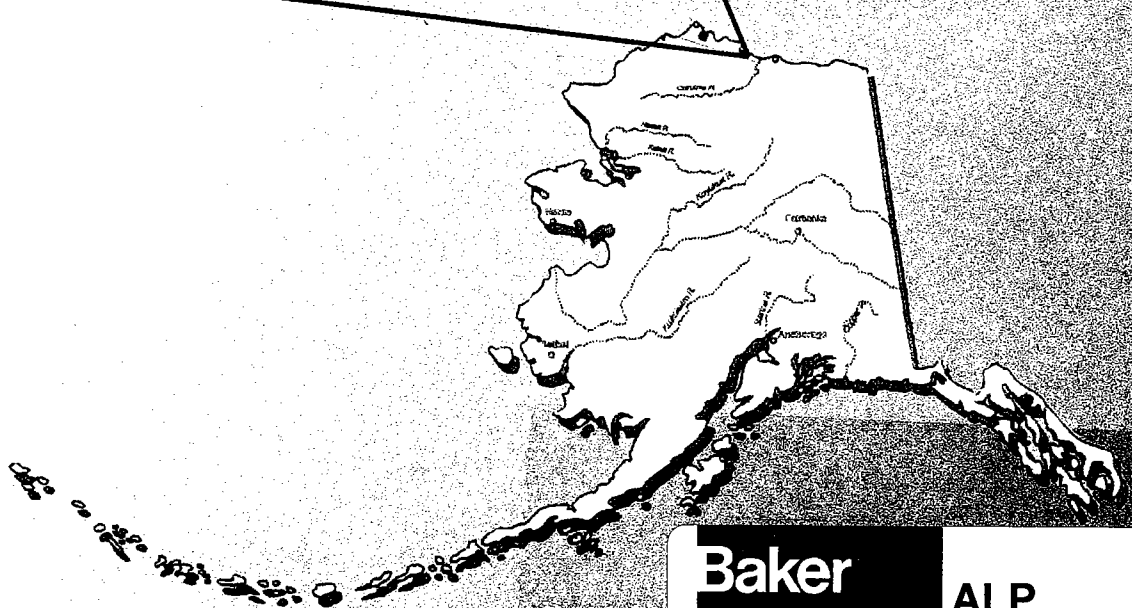
1999 SPRING BREAKUP AND HYDROLOGIC ASSESSMENT

COLVILLE RIVER DELTA
NORTH SLOPE, ALASKA

November 1999



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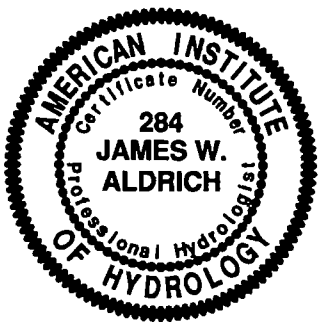

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1999 SPRING BREAKUP AND HYDROLOGIC ASSESSMENT
COLVILLE RIVER DELTA
NORTH SLOPE, ALASKA

1.0 INTRODUCTION

This report summarizes the observations and measurements made during the 1999 spring breakup monitoring of the Colville River Delta. Fieldwork for the 1999 monitoring was performed between 24 May and 11 June. During this time, water surface elevations were monitored on the East Channel at the head of the delta, and on the Nechelik and Sakoonang Channels near the Alpine Development facility. Water surface elevations were also monitored in the swale between Colville Drill Sites 1 and 2 (Figure 1, Appendix A).

2.0 1999 BREAKUP SUMMARY

The tundra immediately adjacent to the facility was not inundated by water from the Nechelik or Sakoonang Channels during the 1999 spring breakup. Thus, no water from the river channels passed through the culverts located in the road that will eventually connect Colville Drill Sites 1 and 2.

Additionally, no or very little water flowed from Nanuk Lake through the swale (located between Colville Drill Sites 1 and 2) to the tap lake on the north side of the road. However, water did back up into the swale from the tap lake.

Neither Lake 93-12 nor Lake 93-13, the lakes providing water for the Alpine Development facility, was recharged by water from the Sakoonang or Nechelik Channels. Similarly, Lake 92-82 was not recharged by water from the Sakoonang Channel. Selected photographs taken in the vicinity of the facility and water supply lakes are presented in Appendix C.

At the head of the delta (Monument 1, Figure 1, Appendix A), the water surface elevation peaked during the night of 29-30 May, at an elevation of 13.97 feet (British Petroleum Mean Sea Level - BPMSL). In the vicinity of the facility, the water surface elevation peaked in the Nechelik Channel during the night of 29-30 May and in the Sakoonang Channel during the night of 30-31 May. The peak water surface elevation was 5.89 feet (BPMSL) on the Nechelik Channel (Monument 22) and 4.64 feet (BPMSL) on the Sakoonang Channel (TBM 27U), in the

vicinity of the facility. Thus, the peak water surface elevation was contained within the banks of the channel at all three locations.

The peak discharge at the head of the delta occurred on 30 May and was approximately 203,000 cubic feet per second (cfs). It is estimated that, on average, the 1999 spring peak discharge at the head of the delta will be equaled or exceeded more than 5 times in 10 years. The peak discharge at the head of the Sakoonang Channel also occurred on 30 May and was approximately 3690 cfs.

3.0 BREAKUP OBSERVATIONS

When the monitoring team arrived on 24 May, water at the head of the delta (river mile E27.09, Figure 1, Appendix A) had already covered the sand bar on the west bank and had frozen. This was due to the warm temperatures that occurred at Anaktuvuk Pass, while the delta and possibly other parts of the drainage basin were still cold (Table 1, Appendix B). This type of weather pattern tends to result in a spring breakup flood that has a lower peak discharge and longer flood duration than would occur if the temperature stayed cool and then warmed up rapidly throughout the drainage basin.

To monitor water surface elevations, staff gages were set at selected locations around the delta (Figure 1, Appendix A). At the head of the delta, staff gages were set at river mile E27.49, E27.09, and E26.92. In the Sakoonang and Nechelik Channels staff gages were set at river mile S16.20, S16.05, S15.79, S5.47, N9.47 and N2.03. In the swale, between Colville Drill Sites 1 and 2, a staff gage was set at TBM SA. The water surface elevation and observation records obtained at these locations are summarized in Tables 2 through 11 (Appendix B).

The condition of the river ice was also monitored periodically throughout breakup. On 29 May, by 16:00 hours, the low-water-channel ice had broken up in the upper portions of the Nechelik and Sakoonang Channels, but was still intact in the East Channel. By 20:00 hours on 30 May the low-water-channel ice in the East Channel had cleared to just below the inlet to the Sakoonang Channel. The low-water-channel ice in the Sakoonang Channel had cleared from the inlet to approximately river mile S7.0, near the Alpine Development facility. However, surface ice jams were still present in all three channels. The low-water-channel ice in the East and Sakoonang Channels continued to clear over the next several days. However, the low-water-channel ice in the Nechelik Channel did not clear significantly until 3 June, by which time the channel had cleared to approximately river mile N7.7, near Drill Site 2. The condition of the ice cover on 29

May, 30 May, 31 May, 2 June and 3 June is shown in Figures 2 through 6 (Appendix A). Monitoring of the river ice in the East Channel was discontinued after 31 May, since the ice in that channel no longer affected the water surface elevation at the Alpine facility.

Daily water-surface-elevation measurements were made at most sites. The peak water surface elevation on the East Channel at the head of the delta and on the Nechelik Channel in the vicinity of the facility occurred during the night of 29-30 May. On the Sakoonang Channel, the peak water surface elevation occurred on the morning of 30 May near the entrance to the channel and during the night of 30-31 May at the facility. The peak water surface elevation (BPMSL) at each of the measurement sites was: 14.07 feet at E27.49, 13.97 feet at E27.09, 14.09 feet at E26.92, 10.28 feet at S16.20, 4.64 feet at S5.47, 5.89 feet at N9.47 and 2.85 feet at N2.03.

Discharge measurements were made in the Sakoonang Channel, near river mile S16.2 on 29 May, 31 May, 4 June and 7 June (Tables 12, 13, 14 and 15, Appendix B). These measurements, along with water surface elevation measurements, and ice observations were used to estimate the instantaneous spring peak discharge and the average daily discharge on days both preceding and succeeding the peak (Table 16, Appendix B). The peak discharge was 3690 cfs and occurred on 30 May, several hours after the peak water surface elevation occurred near river mile S16.2.

The instantaneous peak discharge and the average daily discharge on days both preceding and succeeding the peak discharge were also estimated for the East Channel, near river mile E27.09 (Table 16, Appendix B). During periods affected by ice, normal depth computations were used to estimate the discharge. The computations were based on estimates of ice thickness and width, estimates of hydraulic roughness and cross sectional area from discharge measurements performed in previous years, and water surface slope estimates based on the water surface elevations recorded at various monitoring sites. During periods unaffected by ice, the stage discharge curve presented in the *1996 Colville River Delta Spring Breakup And Hydrologic Assessment, North Slope, Alaska* (Shannon and Wilson, Inc., 1996. Prepared for Michael Baker Jr., Inc., Anchorage, Alaska) was used to estimate the discharge. Based on these computations the instantaneous peak discharge at the head of the delta is estimated to be 203,000 cfs and occurred on 30 May, several hours after the water surface elevation peaked.

The 1999 instantaneous spring peak discharge at the head of the delta (E27.09) was the fourth lowest of the ten recorded spring flood peaks (Table 17, Appendix B). Thus, it is estimated that

at the head of the delta, the 1999 spring peak discharge will be equaled or exceeded more than 5 times in 10 years on average.

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Figure 1: Observation Sites

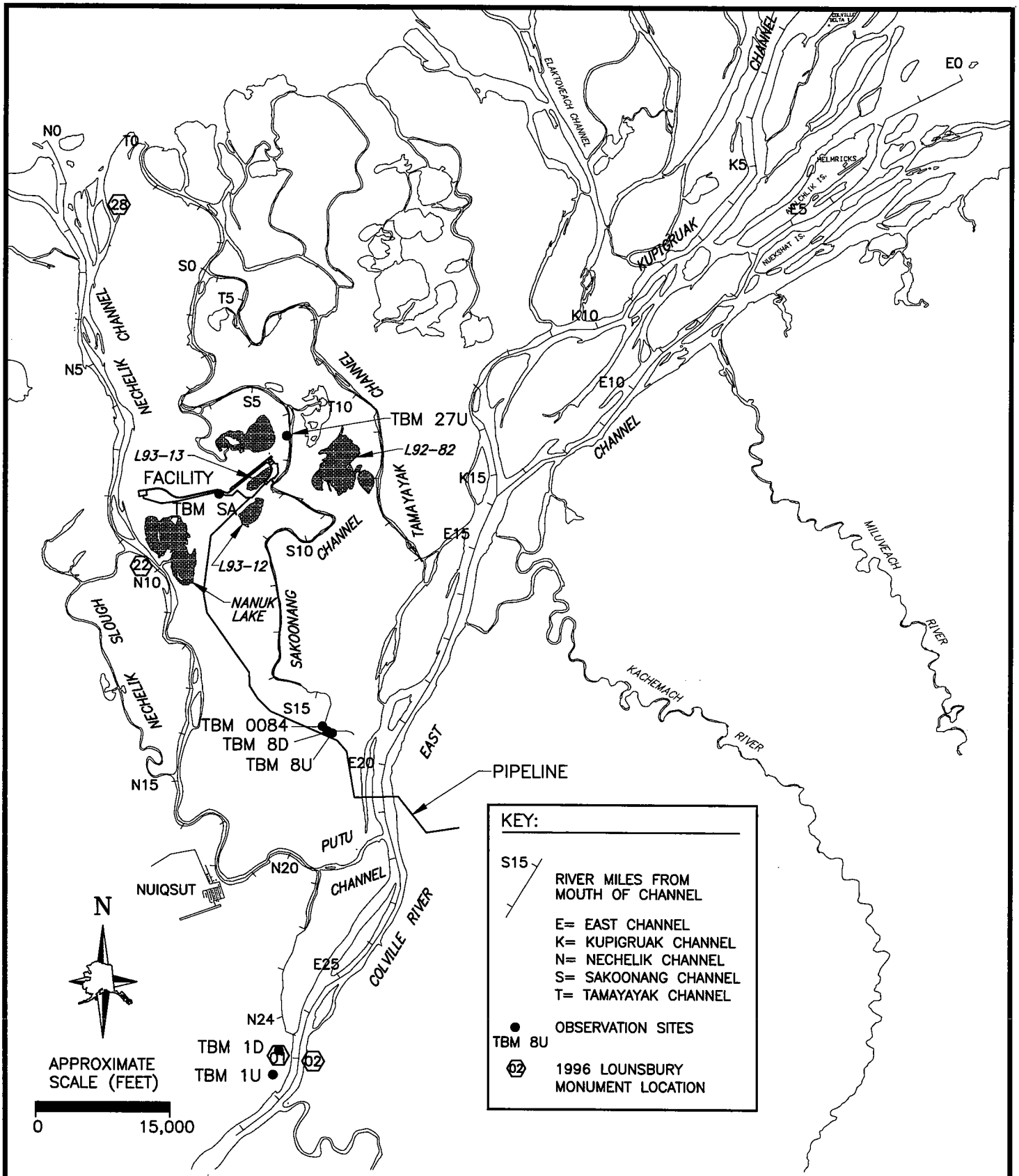
Figure 2: Ice Conditions Within East, Nechelik, And Sakoonang Channels on May 29, 1999 At 16:00 Hours

Figure 3: Ice Conditions Within East, Nechelik, And Sakoonang Channels on May 30, 1999 At 20:00 To 21:00 Hours

Figure 4: Ice Conditions Within East, Nechelik, And Sakoonang Channels on May 31, 1999 At 14:00 To 16:00 Hours

Figure 5: Ice Conditions Within Nechelik And Sakoonang Channels on June 2, 1999 At 17:00 Hours

Figure 6: Ice Conditions Within Nechelik And Sakoonang Channels on June 3, 1999 At 17:00 Hours



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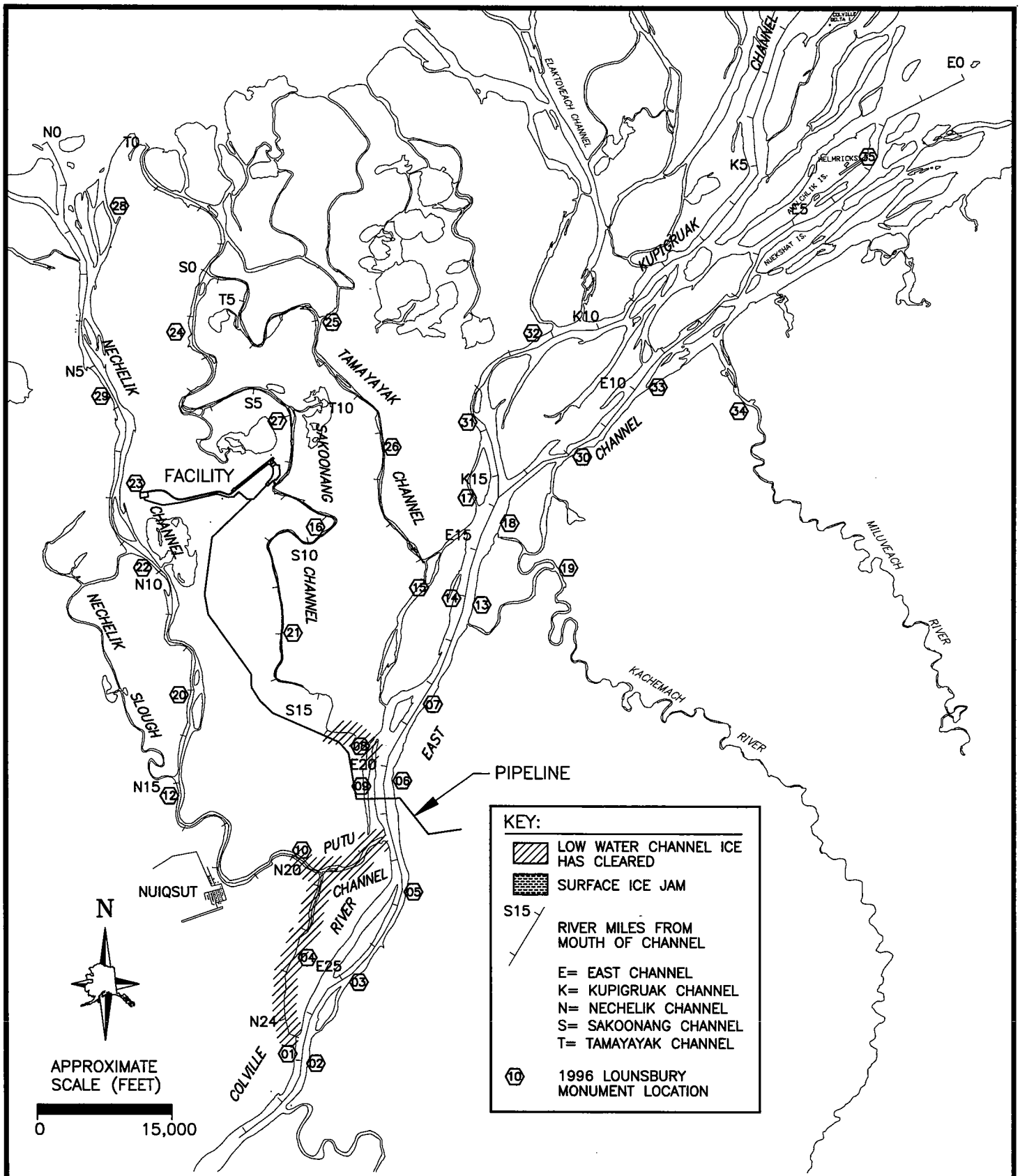
1999 SPRING BREAKUP
COLVILLE RIVER DELTA

OBSERVATION SITES

FIGURE: 1



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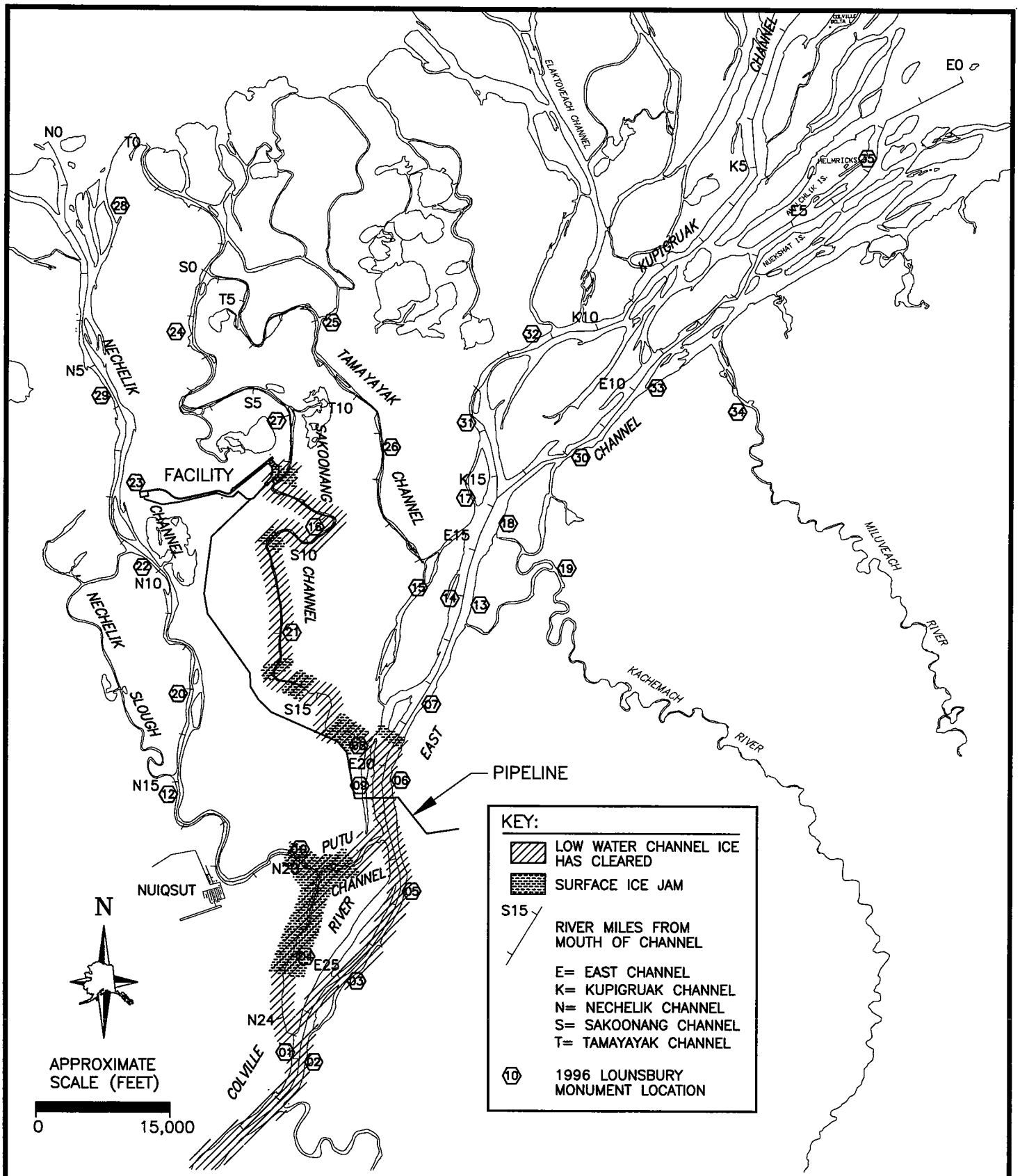
1999 SPRING BREAKUP
COLVILLE RIVER DELTA

ICE CONDITIONS WITHIN EAST, NECHLIK, AND SAKOONANG CHANNELS ON MAY 29, 1999 AT 16:00 HOURS

FIGURE:
2



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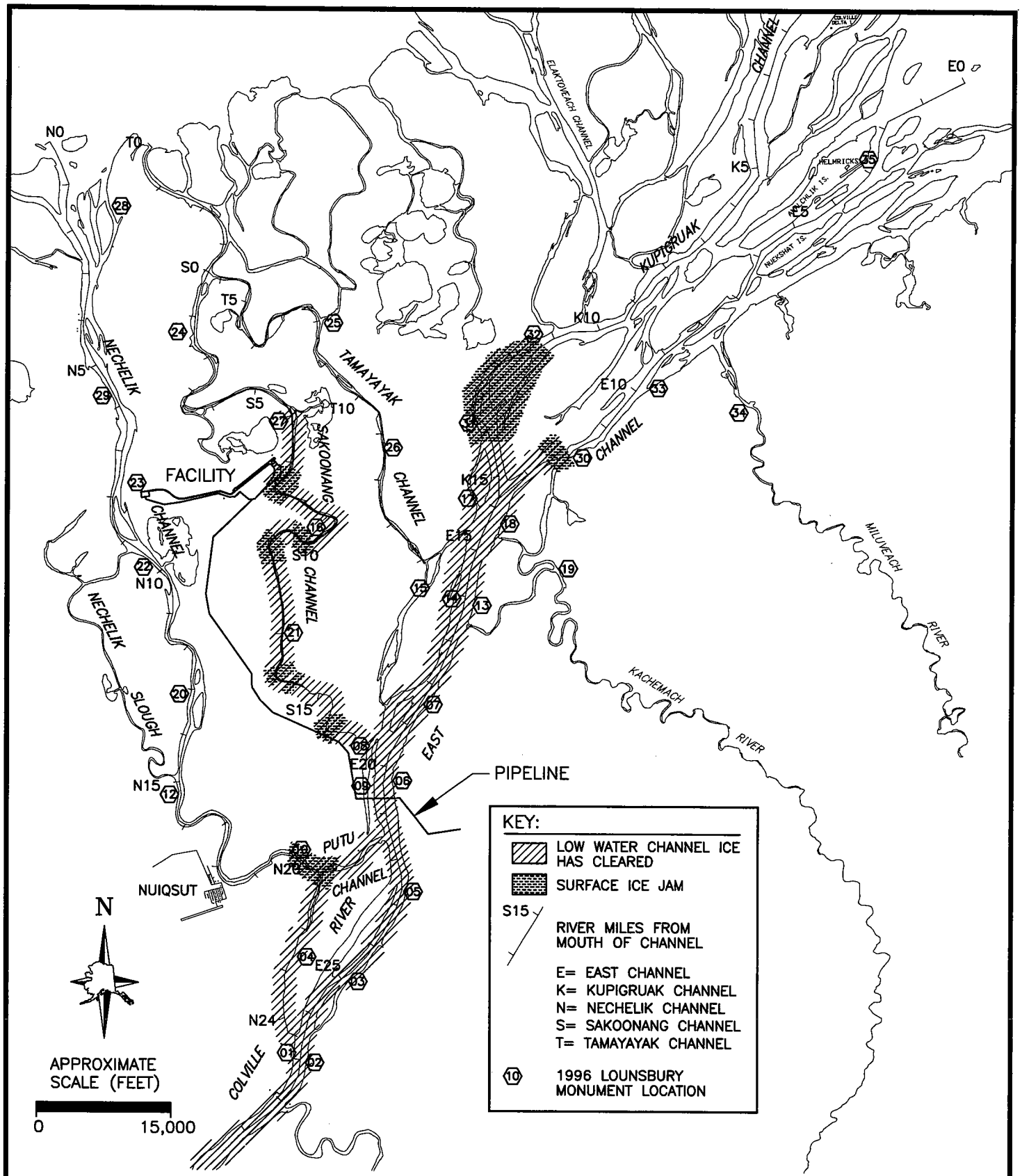
1999 SPRING BREAKUP
COLVILLE RIVER DELTA

ICE CONDITIONS WITHIN EAST, NECHLIK, AND SAKOONANG CHANNELS ON MAY 30, 1999 AT 20:00 TO 21:00 HOURS

FIGURE:
3



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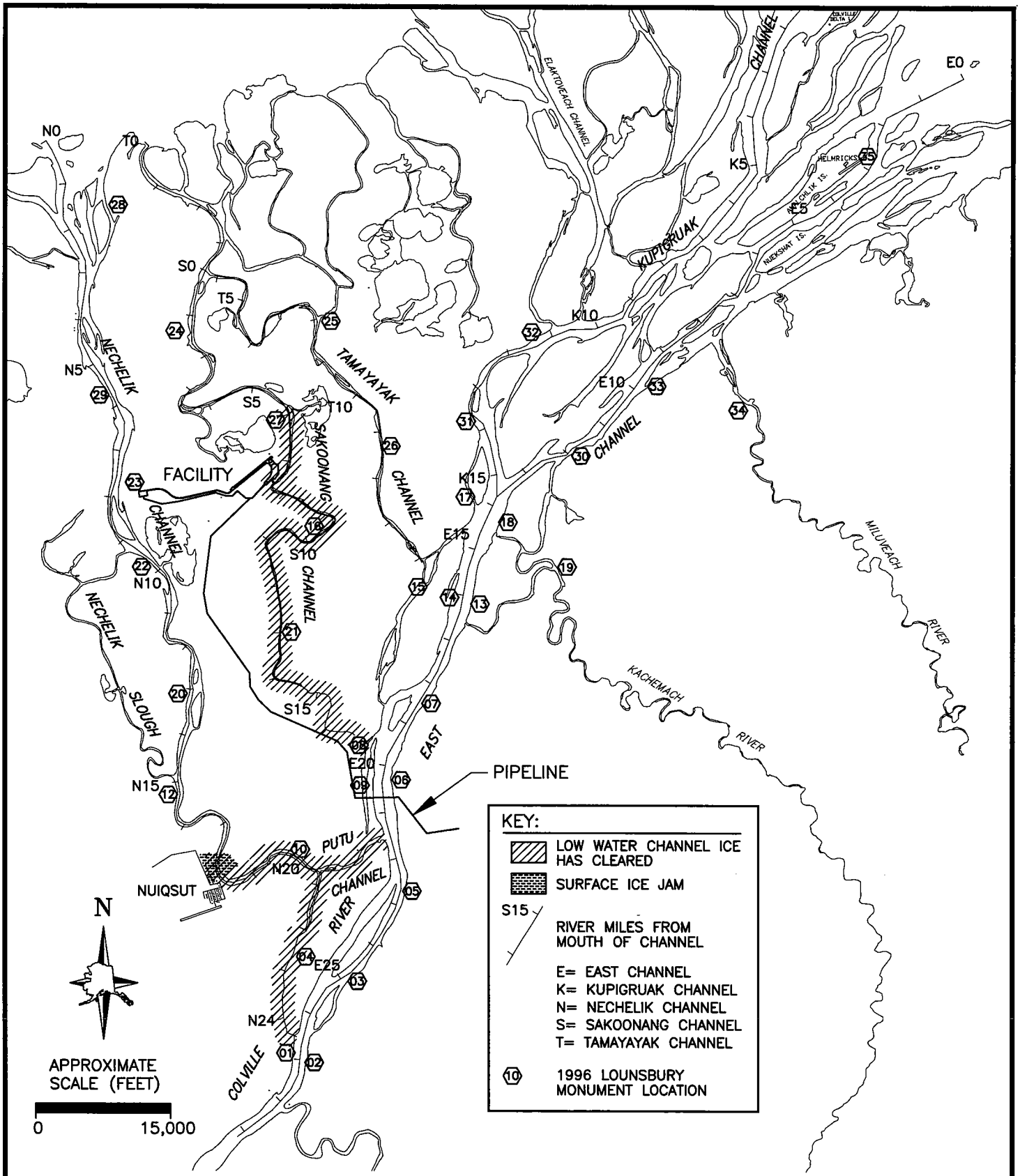
1999 SPRING BREAKUP
COLVILLE RIVER DELTA

ICE CONDITIONS WITHIN EAST, NECHLIK, AND SAKOONANG CHANNELS ON MAY 31, 1999 AT 14:00 TO 16:00 HOURS

FIGURE:
4



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DATE:	7/1/99	PROJECT:	23100-020-0101
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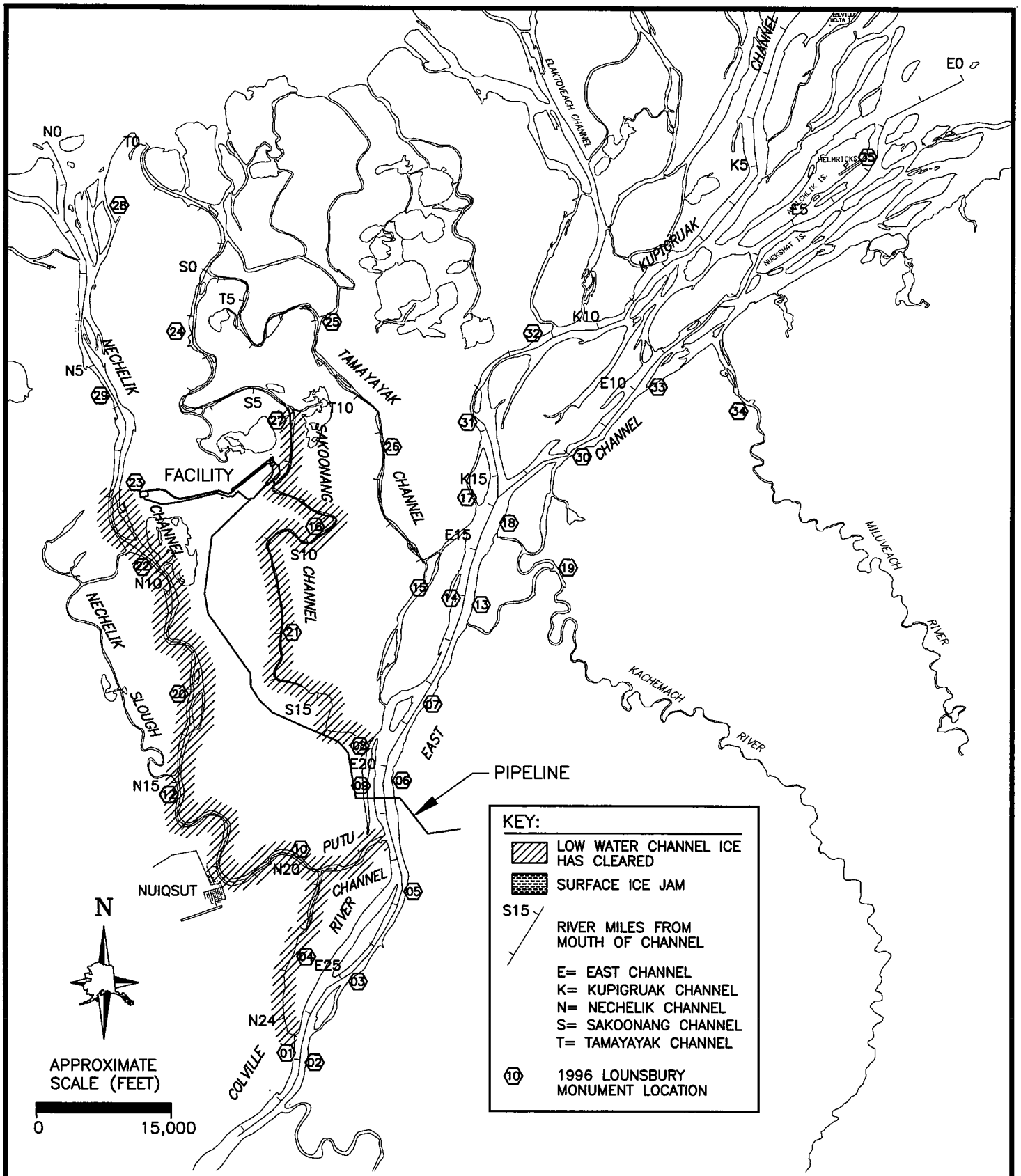
1999 SPRING BREAKUP
COLVILLE RIVER DELTA

ICE CONDITIONS WITHIN NECHLIK AND SAKOONANG CHANNELS ON JUNE 2, 1999 AT 17:00 HOURS

FIGURE:
5



Baker	Michael Baker Jr., Inc.		
DATE:	7/1/99	PROJECT:	23100-020-0101
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1999 SPRING BREAKUP
COLVILLE RIVER DELTA

ICE CONDITIONS WITHIN NECHLIK AND SAKOONANG CHANNELS ON JUNE 3, 1999 AT 17:00 HOURS

FIGURE:
6

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Table 1a: Temperature Data For May 1999

Date	Nuiqsut			Umiat			Anatuvuk Pass		
	Maximum Temp (°F)	Minimum Temp (°F)	Average Temp (°F)	Maximum Temp (°F)	Minimum Temp (°F)	Average Temp (°F)	Maximum Temp (°F)	Minimum Temp (°F)	Average Temp (°F)
5/1/99	26	16	22	32	23	28	28	10	21
5/2/99	23	9	18	23	18	21	21	14	19
5/3/99	12	2	8	18	12	14	16	9	13
5/4/99	11	-4	6	12	1	9	10	1	7
5/5/99	22	5	12	19	7	14	25	1	12
5/6/99	21	13	16	25	10	18	34	9	21
5/7/99	20	11	18	25	10	20	34	16	23
5/8/99	24	9	19	36	23	29	37	25	30
5/9/99	24	18	22	34	23	28	39	25	33
5/10/99	27	13	21	36	21	32	46	27	38
5/11/99	30	23	27	43	32	38	50	32	41
5/12/99	30	25	28	36	27	32	52	28	41
5/13/99	31	24	27	43	27	37	54	30	43
5/14/99	33	30	32	39	34	37	41	30	35
5/15/99	32	27	29	39	32	36	45	28	35
5/16/99	29	25	27	34	30	32	37	27	32
5/17/99	28	15	21	34	23	30	43	21	31
5/18/99	23	12	18	34	21	30	50	25	40
5/19/99	28	15	21	36	21	31	54	27	40
5/20/99	24	19	21	32	23	28	46	28	37
5/21/99	25	18	21	32	21	29	48	19	38
5/22/99	28	21	24	43	21	34	54	25	44
5/23/99	27	18	24	50	32	43	55	32	42
5/24/99	28	24	26	41	30	36	55	39	46
5/25/99	26	22	24	36	27	33	55	34	48
5/26/99	27	22	25	39	27	34	57	28	44
5/27/99	31	25	29	43	37	41	52	39	45
5/28/99	38	28	32	50	34	45	48	41	44
5/29/99	37	28	31	48	36	43	48	36	42
5/30/99	30	26	29	41	32	37	43	39	40
5/31/99	35	29	32	46	37	42			
Average	26.8	18.3	22.8	35.5	24.3	30.5	42.6	24.8	34.1
Extreme	38	-4		50	1		57	1	

Notes:
1. Day includes the hours from midnight to midnight.
2. Temperaures above freezing are shaded.
3. Data provided by the National Weather Service, Fairbanks, Alaska.

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Table 1b: Temperature Data For June 1999

Date	Nuiqsut			Umiat			Anatuvuk Pass		
	Maximum Temp (°F)	Minimum Temp (°F)	Average Temp (°F)	Maximum Temp (°F)	Minimum Temp (°F)	Average Temp (°F)	Maximum Temp (°F)	Minimum Temp (°F)	Average Temp (°F)
6/1/99	35	31	33	55	41	48	43	43	43
6/2/99	33	29	31	52	36	44	46	45	46
6/3/99	33	30	32	37	32	34	34	34	34
6/4/99	36	29	32	43	32	39	39	39	39
6/5/99	40	29	36	63	41	55	50	50	50
6/6/99	34	27	31	46	34	42			
6/7/99	38	26	31	61	39	53			
6/8/99	36	29	33	48	37	44	57	57	57
6/9/99	43	32	37	52	43	49	57	52	55
6/10/99	41	32	36	77	45	61	64	54	61
6/11/99	57	32	45	77	50	67	70	55	65
6/12/99	64	37	50	84	55	73	75	50	65
6/13/99	52	36	43	70	50	62	55	46	50
6/14/99	46	36	41	64	48	59	55	48	50
6/15/99	54	37	45	64	46	57	66	46	54
6/16/99	47	36	42	57	45	53	48	45	46
6/17/99	50	34	41	66	50	58	66	48	59
6/18/99	42	34	38	46	41	44	48	39	41
6/19/99	43	32	37	55	37	48	54	37	46
6/20/99	41	30	35	54	39	47	48	39	44
6/21/99	41	30	35	54	36	45	55	36	45
6/22/99	38	32	34	61	39	54	63	46	54
6/23/99	46	36	43	64	48	60	57	48	54
6/24/99	47	34	40	64	41	57	64	48	55
6/25/99	51	36	45	72	54	67	72	45	60
6/26/99	57	35	46	70	55	64	70	50	60
6/27/99	40	31	37	54	41	49	55	43	51
6/28/99	52	34	41	63	43	57	54	37	45
6/29/99	54	33	45	66	43	58	63	39	53
6/30/99	59	36	49	70	52	64	70	41	57
Average	45.0	32.5	38.7	60.3	43.1	53.7	57.1	45.0	51.4
Extreme	64	26		84	32		75	34	

Notes:
1. Day includes the hours from midnight to midnight.
2. Temperaures above freezing are shaded.
3. Data provided by the National Weather Service, Fairbanks, Alaska.

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Table 2: East Channel Water Surface Elevations And Observations At River Mile E27.49 (TBM 1U)

Date	Time	Water Surface Elevation (feet)	Observations
5/26/99	17:30	10.06	
5/27/99	9:36	11.00	
	10:20	11.04	
	17:38	11.17	Ice sheet over the low-water-channel is continuous.
5/28/99	18:24	11.27	Ice sheet over the low-water-channel is continuous.
5/29/99	8:40	11.92	There is open water near west bank with a few ice floes.
	15:02	12.30	+/- 0.01 ft. The ice that had formed over the bar has moved out, but the low-water-channel ice is still intact. The low-water-channel ice at the entrance to the Nechelik Channel appears to have moved out.
1999 High Water Mark		14.07	High water mark left sometime during the night of 5/29 - 5/30.
5/30/99	9:04	13.54	The low-water-channel ice is broken up in the East Channel above the inlet to the Nechelik Channel. There is a surface ice jam in the East Channel just below the inlet to the Nechelik Channel with a length of about 1000 feet. The low-water-channel ice in the Nechelik Channel is broken up from the inlet to just upstream of Nuiqsut.
	14:25	12.11	A sampling of the rafted ice indicated thicknesses of 1.5, 2.0, 2.3, 2.5, 3.1 and 3.8 feet.
	20:21	11.54	
5/31/99	9:16	10.51	
6/1/99	8:56	8.38	+/- 0.04 ft.

Notes:

1. Elevations are based on an elevation of 28.62 feet (BPMSL) for TBM 1U, which was established by Michael Baker Jr., Inc. in 1999. The elevation of TBM 1U was based on an elevation of 27.74 feet (BPMSL) for Monument 1, which was established by Lounsbury & Associates in 1996.
2. GPS coordinates for TBM 1U are N 70° 09' 37.7" W 150° 56' 31.7" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The distance along the flow path from TBM 1U to Monument 1 was approximately 2129 feet.

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Table 3: East Channel Water Surface Elevations And Observations At River Mile E27.09 (Mon 1 & Mon 2)

Date	Time	Water Surface Elevation (feet)	Observations
5/27/99	17:33	11.01	Ice sheet over the low-water-channel is continuous.
5/28/99	18:28	11.11	Ice sheet over the low-water-channel is continuous.
5/29/99	8:40	11.70	There is open water, and the snow is saturated.
	15:17	12.00	+/- 0.02 ft. The ice that had formed over bar has moved out, but low-water-channel ice is still intact. The low-water-channel ice at the entrance to the Nechelik Channel appears to have moved out.
1999 High Water Mark		13.97	High water mark left sometime during the night of 5/29 - 5/30. Rafted ice is approximately 3.4 feet thick as recorded on 5/30/99.
5/30/99	9:10	13.38	The low-water-channel ice is broken up in the East Channel above the inlet to the Nechelik Channel. There is a surface ice jam in the East Channel just below the inlet to the Nechelik Channel with a length of about 1000 feet. The low-water-channel ice in the Nechelik Channel is broken up from the inlet to just upstream of Nuiqsut.
5/31/99	9:25	10.45	Ice floes are beached on the west bank. No ice was floating.
6/1/99	9:42	8.25	+/- 0.03 ft.
	16:40	7.80	+/- 0.02 ft. Wind from the East.
	17:35	7.62	Water level recorder #10335 deployed. Wind from the East.
	17:49	7.68	+/- 0.03 ft. Wind from the East.
6/2/99	10:54	7.00	+/- 0.02 ft. Wind from the East.
	11:23	6.92	+/- 0.03 ft. Wind from the East.
6/3/99	8:59	6.94	+/- 0.02 ft. Light wind from the Northwest.
	9:23	6.84	+/- 0.03 ft. Wind from the Northwest at 0 - 5 mph.
6/4/99	9:58	6.98	+/- 0.10 ft. Wind from the Southwest at 10 - 15 mph.
6/5/99	10:53	7.60	Wind from the Southeast.
	11:40	7.67	+/- 0.03 ft. Depth of water was 0.3 feet.
6/6/99	10:23	6.87	+/- 0.03 ft. Light wind from the west.
	14:26	6.70	
	15:19	6.67	
6/7/99	9:44	6.04	+/- 0.10 ft.
6/9/99	19:27	5.79	+/- 0.02 ft.

Notes:

1. Elevations are based on an elevation of 27.74 feet (BPMSL) for Monument 1 and 21.29 feet (BPMSL) for Monument 2, which were established by Lounsbury & Associates in 1996.

Table 3: East Channel Water Surface Elevations And Observations At River Mile E27.09 (Mon 1 & Mon 2) (Continued)

Notes:

2. GPS coordinates for Monument 1 are N 70° 09' 58.3" W 150° 56' 12.6" (NAD27). GPS coordinates for Monument 2 are N 70° 09' 47.0" W 150° 54' 43.7" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The top of the Monument 1 cap was about 0.45 feet above the ground.
4. The top of the Monument 2 cap was about 0.80 feet above the ground.
5. The distance along the flow path from TBM 1U to Monument 1 was approximately 2129 feet.
6. The distance along the flow path from Monument 1 to TBM 1D was approximately 882 feet.
7. Data based on Monument 1 was obtained between 5/27 and 6/5. Data based on Monument 2 was obtained between 6/1 and 6/9.

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Table 4: East Channel Water Surface Elevations And Observations At River Mile E26.92 (TBM 1D)

Date	Time	Water Surface Elevation (feet)	Observations
5/29/99	8:51	11.75	Open water along west bank.
	15:25	11.99	
1999 High Water Mark		14.09	High water mark left sometime during the night of 5/29 - 5/30.
5/30/99	9:20	13.37	+/- 0.01 ft. The low-water-channel ice is broken up in the East Channel above the inlet to the Nechelik Channel. There is a surface ice jam in the East Channel just below the inlet to the Nechelik Channel with a length of about 1000 feet. The low-water-channel ice in the Nechelik Channel is broken up from the inlet to just upstream of Nuiqsut. There are ice floes all around the staff gage on the left bank.
	14:54	11.95	Lots of ice rafted on gravel bar along west bank. A sampling of the rafted ice indicated ice thickness of 2.3, 2.7, 3.5, 3.6, 3.7, 3.7, 4.0, 4.0, 4.0, 4.0 and 4.4 feet.
	20:20	11.47	Main channel has minimal ice floes. Floes stacked along left bank.
6/1/99	10:10	8.18	+/- 0.02 ft.

Notes:

1. Elevations are based on an elevation of 28.16 feet (BPMSL) for TBM 1D, which was established by Michael Baker Jr., Inc. in 1999. The elevation of TBM 1D was based on an elevation of 27.74 feet (BPMSL) for Monument 1, which was established by Lounsbury & Associates in 1996.
2. GPS coordinates for TBM 1D are N 70° 10' 04.2" W 150° 56' 09.5" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The distance along the flow path from Monument 1 to TBM 1D was approximately 882 feet.

file: SBWSErpt.xls

Table 5: Sakoonang Channel Water Surface Elevations And Observations At River Mile S16.20 (TBM 8U)

Date	Time	Water Surface Elevation (feet)	Observations
5/27/99	17:56	7.03	
5/28/99	10:56	8.30	
	18:00	8.33	Ice on bottom of channel. At mid-channel, the water depth is 7.8 feet. At about 3/4 of the way across the channel from the left bank, the water depth is 7.5 feet.
	18:39	8.34	
5/29/99	8:50	8.84	Low-water-channel ice is out of the upper Sakoonang Channel. Ice jam downstream near TBM 8D, length of ice jam is approximately 250 feet.
	11:34	8.75	Open water with ice floes.
	13:35	8.77	Open water with ice floes. Ice jam broke loose about 13:25.
	17:21	8.88	
5/30/99	9:37	9.64	Open water with minimal ice floes.
1999 High Water Mark		10.28	High water mark left sometime between 9:37 and 13:58 on 5/30.
5/30/99	13:58	10.03	A new ice jam formed from the inlet to the first bend in the Sakoonang Channel. The East Channel has broken up to the inlet of the Sakoonang Channel.
	20:41	9.53	Ice jam still intact from the inlet of the Sakoonang to the first bend.
5/31/99	9:54	8.50	+/- 0.05 ft.
	16:25	8.05	+/- 0.02 ft. Surface ice jam has moved down to past TBM 8D.
	18:42	7.90	+/- 0.01 ft. Minimal ice floes. Surface jam moved down almost to first bend.
6/1/99	10:47	6.52	+/- 0.03 ft. Ice jam has cleared from the bend located downstream of TBM 8D.
6/2/99	9:27	5.28	+/- 0.02 ft.
	12:19	5.18	+/- 0.02 ft.
6/3/99	9:57	4.83	
6/4/99	10:43	4.66	+/- 0.02 ft.
	14:47	4.72	+/- 0.02 ft.
6/5/99	10:26	5.07	+/- 0.01 ft.
6/6/99	10:57	4.53	+/- 0.02 ft.
6/7/99	10:35	3.85	+/- 0.03 ft.
	15:00	3.80	+/- 0.03 ft.
	16:30	3.75	+/- 0.04 ft.
6/9/99	17:11	3.48	+/- 0.02 ft.
	18:49	3.52	

Table 5: Sakoonang Channel Water Surface Elevations And Observations At River Mile S16.20 (TBM 8U) (Continued)

Notes:

1. Elevations are based on an elevation of 15.31 feet (BPMSL) for TBM 8U, which was established by Michael Baker Jr., Inc. in 1999. The elevation of TBM 8U was based on an elevation of 26.69 feet (BPMSL) for Monument 8, which was established by Lounsbury & Associates in 1996.
2. GPS coordinates for TBM 8U are N 70° 15' 50.3" W 150° 52' 42.9" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The distance along the flow path from TBM 8U to TBM 8D was approximately 792 feet.

file: SBWSErpt.xls

Table 6: Sakoonang Channel Water Surface Elevations And Observations At River Mile S16.05 (TBM 8D)

Date	Time	Water Surface Elevation (feet)	Observations
5/27/99	18:00	6.99	
5/28/99	10:00	8.30	
5/29/99	11:15	8.72	Ice jam at gage extends 150 feet downstream and 100 feet upstream. Open water on either side of jam. Ice floes still arriving from upstream.
	15:24	8.81	+/- 0.01 ft.
	15:33	8.81	+/- 0.01 ft.
	16:30	8.85	Low-water-channel ice has moved out of the upper Sakoonang Channel.
5/30/99	9:30	9.62	+/- 0.02 ft. Open water with minimal ice floes.
	13:41	9.89	A new ice jam formed from the inlet to the first bend in the Sakoonang Channel. The East Channel has broken up to the inlet of the Sakoonang Channel.
	20:49	9.35	Surface ice jam at this location.
5/31/99	10:25	8.21	
	15:54	7.98	+/- 0.01 ft. Surface ice jam cleared upstream.
	19:05	7.84	+/- 0.01 ft. Minimal ice floes. Surface ice jam cleared to near first bend.
6/2/99	12:00	5.21	+/- 0.03 ft.

Notes:

1. Elevations are based on an elevation of 12.38 feet (BPMSL) for TBM 8D, which was established by Michael Baker Jr., Inc. in 1999. The elevation of TBM 8D was based on an elevation of 26.69 feet (BPMSL) for Monument 8, which was established by Lounsbury & Associates in 1996.
2. GPS coordinates for TBM 8D are N 70° 15' 51.4" W 150° 52' 41.1" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The distance along the flow path from TBM 8U to TBM 8D was approximately 792 feet.
4. The distance along the flow path from TBM 8D to TBM 0084 was approximately 1385 feet.

file: SBWSErpt.xls

Table 7: Sakoonang Channel Water Surface Elevations And Observations At River Mile S15.79 (TBM 0084)

Date	Time	Water Surface Elevation (feet)	Observations
6/2/99	17:53	5.06	+/- 0.01 ft. Water level recorder #10084 deployed.
6/3/99	10:23	4.74	
6/4/99	11:12	4.56	
6/5/99	9:11	4.90	
6/6/99	11:15	4.36	+/- 0.01 ft.
6/7/99	10:17	3.68	+/- 0.03 ft.
	14:16	3.64	+/- 0.02 ft.
	17:00	3.58	+/- 0.04 ft.
6/9/99	19:06	3.33	+/- 0.03 ft.
6/10/99	10:55	3.56	+/- 0.02 ft.
	11:43	3.57	+/- 0.02 ft.

Notes:

1. Elevations are based on an elevation of 16.80 feet (BPMSL) for TBM 0084, which was established by Michael Baker Jr., Inc. in 1999. The elevation of TBM 0084 was based on an elevation of 26.69 feet (BPMSL) for Monument 8, which was established by Lounsbury & Associates in 1996.
2. GPS coordinates for TBM 0084 are N 70° 15' 58.3" W 150° 53' 12.8" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The distance along the flow path from TBM 8D to TBM 0084 was approximately 1385 feet.

file: SBWSErpt.xls

Table 8: Sakoonang Channel Water Surface Elevations And Observations At River Mile S05.47 (TBM 27U)

Date	Time	Water Surface Elevation (feet)	Observations
5/28/99	18:13	2.90	
5/29/99	9:08	3.13	Open water with some ice floes.
	17:36	3.13	
5/30/99	12:43	3.71	Low-water-channel ice is discontinuous immediately below staff gage. Some low-water-channel ice is visible where the sea ice road crossed the Sakoonang Channel.
	20:41	4.33	+/- 0.02 ft.
1999 High Water Mark		4.64	High water mark left sometime during the night of 5/30 - 5/31.
5/31/99	10:45	4.60	No floating ice.
	17:30	4.57	+/- 0.02 ft.
6/1/99	10:31	4.38	+/- 0.03 ft.
6/2/99	10:10	3.84	+/- 0.04 ft.
6/3/99	10:45	3.32	+/- 0.01 ft.
6/4/99	15:12	2.94	+/- 0.01 ft.
6/5/99	8:30	2.75	+/- 0.01 ft.
	12:52	2.69	+/- 0.02 ft.
6/6/99	11:30	2.34	
6/7/99	9:42	1.59	+/- 0.03 ft.
6/9/99	16:45	0.67	+/- 0.03 ft.

Notes:

1. Elevations are based on an elevation of 7.05 feet (BPMSL) for TBM 27U, which was established by Michael Baker Jr., Inc. in 1999. The elevation of TBM 27U was based on an elevation of 11.12 feet (BPMSL) for Monument 27, which was established by Lounsbury & Associates in 1998.
2. GPS coordinates for TBM 27U are N 70° 21' 18.0" W 150° 54' 38.6" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The top of the Monument 27 cap was about 0.88 feet above the ground.

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Table 9: Nechelik Channel Water Surface Elevations And Observations At River Mile N09.47 (Mon 22)

Date	Time	Water Surface Elevation (feet)	Observations
5/28/99	15:53	5.48	+/- 0.05 ft.
	18:07	5.43	
5/29/99	9:00	5.71	Ice jam on the upstream side of Monument 22. Rotten ice (snow) on the inside of the bend above Monument 22.
	15:43	5.75	Low-water-channel ice is intact from just upstream of Nuiqsut to mouth of channel.
1999 High Water Mark		5.89	High water mark left sometime during the night of 5/29 - 5/30.
5/30/99	10:27	5.63	Low-water-channel ice is intact from just upstream of Nuiqsut to mouth of channel.
	21:20	5.11	Minimal ice floes in channel, floes do not appear to be moving.
5/31/99	11:05	4.62	+/- 0.02 ft. No drifting floes.
6/1/99	11:23	3.90	+/- 0.03 ft.
6/2/99	9:57	3.62	+/- 0.03 ft.
6/3/99	11:01	3.60	+/- 0.01 ft. Low-water-channel ice cleared from Monument 22 to approximately 1000 feet downstream. Surface ice jam from Monument 22 to approximately 200 feet upstream of Monument 22.
6/4/99	9:20	3.24	+/- 0.03 ft. Low-water-channel ice has moved out.
6/5/99	8:45	3.08	
6/6/99	11:44	2.47	+/- 0.01 ft.

Notes:

1. Elevations are based on an elevation of 10.13 feet (BPMSL) for Monument 22, which was established by Lounsbury & Associates in 1996.
2. GPS coordinates for Monument 22 are N 70° 19' 06.32" W 151° 03' 10.35" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The top of the Monument 22 cap was about 0.50 feet above the ground.

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Table 10: Nechelik Channel Water Surface Elevations And Observations At River Mile N02.03 (Mon 28)

Date	Time	Water Surface Elevation (feet)	Observations
5/29/99	12:12	2.70	+/- 0.02 ft.
	16:02	2.69	+/- 0.02 ft. Slush around gage.
1999 High Water Mark		2.85	High water mark left sometime during the night of 5/29 - 5/30.
5/30/99	11:24	2.59	Some open water in channel.
	21:07	2.40	
5/31/99	11:24	2.25	Nechelik low-water-channel ice is still intact from Monument 22 to mouth. No ice floes observed.
	17:23	2.20	
6/2/99	9:40	1.88	
6/3/99	11:23	2.08	
6/4/99	8:51	2.43	Low-water-channel ice is still intact. Floating ice in channel for first time. Ice floes moving, possibly due to wind from northwest.
6/5/99	8:21	2.22	Low-water-channel ice is still intact.
6/6/99	12:06	1.70	Last of the low-water-channel ice has gone out.

Notes:

1. Elevations are based on an elevation of 3.66 feet (BPMSL) for Monument 28, which was established by Lounsbury & Associates in 1998.
2. GPS coordinates for Monument 28 are N 70° 25' 33.20" W 151° 03' 49.59" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.
3. The top of the Monument 28 cap was about 0.30 feet above the ground.

file: SBWSErpt.xls

Table 11: Swale Water Surface Elevations And Observations (TBM SA)

Date	Time	Water Surface Elevation (feet)	Observations
1999 High Water Mark		5.79	High water mark observed on 5/31. Peak probably occurred sometime during the night of 5/29 - 5/30.
5/30/99	10:48	5.65	
	14:41	5.47	
5/31/99	11:50	4.90	
6/1/99	13:50	4.64	
6/3/99	11:41	4.46	

Notes:

1. Elevations are based on an elevation of 10.43 feet (BPMSL) for TBM SA, which was established by Michael Baker Jr., Inc. in 1999. The elevation of TBM SA was based on an elevation of 24.52 feet (BPMSL) for Alpine Monument 5, which was established by Lounsbury & Associates in 1997.
2. GPS coordinates at TBM SA are N 70° 20' 16.7" W 150° 58' 26.1" (NAD27). The GPS coordinates were obtained with a Garmin GPS II Plus global positioning system.

file: SBWSErpt.xls

Table 12: Discharge Measurement At River Mile S16.20 On 29 May 1999

DISCHARGE MEASUREMENT NOTES

LOCATION: Sakoonang Channel TBM 8U

Date: 5/29 ,1999 **Party:** J. Meckel, J. Abrams

Width: 182' **Area:** 1200 ft^2 **Vel:** 1.22 fps **G.H.:** 8.76 (TBM 8U) **Disch.:** 1450 **cfs**

No Secs. 23 **G.H. change:** 0.02 ft **in.:** 2.01 **hrs.:** **Susp.:** 15 lbs

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** **Meter No.**

Gage Readings

Time	Recorder	Inside	Outside
11:34	SG 9A	WSE = 8.75 BPMSL	-2.09
11:15	TBM 8D	WSE = 8.72 BPMSL	
11:50	Start measurement		
13:35	End measurement		
13:35	SG 9A	WSE = 8.77 BPMSL	-2.07
15:24	SG 14	WSE = 8.81 BPMSL	3.82
Weighted M.G.H.		WSE = 8.76 BPMSL	
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Factory

Meter: 0.5 **ft. above bottom of weight.**

Spin before meas. **after**

Method: Used hand line fom boat to obtain measurements

Levels obtained Yes

Measurement rated: Fair **based on following conditions:** Bottom hard, steady flow

Cross section: Fairly unifrom, snow/ice cover approx. 15% of the right bank based on later observations

Flow: Steady and uniform **Weather:** Overcast **Air oF@:** Mid 30's

Gage: Outside staff gage **Water oF@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Surface ice jam downstream ~ 1000', probable backwater affect. Snow drifts on both banks. Moderate ice floe. Firm bottom

Remarks Ice jam at downstream section cleared at 13:25

G.H. of zero flow: **ft.**

Table 12: Discharge Measurement At River Mile S16.20 On 29 May 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1	8	3.0	1.6	0	0				4.8	0.0	LEW Vertical wall, measurement @ 11:50
1	14	6.0	3.0	0.8	1	43	0.07	0.08	18.0	1.4	Bottom firm - ice
1				0.2	2	69	0.08				
1	20	6.0	5.9	0.2	5	56	0.22	0.19	35.4	6.7	
1				0.8	5	75	0.17				
1	26	6.0	6.0	0.8	10	48	0.47	0.46	36.0	16.6	
1				0.2	10	52	0.44				
1	32	7.0	6.9	0.2	15	49	0.69	0.68	48.3	32.8	
1				0.8	15	50	0.67				
1	40	8.0	7.4	0.2	20	49	0.91	0.83	59.2	49.1	
1				0.8	15	45	0.75				
1	48	8.0	7.2	0.2	25	43	1.29	1.12	57.6	64.5	Bottom less firm
1				0.8	20	47	0.95				
1	56	8.0	7.7	0.2	30	47	1.41	1.14	61.6	70.2	Bottom soft
1				0.8	20	51	0.88				
1	64	8.0	7.8	0.2	30	47	1.41	1.17	62.4	73.0	
1				0.8	20	48	0.93				
1	72	8.0	7.8	0.2	30	44	1.51	1.32	62.4	82.4	Bottom feels like soft slush on ice
1				0.8	25	49	1.13				+/- 0.1 ft
1	80	8.0	8.0	0.2	40	55	1.61	1.42	64.0	90.9	
1				0.8	25	45	1.23				
1	88	8.0	8.0	0.2	30	42	1.58	1.39	64.0	89.0	Bottom firm - ice
1				0.8	25	46	1.20				
1	96	8.0	8.0	0.2	3	42	1.58	1.37	64.0	87.7	
1				0.8	25	48	1.16				
1	104	8.0	7.9	0.2	40	50	1.76	1.50	63.2	94.8	
1				0.8	25	45	1.23				
1	112	8.0	7.7	0.2	40	50	1.76	1.46	61.6	89.9	Bottom firm
1				0.8	25	48	1.16				

Table 12: Discharge Measurement At River Mile S16.20 On 29 May 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1	120	8.0	7.5	0.2	40	48	1.84	1.60	60.0	96.0	
1				0.8	25	41	1.35				
1	128	8.0	7.5	0.2	30	42	1.58	1.46	60.0	87.6	
1				0.8	25	41	1.35				
1	136	8.0	7.8	0.2	40	50	1.76	1.62	62.4	101.1	
1				0.8	30	45	1.47				
1	144	8.0	7.7	0.2	40	51	1.73	1.46	61.6	89.9	
1				0.8	25	47	1.18				
1	152	8.0	7.4	0.2	30	41	1.62	1.46	59.2	86.4	
1				0.8	25	43	1.29				
1	160	8.0	6.7	0.2	30	45	1.47	1.28	53.6	68.6	Bottom firm
1				0.8	20	41	1.08				
1	168	8.0	5.0	0.2	25	41	1.35	1.23	40.0	49.2	
1				0.8	25	50	1.11				
1	176	8.0	3.3	0.2	20	50	0.892	0.85	26.4	22.4	
1				0.8	20	56	0.799				
1	184	7.0	1.5	0.6	3	110	0.079	0.08	10.5	0.8	
1	190	3.0	0.0						0.0	0.0	REW measurement @ 13:35
	182	182							1196	1451	

Table 13: Discharge Measurement At River Mile S16.20 On 31 May 1999

DISCHARGE MEASUREMENT NOTES

LOCATION: Sakoonang Channel TBM 8U

Date: 5/31 ,1999 **Party:** V. Robinson, J. Abrams

Width: 169' **Area:** 1120 ft^2 **Vel:** 1.23 fps **G.H.:** 8.03 (TBM 8U) **Disch.:** 1380 **cfs**

No Secs. 23 **G.H. change:** 0.13 ft **in.:** 2.17 **hrs.:** **Susp.:** 15 lbs

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** **Meter No.**

Gage Readings

Time	Recorder	Inside	Outside
16:25	TBM 8U	WSE = 8.05 BPMSL	
15:53	Start measurement		
17:30	End measurement		
18:42	TBM 8U	WSE = 7.90 BPMSL	
Weighted M.G.H.		WSE = 8.03 BPMSL	
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Factory

Meter: 0.5 **ft. above bottom of weight.**

Spin before meas. **after**

Method: Used hand line to obtain measurements w/ boat & tag line.

Levels obtained Yes

Measurement rated: Fair **based on following conditions:** Bottom is firm

Cross section: Uniform

Flow: Slow and steady **Weather:** Overcast **Air oF@:** Mid 30's

Gage: Outside staff gage **Water oF@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control

Remarks Snow bank at REW. Assumed no flow under this snow bank and that outside edge of snow was the REW.

G.H. of zero flow: **ft.**

Table 13: Discharge Measurement At River Mile S16.20 On 31 May 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1	215	4.0	0.0	0					0.0	0.0	LEW
1											
1	207	8.0	3.1	0.2	7	41	0.392	0.35	24.8	8.7	
1				0.8	7	53	0.308				
1	199	8.0	5.9	0.2	15	52	0.649	0.59	47.2	27.8	
1				0.8	10	44	0.515				
1	191	8.0	7.1	0.2	20	42	1.06	0.97	56.8	55.1	Bottom solid
1				0.8	20	51	0.875				
1	183	8.0	7.3	0.2	25	45	1.23	1.11	58.4	64.8	
1				0.8	20	45	0.989				
1	175	8.0	7.3	0.2	25	43	1.29	1.07	58.4	62.5	
1				0.8	20	53	0.843				
1	167	8.0	7.2	0.2	25	44	1.26	1.08	57.6	62.2	
1				0.8	20	50	0.892				
1	159	8.0	7.3	0.2	30	47	1.41	1.21	58.4	70.7	
1				0.8	20	44	1.01				
1	151	8.0	7.2	0.2	35	53	1.46	1.28	57.6	73.7	
1				0.8	25	51	1.09				
1	143	8.0	7.4	0.2	30	45	1.47	1.33	59.2	78.7	
1				0.8	25	47	1.18				
1	135	8.0	7.4	0.2	30	45	1.47	1.28	59.2	75.8	
1				0.8	20	41	1.08				
1	127	8.0	7.3	0.2	30	43	1.54	1.34	58.4	78.3	Bottom solid
1				0.8	25	49	1.13				
1	119	8.0	7.2	0.2	30	44	1.51	1.40	57.6	80.6	
1				0.8	25	43	1.29				
1	111	8.0	7.3	0.2	30	42	1.58	1.42	58.4	82.9	
1				0.8	25	44	1.26				
1	103	8.0	6.9	0.2	30	42	1.58	1.38	55.2	76.2	
1				0.8	25	47	1.18				

Table 13: Discharge Measurement At River Mile S16.20 On 31 May 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1	95	8.0	6.5	0.2	30	42	1.58	1.42	52.0	73.8	
1				0.8	25	44	1.26				
1	87	8.0	6.6	0.2	35	45	1.72	1.46	52.8	77.1	
1				0.8	25	46	1.2				
1	79	8.0	6.8	0.2	35	46	1.68	1.50	54.4	81.6	
1				0.8	25	42	1.32				
1	71	8.0	6.8	0.2	35	46	1.68	1.44	54.4	78.3	
1				0.8	25	46	1.2				
1	63	8.0	6.7	0.2	35	45	1.72	1.45	53.6	77.7	
1				0.8	25	47	1.18				
1	55	8.0	6.7	0.2	25	40	1.38	1.26	53.6	67.5	
1				0.8	25	49	1.13				
1	47	4.5	6.7	0.2	20	41	1.08	1.00	30.2	30.2	
1				0.8	20	48	0.928				
1	46	0.5	0.0	0	0				0.0	0.0	REW at ice chunk
1											
1	31										REW - bank
	169	169							1118	1384	

Table 14: Discharge Measurement At River Mile S16.20 On 4 June 1999

DISCHARGE MEASUREMENT NOTES

LOCATION: Sakoonang Channel TBM 8U

Date: 6/4 ,1999 **Party:** J. Abrams, J. Meckel

Width: 182' **Area:** 643 ft^2 **Vel:** 1.22 fps **G.H.:** 4.70 (TBM 8U) **Disch.:** 783 **cfs**

No Secs. 27 **G.H. change:** 0.06 ft **in.:** 4 **hrs.:** **Susp.:** Top set. rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.** Standard

Type of meter: Price AA

Date rated:

Meter: **ft. above bottom of weight.**

Spin before meas. **after** 3 min.

Method: Used top setting rod and pontoon boat with tag line

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
10:43	TBM 8U	WSE = 4.66 BPMSL	+/-0.02
11:12	TBM0084	WSE = 4.56 BPMSL	
12:24	Start measurement		
14:22	End measurement		
14:47	TBM 8U	WSE = 4.72 BPMSL	
Weighted M.G.H.		WSE = 4.70 BPMSL	
G.H. corrections			
Correct M.G.H.			

Levels obtained This date

Measurement rated: Good , 5% **based on following conditions:** Flow uniform, steady

Cross section: Uniform, fairly firm, depth meas. +/- 0.1, soft mud but good definition

Flow: Steady **Weather:** **Air oF@:**

Gage: **Water oF@:**

Other:

Record Removed: N/A **Intake flushed:** N/A

Observer

Control Channel free of ice, snow on banks above water surface

Remarks For original measurement data see Field Book #6 pages 24-28, Alpine 1999

G.H. of zero flow: **ft.**

Table 14: Discharge Measurement At River Mile S16.20 On 4 June 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1	208	1.5	0.0		0			0.00	0.0	0.0	LEW measurement @ 1224
1	205	3.5	1.2	0.6	10	61	0.38	0.38	4.2	1.6	
1	201	5.0	2.6	0.2	15	53	0.64	0.44	13.0	5.7	
1				0.6	10	41	0.55				
1				0.8	0	40	0.00				
1	195	7.0	3.5	0.2	20	52	0.86	0.77	24.5	18.9	
1				0.8	15	50	0.67				
1	187	8.0	3.8	0.2	20	43	1.03	0.85	30.4	25.8	
1				0.8	15	50	0.67				
1	179	7.0	4.1	0.2	25	48	1.16	1.00	28.7	28.7	
1				0.8	15	40	0.84				
1	173	7.0	3.9	0.2	25	44	1.26	1.04	27.3	28.4	
1				0.8	15	41	0.82				
1	165	8.0	3.6	0.2	25	43	1.29	1.04	28.8	30.0	
1				0.8	15	43	0.78				
1	157	8.0	3.9	0.2	30	49	1.35	1.12	31.2	34.9	
1				0.8	20	50	0.89				
1	149	8.0	4.0	0.2	30	47	1.41	1.24	32.0	39.7	
1				0.8	20	42	1.06				
1	141	8.0	4.1	0.2	25	40	1.38	1.22	32.8	40.0	
1				0.8	20	42	1.06				
1	133	8.0	4.0	0.2	30	46	1.44	1.24	32.0	39.7	
1				0.8	20	43	1.03				
1	125	8.0	4.0	0.2	30	42	1.58	1.32	32.0	42.2	
1				0.8	25	52	1.07				
1	117	8.0	3.9	0.2	30	41	1.62	1.42	31.2	44.3	
1				0.8	25	45	1.23				

Table 14: Discharge Measurement At River Mile S16.20 On 4 June 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1	109	8.0	4	0.2	40	51	1.73	1.36	32.0	43.5	
1				0.8	20	45	0.989				
1	101	8.0	3.5	0.2	40	50	1.76	1.44	28.0	40.3	
1				0.8	25	49	1.13				
1	93	8.0	3.3	0.2	40	49	1.8	1.5	26.4	39.6	
1				0.8	25	46	1.2				
1	85	8.0	3.4	0.2	40	50	1.76	1.6	27.2	43.5	
1				0.8	30	46	1.44				
1	77	8.0	3.7	0.2	40	50	1.76	1.44	29.6	42.6	
1				0.8	25	49	1.13				
1	69	8.0	3.5	0.2	39	53	1.62	1.44	28.0	40.3	
1				0.8	25	44	1.26				
1	61	8.0	3.5	0.2	40	49	1.8	1.58	28.0	44.2	
1				0.8	25	41	1.35				
1	53	8.0	3.5	0.2	30	43	1.54	1.4	28.0	39.2	
1				0.8	25	44	1.26				
1	45	7.5	3.5	0.2	30	44	1.51	1.31	26	34.3	
1				0.8	20	40	1.11				
1	38	6.0	3.3	0.2	25	44	1.26	1.07	19.8	21.2	
1				0.8	20	51	0.875				
1	33	4.0	2.8	0.2	20	46	0.968	0.9	11.2	10.1	
1				0.8	15	40	0.837				
1	30	2.5	2.5	0.6	15	54	0.636	0.63	6.3	3.9	
1	28	2.0	2		0	40	0		4.0	0.0	
1	26	1.0	0						0.0	0.0	REW measurement @ 14:22
	182	182							643	783	

Table 15: Discharge Measurement At River Mile S16.20 On 7 June 1999

DISCHARGE MEASUREMENT NOTES

LOCATION: Sakoonang Channel TBM 8U

Date: 6/7 ,1999 **Party:** J. Meckel, J. Abrams

Width: 179' **Area:** 488 ft^2 **Vel:** 1.2 fps **G.H.:** 3.78 (TBM 8U) **Disch.:** 585 **cfs**

No Secs. 24 **G.H. change:** 0.05 ft **in.:** 1.5 **hrs.:** **Susp.:** Top set. Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.** Standard

Gage Readings

Time	Recorder	Inside	Outside
14:16	TBM0084	WSE = 3.64 BPMSL	+/- 0.02
15:00	TBM 8U	WSE = 3.80 BPMSL	+/- 0.03
15:12	Start measurement		
16:11	End measurement		
16:30	TBM 8U	WSE = 3.75 BPMSL	+/- 0.04
17:00	TBM0084	WSE = 3.58 BPMSL	+/- 0.04
Weighted M.G.H.		WSE = 3.78 BPMSL	
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated:

Meter: **ft. above bottom of weight.**

Spin before meas. 3:30 min **after** 2:30 min

Method: Wading using top setting rod

Levels obtained Yes, before and after

Measurement rated: Good **based on following conditions:** Flow uniform, steady

Cross section: Excellent

Flow: Uniform **Weather:** Sunny **Air oF@:**

Gage: Windy **Water oF@:**

Other:

Record Removed: N/A **Intake flushed:**

Observer

Control Banks clean, no snow or ice

Remarks At station 166, velocity near bottom disturbed due to clumps of shrubs

G.H. of zero flow: **ft.**

Table 15: Discharge Measurement At River Mile S16.20 On 7 June 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1											
1	206	2.0	0.0						0.0	0.0	LEW
1	202	3.0	1.2	0.6	10	47	0.48	0.48	3.6	1.7	
1	200	6.0	2.0	0.6	15	50	0.67	0.67	12.0	8.0	
1	190	9.0	2.8	0.2	25	48	1.16	1.04	25.2	26.2	
1				0.8	20	49	0.91				
1	182	8.0	3.2	0.2	25	49	1.13	1.01	25.6	25.9	
1				0.8	20	50	0.89				
1	174	8.0	3.0	0.2	25	44	1.26	1.07	24.0	25.7	
1				.8.	20	51	0.88				
1	166	8.0	2.8	0.2	25	44	1.26	0.99	22.4	22.2	
1				0.8	15	47	0.72				
1	158	8.0	3.1	0.2	30	46	1.44	1.25	24.8	31.0	
1				0.8	20	42	1.06				
1	150	8.0	3.0	0.2	30	44	1.51	1.31	24.0	31.4	
1				0.8	20	40	1.11				
1	142	8.0	3.2	0.2	25	39	1.42	1.31	25.6	33.5	
1				0.8	25	46	1.20				
1	134	8.0	3.2	0.2	30	47	1.41	1.22	25.6	31.2	
1				0.8	20	43	1.03				
1	126	8.0	3.1	0.2	30	43	1.54	1.30	24.8	32.2	
1				0.8	20	42	1.06				
1	118	8.0	2.9	0.2	30	47	1.41	1.32	23.2	30.6	
1				0.8	25	45	1.23				
1	110	8.0	3.0	0.2	30	41	1.62	1.34	24.0	32.2	
1				0.8	20	42	1.06				
1	102	8.0	3.0	0.2	30	43	1.54	1.25	24.0	30.0	
1				0.8	20	46	0.97				
1											

Table 15: Discharge Measurement At River Mile S16.20 On 7 June 1999 (Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
1	94	8.0	2.8	0.2	30	42	1.58	1.44	22.4	32.3	
1				0.8	25	43	1.29				
1	86	8.0	2.6	0.2	30	44	1.51	1.32	20.8	27.5	
1				0.8	25	49	1.13				
1	78	8.0	2.8	0.2	30	42	1.58	1.38	22.4	30.9	
1				0.8	25	47	1.18				
1	70	8.0	2.8	0.2	30	46	1.44	1.28	22.4	28.7	
1				0.8	20	40	1.11				
1	62	8.0	2.6	0.2	30	45	1.47	1.26	20.8	26.2	
1				0.8	20	42	1.06				
1	54	8.0	2.6	0.2	25	41	1.35	1.24	20.8	25.8	
1				0.8	25	49	1.13				
1	46	8.0	2.5	0.2	25	41	1.35	1.13	20.0	22.6	
1				0.8	20	49	0.91				
1	38	8.0	2.5	0.2	25	42	1.32	1.2	20.0	24.0	
1				0.8	20	41	1.08				
1	30	5.5	1.8	0.6	10	47	0.48	0.48	9.9	4.8	
1	27	1.5	0						0.0	0.0	REW measurement @ 16:11
	179	179							488	585	

Table 16: Water Surface Elevation And Discharge In The East And Sakoonang Channels

Date	Time	East Channel (E27.09) Water Surface Elevation (BPMSL)	East Channel (E27.09) Discharge (cfs)	Sakoonang Channel (S16.20) Water Surface Elevation (BPMSL)	Sakoonang Channel (S16.20) Discharge (cfs)
5/26/99	17:30	9.90	67,800		
5/27/99	9:36	10.84	77,100		
	10:20	10.88	77,500		
	17:35	11.01	78,900		
	17:58			7.03	1,060
5/28/99	10:28			8.30	1,410
	18:00			8.33	1,420
	18:26	11.11	80,000		
	18:39			8.34	1,430
5/29/99	8:45	11.70	108,000		
	8:50			8.84	1,480
	11:24			8.75	1,450
	12:42			8.76	1,450 **
	13:35			8.77	1,460
	15:13	12.00	132,000		
	15:24			8.84	1,480
	15:33			8.84	1,480
	16:55			8.88	1,490
	unknown	13.97	168,000		
5/30/99	9:12	13.38	203,000		
	9:34			9.64	1,250
	unknown			10.28	2,860
	13:50			10.03	3,610
	14:40	11.96	167,000		
	20:20	11.48	99,600		
	20:45			9.53	3,690
5/31/99	9:20	10.45	88,000		
	10:09			8.50	3,180
	16:09			8.05	1,400
	16:42			8.03	1,380 **
	18:53			7.90	1,260
6/1/99	9:45	8.25	99,700		
	10:47			6.52	1,060
	16:40	7.80	96,200		
	17:49	7.68	94,200		
6/2/99	9:27			5.28	844
	10:54	7.00	83,700		
	12:19			5.18	827
6/3/99	8:59	6.94	82,800		
	9:57			4.83	770

Notes:
** Discharge was measured. All other discharges were estimated. See Section 3.0 for details.

Table 17: Summary Of Breakup Data At The Head Of The Colville River Delta, 1962 - 1999.

Year	Approximate Date Water Began To Flow	Peak Water Surface Elevation (ft)	Peak Breakup Discharge (cfs)	Date of Peak Water Surface Elevation	Notes
1999	22 May	13.97	203,000	30 May	1, 2
1998	21 May	18.11	213,000	29 May	1, 3
1997	20 May	15.05	230,000	29 May	1
1996	15 May	17.19	160,000	26 May	1, 4
1995	8 May	15.7	233,000	16 May	5
1994	16 May	13.0	159,000	25 May	5
1993	---	20.0	379,000	31 May	5
1992	---	14.7	188,000	2 Jun	5
1977	---	19.9	407,000	7 Jun	5
1973	25 May	---	---	8 Jun	5
1971	23 May	---	---	2 Jun	5
1964	28 May	---	---	3 Jun	5
1962	19 May	13.2	215,000	14 Jun	5

Notes:

1. Water surface elevations are based on Monuments set by Lounsbury & Associates in 1996, and are based on British Petroleum Mean Sea Level (BPMSL).
2. Water was flowing in the Colville River at Umiat on this day. It is not known if this was the first day of flow. Therefore, it is not known if water was flowing on the delta prior to this date.
3. Data from Michael Baker Jr., Inc., 1998. *1998 Spring Breakup And Hydrologic Assessment, Colville River Delta, North Slope, Alaska.* Prepared for Arco Alaska, Inc., Anchorage, Alaska.
4. Data from Shannon & Wilson, Inc., 1996. *1996 Colville River Delta Spring Breakup And Hydrologic Assessment, North Slope, Alaska.* Prepared for Michael Baker Jr., Inc., Anchorage, Alaska.
5. Data from Jorgenson et al., 1996. *Geomorphology And Hydrology Of The Colville River Delta, Alaska, 1995.* Prepared for Arco Alaska, Inc. and Kuukpik Unit Owners, Anchorage, Alaska. The water surface elevations presented in this report were based on an elevation of 41.99 feet for the USCGS monument "River". In 1996, Lounsbury & Associates surveyed USCGS monument "River" and tied it to BPMSL. The elevation of "River", based on BPMSL, is 41.83 feet. The values presented in this table are based on the elevation for "River" that is based on BPMSL.

APPENDIX C

LIST OF PHOTOS

Photo 1: Looking north at the road from Colville Drill Site 2 to Colville Drill Site 1. (5/29/99 16:18)

Photo 2: Looking northeast at the swale and Colville Drill Site 1. (5/29/99 16:17)

Photo 3: Looking northeast at the swale. (5/30/99 21:18)

Photo 4: Looking northeast at Lake L93-13. Note that no overflow from the river has entered the lake. (5/30/99 21:19)

Photo 5: Looking north at Lake L93-12. Note that no overflow from the river has entered the lake. (5/30/99 21:20)

Photo 6: Looking northwest at Colville Drill Site 1, the Sakoonang Channel is in the middle of the picture. (6/4/99 15:07)

Photo 7: Looking west at Colville Drill Site 1 with the Sakoonang Channel in the foreground. (6/4/99 15:08)

Photo 8: Looking east at Colville Drill Site 1. (6/7/99 18:14)

Photo 9: Looking southwest at Colville Drill Site 1 and airstrip. (6/7/99 18:15)

Photo 10: Looking north at the swale. (6/8/99 14:49)

Photo 11: Looking southeast at the swale. (6/8/99 14:48)

Photo 1: Looking north at the road from Colville Drill Site 2 to Colville Drill Site 1. (5/29/99 16:18)

1999 SPRING BREAKUP
COLVILLE RIVER DELTA

PHOTOGRAPHS

Michael Baker Jr., Inc.

Date: 7/30/99	Project: 23100-020-0101
Drawn: JDA	File: photos.doc
Checked: JWA	Scale:

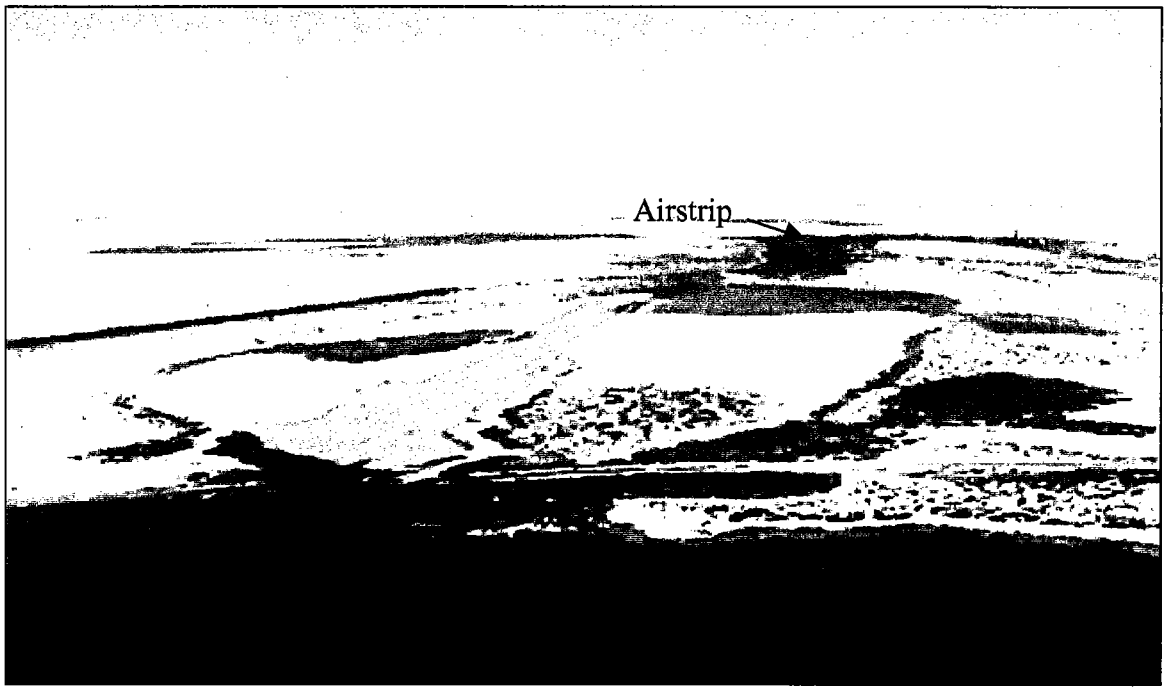

Photo 2: Looking northeast at the swale and Colville Drill Site 1. (5/29/99 16:17)

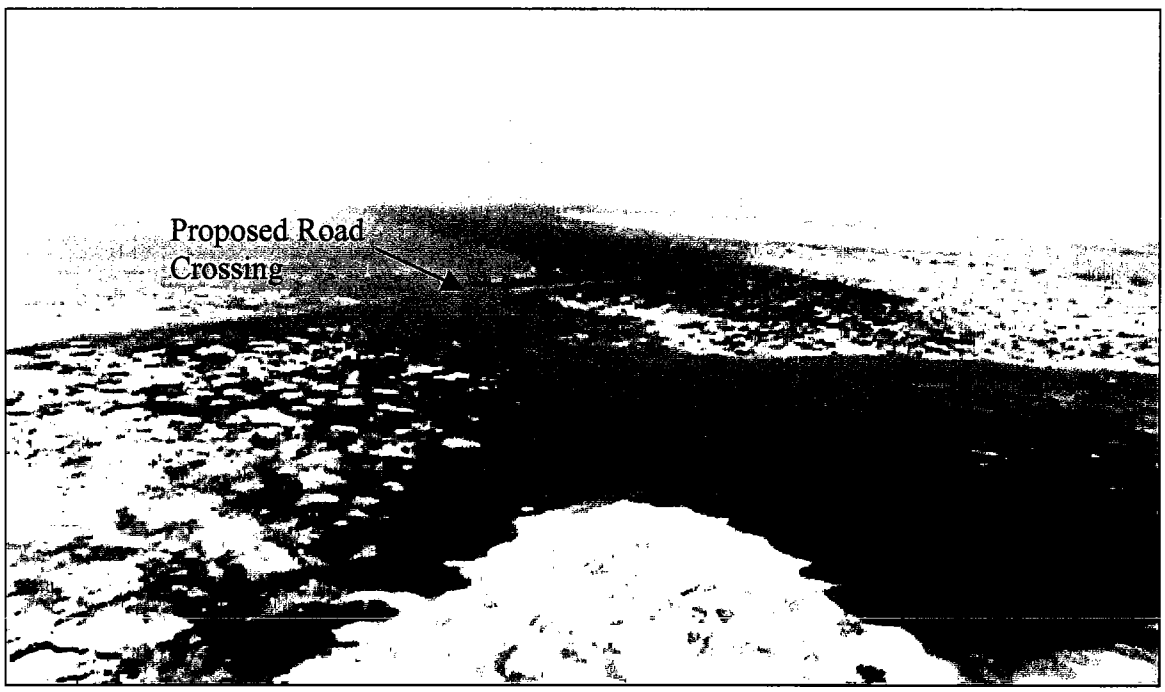

Photo 3: Looking northeast at the swale. (5/30/99 21:18)

Michael Baker Jr., Inc.		1999 SPRING BREAKUP COLVILLE RIVER DELTA	Page Number:
Date: 7/30/99	Project: 23100-020-0101		2
Drawn: JDA	File: photos.doc	PHOTOGRAPHS	
Checked: JWA	Scale:		

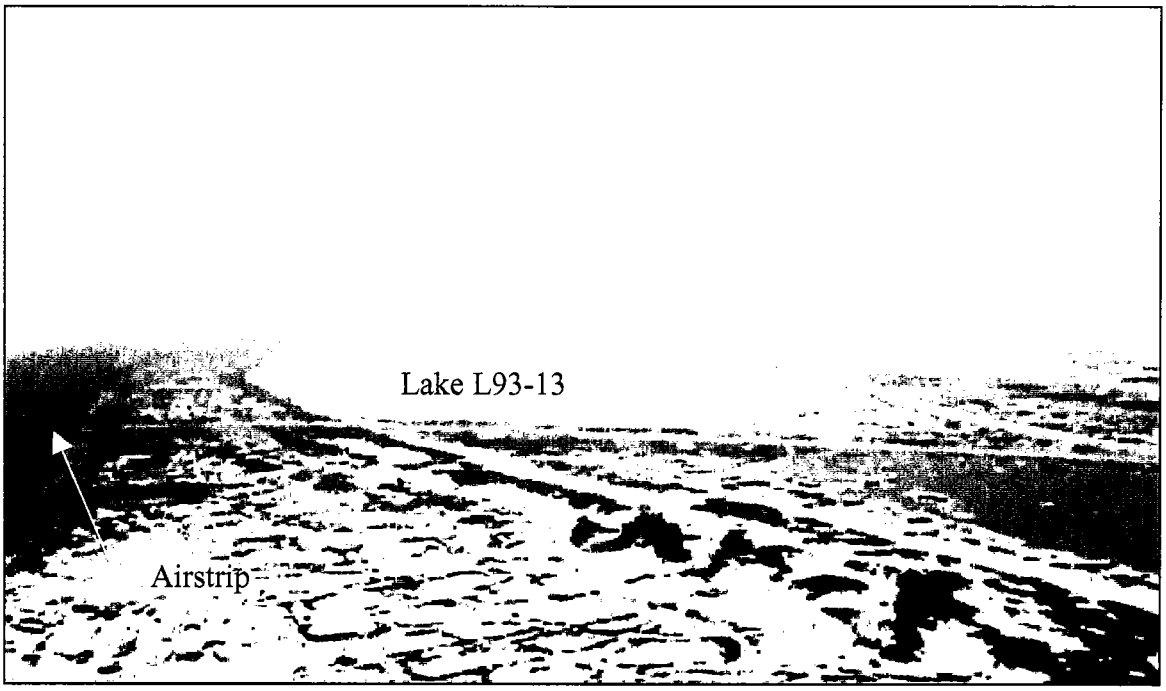

Photo 4: Looking northeast at Lake L93-13. Note that no overflow from the river has entered the lake. (5/30/99 21:19)

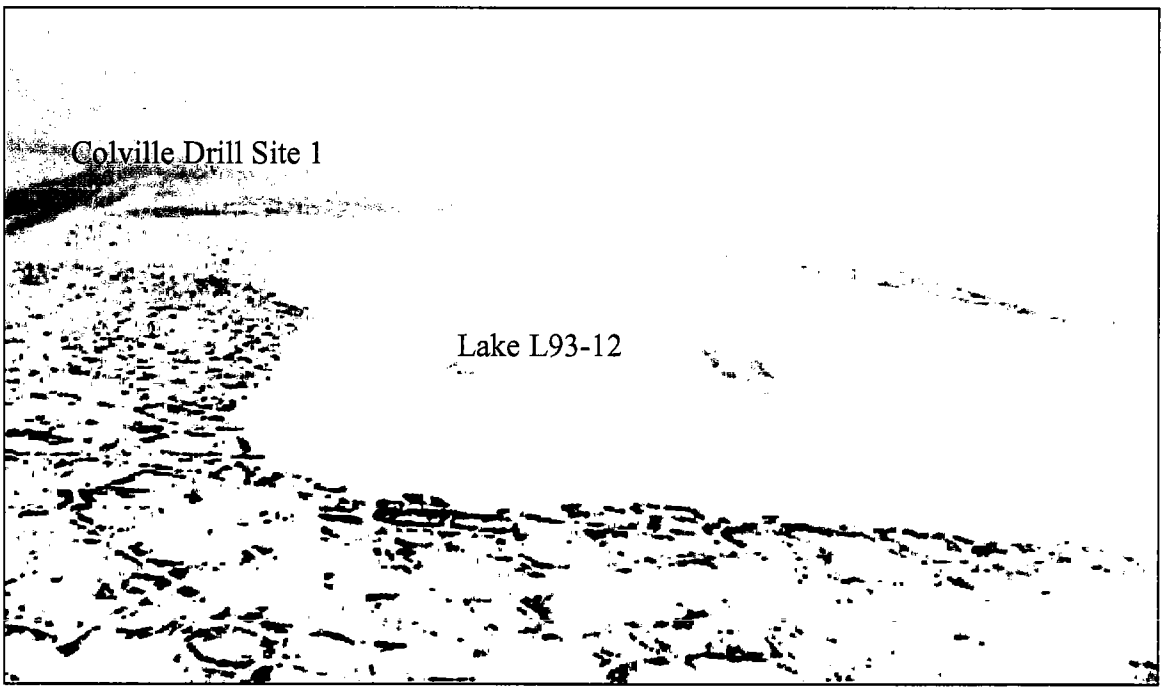

Photo 5: Looking north at Lake L93-12. Note that no overflow from the river has entered the lake. (5/30/99 21:20)

Michael Baker Jr., Inc.	
Date: 7/30/99	Project: 23100-020-0101
Drawn: JDA	File: photos.doc
Checked: JWA	Scale:

1999 SPRING BREAKUP
COLVILLE RIVER DELTA

PHOTOGRAPHS

Page Number: 3

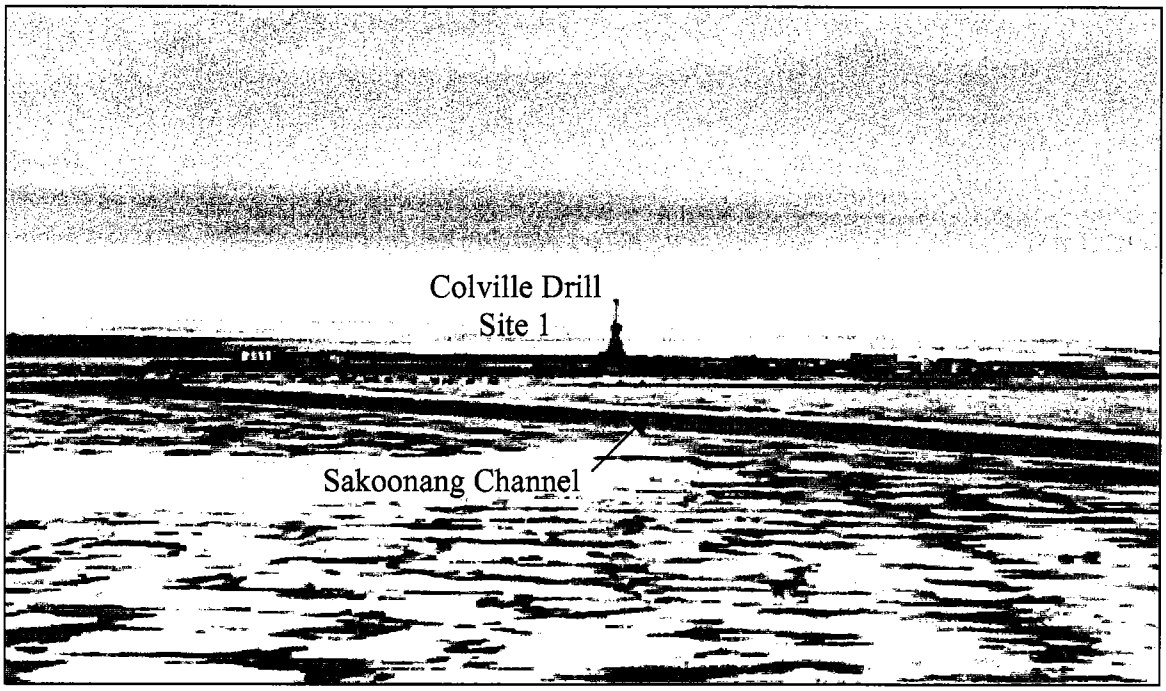

Photo 6: Looking northwest at Colville Drill Site 1, the Sakoonang Channel is in the middle of the picture. (6/4/99 15:07)

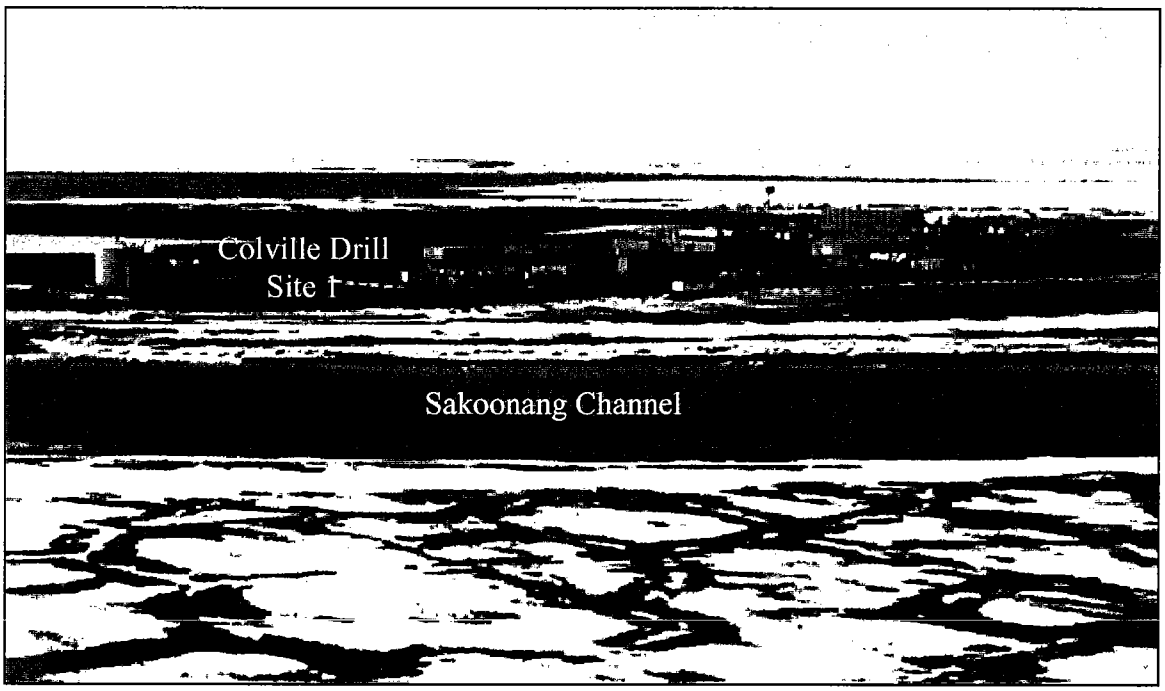

Photo7: Looking west at Colville Drill Site 1 with the Sakoonang Channel in the foreground. (6/4/99 15:08)

Michael Baker Jr., Inc.	
Date: 7/30/99	Project: 23100-020-0101
Drawn: JDA	File: photos.doc
Checked: JWA	Scale:

1999 SPRING BREAKUP
COLVILLE RIVER DELTA

PHOTOGRAPHS

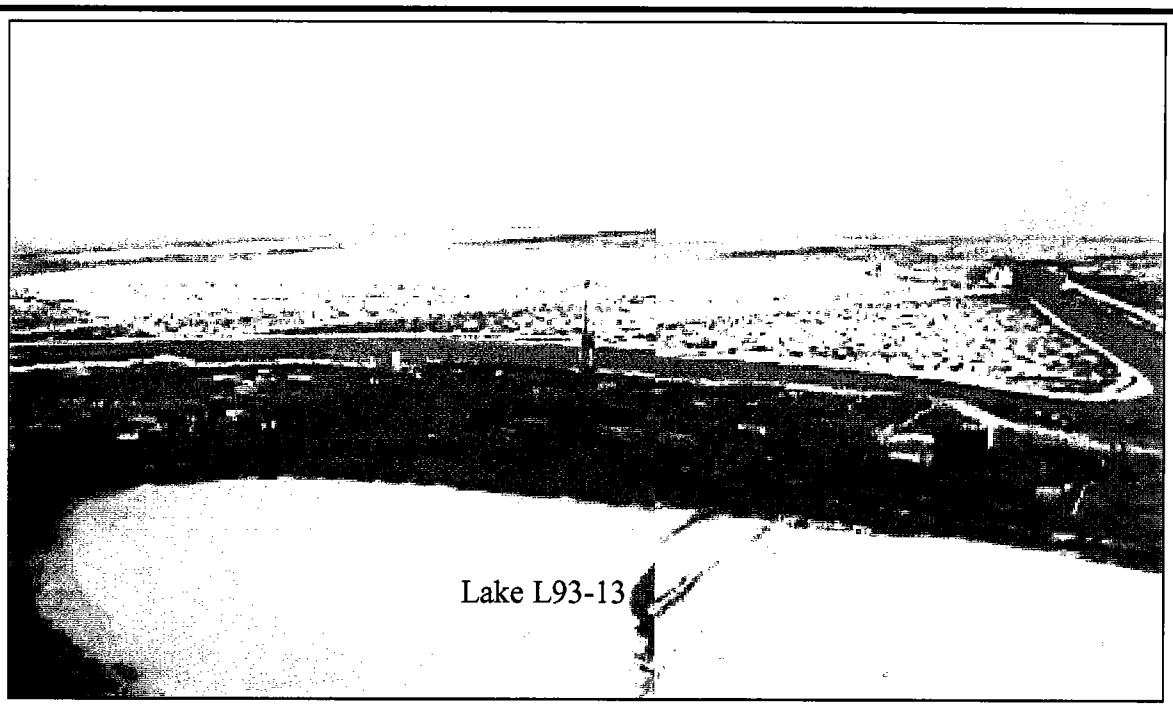

Photo 8: Looking east at Colville Drill Site 1. (6/7/99 18:14)

Photo 9: Looking southwest at Colville Drill Site 1 and airstrip. (6/7/99 18:15)

Michael Baker Jr., Inc.		1999 SPRING BREAKUP COLVILLE RIVER DELTA	Page Number:
Date: 7/30/99	Project: 23100-020-0101		5
Drawn: JDA	File: photos.doc	PHOTOGRAPHS	
Checked: JWA	Scale:		

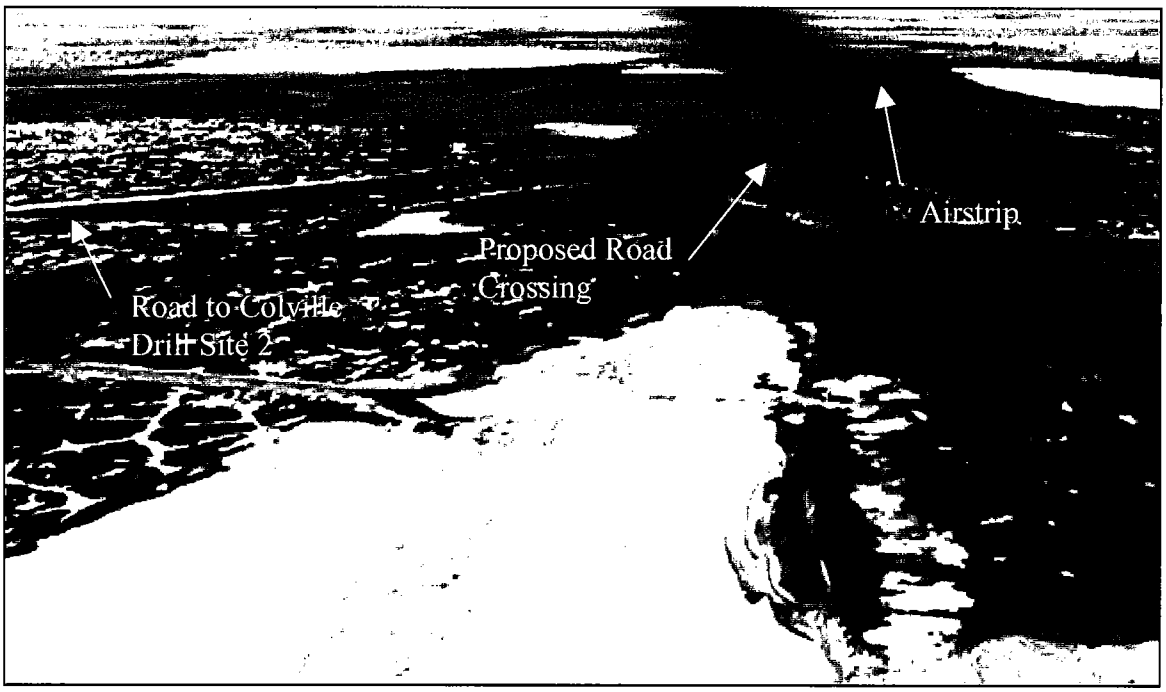

Photo 10: Looking north at the swale. (6/8/99 14:49)

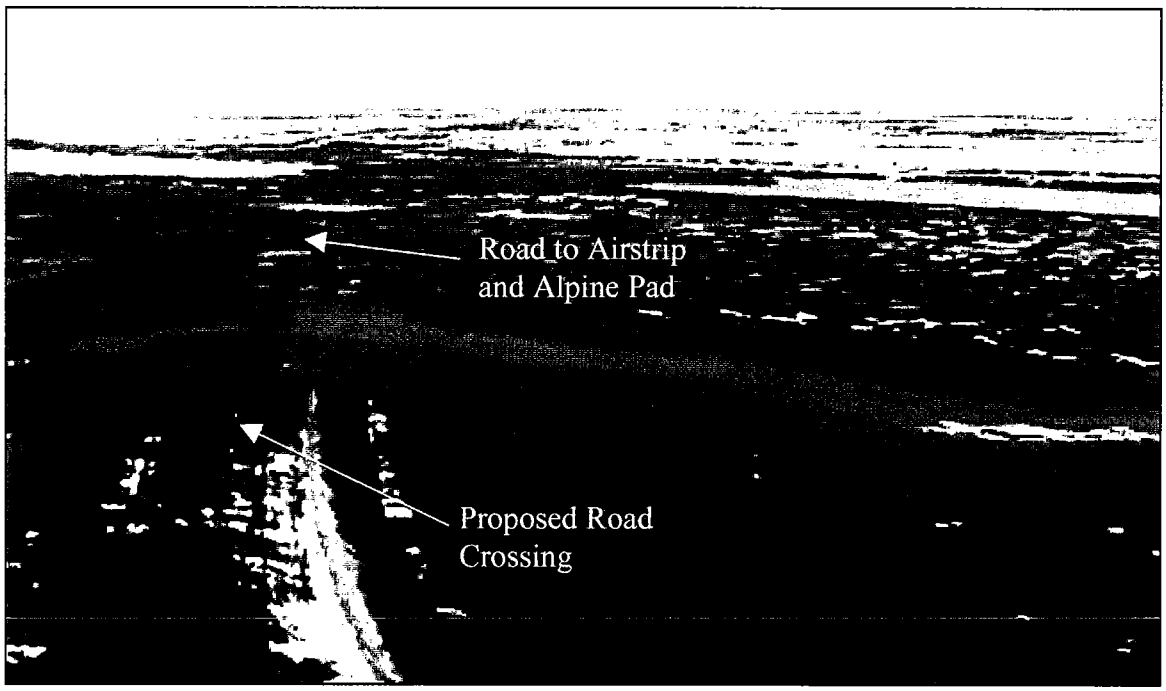

Photo 11: Looking southeast at the swale. (6/8/99 14:48)

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