MONITORING OF WATER-SOURCE LAKES IN THE ALPINE DEVELOPMENT PROJECT: 1999-2003

Final Report

January 2004

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Prepared for:

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Anadarko Petroleum Corp.
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The Woodlands, TX

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EXECUTIVE SUMMARY

Two lakes, designated L9312 (or U6.1) and L9313 (or T6.1), provide the permanent water supply for the Alpine development. A series of permits issued by Alaska Department of Fish and Game (ADF&G) allow water withdrawal from the lakes under restrictions intended to protect fish residing within the lakes. These permits have been modified as information on the lakes has improved and as project needs have changed. Permit stipulations specified that each lake would be monitored for fish at least twice during the ice-free season for a period of five years.

The objectives of this study were to conclude monitoring of fish populations in each water source lake and compare the 2003 catch patterns to those observed in previous years. Fish populations in the lakes had been surveyed prior to issuance of water withdrawal permits, beginning in 1995 when baseline studies specific to the Alpine Development began. Both of the water-source lakes support fish, with eleven species identified from L9312 and seven identified from L9313.

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.

Net locations identified in 1999 as the most appropriate monitoring sites were re-occupied for the 2000 through 2003 sampling. As set forth in the monitoring stipulations, sampling was conducted during two periods in 2003. 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 2002-2003, fish greater than 180 mm were tagged to obtain information on residence time within the lake and potentially allow for estimating population size. In 2001, tags 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. 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 on two occasions in each lake in August 2003.

Bathymetric data were collected in 2002 to estimate water volumes. Ten transects were run on lake L9312 and 14 were recorded on lake L9313. Lake volume was estimated by contour mapping of depth intervals.

RESULTS AND DISCUSSION

History of Water Withdrawal

Lake L9312 is a 111-acre lake containing approximately 323 million gallons of water. An estimated 100.5 million gallons is deeper than the maximum ice thickness of 7 feet; this volume is considered the minimum winter volume available to wintering fish. As a result, 30 million gallons of water are available for use.

Lake L9313 is a 78-acre lake containing approximately 174 million gallons of water. An estimated 19.4 million gallons is deeper than the maximum ice thickness of 7 feet; this volume is considered the minimum winter volume available to wintering fish. At present, 6 million gallons of water are available for use.

Water use has varied considerably in the two lakes over the last three winters as permit conditions have been modified. 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.

Lake L9312

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. Specific conductance has shown a gradual increasing trend since 2000, although the values are low. There was evidence of oxygen depression during winter 2001, but this was not observed in 2002.

Fyke net sampling conducted in July produced a catch of 759 fish from 5 species, while sampling conducted in August produced 415 fish from 6 species. As in previous years, least cisco was again the most numerous species caught in 2003. The July catch rate of least cisco was the highest recorded since July catches of 2000. Catch rates of least cisco in August 2003 decreased from the high catch in 2002, but were greater than those in August 2000 and 2001.

The least cisco in 2000 likely represented many age groups, because the lengths ranged from 60 to 220 mm. In 2001 and 2002,, the captured least cisco were smaller, with age-0 and 1 fish being most abundant. Few larger fish were caught, with only 2 over 190 mm. In 2003, however, the length frequency indicated representation from a broad range of age groups, with fish ranging from 36 to 244 mm. The catch of age-0 fish in each of the last three years may indicate successful spawning, although immigration cannot be ruled out.

Catch rates of fish other than least cisco were mixed in 2003 when compared to previous years, with no discernible pattern to the catches, although catches of slimy sculpin remained low. Thirty-nine

tagged fish were released in 2003 – 35 least cisco and 4 round whitefish. No tagged fish from previous years were caught.

Lake L9313 (T6.1)

Specific conductance in L9313 increased from that recorded in 2002, continuing a trend of increasing specific conductance since 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.

There is evidence of oxygen depression in L9313 during winter. Dissolved oxygen during 2002 reached levels in early April that are lethal to fish (0.0-0.1 mg/l). Water removal during winter 2001/2002 from the lake was about 13% of the volume deeper than 7 feet – removals of this magnitude are not expected to affect dissolved oxygen. Low oxygen levels were also observed in this lake in 2000/2001 when there was no water removal. This lake appears prone to naturally low oxygen levels during late winter, possibly related to the shallowness of the lake.

Fyke net sampling conducted in July and August 2003 produced a combined catch of 582 fish from 6 species. Ninespine stickleback, least cisco and broad whitefish were the most abundant species, with Alaska blackfish, humpback whitefish and round whitefish also caught. As was the case in 2001 and 2002, catch rates of least cisco were higher in July than in August.

As in 2002, least cisco caught during 2003 included a broader range of sizes than has previously been seen in this lake, and included fish in the adult size range. In 1999 and 2000, catches were composed of juveniles but mature fish had been caught in 2001 and some earlier years. The length distribution of young fish in 2003 indicated that ages 0, 1 and 2 were represented.

In 2003, none of the 29 fish tagged in previous years were recaptured. One of 4 least cisco tagged in 2001 was recaptured during 2002. This recapture is direct evidence that at least some fish survived low dissolved oxygen levels recorded in April 2002. Eight least cisco, one broad whitefish and one humpback whitefish were tagged and released in L9313 during 2003. One least cisco released in 2003 was recaptured after being at liberty for 25 days.

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 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. At present, it is unclear whether or not the young least cisco caught in this lake from 2001 to 2003 represent successful spawning or immigration from the river.

Assessment of Water Withdrawal Effects

Mean catch rates for each weekly sampling period were regressed against the percent of the minimum winter volume removed the previous winter to assess the effect of water withdrawal on species abundance. For lake L9312, species used for the analysis were least cisco, slimy sculpin and Alaska blackfish. For lake L9313, the species used were least cisco, broad whitefish and Alaska blackfish. Only one of the regressions (least cisco in lake L9313) was marginally significant. The significant regression for least cisco in lake L9313 depends on the high catch rate in 1999. This high catch was caused by a large school of young least cisco that was present only in that year, then disappeared. The general impression given by the catch rates and population structure is that fish populations in the two lakes are healthy at the present time and are apparently not being significantly affected by the water withdrawals. An exception to this generality is the population of slimy sculpin in lake L9312, which has declined since monitoring began in 1999.

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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 summarizes results of the five years of stipulated monitoring.

Fish populations in the lakes had been surveyed prior to issuance of water withdrawal permits, beginning in 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 conclude monitoring of fish populations in each water source lake and compare the 2003 catch patterns to those observed in previous years. Results of the 1999 through 2002 monitoring are reported in Moulton (1999, 2000, 2002, 2003).

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 through 2003 sampling (Figures 3 and 4). As set forth in the monitoring stipulations, sampling was conducted during two ice-free periods in 2003: July 22-28 and August 16-22. 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, 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 to obtain information on residence time within the lake and potentially allow for estimating population size. In 2002-2003, we changed to smaller Floy FF-94 anchor tags (monofilament = 1/2 inch, vinyl = 3/4 inch), which were applied to broad whitefish, round whitefish, and least cisco exceeding 180 mm fork length. The switch to smaller tags in 2002-2003, and thus smaller tagged fish, was made to increase the number of tagged fish.

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* measurements taken within 15 cm (6 inches) of the surface 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 on two occasions in each lake in August 2003.

Bathymetric data were collected in 2002 using methods described by Michael Baker Jr. (2003) to provide a consistent approach to estimating water volumes. In 2002, location and depth were recorded on a Lowrance Model LCX-15MT integrated GPS/depth sounder. Location and depth were recorded at approximately 1-2 second intervals. Ten transects were run on lake L9312 and 14 were recorded on lake L9313. Lake volume was estimated by contour mapping of depth intervals. Contour maps were prepared by plotting the position and depth data obtained by GPS on geo-referenced aerial photography obtained June 30, 1999. Contours were plotted on the aerial photograph of the surveyed lakes. The surface area of each contour was obtained, and the volume was estimated using the formula for truncated cones:

$V = h/3*(A1+A2+(A1*A2) (1/2))$

Where h = vertical depth of the stratum, A1 = area of the upper surface, and A2 = area of the lower surface of the stratum whose volume is to be determined. The volumes of individual strata are summed to obtain the volume of the desired depth intervals.

RESULTS AND DISCUSSION

History of Water Withdrawal

Lake L9312 is a 111-acre lake containing approximately 323 million gallons of water (previous reports use a surface area of 100 acres based on USGS base maps – the 111 acres is based on digitizing the surface area from June 1999 aerial photography). An estimated 100.5 million gallons is deeper than the maximum ice thickness of 7 feet; this volume is considered the minimum winter volume available to wintering fish. As a result, 30 million gallons of water are available for use. Over 31% of the lake volume is deeper than 7 feet (Figure 5).

Lake L9313 is a 78-acre lake containing approximately 174 million gallons of water (previous reports use a surface area of 69 acres based on USGS base maps – the 78 acres is based on digitizing the surface area from June 1999 aerial photography). An estimated 19.4 million gallons is deeper than the maximum ice thickness of 7 feet; this volume is considered the minimum winter volume available to wintering fish. At present, 6 million gallons of water are available for use. About 11% of the lake volume is deeper than 7 feet (Figure 6).

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. This increase was made because the lakes were to serve as the permanent water supply for the Alpine facilities and the previous criterion imposed a severe constraint on the project.

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, but was only 44% of the permitted amount in 2001/2002. To date, the withdrawals represent between 3% and 26% of the minimum winter volume.

In L9313, only 3% of the permitted withdrawal volume was used in 1998/1999, with 74% 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, even though only 2.1 million gallons had been used after break-up. Investigation of the apparent loss of water determined that the low staff gauge reading was caused by frost-induced movement of the staff gauge, not loss of water from the lake. For 2001/2002, about 21% of the permitted withdrawal was used. To date, the withdrawals represent between 1% and 51% of the minimum winter volume. In

three years water use was near 50% of the minimum winter volume.

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 apparently not flooded during the 2001. MBJ (2002) report that the lake was fully recharged by overflow from the Sakoonang Channel in 2002. Specific conductance has shown a gradual increasing trend since 2000, although the values are low (Figure 7).

Unlike winter 2001, there was little evidence of oxygen depression during 2002, with the minimum levels recorded on April 6 in excess of 9 mg/l (Appendix Table A-2).

Biological Observations. Fyke net sampling conducted July 22-28, 2003 produced a catch of 759 fish from 5 species, while sampling conducted August 16-22 produced 415 fish from 6 species (Table 5). As in previous years, least cisco was again the most numerous species caught in 2003, representing 94% of the non-stickleback catch. The July catch rate of least cisco (102.6 fish per day) was the highest recorded since July catches of 2000 (Figure 8). Catch rates of least cisco in August 2003 decreased from the high catch in 2002, but were greater than those in August 2000 and 2001.

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 and 2002,, the captured least cisco were smaller, with age-0 and 1 fish being most abundant (Figure 9). Few larger fish were caught, with only 2 over 190 mm. In 2003, however, the length frequency indicated representation from a broad range of age groups, with fish ranging from 36 to 244 mm. The catch of age-0 fish in each of the last three years may indicate successful spawning, although immigration cannot be ruled out.

Catch rates of fish other than least cisco were mixed in 2003 when compared to previous years, with no discernible pattern to the catches, although catches of slimy sculpin remained low (Table 5, Figure 8). Thirty-nine tagged fish were released in 2003 – 35 least cisco and 4 round whitefish. No tagged fish from previous years were caught.

Lake L9313 (T6.1)

Water Chemistry. Specific conductance in L9313 increased about 46% from that recorded in 2002, continuing a trend of increasing specific conductance since 1995 (Table 2, Figure 7). 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.

There was evidence of oxygen depression in L9313 during winters 2000/2001, 2001/2002 and 2002/2003 (Table 4). Dissolved oxygen reached levels during April 2002 that are lethal to fish (0.0-0.1 mg/l). Water removal during winter 2001/2002 from the lake was about 13% of the volume deeper than 7 feet – removals of this magnitude are not expected to affect dissolved oxygen. Low oxygen levels were also observed in this lake in 2000/2001 (2.0-2.5 mg/l on April 18, 2001) when there was no water removal. This lake appears prone to naturally low oxygen levels during late winter, possibly related to the shallowness of the lake, as 96% of the lake is shallower than 7 feet.

In April and May 2003, a special effort was made to examine the distribution of oxygen levels at various locations around the lake (Wolf 2003a,b; included as Appendix D). Water chemistry measurements were taken at eight sites roughly along the longitudinal axis of the lake. On April 28, there was some variation in the distribution of dissolved oxygen, ranging from less than 1.0 mg/l at four stations, to near 3.5-4.0 mg/l at two stations in the northeastern portion of the lake. By May 9, dissolved oxygen was less than 2.0 at five stations, and between 2-3 mg/l at the other three stations.

Biological Observations. Fyke net sampling conducted July 22-28, 2003 and again during August 16-22 produced a combined catch of 582 fish from 6 species (Table 5). Ninespine stickleback, least cisco and broad whitefish were the most abundant species, with Alaska blackfish, humpback whitefish and round whitefish also caught. As was the case in 2001 and 2002, catch rates of least cisco were higher in July than in August (Figure 11).

As in 2002, least cisco caught during 2003 included a broader range of sizes than has previously been seen in this lake, and 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 2001 and some earlier years. The length distribution of young fish in 2003 indicated that ages 0, 1 and 2 were represented.

In 2003, none of the 29 fish tagged in previous years were recaptured. One of 4 least cisco tagged in 2001 was recaptured during 2002. This individual was released on July 22, 2001 and recaptured on the same day in 2002. This recapture is direct evidence that at least some fish survived low dissolved oxygen levels recorded in April 2002. Eight least cisco, one broad whitefish and one humpback whitefish were tagged and released in L9313 during 2003. One least cisco released in 2003 was recaptured after being at liberty for 25 days (Appendix Table B-9).

Sampling in lake L9313 prior to 1999 indicated few fish resided in the lake (Appendix Table B-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. At present, it is unclear whether or not the young least cisco caught in this lake from 2001 to 2003 represent successful spawning or immigration from the river.

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 10 and 13). The few burbot (which avoid light when possible) caught in the lakes have also been caught during August.

Assessment of Water Withdrawal Effects

The log-transformed mean catch rates for each weekly sampling period were regressed against the percent of the minimum winter volume removed the previous winter to assess the effect of water withdrawal on species abundance (Figure 15). For lake L9312, species used for the analysis were least cisco, slimy sculpin and Alaska blackfish. For lake L9313, the species used were least cisco, broad whitefish and Alaska blackfish. Only one of the regressions (least cisco in lake L9313) was marginally significant ($p=0.047$).

The significant regression for least cisco in lake L9313 depends on the high catch rate in 1999. This high catch was caused by a large school of young least cisco of uniform age that was present only in that year, then disappeared (see Figure 12). The population has been composed of a more diverse age structure for the last three years, which may indicate either a more stable population, or a greater rate of immigration. The general impression given by the catch rates and population structure is that fish populations in the two lakes are healthy at the present time and are apparently not being significantly affected by the water withdrawals. The population of slimy sculpin in lake L9312, however, has shown a continuous decline since systematic monitoring of the lake began in 1999 (Figure 8). Slimy sculpin are rare on the Arctic Coastal Plain, with only three lakes within 10 miles of the coast known to contain this species. The species is more common inland and at higher elevations in the Brooks Range.

CONCLUSIONS

There are no direct indications that the fish populations in lakes L9312 and L9313 have been substantially damaged by water withdrawals through 2003. 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. Despite low oxygen levels that approached 0 mg/l in April 2002, and were less than 2.0 mg/l throughout much of the lake in late winter 2003, some fish survived the winter.

The highly variable size structure of least cisco in lake L9313, as well as young from species that do not spawn in lakes, 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, round whitefish, Alaska blackfish and slimy sculpin. While other species are caught in L9312, the numbers tend to be low, indicating less immigration than in L9313. The population of slimy sculpin in lake L9312 has declined since monitoring began in 1999.

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Table 1. Water withdrawal at Alpine Development lakes from freeze-up to break-up, 1999-2003.

Lake Name	Month	1998/1999 (gallons)	1999/2000 (gallons)	2000/2001 (gallons)	2001/2002 (gallons)	2002/2003 (gallons)
L9312						
	June		1,625,100			2,011,700
	July					100
	August					0
	September			495,000		0
	October			1,786,600		Combined w/ Nov.
	November			2,435,320		378,800
	December			2,587,600	6,083,500[1]	1,483,400
	January			8,840,220	1,798,000	1,841,900
	February	9,100,325		1,911,100	3,137,100	1,626,800
	March	1,847,370		1,781,600	3,180,400	1,503,100
	April		947,100	2,153,200	799,167	1,499,400
	May		1,865,161	1,980,200	3,375,833	2,271,000
	Total Use	10,947,695	4,437,361	23,970,840	12,290,500	12,616,200
	Minimum Winter Volume[2]	100,545,255	100,545,255	100,545,255	100,545,255	100,545,255
	Percent of Minimum Vol.	10.9%	4.4%	23.8%	12.2%	12.5%
	Permitted Use[3]	12,600,000	19,000,000	32,360,000	32,360,000	30,000,000
L9313						
	June		1,817,300			411,090
	July		2,226,700			1,392,750
	August					1,902,400
	September			2,122,600		1,602,200
	October					Combined w/ Nov
	November					3,438,400
	December		765,600		378,120[1]	0
	January	63,000	1,696,600		362,800	107,600
	February	126,000	1,039,800		228,000	177,000
	March		1,550,800		1,355,300	600
	April		843,900		238,200	300
	May				38,182	38,900
	Total Use	189,000	9,940,700	9,404,700[4]	2,222,482	9,071,240
	Minimum Winter Volume[2]	19,384,330	19,384,330	19,384,330	19,384,330	19,384,330
	Percent of Minimum Vol.	1.0%	51.3%	48.5%	11.5%	46.8%
	Permitted Use[3]	5,600,000	13,400,000	10,340,000	10,340,000	6,000,000

[1] Totals for 4th quarter 2001, not just December.

[2] Volume deeper than 7 feet, based on depth transects obtained during 2002

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

[4] 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, 1995-2003.

Parameter	Date	Mean	Standard Deviation	Number	Range	
Water Temperature (^{o}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	
	Jul 22-29, 2002	12.1	2.0	8	9.9-15.4	
	Aug 21-27, 2002	7.1	1.3	6	5.5-8.7	
	Jul 21-28, 2003	12.6	3.5	7	7.0-17.5	
	Aug 16-22, 2003	6.4	0.6	8	5.5-7.2	
Dissolved Oxygen (mg/l)						
	Jul 9-15, 1997	11.5	0.7	5	10.5-12.4	
	Jul 28-Aug 3, 1999	11.4	0.1	2	11.4-11.5	
	Jul 24-29, 2000	10.9	0.1	4	10.8-10.9	
	Aug 16-21, 2000	--	--	0	--	
	Jul 22-28, 2001	9.7	0.3	7	9.0-10.0	
	Aug 17-23, 2001	11.2	0.9	6	9.8-12.3	
	Jul 22-29, 2002	10.4	0.6	8	9.5-11.4	
	Aug 21-27, 2002	11.8	0.4	6	11.2-12.3	
	Jul 21-28, 2003	10.2	0.5	7	9.5-10.9	
	Aug 16-22, 2003	12.2	0.2	8	11.8-12.5	
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	
	Jul 22-29, 2002	61.6	0.5	8	61.1-62.4	
	Aug 21-27, 2002	62.2	0.3	5	61.8-62.7	
	Jul 21-28, 2003	71.2	0.8	7	70.0-72.3	
	Aug 16-22, 2003	67.9	1.6	8	66.8-70.4	
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	
	Jul 22-29, 2002	1.0	0.3	6	0.7-1.5	
	Aug 21-27, 2002	2.3	1.2	7	1.5-4.9	
	Jul 21-28, 2003	7.6	7.1	6	0.7-18.0	
	Aug 16-22, 2003	1.0	0.2	8	0.8-1.4	

Table 3. Water chemistry profiles measured in conjunction with Alpine Area sampling at lake L9312 during 2003.

(profiles taken at deepest location in lake)

Date	Depth (m)	Water Temp. (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (µS/cm)	pH	Turbidity (NTU)
8/1/2003	surface	8.4	11.9	70.0	7.9	1.2
	1.0	8.4	11.9	69.8	7.9	1.2
	2.0	8.4	11.9	69.8	7.9	1.4
	3.0	8.4	11.9	69.8	7.8	1.3
8/21/2003	surface	5.9	12.2	66.9	7.6	1.3
	1.0	5.9	12.3	67.2	7.7	1.2
	2.0	5.9	12.4	66.8	7.6	1.2
	3.0	5.9	12.3	66.9	7.5	1.0

Table 4. Variation in specific conductance and minimum winter dissolved oxygen observed at lakes L9312 and L9313 from 1997 to 2003.

Lake	Year	Winter Water Withdrawal (million gals.)	July Specific Conductance[1] (μS/cm)	April Specific Conductance[2] (μS/cm)	April Minimum Dissolved Oxygen[2] (mg/l)
L9312	1997	(no withdrawal)	83.5	--	--
	1998	(no withdrawal)	--	--	--
	1999	10,947,695	77.2	--	--
	2000	4,437,361	54.8	--	--
	2001	23,970,840	58.6	232.1	3.5
	2002	12,290,500	61.6	155.5	9.5
	2003	12,616,200	71.2	--	--
L9313					
	1997	(no withdrawal)	126.2	--	--
	1998	(no withdrawal)	--	--	--
	1999	189,000	172.8	--	--
	2000	9,940,700	167.7	--	--
	2001	0	248.6	798.5	2.2
	2002	2,222,482	202.2	988.4	0.05
	2003	9,071,240	295.8	378.7	1.5

[1] Measured at Fyke Net Station

[2] Mean Water Column Value

Table 5. Catches of fish by species from Alpine Area Lakes fyke net sampling, 1999-2003.

	July 1999		July 2000		August 2000		July 2001		August 2001		July 2002		August 2002		July 2003		August 2003	
Species	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**	**No. of Fish**	**CPUE**
L9312																		
Least cisco	62	9.0	1,349	192.3	196	28.4	56	8.1	228	29.1	142	17.1	652	91.9	689	102.6	333	49.7
Arctic cisco	0	0.0	0	0.0	5	0.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Broad whitefish	5	0.7	5	0.7	4	0.6	7	1.0	0	0.0	1	0.1	7	1.0	0	0.0	21	3.1
Humpback whitefish	0	0.0	27	3.8	15	2.2	1	0.1	1	0.1	0	0.0	4	0.6	0	0.0	0	0.0
Round whitefish	24	3.5	7	1.0	17	2.5	5	0.7	4	0.5	15	1.8	4	0.6	2	0.3	0	0.0
Burbot	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	1	0.1
Longnose sucker	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	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	0	0.0	27	3.8	1	0.1	31	4.6
Fourhorn sculpin	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Slimy sculpin	83	12.0	13	1.9	93	13.5	4	0.6	49	6.3	4	0.5	31	4.4	2	0.3	12	1.8
Ninespine stickleback	184	26.7	729	103.9	368	53.3	89	12.8	75	9.6	44	5.3	46	6.5	65	9.7	17	2.5
Total Catch:	365		2,153		801		167		366		206		772		759		415	
Number of Species:	6		8		9		7		7		5		8		5		6	
Net Hours:	165.4		168.3		165.7		166.4		187.8		199.7		170.3		161.2		160.8	
L9313																		
Least cisco	975	135.7	0	0.0	5	0.7	48	7.0	5	0.6	342	40.8	62	8.6	243	36.3	152	22.7
Broad whitefish	5	0.7	4	0.6	7	1.0	2	0.3	3	0.4	71	8.5	175	24.4	24	3.6	2	0.3
Humpback whitefish	0	0.0	0	0.0	5	0.7	1	0.1	4	0.5	2	0.2	31	4.3	1	0.1	0	0.0
Round whitefish	2	0.3	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2	0	0.0	1	0.1	3	0.4
Burbot	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Alaska blackfish	9	1.3	23	3.3	100	14.8	11	1.6	22	2.8	11	1.3	90	12.6	0	0.0	11	1.6
Ninespine stickleback	111	15.5	779	110.2	332	49.3	100	14.6	128	16.2	227	27.1	688	96.0	83	12.4	62	9.2
Total Catch:	1,102		806		450		162		162		655		1,046		352		230	
Number of Species:	5		3		6		5		5		6		5		5		5	
Net Hours:	172.4		169.7		161.6		164.2		189.1		201.1		172.0		160.5		160.9	

Table 6. Water chemistry parameters measured in conjunction with Alpine Area fish sampling at lake L9313, 1995-2003.

Parameter	Date	Mean	Standard Deviation	Number	Range	
Water Temperature (^{o}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	
	Jul 22-29, 2002	12.3	2.0	8	10.6-15.7	
	Aug 21-27, 2002	7.2	1.7	7	5.3-9.4	
	Jul 21-28, 2003	13.1	3.0	7	7.8-16.1	
	Aug 16-22, 2003	6.4	0.3	8	6.0-6.8	
Dissolved Oxygen (mg/l)						
	Jul 9-15, 1997	11.4	0.4	6	11.0-12.2	
	Jul 28-Aug 3, 1999	12.0	0.5	2	11.6-12.3	
	Jul 24-29, 2000	11.0	0.2	3	10.9-11.2	
	Aug 16-21, 2000	--	--	0	--	
	Jul 22-28, 2001	9.5	0.4	7	9.1-10.2	
	Aug 17-23, 2001	11.2	1.2	6	10.1-12.9	
	Jul 22-29, 2002	10.5	0.8	8	9.3-11.5	
	Aug 21-27, 2002	11.7	0.4	7	11.1-12.2	
	Jul 21-28, 2003	10.2	0.5	7	9.8-10.4	
	Aug 16-22, 2003	12.2	0.3	8	11.8-12.8	
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	
	Jul 22-29, 2002	202.2	1.9	8	200.6-206.6	
	Aug 21-27, 2002	208.9	1.8	7	207.7-213.0	
	Jul 21-28, 2003	295.8	0.6	7	295.3-296.8	
	Aug 16-22, 2003	291.6	7.7	8	285.3-305.6	
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	
	Jul 22-29, 2002	1.7	1.5	8	0.9-5.3	
	Aug 21-27, 2002	2.8	0.7	7	1.7-3.7	
	Jul 21-28, 2003	3.3	2.9	6	0.8-8.6	
	Aug 16-22, 2003	1.2	0.5	8	0.7-2.2	

Table 7. Water chemistry profiles measured in conjunction with Alpine Area sampling at lake L9313 during 2003.

(profiles taken at deepest location in lake)

Date	Depth (m)	Water Temp. (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (µS/cm)	pH	Turbidity (NTU)
8/1/2003	surface	8.5	11.9	296.1	7.8	1.4
	1.0	8.5	11.8	295.8	7.9	1.5
	2.0	8.5	11.9	295.7	7.9	1.4
	3.0	8.5	12.0	295.7	7.9	1.7
8/22/2003	surface	6.2	12.8	286.9	7.7	0.7
	1.0	6.0	12.9	285.8	7.9	1.0
	2.0	6.0	13.3	285.8	7.9	2.2
	3.0	6.0	13.2	285.8	7.9	2.9

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

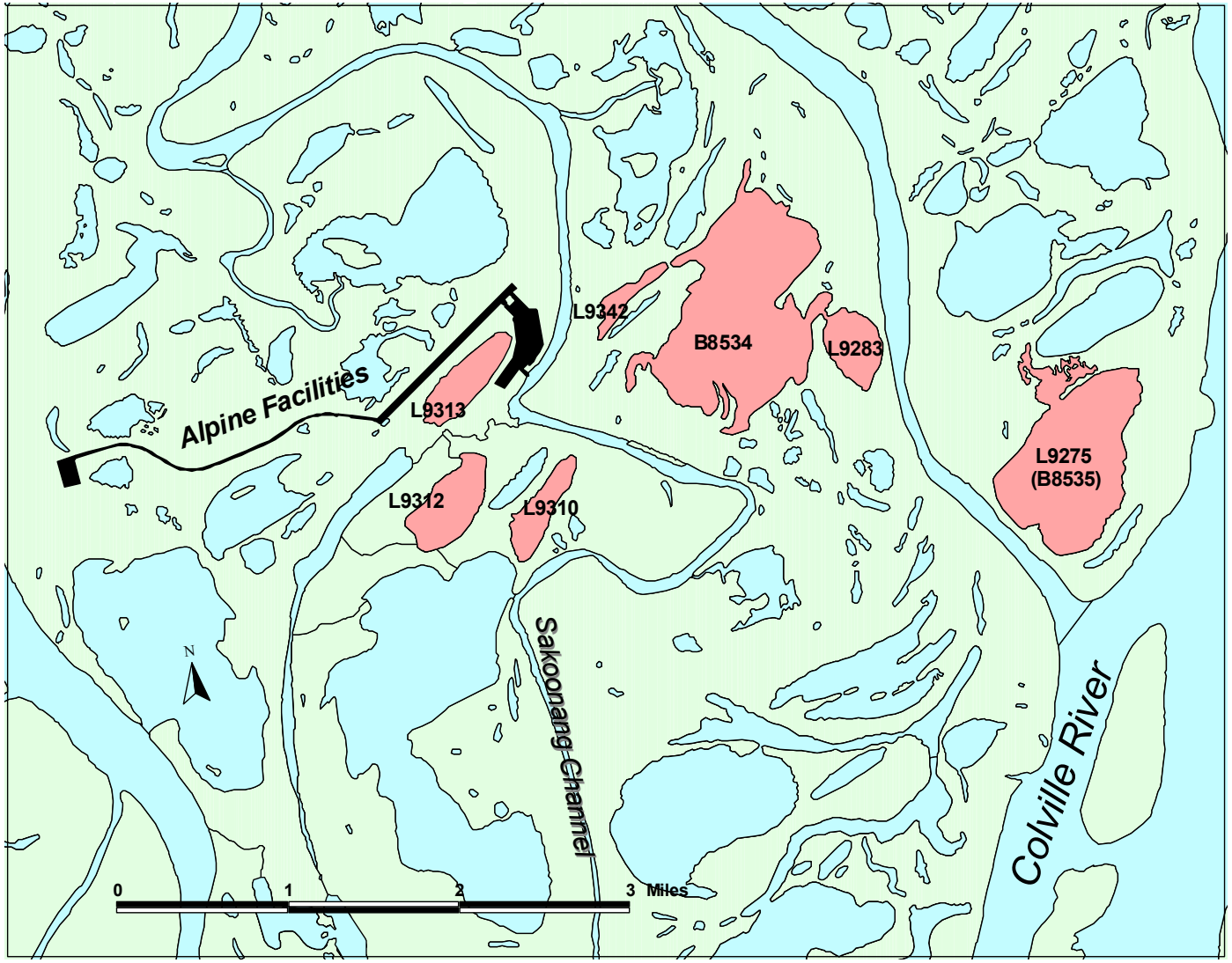

Figure 2. Lakes L9312 and L9313 used as permanent water sources for the Alpine Development.

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

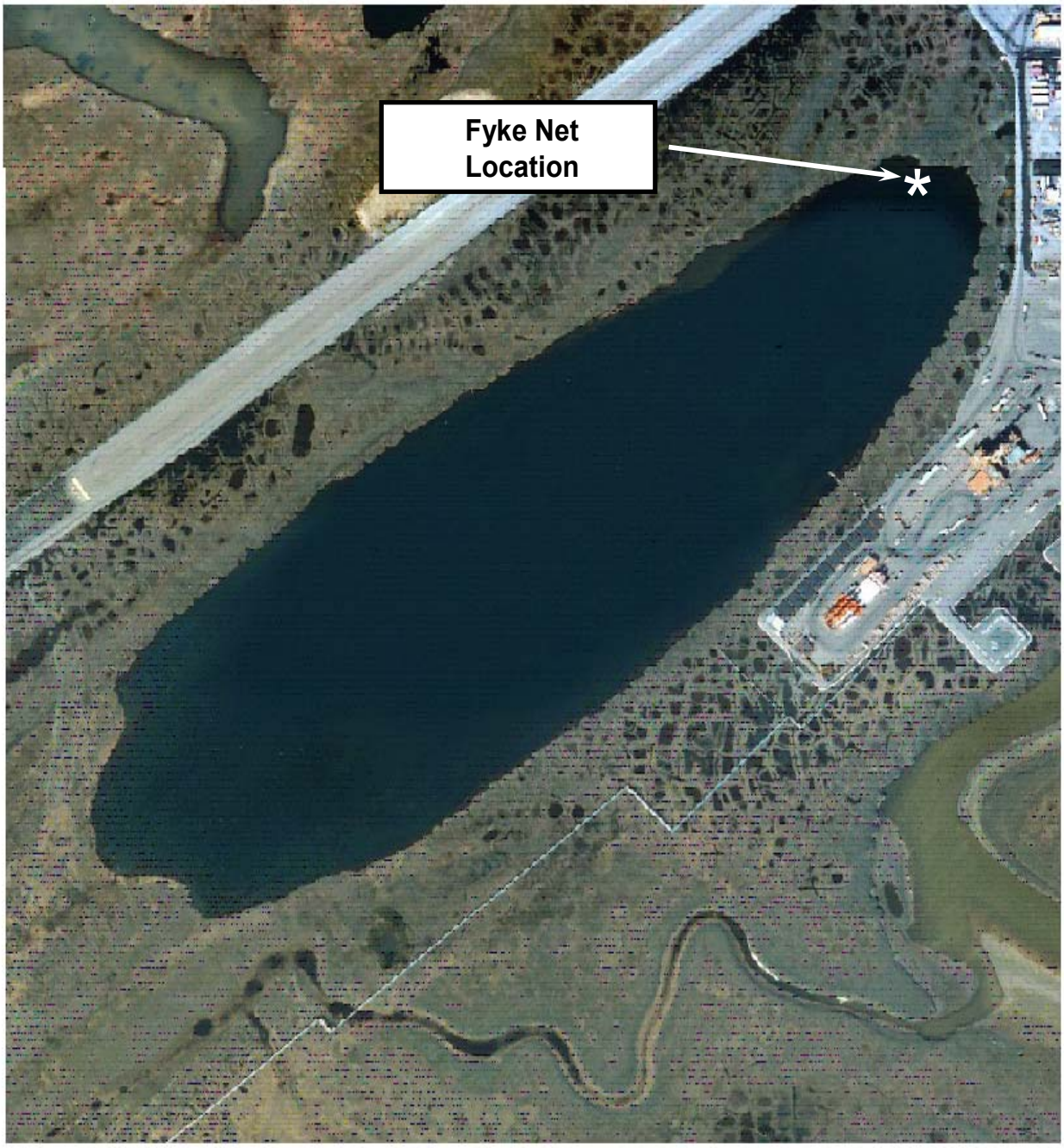

Figure 4. Fyke net station used for long-term monitoring in lake L9313.

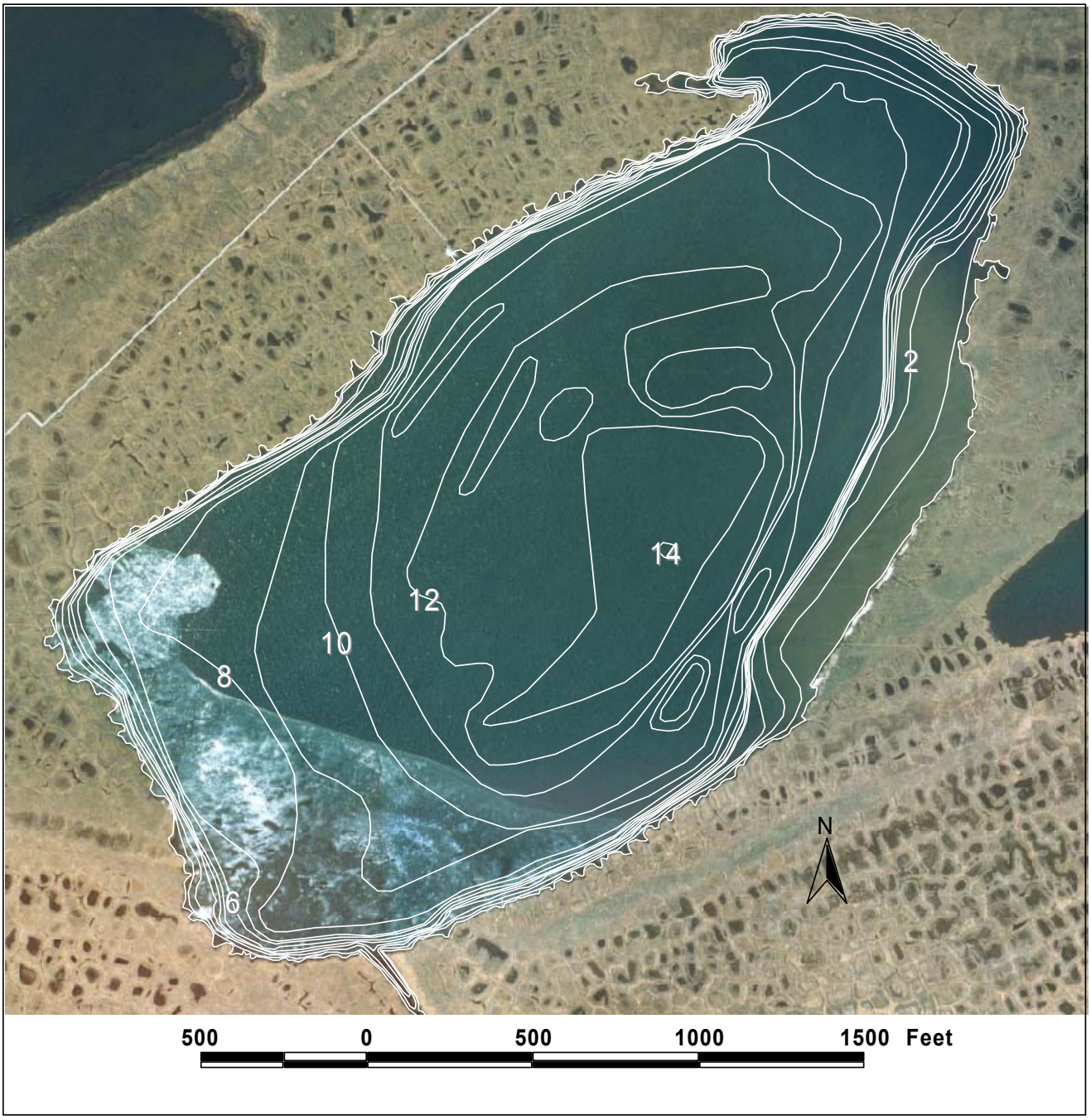

Figure 5. Bathymetric contours (in 1 foot intervals) for lake L9312 based on depth survey of July 28, 2002.

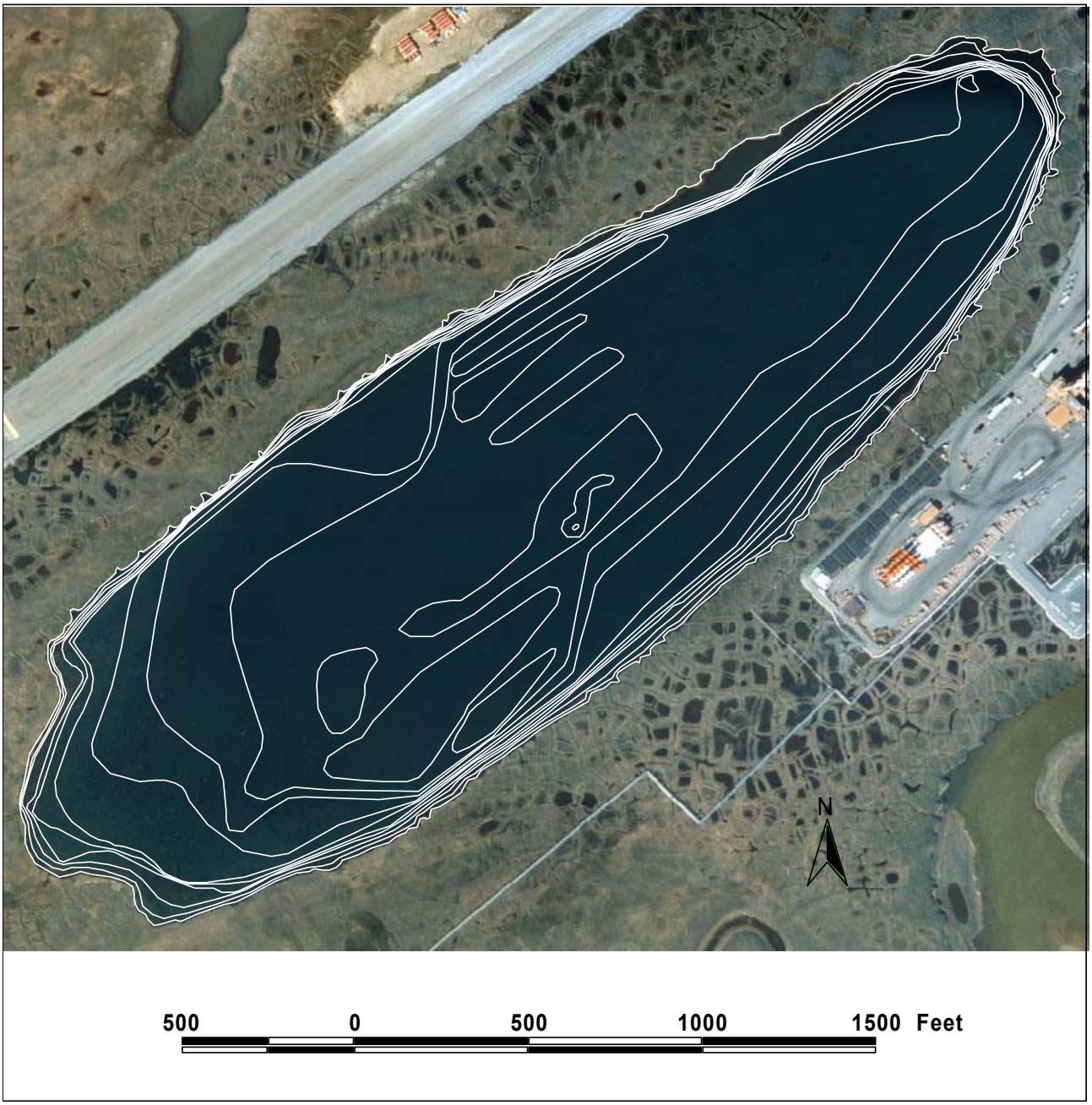

Figure 6. Bathymetric contours (in 1 foot intervals) for lake L9313 based on depth survey of July 28, 2002.

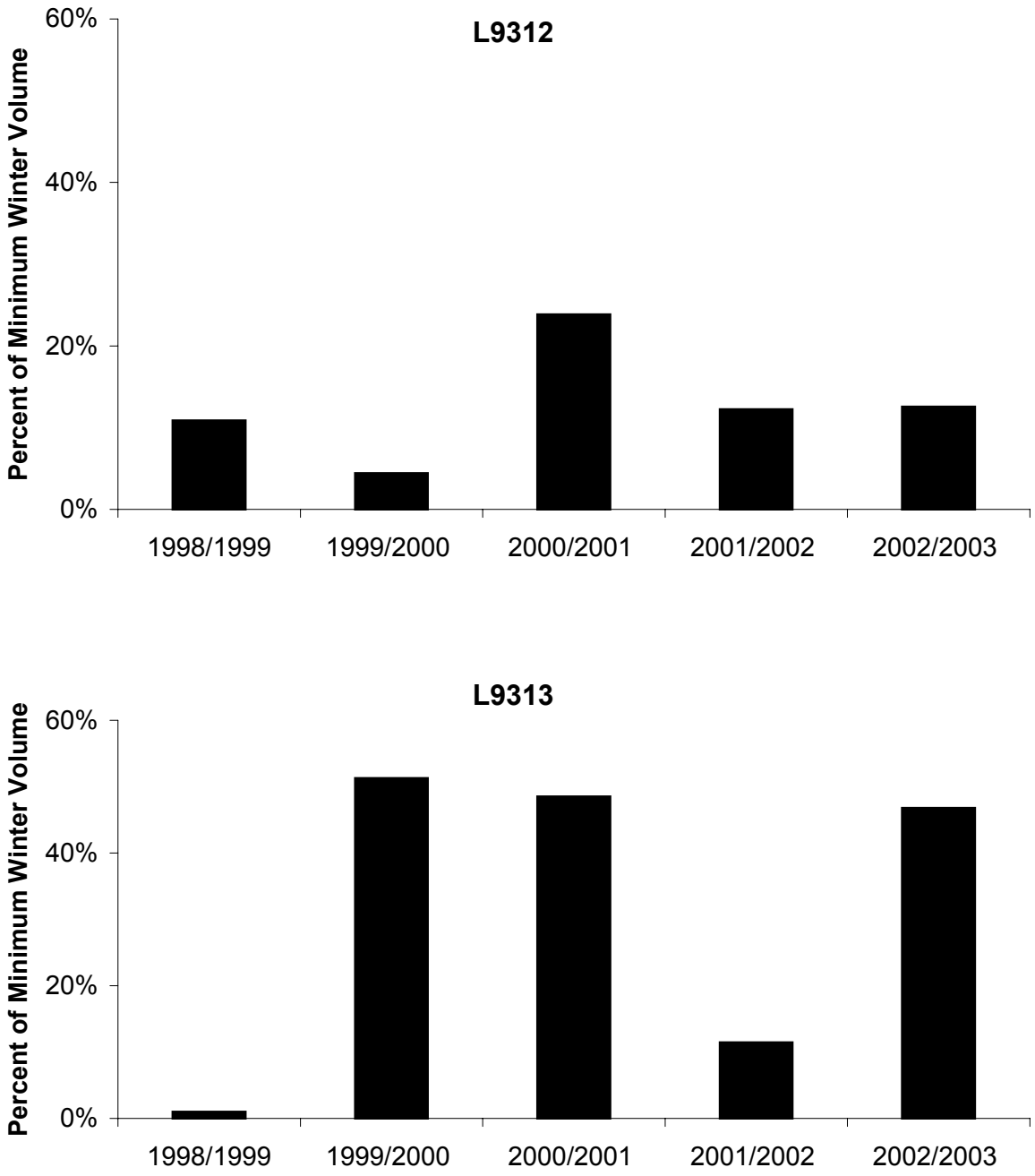

Figure 7. Percent of minimum winter water volume withdrawn from lakes L9312 and L9313 from 1998 to 2003.

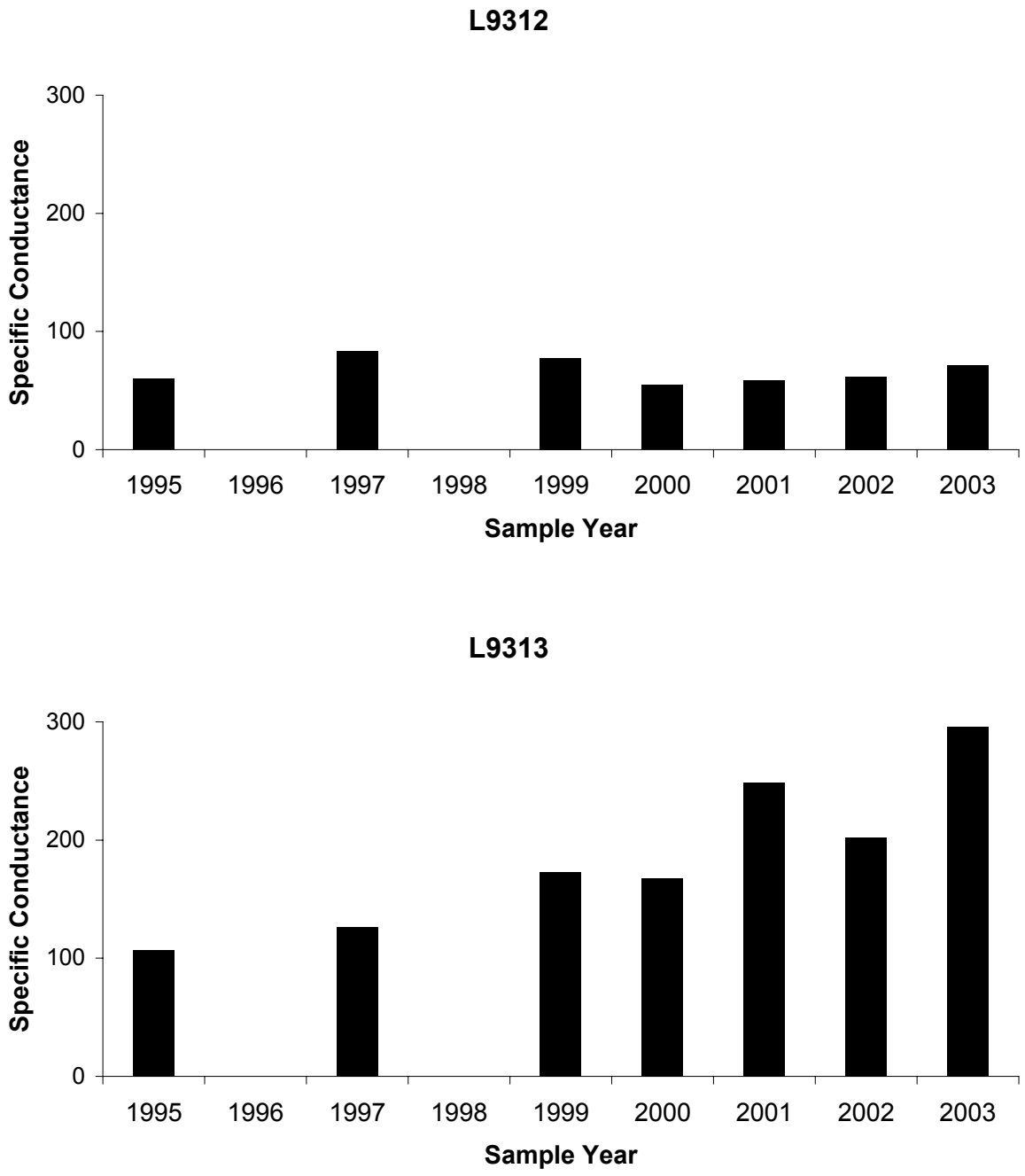

Figure 8. Specific conductance during July (in microS/cm) at two water source lakes in the Alpine Development Area, 1995-2003.

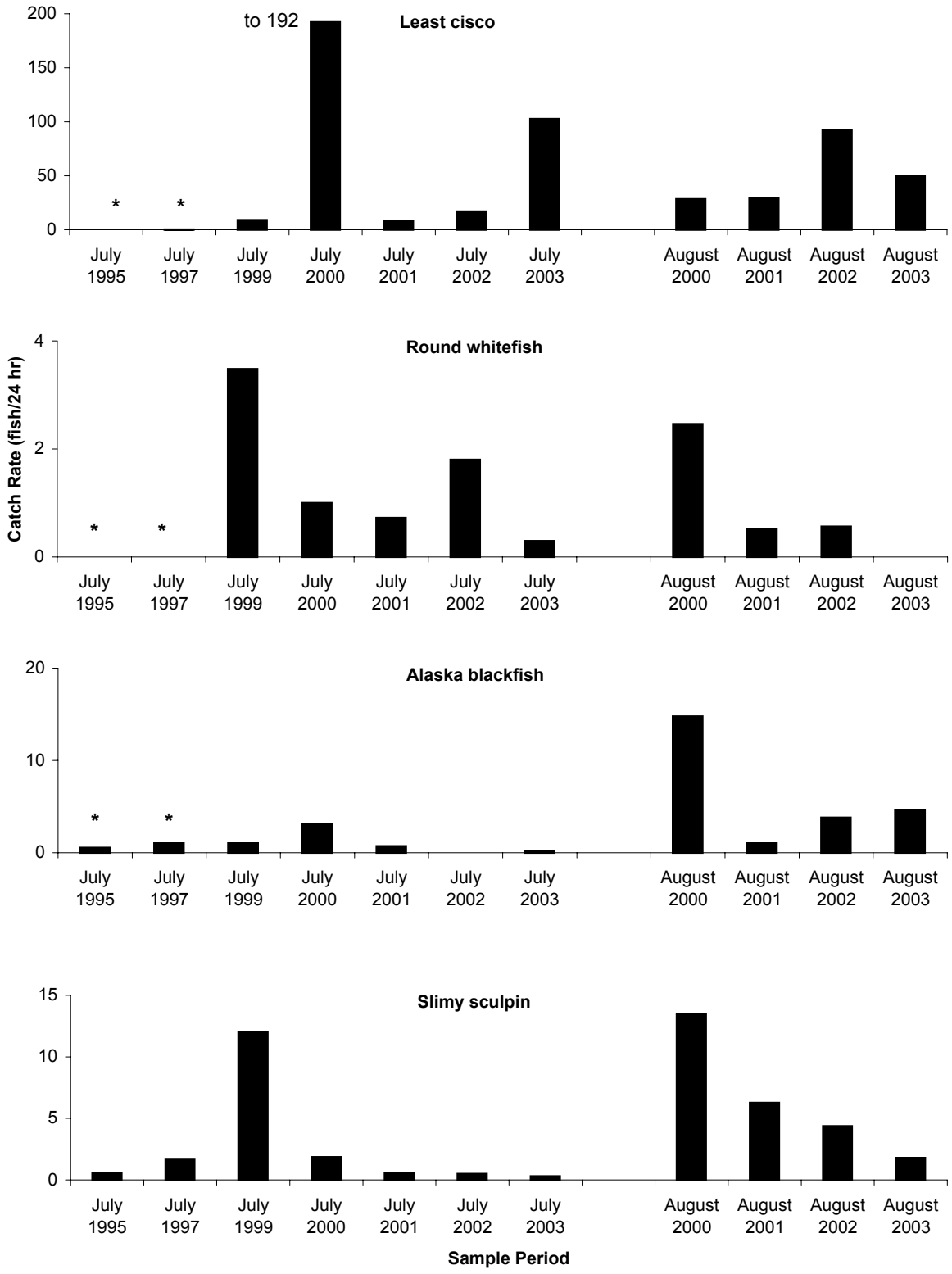

Figure 9. Mean catch rates of selected species in lake L9312, Alpine Development Area, 1995-2003 (* = nets fished in 1995 and 1997 were at different locations).

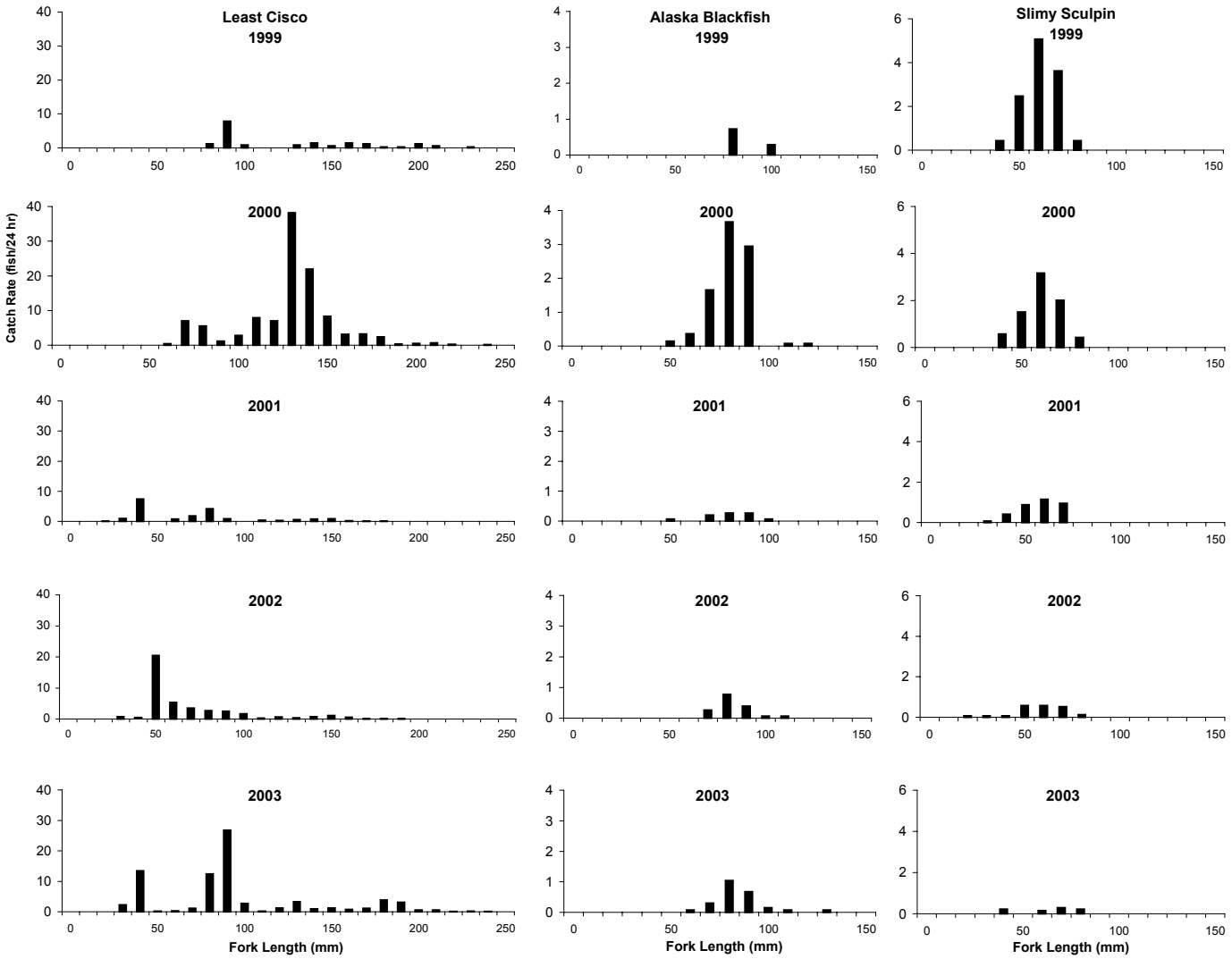

Figure 10. Length frequencies of least cisco, Alaska blackfish and slimy sculpin in lake L9312 during 1999-2003 sampling with fyke n

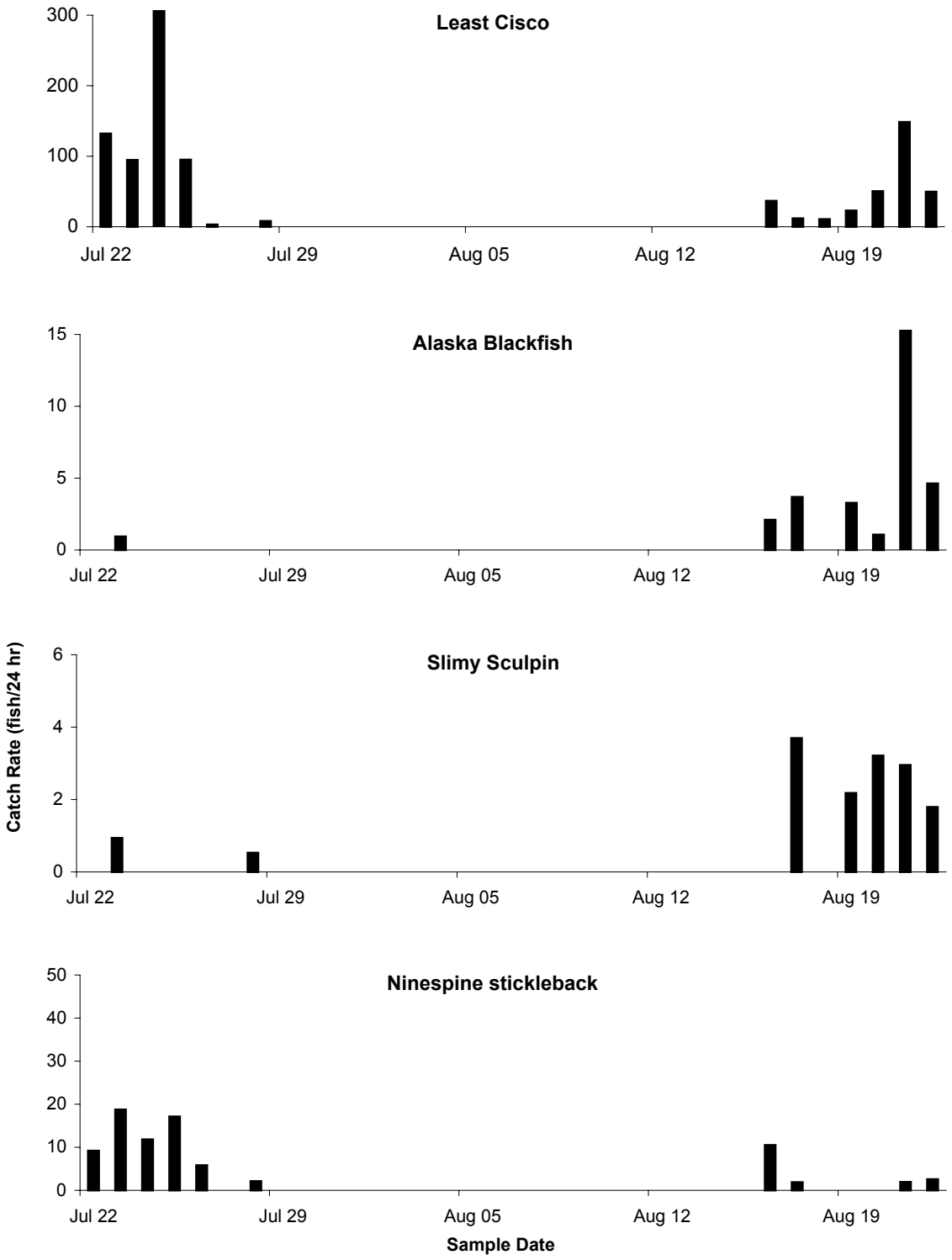

Figure 11. Daily pattern of catch for dominant species in lake L9312 during 2003 fyke net sampling (catches in fish per day).

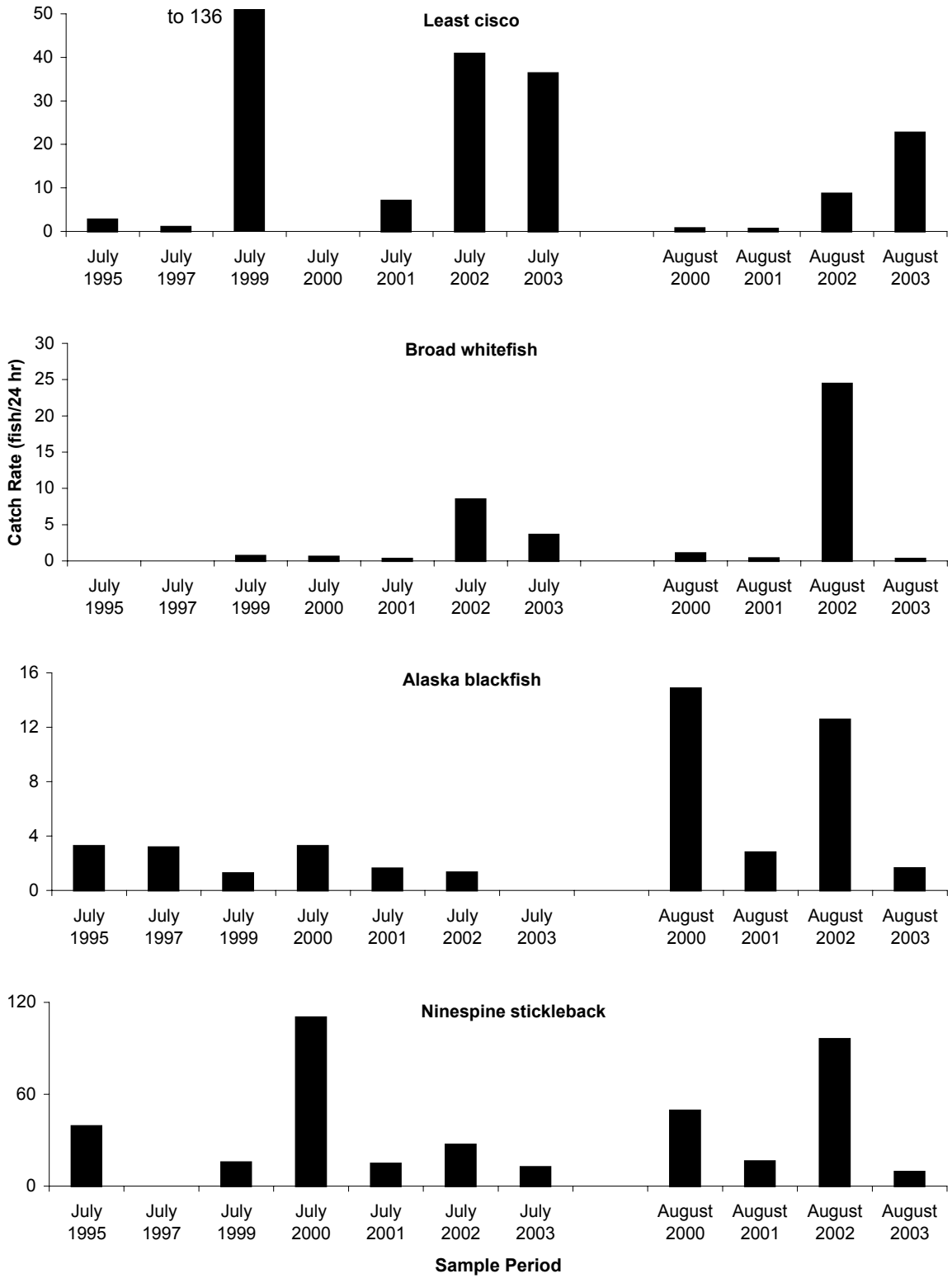

Figure 12. Mean catch rates of selected species in lake L9313, Alpine Development Area, 1995-2003 (* = nets fished in 1995 and 1997 were at different locations).

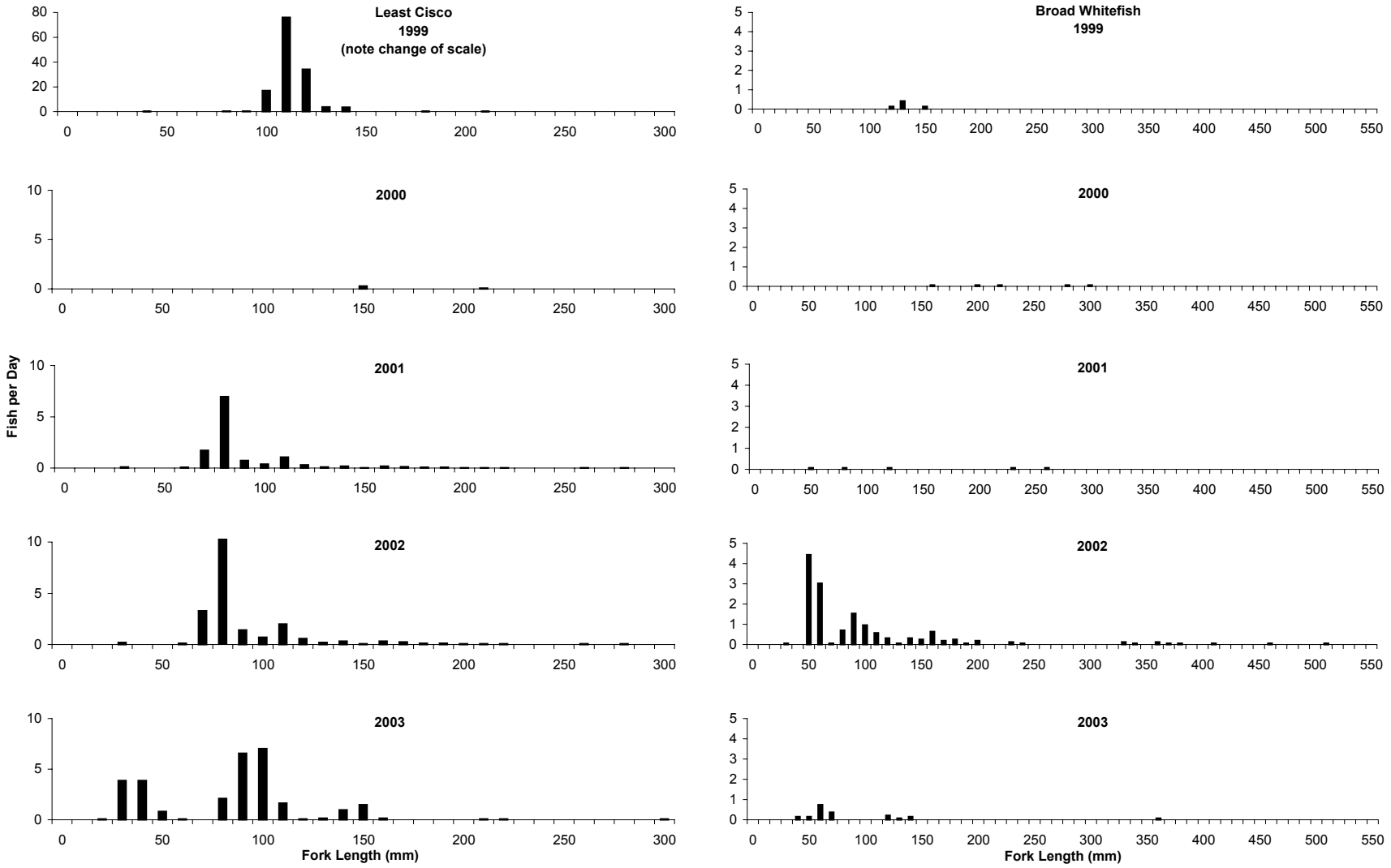

Figure 13. Length frequencies of least cisco and broad whitefish in lake L9313 during 1999-2003 sampling with fyke nets.

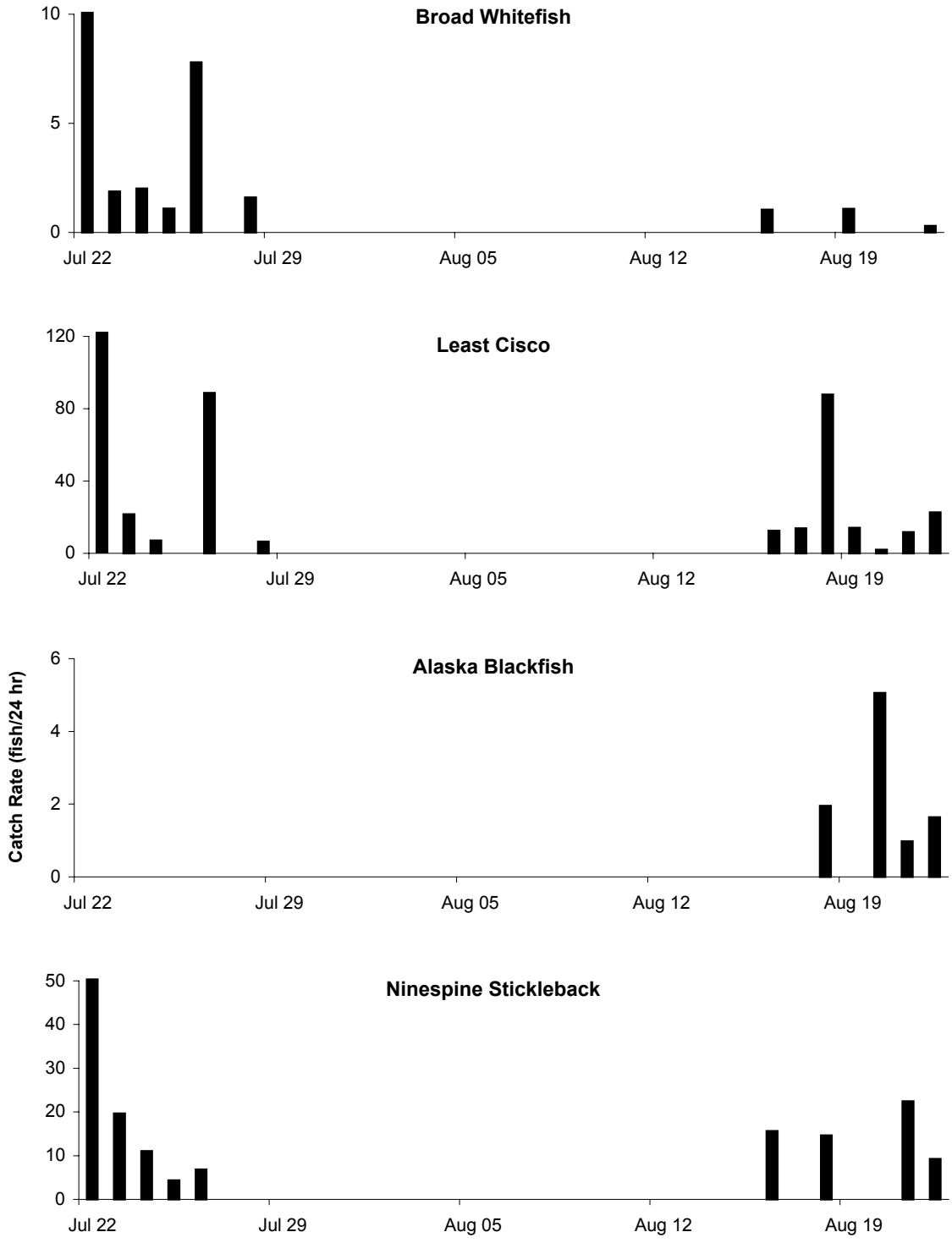

Figure 14. Daily pattern of catch for dominant species in lake L9313 during 2003 fyke net sampling (catches in fish per day).

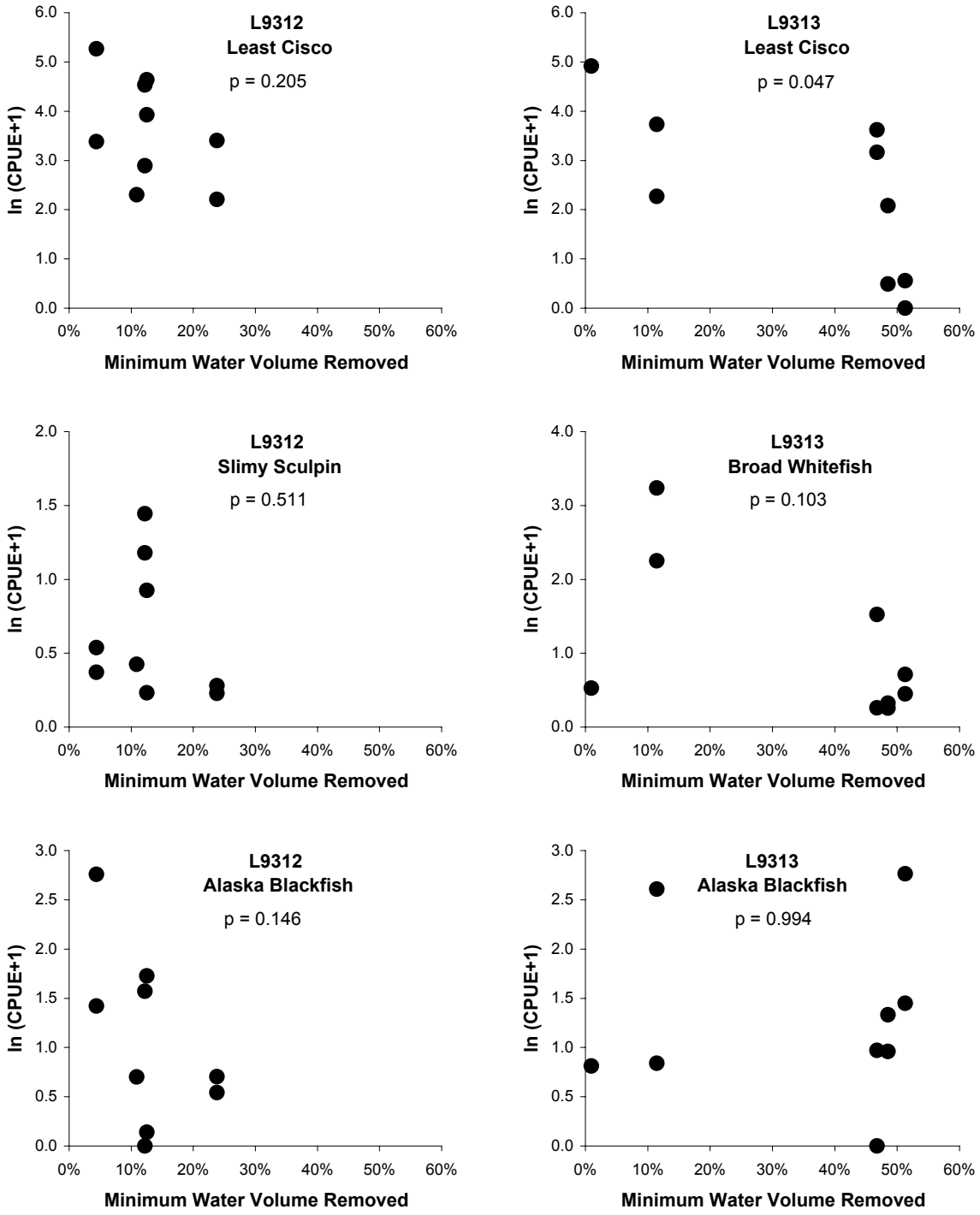

Figure 15. Relationship between percent of the minimum winter volume removed and subsequ
catch rates of fish species in lakes L9312 and L9313.

APPENDIX A
Water Chemistry from Alpine Area Lakes
1995 to 2003

Appendix Table A-1. Water chemistry measurements for lake L9310, 1995 - 2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/12/1995	surface	13.0		186					MJM Research
11/2/1995	surface	0.0		176			12.0	1.1	MJM Research
	1.6	0.1		176			12.0	1.1	MJM Research
	3.3	0.2		176			12.0	1.1	MJM Research
	4.9	0.5		178			12.0	1.1	MJM Research
	6.6	0.5		182			12.0	1.1	MJM Research
	8.2	0.8		182			12.0	1.1	MJM Research
	9.8	1.2		182			12.0	1.1	MJM Research
	11.5	1.9		201			12.0	1.1	MJM Research
7/9/1997	surface	8.7	11.9	126	7.9				MJM Research
7/11/1997	surface	7.4	11.6	127					MJM Research
7/13/1997	surface	8.1	9.7	128					MJM Research
7/14/1997	surface	8.0	11.3	127					MJM Research
7/15/1997	surface	10.0	11.8	128					MJM Research
8/3/1997	surface	14.2	10.5	129	8.1				MJM Research
2/8/2001	6.0	1.3	9.7	347	8.1	0	23.1	4.8	URS
	12.0	1.6	8.2	347	8.2	0	23.1	4.8	URS
	18.0	1.8	6.7	339	7.9	0	23.1	4.8	URS
2/21/2001	12.0	1.8	6.3	325	7.3	0	25.0*	5.1	URS
	16.0	1.9	6.0	299	7.3	1	25.0*	5.1	URS
	22.0	1.4	4.7	251	6.9	3	25.0*	5.1	URS
3/7/2001	6.5	1.9	7.9	353	7.2	0	24.3	5.3	URS
	12.0	2.3	6.1	346	7.0	0	24.3	5.3	URS
	18.0	2.3	5.8	350	6.7	0	24.3	5.3	URS
3/20/2001	7.0	2.6	7.4	367	7.2	0	24.9	5.7	URS
	15.5	2.7	7.8	364	7.0	0	24.9	5.7	URS
	23.5	3.2	7.5	362	6.8	0	24.9	5.7	URS
4/3/2001	12.0	2.9	9.0	377	7.2	0	22.7	6.0	URS
	18.0	3.0	8.2	376	7.1	0	22.7	6.0	URS
	22.0	3.1	8.7	375	6.7	0	22.7	6.0	URS
4/19/2001	16.0	4.4	10.3	359	7.0	0	25.2	6.2	URS
	18.0	5.2	9.3	349	6.8	0	25.2	6.2	URS
	22.0	5.7	10.4	341	6.5	0	25.2	6.2	URS
4/28/2001	10.0	4.2	10.1	373	7.7	0	23.6	6.1	URS
	14.0	4.2	8.7	375	7.7	0	23.6	6.1	URS
	18.0	4.1	8.9	378	7.8	0	23.6	6.1	URS
7/31/2001	surface	10.8	9.9	157	7.9	0.83			MJM Research
	3.3	10.8	9.7	145	7.8	1.2			MJM Research
	6.6	10.9	9.5	142	7.9	0.64			MJM Research
	10.8	10.9	9.4	142	7.9	1.1			MJM Research

Appendix Table A-1. Water chemistry measurements for lake L9310, 1995 - 2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
1/16/2002	5.0	11.3	0.4	210	7.7	0.5	20.9	4.00	MBJ 2002
	8.0	10.7	0.8	210	7.6	0.5	20.9	4.00	MBJ 2002
	11.0	9.5	1.6	222	7.6	0.5	20.9	4.0	MBJ 2002
	14.0	8.1	1.8	229	7.5	0.6	20.9	4.0	MBJ 2002
	17.0	6.1	2.0	242	7.5	0.9	20.9	4.0	MBJ 2002
	19.0	4.8	2.1	254	7.4	1.1	20.9	4.0	MBJ 2002
2/9/2002	6.0	0.5	10.2	451	7.6	0.7	21.4	5.0	MBJ 2002
	9.0	1.2	9.1	334	7.5	0.7	21.4	5.0	MBJ 2002
	12.0	1.6	8.5	320	7.4	0.8	21.4	5.0	MBJ 2002
	15.0	1.9	7.5	313	7.3	1.4	21.4	5.0	MBJ 2002
	18.0	2.0	5.4	310	7.2	1.8	21.4	5.0	MBJ 2002
	20.0	2.1	1.0	311	7.1	1.9	21.4	5.0	MBJ 2002
3/11/2002	6.5	2.5	9.1	352	7.2	0.8	18.5	5.6	MBJ 2002
	9.5	2.6	8.1	348	7.2	0.8	18.5	5.6	MBJ 2002
	12.5	2.4	7.1	345	7.1	0.8	18.5	5.6	MBJ 2002
	15.5	2.5	6.5	351	7.2	1.38	18.5	5.6	MBJ 2002
4/6/2002	7.5	1.3	7.9	660	7.8	0.7	21.1	6.3	MBJ 2002
	10.5	1.6	7.3	653	7.7	0.8	21.1	6.3	MBJ 2002
	13.5	1.9	6.4	637	7.6	0.9	21.1	6.3	MBJ 2002
	16.5	2.3	5.8	625	7.6	0.7	21.1	6.3	MBJ 2002
	19.5	2.3	5.3	639	7.6	0.8	21.1	6.3	MBJ 2002
8/14/2002	5.0	9.6	10.7	159	8.4	0.4	20.2		MBJ 2002
	8.0	9.4	11.1	160	8.6	0.5	20.2		MBJ 2002
	11.0	9.4	11.0	161	8.7	0.6	20.2		MBJ 2002
	14.0	9.4	10.9	161	8.7	0.5	20.2		MBJ 2002
	17.0	9.3	10.9	160	8.6	1.4	20.2		MBJ 2002
	19.0	9.3	10.8	160	8.7	0.5	20.2		MBJ 2002

* denotes soft lake bottom observed during field measurement

Appendix Table A-2. Water chemistry measurements for lake L9312, 1995 to 2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/13/1995	surface	13.4		60					MJM Research
11/2/1995	surface	0.0		136			12.0	1.0	MJM Research
	1.6	0.0		138			12.0	1.0	MJM Research
	3.3	0.5		132			12.0	1.0	MJM Research
	4.9	0.5		132			12.0	1.0	MJM Research
	6.6	0.8		132			12.0	1.0	MJM Research
	8.2	1.1		131			12.0	1.0	MJM Research
	9.8	1.7		132			12.0	1.0	MJM Research
	11.5	1.8		135			12.0	1.0	MJM Research
7/9/1997	surface	8.1	11.9	83	7.9				MJM Research
7/10/1997	surface	7.7	11.6	84	7.7				MJM Research
7/13/1997	surface	8.2	10.5	84					MJM Research
7/14/1997	surface	7.8	11.2	83					MJM Research
7/15/1997	surface	9.5	12.4	84					MJM Research
8/3/1997	surface	13.4	10.6	85	8.2				MJM Research
7/28/1999	surface	8.9	11.4	76					MJM Research
7/29/1999	surface	8.6	11.5	80					MJM Research
7/30/1999	surface	8.8		76					MJM Research
7/31/1999	surface	9.5		76					MJM Research
8/1/1999	surface	11.4		76					MJM Research
8/2/1999	surface	13.5		79					MJM Research
8/3/1999	surface	12.0		76					MJM Research
7/23/2000	surface				7.9				MJM Research
7/24/2000	surface	12.1		55					MJM Research
7/25/2000	surface	10.5	10.9	55					MJM Research
7/26/2000	surface	10.2	10.9	55					MJM Research
7/27/2000	surface	10.0	10.8	55					MJM Research
7/28/2000	surface	10.0		55					MJM Research
7/29/2000	surface	11.2	10.9	55					MJM Research
8/16/2000	surface	8.5		56					MJM Research
8/17/2000	surface	7.4		56					MJM Research
8/18/2000	surface	7.6		55					MJM Research
8/19/2000	surface	7.9		56					MJM Research
8/20/2000	surface	7.5		56					MJM Research
8/21/2000	surface	6.6		56					MJM Research
7/21/2000	surface	10.4	11.1	53		10.5			MJM Research
	4.9	10.0	11.2	53		7.6			MJM Research
	8.2	9.8	11.1	53		7.5			MJM Research
	11.5	9.6	11.1	53		8.6			MJM Research

Appendix Table A-2. Water chemistry measurements for lake L9312, 1995 to 2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
8/15/2000	surface	6.2	11.6	55		4.0			MJM Research
	4.9	6.0	11.7	55		4.1			MJM Research
	8.2	5.9	11.9	55		3.9			MJM Research
	11.5	5.9	11.7	55		5.7			MJM Research
2/8/2001	6.0	0.9	10.9	180	8.5	0	14.9	4.8	URS
	12.0	2.4	1.5	269	8.0	0	14.9	4.8	URS
2/21/2001	6.0	1.2	12.5	161	7.3	0	14.2*	5.1	URS
	8.0	2.2	10.8	149	7.3	0	14.2*	5.1	URS
	12.0	2.9	3.0	118	6.5	0	14.2*	5.1	URS
3/7/2001	6.5	1.4	11.2	178	7.4	0	14.1	5.4	URS
	9.5	2.4	7.8	181	7.8	0	14.1	5.4	URS
	13.0	3.0	4.4	162	6.9	0	14.1	5.4	URS
3/20/2001	7.0	2.3	11.0	169	7.3	0	14.8	5.7	URS
	10.0	3.0	7.5	193	7.6	0	14.8	5.7	URS
	13.5	3.2	2.5	152	6.3	0	14.8	5.7	URS
4/3/2001	8.0	3.0	10.2	186	7.0	0	14.4	6.1	URS
	10.0	3.5	7.0	185	6.8	0	14.4	6.1	URS
	12.0	3.7	6.8	184	6.7	0	14.4	6.1	URS
4/18/2001	12.0	4.3	5.7	208	7.1	0	14.6	6.4	URS
	13.0	4.2	3.3	252	6.8	0	14.6	6.4	URS
	14.0	4.2	1.6	236	7.0	0	14.6	6.4	URS
4/28/2001	8.0	4.3	10.6	195	7.8	0	15.4	6.2	URS
	10.0	4.5	11.2	197	7.8	0	15.4	6.2	URS
	12.0	4.5	11.1	197	7.8	0	15.4	6.2	URS
7/22/2001	surface	15.0	9.9	57	8.1	1.52			MJM Research
7/23/2001	surface	15.9	9.0	59	8.2	3.02			MJM Research
7/24/2001	surface	13.6	9.6	59	7.7	2.02			MJM Research
7/25/2001	surface	13.1	9.8	59	8.0	1.28			MJM Research
7/26/2001	surface	13.3	9.5	59	8.0	2			MJM Research
7/27/2001	surface	14.3	9.9	59					MJM Research
7/28/2001	surface	14.1	10.0	58	7.8	1.3			MJM Research
7/28/2001	surface	13.3	8.6	59	7.8	1.1			MJM Research
	3.3	13.4	8.7	59	7.8	1.1			MJM Research
	6.6	13.4	8.5	59	7.7	1.2			MJM Research
	10.8	13.4	8.5	59	7.6	1.7			MJM Research

Appendix Table A-2. Water chemistry measurements for lake L9312, 1995 to 2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
8/17/2001	surface	8.1	11.1	62	8.2	3.3			MJM Research
8/19/2001	surface	6.2	11.0	60	7.8	1.2			MJM Research
8/20/2001	surface	5.4	10.7	60	7.8	1.6			MJM Research
8/21/2001	surface	5.3	12.2	61	7.9	1.2			MJM Research
8/22/2001	surface	6.0	12.3	60	7.8	1.6			MJM Research
8/23/2001	surface	5.2	9.8	62	7.6	4.7			MJM Research
8/24/2001	surface				7.8	0.8			MJM Research
8/25/2001	surface	4.7	13.2	58	7.9	0.5			MJM Research
	3.3	4.7	13.2	58	7.9	0.7			MJM Research
	6.6	4.7	13.1	58	7.9	1			MJM Research
	10.8	4.7	13.0	58	7.9	0.5			MJM Research
1/16/2002	4	0.4	16.0	151	7.6	0.3	11.40	3.10	MBJ 2002
	7	1.5	14.2	134	7.6	0.5	11.40	3.10	MBJ 2002
	10	2.5	9.8	126	7.5	0.4	11.40	3.10	MBJ 2002
2/9/2002	5	0.6	15.9	152	7.5	1.2	11.40	3.9	MBJ 2002
	8	1.6	15.5	150	7.5	1.5	11.40	3.9	MBJ 2002
	10	2.3	13.7	145	7.2	2.1	11.40	3.9	MBJ 2002
3/11/2002	5	1.3	15.4	185	7.3	2.0	11.5	4.7	MBJ 2002
	8	2.1	14.3	171	7.3	1.6	11.5	4.7	MBJ 2002
	10	2.6	10.0	164	7.2	1.8	11.5	4.7	MBJ 2002
4/6/2002	6.5	2.0	9.7	159	6.9	0.6	11.7	5.4	MBJ 2002
	9.5	2.9	9.3	152	7.1	0.6	11.7	5.4	MBJ 2002
7/22/2002	surface	15.4	9.5	61					MJM Research
7/23/2002	surface	14.0	9.8	61	7.5	0.7			MJM Research
7/24/2002	surface	13.5	9.9	62	7.3				MJM Research
7/25/2002	surface	10.9	10.3	62	7.6	1.5			MJM Research
7/26/2002	surface	10.8	10.6	61	7.7	0.9			MJM Research
7/27/2002	surface	10.7	10.8	62	7.8	1.0			MJM Research
7/28/2002	surface	9.9	10.8	62	7.8	0.8			MJM Research
7/29/2002	surface	11.2	11.4	61	8.3	1.1			MJM Research
8/7/2002	surface	9.7	10.9	63	8.1	1.1			MJM Research
	3.3	9.7	10.8	63	8.1	1.3			MJM Research
	6.6	9.7	10.8	63	8.1	1.2			MJM Research
	9.8	9.7	10.7	63	8.1	1.2			MJM Research
8/14/2002	4	9.4	11.3	68	8.2	1.1	11.9		MBJ 2002
	7	9.3	11.3	70	8.0	1.3	11.9		MBJ 2002
	10	9.3	11.2	71	7.8	1.2	11.9		MBJ 2002

Appendix Table A-2. Water chemistry measurements for lake L9312, 1995 to 2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance microS/cm	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
8/21/2002	surface	5.6	12.0	62	7.7	4.9			MJM Research
8/22/2002	surface	5.5	11.5	62	7.4	2.5			MJM Research
8/23/2002	surface	7.0	12.2	62	7.6	2.2			MJM Research
8/24/2002	surface				7.4	1.5			MJM Research
8/25/2002	surface	7.4	11.2	62	7.4	1.7			MJM Research
8/26/2002	surface	8.1	11.6	63	7.3	1.8			MJM Research
8/27/2002	surface	8.7	12.3	62	7.4	1.5			MJM Research
7/21/2003	surface	17.5	9.5	72					MJM Research
7/22/2003	surface	14.9	10.5	70	8.1	0.7			MJM Research
7/23/2003	surface	14.0	10.3	71	7.8	2.3			MJM Research
7/24/2003	surface	13.7	10.1	71	7.6	1.5			MJM Research
7/25/2003	surface	11.1	9.9	72	7.3	18.0			MJM Research
7/26/2003	surface	9.7	10.5	72	7.4	10.5			MJM Research
7/28/2003	surface	7.0	10.9	71	7.5	12.5			MJM Research
8/15/2003	surface	7.2	12.1	67	7.8	0.9			MJM Research
8/16/2003	surface	7.0	11.8	70	7.5	1.4			MJM Research
8/17/2003	surface	6.5	12.0	67	7.6	0.8			MJM Research
8/18/2003	surface	6.8	12.4	71	7.6	1.0			MJM Research
8/19/2003	surface	6.5	12.2	67	7.6	0.9			MJM Research
8/20/2003	surface	6.1	12.1	67	7.6	0.9			MJM Research
8/21/2003	surface	5.9	12.2	67	7.6	1.2			MJM Research
8/22/2003	surface	5.5	12.5	68	7.6	0.8			MJM Research

* denotes soft lake bottom observed during field measurement

Appendix Table A-3. Water chemistry measurements for lake L9313, 1995-2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/13/1995	surface	13.1		107					MJM Research
10/31/1995	surface	0.0		189			8.5	1.0	MJM Research
	1.6	0.1		189			8.5	1.0	MJM Research
	3.3	0.2		188			8.5	1.0	MJM Research
	4.9	0.4		187			8.5	1.0	MJM Research
	6.6	0.9		182			8.5	1.0	MJM Research
	8.2	1.0		170			8.5	1.0	MJM Research
7/9/1997	surface	7.9	11.2	123	7.7				MJM Research
7/10/1997	surface	7.7	11.6	127	7.7				MJM Research
7/11/1997	surface	8.6	11.6	125					MJM Research
7/13/1997	surface	8.1	11.1	128					MJM Research
7/14/1997	surface	7.7	11.0	127					MJM Research
7/15/1997	surface	9.4	12.2	127					MJM Research
7/28/1999	surface	8.8	12.3	172	7.8				MJM Research
7/29/1999	surface	8.3	11.6	178					MJM Research
7/30/1999	surface	8.6		170					MJM Research
7/31/1999	surface	9.4		171					MJM Research
8/1/1999	surface	11.4		171					MJM Research
8/2/1999	surface	12.5		177					MJM Research
8/3/1999	surface	12.7		171					MJM Research
7/23/2000	surface				8.0				MJM Research
7/25/2000	surface	11.2	10.9	167					MJM Research
7/26/2000	surface	10.6	11.2	167					MJM Research
7/27/2000	surface	10.3		169					MJM Research
7/28/2000	surface	10.3	11.1	167					MJM Research
7/29/2000	surface	10.6		169					MJM Research
8/16/2000	surface	8.5		172					MJM Research
8/17/2000	surface	7.5		170					MJM Research
8/18/2000	surface	7.6		175					MJM Research
8/19/2000	surface	8.0		175					MJM Research
8/20/2000	surface	7.5		177					MJM Research
8/21/2000	surface	6.9		175					MJM Research
7/18/2000	surface	11.2	10.6	162		3.6			MJM Research
	4.9	11.1	10.5	162		3.3			MJM Research
	8.2	10.8	10.8	163		3.3			MJM Research
	11.5	10.8	10.9	163		3.5			MJM Research
8/15/2000	surface	6.6	12.3	170		5.5			MJM Research
	4.9	5.9	12.4	171		5.7			MJM Research
	8.2	5.7	12.6	171		15.0			MJM Research
	11.5	5.7	12.5	171		7.5			MJM Research

Appendix Table A-3. Water chemistry measurements for lake L9313, 1995-2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2001	6.0	0.8	7.8	491	7.9	0	9.5	4.6	URS
2/21/2001	6.0	2.5	5.7	561	6.4	0	9.4*	5.0	URS
	7.5	2.0	5.5	580	6.5	1	9.4*	5.0	URS
	8.0	2.2	5.3	579	6.6	3	9.4*	5.0	URS
3/7/2001	6.5	1.0	4.0	519	6.9	0	9.6	5.2	URS
	8.5	0.8	4.1	517	6.9	0	9.6	5.2	URS
3/20/2001	6.5	1.1	4.0	408	9.0	0	9.6	5.5	URS
	8.5	2.1	3.8	549	8.7	0	9.6	5.5	URS
4/3/2001	6.0	1.3	3.3	634	7.0	56	9.5	5.8	URS
	8.0	2.6	3.9	526	6.7	128	9.5	5.8	URS
4/18/2201	7.5	2.5	2.5	842	7.1	0	9.6	6.1	URS
	8.0	3.6	2.1	785	7.0	0	9.6	6.1	URS
	9.5	4.1	2.0	769	6.8	0	9.6	6.1	URS
4/28/2001	7.0	2.4	3.8	623	7.2	0	9.6	6.1	URS
	8.0	2.7	3.4	671	7.3	0	9.6	6.1	URS
7/22/2001	surface	15.5	9.3	245	8.1	3.2			MJM Research
7/23/2001	surface	15.6	9.1	247	8.0	6.4			MJM Research
7/24/2001	surface	14.1	9.1	247	7.7	2.8			MJM Research
7/25/2001	surface	13.2	9.2	249	7.9	1.9			MJM Research
7/26/2001	surface	13.5	10.2	257	8.0	1.5			MJM Research
7/27/2001	surface	14.1	9.7	247	7.9	2.3			MJM Research
7/28/2001	surface	13.7	9.7	248	7.9	2.5			MJM Research
7/25/2001	surface	13.2	9.2	249	8.0	1.7			MJM Research
	3.3	13.6	9.5	247	8.0	1.4			MJM Research
	6.6	13.6	9.5	247	8.0	1.3			MJM Research
	10.8	13.7	10.0	247	7.9	4.6			MJM Research
8/17/2001	surface	7.0	10.2	255	7.8	1.8			MJM Research
8/19/2001	surface	6.0	10.1	255	7.7	1.4			MJM Research
8/20/2001	surface	5.4	11.3	254	8.0	2.4			MJM Research
8/21/2001	surface	5.5	12.4	253	7.8	1.6			MJM Research
8/22/2001	surface	5.7	12.9	253	7.7	1.5			MJM Research
8/23/2001	surface	5.0	10.1	264	7.9	5.8			MJM Research
8/24/2001	surface				7.8	1.4			MJM Research
8/25/2001	surface	4.4	12.6	249	8.0	0.7			MJM Research
	3.3	4.4	12.6	249	8.0	0.7			MJM Research
	6.6	4.5	12.5	248	8.0	1			MJM Research
	10.8	4.5	12.4	248	8.0	2			MJM Research

Appendix Table A-3. Water chemistry measurements for lake L9313, 1995-2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
1/16/2002	4.7	0.6	10.8	573	8.2	0.6	9.4	3.7	MBJ 2002
	7.7	1.9	9.5	623	7.5	0.6	9.4	3.7	MBJ 2002
2/9/2002	5.3	1.1	7.1	764	7.1	1.1	9.5	4.4	MBJ 2002
	8.3	2.1	6.0	723	7.1	1.1	9.5	4.4	MBJ 2002
3/12/2002	6	1.7	3.8	805	6.3	1.1	9.5	5.4	MBJ 2002
	9	2.2	2.8	836	6.3	1.2	9.5	5.4	MBJ 2002
4/7/2002	6.8	1.4	0.1	910	6.9	0.9	9.4	5.8	MBJ 2002
	8.0	2.1	0.0	1066	6.9	0.9	9.4	5.8	MBJ 2002
5/11/2002	7.0	3.1	4.0	894	7.3	13.9	9.5	5.9	MBJ 2002
7/22/2002	surface	15.7	9.3	201	7.5	1.1			MJM Research
7/23/2002	surface	14.4	9.5	202	7.4	0.9			MJM Research
7/24/2002	surface	13.7	10.2	201	7.5	5.3			MJM Research
7/25/2002	surface	11.6	10.1	202	7.5	1.5			MJM Research
7/26/2002	surface	10.6	10.8	202	7.6	1.3			MJM Research
7/27/2002	surface	10.9	11.1	202	7.5	1.0			MJM Research
7/28/2002	surface	10.6	11.1	207	7.7	1.0			MJM Research
7/29/2002	surface	11.0	11.5	203	8.2	1.4			MJM Research
8/3/2002	surface	15.3	10.0	176	8.2	0.9			MJM Research
	3.3	15.2	9.9	176	8.1	0.9			MJM Research
	6.6	15.1	9.9	176	8.1	0.9			MJM Research
	9.8	15.1	9.7	176	8.1	0.7			MJM Research
8/14/2002	4.7	9.5	11.4	241		1.0	9.5		MBJ 2002
	7.7	9.4	11.4	244		1.6	9.5		MBJ 2002
8/21/2002	surface	5.3	11.8	208	7.9	3.1			MJM Research
8/22/2002	surface	5.5	11.6	208	7.6	3.7			MJM Research
8/23/2002	surface	6.4	11.5	208	7.6	2.8			MJM Research
8/24/2002	surface	6.4	11.8	213	7.5	3.1			MJM Research
8/25/2002	surface	8.1	11.9	208	7.6	2.9			MJM Research
8/26/2002	surface	9.2	11.1	209	7.6	1.7			MJM Research
8/27/2002	surface	9.4	12.2	209	7.7	2.2			MJM Research
4/28/2003	4.5	1.5	0.3	390	7.4		8.8	4.2	MBJ 2003
4/28/2003	7.5	1.9	0.1	420	7.0		8.8	4.2	MBJ 2003
4/28/2003	5.0	0.8	2.7	280	6.7		6.2	4.6	MBJ 2003
4/28/2003	5.0	1.0	0.9	310	6.5		8.8	4.8	MBJ 2003
4/28/2003	8.0	1.0	0.5	400	6.1		8.8	4.8	MBJ 2003
4/28/2003	5.0	2.0	0.6	430	6.6		8.2	4.9	MBJ 2003
4/28/2003	8.0	2.0	0.9	400	6.2		8.2	4.9	MBJ 2003
4/28/2003	4.5	2.0	0.8	390	6.6		8.1	4.2	MBJ 2003
4/28/2003	7.5	2.0	0.6	390	6.6		8.1	4.2	MBJ 2003

Appendix Table A-3. Water chemistry measurements for lake L9313, 1995-2003.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
5/9/2003	4.5	1.0	0.6	300	7.9		9.2	4.3	MBJ 2003
5/9/2003	7.5	2.0	0.1	300	7.3		9.2	4.3	MBJ 2003
5/9/2003	5.0	2.0	2.6	300	7.3		6.7	4.4	MBJ 2003
5/9/2003	5.0	3.0	1.1	400	7.3		9.4	4.9	MBJ 2003
5/9/2003	8.0	3.0	0.9	400	6.9		9.4	4.9	MBJ 2003
5/9/2003	5.5	2.0	2.3	300	7.1		8.8	5.1	MBJ 2003
5/9/2003	8.5	2.0	2.2	400	6.8		8.8	5.1	MBJ 2003
5/9/2003	5.0	2.0	1.5	300	6.8		8.4	4.3	MBJ 2003
5/9/2003	8.0	2.0	0.0	300	6.4		8.4	4.3	MBJ 2003
5/9/2003	5.0	2.0	1.5	410	6.8		9.2	4.7	MBJ 2003
5/9/2003	8.0	2.0	0.0	410	6.2		9.2	4.7	MBJ 2003
5/9/2003	5.0	2.0	1.8	420	6.5		9.0	4.7	MBJ 2003
5/9/2003	8.0	2.0	1.6	430	6.3		9.0	4.7	MBJ 2003
5/9/2003	5.0	1.0	2.9	290	6.7		8.6	4.6	MBJ 2003
5/9/2003	8.0	2.0	2.3	400	6.5		8.6	4.6	MBJ 2003
7/21/2003	surface	16.1	10.4	295					MJM Research
7/22/2003	surface	15.7	10.0	296	8.0	0.8			MJM Research
7/23/2003	surface	14.6	9.9	295	8.0	1.4			MJM Research
7/24/2003	surface	14.3	9.9	295	7.7	1.7			MJM Research
7/25/2003	surface	12.2	9.8	296	7.7	3.9			MJM Research
7/26/2003	surface	11.1	10.4	295	7.8	3.4			MJM Research
7/28/2003	surface	7.8	11.3	297	7.7	8.6			MJM Research
8/15/2003	surface	6.8	12.4	285	7.7	2.2			MJM Research
8/16/2003	surface	6.7	11.8	301	7.7	1.5			MJM Research
8/17/2003	surface	6.5	11.8	285	7.7	1.2			MJM Research
8/18/2003	surface	6.6	12.1	306	7.7	1.1			MJM Research
8/19/2003	surface	6.3	12.2	287	7.7	0.9			MJM Research
8/20/2003	surface	6.3	12.3	289	7.7	1.3			MJM Research
8/21/2003	surface	6.0	12.3	292	7.7	0.9			MJM Research
8/22/2003	surface	6.2	12.8	287	7.7	0.7			MJM Research

* denotes soft lake bottom observed during field measurement

Appendix Table A-4. Water chemistry measurements for lake B8534/L9282, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/18/1995	surface	15.3		276					MJM Research
7/17/1998	surface	13.3	10.5	280					MJM Research
7/17/1998	surface	13.6	10.2	279					MJM Research
7/18/1998	surface	13.1	10.2	282					MJM Research
7/18/1998	surface	13.1	10.1	282					MJM Research
7/18/1998	surface	12.3	9.1	284					MJM Research
7/19/1998	surface	13.6	10.3	281					MJM Research
7/19/1998	surface	13.6	10.1	282					MJM Research
7/19/1998	surface	13.7	10.3	282					MJM Research
7/20/1998	surface	14.1	10.3	281					MJM Research
7/20/1998	surface	14.4	10.3	282					MJM Research
7/20/1998	surface	14.4	10.7	285					MJM Research
7/21/1998	surface	14.2	10.3	282					MJM Research
7/21/1998	surface	14.5	10.4	282					MJM Research
7/21/1998	surface	14.3	9.9	282					MJM Research
7/22/1998	surface	14.6	10.2	282					MJM Research
7/22/1998	surface	14.5	10.3	282					MJM Research
7/22/1998	surface	14.1	10.2	273					MJM Research
7/24/1998	surface	12.6	10.4	282					MJM Research
7/24/1998	surface	13.1	9.9	283					MJM Research
2/8/2001	6.0	1.0	11.4	777	8.4	0	23.6	4.9	URS
	12.0	1.7	10.2	726	8.3	0	23.6	4.9	URS
	18.0	2.2	9.9	696	8.2	0	23.6	4.9	URS
3/7/2001	6.5	1.4	8.2	754	7.5	0	24.6	5.4	URS
	12.0	2.1	8.3	722	7.4	0	24.6	5.4	URS
	18.0	2.6	7.1	706	7.1	10*	24.6	5.4	URS
4/3/2001	12.0	2.5	8.7	786	7.5	0	23.8	5.9	URS
	18.0	2.5	8.7	814	7.3	0	23.8	5.9	URS
	22.0	2.6	8.7	813	6.9	0	23.8	5.9	URS
4/28/2001	12.0	4.3	9.7	759	8.2	0	23.7	6.2	URS
	18.0	4.0	9.9	808	8.0	0	23.7	6.2	URS
	22.0	3.9	9.7	811	7.6	0	23.7	6.2	URS
8/5/2001	surface	7.8	10.7	286	8.2	2.8			MJM Research
1/16/2002	4.8	0.5	9.1	464	7.9	1.4	21.0	3.8	MBJ 2002
	7.8	1.0	8.2	447	7.8	0.7	21.0	3.8	MBJ 2002
	10.8	1.2	10.0	462	7.8	0.5	21.0	3.8	MBJ 2002
	13.8	1.8	10.4	546	7.7	0.4	21.0	3.8	MBJ 2002
	16.8	2.0	9.0	572	7.6	0.6	21.0	3.8	MBJ 2002
	19.8	2.3	7.3	570	7.8	0.6	21.0	3.8	MBJ 2002

Appendix Table A-4. Water chemistry measurements for lake B8534/L9282, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2002	5.0	1.0	11.8	646	7.7	0.5	21.0	4.9	MBJ 2002
	8.0	1.0	10.8	665	7.6	0.5	21.0	4.9	MBJ 2002
	11.0	2.0	10.6	642	7.6	0.5	21.0	4.9	MBJ 2002
	14.0	2.0	10.7	642	7.6	0.7	21.0	4.9	MBJ 2002
	17.0	2.0	10.8	642	7.6	0.9	21.0	4.9	MBJ 2002
	20.0	2.0	10.1	642	7.7	0.8	21.0	4.9	MBJ 2002
3/11/2002	6.0	1.0	9.4	763	7.4	1.4	21.1	5.4	MBJ 2002
	9.0	1.1	9.1	756	7.3	1.9	21.1	5.4	MBJ 2002
	12.0	1.5	8.8	740	7.3	0.9	21.1	5.4	MBJ 2002
	15.0	1.7	8.3	733	7.3	1.0	21.1	5.4	MBJ 2002
	18.0	1.9	8.2	719	7.2	1.0	21.1	5.4	MBJ 2002
4/6/2002	7.0	1.3	7.9	660	7.8	0.7	21.0	5.8	MBJ 2002
	10.0	1.6	7.3	653	7.7	0.8	21.0	5.8	MBJ 2002
	13.0	1.9	6.4	637	7.6	0.9	21.0	5.8	MBJ 2002
	16.0	2.3	5.8	625	7.6	0.7	21.0	5.8	MBJ 2002
	19.0	2.3	5.3	639	7.6	0.8	21.0	5.8	MBJ 2002
5/11/2002	7.0	2.0	10.4	553	6.9	3.5	20.8	6.0	MBJ 2002
	10.0	2.6	9.1	699	7.1	1.2	20.8	6.0	MBJ 2002
	13.0	2.8	7.4	712	7.1	0.7	20.8	6.0	MBJ 2002
	16.0	2.9	6.6	709	7.1	0.6	20.8	6.0	MBJ 2002
	19.0	2.7	5.7	732	7.2	1.1	20.8	6.0	MBJ 2002
8/14/2002	5.0	8.9	10.7	331	8.7	0.6			MBJ 2002
	8.0	8.9	10.6	331	8.8	0.8			MBJ 2002
	11.0	8.8	10.6	332	8.8	0.7			MBJ 2002
	14.0	8.8	10.6	332	8.8	0.6			MBJ 2002
	17.0	8.8	10.6	332	8.9	0.9			MBJ 2002
	20.0	8.8	10.5	332	8.9	0.6			MBJ 2002

Appendix Table A-5. Water chemistry measurements for lake L9283, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/18/1995	surface	16.8		234					MJM Research
2/8/2001	6.0	0.5	7.8	1,043	7.8	0	8.5	4.8	URS
3/7/2001	6.5	1.1	3.9	999	6.9	0	8.6	5.4	URS
3/7/2001	7.0	1.4	3.9	950	6.5	0	8.6	5.4	URS
4/3/2001	7.5	1.9	2.7	1,238	7.0	0	9.0	6.1	URS
4/28/2001	7.0	1.1	4.4	1,078	7.1	0	8.9	6.4	URS
4/28/2001	8.0	1.8	4.0	1,033	8.1	0	8.9	6.4	URS
8/5/2001	surface	7.1	11.1	333	8.1	1.7			MJM Research
1/16/2002	5.0	0.5	12.9	838	6.9	1.2	9.0	4.0	MBJ 2002
	8.0	0.9	12.1	850	7.2	0.8	9.0	4.0	MBJ 2002
2/8/2002	6.0	1.0	7.9	831	7.5	0.8	8.7	5.1	MBJ 2002
	7.0	1.0	8.7	812	7.5	1.0	8.7	5.1	MBJ 2002
3/11/2002	7.0	1.0	9.8	1,008	7.7	3.4	9.0	6.1	MBJ 2002
	8.0	2.0	10.2	945	7.5	6.0	9.0	6.1	MBJ 2002
4/6/2002	7.3	0.6	2.2	1,199	7.4	1.4	9.0	6.3	MBJ 2002
5/11/2002	7.7	2.3	1.7	1,253	7.2	2.1	9.1	6.7	MBJ 2002
8/14/2002	5.0	8.1	11.1	310	8.5	0.8	8.9		MBJ 2002
	8.0	8.0	11.0	312	8.5	0.9	8.9		MBJ 2002

Appendix Table A-6. Water chemistry measurements for lake L9275, 2001-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
2/8/2001	8.0	2.2	13.4	519	7.1	0	16.1	4.8	URS
	12.0	2.1	10.1	525	7.2	0	16.1	4.8	URS
3/7/2001	6.5	1.8	9.2	449	7.6	0	16.2	5.4	URS
	10.0	2.2	9.3	381	7.4	0	16.2	5.4	URS
	15.0	3.1	5.4	309	6.9	0	16.2	5.4	URS
4/3/2001	8.0	2.8	11.3	547	7.7	0	16.2	6.0	URS
	12.0	3.3	11.2	547	7.5	0	16.2	6.0	URS
	16.0	3.5	10.9	562	6.5	0	16.2	6.0	URS
4/28/2001	8.0	4.4	10.9	529	8.3	0	16.1	6.2	URS
	10.0	4.7	11.1	523	8.3	0	16.1	6.2	URS
	14.0	4.9	12.5	497	8.3	0	16.1	6.2	URS
8/5/2001	surface	7.1	11.4	210	8.1	2.4			MJM Research
1/15/2002	4.8	1.0	14.4	419	8.4	0.8	12.5	3.8	MBJ 2002
	7.8	1.4	14.4	402	8.7	0.6	12.5	3.8	MBJ 2002
	10.8	1.9	13.6	395	8.8	0.4	12.5	3.8	MBJ 2002
2/8/2002	5.2	1.0	12.6	499	7.6	0.6	12.5	4.2	MBJ 2002
	8.2	2.0	12.4	464	7.4	0.6	12.5	4.2	MBJ 2002
	11.2	2.0	12.0	464	7.5	0.6	12.5	4.2	MBJ 2002
3/11/2002	5.0	0.6	11.6	569	7.2	1.3	12.8	5.0	MBJ 2002
	8.0	1.3	11.6	541	7.6	0.9	12.8	5.0	MBJ 2002
	11.0	1.9	11.4	501	7.8	0.9	12.8	5.0	MBJ 2002
4/6/2002	6.5	1.3	9.5	493	6.9	0.7	12.7	5.4	MBJ 2002
	9.5	1.9	8.4	474	7.0	0.6	12.7	5.4	MBJ 2002
	11.0	2.2	8.5	464	7.2	0.6	12.7	5.4	MBJ 2002
8/13/2002	5.0	8.9	11.3	241	9.0	0.6	12.5		MBJ 2002
	8.5	8.9	11.4	241	9.0	0.5	12.5		MBJ 2002
	11.0	8.9	11.4	241	8.9	0.5	12.5		MBJ 2002

Appendix Table A-7. Water chemistry measurements for lake L9342, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
7/12/1995	surface	12.7		84					MJM Research
11/2/1995	surface	0.2		186		0.0	8.9	1.1	MJM Research
11/2/1995	surface	0.3		185		0.5	8.9	1.1	MJM Research
11/2/1995	3.3	0.5		184		1.0	8.9	1.1	MJM Research
11/2/1995	4.9	0.7		183		1.5	8.9	1.1	MJM Research
11/2/1995	6.6	1.0		183		2.0	8.9	1.1	MJM Research
11/2/1995	8.2	1.1		184		2.5	8.9	1.1	MJM Research
									MJM Research
4/17/2000	8.2	2.1	5.5	315			11.5	6.5	MJM Research
4/18/2000	8.2	1.8	4.8	339			9.0	6.5	MJM Research
4/18/2000	6.6	0.8	5.3	342			6.8	6.5	MJM Research
4/18/2000	6.0	0.8	5.5	325			6.2	6.0	MJM Research
4/18/2000	6.6	0.8	5.8	338			6.7	6.5	MJM Research
4/19/2000	8.2	2.4	4.7	340			9.1	6.5	MJM Research
4/19/2000	8.2	2.8	4.8	335			11.3	6.5	MJM Research
4/19/2000	8.2	2.2	5.2	337			10.0	6.5	MJM Research
4/19/2000	6.6	0.4	5.0	357			7.5	6.5	MJM Research
4/19/2000	5.7	0.1	5.6	297			6.0	5.8	MJM Research
2/8/2001	5.0	1.5	8.3	348	8.3	0.0	12.8	4.8	URS
2/8/2001	11.0	3.0	5.2	355	8.0	1.0	12.8	4.8	URS
3/7/2001	6.5	1.8	7.9	359	7.0	0.0	12.7	5.3	URS
3/7/2001	11.0	2.8	8.0	335	7.0	0.0	12.7	5.3	URS
4/3/2001	8.0	2.4	8.9	292	7.1	0.0	13.3	6.0	URS
4/3/2001	12.0	3.5	9.3	227	6.9	0.0	13.3	6.0	URS
4/28/2001	8.0	3.0	6.5	448	7.4	0.0	13.2	6.2	URS
4/28/2001	12.0	4.3	6.0	417	7.5	0.0	13.2	6.2	URS
7/31/2001	surface	10.7	9.9	123	7.7	1.1			MJM Research
7/31/2001	3.3	10.6	10.1	117	7.7	1.8			MJM Research
7/31/2001	6.6	10.6	10.2	115	7.7	0.8			MJM Research
7/31/2001	10.8	10.6	9.7	114	7.7	0.8			MJM Research
1/16/2002	5.0	0.6	10.0	275	7.7	0.4	11.3	4.0	MBJ 2002
	8.0	1.4	9.6	262	7.5	0.3	11.3	4.0	MBJ 2002
	10.0	1.9	8.1	270	7.2	0.4	11.3	4.0	MBJ 2002
2/9/2002	5.7	1.3	10.0	322	6.5	0.7	11.3	4.7	MBJ 2002
	8.7	1.9	9.3	306	6.7	0.6	11.3	4.7	MBJ 2002
	10.0	2.4	7.2	299	6.8	0.9	11.3	4.7	MBJ 2002
3/11/2002	6.5	1.1	8.5	383	6.2	1.4	10.8	5.5	MBJ 2002
	9.5	2.1	8.1	361	6.4	1.6	10.8	5.5	MBJ 2002

Appendix Table A-7. Water chemistry measurements for lake L9342, 1995-2002.

Date	Sample Depth (ft)	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Total Depth (ft)	Ice Thickness (ft)	Source
4/6/2002	7.0	1.8	5.7	345	7.6	0.5	11.2	6.0	MBJ 2002
	10.0	2.4	4.5	348	7.4	0.4	11.2	6.0	MBJ 2002
5/11/2002	7.2	2.4	6.8	317	6.3	5.0	11.2	6.2	MBJ 2002
	10.2	3.2	6.3	411	6.3	1.6	11.2	6.2	MBJ 2002
8/14/2002	5.0	8.9	11.0	130	8.3	0.8	11.8		MBJ 2002
	8.0	8.8	10.9	132	8.3	0.5	11.8		MBJ 2002
	10.0	8.8	10.8	132	8.4	0.4	11.8		MBJ 2002

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 [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
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
B8534	1985					103		Bendock & Burr 1986
(L9282)	1992	43	1.5	10.6	19	91	240	J. Lobdell
L9283	1992	2.8	1.8	3.2	29	86	110	J. Lobdell
L9275	1985					103		Bendock & Burr 1986
	1992	13	6.2	9.8	22	95	140	J. Lobdell
L9342	1993	14	5.3	3.2	7.4	32	87	J. Lobdell

APPENDIX B
Catch Data from lakes L9312 and L9313
For 1995 to 2003

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-3. Catches of fish from Alpine Area Lakes fyke net sampling, 2000.

Species	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul 29	July Total	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug Total
L9312																
Broad whitefish	3	0	0	0	2	0	0	5	1	1	0	1	1	0	0	4
Humpback whitefish	3	6	6	3	4	3	2	27	8	4	1	1	1	0	0	15
Arctic cisco	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	5
Least cisco	196	680	380	32	17	14	30	1,349	25	47	45	17	35	12	15	196
Round whitefish	0	3	1	1	1	0	1	7	3	5	6	0	0	0	3	17
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Longnose sucker	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Alaska blackfish	4	3	5	4	3	2	1	22	17	12	15	4	17	18	19	102
Slimy sculpin	1	0	0	5	3	2	2	13	9	30	10	6	7	21	10	93
Ninespine stickleback	292	115	67	53	65	50	87	729	43	146	75	31	20	24	29	368
Net Hours:	18.0	27.4	24.3	25.4	23.7	22.8	26.7	168.3	27.4	18.1	24.2	27.0	27.0	21.2	20.8	165.7
L9313																
Broad whitefish	4	0	0	0	0	0	0	4	1	1	1	2	0	0	2	7
Humpback whitefish	0	0	0	0	0	0	0	0	4	0	0	0	1	0	0	5
Least cisco	0	0	0	0	0	0	0	0	2	0	1	1	0	0	1	5
Round whitefish	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	1	0	0	0	0	0	1
Alaska blackfish	2	10	5	1	0	2	3	23	10	15	20	13	10	13	19	100
Ninespine stickleback	256	200	116	44	53	45	65	779	49	133	41	32	27	26	24	332
Net Hours:	17.7	31.0	24.3	23.3	24.0	23.9	25.4	169.7	23.5	17.9	29.7	23.2	27.0	21.2	19.1	161.6

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

	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	July Total	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug 23	Aug 24	August Total
L9312																	
Broad whitefish	0	5	1	0	1	0	0	7	0		0	0	0	0	0	0	0
Humpback whitefish	0	0	1	0	0	0	0	1	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
Least cisco	8	28	16	1	0	1	2	56	24		64	8	2	65	53	12	228
Round whitefish	1	1	0	1	1	0	1	5	1		1	2	0	0	0	0	4
Burbot	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
Alaska blackfish	0	4	0	0	0	0	1	5	0		1	2	1	2	2	0	8
Fourhorn sculpin	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	11	10	2	49
Ninespine stickleback	16	28	15	3	6	12	9	89	20		18	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	23.0	23.4	26.8	187.8
L9313																	
Broad whitefish	0	1	0	0	0	0	1	2	0		0	1	0	0	0	2	3
Humpback whitefish	0	0	0	0	0	1	0	1	0		1	1	0	0	2	0	4
Least cisco	28	2	2	0	0	8	8	48	0		2	2	0	1	0	0	5
Round whitefish	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
Alaska blackfish	4	2	0	3	0	2	0	11	4		4	3	3	5	1	2	22
Ninespine stickleback	22	7	12	27	17	12	3	100	15		41	37	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	23.4	22.9	26.3	189.1

Appendix Table B-5. Catches of fish from Alpine Area Lakes fyke net sampling, 2002.

	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul 29	July Total	Aug 21	Aug 22	Aug 23	Aug 24	Aug 25	Aug 26	Aug 27	August Total
L9312																	
Broad whitefish	0	0	0	0	0	1	0	0	1	2	4	1	9	2	19	2	39
Humpback whitefish	0	0	0	0	0	0	0	0	0	2	1	1	4	8	16	32	64
Arctic cisco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Least cisco	0	54	65	15	4	1	0	3	142	2	5	308	25	2	34	276	652
Round whitefish	2	1	0	2	0	10	0	0	15	27	54	106	1	1	1	1	191
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
Longnose sucker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alaska blackfish	0	0	0	0	0	0	0	0	0	0	1	1	3	4	12	7	28
Fourhorn sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slimy sculpin	0	1	0	0	0	0	0	3	4	3	4	1	5	4	7	7	31
Ninespine stickleback	0	10	9	4	2	3	5	11	44	3	8	14	10	95	7	4	141
Effort (hrs)	27.1	26.5	24.6	19.8	29.3	25.4	16.0	31.0	199.7	28.6	19.8	25.6	23.5	24.1	23.7	25.0	170.3
L9313																	
Broad whitefish	31	10	11	19					71	1	18	22	20	22	46	46	175
Humpback whitefish	1			1					2	28		1		2			31
Least cisco	113	105	44	37	41		1	1	342	4	9	5	4	3	31	6	62
Round whitefish		1		1					2								0
Burbot									0								0
Alaska blackfish	2	1	3	1	2	1	1		11	5	9	5	8	10	21	32	90
Ninespine stickleback	59	58	40	7	11	11	12	29	227	25	21	137		78	363	64	688
Effort (hrs)	28.1	24.6	24.4	22.0	29.3	22.4	22.9	27.4	201.1	30.0	19.7	26.2	23.1	23.8	23.9	25.4	172.0

Appendix Table B-6. Catches of fish from Alpine Area Lakes fyke net sampling, 2003.

	Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	July Total	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	August Total
L9312																
Broad whitefish	0	0	0	0	0	0	0	0	18	0	0	0	1	2	0	21
Humpback whitefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctic cisco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Least cisco	101	101	380	89	3	0	15	689	57	35	13	9	21	47	151	333
Round whitefish	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Burbot	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Longnose sucker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alaska blackfish	0	1	0	0	0	0	0	1	1	2	4	0	3	1	20	31
Fourhorn sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slimy sculpin	0	1	0	0	0	0	1	2	0	0	4	0	2	3	3	12
Ninespine stickleback	7	20	12	16	6	0	4	65	3	10	2	0	0	0	2	17
Effort (hrs)	18.3	25.6	24.4	22.5	24.8	0.0	45.6	161.2	22.9	22.9	26.0	20.1	22.0	22.4	24.4	160.8
L9313																
Broad whitefish	8	2	2	1	8	0	3	24	0	1	0	0	1	0	0	2
Humpback whitefish	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Least cisco	110	23	7	0	91	0	12	243	11	12	12	90	13	2	12	152
Round whitefish	1	0	0	0	0	0	0	1	0	1	0	0	1	0	1	3
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alaska blackfish	0	0	0	0	0	0	0	0	3	0	0	2	0	5	1	11
Ninespine stickleback	40	21	11	4	7	0	0	83	9	15	0	15	0	0	23	62
Effort (hrs)	19.1	25.7	23.9	22.1	24.6	0.0	45.1	160.5	21.8	23.1	20.9	24.6	22.3	23.8	24.6	160.9

Appendix Table B-7. Tagged fish released in Alpine lakes L9312 and L9313 during 2001.

Lake	Species	Release Date	Release Length	Tag Code
L9312				
	Broad whitefisl	7/23/2001	400	MJM010250
		7/23/2001	362	MJM010426
		7/23/2001	320	MJM010427
		7/24/2001	486	MJM010432
L9313				
	Least cisco	7/23/2001	295	MJM010428
		7/24/2001	262	MJM010433
		8/22/2001	306	MJM011332
	Broad whitefisl	8/20/2001	270	MJM011338

Appendix Table B-8. Tagged fish released in Alpine lakes L9312 and L9313 during 2002.

Lake	Species	Release Date	Release Length	Tag Code	Recapture Date	Days Out
L9312						
	Broad whitefish	8/23/2002	285	MJM020503		
		8/24/2002	326	MJM020509		
	Humpback whitefish	8/22/2002	349	MJM020527		
		8/23/2002	350	MJM020502		
	Least cisco	7/22/2002	196	MJM020469		
		8/24/2002	352	MJM020507		
	Round whitefish	7/22/2002	264	MJM020470		
		7/25/2002	247	MJM020480		
		7/25/2002	281	MJM020482		
		8/25/2002	311	MJM020510		
		8/26/2002	282	MJM020561		
L9313						
	Broad whitefish	7/22/2002	240	MJM020473		
		7/22/2002	200	MJM020474		
		7/22/2002	181	MJM020476		
		7/22/2002	197	MJM020477		
		8/22/2002	386	MJM020528		
		8/22/2002	330	MJM020530		
		8/22/2002	375	MJM020531		
		8/22/2002	366	MJM020533		
		8/22/2002	340	MJM020534		
		8/23/2002	235	MJM020505	8/26/2002	3
		8/23/2002	331	MJM020506		
		8/25/2002	418	MJM020560		
		8/26/2002	200	MJM020537		
		8/26/2002	186	MJM020538		
		8/26/2002	515	MJM020562		
		8/26/2002	365	MJM020564		
		8/26/2002	189	MJM020565		
		8/27/2002	468	MJM020540		
	Least cisco	7/22/2001	281	MJM010243	7/22/2002	365
		7/22/2002	186	MJM020471		
		7/22/2002	215	MJM020472		
		7/22/2002	188	MJM020475	8/26/2002	35
		8/23/2002	250	MJM020504		
		8/26/2002	181	MJM020536		
		8/27/2002	369	MJM020539		

Appendix Table B-9. Tagged fish released in Alpine lakes L9312 and L9313 during 2003.

Lake	Species	Release Date	Release Length	Tag Code	Recapture Date	Days Out
L9312						
	Broad whitefish	8/20/2003	355	MJM021101		
		8/21/2003	345	MJM021102		
		8/21/2003	360	MJM021103		
	Least cisco	7/23/2003	184	MJM020656		
		7/23/2003	192	MJM020658		
		7/22/2003	185	MJM020666		
		7/22/2003	188	MJM020667		
		7/22/2003	186	MJM020668		
		7/22/2003	189	MJM020669		
		7/22/2003	182	MJM020670		
		7/22/2003	209	MJM020672		
		7/23/2003	193	MJM020676		
		7/23/2003	184	MJM020677		
		7/23/2003	187	MJM020679		
		7/23/2003	181	MJM020680		
		7/23/2003	180	MJM020681		
		7/23/2003	183	MJM020682		
		7/23/2003	181	MJM020684		
		7/23/2003	192	MJM020685		
		7/23/2003	185	MJM020687		
		7/23/2003	186	MJM020691		
		7/23/2003	193	MJM020693		
		7/23/2003	217	MJM020694		
		7/23/2003	195	MJM020695		
		7/23/2003	185	MJM020697		
		7/23/2003	183	MJM020699		
		7/23/2003	190	MJM020700		
		7/23/2003	183	MJM020711		
		7/23/2003	193	MJM020712		
		7/23/2003	211	MJM020715		
		7/23/2003	190	MJM020719		
		7/23/2003	181	MJM020720		
		7/23/2003	188	MJM020721		
		7/23/2003	195	MJM020724		
		7/23/2003	196	MJM020725		
		7/23/2003	195	MJM020933		
		7/23/2003	192	MJM020936		
		7/23/2003	185	MJM020937		
		7/23/2003	210	MJM020940		

Appendix Table B-9. Tagged fish released in Alpine lakes L9312 and L9313 during 2003.

Lake	Species	Release Date	Release Length	Tag Code	Recapture Date	Days Out
L9312						
	Least cisco	7/23/2003	198	MJM020941		
		7/23/2003	182	MJM020942		
		7/23/2003	187	MJM020944		
		7/23/2003	192	MJM020945		
		7/23/2003	185	MJM020946		
		7/23/2003	192	MJM020947		
		7/23/2003	181	MJM020949		
		7/23/2003	195	MJM020950		
		7/23/2003	189	MJM020952		
		7/23/2003	185	MJM020954		
		7/23/2003	190	MJM020957		
		7/23/2003	189	MJM020959		
		7/23/2003	190	MJM020962		
		7/23/2003	190	MJM020964		
		7/23/2003	186	MJM020966		
		7/23/2003	186	MJM020967		
		7/23/2003	191	MJM020971		
		7/23/2003	198	MJM020972		
		7/23/2003	186	MJM020975		
		7/23/2003	232	MJM021004		
		7/23/2003	188	MJM021005		
		7/23/2003	190	MJM021006		
		7/23/2003	193	MJM021007		
		7/23/2003	180	MJM021008		
		7/23/2003	185	MJM021010		
		7/23/2003	189	MJM021011		
		7/23/2003	186	MJM021012		
		7/23/2003	186	MJM021013		
		7/23/2003	190	MJM021015		
		7/23/2003	190	MJM021017		
		7/23/2003	190	MJM021018		
		7/23/2003	212	MJM021020		
		7/23/2003	195	MJM021021		
		7/23/2003	184	MJM021022		
		7/23/2003	190	MJM021026		
		7/23/2003	185	MJM021027		
		7/23/2003	180	MJM021028		
		7/23/2003	202	MJM021030		
		7/23/2003	185	MJM021031		

Appendix Table B-9. Tagged fish released in Alpine lakes L9312 and L9313 during 2003.

Lake	Species	Release Date	Release Length	Tag Code	Recapture Date	Days Out
L9312						
	Least cisco	7/23/2003	189	MJM021033		
		7/23/2003	188	MJM021035		
		7/25/2003	190	MJM021051		
		7/25/2003	186	MJM021052		
		7/25/2003	218	MJM021053		
		7/25/2003	195	MJM021054		
		7/25/2003	204	MJM021055		
		7/25/2003	185	MJM021056		
		7/24/2003	188	MJM021067		
		7/24/2003	197	MJM021068		
		7/24/2003	206	MJM021069		
		7/24/2003	190	MJM021070		
		7/24/2003	190	MJM021071		
		7/24/2003	188	MJM021072		
		7/24/2003	189	MJM021073		
		7/28/2003	184	MJM021083		
		7/28/2003	194	MJM021084		
		7/28/2003	199	MJM021085		
		7/28/2003	211	MJM021086		
		7/28/2003	194	MJM021087		
		7/28/2003	194	MJM021088		
		7/28/2003	244	MJM021089		
		7/26/2003	183	MJM021097		
		8/22/2003	238	MJM021104		
		8/16/2003	193	MJM021207		
		8/16/2003	194	MJM021208		
		8/16/2003	186	MJM021209		
		8/16/2003	206	MJM021210		
		8/17/2003	189	MJM021212		
		8/16/2003	212	MJM021213		
		8/18/2003	203	MJM021220		
		8/19/2003	194	MJM021221		
		8/19/2003	200	MJM021222		
		8/19/2003	201	MJM021223		
		8/19/2003	225	MJM021225		
	Round whitefish	7/22/2003	312	MJM020673		
		7/22/2003	350	MJM020674		
		7/23/2003	303	MJM020723		
		7/23/2003	266	MJM020943		

Appendix Table B-9. Tagged fish released in Alpine lakes L9312 and L9313 during 2003.

Lake	Species	Release Date	Release Length	Tag Code	Recapture Date	Days Out
L9313						
	Broad whitefish	7/23/2003	399	MJM021037		
	Humpback whitefish	7/24/2003	356	MJM021066		
	Least cisco	7/24/2003	356	MJM021066		
		7/23/2003	389	MJM021039	8/17/2003	25
		7/23/2003	226	MJM021040		
		7/23/2003	211	MJM021041		
		8/22/2003	319	MJM021105		
		8/17/2003	320	MJM021217		
		8/17/2003	327	MJM021218		
		8/19/2003	308	MJM021224		

APPENDIX C
Length Frequency Data from lakes L9312 and L9313
2003

Appendix Table C-1. Length frequencies of least cisco caught by fyke net in the Alpine study area, 2003.

Fork Length (mm)	**L9312** Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul Total	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug Total
0								0								0
10								0								0
20								0								0
30								0	7	5	1			6	11	30
40								0	28	13	4	2	1	21	111	180
50	1							1					1			1
60	1	1		1	1			4								0
70	5		8				1	14			1					1
80	39	1	105	11			5	161	2					1	2	5
90	39	2	237	41			2	321	10	3	2	2	5	6	10	38
100				5				5	3	2	1		10	5	10	31
110	1		1					2								0
120	2	2	6	5				15					2			2
130	4	5	5	17				31		2			2	5	4	13
140	1	2	2					5	1	3				2	1	7
150	1	1	5	2	1			10		4	1			1		6
160		4		1				5	1	2	1				1	5
170	1	9	4					14				1				1
180	5	38	3	2	1		1	50	1	1						2
190		30	3	2			4	39	2			1				3
200	1	1	1	1				4	1		1	2				4
210		4		1			1	6	1							1
220								0				1				1
230		1						1			1				1	2
240							1	1								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:	101	101	380	89	3	0	15	689	57	35	13	9	21	47	151	333

Appendix Table C-1. Length frequencies of least cisco caught by fyke net in the Alpine study area, 2003.

Fork Length (mm)	**L9313** Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 27	Jul 28	Jul Total	Aug 16	Aug 17	Aug 18	Aug 19	Aug 20	Aug 21	Aug 22	Aug Total
0								0								0
10								0								0
20	1							1								0
30								0			1	50	1			52
40								0		1	8	29	7		7	52
50		1						1			1	7	1		1	10
60	1							1								0
70								0								0
80	16	4			6		2	28								0
90	47	4			18		5	74	4	4			2	1	3	14
100	30	5			45		3	83	4	2	2	1	1	1		11
110	1	1			12		1	15	3	2		1	1			7
120					1			1								0
130			2					2								0
140	5	2	2		3		1	13								0
150	9	3	3		5			20								0
160					1			1				1				1
170								0								0
180								0								0
190								0								0
200								0								0
210		1						1								0
220		1						1								0
230								0								0
240								0								0
250								0								0
260								0								0
270								0								0
280								0								0
290								0								0
300								0				1				1
310								0							1	1
320								0		2						2
330								0								0
340								0								0
350								0		1						1
360								0								0
370								0								0
380		1						1								0
390								0								0
400								0								0
Total:	110	23	7	0	91	0	12	243	11	12	12	90	13	2	12	152

Appendix Table C-2. Length frequencies of broad whitefish caught by fyke net in the Alpine study area, 2003.

Fork Length (mm)	L9312 Aug 16	Aug 20	Aug 21	Aug Total	L9313 Jul 22	Jul 23	Jul 24	Jul 25	Jul 26	Jul 28	Jul Total	Aug 17	Aug 20	Aug Total
30				0							0			0
40	3			3							0			0
50				0							0			0
60				0							0			0
70				0		1	1				2			0
80				0			1		1		2			0
90				0	4			1	5		10			0
100				0					1	2	3	1	1	2
110				0							0			0
120				0							0			0
130				0							0			0
140				0							0			0
150				0	1				1	1	3			0
160				0	1						1			0
170				0	2						2			0
180				0							0			0
190				0							0			0
200				0							0			0
210				0							0			0
220				0							0			0
230				0							0			0
240				0							0			0
250				0							0			0
260				0							0			0
270				0							0			0
280				0							0			0
290				0							0			0
300				0							0			0
310				0							0			0
320				0							0			0
330				0							0			0
340			1	1							0			0
350		1		1							0			0
360			1	1							0			0
370				0							0			0
380				0							0			0
390				0		1					1			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				0							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
Total:	3	1	2	6	8	2	2	1	8	3	24	1	1	2

Appedix Table C-3. Length frequencies of humpback whitefish caught by fyke net in the Alpine study area, 2003.

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

Appendix Table C-4. Length frequencies of round whitefish caught by fyke net in the Alpine study area, 2003.

Fork Length (mm)	L9312 Jul 22	L9312 Jul 23	L9312 Total	L9313 Jul 22	L9313 Aug 17	L9313 Aug 22	L9313 Aug 23	L9313 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	1				1
130			0		1	1	1	3
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		1	1					0
270			0					0
280			0					0
290			0					0
300		1	1					0
310	1		1					0
320			0					0
330			0					0
340			0					0
350	1		1					0
360			0					0
370			0					0
380			0					0
390			0					0
400			0					0
Total:	2	2	4	1	1	1	1	4

Appendix Table C-5. Length frequencies of Alaska blackfish caught by fyke net in the Alpine study area, 2003.

Fork Length (mm)	L9312 Jul 23	Jul Total	Aug 16	Aug 17	Aug 18	Aug 20	Aug 21	Aug 22	Aug Total	L9313 Aug 16	Aug 19	Aug 21	Aug 22	Aug Total
0		0							0					0
10		0							0					0
20		0							0					0
30		0							0					0
40		0							0					0
50		0							0					0
60		0				1			1			1		1
70		0		1	1			2	4			2		2
80	1	1				1		12	13	1	1	1		3
90		0	1		3	1		4	9	1		1	1	3
100		0		1			1		2					0
110		0						1	1	1	1			2
120		0							0					0
130		0						1	1					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
Total:	1	1	1	2	4	3	1	20	31	3	2	5	1	11

Appendix Table C-6. Length frequencies of slimy sculpin caught by fyke net in the Alpine study area, 2003.

Fork Length (mm)	**L9312** Jul 23	Jul 28	Jul Total	Aug 18	Aug 20	Aug 21	Aug 22	Aug Total
0			0					0
10			0					0
20			0					0
30	1		1					0
40		1	1	2			1	3
50			0					0
60			0			2		2
70			0	2		1	1	4
80			0		2		1	3
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	2	4	2	3	3	12

APPENDIX D
Winter Water Chemistry in Lake L9313
during April-May, 2003

Project Note

To: Caryn Rea	Date: May 2, 2003
From: Jon Wolf	Project: 2003 Alpine Lake L9313 Monitoring
Subject: April 28, 2003 Monitoring Event	

On April 28, 2003, Jon Wolf conducted the first of two in situ water quality monitoring events at Alpine lake L9313. The monitoring event was carried out with the assistance of Mr. Jack Tipleman of LCMF surveyors. Access to the lake was provided by LCMF tracked vehicle. Weather on the day of sampling was ideal. Temperatures were in the low 20s and there was little or no wind.

Sampling location selection was based solely on depth. Locations selected represented points where water depths were such that sufficient under-ice free water would be available. Each sampling point was recorded using a hand-held global positioning system (GPS) unit referenced to North American Datum of 1927 (NAD27).

At each sampling location, a two-cycle power auger was used to drill a six-inch sampling hole through the ice. Total depth was measured using a weighted tag line. Freeboard, the distance from the top of ice to the water surface in the sample hole, was measured using a pocket rod. Ice thickness was determined using a pole with a wire hook on the end. The pole was lowered into the hole until the hook found the underside of the ice. The pole was then withdrawn and the pocket rod used to measure the resultant ice thickness as marked along the pole. All measurements were made to the nearest tenth-foot and were referenced to the water surface.

A Horiba U-10 in situ water quality meter was used to measure the following in situ water parameters:

- Temperature in degrees Celsius (^{o}C)
- pH in standard units
- Conductivity in millisiemens per centimeter (mS/cm)
- Dissolved oxygen in milligrams per liter (mg/L)
- Salinity in milligrams per liter (mg/L)

In situ samples were collected at approximately 1-meter (3-foot) intervals between the bottom of the ice and the bottom of the lake.

Baker

2003 Alpine Lake L9313 Monitoring Program
In-Situ Water Quality Parameters

Sample Date: April 28, 2003

Sample Location	Sample Time	Sample Location Coordinates (NAD27)	Total Depth (ft)	Ice Thickness (ft)	Free-board (ft)	In-Situ Sample Depth (ft)	Temp. (°C)	pH	Conduc-tivity (mS/cm)	Salinity (%)	Dissolved Oxygen (mg/L)
L9313	11:05	N70°20'29.3" W150°56'20.2"	8.8	4.2	0.2	4.5	1.5	7.4	0.4	0.0	0.3
						7.5	1.9	7.0	0.4	0.0	0.1
L9313a	11:25	N70°20'22.5" W150°56'47.7"	6.2	4.6	0.2	5.0	0.8	6.7	0.3	0.0	2.7
L9313b	11:35	N70°20'32.3" W150°56'20.3"	8.8	4.8	0.4	5.0	1.0	6.5	0.3	0.0	0.9
						8.0	1.0	6.1	0.4	0.0	0.5
L9313c	12:00	N70°20'25.0" W150°56'36.7"	8.2	4.9	0.3	5.0	2.0	6.6	0.4	0.0	0.6
						8.0	2.0	6.2	0.4	0.0	0.9
L9313d	12:15	N70°20'31.5" W150°56'03.8"	8.1	4.2	0.3	4.5	2.0	6.6	0.4	0.0	0.8
						7.5	2.0	6.6	0.4	0.0	0.6
L9313e	12:25	N70°20'35.5" W150°55'59.0"	8.8	4.7	0.3	5.0	2.0	6.6	0.4	0.0	2.1
						8.0	2.0	6.5	0.4	0.0	0.0
L9313f	12:35	N70°20'39.2" W150°55'48.0"	8.6	4.8	0.3	5.0	2.0	6.5	0.4	0.0	3.5
						8.0	2.0	6.2	0.4	0.0	2.8
L9313g	12:45	N70°20'40.1" W150°55'40.6"	8.2	4.5	0.3	5.0	1.0	6.5	0.3	0.00	4.0
						8.0	2.0	6.4	0.3	0.00	2.8

Notes:

1 - Total depth is measured from the water surface to the lake bottom.

2 - Freeboard is the distance from the top of ice to the water surface.

3 - Sample depth is measured from the water surface.

ConocoPhillips

2003 Alpine Lake L9313 Monitoring Program
April 28, 2003 Monitoring Locations

0 250 500 Feet

N

Baker

Prepared by Michael Baker Jr. Inc. May 2, 2003

Project Note

To: Caryn Rea	Date: May 9, 2003
From: Jon Wolf	Project: 2003 Alpine Lake L9313 Monitoring
Subject: May 9, 2003 Monitoring Event	

On May 9, 2003, Mike Cox and Jim Meckel conducted the second of two in situ water quality monitoring events at Alpine lake L9313. The monitoring event was carried out with the assistance of Mr. Jack Tipleman of LCMF surveyors. Access to the lake was provided by LCMF tracked vehicle. Weather on the day of sampling was ideal. Temperatures were in the low 20s and wind was from the east at approximately 10 miles per hour.

Locations monitored during this event were within 5 feet of the locations monitored during the April 28, 2003 monitoring event (see April 28, 2003 report for sampling locations).

At each sampling location, a two-cycle power auger was used to drill a six-inch sampling hole through the ice. Total depth was measured using a weighted tag line. Freeboard, the distance from the top of ice to the water surface in the sample hole, was measured using a pocket rod. Ice thickness was determined using a pole with a wire hook on the end. The pole was lowered into the hole until the hook found the underside of the ice. The pole was then withdrawn and the pocket rod used to measure the resultant ice thickness as marked along the pole. All measurements were made to the nearest tenth-foot and were referenced to the water surface.

A Horiba U-10 in situ water quality meter was used to measure the following in situ water parameters:

- Temperature in degrees Celsius (^{o}C)
- pH in standard units
- Conductivity in millisiemens per centimeter (mS/cm)
- Dissolved oxygen in milligrams per liter (mg/L)
- Salinity in milligrams per liter (mg/L)

In situ samples were collected at 3-foot intervals between the bottom of the ice and the bottom of the lake.

Project Note

2003 Alpine Lake L9313 Monitoring Program

In-Situ Water Quality Parameters

May 9, 2003

Sample Location	Sample Time	Sample Location Coordinates (NAD27)	Total Depth (ft)	Ice Thickness (ft)	Free-board (ft)	In-Situ Sample Depth (ft)	Temp. (°C)	pH	Conduc-tivity (mS/cm)	Salinity (%)	Dissolved Oxygen (mg/L)
L9313	13:07	N70°20'29.3" W150°56'20.2"	9.2	4.3	0.1	4.5	1.0	7.9	0.3	0.0	0.6
						7.5	2.0	7.3	0.3	0.0	0.1
L9313a	13:28	N70°20'22.5" W150°56'47.7"	6.7	4.4	0.1	5.0	2.0	7.3	0.3	0.0	2.6
L9313b	14:00	N70°20'32.3" W150°56'20.3"	9.4	4.9	0.4	5.0	3.0	7.3	0.4	0.0	1.1
						8.0	3.0	6.9	0.4	0.0	0.9
L9313c	14:10	N70°20'25.0" W150°56'36.7"	8.8	5.1	0.3	5.5	2.0	7.1	0.3	0.0	2.3
						8.5	2.0	6.8	0.4	0.0	2.2
L9313d	14:20	N70°20'31.5" W150°56'03.8"	8.4	4.3	0.3	5.0	2.0	6.8	0.3	0.0	1.5
						8.0	2.0	6.4	0.3	0.0	0.0
L9313e	14:35	N70°20'35.5" W150°55'59.0"	9.2	4.7	0.4	5.0	2.0	6.8	0.4	0.0	1.5
						8.0	2.0	6.2	0.4	0.0	0.0
L9313f	14:45	N70°20'39.2" W150°55'48.0"	9.0	4.7	0.3	5.0	2.0	6.5	0.4	0.0	1.8
						8.0	2.0	6.3	0.4	0.0	1.6
L9313g	14:50	N70°20'40.1" W150°55'40.6"	8.6	4.6	0.3	5.0	1.0	6.7	0.3	0.00	2.9
						8.0	2.0	6.5	0.4	0.00	2.3

Notes:

1 - Total depth is measured from the water surface to the lake bottom.

2 - Freeboard is the distance from the top of ice to the water surface.

3 - Sample depth is measured from the water surface.

APPENDIX E
Water Use Permits for lakes
L9312 and L9313

Appendix Table E-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	2	April 7, 2000	19.00
	FG99-III-0051	3	September 1, 2000	32.36
	FG99-III-0051	4	August 9, 2002	32.36
	FG99-III-0051	5	February 14, 2003	30.00
L9313				
	FG97-III-0190		December 13, 1997	7.80
	FG97-III-0190	1	March 30, 1999	13.40
	FG97-III-0190	2	April 7, 2000	13.40
	FG97-III-0190	3	September 1, 2000	10.34
	FG97-III-0190	4	August 9, 2002	10.34
	FG97-III-0190	5	February 14, 2003	6.00

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
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
Mayor Gorden Brown/Leonard Lampe, Village of Nuiqsut

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

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
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
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

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
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
Thomas Manson/Shannon Donnelly, Phillips, Alpine
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

AGO/wam

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 (FG99-III-0051)

AMENDMENT #4

ISSUED: August 9, 2002
EXPIRES: Upon Abandonment of Lake L93-12
as a Water Source

Bruce St. Pierre, Senior Permit Coordinator
Alpine Development Project
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. St. Pierre:

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 your request to reset the water volume available for use effective June 12, 2002. Lake L93-12 fully recharged during spring breakup 2002. Data demonstrating recharge of Lake L93-12 and the stabilization period were provided with your July 18, 2002, letter. Fish Habitat Permit FG99-III-0051 is hereby amended to reset the permittable water withdrawal volume effective June 12, 2002 – water withdrawal volume set at 32.36 million gallons. All terms and conditions of Amendment #3 (issued September 1, 2000) 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, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

cc: Leonard Lampe, Nuiqsut
Eli Nukapigak, Nuiqsut
Bill Tegoseak/James Patkotak, Barrow
Thomas Napageak, Nuiqsut
Isaac Nukapigak, Nuiqsut

ecc: Harry Bader, ADNR, Fairbanks
Gordon Brower, NSB, Barrow
Glenn Gray, DGC, Juneau
Kaye Laughlin, DGC, Anchorage
Leon Lynch, ADNR, Fairbanks
Ted Rockwell, EPA, Anchorage
Gary Schultz, ADNR, Fairbanks
Louise Smith, USFWS, Fairbanks
Kellie Westphal, ADNR, Anchorage
Jack Winters, ADF&G, Fairbanks
Larry Bright, USFWS, Fairbanks
Joy Earp, ACOE, Anchorage
Kanady/Manson, PHILLIPS, Alpine
Bill Morris, ADF&G, Fairbanks
Sverre Pedersen, ADF&G, Fairbanks
Steve Schmitz, ADNR, Anchorage
Dick Shideler, ADF&G, Fairbanks
Charles Swanton, ADF&G, Fairbanks

Mr. Bruce St. Pierre
FG99-III-0051 Amd. #5

February 14, 2003

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

DIVISION OF HABITAT AND RESTORATION

FRANK MURKOWSKI, *GOVERNOR*

1300 COLLEGE RD.
FAIRBANKS, AK 99701
PHONE: (907) 459-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG99-III-0051)
AMENDMENT #5

ISSUED: February 14, 2003
EXPIRES: Upon Abandonment of Lake L93-12
as a Water Source

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

Dear Mr. St. Pierre:

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); LAS 23889

The Alaska Department of Fish and Game (ADF&G) has received and reviewed your application for a permanent water right for the waters contained in Lake L9312 in the Colville River Delta and for an amendment to Fish Habitat Permit FG99-III-0051. In support of your request, refined bathymetric maps and volume estimates were included for review. The refined data indicates that there is less water available below the ice during winter than previously estimated. Fish Habitat Permit FG99-III-0051 is hereby amended to authorize the removal of up to 30 million gallons (92.04 acre-feet) of water per water year (break-up to break-up regardless of date) with the following stipulation:

1) The permanent staff gage must be recalibrated to reflect the new bathymetry of the lake bottom and minimum lake water surface elevation must be established. The minimum lake water surface elevation will be that elevation corresponding with the withdrawal of 30 million gallons less the change in elevation attributable to evaporation of 1.5 mm of water per day. If the water

surface elevation drops below the established minimum, water use shall cease until the lake is recharged.

Rationale: The loss of water from evaporation, while large in some lakes relative to volume withdrawn for industrial purposes, is less than six inches per year at this lake. Therefore, the above minimum water surface elevation to be established allows for the minimum elevation to be adjusted downwards consistent with the available data indicating an evaporation rate of 1.5 mm per day. Additionally, our under-ice volume calculations are based on a fairly conservative ice thickness of seven feet, while this thickness is reached in some years, in some lakes, more common ice thickness is between 5.5 and 6.0 feet; losses to evaporation easily will be compensated for in this 1 to 1.5 ft of additional water below the ice. Winter dissolved oxygen concentrations have remained high throughout the winter at this lake and the lake has consistently recharged fully each spring regardless of whether the river inundated the lake during break-up. We do not expect prolonged drawdown or depletion of oxygen to occur at the lake under the proposed level of use, given the conditions of the permit.

All conditions and stipulations of the original permit and subsequent amendments 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,

Kevin Duffy, Acting Commissioner

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

ecc: Harry Bader, ADNR, Fairbanks
Steve Schmitz, ADNR, Anchorage
Larry Bright, USFWS, Fairbanks
Joy Earp, ACOE, Anchorage
Gordon Brower, NSB, Barrow
Sverre Pedersen, ADF&G, Fairbanks
Charles Swanton, ADF&G, Fairbanks
Jack Winters, ADF&G, Fairbanks
Patricia Bettis, ADNR, Anchorage
Bill Morris, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Ted Rockwell, EPA, Anchorage
Pete McGee, ADEC, Fairbanks
Gary Schultz/Leon Lynch, ADNR, Fairbanks
Kellie Westphal, ADNR, Anchorage
Shellie Colegrove/Randy Kanady, Phillips, Alpine
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

AGO/wam

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)

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 16.05.870(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 16.05.870(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 16.05.870(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 16.05.870. 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

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
Jim Haynes, ADNR, Anchorage
Glenn Gray, DGC, Juneau
Brad Fristoe, ADEC, Fairbanks
Phillip Martin, USFWS, Fairbanks
Jon Dunham, NSB, Barrow
Lloyd Fanter, ACOE, Anchorage
Fred Andersen, ADF&G, Fairbanks
Terry Haynes, ADF&G, Fairbanks
Carl Hemming, ADF&G, Fairbanks
William Britt, SPCO, Anchorage
Jeanne Hanson, NMFS, Anchorage
Ted Rockwell, EPA, Anchorage
Larry/Chris Brown, AAI, Kuparuk
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Laston Chinn, Kuukpik Corp.

AGO/agc

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
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
Mayor Gorden Brown/Leonard Lampe, Village of Nuiqsut
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 (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

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
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
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

AGO/ago

STATE OF ALASKA

TONY KNOWLES, GOVERNOR

DEPARTMENT OF FISH AND GAME

HABITAT & RESTORATION DIVISION

1300 COLLEGE ROAD
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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

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 #4

ISSUED: August 9, 2002
EXPIRES: Upon Abandonment of Lake L93-13
as a Water Source

Bruce St. Pierre, Senior Permit Coordinator
Alpine Development Project
PHILLIPS Alaska, Inc.
P.O. Box 100360
Anchorage, AK 99510-0360

Dear Mr. St. Pierre:

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 your request to reset the water volume available for use effective June 12, 2002. Lake L93-13 fully recharged during spring breakup 2002. Data demonstrating recharge of Lake L93-13 and the stabilization period were provided with your July 18, 2002, letter. Fish Habitat Permit FG97-III-0190 is hereby amended to reset the permittable water withdrawal volume effective June 12, 2002 – water withdrawal volume set at 10.34 million gallons. All terms and conditions of Amendment #3 (issued September 1, 2000) 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, Regional Supervisor
Habitat and Restoration Division
Alaska Department of Fish and Game

cc: Leonard Lampe, Nuiqsut
Eli Nukapigak, Nuiqsut
Bill Tegoseak/James Patkotak, Barrow
Thomas Napageak, Nuiqsut
Isaac Nukapigak, Nuiqsut

ecc: Harry Bader, ADNR, Fairbanks
Gordon Brower, NSB, Barrow
Glenn Gray, DGC, Juneau
Kaye Laughlin, DGC, Anchorage
Leon Lynch, ADNR, Fairbanks
Ted Rockwell, EPA, Anchorage
Gary Schultz, ADNR, Fairbanks
Louise Smith, USFWS, Fairbanks
Kellie Westphal, ADNR, Anchorage
Jack Winters, ADF&G, Fairbanks
Larry Bright, USFWS, Fairbanks
Joy Earp, ACOE, Anchorage
Kanady/Manson, PHILLIPS, Alpine
Bill Morris, ADF&G, Fairbanks
Sverre Pedersen, ADF&G, Fairbanks
Steve Schmitz, ADNR, Anchorage
Dick Shideler, ADF&G, Fairbanks
Charles Swanton, ADF&G, Fairbanks

AGO/ago

Mr. Bruce St. Pierre
FG97-III-0190

February 14, 2003

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

DIVISION OF HABITAT AND RESTORATION

FRANK MURKOWSKI, *GOVERNOR*

1300 COLLEGE RD.
FAIRBANKS, AK 99701
PHONE: (907) 459-7289
FAX: (907) 456-3091

FISH HABITAT PERMIT (FG97-III-0190)
AMENDMENT #5

ISSUED: February 14, 2003
EXPIRES: Upon Abandonment of Lake L93-13
as a Water Source

Bruce St. Pierre, 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); LAS 23895

The Alaska Department of Fish and Game (ADF&G) has received and reviewed your application for a permanent water right for the waters contained in Lake L9313 in the Colville River Delta and for an amendment to Fish Habitat Permit FG97-III-0190. In support of your request, refined bathymetric maps and volume estimates were included for review. The refined data indicates that there is considerably less water available below the ice during winter than previously estimated. Fish Habitat Permit FG97-III-0190 is hereby amended to authorize the removal of up to 6 million gallons (18.408 acre-feet) of water per water year (break-up to break-up regardless of date) with the following stipulation:

1) The permanent staff gage must be recalibrated to reflect the new bathymetry of the lake bottom and minimum lake water surface elevation must be established. The minimum lake water surface elevation will be that elevation corresponding with the withdrawal of 6 million gallons less the change in elevation attributable to evaporation of 1.4 mm of water per day. If the water

surface elevation drops below the established minimum, water use shall cease until the lake is recharged.

Rationale: The loss of water from evaporation, while large in some lakes relative to volume withdrawn for industrial purposes, is less than six inches per year at this lake. Therefore, the above minimum water surface elevation to be established allows for the minimum elevation to be adjusted downwards consistent with the available data indicating an evaporation rate of 1.4 mm per day. Additionally, our under-ice volume calculations are based on a fairly conservative ice thickness of seven feet, while this thickness is reached in some years, in some lakes, more common ice thickness is between 5.5 and 6.0 feet; losses to evaporation easily will be compensated for in this 1 to 1.5 ft of additional water below the ice. Recharge of this water source lake has been observed every year since development of the Alpine Development Project, even during low magnitude, frequent recurrence rate spring floods, the lake appears to receive water from the Sakoonang Channel of the Colville River.

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,

Kevin Duffy, Acting Commissioner

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

ecc: Harry Bader, ADNR, Fairbanks
Steve Schmitz, ADNR, Anchorage
Larry Bright, USFWS, Fairbanks
Joy Earp, ACOE, Anchorage
Gordon Brower, NSB, Barrow
Sverre Pedersen, ADF&G, Fairbanks
Charles Swanton, ADF&G, Fairbanks
Jack Winters, ADF&G, Fairbanks
Patricia Bettis, ADNR, Anchorage
Bill Morris, ADF&G, Fairbanks
Jeanne Hanson, NMFS, Anchorage
Ted Rockwell, EPA, Anchorage
Pete McGee, ADEC, Fairbanks
Gary Schultz/Leon Lynch, ADNR, Fairbanks
Kellie Westphal, ADNR, Anchorage
Shellie Colegrove/Randy Kanady, Phillips, Alpine
Mayor Gordon Brown/Leonard Lampe, Village of Nuiqsut
Joe Nukapigak/Lanston Chinn, Kuukpik Corp.

AGO/wam