

**Regional Operational Plan SF.4A.2020.07**

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**Operational Plan: Aniak Streamgaging Network,  
2019–2024**

by

**Ann Marie Larquier**

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November 2020

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.

<b>Weights and measures (metric)</b>		<b>General</b>		<b>Mathematics, statistics</b>	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	$H_A$
gram	g			base of natural logarithm	$e$
hectare	ha			catch per unit effort	CPUE
kilogram	kg	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	coefficient of variation	CV
kilometer	km			common test statistics	(F, t, $\chi^2$ , etc.)
liter	L	at	@	confidence interval	CI
meter	m	compass directions:		correlation coefficient	
milliliter	mL	east	E	(multiple)	R
millimeter	mm	north	N	correlation coefficient	
		south	S	(simple)	r
<b>Weights and measures (English)</b>		west	W	covariance	cov
cubic feet per second	ft <sup>3</sup> /s	copyright	©	degree (angular)	°
foot	ft	corporate suffixes:		degrees of freedom	df
gallon	gal	Company	Co.	expected value	$E$
inch	in	Corporation	Corp.	greater than	>
mile	mi	Incorporated	Inc.	greater than or equal to	≥
nautical mile	nmi	Limited	Ltd.	harvest per unit effort	HPUE
ounce	oz	District of Columbia	D.C.	less than	<
pound	lb	et alii (and others)	et al.	less than or equal to	≤
quart	qt	et cetera (and so forth)	etc.	logarithm (natural)	ln
yard	yd	exempli gratia (for example)	e.g.	logarithm (base 10)	log
		Federal Information Code	FIC	logarithm (specify base)	log <sub>2</sub> , etc.
<b>Time and temperature</b>		id est (that is)	i.e.	minute (angular)	'
day	d	latitude or longitude	lat or long	not significant	NS
degrees Celsius	°C	monetary symbols (U.S.)	\$, ¢	null hypothesis	$H_0$
degrees Fahrenheit	°F	months (tables and figures): first three letters	Jan, ..., Dec	percent	%
degrees kelvin	K	registered trademark	®	probability	P
hour	h	trademark	™	probability of a type I error (rejection of the null hypothesis when true)	$\alpha$
minute	min	United States (adjective)	U.S.	probability of a type II error (acceptance of the null hypothesis when false)	$\beta$
second	s	United States of America (noun)	USA	second (angular)	"
		U.S.C.	United States Code	standard deviation	SD
<b>Physics and chemistry</b>		U.S. state	use two-letter abbreviations (e.g., AK, WA)	standard error	SE
all atomic symbols				variance	
alternating current	AC			population	Var
ampere	A			sample	var
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				

***REGIONAL OPERATIONAL PLAN SF.4A.2020.07***

**OPERATIONAL PLAN: ANIAK STREAMGAGING NETWORK,  
2019–2024**

by  
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November 2020

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**Signature Page**

Project Title: Aniak Streamgaging Network, 2019–2024

Project leader: Ann Marie Larquier

Division, Region and Area Sport Fish, Research and Technical Services, Instream Flow Program

Project Nomenclature:

Period Covered: 02/01/2019 to 12/31/2025

Field Dates: 06/01/2019 to 10/01/2024

Plan Type: Category I

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**Approval**

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<u>Title</u>	<u>Name</u>	<u>Signature</u>	<u>Date</u>
<u>ADF&amp;G Project Leader</u>	<u>Ann Marie Larquier</u>		
<u>Research Coordinator</u>	<u>Joe Klein</u>		

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## ABSTRACT

This project will collect the streamflow data necessary to file reservations of water on up to four river reaches in the Aniak watershed, a tributary to the Kuskokwim River. These reservations of water will protect instream flows necessary for fish habitat, migration, and propagation. Discharge measurement data will be analyzed in combination with continuous streamflow data collected at a streamgage established on the Aniak River (index gage). Discharge measurement stations will be established on the Doestock and Buckstock Rivers and potentially the Salmon River.

Discharge measurement stations will be visited a minimum of three times per year over a range of streamflows. Instantaneous discharge data collected at the discharge measurement stations will be regressed against corresponding data from the index gage. For stations with robust correlations, a five-year record of continuous streamflow will be estimated. This hydrologic data will be used to file reservation of water applications with the Department of Natural Resources.

Keywords: Aniak River, Doestock River, Buckstock River, Salmon River, reservation of water, instream flow, discharge measurement, streamgage

## PURPOSE

The rivers of Southwest Alaska (SW AK) support some of North America's most productive sport, commercial, and subsistence salmon fisheries. Salmon migration, spawning, rearing, and ultimately production in these rivers depend on sufficient seasonal quantities of water. Demand for water to support hydroelectric power generation, petroleum production, mining, water supply (including out-of-state export), residential development, forestry, agriculture, and other water development projects have the potential to modify the naturally occurring instream flows to which fish have adapted and are dependent upon (Poff et al. 1997). The purpose of this project is to quantify and reserve instream flows needed to attain long-term protection and conservation of salmon habitat in SW AK rivers.

The Fish and Game Act requires the Alaska Department of Fish and Game (ADF&G) to "...manage, protect, maintain, improve, and extend the fishery resources of the state in the interest of the economy and general well-being of the state" (Alaska Statute 16.05.020: AS). One mechanism ADF&G uses to fulfill its mandate is to reserve waters in rivers and lakes for fish and wildlife (AS 16.05.050). An appropriation of water that remains within a river is legally described under Alaskan law (AS 46.15.145) and is further defined within regulations (11 AAC 93.970) as a reservation of water. To reserve water, an application with supporting data and analyses must be submitted to the Alaska Department of Natural Resources (DNR). A minimum of five years of mean daily flow or lake level (stage) data is recommended by DNR to quantify instream flow or lake level requirements within an application. The supporting data and analyses must demonstrate the need for the amount of water being requested.

The State of Alaska Legislature amended the Alaska Water Use Act in 1980 to allow instream flows to be legally reserved by a private individual, group, or governmental agency in order to maintain specific flow rates in a river or volumes and water levels in a lake during specified time periods for one or a combination of four types of uses:

- protection of fish and wildlife habitat, migration, and propagation;
- recreation and parks purposes;
- navigation and transportation purposes; and
- sanitary and water quality purposes.

Priority dates for reservation of water applications are based on the date that they are accepted by DNR. Alaska water law is based on the doctrine of prior appropriation, also known as "first in time, first in

right.” According to the rules of prior appropriation, the right to the full volume of water is first given to the appropriator who has the earliest priority date to beneficially use the water. This senior water right holder has a legal standing to assert that right against conflicting uses of water from others who do not have water rights or who are junior in priority.

This project will collect and analyze the hydrologic data necessary to file applications for reservations of water with DNR for up to four river reaches in the Aniak River watershed. This watershed was chosen for analysis because of its value as salmon habitat. The Aniak River watershed provides important spawning and rearing habitat for the five species of Pacific salmon (*Oncorhynchus* sp.) as well as abundant resident fish species making it a popular destination for sport fishermen.

This project is supported by the Alaska Sustainable Salmon Fund (AKSSF). Hydrologic data collection to support reservations of water effectively addresses Objective 1 of the AKSSF statewide goals and objectives framework: to directly attain long-term protection of salmon habitat by submitting reservation of water applications on salmon streams or lakes. Currently, there is very limited hydrologic data available on the Aniak River watershed or surrounding watersheds that could be used to support reservations of water.

This operational plan serves to provide project-specific information and rationale to supplement the *Surface-Water Data Manual for the Statewide Aquatic Resources Coordination Unit* (Klein 2013).

## **OBJECTIVES**

The objective of this project is to reserve instream flows to protect fish habitat, migration, and propagation for up to four river reaches in the Aniak River watershed. The three tasks necessary to complete this objective include:

### **TASKS**

1. Operate a streamgaging network across Aniak, Doestock, Buckstock, and Salmon River watersheds following the protocols set forth in Klein (2013). The network will include: an index gage on the Aniak River and up to three discharge measurement stations (Doestock, Buckstock, and Salmon Rivers) operated concurrently.
2. Assess correlations between the index gage and the discharge measurement stations. For those stations with robust correlations, develop a five-year period of record.
3. Complete and file reservations of water applications for each waterbody with a five-year minimum of mean daily flow data (up to four river reaches).

## **METHODS**

### **STUDY AREA**

The Aniak River watershed is located near the city of Aniak in the region generally referred to as the Yukon-Kuskokwim Delta, approximately 100 miles northeast of Bethel (Figure 1). The city of Aniak can be reached only by airplane and field sites are accessed via one to three-hour boat ride in the summer and snow machines in the winter. The Aniak River flows north approximately 95 miles from its headwaters draining the Kilbuck and Kuskokwim mountains through lowlands and tundra to its mouth at the confluence with the Kuskokwim River, one mile upstream from the community of Aniak. The upper approximate two-thirds of the river is characterized by moderately

swift and shallow water with much braiding among numerous gravel bars. Spring runoff and periods of heavy rain cause frequent course changes in the river. High water events regularly deposit large numbers of trees and other plant material on gravel bars and occasionally block or even dam large channels of the river. In the lower reaches, the river has a single deep channel that is slower flowing and the water is less clear (Dunaway 1997).

ADF&G has catalogued the Aniak River as Anadromous Waters Catalog (AWC) stream number 335-20-16600-2400 (Johnson and Blossom 2019). This river is the natal stream for five species of anadromous salmon: Chinook (*O. tshawytscha*), chum (*O. keta*), sockeye (*O. nerka*), pink (*O. gorbuscha*), and coho (*O. kisutch*). Resident fish species inhabiting the Aniak River include: rainbow trout (*O. mykiss*), Dolly Varden (*Salvelinus malma*), northern pike (*Esox Lucius*), Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), sheefish (*Stenodus leucichthys*), lake trout (*Salvelinus namaycush*), whitefish (*Coregonus*), longnose suckers (*Catostomus Catostomus*), blackfish (*Dallia pectoralis*), and slimy sculpin (*Cottus cognatus*; Lafferty and Bingham 2002).

Aniak is a Yup'ik word meaning “the place where it comes out,” which refers to the mouth of the river (Division of Community and Regional Affairs). The lower 45 miles of the Aniak River is generally within the Yukon Delta Wildlife Refuge, although much of the lands directly adjacent to the Aniak River are Alaska Native owned along the lower reaches. Native lands include individual allotments and holdings belonging to various village and regional Native corporations (Dunaway 1997).

Doestock River flows from its headwaters in the foothills of the Kuskokwim Mountains to its confluence with the Aniak River (Figure 2). The anadromous portion of the river is approximately 33 miles long, supporting populations of chum and coho salmon. ADF&G has catalogued this river as AWC stream number 335-20-16600-2400-3011 (Johnson and Blossom 2019).

Buckstock River flows approximately 33 miles from its headwaters in the Kuskokwim Mountains to its confluence with the Aniak River (Figure 2). The anadromous portion of the river is 26 miles long, supporting populations of chum, coho, Chinook, and pink salmon. ADF&G has catalogued this river as AWC stream number 335-20-16600-2400-3101 (Johnson and Blossom 2019).

Salmon River flows approximately 45 miles from its headwaters in the Kilbuck Mountains to its confluence with the Aniak River (Figure 2). The anadromous portion of the river is 15 miles long, supporting populations of chum, coho, Chinook, and pink salmon. ADF&G has catalogued this river as AWC stream number 335-20-16600-2400-3244 (Johnson and Blossom 2019).

## **STUDY DESIGN**

The approach and guidelines set forth in Klein (2013) and the DNR Handbook (Alaska Department of Natural Resources 1985) will be followed for study design, data collection, and preparation of reservation of water applications for submittal to DNR.

To collect the hydrologic data necessary to support reservation of water applications, a streamgaging network will be established within the study areas described above. A streamgaging network consists of an index streamgage that is operated continuously over a long period of time and an associated network of semi-permanent discharge measurement stations operated concurrently on nearby creeks that are hydrologically similar. Instantaneous discharge data collected at the discharge measurement stations will be regressed against corresponding discharge values from the index streamgage. Given a robust correlation between streamflows at a discharge

measurement station and a corresponding index streamgage, a synthetic period of record for the discharge measurement station can be estimated (Klein 2013).

For this project, a streamgage will be established on the mainstem of the Aniak River (index gage) with discharge measurement stations on the Doestock and Buckstock Rivers, both tributaries to the Aniak River (Figures 1 and 2). One potential additional discharge measurement station may be established on the Salmon River which is contingent on potential future funding by the Native Village of Napamiute for continued operation of a salmon weir (Table 1).

Table 1.–Summary of proposed hydrologic measurement stations in the Aniak River watershed.

<b>Name</b>	<b>Station Type</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Proposal</b>
Aniak River	Streamgage	61.4983333 N	-159.3713888 W	Planned installation
Doestock River	Discharge Measurement Station	61.5327777 N	-159.3922222 W	Planned installation
Buckstock River	Potential Discharge Measurement Station	61.3484022 N	-159.2243061 W	Anticipated if access and timing are feasible
Salmon River	Potential Discharge Measurement Station	61.0627176 N	-159.1940722 W	Anticipated contingent on separate funding for continued operation of salmon weir

Streamgage and discharge measurement station locations will be selected to ensure the station represents hydrological conditions within the respective reach. The stream transects at the stations will have fairly uniform depth, velocity, and angle of flow (Rantz et. al 1982). Data collection sites can only be reached by boat or snow machine from Aniak. Permits are not necessary for the discharge measurement stations as no equipment will be temporarily or permanently installed at these locations, but all necessary permits, including a Fish Habitat Permit, will be acquired prior to installation of the streamgage.

The streamgage will be installed and operated by project staff in accordance with standard sampling protocols developed by the United States Geological Survey (USGS) (Rantz and others 1982) and the Instream Flow Program (Klein 2013) and through consultation with USGS staff and other hydrologists as applicable.

## **DATA COMPILATION AND COLLECTION**

### **Hydrologic Data Collection**

At the Aniak River streamgage, stage, and water temperature will be measured and recorded at 15-minute intervals using a vented pressure transducer housed in a 1-1/4" pipe that is secured to the streambed or streambank with custom pipe brackets, expansion bolts, and/or rebar. An In-Situ, Inc.® Level TROLL 700H (or similar) pressure transducer/data logger will be utilized. A

secondary/backup pressure transducer with similar configuration may be established in a different nearby location in case the primary pressure transducer is damaged by ice, debris, or wildlife.

Following procedures described in Kenney (2010) the gage will be surveyed periodically using an auto level and differential survey techniques to ensure the equipment is properly set to an established gage datum and to determine if the gage or any of the three reference marks have shifted over time. A staff gage will be installed at the streamgage site and the data logger will be programmed to read the same as the staff gage to allow for water levels to be read.

Instantaneous discharge measurements will be collected at each discharge measurement station according to USGS protocols (Rantz and others 1982, Klein 2013). The goal is to collect between 10 and 20 total discharge measurements covering a range of streamflows on each river, concurrent with operation of the index gage. The majority of discharge measurements will be collected during the open-water period (roughly April to November). During the winter period, measurements will occur on an opportunistic basis depending on access, site conditions, number of measurements collected, and weather. All scientific equipment will be calibrated and maintained according to manufacturer specifications and USGS standards.

For most conditions, a tethered Teledyne-RDI StreamPro<sup>®</sup> or RiverPro<sup>®</sup> Acoustic Doppler Current Profiler (ADCP) will be used to collect discharge data. When conditions allow, the ADCP may be attached to a remote-controlled boat, a Teledyne Oceanscience<sup>®</sup> Q-Boat 1250, that is operable from the streambank. If low flow conditions are present, an Acoustic Doppler Velocimeter (ADV) may be used; a Price AA or Pygmy current meter will serve as a backup in case of any problems with the ADV or ADCP. All scientific equipment will be calibrated and maintained according to manufacturer specifications and USGS standards.

## **Biologic Data Compilation**

Fish distribution and periodicity data will be compiled and summarized from scientific literature, local ADF&G biologists, and the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* (Johnson and Blossom 2019). With the assistance of regional ADF&G area fishery biologists, a fish periodicity chart (Appendix A) that includes fish species present and the timing of their life history phases will be finalized and included in each reservation of water application.

## **DATA REDUCTION**

### **Hydrologic Data Reduction**

Stage and water temperature data will be transferred from the Aniak River streamgage data loggers to a field laptop and then uploaded to a personal desktop computer upon return to the office. The stage data will then be converted to Excel or comma delimited text files and entered into the Water Information System Kisters Inc. (WISKI<sup>®</sup>) hydrologic software package. Discharge measurements and observed staff gage readings will be entered into the BIBER<sup>®</sup> component of WISKI<sup>®</sup>. Electronic copies of field notes, photographs, and discharge and level summary records will be stored in folders associated with the gaging station name and number on the WISKI<sup>®</sup> dedicated server. Further data reduction details are provided in Klein (2013).

## **DATA ANALYSIS**

Analysis for the Aniak River streamgage will be performed using the WISKI<sup>®</sup> hydrological software package following USGS standards and protocols. This will include: development of a stage-discharge rating, discharge measurement summaries, associated shift analysis if applicable, a table of applied datum and gage-height corrections, mean daily flow computations for each day of record, mean monthly flow for each month of record, and a station description manuscript (a synopsis that describes the gage site, mechanics and other pertinent information regarding the gage station operation).

In general, data for each discharge measurement station will be analyzed after a minimum of 10 discharge measurements have been collected. A simple linear regression model using a log-log transformation will be used to estimate the relationship between streamflows at each discharge measurement station and streamflows at the corresponding index gage. The results of the model will be used to determine the next step:

- 1) If the regression results in a robust correlation, discharge measurements may cease on that waterway, and further analysis will continue (see below).
- 2) If the regression indicates a poor relationship between flows at the discharge measurement station and flows at the index gage, discharge measurements and further analysis will cease. In this case, further hydrologic investigations may be explored for the site to produce the necessary data.
- 3) If the regression results are inconclusive in regard to the strength of the correlation, additional discharge measurements may be collected to further refine the regression model.

For all waterways with a robust relationship (Klein 2013) between the discharge measurement station and the index streamgage, the estimated regression parameters will be used to calculate a five-year period of record. From that record, annual, monthly, mean daily, and flow duration summaries will be calculated using Statistical Analysis Systems<sup>®</sup> (SAS) software.

## **RESERVATIONS OF WATER**

Instream flow and lake level requests will be determined using the flow/ lake level duration method (Annear et al. 2004) combined with available fish use information. For each reservation of water application, flows within the 25 to 75% exceedance range will be requested (USGS 2009). These flows represent the normal hydrologic conditions providing habitat to which fish have adapted. In addition to the hydrologic data (discussed above), reservation of water applications will include biological data based on the AWC and the expertise of the local management biologists. The final deliverables for this project will be hydrologic data summaries prepared for the purpose of submitting applications for reservations of water to DNR.

## SCHEDULE AND DELIVERABLES

<b>Activity</b>	<b>Dates</b>
Install streamgage on Aniak River	Before August 1, 2019
Operation of Aniak River streamgage	August 2019 to September 2024
Visit discharge measurement stations	July/August 2019 to September 2024
Complete gage records for preceding water year	Before March 1 of each year
Field data collection completed	September 30, 2024
Correlate measurements and develop period of record	February 2025
Complete and submit reservation of water applications	October 2025
Complete Fishery Data Series report	December 2025

## RESPONSIBILITIES

Ann Marie Larquier, Habitat Biologist III (ADF&G)

Duties: Project Manager. Responsible for study design, field logistics, data collection, analysis, and administration of project responsibilities. Responsible for preparations and review of operational plan, reservation of water application(s), reports. Maintenance and care of field equipment. Maintain project funding and budget.

Leah Ellis, Habitat Biologist II (ADF&G)

Duties: Assist with data collection and analysis. Maintenance and care of field equipment. Responsible for review of operational plan, reservation of water application(s), and reports.

Kevin Keith, Habitat Biologist III (ADF&G)

Duties: Assist with data collection and analysis. Maintenance and care of field equipment. Assist with review of operational plan, preparation of reservation of water application(s), and reports.

Joe Klein, Environmental Engineer II (ADF&G)

Duties: Provide technical oversight. Assist with data collection. Submit reservations of water applications to DNR.

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## **FIGURES**

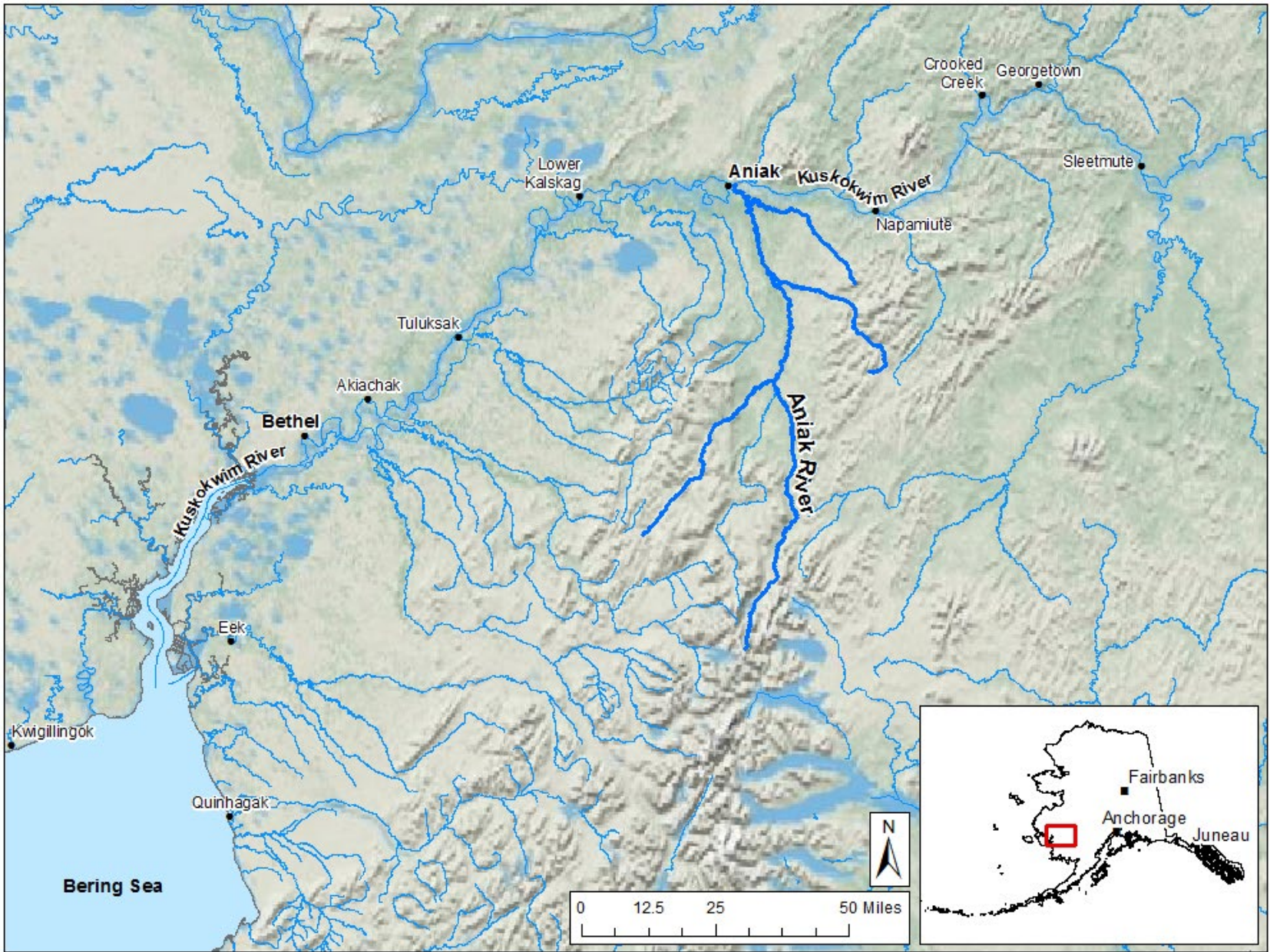


Figure 1.—Location of Aniak River in southwest Alaska, approximately 100 miles northeast of Bethel.



Figure 2.—Location of Aniak River streamgaging and discharge measurement (DM) stations in the Aniak River watershed.



**APPENDIX A:  
EXAMPLE FISH PERIODICITY TABLE**

Appendix A1.–Example of a fish periodicity table for use in a reservation of water application.

<b>Coho Salmon</b>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage					XX	XXXX						
Adult Passage								X	XXXX	XXXX		
Spawning									XX	XXXX	XXXX	
Incubation	XXXX	XXXX	XXXX	XXXX					XX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
<b>Sockeye Salmon</b>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage					XXXX	XXXX	X					
Adult Passage							X	XXXX	XXXX	XX		
Spawning							X	XXXX	XXXX	XX		
Incubation	XXXX	XXXX	XXXX	XXXX			X	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
<b>Pink Salmon?</b>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage					XX	XXXX						
Adult Passage								XXXX	XXX			
Spawning								XX	XXXX			
Incubation	XXXX	XXXX	XXXX	XXXX				XX	XXXX	XXXX	XXXX	XXXX
Rearing					XX							
<b>Dolly Varden</b>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult Passage						XXXX	XXXX	XXXX	XXXX	XXXX	X	
Smolt Passage					XXXX	XXXX						
Spawning									XXXX	XXXX	X	
Incubation	XXXX	XXXX	XXXX						XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Based on professional judgment of ADF&G biologists												
Smolt passage is for juvenile emigration to estuarine/marine environment												
Adult passage: for salmon is immigration: for trout, char, and other species, immigration and emigration.												
Incubation life phase includes time of egg deposition to fry emergence												
? = Data not available or timing is incomplete												

**APPENDIX B:  
FIELD FORMS**

Appendix B1.–Example of ADV Discharge Measurement form.

ADV DISCHARGE MEASUREMENT NOTES					DISCHARGE MEASUREMENTS				
River Name:					Start time:		LEW or REW		End time:
Date:		Party:			Distance	Depth	Velocity	Notes	
Raw Data File:					1				
Coordinates:					2				
Location Details:					3				
					4				
					5				
Weather:			Wind Speed/Dir:		6				
Substrate:					7				
Control:					8				
Flow:		Low	Low-Medium	Medium	Medium-High	High	9		
Turbidity:		Low	Medium	High		10			
Measurement Rated:		excellent (2%)	good (5%)	fair (8%)	poor (>8%)	11			
Reasoning for Rating:					12				
Discharge (cfs)		Q Uncertainty (%)		Mean Velocity (ft/s)	13				
					14				
Width (ft)		Area (ft <sup>2</sup> )		Mean Depth (ft)	15				
					16				
Mean SNR (dB)		ADV Water Temp (°F)		Measured Water Temp (°F)	17				
					18				
Comments:					19				
					20				
					21				
					22				
					23				
<i>DISCHARGE MEASUREMENTS CONTINUED...</i>					24				
Distance	Depth	Velocity	Notes		25				
					26				
					27				
					28				
					29				
					30				
					31				

Appendix B2.-Example of ADCP Discharge Measurement form.

9-275-I	10/12/2005	U.S. DEPARTMENT OF THE INTERIOR <i>U.S. Geological Survey</i>				Meas. No.	
Station Number		Acoustic Profiler Discharge Measurement Notes				Processed by	
						Checked by	
Station Name							
Date		, 20__	Party				
Width	Area / Rated Area	Velocity	Index Vel.	Gage Height	Discharge		
Boat/Motors Used		GPS Used	ADCP Depth	Gage Height Change			
				in hrs.			
ADCP Mfr	ADCP Model	Frequency	Serial No.	Firmware	Software		
Filename Prefix		Diagnostic Test – Errors?	Moving Bed File	Moving Bed?			
		<input type="checkbox"/> Y or N		Y or N			
ADCP Sync'd to WT	Meas. Water Temp	ADCP Water Temp		Weather			
Y at ___ or N	°F / C at	°F / C at					
Compass Calibration	MagVar Used	MagVar Method		Wind Speed / Dir			
Y or N		On-site	Model	Previous			
<b>Gage Readings</b>				<b>Site Conditions</b>			
Time			Inside	Outside	Max Water Depth		
					Max Water Speed		
					Max Boat Speed		
					Water Mode		
					Bottom Mode		
					Streambed material		
					Salinity		
					ppt at		
Weighted MGH					Checkbar found		
GH corrections					Checkbar changed to:		
Correct MGH					at		
Wading, cable, ice, boat, upstr., downstr., side bridge				ft., mi. upstr., downstr. of gage			
Measurement rated:	excellent (2%), good (5%), fair (8%), poor (>8%)				based on following conditions		
Flow							
Cross section:							
Control:							
Gage operating:	Y or N	Record removed:	Y or N	Filename:			
Battery voltage	V	Intakes/Orifice cleaned/purged:					
Bubble-gage psi:	Tank	Line	Bubble rate	/ min			
Extreme-GH indicators:	Max	Min	CSG Checked	Y or N			
HWM on stick	Ref elev.	HWM elevation					
GH of zero flow = GH	- depth at control	=	ft,	Rated=			
Sheet No.		of	sheets				

-continued-

<i>Acoustic Profiler Discharge Measurement Notes</i>								
Left Bank:	Sloping Vertical Other: _____					Right Bank:	Sloping Vertical Other: _____	
Transect No.	Starting			Ending		Total Discharge	Notes	
	Bank	Time	Distance	Distance	Time			
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
	L R							
Notes								





**APPENDIX C:  
FIELD CHECKLIST**

Appendix C1.–Example of field checklist.

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**General Field Gear**

- first aid kit
- survival gear
- safety gear
- communications (InReach®, cell phone, and/or VHF)
- bug spray / mosquito head nets
- camera, digital storage, batteries
- personal gear
- bear protection
- GPS
- calculator

**Discharge Equipment**

- ADCP, trimaran, Q-boat
- ADV
- laptop computer
- 200' of rope
- wading rod
- extra batteries (8 AA's)
- thermometer
- data book/forms/pencils
- tape measure
- tag line
- rebar, hammer

**Optional Discharge Equipment**

- price AA and cord
- pygmy, cord, extra wire connector
- headphones and stopwatch