17:30
Latitude N	67.090632	**Longitude W**	152.728927
Observers	JCS, SDG, MMA		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	3
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	2
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	2
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Lots of dead tree roots on right bank
Heavy periphyton cover all along transect

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	Spruce-10% cover
Understory (0.5 - 5 m)	
Dominated by willow-15% cover	Dominated by willow, some alder, some spruce-35% cover
Ground (< 0.5 m)	
85% bare ground (cobble, gravel)	Herbaceous vegetation, berries, labrador tea-almost total cover No bare ground

Site Name	SF-T1-13	**Event Code**	
Date	22 August 2013	**Time**	15:33
Latitude N	66.846855	**Longitude W**	151.097338
Observers	SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	10.5 °C	Bankfull Width	85 m
Dissolved Oxygen	102.70%	Wetted Width	56 m
Dissolved Oxygen	11.42 mg/L	Thalweg Depth	1.04 m
Conductivity	180.8 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.250 mS/cm	Stream Gradient	<1%
pH	7.89	Stream Stage	Low
Turbidity	1.14 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 178°

RB Angle- 173°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	15
Cobble	64-256mm (2.5-10in)	40
Gravel	2-64mm (0.1-2.5in)	30
Sand	0.06-2mm	15
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	2.8	9	0.06
	2	8.4	23	0.34
	3	14	44	0.33
	4	19.6	51	0.34
	5	25.2	63	0.54
	6	30.8	72	0.78
	7	36.4	93	0.51
	8	42	87	0.5
	9	47.6	55	0.41
RB	10	53.2	19	0.1

Comments:

Sluffed bank above right bank angle measurement. Increment=5.6 m. We ended 1.55 meters from right bank instead of 2.8 m (used range finder for wetted width). Wetted width and bankfull measured with rangefinder. A meter from WW left bank angle decreases to 169°. Visual observation of dead burbot (LIM touched it). Thalweg was 2.3 meters towards right bank from flow measurement 7. Photos: 0066 (Winter trail at RB), 0067 (US), 0068 (DS), 0069 (LB), 0070 (LB), 0071 (RB), 0072 (Center substrate), 0073 (LB substrate), 0074 (LB substrate)

Site Name	SF-T1-13	**Event Code**	
Date	22 August 2013	**Time**	15:33
Latitude N	66.846855	**Longitude W**	151.097338
Observers	SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	0
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	0
Undercut Bank	0
Artificial Structures	2

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Periphyton cover is moderate to heavy
Beyond our 10 meter zone there is overhanging vegetation due to sluffed bank
Artificial structure was the winter trail which took up almost half of our 10 meter buffer downstream of transect. Cabin and mailbox were within sight of transect.

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	Mainly birch, willow, and spruce-10% Lack of more canopy may be due to presence of winter trail
Understory (0.5 - 5 m)	
Willow, rose, fireweed-15%	Poplar, fireweed, rose, tall grasses, and willow-70%
Ground (< 0.5 m)	
Bare ground-90% (cobble, gravel, and sand) Herbaceous vegeation, fireweed, and small willow-10%	Bare ground-25% (Less than 10% of bare ground is natural, most of the 25% can be attributed to the winter trail) Herbaceous vegetation, moss, poplar saplings-75%

Site Name	JM-T1-13	**Event Code**	
Date	22 August 2013	**Time**	12:50
Latitude N	66.793188	**Longitude W**	150.732181
Observers	SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	6.4 °C	Bankfull Width	65.0 m
Dissolved Oxygen	105.50%	Wetted Width	23.5 m
Dissolved Oxygen	13.00 mg/L	Thalweg Depth	0.71 m
Conductivity	53.6 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.083 mS/cm	Stream Gradient	<1%
pH	7.04	Stream Stage	Low
Turbidity	1.35 NTU	Water Color	Mostly Clear

Bank Angle Sketches

LB Angle- 158°

RB Angle- 175°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	35
Gravel	2-64mm (0.1-2.5in)	45
Sand	0.06-2mm	15
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	1.17	6	0.03
	2	3.52	23	0.13
	3	5.87	47	0.29
	4	8.22	65	0.37
	5	10.57	68	0.43
	6	12.92	71	0.44
	7	15.27	60	0.52
	8	17.62	67	0.44
	9	19.98	64	0.43
LB	10	22.33	64	0.41

Comments:

Thalweg is 51 cm towards right bank from flow measurement 5. Increment=2.35 m

Crew was going to do a second transect downstream of first transect but didn't because of visual observation of grizzly bear sow and two cubs in proximity to the transect site. Photos:

0051 (Vegetation above bankfull width onLB), 0052 (RB from LB BFW), 0053 (US), 0054 (DS), 0055 (RB), 0056 (LB), 0057 (Substrate), 0058 (Substrate), 0059 (Substrate)

Site Name	JM-T1-13	**Event Code**	
Date	22 August 2013	**Time**	12:50
Latitude N	66.793188	**Longitude W**	150.732181
Observers	SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	1
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	0
Undercut Bank	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Periphyton cover is heavy along transect

No undercut at wetted width, moderate undercut at bankfull due to sluffing

Sluffed bank with live vegetation 2 meters from wetted width

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	No canopy
Understory (0.5 - 5 m)	
Willow, alder, birch (predominately birch), some fireweed- 60%	Willow and fireweed-15%
Ground (< 0.5 m)	
Bare ground-50% Moss, herbaceous vegetation, fireweed, and small birch-50%	Bare ground-90% Small fireweed and willow-10%

Site Name	UN30-T1-13n	**Event Code**	
Date	21 August 2013	**Time**	12:48
Latitude N	67.060008	**Longitude W**	156.030637
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	5.8 °C	Bankfull Width	46 m
Dissolved Oxygen	103.20%	Wetted Width	19.5 m
Dissolved Oxygen	12.79 mg/L	Thalweg Depth	0.97 m
Conductivity	140.0 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.221 mS/cm	Stream Gradient	1%
pH	7.95	Stream Stage	Low
Turbidity	0.72 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 170° (estimated)

RB Angle- 165°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	50
Cobble	64-256mm (2.5-10in)	30
Gravel	2-64mm (0.1-2.5in)	15
Sand	0.06-2mm	5
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	0.97	10	0.04
	2	2.92	16	0.29
	3	4.87	38	0.35
	4	6.82	15	0.63
	5	8.77	59	0.79
	6	10.72	71	0.76
	7	12.67	80	0.49
	8	14.62	54	0.36
	9	16.57	44	0.14
RB	10	18.52	24	0.18

Comments:

Thalweg is 50 cm towards left bank from flow measurement 7. More sand on exposed banks and on bends with slower flow (as compared to our transect). Above where right bank angle was measured, bank angle increases towards 90 degrees. Increment=1.95 m. Photos: 0005 (US), 0006 (DS), 0007 (LB), 0008 (RB), 0009 (Substrate), 0010 (Substrate)

Site Name	UN30-T1-13n	**Event Code**	
Date	21 August 2013	**Time**	12:48
Latitude N	67.060008	**Longitude W**	156.030637
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	2
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	0
Boulders	3
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Periphyton cover from center to right bank was moderate

If water was higher, overhanging vegetation would be moderate

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	Paper birch, willow, spruce, alder-30%
Understory (0.5 - 5 m)	
Willow-30%	Herbaceous vegetation, willow, alder, and spruce-50%
Ground (< 0.5 m)	
Bare ground-50% Small willow, grasses, and fireweed-50%	Bare ground-20% Moss, lichen, small grasses, cranberry, blueberry, and woody shrubs-80%

Site Name	MN-T1-13n	**Event Code**	
Date	21 August 2013	**Time**	16:16
Latitude N	67.051217	**Longitude W**	155.765139
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	8.3 °C	Bankfull Width	60 m
Dissolved Oxygen	106.40%	Wetted Width	33.7 m
Dissolved Oxygen	12.47 mg/L	Thalweg Depth	0.99 m
Conductivity	171.3 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.251 mS/cm	Stream Gradient	<1%
pH	7.67	Stream Stage	Low
Turbidity	0.63 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 170° (estimated) RB Angle- 115°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	15
Gravel	2-64mm (0.1-2.5in)	65
Sand	0.06-2mm	15
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	1.69	6	0.12
	2	5.06	20	0.37
	3	8.43	36	0.5
	4	11.8	54	0.58
	5	15.17	68	0.7
	6	18.54	81	0.7
	7	21.91	91	0.89
	8	25.28	99	0.92
	9	28.65	95	0.9
RB	10	32.02	62	0.64

Comments:

Flow measurement 8 marks the thalweg. Increment=3.37 m

Photos: 0015(US), 0016 (DS), 0017 (LB), 0018 (RB), 0019 (Substrate), 0020 (Substrate), 0021 (LB from LB)

Site Name	MN-T1-13n	**Event Code**	
Date	21 August 2013	**Time**	16:16
Latitude N	67.051217	**Longitude W**	155.765139
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	1
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Filamentous algae is low-moderate
Periphyton is moderately high

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	No canopy
Understory (0.5 - 5 m)	
No understory	Willow and tall grass-40%
Ground (< 0.5 m)	
Bare ground is > 95% composed of cobble, gravel, sand Remainder is horsetail Also some standing water at outskirts of 10 meter buffer, shows signs of redox	Fireweed, herbaceous vegetation, and willow-50% Bare ground-50% (sand and silt)

Site Name	RD-T1-13s	**Event Code**	
Date	19 August 2013	**Time**	13:35
Latitude N	66.886494	**Longitude W**	154.837675
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	9.1 °C	Bankfull Width	65.5 m
Dissolved Oxygen	106.70%	Wetted Width	57 m
Dissolved Oxygen	12.24 mg/L	Thalweg Depth	0.93 m
Conductivity	94.1 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.135 mS/cm	Stream Gradient	<1%
pH	7.56	Stream Stage	Low
Turbidity	3.11 NTU	Water Color	Mostly Clear

Bank Angle Sketches

LB Angle- 170°

RB Angle- 165°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	10
Cobble	64-256mm (2.5-10in)	40
Gravel	2-64mm (0.1-2.5in)	20
Sand	0.06-2mm	30
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	2.85	36	0.29
	2	8.55	81	0.45
	3	14.25	92	0.58
	4	19.95	72	0.67
	5	25.65	73	0.66
	6	31.35	84	0.73
	7	37.05	86	0.71
	8	42.75	61	0.63
	9	48.45	40	0.54
RB	10	54.15	18	0.19

Comments:

Increment= 5.7 m. Thalweg was 93cm deep and very close to flow measurement #3.
Photos: 0941 (US), 0942 (DS), 0943 (LB), 0944 (RB), 0945-Right bank substrate,
0946-Righ bank substrate, 0947-Center substrate, 0948-Center substrate, 0949-Left bank substrate.

Site Name	RD-T1-13s	**Event Code**	
Date	19 August 2013	**Time**	13:35
Latitude N	66.886494	**Longitude W**	154.837075
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	0
Undercut Bank	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Periphyton cover is heavy

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Birch and spruce-40%	No canopy
Understory (0.5 - 5 m)	
Alder, grasses, willow, herbaceous vegetation-40% cover	Willow, alder, grasses-70%
Ground (< 0.5 m)	
Bare ground-50% Grasses, willow, fireweed, herbaceous vegetation. Woody shrubs, moss-50% cover	Bare ground-20% Herbaceous-80%

Site Name	RD-T2-13s	**Event Code**	
Date	19 August 2013	**Time**	12:16
Latitude N	66.887137	**Longitude W**	154.834857
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	8.7 °C	Bankfull Width	80 m
Dissolved Oxygen	102.80%	Wetted Width	46.5 m
Dissolved Oxygen	11.93 mg/L	Thalweg Depth	0.81 m
Conductivity	91.4 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.133 mS/cm	Stream Gradient	<1%
pH	7.55	Stream Stage	Low
Turbidity	2.27 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 82°

RB Angle- 175°

Substrate (inorganic) = 100%

Type	**Diameter**	**% Composition**	
		Main Channel	**Side Channel**
Bedrock		0	0
Boulder	>256mm (10in)	5	0
Cobble	64-256mm (2.5-10in)	35	10
Gravel	2-64mm (0.1-2.5in)	30	30
Sand	0.06-2mm	30	60
Silt	0.06-2mm	0	0
Clay	0.004-0.06 mm	0	0

Flow

Main Channel

	#	**Width (m)**	**Depth (cm)**	**Flow (m/s)**
LB	1	2.33	12	0.33
	2	6.98	58	0.54
	3	11.63	72	0.7
	4	16.28	57	0.76
	5	20.93	65	0.8
	6	25.58	81	0.85
	7	30.23	77	0.99
	8	34.88	71	0.85
	9	39.53	57	0.84
RB	10	44.18	36	0.57

Side Channel

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	0.64	19	0.08
	2	1.92	44	0.13
	3	3.2	58	0.18
	4	4.48	58	0.19
	5	5.76	70	0.25
	6	7.04	76	0.35
	7	8.32	92	0.34
	*8	9.6	88	0.05
	9	10.88	66	0.26
LB	10	12.16	52	0.38

Comments:

Wetted width of main channel is 46.5 m. Island is 15 m across. Wetted width of side channel is 12.8 m

Main channel thalweg is 25.5 m from left bank.

Side channel thalweg is 0.76 m before flow measurement #7, depth is 1.03 m.

Main channel increment= 4.65 m, Side channel increment= 1.28 m

* flow measurement taken behind mound of sand

Main Channel Photos-

0929-US

0930-DS

0931-LB

0932-RB

0933-Center substrate

0934/0935- Right bank substrate

Side Channel Photos-

0936-US

0937-DS

0938-RB

0939-LB

0940-Substrate

Site Name	RD-T2-13s	**Event Code**	
Date	19 August 2013	**Time**	12:16
Latitude N	66.887137	**Longitude W**	154.834857
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	1
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Undercut bank is on left bank by side channel

Periphyton is heavy (mostly on banks)

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	Mainly spruce-30%
Understory (0.5 - 5 m)	
Dominated by willow, some grasses-65% cover	Alder, spruce saplings, willow, grasses, berries, roses-80%
Ground (< 0.5 m)	
Bare ground-30% Small grasses, herbaceous vegetation-70%	Bare ground-40% Small grasses, moss, berries-60%

Site Name	KB-T1-13s	**Event Code**	
Date	19 August 2013	**Time**	15:45
Latitude N	66.889348	**Longitude W**	154.635693
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	12.4 °C	Bankfull Width	113 m
Dissolved Oxygen	109.40%	Wetted Width	77 m
Dissolved Oxygen	11.67 mg/L	Thalweg Depth	1.03 m
Conductivity	140.1 uS/cm	48 hr. Precipitatio	Low
Sp. Cond.	0.184 mS/cm	Stream Gradient	< 1% (estimated)
pH	8.31	Stream Stage	Low
Turbidity	1.21 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 177°

RB Angle- 172°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	35
Gravel	2-64mm (0.1-2.5in)	50
Sand	0.06-2mm	10
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	3.85	17	0.12
	2	11.55	57	0.72
	3	19.25	86	0.77
	4	26.95	93	0.83
	5	34.65	96	0.63
	6	42.35	77	0.57
	7	50.05	38	0.55
	8	57.75	40	0.65
	9	65.45	24	0.79
	10	73.15	18	0.6
RB	11	80.85	14	0.63

Comments:

Wetted width measured with range finder, may be a few meters off from actual wetted width (as shown by flow measurements). Increment= 7.7 m. Thalweg was 41 meters from left bank. Photos: 0950 (US), 0951 (DS), 0952 (LB), 0953 (RB), 0955 (Substrate between LB and center), 0956 (LB substrate), 0958 (Center sand substrate)

Site Name	KB-T1-13s	**Event Code**	
Date	19 August 2013	**Time**	15:35
Latitude N	66.889348	**Longitude W**	154.635693
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	0
Undercut Bank	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:

Beaver activity on right bank

Outisde of transect overhanging vegetation is moderate on right bank only

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	One black spruce on high bank- 5%
Understory (0.5 - 5 m)	
No understory	Willow, spruce, fireweed, blueberry-50%
Ground (< 0.5 m)	
Bare ground-95% Woody saplings, moss, and small grasses-5%	Bare ground-60% Woody and herbaceous vegetation, blueberry, fireweed-40%

Site Name	HG-T1-13s	**Event Code**	
Date	20 August 2013	**Time**	12:31
Latitude N	66.822889	**Longitude W**	153.989294
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	6.8 °C	Bankfull Width	27.5 m
Dissolved Oxygen	98.70%	Wetted Width	9.2 m
Dissolved Oxygen	12.0 mg/L	Thalweg Depth	0.42 m
Conductivity	71.3 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.109 mS/cm	Stream Gradient	0%
pH	6.69	Stream Stage	Low
Turbidity	0.82 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 80°

RB Angle- 174°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	10
Cobble	64-256mm (2.5-10in)	40
Gravel	2-64mm (0.1-2.5in)	35
Sand	0.06-2mm	15
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	0.46	3	0
	2	1.38	4	0.01
	3	2.3	9	0.15
	4	3.22	16	0.32
	5	4.14	27	0.36
	6	5.06	34	0.25
	7	5.98	30	0.43
	8	6.9	30	0.47
	9	7.82	32	0.37
LB	10	8.74	14	0.31

Comments:

Thalweg about 3 meters from left bank. Visual observation of Arctic Grayling 25 meters downstream of transect. Depth variable due to substrate. Increment-0.92 m

Photos: 0963 (US), 0964 (DS), 0965 (LB), 0966 (RB), 0967 (Center substrate), 0968 (Center substrate), 0969 (Center substrate)

Site Name	HG-T1-13s	**Event Code**	
Date	20 August 2013	**Time**	12:31
Latitude N	66.822889	**Longitude W**	153.989294
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	1
Brush/Woody Debris (Small) <0.3m	2
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	1
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Heavy periphyton cover all along transect

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Spruce-20% Outside 10 meter zone spruce density is heavier	No canopy
Understory (0.5 - 5 m)	
Willow, alder, berries, tall grass-80% cover	Willow-15%
Ground (< 0.5 m)	
Bare ground-10% Moss, small grass, saplings, berries-90%	Bare ground-90% Small grass, willow, and fireweed-10%

Site Name	HG-T2-13MCs	**Event Code**	
Date	20 August 2013	**Time**	13:39
Latitude N	66.820099	**Longitude W**	153.990330
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	7.3 °C	Bankfull Width	12.5 m
Dissolved Oxygen	100.60%	Wetted Width	5.6 m
Dissolved Oxygen	12.13 mg/L	Thalweg Depth	0.84 m
Conductivity	72.2 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.109 mS/cm	Stream Gradient	< 1%
pH	6.87	Stream Stage	Low
Turbidity	1.42 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 160°

RB Angle- 155°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	40
Gravel	2-64mm (0.1-2.5in)	40
Sand	0.06-2mm	15
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	0.28	14	0.01
	2	0.84	31	0.12
	3	1.4	44	0.18
	4	1.96	60	0.2
	5	2.52	72	0.22
	6	3.08	72	0.29
	7	3.64	77	0.3
	8	4.2	62	0.24
	9	4.76	42	0.12
RB	10	5.32	22	0.06

Comments:

Transect is side channel-island-side channel. 16 Arctic Grayling on right bank of first side channel (GoPro video). Thalweg is 2.65 meters from left bank. Side channel 2-see separate data sheet. Photos: 0970 (US), 0971 (DS), 0972 (LB), 0973 (RB), 0974 (Center substrate), 0975 (RB substrate) 0976 (LB substrate). Increment=0.56 m

Site Name	HG-T2-13MCs	**Event Code**	
Date	20 August 2013	**Time**	13:39
Latitude N	66.820099	**Longitude W**	153.990330
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	1
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Periphyton cover is moderate to heavy

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	Willow-40%
Understory (0.5 - 5 m)	
Willow, tall grasses-50%	Tall grasses and willow-50%
Ground (< 0.5 m)	
Bare ground-30% Small grasses, willow, fireweed, moss-70%	Bare ground-10% Herbaceous vegetation, small grasses-90%

Site Name	HG-T2-13SCs	**Event Code**	
Date	20 August 2013	**Time**	14:27
Latitude N	66.820099	**Longitude W**	153.990330
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	7.6 °C	Bankfull Width	11.2 m
Dissolved Oxygen	95.30%	Wetted Width	9.4 m
Dissolved Oxygen	11.29 mg/L	Thalweg Depth	0.53 m
Conductivity	72.7 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.109 mS/cm	Stream Gradient	<1%
pH	6.53	Stream Stage	Low
Turbidity	1.45 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 120°

RB Angle- 70°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	20
Gravel	2-64mm (0.1-2.5in)	50
Sand	0.06-2mm	25
Silt	0.06-2mm	0
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	0.47	4	0
	2	1.41	6	0
	3	2.35	6	0
	4	3.29	26	0.05
	5	4.23	22	0.07
	6	5.17	29	0.07
	7	6.11	30	0.05
	8	7.05	27	0.07
	9	7.99	33	0.06
RB	10	8.93	48	0.05

Comments:

Flow measurement 3 was on top of gravel mound. Flow measurement 5 was on top of rock. Thalweg is 41 cm from right bank. Photos: 0977 (US), 0978 (DS), 0979 (LB), 0980 (RB), 0981 (Left substrate), 0982 (Left substrate), 0983 (Left substrate)

Site Name	HG-T2-13SCs	**Event Code**	
Date	20 August 2013	**Time**	14:27
Latitude N	66.820099	**Longitude W**	153.990330
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	2
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	2
Live Trees Root	1
Overhanging Vegetation	2
Undercut Bank	2
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Periphyton moderate cover

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Spruce, alder-60%	Spruce, alder-50%
Understory (0.5 - 5 m)	
Alder, willow, tall grasses-30%	Willow, tall grasses, alder-50%
Ground (< 0.5 m)	
Bare ground-25% Moss, herbaceous vegetation, woody shrubs (small alder and willow)- 75%	Bare ground-20% Moss, small grasses, herbaceous vegetation, woody shrubs (willow and rose)- 80%

Site Name	HJ-T1-13s	**Event Code**	
Date	18 August 2013	**Time**	15:05
Latitude N	67.040438	**Longitude W**	153.591748
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	9.2 °C	Bankfull Width	39.2 m
Dissolved Oxygen	103.30%	Wetted Width	11.15 m
Dissolved Oxygen	11.74 mg/L	Thalweg Depth	0.92 m
Conductivity	156.5 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.224 mS/cm	Stream Gradient	<1%
pH	7.67	Stream Stage	Low
Turbidity	5.6 NTU	Water Color	Clear/Glacial Low Turbidity

Bank Angle Sketches

LB Angle- 177°

RB Angle- 80°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	5
Cobble	64-256mm (2.5-10in)	30
Gravel	2-64mm (0.1-2.5in)	0
Sand	0.06-2mm	40
Silt	0.06-2mm	25
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	0.55	10	0
	2	1.65	17	0.02
	3	2.75	32	0.03
	4	3.85	52	0.13
	5	4.95	72	0.26
	6	6.05	82	0.36
	7	7.15	88	0.27
	*8	8.25	88	0.27
	9	9.35	88	0.24
RB	10	10.45	68	0.5

Comments:

Sinusodal river. Thalweg is 7.7 meters from right bank.

Photos: 0910 (US), 0911 (DS), 0912 (LB), 0913 (RB), 0914 (Left bank substrate)

Site Name	HJ-T1-13s	**Event Code**	
Date	18 August 2013	**Time**	15:05
Latitude N	67.040438	**Longitude W**	153.591748
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	1
Brush/Woody Debris (Small) <0.3m	2
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	1
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Periphyton mixed with silt = Heavy (greater than 40%)

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	Spruce and alder-20% (more alder than spruce)
Understory (0.5 - 5 m)	
Willow-25%	Alder,some willow, tall grass-75%
Ground (< 0.5 m)	
Small willow-20% Bare gravel and cobble-80%	Bare ground-10% Herbaceous vegetation, small grasses, moss, blueberries, and roses-90%

Site Name	HJ-T2-13s	**Event Code**	
Date	18 August 2013	**Time**	16:18
Latitude N	67.038627	**Longitude W**	153.592427
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	10.3 °C	Bankfull Width	19.3 m
Dissolved Oxygen	106.10%	Wetted Width	10.5 m
Dissolved Oxygen	11.74 mg/L	Thalweg Depth	0.81 m
Conductivity	161.7 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.224 mS/cm	Stream Gradient	<1%
pH	7.84	Stream Stage	Low
Turbidity	4.55 NTU	Water Color	Mostly Clear

Bank Angle Sketches

LB Angle- 175°

RB Angle- 105°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	30
Cobble	64-256mm (2.5-10in)	40
Gravel	2-64mm (0.1-2.5in)	20
Sand	0.06-2mm	5
Silt	0.06-2mm	5
Clay	0.004-0.06 mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
LB	1	0.52	8	0.16
	2	1.57	26	0.4
	3	2.62	39	0.46
	4	3.67	59	0.29
	5	4.72	63	0.38
	6	5.77	78	0.36
	7	6.82	68	0.44
	*8	7.87	30	0.56
	9	8.92	20	0.35
RB	10	9.97	32	0.07

Comments:

Thalweg is 5.57 meters from left bank, shortly before flow measurement number 6. Increment= 1.05 m

* Measurement taken on top of boulder. Photos: 0915 (US), 0916 (DS), 0917 (LB), 0918 (RB), 0919 (Substrate at LB with JCS boot), 0920 (Substrate in center-boulders), 0921 (Substrate in center)

Site Name	HJ-T2-13s	**Event Code**	
Date	18 August 2013	**Time**	16:18
Latitude N	67.038627	**Longitude W**	153.592427
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	1
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	1
Boulders	2
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Boulders highly moderate
Heavy periphyton mixed with silt cover

Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
No canopy	All spruce-35% cover
Understory (0.5 - 5 m)	
Mostly willow and some spruce-20% cover	Dense with willow, herbaceous vegetation, spruce saplings, blueberry, and rose-almost total cover
Ground (< 0.5 m)	
Bare ground (gravel and cobble)-65% Small grass-35%	Bare ground-5% Moss, small grass, berries, and rose-95%

Site Name	HJ-T3-13s	**Event Code**	
Date	18 August 2013	**Time**	17:05
Latitude N	67.039417	**Longitude W**	153.590255
Observers	JCS,SDG,LIM		

Aquatics Data

Ambient Water Quality		**Channel Characteristics**	
Temperature	11.0 °C	Bankfull Width	24.2 m
Dissolved Oxygen	106.40%	Wetted Width	10.9 m
Dissolved Oxygen	11.64 mg/L	Thalweg Depth	0.69 m
Conductivity	164.6 uS/cm	48 hr. Precipitation	Low
Sp. Cond.	0.225 mS/cm	Stream Gradient	1%
pH	7.75	Stream Stage	Low
Turbidity	3.71 NTU	Water Color	Clear

Bank Angle Sketches

LB Angle- 175°

RB Angle- 90°

Substrate (inorganic) = 100%

Type	Diameter	% Composition
Bedrock		0
Boulder	>256mm (10in)	10
Cobble	64-256mm (2.5-10in)	50
Gravel	2-64mm (0.1-2.5in)	20
Sand	0.06-2mm	0
Silt	0.06-2mm	20
Clay	0.004-0.06mm	0

Flow

	#	Width (m)	Depth (cm)	Flow (m/s)
RB	1	0.55	3	0
	2	1.64	19	0.01
	3	2.73	31	-0.01
	4	3.82	52	-0.01
	5	4.91	52	0.11
	6	6	60	0.36
	7	7.09	68	0.61
	8	8.18	68	0.83
	9	9.27	68	1.03
LB	10	10.36	58	0.2

Comments:

Increment=1.09 m. Thalweg was 3.22 meters from left bank

Photos: 0922 (US), 0923 (DS), 0924 (LB), 0925 (RB)

Site Name	HJ-T3-13s	**Event Code**	
Date	18 August 2013	**Time**	17:05
Latitude N	67.039417	**Longitude W**	153.590255
Observers	JCS,SDG,LIM		

Channel Cover in Stream Transect

Cover in Transect	
Filamentous Algae	0
Macrophytes	0
Woody Debris (Big) >0.3m	0
Brush/Woody Debris (Small) <0.3m	1
Live Trees Root	0
Overhanging Vegetation	1
Undercut Bank	0
Boulders	1
Artificial Structures	0

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

Comments:
Periphyton = heavy (mixed with silt)

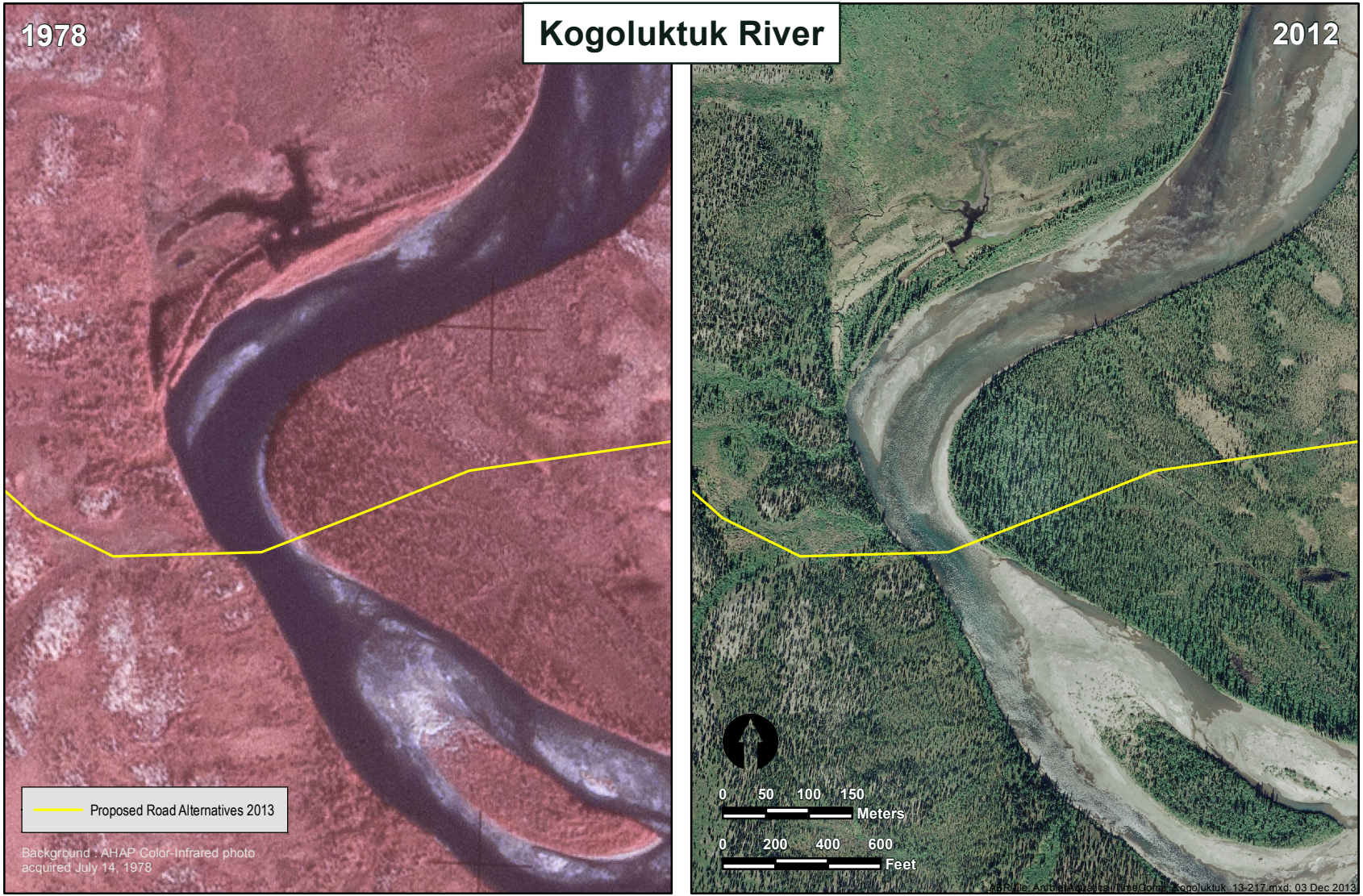
Riparian Vegetation (percentage and type 10 meters from bank)	
Left Bank	Right Bank
Canopy (> 5 m)	
Spruce-40%	No canopy
Understory (0.5 - 5 m)	
Willow, alder, blueberry, and spruce-70%	Willow and tall grass-10%
Ground (< 0.5 m)	
Bare ground-0% Grasses, herbs, and willow-100%	Bare ground-95% Small grasses-5%

Appendix C. A comparison of stream corridor aerial imagery from 1978–1982 versus imagery from 2012 of waterbodies traversed by the Brooks East Corridor, Alaska.

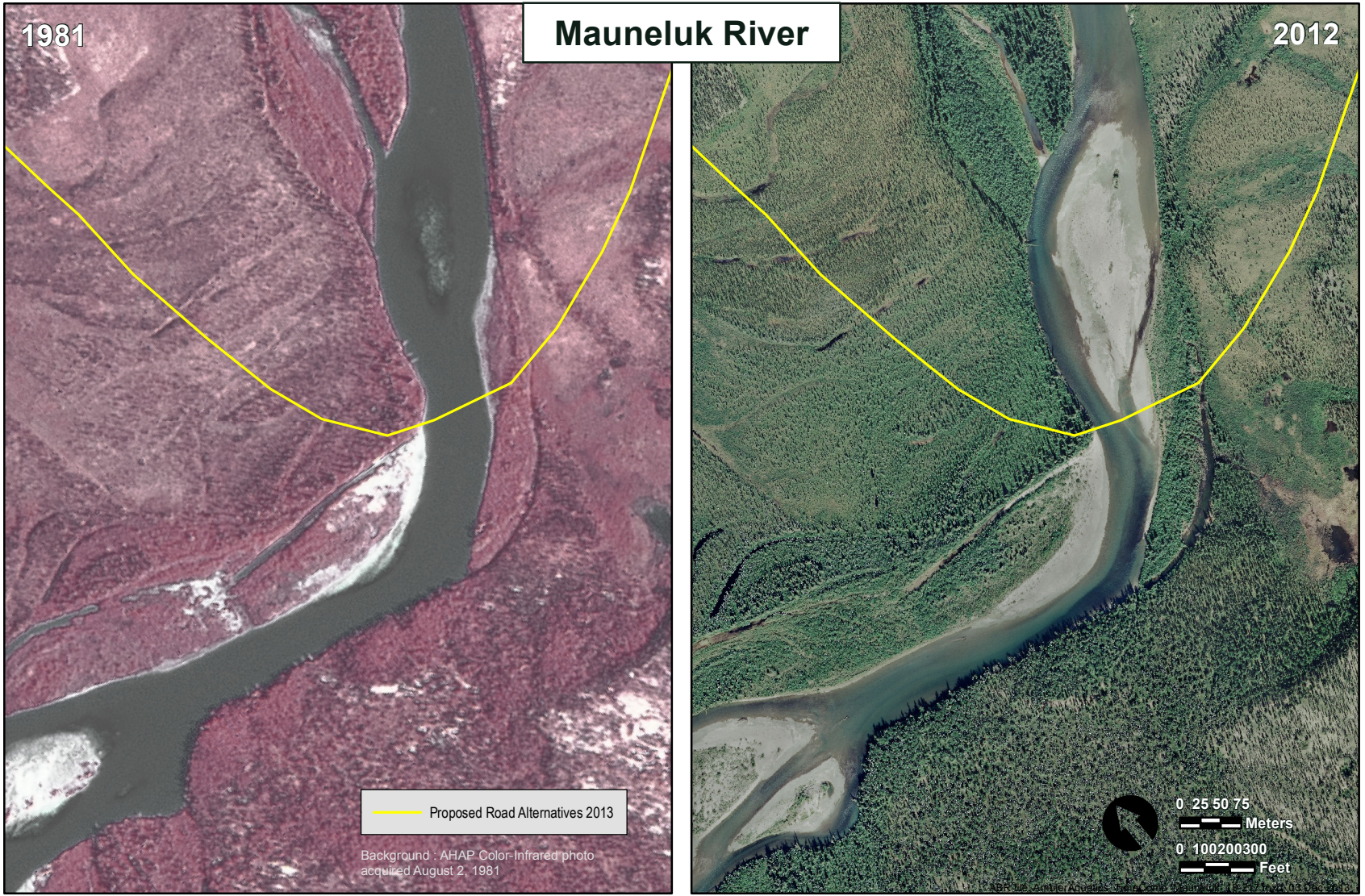
Shungnak River

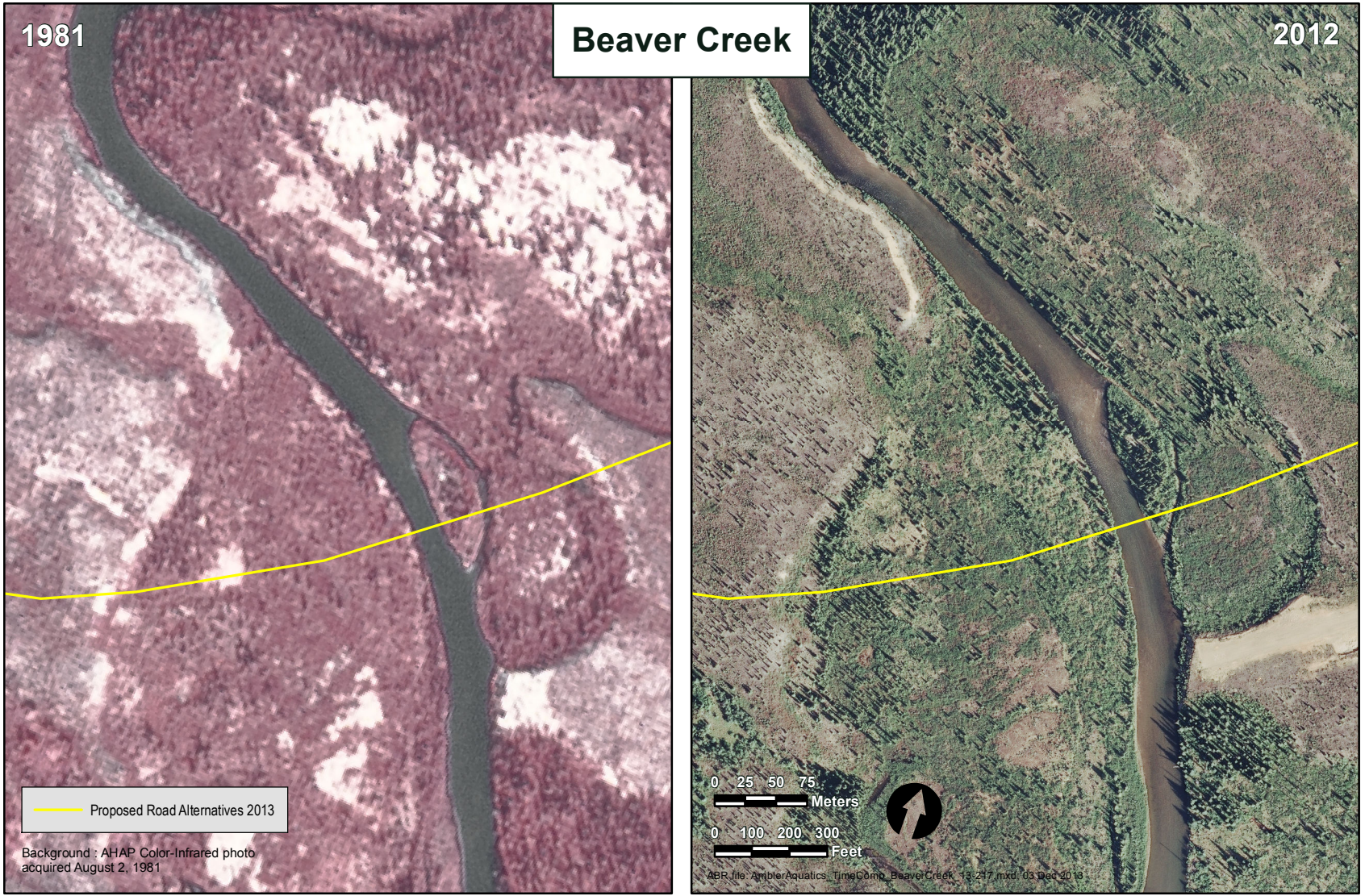


Kogoluktuk River

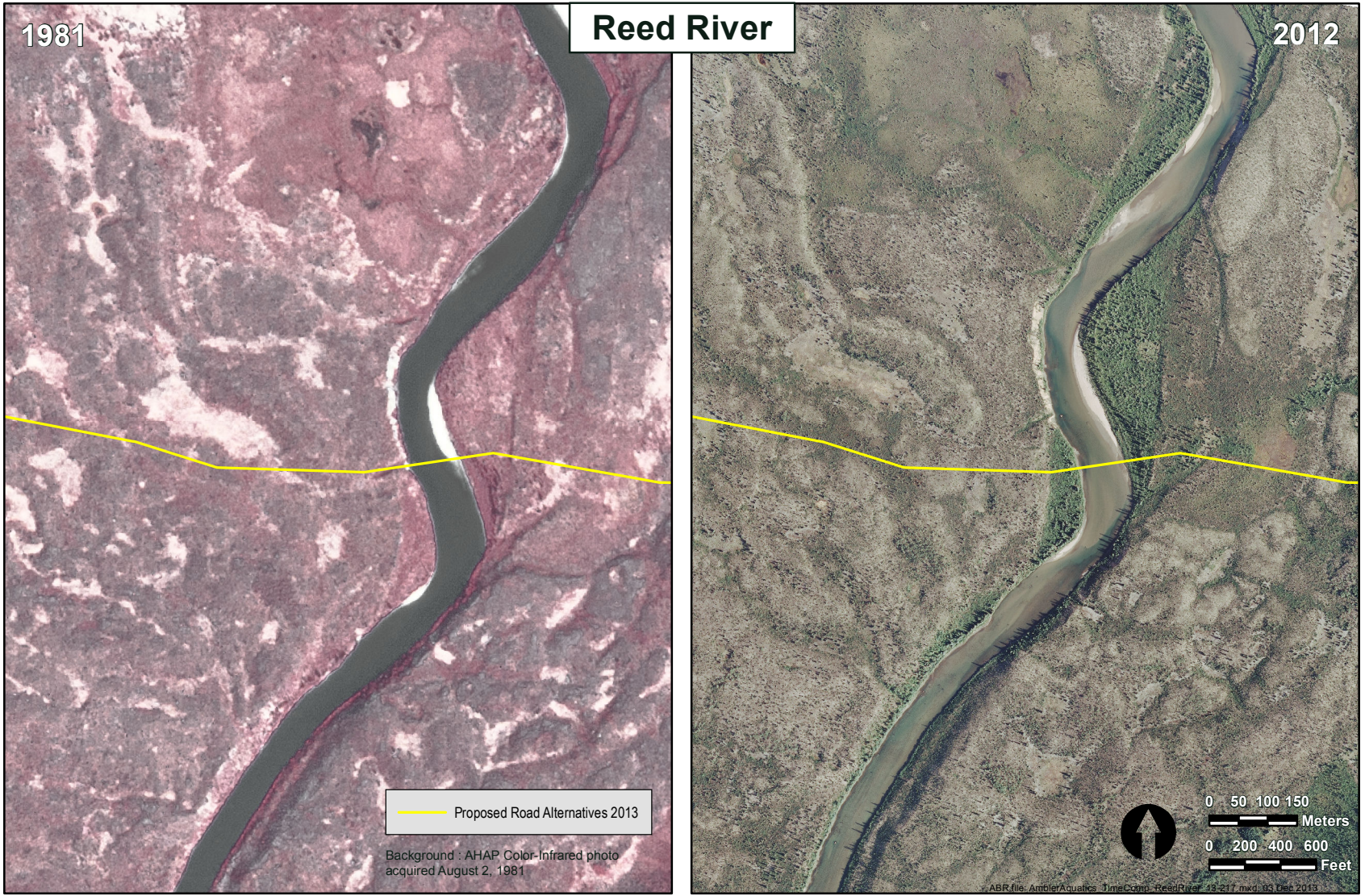


Mauneluk River

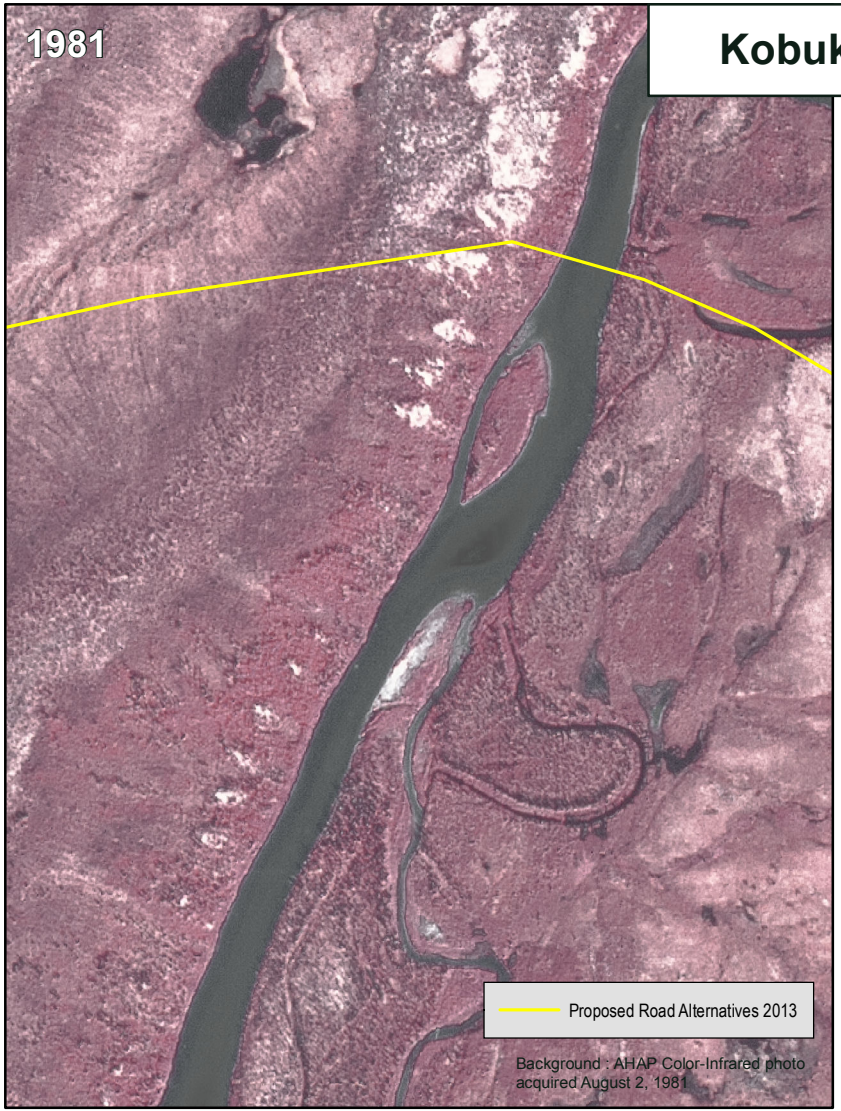


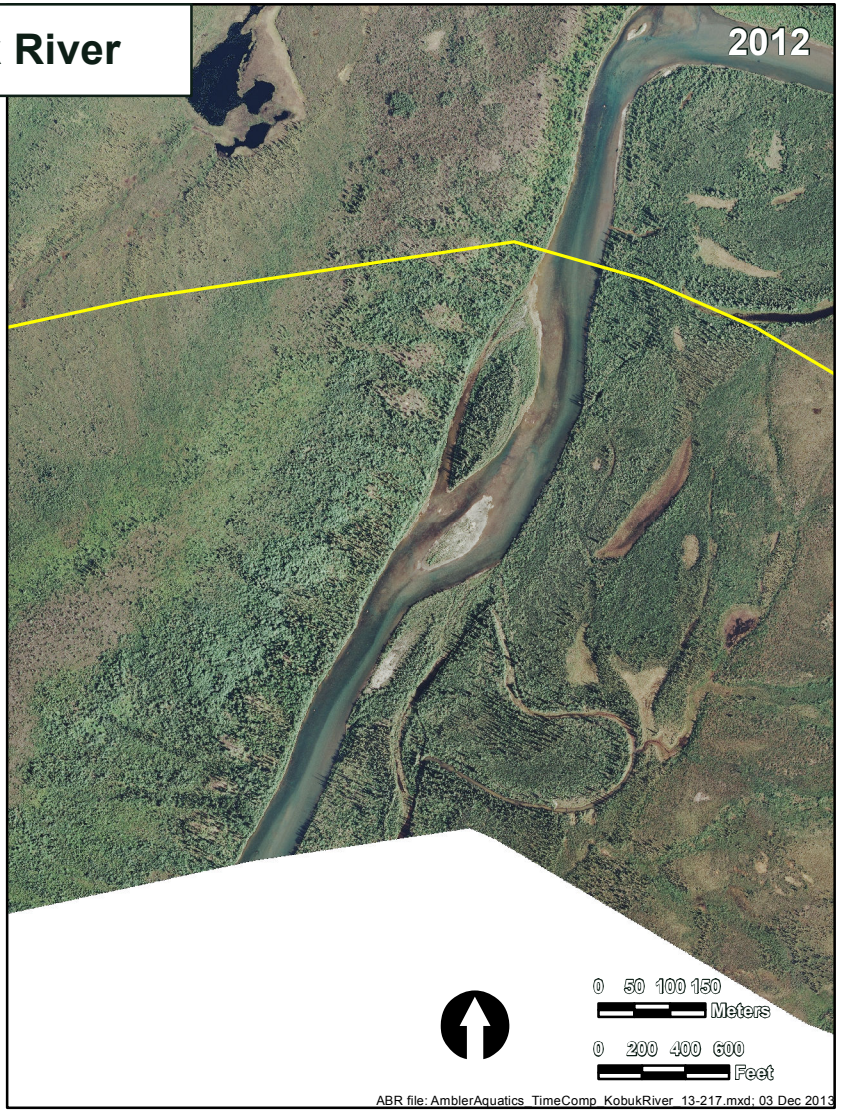

1981
Beaver Creek
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 2, 1981
0 25 50 75
Meters
0 100 200 300
Feet
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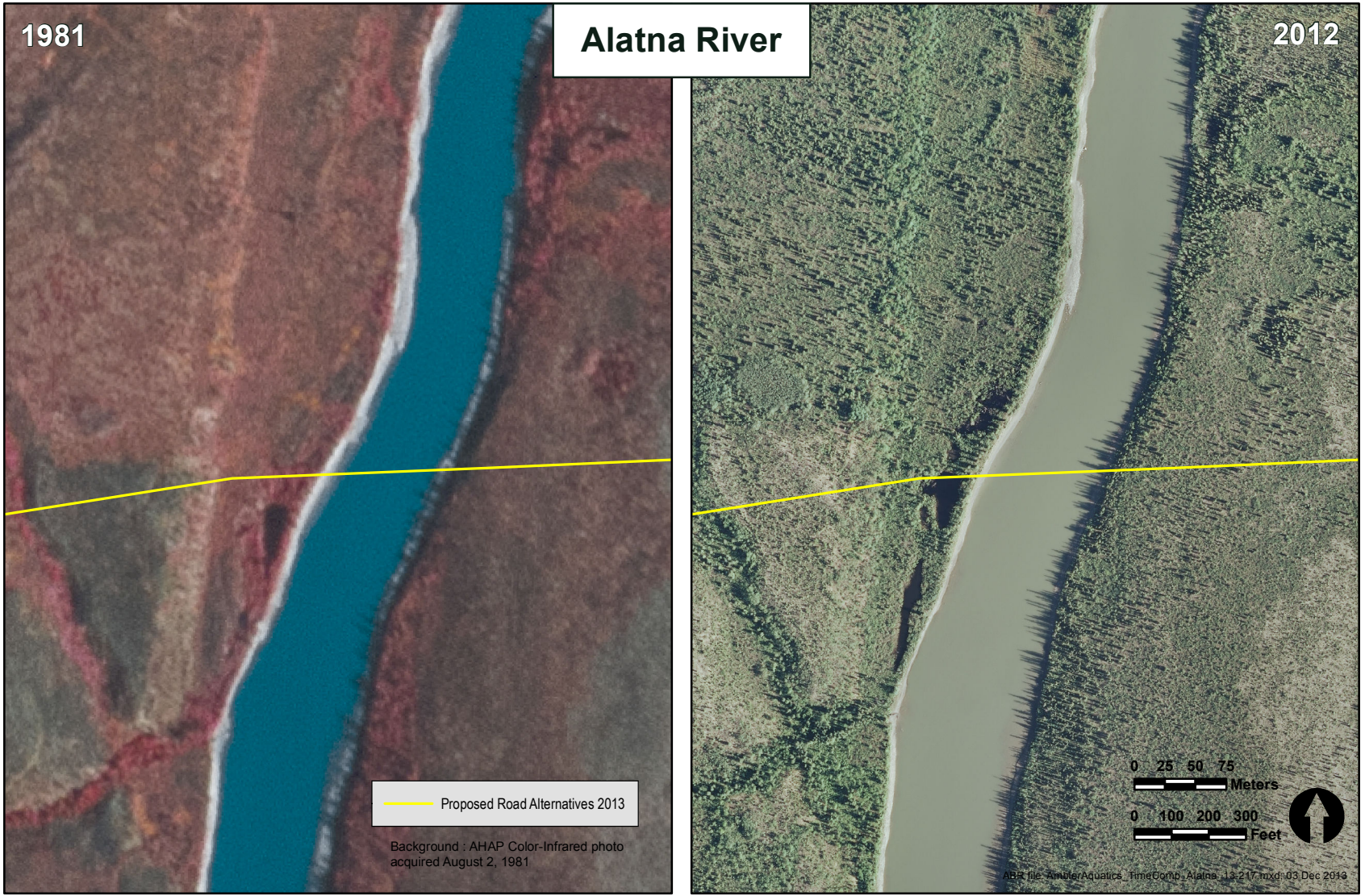
Reed River


1981
2012
Proposed Road Alternatives 2013
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acquired August 2, 1981
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Meters
0 200 400 600
Feet
ABR file: AmblerAquatics_TimeComp_ReedRiver_13-217.mxd 03 Dec 2013

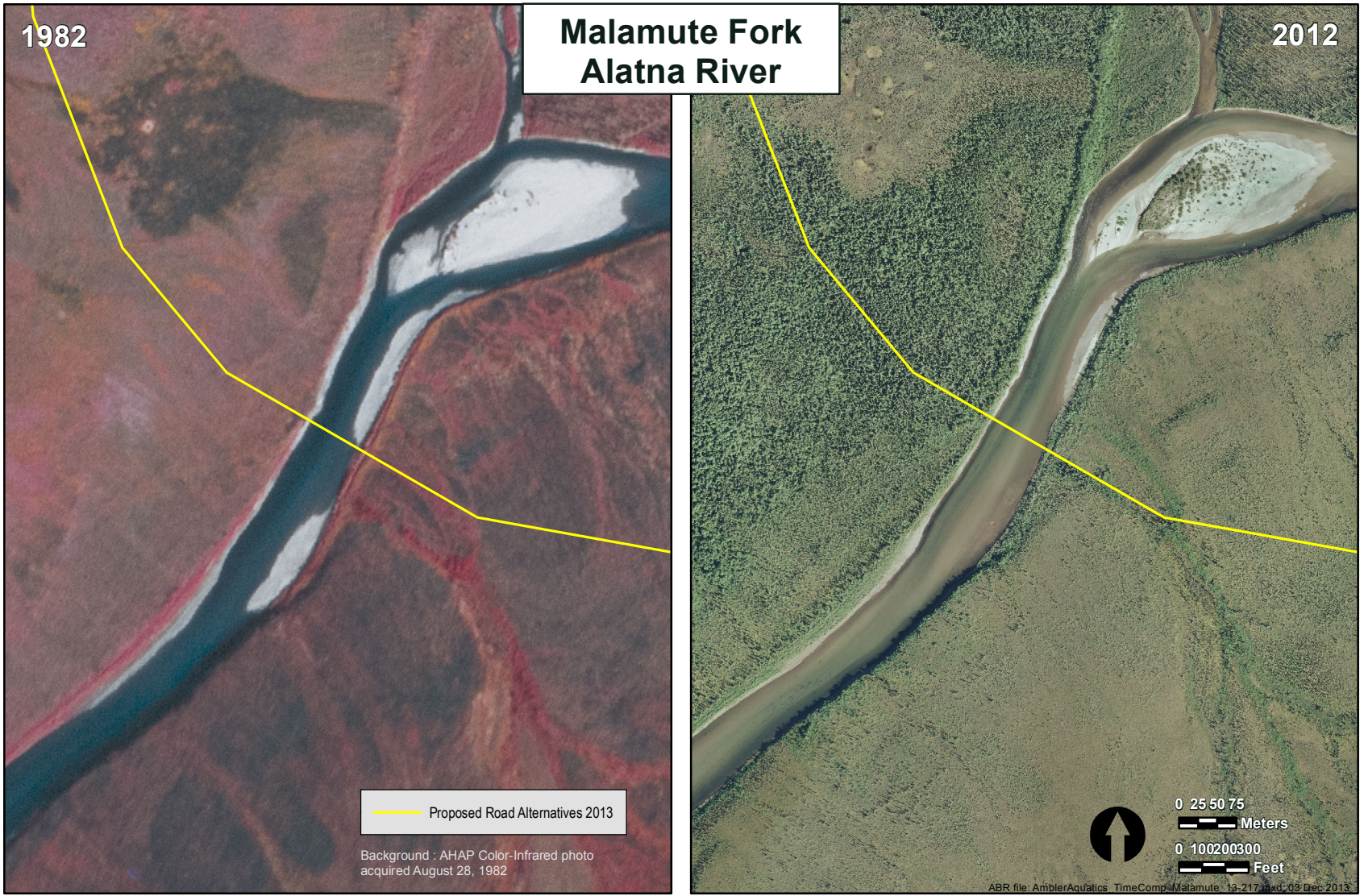
Kobuk River

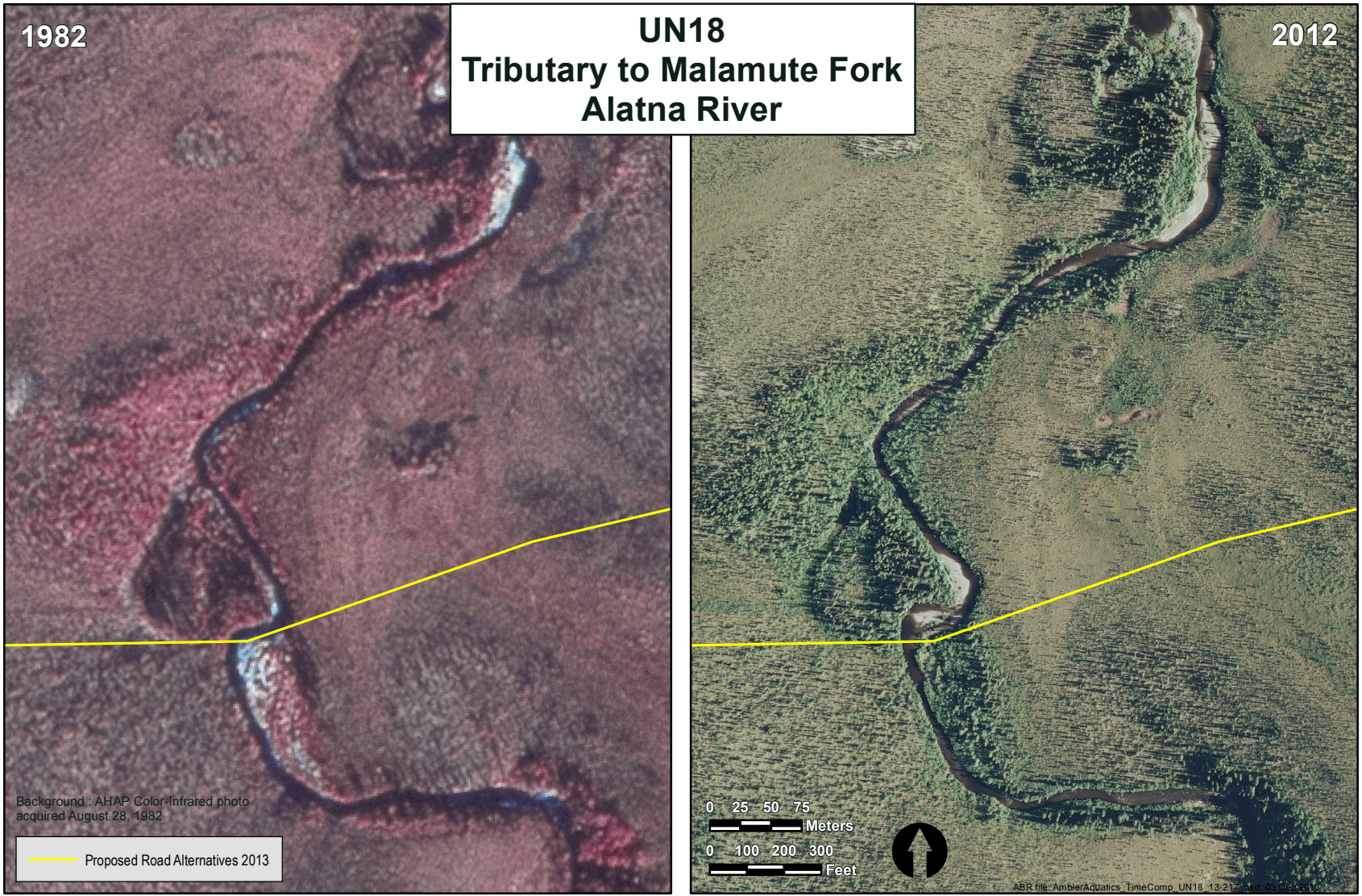

1981
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 2, 1981


2012
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Meters
0 200 400 600
Feet
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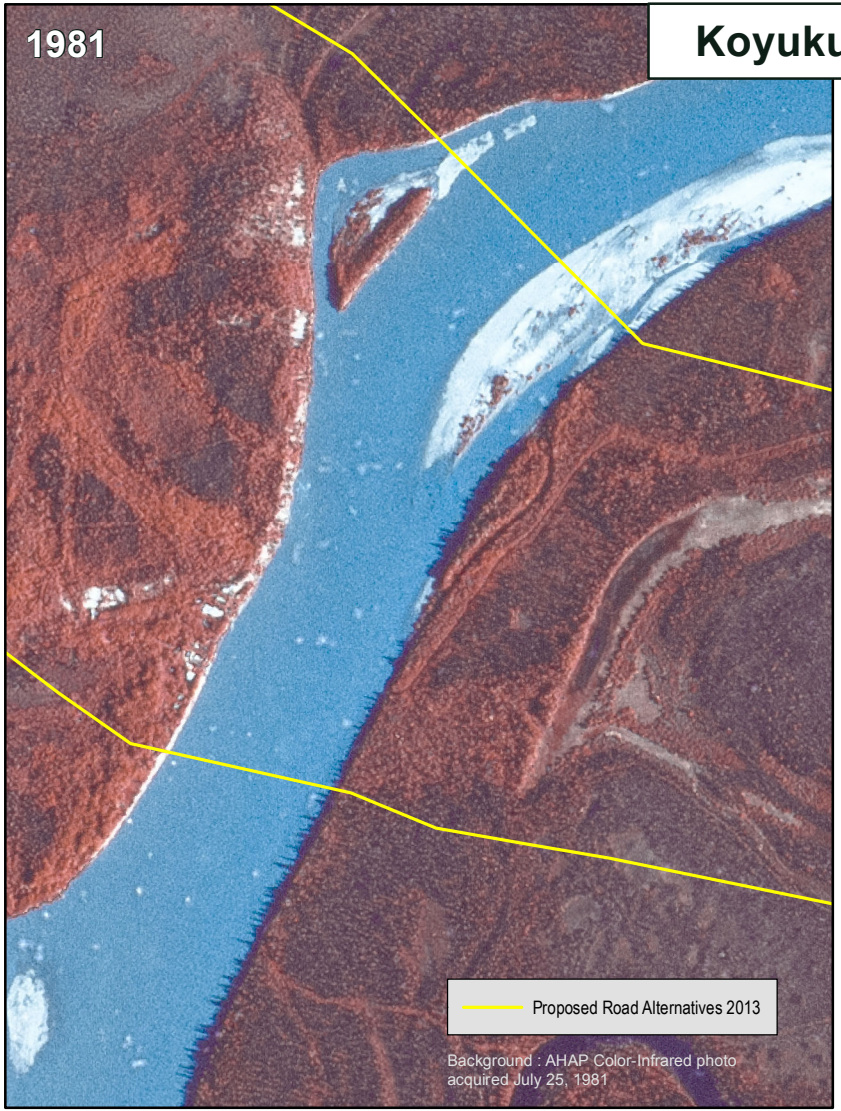

1981
Alatna River
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 2, 1981
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: AmbierAquatics_TimeComp_Alatna_13-217.mxd 03 Dec 2013

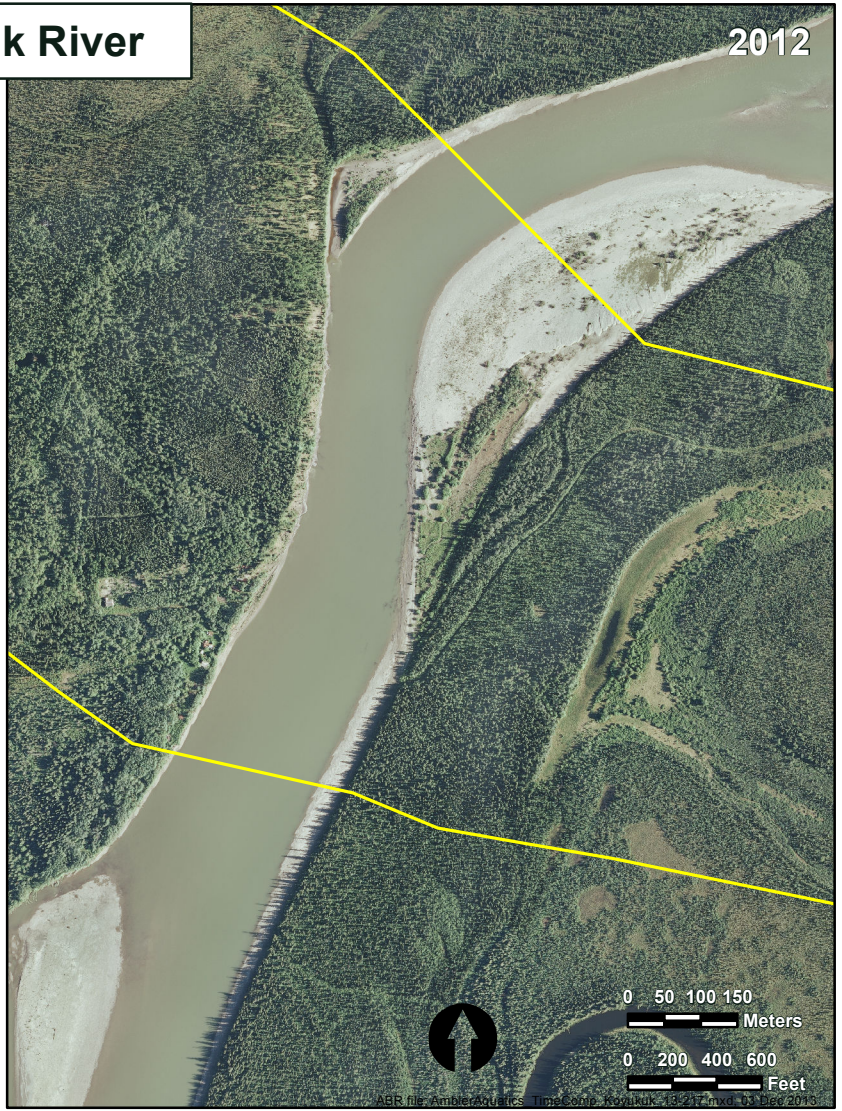
Malamute Fork Alatna River




1982
UN18
Tributary to Malamute Fork
Alatna River
2012
Background : AHAP Color-Infrared photo
acquired August 28, 1982
Proposed Road Alternatives 2013
0 25 50 75
Meters
0 100 200 300
Feet

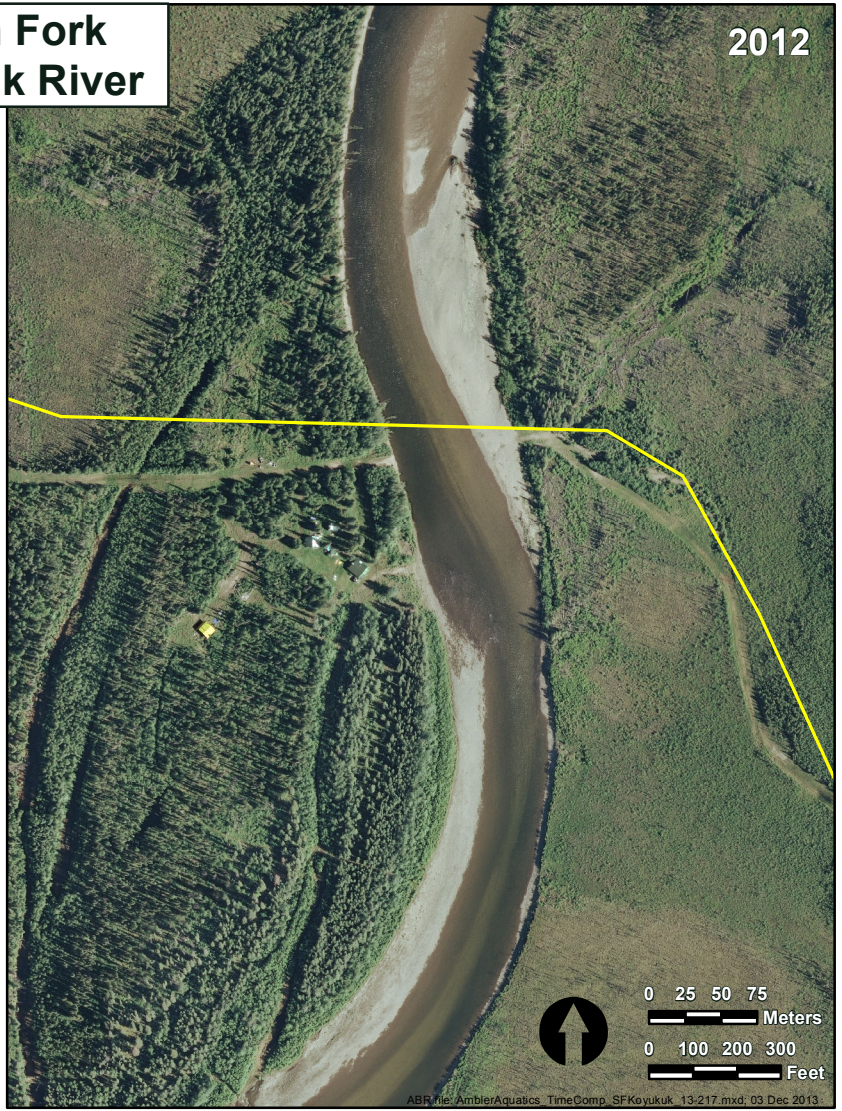
Koyukuk River



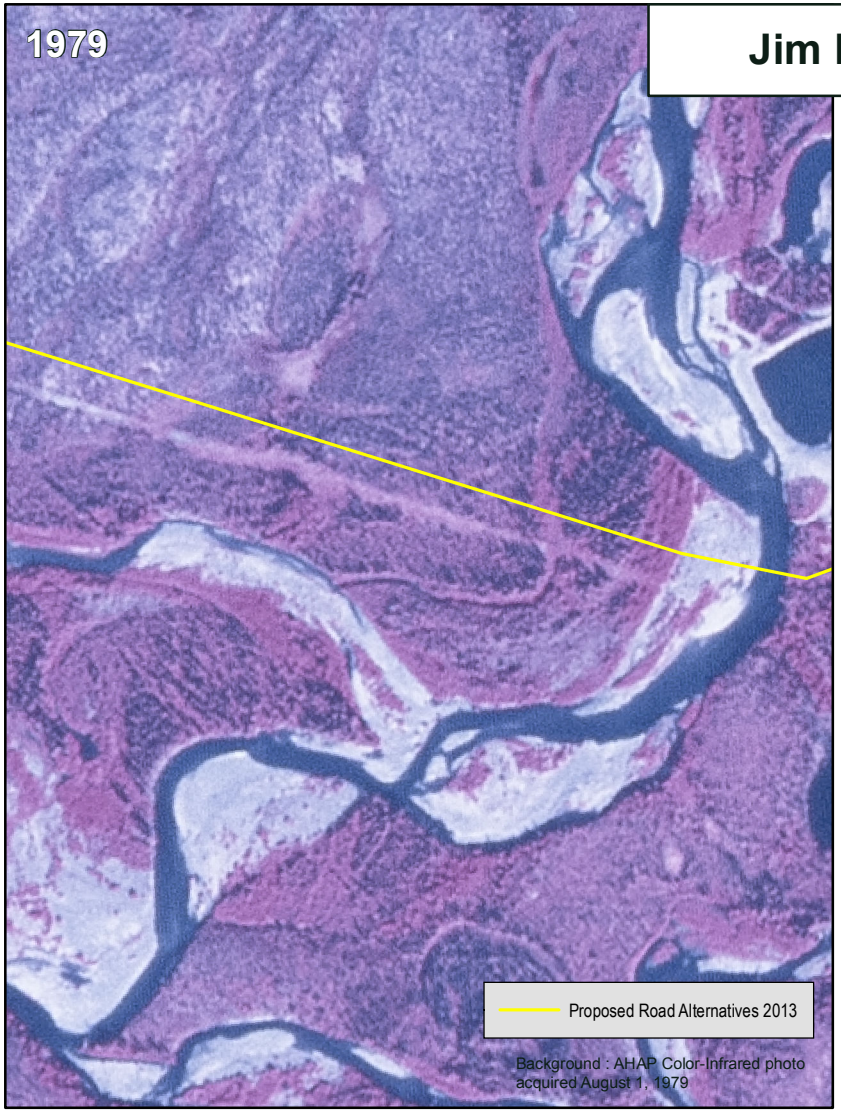


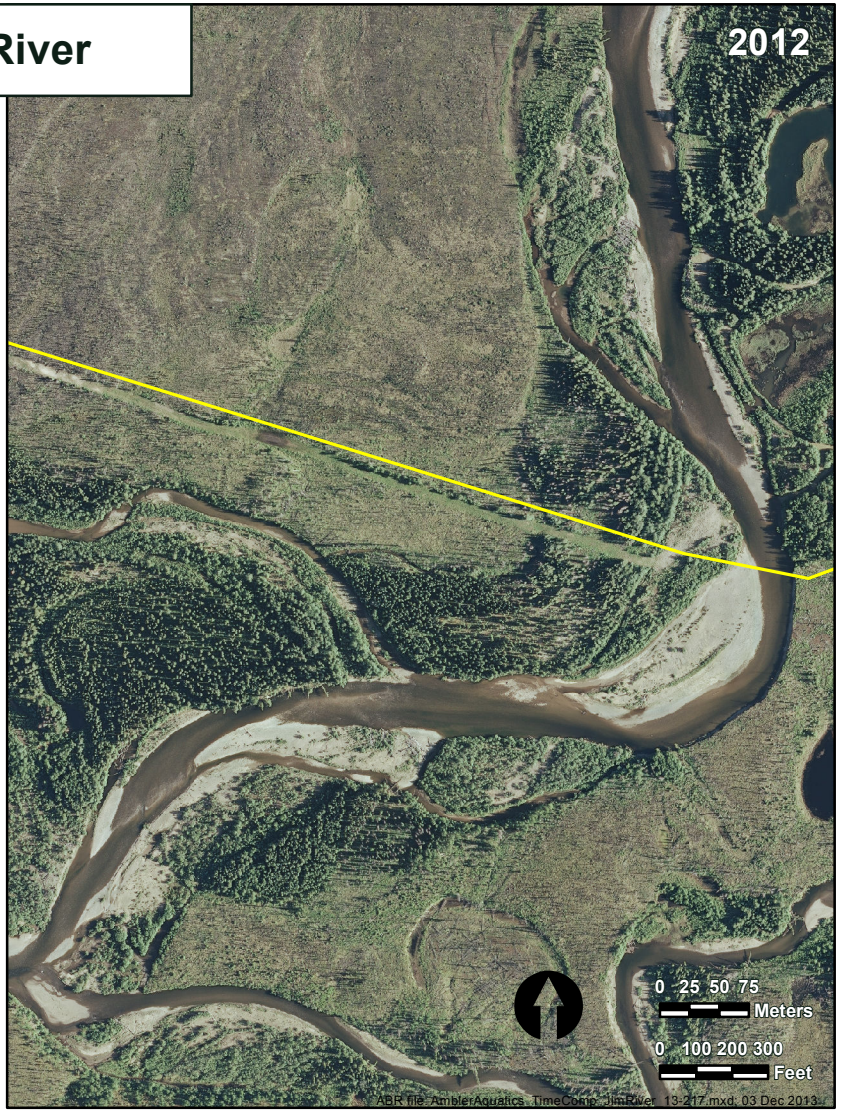
South Fork Koyukuk River



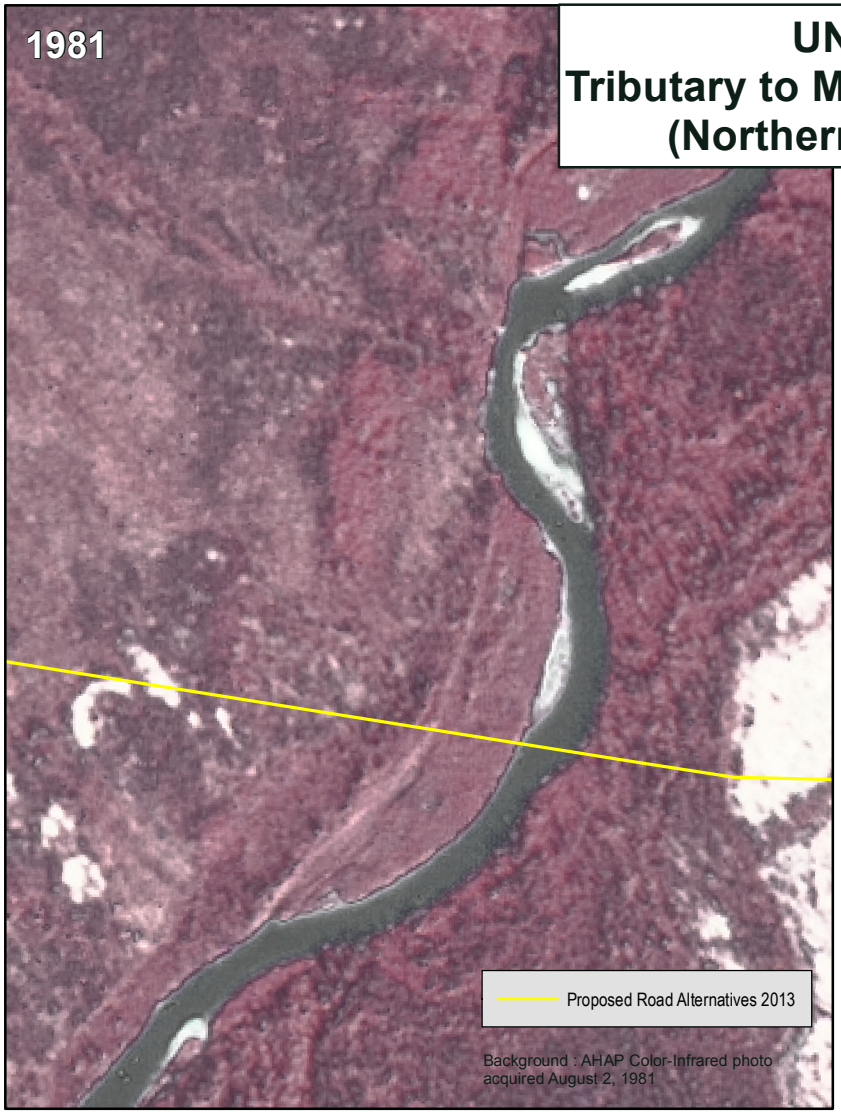


Jim River


1979
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 1, 1979

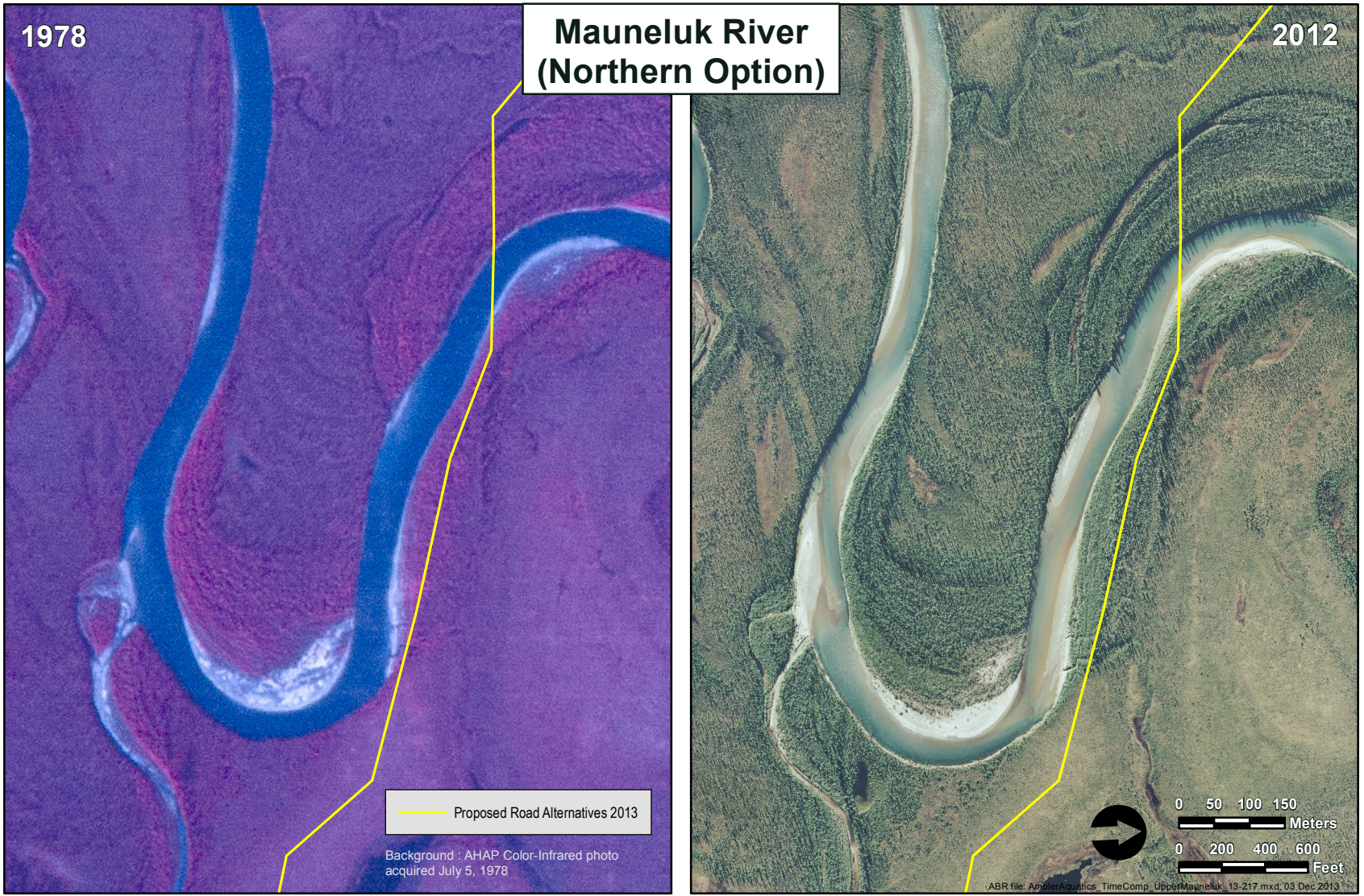

2012
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: AmblerAquatics_TimeComp_JimRiver_13-217.mxd; 03 Dec 2013

UN30
Tributary to Mauneluk River
(Northern Option)

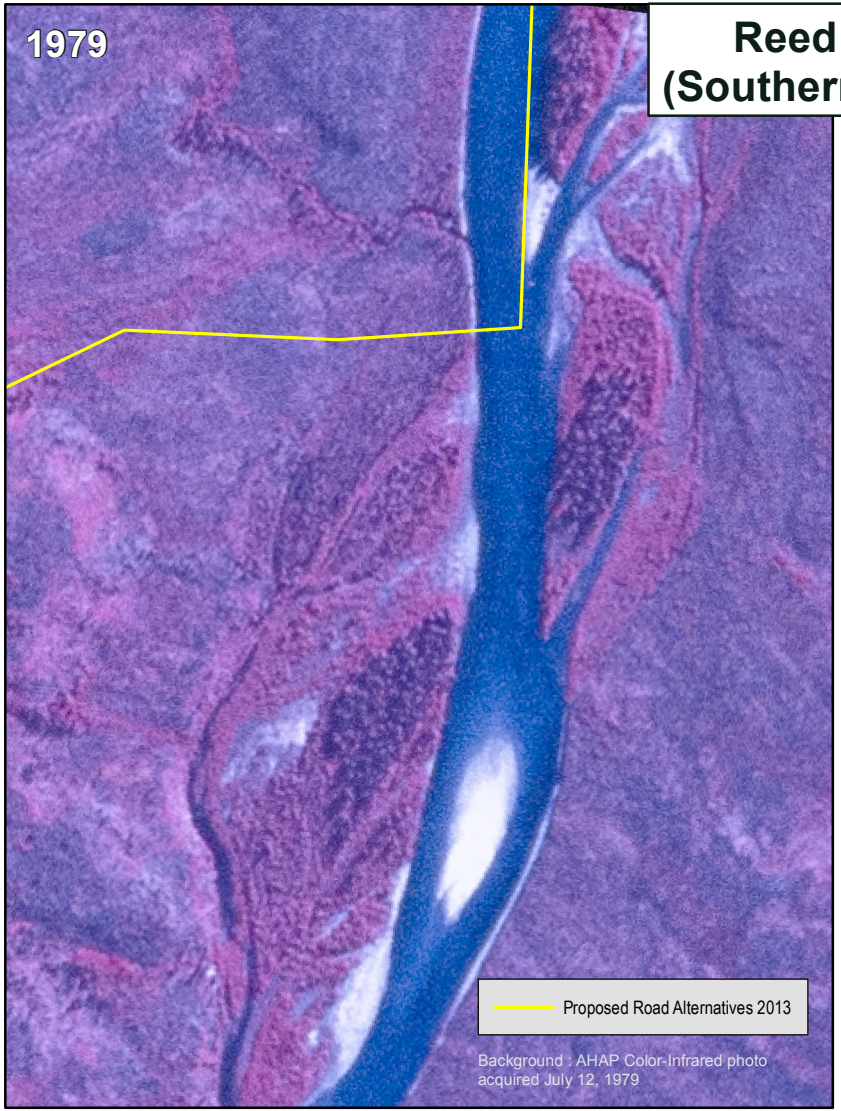


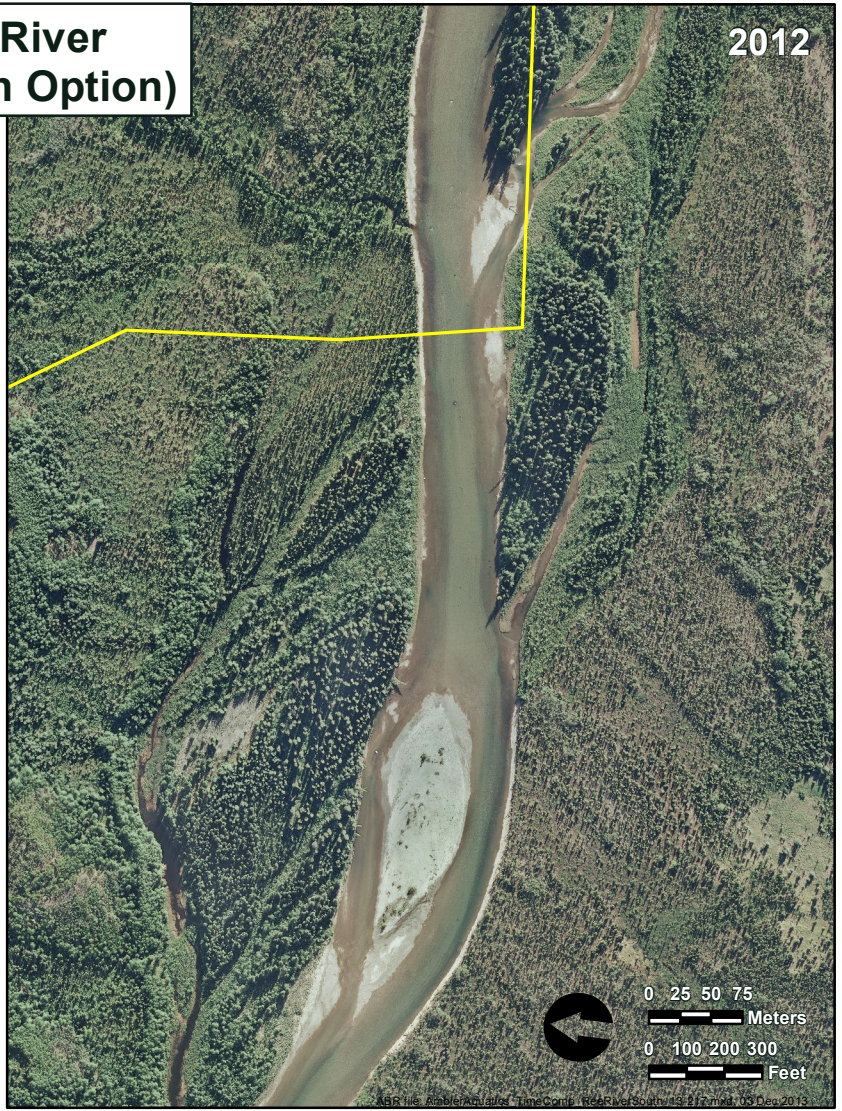


Mauneluk River (Northern Option)

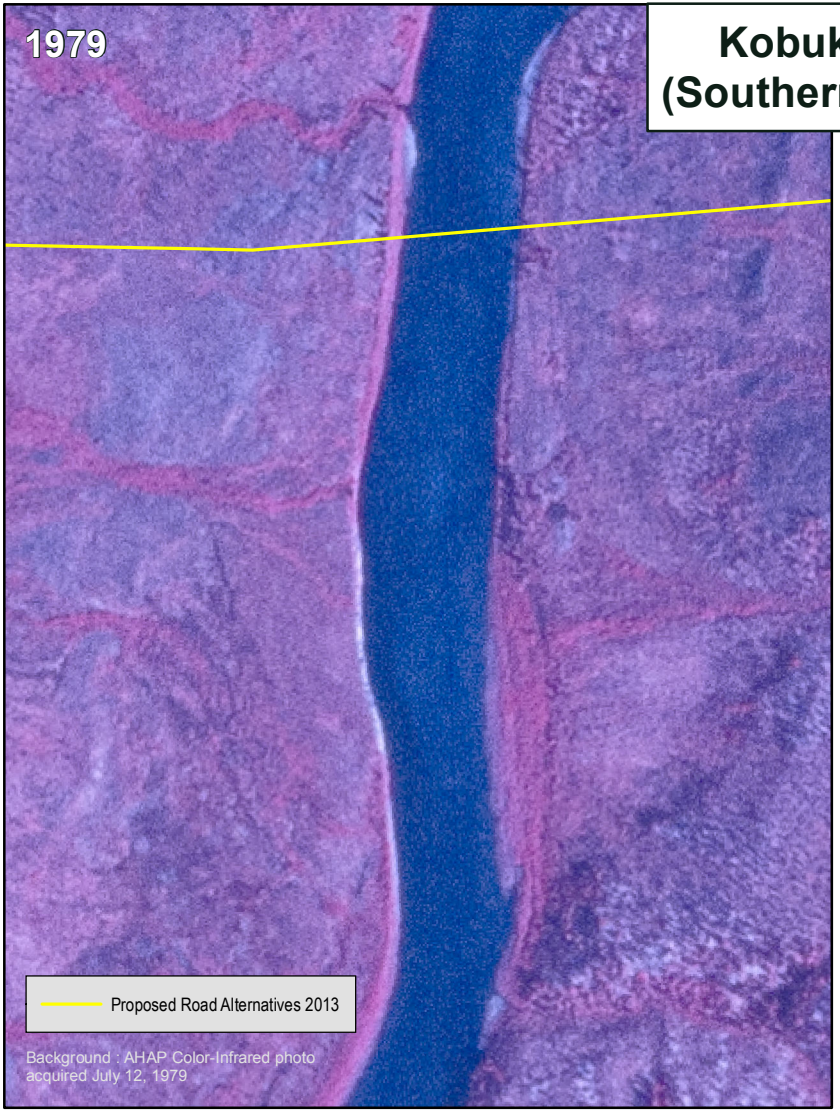


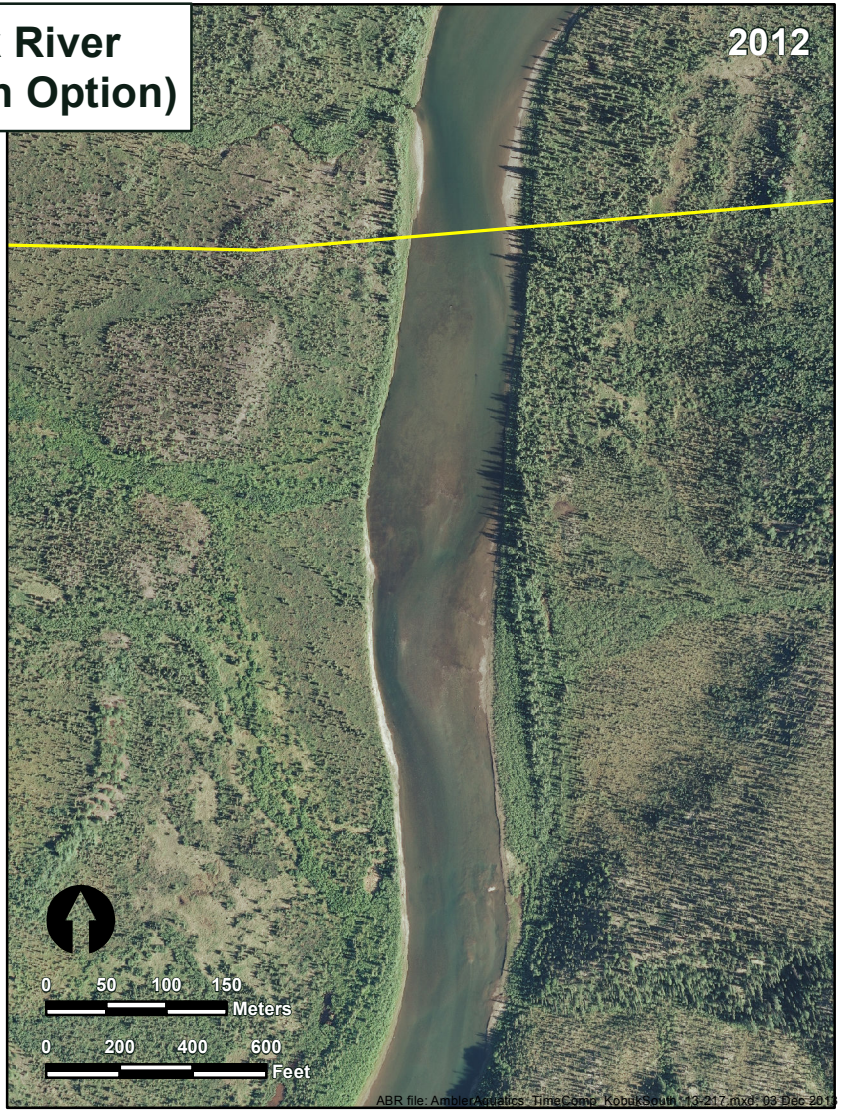
Reed River (Southern Option)

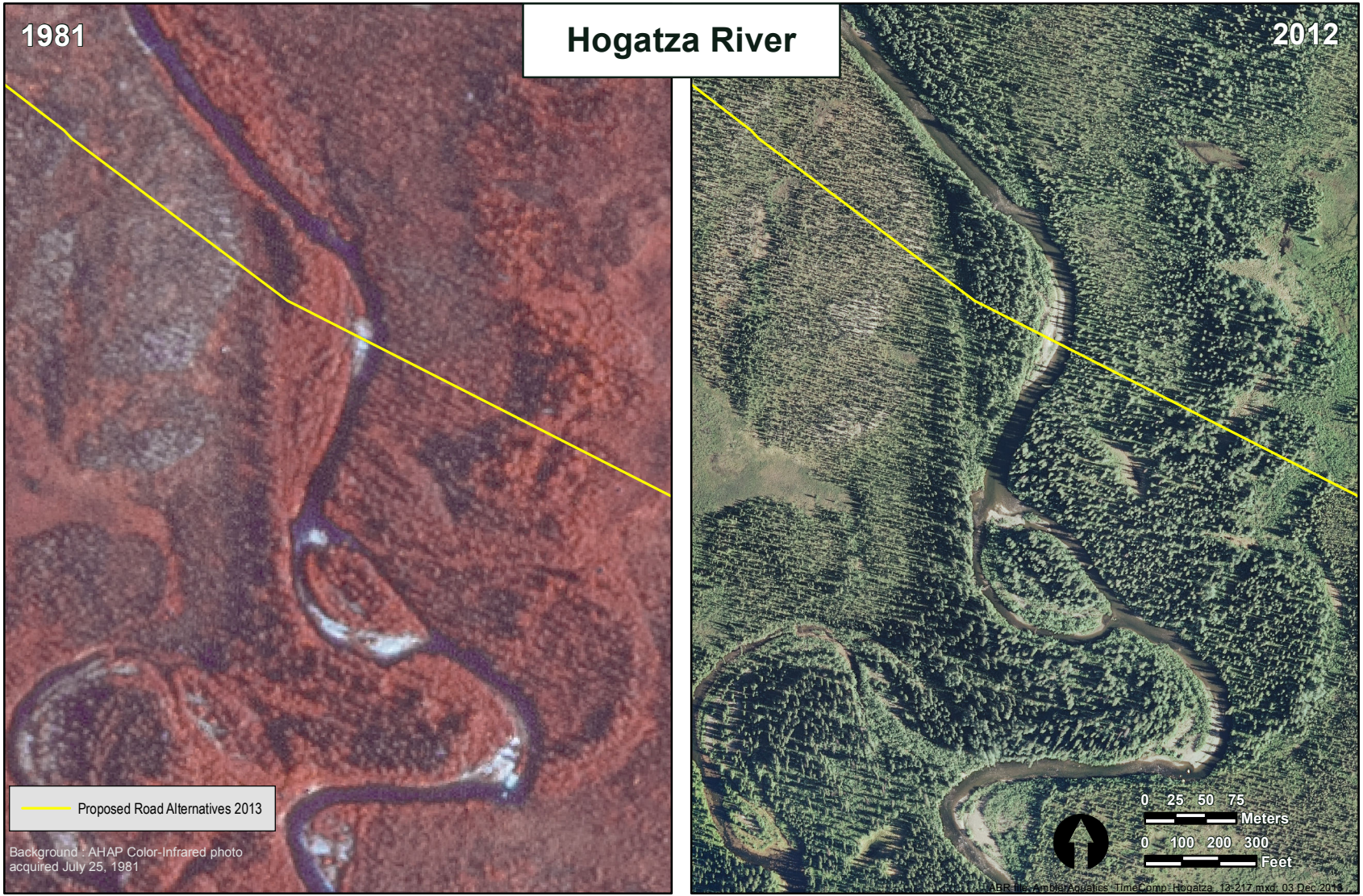


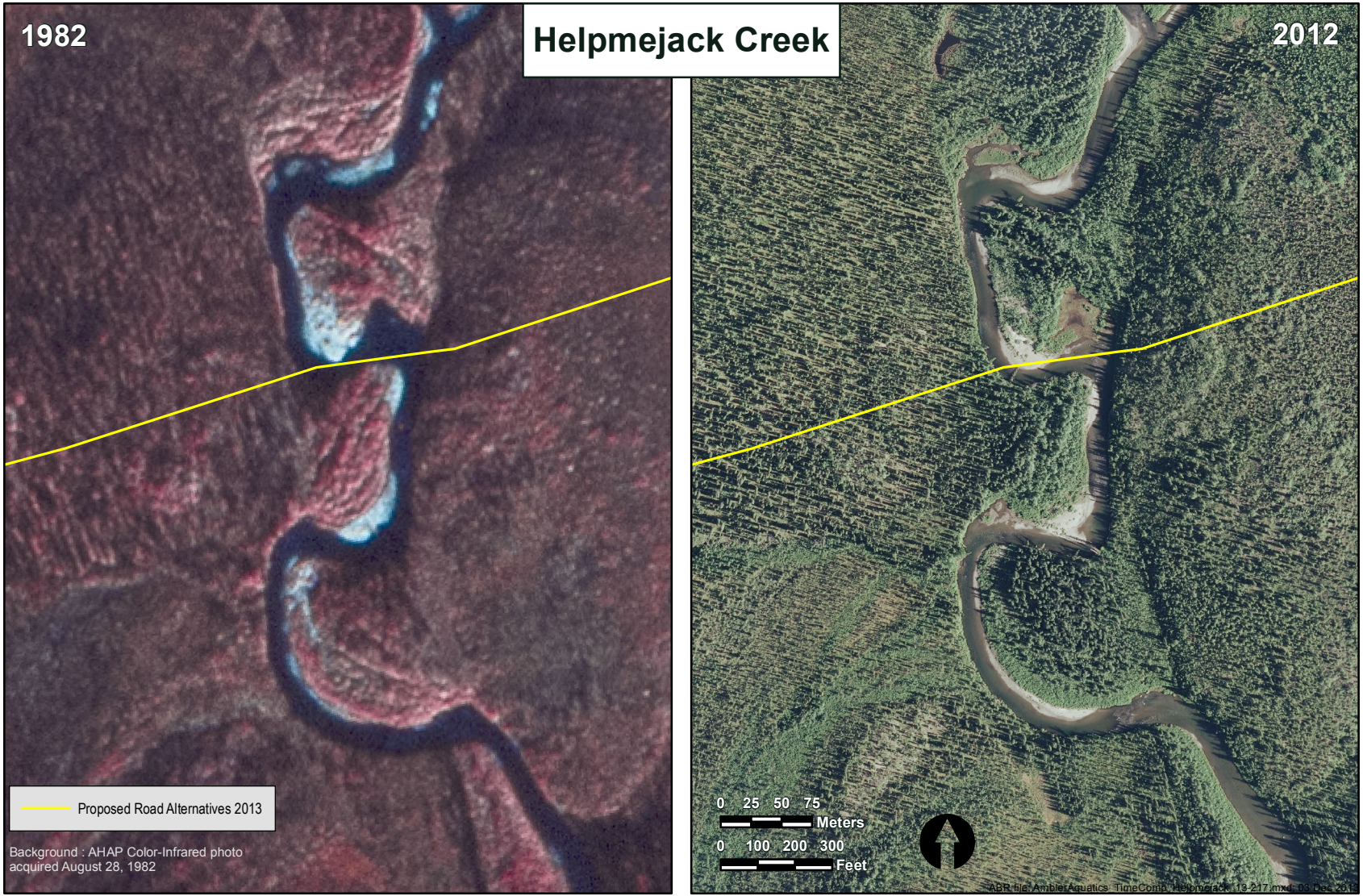


Kobuk River (Southern Option)






1981
Hogatza River
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo acquired July 25, 1981
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: AmblerAquatics\TimeComp\Hogatza_13-217.mxd; 03 Dec 2013


1982
Helpmejack Creek
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 28, 1982
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: Ambler Aquatics_TimeComp_Helpmejack_13-217.mxd 03 Dec 2015

Appendix D. Ambient water chemistry collected at habitat survey transects located on waterbodies traversed by the Brooks East Corridor, Alaska, August 2013.

Transect	Waterbody	Latitude (°N)	Longitude (°W)	Date	Temperature (°C)	DO (%)	DO (mg/L)	Conductivity (µS/cm)	Specific Conductance (mS/cm)	pH	Turbidity (NTU)
SH-T1-13	Shungnak River	67.120893	-156.98513	8/12/2013	9.5	100	11.32	115.3	0.164	6.58	1.92
SH-T2-13	Shungnak River	67.120226	-156.97909	8/12/2013	9.9	102.1	11.51	115.7	0.162	7.95	1.71
SH-T3-13	Shungnak River	67.117791	-156.96872	8/12/2013	10.5	106.9	11.92	116.7	0.161	7.57	1.79
KG-T1-13	Kogoluktuk River	67.016932	-156.69449	8/13/2013	11.3	103.9	11.35	195.2	0.264	7.83	0.99
KG-T2-13	Kogoluktuk River	67.018092	-156.68706	8/13/2013	12.3	106.1	11.35	200.7	0.265	8.11	0.89
MN-T1-13	Mauneluk River	67.008356	-156.0743	8/13/2013	11.1	110.3	12.07	151.6	0.206	7.73	1.14
MN-T2-13	Mauneluk River	67.016628	-156.0547	8/13/2013	11.9	110.4	11.9	155.9	0.208	7.71	0.95
BV-T1-13	Beaver Creek	67.021206	-155.15079	8/14/2013	8.7	100.5	11.66	126.9	0.184	7.86	0.86
BV-T2-13	Beaver Creek	67.023342	-155.158	8/14/2013	9.1	102.7	11.78	128.6	0.184	7.79	0.74
RD-T1-13	Reed River	67.035785	-154.83514	8/15/2013	8.1	103	12.13	81.1	0.12	6.72	1.13
KB-T1-13	Kobuk River	67.012346	-154.36742	8/15/2013	10.6	106.5	11.84	142.2	0.196	7.45	0.68
AL-T2-13	Alatna River	67.077422	-153.3279	8/17/2013	12.5	103.1	10.97	355.8	0.467	7.83	5.47
MF-T1-13	Malamute Fork Alatna River	67.06431	-153.17605	8/17/2013	12.6	108.1	11.4	273.2	0.357	8.3	0.98
UN18-T1-13	Unnamed tributary to Malamute Fork Alatna River	67.091882	-152.73017	8/16/2013	12.2	102.3	10.96	116.5	0.154	7.33	1.63
UN18-T2-13	Unnamed tributary to Malamute Fork Alatna River	67.090632	-152.72893	8/16/2013	12.5	100.6	10.76	117.1	0.154	7.47	1.92
SF-T1-13	South Fork Koyukuk River	66.846855	-151.09734	8/22/2013	10.5	102.7	11.42	180.8	0.25	7.89	1.14
JM-T1-13	Jim River	66.793188	-150.73218	8/22/2013	6.4	105.5	13	53.6	0.083	7.04	1.35
UN30-T1-13n	Unnamed tributary to Mauneluk River	67.060008	-156.03064	8/21/2013	5.8	103.2	12.79	140	0.221	7.95	0.72
MN-T1-13n	Mauneluk River	67.051217	-155.76514	8/21/2013	8.3	106.4	12.47	171.3	0.251	7.67	0.63
RD-T1-13s	Reed River	66.886494	-154.83768	8/19/2013	9.1	106.7	12.24	94.1	0.135	7.56	3.11
RD-T2-13s	Reed River	66.887137	-154.83486	8/19/2013	8.7	102.8	11.93	91.4	0.133	7.55	2.27
KB-T1-13s	Kobuk River	66.889348	-154.63569	8/19/2013	12.4	109.4	11.67	140.1	0.184	8.31	1.21
HG-T1-13s	Hogatza River	66.822889	-153.98929	8/20/2013	6.8	98.7	12	71.3	0.109	6.69	0.82

Transect	Waterbody	Latitude (°N)	Longitude (°W)	Date	Temperature (°C)	DO (%)	DO (mg/L)	Conductivity (µS/cm)	Specific Conductance (mS/cm)	pH	Turbidity (NTU)
HG-T2-13MCs	Hogatza River	66.820099	-153.99033	8/20/2013	7.3	100.6	12.13	72.2	0.109	6.87	1.42
HG-T2-13SCs	Hogatza River	66.820099	-153.99033	8/20/2013	7.6	95.3	11.29	72.7	0.109	6.53	1.45
HJ-T1-13s	Helpmejack Creek	67.040438	-153.59175	8/18/2013	9.2	103.3	11.74	156.5	0.224	7.67	5.6
HJ-T2-13s	Helpmejack Creek	67.038627	-153.59243	8/18/2013	10.3	106.1	11.74	161.7	0.224	7.84	4.55
HJ-T3-13s	Helpmejack Creek	67.039417	-153.59026	8/18/2013	11	106.4	11.64	164.6	0.225	7.75	3.71

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Fisheries and Aquatic Inventory of The Koyukuk, John, and Wild rivers, 2014

Ambler Mining District Industrial Access Road

By Heather L. Scannell
Alaska Department of Fish and Game, Division of Habitat
Fairbanks

for

The Alaska Industrial and Export Authority
813 W. Northern Lights Blvd.
Anchorage, AK 99503

June 2015

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Acknowledgements

We thank the Alaska Industrial Development and Export Authority (AIDEA) for their financial support and DOWL HKM for their logistical support. We specifically acknowledge the assistance provided by Alan and Betty Maness from Sourdough Outfitters, Bettles Lodge, and Brooks Range Aviation.

Ms. Laura Jacobs and Mr. Parker Bradley with the Division of Habitat, Alaska Department of Fish and Game (ADF&G) provided assistance with laboratory work. Mr. Loren St. Amand (ADF&G) participated in 2014 field sampling events.

Introduction

In 2009, the state of Alaska began studying the feasibility of a potential road to the Ambler Mining District located in the northwestern region of the state. The Alaska Department of Transportation and Public Facilities (ADOT&PF) was tasked with the preliminary work to identify, design, and potentially construct an access and transportation corridor road that would connect the Dalton Highway to the mining district. When the ADOT&PF evaluated potential routes, there were initially eight corridors being considered; however, only one of those routes, the Brooks East Corridor, was selected for field studies in preparation for the National Environmental Policy Act (NEPA) process. The corridor crossed several rivers including the Koyukuk and Alatna rivers located on the western end of the corridor near Bettles/Evansville. ABR. Inc. - Environmental Research and Services had conducted anadromous fish surveys throughout the corridor; however, there had not been any systematic sampling of fish or aquatic habitat. In 2013, the Alaska Industrial Development and Export Authority (AIDEA) contracted the Alaska Department of Fish and Game (ADF&G), Division of Habitat to conduct fish and fish habitat sampling within the Koyukuk, John, and Wild rivers. This sampling would aid the Division of Habitat in permitting specific portions of road development and would provide extensive data for the NEPA analysis. Fish and aquatic habitat sampling (Figure 1) was conducted by the Division of Habitat from July 1 through 14, 2014 and August 28 through September 7, 2014.

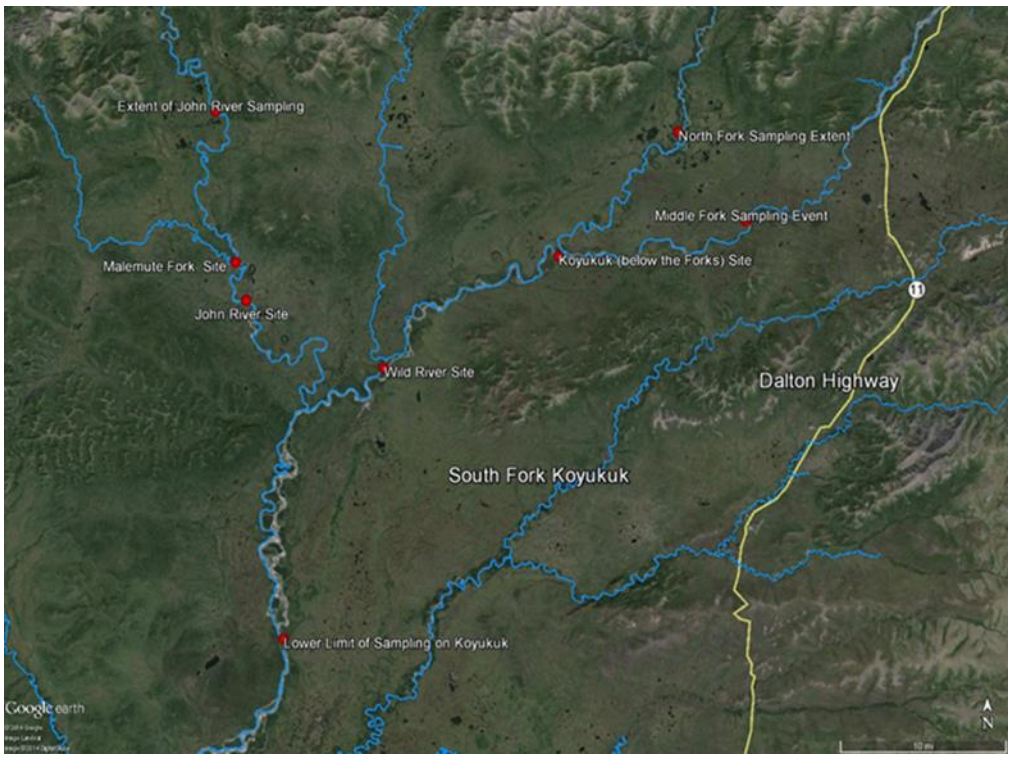


Figure 1. 2014 study area, including aquatic habitat sampling sites, and extent of fish sampling, on the Koyukuk, Wild, and John rivers.

Objectives

- Identify fish species assemblages in water bodies along the corridor.
- Collect fish samples to determine fish population characteristics and life history traits including length/age, age at maturity, diet, and fecundity.
- Measure water chemistry (pH, conductivity, turbidity, temperature).
- Invertebrate sampling to qualitatively and quantitatively identify lower trophic level productivity.

Methods and Results

Fish Sampling

Fish capture gear included gillnets, fyke nets, hoop nets, beach seines, and hook and line sampling. The efficiency of sampling gear was largely influenced by high water events encountered during the sampling periods. Fyke nets in the Wild River and in an unnamed channel located approximately 10 river miles upstream of Bettles had to be pulled and reset frequently which resulted in lower catch rates than anticipated. Additionally, the effectiveness of gillnets was reduced during high water events from debris entanglement. Electrofishing, hoop traps, minnow traps, and beach seines were our most productive capture gear and captured the majority of fish for population characterization work. Capture information for the spring sampling event is in Appendix A, and capture information for the fall event is in Appendix B.

Table 1. 2014 species composition from both summer and fall sampling events.

Fish	#	Minimum (mm)	Maximum (mm)	Mean (+/-SE) (mm)	% of Total Catch
Arctic grayling (*Thymallus arcticus*)	615	28	588	226.70 (**3.64**)	43.25%
Round whitefish (*Prosopium cylindraceum*)	180	25	390	180.43 (**6.55**)	12.66%
Longnose Sucker (*Catostomous catostomus*)	173	33	410	185.11 (**9.96**)	12.17%
Burbot *(Lota lota*)	121	91	930	432.62 (**14.48**)	8.51%
Lake chub (*Couesius plumbeus*)	110	30	133	86.74 (**2.21**)	7.74%
Slimy Sculpin (*Cottus cognatus*)	103	20	110	49.09 (**1.71**)	7.24%
Least cisco (*Coregonus sardinella*)	34	30	113	46.41 (**2.79**)	2.39%
Northern pike (*Esox lucius*)	30	55	705	390.53 (**29.84**)	2.11%
Humpback whitefish (*Coregonus pidschian*)	25	203	465	388.96 (**13.68**)	1.76%
Chinook salmon-juvenile (*Oncorhynchus tshawytscha*)	23	38	70	51.35 (**1.84**)	1.62%
Broad whitefish (*Coregonus nasus*)	3			538.67	0.21%
Sheefish (*Stenodus leucicthyes*)	3			593.67	0.21%
Arctic lamprey (Lethenteron camtschaticum)	2				0.14%

Ninety three fish were euthanized for further analysis (44 during the summer event, and 49 during the fall event). Data/samples collected in the field included fork length or total length depending on species (nearest mm), weight (nearest gram), stage of maturity,

gonadal weight (nearest gram) to determine gonadosomatic indices (GSI= ((weight/gonad weight) x 100), otoliths, and stomach contents. A complete description of dissection data is in Appendix C.

Table 2. Sexual maturity scale (Moulton 2010).

stage	maturity
1	immature
2	mature but not spawning this season
3	mature and spawning this season
4	mature and ripe
5	spent (post-spawn)
6	reabsorded eggs (did not spwan)

Arctic grayling

Arctic grayling (AG) are a popular sport and subsistence fish throughout mainland Alaska, inhabiting both rivers and lakes. In rivers they tend to be migratory fish relying on seasonal water conditions to guide their movements towards optimal habitats. They spawn in the spring after break-up and emerge from the gravels in approximately two to three weeks depending on water temperatures. They grow quickly their first few summers until eventually allocating their energy towards sexual maturity. Arctic grayling were abundant throughout the study area; captured fish had a mean fork length (FL) of 227 mm (range= 28–588; Figure 2). Twenty-two Arctic grayling were dissected, and based on stomach contents, chironomids (non-biting midges), mites, black flies, caddis flies, mayflys, stoneflys, copepods, and shrews made up their diet (Figure 3). Five females had eggs present indicating they were already allocating energy towards the 2015 spring spawning event. The mean FL of mature fish was 345.4 mm, and the mean gonadosomatic index (GSI) was 1.79%. Otoliths were aged to conduct length at age analysis and based on linear regression there was a negative correlation which indicates that there is no relationship between length at age, with some older fish displaying a shorter FL than was observed in younger fish. This is likely due to inconsistent food availability, or variability in the productivity of different habitats in which they reside. (Figure 4).

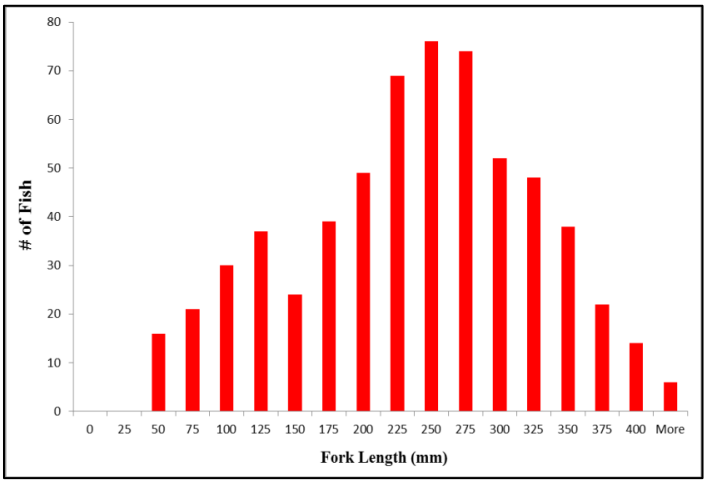


Figure 2. Length frequency for Arctic grayling.



Figure 3. A dissected Arctic grayling, a shrew and digested insect were removed from the stomach.

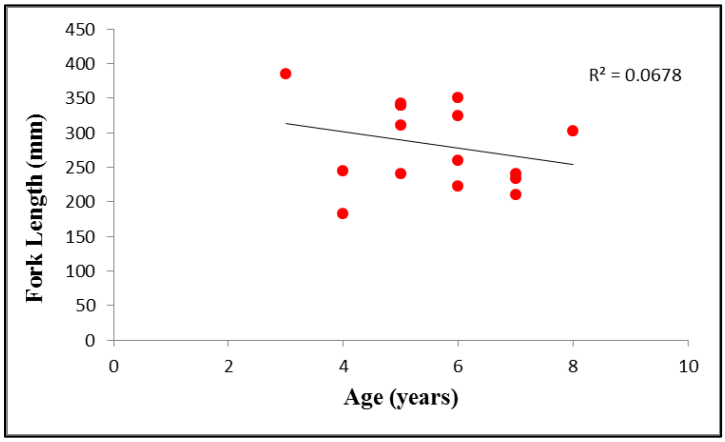


Figure 4. Length at age for dissected Arctic grayling.

Longnose sucker

Longnose suckers (LNS) were the third most abundant species captured (n=173). Captured longnose suckers had a mean FL of 227 mm (range= 28–588; Figure 5). They are distributed throughout Alaska, and are bottom feeders foraging primarily on invertebrates. All of the fish that were dissected (n=5) had empty stomachs. There is great variability in the documented length at maturity; in Western Lake Superior (Bailey 1969) estimated it to be 292 mm. They are spring spawners and three fish were classified as mature; the mean GSI was 3.63%, and the mean FL was 416.67 mm. Otolith analysis of two fish indicated that one fish was seven years old and mature (TL=397 mm), and the other eight years old (TL=290 mm).

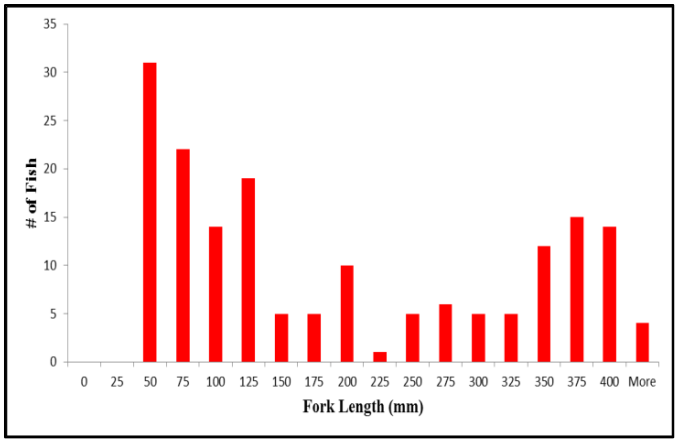


Figure 5. Length frequency for longnose sucker.

Burbot

Burbot (BB) were the fourth most abundant species captured (n=121) largely due to the effectiveness of hoop traps in the high water events that were encountered. Burbot are a voracious predator common throughout the lakes and rivers of Alaska. In the Koyukuk River drainage, they are a subsistence fish harvested under the ice in fish traps (Andersen et al. 2004). They are winter spawners, spawning under the ice in temperatures ranging from 1–4°C (McPhail and Lindsey 1970, Scott and Crossman 1973). Captured burbot had a mean total length (TL) of 443 mm (range= 91–930 mm; Figure 6). Twenty six burbot were dissected and 50% had empty stomachs; the remaining 50% of stomachs contained a wide variety of prey items including burbot, whitefish, slimy sculpins, juvenile salmon, and shrews (Figure 7). Thirteen burbot were classified as likely to spawn that winter; these fish had a mean TL of 537.22 mm (range= 330–842 mm), and mean GSI of 0.91%. One burbot was classified as immature and measured 420 mm. Otoliths were aged to conduct length at age analysis. Based on a linear regression there was a positive correlation between TL and age (Figure 8).

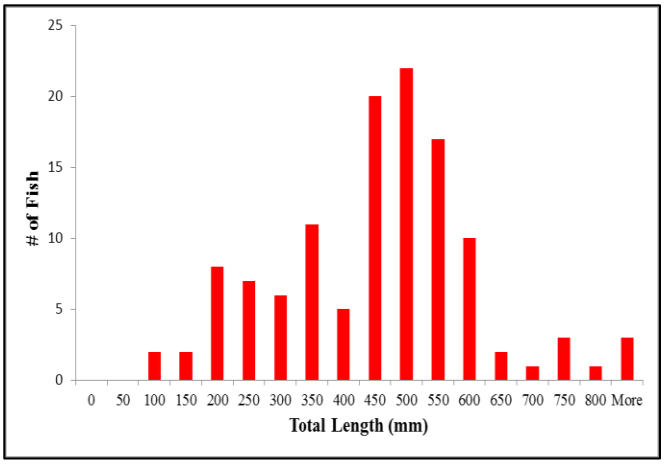


Figure 6. Length frequency for burbot.



Figure 7. A captured burbot with a smaller burbot in its mouth.

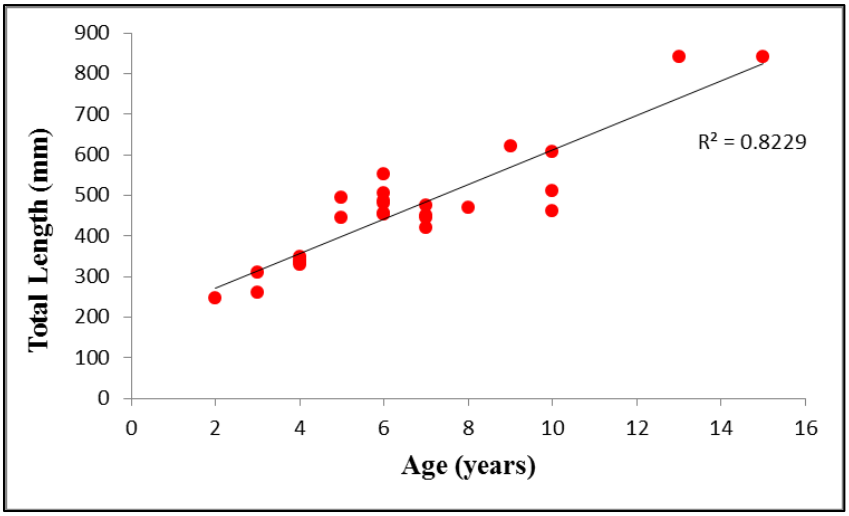


Figure 8. Length at age for dissected burbot.

Lake chub

Lake chubs (chub) were the fifth most abundant species captured (n=110), and were captured primarily in minnow traps and beach seines. In Alaska, lake chubs are known to exist only in the Yukon River and its tributaries (Mecklenberg et al. 2002). Little is known about them other than they spawn in the spring and summer; in British Columbia, Canada, they are thought to mature at age three or four, and do not survive past age 5 (Morrow 1980). Their diet consists primarily of freshwater crustaceans and zooplankton (Morrow 1980). On the Koyukuk River they are likely an important prey species for burbot, northern pike, and sheefish. The mean FL of lake chubs was 87 mm (range = 30–113; Figure 9). Four lake chubs were dissected; their stomachs contained partially digested insect larvae. Unfortunately, we were not able to collect any otoliths; however

we did classify one fish as an immature female (108 mm).

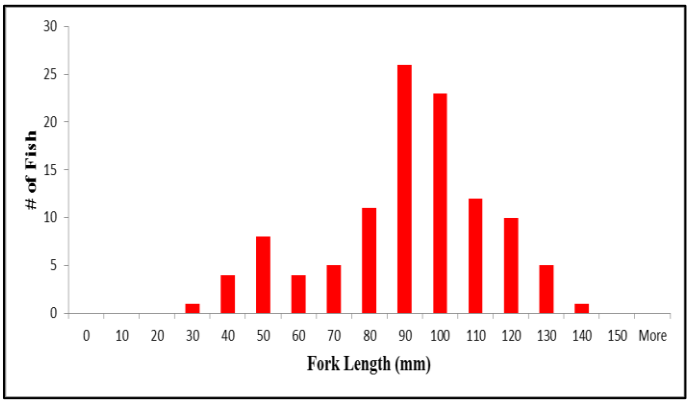


Figure 9. Length frequency for lake chub.

Slimy Sculpin

Slimy sculpin (SS) (n=103) are distributed in large numbers throughout the northern parts of North America, Canada, and Russia (Scott and Crossman 1973). There is little known about this species other than they spawn in the spring following break up, they are relatively sedentary, and typically eat aquatic insect larvae. One hundred three slimy sculpin were captured; the mean TL was 49 mm (range= 20–110 mm; Figure 10). On the Koyukuk River they appear to be an important prey species to burbot and northern pike, often showing up in dissected stomachs of those species.

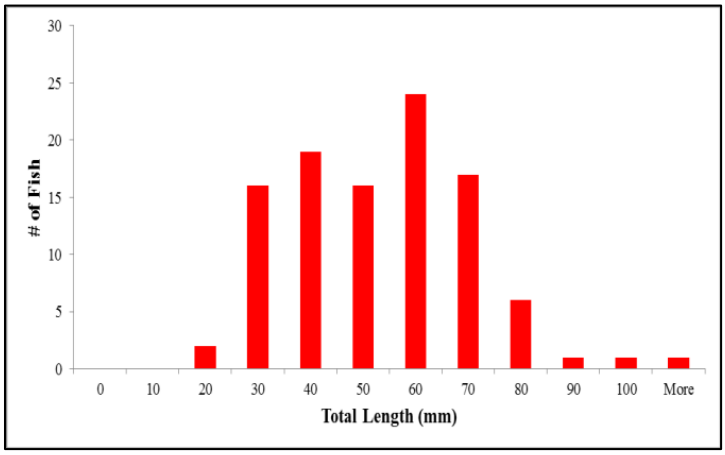


Figure 10. Length frequency for slimy sculpin.

Northern pike

Northern pike (NP) are an important subsistence fish often harvested in the fall along with whitefish (Andersen 2007). They are a voracious predator common to the Yukon River and its tributaries. In general, they are considered a sedentary fish and in the summer they are often found residing in clear, warm, heavily vegetated areas of rivers (Scott and Crossman 1973). Thirty fish were captured and had a mean length of 391 mm

(range = 55–705 mm; Figure 11). Sixteen fish were dissected: of those 31.25% had empty stomachs; the remaining stomachs contained various fish species (whitefish, Arctic grayling, and juvenile northern pike), insects, and shrews (Figure 12). During the fall, two pike were classified as mature and likely to spawn the following spring; their lengths were 655 and 665 mm, and their respective GSIs were 2.86% and 2.12%. Otoliths were aged to conduct length at age analysis, and based on a linear regression there was a positive correlation between TL and age (Figure 13).

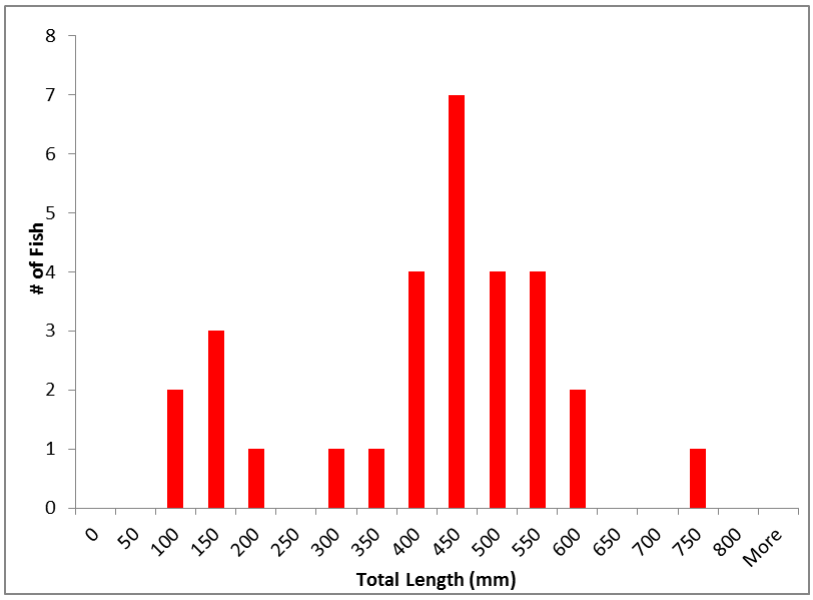


Figure 11. Length frequency for northern pike.



Figure 11. A dissected northern pike with a partially digested round whitefish in its stomach.

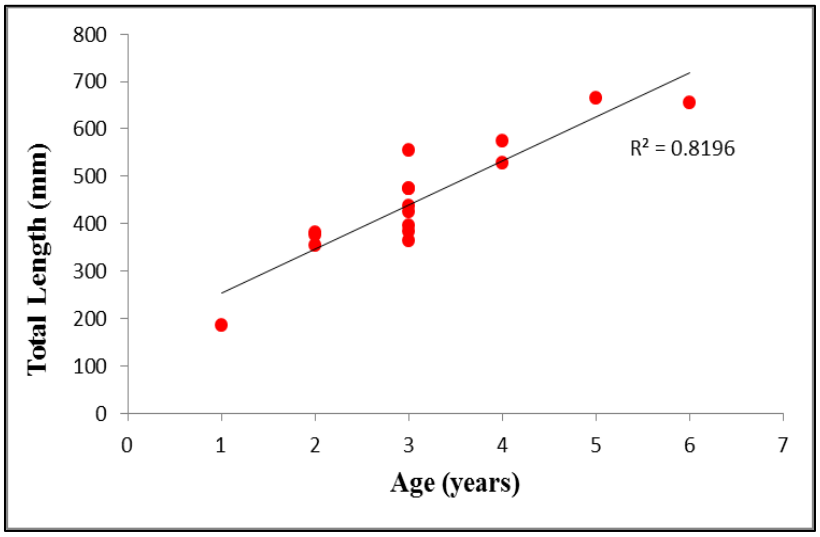


Figure 12. Length at age for dissected northern pike.

Round whitefish

Round whitefish (RWF) were the most abundant whitefish captured and sampled (n= 180), with the majority being juveniles captured in beach seine sets. Round whitefish are found throughout the lakes and rivers of interior Alaska and are a common prey species of northern pike, burbot, and sheefish. Like other species of whitefish they spawn in the fall. The mean FL of sampled round whitefish was 180 mm (range= 25–390 mm; Figure 14). Ten round whitefish were dissected and their stomachs were either empty or contained chironomids and/or vegetation. Given that their mean GSI was 0.90%, we assumed that they were not spawning in fall 2014. Otoliths were aged to conduct length at age analysis, and based on a linear regression there was a positive correlation between FL and age (Figure 15).

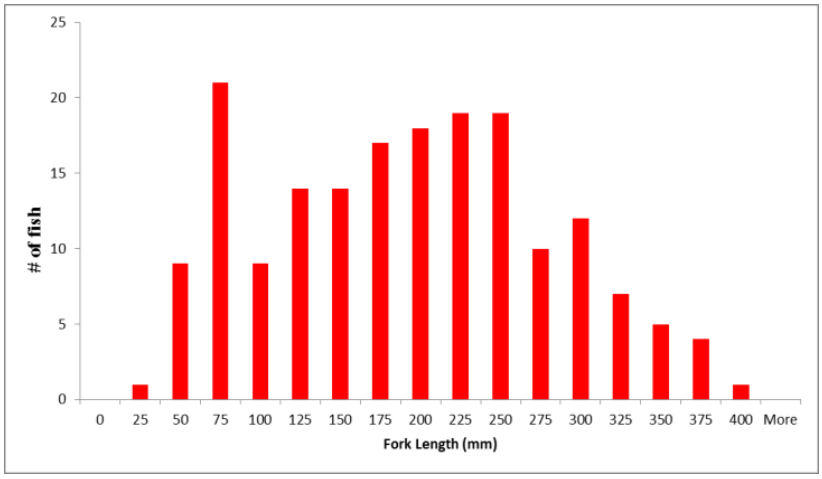


Figure 13. Length at age for dissected round whitefish.

Humpback whitefish, Broad whitefish and Sheefish

Humpback whitefish (HWF), broad whitefish (BWF), and sheefish are important subsistence fishes throughout the Yukon drainage, including both the Koyukuk and Alatna rivers. They (including least cisco) all exist in both freshwater and anadromous forms with the current upper extent of documented anadromy occurring on the Alatna River (Brown et al. 2007, Brown and Burr 2012).

Humpback whitefish (HWF) are bottom feeders, and based on dissections of nine HWF their diet contained snails, beetles, vegetation, and mud. Five fish that were examined were spawning ready (Figure 16) with an average length of 410.2 mm, and an average GSI of 11.87%, which, based on previous work done on the Chatanika River, could produce approximately 20,000 eggs/mature fish (Dupuis and Sutton 2011). One immature female was dissected (length=235 mm). Otoliths were aged to conduct length at age analysis, and based on a linear regression there was a negligible correlation between FL and age (Figure 15).

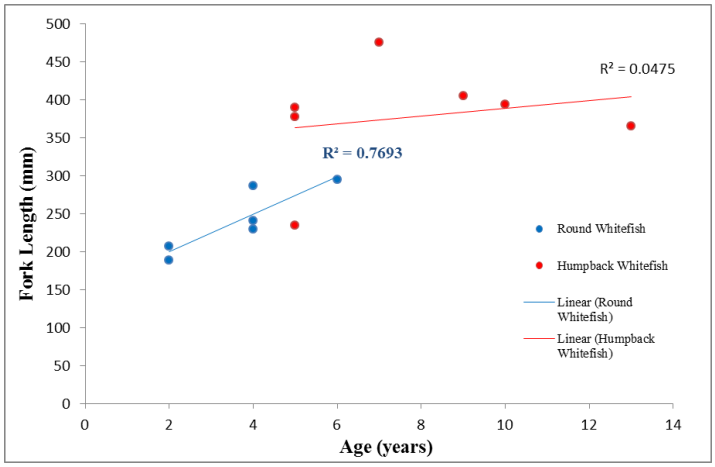


Figure 14. Length at age for dissected round whitefish, and humpback whitefish .



Figure 15. A humpback whitefish being dissected, its eggs are on the scale to determine the GSI.

Only three broad whitefish and three sheefish were captured and all were implanted with radio tags, with the intention of identifying spawning grounds.

Chinook salmon

During the summer event 23 juvenile Chinook salmon (KS) were captured, primarily with beach seines (Figures 17 and 18). The Koyukuk River is a catalogued anadromous water body and although the main stem of the Koyukuk River is not catalogued for KS spawning habitat, it serves as a migration route for spawners using the North Fork, Wild, Alatna, and Jim rivers.



Figure 16. A beach seine being pulled into shore.



Figure 17. A juvenile Chinook salmon captured in a beach seine.

Aquatic Sampling

Water Chemistry

Throughout the study area water, chemistry parameters were measured to assess general fish habitat conditions. Temperature, conductivity, and pH were measured using a HACH HQ40d multi-parameter meter, and a surface grab sample was obtained for turbidity (Figure 19). Water temperature in the spring was warmer that what was observed in the fall. Conductivity was lower in spring than what was observed in the fall, and pH was similar for both sampling events.

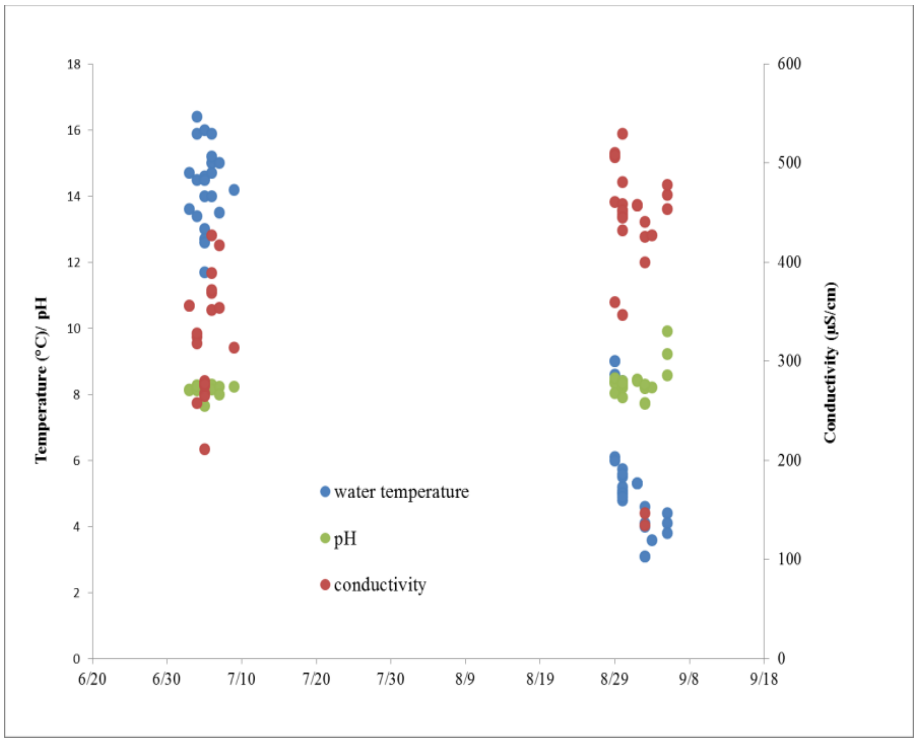


Figure 18. Water chemistry data taken from beach seine sites throughout the study area during both the summer and fall events.

Qualitative and Quantitative Trophic Level Productivity

Four sites were examined for aquatic productivity (Table 3). Aquatic productivity sampling consisted of invertebrate sampling using a D-net, plankton tow, and a petite ponar dredge to collect invertebrates in the substrate. Overall the density and diversity of samples collected was low. This observation was likely influenced by the high water events that were encountered during the spring sampling event. The observed low density of invertebrates may potentially explain the relationship of length at age for Arctic grayling, a species that is primarily an insectivore.

Table 3. Location of sample sites and factors measured.

Sample Site	Temp. (°C)	Conductivity (µS/cm)	pH	Turbidity (NTU)	Invertebrate Taxon	Invertebrate #
Wild River	16.4	258	8.25	4.14	Chironomidae	2
					Limnephila spp.	1
					Acarina	3
Malemute Fork John R.	14.2	314	8.24	8.13	Chironomidae	13
					Acarina	1
					Oligochaeta	1
Mainstem John R.	13.5	354	8	45.4	Chironomidae	11
					Lophognathella spp.	1
					Unk. Ephemeropteran	1
					Unk. Plecopteran	1
					Cyclopoida	1
					Misc. terrestrial	1
					Terrestrial diptera	2
Middle/ N. Fork Confluence of Koyukuk R.	14.5	211.3	8	92.8	Chironomidae	1
					Bosmina spp.	1
					Simulium spp.	1

Summary

Limited sampling due to high water events within the Upper Koyukuk River drainage yielded low catches of several species from the lack of effectiveness of several gear types. Although sampling was limited, the fish assemblage was consistent of those found throughout the Yukon River drainage. Arctic grayling were captured in the mainstem of both the Koyukuk and John rivers, despite the refuge offered by off-channel habitat, which would likely have been more productive; this habitat choice may explain the negative correlation between length and age that was observed. Lake chubs, juvenile whitefish, and juvenile Chinook salmon were using the nearshore areas as would be expected of fish migrating to rearing/over wintering habitat. Northern pike, burbot, and longnose suckers were found in their typical habitats. A few sheefish and broad whitefish, and several humpback whitefish were captured and implanted with radio-tags by the Division of Sport Fish. From fall radio tracking flights, these fish were found congregating near the mouth of the John River, and the confluence of the North Fork and mainstem Koyukuk River (M. Albert, personal communication). Currently, sheefish are the only documented anadromous fish present on the Koyukuk River, and not the John River where three were caught. Future studies should focus on capturing both broad whitefish and humpback whitefish in the fall to use otolith microchemistry to determine anadromy.

Identification of areas used by fish within this project area during this project will allow more thorough and accurate assessments of potential impacts of road siting and construction during the NEPA process. Identification of fish species and their life stages in individual streams will also provide the necessary information to evaluate and design crossing structures such as bridges or culverts. It will also provide information needed to design effective water intake structures needed for water withdrawal during construction and maintenance of the road.

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Appendix A. Capture gear types, dates, locations, and species captured during the July 2014 sampling event.

Set #	Gear	Date Set	Time set	Date pulled	Time pulled	Lat.	Long.	Fish	Size (mm)	Comments
1a (up)	fyke	7/1/2014	1730	7/2/2014	1730			NP	425	Wild R.- flooded out
1b (down)	fyke	7/1/2014	1945	7/2/2014	1730			0		Wild R.- flooded out
2	hoop	7/2/2014	1015	7/3/2014	1720	66°56.959	151°28.848	0		mouth of Wild R.
4	minnow	7/2/2014	1045	7/3/2014	1630	66°57.561	151°26.426	0		clear water slough
5	minnow	7/2/2014	1048	7/3/2014	1630	66°57.544	151°26.501	0		clear water slough
6	minnow	7/2/2014	1209	7/7/2014	1630	66°59.594	151°24.615	0		
7	minnow	7/2/2014	1210	7/7/2014	1630	66°59.601	151°24.587	0		
8	minnow	7/2/2014	1210	7/7/2014	1630	66°59.624	151°24.543	0		
10	Gillnet	7/4/2014	1402	7/4/2014	1800	67°01.589	151°49.127	NP	290	lots of debris floating down
								NP	540	radio tagged
11a (up)	fyke	7/4/2014	1754	7/5/2014	1150	67°02.279	151°49.196	0		
11b(down)	fyke	7/4/2014	1754	7/5/2014	1150	67°02.279	151°49.196	AG	214	
								AG	257	
12	gillnet	7/5/2014	1255	7/5/2014	1430	67°03.742	151°49.984	LNS	390	
								LNS	230	
								LNS	230	
								AG	254	mort
13	beach seine	7/5/2014	1315			67°04.021	151°52.458	chub	75	
								chub	68	
								UNK	25	
14	beach seine	7/5/2014	1416			67°03.651	151°51.172	AG	75	
								AG	75	
								AG	152	mort
15	beach seine	7/5/2014	1457			67°02.202	151°48.536	SS	105	
								AG	82	
16	beach seine	7/5/2014	15:15			67°02.067	151°47.249	chub	82	muddy bar
17	beach seine	7/5/2014	15:50			67°01.478	151°49.527	AG	44	
								AG	84	
18	beach seine	7/6/2014	16:30			67°02.053	151°11.708	0		
19	beach seine	7/6/2014	17:00			67°01.550	151°07.876	BB	260	
20	beach seine	7/6/2014	17:15			67°02.198	151°07.738	chub	87	
								AG	42	
21	beach seine	7/6/2014	17:30			67°03.056	151°06.838	0		
22	beach seine	7/6/2014	18:00			67°02.566	151°05.446	AG	40	
								AG	40	
								AG	240	
								SS	51	
								chub	40	
23	hoop	7/6/2014	19:30	7/7/2014	12:35	67°03.047	151°06.052	0		back eddy
24	minnow	7/6/2014	19:47	7/7/2014	13:13	67°02.984	151°07.097	0		
25	hoop	7/6/2014	19:47	7/7/2014	13:13	67°02.984	151°07.097	0		
26	hoop	7/6/2014	19:55	7/7/2014	13:30	67°02.206	151°07.832	SS	77	
27	minnow	7/6/2014	20:15	7/7/2014	12:30	67°02.236	151°07.808	0		
28	minnow	7/6/2014	20:30	7/7/2014	12:45	67°02.873	151°06.150	chub	89	
29	minnow	7/6/2014		7/7/2014	13:24	67.02655	151.1248	0		
30	minnow	7/6/2014		7/7/2014	13:45	67.02548	151.1431	0		
31	hoop	7/6/2014		7/7/2014	13:45	67.02548	151.1431	NP	370	
32	hoop	7/6/2014		7/7/2014	13:50	67.02465	151.1364	BB	570	radio tagged
								BB	825	radio tagged
33	minnow	7/6/2014		7/7/2014	15:00	67.01967	151.1549	0		
34	minnow	7/6/2014		7/7/2014	15:04	67.02059	151.1552	SS	45	
								SS	52	
								SS	50	
								SS	45	
35	minnow	7/6/2014		7/7/2014	14:59	67.02164	151.164	0		
36	hoop	7/6/2014		7/7/2014	15:21	67.03616	151.1884	0		
37	hoop	7/6/2014		7/7/2014	15:21	67.03616	151.1884	chub	111	
38	minnow	7/6/2014		7/7/2014	15:21	67.03616	151.1884	SS	36	
39	minnow	7/6/2014		7/7/2014	15:33	66.02814	151.1967	0		
40	fyke (down)	7/8/2014	16:20	7/9/2014	11:15	66.94949	151.4809	KS	59	
								AG	244	
								SS	67	
41	fyke (up)	7/8/2104	16:20	7/9/2014	11:25			SS	89	
								SS	74	
								KS	51	
								AG	266	
42	fyke (up)	7/9/2014	11:25	7/10/2014	11:30			KS	50	
43	fyke (down)	7/9/2014	11:15	7/10/2014	11:35			NP	175	

Set #	Gear	Date Set	Time set	Date pulled	Time pulled	Lat.	Long.	Fish	Size (mm)	Comments
								NP	387	
44	fyke (up)	7/10/2014	11:30	7/11/2014	13:15	Wild		0		
45	fyke (down)	7/10/2014	11:35	7/11/2014	13:15			NP		escaped
46	minnow	7/10/2014	12:07	7/11/2014	13:00	66.97939	151.4246	0		
47	minnow	7/11/2014	13:16	7/12/2014	13:00	66.97939	151.4246	0		
48	hoop (small)	7/10/2014	12:09	7/11/2014	13:02	66.97942	151.4231	0		
49	hook & line	7/11/2014				Wild		AG	325	eggs present
50	minnow	7/10/2014	13:44	7/11/2014	11:30	Clear		KS	52	
51	minnow	7/10/2014	13:44	7/11/2014	10:30	Clear		chub	81	
								chub	96	
51	hoop (small)	7/10/2014	13:44	7/11/2014	10:45			0		
52	hoop (large)	7/10/2014	14:07	7/11/2014	10:20			0		
53	hook & line	7/11/2014	11:00					0		
54	beach seine	7/11/2014	15:00					SS	38	
55	beach seine	7/10/2014	15:20					AG	70	
56	hoop	7/10/2014	15:39	7/11/2014	11:32			chub	100	
57	minnow	7/10/2014	15:45	7/11/2014	11:42			SS	40	
								SS	60	
								SS	61	
								SS	72	
58	beach seine	7/10/2014	16:00					0		
59	hoop	7/10/2014	16:10	7/11/2014	11:58			SS	93	
								SS	93	
								chub	91	
								chub	78	
								chub	95	
								KS	50	
60	minnow	7/10/2014	16:15	7/11/2014	11:57			chub	87	
61	seine	7/10/2014	16:45					SS	61	
								SS	51	
								SS	48	
								AG	48	
								KS	43	
								RWF	90	
62	minnow	7/10/2014	17:11	7/11/2014	12:32			chub	82	
								SS	50	
								SS	53	
63	minnow	7/10/2014	17:11	7/11/2014	12:36			chub	76	
								chub	81	
								chub	81	
								chub	51	
								chub	46	
								chub	47	
								chub	46	
								chub	54	
								chub	61	
								SS	52	
								SS	46	
								SS	56	
								SS	57	
								SS	51	
								SS	66	
								SS	51	
								SS	50	
64	fyke (up)	7/11/2014	13:00	7/12/2014	13:15			0		
65	fyke (down)	7/11/2014	13:00	7/12/2014	13:15			SS	55	
								SS	65	
								SS	67	
								SS	44	
								SS	69	
								SS	64	
								SS	44	
								SS	35	
								KS	64	
								KS	55	
								KS	60	
								KS	59	
								KS	61	
								KS	50	
								lamprey	193	
66	beach seine	7/11/2014						0		
67	hoop (large)	7/11/2014	17:15	7/12/2014	12:20			BB	842	
68	hoop (large)	7/11/2014	12:15	7/12/2014	13:33			0		hi grade
69	hoop (large)	7/11/2014	12:40	7/12/2014	13:46			0		hi grade

Set #	Gear	Date Set	Time set	Date pulled	Time pulled	Lat.	Long.	Fish	Size (mm)	Comments
70	hoop (large)	7/11/2014	13:35	7/12/2014	11:30			NP	588	radio tagged
71	hoop (large)	7/11/2014	14:00	7/12/2014	14:00			BB	774	radio tagged
72	hoop (large)	7/11/2014	15:56	7/12/2014	15:56			SS	379	used for bait
73	hoop (large)	7/12/2014	16:09	7/13/2014	12:15	66.93014	151.5998	BB	450	mort
								BB	592	radio tagged
								BB	518	mort
								BB	408	
74	hoop (large)	7/12/2014	16:25	7/13/2014				BB	470	mortality
75	hoop (large)	7/12/2014	16:40	7/13/2014	11:30	66.92708	151.6066	BB	499	radio tagged
76	hoop (large)	7/12/2014	17:05	7/13/2014	11:18			SS	300	
								BB	334	mort
78	hoop (large)	7/12/2014	17:15	7/13/2014	10:45	66.9211	151.622	BB	460	radio tagged
								SS	410	
79	hook & line	7/12/2014	16:09					NP	349	

AG= Arctic grayling, BB= burbot, chub= lake chub, KS= Chinook salmon, LNS= longnose sucker, NP= northern pike, RWF= round whitefish, SS= slimy sculpin, UNK= unknown

Appendix B. Capture gear types, dates, locations, and species captured during the August 2014 sampling event.

Set #	Gear	Date Set	Time set	Date pulled	Time pulled	Lat.	Long.	Fish	Size (mm)	Comments
1a (up)	fyke	7/1/2014	1730	7/2/2014	1730			NP	425	Wild R.- flooded out
1b (down)	fyke	7/1/2014	1945	7/2/2014	1730			0		Wild R.- flooded out
2	hoop	7/2/2014	1015	7/3/2014	1720	66°56.959	151°28.848	0		mouth of Wild R.
4	minnow	7/2/2014	1045	7/3/2014	1630	66°57.561	151°26.426	0		clear water slough
5	minnow	7/2/2014	1048	7/3/2014	1630	66°57.544	151°26.501	0		clear water slough
6	minnow	7/2/2014	1209	7/7/2014	1630	66°59.594	151°24.615	0		
7	minnow	7/2/2014	1210	7/7/2014	1630	66°59.601	151°24.587	0		
8	minnow	7/2/2014	1210	7/7/2014	1630	66°59.624	151°24.543	0		
10	Gillnet	7/4/2014	1402	7/4/2014	1800	67°01.589	151°49.127	NP	290	lots of debris floating down
								NP	540	radio tagged
11a (up)	fyke	7/4/2014	1754	7/5/2014	1150	67°02.279	151°49.196	0		
11b(down)	fyke	7/4/2014	1754	7/5/2014	1150	67°02.279	151°49.196	AG	214	
								AG	257	
12	gillnet	7/5/2014	1255	7/5/2014	1430	67°03.742	151°49.984	LNS	390	
								LNS	230	
								LNS	230	
								AG	254	mort
13	beach seine	7/5/2014	1315			67°04.021	151°52.458	chub	75	
								chub	68	
								UNK	25	
14	beach seine	7/5/2014	1416			67°03.651	151°51.172	AG	75	
								AG	75	
								AG	152	mort
15	beach seine	7/5/2014	1457			67°02.202	151°48.536	SS	105	
								AG	82	
16	beach seine	7/5/2014	15:15			67°02.067	151°47.249	chub	82	muddy bar
17	beach seine	7/5/2014	15:50			67°01.478	151°49.527	AG	44	
								AG	84	
18	beach seine	7/6/2014	16:30			67°02.053	151°11.708	0		
19	beach seine	7/6/2014	17:00			67°01.550	151°07.876	BB	260	
20	beach seine	7/6/2014	17:15			67°02.198	151°07.738	chub	87	
								AG	42	
21	beach seine	7/6/2014	17:30			67°03.056	151°06.838	0		
22	beach seine	7/6/2014	18:00			67°02.566	151°05.446	AG	40	
								AG	40	
								AG	240	
								SS	51	
								chub	40	
23	hoop	7/6/2014	19:30	7/7/2014	12:35	67°03.047	151°06.052	0		back eddy
24	minnow	7/6/2014	19:47	7/7/2014	13:13	67°02.984	151°07.097	0		
25	hoop	7/6/2014	19:47	7/7/2014	13:13	67°02.984	151°07.097	0		
26	hoop	7/6/2014	19:55	7/7/2014	13:30	67°02.206	151°07.832	SS	77	
27	minnow	7/6/2014	20:15	7/7/2014	12:30	67°02.236	151°07.808	0		
28	minnow	7/6/2014	20:30	7/7/2014	12:45	67°02.873	151°06.150	chub	89	
29	minnow	7/6/2014		7/7/2014	13:24	67.02655	151.1248	0		
30	minnow	7/6/2014		7/7/2014	13:45	67.02548	151.1431	0		
31	hoop	7/6/2014		7/7/2014	13:45	67.02548	151.1431	NP	370	
32	hoop	7/6/2014		7/7/2014	13:50	67.02465	151.1364	BB	570	radio tagged
								BB	825	radio tagged
33	minnow	7/6/2014		7/7/2014	15:00	67.01967	151.1549	0		
34	minnow	7/6/2014		7/7/2014	15:04	67.02059	151.1552	SS	45	
								SS	52	
								SS	50	
								SS	45	
35	minnow	7/6/2014		7/7/2014	14:59	67.02164	151.164	0		
36	hoop	7/6/2014		7/7/2014	15:21	67.03616	151.1884	0		
37	hoop	7/6/2014		7/7/2014	15:21	67.03616	151.1884	chub	111	
38	minnow	7/6/2014		7/7/2014	15:21	67.03616	151.1884	SS	36	
39	minnow	7/6/2014		7/7/2014	15:33	66.02814	151.1967	0		
40	fyke (down)	7/8/2014	16:20	7/9/2014	11:15	66.94949	151.4809	KS	59	
								AG	244	
								SS	67	
41	fyke (up)	7/8/2104	16:20	7/9/2014	11:25			SS	89	
								SS	74	
								KS	51	
								AG	266	
42	fyke (up)	7/9/2014	11:25	7/10/2014	11:30			KS	50	
43	fyke (down)	7/9/2014	11:15	7/10/2014	11:35			NP	175	
44	fyke (up)	7/10/2014	11:30	7/11/2014	13:15	Wild		0		
45	fyke (down)	7/10/2014	11:35	7/11/2014	13:15			NP		escaped
46	minnow	7/10/2014	12:07	7/11/2014	13:00	66.97939	151.4246	0		
47	minnow	7/11/2014	13:16	7/12/2014	13:00	66.97939	151.4246	0		

Set #	Gear	Date Set	Time set	Date pulled	Time pulled	Lat.	Long.	Fish	Size (mm)	Comments
48	hoop (small)	7/10/2014	12:09	7/11/2014	13:02	66.97942	151.4231	0		
49	hook & line	7/11/2014				Wild		AG	325	eggs present
50	minnow	7/10/2014	13:44	7/11/2014	11:30	Clear		KS	52	
51	minnow	7/10/2014	13:44	7/11/2014	10:30	Clear		chub	81	
								chub	96	
51	hoop (small)	7/10/2014	13:44	7/11/2014	10:45			0		
52	hoop (large)	7/10/2014	14:07	7/11/2014	10:20			0		
53	hook & line	7/11/2014	11:00					0		
54	beach seine	7/11/2014	15:00					SS	38	
55	beach seine	7/10/2014	15:20					AG	70	
56	hoop	7/10/2014	15:39	7/11/2014	11:32			chub	100	
57	minnow	7/10/2014	15:45	7/11/2014	11:42			SS	40	
								SS	60	
								SS	61	
								SS	72	
58	beach seine	7/10/2014	16:00					0		
59	hoop	7/10/2014	16:10	7/11/2014	11:58			SS	93	
								SS	93	
								chub	91	
								chub	78	
								chub	95	
								KS	50	
60	minnow	7/10/2014	16:15	7/11/2014	11:57			chub	87	
61	seine	7/10/2014	16:45					SS	61	
								SS	51	
								SS	48	
								KS	43	
								RWF	90	
62	minnow	7/10/2014	17:11	7/11/2014	12:32			chub	82	
								SS	50	
								SS	53	
63	minnow	7/10/2014	17:11	7/11/2014	12:36			chub	76	
								chub	81	
								chub	81	
								chub	51	
								chub	46	
								chub	47	
								chub	46	
								chub	54	
								chub	61	
								SS	52	
								SS	46	
								SS	56	
								SS	57	
								SS	51	
								SS	66	
								SS	51	
								SS	50	
64	fyke (up)	7/11/2014	13:00	7/12/2014	13:15			0		
65	fyke (down)	7/11/2014	13:00	7/12/2014	13:15			SS	55	
								SS	65	
								SS	67	
								SS	44	
								SS	69	
								SS	64	
								SS	44	
								SS	44	
								SS	35	
								KS	64	
								KS	55	
								KS	60	
								KS	59	
								KS	61	
								KS	50	
								lamprey	193	
66	beach seine	7/11/2014						0		
67	hoop (large)	7/11/2014	17:15	7/12/2014	12:20			BB	842	
68	hoop (large)	7/11/2014	12:15	7/12/2014	13:33			0		hi grade
69	hoop (large)	7/11/2014	12:40	7/12/2014	13:46			0		hi grade
70	hoop (large)	7/11/2014	13:35	7/12/2014	11:30			NP	588	radio tagged
71	hoop (large)	7/11/2014	14:00	7/12/2014	14:00			BB	774	radio tagged
72	hoop (large)	7/11/2014	15:56	7/12/2014	15:56			SS	379	used for bait
73	hoop (large)	7/12/2014	16:09	7/13/2014	12:15	66.93014	151.5998	BB	450	mort
								BB	592	radio tagged
								BB	518	mort
								BB	408	
74	hoop (large)	7/12/2014	16:25	7/13/2014				BB	470	mortality

Set #	Gear	Date Set	Time set	Date pulled	Time pulled	Lat.	Long.	Fish	Size (mm)	Comments
75	hoop (large)	7/12/2014	16:40	7/13/2014	11:30	66.92708	151.6066	BB	499	radio tagged
76	hoop (large)	7/12/2014	17:05	7/13/2014	11:18			SS	300	
								BB	334	mort
78	hoop (large)	7/12/2014	17:15	7/13/2014	10:45	66.9211	151.622	BB	460	radio tagged
								SS	410	
79	hook & line	7/12/2014	16:09					NP	349	

AG= Arctic grayling, BB= burbot, chub= lake chub, LC= least cisco. LNS= longnose sucker, NP= northern pike, RWF= round whitefish, SS= slimy sculpin

Appendix C. Biological data collected from dissected fish from both the spring and fall sampling events.

								Stomach			
Sample	Species	Fork (mm)	Weight (g)	Sex	Maturity	Gonad Weight (g)	Age	% Full	Contents	GSI	Comments
1	AG	342	480	F	2	10	5	100	ants/flies/beetles/veg	2.08%	
2	BB	462	478	F	3	6	10	0		1.26%	
3	AG	225	114	F	1			25	veg/beetles	0.00%	no oto
4	AG	233	126	F	1		7	25	veg/beetles	0.00%	
5	LNS	446	676	F	3	8		0		1.18%	no oto
6	AG	222	110	F	2		6	75	veg/beetles	0.00%	
7	AG	240	152	F	2			25	veg/beetles	0.00%	no oto
8	AG	240	156	M	2		7	25	veg/beetles	0.00%	
9	AG	182	62	F	1		4	20	veg/beetles/flies	0.00%	
10	NP	355	268	M	2		2	0		0.00%	
11	NP	380	368	F	1		2	0		0.00%	
12	BB	420	464	F	1		7	5	UNK	0.00%	
13	AG	350	372	F	3	6	6	85	veg/beetles/ants	1.61%	
14	AG	340	424	F	3	6	5	80	veg/beetles	1.42%	
15	AG	385	540	F	3	10	3	100	veg/beetles/ants	1.85%	
16	AG	196	68	M	1			65	veg/beetles/ants	0.00%	no oto
17	AG	176	46	U	UNK			80	veg/ants	0.00%	no oto
18	BB	247	78	U	UNK			0		0.00%	no oto
19	RWF	207	80	M	1		2	20	nymphs/UNK	0.00%	
20	RWF	189	48	F	1		2	20	veg	0.00%	
21	NP	555	1060	M	1		3	20	sculpins/bugs	0.00%	
22	NP	436	602	M	1		3	30	dragonfly larvae/nymphs/veg	0.00%	
23	NP	475	730	M	1		3	60	mayflies/sculpins	0.00%	
24	NP	375	340	U	UNK		2	70	small digested fish	0.00%	
25	NP	396	428	M	1		3	10	white insects	0.00%	
26	NP	527	1054	M	1		4	30	insects/UNK	0.00%	roundworms
27	AG	303	312	M	1		8	30	beetles	0.00%	
28	AG	210	102	F	1		7	0		0.00%	
29	NP	384	362	M	1		3	0		0.00%	
30	AG	260	214	M	1		6	50	beetles/digested fish	0.00%	broken oto
31	LNS	407	694	F	4	16		0		2.31%	
32	LNS	397	644	F	4	46	7	0		7.14%	
33	LNS	185	56	M	1			0		0.00%	
34	LNS	290	248	M	2		8	0		0.00%	
35	NP	575	1116	M	3		4	0		0.00%	
36	NP	425	634	M	3		3	0		0.00%	
37	NP	475	620	M	2		3	10	shrew	0.00%	
38	BB	310	156	M	2		3	40	burbot	0.00%	
39	chub	85	6	U	UNK			10	UNK	0.00%	no oto
40	chub	78	4	U	UNK			11	UNK	0.00%	no oto
41	AG	350	264	F	1			10	veg/insects	0.00%	
42	BB	350	152	M	1		4	10	nymphs/digested fish	0.00%	
43	RWF	287	222	F	3	2	4	0		0.90%	
44	chub	108	12	F	2			0		0.00%	no oto
45	NP	363	362	M	2		3	10	UNK	0.00%	
46	NP	185	50	M	2		1	30	digested fish	0.00%	
47	AG	240	156	F	2		5	30	UNK	0.00%	
48	BB	261	102	M	2		3	60	sculpins	0.00%	no oto
49	chub	83	6	U	UNK			75	insect larvae	0.00%	
50	BB	475	515	M	3		7	0		0.00%	
51	AG	245	125	M	2		4	80	yellow jacket, flies, veg	0.00%	broken oto
52	AG	190	56	F	2			30	flies/beetles/veg	0.00%	no oto
53	RWF	116	14	F	2			50	veg/UNK	0.00%	no oto
54	HWF	377	626	M	3		5	40	snails/beetles	0.00%	
55	HWF	412	846	F	3	16		30	UNK	1.89%	
56	BB	842	4442	F	3	28	15	0		0.63%	
57	BB	622	1132	F	3	8	9	0		0.71%	
58	BB	470	634	F	3	6	8	0		0.95%	
59	BB	511	744	F	3	4	10	0		0.54%	
60	BB	455	414	M	2		6	5	juvenile burbot	0.00%	
61	BB	335	196	F	3	2	4	0		1.02%	
62	RWF	231	114	M	1			0		0.00%	
63	RWF	229	94	M	1		4	0		0.00%	
64	RWF	241	114	M	1		4	10	veg/UNK	0.00%	
65	RWF	261	166	M	3			5	veg/UNK	0.00%	
66	RWF	295	186	F	2		6	0		0.00%	

								Stomach			
Sample	Species	Fork (mm)	Weight (g)	Sex	Maturity	Gonad Weight (g)	Age	% Full	Contents	GSI	Comments
67	NP	665	2730	F	3	78	5	85	mature RWF male	2.86%	
68	BB	608	1110	F	3	30	10	0		2.70%	
69	HWF	405	784	F	4	112	9	0		14.29%	
70	AG	325	318	M	3		6	80	shrew/UNK	0.00%	
71	AG	310	300	F	4	6	5	5	veg	2.00%	
72	NP	655	2450	F	3	52	6	90	mature RWF female	2.12%	
73	BB	495	568	M	3		5	0		0.00%	
74	BB	340	210	M	2		4	0		0.00%	
75	HWF	365	462	F	4	84	13	0		18.18%	
76	RWF	330	246	F	3	2		0		0.81%	
77	HWF	235	134	F	2		5	5	UNK	0.00%	
78	BB	452	444	M	1		6	0		0.00%	
79	BB	445	394	F	3	2	7	5	digested fish/UNK	0.51%	
80	BB	450	482	M	3	4	7	8	digested fish/UNK	0.83%	
81	BB	482	574	F	3	2	6	0		0.35%	
82	HWF	475	1340	F	4	168	7	1	water beetle	12.54%	
83	BB	330	172	F	3	2	4	100	4 lake chubs	1.16%	
84	BB	446	490	M	3		5	75	hair/UNK	0.00%	
85	BB	485	604	F	3	2	6	75	shrew/ sculpin	0.33%	
86	AG	340	372	M	2		5	30	cranberry/ nematode/veg	0.00%	
87	HWF	382	724	M	2			5	beetles/UNK	0.00%	
88	HWF	394	818	F	3	102	10	50	mud/snails	12.47%	
89	BWF	540	2478	F	3	498	12	0		20.10%	
90	HWF	390	670	M	2		5	5	worms (?)	0.00%	
91	BB	840	3976	F	3	72	13	95	burbot/shrew	1.81%	
92	BB	552	704	F	3	16	6	25	RWF tails	2.27%	
93	BB	505	700	M	3		6	25	shrew	0.00%	

AG= Arctic grayling, BB= burbot, BWF- broad whitefish, chub= lake chub, HBF= humpback whitefish, LNS= longnose sucker, NP= northern pike, RWF= round whitefish, UNK= unknown
oto= otolith
Maturity: 1 = immature, 2= mature but not spawning this season, 3= mature and spawning this season, 4= mature and ripe, 5= spent (post-spawn), 6= reabsorbed eggs (did not spawn) (Moulton 2010).

Fishery Data Series No. 15-37

Fishery Investigations along the Proposed Ambler Road Corridor, 2014

by

Klaus G. Wuttig

Matthew L. Albert

April E. Behr

and

James W. Savereide

November 2015

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	ã
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	â
trademark	ä
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, c^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	³
harvest per unit effort	HPUE
less than	<
less than or equal to	£
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	a
probability of a type II error (acceptance of the null hypothesis when false)	b
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA REPORT NO. 15-37

FISHERY INVESTIGATIONS ALONG THE PROPOSED AMBLER ROAD CORRIDOR, 2014

by
Klaus G. Wuttig, Matthew L. Albert, April E. Behr, and James W. Savereide
Alaska Department of Fish and Game, Division of Sport Fish, Fairbanks

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

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Klaus G. Wuttig, Matthew L. Albert, April E. Behr, and James W. Savereide
Alaska Department of Fish and Game, Division of Sport Fish,
1300 College Road, Fairbanks, AK 99701-1599, USA

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ABSTRACT

In 2009, the state of Alaska began studying the feasibility of a potential road to the Ambler Mining District located in the northwestern region of the state. One potential route, the Brooks East Corridor, was selected for field studies in preparation for the National Environmental Policy Act (NEPA) process. The proposed corridor crosses several rivers including the Koyukuk and Alatna rivers located on the eastern end of the corridor near Bettles/Evansville and the Kobuk River on the western end of the corridor. In 2013, the Alaska Industrial Development and Export Authority (AIDEA) contracted the Alaska Department of Fish and Game (ADF&G) to conduct fisheries assessments in water bodies in and along the proposed corridor. This report describes 3 separate studies of various fisheries along the proposed corridor.

Study 1: This study was designed to collect information on the locations of seasonal habitats of freshwater fishes and their movements within the Upper Koyukuk River drainage in the vicinity of the proposed road crossing over a 14-month period using radiotelemetry. A total of 237 radio tags were deployed July–September 1, 2014 in the upper mainstem Koyukuk River and its tributaries around Bettles. The number of radio tags deployed by species included Arctic grayling *Thymallus arcticus* (*n* = 137), northern pike *Esox lucius* (*n* = 17), burbot *Lota lota* (n = 56), broad whitefish *Coregonus nasus* (*n* = 4), humpback *Coregonus pidschian* (*n* = 19), and sheefish *Stenodus leucicthyes* (*n* = 4). An emphasis was placed on Arctic grayling because they were assumed to be the most widespread and prevalent of all freshwater species, they can be readily sampled, and Arctic grayling commonly require a wide range of habitat types. A total of 11 aerial surveys were flown between August 2014 and August 2015. The seasonal locations and movements exhibited by all species demonstrated the importance of main channels, tributaries, and connected off-channel waters that support important habitats year round and underscored the dynamic nature of fish movements between these waters seasonally. Moreover, evidence indicated that discrete spawning stocks for all species exist throughout the study area, such as the spawning population of Arctic grayling in the Malamute Fork, as well as demonstrating the potential of spawning aggregations that are partially composed of fish migrating from outside the study area.

Study 2: This study was designed to collect baseline information about the current status of aquatic communities and habitat in lake systems along the proposed Ambler Road corridor. Four lakes (Birch Hill Lake, Heart Mountain Lake, Sleeper Lake, and Nutuvuki Lake) along the proposed Ambler Road corridor were sampled during the 2014 field season. Sampling was conducted July 7–13, 2014. Fish, water quality, and bathymetric data were collected. Northern pike were captured in all 4 study lakes. Northern pike ranged in size from 32 to 575 mm FL. One slimy sculpin (80 mm FL) was captured in Sleeper Lake; 1 burbot (35 mm TL), 3 lake trout (510-540 mm FL), and 1 ninespine stickleback (40 mm TL) were captured in Nutuvuki Lake. Recorded water temperature did not exceed 21° C in any of the lakes. Nutuvuki Lake and Sleeper Lake were clear with no color, Birch Hill Lake was ferric, and Heart Mountain Lake was humic. Secchi readings for all lakes ranged from 1.75 to 4.75 m and total alkalinity ranged from 11 to 130 mg CaCO3/L.

Study 3: This study used sonar techniques to enumerate the spawning abundance of sheefish *Stenodus leucichthys* in the Kobuk River. Two DIDSON (Dual frequency Identification Sonar) side-scanning sonars were used from 15 September through 6 October 2014 to enumerate outmigrating sheefish from their spawning grounds. All recorded images of sheefish migrating up- and downstream were counted for every hour of every day in the sampling period. The final count of outmigrating sheefish was 8,511. The spawning abundance was less than expected because high water and early ice flows made conditions such that the sonars could not be positioned in a manner that allowed for full coverage of the river bottom. A future sonar site was located that will allow for one sonar to be placed on each side of the river to ensure complete coverage of the river profile.

Key words: Ambler Road Corridor, Koyokuk River, John River, Wild River, North Fork Koyukuk River, Birch Hill Lake, Heart Mountain Lake, Sleeper Lake, Nutuvuki Lake, Kobuk River, Arctic grayling, burbot, northern pike, humpback whitefish, broad whitefish, sheefish, sonar, radiotelemetry.

INTRODUCTION

In 2009, the state of Alaska began studying the feasibility of a potential road to the Ambler Mining District located in the northwestern region of the state. The Alaska Department of Transportation and Public Facilities (ADOT&PF) was tasked with the preliminary work to identify, design, and potentially construct an access and transportation corridor that would connect the Dalton Highway (Haul Road) to the mining district. When ADOT&PF evaluated potential routes, there were initially eight corridors being considered; however, only one of those routes, the Brooks East Corridor, was selected for field studies in preparation for the National Environmental Policy Act (NEPA) process. The proposed corridor crosses several rivers including the Koyukuk and Alatna rivers located on the eastern end of the corridor near Bettles/Evansville and the Kobuk River on the western end of the corridor. In 2013, the Alaska Industrial Development and Export Authority (AIDEA) contracted the Alaska Department of Fish and Game (ADF&G) to conduct fisheries assessments in water bodies in and along the proposed corridor. A portion of that work included systematic sampling of fish and fish habitat within the Koyukuk, John, and Wild rivers and was conducted by the Division of Habitat (Scannell 2015). AIDEA also contracted the Division of Sport Fish to conduct fisheries sampling in rivers and lakes within the proposed corridor, and this report summarizes three separate studies conducted during 2014. Additional contract work concerning anadromous fish surveys throughout the corridor was conducted by ABR Inc. Environmental Research and Services (Lemke et al. 2013). Other fisheries inventory or assessment studies in waters within the corridor are extremely limited and outdated.

STUDY 1: FISH ASSEMBLAGES AND THEIR HABITAT USAGE IN THE KOYUKUK RIVER DRAINAGE

INTRODUCTION

Study 1 was done in collaboration with the Division of Habitat and included several objectives; 4 objectives have already been reported on by Scannell (2015). These objectives were as follows: 1) identify fish species assemblages in water bodies along the corridor; 2) collect fish samples to determine fish population characteristics and life history traits including length/age, age at maturity, diet, and fecundity; 3) measure water chemistry (pH, conductivity, turbidity, temperature); and 4) take invertebrate samples to qualitatively and quantitatively identify lower trophic level productivity.

The remaining portions of Study 1 were directed at collecting information on the seasonal habitats of resident fish species inhabiting the Upper Koyukuk River drainage using radiotelemetry over a 14-month period. The study area included tributaries and mainstem portions of the Koyukuk River, Middle and North Fork Koyukuk rivers, and the John River in the vicinity of Bettles. To investigate seasonal habitats, an emphasis was placed on Arctic grayling *Thymallus arcticus* because they were assumed to be the most widespread and prevalent of all freshwater species, they can be readily sampled, and Arctic grayling commonly require a wide range of habitat types. For example, an Arctic grayling may easily travel 70 km over the course of a year by spawning in a small tundra stream during spring, feeding in a first-order mountainous creek during summer, and overwintering in large rivers. Other migratory freshwater species of interest included northern pike *Esox lucius*, burbot *Lota lota*, and whitefish species; (sheefish *Stenodus leucicthyes*, broad whitefish *Coregonus nasus* and humpback whitefish

Coregonus pidschian). Prior to this study, information on resident fishes inhabiting the Upper Koyukuk drainage was minimal because of its remote geography and relatively small consumptive uses by sport, commercial, and subsistence fishers.

OBJECTIVES

1. Use radiotelemetry to document seasonal locations of mature-sized Arctic grayling (≥330 mm fork length [FL]) captured in the mainstem Koyukuk River and its tributaries during late summer/early fall 2014 with an emphasis on documenting overwintering and spawning areas.
2. Use radiotelemetry to document seasonal locations of other fish species that may be prevalent (northern pike, sheefish, burbot, or whitefish spp.) in the mainstem Koyukuk River during 2014 (summer and fall) with an emphasis on documenting overwintering and spawning areas.

METHODS

The generalized field schedule for 2014 consisted of the following:

1. June 9–12, preparing and testing equipment and methods near Bettles;
2. July 1–14, sampling the mainstem Koyukuk River including deployment of radio tags in prevalent resident fishes;
3. July 29–Aug 10, deploying radio tags in Arctic grayling within Koyukuk River tributaries; and
4. Aug 28–Sept 8, sampling of the mainstem Koyukuk River, which included deployment of radio tags in resident fishes.

To facilitate sampling and the distribution of radio tags, the mainstem portions of major rivers within the study area were divided into 9 study sections (each ~10 km in length), and distributed across portions of the Koyukuk River, Middle and North Fork Koyukuk rivers, and the John River (Figure 1). In general, the area included 170 river kilometers (rkm), and approximately every other 10 km of river was sampled. This division of the sampling area helped to ensure that a large geographic area was sampled, that the amount of area (i.e., a 10-km section) could be reasonably sampled in a given day, and that all habitat types were encountered and sampled.

In the mainstem sections, a combination of boat electrofishing and baited hoop traps were used to capture fish. In the tributary streams, a helicopter was used to access sampling locations for Arctic grayling and hook-and-line gear was used to capture fish. During planning, aerial images were used to locate 22 potential sampling locations across 16 tributary streams for the deployment of radio tags in Arctic grayling during August (Figure 2). These candidate tributaries were selected based on their proximity to the proposed road and to detect a broad range of possible movements. Fish of mature size were targeted during sampling to help maximize detection of probable spawning areas.

Standardized telemetry practices were employed. For all fish species, radio tags were surgically implanted using Aqui-S 20E for anesthesia and following the basic surgical methods detailed by Brown (2006) and Morris (2003). The transmitters used for this project were Lotek coded tags with motion sensors. Radio tags had a 14-month operational life and operated on 4 frequencies between 149.500 and 149.999 MHz with individual transmitters digitally coded for identification.

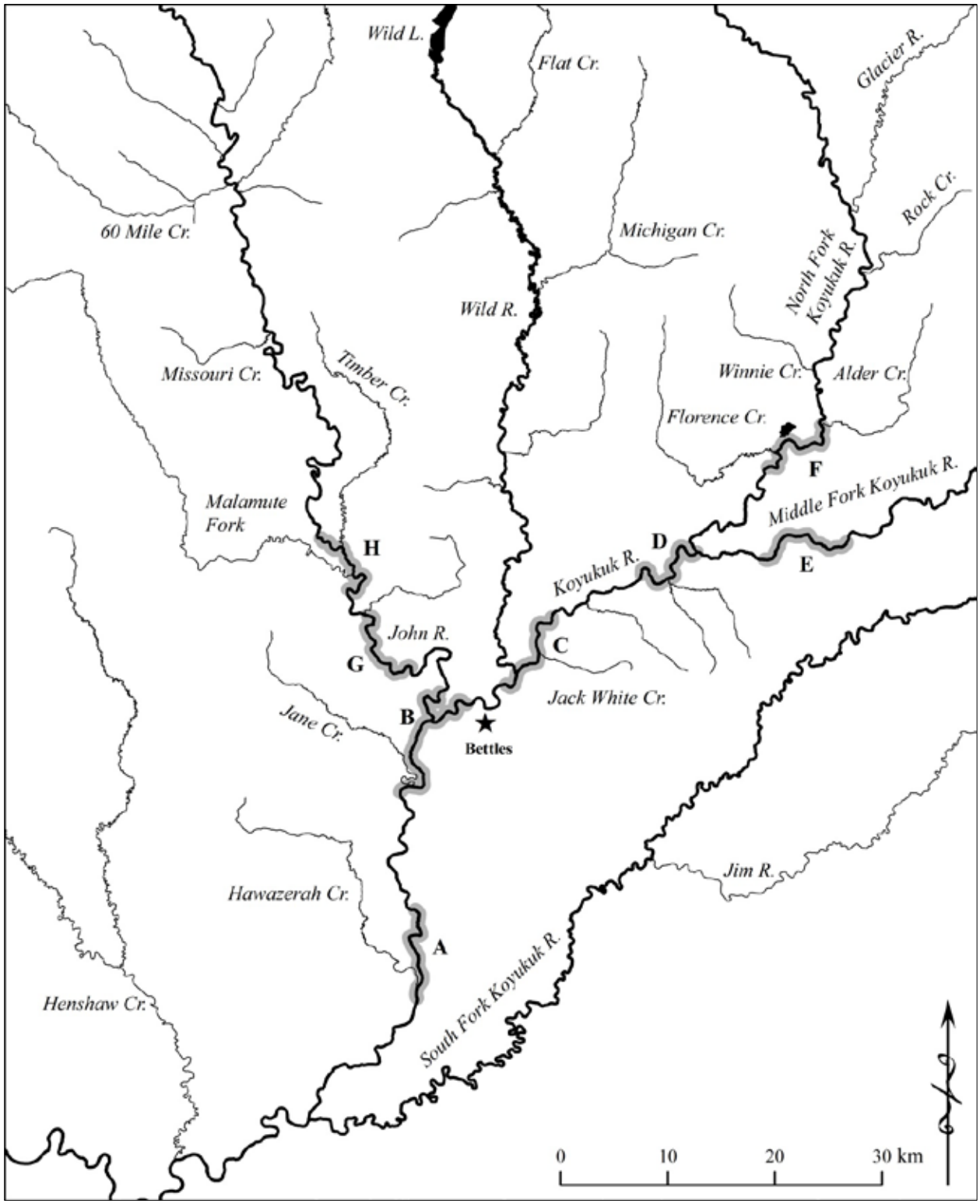


Figure 1.–Koyukuk River sampling area with mainstem sampling sections (A–H) highlighted.

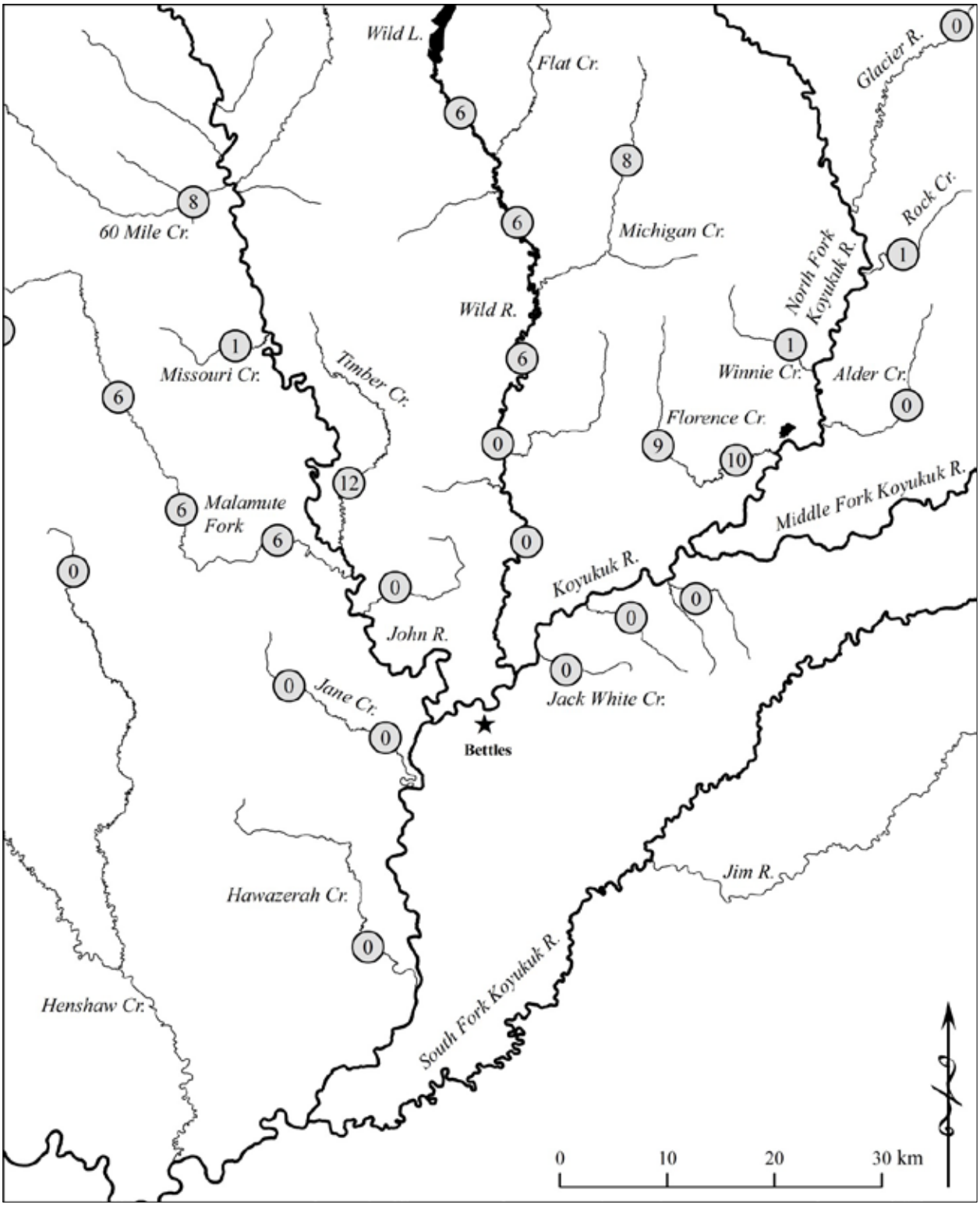


Figure 2.–Locations of tributaries sampled for Arctic grayling with a helicopter. Circles represent all areas investigated or sampled, and numbers indicate the number of radio tags deployed into Arctic grayling.

Tracking flights were conducted using a fixed-wing aircraft and a Lotek SRX 600 receiver with an internal GPS that recorded time and location data. Over a 14-month period, surveys were conducted to coincide with periods before and after major movements to spawning, overwintering, and summer feeding areas. The aerial surveys extended from Allakaket to Coldfoot, including all tributaries, the Wild River drainage and the lower ~100 km of the John and North Fork Koyukuk rivers. The accuracy of locations was within a 0.5-km radius.

In 2014, aerial surveys were conducted on 25 September, 1 October, and 13 December. In 2015, surveys were on 1 and 3 February, 30 March, 7 May, 20 May, 2 June, and 1 August. The February flights were assumed to best represent the burbot spawning period, the June flight best corresponded to the spawning periods for Arctic grayling and northern pike, and the October flight best corresponded to potential spawning periods for sheefish, humpback whitefish, and broad whitefish.

Seasonal distributions of fish were described and summarized by plotting coordinates of all located fish deemed to be alive at the time of the survey onto a digitized map of the drainage using the program ArcGIS. To help visualize geographic differences in seasonal habitat use, the plotted locations by survey were color-coded by their original tagging area. For example, on a given survey, the locations of all fish originally tagged in Florence Creek were represented by green circles and fish tagged in Timber Creek were represented by blue circles. Each colored dot only represented a fish judged to be alive at the time of the survey. Fish that did not survive the initial tagging were removed from all maps, including the map depicting original tagging locations.

Patterns in fish locations were then used to infer behavior and habitat use, and aggregations of fish would identify potentially significant habitats such as spawning and overwintering. Because sample sizes of surviving tags were relatively small for most species, a single dot could represent an important spawning area, although with far less certainty than if 3 fish were in close proximity (i.e., <3 km).

The fate of each fish (i.e., dead, alive, or not located) by survey was determined by examining the movement history and data provided by the motion sensors. Reviewing the movement history of each radiotagged fish was required because the motion sensor sometimes did not accurately reflect the fate of a tagged fish during a given survey. The history of sensor recordings for each fish was then examined to decipher when and if the fish had died, and its fate was corrected for subsequent surveys. For example, a fish with an inactive signal for one or more surveys that later made significant movements and emitted an active signal was considered alive for the inactive period. Conversely, when a fish emitted an active signal intermittently, all the while exhibiting no detectable movement throughout the tracking history, it was considered dead at the time when the first of consecutive inactive signals occurred. By the end, all fish were classified as alive, dead, or missing.

RESULTS AND DISCUSSION

A total of 237 fish were radiotagged during the July, August, and September sampling trips (Table 1 and 2). Inferences on fish movements and seasonal habitats were based on the number of surviving fish at each survey. The life expectancy of the radio tags was 14 months, but after ~12 there appeared to be an abnormally large decline in the number of fish located, suggesting that the radio tags had ended their expected life prematurely. In general, annual survival rates of radiotagged fish were within expected ranges (~30%-70%) for a given species.

Table 1.–Number of fish radiotagged by water body and species in the Koyukuk River study area, 2014 .

Water body	Arctic grayling	Burbot	Broad Whitefish	Humpback Whitefish	Northern Pike	Sheefish	Total
60 Mile Creek	8						8
Florence Lake Creek	19						19
John River	1	6	4	3	8	3	25
Mainstem Koyukuk (Upper)	36	35			8	1	82
Malamute Fork	18						18
Middle Fork Koyukuk		9					10
Michigan Creek	8						8
Missouri Creek	1						1
North Fork Koyukuk	12	6		16	1		35
Rock Creek	1						1
Timber Creek	12						12
Wild River	18						18
Wild River Mouth	2						2
Winnie Creek	1						1
Total	137	56	4	19	17	4	237

Table 2.–Mean length and range of fish radiotagged, by species, in the Koyukuk River study area, 2014.

Species	Number of fish	Mean length (mm FL)	Length range (mm FL)
Arctic Grayling	137	348	293 – 447
Burbot	56	562	435 – 930
Broad whitefish	4	524	483 – 537
Humpback whitefish	19	407	315 – 465
Sheefish	4	597	556 – 625
Northern Pike	17	643	476 – 950

ARCTIC GRAYLING

Arctic grayling migrate seasonally. Their migrations vary in duration, occur within a river and among rivers, and often involve homing to specific areas (Reed 1964; Tack 1980; Ridder 2000; Buzby and Deegan 2000; Gryska 2006). During autumn, Arctic grayling tend to vacate tributaries and upper portions of drainages because of the impending loss of habitat during winter, when river discharge reaches annual lows and some streambeds go dry while others freeze to the bottom. For winter, Arctic grayling seek out habitat that minimizes energy expenditure (e.g., low-velocity water), has physio-chemically suitable water (e.g., adequate depth and oxygen, and no frazzle ice), and provides cover from predators (e.g., overhead ice; Cunjak 1996). As winter ends, Arctic grayling begin their migrations to spawning areas, often located nearby, just before and after breakup. After spawning, Arctic grayling redistribute to summer feeding areas often located in the headwater tributaries. For approximately 2–4 months in the summer and 6–8 months in the winter, Arctic grayling are relatively stationary as they occupy their seasonal habitats (Fish 1998; Gryska 2006). The occupation of spawning areas is short term (about 2 weeks) and a dynamic part of the migration from winter habitats to summer habitats. This same generalized pattern of seasonal habitat use was observed in the Koyukuk study area (Appendices A1-B8).

Most Arctic grayling tagged in tributaries began vacating their summer feeding areas during September. Overwintering areas were mostly concentrated downstream of their respective tributaries in main river channels. Migration distances to overwintering areas were varied, but generally localized and relatively short (<30 km). Maximum distances recorded between tagging and overwintering areas were ~90 km for fish tagged in Timber Creek, ~120 km for those in the Malamute Fork Creek, and ~80 km for those tagged in Florence Creek. Upriver spawning migrations had been initiated by the March 30 aerial survey, with peak spawning occurring near the June 2 aerial survey. Spawning was widely distributed and strong fidelity to their initial tagging location was observed during spawning and summer feeding the following year. This fidelity suggested that populations are likely defined, and should be protected, at the scale of a tributary, such as the Malamute Fork or Timber Creek.

Fish tagged in the mainstem portions of the Koyukuk, John, and North Fork Koyukuk rivers in general showed small downstream movements to mainstem overwintering habitats. Upriver migrations to spawning habitats had been initiated by the end of March and most moved into tributaries for spawning and summer feeding. Interestingly, fish tagged upstream of the Wild River tended to move into tributaries of the North Fork Koyukuk River, whereas fish tagged downstream of the Wild River tended to migrate to the John River drainage. This tendency may be in part attributed to the fact that most (~90%) of these fish were tagged in September and they may have already vacated their tributary streams in route to fall or winter habitats.

For fish that remained in the mainstem Koyukuk River year round, their movements may be explained by two possibilities. The first is that the mainstem Koyukuk River provided suitable spawning, summer feeding, and overwintering habitat year round. The second may be that these fish did not spawn the following spring due to being immature, lacked fitness for sufficient gonadal development, or were affected by the transmitter.

As has been observed in other telemetry studies, there is always a small fraction (i.e., <10%) of a population that are far ranging and possibly establishing new territories, as has been observed in the Tanana Drainage (Gryska *In prep*). For example, one fish tagged in the lower Koyukuk River

was located near the Jim River the following year, and another fish that was tagged in the upper Koyukuk River mainstem summered in Rock Creek the following year.

During deployment of radio tags, several candidate streams were identified for sampling grayling, but either no Arctic grayling were observed or fish were of insufficient size for tagging (Figure 2). For example, no Arctic grayling >330 mm FL were captured in upper Henshaw Creek. Although many streams were not represented with radio tags, it is noted that based on field observations and known life histories, most small first-order tributaries are likely to support various life-history stages of Arctic grayling, at least seasonally.

This study demonstrated that all waters including first-order tributaries probably provide seasonal habitats (rearing, spawning, and summer feeding) for discrete populations of Arctic grayling. The mainstem portions of the Wild, John, North Fork, Middle Fork, and Koyukuk rivers provide overwintering habitat that supports mixed spawning stocks, as well providing migration corridors between all seasonal habitats year round.

BURBOT

The few telemetric studies on burbot in Alaska demonstrated that movements can be highly variable and difficult to predict for a given river system. Evenson (1994) radiotagged 55 burbot and found ranges of small burbot (<450 mm FL) to be less variable (<40 river km) compared to larger fish (5–255 river km), with all fish most active during freeze-up and ice-out. In the Kuskokwim River, burbot were tagged near Sleetmute during fall, and most of these fish made large migrations between breakup and spawning. They started between Bethel and Aniak and ended near McGrath, migrating up to ~800 km (Albert and Wuttig *In prep*).

The largest movements in this study were associated with spawning where a general upriver migration was observed between late summer and mid-winter (Appendix C1–C8). It is believed the survey on 2 February best represents probable spawning areas (Appendix C3). Burbot in the John, North Fork Koyukuk, and Middle Fork Koyukuk rivers tended to remain in their respective drainage for spawning, whereas burbot tagged in the mainstem Koyukuk River dispersed most widely using all the major tributaries. The largest observed spawning movements were for fish bound for the upper Wild River, a distance of ~ 120 km. This was a relatively modest distance compared to spawning migrations observed on the Kuskokwim River.

This study demonstrated that spawning for burbot is widespread, potentially occurring outside of the search area, and that moderately sized tributaries such as the Wild River can afford significant spawning habitats. Any aggregations of two or more radiotagged burbot during the February survey likely represented a significant spawning area. For example, the mouth of Michigan Creek in the Wild River and the North Fork Koyukuk River downstream of Florence Lake Creek were particularly notable.

From the spawning period to breakup, burbot appeared to slowly shift back downstream to their original tagging areas, displaying a generalized pattern of fidelity to their summer feeding areas, with several exceptions. For example, one burbot tagged in the lower Koyukuk river mainstem during September migrated to Fish Creek the following summer, a distance of approximately 90 km. This particular fish was tagged on 1 September and may have already been en route to its upriver spawning area, thereby demonstrating the potential of fish from areas well outside of the study area moving in to spawn. The least amount of movements was observed during summer

between the June and August surveys when fluvial burbot are relatively sedentary (Evenson 1994, McPhail and Paragamian 2000).

SHEEFISH, HUMPBACK WHITEFISH, AND BROAD WHITEFISH

The life histories of sheefish, humpback whitefish, and broad whitefish in Alaska are similar in that they spawn in rivers during fall (i.e., late September/early October), exhibit either localized (<100 km) or extensive (>1,000 km) migrations to spawning areas, may seasonally utilize brackish waters as juveniles or adults, and exhibit fidelity to spawning areas and summer feeding areas (Alt 1979, Brown 2000, Brown 2006, Brown et al. 2007, Dupuis 2010, Morrow 1980, Scott and Crossman 1973, Stuby 2012). All three species are known to share the same river reaches for spawning, as has been observed in the Tanana and Chatanika rivers near Fairbanks (Andy Gryska, Fisheries Biologist, Alaska Department of Fish and Game, Fairbanks, personal communication).

In general, catches of sheefish, broad whitefish, and humpback whitefish while using boat electrofishing were very low (Scannell 2015). Despite these small sample sizes, the telemetry and catch data did indicate the existence of at least 3–4 possible spawning areas within the study area; one for humpback whitefish in the lower North Fork Koyukuk River, one for broad whitefish in the lower John River, and possibly a combined spawning area for all three species in the mainstem Koyukuk River downstream of the John River (Appendices D1–D9). For all three species, the aerial survey on October 1 was in closest proximity to peak spawning (Appendix D2).

For humpback whitefish, the majority of radiotagged fish were captured in an unnamed, connected slough opposite of Florence Creek (14 out of 17 total radiotagged fish). Of these, nearly all surviving fish migrated only a short distance (i.e., <15 km) upstream by October 1, remaining in the lower portions of the North Fork Koyukuk River for the year, and exhibiting some measure of fidelity to this unnamed slough the following summer. One fish migrated a considerable distance (>50 km) up the North Fork Koyukuk River by October 1, suggesting the presence of an additional spawning area farther upstream. On October 1, the 2 remaining humpback whitefish were below the mouth the John River in the vicinity of other sheefish and broad whitefish, indicating another potentially significant spawning reach for all 3 species.

Only 3 humpback whitefish were tagged in the John River but all made notable spawning migrations. Two made upriver migrations indicating potential spawning areas in the John River, and the third moved to the suspected spawning area downstream of the John River to where 2 humpback whitefish from the Florence Creek area had migrated.

For broad whitefish, the telemetry and catch data indicated the existence of a small population of broad whitefish that utilizes the lower John River for spawning, and downriver areas, such as the Alatna River, Fish Creek or beyond, for overwintering and summer feeding. During early fall (29 August–1 September), a total of 4 broad whitefish were radiotagged in the lower John River where a notable cluster (i.e., >20 fish) was encountered (~5 km from its mouth). The absence of broad whitefish during July and the presence of this cluster in fall, combined with the telemetry data, strongly suggested that during August, broad whitefish migrated from outside the study area to a spawning area located in the lower John River. Two broad whitefish survived to overwintering and were observed in the lower Alatna River in late March. One of these survivors appeared to have migrated to summer feeding areas downstream of Allakaket and eventually

outside of the search area. The other survivor was last seen in the lower Fish Creek just after ice-out in mid-May.

Catch data indicated that sheefish are present in the study area during midsummer, including the lower North Fork Koyukuk River, but probably in very low densities (Scannell 2015). Three radiotagged sheefish were located in the loose aggregations of humpback and broad whitefish downstream of the John River, strengthening the possibility of shared spawning area. By February, only one fish was observed overwintering within the study area, and after breakup in late May, 2 were observed in or near the mouth of Fish Creek. Sheefish are highly migratory, but the limited evidence collected in this study indicated a relatively small and regional population, unlike those in the Yukon River that migrate to brackish waters.

The juvenile least cisco *Coregonus sardinella* captured during July sampling using a beach seine in the North Fork Koyukuk River provided strong evidence that spawning for this species probably occurs in the lower portions (i.e., 30 km) of the river. Whitefish species are often found spawning in the same river reach, such as has been observed in the Chatanika, Tanana, and Yukon rivers. Thus, the spawning area utilized by the radiotagged humpback whitefish may also be utilized by least cisco.

NORTHERN PIKE

Northern pike spawn in spring just after ice-out, typically in shallow waters with emergent vegetation, which for river populations is found in connected sloughs and lakes, and typically return to the same spawning area annually (Morrow 1980). Telemetric studies on riverine northern pike show that movements can be highly variable and difficult to predict for a given river system. In the Nowitna River, approximately half of the 70 radiotagged northern pike migrated to the mainstem Yukon River to overwinter for ~6 months, whereas the other half traveled up to ~160 km upstream to riffle-pool sections of the Nowitna River where higher dissolved oxygen concentration were likely present (Scanlon *In prep*). The Nowitna study is in contrast to the Chena River, where all radiotagged northern pike remained in the lower 37 km of the river and displayed only small local movements (e.g., <5 km) from the spawning areas near where they were tagged (Pearse 1994).

In the Koyukuk River, northern pike generally displayed only small localized movements, similar to that of the Chena River (Appendices E1–E4). They tended to overwinter in the mainstem Koyukuk River and returned to the same habitat (side channels and tributary mouths) in which they were captured and tagged for spawning or summer feeding. In general, there is very little interconnected off-channel habitat, such as large oxbow lakes, for northern pike to utilize in spring for spawning and for summer feeding, which underscores the importance of these few available habitats. Densities of northern pike in the study area were in general very low.

CONCLUSION

Despite the limited sample sizes, the movements exhibited by all species demonstrated the importance of main channels, tributaries, and connected off-channel waters that support important habitats year round and underscored the dynamic nature of fish movements between these waters seasonally. Moreover, evidence indicated that discrete spawning stocks for all species exist throughout the study area, such as the spawning population of Arctic grayling in the

Malamute Fork, as well as demonstrating the potential of spawning aggregations that are partially composed of fish migrating from outside the study area.

STUDY 2: INVESTIGATIONS OF AQUATIC COMMUNITIES AND HABITAT IN LAKE SYSTEMS

INTRODUCTION

This project was designed to collect baseline information about the current status of aquatic communities and habitat in lake systems along the proposed Ambler Road corridor. For many lakes in Interior Alaska, species and habitats have not been investigated, documented, or, in some cases, sampled in over 50 years. Lakes and fish populations within this corridor may be impacted by road construction, increased public use after construction, and future resource development.

Fish information, water quality, and bathymetry data are needed to assist state and federal agencies in developing management plans, assessing the impacts of current or proposed development, issuing permits, and monitoring changes in aquatic systems over time. In addition to documenting species and habitat, these sampling actives will help ADF&G Sport Fish Division area managers identify new angling opportunities.

Fish Populations

Basic fish population information is needed to document native species present, their size and age range, and their overall condition. This information is used by biologists and managers to identify critical habitats, fish distributions, the current status of fish communities, and fish populations that require further study. Length compositions are used in management models to establish harvest guidelines. Age information is used to gauge the impacts of harvest over time and to identify stocks that are particularly vulnerable to increased angling pressure. Basic fish population information is also used to identify new angling opportunities and to respond to public inquires.

Water Quality

Water quality data is needed to help biologists interpret fish sample results; identify the habitat needs, usage, and limitations of fish species; monitor habitat changes over time; and plan more detailed fishery or habitat research. Water quality information such as dissolved oxygen and temperature is useful when evaluating fish species' presence or absence and is used to establish fish sampling protocol in future studies such as appropriate capture gear and sample locations.

Bathymetric Maps

Bathymetric maps are used to describe a lake's physical characteristics. A bathymetric map is used to calculate several measurements such as surface area, maximum length and width, mean depth, maximum depth, shoreline length, shoreline development, and volume. Documentation of the physical attributes of a lake can be used to monitor changes, such as lake succession and water level, and to identify attributes (e.g., deep vs. shallow) that may limit fish presence or habitat. Additionally, volumetric calculations from bathymetric data are often required before permits for water resource use and extraction are issued.

OBJECTIVES

Fish Populations

Objective 1: Survey selected lakes to determine fish species present, characterize the size range of the fish captured, and describe the overall appearance and condition of captured fish.

Objective 2: Determine the age of 2–5 fish from each specified length category for captured game fish species >150 mm in length. Length categories will be increments of 50 or 100 mm depending on species. Game fish species include Arctic grayling, burbot, lake trout, northern pike, and whitefish.

Water Quality

Objective 3: Measure water clarity, temperature, dissolved oxygen, pH, total dissolved solids, specific conductivity, and alkalinity.

Bathymetric Maps and Other Lake Characteristics

Objective 4: Survey the lake bottom to obtain depth, longitude, and latitude data for producing bathymetric maps.

Objective 5: Describe the lake watershed and the immediate surroundings, such as tree/shrub cover, and inlets and outlets.

Objective 6: Photograph the lake and surrounding area from north and south locations and, if flown into a lake, take aerial photographs of the lake and surrounding area.

METHODS

Four lakes (Birch Hill Lake, Heart Mountain Lake, Sleeper Lake, and Nutuvuki Lake) along the proposed Ambler Road corridor were sampled during the 2014 field season (Table 3, Figure 3). Sampling was conducted July 7–13, 2014. Fish, water quality, and bathymetric data were collected.

Table 3.–Location and description of lake morphometrics for 2014 study lakes along the proposed Ambler Road corridor.

	Birch Hill Lake	Heart Mountain Lake	Nutuvuki Lake	Sleeper Lake
Lat (WGS 84)	66.92446	67.12128	66.989305	67.049155
Long (WGS 84)	-151.418	-152.523	-154.723957	-153.522377
Elevation (m)	210	334	192	260
Surface area (ha)	28.6	79.6	1,535.5	36.9
Shoreline length (m)	2,776	8,186	23,895	3,004
Volume (m^3)	473,592	4,662,260	329,600,991	1,316,147
Maximum depth (m)	5.2	22.0	52.6	10.4
Mean depth (m)	1.8	3.8	9.2	2.4

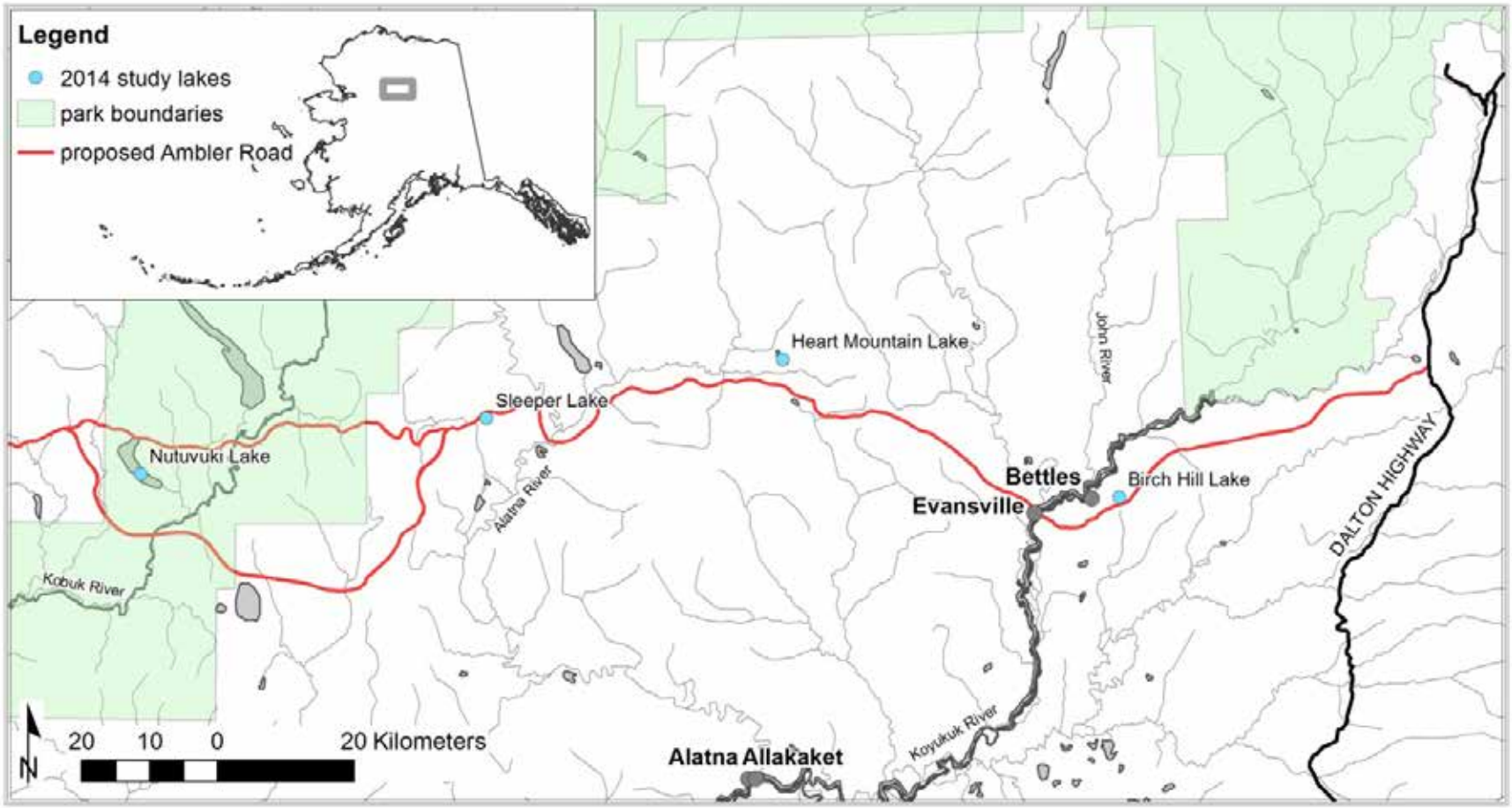


Figure 3.–Location of 2014 study lakes along the proposed Ambler Road corridor.

Fish Populations

Fyke nets, tangle nets, and minnow traps were used to sample fish populations in each lake. The amount of capture gear and duration of sampling was based on lake size and is summarized in Table 4. Captured fish were measured to the nearest mm fork length (FL) or total length (TL), depending on the species, and visually inspected for signs of parasites and disease.

Table 4.–Amount of capture gear and duration of sampling used to capture fish in 2014 study lakes along the proposed Ambler Road corridor.

	Birch Hill Lake	Heart Mountain Lake	Nutuvuki Lake	Sleeper Lake
Nights	2	3	3	2
Fyke Nets	4	4	8	4
Tangle Nets	1	2	2	1
Minnow Traps	4	4	6	4

Water Quality

Water quality parameters were measured at two stations in each lake. Water color, Secchi reading, and total alkalinity were recorded at one sample station in each lake; and specific conductivity, pH, TDS, temperature, and dissolved oxygen were recorded at depth at two sample stations in each lake.

Bathymetric Maps and Other Lake Characteristics

Study lakes were surveyed for bathymetry data and peripheral watershed features were documented. Position and depth data for bathymetry mapping were collected with a Lowrance HDS-5 sonar unit equipped with a GPS receiver. Data were collected by first following the shoreline in a small skiff within 5 m of shore where adequate depth (>0.5 m) allows. After surveying the shoreline the rest of the lake will be surveyed along multiple circular transects, spaced equidistance apart paralleling the shoreline and decreasing in size until the middle of the lake is reached. The number of transects will be determined by lake size and by the variability of the lake bottom. Collected data will be used to generate lake maps using Arc Map 3D Spatial Analyst.

The terrestrial surroundings (up to 5 m from shore) were documented. This included documenting inlets and outlets and noting the general vegetation types present (e.g., sedge, shrub willow, deciduous, coniferous).

A minimum of two photographs were taken at each lake, one from the south shore looking north and one from the north shore looking south.

RESULTS AND DISCUSSION

Fish Populations

Northern pike were captured in all 4 study lakes. Northern pike ranged in size from 32 to 575 mm FL. One slimy sculpin (80 mm FL) was captured in Sleeper Lake and 1 burbot (35 mm TL), 3 lake trout (510-540 mm FL), and 1 ninespine stickleback (40 mm TL) were captured in Nutuvuki Lake. All fish appeared to be in good condition and had no external signs of parasite or

disease. Basic summary statistics for fish captured in 2014 study lakes are represented in Table 5.

Water Quality

Recorded water temperature did not exceed 21° C in any of the lakes. Nutuvuki Lake and Sleeper Lake were clear with no color, Birch Hill Lake was ferric, and Heart Mountain Lake was humic. Secchi readings for all lakes ranged from 1.75 to 4.75 m and total alkalinity ranged from 11 to 130 mg CaCO3/L. Values observed for these and other water quality parameters measured during July 2014 sampling are summarized in Table 6.

Table 5.–Basic summary statistics for fish captured in 2014 study lakes along the proposed Ambler Road corridor.

	Birch Hill	Heart Mountain	Nutuvuki	Sleeper
Northern pike *Esox lucius*				
Mean length (mm)	364	120	114	58
Standard Error	21	28	40	2
Median	346	67	65	57
Mode	-	-	65	54
Minimum	340	51	38	32
Maximum	405	320	575	145
Count	3	10	13	43
Slimy sculpin *Cottus cognatus*				
Mean length (mm)	-	-	-	80
Standard Error	-	-	-	-
Median	-	-	-	80
Mode	-	-	-	-
Minimum	-	-	-	80
Maximum	-	-	-	80
Count	-	-	-	1
Burbot *Lota lota*				
Mean length (mm)	-	-	35	-
Standard Error	-	-	-	-
Median	-	-	35	-
Mode	-	-	-	-
Minimum	-	-	35	-
Maximum	-	-	35	-
Count	-	-	1	-
Lake trout *Salvelinus namaycush*				
Mean length (mm)	-	-	522	-
Standard Error	-	-	9	-
Median	-	-	515	-
Mode	-	-	-	-
Minimum	-	-	510	-
Maximum	-	-	540	-
Count	-	-	3	-
Ninespine stickleback *Pungitius pungitius*				
Mean length (mm)	-	-	40	-
Standard Error	-	-	-	-
Median	-	-	40	-
Mode	-	-	-	-
Minimum	-	-	40	-
Maximum	-	-	40	-
Count	-	-	1	-

Bathymetric Maps and Other Lake Characteristics

Lakes ranged in size from 28.6 to 1,535.5 ha, in maximum depth from 5.2 to 52.6 m, and in elevation from 192 to 334 m. Lake morphometrics for 2014 study lakes are summarized in Table 3. Bathymetric maps generated from collected depth data are shown in Figures 4–7. Aerial and ground photographs of the lakes are available at http://www.adfg.alaska.gov/index.cfm?adfg=fishingSportStockingHatcheries.lakesdatabase.

Study lakes were surrounded by rolling hills with both coniferous and deciduous trees present; coniferous trees were more abundant. Inlets and outlets were observed at three lakes: Birch Hill Lake, Nutuvuki Lake, and Sleeper Lake. Birch Hill Lake had a small outlet at the north end that flowed into the Koyukuk River. Nutuvuki Lake had an outlet at the south end that flowed into the Kobuk River and multiple inlets at the north end. Sleeper Lake had one outlet that flowed into Helpmejack Creek and the Alatna River, one small inlet located on the western shore, and several small inlets that flowed from a lowland bog on the eastern shore. Heart Mountain Lake did not appear to have inlets or outlets at the time of sampling.

Table 6.–Range of physical and chemical water quality parameters recorded in 2014 study lakes along the proposed Ambler Road corridor. Data were recorded July 8–12, 2014.

	Birch Hill Lake	Heart Mountain Lake	Nutuvuki Lake	Sleeper Lake
water color	ferric	humic	clear	clear
Secchi reading (m)	1.75	2.75-4.13	3.88	4.75
total alkalinity (mg/L CaCO3)	11	62	29	130
specific conductivity (µS/cm)	35-40	157-295	84-89	307-612
pH	6.2-6.9	6.0-8.4	7.1-7.5	7.3-7.8
TDS (ppm)	0.023-0.026	0.100-0.189	0.053-0.059	0.199-0.398
temperature (°C)	15.5-20.4	3.3-20.7	4.7-18.8	5.2-17.8
dissolved oxygen (mg/L) [a]	5.1-8.1	0.0-10.5	9.5-11.3	0.5-12.2
maximum depth sampled (m)	2.5	13	15	9.75

[a] Dissolved oxygen saturation exceeded 100% in some areas during July 2014 sampling. We do not typically see values greater than 100% in Interior Alaska lakes; however, super saturation of oxygen in water can occur during photosynthesis or when abrupt changes in temperature, salinity, or air pressure occur. These high readings may be a result of natural processes or due to a faulty oxygen probe.



Figure 4.–Bathymetric map for Birch Hill Lake, July 2014.



Figure 5.–Bathymetric map for Heart Mountain Lake, July 2014.



Figure 6.–Bathymetric map for Nutuvuki Lake, July 2014.

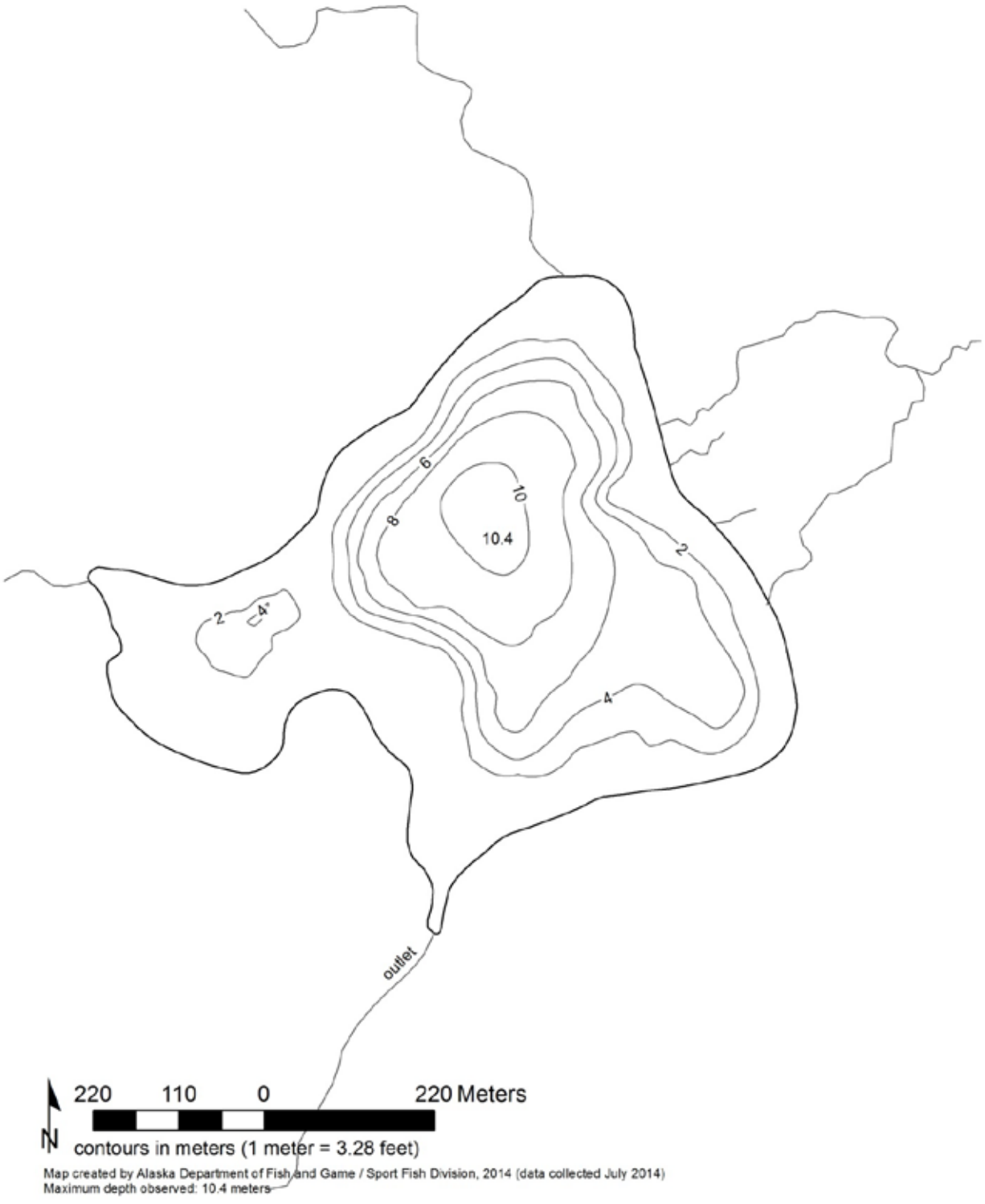


Figure 7.–Bathymetric map for Sleeper Lake, July 2014.

STUDY 3: SPAWNING ABUNDANCE OF KOBUK RIVER SHEEFISH

INTRODUCTION

Sheefish, or inconnu *Stenodus leucichthys*, are an extremely important resource in northwest Alaska. Their importance stems from their extensive use as a subsistence food, their value as a commercial resource, and their reputation as a trophy sport fish (Georgette and Loon 1990). The Kobuk River sheefish population supports inriver subsistence and sport fisheries along with winter subsistence and commercial fisheries that occur in Hotham Inlet and Selawik Lake (Figure 8). Sheefish harvested in Hotham Inlet and Selawik Lake are a mixed stock composed of the only 2 known spawning populations in the region, the Selawik and Kobuk river populations (Alt 1987). The exploitation of these stocks is poorly understood due to incomplete estimates of total annual harvest, unknown stock composition in the mixed stock winter fisheries, and unknown total exploitable stock abundance.

An understanding of these basic elements is necessary to describe the population dynamics of each stock and identify sustainable harvest levels. Because sheefish are iteroparous and known to skip a year after spawning, estimates of spawning frequency are critical in determining whole population estimates. Recent studies have led to a better understanding of spawning frequency and timing, which may be coupled with a sonar assessment of spawning abundance to derive an estimate of total stock abundance. If the spawning frequency strategies are sporadic and a total stock abundance cannot be derived, then the counts of spawning abundance would provide a reliable index of the stock's status.

OBJECTIVE

The objective of this study was to use DIDSON sonar techniques to enumerate the abundance of outmigrating mature sheefish near the village of Kobuk from 15 September through 15 October 2014.

METHODS

Two sonar units (DIDSON) were placed on the north side of the Kobuk River near the lower boundary of the known spawning areas on an inclined gravel bar that stretches across the river to the southside cut bank (Figure 8). This type of river profile is preferred to ensure ensonification of the entire area where fish are migrating. Low frequency settings that allow for up to 40 m of the area to be ensonified were used to maximize coverage of the river profile. One sonar was set up to ensonify the first 30 m of the river and the other sonar was set up to ensonify the remainder of the river. Images were recorded 24 h a day over the course of the outmigration, which was approximately 30 days.

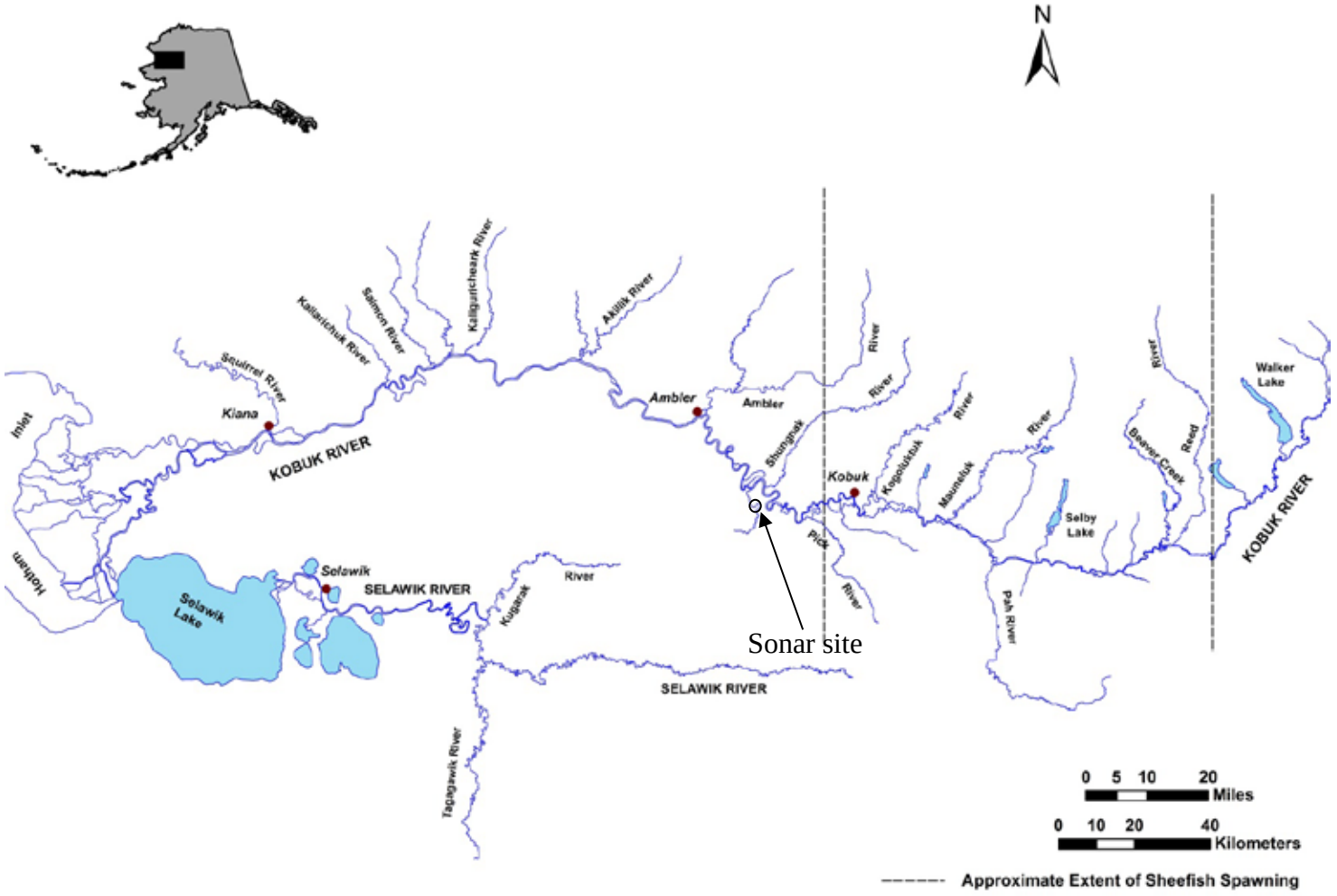


Figure 8.–A map of the Kobuk and Selawik river drainages including the sonar site and surrounding communities.

All targets measuring ≤650 mm in total length (TL) were culled from the analysis because the length composition of spawning sheefish in the Kobuk River indicated there are no mature sheefish smaller than 650 mm TL (Savereide *In prep*).

A beach seine (200 ft long x 8 ft deep) was used to ensure all fish in the ensonified area were actually sheefish.

Daily estimates of abundance were determined inseason by expanding the number of targets counted for a portion of every hour. A census of spawning abundance was completed postseason by counting the total number of targets over the entire outmigration.

RESULTS

A total of 8,511 mature sheefish were enumerated from 15 September to 5 October 2014 (Figure 9). Each sonar recorded all hours of each day within the sampling period. Early river ice on the eve of 5 October forced the crew to remove the sonar units and demobilize camp.

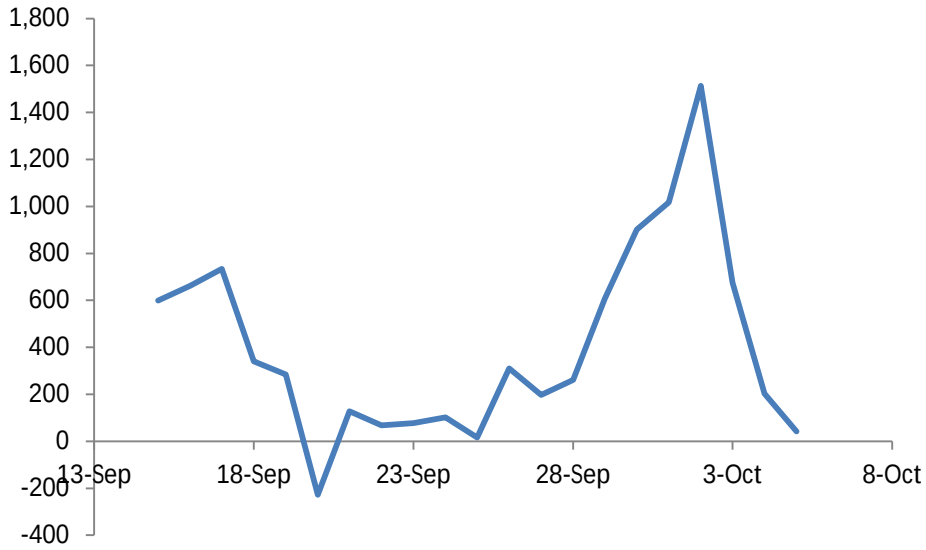


Figure 9.–Daily counts of outmigrating sheefish (a negative number indicates more fish went upstream that day than downstream).

One beach seine haul near the sonar site was conducted each day over the first 10 days of sampling and indicated that nearly all fish (>92%) recorded on the DIDSON images were sheefish (Table 7).

Table 7.–Total catch per daily seine haul.

Date	Sheefish	Arctic Grayling	Whitefish
15-Sep	6	1	1
16-Sep	12	1	1
17-Sep	21	1	0
18-Sep	24	1	0
19-Sep	25	0	1
20-Sep	18	0	2
21-Sep	16	1	0
22-Sep	15	2	1
23-Sep	19	0	0
24-Sep	24	0	0

DISCUSSION

Previous studies and local knowledge have established that sheefish in the Kobuk River tend to reach spawning areas upstream of Kobuk village from mid-July to late August and leave those same areas from late September to mid-October (Alt 1987, Taube and Wuttig 1998, Savereide *In prep*). In addition, Savereide (*In prep*) has shown that anywhere from 18% to 49% of Kobuk River sheefish exhibit sequential year spawning, including males and females. This evidence suggests that deriving total stock abundance estimates of mature sheefish are unlikely when 51% to 82% may skip spawn in any particular year. For these reasons, an annual enumeration of the sheefish outmigration from their spawning grounds using sonar methodology would be necessary to provide a reliable index of the total stock abundance.

Previous spawning abundance estimates based on mark–recapture techniques have ranged from 32,000 to 40,000 sheefish (Taube and Wuttig 1998). After enumerating 20 days of recorded DIDSON images of outmigrating sheefish, the total count was only 8,511 sheefish, which is not even half of what was expected. However, high water, early ice, and a thalweg that was deeper than expected limited our ability to ensonify the majority of the river, especially the thalweg, which, based on Selawik River sonar studies (R.F. Hander, Fish Biologist U.S.F.W.S., Fairbanks, personal communication), is known to be the preferred corridor of migrating sheefish. Based on these circumstances it is likely more than half of the outmigration was not enumerated.

Despite the fact the entire outmigration corridor was not ensonified, the ability to obtain a reliable count of the spawning abundance is possible. Based on the beach seine catches and the length composition of mature sheefish, the majority of fish in the ensonified area are sheefish and if not, they can easily be culled from the count. In addition, the project biologist and crew surveyed another sonar location downstream where a DIDSON can be placed on each side of the river to obtain full images of the river profile, including the thalweg. The gradient of the river bottom in this area is more conducive to sonar techniques and will provide a more complete enumeration of the entire outmigration.

ACKNOWLEDGEMENTS

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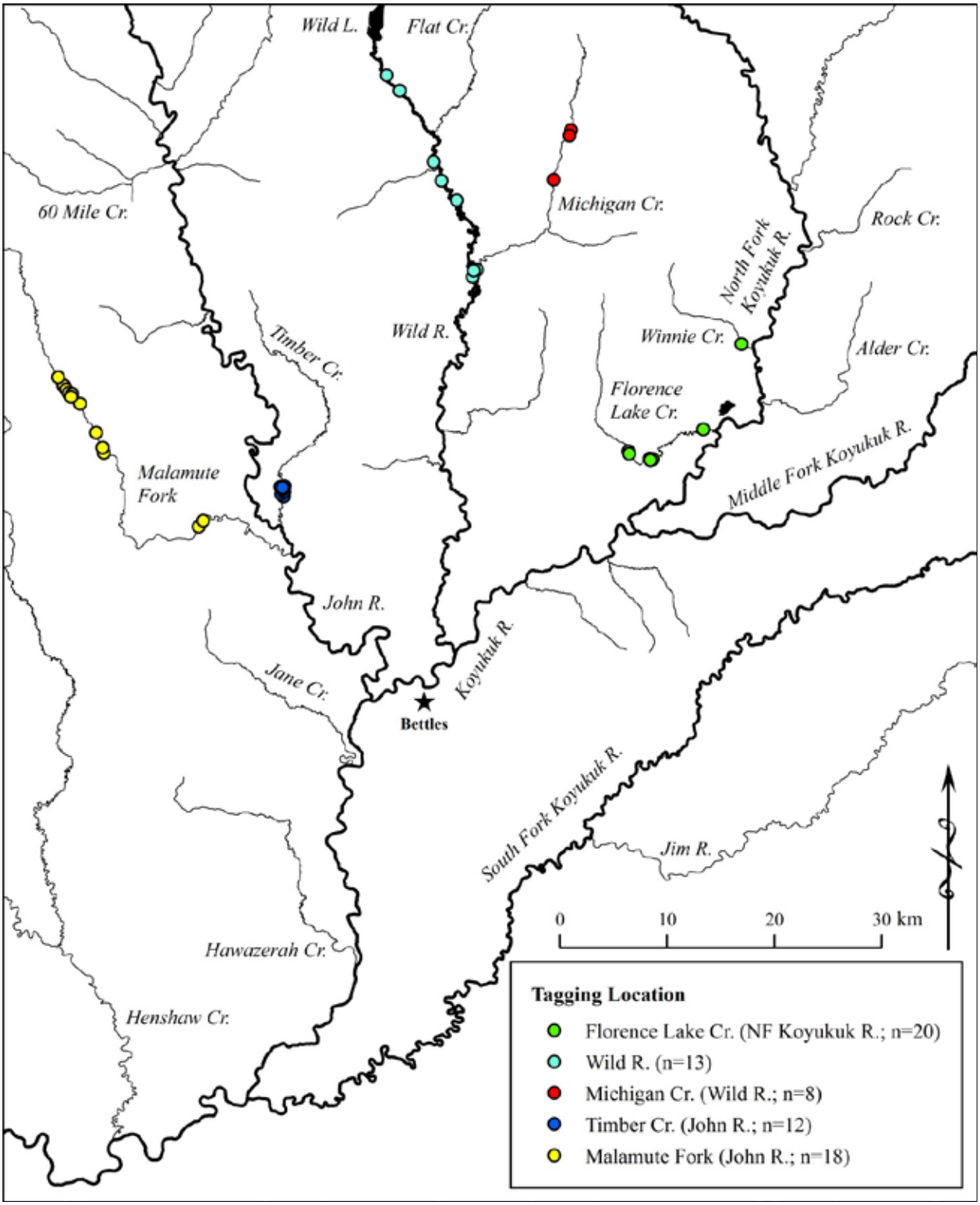
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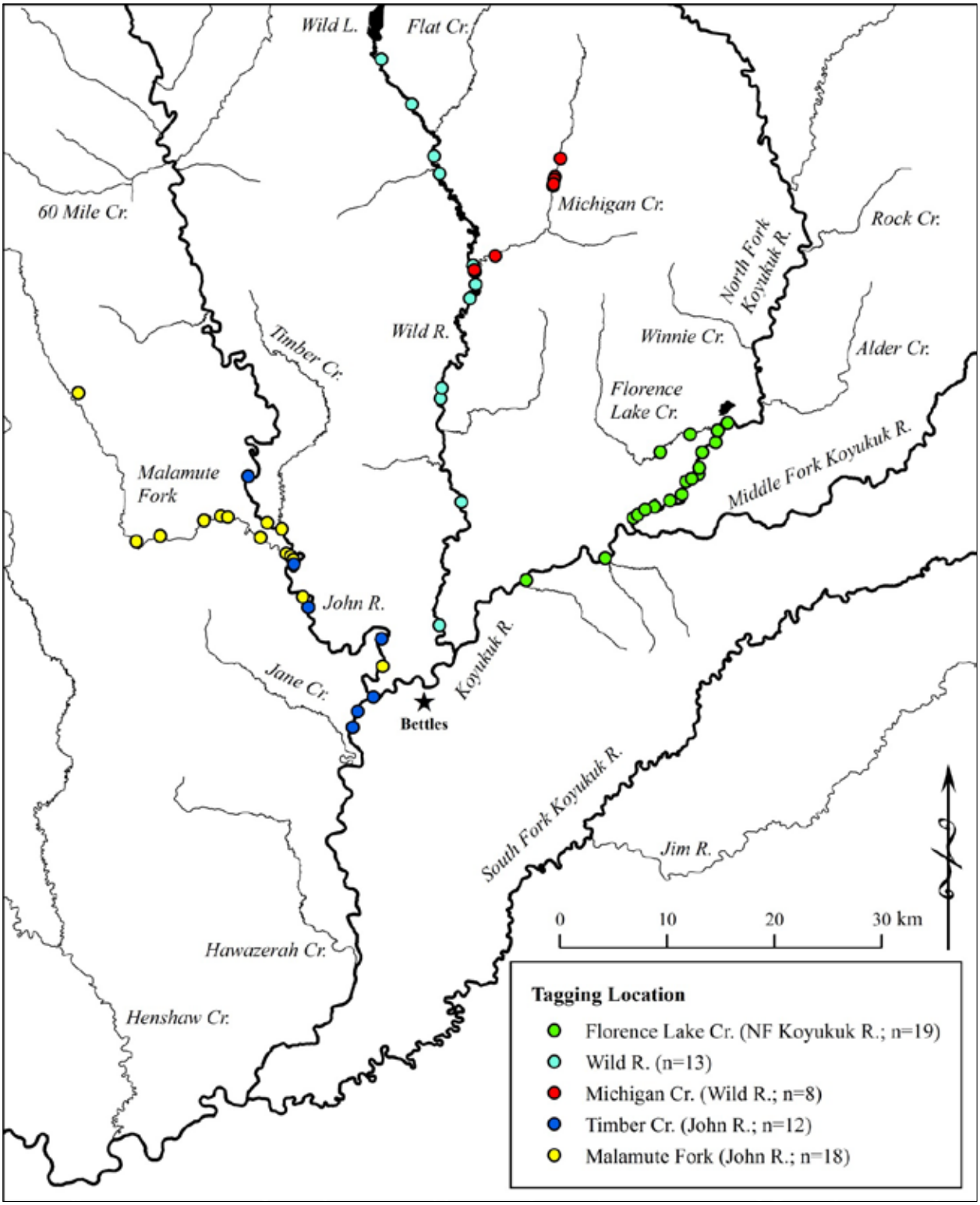
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APPENDIX A:
LOCATIONS OF RADIOTAGGED ARCTIC GRAYLING CAPTURED IN TRIBUTARIES WITHIN THE KOYUKUK STUDY AREA

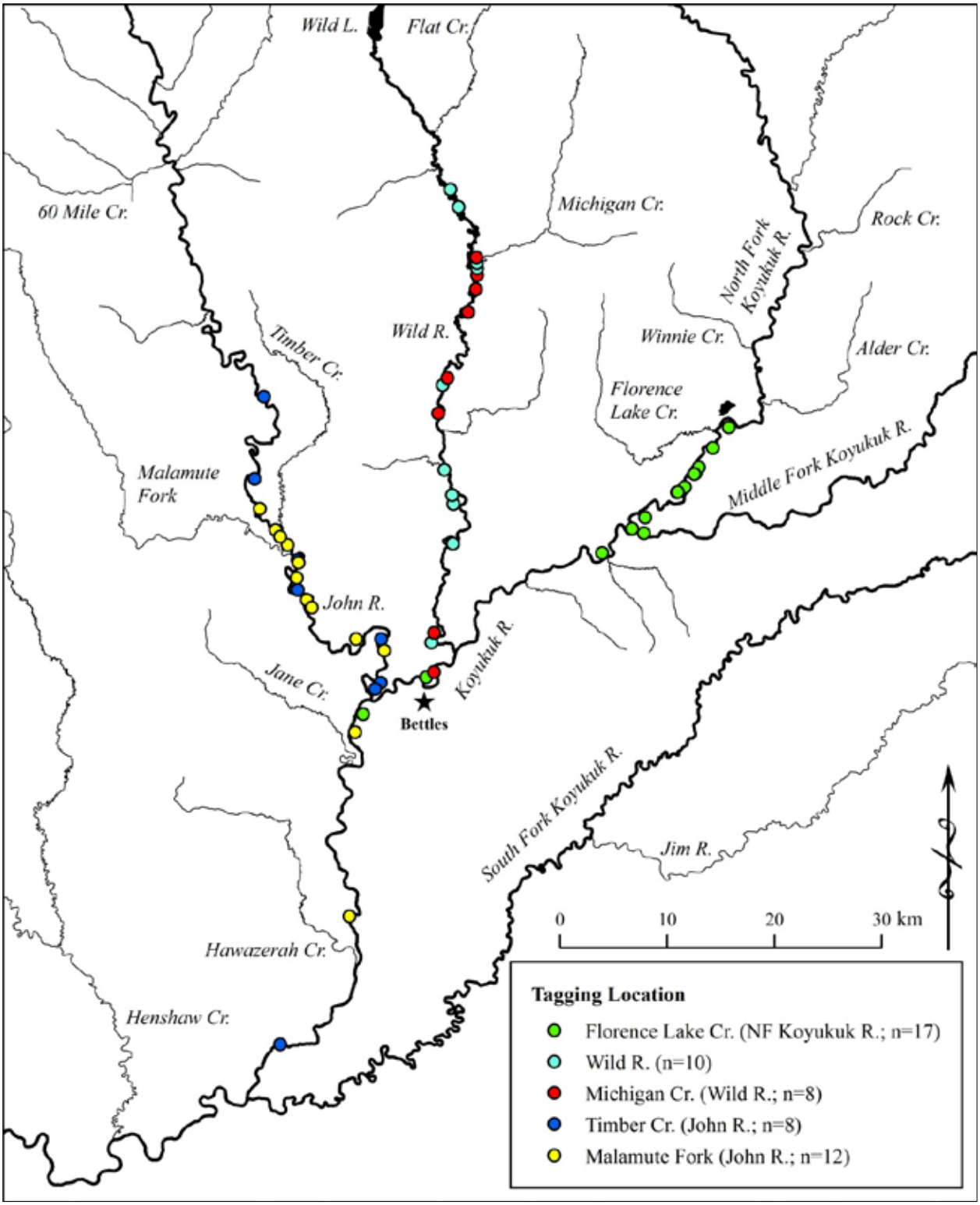
Appendix A1.–Tagging locations for Arctic grayling sampled in tributaries within the Koyukuk study area, 2014. Colors depict a general tagging area and the total number of surviving radiotagged fish are labeled parenthetically in legend.



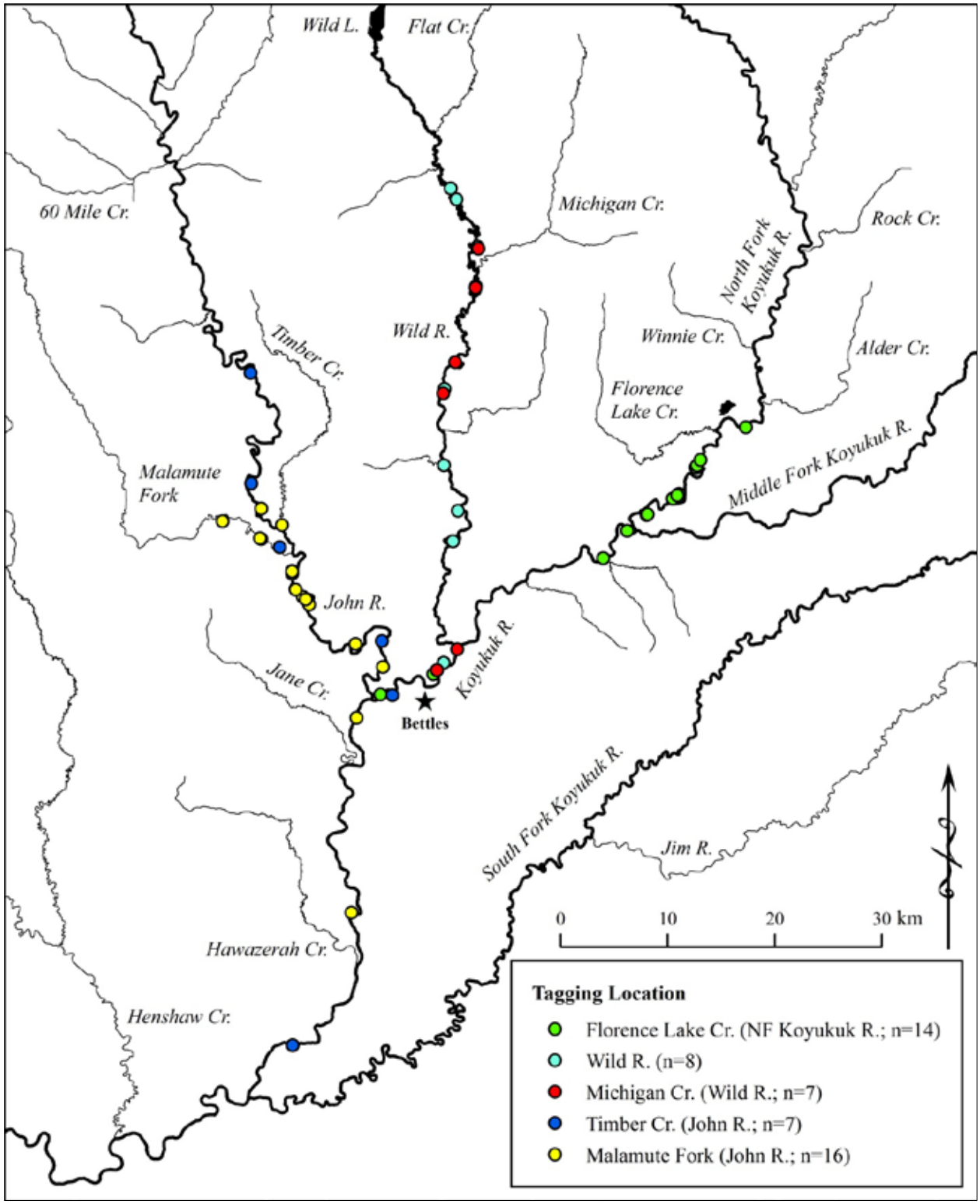
Appendix A2.–Locations of radiotagged Arctic grayling on 25 September 2014 sampled in tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



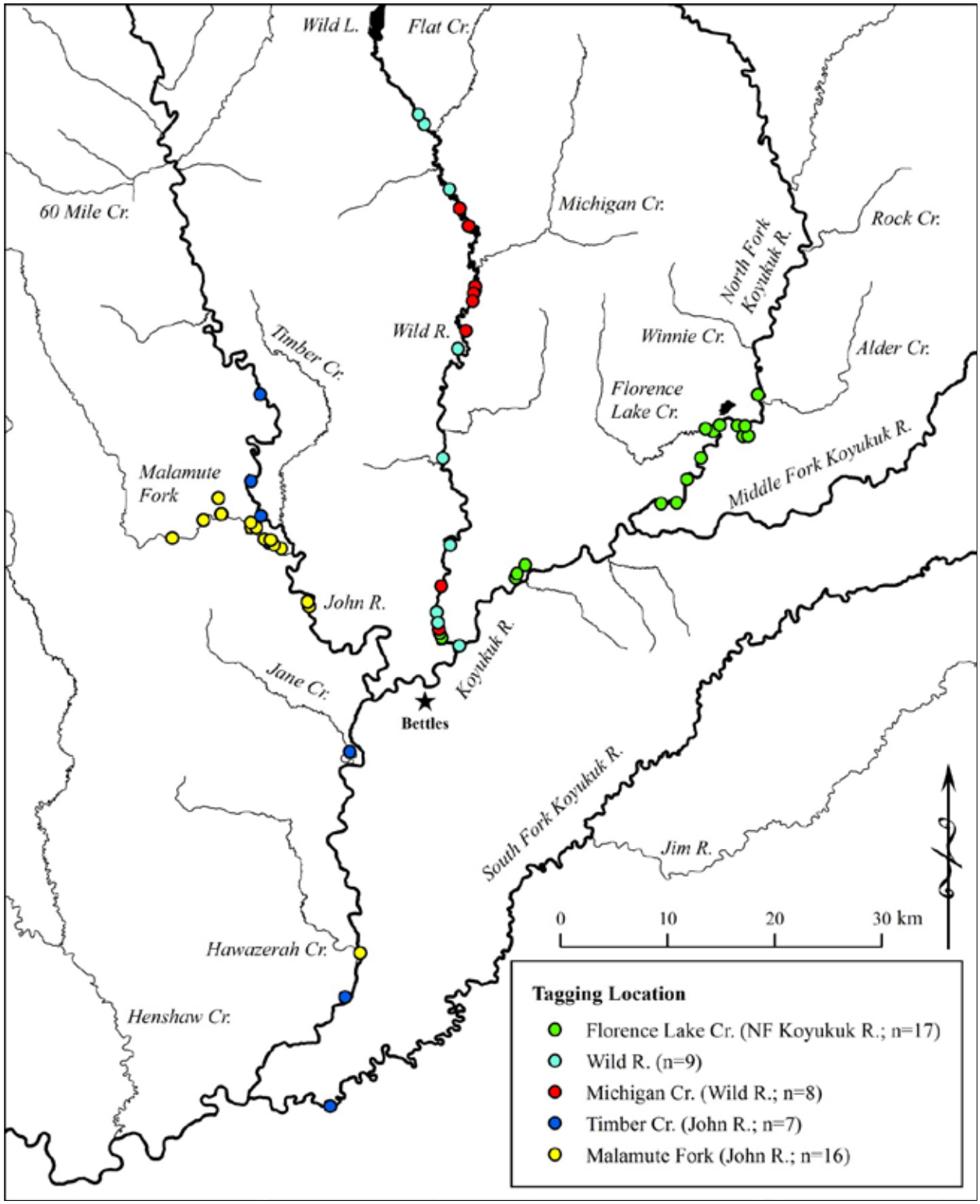
Appendix A3.–Locations of radiotagged Arctic grayling on 1 February 2015 sampled in tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



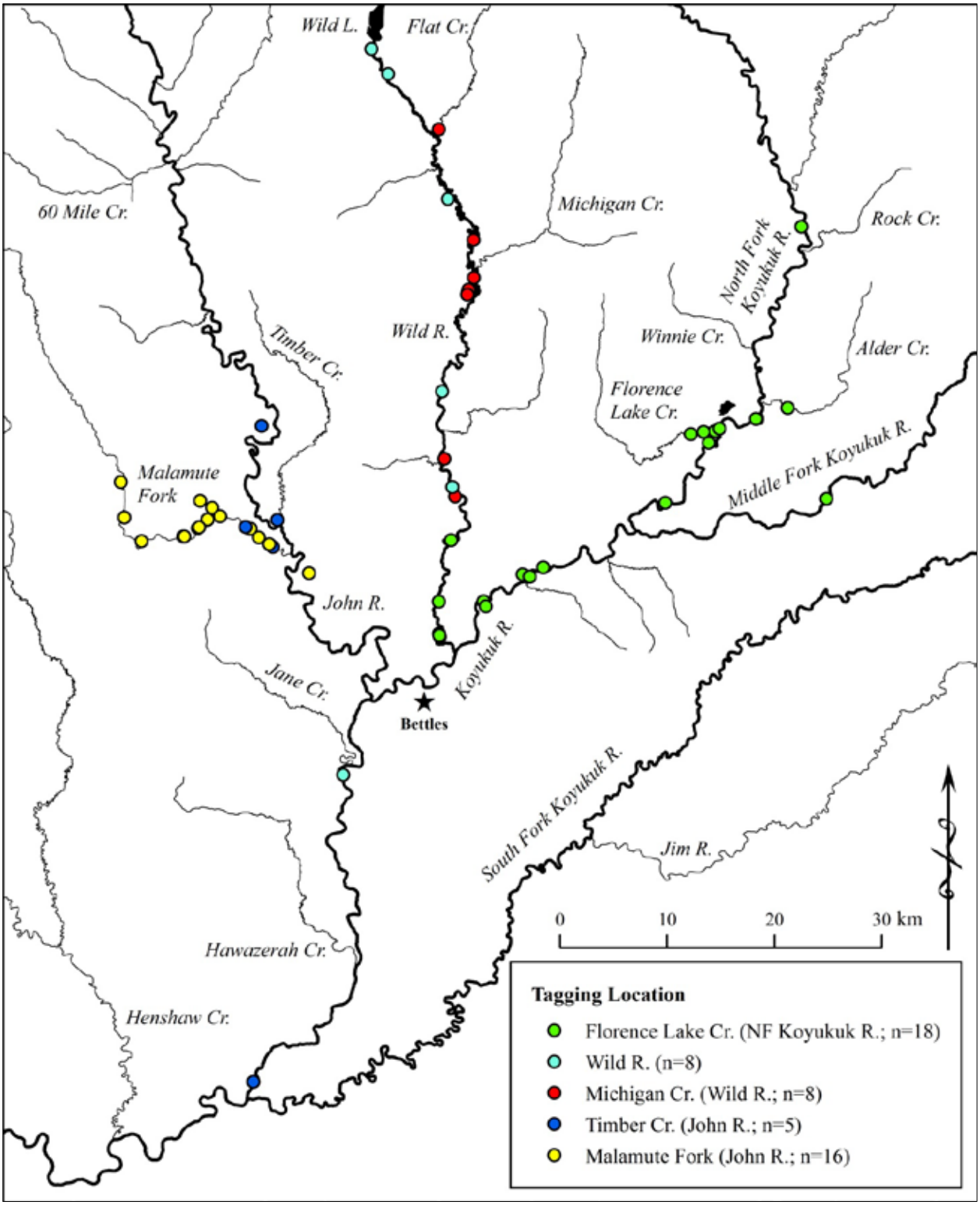
Appendix A4.–Locations of radiotagged Arctic grayling on 30 March 2015 sampled in tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



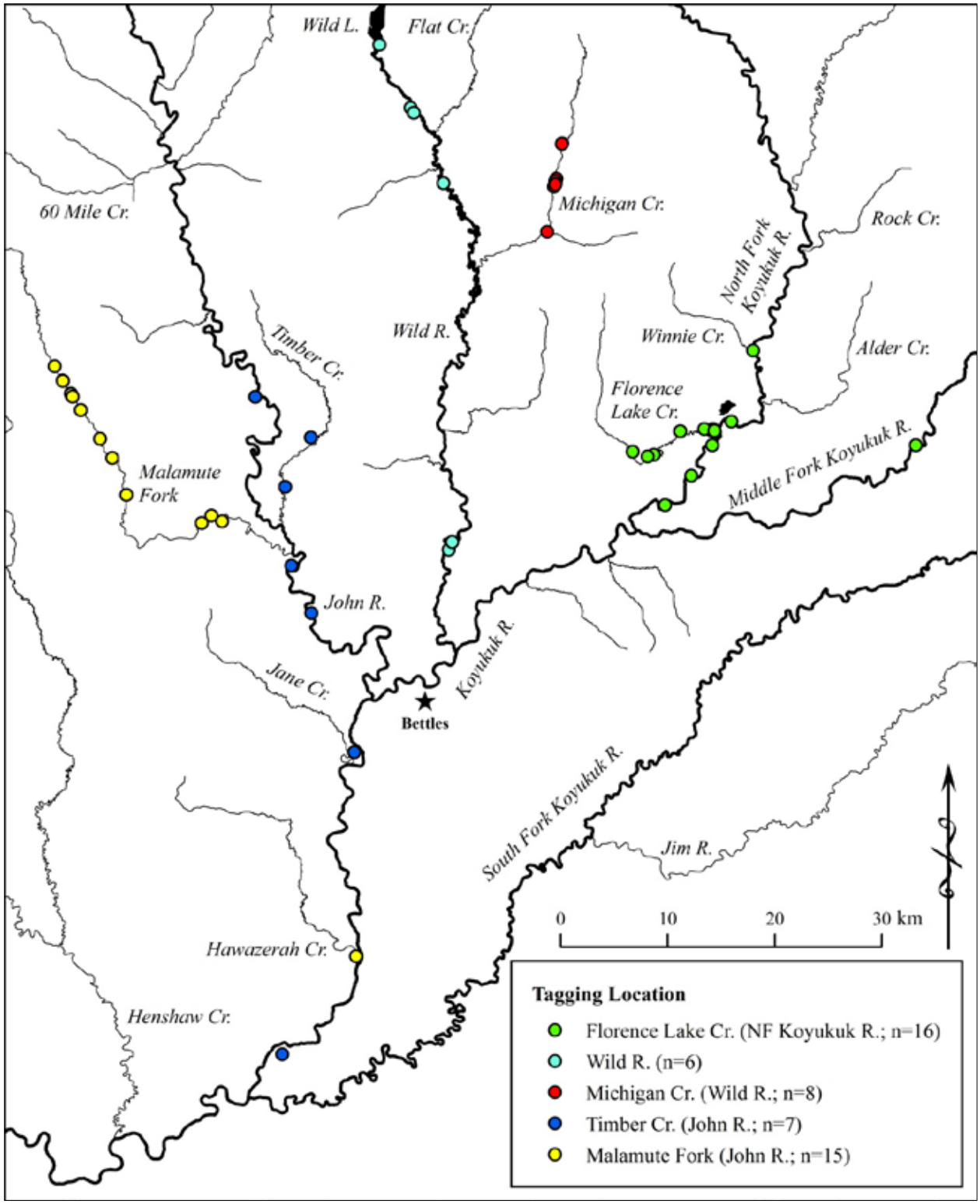
Appendix A5.–Locations of radiotagged Arctic grayling on 7 May 2015 sampled in tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



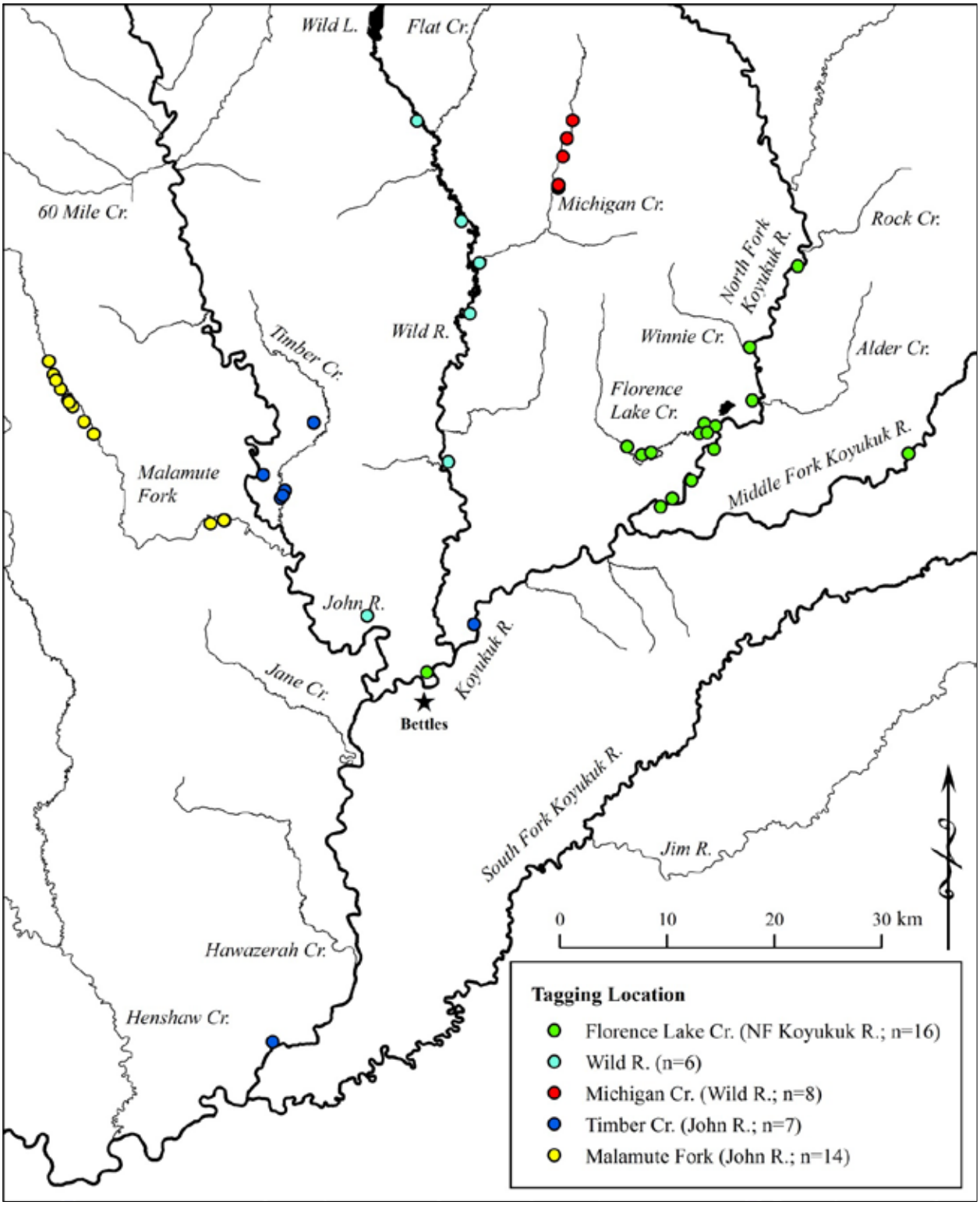
Appendix A6.–Locations of radiotagged Arctic grayling on 20 May 2015 sampled in tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



Appendix A7.–Locations of radiotagged Arctic grayling on 2 June 2015 sampled in tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

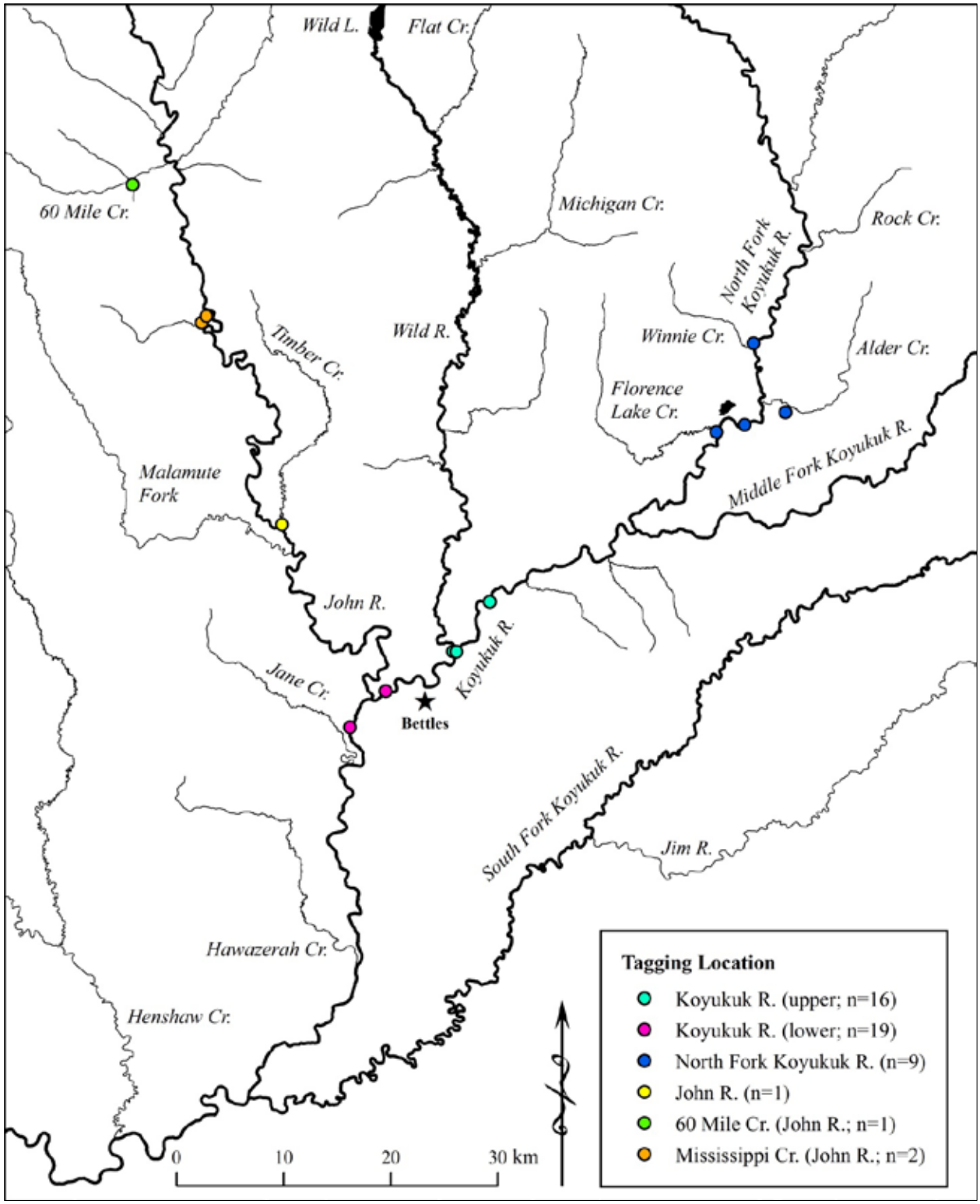


Appendix A8.–Locations of radiotagged Arctic grayling on 1 August 2015 sampled in tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

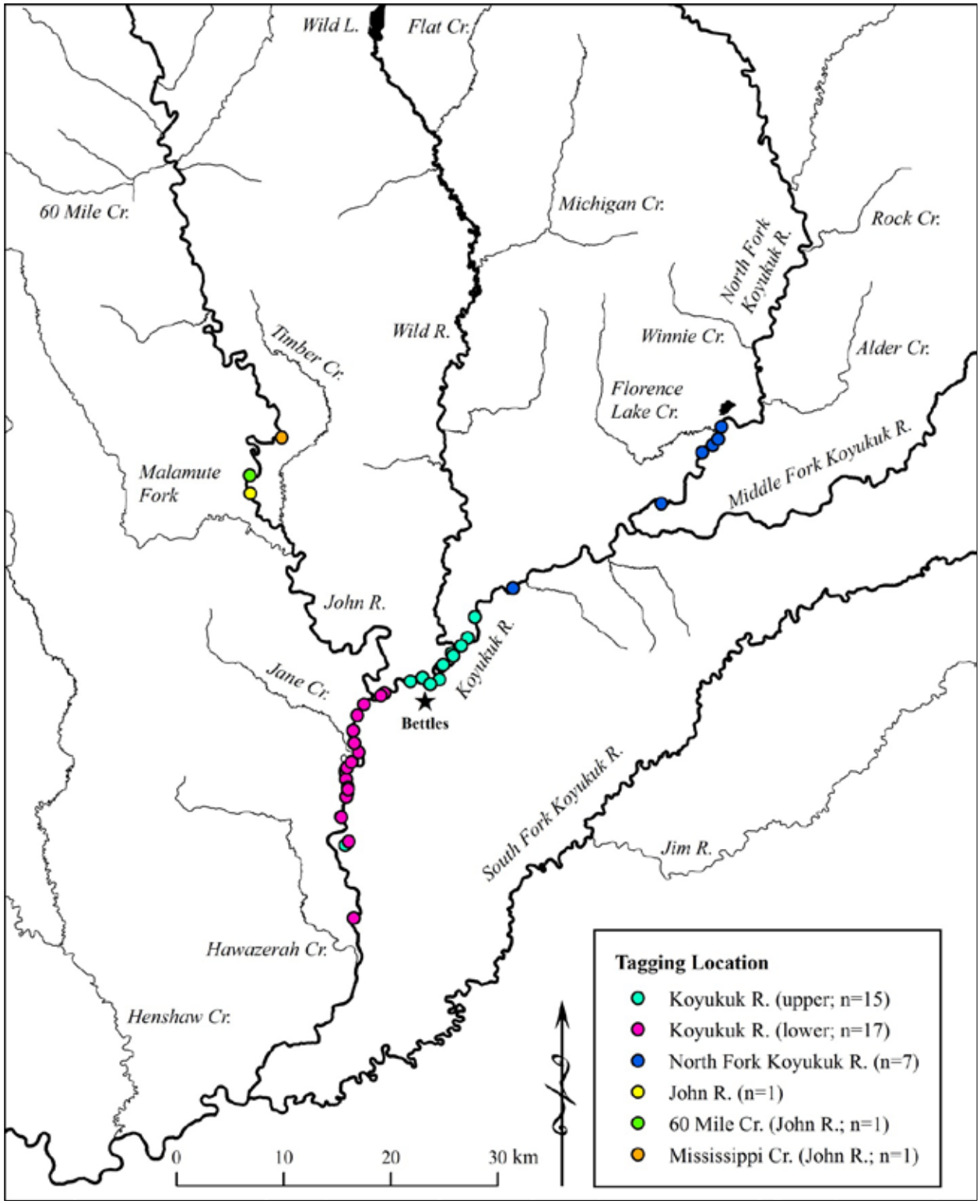


APPENDIX B:
LOCATIONS OF RADIOTAGGED ARCTIC GRAYLING SAMPLED IN THE MAINSTEM REACHES AND TRIBUTARIES WITHIN THE KOYUKUK STUDY AREA

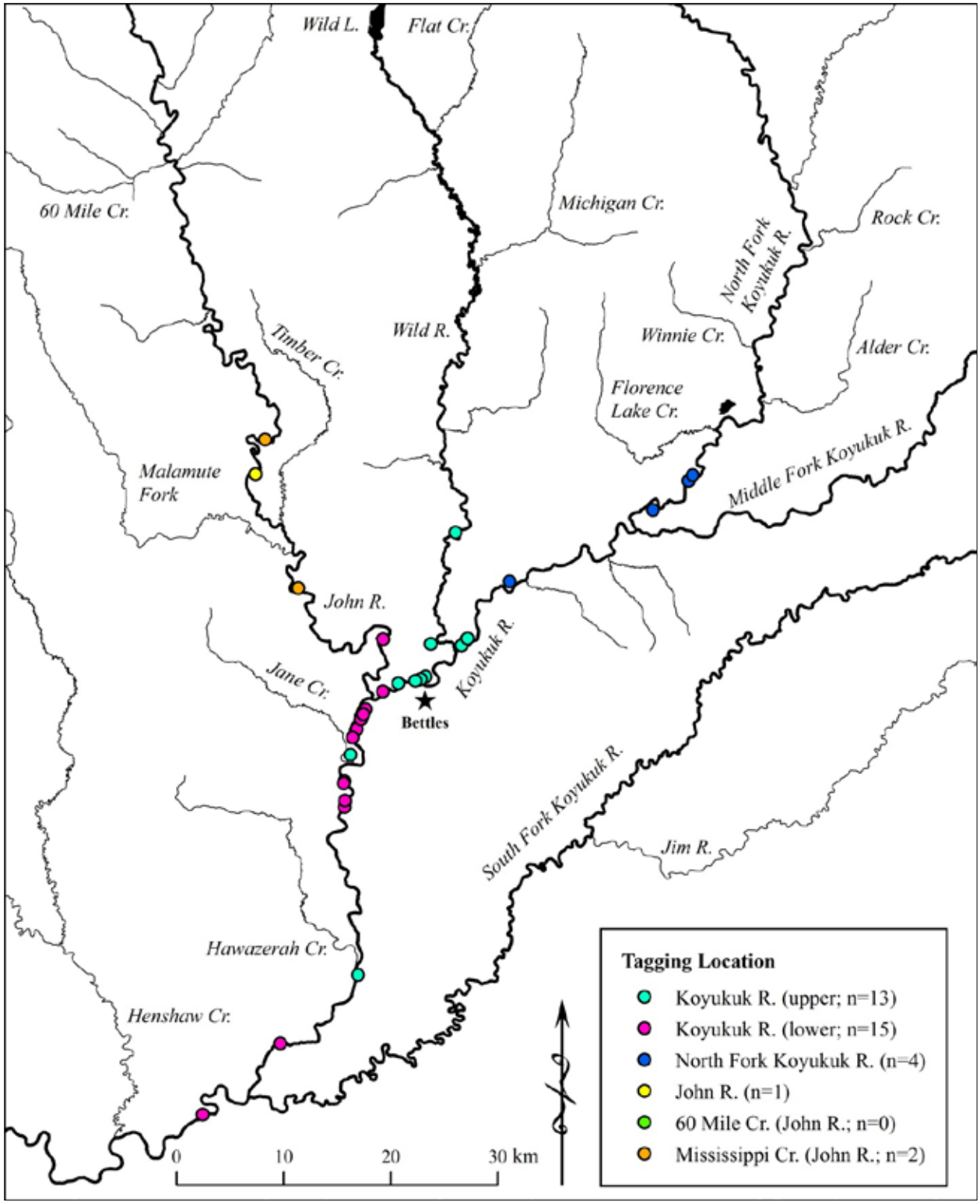
Appendix B1.–Tagging locations for Arctic grayling sampled in mainstem reaches and tributaries within the Koyukuk study area, 2014. Colors depict a general tagging area and the total number of surviving radiotagged fish are labeled parenthetically in legend.



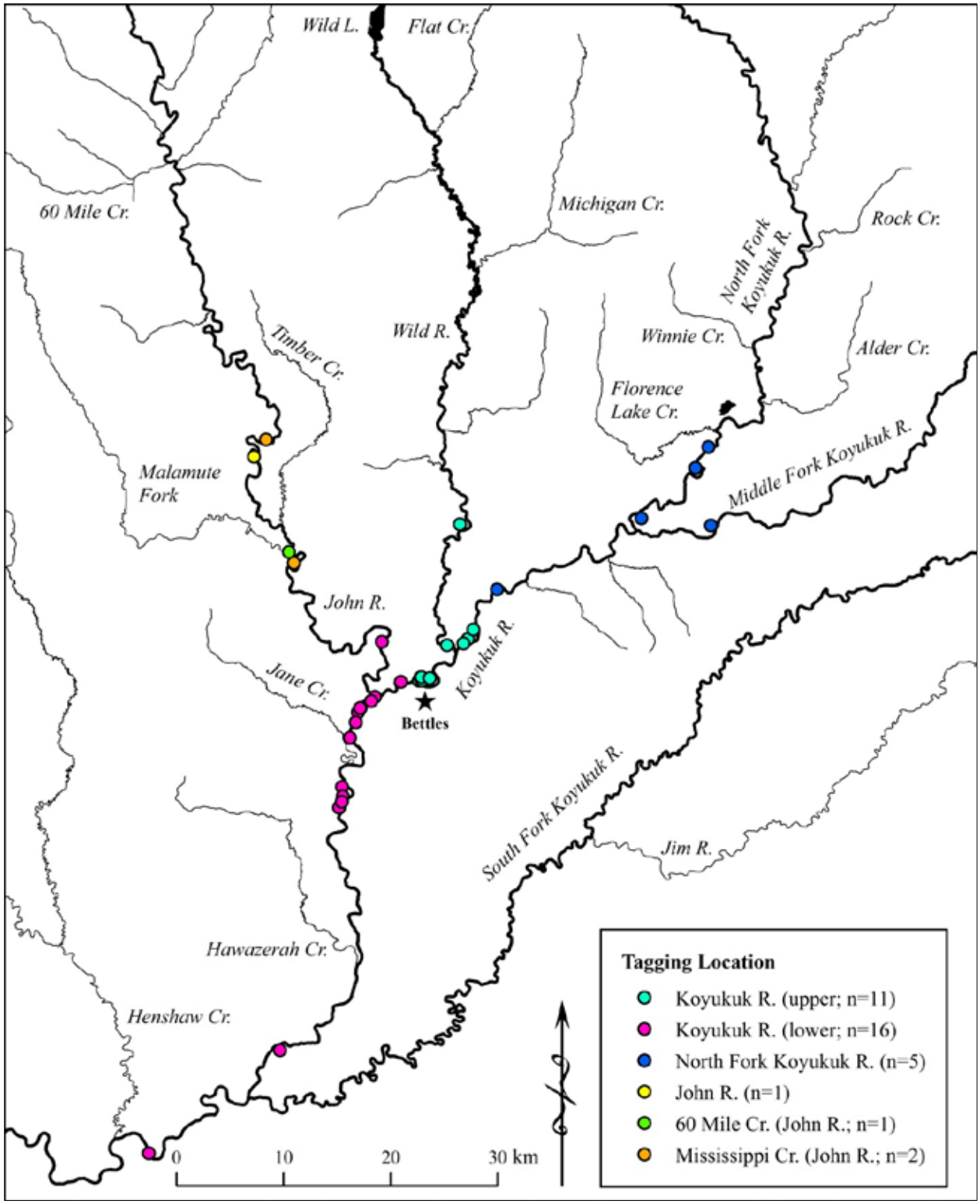
Appendix B2.–Locations of radiotagged Arctic grayling on 25 September 2014 sampled in mainstem reaches and tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



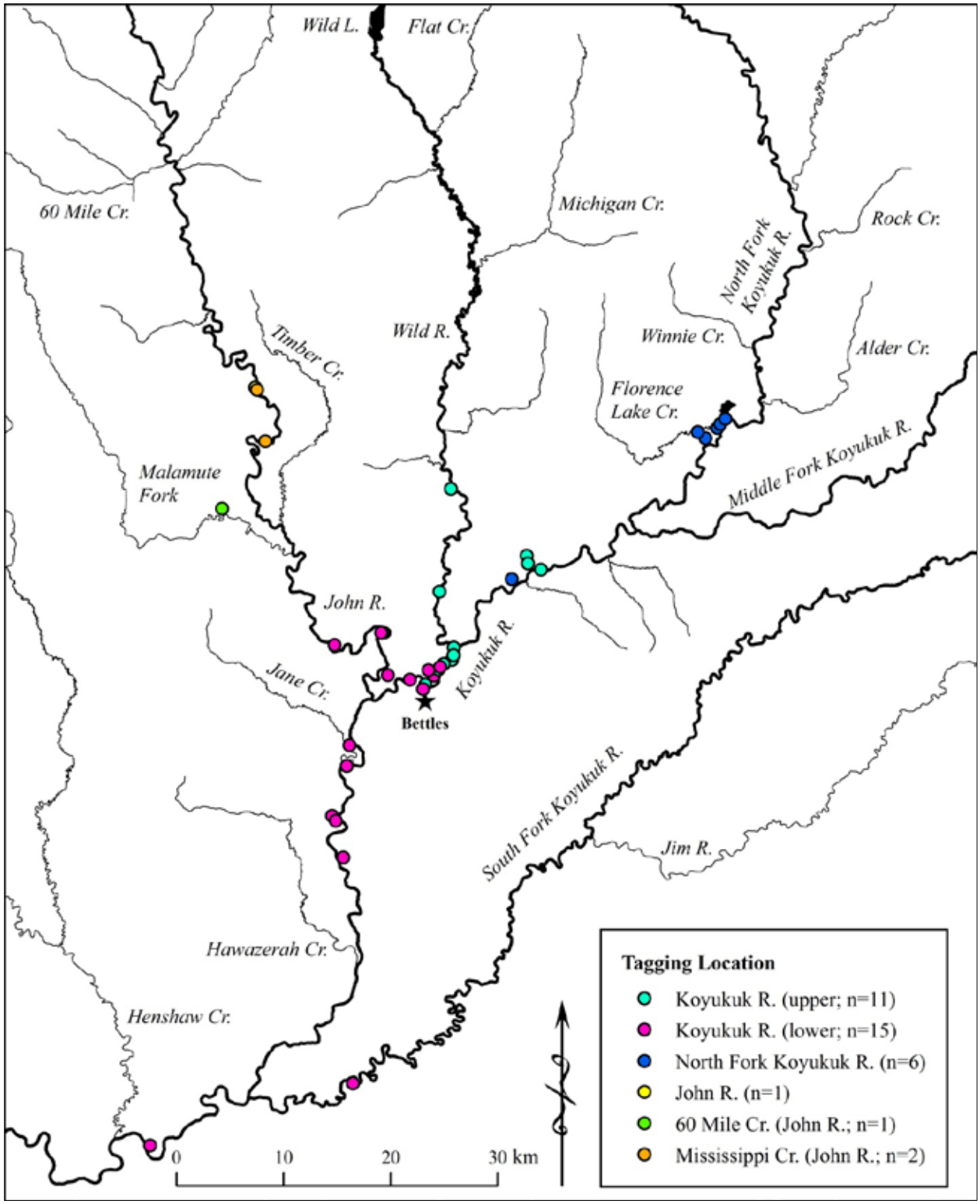
Appendix B3.–Locations of radiotagged Arctic grayling on 1 February 2015 sampled in mainstem reaches and tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



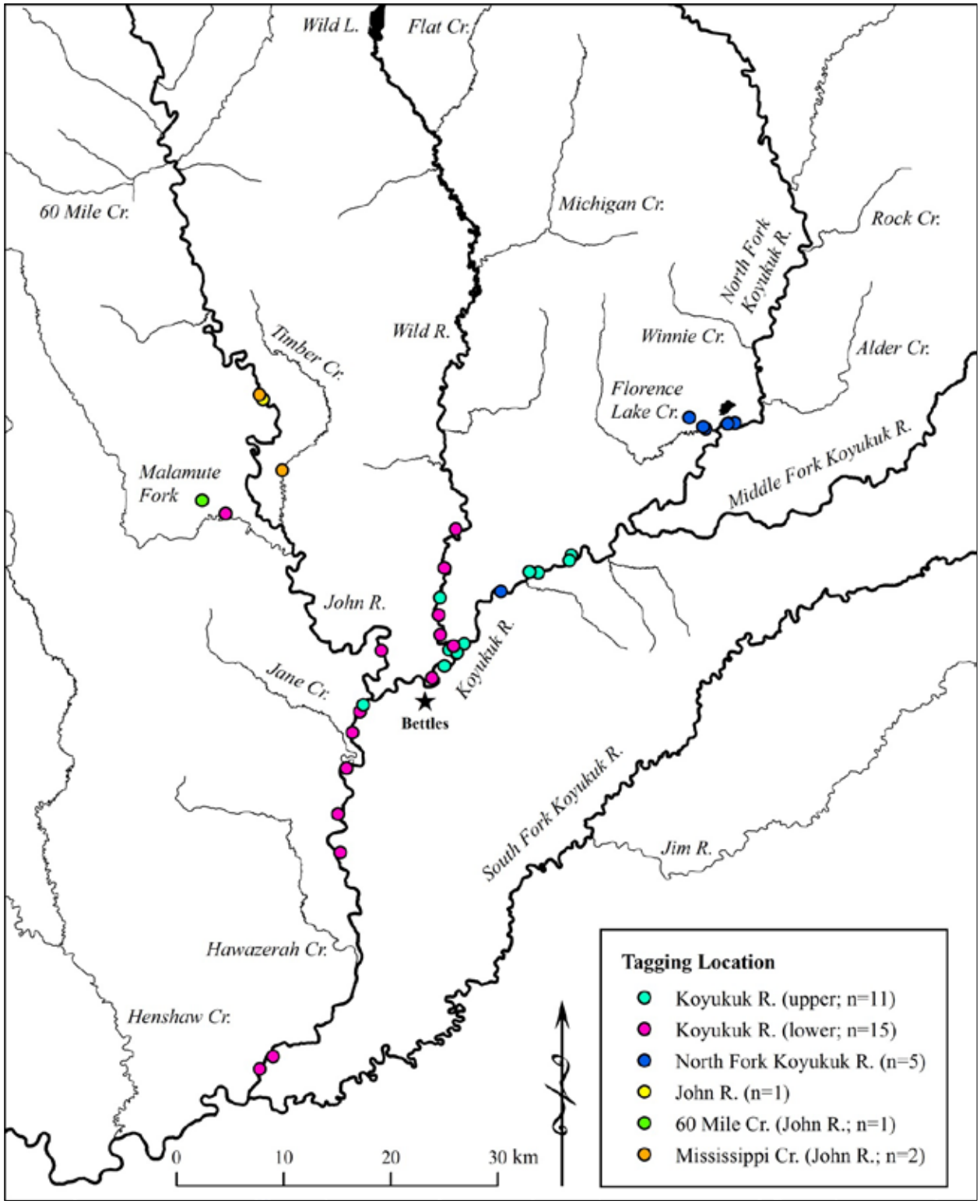
Appendix B4.–Locations of radiotagged Arctic grayling on 30 March 2015 sampled in mainstem reaches and tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



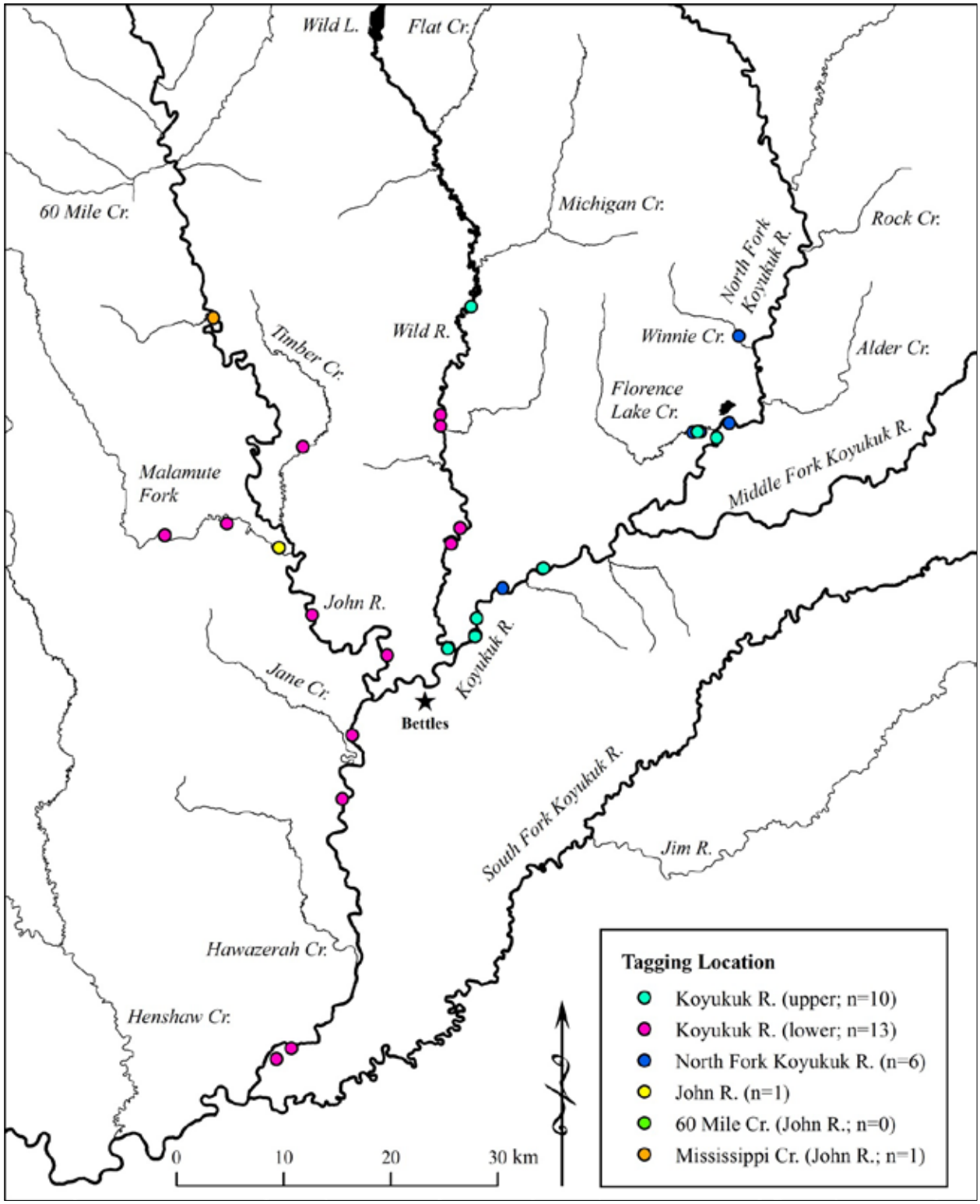
Appendix B5.–Locations of radiotagged Arctic grayling on 7 May 2015 sampled in mainstem reaches and tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



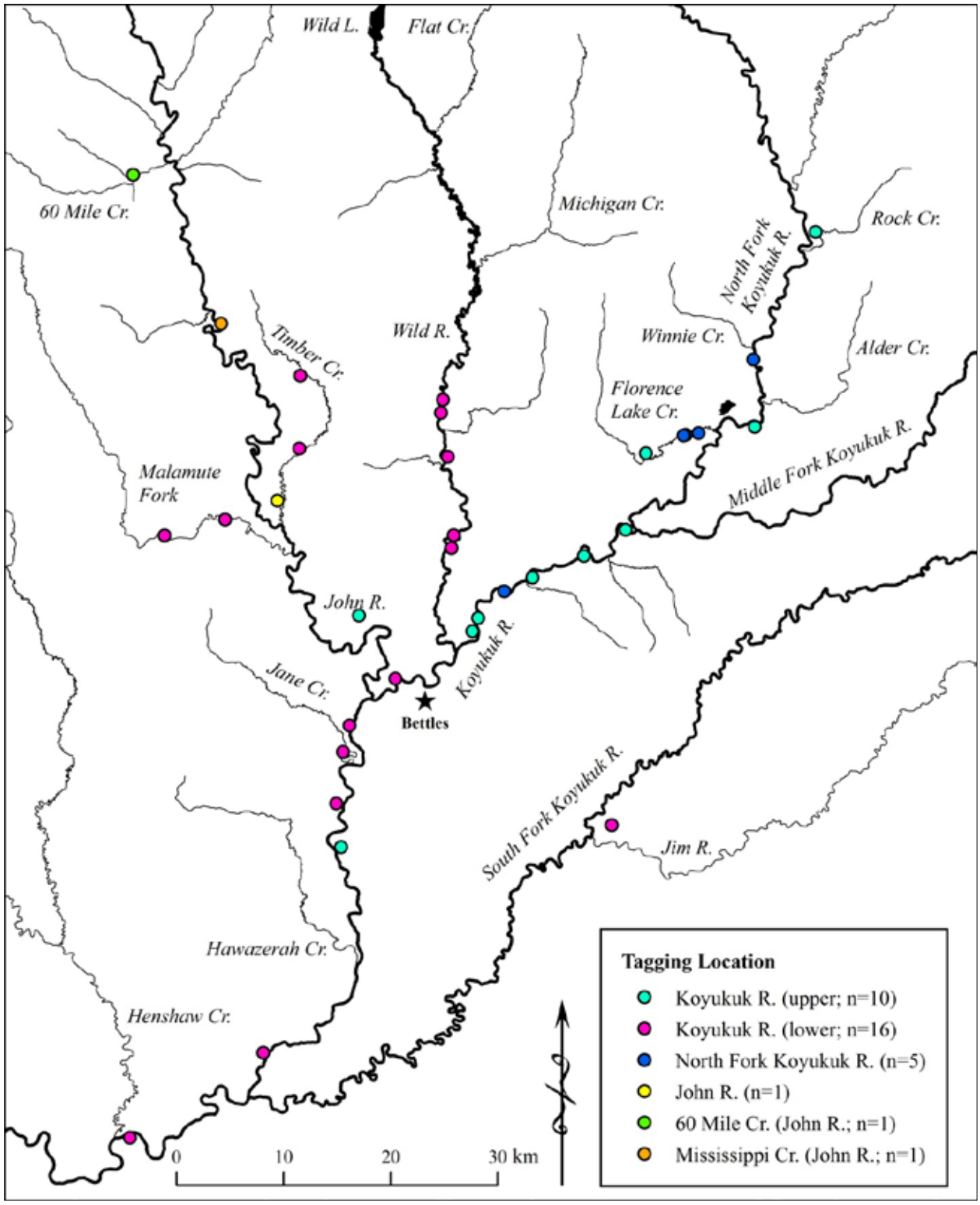
Appendix B6.–Locations of radiotagged Arctic grayling on 20 May 2015 sampled in mainstem reaches and tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



Appendix B7.–Locations of radiotagged Arctic grayling on 2 June 2015 sampled in mainstem reaches and tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

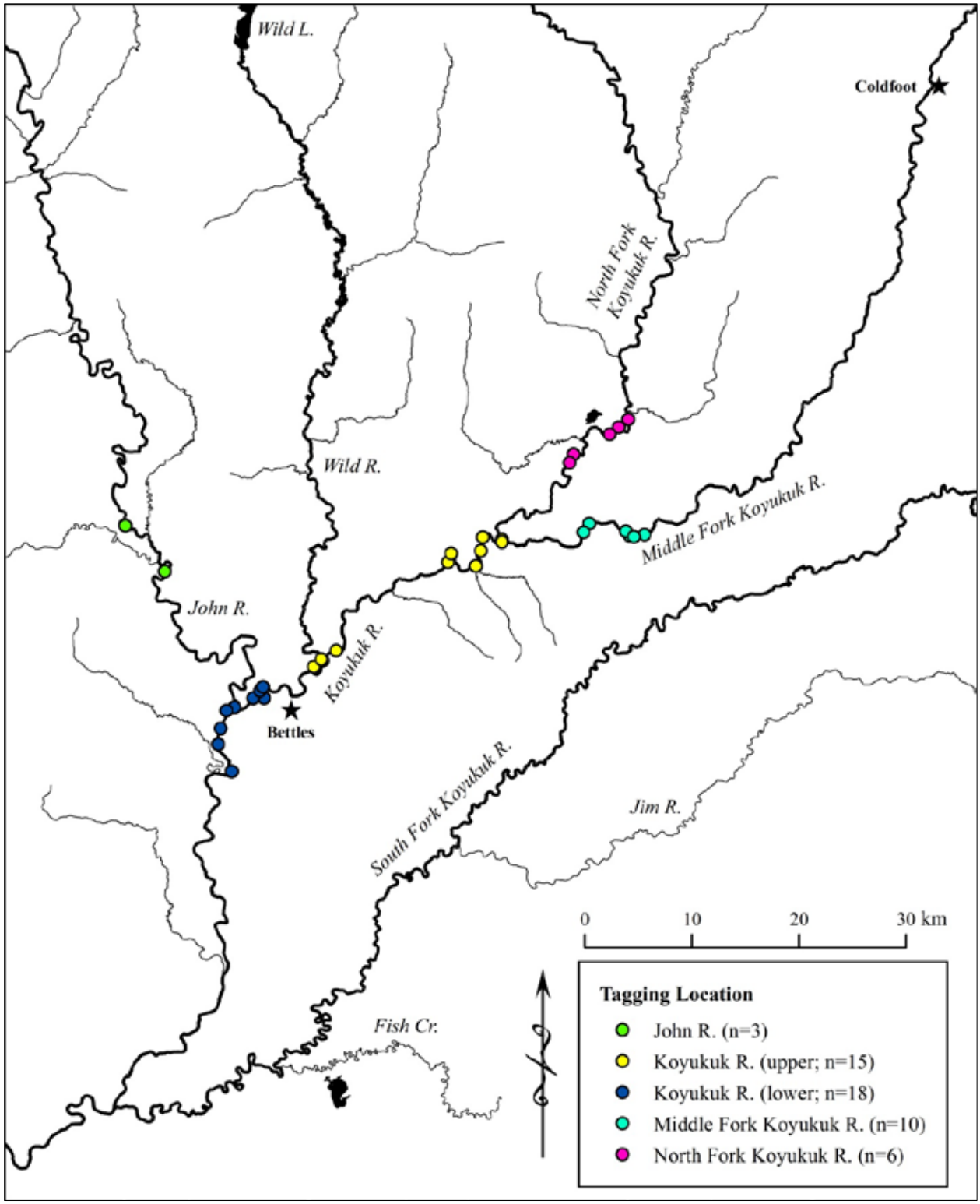


Appendix B8.–Locations of radiotagged Arctic grayling on 1 August 2015 sampled in mainstem reaches and tributaries within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

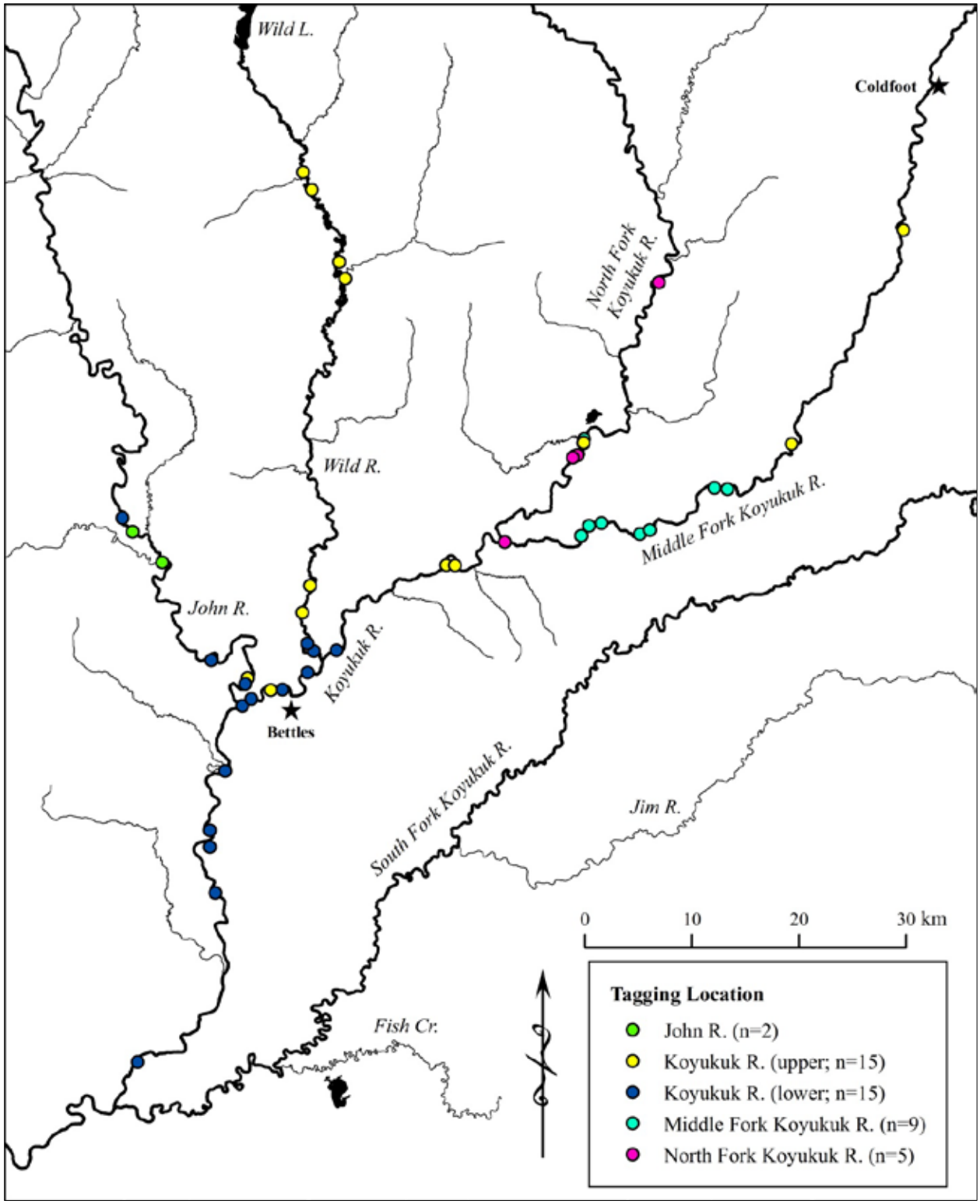


APPENDIX C:
LOCATIONS OF RADIOTAGGED BURBOT SAMPLED IN THE MAINSTEM REACHES WITHIN THE KOYUKUK STUDY AREA

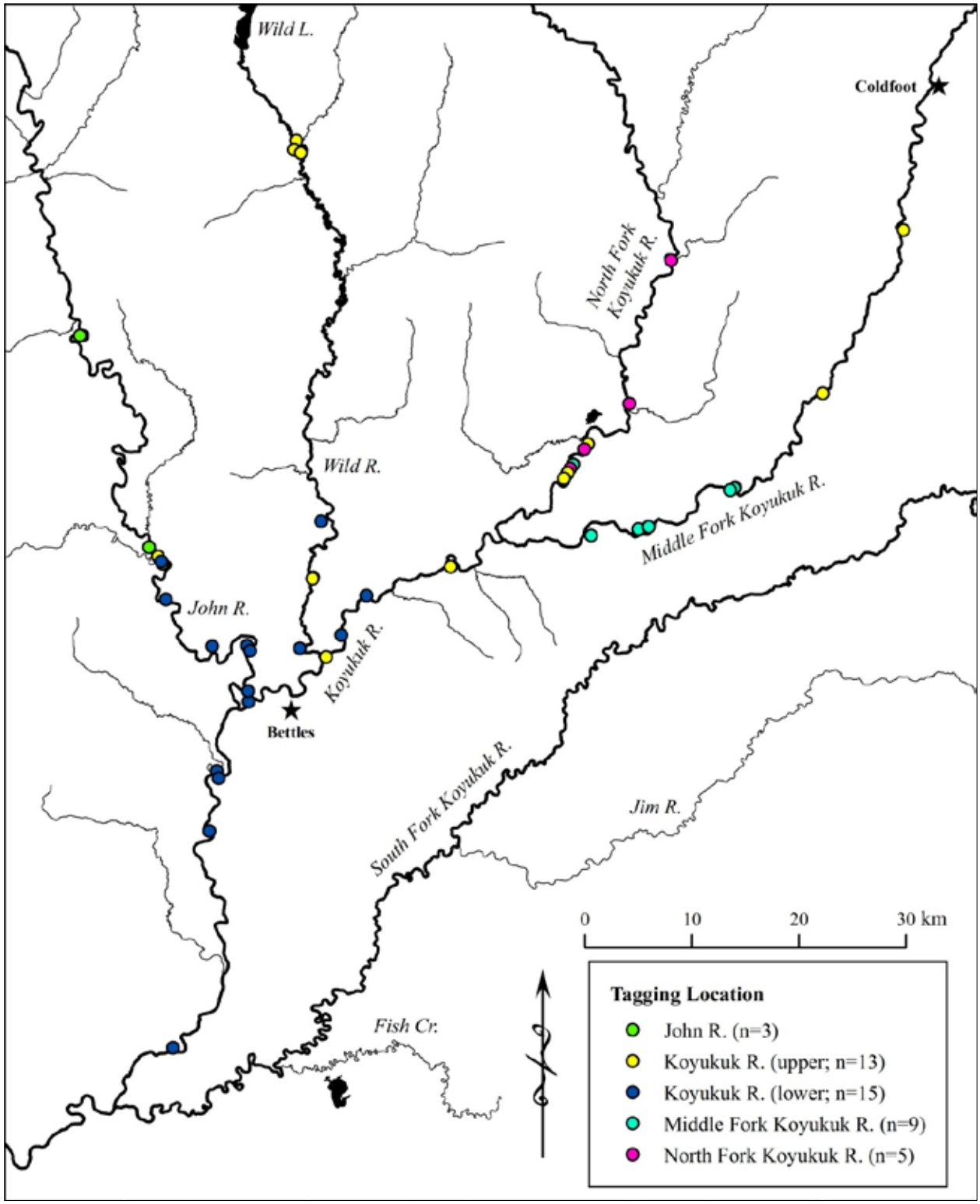
Appendix C1.–Tagging locations for burbot sampled in mainstem reaches within the Koyukuk study area, 2014. Colors depict a general tagging area and the total number of surviving radiotagged fish are labeled parenthetically in legend.



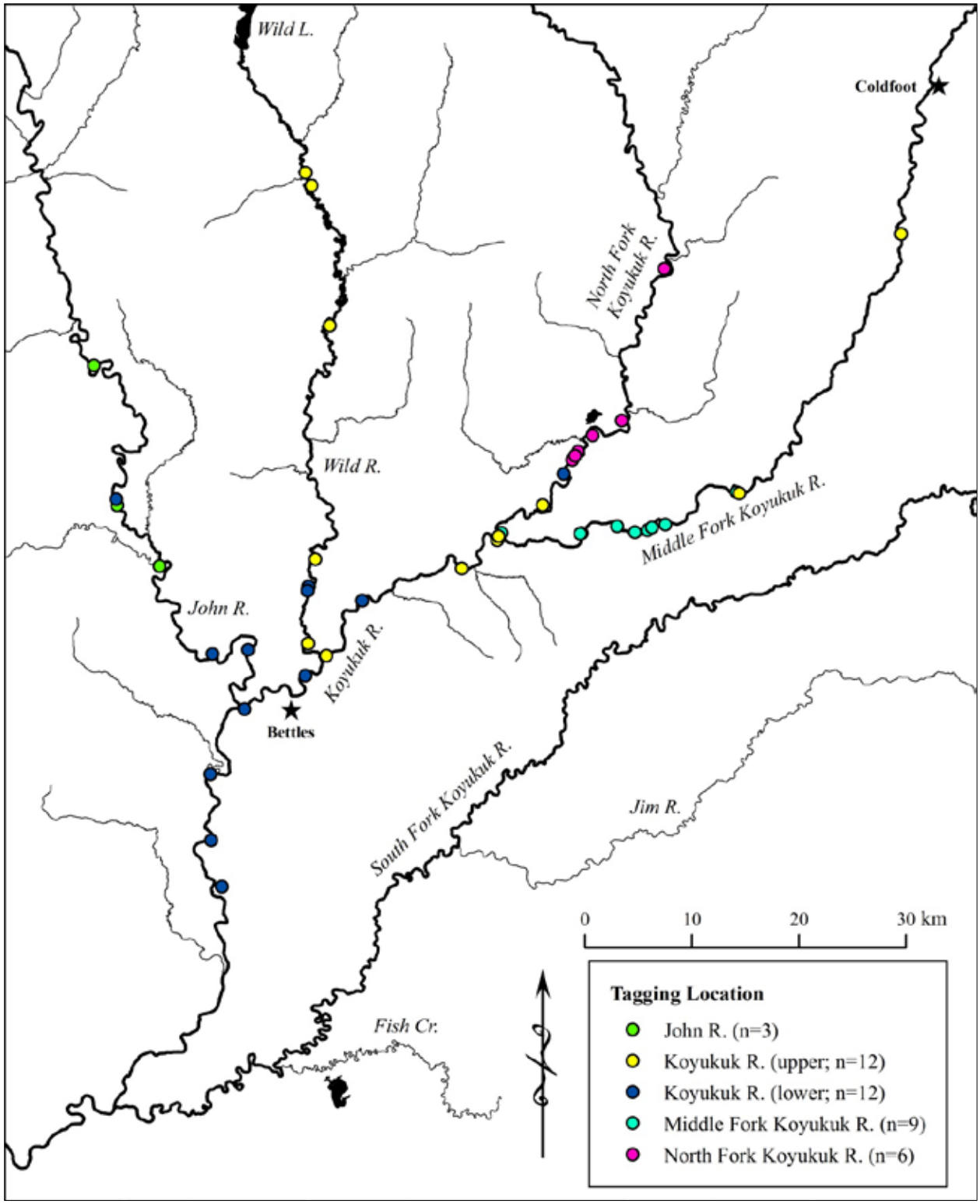
Appendix C2.–Locations of radiotagged burbot on 13 December 2014 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



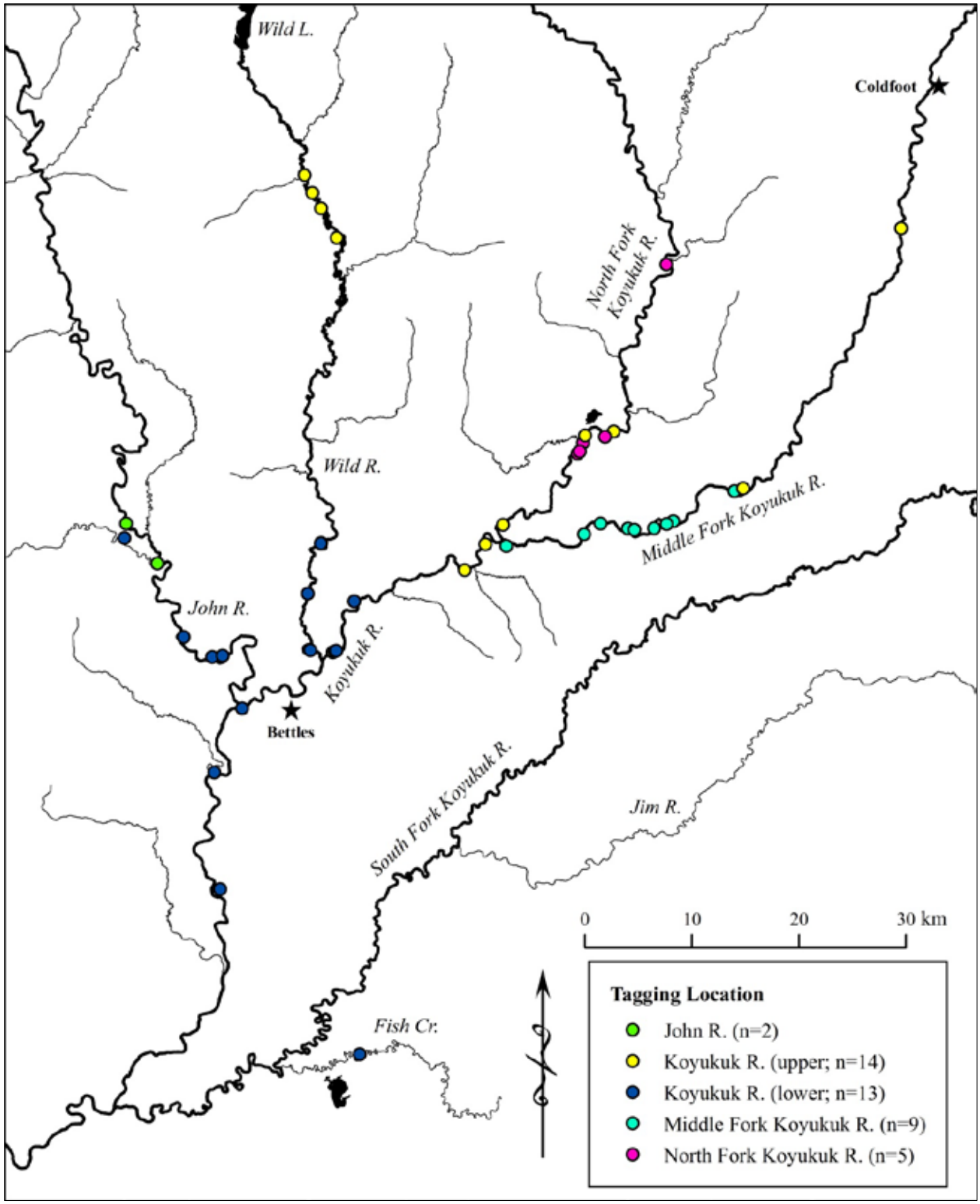
Appendix C3.–Locations of radiotagged burbot on 1 and 3 February 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



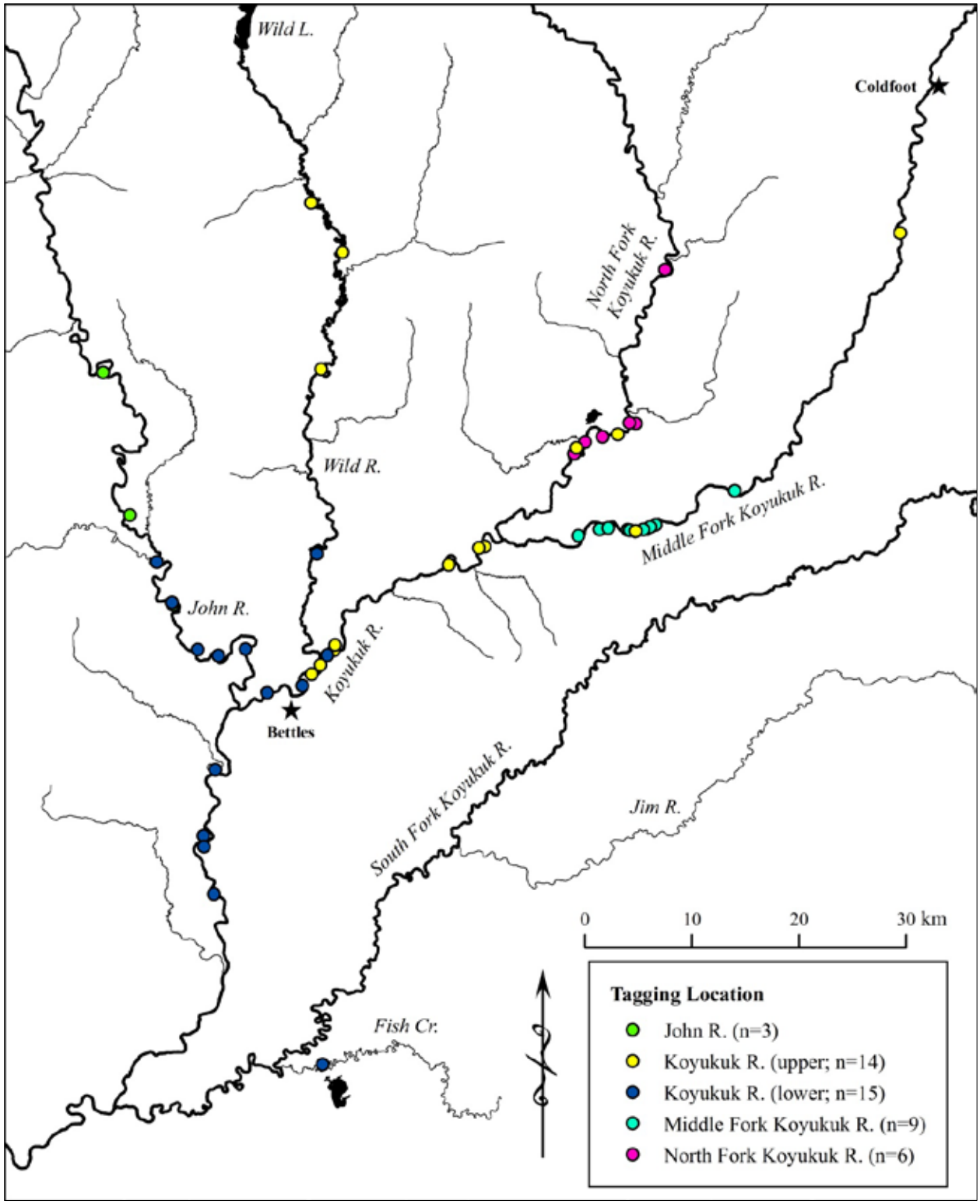
Appendix C4.–Locations of radiotagged burbot on 30 March 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



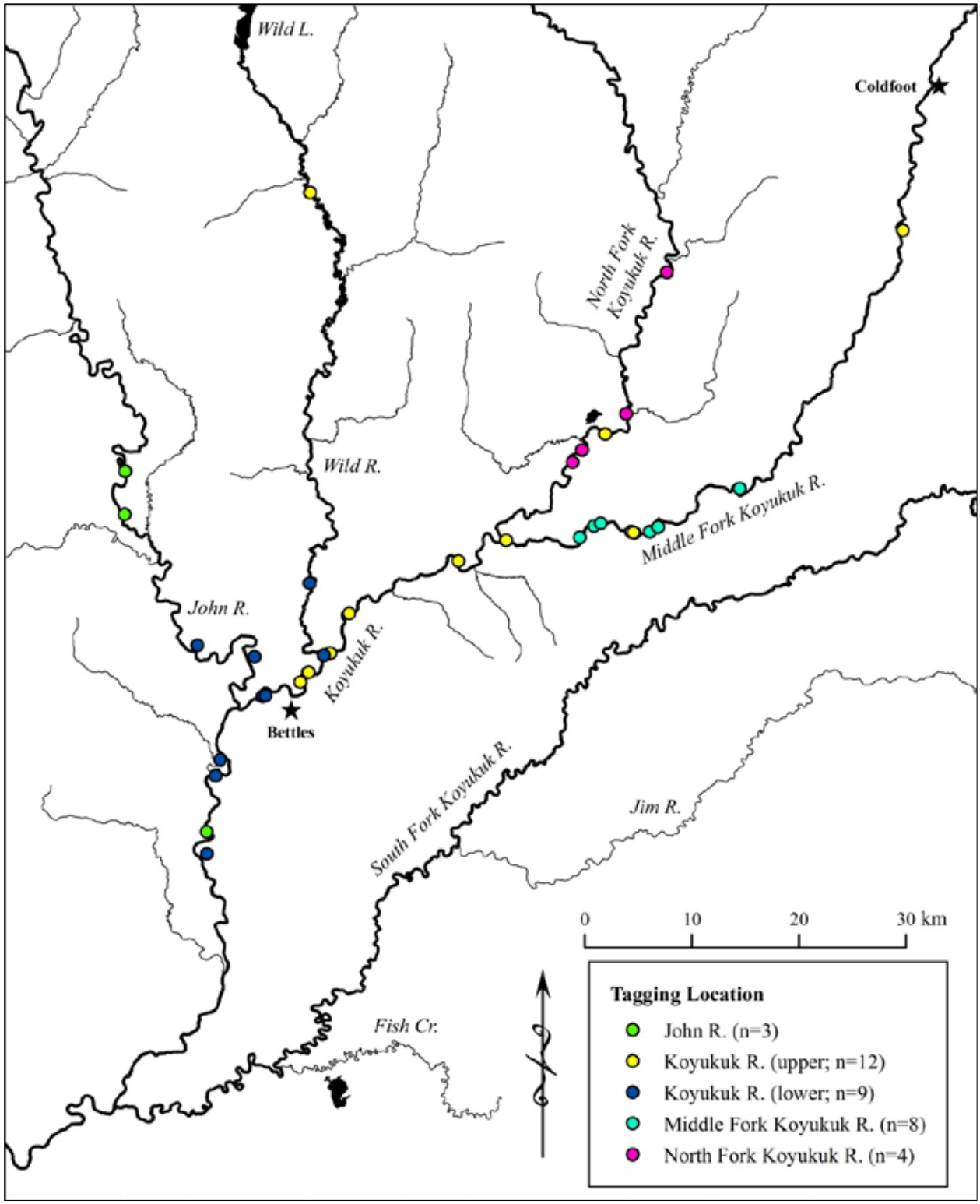
Appendix C5.–Locations of radiotagged burbot on 7 May 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



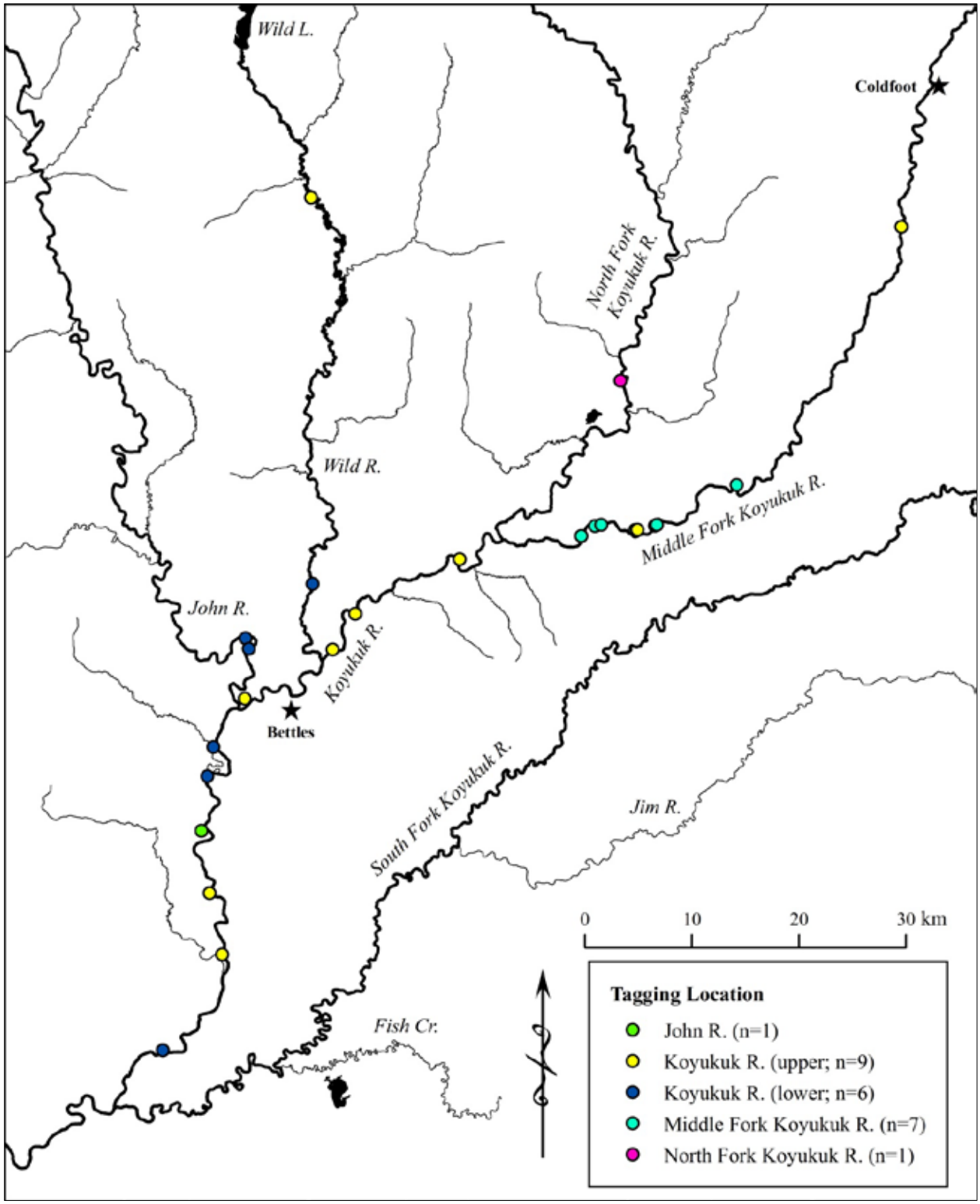
Appendix C6.–Locations of radiotagged burbot on 20 May 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



Appendix C7.–Locations of radiotagged burbot on 2 June 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

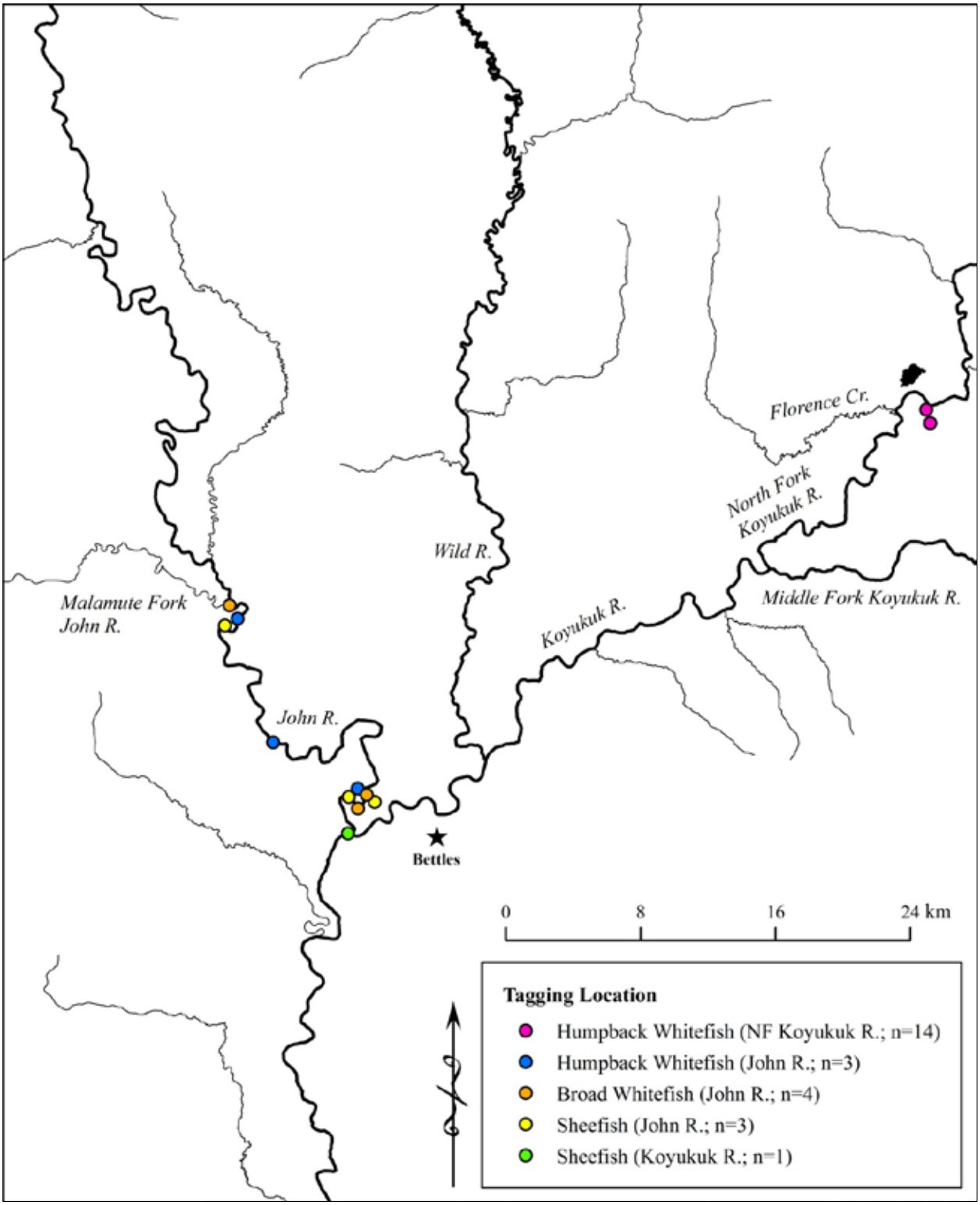


Appendix C8.–Locations of radiotagged burbot on 1 August 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

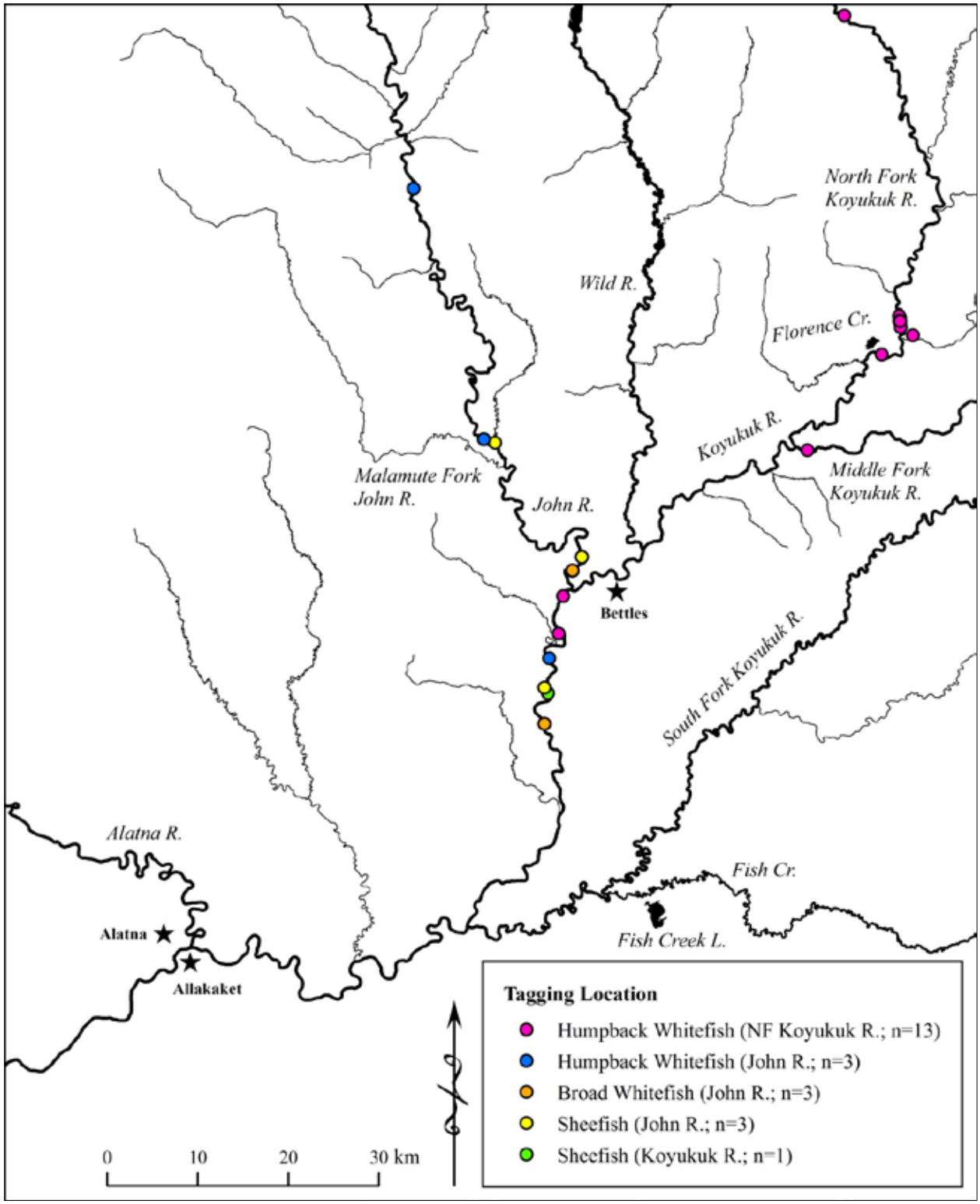


APPENDIX D:
LOCATIONS OF RADIOTAGGED WHITEFISH SAMPLED IN THE MAINSTEM REACHES WITHIN THE KOYUKUK STUDY AREA

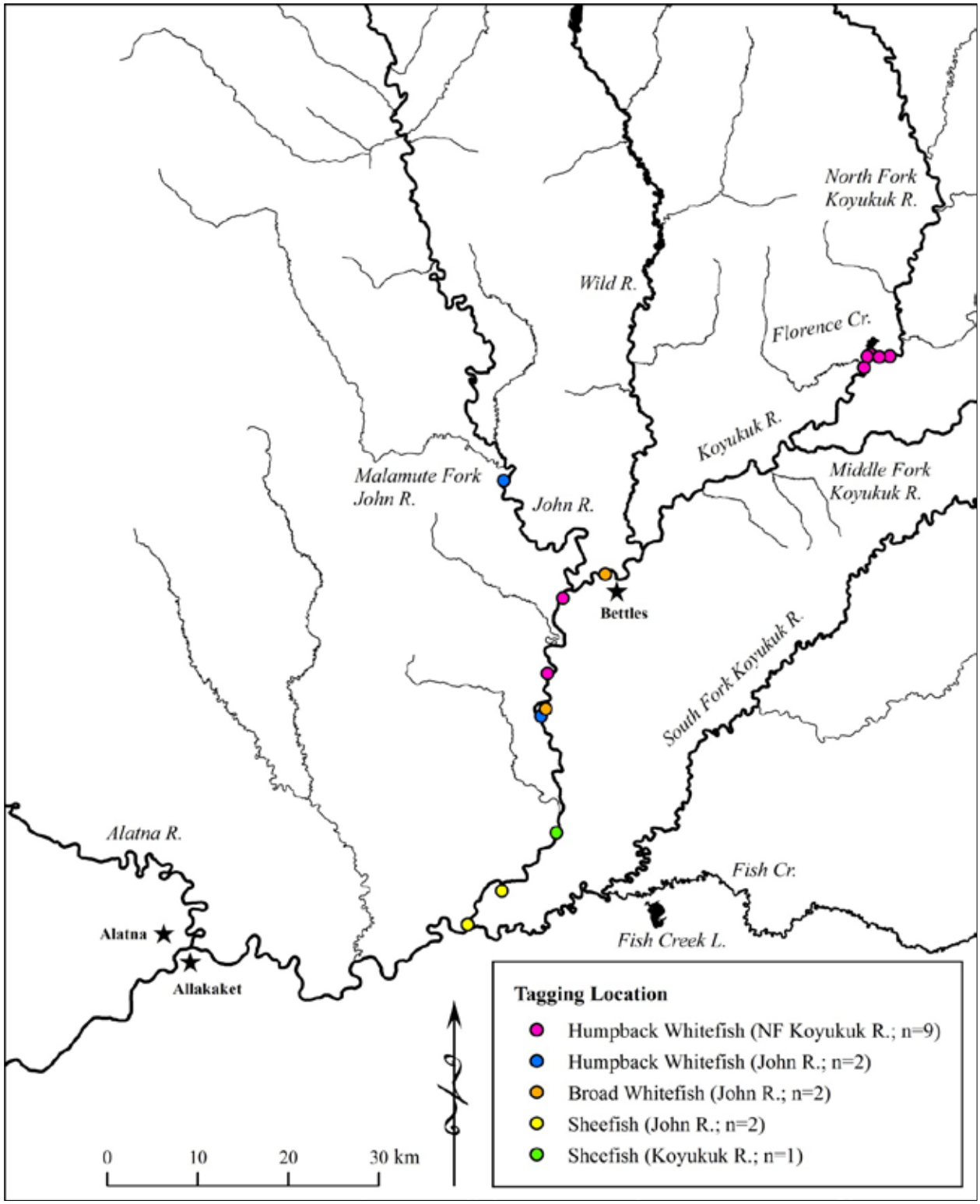
Appendix D1.–Tagging locations of whitefishes sampled in mainstem reaches within the Koyukuk study area, 2014. Colors depict a general tagging area and the total number of surviving radiotagged fish are labeled parenthetically in legend.



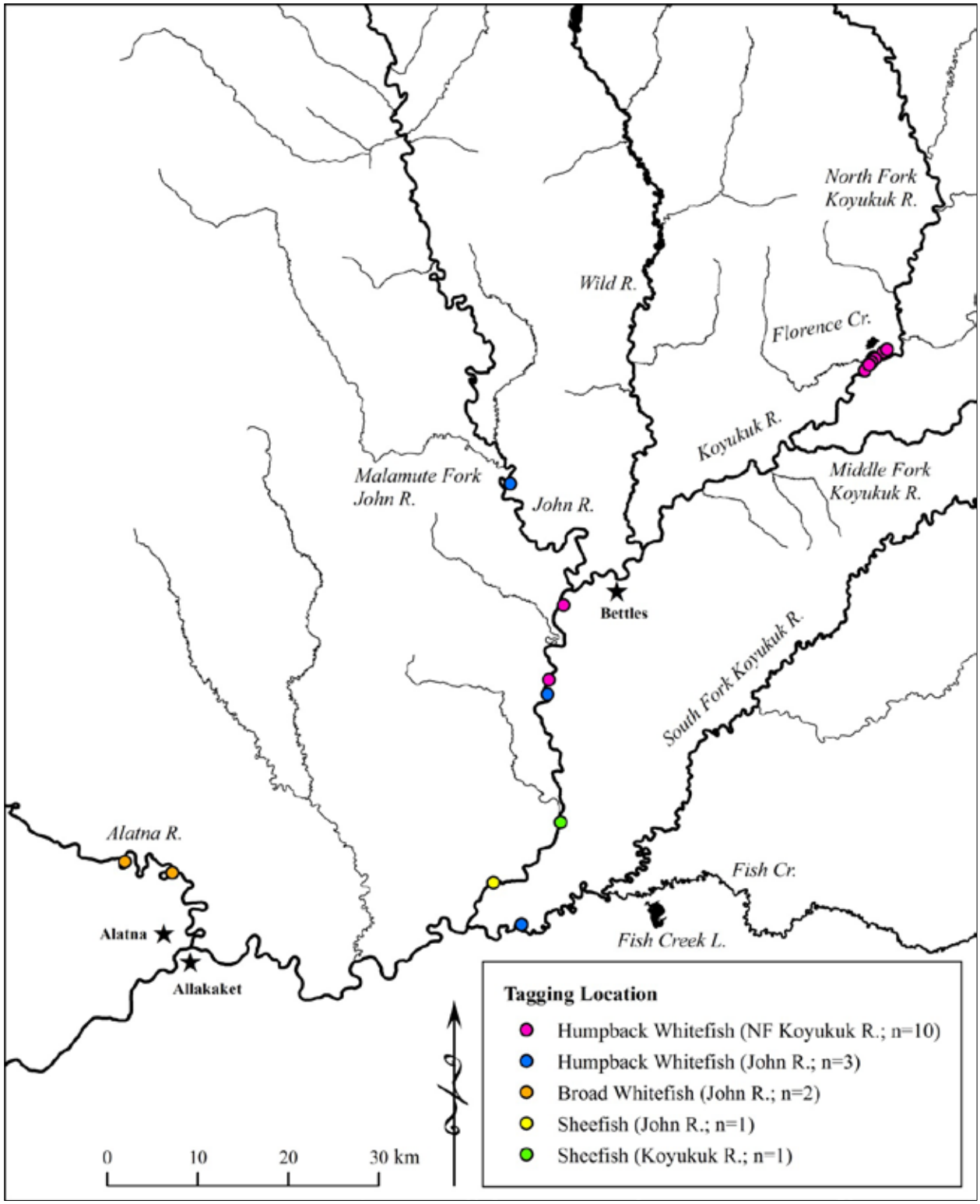
Appendix D2.–Locations of radiotagged whitefishes on 1 October 2014 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



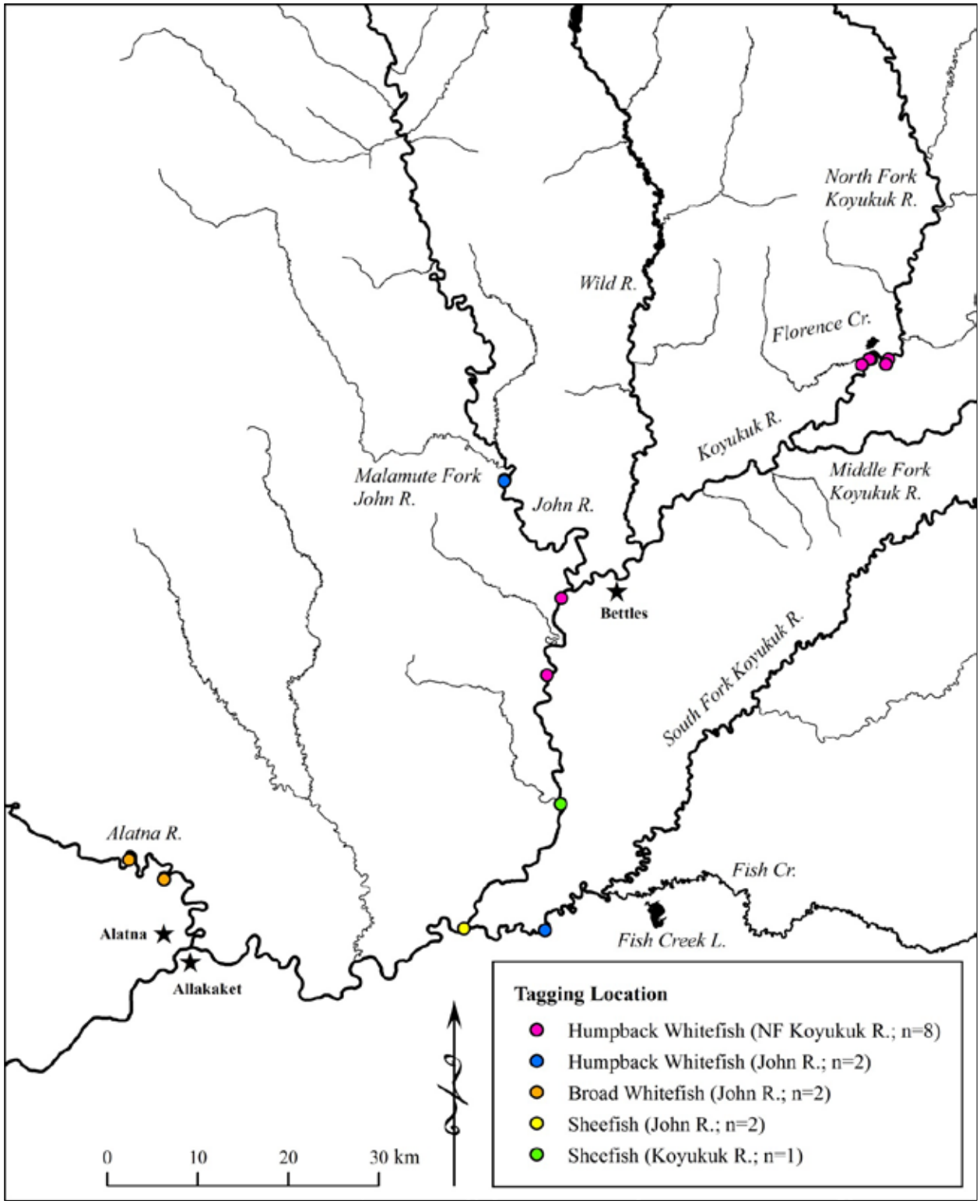
Appendix D3.–Locations of radiotagged whitefishes on 13 December 2014 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



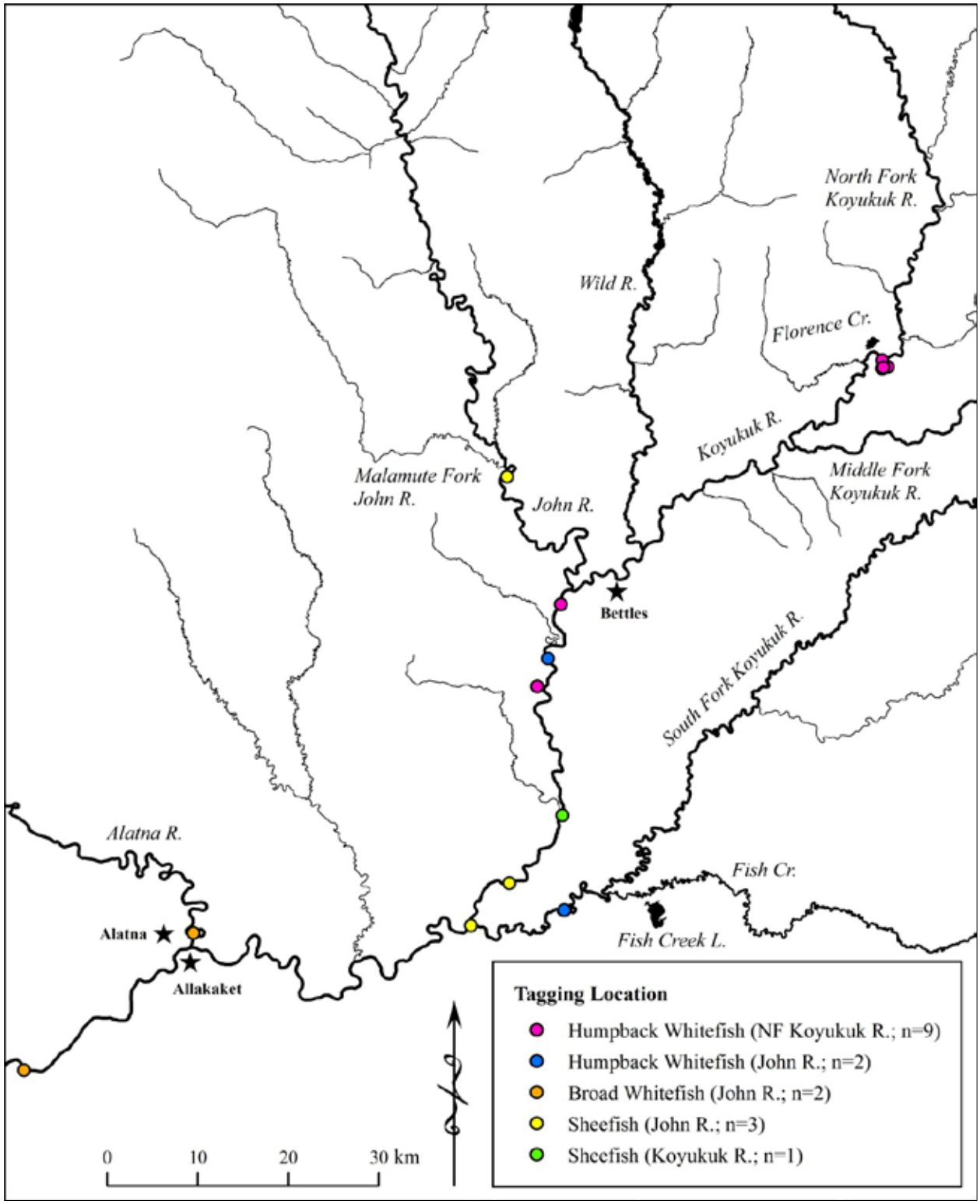
Appendix D4.–Locations of radiotagged whitefishes on 1 February 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



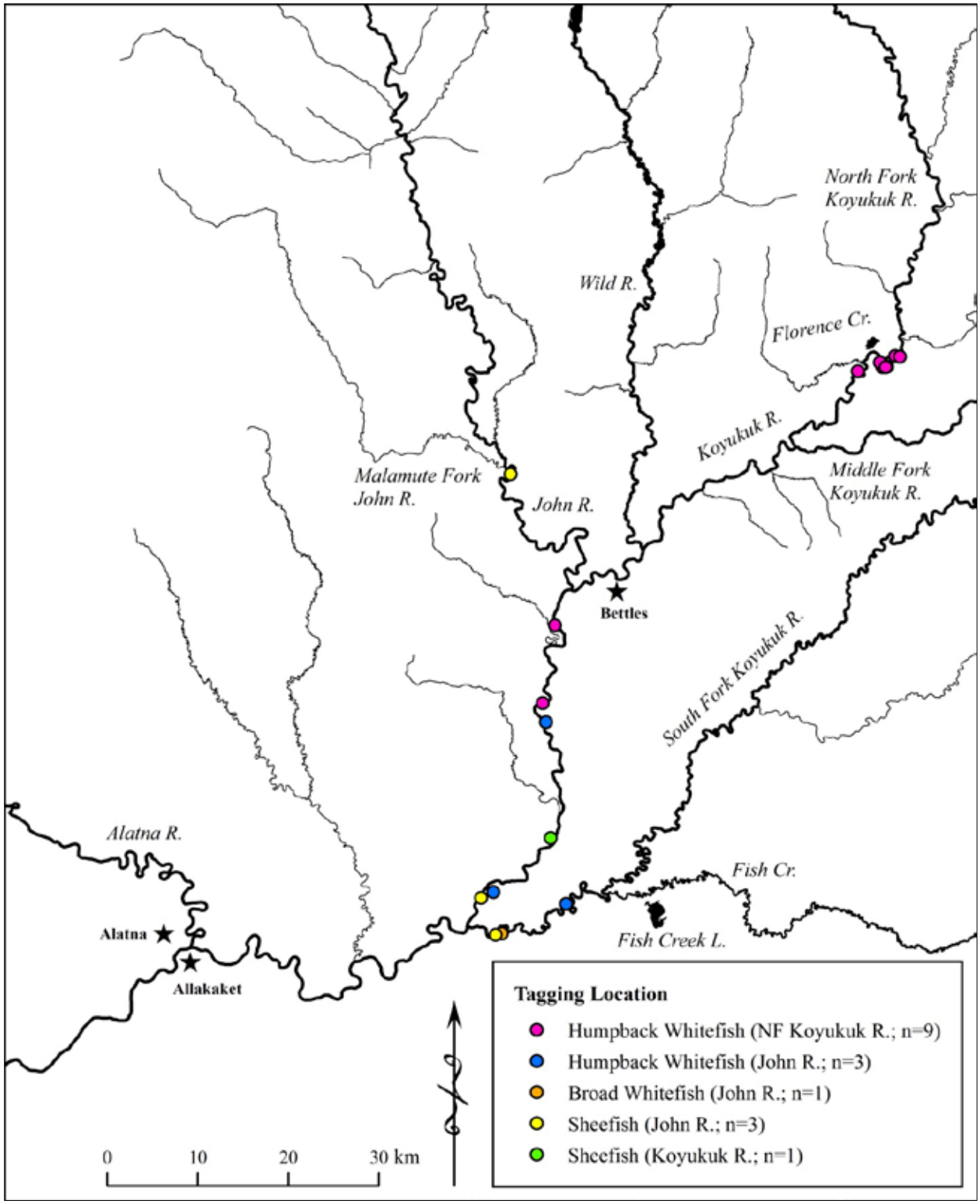
Appendix D5.–Locations of radiotagged whitefishes on 30 March 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



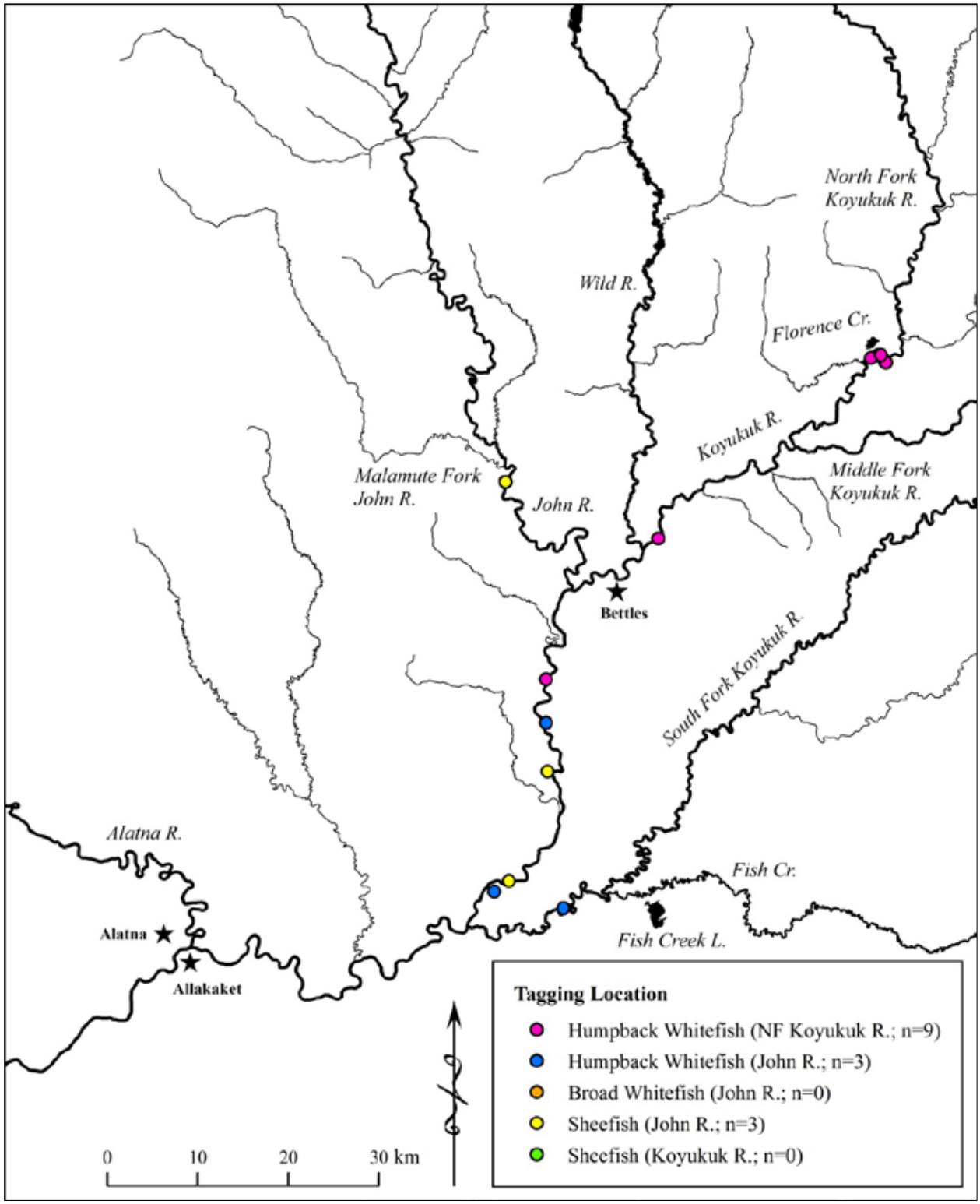
Appendix D6.–Locations of radiotagged whitefishes on 7 May 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



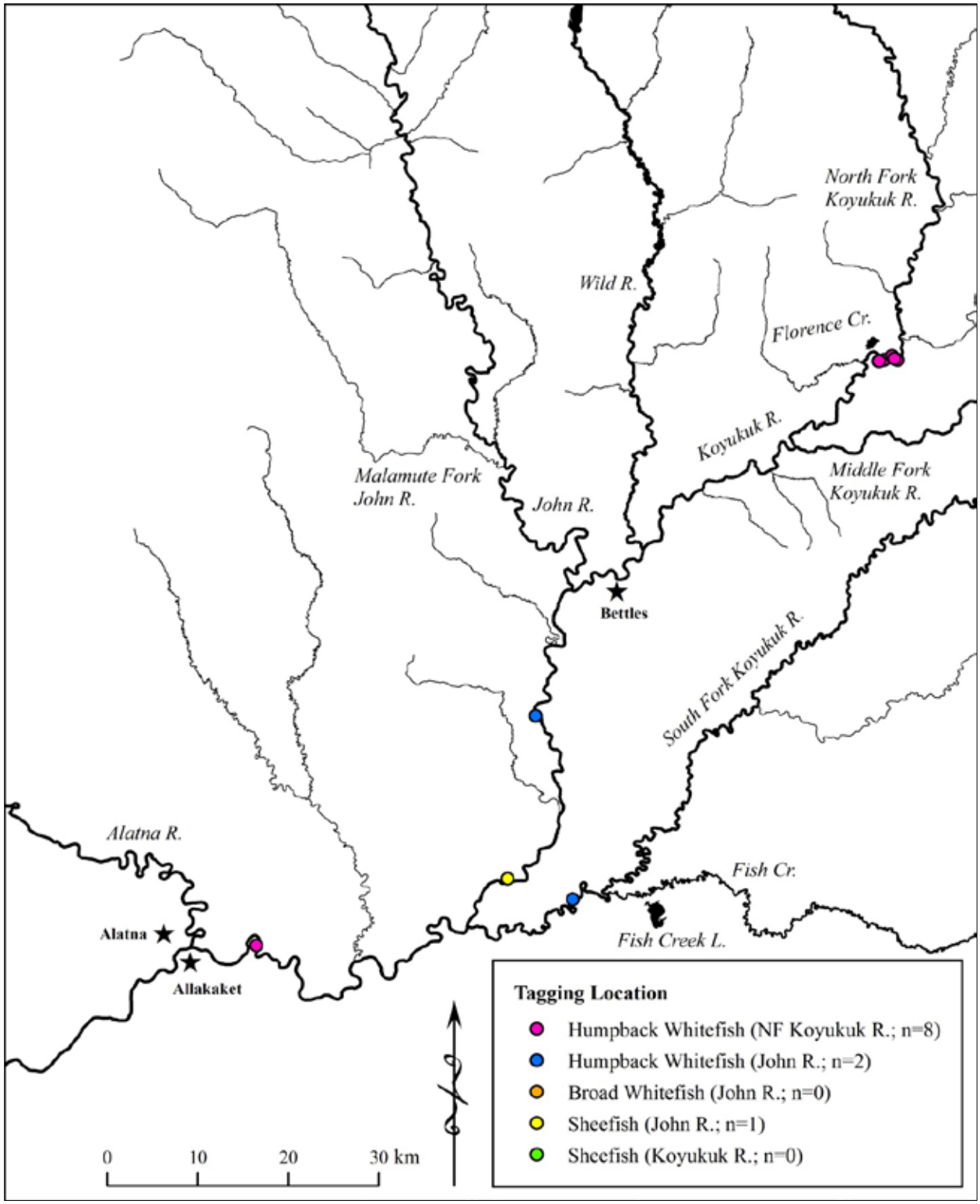
Appendix D7.–Locations of radiotagged whitefishes on 20 May 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



Appendix D8.–Locations of radiotagged whitefishes on 2 June 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

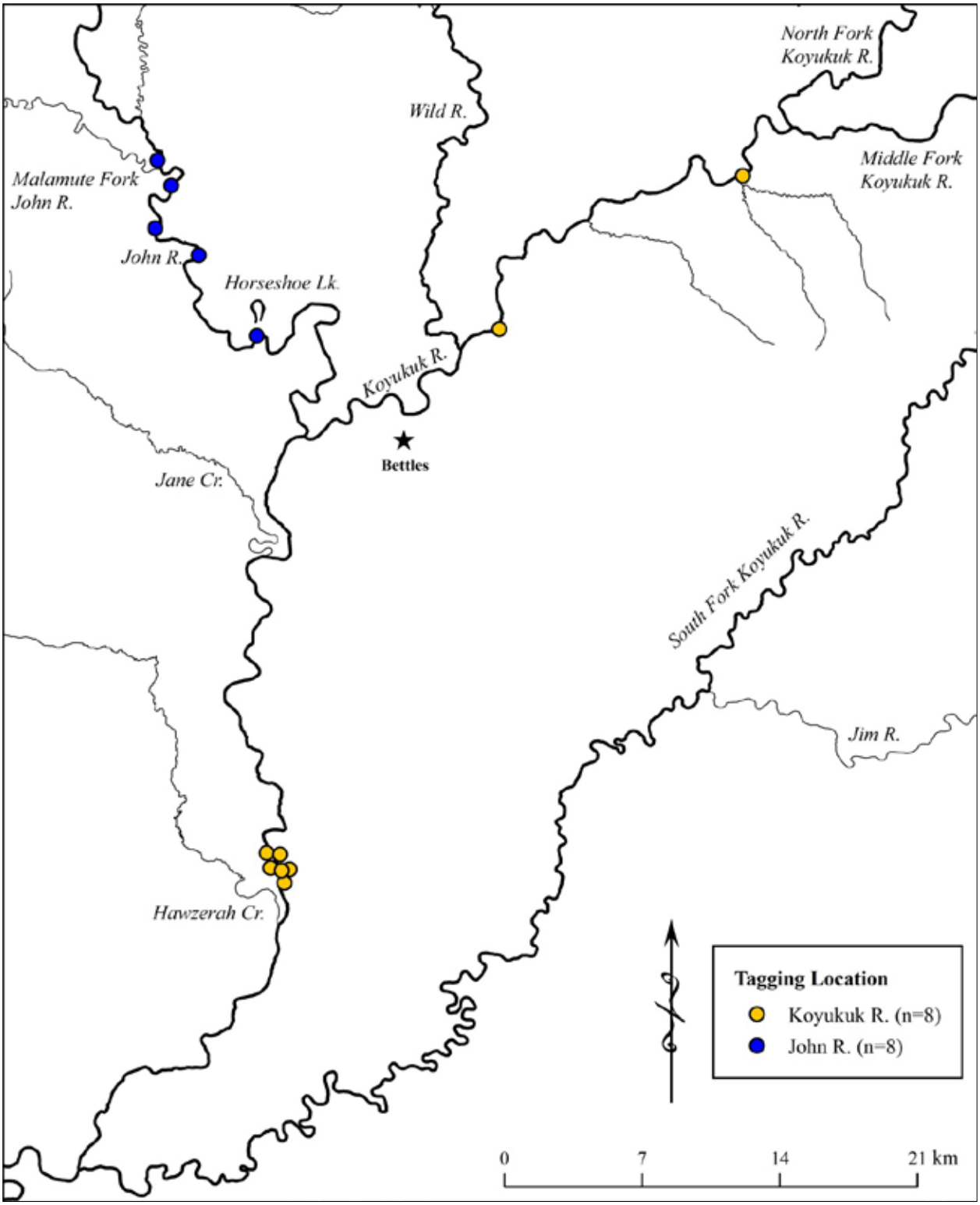


Appendix D9.–Locations of radiotagged whitefishes on 1 August 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

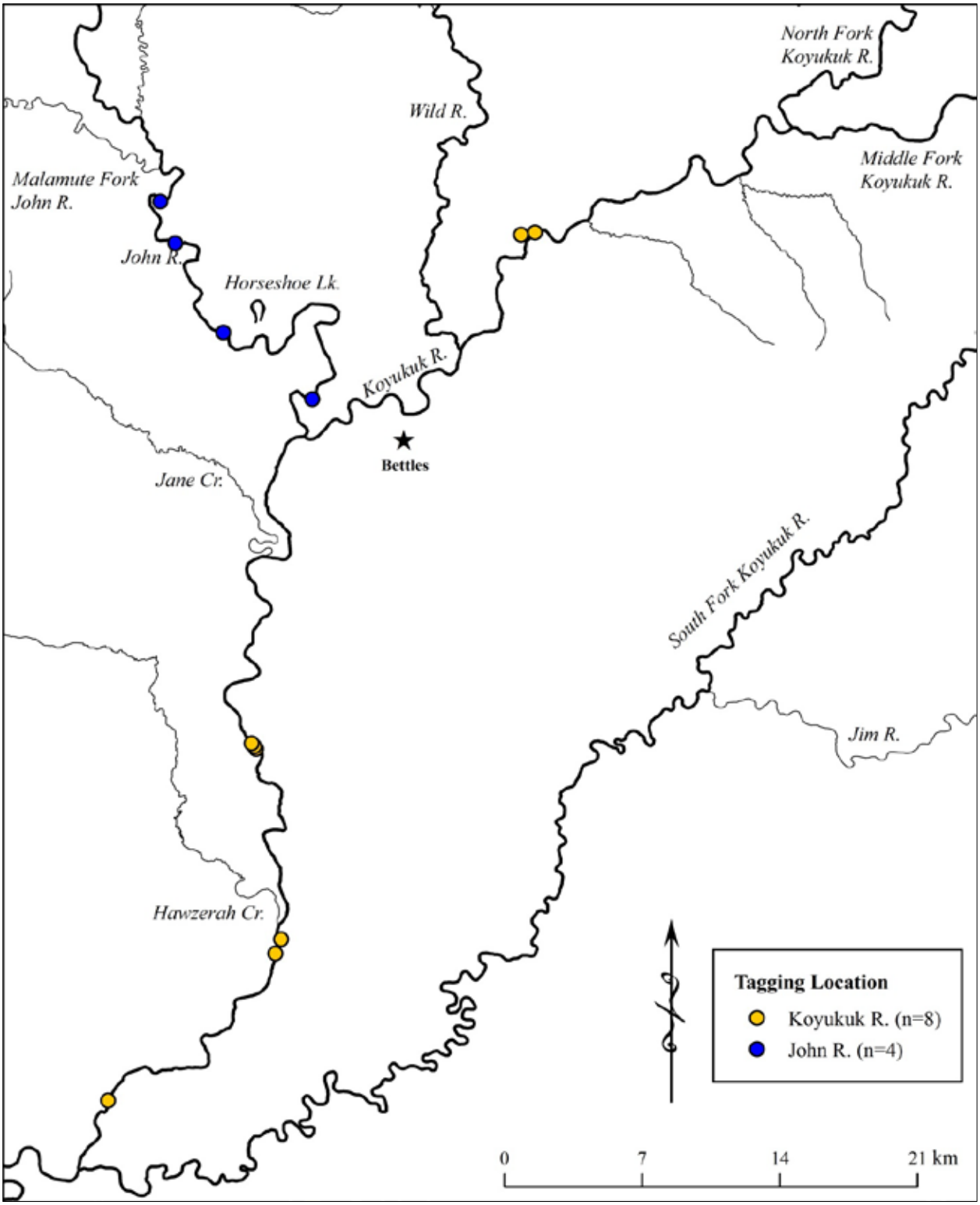


APPENDIX E:
LOCATIONS OF RADIOTAGGED NORTHERN PIKE SAMPLED IN THE MAINSTEM REACHES WITHIN THE KOYUKUK STUDY AREA

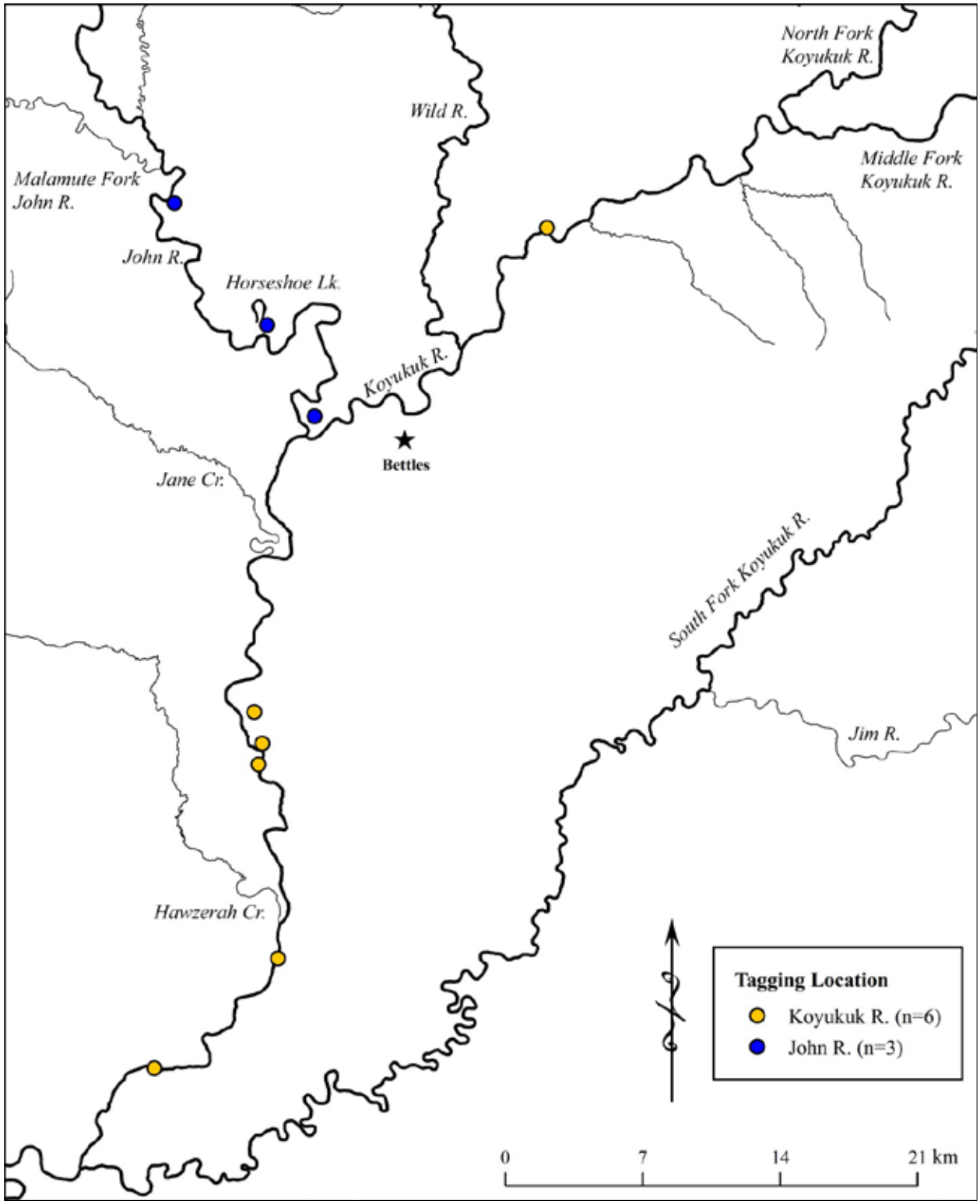
Appendix E1.–Tagging locations for northern pike sampled in mainstem reaches within the Koyukuk study area, 2014. Colors depict a general tagging area and the total number of surviving radiotagged fish are labeled parenthetically in legend.



Appendix E2.–Locations of radiotagged northern pike during fall 2014 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



Appendix E3.–Locations of radiotagged northern pike on 1 February 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.



Appendix E4.–Locations of radiotagged northern pike on 2 June 2015 sampled in mainstem reaches within the Koyukuk study area. Colors depict original tagging areas and the number of surviving radiotagged fish are labeled parenthetically in legend.

