United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Rd.
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:

SEP 20 2002

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RE/5302.WJK

Mr. Pat Pourchot, Commissioner
Alaska Department of Natural Resources
550 West 7[th] Avenue, Suite 1400
Anchorage, Alaska 99501

Dear Commissioner Pourchot:

Enclosed are 10 instream water rights applications for streams of the Yukon Flats National Wildlife Refuge. By copy of this letter, supporting documents attached to these applications will be transmitted to your staff in the Division of Mining, Land, and Water Management. Enclosed is the required filing fee of $500.00 for each application, totaling $5,000.00 (Order No. 701812M666).

Please notify Mr. Warren Keogh, Regional Water Rights Coordinator, of file numbers assigned to these applications by the Department of Natural Resources, and when the U.S. Fish and Wildlife Service might expect review and action on these instream water rights filings. He may be reached at the above address, telephoned at 786-3564, or contacted by electronic mail at Warren_Keogh@fws.gov.

Sincerely,

ACTING — Regional Director

Enclosures

cc: Chief, Water Resources Section, Division of Mining, Land, and Water Management, Department of Natural Resources
Refuge Manager, Yukon Flats National Wildlife Refuge

DIVISION OF MINING, LAND & WATER
WATER RESOURCES SECTION

Alaska Department of NATURAL RESOURCES

550 West 7th Avenue, Suite 900A
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APPLICATION FOR RESERVATION OF WATER

Instructions

- *Complete one application per stream segment or water body –* ***Incomplete applications will not be accepted***
- *Attach map(s) indicating all sections from the beginning to the end of stream segment* **or** *for all parts of the lake or water body –* ***Map must include sections lines***
- *Submit filing fee of $500.00 –* ***Non-refundable***
- *Attach extra pages for each section, as needed*

U.S. Fish and Wildlife Service
Business Name

Regional Water Rights Coordinator
Contact Person

1011 E. Tudor Rd.
Mailing Address

Anchorage
City

AK
State

99503
Zip Code

907-786-3564
Phone Number

907-786-3901
Fax Number

Warren_Keogh@fws.gov
E-mail Address

Location of Proposed Reservation of Water

Name of the Stream or Water Body in which Water is Proposed to be Reserved **Sheenjek River, located in the Yukon Flats National Wildlife Refuge and the Arctic National Wildlife Refuge.**

Meridian	Township	Range	Section	Quarter Sections	
See Attachment A					

Describe the location of the point or points defining the boundary of the proposed reservation of water by river mile index, river mile, geographical or cultural landmark, etc., on the stream or water body.

This reservation applies to stream flows within the Sheenjek River and its floodplain, beginning below the confluence of Thluichohnjik Creek and Sheenjek River within Section 28, Township 31 North, Range 16 East, Fairbanks Meridian. The stream segment is approximately 108.88 river miles in length, and ends at the confluence of the Sheenjek River and the Porcupine River within Section 18, Township 22 North, Range 15 East, Fairbanks Meridian. See map accompanying this application entitled Instream Water Right River Segment - Sheenjek River for the site specific location of the river segment.

Attach a US Geological Survey map at 1:63,360 scale, or 1;250,000 scale if 1:63,360 scale is unavailable for the area, clearly identifying the following for the proposed reservation of water:

1. Sections, townships, range and meridians

   See Attachment A (Section I).

2. The stream or water body in which the reservation of water is proposed

   Sheenjek River (See maps in Attachment A, Section I).

3. Specific point or points defining the boundary of the proposed reservation of water

   The map of the river segment accompanying this application was prepared using a Geographic Information System and hydrography obtained from the U.S. Geological Survey website, source dates 1978, 1981, 1982, 1985, and 1990 provisional revisions. USGS quad maps at 1:63,360 scale for the river segment include: Black River C-5, C-6, D-5, and D-6; Christian A-1, A-2, B-1, B-2, and C-1; Coleen A-5, A-6, B-5, and B-6; and Ft. Yukon C-1, C-2, D-1, and D-2.

4. Permanent, temporary or planned locations of water measurement devices (such as gaging stations, weirs, staff gages)

   A temporary gaging station was operated on this river segment from July, 1993 through the end of water year 1998, located within the S½NW¼ Section 17, Township 24 North, Range 16 East, Fairbanks Meridian, Latitude 66°54.62' North, Longitude 144°19.91'West. See Instream Water Right River Segment Map - Sheenjek River accompanying this application.

6. Permanent, temporary or planned bench marks

   There are no permanent, temporary, or planned bench marks associated with the stream segment or the gaging station that relate to this application.

Water Use

Identify the purpose(s) of the proposed reservation of water by checking the appropriate box(es).

[X] Protection of fish and wildlife habitat, migration, and propagation

[X] Recreation and park purposes

[ ] Navigation and transportation purposes

[ ] Sanitary and water quality purposes

Describe in detail the purpose(s) of the proposed reservation, including, when appropriate; species and life stage, type of recreation, vehicle, or water quality parameter, or other relevant information.

See Attachment A (Section II).

Is the water currently being used for the purpose(s) applied for?

[X] Yes

[ ] No If no, when will use for this purpose begin? Specify approximate date ____

Water Quantity

Water requested to be reserved – ***Check one***

[X] To maintain a specific instream flow rate, measured in cubic feet per second

[ ] To maintain a specific level of surface water, flow or volume, measured in cubic feet or acre feet

[ ] To maintain a specific surface water elevation, measured in relation to a permanent benchmark

Quantify the specific amount of water requested to be reserved. Identify and quantify, as appropriate; flow rates, quantities, surface water elevations, depths, etc., as they relate tot he daily durations and months of the year during which the reservation is proposed. Include any flow release schedules from projects upstream of the proposed reservation that would apply.

Quantity to be reserved:

January 1 - April 30	**50 cfs**
May 1 - May 31	**4500 cfs**
June 1 - June 30	**5260 cfs**
July 1 - July 30	**4475 cfs**
August 1 - August 31	**2925 cfs**
September 1 - October 15	**2590 cfs**
October 16 - December 31	**220 cfs**

See Attachment A, Section III, pages 9-14.

Methodology and Monitoring

Attach and submit with this application documentation or reports showing facts to support the following:

(a) The need for the proposed reservation of water, including reasons why the reservation is being requested.

(b) Identify and describe the methodology, data, and data analysis used to substantiate the need for and the quantity of water requested for the proposed reservation of water, including:

1. Name and description of method used
2. Who conducted the study and analysis
3. Schedule of when data collection and analysis occurred
4. Type(s) of instrument(s) used to collect and analysis data
5. Description of data and how the data was collected, including when applicable, (A) selection of stream reach, study site and transect selection, (B) flow, survey, elevation, and depth measurements, (C) pertinent physical, biological, water chemistry and socio-economic data
6. Description of how data was analyzed, and
7. Maps, photos, aerial photos, calculations, and any other documents supporting this application

If there are provisions for monitoring this proposed reservation of water, include the following:

(a) Description of monitoring equipment (such as gaging stations, staff gages, weirs)

(b) Location of monitoring equipment

(c) Provisions for payment of monitoring

(d) Reporting system

See Attachment A (Section IV) and Attachment C.

THIS APPLICATION IS NOT A WAIVER OF THE RIGHTS OF THE UNITED STATES UNDER THE SUPREMACY CLAUSE OF THE UNITED STATES CONSTITUTION, OR OF ANY OTHER RIGHTS UNDER FEDERAL LAW AND IN NO WAY IS INTENDED TO QUANTIFY, DIMINISH, OR OTHERWISE AFFECT ANY FEDERAL RESERVED WATER RIGHT CLAIM.

Address all questions concerning this application to the Regional Water Rights Coordinator, U.S. Fish and Wildlife Service, Water Resources Branch, 786-3564.

The information presented in this application is true and correct to the best of my knowledge.

Richard S. Pospahala — Signature

SEP 20 2002 — Date

RICHARD S. POSPAHALA — Name (please print)

ACTING REGIONAL DIRECTOR — Title

ATTACHMENTS

Sheenjek River
Yukon Flats National Wildlife Refuge

ATTACHMENT A

ATTACHMENT B

ATTACHMENT C

ATTACHMENT A

I. LOCATION OF PROPOSED RESERVATION OF WATER

This reservation applies to the lower **Sheenjek River** and its floodplain, Yukon Flats National Wildlife Refuge and Arctic National Wildlife Refuge, beginning at the confluence of Thluichohnjik Creek and Sheenjek River, and ending at the confluence of the Sheenjek and Porcupine rivers (See map).

Upstream point: The confluence of Thluichohnjik Creek and Sheenjek River in

Township 31 North, Range 16 East, Fairbanks Meridian
Section 28.

River segment includes: Those parts of the Sheenjek River in the following sections, from upstream point to downstream point:

Township 31 North, Range 16 East, Fairbanks Meridian
Sections 28 and 33

Township 30 North, Range 16 East, Fairbanks Meridian
Sections 4, 5, 8, 9, 17, 20, 21, 28, 29, 33, and 34

Township 29 North, Range 16 East, Fairbanks Meridian
Sections 3, 10, 15, 16, 21, 27, 28, 33, and 34

Township 28 North, Range 16 East, Fairbanks Meridian
Sections 1, 2, 10, 11, 13, 14, 15, 23, 24, 25, 26, and 35

Township 27 North, Range 16 East, Fairbanks Meridian
Sections 2, 3, 10, 11, 13, 21, 22, 27, 28, 33, and 34

Township 26 North, Range 16 East, Fairbanks Meridian
Sections 3, 10, 15, 16, 20, 21, 28, and 33

Township 25 North, Range 16 East, Fairbanks Meridian
Sections 4, 5, 8, 9, 16, 17, 21, 28, 29, 32, and 33

Township 24 North, Range 16 East, Fairbanks Meridian
Sections 3, 4, 7, 8, 9, 10, 16, 17, 18, 19, 20, 30, and 31

Township 24 North, Range 15 East, Fairbanks Meridian
Sections 13, 24, 25, and 36

Township 23 North, Range 15 East, Fairbanks Meridian
Sections 1, 2, 11, 12, 13, 14, 22, 23, 27, 32, 33, 34

Township 22 North, Range 15 East, Fairbanks Meridian
Sections 5, 8, 17, and 18.

Downstream Point: The confluence of the Sheenjek and Porcupine rivers in

Township 22 North, Range 15 East, Fairbanks Meridian
Section 18.

II. WATER USE

Describe in detail the purposes(s) of the proposed reservation, including, when appropriate; species and life stage, type of recreation, vehicle, or water parameter, or other relevant information.

The purpose of this reservation is to protect fish and wildlife habitat, migration, and propagation and to protect the natural biodiversity in this segment of the Sheenjek River throughout the year. The free flowing, unregulated waters of the Sheenjek River provide the necessary habitat that supports a rich and abundant biota. Additional purposes that will be protected by reserved stream flows include recreational boating and subsistence activities.

Fisheries

This reservation segment of the Sheenjek River provides important aquatic habitat for a variety of fish. Few comprehensive fishery inventory studies have been conducted in this segment of the Sheenjek River or the adjacent waters of the Porcupine River (DOI 1999). However, the following fish species have been documented to use the Sheenjek River: chum salmon (*Onchoryncus keta*), coho salmon (*Onchoryncus kisutch*), chinook salmon (*Onchoryncus tshawytscha*), northern pike (*Esox lucius*), broad whitefish (*Coregonus nasus*), humpback whitefish (*Coregonus pidschian*), round whitefish (*Prosopium cylandraceum*), least cisco (*Coregonus sardinella*), burbot (*Lota lota,*) slimy sculpin (*Cottus cognatus*), Arctic grayling (*Thymallius arcticus*), and longnose sucker (*Catostomus leucicthys*). For documentation of these species, see the fish periodicity table for the Sheenjek River (pages 4 and 5), the fishery data references (page 6), and the references and personal communications at the end of this Attachment A.

Sheenjek River Fish Periodicity Table

	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Chum salmon												
passage					??SS	SS??	AAAA	AAAA	AAAA			
spawning								XXX	XXXX	XXXX	XXXX	XXXX
incubation	XXXX	XXXX	XXXX	XXXX	???			XXX	XXXX	XXXX	XXXX	XXXX
rearing				??	XX?							
Chinook salmon												
passage				?	SSSS	SS A	AAAA	AAAA				
spawning							XXX	XXXX	X			
incubation	XXXX	XXXX	XXXX	XXXX			XXX	XXXX	XXXX	XXXX	XXXX	XXXX
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Coho salmon												
passage					?	SSSS	S??	?AAA	AAA?			
spawning									?XX	XX??		
incubation	XXXX	XXXX	XXXX	XXX?	??				?XX	XXXX	XXXX	XXXX
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Round whitefish												
presence	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
spawning									?X	XXXX		
incubation	XXXX								?X	XXXX	XXXX	XXXX
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Humpback whitefish												
passage	XXXX	XXXX	XXXX	XXJJ	JJJJ	JJ			AA	AAAA	AAXX	XXXX
spawning										XXXX	XXXX	
incubation	XXXX	XXXX	XXXX	XX??	??					XXXX	XXXX	XXXX
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Least cisco												
passage						???J	JJJJ	??				
passage					????	XXXX	XXXX	XXXX	AA	AAAA	AAXX	
spawning									XX	XX		
incubation	XXXX	XXXX	XXXX	XXXX	XX??	?			XX	XXXX	XXXX	XXXX
rearing				XX	XXXX	XXXX	XXXX	?				

Sheenjek River Fish Periodicity Table (cont.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Arctic grayling												
presence	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
spawning					XX	XX						
incubation					XX	XXXX	XX					
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Northern pike												
presence	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
spawning				XX	XXXX							
incubation				XX	XXXX	XX						
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Burbot												
presence	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
spawning	XX	XXXX										
incubation	XX	XXXX	XXXX	??								
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Longnose sucker												
presence	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
spawning						XXXX	XXXX	XXXX				
incubation						XXXX	XXXX	XX				
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Slimy sculpin												
presence	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
spawning					X	XXX						
incubation					X	XXX						
rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Broad whitefish												
passage			????	JJJJ	JJJJ	JJ						
passage						XXXX	XXXX	XXXX	XXAA	AAAA	AA	
spawning										XXXX	XXXX	
incubation	XXXX	XXXX	XXXX	XX??	??					XXXX	XXXX	XXXX
rearing	????	????	XXXX	XXXX	XXXX	XX??	????	????	????	????	????	????

X - presence of the species (lifestage not specified)
S - smolt
A- adult
J - juvenile
? - information incomplete or unavailable

Passage - immigration of anadromous adults or emigration of anadromous juveniles
Incubation - time period from egg deposition to emergence
Rearing - time period from emergence to maturity in resident species or from emergence to departure from natal stream in anadromous species

River-specific Fishery Data, Yukon Flats Refuge

River	Chum salmon	Coho salmon	Chinook salmon	Northern pike	Broad whitefish	Humpback whitefish	Round whitefish	Least cisco	Bering cisco	Burbot	Arctic grayling	Sheefish (Inconnu)	Slimy sculpin	Longnose sucker	Dolly Varden	Unidentified whitefish	Unidentified salmonid	Arctic lamprey	Reference	Comments
Beaver Creek	x		x	x		@	x	x		x	x	x	@	x		x			2,6,11,12,22	
Birch Creek	x		x	x	x	x	x	x		x	x	x	x	x		x			2,3,12,19	
Black	x	x	x	x	x					x	x	x		x		x			2,3,6,12,14,16	Coho-downstream of Chalkyitsik
Hadweenzic	x*			*		*		*	*	*	*		*	*					8,15	
Hodzana	x*			x	x	x	x	x		x	x	x	x	x	x	x		x	4,8,12,13,20	Dolly Varden-headwater tributaries
Kevinjek Creek	x*		x*	*			*				*		*	*				*	8,10,16	
Little Black				x	x	x					x			x			x		3,14	
Preacher Creek	*				x		x		x		x		x				*		3	
Salmon Fork	x	x		x	x	x	x			x	x	x	x	x			x	x	1,3,8,14,17,18	
Sheenjek	x	x	x	x	x	x	x	x		x	x	x	x	x		x			5,6,7,8,9,12	

* Observed in river by Trawicki or Wolfe (July - September, 1996)
x Presence documented in literature (see References)
@' Presence highly likely, but not documented in literature.

References

1. Alt, K.T. 1978. A life history of sheefish and whitefish in Alaska: Movements, abundance, and spawning ecology of sheefish in the middle Yukon River and lower Yukon River. Sport Fish Division. Federal Aid in Fish Restoration, Annual Report of Progress, Project F-9-10(R-II-B).
2. Anonymous. 1983. Resource management recommendations for Yukon Flats National Wildlife Refuge and surrounding area. State of Alaska, CSU Coordinator's Office, Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage.
3. Gordon, J. 1998. Fisheries Baseline Studies on Yukon Flats NWR for 1994 and 1995. Unpublished data. USFWS Fishery Resource Office, Fairbanks, Alaska.
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8. Rost, P.J. 1986. Aerial surveys for summer and fall salmon in the upper Yukon River drainage, 1985. Internal report, USFWS Fishery Resource Office, Fairbanks, Alaska.
9. Barton, L.H. 1984. A catalog of Yukon River salmon spawning escapement surveys. Technical Data Report No. 121. Alaska Department of Fish and Game, Juneau, Alaska.
10. Wedemeyer, K. 1987. Radio telemetry and aerial surveys for locating fall chum salmon spawning grounds on the Black River, September 1987. Unpublished draft report. U.S. Fish and Wildlife Service, Fairbanks Fishery Assistance Office, Fairbanks, Alaska.
11. Kacher, I. 1995. Beaver Creek salmon observation numbers and locations (1991-1995). Unpublished field notes. Northern District Office, Bureau of Land Management, Fairbanks, Alaska.
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15. Wolfe, C., J. Trawicki, 1996. Fishery survey of the Hadweenzic River and Kevinjik Creek, Yukon Flats National Wildlife Refuge. Internal report. USFWS Water Resources Branch, Anchorage.
16. Caulfield, R.A. 1983. Subsistence land use in upper Yukon-Porcupine communities, Alaska. Technical Paper No. 16 Alaska Department of Fish and Game, Division of Subsistence, Fairbanks, Alaska.
17. Shore, E.B. 1954. Born on snowshoes. Houghton Mifflin, Boston.
18. Kostohrys, J., B. Lubinski, N. Collin. 1994. Aquatic resources of the Salmon Fork Black River, Alaska: a preliminary survey, 1991. U.S. Bureau of Land Management, White Mountains District, Fairbanks, Alaska.
19. Gammon, J.R. 1990. Fish communities and turbidity of Birch Creek, Alaska and its tributaries in late July and early August 1990. A report to the Bureau of Land Management and the Alaska Department of Fish and Game.
20. Glesne, R.S., S.J. Deschermeier, and P.J. Rost. 1985. Fisheries and aquatic habitat survey of the Hodzana River, Yukon Flats National Wildlife Refuge, 1983 and 1984. Unpubl. Final Rpt. No. FY85/3. USFWS Fishery Resource Office, Fairbanks, Alaska.
21. Webb, J. 1982. Beaver Creek overwintering inventory. Internal paper. Northern District, Bureau of Land Management Fairbanks, Alaska.
22. U.S. Department of Interior, BLM and USFWS. 1983. Beaver Creek: A component of the National Wild and Scenic Rivers System. River Management Plan.

The most comprehensive fishery documentation for this segment of the Sheenjek River exists for chum salmon. These data result from annual aerial surveys conducted by the Alaska Department of Fish and Game since 1973, as well as data gathered from a counting tower and river sonar facility on the lower Sheenjek River. Fall chum salmon are, by far, the most abundant salmon species in this segment of the Sheenjek River. Chum salmon runs arrive in the river in early August, peak in early September, and last until early October (DOI 1999). Based on spawning escapement counts, the Sheenjek River fall chum run is one of the largest stocks within the Yukon River drainage (USFWS 1990). This stock is a major component of mixed stock subsistence and commercial fisheries that occur along nearly 1,000 miles of the Yukon River. The average spawning escapement for the Sheenjek River from 1990 to 1996 was 131,706 chum salmon, with nearly 250,000 salmon returning in 1996. Based upon extensive aerial surveys, the lower 100 miles of the river is the most important fall chum spawning habitat in the Sheenjek drainage. Principal known fall chum spawning areas within this reservation segment are located at River Mile 12, 30, 45, 70, and 80 of the Sheenjek River (DOI 1999).

The importance of these spawning areas was again documented in 1998 by the Service and the National Marine Fisheries Service using radio transmitters implanted in migrating fall chum salmon. Of the 481 transmitters deployed in the mainstem Yukon River near Rampart, 120 transmitters (25%) were relocated in the Sheenjek River. Aerial tracking surveys in the Sheenjek River documented spawning areas extending from the Refuge boundary at approximately River Mile 99, downstream to the ADF&G sonar camp at River Mile 6. Results from these studies indicate that this reservation segment of the Sheenjek River encompasses the majority of the fall chum spawning habitat in the Sheenjek drainage (DOI 1999).

Less is known about the abundance and spawning distribution of chinook and coho salmon in this segment of the Sheenjek River. A 1985 aerial survey conducted by the Service documented 45 chinook salmon spawning in a 20 mile section of the mainstem Sheenjek River, approximately five miles below Thluichohnjik Creek. Coho stock abundance within the Sheenjek drainage is thought to be small. A 1974 ADF&G survey counted 28 coho salmon scattered near the mouth of the Sheenjek River upstream to Koness River (DOI 1999).

While not documented in literature, the presence of Dolly Varden (*Salvelinus malma*) and Arctic lamprey (*Lamptera japonica*) are highly likely. Resident form of Dolly Varden probably exist in the upper Sheenjek River. Other fisheries studies have confirmed the presence of small populations of these fish in upper headwater streams north of the Yukon River. Arctic lamprey also have a high likelihood of being present in the Sheenjek River since they have been found in other similar type streams in the Yukon drainage (Daum, pers.com. 2001).

Wildlife

This reservation segment of the Sheenjek River provides important habitat for a variety of wildlife. However, few comprehensive wildlife surveys have focused on this lower segment of the Sheenjek River. The wildlife information described below was compiled from surveys conducted by the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game, and summarized in the Wild and Scenic River Study and Legislative Environmental Impact Statement for the Lower Sheenjek River prepared by the Department of the Interior in 1999.

Breeding pair surveys conducted in 1991 indicate that this segment of the Sheenjek River contains low to moderate duck densities ranging from 0.8 to 13.0 ducks per square mile. Although goose surveys have not been conducted for this lower segment of the Sheenjek River, relatively low densities have been identified to the south of the Yukon River. Swan densities are suspected to be low based on surveys conducted on nearby areas. Aerial surveys on this segment of the Sheenjek indicate that loons are common. Little information has been collected on other migratory or resident birds on this segment of the Sheenjek River (DOI 1999).

Moose generally occur throughout the Refuge in relatively low densities. A recent population survey for the Porcupine River area, that included the lower Sheenjek River segment, gave density estimates of 0.25 moose per square mile (Stephenson et al. 2000). The river and its surrounding area also provide winter habitat for the Porcupine caribou herd. Black and grizzly bear are likely common due to the rich chum salmon fishery on the river (DOI 1999).

Fur-bearing animals using this segment of the Sheenjek River and its river corridor include beaver, coyote, lynx, marten, mink, muskrat, red fox, river otter, snowshoe hare, weasel, wolf, and wolverine. Aerial surveys suggest wolves occur at low densities (ADF&G 2000). Marten is the economic staple for most trappers in the region. Trapper interviews and harvest information suggest that mink, otter, and wolverine may occur in low densities in and around the Lower Sheenjek (DOI 1999).

Aquatic Invertebrates

Rivers and streams on the Yukon Flats Refuge provide habitat for aquatic invertebrates that are a primary food source for fish and water birds using riverine habitats. In addition to providing habitat for aquatic invertebrates during the open water season, unfrozen water in Refuge rivers and streams is important to many overwintering species. The most abundant taxa include midges, stoneflies, danceflies, mayflies, and caddisflies. Non-insect taxa include oligochaetes, gastropods, nematodes, ostracods, molluscs, and leeches. Attachment B summarizes overwintering strategies of aquatic invertebrates in Alaskan streams.

Subsistence Use

Trapping is the primary subsistence activity along this segment of the Sheenjek River. Hunting also occurs, primarily for moose, although black and grizzly bears are taken incidentally. Hunters typically use flat-bottomed riverboats with outboard motors. Most fishing on the river is incidental to other activities. Fishing is primarily hook-and-line and is oriented to northern pike and arctic grayling. Some fishing for chum salmon, whitefish, and burbot may also occur for subsistence purposes (DOI 1999).

Recreational Use

Float trips in rafts and canoes are the major recreational use along this segment of the Sheenjek River. This part of the river is generally tranquil and offers travelers the opportunity to observe wildlife and scenery along the river. This segment of the Sheenjek River is rated as Class I on the International Whitewater Scale (moving water with few riffles or waves; few or no obstructions and these are easy to avoid). A few non-local parties hunt moose on this segment of the Sheenjek River. Many use conventional riverboats, although some have used jetboats (DOI 1999).

III. WATER QUANTITY

Quantify the specific amount of water requested to be reserved. Identify and quantify, as appropriate; flow rates, quantities, surface water elevations, depths, etc., as they relate to the daily durations and months of the year during which the reservation is proposed. Include any flow release schedules from projects upstream of the proposed reservation that would apply.

Quantity to be Reserved:

January 1 - April 30	50 cfs
May 1-May 31	4500 cfs
June 1- June 30	5260 cfs
July 1 - July 31	4475 cfs
August 1 - August 31	2925 cfs
September 1 - October 15	2590 cfs
October 16 - December 31	220 cfs

Average discharge and instream flow reservations for these seasonal periods are indicated on the summary table of the following page. Average Sheenjek River discharges and instream flow requirements are further illustrated on the bar graph on page 11. See Attachment C for the analysis method used to determine instream flow reservation.

The Service's management objective for riverine habitats in the Yukon Flats Refuge is to maintain the natural water quantity and quality of streamflows and water levels that will provide suitable habitat for fish, migratory waterbirds, and other wildlife. The goal of this instream water right reservation is to mimic the natural hydrologic system to protect fish and wildlife aquatic habitat and to protect the natural biological diversity of the river system and its floodplain. A large body of evidence has shown that the natural flow regime of virtually all rivers is inherently variable, and that this variability is critical to ecosystem function and native biodiversity (Poff, et al. 1997).

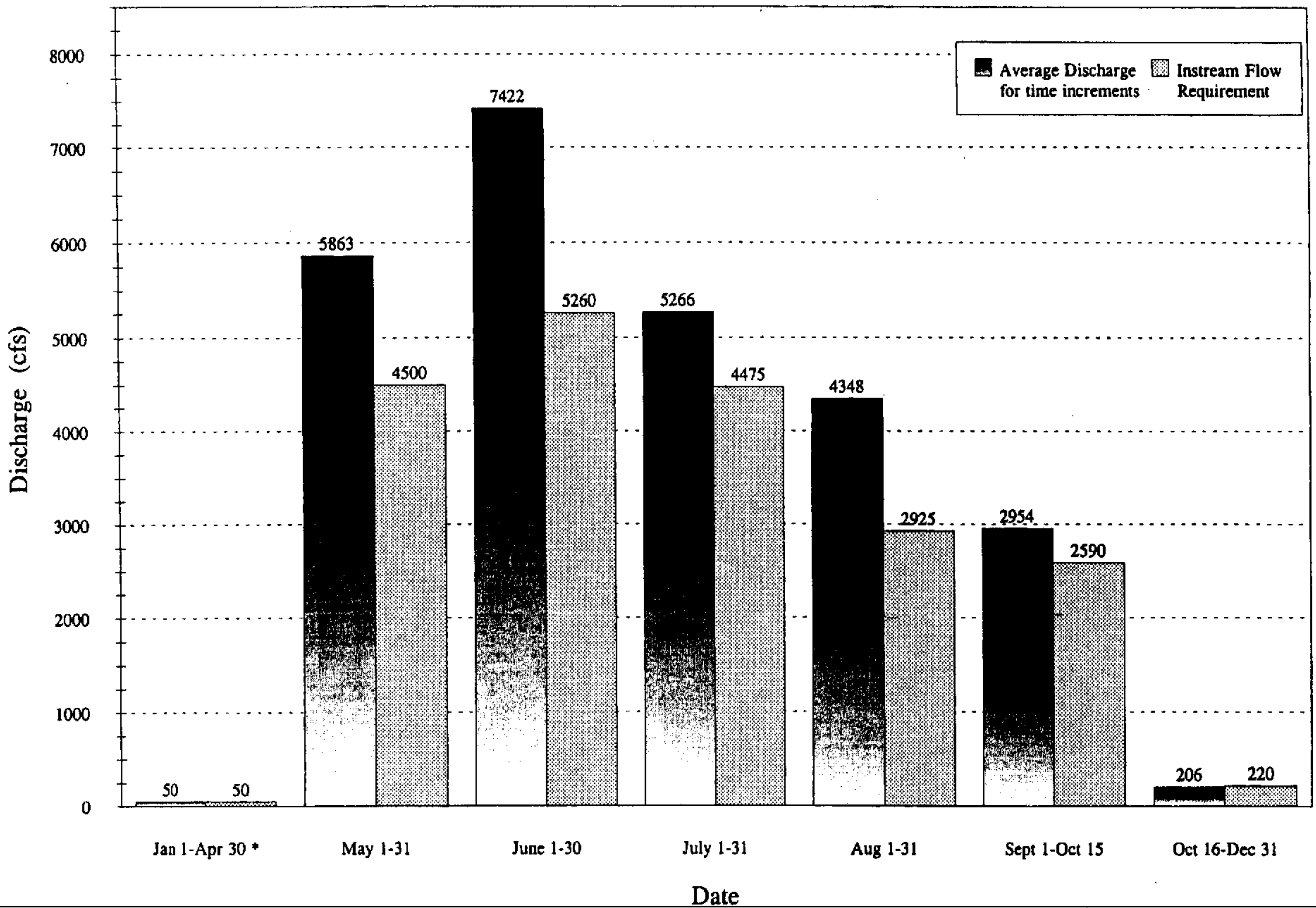
Instream Water Right Summary, Sheenjek River, Yukon Flats NWR, Alaska.

SEASONAL PERIOD	AVG. DISCHARGE FOR PERIOD (cfs)	INSTREAM FLOW RESERVATION (cfs)
Jan 1-Apr 30 *	50	50
May 1-31	5863	4500
June 1-30	7422	5260
July 1-31	5266	4475
Aug 1-31	4348	2925
Sept 1-Oct 15	2954	2590
Oct 16-Dec 31	206	220

* The lower of 25 percent exceedance flow or average discharge.

Sheenjek River

Average Discharge and Instream Flow Requirement

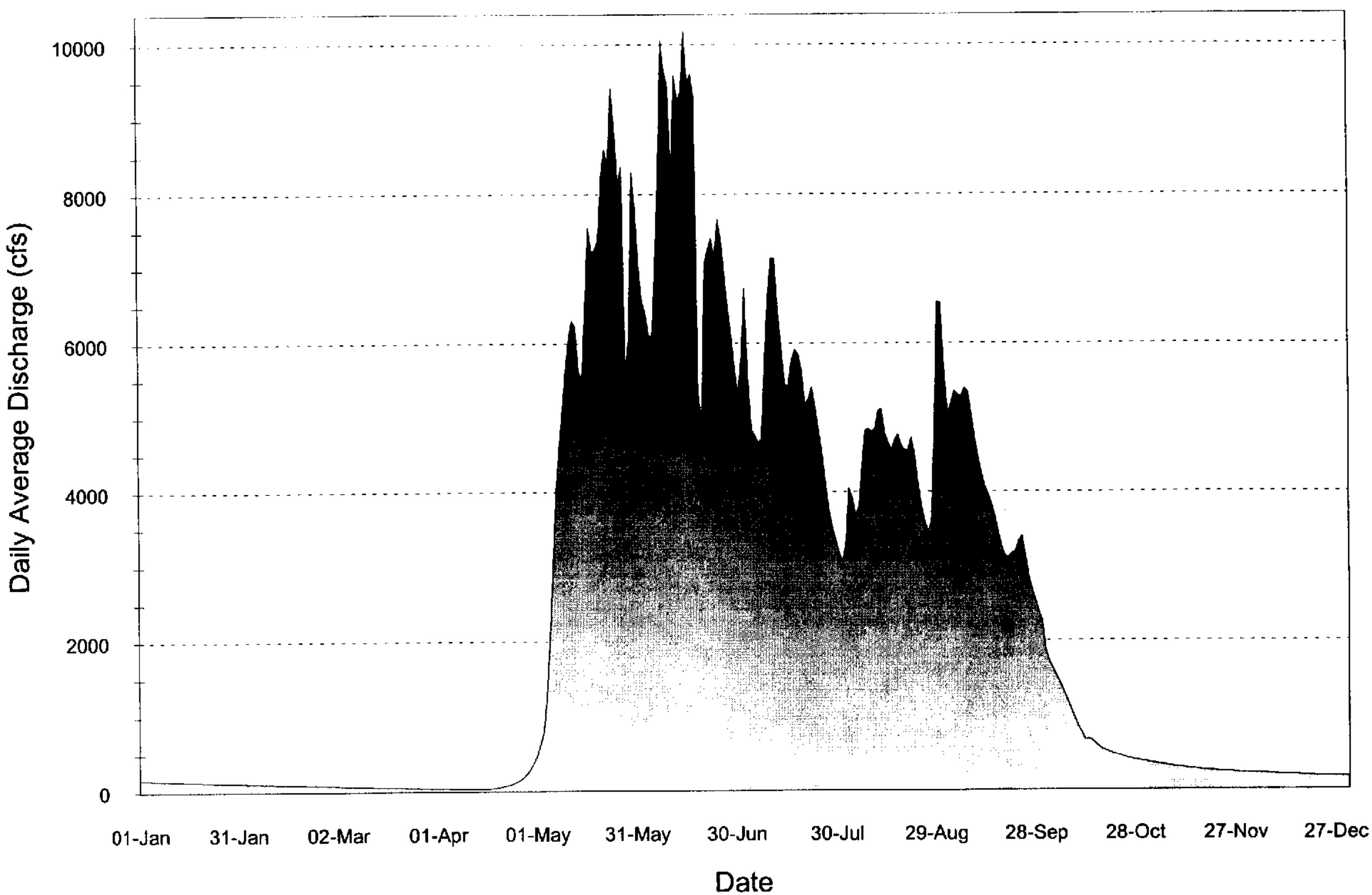


The Sheenjek River headwaters in the Brooks Range and flows south through the Arctic and Yukon Flats Refuges approximately 270 miles before entering the Porcupine River (Trawicki, 2000). This reservation segment of the river extends approximately 108.88 miles from River Mile 0 at the confluence of the Porcupine River upriver to the confluence of Thluichohnjik Creek, just above the Yukon Flats Refuge boundary within the Arctic Refuge.

A typical water year for the Sheenjek River, illustrated with the average annual hydrograph (following page), begins in fall. Water levels in October drop quickly as air temperatures decrease, ice begins to form in the rivers, and precipitation is snow. By late October, most rivers are frozen over and discharge continues to decrease. Throughout the winter ice thickness increases and flow decreases. Rivers generally reach their base flow in February, March, and April. Portions of the river may freeze to substrate. April brings longer days and warmer temperatures and the start of breakup. Breakup is characterized by rising stage and discharge from snow melt and extensive ice flows. Breakup varies significantly from year to year and location to location. Depending on ice flow conditions, breakup can be mild or cause extensive flooding. By late May, the ice is gone and discharge is decreasing. Interior Alaska experiences intense, short duration thunderstorms during the June and July. These thunderstorms are localized and often cause high water or flooding in localized areas. August is still warm, but the thunderstorm activity decreases significantly. Rain events later in the year are generally associated with fronts. These weather systems affect large portions of the region. September brings cooler temperatures and a steady decrease in discharge (Trawicki 2000). The table on page 14 illustrates the exceedance discharge percentages for the Sheenjek River.

The Sheenjek River and its surrounding watershed are presently healthy and are not subject to human development, diversions, or perturbations. Continued biologic productivity of this river is dependent upon maintaining and mimicking the natural variability of the existing hydrologic regime. The river and its watershed must be monitored in the event that stream flow diversions or development in the watershed occur that would alter the natural hydrologic regime of the river.

Sheenjek River
Average Annual Hydrograph



Flow exceedance table indicating the percent of time discharge equals or exceeds a given discharge in cubic feet per second, Sheenjek River, Yukon Flats NWR, Alaska.

Percent Exceedence	Jan 1 - April 30	May 1-31	June 1-30	July 1-31	Aug 1-31	Sept 1 - Oct 15	Oct 16 - Dec 31
95	10	1368	2381	2925	1947	311	67
90	19	1631	3171	3055	2240	713	77
85	24	1909	3741	3193	2433	1049	87
80	28	2203	4136	3339	2547	1333	100
75	30	2517	4398	3495	2608	1574	113
70	31	2852	4572	3661	2638	1787	129
65	32	3212	4702	3840	2661	1983	147
60	34	3601	4831	4033	2701	2173	167
55	37	4024	5003	4242	2780	2371	191
50	42	4488	5263	4472	2922	2588	217
45	49	5000	5652	4726	3152	2837	247
40	60	5572	6216	5010	3491	3129	282
35	76	6221	6999	5332	3964	3478	321
30	95	6970	8043	5703	4595	3894	365
25	121	7856	9393	6143	5406	4390	416
20	152	8941	11092	6680	6421	4978	474
15	191	10339	13185	7374	7664	5671	540
10	237	12309	15714	8351	9158	6480	615
5	292	15678	18725	10021	10926	7418	700

IV. METHODOLOGY AND MONITORING

A) The need for the proposed reservation of water, including reasons why the reservation is being requested.

Habitat Needs

This reservation is needed to protect aquatic habitat needs of fish, waterfowl, and other wildlife and to protect the natural biodiversity of the river and its associated floodplain.

The Yukon Flats Refuge encompasses approximately 11.2 million acres and surrounds a vast wetland basin known as the "Yukon Flats". The Refuge provides one of the greatest waterfowl breeding areas in North America and is one of the most consistent waterfowl production areas on the continent. Thirty-eight species of mammals, 18 species of fish, 1 species of amphibian, and 160 species of birds, including 13 species of raptors and 24 species of waterfowl, occur on the Refuge (USFWS 1997; Sowl, pers. com. 2000).

The predominant feature of the Refuge is the Yukon River and associated floodplain, that occupy the majority of the Refuge. Lakes, sloughs, and streams dominate the landscape of the Refuge. The estimated 40,000 lakes and 7,000 stream miles that occur on the Refuge provide abundant and diverse fishery resources. The Yukon Flats area is susceptible to spring flooding which recharges many of the lakes, sloughs and marshes on the Flats which maintains the area as high value waterfowl and fish habitat (USFWS 1997).

The Yukon Flats is considered one of the most productive waterfowl breeding grounds in North America. The Yukon Flats has a high sustained rate of production and provides critical habitat for an estimated population of 1.5 million ducks, geese, and swans. Based on 1992 statewide waterfowl production surveys, the Yukon Flats basin produces over 200,000 ducklings annually. Annual aerial surveys indicate the Yukon Flats has the highest number of ducks per square mile of any area in Alaska. In 2000, seventy percent of the canvasback ducks observed during the statewide breeding pair survey were observed in the Yukon Flats (USFWS 2000).

The most common duck species on the Yukon Flats Refuge are lesser scaup, northern pintail, American wigeon, northern shoveler, green-winged teal, mallard, canvasback, and scoter species. Numerous other waterbirds nest on the Refuge, including loons, grebes, plovers, yellowlegs, common snipe, sandpipers, gulls, and arctic terns.

The Refuge also provides breeding habitat for a diverse songbird population and serves as a migration corridor for birds. The most abundant migratory songbirds include the Swainson's thrush, alder flycatcher, dark-eyed junco, white-crowned sparrow, yellow-rumped warbler, yellow warbler, and American robin. Approximately 40 species of songbirds breed on the Refuge. Twenty-eight species are neotropical migrants and 15 of these species winter primarily or entirely south of the U.S.-Mexico border (USFWS 1997).

The Refuge provides key habitat for 39 species of mammals. Common species include moose, black and grizzly bear, gray wolf, martin, beaver, wolverine, lynx, river otter, red fox, and snowshoe hare. Two caribou herds may be found seasonally and sporadically on the Refuge. The Porcupine caribou herd ranges seasonally onto the northern and eastern portions of the Refuge, while the White Mountain herd is a small, relatively stationary herd whose range is centered in the White Mountains (USFWS 1997).

At least 18 species of fish have been documented to occur within the Yukon Flats Refuge (USFWS 1997). Important species include chinook, coho, and chum salmon, Dolly Varden char, Arctic grayling, northern pike, broad whitefish, humpback whitefish, least cisco, longnose sucker, and burbot (USFWS 1990).

Legal Mandates and Management Directives

A long legislative history preceded the designation of the Yukon Flats Refuge. Prior to 1969, the interior basin known as the "Yukon Flats" was part of the public domain administered by the Bureau of Land Management. On January 17, 1969, the Secretary of the Interior withdrew unreserved lands in Alaska under Public Land Order 4582 also known as the "Udall Land Freeze" to protect Native land claims. With the passage of the Alaska Native Claims Settlement Act in 1971, the Secretary of the Interior withdrew the lands now within the Refuge from all forms of appropriation. Lands available for Native selection were identified as potential "national interest lands" and as "public interest lands".

On November 16, 1978, the Secretary of the Interior invoked his emergency withdrawal powers to withdraw approximately 110 million acres throughout Alaska including what is now the Yukon Flats Refuge. These lands were withdrawn for 3 years from settlement, location, entry, and selection under public land laws. The intent of this action was to preserve and protect the resource values of these lands, allowing Congress time to enact national interest lands legislation.

On December 1, 1978, President Carter signed an executive order under the Antiquities Act of 1906, creating 17 national monuments. Included was the Yukon Flats National Wildlife Monument, consisting of approximately 10.6 million acres. On February 11, 1980, the Secretary of the Interior signed public land orders establishing 12 new wildlife refuges in Alaska.

On December 2, 1980, President Carter signed the Alaska National Interest Lands Conservation Act. With the enactment of ANILCA, the Wildlife Monument designation was dropped, boundary adjustments occurred, and the area became the Yukon Flats National Wildlife Refuge (USFWS 1997). Section 302(9)(B) of ANILCA sets forth the following purposes for which the Yukon Flats Refuge was established and shall be managed. These include:

"(i) <u>to conserve fish and wildlife populations and habitats in their natural diversity including but not limited to, canvasbacks and other migratory birds, Dall sheep, bears, moose, wolves, wolverines and other furbearers, caribou (including participation in</u>

coordinated ecological studies and management of the Porcupine and Fortymile caribou herds) and salmon;

(ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats;

(iii) to provide, in a manner consistent with the purposes set forth in subparagraphs (i) and (ii), the opportunity for continued subsistence uses by local residents; and

(iv) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the refuge" (emphasis added) (USFWS 1987).

Clearly, the intent of Congress is to reserve necessary waters to protect fish and wildlife and their habitats in their natural diversity.

The National Wildlife Refuge System Improvement Act was enacted by Congress in 1997. Section 5 of the Act, which addresses administration of the Refuge System nationwide, pertains to protecting aquatic habitats. Subsection 4 provides that the Secretary of the Interior shall (A) provide for the conservation of fish, wildlife, and plants and their habitats within the System, and (B) ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans. Subsections (F) and (G) further provide that the Secretary shall assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the System and the purposes of each refuge, and acquire, under State law, water rights that are needed for refuge purposes (Refuge System Improvement Act 1997).

The Comprehensive Conservation Plan (USFWS 1987) and the Fishery Management Plan (USFWS 1990) for the Yukon Flats Refuge both direct that the Service will work cooperatively with the State of Alaska to quantify and record instream flows and lake elevations to support the values for which the Refuge was established.

(B) Identify and describe the methodology, data, and data analysis used to substantiate the need for the quantity of water requested for the proposed reservation of water, including:

(1) Name and description of method used

Trawicki (2000) describes data collection methods and analysis of discharge data and presents annual summaries of discharge data collected at the stream gage site located within this segment of the Sheenjek River. Data were collected from July, 1993 through October, 1998. See Attachment C for a description of the flow duration analysis method used for this instream flow reservation. By letter dated March 21, 1996 from Gary J. Prokosch, Chief, Water Resources Section, Alaska Department of Natural Resources to Steve Lyons, Regional Hydrologist for the Service in Region 7, five years of discharge data are acceptable for instream water right analysis and quantification. Further, DNR stated that using monthly flow duration curves for instream flow reservation analysis is an acceptable method (Prokosch 1996).

(2) Who conducted the study and analysis

Discharge data collection and analysis as well as instream flow reservation analysis were conducted by Service hydrologists John Trawicki and Steve Lyons.

(3) Schedule of when data collection and analysis occurred

Field discharge data collection for this segment of the Sheenjek River was conducted from July, 1993 through October, 1998. Data analysis and reporting were completed in April, 2000 (Trawicki 2000). Instream flow analysis and quantification were subsequently completed in October, 2000.

(4) Type(s) of instrument(s) used to collect and analyze data

See pages 7 - 10 of Trawicki (2000).

(5) Description of data and how the data was collected, including when applicable, (a) selection of stream reach, study site and transect selection, (b) flow, survey, elevation, and depth measurements, (c) pertinent physical, biological, water chemistry and socio-economic data.

See Trawicki (2000).

(6) Description of how data was analyzed, and

See Trawicki (2000) for a description of discharge data analysis and Appendix C for instream flow quantification analysis.

(7) Maps, photos, aerial photos, calculations, and any other documents supporting this application.

Trawicki (2000) presents annual discharge data for the stream gage established within this river segment. See page 13 for the annual hydrograph and page 14 for the exceedance table for this segment of the Sheenjek River.

Photographs of the gage site on this segment of the river are available at the Region 7 Water Resources Branch office.

If there are provisions for monitoring this proposed reservation of water, include the following:

(a) Description of monitoring equipment (such as gaging stations, staff gages, weirs)

No monitoring program is currently proposed for this reservation. Should water withdrawals or diversions occur in the future that would affect this river, developers will be required to operate a monitoring program.

(b) Location of monitoring equipment - Not Applicable

(c) Provisions for payment of monitoring - Not Applicable

(d) Reporting system - Not Applicable

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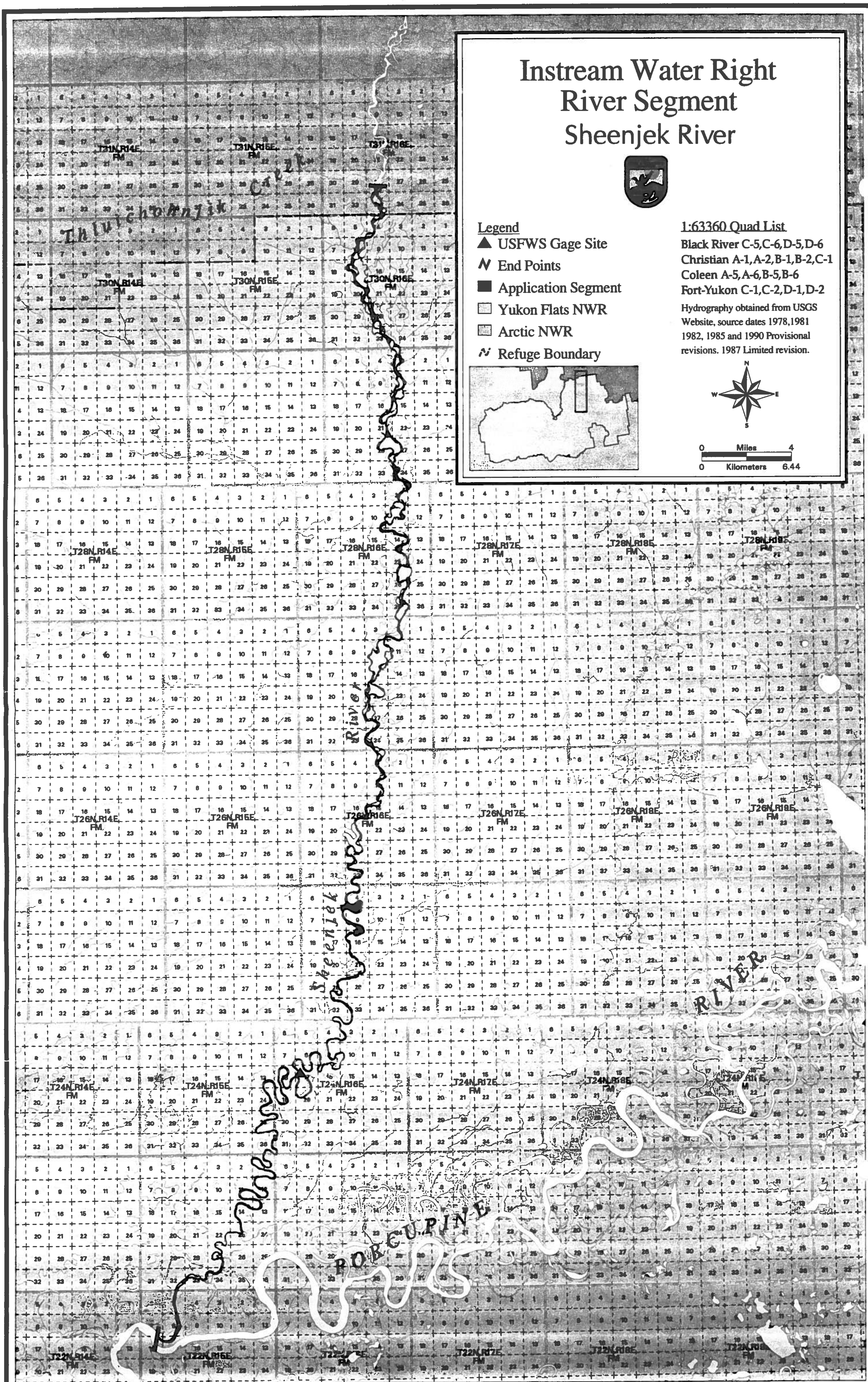

Instream Water Right
River Segment
Sheenjek River
Legend
USFWS Gage Site
End Points
Application Segment
Yukon Flats NWR
Arctic NWR
Refuge Boundary
1:63360 Quad List
Black River C-5,C-6,D-5,D-6
Christian A-1,A-2,B-1,B-2,C-1
Coleen A-5,A-6,B-5,B-6
Fort-Yukon C-1,C-2,D-1,D-2
Hydrography obtained from USGS
Website, source dates 1978,1981
1982, 1985 and 1990 Provisional
revisions. 1987 Limited revision.
N
W
E
S
0 Miles 4
0 Kilometers 6.44
Thluichohnjik Creek
Sheenjek River
PORCUPINE
RIVER
T31N,R14E, FM
T31N,R15E, FM
T30N,R14E, FM
T30N,R15E, FM
T30N,R16E, FM
T28N,R14E, FM
T28N,R15E, FM
T28N,R16E, FM
T28N,R17E, FM
T28N,R18E, FM
T26N,R14E, FM
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T24N,R14E, FM
T24N,R15E, FM
T24N,R16E, FM
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T24N,R18E, FM
T22N,R14E, FM
T22N,R15E, FM
T22N,R17E, FM
T22N,R18E, FM

ATTACHMENT B

Overwintering Strategies of Aquatic Invertebrates in Alaskan Streams

Freshwater invertebrates are subjected annually to freezing of shallow water habitats. To avoid these potentially lethal environmental conditions invertebrates employ a range of physiological or ecological adaptations. Overwintering strategies include (1) migrating laterally or vertically to avoid an advancing freezing front (Danks 1978; Danks 1991; Irons et al. 1993), (2) spending the entire life cycle in a habitat not subject to freezing, e.g., deep water refuges (Olsson 1981, 1982), or (3) avoiding or tolerating freezing by physiologically manufacturing antifreeze compounds (Salt 1959) or cryoprotectants (Lee 1991). Large benthic macroinvertebrates with low vagility may be more likely than small vagile taxa to show these latter physiological adaptations to freezing (Finni and Chandler 1979).

While most studies of overwintering aquatic invertebrates have concentrated on lentic (lakes and ponds) rather than lotic (rivers and streams) habitats, there is a growing body of literature concerning the overwintering strategies of lotic fauna. Most aquatic insects inhabiting shallow waters move into the more stable, deeper zones for overwintering (Danks 1991; Irons et al. 1993). Laboratory and field experiments have indicated that most taxa occurring in Alaskan streams lack the ability to survive subzero temperatures (Irons et al. 1993).

The Diptera (especially Chironomidae--midges) and Plecoptera (stoneflies) constitute an increasing proportion of the aquatic insect fauna as latitude increases (Hobbie 1973, Oswood et al. 1991). Ephemeroptera (mayflies), Empididae (dance flies), Trichoptera (caddisflies) and several non-insect taxa (oligochaetes, nematodes, gastropods, and amphipods) are also abundant in arctic streams (Craig and McCart 1975; Glesne and Deschermeir 1984). The following discussion summarizes the available empirical data for each of the most abundant taxa in Alaska.

Chironomidae Most midges overwinter as larvae (Danks 1971). Several north temperate and arctic species construct sealed winter cocoons (Danks 1971; Danell 1981) and other species overwinter in the frozen mud substrate (Danks 1971). Migration to habitats that do not freeze may occur in some species (Oswood et. al. 1991; Barton et al. 1987). Irons et. al. (1993) found that midges comprised approximately 70% of the macroinvertebrate fauna in frozen stream bed samples collected from interior Alaska. The community frozen in the gravel was only a small subset of the stream community, however, suggesting that migration away from encroaching ice may be hampered by the limited mobility of midge larvae (which lack true legs). Approximately 25% of the frozen individuals were alive, indicating that midges have some ability to survive winter in frozen habitats.

Plecoptera Both field (Pugsley and Hynes 1986; Irons et al. 1993) and laboratory (Irons et al. 1993) studies indicate that stoneflies migrate both laterally and vertically and move into and out of the hyporheic, using it as a refuge from adverse conditions on the stream bed.

Empididae Irons et. al. (1993) found small numbers of dance fly larvae in the unfrozen benthos and larger numbers in the frozen near-bank gravel. Dance fly larvae comprised approximately 20% of the macroinvertebrate fauna in frozen stream bed samples and had a high survival rate (78%) after thawing.

Ephemeroptera Both laboratory experiments (Oswood et. al. 1991) and field investigations (Olsson 1983; Ciborowski and Clifford 1983) indicate that mayflies actively move away from a freezing front. Mayflies were observed to move into the center of the river in winter, to the only portion that maintained a flow of water beneath the ice (Ciborowski and Clifford 1983).

Trichoptera Caddisfly larvae actively move away from a freezing front in laboratory experiments (Irons et. al. 1993). A similar result has been observed in the field (Tozer et al. 1981). However, there is evidence that at least some species can survive periods of freezing. Olsson (1981) found living specimens of four species of caddisflies in frozen sediments of a north Swedish River. Paterson and Fernando (1969) reported that a small number of caddisflies survived freezing in a drained area in winter.

Other taxa Many non-insect taxa, e.g. oligochaetes, gastropods, nematodes, ostracods, molluscs and leeches can survive encased in ice or frozen sediments (Holmquist 1973; Danell 1981; Olsson 1981). However, interspecific differences in overwintering strategies may exist within these taxa. Olsson (1984) found that one species of snail (gastropod) was able to survive encased in the frozen substrate while another could not. The latter avoided freezing by overwintering in the deeper parts of the river.

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ATTACHMENT C

INSTREAM WATER RIGHT ANALYSIS PROCESS

INTRODUCTION

The Alaska National Interest Lands Conservation Act (ANILCA) P.L. 96-487 and the National Wildlife Refuge System Improvement Act of 1997 (NWRSIA) P.L.105-57 state that one of the purposes of National Wildlife Refuges in Alaska is to maintain adequate water quantity and water quality to conserve fish and wildlife and their habitats. Biological information and surface water data, such as streamflow, limnologic data, and water quality data are scarce in Alaska. Biological data are generally limited to species presence/absence and general population numbers. Species specific habitat data are generally not documented. Plant species critical to winter habitats for terrestrial species are not clearly understood. Thus, species specific instream flow methods, such as the Instream Flow Incremental Method, that evaluate fish and wildlife habitat needs are not feasible under present hydrologic, biologic, and funding limitations.

Region 7 of the U.S. Fish and Wildlife Service has developed a hydrologic-based instream flow method that is based on the natural flow pattern from which aquatic and riparian habitats have evolved. The objective of this method is to maintain a flow pattern with a wide range of flows, both high and low, to meet riparian and aquatic habitat needs and to maintain the different habitat features of the river system. This method analyzes the natural flow pattern and its annual variability, and results in recommendations for instream flow requirements that conform with western water law, specifically Alaska water law.

HYDROLOGIC-BASED INSTREAM FLOW METHOD

Alaska is extremely large with relatively few miles of road, and thus offers logistical and cost challenges for ecological data collection. As a result, the distribution, seasonal use, and habitat of fish and wildlife are largely unknown and not documented. For example, we may know what species of salmon are found in a given river system. However, where they spawn, rear, and over-winter is often not known. In addition, locations of riparian habitats critical for over-wintering of moose and other wildlife are not well known. Thus a new approach for quantifying instream water rights is necessary to maintain healthy habitats and populations of the fish and wildlife that make the State of Alaska unique. This hydrologic-based instream flow method mimics the natural flow regime as represented by the average annual hydrograph (Poff et al. 1997).

The intent of the hydrologic-based instream flow method is to protect natural habitats, preserve fish and wildlife diversity through maintenance of natural flow variability, while providing water for other users. With the special considerations described on page 6, the method is applicable statewide, protects natural resources, uses limited hydrologic and biologic data, conforms with Alaska State water law, and is affordable in time and dollars. The hydrologic-based instream flow method is based upon the following premises:

- Habitats in and adjacent to the river channel have evolved from the diversity of flows represented by the average annual hydrograph. The average annual hydrograph represents a predictable pattern of high and low flows that normally occur throughout the year.

- Rivers are not regulated, and natural high and low flows are expected to occur each year.

- For water rights purposes, five years of daily discharge are sufficient to quantify instream flows or to synthesize a hydrograph for similar watersheds.

- Biological data include, at a minimum, species presence/absence and periodicity.

- Special considerations may alter the analysis during specific times of the year. These special considerations may include, but are not limited to recreation, fish migration and propagation, water quality, and fish overwintering. See special considerations below.

Given that aquatic and riparian environments have evolved from a predictable flow pattern, it follows that reserving instream water rights that mimic this natural rhythm will provide the water necessary to maintain the natural aquatic and riparian habitats.

PROCEDURE

The first step is to assemble the daily average flow record for the stream reach of interest. A minimum of 5 years of record should make up this database. With less than five years of data there is an inherent risk that a single unusual large storm or extended dry period may skew the data for a given period of the year. The larger the database, the greater the confidence that the hydrograph reflects the true historical natural flow pattern.

A hydrograph is a graph showing stream discharge over time. An average annual hydrograph is developed by finding the average of all daily discharges for a given day and plotting this average daily discharge on a single graph for the entire year. This graph provides a visual representation of the seasonal variability for the watershed at the point of measurement (Figure 1).

Using the hydrograph, Figure 1, incremental time periods for analysis are identified. Incremental time periods may vary in length from weeks to several months. The goal is to separate the homogenous discharge periods from periods where significant hydrologic change is occurring. Using Figure 1 as an example of a typical interior Alaska stream, a single incremental period during the winter may be defined from January 1 through April 15. Beginning about April 15, discharge begins to increase as air temperatures begin to rise and the snowpack begins to melt. A second incremental time period for analysis would be from April 16 through May 15, representing the period of spring snowmelt and/or river breakup. A third incremental time period would be defined as beginning May 16 and would end near the peak of the rising hydrograph on May 30. An additional time period would bracket the falling limb of the hydrograph to a point in time around the end of June or first of July when the curve of the hydrograph flattens to summer flows. During the summer there may be frequent small spikes resulting from rain events. However, these small spikes occur sporadically and are not considered significant hydrologic changes and therefore do not justify separate incremental time periods. A separate incremental time period is considered only when there is a significant change of average discharge over time. Separate incremental time periods are based on a predictable pattern (event) that occurs annually, e.g., spring breakup, rising limb, falling limb, summer flows, fall flows, early and late winter flows, etc. (Figure 1).

Once incremental periods are selected from the average annual hydrograph, a flow exceedance curve is developed for each incremental time period (Figure 2). An exceedance curve is a cumulative frequency curve of discharge resulting in a smooth line fit to a group of daily discharge data. A point along the curve indicates the percent of the time that a given discharge can be expected to be equaled or exceeded. The discharge associated with the 50 percent exceedance (Q_{50}) is the median discharge for that period of time (not to be confused with the average or mean discharge). Data for the exceedance curves are then summarized into a flow exceedence table (Table 1) for the water right application.

Given that the ecosystem within and adjacent to the river corridor has evolved about the flow regime of the river, it is reasonable that the instream flow recommendation would be the discharge associated with the 50 percent exceedance. The 50 percent exceedance (median discharge) then, is equalled or exceeded half of the time during that time period. For most incremental time periods this is a good estimate of the instream flow need. However, there may be special considerations for a given time period that require modifying the instream flow recommendation. Examples of special considerations include, but are not limited to, channel maintenance flows, water quality concerns, riparian habitat, considerations based on professional judgement derived from field experience, and specific wildlife-defined needs such as fish spawning, migration, rearing or incubation needs.

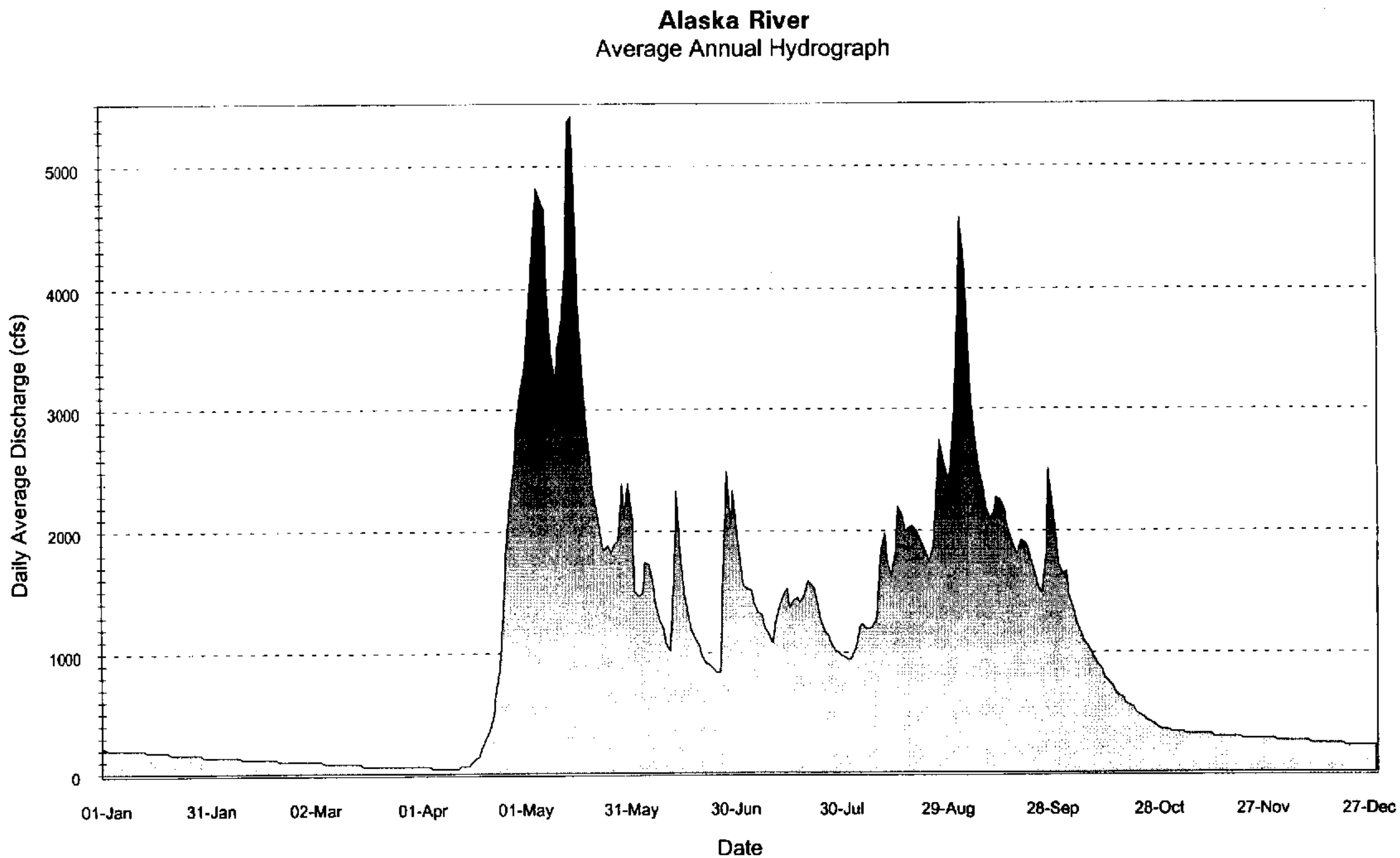


Figure 1. Example of typical hydrograph for interior Alaska river.

Table 1. Example of a flow exceedance table for a typical interior Alaska river – indicates the percent of time discharge equals or exceeds a given discharge in cubic feet per second.

Percent Exceedence	Jan 1 - April 30	May 1 - 31	June 1 - 30	July 1 - 31	Aug 1 - 31	Sept 1 Oct 31	Nov 1 - Dec 31
95%	17	605	553	375	663	311	138
90%	32	965	723	539	811	482	166
85%	44	1255	843	670	927	609	191
80%	56	1489	921	773	1016	703	213
75%	66	1677	966	852	1086	771	232
70%	75	1832	989	912	1142	822	248
65%	84	1964	998	958	1193	865	261
60%	93	2087	1002	996	1243	909	273
55%	101	2211	1012	1030	1301	962	283
50%	110	2348	1036	1064	1371	1034	292
45%	119	2510	1083	1104	1462	1134	301
40%	129	2709	1163	1155	1579	1269	309
35%	140	2957	1286	1222	1729	1449	317
30%	152	3265	1460	1309	1919	1682	326
25%	166	3644	1695	1421	2155	1978	335
20%	181	4108	2000	1564	2445	2345	346
15%	199	4667	2385	1741	2793	2792	359
10%	218	5333	2858	1959	3208	3328	373
5%	240	6118	3430	2222	3695	3961	390

SPECIAL CONSIDERATIONS

Special considerations may apply depending on geographic locations or specific stream characteristics. For instance, a special consideration appropriate for a stream on the Arctic coastal plain may not be applicable for a coastal stream of southwestern Alaska. The following are more common special considerations that may be used to adjust the instream flow recommendations:

- Over-bank flow: to provide necessary water to support wetlands and riparian habitat adjacent to the channel and other water dependent habitats during critical time(s) of the year. These flows also fill oxbow lakes and allow for migration of fish in and out of these lakes, and are necessary to replenish the nutrients of the wetlands and oxbow lakes. Step-backwater, elevation, or high water mark surveys are indirect methods to help determine this flow.

- Channel maintenance flow: discharge of a specific magnitude and velocity sufficient to move the substrate for the purposes of flushing fine sediments from spawning gravels, flush seeds and seedlings from gravel bars, etc. At least one high flow period each year is necessary to maintain the in-channel characteristics. An instream maintenance flow is two times (2X) the average annual discharge. Using this as a rule of thumb, the instream flow for the incremental period with the greatest discharge will be the larger of either the 50 percent exceedance (Q_{50}) or two times the average annual discharge (QAA).

- Water quality maintenance flow: specific discharges to maintain water temperatures, sediment dilution, contaminant dilution, desired salinity in estuaries, nutrient replenishment and desired water quality levels in oxbow lakes.

- Incubation or over-wintering flow: the limiting factor that defines fish egg incubation success is the 7-day average winter low flow (Milhouse 1982). As the stage of the stream drops during the winter months, fish eggs in the gravels along the margin of the stream become dry and/or freeze, then die. The viable eggs are those in gravels below the water stage associated with the 7-day average winter low flow. The eggs near the upper parts of this flow will freeze and die unless thermic conditions of the gravels are adequate to prevent freezing of the substrate. Thus, discharge must be maintained at a level above the 7-day average winter low flow in order to maintain thermic conditions to prevent freezing of the substrate and to incubate fish eggs. The winter instream flow must be greater than two times (2X) the 7-day average low-flow. The winter instream flow also must be the lower of two flow values, the 25 percent exceedance (Q_{25}) or the average discharge for the winter incremental period.

- Spring breakup flow: to flush ice from the river systems and provide thermic water to the estuaries that initiates melting of the ice pack and allows fish migration. In areas of Alaska, such as the north slope or the northwest coast where substantial sea ice forms and there are early migrating fish species, riverine water is required to initiate sea ice melting. This thermic situation requires an instream flow of the 25 percent exceedance (Q_{25}) for a minimum of 1 week.

- Spawning flow: discharge necessary to meet spawning velocity conditions for the purpose of moving gravels onto the fish redds. Periodicity tables for each target species are required.

- Fish passage flow: discharge necessary to support fish passage of adults upstream for spawning and flush fry and juveniles downstream for out migration.

- Recreation and navigation flow: discharge to support rafting, kayaking, or general navigation.

- Fish harvest: discharge to support fish harvest by subsistence users and commercial fish operations, the operation of fish wheels, nets, etc.

PRODUCTS

Annual Hydrograph: A graph representing the average annual daily discharge is developed, Figure 1. This figure is an aid to identifying the incremental periods and is part of the water right application.

Exceedance Table: When the exceedance analysis is completed for each incremental period, an exceedance table should be developed, Table 1. This table should include an expected discharge at 5 percent exceedance intervals for each incremental period. This table will be included in the water right application.

Water Right Summary Table: A table that includes the average discharge and water right need for each incremental period will be developed for inclusion in the water right application, Table 2. The intent of this table is to provide a quick reference for comparing the water right request to the average discharge which can be expected during each incremental period.

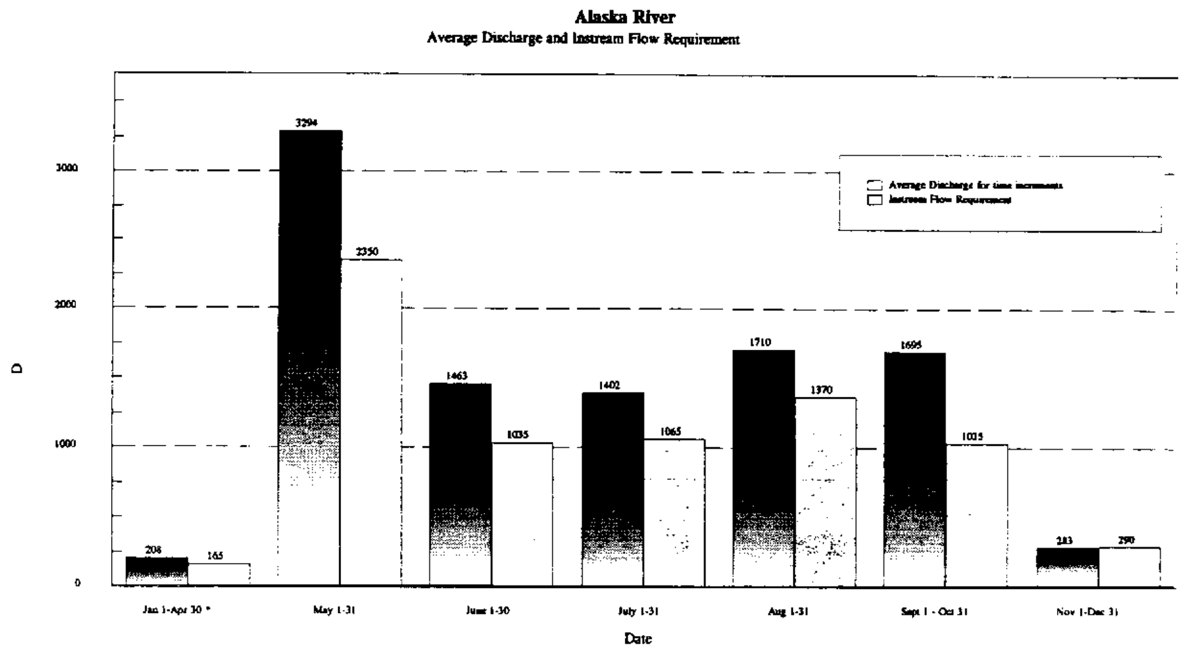
Table 2. Example of the water rights summary table.

SEASONAL PERIOD	AVG. DISCHARGE FOR PERIOD (cfs)	INSTREAM FLOW RESERVATION (cfs)
Jan 1-Apr 30 *	208	165
May 1-31	3294	2350
June 1-30	1463	1035
July 1-31	1402	1065
Aug 1-31	1710	1370
Sept 1 - Oct 31	1695	1035
Nov 1-Dec 31	283	290

* The lower of 25 percent exceedance flow or average discharge.

Water Right Summary Graph: The information from the Water Right Summary Table can also be summarized in a bar graph to provide a visual graphic of the water right request as compared to the average discharge for the incremental period. This graph should be included in the water right application.

Figure 2. Example of a water rights summary graph.



Exceedance Curves: Exceedance curves for each incremental period used to develop the exceedance table should be available as backup reference for the exceedance table. These curves are for reference only, will be kept on file at the Water Resources Branch office.

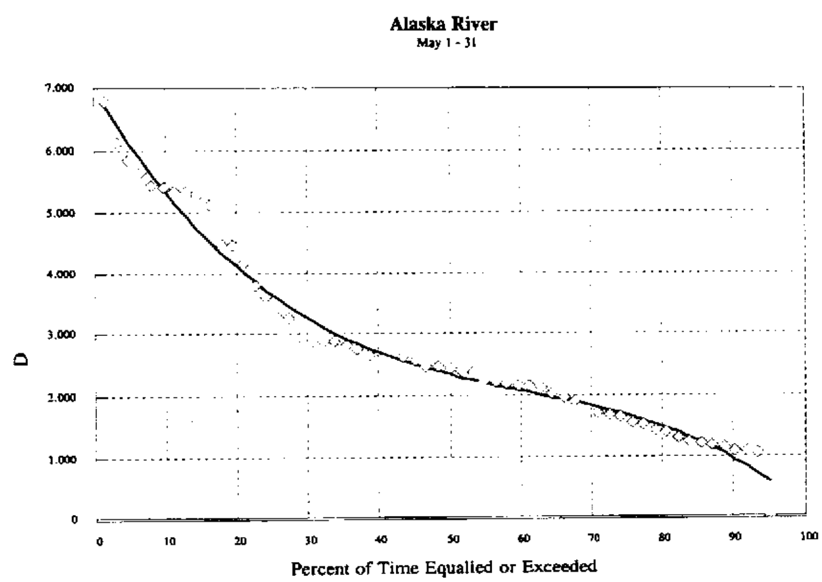


Figure 3. Example of an exceedance curve.

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