FINAL REPORT

2001 LAKE MONITORING STUDY

NATIONAL PETROLEUM RESERVE - ALASKA

Prepared for

Phillips Alaska, Inc.
PO Box 100360
Anchorage, AK 99510-0360

October 22, 2001

URS

2700 Gambell St. Suite 200
Anchorage, AK 99503

74-PAI01001.00

TABLE OF CONTENTS

Tables

Figures

Appendices

Acronyms and Abbreviations

BLM	Bureau of Land Management
ft	feet
GPS	Global Positioning System
mg/l	milligrams per liter
mS/cm	milli-Siemens per centimeter
NPR-A	National Petroleum Reserve – Alaska
NTU	Nephelometric Turbidity Units
PAI	Phillips Alaska, Inc.
ppm	parts per million

Current winter oil and gas exploration and development practices on the North Slope of Alaska include construction of ice roads and ice pads to facilitate vehicle and equipment mobilization and stable camp and work areas. The use of ice roads and pads allows winter exploration activity with little to no impact to underlying tundra as well as access to roadless developments such as Alpine. Construction of these ice roads and pads requires withdrawal of water from nearby lakes during winter. Water is sprayed along the ice roadway, where it freezes quickly on the surface of the tundra. Additional layers of water are added until the ice roads/pads are of sufficient thickness and width to support the heaviest equipment. Smaller amounts of water are pumped periodically from the lakes throughout the winter for ice road/pad maintenance purposes. During breakup, the ice melts, leaving the tundra relatively free of impact.

The purpose of the Lake Recharge Study is to fulfill the following stipulation contained in the Finding of No Significant Impact - Record of Decision (FONSI-ROD) prepared by the Bureau of Land Management (BLM) for Permit to Drill 3100.00 and Right-of-Way Permit 2884.01.

> "Monitoring the effect of water use from lakes used for ice road construction. The concern exists in the case of multiple year use of lakes for ice road construction where the assumption is that recharging will be acceptable for the continuing use of these lakes. Applicant is to develop a monitoring plan to measure water volumes before use, measuring amounts used, and lake drawdown. An annual plan for water use will be required for the use of multi-year lake use after the first year of use."

1.1 BACKGROUND

Concern exists that water withdrawal from North Slope lakes could lower water levels to such an extent that the lakes freeze completely or otherwise adversely impact fish overwintering habitat by disturbing bottom sediments, disrupting stratification or effecting water quality in the free water beneath the surface ice. A monitoring plan, that includes water level and water quality monitoring, was developed to address these concerns and is included in Appendix A.

In 1999 and 2000, Phillips Alaska, Inc. (PAI) conducted a study of the lakes in the eastern portion of NPR-A (National Petroleum Reserve - Alaska) to determine which lakes in that area could be used as water sources (see Fish Utilization of Lakes in Eastern NPR-A: 1999-2000, Final Data Report, November 2000, MJM Research). Data collection involved water quality sampling, fish sampling, and volumetric calculations. PAI also conducted a lake recharge study in 2000 that included two water source lakes and one unused lake as a reference (PAI 2001). The data from these previous studies were consulted to select lakes for the 2001 study that would be representative of the variety of lakes cited in the BLM December 2000 protocol for lake monitoring. The 2001 Monitoring Plan includes two of the previously studied lakes (M9906 and M9915) for this purpose as well as for data comparison.

1.2 APPROACH

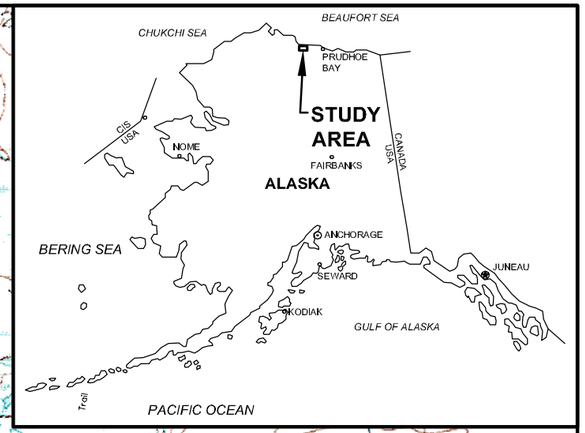
The monitoring approach was developed in coordination with BLM to determine the amount of free water available under the ice and to assess the amount of recharge by the lakes in the summer, following water withdrawal during the winter construction season.

The water source lakes chosen for this study were selected to represent varied lake sizes and types and were paired with reference lakes that have similar physical characteristics. The two pairs of NPR-A lakes studied during 2001 include the following (Figure 1.1):

- M9907 (Pumped) and M9906 (Reference Lake)
- M9915 (Pumped) and M9913 (Reference Lake)

Initially, the Monitoring Plan included three lakes that were to be used for water sources during the 2001 NPR-A exploration program (i.e. pumped) plus three unused lakes to serve as references. However, one of the proposed lakes (M9909) and its associated reference lake (M9911) were dropped from the study when the ice road contractor announced that M9909 was not going to be needed for ice road construction and therefore no water would be withdrawn. These lakes were originally included in the study to be representative of fish bearing lakes in the area. Unfortunately, water withdrawal from potential replacement lakes had occurred before a suitable lake could be added to the study. The four remaining lakes included in this study are tundra lakes that do not support fish. For this reason, an analysis of fish overwintering habitat was not performed.

MJM Research obtained some water quality data during 1999 and 2000 that includes all four of the 2001 study lakes that were sampled during 1999 and two lakes (M9906 and M9915) that were included in their 2000 Recharge Study (MJM 2000b). These data are presented and compared in Sections 3.1 and 3.2.



M9907

M9906 (Control)

M9913 (Control)

M9915

Judy Cr

Judy Creek

FISH CREEK

WINTER TRAIL

LEGEND

- STUDY LAKE
- SAMPLE LOCATION

0 1500 3000 6000

SCALE IN FEET

Source:
USGS 1:63360 Topographic Map Series
Harrison Bay (A-3), (A-4), (B-3), and (B-4) Quadrangles

PHILLIPS ALASKA, INC.
2001 NPR-A LAKE MONITORING

STUDY LAKE AND SAMPLE LOCATIONS

NATIONAL PETROLEUM RESERVE - ALASKA

URS

JOB NO: 74-PAI010001.00	DRAWN: ELK
DATE: OCTOBER 2001	FILE: FISHJUDY.DWG

FIGURE 1.1

The procedures described in the Monitoring Plan (Appendix A) were followed to the extent possible, with the exception of the reduction in the number of lakes studied, as described previously. The Monitoring Plan includes measurement of water volumes, water levels, and water quality. Four sampling trips were conducted to detect any measurable changes in water quality potentially caused by water withdrawal. These trips occurred as follows:

- Trip 1 on 6-Feb-01—prior to pumping water from the lakes,
- Trip 2 on 21-Mar-01—after pumping (10 days following pumping at M9907 and 13 days after pumping at M9915),
- Trip 3 on 27-Apr-01—immediately before ice road closure/prior to breakup, and
- Trip 4 on 12-Aug-01—in late summer to check status of lake recharge.

In January, PAI established sampling points at the deepest point of each lake using bathymetric information contained in the 2000 Recharge Study (MJM 2000b). These locations were recorded using a handheld global positioning system (GPS) and marked with survey lath for future reference. Table 2.1 includes these water quality measurement and sample locations.

Table 2.1: Water Quality Measurement and Sample Locations.

Lake	Approx. Depth (feet)	Latitude (NAD 27)	Longitude (NAD 27)
M9906 (reference)	8	70° 14’ 14.6” N	151° 51’ 21.06” W
M9907	8.5	70° 14’ 26.3” N	151° 52’ 38.2” W
M9913 (reference)	7.7	70° 15’ 07.1” N	151° 32’ 23.6” W
M9915	6.8	70° 12’ 12.8” N	151° 45’ 37.1” W

For the first three trips, the sampling point was accessed using a Tucker and/or snowmobile and the following procedures were followed:

- A 6-inch diameter ice auger was used to drill a hole through the ice
- Water samples were collected according to the procedures described in Section 2.1.
- In-situ water quality measurements were recorded according to the procedures described in Section 2.2
- Ice surface elevations and water surface elevations were surveyed and recorded
- Ice thickness and water depth were measured and recorded.

A helicopter and an inflatable boat were used to access the sampling point for the summer sampling trip and these procedures were followed:

- Shoreline staff gages were installed and used to record water surface elevations
- An inflatable boat and GPS were used to access sampling points
- The boat was anchored into position and water samples were collected according to the procedures described in Section 2.1.

- In-situ water quality measurements and water depths were recorded according to the procedures described in Section 2.2.

Left: Augering a hole through the ice at a sampling location at the deepest part of the lake.

Above: Some equipment used during monitoring. Stadia rod used to measure freeboard distance between ice surface elevation and water surface.

2.1 WATER QUALITY SAMPLING

One grab water sample was collected from each lake and submitted for laboratory analysis. Using a plastic bailer or vertical water sampler and following URS standard environmental sampling procedures, grab samples were collected from below the ice and poured into specially prepared plastic sample jars that were provided by the contracted laboratory. A total of four primary samples plus one duplicate (quality control) sample was collected during each trip. Similar to the 2000 Recharge Study, each sample was analyzed for:

- Hardness as $CaCO_3$ (SM 3500/ICP)
- Calcium (EPA 200.7)
- Magnesium (EPA 200.7)
- Sodium (EPA 200.7)
- Potassium (EPA 200.7)
- Iron (EPA 200.7)
- Silicon (EPA 200.7)
- Chloride (EPA 300.0)
- Total Dissolved Solids (SM2540-C).

Left: Sampling at M9915 during April. Sampling methods included using a plastic bailer to collect a grab sample.

A summary of analytical results from each of the four sampling trips are included in Section 3.1. Appendix B contains detailed laboratory reports of these results. Appendix C includes a full set of plots and graphs of the monitoring results.

2.2 IN-SITU WATER QUALITY

A Horiba U-10 water quality meter was lowered into the ice hole to collect *in-situ* measurements including:

- Temperature
- Dissolved Oxygen
- pH
- Conductivity
- Turbidity.

Right: Lowering the Horiba U-10 Water Quality Checker into the ice hole to collect in-situ water quality measurements.

The Monitoring Plan indicates that, at lakes with greater than 7 feet of available water depth, *in situ* readings would be taken at the surface, middle and immediately above the bottom. However, in most instances during ice covered months, less than 7 feet of free water was available at the study lakes. Thus with one exception, measurements were recorded at mid-depth (free water depth) only and a detailed study of lake stratification was not performed.

Precautions were taken to ensure proper operation of the Horiba instrument in sub-zero temperatures. A one-point calibration was performed each day, using the calibration solution provided with the instrument. The Horiba was fitted with a 10-m cable which allowed the field

team to keep the digital readout portion of the instrument in the Tucker during the *in situ* analyses. The instrument probes were protected by quickly moving the instrument from the warm vehicle or a container of relatively warm water and immersing them in the lake water. Immediately after the water quality parameters were recorded, the probes were returned to the vehicle or container of water, thus limiting the probes' exposure to sub-zero ambient temperatures. Additionally, several chemical heat packets were kept inside of the instrument case and a back-up instrument was available.

Since the dissolved oxygen probe is the most susceptible to failure in sub-zero temperatures, additional back-up dissolved oxygen test kits were also available for verification purposes in instances when dissolved oxygen readouts appeared unreliable. CHEMets Colorimetric Test Kits are color coded field kits in the test range from 1 to 12 parts per million (ppm) that are commonly used for water testing. Testing using these kits was done at the sampling site and according to the manufacturer's directions.

2.3 WATER LEVEL MEASUREMENTS

Measurements of ice thickness and water depth were recorded and used to determine free water availability in both the pumped lakes and corresponding reference lakes. Lounsbury & Associates surveyed ice surface and in-hole water surface elevations to show any variation in lake levels. During winter, the water surface elevation in a hole drilled through the ice is assumed equivalent to the water surface elevation during ice-free conditions.

Following breakup in June, URS installed staff gages at the shore of the lakes to obtain water surface elevations. Staff gages were installed using standard level loop survey techniques. Each staff gage consists of a mounted 3-foot graduated staff attached to a 6-foot piece of angle iron pounded into the lake sediment. The elevation of each staff gage was established using temporary benchmarks established by Lounsbury & Associates in February, 2001.

Using this method, lake levels were recorded at total of three times; in June, August, and September 2001. Staff gage maintenance included re-surveying the gages in order to account for any disturbance or settling of the gage. Staff gages at lakes M9913 and M9915 were re-surveyed during the August event as they appeared to have been bent over. All four gages were re-surveyed in September as it was the last lake measurement for the summer.

Ice and water surface elevations, ice thickness, and water depth/available free water are reported in Section 3.

2.4 WATER VOLUMES

Based on the data collected, the effective water depth was calculated. The available water volume and the amount of lake recharge that occurred following water withdrawal can be assessed by comparing lake volumes throughout the season. Since none of the study lakes contained fish, available water volumes suitable for overwintering fish habitat was not evaluated.

Total water volumes for each lake were previously estimated by MJM Research using aerial photography for surface area, maximum depth, and assuming lake shape averages roughly the volume of a cone (MJM 2000). Water volumes withdrawn from each lake during the 2001

exploration season were recorded by the ice road construction contractors. PAI provided this data to URS for inclusion in this report (Section 3).

3.1 WATER QUALITY SAMPLING

Water quality sampling included analysis for hardness, calcium, magnesium, sodium, potassium, iron, silicon, chloride and total dissolved solids. Analytical results for the study period are summarized in Table 3.1. Graphs of the results are included in Appendix C.

Laboratory water quality results are included in Appendix B. The results were plotted and provided in Appendix C. In general, it appears that hardness, chloride, total dissolved solids, and the selected metal concentrations in the water from each set of paired lakes have similar trends. There is a continuous increase in analyte concentration between February and April, and then a significant decrease in concentrations to below February levels by late summer. This trend is upheld regardless of whether the lake was utilized for water withdrawal. Calculations confirm that analyte concentrations, as expected, were inversely proportional to liquid water volume, which decreased as the ice thickened. Figure 3.1 shows the plot of ice thickness and the plot for magnesium concentrations at each of the lakes throughout the study. Magnesium is shown to represent a typical trend for analyte concentrations.

Slight exceptions to this trend can be seen in the graphs for silicon, iron, and potassium. Silicon concentrations in the water sampled from Lake M9907 (pumped) decreased from 1.87 to 1.59 milligrams per liter (mg/l) between March and April, while all other lakes showed an increase at this time. This decrease of 0.28 mg/l is not considered significant since the silicon concentration remained greater than that of its reference lake, M9906, thereby indicating that silicon in the water at M9907 is not outside naturally occurring background concentrations.

In general, iron concentrations appear to increase until around breakup and then return to low levels by summer. M9906 and M9907 have relatively low iron concentrations (below 2.6 mg/l) and similar trends with the exception that iron concentrations in the water sampled from lake M9906 (reference) decreased slightly from 0.811 to 0.504 mg/l between March and April. For pumped lake M9915, the iron concentration appears to have increased more significantly after pumping (from 1.27 to 10.1 mg/l), when compared to the other lakes. It is possible that the increase is partially due to pumping since iron is known to precipitate out of the water column and settle on the bottom of lakes. Sediments containing iron can be relatively easy to stir up temporarily, during pumping and/or auguring a hole through the ice, especially in shallow lakes with little free water. However, the increase observed does not appear to be detrimental to overall water quality since the natural iron concentrations found in the reference lake, M9913, were at higher levels than lake M9915 by April (up to 17.5 mg/l for M9913 and 11.8 mg/l for M9915). Iron concentrations at all of the study lakes dropped to very low levels (below 0.06 mg/l) by August.

Potassium concentrations at the study lakes appear to increase over the winter, similar to the other metal concentrations, with the exception of one data point for reference lake M9913 in March. Potassium was not detected in this water sample. However, the detection limit for potassium was set relatively high, at 2.5 mg/l, indicating potassium may have been present in the sample at any concentration below this limit.

Comparing summer data for total dissolved solids, hardness, chloride, calcium, magnesium, and sodium with that from the previous two years (MJM 2000a, MJM 2000b, and PAI 2000), it appears that concentrations of these analytes vary somewhat from year to year, but are within the

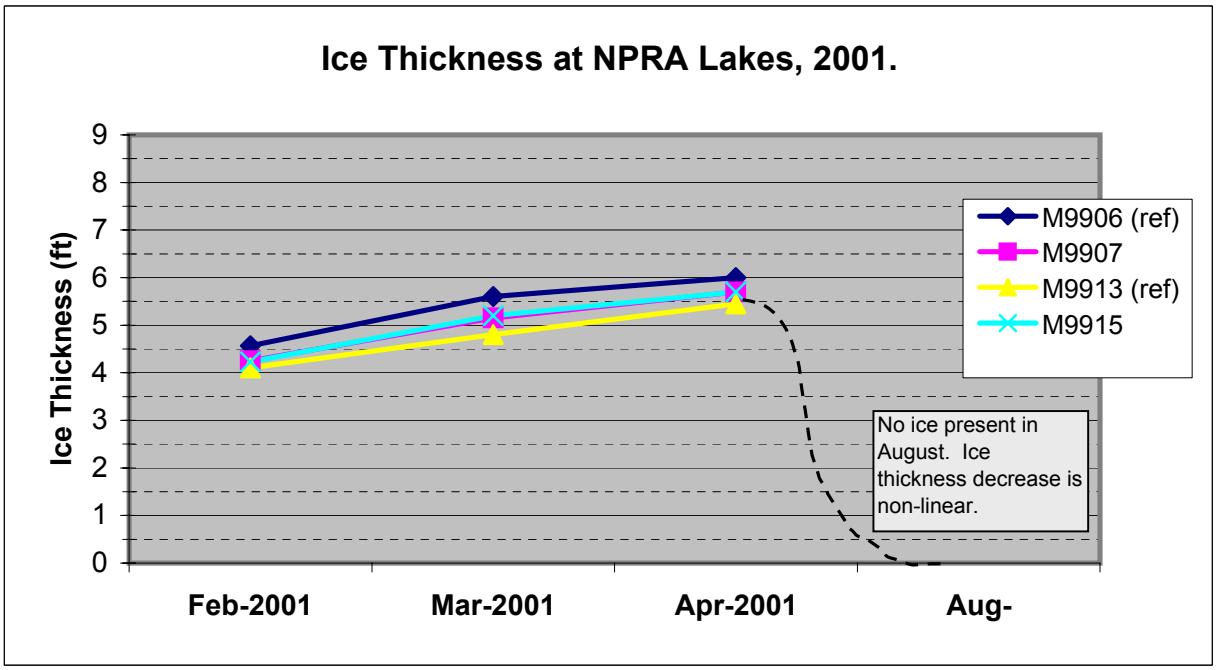
Table 3.1: Water Quality Sampling Analytical Results. 2001 NPR-A Lake Monitoring, Alaska.

Lake	Date	Cl (mg/L)	TDS (mg/L)	Hard (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Fe (mg/L)	Si (mg/L)	Ice Thick (ft)
M9906	2/7/2001	52.5	354	295	95.9	13.5	21.2	3.0	0.186	0.6	4.6
reference	#######	92.6	476	415	135	18.8	28.3	3.49	0.811	1.22	5.6
	#######	101	641	528	171	24.7	36.8	3.68	0.504	1.4	6
	#######	15.2	136	86	27.7	4.11	6.21	0.697	0.0579	ND(.500)	0
M9907	2/7/2001	34.9	268	230	73.5	11.1	16.6	3	0.342	1.4	4.3
	#######	61.9	364	314	100	15.5	22.7	3.25	1.05	1.87	5.2
	#######	67.5	474	418	133	20.8	30.1	3.75	2.57	1.59	5.7
	#######	13.8	164	86.3	27.3	4.40	6.58	0.884	0.0457	ND(.500)	0
M9913	2/6/2001	47.9	198	141	41.9	8.9	15.1	1.7	1.93	0.6	4.1
reference	#######	95	344	209	61.7	13.2	22.7	ND(2.5)	4.5	1.11	4.8
	#######	124	454	329	97.3	20.8	34.7	2.74	17.5	2.06	5.5
	#######	13.1	95	38.9	11.4	2.54	4.59	ND(.500)	0.203	ND(.500)	0
M9915	2/7/2001	64.1	232	162	48.1	10.1	17.9	2.2	1.27	0.5	4.2
	#######	121	446	291	85.7	18.6	30.2	3.25	10.1	1.3	5.2
	#######	166	528	386	112	26.0	42.0	3.02	11.80	2.24	5.7
	#######	11.8	90	32.9	9.43	2.27	3.92	0.508	0.312	ND(.500)	0

Notes:

Elevations are based on assumed base elevation.
-- indicates "not measured"
ND indicates analyted not detected at detection limit shown in parentheses

February data is "before pumping"
March: "after pumping"
April: just "before breakup"
August is the "late summer" sampling to check for recharge.



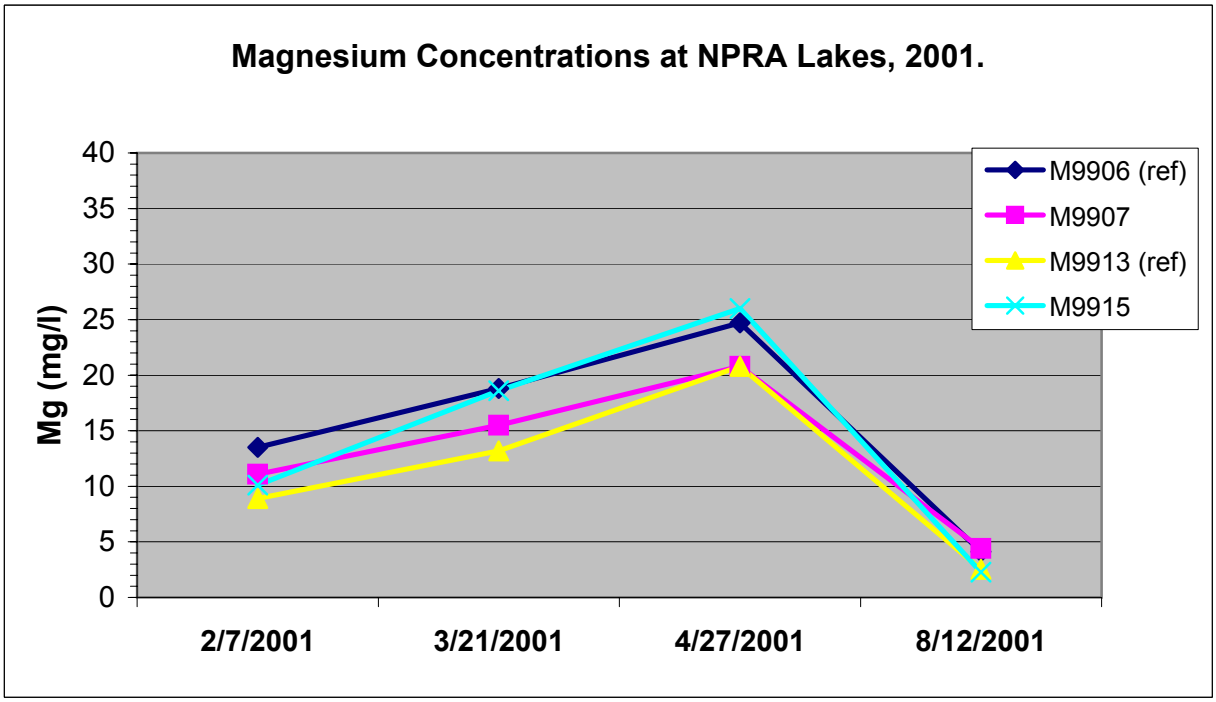


Figure 3.1: **Ice Thickness and Magnesium Concentrations at NPR-A Lakes, 2001. Magnesium is presented to represent typical trend of analyte concentrations sampled at the lakes. Refer to Appendix C for a full set of plots, including each of the parameters analyzed. Note: Lakes M9906 and M9913 are references for Lakes M9907 and M9915, respectively.**

same order of magnitude. Over the three years, total dissolved solids ranged from 55 to 164 mg/l with the highest measurement recorded at M9907 during both 2000 and 2001. Hardness ranged from 32 to 89 mg/l. Chloride ranged from 8.2 to 32 mg/l. Calcium ranged from 9 to 35.5 mg/l. Magnesium ranged from 2.1 to 5.5 mg/l. Sodium ranged from 3.8 to 11.9 mg/l (MJM 2000a, MJM 2000b, and PAI 2000). A summary of 1999 and 2000 water quality data reported by MJM and PAI is provided in Appendix D.

3.2 IN-SITU WATER QUALITY

In-situ water quality was measured with a Horiba U-10 Water Quality Checker. Measurements were recorded using the instrument's expanded resolution mode. These figures are accurate only to the repeatability of the instrument. According to the manufacturer, the Horiba U-10 instrument has the specifications shown in Table 3.2. Using this information, error bars showing the interval of confidence in the water quality measurements are included on the graphs.

Table 3.2: Horiba U-10 Water Quality Checker Manufacturer's Specifications.

Parameter	Range	Standard Resolution	Expanded Resolution	Repeatability
pH	0 - 14 pH	0.1 pH	0.01 pH	+/- 0.05 pH
Conductivity	0 - 100 mS/cm	0.01 mS/cm	0.001 pH	+/- 1% of full scale (~0.01 mS/cm)
Turbidity	0 - 800 NTU	10 NTU	1 NTU	+/- 3% of full scale (~3 NTU)
Dissolved Oxygen	0 - 19.9 mg/l	0.1 mg/l	0.01 mg/l	+/- 0.1 mg/l
Temperature	0 - 50 °C	1 °C	0.1 °C	+/- 0.3 °C

In general, there did not appear to be a significant change in water quality that could be directly attributable to water withdrawal. Natural processes, which as winter progressed, appeared to cause variations in the parameters measured, such as an increase in conductivity and a decrease in dissolved oxygen. Plots of ice thickness as well as turbidity, dissolved oxygen, conductivity, temperature, and pH are included in Figure 3.2.

Turbidity during the February sampling effort was low, with 0.0 Nephelometric turbidity units (NTU) recorded at three of the lakes and 6.0 NTU at M9913. In March, the meter recorded 10.0 NTU and a "yellowish water color" was observed at all of the lakes.

In April, turbidity recorded at pumped lake M9907 and reference lake M9913 indicated elevated levels when compared to previous measurements. No measurements could be obtained for turbidity at lakes M9906 and M9915 during April due to instrument failure. The instrument was calibrated successfully but the cause of the failure is unknown. Field visual observations indicated that these lakes had "a soft bottom, limited free water due to increased ice thickness (1.8 feet [ft] for M9906 and 1.1 ft for M9915), and very turbid water with suspended organic material". It was also noted that M9907 had "some suspended organics" and M9913 was "murky and had yellowish, water color". From these observations, it can be deduced that the turbidity at these lakes was noticeably higher than that observed during the previous field sampling events. By late summer, the turbidity at the study lakes ranged from 1 to 3 NTU. In summary, an increase in turbidity was measured and/or observed at all four of the lakes between February and April and then turbidity levels returned to low levels by August.

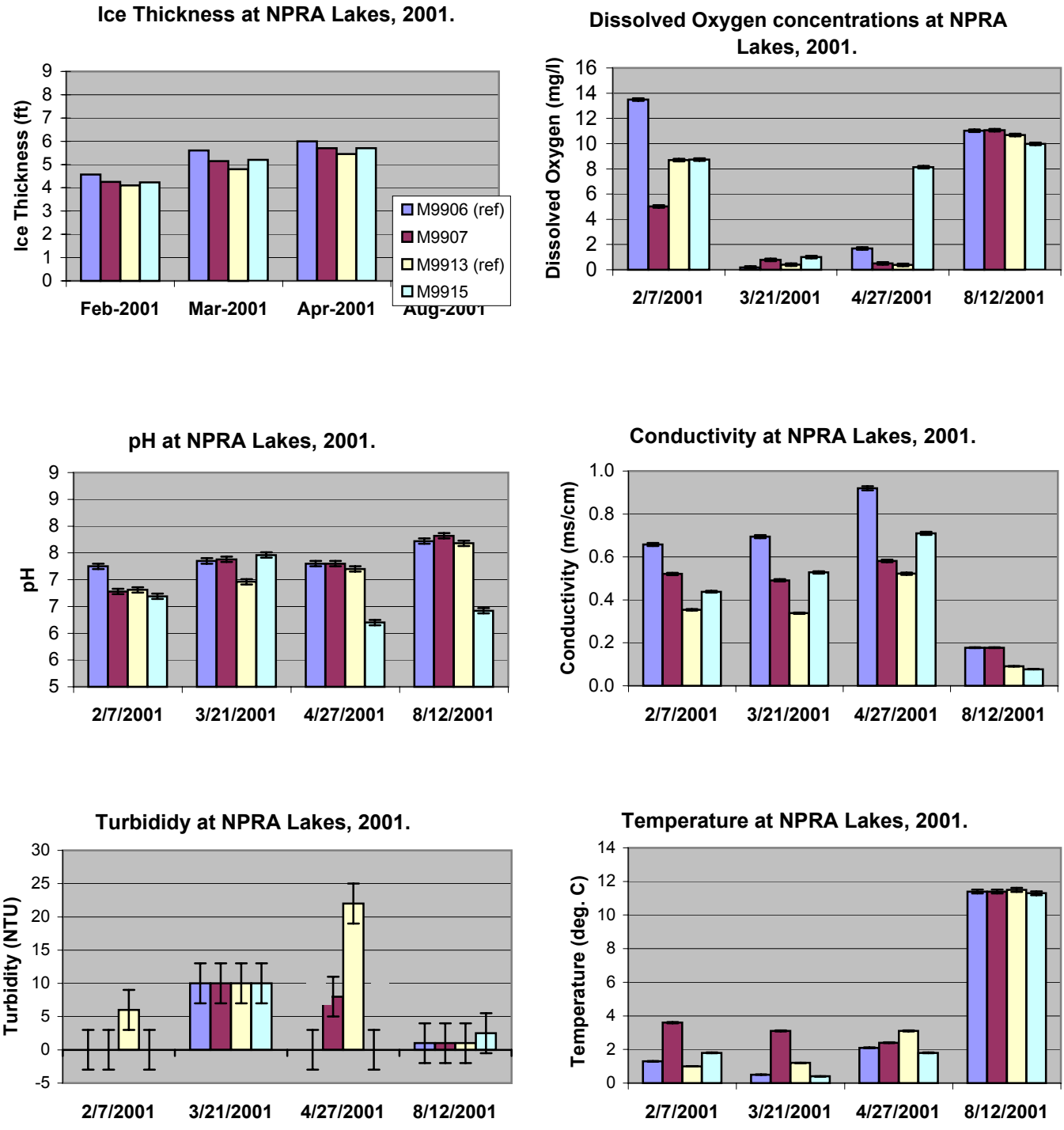


Figure 3.2: Ice thickness and in-situ water quality measurements recorded at two reference and two pumped lakes in NPR-A. Error bars are based on the instrument manufacturer's repeatability specifications. Note: Lakes M9906 and M9913 are references for pumped lakes M9907 and M9915, respectively.

Natural processes would result in an observed increase in lake turbidity during breakup, as runoff enters the lake. Turbidity during summer varies with the depth of the lake and the amount of wind disturbance. At freeze-up there is usually a dramatic drop in turbidity as ice cover eliminates wind disturbances. Turbidity does not usually increase as a result of thickening ice cover, like that measured between February and March and between March and April. It should be recognized that turbidity is not solely a function of suspended sediments: the meter calculates turbidity by measuring permeable diffused light, which can vary due to ice and snow cover, water color, and other factors. This and the fact that the meter did not appear to be recording accurate data at other lakes that day, suggests that the increase measured in reference lake M9913 during April was an anomaly.

For the less significant increase measured between February and March, the measurements may be considered too close within the confidence intervals specified by the accuracy of the instrument used. An additional factor to consider is the effect of boring a hole through the ice with an auger and the possibility of stirring up bottom sediments in cases where little free water is available. Obviously, this may occur equally at both reference and pumped lakes. However, neither field observations nor turbidity measurements indicated a noticeable difference in turbidity levels at pumped versus reference lakes such that any increases in turbidity could be directly attributable to water withdrawal activities.

The measurement of dissolved oxygen refers to the amount of gaseous oxygen dissolved in the water. Oxygen gets into the water by transmission from the surrounding air, aeration (rapid movement), and as a waste product of photosynthesis. The amount of oxygen that can be held by the water is a function of temperature, salinity, and pressure (i.e. gas solubility). Gas solubility decreases with increasing salinity/conductivity and with decreasing pressure. As expected, there was a notable decrease in dissolved oxygen between February and March (levels dropped to less than 1mg/l in all four lakes), when the most significant increase in ice thickness and corresponding increase in conductivity occurred. Dissolved oxygen levels remained relatively low in April (< 2 mg/l), with the exception of Lake M9915, which increased to 8.14 mg/l. By the late summer sampling event, all of the ice had melted and dissolved oxygen levels had increased to the 10-11 mg/l range. In general, dissolved oxygen appeared to change consistently between both reference and pumped lakes. The more significant dissolved oxygen increase measured in M9915 in April may have been due to introduction of oxygen during ice hole auguring, the range of instrument accuracy, and external factors such as pumping. Such increases in dissolved oxygen, that are within the lakes' natural range, are not considered to be a degradation of water quality.

Conductivity appeared to follow the trends of the metal concentrations, as would be expected due to its dependence on ion concentrations in the water. There was a general increase in conductivity between February and April followed by a significant decrease in August, to levels below those found in February. For the entire study, conductivity ranged between 0.077 and 0.920 mS/cm.

Temperature and pH measurements appeared within the normal range for freshwater lakes on the North Slope (Radian 1999). Values measured for pH ranged from 6.2 to 7.8 and water temperature ranged from 0.4 to 11.5 degrees Celsius throughout the study period.

Comparing summer data for dissolved oxygen, conductivity, temperature, and pH with that from the previous two years, it appears that *in-situ* measurements did not appear to vary greatly from

year to year. Dissolved oxygen measurements collected during summer were between 9.76 and 9.90 mg/l in 1999, 9.8 and about 11.83 mg/l in 2000, and 9.98 and 11.06 mg/l in 2001. Summer conductivity measurements ranged from 0.086 to 0.200 mS/cm in 1999, 0.192 to 0.295 in 2000, and 0.077 to 0.177 in 2001 (MJM 2000a and MJM 2000b). Summer temperatures ranged from 13.0 to 14.7 °C in 1999, 7.4 to 14.8 °C in 2000, and 11.3 to 11.5 °C in 2001 (MJM 2000a, MJM 2000b, and PAI 2000). Measurements for pH were slightly lower in most of the lakes in 2001, but all were within a range of 6.4 to 8.6 over the three-year period (MJM 200a and MJM 2000b) which is within the background range (Radian 1999). A summary of water quality data reported by MJM and PAI is provided in Appendix D.

3.3 WATER LEVEL MEASUREMENTS

Measurements of ice thickness and water depth were used to determine free water availability in both the pumped lakes and corresponding reference lakes. This was used to answer a question raised by BLM as to whether water withdrawal could be playing a part in advancing the freezing rate of pumped lakes. Upon viewing the plots of ice thickness and free water during the winter months (Figure 3.3), it appears that these measurements are effectively proportional and water withdrawal had no measurable affect in advancing the freezing rate of lake water.

Water surface elevations were measured to determine the ability for the pumped lakes to fully recharge following water withdrawal. Figure 3.4 depicts water surface elevation measurements for the entire study. During winter, the water surface elevation in a hole drilled through the ice is often assumed to be equivalent to the water surface elevation during ice-free conditions, all other factors being equal. This is a reasonable assumption as long as the ice is free floating: although the ice on the edges of the lake may be frozen to the ground, any ice over water is generally free to deflect such that it is, in effect, floating.

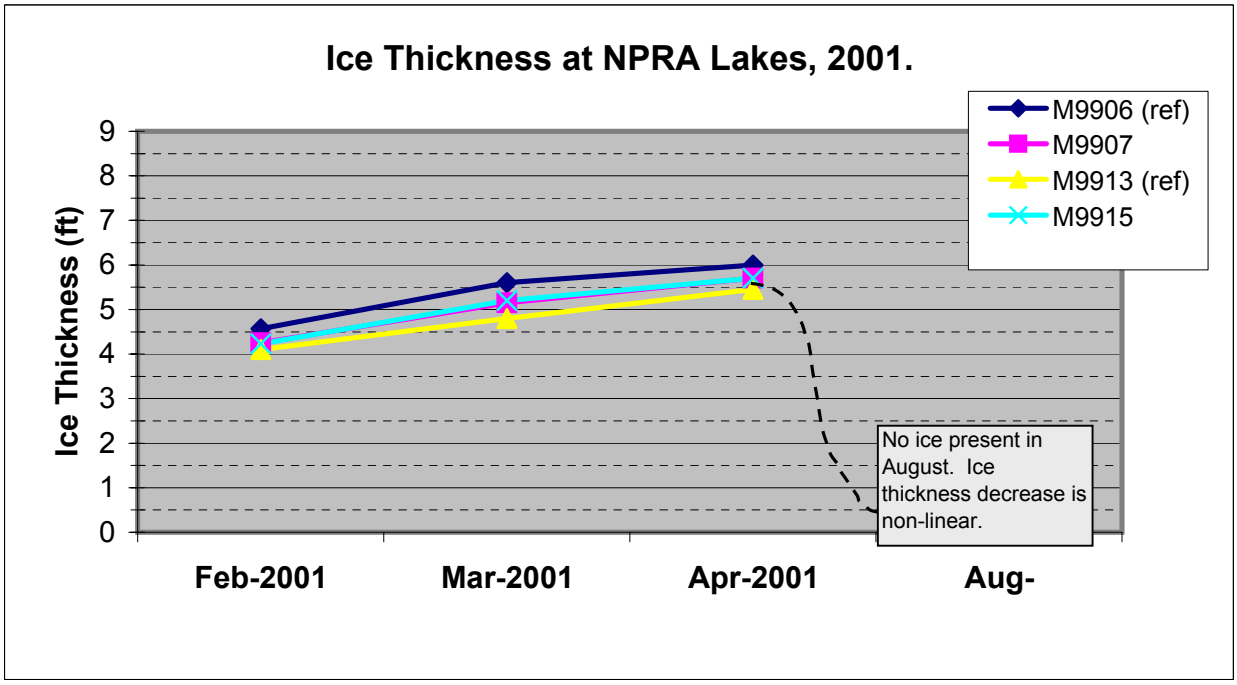
Following pumping, in March, both pumped lakes showed a decrease in surface elevation (0.1 ft at M9907 and 0.2 ft at M9915) when compared to elevations measured prior to pumping, in February. In contrast, the reference lakes remained at the same level or increased in elevation during this period. Additionally, the water levels at the pumped lakes decreased by an additional 0.1 ft by April, while the reference lakes remained at the same elevation.

Following breakup, in June, all of the lake levels increased and pumped lakes increased by a greater amount than the reference lakes (0.53 ft at M9907, 0.88 ft at M9915, and about 0.3 ft at each reference lake). This seems to indicate that the lake levels at the pumped lakes tend to retain more runoff water associated with breakup and hence recharge to levels greater than the levels measured in February.

By mid-August all of the lakes had lower water levels, indicating net water loss due to evaporation was greater than the net gain due to precipitation/recharge. Previous studies indicate that evaporation is a significant cause of water loss from lakes on the North Slope.

In early September, lake level changes were small and variable. M9907 decreased by 0.12 ft while its reference lake, M9906, increased by 0.02 ft. M9915 decreased by 0.01 ft and its reference, M9913, decreased by 0.1 ft.

Historically, August has the largest amount of rainfall of any month (based on monthly climate summary data at Kuparuk during 1971-2000) and averages 1.11 inch (0.09 ft). This, as well as



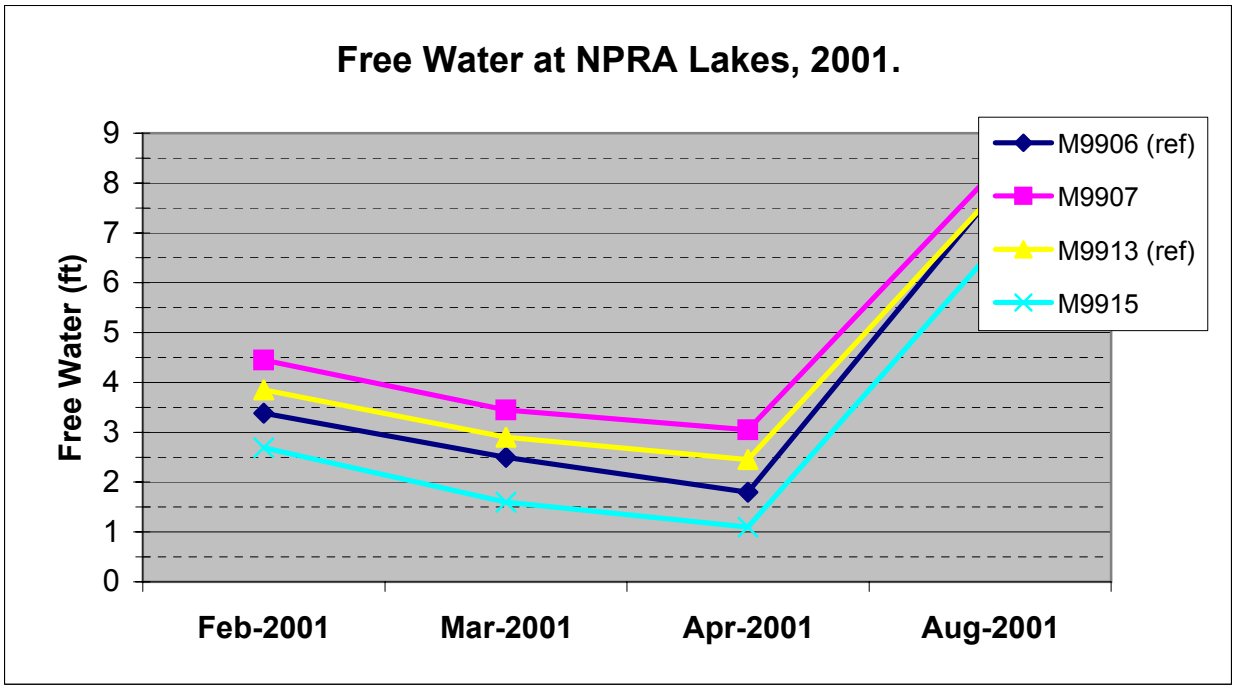


Figure 3.3: **Plots of Ice Thickness and Free Water at two pumped lakes and two reference lakes in NPR-A. Note: Lakes M9906 and M9913 are references for pumped lakes M9907 and M9915, respectively.**

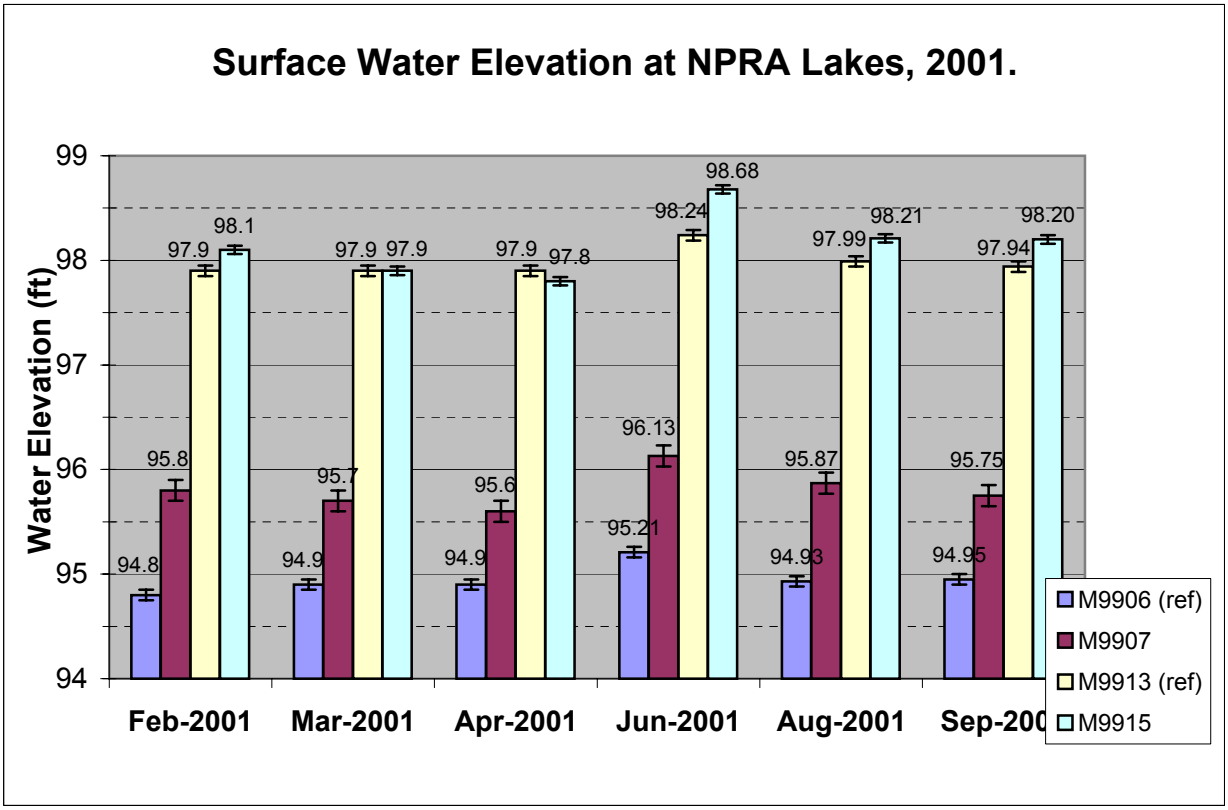


Figure 3.4: Surface Water Elevations at NPR-A Lakes, 2001. Note: Lakes M9906 and M9913 are references for pumped lakes M9907 and M9915, respectively.

the local effects of runoff and evaporation rates may contribute to measurable changes in lake levels. In addition, variation in shoreline staff gage readings may occur due to wind setup/setdown and wind induced waves. These natural effects combined with the lack of multi-year water level measurements, cause difficulty in determining whether water level variations can be attributed to water withdrawal for ice road construction and whether the lakes fully recharge (i.e. there are no pre-freezeup data for comparison).

3.4 WATER VOLUMES

PAI subcontractors utilized water from Lakes M9907 and M9915 for ice road and ice pad construction during winter 2001. A total of 205,800 gallons of water was pumped from M9907 and a total of 1,232,772 gallons was pumped from M9915. No water was withdrawn from the reference lakes, M9906 and M9913.

Water withdrawal at the lakes included in this study is summarized Table 3.3 below.

Table 3.3: Water Withdrawal and Total Lake Volumes for Four Lakes in NPR-A.

Lake	Date	Total Daily Water Withdrawn in 2000 (gallons)	Lake Volume[1] (gallons)
M9906			
Total		**0**	**211,600,000**
M9907	2/26/01	17,640	
	2/27/01	188,160	
Total		**205,800**	**150,900,000**
M9913			
Total		**0**	**17,000,000**
M9915	2/28/01	64,680	
	3/5/01	136,080	
	3/6/01	257,376	
	3/7/01	588,168	
	3/8/01	186,468	
Total		**1,232,772**	**23,000,000**

[1]Total lake volume is a rough calculation based on the volume of a cone, maximum depth, and surface area (MJM 2000).

Based on the data collected, the effective water depth and the water volumes were calculated. If these were fish-bearing lakes, similar calculations could be performed to determine the volume of water available for overwintering fish habitat. The following table shows the volume of available free water under the ice that was calculated from the measurements collected during each sampling effort.

Table 3.4: Under Ice Water Volumes at Four Lakes in NPR-A.

Lake	Month	Free Water Depth (ft)	Volume Under Ice (gal)	Notes
M9906	February	3.38	89,401,000	Reference Lake
	March	2.5	66,125	
	April	1.8	47,610,000	
	August	8	211,600,000	
M9907	February	4.45	79,000,600	205,800 gallons pumped equals 0.33% of the volume under the ice.
	March	3.45	61,247,600	
	April	3.05	54,146,500	
	August	8.5	150,900,000	
M9913	February	3.85	8,500,000	Reference Lake
	March	2.9	6,402,600	
	April	2.45	5,409,100	
	August	7.7	17,000,000	
M9915	February	2.69	9,098,500	1,232,772 gallons pumped equals 22.7% of the volume under the ice.
	March	1.6	5,411,800	
	April	1.1	3,720,600	
	August	6.8	23,000,000	

Calculations determined that at the maximum ice thickness more free water was available in pumped lake M9907 than its reference M9906. This is not the case for the other pair of lakes. Less than 1 percent of the available water was pumped from M9907 whereas about 23 percent was pumped from M9915.

4.1 CONCLUSIONS

The goals of the 2001 Monitoring Plan included studying water levels and water quality at both pumped and reference lakes to determine the following:

1. Measure water level changes and study whether the changes may be caused by water withdrawal (pumping) used for ice road and pad construction.
2. Determine whether pumping and associated lake level decreases caused an increase in freezing rates.
3. Determine whether water volumes for fish habitat may be affected by pumping and/or lake drawdown, including disturbance of sediments and specific water quality parameters.

4.1.1 Water Levels

The lakes included in this study are tundra lakes, meaning they are not connected to a river channel. Hence, water enters these lakes by direct precipitation and drainage from the surrounding area and water leaves the lakes by evaporation and sublimation. Summer evaporation on the North Slope can be significant, 1 to 3 mm per day, and can exceed summer precipitation (Kane and Janowicz 1989). Thus, the water surface elevations in the study lakes fluctuate due to precipitation, evaporation, and unnatural causes (in this case, water withdrawal by pumping).

Water surface elevation measurements in this study showed that water level decreases caused by pumping did not advance the freezing rate of the lakes. Additionally, lake levels returned to the pre-pumping levels prior to freeze up. More data, such as local precipitation, evaporation, and runoff, is required to determine whether lake recharge is likely to occur in an average year or a dry year. Additionally, multi-year data including pre-freezeup elevations, prior to pumping, would be useful to determine if water surface elevations return to original levels.

4.1.2 Water Quality

The original study design included an evaluation of water quality on fish-bearing lakes, but since the proposed "pumped" lake was not used for water withdrawal, study of these lakes was discontinued. Although, water quality parameters, including those that may be considered critical to fish habitat, were studied at the remaining non fish-bearing lakes, this study was unable to fully evaluate the potential impacts of water withdrawal on fish habitat.

Overall, the water quality parameters measured directly and analyzed in a laboratory do not suggest that pumping caused a significant degradation in water quality. Turbidity and iron measurements suggest that pumping may have partially contributed to bottom sediments becoming temporarily suspended in the free water column of the shallow lakes. However, auguring an ice hole through the lakes prior to sampling would create suspended sediments in shallow lakes. Taking this into consideration and the fact that changes were observed in both pumped and reference lakes, it does not appear that pumping caused a significant increase in suspended sediments. Both turbidity and iron concentrations appeared to return to pre-pumping conditions before the summer sampling effort.

Other water quality measurement changes appeared to be naturally occurring and were consistent between pumped and reference lakes. Parameters such as total dissolved solids, chloride, hardness, and metal concentrations, followed similar trends such that concentrations of these parameters increased in proportion to the increase in ice thickness over the course of the winter. A large portion of these analytes is excluded from the ice as it forms, causing concentrations to increase in the underlying free water. Since conductivity is dependent on salt concentrations, this also appeared to follow a similar trend.

Dissolved oxygen generally decreases over the course of the winter, as less oxygen is available under the ice. Auguring the ice hole, which disturbs and potentially introduces oxygen into the water column, may have caused some inconsistencies in dissolved oxygen measurement, such as the increase recorded at one lake in April.

Hutchinson, G.E. A Treatise on Limnology. Yale University. Published by John Wiley and Sons, Inc., New York. 1957.

Kane, D.L. and R.J. Janowicz. Flood Frequency Estimation for Alaska. Published by the State of Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys. Report of investigations series R88-17. April, 1989.

MJM Research (MJM) 2000a. Fish Utilization of Lakes in Eastern NPR-A – 1999. Final Data Report. Prepared for ARCO Alaska, Inc. January 2000.

MJM Research (MJM) 2000b. Fish Utilization of Lakes in Eastern NPR-A: 1999-2000. Final Data Report. Prepared for ARCO Alaska, Inc. November 2000.

Phillips Alaska, Inc . (PAI) 2000. 2000 NPR-A Lake Recharge Study Results. Prepared by Phillips Alaska, Inc. December 22, 2000.

Radian International. Environmental Background Properties of North Slope (AK) Provinces. Final report prepared for ARCO Alaska, Inc. October 1999.

Appendix A
Monitoring Plan

Phillips Alaska, Inc.
2001 NPR-A Lake Recharge Study

Purpose of Recharge Study:

To fulfill the following stipulation contained in the Finding of No Significant Impact - Record of Decision (FONSI-ROD) prepared by the Bureau of Land Management for Permit to Drill 3100.00 and Right-of-Way Permit 2884.01.

> "Monitoring the effect of water use from lakes used for lake road construction. The concern exists in the case of multiple year use of lakes for ice road construction where the assumption is that recharging will be acceptable for the continuing use of these lakes. Applicant is to develop a monitoring plan to measure water volumes before use, measuring amounts used, and lake drawdown. An annual plan for water use will be required for the use of multi-year lake use after the first year of use."

Monitoring Plan:

The intent of the Monitoring Plan is to determine the amount of free water available under the ice and to assess the amount of recharge by the lake in the summer, following water withdrawal during the winter construction season. Phillips Alaska, Inc. (PAI) proposes to monitor three lakes used for water sources during the 2001 NPR-A exploration program plus three unused lakes to serve as controls. This is an increase in the number of lakes studied under the 2000 Recharge Program and is intended to provide for a better comparison between lakes with similar physical characteristics, as well as to take into account the variability between lakes by incorporating more than one control into the program. This monitoring approach was developed in coordination with bp and the BLM.

The study lakes proposed for 2001 are as follows:

- M9906 (Control Lake) - also sampled in 2000 Recharge Study.
- M9907
- M9913 (Control Lake)
- M9915 - also used in 2000 Recharge Study.
- M9911 (Control Lake)
- M9909

In 1999 and 2000, PAI conducted a study of the lakes in the eastern portion of NPR-A to determine which lakes in the area could be used as water sources (see *Fish Utilization of Lakes in Eastern NPR-A: 1999-2000, Final Data Report*, November 2000, MJM Research). Data collection involved water quality sampling, fish sampling, and volumetric calculations. These data were consulted

to select lakes for study that would be representative of the variety of lakes cited in the BLM's December 2000 protocol for lake monitoring.

For the lakes in this study, the report lists the following information:

Summary of Study Lakes for 2001 Recharge Program			
Lake Number	Lake Volume	Maximum depth	Fish Presence?
M9906 *	211.6 million gals	9.7 feet	No fish
M9907	150.9 million gals	9.5 feet	No fish
M9913 *	17.0 million gals	7.9 feet	No fish
M9915	23.4 million gals	7.1 feet	No fish
M9911 *	237.2 million gals	15.3 feet	Fish present
M9909	207.3 million gals	16.4 feet	Fish present

Note: asterisk designates a lake to be used as a control in the study

The lakes were selected to represent varied lake sizes and types (fish-bearing versus non fish-bearing) and were paired with lakes having similar physical characteristics as reference lakes.

Study Methods:

Water volumes withdrawn from each lake for use by PAI will be recorded during the exploration season.

Water Level Measurements

Concern exists that water withdrawal could lower water levels to such an extent that the lakes freeze completely, thus adversely impacting fish overwintering habitat. PAI proposes to collect data on ice thickness and free water availability in a pumped lake and corresponding reference lake to determine if water withdrawal could be playing a part in advancing the freezing level of pumped lakes.

In January 2001, PAI will establish a sampling point at the deepest point of the lake using information contained in the above referenced MJM report. This location will be surveyed for future reference and the following information collected:

- elevation of ice surface;
- elevation of ice bottom; and
- elevation of bottom of lake.

Based on the data collected, the effective water depth will be calculated. This effort will be conducted immediately prior to pumping and after pumping ceases to assess the available water quantity for potential overwintering habitat for fish and aquatic invertebrates and the amount of recharge experienced by the lakes following water withdrawal.

The recharge portion of the survey will commence just prior to breakup with the installation of a water level gauge at a near shore location that is tied to a common reference point and read periodically through the summer (post-breakup). After break-up (approximately mid-June), the study lakes will be surveyed to determine water surface elevation and lake bottom elevation at the same sample locations. In Fall 2001, the study lakes will once again be surveyed for water surface and lake bottom elevations.

Water Quality Sampling

There are concerns that withdrawal of water from north slope lakes could disturb bottom sediments, disrupt stratification or effect water quality in the free water beneath the surface ice. In discussions with BLM personnel, it was agreed that samples collected prior to pumping, immediately after pumping, and again before breakup would enable us to detect a measurable change in water quality.

Four sampling trips will be conducted to assess water quality at the six lakes:

- Trip 1– immediately prior to pumping
- Trip 2– at the conclusion of pumping
- Trip 3– immediately prior to ice road close-out (prior to break up)
- Trip 4– in late summer.

A two-person team will conduct *in situ* water quality measurements using a Horiba water quality meter. The *in situ* measurements to be taken include:

- Temperature
- Dissolved Oxygen
- pH
- Conductivity
- Turbidity

An ice auger will be used to punch a hole at the sampling point established at the deepest point of the lake. Depending on the depth of water available in a given sample lake, one or more measurements will be taken. For lakes with greater than 7 feet of available water depth, *in situ* readings will be taken at the surface, middle and immediately above the bottom. Should less water be available, fewer readings will be taken.

In order for the Horiba to work properly in the sub-zero temperatures expected to be encountered during the first two sampling trips, we plan to use several methods to keep both the meter and the probes warm. The Horiba will be fitted with a 10-m cable which may allow the field team to keep the instrument in the Tucker or other transportation vehicle during the *in situ* analyses. If this is not possible, we will keep several chemical “heat packets” or Hot Hands” inside of the instrument case. The instrument probe(s) will be kept in warm water in a small cooler or other insulated container. Rubbing alcohol can be added to the water in the cooler to keep it from freezing or additional heat packets can be placed in the cooler. The probes will remain in the warm water until immersion in the lake water, and will be returned immediately to the warm cooler water after readings are taken. At least one back-up meter and probe(s) will be available should the primary meter fail.

Additional back-up *in situ* testing for dissolved oxygen will be conducted using CHEMets Colorimetric Test Kits in the test range from 1 to 12 ppm. Surface water

will be collected from the hole by inverting the 25 ml cylinder included in the CHEMetrics kit and inserting it to a depth of 4-6 inches in the water. The cylinder will then be turned 180 degrees and allowed to fill with the water with minimal agitation. Testing of the water in the cylinder using the kits will be conducted according to following the manufactures directions and will occur immediately adjacent to the test hole if possible, or in the nearby Tucker. The most critical point of this sampling is in collecting the sample in order to assure that it is not agitated and thereby aerated. Readings should not be greatly affected if it is necessary to carry the sample cylinder to the directly adjacent Tucker to add the kit chemicals and conduct the colormetric comparison.

In addition to the *in situ* testing, one water sample will be collected from each lake for laboratory analysis. Using the bailer or vertical water sampler, a total of 6 primary samples, and one random duplicate sample per trip will be collected into specially prepared sample jars to be provided by the contracted laboratory (Northern Testing Laboratories Inc.). Proposed laboratory tests include:

- Hardness as $CaCO_3$ (SM 3500 CaD)
- Calcium (EPA 200.7/6010B)
- Magnesium (EPA 200.7/6010B)
- Chloride (EPA 300.0)
- Sodium (EPA 200.7/6010B)
- Potassium (EPA 200.7/6010B)
- Iron (EPA 200.7/6010B)
- Silicon (EPA 200.7/6010B)
- Total Dissolved Solids (SM2540-C).

This suite of tests includes all tests also conducted for the 2000 NPRA Lake Recharge Study.

Reporting of Study Results:

PAI will summarize the results of this study in a report to the BLM by October 31, 2001. If subsequent exploration work is planned in 2002, PAI will submit an updated Lake Recharge Study Plan to the BLM by December 15, 2001.

Appendix B

Laboratory Results

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701 (907) 456-3116 • FAX 456-3125
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518 (907) 349-1000 • FAX 349 1016
POUCH 340043, PRUDHOE BAY, ALASKA 99734 (907) 659-2145 • FAX 659 2146

URS Corporation
3501 Denali St.; Ste 101
Anchorage, AK 99503
Attn: Sue Ban
Phone: (907) 561-1020
Fax: (907) 563-9732

COC #: 20963
NTL Lab#: F202177
Sample Matrix: Water
Location/Project: 2001 NPR-A Lake Recharge Study
Client Sample ID: [redacted]

Comments:

Report Date: 2/14/01
Date Arrived: 2/9/01
Date Sampled: 2/6/01
Time Sampled: 1:56:00 PM
Sampled By: EC/CL

MRL = Method Reporting Limit

Flag Definitions
B = Below Regulatory Minimum
H = Above Regulatory Maximum
M = Matrix Interference
* = Less Than Reporting Limit

Method	Parameter	Result	Units	Flag	MRL	Analysis Date
EPA 300.0	Chloride	29.5	mg/L		0.80	2/9/01
SM 2540-C	Total Dissolved Solids	224	mg/L		35.0	2/12/01
EPA 200.7	Hardness as CaCO3	205	mg/L		0.2	2/12/01
EPA 200.7	Calcium	66.8	mg/L		0.04	2/12/01
EPA 200.7	Magnesium	9.2	mg/L		0.2	2/12/01
EPA 200.7	Sodium	12.2	mg/L		0.1	2/13/01
EPA 200.7	Potassium	2.0	mg/L		0.2	2/13/01
EPA 200.7	Iron	0.094	mg/L		0.015	2/13/01
EPA 200.7	Silicon	0.4	mg/L		0.2	2/12/01

Reported by Jeremy Nicoll
Fairbanks Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
8005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
PRUDHOE BAY, ALASKA 99734

(907) 456-3116 • FAX 456-3125
(907) 349-1000 • FAX 349-1011
(907) 659-2145 • FAX 659-2146

URS Corporation
3501 Denali St; Ste 101
Anchorage, AK 99503
Attn: Sue Ban
Phone: (907) 561-1020
Fax: (907) 563-9732

COC #: 20963
NTL Lab#: F202178
Sample Matrix: Water
Location/Project: 2001 NPR-A Lake Recharge Study
Client Sample ID: [redacted]

Comments:

Report Date: 2/14/01
Date Arrived: 2/9/01
Date Sampled: 2/6/01
Time Sampled: 2:30:00 PM
Sampled By: EC/CL

MRL = Method Reporting Limit

Flag Definitions
B = Below Regulatory Minimum
H = Above Regulatory Maximum
M = Matrix Interference
* = Less Than Reporting Limit

Method	Parameter	Result	Units	Flag	MRL	Analysis Date
EPA 300.0	Chloride	43.5	mg/L		0.80	2/9/01
SM 2540-C	Total Dissolved Solids	164	mg/L		35.0	2/12/01
EPA 200.7	Hardness as CaCO3	142	mg/L		0.2	2/12/01
EPA 200.7	Calcium	42.7	mg/L		0.04	2/12/01
EPA 200.7	Magnesium	8.5	mg/L		0.2	2/12/01
EPA 200.7	Sodium	13.9	mg/L		0.1	2/13/01
EPA 200.7	Potassium	1.8	mg/L		0.2	2/13/01
EPA 200.7	Iron	0.028	mg/L		0.015	2/13/01
EPA 200.7	Silicon	0.2	mg/L		0.2	2/12/01

Reported by Jeremy Nicoll
Fairbanks Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701 (907) 456-3116 • FAX 456-3123
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518 (907) 349-1000 • FAX 349-1010
POUCH 340043, PRUDHOE BAY, ALASKA 99734 (907) 659-2145 • FAX 659-2146

URS Corporation
3501 Denali St.; Ste 101
Anchorage, AK 99503
Attn: Sue Ban
Phone: (907) 561-1020
Fax: (907) 563-9732

COC #: 20963
NTL Lab#: F202179
Sample Matrix: Water
Location/Project: 2001 NPR-A Lake Recharge Study
Client Sample ID: [redacted]

Comments:

Report Date: 2/14/01
Date Arrived: 2/9/01
Date Sampled: 2/6/01
Time Sampled: 2:30:00 PM
Sampled By: EC/CL

MRL = Method Reporting Limit

Flag Definitions
B = Below Regulatory Minimum
H = Above Regulatory Maximum
M = Matrix Interference
* = Less Than Reporting Limit

Method	Parameter	Result	Units	Flag	MRL	Analysis Date
EPA 300.0	Chloride	43.7	mg/L		0.80	2/9/01
SM 2540-C	Total Dissolved Solids	162	mg/L		35.0	2/12/01
EPA 200.7	Hardness as CaCO3	141	mg/L		0.2	2/12/01
EPA 200.7	Calcium	42.5	mg/L		0.04	2/12/01
EPA 200.7	Magnesium	8.5	mg/L		0.2	2/12/01
EPA 200.7	Sodium	14.6	mg/L		0.1	2/13/01
EPA 200.7	Potassium	1.8	mg/L		0.2	2/13/01
EPA 200.7	Iron	0.032	mg/L		0.015	2/13/01
EPA 200.7	Silicon	0.2	mg/L		0.2	2/12/01

Reported by Jeremy Nicoll
Fairbanks Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701, (907) 456-3116 • FAX 456-3125
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518, (907) 349-1000 • FAX 349-1016
POUCH 340043, PRUDHOE BAY, ALASKA 99734, (907) 659-2145 • FAX 659-2146

URS Corporation
3501 Denali St.; Ste 101
Anchorage, AK 99503
Attn: Sue Ban
Phone: (907) 561-1020
Fax: (907) 563-9732

COC #: 20963
NTL Lab#: F202180
Sample Matrix: Water
Location/Project: 2001 NPR-A Lake Recharge Study
Client Sample ID: [redacted]

Comments:

Report Date: 2/14/01
Date Arrived: 2/9/01
Date Sampled: 2/6/01
Time Sampled: 3:15:00 PM
Sampled By: EC/CL

MRL = Method Reporting Limit

Flag Definitions
B = Below Regulatory Minimum
H = Above Regulatory Maximum
M = Matrix Interference
* = Less Than Reporting Limit

Method	Parameter	Result	Units	Flag	MRL	Analysis Date
EPA 300.0	Chloride	47.9	mg/L		0.80	2/9/01
SM 2540-C	Total Dissolved Solids	198	mg/L		35.0	2/12/01
EPA 200.7	Hardness as CaCO3	141	mg/L		0.2	2/12/01
EPA 200.7	Calcium	41.9	mg/L		0.04	2/12/01
EPA 200.7	Magnesium	8.9	mg/L		0.2	2/12/01
EPA 200.7	Sodium	15.1	mg/L		0.1	2/13/01
EPA 200.7	Potassium	1.7	mg/L		0.2	2/13/01
EPA 200.7	Iron	1.93	mg/L	H	0.015	2/13/01
EPA 200.7	Silicon	0.6	mg/L		0.2	2/12/01

Reported by Jeremy Nicoll
Fairbanks Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701 (907) 456-3116 • FAX 456-3125
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518 (907) 349-1000 • FAX 349-1016
POUCH 340043, PRUDHOE BAY, ALASKA 99734 (907) 659-2145 • FAX 659-2146

URS Corporation
3501 Denali St.; Ste 101
Anchorage, AK 99503
Attn: Sue Ban
Phone: (907) 561-1020
Fax: (907) 563-9732

COC #: 20963
NTL Lab#: F202181
Sample Matrix: Water
Location/Project: 2001 NPR-A Lake Recharge Study
Client Sample ID: [redacted]

Comments:

Report Date: 2/14/01
Date Arrived: 2/9/01
Date Sampled: 2/7/01
Time Sampled: 8:36:00 AM
Sampled By: EC/CL

MRL = Method Reporting Limit

Flag Definitions
B = Below Regulatory Minimum
H = Above Regulatory Maximum
M = Matrix Interference
* = Less Than Reporting Limit

Method	Parameter	Result	Units	Flag	MRL	Analysis Date
EPA 300.0	Chloride	34.9	mg/L		0.80	2/9/01
SM 2540-C	Total Dissolved Solids	268	mg/L		35.0	2/12/01
EPA 200.7	Hardness as CaCO3	230	mg/L		0.2	2/12/01
EPA 200.7	Calcium	73.5	mg/L		0.04	2/12/01
EPA 200.7	Magnesium	11.1	mg/L		0.2	2/12/01
EPA 200.7	Sodium	16.6	mg/L		0.1	2/13/01
EPA 200.7	Potassium	3.0	mg/L		0.2	2/13/01
EPA 200.7	Iron	0.342	mg/L	H	0.015	2/13/01
EPA 200.7	Silicon	1.4	mg/L		0.2	2/12/01

Reported by Jeremy Nicoll
Fairbanks Chemistry Supervisor

CT&E Environmental Services Inc.
Laboratory Division

Laboratory Analysis Report

200 W. Potter Drive
Anchorage, AK 99518-1605
Tel: (907) 562-2343
Fax: (907) 561-5301
Web: http://www.cteesi.com

Kim Nielson
URS Corporation
3501 Denali St. #101
Anchorage, AK 99503

Work Order:	1011452
	NPRA Lake Recharge
Client:	URS Corporation
Report Date:	April 10, 2001

Enclosed are the analytical results associated with the above workorder.

As required by the state of Alaska and the USEPA, a formal Quality Assurance/Quality Control Program is maintaned by CT&E. A copy of our Quality Control Manual that outlines this program is available at your request.

Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth in our Quality Assurance Program Plan.

If you have any questions regarding this report or if we can be of any other assistance, please call your CT&E Project Manager at (907) 562-2343.

The following descriptors may be found on your report which will serve to further qualify the data.

U	Indicates the analyte was analyzed for but not detected.
J	Indicates an estimated value that falls below PQL, but is greater than the MDL.
B	Indicates the analyte is found in the blank associated with the sample.
*	The analyte has exceeded allowable limits.
GT	Greater Than
D	Secondary Dilution
LT	Less Than
!	Surrogate out of range

CT&E Environmental Services Inc.

CT&E Ref.#	1011452001	**Client PO#**	74-PA101001.00-20
Client Name	URS Corporation	**Printed Date/Time**	04/10/2001 9:21
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	03/21/2001 15:35
Client Sample ID	032101M9913-01	**Received Date/Time**	03/23/2001 13:00
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	

Sample Remarks:

EPA 200.8 Metals by ICPMS: Ca was >4x spike amount

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	61.7	0.500	mg/L	EPA 200.7		03/25/01	04/03/01
Iron	4.50	0.0250	mg/L	EPA 200.7		03/25/01	04/03/01
Magnesium	13.2	0.0500	mg/L	EPA 200.7		03/25/01	04/03/01
Silicon	1.11	0.250	mg/L	EPA 200.7		04/03/01	04/05/01
Sodium	22.7	0.139	mg/L	EPA 200.7		03/25/01	04/03/01
Hardness as CaCO3	209	2.00	mg/L	SM17 2340B			04/04/01
Metals by ICP/MS							
Potassium	2500 U	2500	ug/L	EPA 200.8		04/06/01	04/09/01
Waters Department							
Chloride	95.0	25.0	mg/L	EPA 300.0			03/23/01
Total Dissolved Solids	344	50.0	mg/L	SM20 2540C			03/23/01

F-7901

CT&E Environmental Services Inc.

CT&E Ref.#	1011452002	**Client PO#**	74-PA101001.00-20
Client Name	URS Corporation	**Printed Date/Time**	04/10/2001 9:21
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	03/21/2001 17:05
Client Sample ID	032101M9915-01	**Received Date/Time**	03/23/2001 13:00
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	85.7	0.500	mg/L	EPA 200.7		03/25/01	04/03/01
Iron	10.1	0.0250	mg/L	EPA 200.7		03/25/01	04/03/01
Magnesium	18.6	0.0500	mg/L	EPA 200.7		03/25/01	04/03/01
Silicon	1.30	0.250	mg/L	EPA 200.7		04/03/01	04/05/01
Sodium	30.2	0.139	mg/L	EPA 200.7		03/25/01	04/03/01
Hardness as CaCO3	291	2.00	mg/L	SM17 2340B			04/04/01
Metals by ICP/MS							
Potassium	3250	2500	ug/L	EPA 200.8		04/06/01	04/09/01
Waters Department							
Chloride	121	25.0	mg/L	EPA 300.0			03/23/01
Total Dissolved Solids	446	50.0	mg/L	SM20 2540C			03/23/01

CT&E Environmental Services Inc.

CT&E Ref.#	1011452003	**Client PO#**	74-PA101001.00-20(
Client Name	URS Corporation	**Printed Date/Time**	04/10/2001 9:21
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	03/21/2001 17:10
Client Sample ID	032101M9915-02	**Received Date/Time**	03/23/2001 13:00
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	Shawn Peck

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	88.2	0.500	mg/L	EPA 200.7		03/25/01	04/03/01
Iron	10.8	0.0250	mg/L	EPA 200.7		03/25/01	04/03/01
Magnesium	19.1	0.0500	mg/L	EPA 200.7		03/25/01	04/03/01
Silicon	1.27	0.250	mg/L	EPA 200.7		04/03/01	04/05/01
Sodium	30.7	0.139	mg/L	EPA 200.7		03/25/01	04/03/01
Hardness as CaCO3	299	2.00	mg/L	SM17 2340B			04/04/01
Metals by ICP/MS							
Potassium	3030	2500	ug/L	EPA 200.8		04/06/01	04/09/01
Waters Department							
Chloride	126	25.0	mg/L	EPA 300.0			03/23/01
Total Dissolved Solids	438	50.0	mg/L	SM20 2540C			03/23/01

F-PA1

CT&E Environmental Services Inc.

CT&E Ref.#	1011452004	**Client PO#**	74-PA101001.00-20
Client Name	URS Corporation	**Printed Date/Time**	04/10/2001 9:21
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	03/21/2001 18:10
Client Sample ID	032101M9906-01	**Received Date/Time**	03/23/2001 13:00
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	135	0.500	mg/L	EPA 200.7		03/25/01	04/03/01
Iron	0.811	0.0250	mg/L	EPA 200.7		03/25/01	04/03/01
Magnesium	18.8	0.0500	mg/L	EPA 200.7		03/25/01	04/03/01
Silicon	1.22	0.250	mg/L	EPA 200.7		04/03/01	04/05/01
Sodium	28.3	0.139	mg/L	EPA 200.7		03/25/01	04/03/01
Hardness as CaCO3	415	2.00	mg/L	SM17 2340B			04/04/01
Metals by ICP/MS							
Potassium	3490	2500	ug/L	EPA 200.8		04/06/01	04/09/01
Waters Department							
Chloride	92.6	25.0	mg/L	EPA 300.0			03/23/01
Total Dissolved Solids	476	50.0	mg/L	SM20 2540C			03/28/01

CT&E Environmental Services Inc.

CT&E Ref.#	1011452005	**Client PO#**	74-PAI01001.00-20
Client Name	URS Corporation	**Printed Date/Time**	04/10/2001 9:21
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	03/21/2001 18:55
Client Sample ID	032101M9907-01	**Received Date/Time**	03/23/2001 13:00
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	100	0.500	mg/L	EPA 200.7		03/25/01	04/03/01
Iron	1.05	0.0250	mg/L	EPA 200.7		04/03/01	04/05/01
Magnesium	15.5	0.0500	mg/L	EPA 200.7		03/25/01	04/03/01
Silicon	1.87	0.250	mg/L	EPA 200.7		04/03/01	04/05/01
Sodium	22.7	0.139	mg/L	EPA 200.7		03/25/01	04/03/01
Hardness as CaCO3	314	2.00	mg/L	SM17 2340B			04/04/01
Metals by ICP/MS							
Potassium	3250	2500	ug/L	EPA 200.8		04/06/01	04/09/01
Waters Department							
Chloride	61.9	25.0	mg/L	EPA 300.0			03/23/01
Total Dissolved Solids	364	50.0	mg/L	SM20 2540C			03/28/01

CT&E Environmental Services Inc.
Laboratory Division

pink

(1)

CLIENT: URS Corp.

CONTACT: Kim Nielsen PHONE NO: (907) 201-9747

PROJECT: NPRA Lake Recharge SITE: NPRA Lakes

REPORTS TO: Kim Nielsen FAX NO: ( ) 563-3198

INVOICE TO: 3501 Denali St #101 Anchorage AK 9950[illegible] PURCHASE ORDER NUMBER:

CT&E Reference:

PAGE 1 OF 1

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C = COMP G = GRAB	Preservatives Used	Analysis Required (3) ICP Metals 20.7	Hardness as CaCO3	TDS (SM 2540-C)	Chloride (EPA 300.0)	REMARKS
							HNO3					
(1)	032101M9913-01	3/21/01	1535	WA	3	G		X	X	X	X	
(2)	032101M9915-01	3/21/01	1705	WA	3	G		X	X	X	X	
(3)	032101M9915-02	3/21/01	1710	WA	3	G		X	X	X	X	
(4)	032101M9906-01	3/21/01	1810	WA	3	G		X	X	X	X	
(5)	032101M9907-01	3/21/01	1855	WA	3	G		X	X	X	X	

(5)

Collected/Relinquished By: (1)	Date	Time	Received By:
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date 3/23/01	Time 1300	Received For Laboratory By:

(4)

Shipping Carrier:	Samples Received Cold? (Circle) YES NO
Shipping Ticket No:	Temperature °C: 5.8°C
Data Deliverables Required	Chain of Custody Seal: (Circle)
Level I Level II Level III	INTACT BROKEN ABSENT
Requested Turnaround Time and Special Instructions:	

200 W. Potter Drive Anchorage, AK 99518 Tel: (907) 562-2343 Fax: (907) 561-5301
3180 Peger Road Fairbanks, AK 99701 Tel: (907) 474-8656 Fax: (907) 474-9685

Yes	No		
	X	Are samples **RUSH**, priority, or *within 72 hrs.* of hold time?	
		If yes have you done *e-mail notification*?	
	X	Are samples *within 24 hrs.* of hold time or due date?	
		If yes, have you *spoken with* Supervisor?	
	X	Are there any **problems** (e.g., ids, analyses)?	
		Were samples preserved correctly and pH verified?	
		Has Project Manager been notified of problems?	
		Is this an ACOE / AFCEE / ADEC project?	
		Will a **data package** be required?	
		If this is for PWS, provide **PWSID.**	
		Is there a **quote** for this project?	
	X	Will courier charges apply?	

Completed by (sign): S Phillips **(print):** S. Phillips

Due Date: 4/4
Received Date/Time: 3/23 1530
Received Temperature: 5.8

Matrix of each Sample:

1	"	1-5
	"	
	"	
	Trip Blank	
	BMS/BMSD	

Additional Sample Remarks:

_____ Extra Sample Volume?
_____ Limited Sample Volume?
_____ Field pres'd for volatiles?
_____ Field-filtered for dissolved _____?
_____ Lab-filtered for dissolved _____?
_____ Ref Lab required? _____

Notes: _____

*********The following *must* be completed for *all* ACOE & AFCEE: *********

Yes	No		
		Is received temperature 4 ± 2°C? Temp:	
		Thermometer used:	
		Was there an airbill, etc.? Note #:	
		Was cooler sealed with custody seals? Fax'd to COE?	
		# / where:	
		Were seals intact upon arrival?	
		Was there a COC with cooler?	
		Was the COC filled out properly?	
		Did the COC indicate ACOE / AFCEE project? (if applicable)	
		Did the COC and samples correspond?	
		Were all samples packed to prevent breakage?	
		packing material:	
		Were all samples unbroken and clearly labeled?	
		Were all samples sealed in separate plastic bags?	
		Were all bottles for volatiles free of headspace?	
		Were correct container / sample sizes submitted?	
		Is sample condition good?	
		Was client notified of problems? (specify below)	

# of each Container Received:

_____ 950 ml amber unpres'd
_____ 950 ml amber w / HCl
_____ 500 ml amber w / H_2SO_4
5 1L cubies unpres'd
5 1L cubies w / HNO_3
_____ 1L cubies w / H_2SO_4
_____ 1L cubies w / NaOH + ZnAc
_____ 120 ml coli bottles
5 60 ml Nalgene
_____ 8 oz amber unpres'd
_____ 4 oz amber unpres'd
_____ 4 oz w / septa w / MeOH
_____ 40 ml vials w / HCl
_____ Other (specify) _____
_____ Other (specify) _____

Individual contacted: _____
Date / Time: _____ Phone / Fax: _____

Log-in proofed by: _____

Form F004r03.1 (Revised 03/08/01)

TO BE COMPLETED IN ANCHORAGE UPON ARRIVAL FROM FAIRBANKS:
DATE / TIME: _____ **COOLER TEMP:** _____
CUSTODY SEALS INTACT: YES / NO # / WHERE: _____
COMPLETED BY (INITIAL): _____

CT&E Environmental Services Inc.
Laboratory Division

Laboratory Analysis Report

200 W. Potter Drive
Anchorage, AK 99518-1605
Tel: (907) 562-2343
Fax: (907) 561-5301
Web: http://www.cteesi.com

Kim Nielson
URS Corporation
3501 Denali St. #101
Anchorage, AK 99503

Work Order:	1012194
	Alpine/NPRA
Client:	URS Corporation
Report Date:	May 11, 2001

Enclosed are the analytical results associated with the above workorder.

As required by the state of Alaska and the USEPA, a formal Quality Assurance/Quality Control Program is maintained by CT&E. A copy of our Quality Control Manual that outlines this program is available at your request.

Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth in our Quality Assurance Program Plan.

If you have any questions regarding this report or if we can be of any other assistance, please call your CT&E Project Manager at (907) 562-2343.

The following descriptors may be found on your report which will serve to further qualify the data.

U	Indicates the analyte was analyzed for but not detected.
J	Indicates an estimated value that falls below PQL, but is greater than the MDL.
B	Indicates the analyte is found in the blank associated with the sample.
*	The analyte has exceeded allowable limits.
GT	Greater Than
D	Secondary Dilution
LT	Less Than
!	Surrogate out of range

CT&E Environmental Services Inc.

CT&E Ref.#	1012194001	**Client PO#**	74-PA101001.00-20C
Client Name	URS Corporation	**Printed Date/Time**	05/11/2001 16:28
Project Name/#	Alpine/NPRA	**Collected Date/Time**	04/27/2001 14:41
Client Sample ID	01-M9913-002	**Received Date/Time**	04/30/2001 15:30
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	97.3	0.500	mg/L	EPA 200.7		05/09/01	05/10/01
Iron	17.5	0.0250	mg/L	EPA 200.7		05/09/01	05/10/01
Magnesium	20.8	0.0500	mg/L	EPA 200.7		05/09/01	05/10/01
Silicon	2.06	0.250	mg/L	EPA 200.7		05/09/01	05/10/01
Sodium	34.7	0.139	mg/L	EPA 200.7		05/09/01	05/10/01
Hardness as CaCO3	329	2.00	mg/L	SM17 2340B			05/11/01
Metals by ICP/MS							
Potassium	2740	500	ug/L	EPA 200.8		05/01/01	05/08/01
Waters Department							
Chloride	124	5.00	mg/L	EPA 300.0			05/02/01
Total Dissolved Solids	454	50.0	mg/L	SM20 2540C			05/01/01

CT&E Environmental Services Inc.

CT&E Ref.#	1012194002	**Client PO#**	74-PAI01001.00-20(
Client Name	URS Corporation	**Printed Date/Time**	05/11/2001 16:28
Project Name/#	Alpine/NPRA	**Collected Date/Time**	04/27/2001 10:54
Client Sample ID	01-M9915-002	**Received Date/Time**	04/30/2001 15:30
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	112	0.500	mg/L	EPA 200.7		05/09/01	05/10/01
Iron	11.8	0.0250	mg/L	EPA 200.7		05/09/01	05/10/01
Magnesium	26.0	0.0500	mg/L	EPA 200.7		05/09/01	05/10/01
Silicon	2.24	0.250	mg/L	EPA 200.7		05/09/01	05/10/01
Sodium	42.0	0.139	mg/L	EPA 200.7		05/09/01	05/10/01
Hardness as CaCO3	386	2.00	mg/L	SM17 2340B			05/11/01
Metals by ICP/MS							
Potassium	3020	500	ug/L	EPA 200.8		05/01/01	05/08/01
Waters Department							
Chloride	166	5.00	mg/L	EPA 300.0			05/02/01
Total Dissolved Solids	528	50.0	mg/L	SM20 2540C			05/01/01

F-7281

CT&E Environmental Services Inc.

CT&E Ref.#	1012194003	**Client PO#**	74-PAI01001.00-20(
Client Name	URS Corporation	**Printed Date/Time**	05/11/2001 16:28
Project Name/#	Alpine/NPRA	**Collected Date/Time**	04/27/2001 12:03
Client Sample ID	01-M9906-002	**Received Date/Time**	04/30/2001 15:30
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	171	5.00	mg/L	EPA 200.7		05/09/01	05/10/01
Iron	0.504	0.0250	mg/L	EPA 200.7		05/09/01	05/10/01
Magnesium	24.7	0.0500	mg/L	EPA 200.7		05/09/01	05/10/01
Silicon	1.40	0.250	mg/L	EPA 200.7		05/09/01	05/10/01
Sodium	36.8	0.139	mg/L	EPA 200.7		05/09/01	05/10/01
Hardness as CaCO3	528	2.00	mg/L	SM17 2340B			05/11/01
Metals by ICP/MS							
Potassium	3680	500	ug/L	EPA 200.8		05/01/01	05/08/01
Waters Department							
Chloride	101	5.00	mg/L	EPA 300.0			05/02/01
Total Dissolved Solids	641	50.0	mg/L	SM20 2540C			05/01/01

CT&E Environmental Services Inc.

CT&E Ref.#	1012194004	**Client PO#**	74-PAI01001.00-20(
Client Name	URS Corporation	**Printed Date/Time**	05/11/2001 16:28
Project Name/#	Alpine/NPRA	**Collected Date/Time**	04/27/2001 12:44
Client Sample ID	01-M9907-002	**Received Date/Time**	04/30/2001 15:30
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	133	0.500	mg/L	EPA 200.7		05/09/01	05/10/01
Iron	2.57	0.0250	mg/L	EPA 200.7		05/09/01	05/10/01
Magnesium	20.8	0.0500	mg/L	EPA 200.7		05/09/01	05/10/01
Silicon	1.59	0.250	mg/L	EPA 200.7		05/09/01	05/10/01
Sodium	30.1	0.139	mg/L	EPA 200.7		05/09/01	05/10/01
Hardness as CaCO3	418	2.00	mg/L	SM17 2340B			05/11/01
Metals by ICP/MS							
Potassium	3750	500	ug/L	EPA 200.8		05/01/01	05/08/01
Waters Department							
Chloride	67.5	5.00	mg/L	EPA 300.0			05/02/01
Total Dissolved Solids	474	50.0	mg/L	SM20 2540C			05/01/01

CT&E Environmental Services Inc.

CT&E Ref.#	1012194005	**Client PO#**	74-PAI01001.00-20(
Client Name	URS Corporation	**Printed Date/Time**	05/11/2001 16:28
Project Name/#	Alpine/NPRA	**Collected Date/Time**	04/27/2001 12:50
Client Sample ID	01-M9907-003	**Received Date/Time**	04/30/2001 15:30
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	125	0.500	mg/L	EPA 200.7		05/09/01	05/10/01
Iron	2.50	0.0250	mg/L	EPA 200.7		05/09/01	05/10/01
Magnesium	19.6	0.0500	mg/L	EPA 200.7		05/09/01	05/10/01
Silicon	1.49	0.250	mg/L	EPA 200.7		05/09/01	05/10/01
Sodium	28.7	0.139	mg/L	EPA 200.7		05/09/01	05/10/01
Hardness as CaCO3	393	2.00	mg/L	SM17 2340B			05/11/01
Metals by ICP/MS							
Potassium	3720	500	ug/L	EPA 200.8		05/01/01	05/08/01
Waters Department							
Chloride	63.6	5.00	mg/L	EPA 300.0			05/02/01
Total Dissolved Solids	480	50.0	mg/L	SM20 2540C			05/01/01

CT&E Environmental Services Inc.
Laboratory Division

(1)

CLIENT: URS

CONTACT: CAL LARSON PHONE NO: (907) 561-1020

PROJECT: Alpine/NPRA SITE: NPRA

REPORTS TO: Kim Nielsen FAX NO: (907) 563-3198

INVOICE TO:

P.O. NUMBER: 74-PAID1001.00 2000

CT&E Reference:

PAGE 1 OF 1

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C = COMP G = GRAB	(3) Analysis Required: EPA 200.7	EPA 300.0	SM 2540C	REMARKS
1	01-M9913-002	4/27/01	14:41	W	3	G	X	X	X	
2	01-M9915-002		10:54				X	X	X	
3	01-M9906-002		12:03				X	X	X	
4	01-M9907-002		12:44				X	X	X	
5	01-M9907-003		12:50				X	X	X	

(5)

Collected/Relinquished By: (1)	Date	Time	Received By:
Cindy Cuddy	4/30/01	10:00	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date 4/30/01	Time 1530	Received For Laboratory By:

(4)

Shipping Carrier: Hand Delivered

Shipping Ticket No: 21

Samples Received Cold? (Circle) YES NO

Temperature °C: 0.6°C

Data Deliverables Required

Level I Level II Level III

Chain of Custody Seal: (Circle)

(INTACT) BROKEN ABSENT

Requested Turnaround Time and Special Instructions: 2 lid

SEE SHEET FOR METALS

200 W. Potter Drive Anchorage, AK 99518 Tel: (907) 562-2343 Fax: (907) 561-5301
3180 Peger Road Fairbanks, AK 99701 Tel: (907) 474-8656 Fax: (907) 474-8685

White - Retained by Lab (Project File) Yellow - Returned with Report Pink - Retained by Sampler

0-720

Yes	No	
		Are samples **RUSH**, priority, or *within 72 hrs.* of **hold time**?
		If yes have you done *e-mail notification*?
		Are samples *within 24 hrs.* of **hold time** or **due date**?
		If yes, have you *spoken with* Supervisor?
		Are there any **problems** (e.g., lds, analyses)?
		Were samples preserved correctly and pH verified?

Has Project Manager been notified of problems?
Is this an ACOE / AFCEE / ADEC project?
Will a **data package** be required?
If this is for PWS, provide **PWSID**.
Is there a **quote** for this project?
Will **courier** charges apply?

Completed by (sign): [signature] **(print):** Jim Hansen

Due Date: 5/4/01
Received Date/Time: 4/30/01 1530
Received Temperature: _____
Matrix of each Sample:
1 - - 1-5
- - -
- - -
Trip Blank
BMS/BMSD

Additional Sample Remarks:
Extra Sample Volume?
Limited Sample Volume?
Field pres'd for volatiles?
Field-filtered for dissolved ____?
Lab-filtered for dissolved ____?
Ref Lab requred?

Notes: See attached for metals

*********The following *must* be completed for all ACOE & AFCEE: *********

Yes	No	
		Is received temperature 4 ± 2°C? Temp:
		Thermometer used:
		Was there an airbill, etc.? Note #:
		Was cooler sealed with custody seals? Fax'd to COE?
		# / where:
		Were seals intact upon arrival?
		Was there a COC with cooler?
		Was the COC filled out properly?
		Did the COC indicate ACOE / AFCEE project? (if applicable)
		Did the COC and samples correspond?
		Were all samples packed to prevent breakage?
		packing material:
		Were all samples unbroken and clearly labeled?
		Were all samples sealed in separate plastic bags?
		Were all bottles for volatiles free of headspace?
		Were correct container / sample sizes submitted?
		Is sample condition good?
		Was client notified of problems? (specify below)

# of each Container Received:
- ____ 950 ml amber unpres'd
- ____ 950 ml amber w / HCl
- ____ 500 ml amber w / H_2SO_4
- 5 1L cubies unpres'd
- 5 1L cubies w / HNO_3
- ____ 1L cubies w / H_2SO_4
- ____ 1L cubies w / NaOH + ZnAc
- ____ 120 ml coli bottles
- 5 60 ml Nalgene
- ____ 8 oz amber unpres'd
- ____ 4 oz amber unpres'd
- ____ 4 oz w / septa w / MeOH
- ____ 40 ml vials w / HCl
- ____ Other (specify)
- ____ Other (specify)

Individual contacted: _____
Date / Time: _____ Phone / Fax: _____

Log-in proofed by: _____

TO BE COMPLETED IN ANCHORAGE UPON ARRIVAL FROM FAIRBANKS:
DATE / TIME: _____ **COOLER TEMP:** _____
CUSTODY SEALS INTACT: YES / NO # / WHERE: _____
COMPLETED BY (INITIAL): _____

CT&E Environmental Services Inc.
Laboratory Division

Laboratory Analysis Report

200 W. Potter Drive
Anchorage, AK 99518-1605
Tel: (907) 562-2343
Fax: (907) 561-5301
Web: http://www.cteesi.com

Kim Nielson
URS Corporation
3501 Denali St. #101
Anchorage, AK 99503

Work Order:	1015315
	NPRA Lake Recharge
Client:	URS Corporation
Report Date:	August 31, 2001

Enclosed are the analytical results associated with the above workorder.

As required by the state of Alaska and the USEPA, a formal Quality Assurance/Quality Control Program is maintained by CT&E. A copy of our Quality Control Manual that outlines this program is available at your request.

Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth in our Quality Assurance Program Plan.

If you have any questions regarding this report or if we can be of any other assistance, please call your CT&E Project Manager at (907) 562-2343.

The following descriptors may be found on your report which will serve to further qualify the data.

U	Indicates the analyte was analyzed for but not detected.
F	Indicates an estimated value that falls below PQL, but is greater than the MDL.
B	Indicates the analyte is found in the blank associated with the sample.
*	The analyte has exceeded allowable limits.
GT	Greater Than
D	Secondary Dilution
LT	Less Than
!	Surrogate out of range

CT&E Environmental Services Inc.

CT&E Ref.#	1015315001	**Client PO#**	74-PAI01001.00-20
Client Name	URS Corporation	**Printed Date/Time**	08/31/2001 13:42
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	08/12/2001 21:30
Client Sample ID	081201M9906-01	**Received Date/Time**	08/14/2001 11:15
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	27.7	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Iron	0.0579	0.0200	mg/L	EPA 200.7		08/27/01	08/28/01
Magnesium	4.11	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Silicon	0.500 U	0.500	mg/L	EPA 200.7		08/17/01	08/27/01
Sodium	6.21	1.00	mg/L	EPA 200.7		08/17/01	08/27/01
Hardness as CaCO3	86.0	2.00	mg/L	SM17 2340C			08/30/01
Metals by ICP/MS							
Potassium	697	500	ug/L	EPA 200.8		08/17/01	08/28/01
Waters Department							
Chloride	15.2	0.500	mg/L	EPA 300.0			08/14/01
Total Dissolved Solids	136	50.0	mg/L	SM20 2540C			08/15/01

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	1015315002	**Client PO#**	74-PAI01001.00-20
Client Name	URS Corporation	**Printed Date/Time**	08/31/2001 13:42
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	08/12/2001 22:45
Client Sample ID	081201M9907-01	**Received Date/Time**	08/14/2001 11:15
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	27.3	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Iron	0.0457	0.0200	mg/L	EPA 200.7		08/27/01	08/28/01
Magnesium	4.40	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Silicon	0.500 U	0.500	mg/L	EPA 200.7		08/17/01	08/27/01
Sodium	6.58	1.00	mg/L	EPA 200.7		08/17/01	08/27/01
Hardness as CaCO3	86.3	2.00	mg/L	SM17 2340C			08/30/01
Metals by ICP/MS							
Potassium	884	500	ug/L	EPA 200.8		08/17/01	08/28/01
Waters Department							
Chloride	13.8	0.500	mg/L	EPA 300.0			08/14/01
Total Dissolved Solids	164	50.0	mg/L	SM20 2540C			08/15/01

CT&E Environmental Services Inc.

CT&E Ref.#	1015315003	**Client PO#**	74-PAI01001.00-20
Client Name	URS Corporation	**Printed Date/Time**	08/31/2001 11:25
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	08/13/2001 0:15
Client Sample ID	081301M9913-01	**Received Date/Time**	08/14/2001 11:15
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	Shawn Pratt

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	11.4	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Iron	0.203	0.0200	mg/L	EPA 200.7		08/27/01	08/28/01
Magnesium	2.54	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Silicon	0.500 U	0.500	mg/L	EPA 200.7		08/17/01	08/27/01
Sodium	4.59	1.00	mg/L	EPA 200.7		08/17/01	08/27/01
Hardness as CaCO3	38.9	2.00	mg/L	SM17 2340C			08/30/01
Metals by ICP/MS							
Potassium	500 U	500	ug/L	EPA 200.8		08/17/01	08/28/01
Waters Department							
Chloride	13.1	0.500	mg/L	EPA 300.0			08/14/01
Total Dissolved Solids	95.0	50.0	mg/L	SM20 2540C			08/15/01

CT&E Environmental Services Inc.

CT&E Ref.#	1015315004	**Client PO#**	74-PAI01001.00-200
Client Name	URS Corporation	**Printed Date/Time**	08/31/2001 11:25
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	08/13/2001 5:15
Client Sample ID	081301M9915-01	**Received Date/Time**	08/14/2001 11:15
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	Shawn Pet

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	9.43	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Iron	0.312	0.0200	mg/L	EPA 200.7		08/27/01	08/28/01
Magnesium	2.27	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Silicon	0.500 U	0.500	mg/L	EPA 200.7		08/17/01	08/27/01
Sodium	3.92	1.00	mg/L	EPA 200.7		08/17/01	08/27/01
Hardness as CaCO3	32.9	2.00	mg/L	SM17 2340C			08/30/01
Metals by ICP/MS							
Potassium	508	500	ug/L	EPA 200.8		08/17/01	08/28/01
Waters Department							
Chloride	11.8	0.500	mg/L	EPA 300.0			08/14/01
Total Dissolved Solids	90.0	50.0	mg/L	SM20 2540C			08/15/01

CT&E Environmental Services Inc.

CT&E Ref.#	1015315005	**Client PO#**	74-PAI01001.00-20(
Client Name	URS Corporation	**Printed Date/Time**	08/31/2001 11:25
Project Name/#	NPRA Lake Recharge	**Collected Date/Time**	08/13/2001 5:20
Client Sample ID	081301M9915-02	**Received Date/Time**	08/14/2001 11:15
Matrix	Water (Surface, Eff., Ground)	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date
Metals Department							
Calcium	9.34	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Iron	0.302	0.0200	mg/L	EPA 200.7		08/27/01	08/28/01
Magnesium	2.24	0.100	mg/L	EPA 200.7		08/17/01	08/27/01
Silicon	0.500 U	0.500	mg/L	EPA 200.7		08/17/01	08/27/01
Sodium	3.89	1.00	mg/L	EPA 200.7		08/17/01	08/27/01
Hardness as CaCO3	32.6	2.00	mg/L	SM17 2340C			08/30/01
Metals by ICP/MS							
Potassium	500	500	ug/L	EPA 200.8		08/17/01	08/28/01
Waters Department							
Chloride	11.8	0.500	mg/L	EPA 300.0			08/14/01
Total Dissolved Solids	98.0	50.0	mg/L	SM20 2540C			08/15/01

F-791

CT&E Environmental Services Inc.

CT&E Ref# 385998 Matrix Spike

Printed Date/Time 09/04/2001 7:58
Prep Batch
Method
Date

Original Matrix Water (Surface, Eff., Ground)

QC results affect the following production samples:
1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter		Original Result	QC Result	Per Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Waters Department									
Nitrate-N	MS	0.500 U	3.86	81	(80-120)			4.51 mg/L	08/14/01

Batch WIC 2494
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	386556	Matrix Spike	**Printed Date/Time**	09/04/2001 7:58
	386557	Matrix Spike Duplicate	**Prep Batch**	MXX 9134
			Method	
			Date	08/17/2001
Original	1015315001			
Matrix	Water (Surface, Eff., Ground)			

QC results affect the following production samples:
1015315001, 1015315002

Parameter		Original Result	QC Result	Per Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Metals Department									
Calcium	MS	27.7	38.0	103	(70-130)			10 mg/L	08/27/01
	MSD		37.6	100		1	(< 20)	10 mg/L	08/27/01
Magnesium	MS	4.11	13.8	97	(70-130)			10 mg/L	08/27/01
	MSD		13.7	96		0	(< 20)	10 mg/L	08/27/01
Silicon	MS	0.500 U	10.2	101	(70-130)			10 mg/L	08/27/01
	MSD		10.1	101		1	(< 20)	10 mg/L	08/27/01
Sodium	MS	6.21	16.1	99	(70-130)			10 mg/L	08/27/01
	MSD		15.9	97		1	(< 20)	10 mg/L	08/27/01

Batch MP 3574
Method EPA 200.7
Instrument TJA Enviro II ICP P2

CT&E Environmental Services Inc.

CT&E Ref.#	386575	Matrix Spike	**Printed Date/Time**		09/04/2001 7:58
			Prep	**Batch**	MXX 9136
				Method	
				Date	08/17/2001

Original Matrix Water (Surface, Eff., Ground)

QC results affect the following production samples:

1015315002, 1015315003, 1015315004, 1015315005

Parameter	Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limit	Spiked Amount	Analysis Date
Batch MMS 1727								
Method EPA 200.8								
Instrument Perkin Elmer Sciex ICP-MS P3								

Metals by ICP/MS

CT&E Environmental Services Inc.

CT&E Ref.#	386575	Matrix Spike	**Printed Date/Time**	09/04/2001 7:58
	386576	Matrix Spike Duplicate	**Prep Batch**	MXX 9136
			Method	
			Date	08/17/2001
Original	1015315002			
Matrix	Water (Surface, Eff., Ground)			

Parameter		Original Result	QC Result	Per Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Metals by ICP/MS									
Manganese	MS		906	90	(70-130)			1000 ug/L	08/28/01
	MSD		890	89		2	(< 20)	1000 ug/L	08/28/01
Copper	MS		909	91	(70-130)			1000 ug/L	08/28/01
	MSD		875	87		4	(< 20)	1000 ug/L	08/28/01
Zinc	MS		974	99	(70-130)			1000 ug/L	08/28/01
	MSD		944	96		3	(< 20)	1000 ug/L	08/28/01
Vanadium	MS		889	89	(70-130)			1000 ug/L	08/28/01
	MSD		859	86		3	(< 20)	1000 ug/L	08/28/01
Thallium	MS		950	94	(70-130)			1010 ug/L	08/28/01
	MSD		921	91		3	(< 20)	1010 ug/L	08/28/01
Sodium	MS		16700	100	(70-130)			10000 ug/L	08/28/01
	MSD		15900	92		5	(< 20)	10000 ug/L	08/28/01
Silver	MS		192	96	(70-130)			200 ug/L	08/28/01
	MSD		189	95		2	(< 20)	200 ug/L	08/28/01
Selenium	MS		947	95	(70-130)			1000 ug/L	08/28/01
	MSD		919	92		3	(< 20)	1000 ug/L	08/28/01
Potassium	MS	884	10100	92	(70-130)			10000 ug/L	08/28/01
	MSD		9630	88		5	(< 20)	10000 ug/L	08/28/01
Nickel	MS		904	90	(70-130)			1000 ug/L	08/28/01
	MSD		866	87		4	(< 20)	1000 ug/L	08/28/01
Molybdenum	MS		961	96	(70-130)			1000 ug/L	08/28/01
	MSD		931	93		3	(< 20)	1000 ug/L	08/28/01
Cadmium	MS		479	96	(70-130)			500 ug/L	08/28/01
	MSD		453	91		6	(< 20)	500 ug/L	08/28/01
Lead	MS		951	95	(70-130)			1000 ug/L	08/28/01
	MSD		924	93		3	(< 20)	1000 ug/L	08/28/01
Magnesium	MS		14500	99	(70-130)			10000 ug/L	08/28/01
	MSD		13700	91		6	(< 20)	10000 ug/L	08/28/01
Arsenic	MS		914	91	(70-130)			1000 ug/L	08/28/01
	MSD		886	89		3	(< 20)	1000 ug/L	08/28/01
Aluminum	MS		967	97	(70-130)			1000 ug/L	08/28/01
	MSD		917	92		5	(< 20)	1000 ug/L	08/28/01
Beryllium	MS		355	88	(70-130)			402 ug/L	08/28/01
	MSD		349	87		2	(< 20)	402 ug/L	08/28/01
Antimony	MS		951	95	(70-130)			1000 ug/L	08/28/01
	MSD		914	91		4	(< 20)	1000 ug/L	08/28/01
Calcium	MS		37500	101	(70-130)			10000 ug/L	08/28/01
	MSD		36100	86		4	(< 20)	10000 ug/L	08/28/01
Chromium	MS		938	94	(70-130)			1000 ug/L	08/28/01
	MSD		915	92		3	(< 20)	1000 ug/L	08/28/01

F-70-

CT&E Environmental Services Inc.

CT&E Ref.#	386575	Matrix Spike	**Printed Date/Time**	09/04/2001 7:58
	386576	Matrix Spike Duplicate	**Prep Batch**	MXX 9136
			Method	
			Date	08/17/2001
Original	1015315002			
Matrix	Water (Surface, Eff., Ground)			

Parameter		Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Metals by ICP/MS									
Cobalt	MS		915	92	(70-130)			1000 ug/L	08/28/01
	MSD		885	89		3	(< 20)	1000 ug/L	08/28/01
Iron	MS		1040	104	(70-130)			1000 ug/L	08/28/01
	MSD		929	92		12	(< 20)	1000 ug/L	08/28/01
Barium	MS		1110	100	(70-130)			1000 ug/L	08/28/01
	MSD		1040	93		7	(< 20)	1000 ug/L	08/28/01

Batch MMS 1727
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	388680	Matrix Spike	**Printed Date/Time**	09/04/2001 7:58
	388681	Matrix Spike Duplicate	**Prep Batch**	MXX 9184
			Method	
			Date	08/27/2001
Original	1015315001			
Matrix	Water (Surface, Eff., Ground)			

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter		Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Metals Department									
Iron	MS	0.0579	1.00	94	(70-130)			1 mg/L	08/28/01
	MSD		1.01	95		1	(< 20)	1 mg/L	08/28/01

Batch MIP 3575
Method EPA 200.7
Instrument TJA Enviro II ICP P2

F-761

CT&E Environmental Services Inc.

CT&E Ref.#	386503 · Method Blank	**Printed Date/Time**	09/04/2001 7:57
Client Name	URS Corporation	**Prep Batch**	
Project Name/#	NPRA Lake Recharge	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Results	PQL	Units	Analysis Date
Waters Department				
Bromide	0.500 U	0.500	mg/L	08/14/01
Chloride	0.0928F	0.500	mg/L	08/14/01
Fluoride	0.500 U	0.500	mg/L	08/14/01
Nitrate-N	0.500 U	0.500	mg/L	08/14/01
Nitrite-N	0.500 U	0.500	mg/L	08/14/01
Ortho Phosphate-P	0.500 U	0.500	mg/L	08/14/01
Sulfate	0.500 U	0.500	mg/L	08/14/01

Batch WIC 2494
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	386504 Lab Control Sample	**Printed Date/Time**	09/04/2001 7:58
		Prep Batch	
Client Name	URS Corporation	**Method**	
Project Name/#	NPRA Lake Recharge	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Bromide	LCS	9.50	95	(90-110)			10 mg/L	08/14/01
Chloride	LCS	9.41	94	(90-110)			10 mg/L	08/14/01
Fluoride	LCS	9.58	96	(90-110)			10 mg/L	08/14/01
Nitrate-N	LCS	2.06	91	(90-110)			2.26 mg/L	08/14/01
Nitrite-N	LCS	2.38	78 *	(90-110)			3.05 mg/L	08/14/01
Ortho Phosphate-P	LCS	2.83	87 *	(90-110)			3.27 mg/L	08/14/01
Sulfate	LCS	9.18	92	(90-110)			10 mg/L	08/14/01

Batch WIC 2494
Method EPA 300.0
Instrument Dionex DX-300 HPLC

CT&E Environmental Services Inc.

CT&E Ref.#	385997	Undigested Duplicate	**Printed Date/Time**		09/04/2001 7:58
Client Name	URS Corporation		**Prep**	**Batch**	
Project Name/#	NPRA Lake Recharge			**Method**	
Original				**Date**	
Matrix	Water (Surface, Eff., Ground)				

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date
Waters Department					
Sulfate		5.49			08/14/01
Bromide		0.500 U			08/14/01
Chloride		0.817			08/14/01
Fluoride		0.500 U			08/14/01
Nitrite-N		0.500 U			08/14/01
Nitrate-N	0.500 U	0.223F	1	(< 20)	08/14/01
Ortho Phosphate-P		0.500 U			08/14/01

Batch WIC 2494
Method EPA 300.0
Instrument Dionex DX-300 HPLC

F-7261

CT&E Environmental Services Inc.

CT&E Ref.#	386251	Method Blank	**Printed Date/Time**	09/04/2001 7:57
Client Name	URS Corporation		**Prep Batch**	
Project Name/#	NPRA Lake Recharge		**Method**	
Matrix	Water (Surface, Eff., Ground)		**Date**	

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Results	PQL	Units	Analysis Date
Waters Department				
Total Dissolved Solids	50.0 U	50.0	mg/L	08/15/01

Batch WAT 3112
Method SM20 2540C
Instrument

CT&E Environmental Services Inc.

CT&E Ref.#	386252 Lab Control Sample	**Printed Date/Time**	09/04/2001 7:58
		Prep Batch	
Client Name	URS Corporation	**Method**	
Project Name/#	NPRA Lake Recharge	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Total Dissolved Solids	LCS	229	107	(75-125)			214 mg/L	08/15/01
Batch	WAT 3112							
Method	SM20 2540C							
Instrument								

F-703

CT&E Environmental Services Inc.

CT&E Ref.#	386253 Duplicate	**Printed Date/Time**	09/04/2001 7:58
Client Name	CRS Corporation	**Prep Batch**	
Project Name/#	NPRA Lake Recharge	**Method**	
Original	1015315001	**Date**	
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date
Waters Department					
Total Dissolved Solids	136	134	2	(< 25)	08/15/01
Batch WAT 3112					
Method SM20 2540C					
Instrument					

CT&E Environmental Services Inc.

CT&E Ref.#	386554	Method Blank	**Printed Date/Time**		09/04/2001 7:57
Client Name	URS Corporation		**Prep**	**Batch**	MXX 9134
Project Name/#	NPRA Lake Recharge			**Method**	
Matrix	Water (Surface, Eff., Ground)			**Date**	08/17/2001

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Results	PQL	Units	Analysis Date
Metals Department				
Calcium	0.100 U	0.100	mg/L	08/27/01
Magnesium	0.100 U	0.100	mg/L	08/27/01
Silicon	0.500 U	0.500	mg/L	08/27/01
Sodium	1.00 U	1.00	mg/L	08/27/01

Batch MIP 3574
Method EPA 200.7
Instrument TJA Enviro II ICP P2

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	386555 Lab Control Sample	**Printed Date/Time**	09/04/2001 7:58
		Prep Batch	MXX 9134
Client Name	URS Corporation	**Method**	
Project Name/#	NPRA Lake Recharge	**Date**	08/17/2001
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Silicon	LCS	9.86	99	(85-115)			10 mg/L	08/27/01
Batch MIP 3574								
Method EPA 200.7								
Instrument TJA Enviro II ICP P2								

TOTAL METALS ANALYSIS

Calcium	LCS	9.75	98	(85-115)			10 mg/L	08/27/01
Magnesium	LCS	9.55	96	(85-115)			10 mg/L	08/27/01
Sodium	LCS	9.64	96	(85-115)			10 mg/L	08/27/01
Batch MIP 3574								
Method EPA 200.7								
Instrument TJA Enviro II ICP P2								

F-703

CT&E Environmental Services Inc.

CT&E Ref.#	388683 Undigested Duplicate	**Printed Date/Time**	09/04/2001 7:58
Client Name	URS Corporation	**Prep Batch**	
Project Name/#	NPRA Lake Recharge	**Method**	
Original		**Date**	
Matrix	Drinking Water		

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date
Zirconium		0.100 U			08/27/01
Manganese		0.507			08/27/01
Molybdenum		0.0400 U			08/27/01
Nickel		0.0400 U			08/27/01
Potassium		40.0 U			08/27/01
Selenium		0.200 U			08/27/01
Silver		0.0400 U			08/27/01
Strontium		0.0584			08/27/01
Magnesium		2.39			08/27/01
Zinc		0.0347			08/27/01
Silicon		7.09			08/27/01
Vanadium		0.0200 U			08/27/01
Barium		0.0127			08/27/01
Sodium		3.46			08/27/01
Lead		0.200 U			08/27/01
Arsenic		0.100 U			08/27/01
Beryllium		0.00400 U			08/27/01
Boron		0.0190J			08/27/01
Aluminum		0.200 U			08/27/01
Copper		0.0400 U			08/27/01
Calcium		4.99			08/27/01
Chromium		0.0400 U			08/27/01
Cobalt		0.0200 U			08/27/01
Cadmium		0.0200 U			08/27/01
Iron	2.91	2.91	0		08/27/01
Antimony		0.200 U			08/27/01

Batch MIP 3574
Method EPA 200.7
Instrument TJA Enviro II ICP P2

F-701

CT&E Environmental Services Inc.

CT&E Ref.#	386570 Method Blank	**Printed Date/Time**	09/04/2001 7:57
Client Name	URS Corporation	**Prep Batch**	MXX 9136
Project Name/#	NPRA Lake Recharge	**Method**	
Matrix	Water (Surface, Eff., Ground)	**Date**	08/17/2001

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Results	PQL	Units	Analysis Date
Phosphorus	500 U	50	ug/L	08/28/01

Batch MMS 1727
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

Metals by ICP/MS

Aluminum	20.0 U	20.0	ug/L	08/28/01
Antimony	1.50 U	1.50	ug/L	08/28/01
Arsenic	1.50 U	1.50	ug/L	08/28/01
Barium	3.00 U	3.00	ug/L	08/28/01
Beryllium	0.400 U	0.400	ug/L	08/28/01
Cadmium	0.100 U	0.100	ug/L	08/28/01
Calcium	500 U	50	ug/L	08/28/01
Chromium	4.50 U	4.50	ug/L	08/28/01
Cobalt	4.00 U	4.00	ug/L	08/28/01
Copper	0.800 U	0.800	ug/L	08/28/01
Iron	250 U	25	ug/L	08/28/01
Lead	0.400 U	0.400	ug/L	08/28/01
Magnesium	500 U	50	ug/L	08/28/01
Manganese	3.00 U	3.00	ug/L	08/28/01
Molybdenum	10.0 U	10.0	ug/L	08/28/01
Nickel	2.00 U	2.00	ug/L	08/28/01
Potassium	500 U	50	ug/L	08/28/01
Selenium	2.00 U	2.00	ug/L	08/28/01
Sodium	500 U	50	ug/L	08/28/01
Zinc	2.00 U	2.00	ug/L	08/28/01
Silver	2.50 U	2.50	ug/L	08/28/01
Thallium	0.300 U	0.300	ug/L	08/28/01
Vanadium	5.00 U	5.00	ug/L	08/28/01

Batch MMS 1727
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	386571 Lab Control Sample	**Printed Date/Time**	09/04/2001 7:58
		Prep Batch	MXX 9136
Client Name	URS Corporation	**Method**	
Project Name/#	NPRA Lake Recharge	**Date**	08/17/2001
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
Chromium	LCS	991	99	(85-115)			1000 ug/L	08/28/01
Aluminum	LCS	958	96	(85-115)			1000 ug/L	08/28/01
Antimony	LCS	958	96	(85-115)			1000 ug/L	08/28/01
Arsenic	LCS	938	94	(85-115)			1000 ug/L	08/28/01
Barium	LCS	988	99	(85-115)			1000 ug/L	08/28/01
Beryllium	LCS	382	95	(85-115)			402 ug/L	08/28/01
Molybdenum	LCS	941	94	(85-115)			1000 ug/L	08/28/01
Zinc	LCS	944	94	(85-115)			1000 ug/L	08/28/01
Vanadium	LCS	928	93	(85-115)			1000 ug/L	08/28/01
Thallium	LCS	927	92	(85-115)			1010 ug/L	08/28/01
Sodium	LCS	9770	98	(85-115)			10000 ug/L	08/28/01
Silver	LCS	196	98	(85-115)			200 ug/L	08/28/01
Selenium	LCS	974	97	(85-115)			1000 ug/L	08/28/01
Potassium	LCS	9020	90	(85-115)			10000 ug/L	08/28/01
Cadmium	LCS	480	96	(85-115)			500 ug/L	08/28/01
Nickel	LCS	957	96	(85-115)			1000 ug/L	08/28/01
Calcium	LCS	9970	100	(85-115)			10000 ug/L	08/28/01
Manganese	LCS	940	94	(85-115)			1000 ug/L	08/28/01
Magnesium	LCS	9760	98	(85-115)			10000 ug/L	08/28/01
Lead	LCS	949	95	(85-115)			1000 ug/L	08/28/01
Iron	LCS	997	100	(85-115)			1000 ug/L	08/28/01
Copper	LCS	955	96	(85-115)			1000 ug/L	08/28/01
Cobalt	LCS	955	96	(85-115)			1000 ug/L	08/28/01

Batch MMS 1727
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

CT&E Environmental Services Inc.

CT&E Ref.#	388791	Undigested Duplicate	**Printed Date/Time**	09/04/2001	7:58
Client Name	URS Corporation		**Prep Batch**		
Project Name/#	NPRA Lake Recharge		**Method**		
Original	101541200I		**Date**		
Matrix	Drinking Water				

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Original Result	QC Result	RPD	RPD Limits	Analysis Date
Magnesium		5310	1		08/28/01
Manganese		536	2		08/28/01
Molybdenum		10.0 U	0		08/28/01
Nickel	2.00 U	1.08F	1		08/28/01
Phosphorus		500 U			08/28/01
Selenium	2.00 U	2.00 U	-1,160		08/28/01
Silver		2.50 U	25		08/28/01
Lead		0.484	45		08/28/01
Barium	53.8	52.4	3		08/28/01
Sodium		6170	2		08/28/01
Potassium		1050	1		08/28/01
Iron		305	1		08/28/01
Copper		756	0		08/28/01
Cobalt		4.00 U	0		08/28/01
Chromium	4.50 U	4.50 U	32		08/28/01
Calcium		31800	1		08/28/01
Beryllium	0.400 U	0.400 U	-200		08/28/01
Arsenic	15.9	15.7	1		08/28/01
Antimony	1.00 U	1.00 U	14		08/28/01
Aluminum		20.0 U	-1		08/28/01
Vanadium		5.00 U	-945		08/28/01
Zinc		801	2		08/28/01
Cadmium	0.100 U	0.100 U	-35		08/28/01
Thallium	0.300 U	0.300 U	-5		08/28/01

Batch MMS 1727
Method EPA 200.8
Instrument Perkin Elmer Sciex ICP-MS P3

F-705

CT&E Environmental Services Inc.

CT&E Ref.#	388678	Method Blank	**Printed Date/Time**		09/04/2001 7:57
Client Name	URS Corporation		**Prep**	**Batch**	MXX 9184
Project Name/#	NPRA Lake Recharge			**Method**	
Matrix	Water (Surface, Eff., Ground)			**Date**	08/27/2001

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter	Results	PQL	Units	Analysis Date
Metals Department				
Iron	0.0200 U	0.020	mg/L	08/28/01
Batch MIP 3575				
Method EPA 200.7				
Instrument TJA Enviro II ICP P2				

CT&E Environmental Services Inc.

CT&E Ref.#	388679 Lab Control Sample	**Printed Date/Time**	09/04/2001 7:58
		Prep Batch	MXX 9184
Client Name	URS Corporation	**Method**	
Project Name/#	NPRA Lake Recharge	**Date**	08/27/2001
Matrix	Water (Surface, Eff., Ground)		

QC results affect the following production samples:

1015315001, 1015315002, 1015315003, 1015315004, 1015315005

Parameter		QC Results	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analysis Date
TOTAL METALS ANALYSIS								
Iron	LCS	0.961	96	(85-115)			1 mg/L	08/28/01

Batch MIP 3575
Method EPA 200.7
Instrument TJA Enviro II ICP P2

CHAIN OF CUSTODY RECORD

1015315

CT&E Environmental Services Inc.
Laboratory Division

(1)

CLIENT: URS CORP.

CONTACT: Kim Nielson PHONE NO: (907) 261-9747

PROJECT: NPRA LAKE Recharge SITE: NPRA Lakes

REPORTS TO:
Kim Nielson FAX NO: (907) 563-3198

INVOICE TO:
3501 Denali St. #101
Anchorage AK 99503 P.O. NUMBER:

CT&E Reference:

PAGE 1 OF 1

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C=COMP G=GRAB	Preservatives Used	HNO3	-	-	-							REMARKS
							Analysis Required (3)	ICP Metals 200.7 → Ca, Mg, Na, K, Fe, Si	Hardness as CaCO3	TDS (SM 2540C)	Chloride (EPA 300.0)							
(1)	081201M9906-01	8/12/01	2130	WA	3	G		X	X	X	X							
(2)	081201M9907-01	8/12/01	2245	WA	3	G		X	X	X	X							
(3)	081301M9913-01	8/13/01	0015	WA	3	G		X	X	X	X							
(4)	081301M9915-01	8/13/01	0515	WA	3	G		X	X	X	X							
(5)	081301M9915-02	8/13/01	0520	WA	3	G		X	X	X	X							

(5)

Collected/Relinquished By: (1)	Date	Time	Received By:
[signature]	8/13/01	650	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date	Time	Received For Laboratory By:
	8/14/01	1115	[signature]

(4)

Shipping Carrier:	Samples Received Cold? (Circle) YES NO
Shipping Ticket No:	Temperature °C: 2.0°C
Data Deliverables Required	Chain of Custody Seal: (Circle)
Level I (Level II) Level III	INTACT BROKEN ABSENT
Requested Turnaround Time and Special Instructions: STANDARD TAT	

CT&E Environmental Services Inc.

SAMPLE RECEIPT FORM

CT&E WO: 1015315

Yes	No		
		Are samples **RUSH**, priority, or *within 72 hrs.* of hold time?	
		If yes have you done *e-mail notification*?	
		Are samples *within 24 hrs.* of **hold time** or due date?	
		If yes, have you *spoken with* Supervisor?	
		Are there any **problems** (e.g., ids, analyses)?	
		Were samples preserved correctly and pH verified?	
		Has Project Manager been notified of problems?	
		Is this an ACOE / AFCEE / ADEC project?	
		Will a **data package** be required?	Level I
		If this is for PWS, provide **PWSID**.	
		Is there a **quote** for this project?	
		Will **courier** charges apply?	

Completed by (sign): [signature] (print): Tim Hawker

Due Date: 8/22/01
Received Date/Time: 8/14/01 1115
Received Temperature: 2.0°C

Matrix of each Sample:

1	-	1-5
	-	
	-	
	Trip Blank	
	BMS/BMSD	

Additional Sample Remarks:

- Extra Sample Volume?
- Limited Sample Volume?
- Field pres'd for volatiles?
- Field-filtered for dissolved ____?
- Lab-filtered for dissolved ____?
- Ref Lab required?

Notes:

*********The following *must* be completed for *all* ACOE & AFCEE: *********

Yes	No		
		Is received temperature 4 ± 2°C?	Temp:
			Thermometer used:
		Was there an airbill, etc.?	Note #:
		Was cooler sealed with custody seals? Fax'd to COE?	
			# / where:
		Were seals intact upon arrival?	
		Was there a COC with cooler?	
		Was the COC filled out properly?	
		Did the COC indicate ACOE / AFCEE project? (if applicable)	
		Did the COC and samples correspond?	
		Were all samples packed to prevent breakage?	
			packing material:
		Were all samples unbroken and clearly labeled?	
		Were all samples sealed in separate plastic bags?	
		Were all bottles for volatiles free of headspace?	
		Were correct container / sample sizes submitted?	
		Is sample condition good?	
		Was client notified of problems? (specify below)	

# of each Container Received:

- ____ 950 ml amber unpres'd
- ____ 950 ml amber w / HCl
- ____ 500 ml amber w / H_2SO_4
- 5 1L cubies unpres'd
- 5 1L cubies w / HNO_3
- ____ 1L cubies w / H_2SO_4
- ____ 1L cubies w / NaOH + ZnAc
- ____ 120 ml coli bottles
- 5 60 ml Nalgene
- ____ 8 oz amber unpres'd
- ____ 4 oz amber unpres'd
- ____ 4 oz w / septa w / MeOH
- ____ 40 ml vials w / HCl
- ____ Other (specify)
- ____ Other (specify)

Individual contacted: ____
Date / Time: ____ Phone / Fax: ____

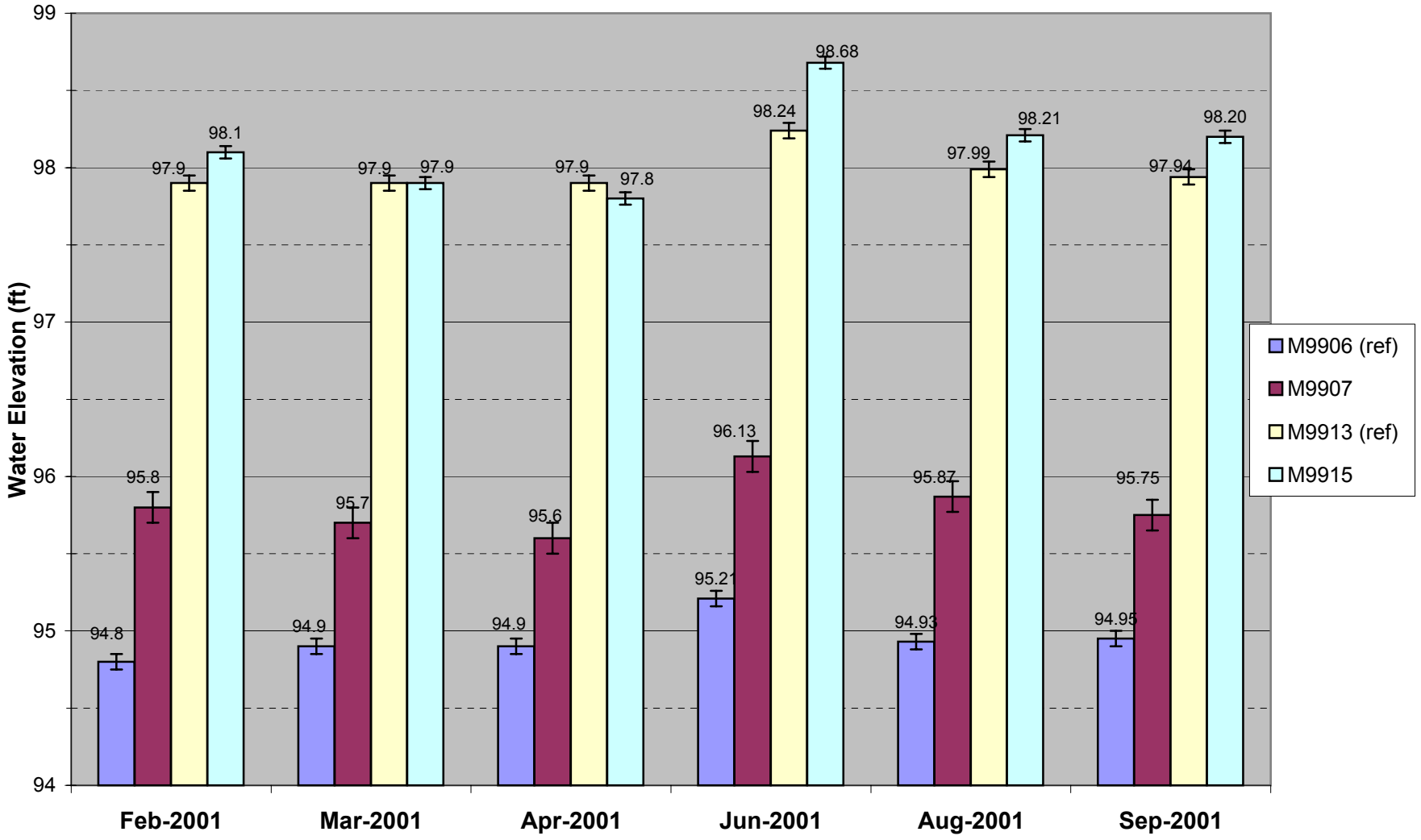
Log-in proofed by: ____

TO BE COMPLETED IN ANCHORAGE UPON ARRIVAL FROM FAIRBANKS:
DATE / TIME: ____ **COOLER TEMP:** ____
CUSTODY SEALS INTACT: YES / NO **# / WHERE:** ____

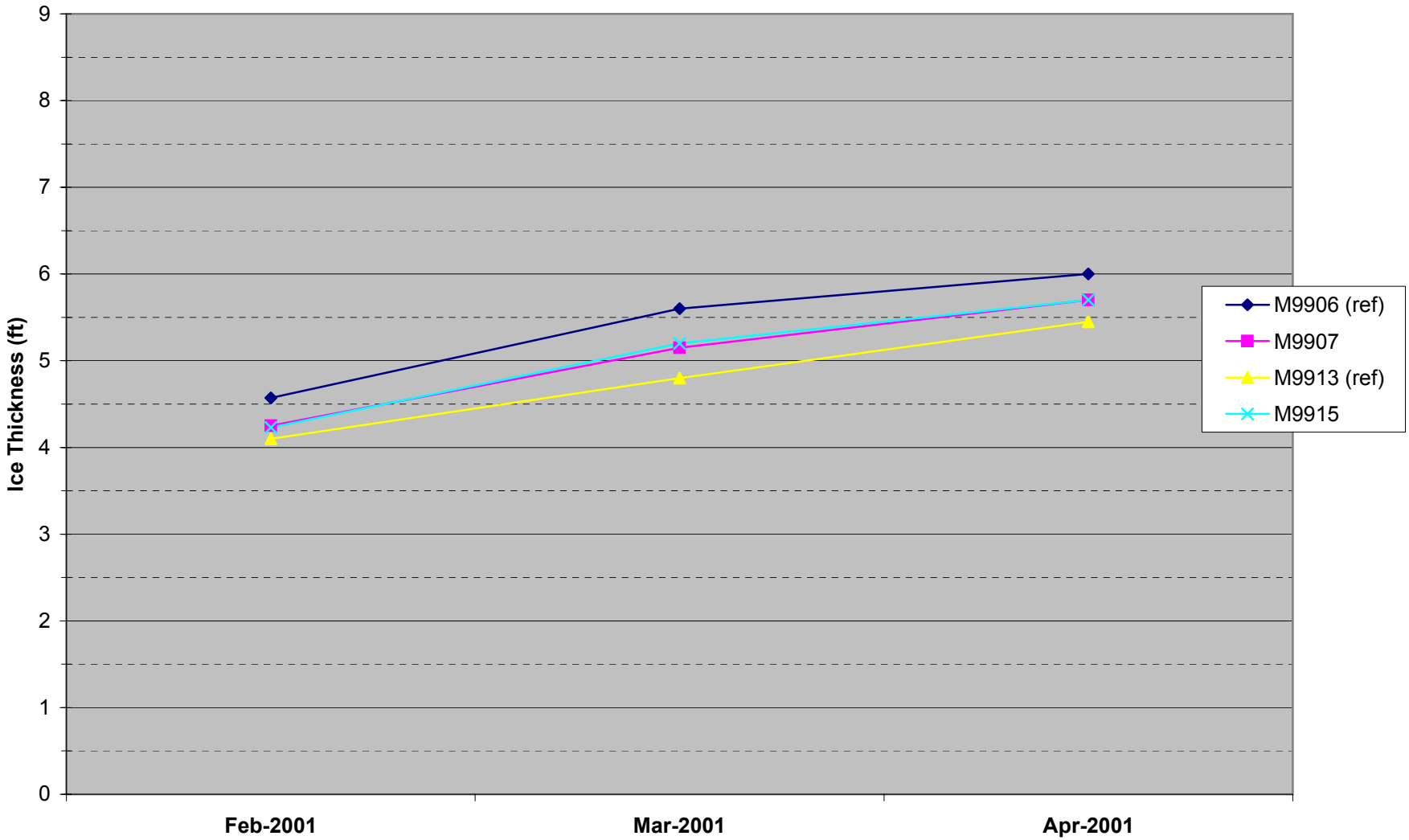
Appendix C

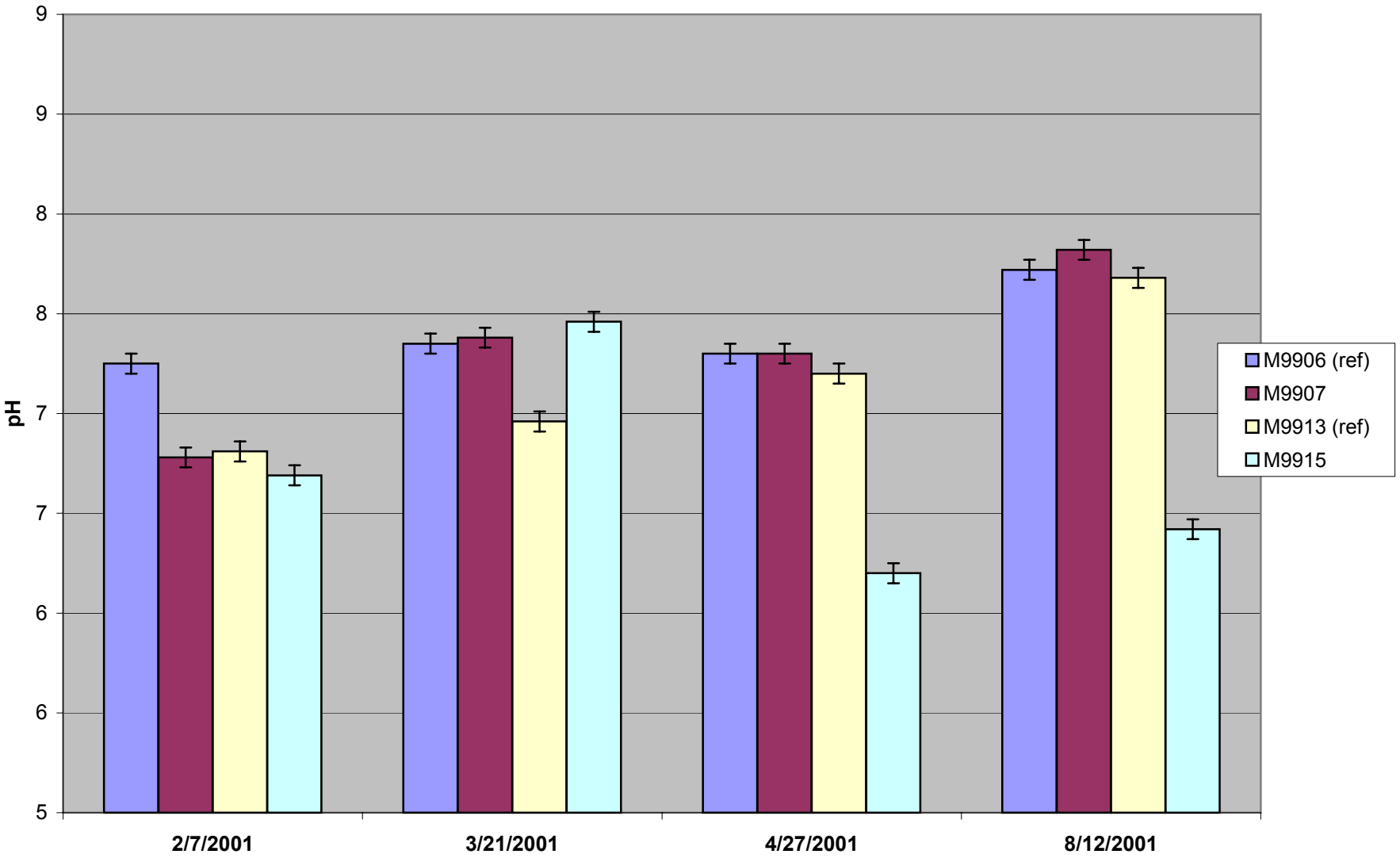
Plots and Graphs of Water Quality Results

Surface Water Elevation at NPRA Lakes, 2001.

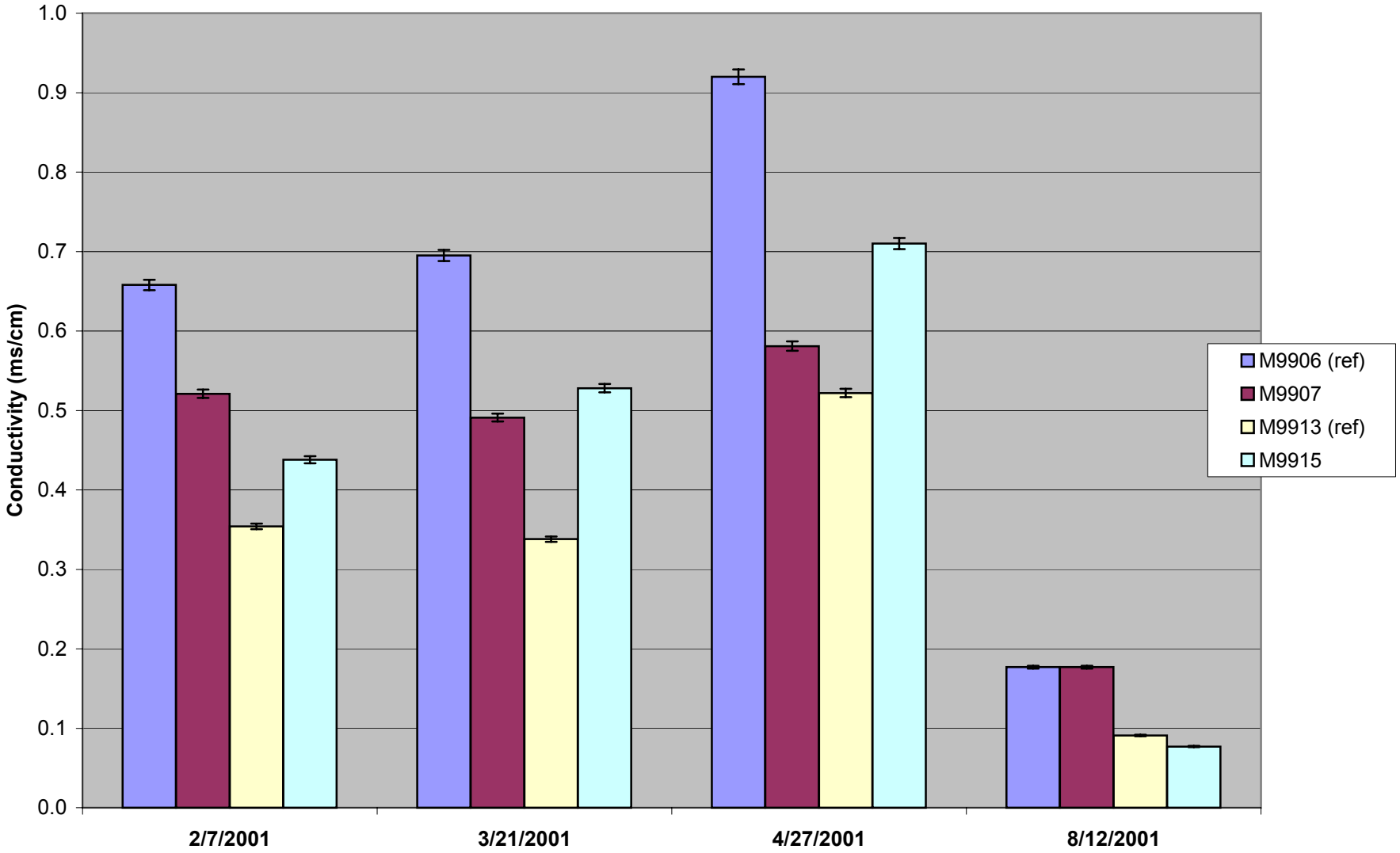


Ice Thickness at NPRA Lakes, 2001.

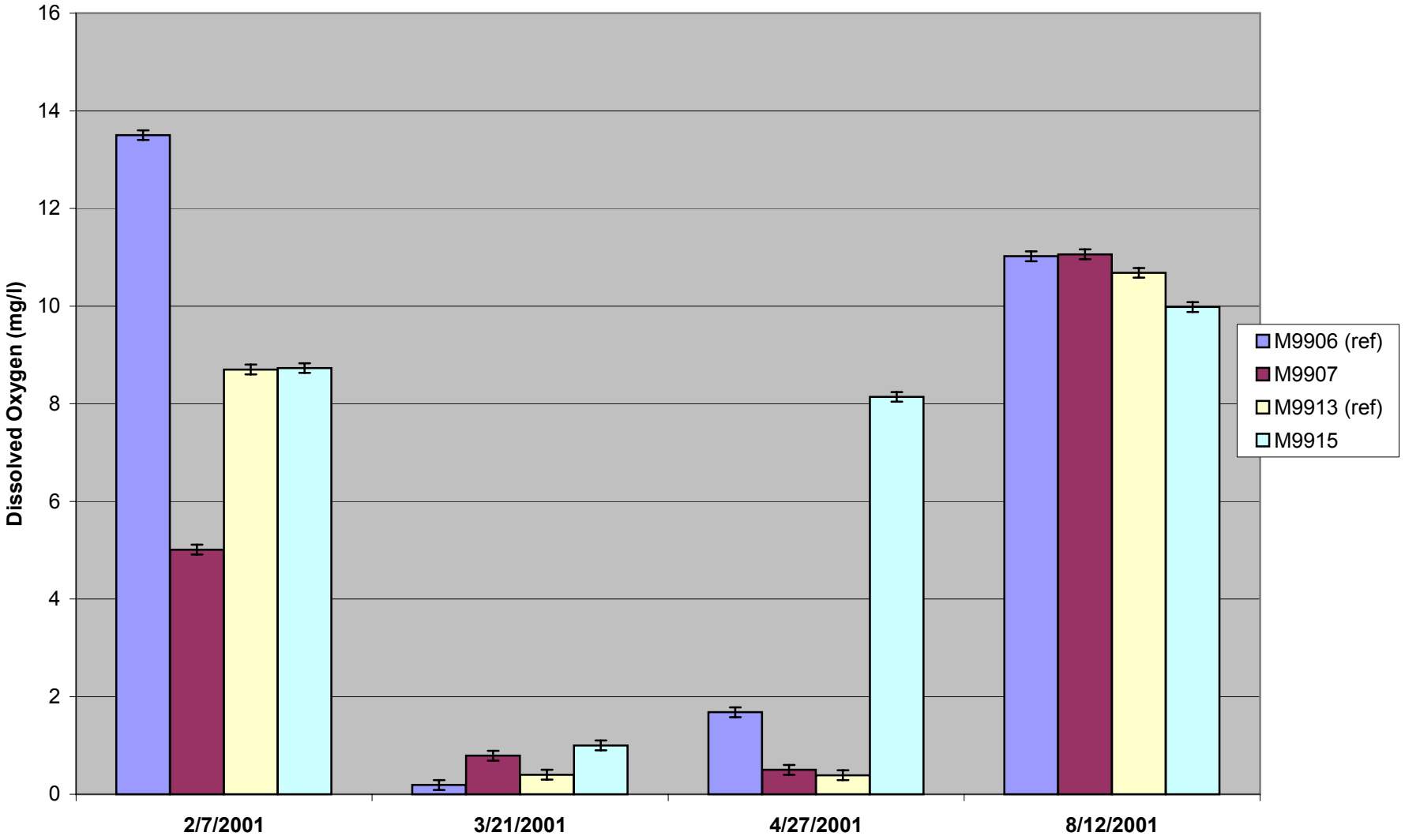


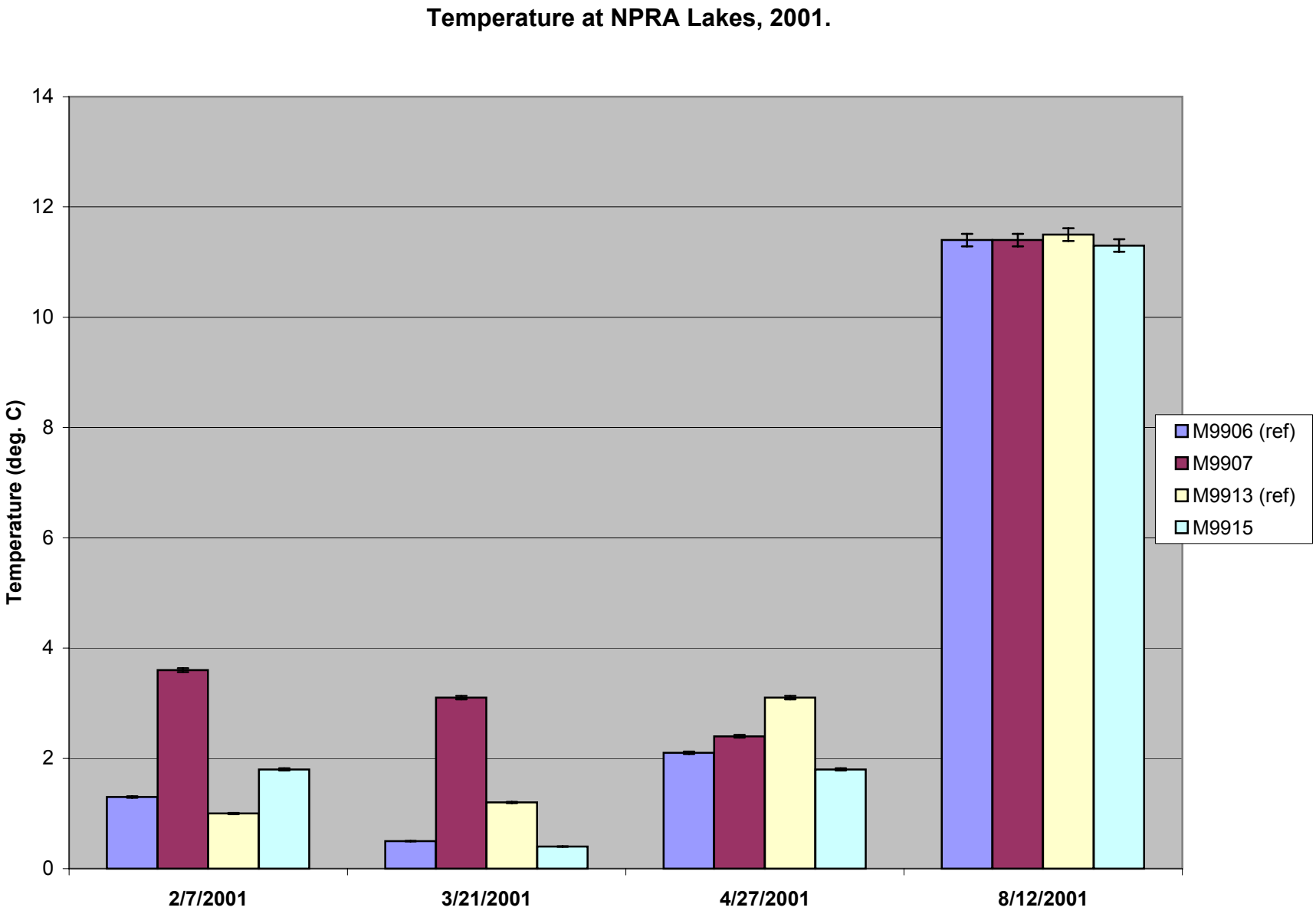

pH at NPRA Lakes, 2001.
pH
9
9
8
8
7
7
6
6
5
2/7/2001
3/21/2001
4/27/2001
8/12/2001
M9906 (ref)
M9907
M9913 (ref)
M9915

Conductivity at NPRA Lakes, 2001.

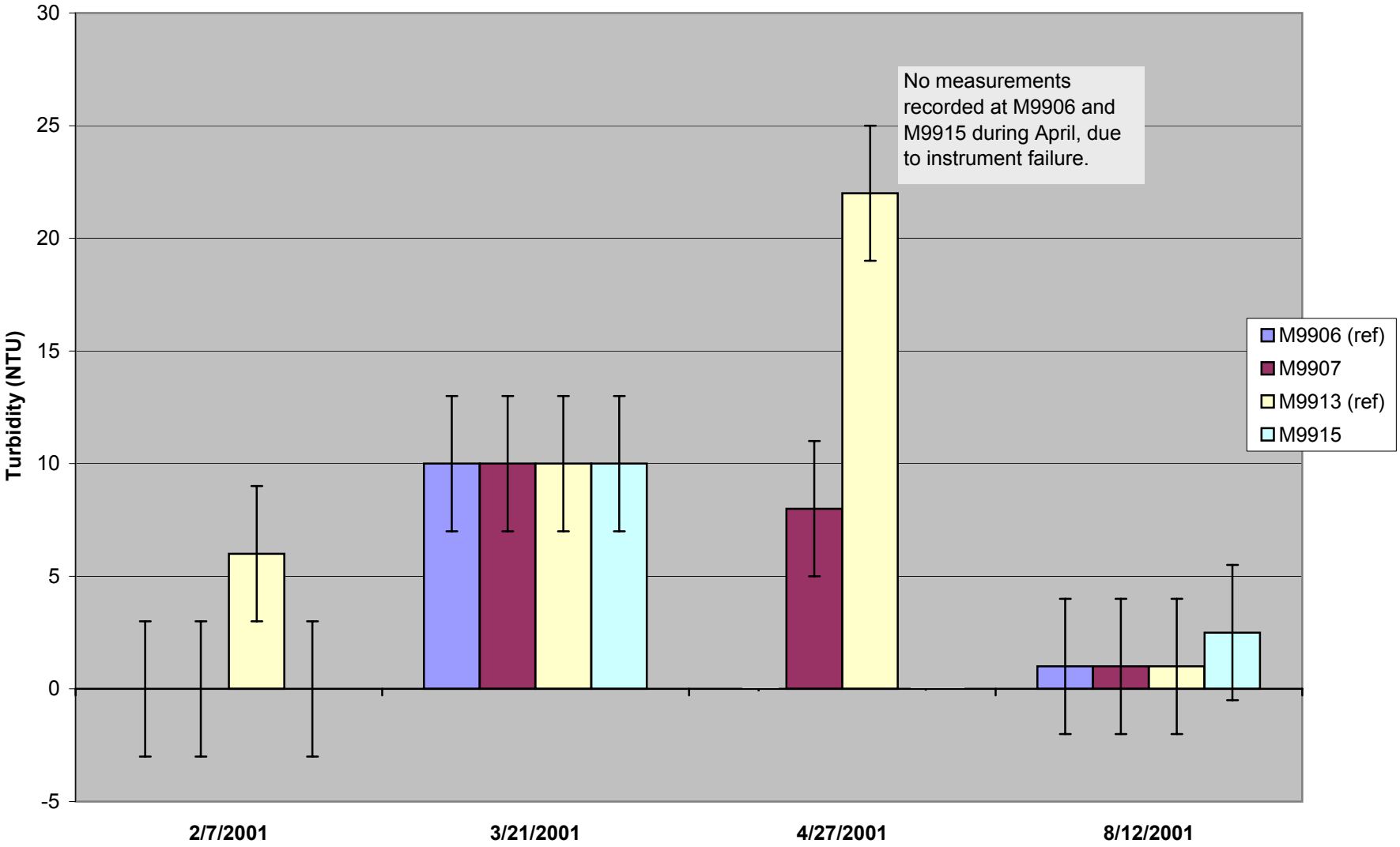


Dissolved Oxygen concentrations at NPRA Lakes, 2001.

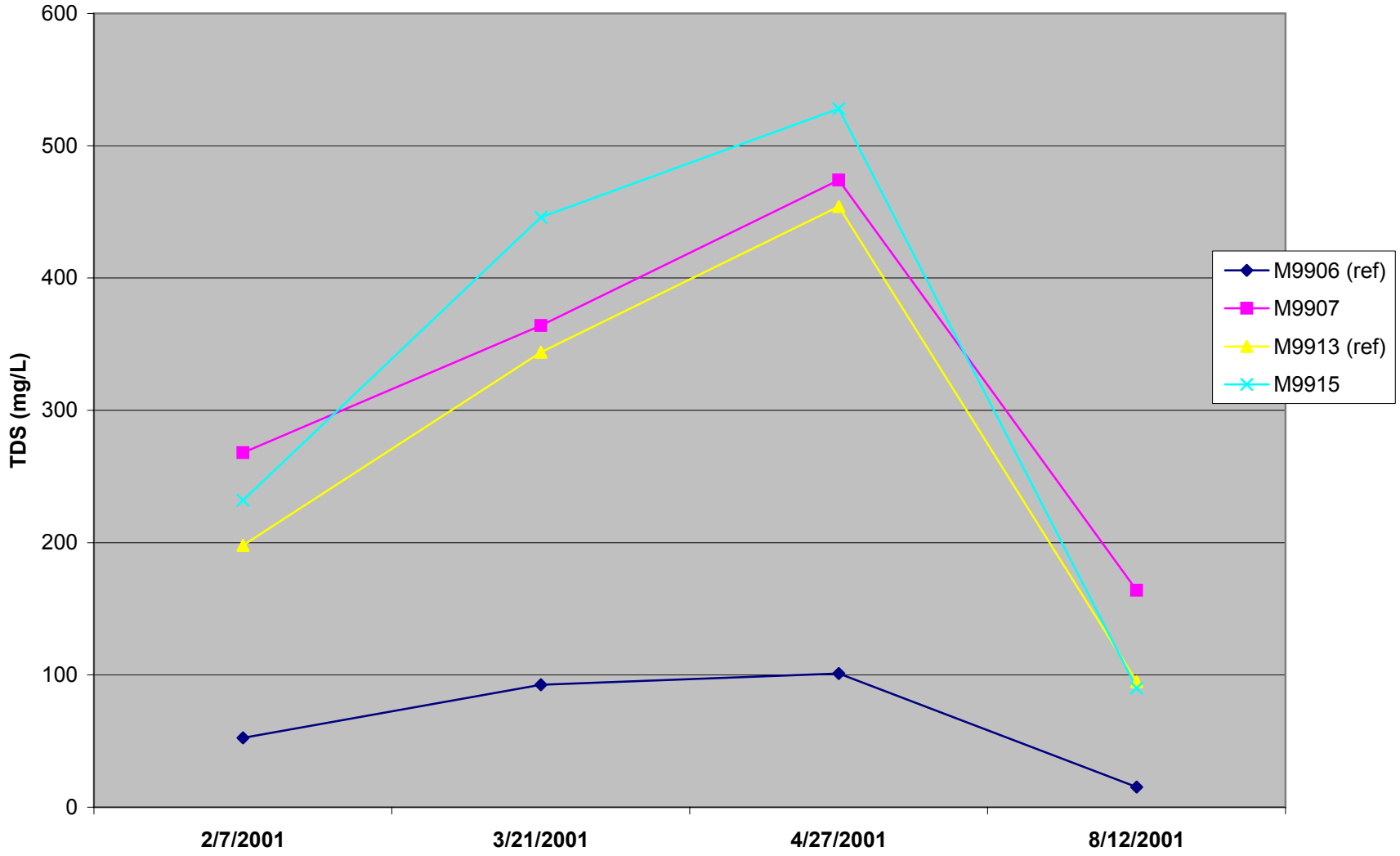



Temperature at NPRA Lakes, 2001.
Temperature (deg. C)
14
12
10
8
6
4
2
0
2/7/2001
3/21/2001
4/27/2001
8/12/2001
M9906 (ref)
M9907
M9913 (ref)
M9915

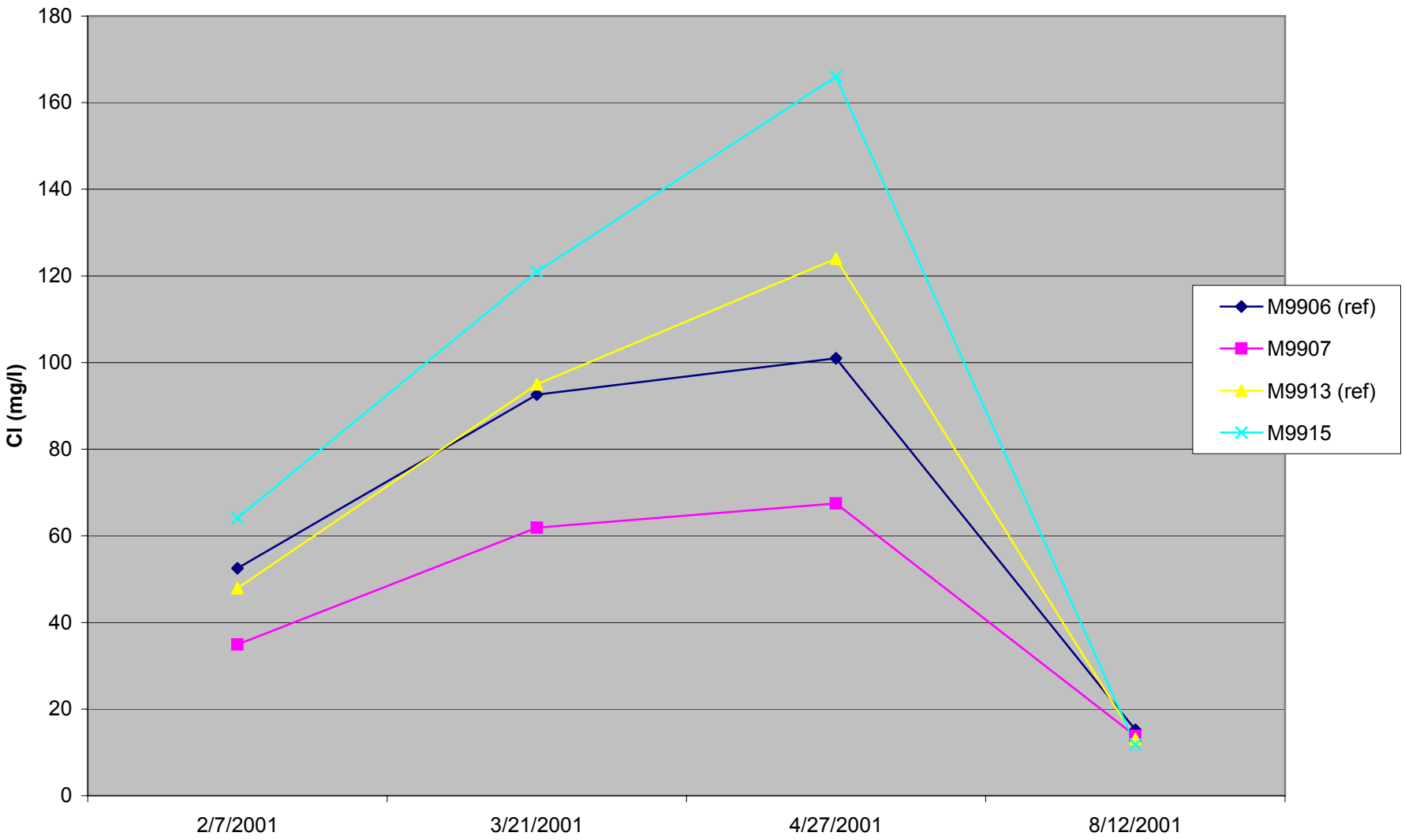
Turbididy at NPRA Lakes, 2001.



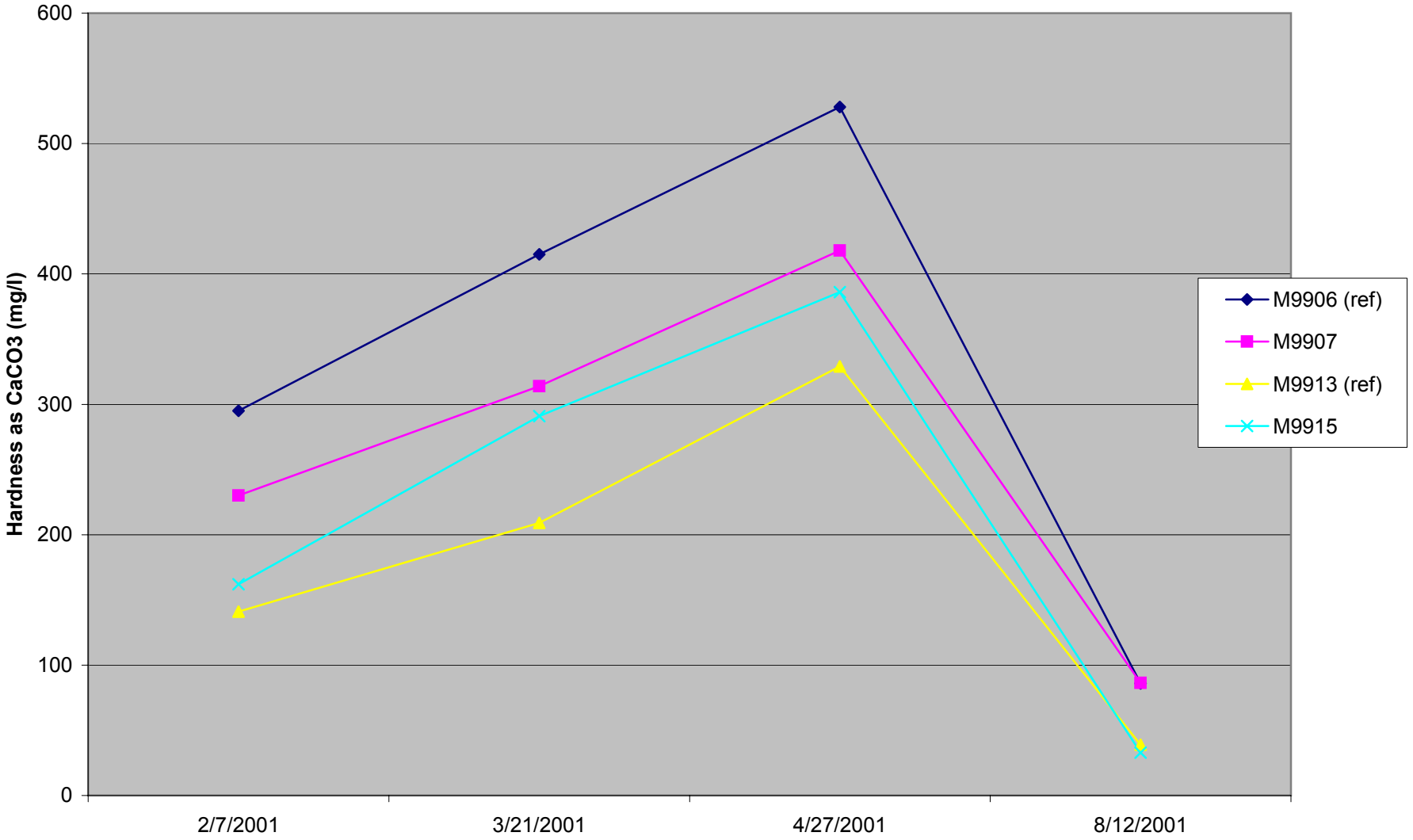
Total Dissolved Solids at NPRA Lakes, 2001.



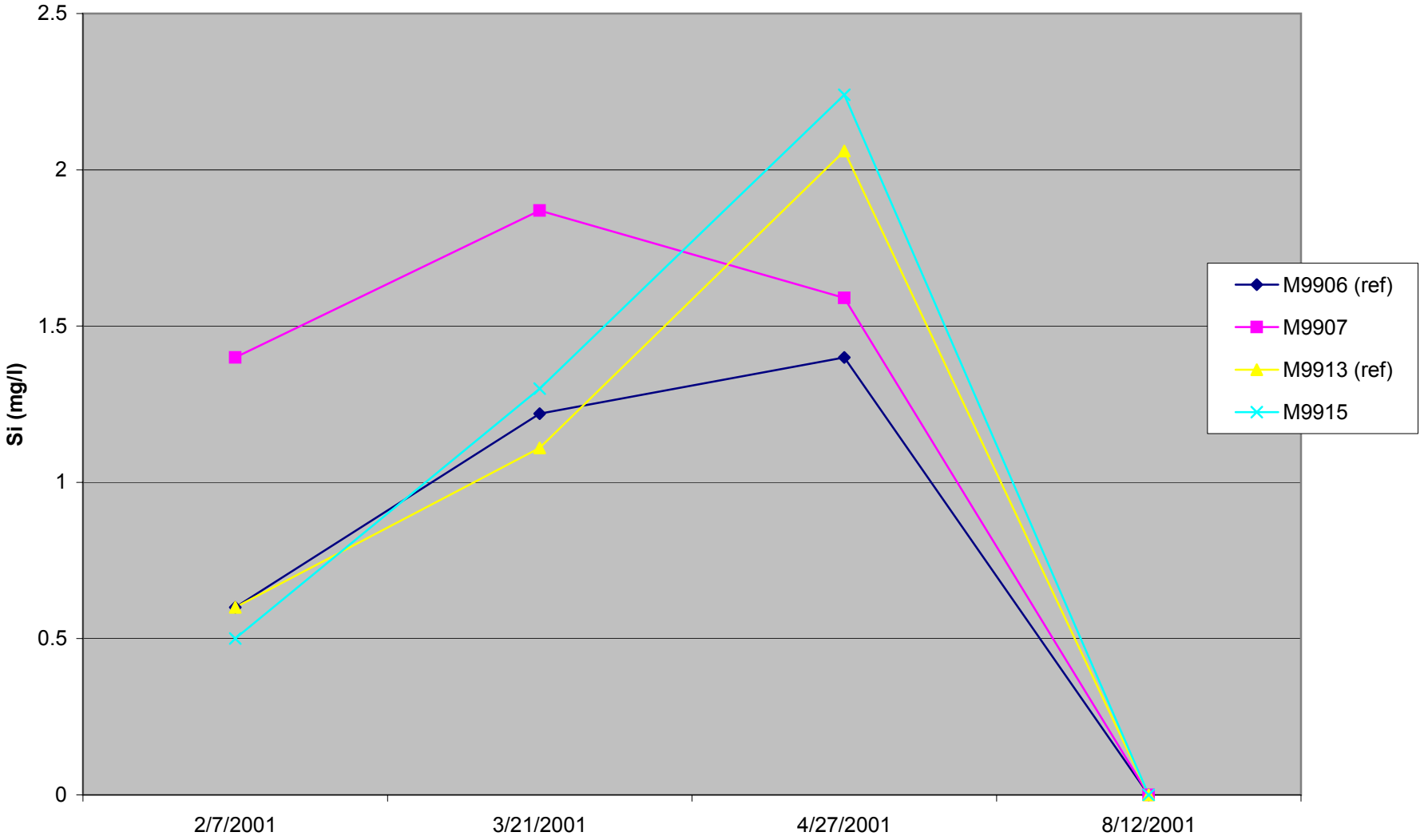
Chloride Concentrations at NPRA Lakes, 2001.



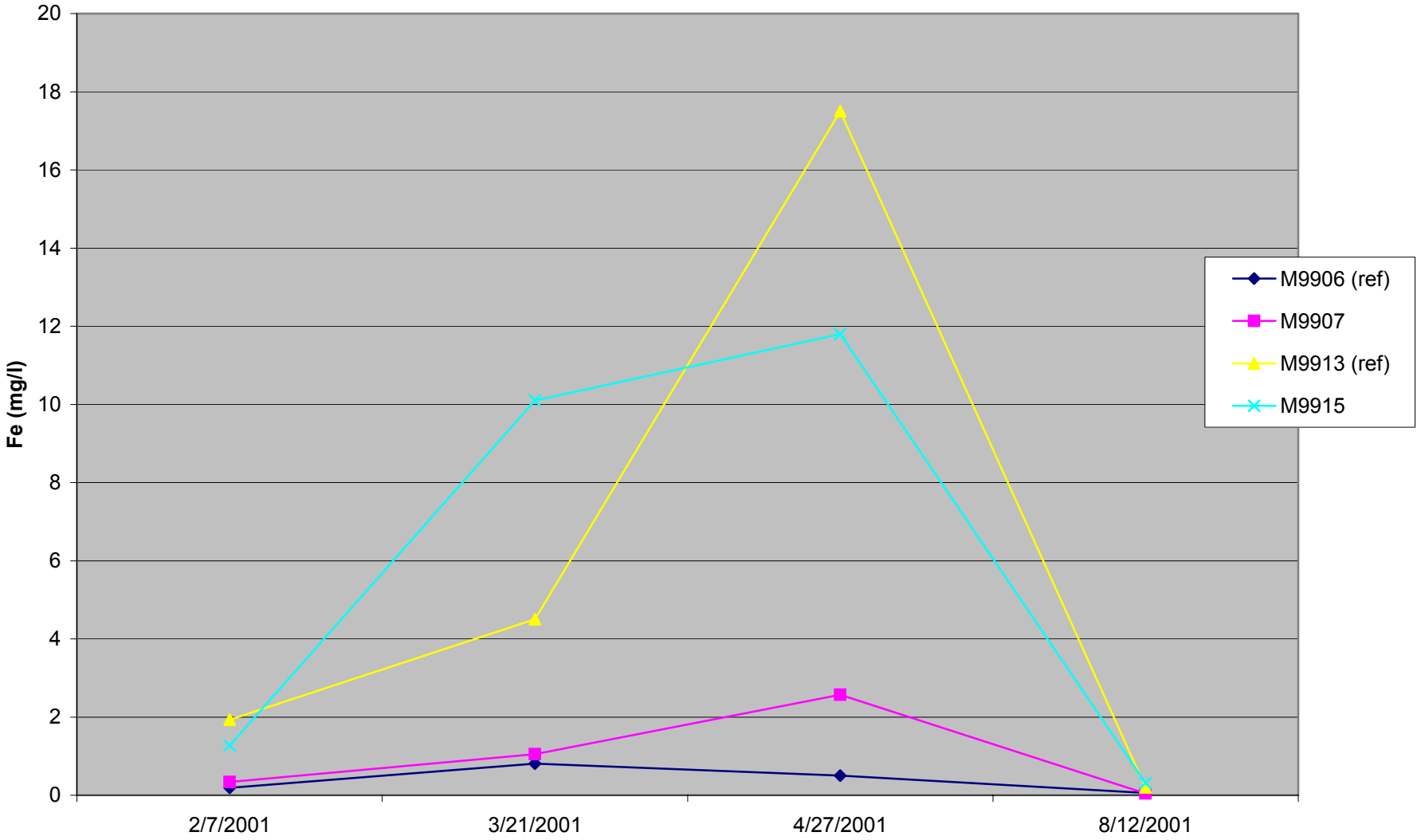
Hardness at NPRA Lakes, 2001.



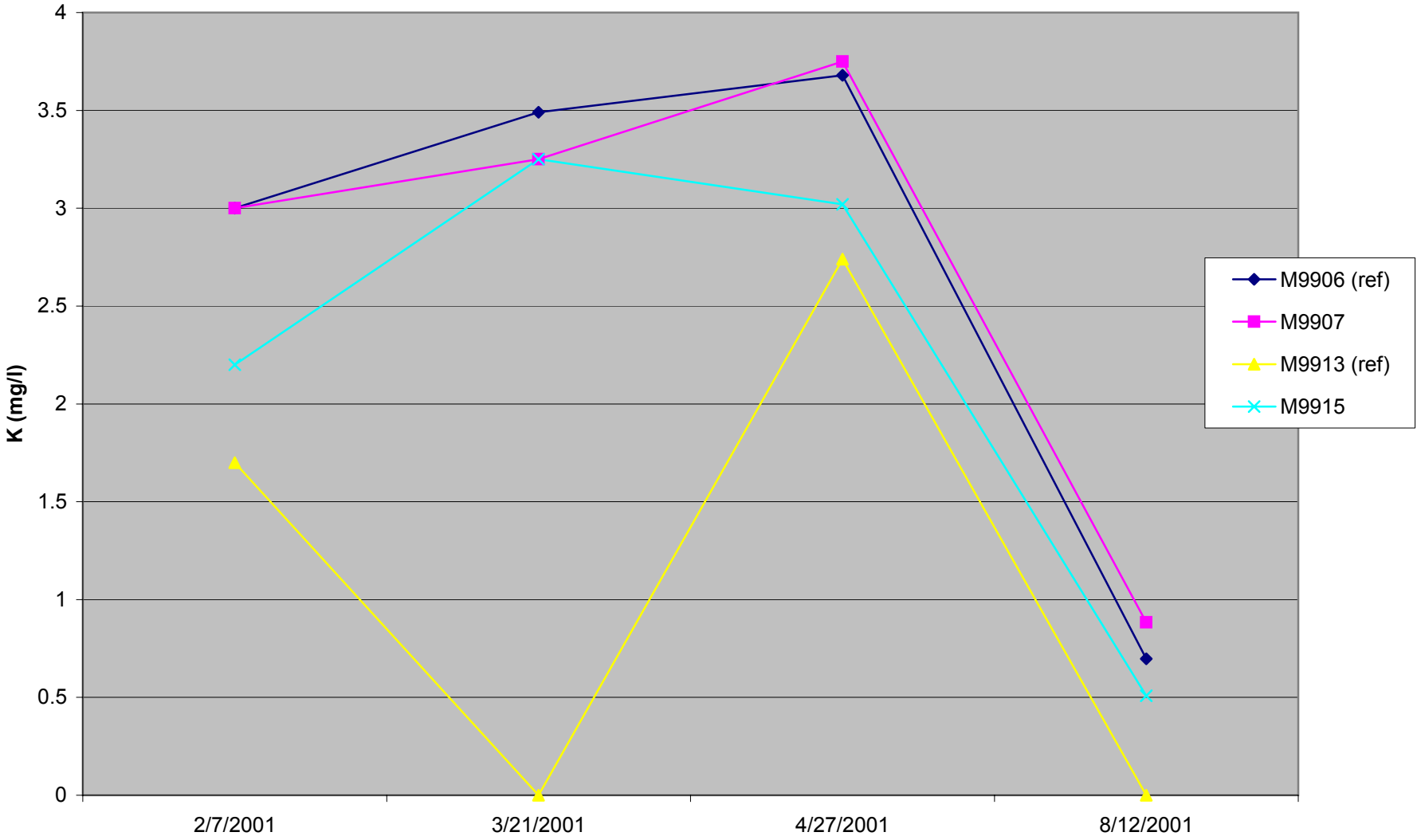
Silicon Concentrations at NPRA Lakes, 2001.



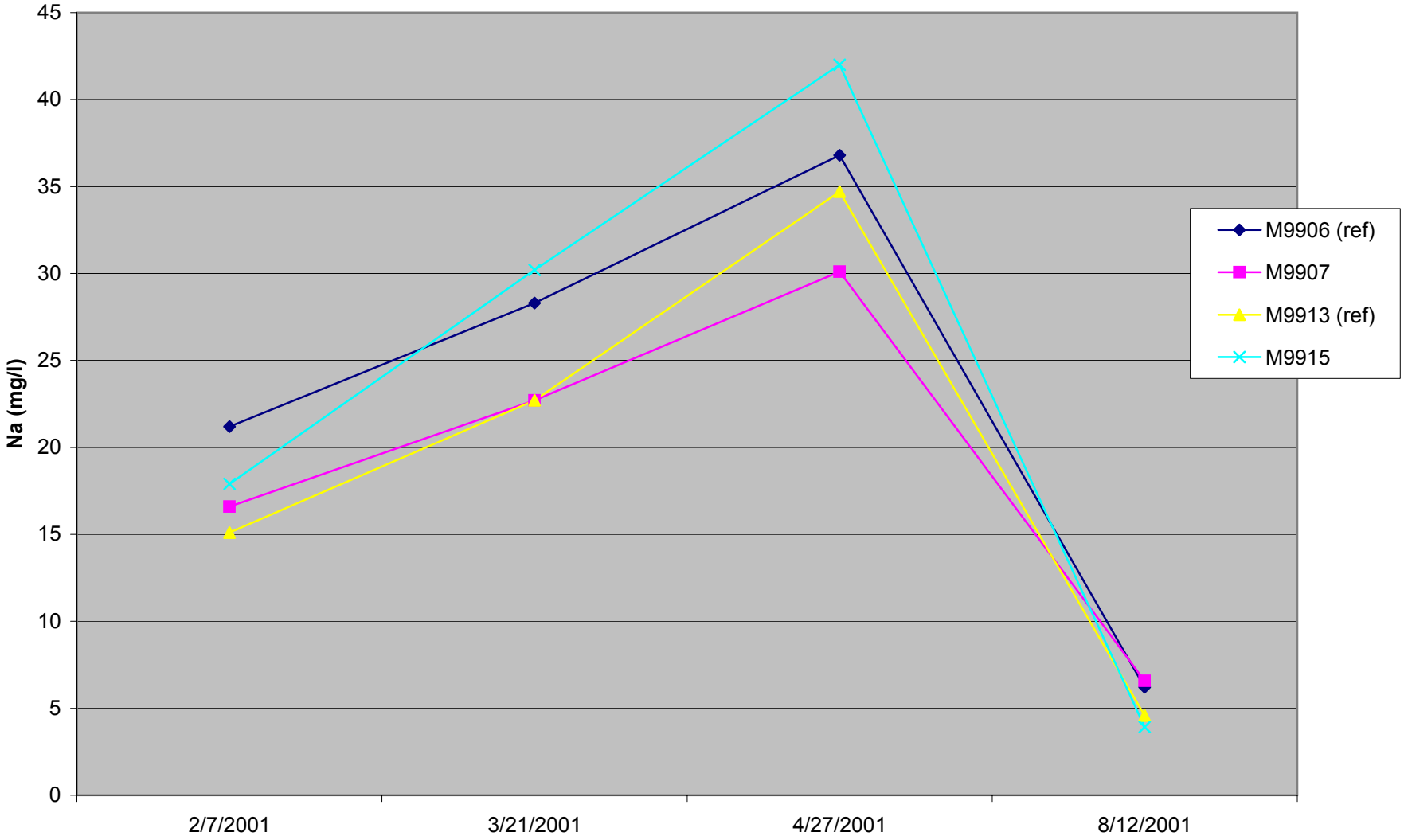
Iron Concentrations at NPRA Lakes, 2001.



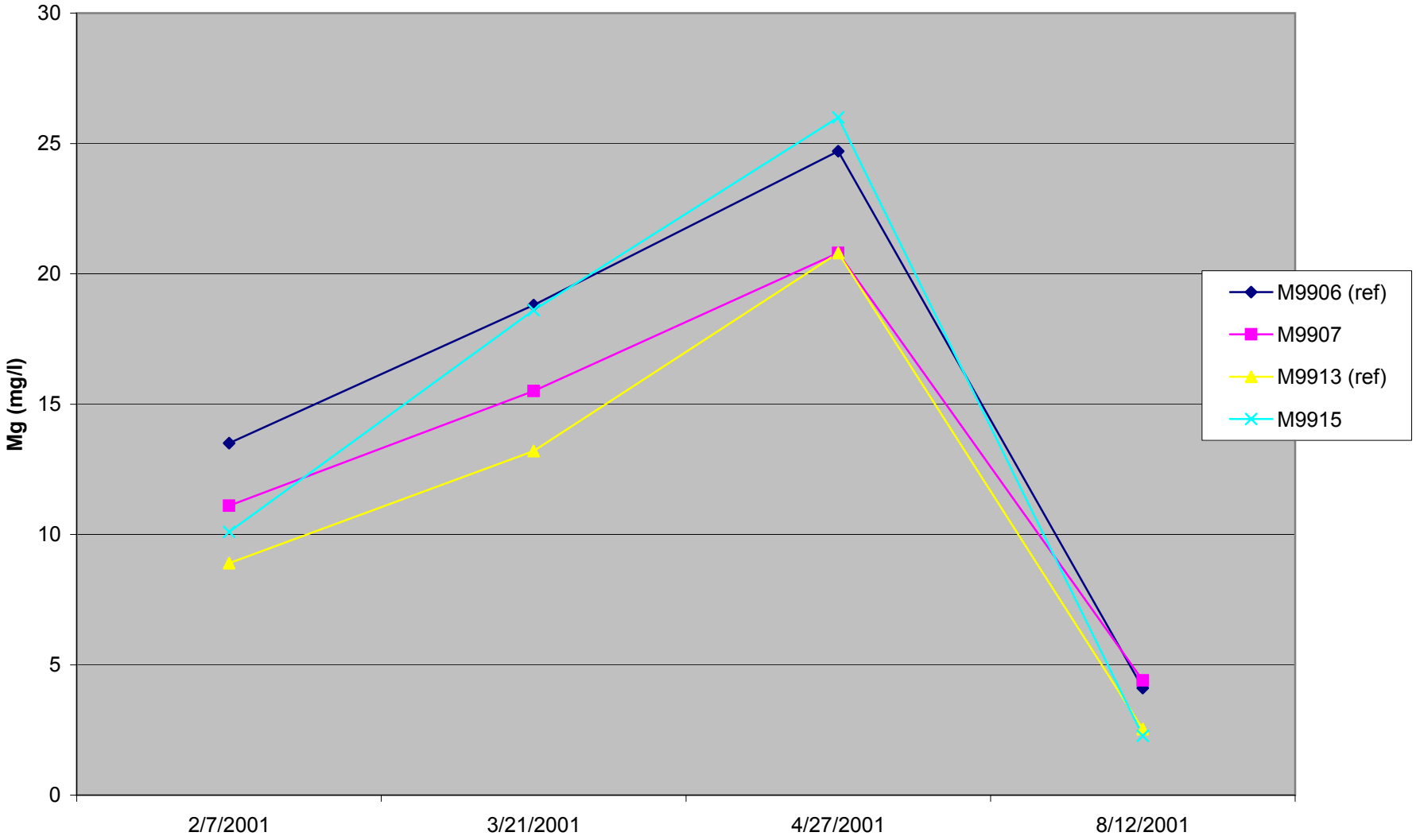
Potasium Concentrations at NPRA Lakes, 2001.



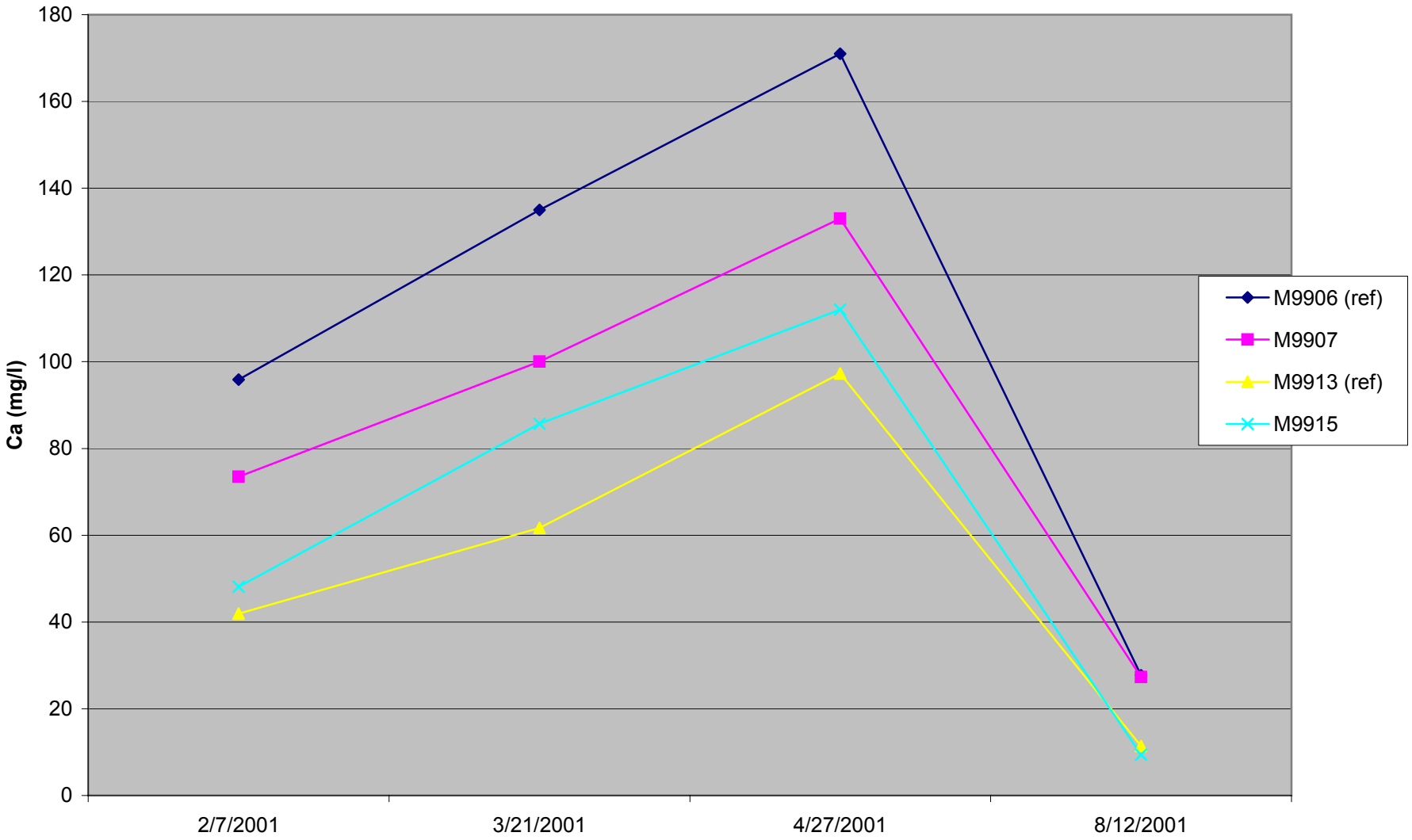
Sodium Concentrations at NPRA Lakes, 2001.



Magnesium Concentrations at NPRA Lakes, 2001.



Calcium Concentrations at NPRA Lakes, 2001.



Appendix D

Water Quality Data Collected during 1999 and 2000

From MJM Research, January 2000: Fish Utilization of Lakes in Eastern NPR-A during 1999.

Lake	Date	pH	Cond (mS/cm)	DO (mg/l)	Temp (C)	Cl (mg/L)	TDS (mg/L)	Hard (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)
M9906	07/15/99	8.25	0.1997	9.9	13.0	13.8	112	85.6	26.9	4	5
M9907	07/15/99	8.3	0.1993	9.88	13.2	13.3	116	84	25.4	4.3	5.4
M9913	07/12/99	7.37	0.0859	9.82	13.9	11.9	55	32	9.2	2.1	3.9
M9915	07/13/99	7.58	0.0887	9.76	14.7	14.1	61	32.8	9	2.3	4.1

From MJM Research, November 2000: Fish Utilization of Lakes in Eastern NPR-A 1999-2000.

Lake	Date	pH	Cond (mS/cm)	DO (mg/l)	Temp (C)	Cl (mg/L)	TDS (mg/L)	Hard (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)
M9906	07/15/00	8	0.223	10.6	9.9	21.2	134	89	27.4	5.1	9.7
M9907	07/16/00	8.15	0.295	11.2	11.4	32.0	164	111	35.5	5.5	11.9
M9913	07/20/00	8.6	0.192	11.2	11.1	8.2	136	87	28.9	3.5	7.2
M9915	07/21/00	7.8	0.204	9.8	14.8	23.5	156	69	21.2	3.9	10.1

From Phillips Alaska, Inc., December 2000: 2000 NPR-A Lake Recharge Study Results.

Lake	Date	pH	Cond (mS/cm)	DO* (mg/l)	Temp (C)	Cl (mg/L)	TDS (mg/L)	Hard (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)
M9906	8/15/2000	--	--	11.54	7.4	15.6	136	86.0	27.6	4.2	6.1
M9915	8/15/2000	--	--	11.83	6.4	14.1	88	32.1	9.0	2.3	3.8

Note: "--" indicates the parameter was not reported
* indicates dissolved oxygen was measured as % saturation and converted to mg/l using recorded temperature and an assumed barometric pressure of 760 mmHg.