GEOMORPHOLOGY AND HYDROLOGY OF THE COLVILLE RIVER DELTA, ALASKA, 1994

1994 Data Report for Spring Breakup

Prepared for:

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Prepared by:

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INTRODUCTION

This data report presents a summary of the data collected and observations made during breakup of the Colville River in 1994. This project continues studies initiated in 1992 that have focused on geomorphic and hydrologic conditions in the Colville River Delta that are important to assessing the feasibility of oil development in the delta. In 1994, data collection was limited to acquiring an indirect measurement of peak stage from high-water marks during breakup that could be used to estimate peak discharge. In line with this reduced effort in 1994, this annual report is limited to a brief tabular presentation of observations and data that were collected. This information includes:

1) a tabular summary of river and weather conditions during breakup obtained by calling various sources on the North Slope and the National Weather Service (Table 1),

2) a tabular summary of annual peak stage and discharge measurements for the Colville for 5 years since 1962 (Table 2). In 1994, water levels were monitored aerially during peak flow and peak stage was estimated from high water marks that were surveyed on the ground (Appendix Table 1). Jim Aldrich, Shannon and Wilson, then estimated peak discharge using the stage information (Appendix). Peak stage was thought to have occurred on 25 May and the associated discharge was estimated to be 165,000 cfs.

3) photos illustrating ice conditions during the time of peak discharge (Figure 1, Appendix), and,

4) a tabular listing of oblique aerial photographs that were acquired for some of the small study areas used for analyzing flood distribution (Appendix Table 2). A complete set of aerial photographs of the study areas was not taken because the discharge in 1994 was relatively low.

DATA SUMMARY

Tabular summaries of information collected during breakup are provided in Tables 1 and 2 and Appendix Table 1.

Table 1. Summary of observation of river and weather conditions during breakup of the Colville River, 1994.

Date	Comments
16-24 May	This period had relatively warm temperatures in the foothills that initiated snowmelt. Daily maximum temperatures at Umiat were in the upper 30's to lower 50's. During 21-24 May temperatures remained above freezing at night. According to Nuiqsut villagers on 24 May, water was over the ice and they didn't think water had peak yet.
25-27 May	This period had cooling temperatures with high's in the 30's and low in the 20's. Jorgenson arrived on the North Slope on 25 May to monitor water levels from an airplane using ARCO's Otter based in Kuparuk. Low-level, large scale photos of the east and west banks at Cross Section 6 were obtained on 25, 26, and 27 May. The photos revealed that water levels were receding after 25 May. Based on this information, Jorgenson estimates that the peak occurred on either 24 May or 25 May. Because temperatures remained above freezing at Umiat on 24 May and dropped below freezing for the first time in many days on 25 May, it is likely that the peak occurred on 25 May. Due to falling temperatures, the formation of new ice on the riverbanks, and receding waters, Jorgenson returned to Fairbanks on 27 May on the assumption that peak flooding had not yet occurred.
27 May - 2 June	High temperatures at Umiat were in the 20's and 30's and low temperatures were in the 10's and 20's. On 30 May, Umiat reported that most of the snow was gone and that snow was limited to scattered, little patches. They also reported that the peak occurred somewhere around the 25th of May.
2 June - 5 June	High temperatures at Umiat were in the 40's to 60's and low temperatures remained above freezing. Photos were taken at Cross section 6 by ARCO's Otter pilots on 2 and 4 June. They revealed that the water level continued to drop during this period and that most of the barren riverbed/sandbar on the west bank was exposed. There was a continuous layer of ice down the main channel.
6 June	Jorgenson flew out to the gauging station on 6 June with ERA helicopters. This date was the only day when the helicopter was going to be available from 1-20 June. An airphoto of the site revealed that the water level had risen slightly but that most of the riverbed/sandbar on the west bank was still exposed. Examination of the shoreline on the west riverbank revealed three recent driftlines. The highest driftline was mostly obscured by meltwater and sediment derived by the snowbank on the sand dunes. In contrast, the other driftlines were distinct and easily traceable along the shore. Measurements of elevations along the driftlines were made relative to TBMs established by Aldrich. The highest driftline had an elevation of 11.8 ft. According to Helmericks on 6 June, the river had not come up very much lately and the ice was still there. It was his opinion that there would be no more big breakup flooding. Observations of snow conditions on the North Slope made from the Mark Air flight from Fbks-Deadhorse-Barrow-Fbks revealed that most of the snow in the foothills regions was gone. Snow distribution was limited to snowdrifts in gullies. On the coast plain, snow cover was about 30-50% and there was a lot of meltwater standing on the tundra. The 6th was a high snowmelt day on the coastal plain.
9 June	According to Nuiqsut villagers, the ice in the channel went out on the 9th and the river was clear for boating on the 10th. They regarded 1994 breakup as unusual.
11 June	Debbie Flint, ABR took oblique aerial photos of XSEC 6 on 11 June. Large driftlines in the photos indicate the water level associated with a second crest on 9 June rose to within 1-2 ft below the level measured for 25 May.

Table 2. Summary of measured and estimated values for peak stages and discharges, Colville River Delta.

Year	Peak Stage (ft)	Method for Stage	Peak Discharge (cfs)	Method for Discharge	Source
1962	11.9	1	215,000	3	Arnborg et al. (1966)
1977	18.6	1	374,000	4	USGS (1978)
1992	13.4	2	164,000	4	Jorgenson et al. (1993)
1993	18.7	1	379,000	5	Jorgenson et al. (1994)
1994	11.8	2	165,000	6	This data report
Mean	14.9		259,400		

Methods for measurement of peak stage:

1 - direct measurement of water surface elevation

2 - indirect measurement of high water marks

Methods for measurement of peak discharge:

3 - direct measurement at time of peak discharge.

4 - estimated using data from 1962 to extrapolate to the peak discharge from the discharge measured 2 days after the peak.

5 - estimated using the measured peak water-surface elevation, the water-surface slope based on high water marks, and the computed hydraulic roughness values.

6 - estimated using indirect measurement of peak stage of high water marks, extrapolation from preliminary stage-discharge curve, and adjusted for channel ice.

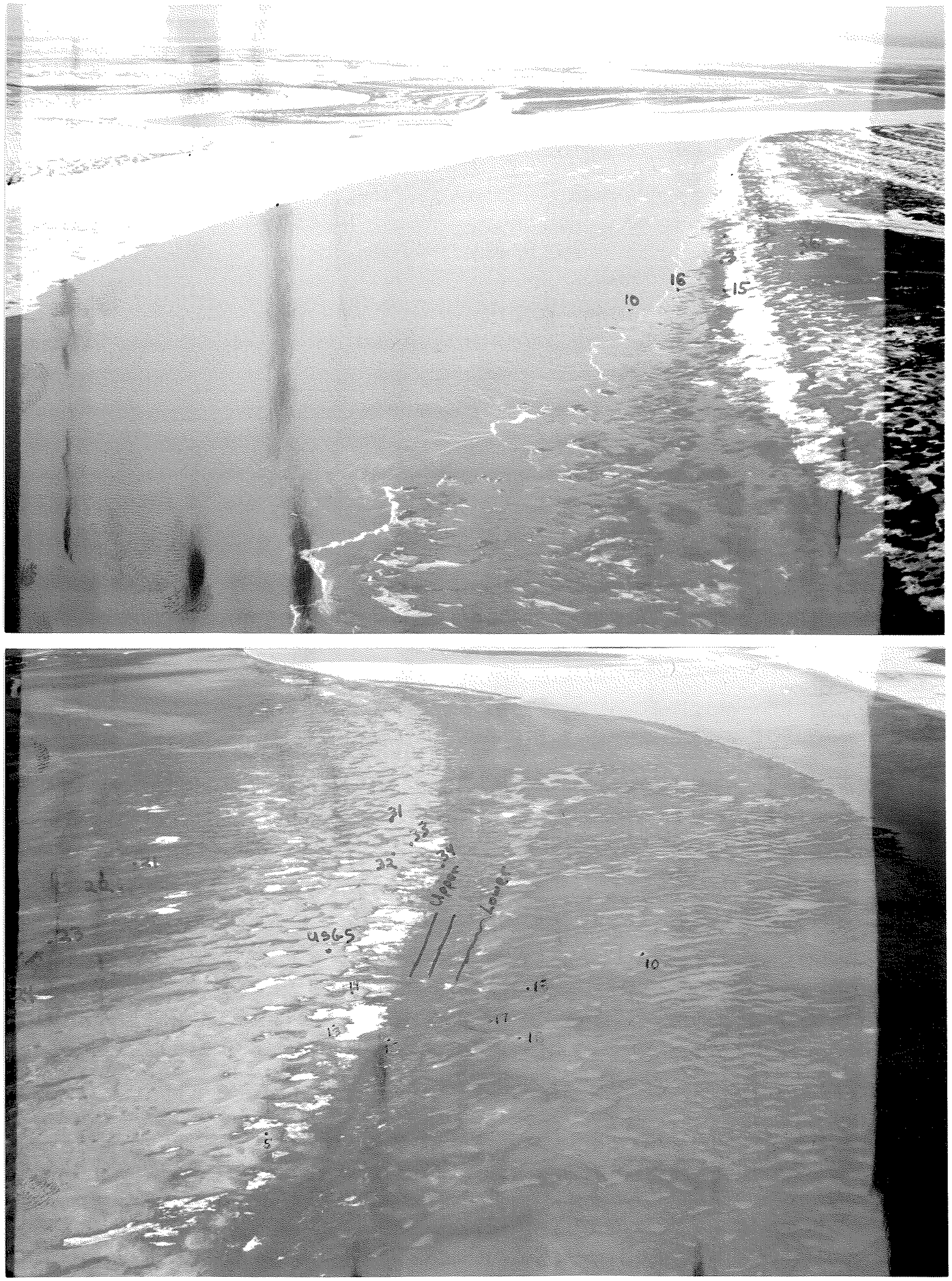

Figure 1. Aerial views of the Colville River at Cross Section 6 taken on 26 May (upper photo looking south) and 6 June 1994 (lower photo looking north). Numbers on the photos refer to common locations found on both photographs and the lines indicate drift lines that were measured on 6 June.

APPENDIX

DATA FILE LISTINGS, PEAK DISCHARGE CALCULATION, AND AERIAL PHOTOGRAPHY USED TO MONITOR WATER LEVELS

Appendix Table 1. Elevation measurements of high water marks at Cross-Section 6 two weeks after peak stage during breakup on the Colville River Delta.

Location	First Set Up Rod Ht. (cm)	Elevation (ft)	Second Set Up Rod Ht. (cm)	Elevation (ft)	Comments
USGS-top		29.50			Elevation from J.W. Aldrich, 1993
TBM10-top		27.21			Elevation from J.W. Aldrich, 1993
TBM6-top		29.06			Elevation from J.W. Aldrich, 1993
TBM5-top		14.60			Elevation from J.W. Aldrich, 1993
USGS-top			-14.5	29.50	Top of rebar, USGS Post, sticks up 3.18 ft
USGS-gnd			82.5	26.30	ground surface
TBM10-top			55.0	27.21	top of angle iron, sticks up 0.67 ft
TBM10-gnd			75.5	26.53	ground surface
TBM6-top			-2.0	29.09	top of stake, sticks up 11 cm
TBM6-gnd			9.5	28.71	ground surface
TBM5-ice	152.0	14.70	436.5	14.70	ice surface above ground level, no rebar
94.1	283.0	10.41			middle drift line, height relative to TBM5
94.2	284.0	**10.37**			middle drift line, height relative to TBM5
94.2			569.0	**10.36**	middle drift line, height relative to USGS Post
94.3	284.5	10.36			middle drift line, height relative to TBM5
94.4	284.0	10.37			middle drift line, height relative to TBM5
94.5	284.5	10.36			middle drift line, height relative to TBM5
94.6	313.0	9.42			lowest drift line, height relative to TBM5
94.7	313.5	9.41			lowest drift line, height relative to TBM5
94.8	313.5	9.41			lowest drift line, height relative to TBM5
94.9	241.0	**11.78**			highest drift line, height relative to TBM5
94.9			525.0	**11.80**	highest drift line, height relative to USGS Post
94.10	242.0	11.75			highest drift line, height relative to TBM5
94.11	242.0	11.75			highest drift line, height relative to TBM5
94.12	242.5	11.74			highest drift line, height relative to TBM5

Appendix Table 2. Summary of elevations of high water marks measured two weeks after peak stage.

Mean (ft)	SD (ft)	Drift Line
11.76	**0.02**	**Highest drift line, n=4**
10.37	0.02	Middle drift line, n=5
9.41	0.01	Lowest drift line, n=3

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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BOSTON

1954 - 1994

September 27, 1994

Alaska Biological Research, Inc.
P.O. Box 81934
Fairbanks, Alaska 99708

Attn: Mr. Torre Jorgenson

RE: COLVILLE RIVER 1994 PEAK DISCHARGE

This letter reports the estimated peak discharge for the Colville River at Cross Section 6 on May 24-25, 1994. Based on your field observations and measurements as well as our hydrologic analysis, the estimated peak discharge is 165,000 cfs. A brief discussion of how this estimate was obtained follows.

In general, the estimate was made by assuming that the channel bottom elevations and the open water stage-discharge relationship were as estimated in the report titled "1993 Spring Breakup Observations At Cross Section 6 On The Coleville River" (Shannon & Wilson, 1993). The peak water surface elevation was assumed to be 11.76 feet, based on a ground survey of the highest drift line made by you on June 6 ("Breakup Observations 1994", Torre Jorgenson, ABR). Because broken ice was floating on the surface of the river at the time of the peak water surface elevation, the cross sectional area associated with the discharge at the time of the peak water surface elevation was estimated by subtracting the cross sectional area of the ice from the cross sectional area of the open water cross section below an elevation of 11.76 feet. The stage and discharge corresponding to the cross sectional area of flow were then estimated, using the stage-discharge relationships developed for the report titled "1993 Spring Breakup Observations At Cross Section 6 On The Coleville River" (Shannon & Wilson, 1993).

The cross sectional area of the ice was estimated based on the top width of the ice estimated by you from aerial photographs and the average ice thickness reported in the 1993 Shannon & Wilson report. This method of accounting for the impact of the ice was considered acceptable for this estimate because: the ice cover was broken, it extended across only a portion of the cross section, and it was moving.

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Please note that the discharge estimate is based on several key assumptions and that, to the extent the actual conditions varied from those that were assumed, the actual discharge may vary from that estimated. However, all things considered, we consider this a reasonable estimate of the peak discharge in 1994.

It should also be noted that we now have five annual peak flow estimates. This is the minimum number required to estimate the flood peak frequency relationship based on statistical analysis. As you are aware, a flood-peak-frequency relationship was reported in our 1993 report. However, with the information that is currently available, a more reliable estimate could be made using both the methods described in our 1993 report and a statistical analysis. The results of the two methods, each based on limited data, could then be combined to provide a more reliable estimate of the flood-peak-frequency relationship.

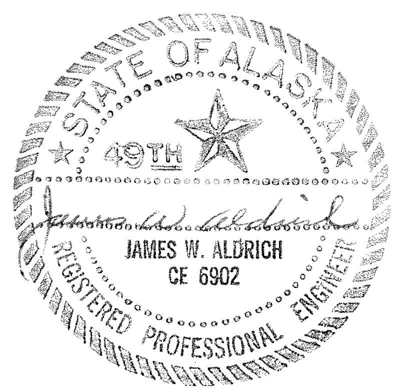
I trust that this will be sufficient for your purposes at this time. If you have any questions, or if we can be of any further assistance to you, please do not hesitate to call.

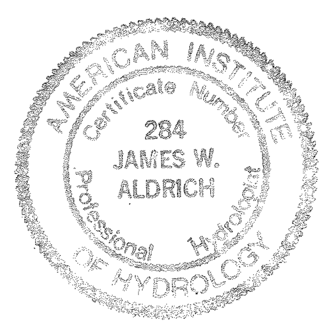
We look forward to working with you again.

Sincerely,

SHANNON & WILSON, INC.

By: [signature]
James W. Aldrich, P.E., P.H.
Senior Associate





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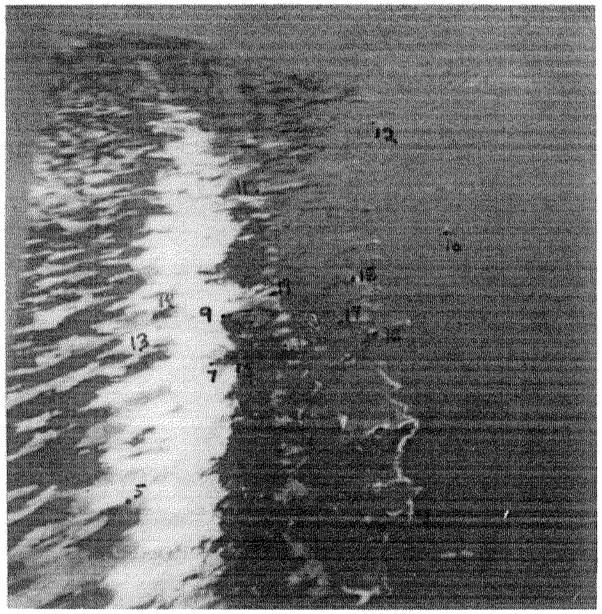

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25 May 94, 4 PM

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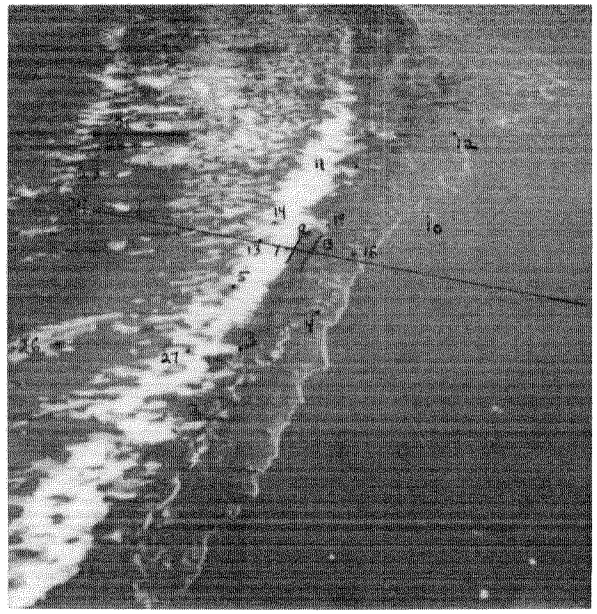

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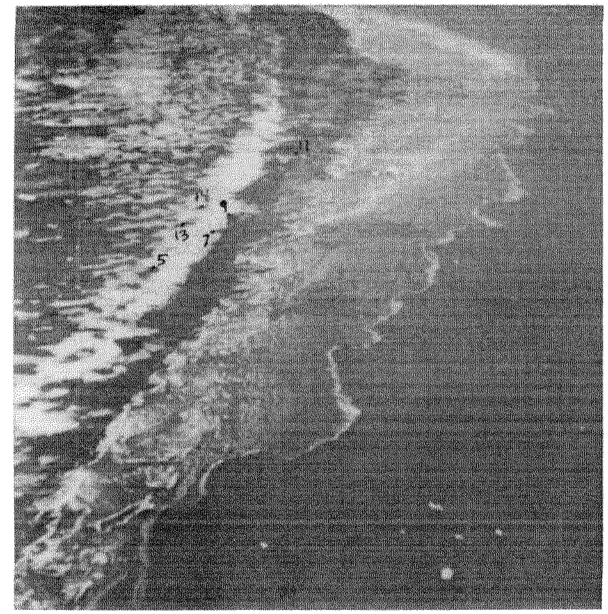

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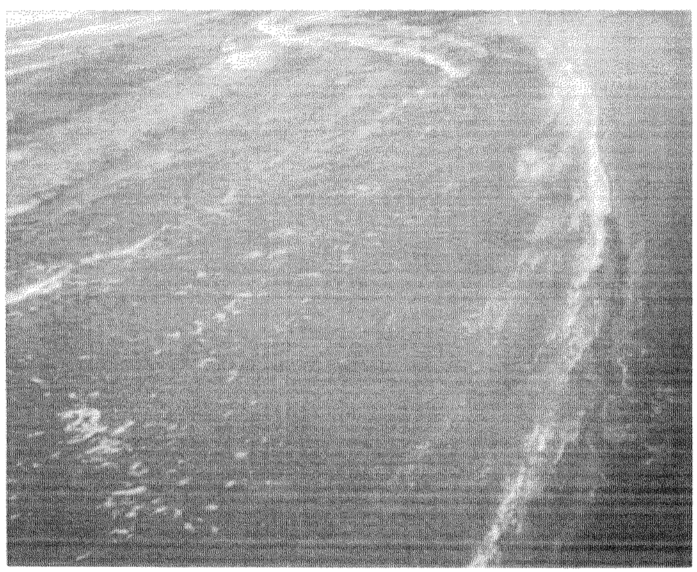
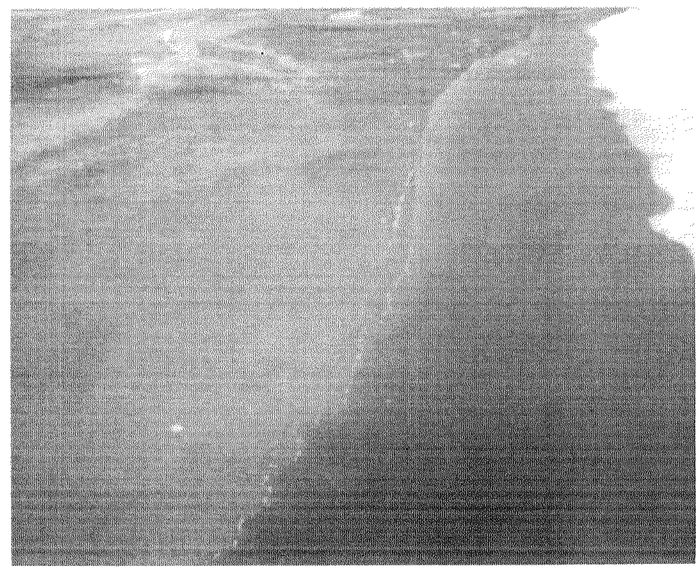


2 June 94, XSEC 6
W. Bank, Colville



4 June 94, XSEC 6
W. Bank, Colville River

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ESTIMATE OF AMOUNT OF ICE COVERAGE IN CHANNEL AT CROSS SECTION 6 ON 26 MAY 19[illegible]

	Photo (mm)	Grnd (m)	Scale
Measurement from photo TJ94C23a			
Distance from pnt 40 to 41 on 1:18,000 CIR	10.8	194.4	18000
Distance from pnt 40 to 41 on aerial oblique	24.6	194.4	7902
Distance from pnt 41 to 42 on aerial oblique	57.0	**450**	7902
Measurement from photo tj94c-33a			
Distance from east bank to base of sand dunes on aerial oblique	46.0		
Distance from east bank to edge of ice	24.0		
Percent of distance covered by ice	52.2		
Distance across channel on CIR	51.5	927	18000
Distance of ice across channel		**484**	
Measurement from photo tj94c-30a			
Distance from east bank to base of sand dunes on aerial oblique	89.0		
Distance from east bank to edge of ice	41.0		
Percent of distance covered by ice	46.1		
Distance across channel on CIR	52.0	936	18000
Distance of ice across channel		**431**	
Measurement from CIR photo 17-13 (8 July 92)			
Distance of water across channel	25.0		
Percent of channel covered by water	48.5		
Distance across channel on CIR	51.5	927	18000
Distance of water across channel		**450**	

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Prepared by Torre Jorgenson 9/13/94