

MONITORING OF WATER-SOURCE LAKES IN THE ALPINE DEVELOPMENT PROJECT: 1999-2001

Final Report

May 2002



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Prepared for:

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and

**Anadarko Petroleum Corp.
1200 Timberloch Place
The Woodlands, TX**

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Executive summary

Lakes L9312 and L9313 provide the permanent water supply for the Alpine development. Both of the water-source lakes support fish, as was first documented by baseline studies beginning in 1995. A series of permits have been issued by Alaska Department of Fish and Game (ADF&G) that allow water withdrawal from the lakes under restrictions intended to protect fish residing within the lakes. The sampling in 2001 represented the third year of a 5-year monitoring program required by the ADF&G permit. The objectives of this study were to conduct required monitoring for fish presence and compare the 2001 catch patterns to those observed in previous years.

Monitoring of the water-source lakes consisted of sampling with fyke nets combined with physical measurements. Water chemistry measurements obtained in conjunction with fish sampling included surface measures (depth = 0.5 ft) of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. During winter 2000/2001, additional water chemistry measurements were obtained by URS, Inc. as part of a PHILLIPS Alaska study on the effects of water withdrawal on delta lakes.

Water use has varied considerably in the two lakes over the last three winters. During summer 2000, staff gauges were installed in the lakes to allow direct measurement of the water surface elevation. Both lakes were flooded during break-up 2000 and the water surface elevations observed after the lakes stabilized were set as benchmarks to monitor water use. The lakes were estimated to be bankfull when the water surface elevation was 8.1 ft in L9312 and 6.3 ft in L9313. Water withdrawals were to cease when the water surface elevation reached 7.0 ft in L9312 and 5.8 ft in L9313.

Lake L9312 was used heavily during winter 2000/2001, with over 26 million gallons removed between September and June. No water was used from L9313 in winter 2000/2001 because the water surface elevation fell below the permitted level prior to ice formation in the fall. There was an unexpected high loss of water during summer 2000, most likely from a combination of continued run-off and evaporation.

Lake L9312 (U6.1)

Water Chemistry. The lake was not flooded during the 2001 break-up. Specific conductance at the lake edge has not shown any consistent trend since sampling began in 1995. During winter 2001, there was evidence of oxygen depression in late winter, which, while low (1.6 to 5.7 mg/l on April 18), was not low enough to jeopardize fish residing in the lake.

Biological Observations. Fyke net sampling conducted July 21-28, 2001 produced a catch of 167 fish from 7 species, while sampling conducted August 16-24 produced 366 fish from 8 species. Through 2001, a total of 11 species has been recorded from the lake. As in previous years, least cisco was again the most numerous species caught in 2001. The July catch rate of least cisco was a substantial decrease from that recorded in 2000, but was similar to that in 1999. Catch rates in August 2001 were similar to those recorded in 2000.

In 2001, the captured least cisco were smaller than in 2000, with age-0 and 1 fish being most abundant. Since there was no evidence of flooding in spring 2001, the high catch of age-0 fish indicates successful spawning in fall 2000. The lack of larger fish in 2001 may be a sampling artifact – age-1 fish were relatively abundant in 2001 yet fish of the same year class were not caught as age-0 fish in 2000.

Catch rates of fish other than least cisco were generally lower in 2001 when compared to 1999 and 2000. Round whitefish, Alaska blackfish and slimy sculpin all showed reduced abundance in 2001 in both the July and August sampling periods.

Lake L9313 (T6.1)

Water Chemistry. Specific conductance at the fyke net in L9313 increased 48% above that recorded in 2000. Specific conductance has been increasing steadily in this lake since monitoring began in 1995. The high levels of dissolved solids compared to lake L9312 are likely related to more frequent influence from the river because of the lower elevation. L9313 is flooded annually during spring break-up, while L9312 is only occasionally flooded.

As with lake L9312, there was evidence of oxygen depression in L9313 during winter 2000/2001, although the oxygen levels were lower than those recorded in L9312. These low levels reached levels that were likely to be stressful to fish during late April (2.0-2.5 mg/l on April 18). There was no water removal during winter 2000/2001 from this lake, thus the reduced oxygen levels were a natural occurrence.

Biological Observations. Fyke net sampling conducted July 21-28, 2001 and again during August 16-24 both produced catches of 162 fish from 5 species. Ninespine stickleback least cisco and Alaska blackfish were the most abundant species, with broad whitefish and humpback whitefish also caught. Least cisco caught during 2001 included fish of adult size. In 1999 and 2000, catches were composed of juveniles but mature fish had been caught in previous sampling, which was initiated in 1995.

Sampling in lake L9313 prior to 1999 indicated few fish resided in the lake, with ninespine stickleback and low densities of least cisco and Alaska blackfish present. The high variability in catch rates of least cisco, along with the highly variable length distribution, likely indicates that fish enter and leave the lake annually during high water.

Summary: There are no indications that the fish populations in lakes L9312 and L9313 have been substantially damaged by water withdrawals through 2001. Similarly, there have been no changes in water chemistry that can be definitively assigned to the effects of water withdrawal. Lake L9313 appears to be marginal as wintering habitat because of depressed oxygen levels in late winter.

In general, catch rates were lower in 2001 than in previous years. These catch patterns will be

scrutinized in future monitoring. The catch rates were lower in both lakes, however, and only one was used for winter withdrawal in winter 2000/20001, thus it is difficult, at this time, to assign the lower catches to effects of water withdrawal.

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MONITORING OF WATER-SOURCE LAKES IN THE ALPINE DEVELOPMENT PROJECT: 1999-2001

INTRODUCTION

Two lakes, designated L9312 (or U6.1) and L9313 (or T6.1), provide the permanent water supply for the Alpine development (Figures 1 and 2). Two naming conventions are used to identify the lakes in the Colville Delta region – one name conveys information on initial sampling and the investigator responsible for the sampling, the other name conveys information on location within the North Slope Emergency Response grid (Moulton 1998).

A series of permits have been issued by Alaska Department of Fish and Game (ADF&G) that allow water withdrawal from the lakes under restrictions intended to protect fish residing within the lakes (Appendix C). These permits have been modified as information on the lakes has improved and as project needs have changed. A permit stipulation added to the March 30, 1999 amendments was that each lake would be monitored for fish presence at least twice during the ice-free season for a period of three years. On September 1, 2000, an additional modification specified that the fish monitoring be continued for a minimum of 5 years. This report is intended to fulfill those permit stipulations.

Fish populations in the lakes have been surveyed several times since 1995, when baseline studies specific to the Alpine Development began (Moulton 1997). Both of the water-source lakes support fish, with eleven species identified from L9312 and seven identified from L9313 (Moulton 1999, 2000).

The objectives of this study were to continue monitoring for fish presence in each water source lake and compare the 2001 catch patterns to those observed in previous years. Results of the 1999 and 2000 monitoring are reported in Moulton (1999, 2000).

METHODS

Monitoring of the water-source lakes consisted of sampling with fyke nets combined with physical measurements. Sampling was by fyke net because the objective was to sample fish with non-lethal gear so that the sampling would not be the cause of any observed changes to the populations. In past years, beginning in 1995, a variety of gear types were tested to evaluate the fish populations in delta lakes (see Appendix B-1 for a list of gear used and resulting catches). Based on those catches, it was decided to use only fyke nets because they sampled the entire range of species and allowed live release of captured fish.

Net locations identified in 1999 as the most appropriate monitoring sites (Moulton 1999) were re-

occupied for the 2000 and 2001 sampling (Figures 3 and 4). As set forth in the monitoring stipulations, sampling was conducted during two periods: July 22-29 and August 15-22. Fish were measured and released, with no fish retained for laboratory analysis. Duration of each set was recorded in order to calculate catch rates.

In 2001, fish greater than 250 mm were tagged to obtain information on residence time within the lake and potentially allow for estimating population size. Floy FD-68B anchor tags (monofilament = 5/8 inch, vinyl = 1 1/8 inch) were applied to broad whitefish and least cisco exceeding 250 mm fork length.

Water chemistry measurements obtained at the two lakes included surface measures of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. Temperature, specific conductance and dissolved oxygen were *in situ* surface measurements taken at the fyke net station in each lake with a YSI Model 85 meter. A sample was returned to the field office to measure pH and turbidity. PH was measured with either a Corning pH meter or an Oaktron pH Tester III. Turbidity was measured with an H.F. Scientific DRT15CE turbidity meter. In addition to the measurements taken at the fyke net, profiles of the same parameters were measured in 1 m increments at the deepest location in each lake in July and August of both 2000 and 2001.

During winter 2000/2001, additional water chemistry measurements in L9312 and L9313 were obtained by URS, Inc. as part of a PHILLIPS Alaska study on effects of water withdrawal on delta lakes. Measurements were obtained *in situ* at the deepest location of the lake with a Horiba Model U-10 water quality meter.

RESULTS AND DISCUSSION

History of Water Withdrawal

Water use has varied considerably in the two lakes over the last three winters as permit conditions have been modified (Table 1). The initial water use permits that designated the lakes as permanent water sources, issued March 30, 1999, allowed 15% of the estimated minimum winter volume to be removed. The volume allowed for removal was increased to 30% of the minimum winter volume on January 27, 2000.

During summer 2000, staff gauges were installed in the lakes to allow direct measure of the water surface elevation. Both lakes were flooded during break-up 2000 and the water surface elevations observed after the lakes stabilized were set as benchmarks to monitor water use. Water withdrawals were to cease when the water surface elevation reached 7.0 ft in L9312 and 5.8 ft in L9313. The permitted removals were also amended to reflect new estimates of lake volumes.

In L9312, 87% of the permitted withdrawal was used in winter 1998/1999, while only 15% was used in 1999/2000. Use exceeded 81% of the permitted withdrawal in 2000/2001.

In L9313, only 3% was used in 1998/1999, with 85% used in 1999/2000. No water was used from L9313 in winter 2000/2001 because the water surface elevation fell below the permitted level (5.8 ft) prior to ice formation in the fall. There was an unexpected high loss of water during summer, most likely from a combination of continued run-off and evaporation.

Lake L9312 (U6.1)

Water Chemistry. Water chemistry parameters measured in association with fish sampling since 1995 are summarized in Table 2. Flooding during break-up in 2000 appeared to decrease specific conductance, as there was a 29% decrease between July 1999 and July 2000. Specific conductance in L9312 during July increased slightly (7%) between 2000 and 2001. The lake was not flooded during the 2001 break-up. Specific conductance has not shown any consistent trend since sampling began in 1995 (Figure 6).

During winter 2001, there was evidence of oxygen depression, with the minimum levels recorded on April 18 (Table 5). These dissolved oxygen levels, while low, were not low enough to jeopardize fish residing in the lake.

Biological Observations. Fyke net sampling conducted July 21-28, 2001 produced a catch of 167 fish from 7 species, while sampling conducted August 16-24 produced 366 fish from 8 species (Table 2, Figure 5). The fourhorn sculpin caught on August 24 was the first record of this species from lake L9312, bringing the total number of species recorded from the lake to 11.

As in previous years, least cisco was again the most numerous species caught in 2001, representing 77% of the non-stickleback catch. The July catch rate of least cisco (8.1 fish per day) was a substantial decrease from the 192.3 per day in 2000, but was similar to the 9.0 per day recorded in 1999 (Figure 6). Catch rates in August 2001 were similar to those recorded in 2000 (29.1 in 2001 vs. 28.4 in 2000).

The least cisco in 2000 likely represented many age groups (based on length frequency analysis – Appendix B), because the lengths ranged from 60 to 220 mm. In 2001, the captured least cisco were smaller, with age-0 and 1 fish being most abundant. Few larger fish were caught, with none over 190 mm. Since there was no evidence of flooding in spring 2001, the high catch of age-0 fish likely indicates successful spawning in fall 2000. The lack of larger fish in 2001 may be a sampling artifact – note that age-1 fish were relatively abundant in 2001 yet fish of the same year class were not caught as age-0 fish in 2000.

Catch rates of fish other than least cisco were generally lower in 2001 when compared to 1999 and 2000 (Table 2, Figure 7). Round whitefish, Alaska blackfish and slimy sculpin all showed reduced abundance in 2001 in both the July and August sampling periods. Four broad whitefish were tagged and released – these were the only fish large enough to be tagged.

Lake L9313 (T6.1)

Water Chemistry. Specific conductance in L9313 increased 48% above that recorded in 2000 (Table 2, Figure 5). Specific conductance has been increasing steadily in this lake since monitoring began in 1995. The high levels of dissolved solids compared to lake L9312 are likely related to more frequent influence from the river because of the lower elevation. L9313 is flooded annually during spring break-up, while L9312 is only occasionally flooded.

As with lake L9312, there was evidence of oxygen depression in L9313 during winter 2000/2001 (Table 7), although the oxygen levels were lower than those recorded in L9312. These low levels reached levels that were likely to be stressful to fish during late April (2.0-2.5 mg/l). There was no water removal during winter 2000/2001 from this lake, thus the reduced oxygen levels were a natural occurrence.

Biological Observations. Fyke net sampling conducted July 21-28, 2001 and again during August 16-24 both produced catches of 162 fish from 5 species (Table 2). Ninespine stickleback, least cisco and Alaska blackfish were the most abundant species, with broad whitefish and humpback whitefish also caught. Catch rates of least cisco were much higher in July than in August (Figure 11), while Alaska blackfish catches were higher in August.

The least cisco caught during 2001 included fish in the adult size range (Figure 12). In 1999 and 2000, catches were composed of juveniles but mature fish had been caught in earlier years.

Three least cisco and one broad whitefish were tagged and released in L9313.

Sampling in lake L9313 prior to 1999 indicated few fish resided in the lake (Appendix Table A-1), with ninespine stickleback and low densities of least cisco and Alaska blackfish present. The high catches of age-2 and 3 least cisco in 1999 and their subsequent disappearance, along with the highly variable length distribution, likely indicate that fish enter and leave the lake annually during high water.

Sampling during July is conducted during 24-hours of daylight, while sampling in late August includes periods of darkness at night. The catches in late August in both L9312 and L9313 may reflect this difference in daylight pattern. The pattern of daily catch indicates that both slimy sculpin and Alaska blackfish were more active at night (Figures 7 and 11).

CONCLUSIONS

There are no indications that the fish populations in lakes L9312 and L9313 have been substantially damaged by water withdrawals through 2001. Similarly, there have been no changes in water chemistry that can be definitively assigned to effects of water withdrawal. Lake L9313 appears to

be marginal as wintering habitat because of depressed oxygen levels in late winter. The highly variable size structure of least cisco in this lake indicate that the population is transitory and is likely subject to high rates of immigration and emigration on an annual basis. This is in contrast to lake L9312, which appears to support a reproducing population of stunted least cisco.

In general, catch rates were lower in 2001 than in previous years. These catch patterns will be scrutinized in future monitoring. The catch rates were lower in both lakes, however, and only one was used for winter withdrawal in winter 2000/20001, thus it is difficult, at this time, to assign the lower catches to effects of water withdrawal.

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Table 1. Water withdrawal at Alpine Development lakes from freeze-up to break-up, 1999-2001.

Lake Name	Month	1998/1999 (gallons)	1999/2000 (gallons)	2000/2001 (gallons)	
L9312	September			495,000	
	October			1,786,600	
	November			2,435,320	
	December			2,587,600	
	January			8,840,220	
	February	9,100,325		1,911,100	
	March	1,847,370		1,781,600	
	April		947,100	2,153,200	
	May		1,865,161	1,980,200	
	Jun			2,379,200	
	Total Use		10,947,695	2,812,261	26,350,040
	Permitted Use		12,600,000	19,000,000	32,360,000
	L9313	September			2,122,600
October					
November					
December			765,600		
January		63,000	1,696,600		
February		126,000	1,039,800		
March			1,550,800		
April			843,900		
May					
Total Use		189,000	5,896,700	9,404,700 ²	
Permitted Use	5,600,000	6,940,000	10,340,000		

¹ These permitted use levels were used by PHILLIPS Alaska, Inc. (formerly ARCO Alaska) for tracking purposes, some of these levels are less than permitted levels found in the ADF&G permits.

² 7,282,100 million gallons were used prior to freeze-up

Table 2. Water chemistry parameters measured in conjunction with Alpine Area fish sampling at lake L9312.

Parameter	Date	Standard		Number	Range	
		Mean	Deviation			
Water Temperature (°C)						
	Jul 13, 1995	13.4	--	1	13.4	
	Nov 2, 1995	0.8	0.7	8	0-1.8	(under ice)
	Jul 9-15, 1997	8.3	0.7	5	7.7-9.5	
	Jul 28-Aug 3, 1999	10.4	1.9	7	8.6-13.5	
	Jul 24-29, 2000	10.7	0.8	6	10.0-12.1	
	Aug 16-21, 2000	7.6	0.6	6	6.6-8.5	
	Jul 22-28, 2001	14.2	1.0	7	13.1-15.9	
	Aug 17-23, 2001	6.0	1.1	6	5.2-8.1	
Dissolved Oxygen (% Saturation)						
	Jul 13, 1995	--	--	0	--	
	Nov 2, 1995	--	--	0	--	
	Jul 9-15, 1997	99.4	6.9	5	90.8-110.0	
	Jul 28-Aug 3, 1999	98.8	0.2	2	98.6-98.9	
	Jul 24-29, 2000	97.4	1.4	4	95.5-99.0	
	Aug 16-21, 2000	--	--	0	--	
	Jul 22-28, 2001	94.7	3.1	7	89.7-98.9	
	Aug 17-23, 2001	89.7	8.6	6	76.0-98.7	
Specific Conductance (µS/cm)						
	Jul 13, 1995	60.0	--	1	60.0	
	Nov 2, 1995	133.2	2.6	8	130.6-137.8	(under ice)
	Jul 9-15, 1997	83.5	0.5	5	82.7-83.9	
	Jul 28-Aug 3, 1999	77.2	1.5	7	76.2-79.5	
	Jul 24-29, 2000	54.8	0.2	6	54.5-55.2	
	Aug 16-21, 2000	55.7	0.4	6	55-56.3	
	Jul 22-28, 2001	58.6	0.7	7	57.1-59.2	
	Aug 17-23, 2001	60.9	0.8	6	60.2-62.0	
Turbidity (NTU)						
	Jul 21, 2000	8.6	1.4	4	7.5-10.5	
	Aug 15, 2000	4.4	0.9	4	3.9-5.7	
	Jul 22-28, 2001	1.9	0.7	6	1.3-3.0	
	Aug 17-23, 2001	2.3	1.4	6	1.2-4.7	

Table 3. Water chemistry profiles measured in conjunction with Alpine Area sampling at lake L9312 during 2001 (February to April data from URS).

(profiles taken at deepest location in lake)

Date	Depth (m)	Water Temp. (°C)	Dissolved Oxygen		Specific Conductance (µS/cm)	Turbidity (NTU)
			(mg/l)	Percent Saturation		
2/8/2001	1.8	0.9	10.9		180	0.0
2/8/2001	3.7	2.4	1.5		269	0.0
2/21/2001	1.8	1.2	12.5		161	0.0
2/21/2001	2.4	2.2	10.8		149	0.0
2/21/2001	3.7	2.9	3.0		118	0.0
3/7/2001	2.0	1.4	11.2		178	0.0
3/7/2001	2.9	2.4	7.8		181	0.0
3/7/2001	4.0	3.0	4.4		162	0.0
3/20/2001	2.1	2.3	11.0		169	0.0
3/20/2001	3.0	3.0	7.5		193	0.0
3/20/2001	4.1	3.2	2.5		152	0.0
4/3/2001	2.4	3.0	10.2		186	0.0
4/3/2001	3.0	3.5	7.0		185	0.0
4/3/2001	3.7	3.7	6.8		184	0.0
4/18/2001	3.7	4.3	5.7		208	0.0
4/18/2001	4.0	4.2	3.3		252	0.0
4/18/2001	4.3	4.2	1.6		236	0.0
4/28/2001	2.4	4.3	10.6		195	0.0
4/28/2001	3.0	4.5	11.2		197	0.0
4/28/2001	3.7	4.5	11.1		197	0.0
7/28/2001	surface	13.3	8.6	83.1	59	1.1
	1.0	13.4	8.7	83.2	59	1.1
	2.0	13.4	8.5	81.5	59	1.2
	3.0	13.4	8.5	81.3	59	1.7
8/25/2001	surface	4.7	13.2	102.3	58	0.5
	1.0	4.7	13.2	102.1	58	0.7
	2.0	4.7	13.1	101.4	58	1.0
	3.0	4.7	13.0	101.2	58	0.5

Table 4. Variation in specific conductance observed at lakes L9312 and L9313 from 1997 to 2001 as measured at fyke net stations.

Lake	Year	Winter Water Withdrawal (million gals.)	July Specific Conductance (μS/cm)
L9312	1997	(no withdrawal)	83.5
	1998	(no withdrawal)	--
	1999	10,947,695	77.2
	2000	2,812,261	54.8
	2001	26,350,040	58.6
L9313	1997	(no withdrawal)	126.2
	1998	(no withdrawal)	--
	1999	189,000	172.8
	2000	5,896,700	167.7
	2001	0	248.6

Table 5. Catches of fish from Alpine Area Lakes fyke net sampling, 1999-2001.

Species	July 1999		July 2000		August 2000		July 2001		August 2001	
	Number	CPUE	Number	CPUE	Number	CPUE	Number	CPUE	Number	CPUE
L9312										
Least cisco	62	9.0	1,349	192.3	196	28.4	56	8.1	228	29.1
Arctic cisco	0	0.0	0	0.0	5	0.7	0	0.0	0	0.0
Broad whitefish	5	0.7	5	0.7	4	0.6	7	1.0	0	0.0
Humpback whitefish	0	0.0	27	3.8	15	2.2	1	0.1	1	0.1
Round whitefish	24	3.5	7	1.0	17	2.5	5	0.7	4	0.5
Burbot	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0
Longnose sucker	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0
Alaska blackfish	7	1.0	22	3.1	102	14.8	5	0.7	8	1.0
Fourhorn sculpin	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1
Slimy sculpin	83	12.0	13	1.9	93	13.5	4	0.6	49	6.3
Ninespine stickleback	184	26.7	729	103.9	368	53.3	89	12.8	75	9.6
Net Hours:	165.4		168.3		165.7		166.4		187.8	
L9313										
Least cisco	975	135.7	0	0.0	5	0.7	48	7.0	5	0.6
Broad whitefish	5	0.7	4	0.6	7	1.0	2	0.3	3	0.4
Humpback whitefish	0	0.0	0	0.0	5	0.7	1	0.1	4	0.5
Round whitefish	2	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Burbot	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0
Alaska blackfish	9	1.3	23	3.3	100	14.8	11	1.6	22	2.8
Ninespine stickleback	111	15.5	779	110.2	332	49.3	100	14.6	128	16.2
Net Hours:	172.4		169.7		161.6		164.2		189.1	

Table 6. Water chemistry parameters measured in conjunction with Alpine Area fish sampling at lake L9313.

Parameter	Date	Standard		Number	Range	
		Mean	Deviation			
Water Temperature (°C)						
	Jul 13, 1995	13.1	--	1	13.1	
	Oct 31, 1995	0.4	0.4	6	0.0-1.0	(under ice)
	Jul 9-15, 1997	8.0	0.4	5	7.7-8.6	
	Jul 28-Aug 3, 1999	10.2	1.9	7	8.3-12.7	
	Jul 24-29, 2000	10.6	0.4	5	10.3-11.2	
	Aug 16-21, 2000	7.7	0.5	6	6.9-8.5	
	Jul 22-28, 2001	14.2	0.9	7	13.2-15.6	
	Aug 17-23, 2001	5.8	0.7	6	5.0-7.0	
Dissolved Oxygen (% Saturation)						
	Jul 13, 1995	--	--	0	--	
	Oct 31, 1995	--	--	0	--	
	Jul 9-15, 1997	96.3	2.1	5	93.9-99.1	
	Jul 28-Aug 3, 1999	100.7	2.2	2	99.1-102.2	
	Jul 24-29, 2000	98.6	1.3	3	97.4-100.0	
	Aug 16-21, 2000	--	--	0	--	
	Jul 22-28, 2001	92.7	3.8	7	87.0-97.8	
	Aug 17-23, 2001	89.1	9.7	6	78.9-102.6	
Specific Conductance (µS/cm)						
	Jul 13, 1995	107.0	--	1	107.0	
	Oct 31, 1995	184.1	7.5	6	169.9-189.5	(under ice)
	Jul 9-15, 1997	126.2	2.0	5	123.3-128.5	
	Jul 28-Aug 3, 1999	172.8	3.3	7	170.2-177.9	
	Jul 24-29, 2000	167.7	1.1	5	166.7-169.2	
	Aug 16-21, 2000	174.1	2.5	6	170.3-176.5	
	Jul 22-28, 2001	248.6	4.0	7	244.9-257.3	
	Aug 17-23, 2001	255.6	4.2	6	253.0-263.9	
Turbidity (NTU)						
	Jul 18, 2000	3.4	0.2	4	3.3-3.6	
	Aug 15, 2000	8.4	4.5	4	5.5-15.0	
	Jul 22-28, 2001	2.9	1.6	7	1.5-6.4	
	Aug 17-23, 2001	2.4	1.7	6	1.4-5.8	

Table 7. Water chemistry profiles measured in conjunction with Alpine Area sampling at lake L9313 during 2001 (February to April data from URS).

(profiles taken at deepest location in lake)

Date	Depth (m)	Water Temp. (°C)	Dissolved Oxygen		Specific Conductance (µS/cm)	Turbidity (NTU)
			(mg/l)	Percent Saturation		
2/8/2001	1.8	0.8	7.8		491	0.0
2/21/2001	1.8	2.5	5.7		561	0.0
2/21/2001	2.3	2.0	5.5		580	1.0
2/21/2001	2.4	2.2	5.3		579	3.0
3/7/2001	2.0	1.0	4.0		519	0.0
3/7/2001	2.6	0.8	4.1		517	0.0
3/20/2001	2.0	1.1	4.0		408	0.0
3/20/2001	2.6	2.1	3.8		549	0.0
4/3/2001	1.8	1.3	3.3		634	56.0
4/3/2001	2.4	2.6	3.9		526	128.0
4/18/2201	2.3	2.5	2.5		842	0.0
4/18/2201	2.4	3.6	2.1		785	0.0
4/18/2201	2.9	4.1	2.0		769	0.0
4/28/2001	2.1	2.4	3.8		623	0.0
4/28/2001	2.4	2.7	3.4		671	0.0
7/25/2001	surface	13.2	9.2	87.0	249	1.7
	1.0	13.6	9.5	91.2	247	1.4
	2.0	13.6	9.5	91.7	247	1.3
	3.0	13.7	10.0	94.5	247	4.6
8/25/2001	surface	4.4	12.6	97.4	249	0.7
	1.0	4.4	12.6	97.0	249	0.7
	2.0	4.5	12.5	97.0	248	1.0
	3.0	4.5	12.4	96.2	248	2.0

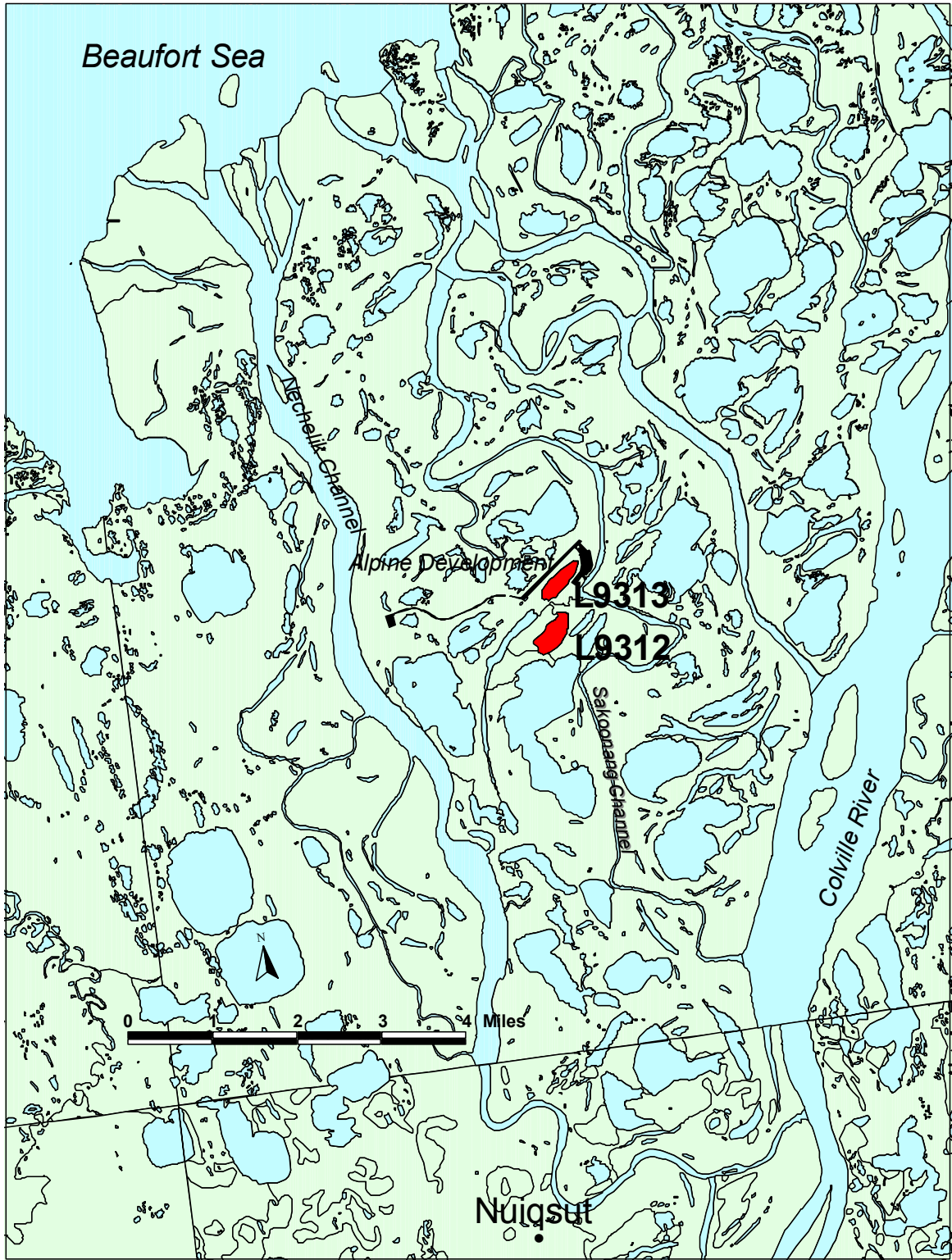


Figure 1. Location of the Alpine Development in the Colville River delta.

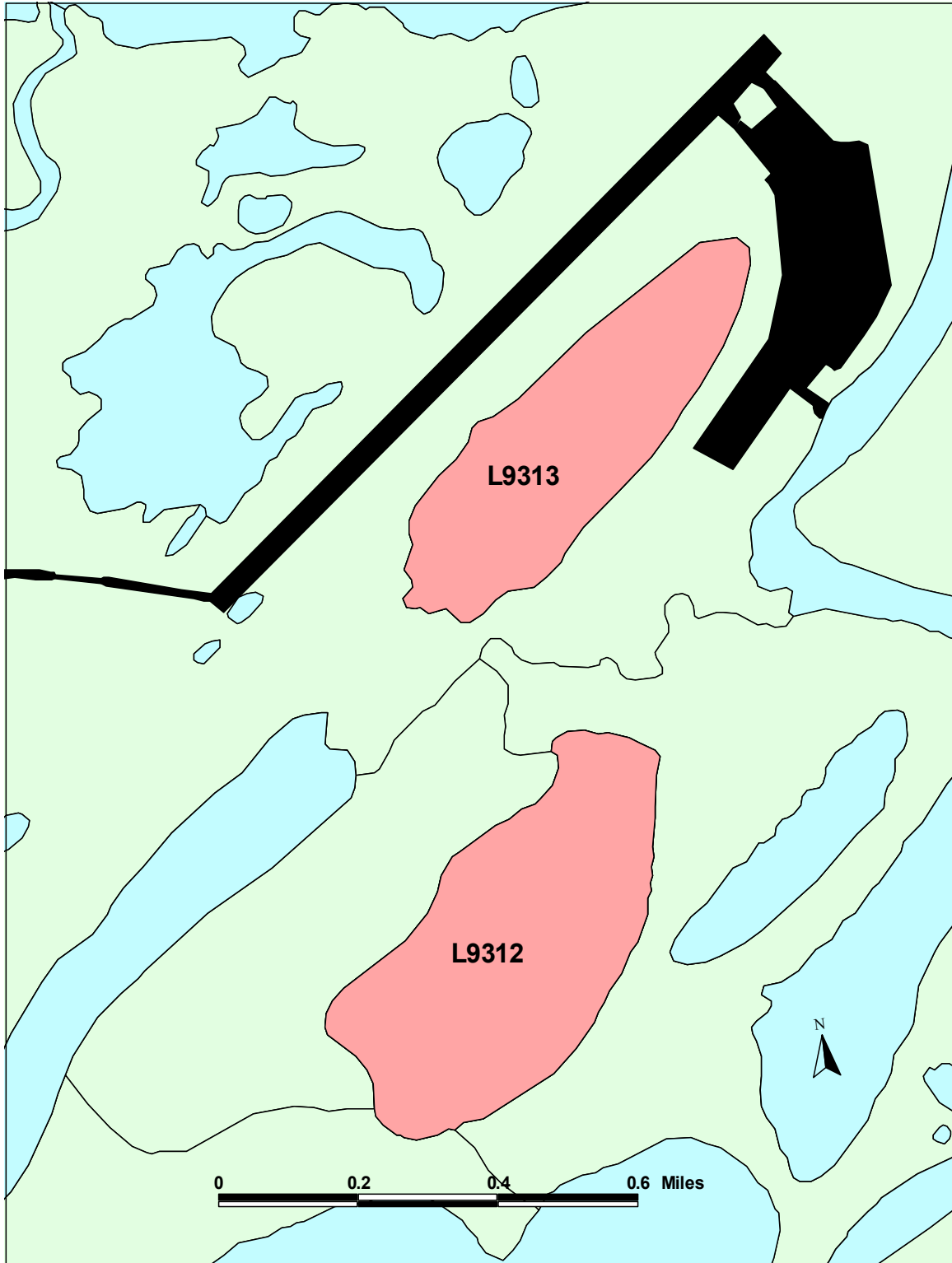


Figure 2. Lakes L9312 and L9313 used as permanent water sources for the Alpine Development.

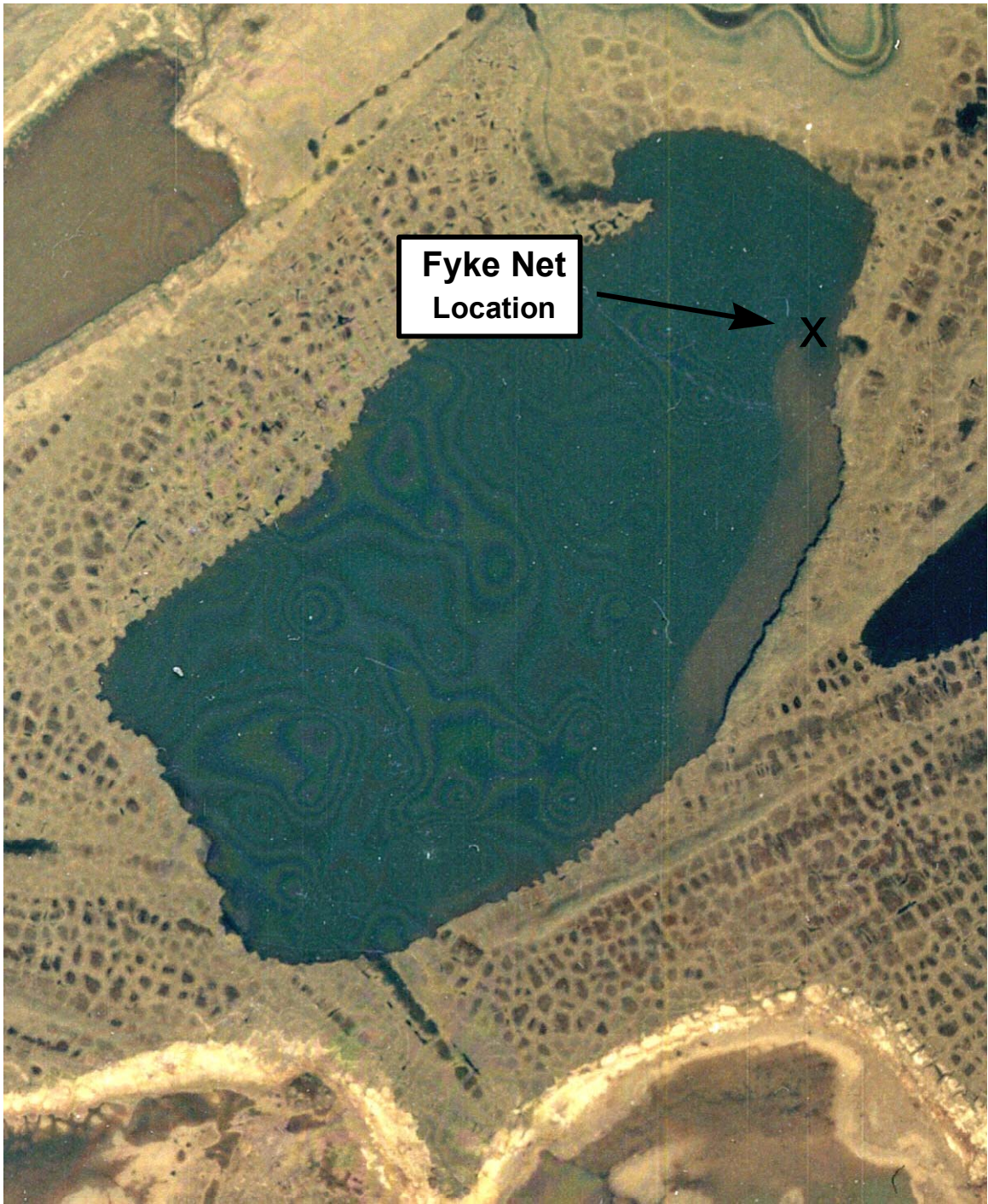


Figure 3. Fyke net station used for long-term monitoring in lake L9312.

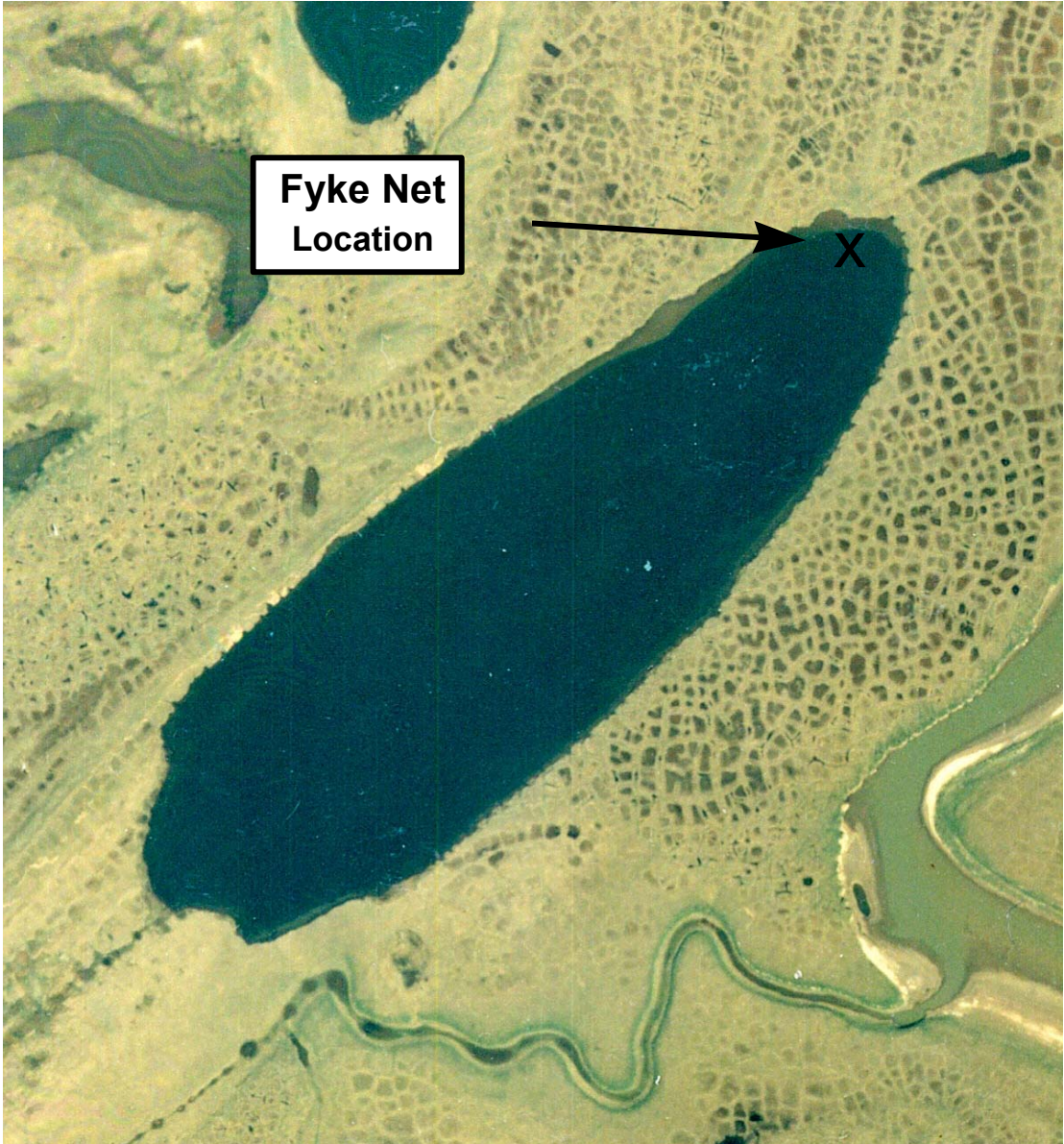
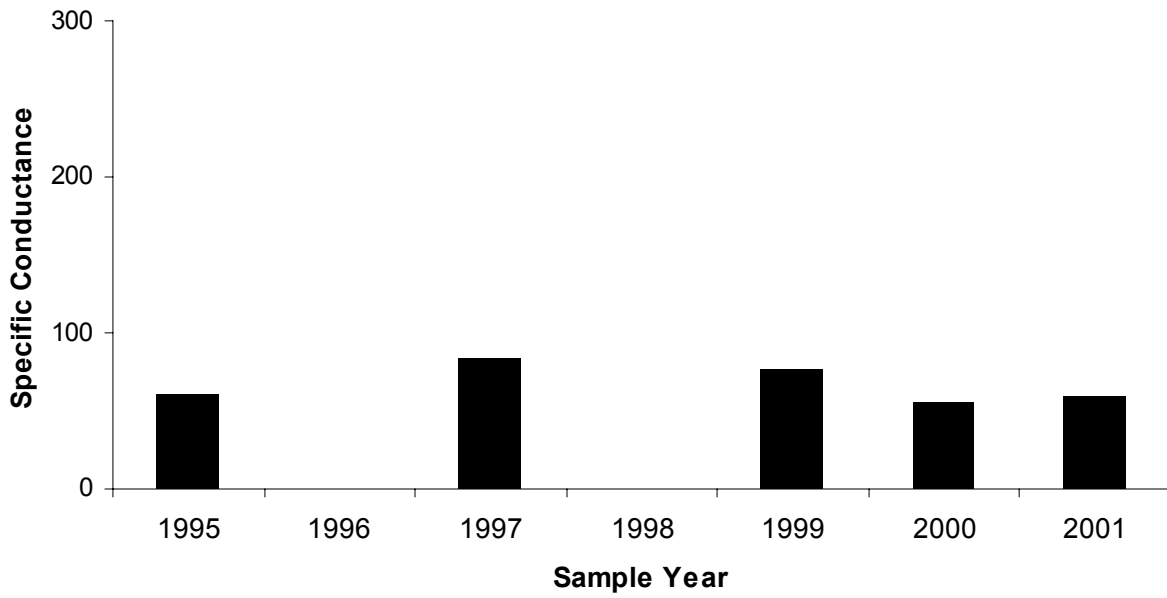


Figure 4. Fyke net station used for long-term monitoring in lake L9313.

L9312



L9313

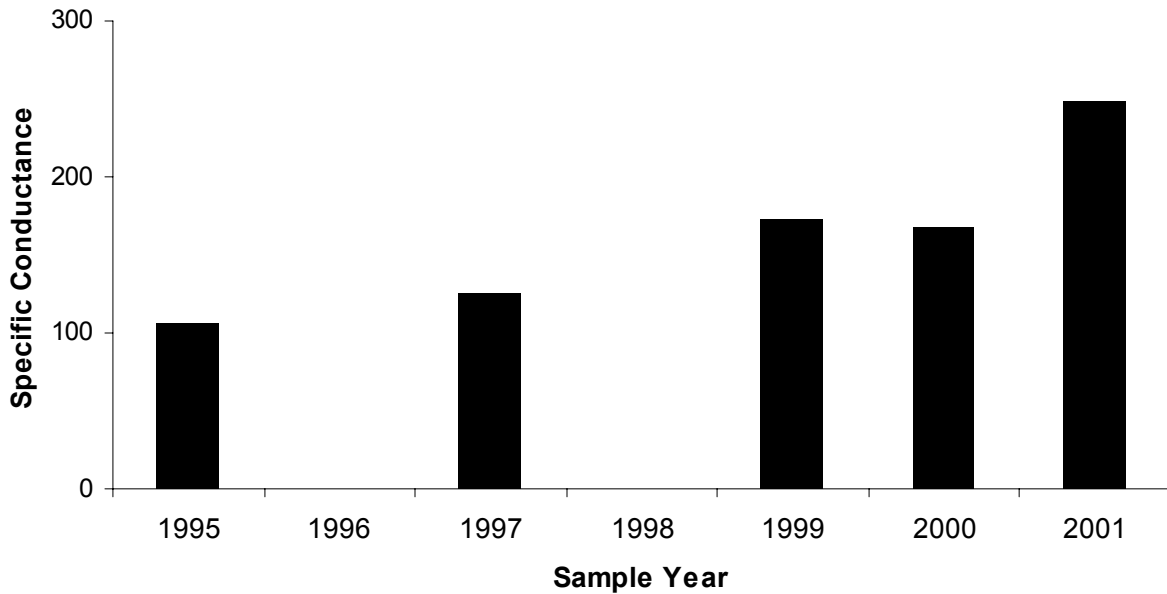


Figure 5. Specific conductance during July (in microS/cm) at two water source lakes in the Alpine Development Area, 1995-2001.

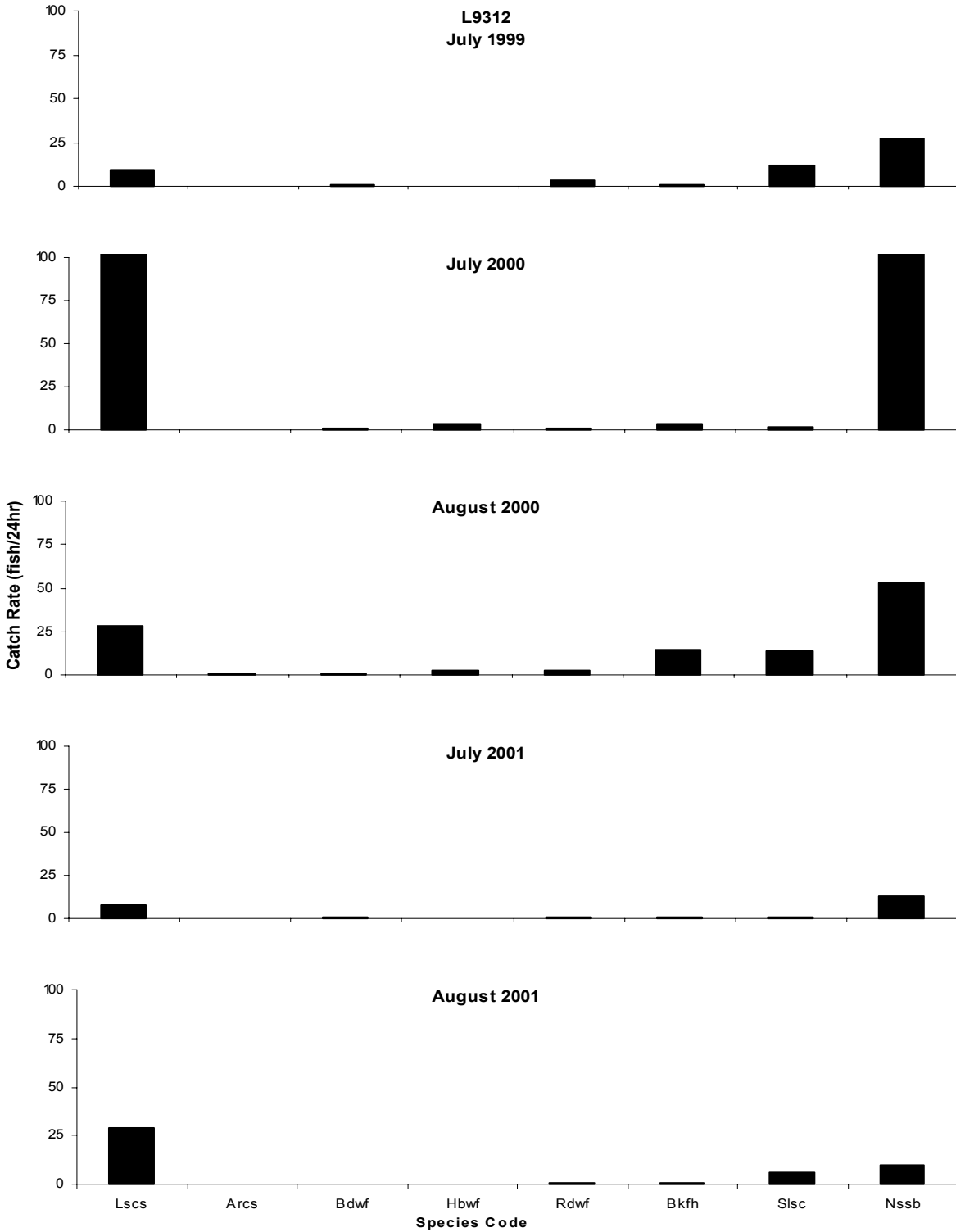


Figure 6. Abundance of fish by species in lake L9312 from 1999 to 2001 (based on fyke net catches expressed as fish per day, species represented by only 1 fish not included).

LSCS = least cisco
 ARCS = arctic cisco
 BDWF = broad whitefish

HBWF = humpback whitefish
 RDWF = round whitefish
 BKFH = Alaska blackfish

SLSC = slimy sculpin
 NSSB = ninespine stickleback

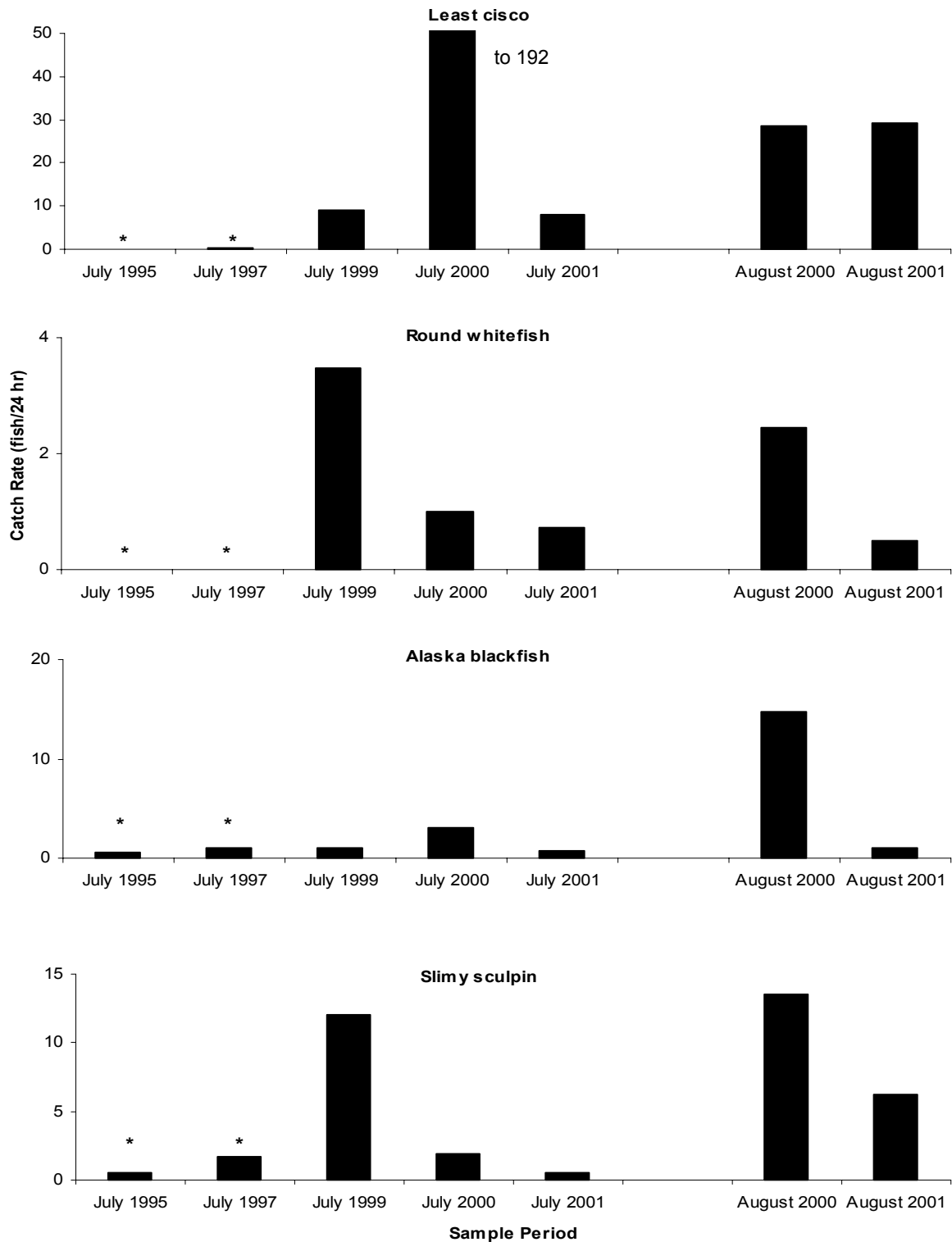


Figure 7. Mean catch rates of selected species in lake L9312, Alpine Development Area, 1995-2001 (* = nets fished in 1995 and 1997 were at different locations).

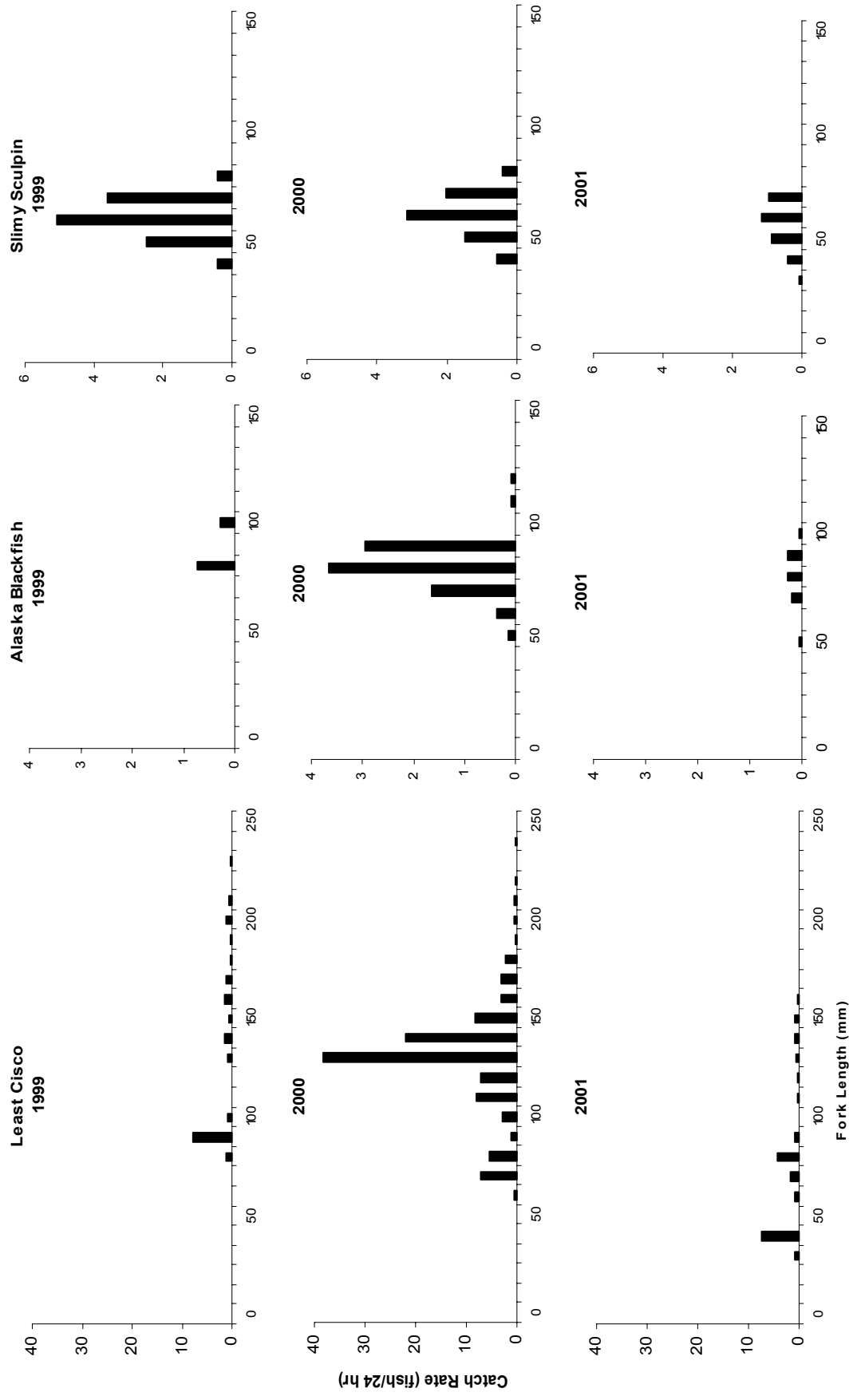


Figure 8. Length frequencies of least cisco, Alaska blackfish and slimy sculpin in lake L9312 during 1999-2001 sampling with fyke nets

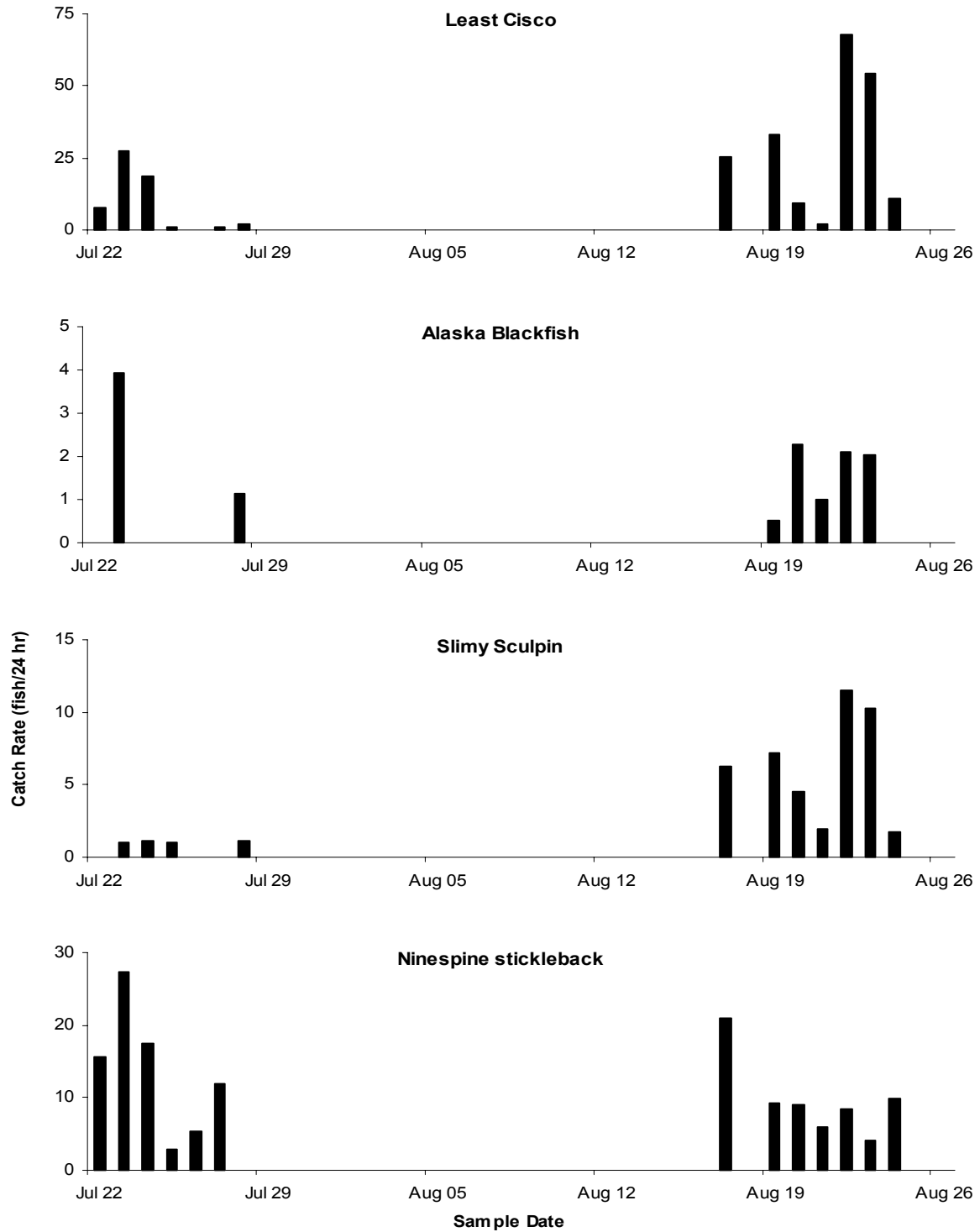


Figure 9 Daily pattern of catch for dominant species in lake L9312 during 2001 fyke net sampling (catches in fish per day).

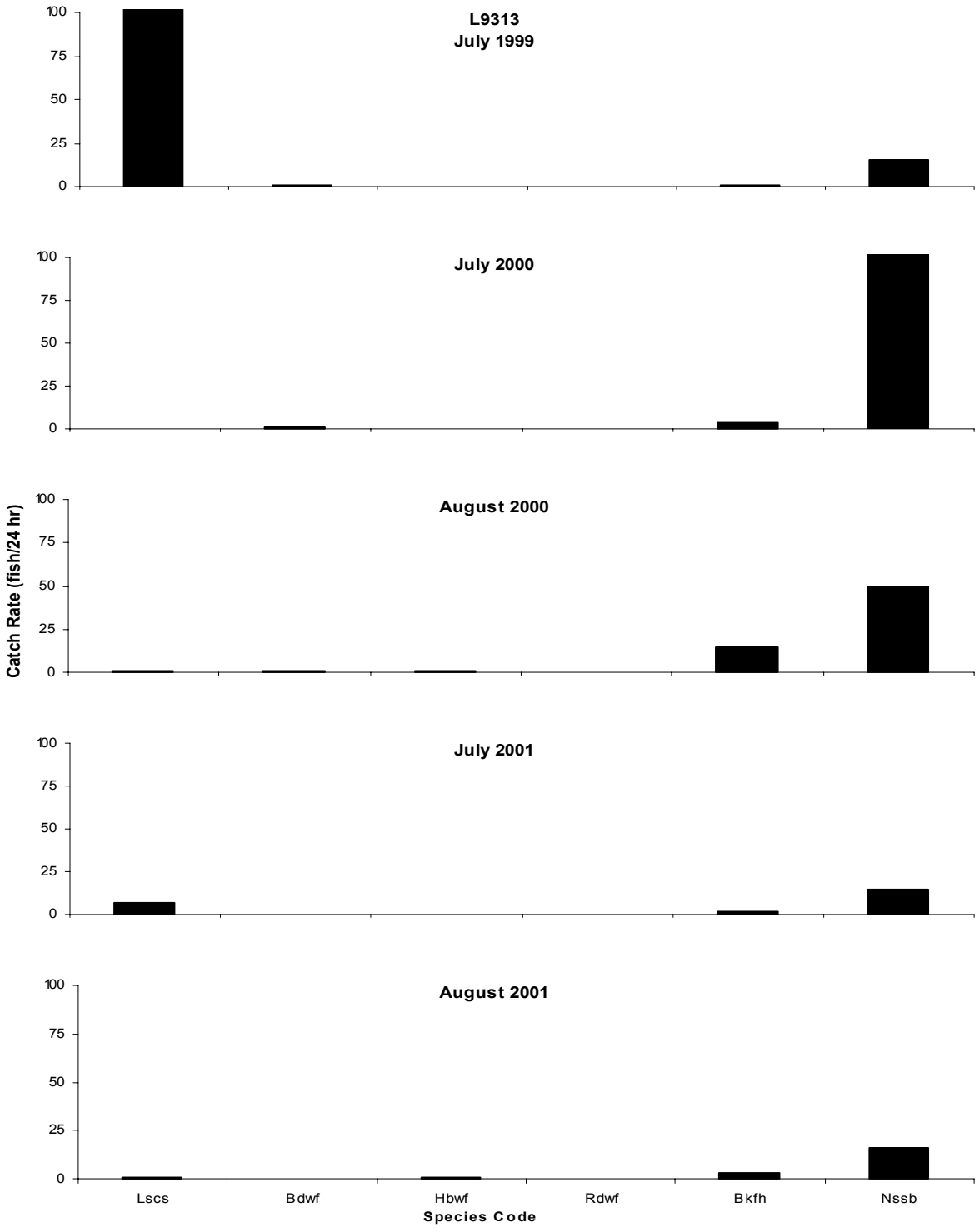


Figure 10. Abundance of fish by species in lake L9313 from 1999 to 2001 (based on fyke net catches expressed as fish per day, species represented by only 1 fish not included).

LSCS = least cisco
 ARCS = arctic cisco
 BDWF = broad whitefish

HBWF = humpback whitefish
 RDWF = round whitefish
 BKFH = Alaska blackfish

SLSC = slimy sculpin
 NSSB = ninespine stickleback

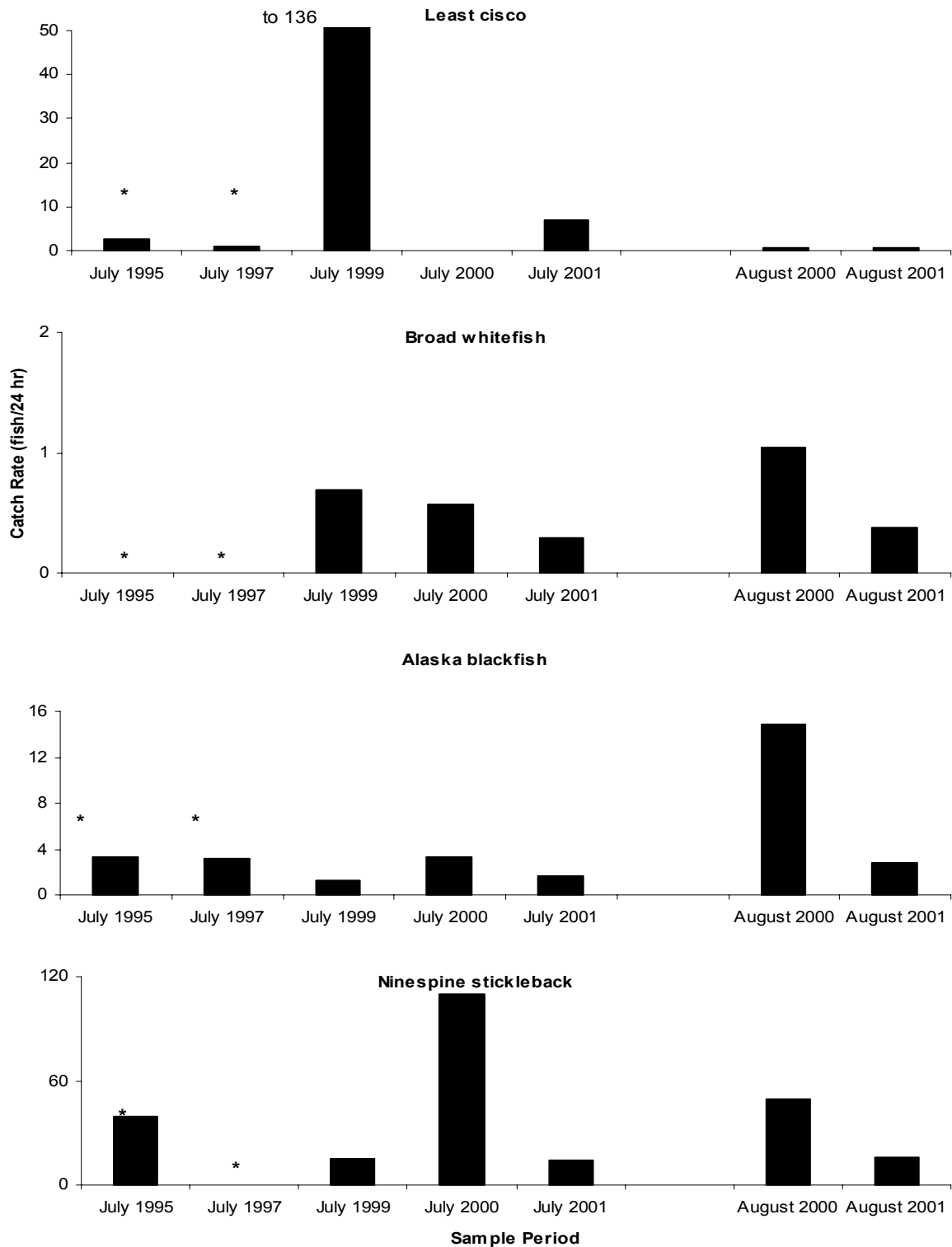


Figure 11. Mean catch rates of selected species in lake L9313, Alpine Development Area, 1995-2001 (* = nets fished in 1995 and 1997 were at different locations).

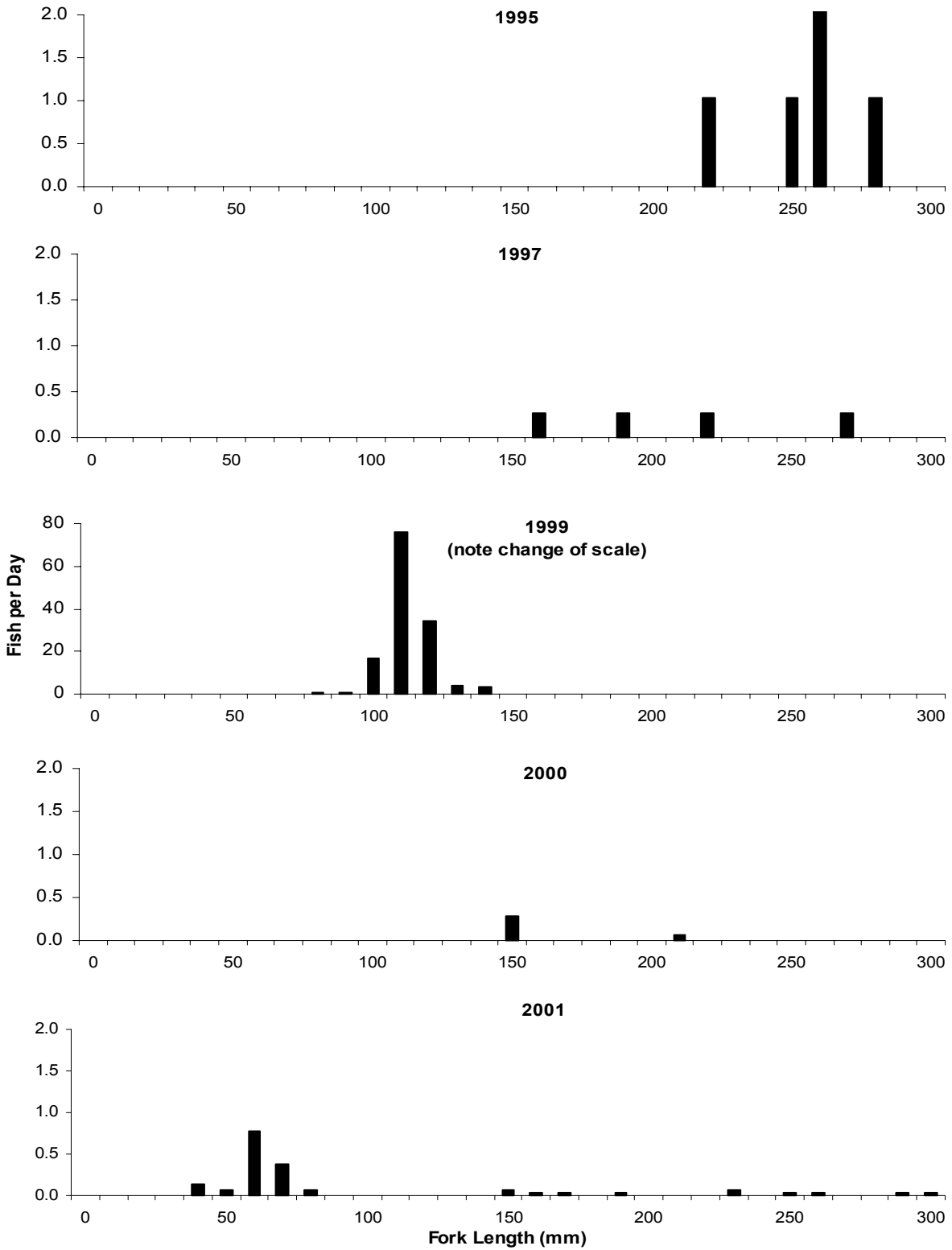


Figure 12. Length frequencies of least cisco in lake L9313 during 1995-2001 sampling with fyke nets.

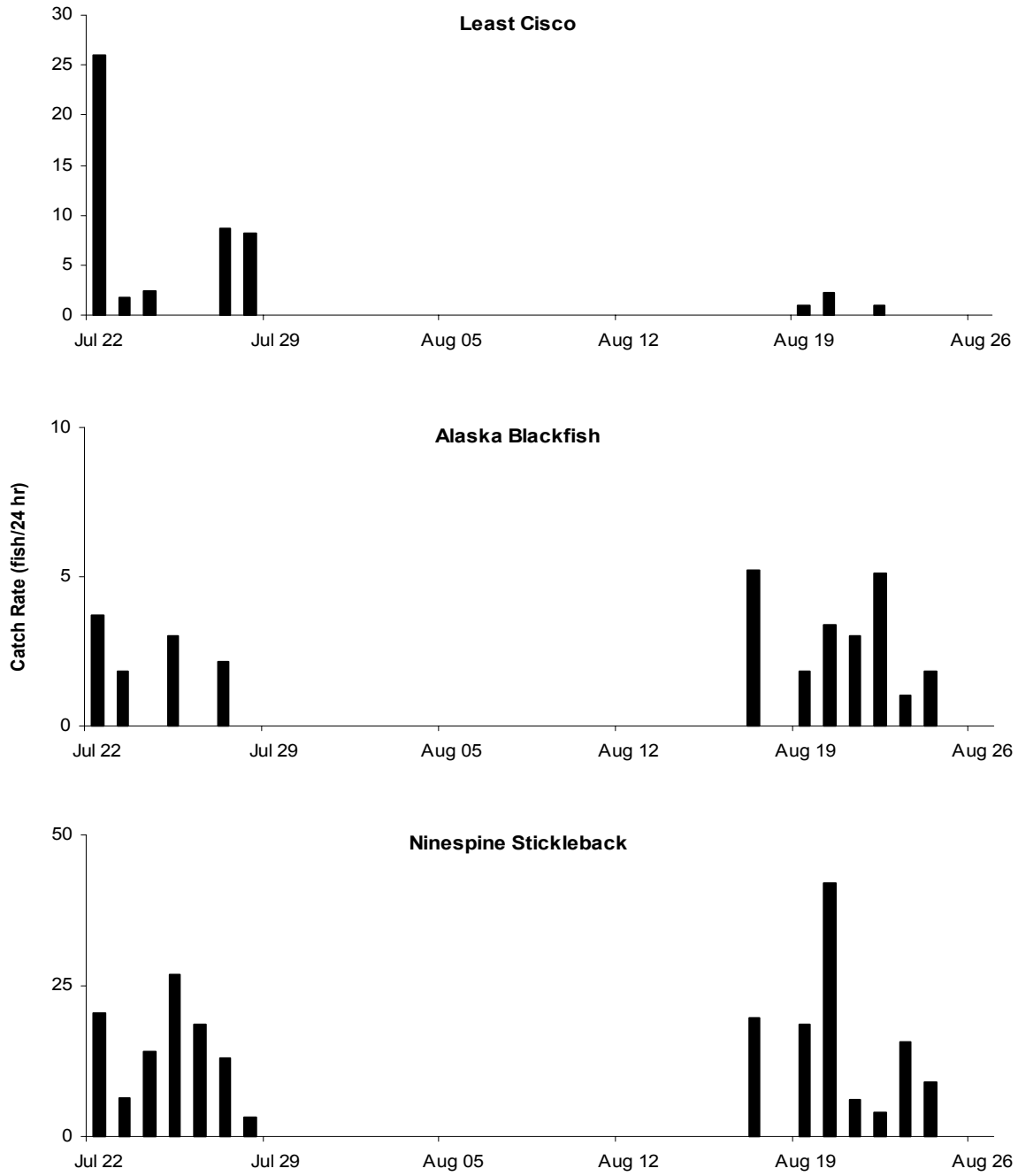


Figure 13. Daily pattern of catch for dominant species in lake L9313 during 2001 fyke net sampling (catches in fish per day).

APPENDIX A
Water Chemistry from lakes L9312 and L9313
1995 to 2001

Appendix Table A-1. Summary of water chemistry measurements for lake L9310, 1995 - 2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (ms/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
7/12/1995	surface		0.097	0.186			13.00			MJM Research
11/2/1995	surface		0.092	0.176			0.00	12.0	1.1	MJM Research
11/2/1995	1.6		0.092	0.176			0.10	12.0	1.1	MJM Research
11/2/1995	3.3		0.092	0.176			0.20	12.0	1.1	MJM Research
11/2/1995	4.9		0.093	0.178			0.50	12.0	1.1	MJM Research
11/2/1995	6.6		0.095	0.182			0.50	12.0	1.1	MJM Research
11/2/1995	8.2		0.095	0.182			0.80	12.0	1.1	MJM Research
11/2/1995	9.8		0.095	0.182			1.20	12.0	1.1	MJM Research
11/2/1995	11.5		0.105	0.201			1.90	12.0	1.1	MJM Research
7/9/1997	surface	7.85	0.087	0.126		11.86	8.70			MJM Research
7/11/1997	surface		0.084	0.127		11.60	7.40			MJM Research
7/13/1997	surface		0.087	0.128		9.70	8.10			MJM Research
7/14/1997	surface		0.086	0.127		11.30	8.00			MJM Research
7/15/1997	surface		0.091	0.128		11.80	10.00			MJM Research
8/3/1997	surface	8.06	0.102	0.129		10.46	14.20			MJM Research
2/8/2001	6.0	8.13	0.190	0.347	0	9.70	1.30	23.1	4.8	URS
2/8/2001	12.0	8.15	0.192	0.347	0	8.16	1.60	23.1	4.8	URS
2/8/2001	18.0	7.86	0.189	0.339	0	6.70	1.80	23.1	4.8	URS
2/21/2001	12.0	7.32	0.181	0.325	0	6.32	1.80	25.0*	5.1	URS
2/21/2001	16.0	7.26	0.167	0.299	1	6.03	1.90	25.0*	5.1	URS
2/21/2001	22.0	6.87	0.138	0.251	3	4.67	1.40	25.0*	5.1	URS
3/7/2001	6.5	7.19	0.197	0.353	0	7.87	1.90	24.3	5.3	URS
3/7/2001	12.0	7.03	0.196	0.346	0	6.14	2.30	24.3	5.3	URS
3/7/2001	18.0	6.72	0.198	0.350	0	5.81	2.30	24.3	5.3	URS
3/20/2001	7.0	7.17	0.210	0.367	0	7.35	2.60	24.9	5.7	URS
3/20/2001	15.5	7.00	0.209	0.364	0	7.83	2.70	24.9	5.7	URS
3/20/2001	23.5	6.77	0.211	0.362	0	7.51	3.20	24.9	5.7	URS
4/3/2001	12.0	7.21	0.218	0.377	0	8.97	2.90	22.7	6.0	URS
4/3/2001	18.0	7.10	0.218	0.376	0	8.15	3.00	22.7	6.0	URS
4/3/2001	22.0	6.71	0.218	0.375	0	8.69	3.10	22.7	6.0	URS
4/19/2001	16.0	6.97	0.218	0.359	0	10.32	4.40	25.2	6.2	URS
4/19/2001	18.0	6.75	0.217	0.349	0	9.27	5.20	25.2	6.2	URS
4/19/2001	22.0	6.52	0.215	0.341	0	10.42	5.70	25.2	6.2	URS
4/28/2001	10.0	7.71	0.225	0.373	0	10.08	4.20	23.6	6.1	URS
4/28/2001	14.0	7.74	0.226	0.375	0	8.72	4.20	23.6	6.1	URS
4/28/2001	18.0	7.80	0.227	0.378	0	8.87	4.10	23.6	6.1	URS
7/31/2001	surface	7.87	0.115	0.157	0.83	9.87	10.80			MJM Research
7/31/2001	3.3	7.84	0.106	0.145	1.2	9.69	10.80			MJM Research
7/31/2001	6.6	7.86	0.104	0.142	0.64	9.50	10.90			MJM Research
7/31/2001	10.8	7.86	0.104	0.142	1.1	9.44	10.90			MJM Research

* denotes soft lake bottom observed during field measurement

Appendix Table A-2. Summary of water chemistry measurements for lake L9312, 1995 to 2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
7/13/1995	surface		0.047	0.060			13.4			MJM Research
11/2/1995	surface		0.071	0.136			0.0	12.0	1.0	MJM Research
11/2/1995	1.6		0.072	0.138			0.0	12.0	1.0	MJM Research
11/2/1995	3.3		0.070	0.132			0.5	12.0	1.0	MJM Research
11/2/1995	4.9		0.070	0.132			0.5	12.0	1.0	MJM Research
11/2/1995	6.6		0.071	0.132			0.8	12.0	1.0	MJM Research
11/2/1995	8.2		0.071	0.131			1.1	12.0	1.0	MJM Research
11/2/1995	9.8		0.073	0.132			1.7	12.0	1.0	MJM Research
11/2/1995	11.5		0.075	0.135			1.8	12.0	1.0	MJM Research
7/9/1997	surface	7.85	0.056	0.083		11.88	8.1			MJM Research
7/10/1997	surface	7.66	0.056	0.084		11.60	7.7			MJM Research
7/13/1997	surface		0.057	0.084		10.50	8.2			MJM Research
7/14/1997	surface		0.056	0.083		11.20	7.8			MJM Research
7/15/1997	surface		0.059	0.084		12.40	9.5			MJM Research
8/3/1997	surface	8.20	0.066	0.085		10.58	13.4			MJM Research
7/28/1999	surface		0.053	0.076		11.36	8.9			MJM Research
7/29/1999	surface		0.055	0.080		11.49	8.6			MJM Research
7/30/1999	surface		0.053	0.076			8.8			MJM Research
7/31/1999	surface		0.054	0.076			9.5			MJM Research
8/1/1999	surface		0.057	0.076			11.4			MJM Research
8/2/1999	surface		0.062	0.079			13.5			MJM Research
8/3/1999	surface		0.058	0.076			12.0			MJM Research
7/23/2000	surface	7.85								MJM Research
7/24/2000	surface		0.041	0.055			12.1			MJM Research
7/25/2000	surface		0.040	0.055		10.91	10.5			MJM Research
7/26/2000	surface		0.039	0.055		10.89	10.2			MJM Research
7/27/2000	surface		0.039	0.055		10.76	10.0			MJM Research
7/28/2000	surface		0.039	0.055			10.0			MJM Research
7/29/2000	surface		0.040	0.055		10.90	11.2			MJM Research
8/16/2000	surface		0.038	0.056			8.5			MJM Research
8/17/2000	surface		0.037	0.056			7.4			MJM Research
8/18/2000	surface		0.037	0.055			7.6			MJM Research
8/19/2000	surface		0.038	0.056			7.9			MJM Research
8/20/2000	surface		0.037	0.056			7.5			MJM Research
8/21/2000	surface		0.036	0.056			6.6			MJM Research
7/21/2000	surface		0.038	0.053	10.5	11.06	10.4			MJM Research
7/21/2000	4.9		0.038	0.053	7.6	11.16	10.0			MJM Research
7/21/2000	8.2		0.038	0.053	7.5	11.13	9.8			MJM Research
7/21/2000	11.5		0.038	0.053	8.6	11.08	9.6			MJM Research

Appendix A-2. Summary of water chemistry measurements for lake L9312, 1995 to 2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
8/15/2000	surface		0.035	0.055	4.0	11.61	6.2			MJM Research
8/15/2000	4.9		0.035	0.055	4.1	11.71	6.0			MJM Research
8/15/2000	8.2		0.035	0.055	3.9	11.92	5.9			MJM Research
8/15/2000	11.5		0.035	0.055	5.7	11.74	5.9			MJM Research
2/8/2001	6.0	8.47	0.097	0.180	0	10.86	0.9	14.9	4.8	URS
2/8/2001	12.0	7.95	0.153	0.269	0	1.46	2.4	14.9	4.8	URS
2/21/2001	6.0	7.25	0.088	0.161	0	12.46	1.2	14.2*	5.1	URS
2/21/2001	8.0	7.25	0.084	0.149	0	10.84	2.2	14.2*	5.1	URS
2/21/2001	12.0	6.52	0.068	0.118	0	2.96	2.9	14.2*	5.1	URS
3/7/2001	6.5	7.39	0.098	0.178	0	11.22	1.4	14.1	5.4	URS
3/7/2001	9.5	7.77	0.103	0.181	0	7.82	2.4	14.1	5.4	URS
3/7/2001	13.0	6.92	0.094	0.162	0	4.39	3.0	14.1	5.4	URS
3/20/2001	7.0	7.25	0.096	0.169	0	11.03	2.3	14.8	5.7	URS
3/20/2001	10.0	7.64	0.112	0.193	0	7.54	3.0	14.8	5.7	URS
3/20/2001	13.5	6.31	0.089	0.152	0	2.50	3.2	14.8	5.7	URS
4/3/2001	8.0	6.98	0.108	0.186	0	10.17	3.0	14.4	6.1	URS
4/3/2001	10.0	6.81	0.109	0.185	0	7.01	3.5	14.4	6.1	URS
4/3/2001	12.0	6.66	0.109	0.184	0	6.77	3.7	14.4	6.1	URS
4/18/2001	12.0	7.06	0.126	0.208	0	5.72	4.3	14.6	6.4	URS
4/18/2001	13.0	6.80	0.152	0.252	0	3.30	4.2	14.6	6.4	URS
4/18/2001	14.0	6.98	0.142	0.236	0	1.61	4.2	14.6	6.4	URS
4/28/2001	8.0	7.80	0.118	0.195	0	10.55	4.3	15.4	6.2	URS
4/28/2001	10.0	7.75	0.120	0.197	0	11.23	4.5	15.4	6.2	URS
4/28/2001	12.0	7.79	0.120	0.197	0	11.05	4.5	15.4	6.2	URS
7/28/2001	surface	7.78	0.046	0.059	1.1	8.56	13.3			MJM Research
7/28/2001	3.3	7.78	0.046	0.059	1.1	8.67	13.4			MJM Research
7/28/2001	6.6	7.73	0.046	0.059	1.2	8.51	13.4			MJM Research
7/28/2001	10.8	7.55	0.046	0.059	1.7	8.48	13.4			MJM Research
8/25/2001	surface	7.89	0.036	0.058	0.5	13.17	4.7			MJM Research
8/25/2001	3.3	7.90	0.036	0.058	0.7	13.15	4.7			MJM Research
8/25/2001	6.6	7.89	0.036	0.058	1	13.06	4.7			MJM Research
8/25/2001	10.8	7.90	0.036	0.058	0.5	13.03	4.7			MJM Research

* denotes soft lake bottom observed during field measurement

Appendix Table A-3. Summary of water chemistry measurements for lake L9313, 1995-2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
7/13/1995	surface		0.083	0.107			13.1			MJM Research
10/31/1995	surface		0.099	0.189			0.0	8.5	1.0	MJM Research
10/31/1995	1.6		0.099	0.189			0.1	8.5	1.0	MJM Research
10/31/1995	3.3		0.099	0.188			0.2	8.5	1.0	MJM Research
10/31/1995	4.9		0.099	0.187			0.4	8.5	1.0	MJM Research
10/31/1995	6.6		0.098	0.182			0.9	8.5	1.0	MJM Research
10/31/1995	8.2		0.092	0.170			1.0	8.5	1.0	MJM Research
7/9/1997	surface	7.71	0.083	0.123		11.18	7.9			MJM Research
7/10/1997	surface	7.73	0.085	0.127		11.60	7.7			MJM Research
7/11/1997	surface		0.086	0.125		11.60	8.6			MJM Research
7/13/1997	surface		0.087	0.128		11.10	8.1			MJM Research
7/14/1997	surface		0.085	0.127		11.00	7.7			MJM Research
7/15/1997	surface		0.089	0.127		12.20	9.4			MJM Research
7/28/1999	surface	7.82	0.119	0.172		12.34	8.8			MJM Research
7/29/1999	surface		0.121	0.178		11.61	8.3			MJM Research
7/30/1999	surface		0.117	0.170			8.6			MJM Research
7/31/1999	surface		0.120	0.171			9.4			MJM Research
8/1/1999	surface		0.126	0.171			11.4			MJM Research
8/2/1999	surface		0.135	0.177			12.5			MJM Research
8/3/1999	surface		0.131	0.171			12.7			MJM Research
7/28/1999	surface		0.053	0.076		11.36	8.9			MJM Research
7/23/2000	surface	7.98								MJM Research
7/25/2000	surface		0.123	0.167		10.86	11.2			MJM Research
7/26/2000	surface		0.121	0.167		11.15	10.6			MJM Research
7/27/2000	surface		0.122	0.169			10.3			MJM Research
7/28/2000	surface		0.120	0.167		11.08	10.3			MJM Research
7/29/2000	surface		0.122	0.169			10.6			MJM Research
8/16/2000	surface		0.118	0.172			8.5			MJM Research
8/17/2000	surface		0.113	0.170			7.5			MJM Research
8/18/2000	surface		0.117	0.175			7.6			MJM Research
8/19/2000	surface		0.118	0.175			8.0			MJM Research
8/20/2000	surface		0.118	0.177			7.5			MJM Research
8/21/2000	surface		0.115	0.175			6.9			MJM Research
7/18/2000	surface		0.119	0.162	3.6	10.55	11.2			MJM Research
7/18/2000	4.9		0.119	0.162	3.3	10.54	11.1			MJM Research
7/18/2000	8.2		0.118	0.163	3.3	10.76	10.8			MJM Research
7/18/2000	11.5		0.119	0.163	3.5	10.91	10.8			MJM Research
8/15/2000	surface		0.111	0.170	5.5	12.32	6.6			MJM Research
8/15/2000	4.9		0.109	0.171	5.7	12.36	5.9			MJM Research
8/15/2000	8.2		0.108	0.171	15.0	12.62	5.7			MJM Research
8/15/2000	11.5		0.108	0.171	7.5	12.52	5.7			MJM Research

Appendix Table A-3. Summary of water chemistry measurements for lake L9313, 1995-2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2001	6.0	7.93	0.264	0.491	0	7.80	0.8	9.5	4.6	URS
2/21/2001	6.0	6.39	0.320	0.561	0	5.68	2.5	9.4*	5.0	URS
2/21/2001	7.5	6.52	0.325	0.580	1	5.53	2.0	9.4*	5.0	URS
2/21/2001	8.0	6.59	0.327	0.579	3	5.28	2.2	9.4*	5.0	URS
3/7/2001	6.5	6.89	0.281	0.519	0	3.95	1.0	9.6	5.2	URS
3/7/2001	8.5	6.89	0.278	0.517	0	4.10	0.8	9.6	5.2	URS
3/20/2001	6.5	8.95	0.222	0.408	0	3.98	1.1	9.6	5.5	URS
3/20/2001	8.5	8.65	0.309	0.549	0	3.80	2.1	9.6	5.5	URS
4/3/2001	6.0	6.95	0.347	0.634	56	3.31	1.3	9.5	5.8	URS
4/3/2001	8.0	6.71	0.301	0.526	128	3.93	2.6	9.5	5.8	URS
4/18/2201	7.5	7.07	0.480	0.842	0	2.48	2.5	9.6	6.1	URS
4/18/2201	8.0	6.98	0.464	0.785	0	2.13	3.6	9.6	6.1	URS
4/18/2201	9.5	6.80	0.462	0.769	0	2.03	4.1	9.6	6.1	URS
4/28/2001	7.0	7.23	0.354	0.623	0	3.77	2.4	9.6	6.1	URS
4/28/2001	8.0	7.25	0.385	0.671	0	3.44	2.7	9.6	6.1	URS
7/25/2001	surface	7.96	0.193	0.249	1.7	9.15	13.2			MJM Research
7/25/2001	3.3	7.95	0.193	0.247	1.4	9.47	13.6			MJM Research
7/25/2001	6.6	7.98	0.194	0.247	1.3	9.54	13.6			MJM Research
7/25/2001	10.8	7.94	0.194	0.247	4.6	9.97	13.7			MJM Research
8/25/2001	surface	8.01	0.151	0.249	0.7	12.62	4.4			MJM Research
8/25/2001	3.3	8.02	0.151	0.249	0.7	12.55	4.4			MJM Research
8/25/2001	6.6	8.01	0.151	0.248	1	12.54	4.5			MJM Research
8/25/2001	10.8	8.01	0.151	0.248	2	12.42	4.5			MJM Research

* denotes soft lake bottom observed during field measurement

Appendix Table A-4. Summary of water chemistry measurements for lake B8534/L9282, 1995-2001

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
7/18/1995	surface		0.225	0.276			15.30			MJM Research
7/17/1998	surface		0.217	0.280		10.50	13.30			MJM Research
7/17/1998	surface		0.218	0.279		10.20	13.60			MJM Research
7/18/1998	surface		0.218	0.282		10.20	13.10			MJM Research
7/18/1998	surface		0.218	0.282		10.10	13.10			MJM Research
7/18/1998	surface		0.215	0.284		9.10	12.30			MJM Research
7/19/1998	surface		0.219	0.281		10.30	13.60			MJM Research
7/19/1998	surface		0.221	0.282		10.10	13.60			MJM Research
7/19/1998	surface		0.221	0.282		10.30	13.70			MJM Research
7/20/1998	surface		0.222	0.281		10.30	14.10			MJM Research
7/20/1998	surface		0.224	0.282		10.30	14.40			MJM Research
7/20/1998	surface		0.228	0.285		10.70	14.40			MJM Research
7/21/1998	surface		0.224	0.282		10.30	14.20			MJM Research
7/21/1998	surface		0.225	0.282		10.40	14.50			MJM Research
7/21/1998	surface		0.224	0.282		9.90	14.30			MJM Research
7/22/1998	surface		0.226	0.282		10.20	14.60			MJM Research
7/22/1998	surface		0.225	0.282		10.30	14.50			MJM Research
7/22/1998	surface		0.216	0.273		10.20	14.10			MJM Research
7/24/1998	surface		0.216	0.282		10.40	12.60			MJM Research
7/24/1998	surface		0.218	0.283		9.90	13.10			MJM Research
2/8/2001	6.0	8.38	0.421	0.777	0	11.41	1.00	23.6	4.9	URS
2/8/2001	12.0	8.33	0.403	0.726	0	10.22	1.70	23.6	4.9	URS
2/8/2001	18.0	8.24	0.393	0.696	0	9.87	2.20	23.6	4.9	URS
3/7/2001	6.5	7.53	0.414	0.754	0	8.16	1.40	24.6	5.4	URS
3/7/2001	12.0	7.35	0.406	0.722	0	8.31	2.10	24.6	5.4	URS
3/7/2001	18.0	7.05	0.404	0.706	10*	7.06	2.60	24.6	5.4	URS
4/3/2001	12.0	7.46	0.448	0.786	0	8.71	2.50	23.8	5.9	URS
4/3/2001	18.0	7.32	0.464	0.814	0	8.71	2.50	23.8	5.9	URS
4/3/2001	22.0	6.88	0.465	0.813	0	8.72	2.60	23.8	5.9	URS
4/28/2001	12.0	8.16	0.459	0.759	0	9.73	4.30	23.7	6.2	URS
4/28/2001	18.0	7.96	0.484	0.808	0	9.88	4.00	23.7	6.2	URS
4/28/2001	22.0	7.64	0.484	0.811	0	9.67	3.90	23.7	6.2	URS
8/5/2001	surface	8.17	0.192	0.286	2.8	10.69	7.80			MJM Research

Appendix Table A-5. Summary of water chemistry measurements for lake L9283, 1995-2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
7/18/1995	surface		0.197	0.234			16.80			MJM Research
2/8/2001	6.0	7.76	0.555	1.043	0	7.76	0.50	8.5	4.8	URS
3/7/2001	6.5	6.90	0.543	0.999	0	3.87	1.10	8.6	5.4	URS
3/7/2001	7.0	6.49	0.522	0.950	0	3.94	1.40	8.6	5.4	URS
4/3/2001	7.5	6.99	0.692	1.238	0	2.73	1.90	9.0	6.1	URS
4/28/2001	7.0	7.09	0.586	1.078	0	4.35	1.10	8.9	6.4	URS
4/28/2001	8.0	8.05	0.575	1.033	0	4.03	1.80	8.9	6.4	URS
8/5/2001	surface	8.1	0.17	0.333	1.700	11.1	7.10			MJM Research

Appendix Table A-6. Summary of water chemistry measurements for lake L9275, 2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2001	8.0	7.09	0.293	0.519	0	13.42	2.20	16.1	4.8	URS
2/8/2001	12.0	7.19	0.295	0.525	0	10.13	2.09	16.1	4.8	URS
3/7/2001	6.5	7.63	0.250	0.449	0	9.24	1.80	16.2	5.4	URS
3/7/2001	10.0	7.39	0.215	0.381	0	9.34	2.20	16.2	5.4	URS
3/7/2001	15.0	6.92	0.180	0.309	0	5.40	3.10	16.2	5.4	URS
4/3/2001	8.0	7.65	0.315	0.547	0	11.30	2.80	16.2	6.0	URS
4/3/2001	12.0	7.51	0.320	0.547	0	11.22	3.30	16.2	6.0	URS
4/3/2001	16.0	6.53	0.331	0.562	0	10.87	3.50	16.2	6.0	URS
4/28/2001	8.0	8.32	0.321	0.529	0	10.87	4.40	16.1	6.2	URS
4/28/2001	10.0	8.27	0.320	0.523	0	11.05	4.70	16.1	6.2	URS
4/28/2001	14.0	8.30	0.306	0.497	0	12.45	4.90	16.1	6.2	URS
8/5/2001	surface	8.1	0.1379	0.210	2.4	11.37	7.10			MJM Research

Appendix Table A-7. Summary of water chemistry measurements for lake L9342, 1995-2001.

Date	Sample Depth (ft)	pH	Cond (ms/cm)	Spec Cond (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Water Temp (oC)	Total Depth (ft)	Ice Thickness (ft)	Source
7/12/1995	surface		0.064	0.084			12.70			MJM Research
11/2/1995	surface		0.098	0.186	0.0		0.20	8.9	1.1	MJM Research
11/2/1995	surface		0.098	0.185	0.5		0.33	8.9	1.1	MJM Research
11/2/1995	3.3		0.098	0.184	1.0		0.50	8.9	1.1	MJM Research
11/2/1995	4.9		0.098	0.183	1.5		0.70	8.9	1.1	MJM Research
11/2/1995	6.6		0.099	0.183	2.0		1.00	8.9	1.1	MJM Research
11/2/1995	8.2		0.100	0.184	2.5		1.10	8.9	1.1	MJM Research
4/17/2000	8.2		0.177	0.315		5.51	2.10	11.5	6.5	MJM Research
4/18/2000	8.2		0.189	0.339		4.78	1.80	9.0	6.5	MJM Research
4/18/2000	6.6		0.184	0.342		5.31	0.80	6.8	6.5	MJM Research
4/18/2000	6.0		0.175	0.325		5.45	0.80	6.2	6.0	MJM Research
4/18/2000	6.6		0.182	0.338		5.80	0.80	6.7	6.5	MJM Research
4/19/2000	8.2		0.193	0.340		4.72	2.40	9.1	6.5	MJM Research
4/19/2000	8.2		0.193	0.335		4.83	2.80	11.3	6.5	MJM Research
4/19/2000	8.2		0.190	0.337		5.17	2.20	10.0	6.5	MJM Research
4/19/2000	6.6		0.189	0.357		5.02	0.40	7.5	6.5	MJM Research
4/19/2000	5.7		0.156	0.297		5.55	0.10	6.0	5.8	MJM Research
2/8/2001	5.0	8.33	0.192	0.348	0.0	8.30	1.50	12.8	4.8	URS
2/8/2001	11.0	8.03	0.206	0.355	1.0	5.15	3.00	12.8	4.8	URS
3/7/2001	6.5	6.95	0.200	0.359	0.0	7.85	1.80	12.7	5.3	URS
3/7/2001	11.0	6.97	0.193	0.335	0.0	7.98	2.80	12.7	5.3	URS
4/3/2001	8.0	7.09	0.166	0.292	0.0	8.94	2.40	13.3	6.0	URS
4/3/2001	12.0	6.88	0.134	0.227	0.0	9.31	3.50	13.3	6.0	URS
4/28/2001	8.0	7.35	0.260	0.448	0.0	6.49	3.00	13.2	6.2	URS
4/28/2001	12.0	7.45	0.252	0.417	0.0	5.96	4.30	13.2	6.2	URS
7/31/2001	surface	7.70	0.089	0.123	1.1	9.94	10.70			MJM Research
7/31/2001	3.3	7.70	0.085	0.117	1.8	10.13	10.60			MJM Research
7/31/2001	6.6	7.68	0.083	0.115	0.8	10.19	10.60			MJM Research
7/31/2001	10.8	7.70	0.083	0.114	0.8	9.69	10.60			MJM Research

Appendix Table A-8. Historical measurements of ion concentrations at lakes in the Alpine region.

Lake	Year of Test	Chloride (mg/l)	Sodium (mg/l)	Magnesium (mg/l)	Calcium (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
L9275	1985					103		Bendock & Burr 1986
L9275	1992	13	6.2	9.8	22	95	140	J. Lobdell
L9283	1992	2.8	1.8	3.2	29	86	110	J. Lobdell
L9282	1985					103		Bendock & Burr 1986
L9282	1992	43	1.5	10.6	19	91	240	J. Lobdell
L9342	1993	14	5.3	3.2	7.4	32	87	J. Lobdell
L9310	1993	10	4.8	3.7	11	43	130	J. Lobdell
L9312	1993	8	4.5	2.1	7.2	27	150	J. Lobdell
L9313	1993	19	9.3	3.1	8	33	54	J. Lobdell

APPENDIX B
Catch Data from lakes L9312 and L9313
1995 to 2001

Appendix Table B-1. Results of fish sampling in lakes L9312 and L9313 prior to 1999.

Lake	Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
L9312	Fyke Net	Jul 14, 1995	23.9	Alaska blackfish	1	
				Slimy sculpin	1	
				Ninespine stickleback	10	
		Jul 26, 1995	20.0	Broad whitefish	1	428
				Ninespine stickleback	2	
		Jul 11-15 1997	116.6	Least cisco	1	56
				Alaska blackfish	5	70
				Slimy sculpin	8	38-84
				Ninespine stickleback	57	
	Gill Net	Nov 2, 1995	21.7	Least cisco	62	116-303
Broad whitefish				5	334-470	
Minnow Trap	Jul 14, 1995	48.6	Slimy sculpin	2		
			Ninespine stickleback	1		
Set Line	Jul 14, 1995	23.5	None	0		
L9313	Fyke Net	Jul 14, 1995	23.3	Least cisco	5	229-283
				Alaska blackfish	6	42-90
				Ninespine stickleback	63	
		Jul 26, 1995	20.7	Ninespine stickleback	9	
		Jul 11-15 1997	91.2	Least cisco	4	167-276
				Alaska blackfish	12	79
				Slimy sculpin	1	
	Gill Net	Nov 1, 1995	20.6	None	0	
		Aug 8, 1996	9.1	None	0	
	Minnow Trap	Jul 15, 1995	43.2	Ninespine stickleback	9	
Set Line	Jul 15, 1995	21.6	None	0		
	Jul 16, 1995	24.3	None	0		

Appendix Table B-2. Catches of fish from Alpine Area Lakes fyke net sampling, 1999.

Species	Net A Jul 29	Net A Jul 30	Net A Jul 31	Net B Aug 1	Net B Aug 2	Net B Aug 3	Net B Aug 4	Net A Total	Net B Total
L9312									
Least cisco	0	2	0	40	9	5	6	2	60
Broad whitefish	0	0	0	0	0	1	4	0	5
Humpback whitefish	0	0	0	0	0	0	0	0	0
Round whitefish	11	1	0	4	3	2	3	12	12
Alaska blackfish	0	0	0	0	1	5	1	0	7
Slimy sculpin	0	2	2	32	28	6	13	4	79
Ninespine stickleback	3	4	13	28	46	53	37	20	164
Effort (hours):	20.3	24.2	24.0	25.3	26.1	19.3	26.3	68.4	97.0
L9313									
Least cisco	0	1	1	339	11	623	0	1	974
Broad whitefish	0	0	0	4	0	1	0	0	5
Humpback whitefish	0	0	0	1	0	1	0	0	2
Round whitefish	0	0	0	1	0	1	0	0	2
Alaska blackfish	0	1	3	1	1	0	3	1	8
Slimy sculpin	0	0	0	0	0	0	0	0	0
Ninespine stickleback	7	8	6	5	43	20	22	15	96
Effort (hours):	26.8	24.2	24.1	25.3	26.0	19.3	26.7	51.1	121.3

Appendix Table B-4. Catches of fish from Alpine Area Lakes fyke net sampling, 2001.

	July							August							Total		
	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul Total	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22		Aug 23	Aug 24
L9312																	
Broad whitefish	0	5	1	0	1	0	0	7	0	0	0	0	0	0	0	0	0
Humpback whitefish	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1
Arctic cisco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Least cisco	8	28	16	1	0	1	2	56	24	64	8	2	2	65	53	12	228
Round whitefish	1	1	0	1	1	0	1	5	1	1	2	0	0	0	0	0	4
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Longnose sucker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alaska blackfish	0	4	0	0	0	0	1	5	0	1	2	1	2	2	2	0	8
Fourhorn sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Slimy sculpin	0	1	1	1	0	0	1	4	6	14	4	2	2	11	10	2	49
Ninespine stickleback	16	28	15	3	6	12	9	89	20	18	8	8	6	8	4	11	75
Effort (hrs)	24.8	24.5	20.5	24.4	27.3	24.0	21.0	166.4	22.9	46.6	21.1	24.1	24.1	23.0	23.4	26.8	187.8
L9313																	
Broad whitefish	0	1	0	0	0	0	1	2	0	0	0	1	0	0	0	2	3
Humpback whitefish	0	0	0	0	0	1	0	1	0	1	1	0	0	0	2	0	4
Least cisco	28	2	2	0	0	8	8	48	0	2	2	0	0	1	0	0	5
Round whitefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alaska blackfish	4	2	0	3	0	2	0	11	4	4	3	3	3	5	1	2	22
Ninespine stickleback	22	7	12	27	17	12	3	100	15	41	37	6	6	4	15	10	128
Effort (hrs)	25.9	26.4	20.4	24.1	21.9	22.2	23.3	164.2	18.3	53.0	21.2	23.9	23.9	23.4	22.9	26.3	189.1

Appendix Table B-5. Tagged fish released in Alpine lakes L9312 and L9313 during 2001.

Lake	Release Date	Species	Release Length (mm)	Tag Code
L9312				
	7/23/2001	BDWF	400	MJM010250
	7/23/2001	BDWF	362	MJM010426
	7/23/2001	BDWF	320	MJM010427
	7/24/2001	BDWF	486	MJM010432
L9313				
	7/23/2001	LSCS	295	MJM010428
	7/24/2001	LSCS	262	MJM010433
	8/22/2001	LSCS	306	MJM011332
	8/20/2001	BDWF	270	MJM011338

APPENDIX C
Length Frequency Data from lakes L9312 and L9313
2001

Appendix Table C-1. Length frequencies of least cisco caught by fyke net in the Alpine study area, 2001.

Fork Length (mm)	L9312							Aug							
	Jul 22	Jul 23	Jul 24	Jul 25	Jul 27	Jul 28	Jul Total	Aug 17	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24	Aug Total
0							0								0
10							0								0
20							0	1							1
30							0	1				12	1		14
40				1			1					53	51	4	108
50							0								0
60	2	5	4				11								0
70	1	5	3				9	2	12	3				1	18
80							0	13	38	5	1			5	62
90							0	6	7						13
100							0								0
110							0		3					2	5
120		2	1				3								1
130		6					6		1				1		2
140		6	3			1	11								0
150	5	2	1		1		9	1	2		1				4
160			3				3								0
170							1								0
180		2					2								0
190							0								0
200							0								0
210							0								0
220							0								0
230							0								0
240							0								0
250							0								0
260							0								0
270							0								0
280							0								0
290							0								0
300							0								0
310							0								0
320							0								0
330							0								0
340							0								0
350							0								0
360							0								0
370							0								0
380							0								0
390							0								0
400							0								0
Total:	8	28	16	1	1	2	56	24	64	8	2	65	53	12	228

Table C-1. Length frequencies of least cisco caught by fyke net in the Alpine study area, 2001.

Fork Length (mm)	L9313						Aug			
	Jul 22	Jul 23	Jul 24	Jul 27	Jul 28	Jul Total	Aug 19	Aug 20	Aug 22	Aug Total
0						0				0
10						0				0
20						0				0
30						0				0
40						0	2	2		4
50	2					2				0
60	19			3	1	23				0
70	3	1		2	5	11				0
80					2	2				0
90						0				0
100						0				0
110						0				0
120						0				0
130						0				0
140						0				0
150					2	2				0
160					1	1				0
170			1			1				0
180						0				0
190	1					1				0
200						0				0
210						0				0
220						0				0
230	2					2				0
240						0				0
250	1					1				0
260			1			1				0
270						0				0
280						0				0
290			1			1				0
300						0			1	1
310						0				0
320						0				0
330						0				0
340						0				0
350						0				0
360						0				0
370						0				0
380						0				0
390						0				0
400						0				0
Total:	28	2	2	8	8	48	2	2	1	5

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in the Alpine study area, 2001.

Fork Length (mm)	L9312				L9313					
	Jul 23	Jul 24	Jul 26	Jul Total	Jul 23	Jul 28	Jul Total	Aug 20	Aug 24	Aug Total
50				0	1		1			0
60	1			1			0			0
70				0			0			0
80				0		1	1			0
90				0			0			0
100				0			0			0
110				0			0			0
120	1			1			0		1	1
130				0			0			0
140				0			0			0
150				0			0			0
160				0			0			0
170				0			0			0
180				0			0			0
190				0			0			0
200				0			0			0
210				0			0			0
220				0			0			0
230				0			0		1	1
240				0			0			0
250				0			0			0
260				0			0	1		1
270				0			0			0
280				0			0			0
290				0			0			0
300				0			0			0
310	1			1			0			0
320				0			0			0
330				0			0			0
340				0			0			0
350				0			0			0
360	1			1			0			0
370				0			0			0
380				0			0			0
390	1			1			0			0
400				0			0			0
410				0			0			0
420				0			0			0
430				0			0			0
440				0			0			0
450				0			0			0
460				0			0			0
470				0			0			0
480			1	1			0			0
490				0			0			0
500				0			0			0
510				0			0			0
520				0			0			0
530				0			0			0
540				0			0			0
550				0			0			0
560				0			0			0
570				0			0			0
580				0			0			0
590				0			0			0
600			1	1			0			0
610				0			0			0
Total:	5	1	1	7	1	1	2	1	2	3

Appedix Table C-3. Length frequencies of humpback whitefish caught by fyke net in the Alpine study area, 2001.

Fork Length (mm)	L9312			L9313				
	Jul 24	Aug 19	Total	Jul 27	Aug 19	Aug 20	Aug 23	Total
0			0					0
10			0					0
20			0					0
30			0					0
40			0					0
50			0					0
60			0	1				1
70			0			1		1
80			0					0
90	1		1				1	1
100			0					0
110			0					0
120			0		1		1	2
130		1	1					0
140			0					0
150			0					0
160			0					0
170			0					0
180			0					0
190			0					0
200			0					0
210			0					0
220			0					0
230			0					0
240			0					0
250			0					0
260			0					0
270			0					0
280			0					0
290			0					0
300			0					0
310			0					0
320			0					0
330			0					0
340			0					0
350			0					0
360			0					0
370			0					0
380			0					0
390			0					0
400			0					0
Total:	1	1	2	1	1	1	2	5

Appendix Table C-4. Length frequencies of round whitefish caught by fyke net in the Alpine study area, 2001.

Fork Length (mm)	L9312						Aug			
	Jul 22	Jul 23	Jul 25	Jul 26	Jul 28	Jul Total	Aug 17	Aug 19	Aug 20	Aug Total
0						0				0
10						0				0
20						0				0
30						0				0
40						0				0
50						0				0
60						0				0
70						0				0
80						0				0
90						0				0
100						0				0
110						0				0
120						0				0
130						0		1		1
140						0				0
150						0			1	1
160						0				0
170						0				0
180			1			1				1
190		1				1				1
200					1	1				1
210						0				0
220						0	1			1
230						0				0
240	1					1				1
250					1	1			1	1
260						0				0
270						0				0
280						0				0
290						0				0
300						0				0
310						0				0
320						0				0
330						0				0
340						0				0
350						0				0
360						0				0
370						0				0
380						0				0
390						0				0
400						0				0
Total:	1	1	1	1	1	5	1	1	2	9

Appendix Table C-5. Length frequencies of Alaska blackfish caught by fyke net in the Alpine study area, 2001.

Fork Length (mm)	L9312					L9313					Jul Total	Aug Total	Total										
	Jul 23	Jul 28	Jul Total	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug Total	Jul 22				Jul 23	Jul 25	Jul 27	Jul Total	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24
0			0		0			0						0									0
10			0		0			0						0									0
20			0		0			0						0									0
30			0		0			0						0									0
40			0		0			0						0									0
50			0		0			1						1									0
60			0		0			0						0									0
70		2	2		4		1	1						2									3
80		1	1	2		4		1						2									6
90		1	1	1		3		1						3									6
100			0		1			1						1									3
110			0		0			0						0									0
120			0		0			0						0									0
130			0		0			0						0									0
140			0		0			0						0									0
150			0		0			0						0									0
160			0		0			0						0									0
170			0		0			0						0									0
180			0		0			0						0									0
190			0		0			0						0									0
200			0		0			0						0									0
Total:	4	1	5	1	2	1	2	2	8	4	2	3	2	11	4	4	3	3	5	1	2	2	22

Appendix Table C-6. Length frequencies of slimy sculpin caught by fyke net in the Alpine study area, 2001.

Fork Length	L9312				Jul	Aug						Aug
	Jul 23	Jul 24	Jul 25	Jul 28	Total	Aug 17	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Total
0					0							0
10					0							0
20					0							0
30					0					1		1
40	1				1			2		2	1	5
50					0	2	4	1	1	3	2	13
60					0	3	6	1	1	3	3	17
70		1	1	1	3	1	4			2	4	11
80					0							0
90					0							0
100					0							0
110					0							0
120					0							0
130					0							0
140					0							0
150					0							0
160					0							0
170					0							0
180					0							0
190					0							0
200					0							0
Total:	1	1	1	1	4	6	14	4	2	11	10	47

APPENDIX D
Water Use Permits for lakes
L9312 and L9313

Appendix Table D-1. Permits issued by Alaska Dept of Fish and Game regarding water withdrawal from Alpine Development water-source lakes L9312 and L9313.

Lake	ADF&G Permit	Amendment Number	Date Issued	Authorized Withdrawal (million gals.)
L9312				
	FG97-III-0280		December 15, 1997	11.43
	FG99-III-0051		March 30, 1999	19.00
	FG99-III-0051	1	January 27, 2000	19.00
	FG99-III-0051	3	September 1, 2000	32.36
L9313				
	FG97-III-0190		December 13, 1997	7.80
	FG97-III-0190	1	March 30, 1999	13.40
	FG97-III-0190	3	September 1, 2000	10.34

FISH HABITAT PERMIT (FG99-III-0051)

ISSUED: March 30, 1999
EXPIRES: Upon Abandonment of Lake L93-12
as a Water Source

William M. Fowler, Senior Permit Coordinator
Alpine Development Project
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Fowler:

RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-12; Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-03OG; Colville River 18 (2-960874)

The Alaska Department of Fish and Game (ADF&G) originally authorized winter water removal from Lake L93-12 (U6.1) under Fish Habitat Permit FG97-III-0280. Stipulation #1 of FG97-III-0280 read as follows:

Summer water use is prohibited.

Note: Summer water use can be authorized with a permit amendment request from ARCO Alaska Inc. which includes the following information: access to and from the lake for equipment and transfer of water, location of pump/fuel, water removal rate and quantity, specifications for a screened intake to minimize fish entrainment/impingement, and monitoring of water surface elevations.

Lake L93-12 (U6.1) has now been designated as a permanent water source to support Alpine oilfield development. Information needed for summer water use was provided in your letter, with attachments, dated February 18, 1999.

Pursuant to AS 16.05.870(b), the Alaska Department of Fish and Game (ADF&G) is issuing a new permit (FG99-III-0051) for water withdrawal and placement of intake structures in Lake L93-12 (U6.1). ARCO Alaska Inc. requested authorization to remove up to 30 percent of the under-ice water volume from Lake L93-12 (U6.1). Based on revised calculations and additional data on water depth compiled by Dr. Larry Moulton (Alpine Development Area Lakes Contour Maps and Volume Estimates, December 1998) this would provide up to 19.0 million gallons (winter withdrawal) from Lake L93-12 (U6.1). The calculated drawdown in Lake L93-12 (U6.1) would be 8.4 inches if the 19.0 million gallons of water were removed.

ARCO Alaska Inc. included the final design drawings and specifications for the water intake structures for Lake L93-12 (U6.1). Lake L93-12 (U6.1) will have two intakes, each capable of supplying 100 percent of demand. Intake lines will be routed to a pile-supported valve house located on the lakeshore. The intake drum screen is sized to

limit screen face velocity to 0.1 foot/second through 0.04-inch (1 mm) wide screen slots. Each screen drum is sized to a maximum pumping rate of about 170 gallons per minute. The plans and specifications for the water intake system submitted with your letter of February 18, 1999, satisfy Stipulation #1 of Fish Habitat Permit FG97-III-0280 and are approved under the new permit (FG99-III-0051).

Construction plans for the placement of the intake structures and water lines in Lake L93-12 (U6.1) also were provided to the ADF&G in your February 18, 1999, letter. All construction will be carried out from ice pads or from the ice surface of the lake. The proposed design and construction plan does not require excavation of the shoreline for placement of the intake lines. The construction plan as submitted along with provisions for site rehabilitation, if needed, is approved.

Your proposed summer and winter water use from Lake L93-12 (U6.1) may have adverse effects on anadromous fish or their habitat, but should not obstruct the free passage of fish. In accordance with AS 16.05.870(d), project approval is hereby given subject to the following stipulations:

- (1) Winter water use from Lake L93-12 (U6.1) is limited to 15% of the total water volume below 7 feet (normal depth of ice cover).
- (2) Quantity of water taken from Lake L93-12 (U6.1) shall be monitored and gallons removed shall be reported quarterly to the Alaska Department of Natural Resources with a copy to the ADF&G.
- (3) ARCO Alaska Inc. shall monitor the water surface elevation of Lake L93-12 (U6.1). Water surface elevations shall be taken immediately after ice breakup and at least once a week for three weeks following breakup. Water surface elevations also shall be taken once each month until freezeup.
- (4) ARCO Alaska Inc. shall monitor water quality (dissolved oxygen, conductivity, turbidity) in Lake L93-12 (U6.1) in late winter and twice during the ice-free season. During the ice-free season, water quality samples shall be taken at 1 m intervals.
- (5) ARCO Alaska Inc. shall sample, with appropriate gear type, for fish presence in Lake L93-12 (U6.1) at least twice during the ice-free season.
- (6) ARCO Alaska Inc. shall submit, during the ice-free season, monthly reports containing data collected as required in Stipulations 3 through 5.

NOTE: The monitoring requirements identified in Stipulations 3 through 6 shall be followed for at least three years. Based on results of the first three years of data collection, the need for and frequency of monitoring will be assessed and the need for continuation will be determined.

The permittee is responsible for the actions of contractors, agents, or other persons who perform work to accomplish the approved plan. For any activity that significantly deviates from the approved plan, the permittee shall notify the ADF&G and obtain written approval in the form of a permit amendment before beginning the activity. Any action taken by the permittee, or an agent of the permittee, that increases the project's overall

scope or that negates, alters, or minimizes the intent or effectiveness of any stipulation contained in this permit will be deemed a significant deviation from the approved plan. The final determination as to the significance of any deviation and the need for a permit amendment is the responsibility of the ADF&G. Therefore, it is recommended that the ADF&G be consulted immediately when a deviation from the approved plan is being considered.

This letter constitutes a permit issued under the authority of AS 16.05.870. This permit must be available to the on site field supervisor during the permitted activity. Please be advised that this approval does not relieve you of the responsibility of securing other permits, state, federal or local.

Pursuant to 6 AAC 80.010(b), the conditions of this permit are consistent with the Standards of the Alaska Coastal Management Program and the North Slope Borough Coastal District Program.

In addition to the penalties provided by law, this permit may be terminated or revoked for failure to comply with its provisions or failure to comply with applicable statutes and regulations. The department reserves the right to require mitigation measures to correct disruption to fish and game created by the project and which were a direct result of the failure to comply with this permit or any applicable law.

The recipient of this permit (the permittee) shall indemnify, save harmless, and defend the department, its agents and its employees from any and all claims, actions or liabilities for injuries or damages sustained by any person or property arising directly or indirectly from permitted activities or the permittee's performance under this permit. However, this provision has no effect if, and only if, the sole proximate cause of the injury is the department's negligence.

This permit decision may be appealed in accordance with the provisions of AS 44.62.330--44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner

BY: Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

cc: Nancy Welch, ADNR, Fairbanks
Gene Pavia, DGC, Juneau
Phillip Martin, USFWS, Fairbanks
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Ted Rockwell, EPA, Anchorage
Steve Geddes, ARCO, Anchorage
Mayord Gorden Brown/Leonard Lampe, Village of Nuiqsut

Jim Haynes, ADNR, Anchorage
Brad Fristoe, ADEC, Fairbanks
Jon Dunham, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Bill Morris, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Bruce St. Pierre/Chris Brown, AAI, Kuparuk

Bill Fowler
(FG99-III-0051)

4

3/30/99

Joe Nukapigak/Laston Chinn, Kuukpik Corp.
Tom Mortensen, Nuiqsut Constructors, Anchorage

AGO/ago

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

TONY KNOWLES, GOVERNOR

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 459-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG99-III-0051)

AMENDMENT #1

ISSUED: January 27, 2000

EXPIRES: Upon Abandonment of Lake L93-12
as a Water Source

William M. Fowler, Senior Permit Coordinator
Alpine Development Project
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Fowler:

RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-12;
Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-03OG;
Colville River 18 (2-960874)

The Alaska Department of Fish and Game (ADF&G) has received and reviewed your request to increase the quantity of water removed from Lake L93-12 (U6.1) during winter. Your letter dated January 19, 2000, requested approval to allow for withdrawal of up to 30% of the under-ice water volume. In support of the request to remove up to 30% of the under-ice water volume, you provided data (water surface elevations, water surface and volume change during summer 1999, past water use, etc.) specific to the Lake L93-12 (U6.1). The intent of monitoring water surface elevations, water volumes removed, and recharge is to ensure that adequate water remains during winter to ensure the proper protection of fish resources. Data presented in the attachments to your January 19, 2000, letter constitutes our baseline data set for Lake L93-12 (U6.1). Fish Habitat Permit FG99-III-0051 is hereby amended to authorize removal of up to 30% on the under-ice volume of water. The exact amount of water to be removed will be adjusted annually based on the water use, recharge, and the water surface elevation in fall just prior to freezeup. All terms and conditions of the original permit remain in effect.

This permit decision may be appealed in accordance with the provisions of AS 44.62.330--44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner



BY: Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

cc: Nancy Welch, ADNR, Fairbanks
Glenn Gray, DGC, Juneau
Larry Bright, USFWS, Fairbanks
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Ted Rockwell, EPA, Anchorage
Steve Geddes, AAI, Anchorage
Riki Lebman, SPCO/DGC, Anchorage
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.
Mike Stahl, ARCO, Anchorage

Jim Haynes, ADNR, Anchorage
Gary Schultz, ADNR, Fairbanks
Gordon Brower, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Jack Winters, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Bruce St. Pierre/Leigh Gooding, AAI, Kuparuk
Kellie Westphal, ADNR, Anchorage
Stan Pavlas, ARCO, Anchorage

AGO/ago

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

TONY KNOWLES, GOVERNOR

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 459-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG99-III-0051)

AMENDMENT #2

ISSUED: April 7, 2000
EXPIRES: Upon Abandonment of Lake L93-12
as a Water Source

William M. Fowler, Senior Permit Coordinator
Alpine Development Project
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Fowler:

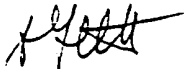
RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-12;
Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-03OG;
Colville River 18 (2-960874)

The Alaska Department of Fish and Game (ADF&G) has received and reviewed your remedial plan for water intake pipeline settlement at Lake L93-12. Affected sections of the water pipelines will be elevated and placed on VSMS. Concrete saddles will be removed and disturbed areas revegetated and stabilized as needed. Plans call for work to begin this winter with completion by the summer of 2001. A complete description of the project was contained in your letter, with attachments, dated April 7, 2000. Fish Habitat Permit FG99-III-0051 is hereby amended to cover remedial work to stabilize the water pipelines and tundra.

This permit decision may be appealed in accordance with the provisions of AS 44.62.330--44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner



BY: Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

Bill Fowler
(FG99-III-0051, Amendment #2)

4/7/00

cc: Nancy Welch, ADNR, Fairbanks
Riki Lebman, SPCO/DGC, Anchorage
Larry Bright, USFWS, Fairbanks
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Ted Rockwell, EPA, Anchorage
Mike Joyce, AAI, Anchorage
Steve Geddes, AAI, Anchorage
Mike Stahl, ARCO, Anchorage
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

Jim Haynes, ADNR, Anchorage
Gary Schultz, ADNR, Fairbanks
Gordon Brower, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Jack Winters, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Leigh Gooding/Sally Rothwell, AAI, Kuparuk
Bill Morris, ADF&G, Fairbanks
Bob Hale, AAI, Anchorage
Stan Pavlas, ARCO, Anchorage

AGO/ago

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

TONY KNOWLES, GOVERNOR

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 459-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG99-III-0051) AMENDMENT #3

ISSUED: September 1, 2000
EXPIRES: Upon Abandonment of Lake L93-12
as a Water Source

Mike Stahl, Senior Permit Coordinator
Alpine Development Project
Phillips Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Stahl:

RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-12;
Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-030G;
Colville River 18 (2-960874)

The Alaska Department of Fish and Game (ADF&G) has received your request to reset the water volume available for use effective 29 June 2000, and increase the permittable withdrawal volume of water in accordance with the lake-full water elevation achieved during break-up 2000. The ADF&G also received water surface elevation data obtained after break-up and lake water elevation stabilization had occurred. Phillips Alaska, Inc. has also provided updated volume calculations for Lake L93-12 (U6.1). Fish Habitat Permit FG99-III-0051 is hereby amended to reset the permittable water withdrawal volume effective 29 June 2000 and increase the withdrawal volume to 32.36 million gallons, with the following stipulations:

- 1) Annual permittable water volumes will be reset each year after break-up; a water-use year will be considered to extend from break-up to break-up regardless of elapsed time in days.
- 2) The permittable water withdrawal volume is increased in accordance with the new, lake-full, water surface elevation and volume to 32.36 million gallons.
 - a. This volume represents 30% of the under-ice water volume, assuming 7 feet of ice cover, at the recharged water surface elevation and volume.
 - b. At no point shall water withdrawal, evaporation, drainage, or any other event, or combination of events, exceed this volume of water unless a recharge event or events occur(s) during the open water season.

- c. Water surface elevation at the staff gage in Lake L93-12 should never fall below 7.0 feet, if this occurs water use must stop or the lake must be recharged.
- 3) Monitoring of fish, water, and water quality as described in the original permit stipulations 2 through 6 shall be continued for a minimum of 5 years to help assess potential impacts to anadromous fish and/or their habitat.
- 4) A method for lake recharge in the event natural flooding does not occur must be implemented in order to continue water withdrawal of 30% of the under-ice water volume.

All conditions and stipulations not specifically addressed in this permit amendment remain in effect.

This permit amendment may be appealed in accordance with the provisions of AS 44.62.330 – 44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner



BY: Alvin G. Ott
Habitat and Restoration Division
Alaska Department of Fish and Game

cc: Nancy Welch, ADNR, Fairbanks
Riki Lebman, SPCO/DGC, Anchorage
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Bill Morris, ADF&G, Fairbanks
Ted Rockwell, EPA, Anchorage
Gary Schultz/Leon Lynch, ADNR, Fairbanks
Thomas Manson/Shannon Donnelly, Phillips, Alpine
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

Steve Schmitz, ADNR, Anchorage
Larry Bright, USFWS, Fairbanks
Gordon Brower, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Jack Winters, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Pete McGee, ADEC, Fairbanks
Kellie Westphal, ADNR, Anchorage

AGO/wam

TONY KNOWLES, GOVERNOR

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 456-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG97-III-0190)

ISSUED: December 13, 1997
EXPIRES: Upon Abandonment of Lake L93-13
as a Water Source

Mark J. Schindler, Director
Colville Permits and Compliance
ARCO Alaska Inc.
P.O. Box 100360
Anchorage, AK 99510-1215

Dear Mr. Schindler:

RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-13;
Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-03OG;
Colville River 18 (2-960874)

Pursuant to AS 16.05.670(b), the Alaska Department of Fish and Game (ADF&G) has received and reviewed your proposal to develop the Alpine oilfield. Water sources for project startup, ice road construction and maintenance, development drilling, and operations were identified in the revised Environmental Evaluation Document dated September 1997 and the Michael Baker memorandum (Alpine Temporary Water Source Lakes) from Ms. Brooks dated October 15, 1997. About 42 to 65 million gallons will be used for ice road construction each year during Phase I and II, but only every three to five years during Phase III, and 10 million gallons will be used for the HDD crossing of the Colville River. Start-up development drilling will require 42,000 to 63,000 gallons per day. A pumphouse will be placed in Lake L93-13 and water moved via a pipeline to Alpine Pad 1.

Waters in the Colville River Delta supports both resident and anadromous fish species. Lake L93-13 is a perched lake with infrequent flooding that supports least cisco, ninespine stickleback, and Alaskan blackfish (Moulton 1997). Waters in the delta have been specified as being important for the migration, spawning, or rearing of anadromous fishes in accordance with AS 16.05.670(a). Lake L93-13 is located near Alpine Pad 1. Some inflow to Lake L93-13 was noted in June 1997 and the maximum depth found was 12.3 feet by Moulton (1997). Three cross sections for depth in Lake L93-13 were taken by Moulton (1997). Your proposed water use from this lake may have adverse effects on anadromous fish or their habitat, but should not obstruct the free passage of fish. In accordance with AS 16.05.670(d), project approval is hereby given subject to the following stipulations:

- (1) ARCO Alaska Inc. shall identify the total quantity of water needed from Lake L93-13 summer (June 15 to September 30) and winter (October 1 to June 15).

(Note: Since Lake L93-13 is the primary water source for development drilling and operations, the department will consider removal of water in excess of the winter criteria developed for waters in the Colville River delta. Based on Moulton's cross sections, we estimate total winter water available under the ice is about 7.8 million gallons using the 15% criteria.

- (2) ARCO Alaska Inc. shall provide to the department information on rate of water removal and provisions used to minimize the impingement or entrainment of fish. Design drawings for the pumphouse, water intake structure, screening, etc. shall be submitted to the department for review and approval.
- (3) ARCO Alaska Inc. shall report the quantity of water used from Lake L93-13 for the winter and summer time period to the Alaska Department of Natural Resources with a copy sent to the ADF&G.
- (4) Water surface elevation in Lake L93-13 shall be monitored to determine if drawdown over time occurs. Water surface elevations taken shall be submitted to the department. If natural recharge is not adequate to maintain an adequate water volume for industrial use and to ensure the proper protection of fish, then ARCO Alaska Inc. shall prepare and submit a plan for recharging Lake L93-13 to the department for review and approval.

The permittee is responsible for the actions of contractors, agents, or other persons who perform work to accomplish the approved plan. For any activity that significantly deviates from the approved plan, the permittee shall notify the ADF&G and obtain written approval in the form of a permit amendment before beginning the activity. Any action taken by the permittee, or an agent of the permittee, that increases the project's overall scope or that negates, alters, or minimizes the intent or effectiveness of any stipulation contained in this permit will be deemed a significant deviation from the approved plan. The final determination as to the significance of any deviation and the need for a permit amendment is the responsibility of the ADF&G. Therefore, it is recommended that the ADF&G be consulted immediately when a deviation from the approved plan is being considered.

This letter constitutes a permit issued under the authority of AS 16.05.670. This permit must be available to the on site field supervisor during the permitted activity. Please be advised that this approval does not relieve you of the responsibility of securing other permits, state, federal or local.

Pursuant to 6 AAC 80.010(b), the conditions of this permit are consistent with the Standards of the Alaska Coastal Management Program and the North Slope Borough Coastal District Program.

In addition to the penalties provided by law, this permit may be terminated or revoked for failure to comply with its provisions or failure to comply with applicable statutes and regulations. The department reserves the right to require mitigation measures to

Mark J. Schindler
(FG97-III-0190)

3

December 13, 1997

correct disruption to fish and game created by the project and which were a direct result of the failure to comply with this permit or any applicable law.

The recipient of this permit (the permittee) shall indemnify, save harmless, and defend the department, its agents and its employees from any and all claims, actions or liabilities for injuries or damages sustained by any person or property arising directly or indirectly from permitted activities or the permittee's performance under this permit. However, this provision has no effect if, and only if, the sole proximate cause of the injury is the department's negligence.

This permit decision may be appealed in accordance with the provisions of AS 44.62.330—44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner



BY: Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

Moulton, L.L. 1997. Lakes sampled for fish in and near the Colville River delta, Alaska 1979-1996. Prepared by MJM Research for ARCO Alaska, Inc. pp 2-365.

Moulton, L.L. 1997. Daily reports from 1997 summer field data collection distributed to ADF&G by e-mail.

cc: Nancy Welch, ADNR, Fairbanks
Glenn Gray, DGC, Juneau
Phillip Martin, USFWS, Fairbanks
Lloyd Fanter, ACOE, Anchorage
Terry Haynes, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Ted Rockwell, EPA, Anchorage
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Laston Chinn, Kuukpik Corp.

Jim Haynes, ADNR, Anchorage
Brad Fristoe, ADEC, Fairbanks
Jon Dunham, NSB, Barrow
Fred Andersen, ADF&G, Fairbanks
Carl Hemming, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Larry/Chris Brown, AAI, Kuparuk

AGO/agg

FISH HABITAT PERMIT (FG97-III-0190 - AMENDMENT #1)

ISSUED: March 30, 1999
EXPIRES: Upon Abandonment of Lake L93-13
as a Water Source

William M. Fowler, Senior Permit Coordinator
Alpine Development Project
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Fowler:

RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-13;
Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-03OG;
Colville River 18 (2-960874)

Pursuant to AS 16.05.870(b), the Alaska Department of Fish and Game (ADF&G) has received and reviewed your request to amend Fish Habitat Permit FG97-III-0190 (letter dated February 18, 1999, with attachments). ARCO Alaska Inc. requests authorization to remove up to 30 percent of the under-ice water volume from Lake L93-13 (T6.1). Based on revised calculations and additional data on water depth compiled by Dr. Larry Moulton (Alpine Development Area Lakes Contour Maps and Volume Estimates, December 1998) this would provide up to 13.4 million gallons (winter withdrawal) from Lake L93-13 (T6.1). The calculated drawdown in Lake L93-13 (T6.1) would be 7.2 inches if the 13.4 million gallons of water were removed.

ARCO Alaska Inc. included the final design drawings and specifications for the water intake structures for Lake L93-13 (T6.1). Lake L93-13 (T6.1) will have two intakes, each capable of supplying 100 percent of demand. Intake lines will be routed to a pile-supported valve house located on the lakeshore. The intake drum screen is sized to limit screen face velocity to 0.1 foot/second through 0.04-inch (1 mm) wide screen slots. Each screen drum is sized to a maximum pumping rate of about 170 gallons per minute. The plans and specifications for the water intake system submitted with your letter of February 18, 1999, satisfy Stipulation #2 of Fish Habitat Permit FG97-III-0190 and are approved.

Construction plans for the placement of the intake structures and water lines in Lake L93-13 (T6.1) also were provided to the ADF&G in your February 18, 1999, letter. All construction will be carried out from ice pads or from the ice surface of the lake. The proposed design and construction plan does not require excavation of the shoreline for placement of the intake lines. The construction plan as submitted along with provisions for site rehabilitation, if needed, is approved.

The original permit (FG97-III-0190) issued on December 13, 1997, stated that the ADF&G would consider a winter water removal in excess of 15 percent. Based on supplement information submitted by ARCO Alaska Inc. (February 18, 1999, letter with attachments) and the commitment to develop a plan for recharge of Lake L93-13 (T6.1), the department hereby amends Fish Habitat Permit FG97-III-0190 to authorize removal of up to 30 percent of the under-ice water, subject to the following additional terms and conditions:

- (1) ARCO Alaska Inc. shall monitor the water surface elevation of Lake L93-13 (T6.1). Water surface elevations shall be taken immediately after ice breakup and at least once a week for three weeks following breakup. Water surface elevations also shall be taken once each month until freezeup.
- (2) ARCO Alaska Inc. shall monitor water quality (dissolved oxygen, conductivity, turbidity) in Lake L93-13 (T6.1) in late winter and twice during the ice-free season. During the ice-free season, water quality samples shall be taken at 1 m intervals.
- (3) ARCO Alaska Inc. shall sample, with appropriate gear type, for fish presence in Lake L93-13 (T6.1) at least twice during the ice-free season.
- (4) ARCO Alaska Inc. shall submit, during the ice-free season, monthly reports containing data collected as required in Stipulations 1 through 3.

NOTE: The monitoring requirements identified in Stipulations 1 through 4 shall be followed for at least three years. Based on results of the first three years of data collection, the need for and frequency of monitoring will be assessed and the need for continuation will be determined.

All terms and conditions of the original permit remain in effect.

Sincerely,

Robert G. Bosworth, Deputy Commissioner

BY: Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

cc: Nancy Welch, ADNR, Fairbanks
Gene Pavia, DGC, Juneau
Phillip Martin, USFWS, Fairbanks
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Ted Rockwell, EPA, Anchorage
Steve Geddes, ARCO, Anchorage
Mayor Gorden Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Laston Chinn, Kuukpik Corp.
Tom Mortensen, Nuiqsut Constructors, Anchorage
Jim Haynes, ADNR, Anchorage
Brad Fristoe, ADEC, Fairbanks
Jon Dunham, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Bill Morris, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Bruce St. Pierre/Chris Brown, AAI, Kuparuk

Bill Fowler
(FG97-III-0190, Amendment #1)

3

3/30/99

AGO/ago

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

TONY KNOWLES, GOVERNOR

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 459-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG97-III-0190 - AMENDMENT #2)

ISSUED: April 7, 2000
EXPIRES: Upon Abandonment of Lake L93-13
as a Water Source

William M. Fowler, Senior Permit Coordinator
Alpine Development Project
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Fowler:

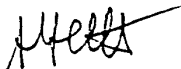
RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-13;
Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-03OG;
Colville River 18 (2-960874)

The Alaska Department of Fish and Game (ADF&G) has received and reviewed your remedial plan for water intake pipeline settlement at Lake L93-13. Affected sections of the water pipelines will be elevated and placed on VSMs. Concrete saddles will be removed and disturbed areas revegetated and stabilized as needed. Plans call for work to begin this winter with completion by the summer of 2001. A complete description of the project was contained in your letter, with attachments, dated April 7, 2000. Fish Habitat Permit FG97-III-0190 is hereby amended to cover remedial work to stabilize the water pipelines and tundra.

This permit decision may be appealed in accordance with the provisions of AS 44.62.330--44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner



BY: Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

Bill Fowler
(FG97-III-0190, Amendment #2)

2

4/7/00

cc: Nancy Welch, ADNR, Fairbanks
Riki Lebman, SPCO/DGC, Anchorage
Larry Bright, USFWS, Fairbanks
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Ted Rockwell, EPA, Anchorage
Mike Joyce, AAI, Anchorage
Steve Geddes, AAI, Anchorage
Mike Stahl, ARCO, Anchorage
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

Jim Haynes, ADNR, Anchorage
Gary Schultz, ADNR, Fairbanks
Gordon Brower, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Jack Winters, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Leigh Gooding/Sally Rothwell, AAI, Kuparuk
Bill Morris, ADF&G, Fairbanks
Bob Hale, AAI, Anchorage
Stan Pavlas, ARCO, Anchorage

AGO/ago

STATE OF ALASKA

TONY KNOWLES, GOVERNOR

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 459-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG97-III-0190) AMENDMENT #3

ISSUED: September 1, 2000
EXPIRES: Upon Abandonment of Lake L93-13
as a Water Source

Mike Stahl, Senior Permit Coordinator
Alpine Development Project
Phillips Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Stahl:

RE: Water Withdrawal/Intake Structure and Winter Ice Road Access; Lake L93-13;
Colville River Delta (Stream No. 330-00-10700-0910); SIDAK9703-030G;
Colville River 18 (2-960874)

The Alaska Department of Fish and Game (ADF&G) has received your request to reset the water volume available for use effective 29 June 2000, and increase the permittable withdrawal volume of water in accordance with the lake-full water elevation achieved during break-up 2000. The ADF&G also received water surface elevation data obtained after break-up and lake water elevation stabilization had occurred. Phillips Alaska, Inc. has also provided updated volume calculations for Lake L93-13 (T6.1). Fish Habitat Permit FG97-III-0190 is hereby amended to reset the permittable water withdrawal volume effective 29 June 2000 and increase the withdrawal volume to 10.34 million gallons, with the following stipulations:

- 1) Annual permittable water volumes will be reset each year after break-up; a water-use year will be considered to extend from break-up to break-up regardless of elapsed time in days.
- 2) The permittable water withdrawal volume is increased in accordance with the new, lake-full, water surface elevation and volume to 10.34 million gallons.
 - a. This volume represents 30% of the under-ice water volume, assuming 7 feet of ice cover, at the recharged water surface elevation and volume.
 - b. At no point shall water withdrawal, evaporation, drainage, or any other event, or combination of events, exceed this volume of water unless a recharge event or events occur(s) during the open water season.
 - c. Water surface elevation at the staff gage in Lake L93-13 should never fall below 5.8 feet, if this occurs water use must stop or the lake must be recharged.

- 3) Monitoring of fish, water, and water quality as described in the original permit and amendment #1 stipulations 1 through 4 shall be continued for a minimum of 5 years to help assess potential impacts to anadromous fish and/or their habitat.
- 4) A method for lake recharge in the event natural flooding does not occur must be implemented in order to continue water withdrawal of 30% of the under-ice water volume.

All conditions and stipulations not specifically addressed in this permit amendment remain in effect.

This permit amendment may be appealed in accordance with the provisions of AS 44.62.330 – 44.62.630.

Sincerely,

Robert G. Bosworth, Deputy Commissioner



BY: Alvin G. Ott
Habitat and Restoration Division
Alaska Department of Fish and Game

cc: Nancy Welch, ADNR, Fairbanks
Riki Lebman, SPCO/DGC, Anchorage
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Bill Morris, ADF&G, Fairbanks
Ted Rockwell, EPA, Anchorage
Gary Schultz/Leon Lynch, ADNR, Fairbanks
Thomas Manson/Shannon Donnelly, Phillips, Alpine
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

Steve Schmitz, ADNR, Anchorage
Larry Bright, USFWS, Fairbanks
Gordon Brower, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Jack Winters, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Pete McGee, ADEC, Fairbanks
Kellie Westphal, ADNR, Anchorage

AGO/wam

APPENDIX E
Miscellaneous Correspondence Regarding
lakes L9312 and L9313

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

TONY KNOWLES, GOVERNOR

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 459-7289
FAX: (907) 456-3091

November 11, 1999

William M. Fowler, Senior Permit Coordinator
Colville Permits and Compliance
ARCO Alaska Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. Fowler:

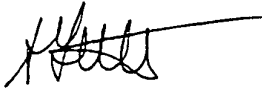
RE: Lake L93-13 (T6.1) - FG97-III-0190
Lake L93-12 (U6.1) - FG99-III-0051

The Alaska Department of Fish and Game (ADF&G) received a copy of a memorandum from Mr. Aldrich and Ms. Abrams dated October 21, 1999, that contained information on basic water quality and water surface elevations for Lakes L93-13 (T6.1) and L93-12 (U6.1). Data contained in the October 21, 1999, memorandum satisfied Stipulations #3, #4, and #6 of FG99-III-0051 and #1, #2, and #4 of FG97-III-0190 (Amendment #1). Fish sample reports for the 1999 summer field season were received daily from Dr. Moulton, satisfying that requirement.

Based on a preliminary review of the water quality data presented, there were no apparent changes in water quality due to water use from Lake L93-13. Summer and winter dissolved oxygen concentrations were adequate to support overwintering fish. Other parameters measured (e.g., temperature, salinity, conductivity, and turbidity) followed expected patterns of change for summer and winter.

As discussed, there is a need to develop a simple reporting system for water balance in Lakes L93-13 and L93-12. We suggest that a permanent staff gauge be installed in both lakes to monitor water surface elevation and that ARCO Alaska Inc. consider the use of snow fences to increase snow accumulation in the lake basins. If there are any questions, please give me a call at 907-459-7289.

Sincerely,



Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

TONY KNOWLES, GOVERNOR

1300 COLLEGE ROAD
FAIRBANKS, ALASKA 99701-1599
PHONE: (907) 459-7289
FAX: (907) 456-3091

December 2, 2000

Shannon Donnelly/Thomas W. Manson
Alpine Environmental Supervisor
PHILLIPS Alaska Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Ms. Donnelly and Mr. Manson:

RE: Water Use, Alpine, Lakes L93-12 and L93-13

Lakes L93-12 (U6.1) and L93-13 (T6.1) currently are the two primary all season watersources to support activities at the Alpine Oilfield Development. On November 29, 2000, we met to discuss project water requirements, options to facilitate recharge of the lakes, and the possible need to identify alternate watersources.

The possibility of increasing the water use from Lakes L93-12 (U6.1) and L93-13 (T6.1) was discussed. Based on results from the biological monitoring being conducted by PHILLIPS Alaska Inc. (PHILLIPS), we had no biological basis for increasing the amount above the criterion currently established to ensure adequate water to support anadromous fish resources.

One option raised was to check to determine if suitable gravel material exists below the lake bed. The department would be receptive to mining gravel from the lake bed to both provide gravel for new projects and to increase the water holding capacity of the lake. We recognize that removal of gravel from the lake would have an adverse effect on water quality and fish resources; however, we believe the impact would be short-term and increasing water storage would have a long-term benefit to anadromous fish habitat.

Lakes L93-12 (U6.1) and L93-13 (T6.1) both filled during spring breakup 2000 due to overflowing from the Colville River. Water use from Lake L93-13 was stopped in late August as the allowable amount of water based on water surface

elevation had been reached. Current water use is from Lake L93-12 and there appears to be just enough water to support activities throughout the remainder of this winter season. We recommended that if projections of water use indicate a potential shortage, that trucking of water from other approved watersources be initiated.

We reviewed lakes in the immediate area of the Alpine facility in terms of total quantities of available water and tentatively selected Lake L92-82 (T7.2) as the best option proximate to Alpine if an additional lake watersource is needed for all season use. The lake is perched, has a well defined high water channel and likely floods annually. The lake has 1,446.1million gallons of water during the ice-free season based on depth contours (Moulton 1998). Development of this lake as a watersource would involve installation of a screened intake structure similar to those in place in Lakes L93-12 and L93-13 and the construction of a pipeline back to the Alpine facilities. The pipeline route would have to cross the Sakoonang Channel.

Based on data supplied by PHILLIPS, it appears that water loss due to factors other than actual water use have reduced the water elevation in Lake L93-13 to the point where water removal was stopped. The amount of water loss due to other factors was more than double the water used.

Recharge options including construction of temporary snowfences to increase snow accumulation in the lakes or installation of an infiltration gallery in the Sakoonang were discussed. Use of snow fences would definitely ensure adequate annual recharge in years where flooding of the lakes from the Colville River does not occur, but it would not eliminate the potential need for more water.

We will work with PHILLIPS to identify the best option for ensuring adequate water resources for the Alpine Oilfield Development. If there are any questions, please contact either Mr. Morris or me at 907-4590-7289.

Sincerely,



Alvin G. Ott, Regional Supervisor
Habitat and Restoration Division
Department of Fish and Game

cc: Chris Milles, ADNR, Fairbanks
Glenn Gray, DGC, Juneau
Lloyd Fanter, ACOE, Anchorage
Sverre Pedersen, ADF&G, Fairbanks
Pat Valkenburg, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Bill Morris, ADF&G, Fairbanks
Ted Rockwell, EPA, Anchorage

Steve Schmitz, ADNR, Anchorage
Larry Bright, USFWS, Fairbanks
Gordon Brower, NSB, Barrow
Charles Swanton, ADF&G, Fairbanks
Kellie Westphal, ADNR, Anchorage
Jack Winters, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Pete McGee, ADEC, Fairbanks

Shannon Donnelly/Thomas Manson
(Water Use, Alpine)

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12/02/00

Caryn Rea, PHILLIPS, Anchorage

Mike Stahl, PHILLIPS, Anchorage

Gary Schultz/Leon Lynch, ADNR, Fairbanks

Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut

Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

AGO/ago