A SUMMARY OF ACIDIFICATION ASSESSMENT DATA FOR 107 LAKES IN NORTHERN ALBERTA

Prepared by: E. Dromey
D. O. Trew

Environmental Quality Monitoring Branch
Environmental Assessment Division
Environmental Protection Services
Alberta Environment

1988

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1.0 INTRODUCTION

In 1987 a report was released by Alberta Environment detailing the potential sensitivity of Alberta lakes to acidic deposition (Erickson 1987). Included in the 982 evaluated lakes were 107 lakes which had been part of a preliminary water quality survey conducted in the autumn of 1983. These 107 lakes are located in the northern half of the province and were sampled during the course of 13 flight trips.

The lakes are identified, the station codes assigned to the lakes and the types of samples taken are tabulated. In addition, the chemical variables selected as criteria to identify potentially sensitive lakes are listed and the associated NAQUADAT codes assigned. These variables include: pH, calcium, alkalinity and total dissolved solids (TDS). However, there are a number of other data not used in the sensitivity report which are mentioned herein. These include most of the other routine tests performed on lake water samples such as major ions and nutrients. The NAQUADAT codes used for these variables are also tabulated. The data are stored on the regular NAQUADAT water quality file used by Environmental Quality Monitoring Branch.

2.0 SAMPLING METHODS

2.1 PHYSICAL AND MORPHOMETRIC MEASUREMENTS

Sampling was conducted between 29 August 1983 and 26 October 1983, the period when most lakes were expected to be nearly or completely mixed as a result of fall turnover. Physical variables were measured at the (assumed) deepest part of the lake. Hydrographic maps were consulted, where available, to establish the point of maximum depth of

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the lake. Where hydrographic maps were not available, efforts were made to land near the center of the lake. Upon landing, depth was measured by use of a depth sounding line.

2.1.1 Dissolved Oxygen, Temperature, Specific Conductance, Secchi Depth

For each lake, the dissolved oxygen and temperature values were obtained near the surface (0.25 m), and at one metre intervals down to the sediment to determine the extent of stratification and the lower boundary of the epilimnion. A surface (0.25 m) conductivity value was also obtained. Secchi disk transparency depth was determined, and, subsequently, the euphotic zone was estimated as 2.5 times Secchi disk depth.

2.2 CHEMICAL SAMPLING

2.2.1 In Situ pH

Field pH was recorded at the surface (0.25 m), and one metre above the sediment.

2.2.2 Collection of Samples

Depth integrated samples were collected using weighted Tygon tubing. Samples were collected from five widespread areas of the lake in an attempt to reduce the influence of any spatial heterogeneity on sample representativeness. In stratified lakes, samples were taken from the euphotic zone. In shallow lakes (<2 metres), where the euphotic zone extended to the bottom, samples were collected to within 0.5 - 1 metres of the sediment.

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All sample containers and Tygon tubing were triple rinsed with sample water. Samples were placed in a 19 litre polyethylene carboy and mixed. Three subsamples of the water were then removed. A 250 mL water sample was transferred to an opaque polyethylene bottle for later laboratory analysis of ammonia-nitrogen, total Kjeldahl nitrogen and total phosphorus; 2.5 mL of concentrated H_2SO_4 was added as a preservative. A one-litre water sample was transferred to a polyethylene bottle for subsequent routine chemical analysis for major ions and related parameters. Samples were kept cool, in the dark, and were shipped to Edmonton by air within two days. Analyses were conducted by the Alberta Environmental Centre at Vegreville. The water quality variables analyzed during this preliminary survey are summarized along with the corresponding methods of analysis in Table 1. Access to the data can be provided through the NAQUADAT storage system, Water Quality Control Branch. Entry to the system and subsequent access to the data is obtained through using the assigned station code for any given lake.

2.2.3 Field Alkalinity

A third subsample was collected in a one litre polyethylene bottle for alkalinity determination. Alkalinity was determined on the day of sampling by potentiometric titration. One hundred millilitres of water were titrated, using 0.0248 N sulphuric acid solution, to a pH in the range of 4.3 to 4.7. The volume of acid and pH of the sample were recorded and alkalinity determined accordingly (American Public Health Association 1978).

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Table 1. Selected water quality variables, methods of analysis and corresponding NAQUADAT codes.

Variable	Method of Analysis	NAQUADAT Code
Field		
Conductivity	Meter (Model TC-2, Hydrolab Ltd.)	02041F
Depth	Measured from surface in metres	97251F
Dissolved Oxygen	Meter (Model TDO-W Hydrolab Ltd.)	08102F
Light Penetration	Secchi disk	02078F
pH	Meter (Model E588, Metrohin Ltd.)	10301F
Temperature	Meter (Model TDO-W, Hydrolab Ltd.)	02061F
Laboratory		
Alkalinity Total	Potentiometric titration	10101L
Ammonia-N	Colourimetry using dipotassium-hydrogen phosphate-disodium EDTA	07562L
Bicarbonate	Calculated	06201L
Calcium	Atomic Absorption - automated	20110L
Chloride (diss)	Colourimetry using heteroply blue	17203L
Conductivity	Conductivity meter	02041L
Fluoride	Potentiometrically with specific ion electrode	09107L
Hardness Total	Calculated	10602L
Iron (extr.)	Atomic absorption - automated	26304L
Magnesium (extr.)	Atomic absorption by direct aspiration	12303L
Nitrite (diss.)	Colourimetry on Autoanalyzer with sulphanilic acid	07205L
Nitrogen TK	H_2SO_4 digested, automated colourimetry	07021L
NO_2+NO_3 (diss.)	Colourimetry on Autoanalyzer	07105L
pH	Meter standardized with pH buffer	10301L
Phosphorous Total	H_2SO_4 digested. Automated colourimetry	15421L
Potassium (diss.)	Flame photometry with internal standard	19103L
Silica Reactive	Automated colourimetry using heteroply blue	14102L
Sodium (diss.)	Flame photometry	11103L
Sulfate	Colourimetry with methylthymol	16306L
TDS	Calculated	00205L

extr. = extractable
diss. = dissolved

3.0 STATION CODES

Each lake was assigned a station code based on its geographic location, watershed and the type of sample taken. For every lake there were two types of sampling: euphotic composite and profile. The lakes are grouped according to the flight trips that were undertaken: a total of thirteen in all. For each flight trip the names of the lakes, their geographic coordinates and their assigned station codes are tabulated. This information is presented in Table 2. The station codes are used to access the chemical data stored in the NAQUADAT data base.

4.0 CHEMICAL DATA

The chemical variables selected to identify potentially sensitive lakes are presented in Table 3. These variables, in particular alkalinity and calcium, were used to create sensitivity maps of the areas in question. As is the case in Table 2, the lakes are grouped according to the flight trips that were taken (at total of 13 in all).

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Table 2 Names, locations and NAQUADAT station codes of 107 lakes sampled in the Autumn of 1983. The lakes are grouped according to the flight trips.

Lake	Latitude	Longitude	Euphotic Code	Profile Code
Region: Fort McMurray Flight Trip #1				
Unnamed (near Christina River)	56°04'03"	111°24'35"	CE0500	CE0501
Unnamed	56°10'45"	111°06'16"	CE0600	CE0701
Base	55°38'59"	111°50'42"	CE0700	CE0701
Goodwin	55°25'11"	111°39'21"	CA0500	CA0501
Christina	55°37'36"	110°49'20"	CE3100	CE3101
Grist	55°22'47"	110°28'27"	CE2000	CE2001
Unnamed (N. Cowper Lake)	55°57'10"	110°23'18"	CE2500	CE2501
Birch	56°23'04"	110°25'17"	CE3500	CE3501
Region: Fort McMurray Flight Trip #2				
Unnamed	57°57'36"	110°23'49"	DD0400	DD0401
Johnson	57°39'23"	110°23'41"	DD0300	DD0301
Audet	57°38'51"	110°54'42"	DC0500	DC0501
Unnamed	57°16'06"	110°12'10"	DC0600	DC0601
Kearl	57°17'43"	111°14'26"	DA3700	DA3701
Unnamed	57°09'06"	110°50'25"	DC0700	DC0701
Unnamed (15 mile lake)	56°53'39"	110°54'12"	DA2200	DA2201
Unnamed	56°51'13"	110°05'56"	CD0500	CD0501
Unnamed	57°27'50"	110°27'22"	DC0800	DC0801
Region: Fort McMurray Flight Trip #3				
Wood Buffalo	56°19'15"	113°08'04"	JB0500	JB0501
Kamaskikawik	56°09'28"	113°31'41"	JB0600	JB0601
Teepee	56°25'25"	113°57'26"	JB0700	JB0701
Corn	56°38'31"	113°58'25"	JB0800	JB0801
Unnamed	56°46'02"	113°16'09"	JB0900	JB0901
Carrot	56°58'34"	113°23'51"	JB1000	JB1001
Rabbit	57°02'13"	112°56'42"	DB0500	DB0501
Unnamed	56°46'15"	111°56'47"	DB0600	DB0601

Table 2 Continued

Lake	Latitude	Longitude	Euphotic Code	Profile Code
Region: Fort McMurray Flight Trip #4				
Bayard	57°46'14"	112°23'47"	KF0500	KF0501
Unnamed	57°41'22"	112°44'10"	KD0500	KD0501
Unnamed	57°51'20"	112°58'18"	KD0600	KD0601
Unnamed	57°35'50"	113°18'21"	KD0700	KD0701
Jean	57°29'33"	113°46'24"	JE1900	JE1901
Osi	57°11'13"	113°34'12"	JB1100	JB1101
Legend	57°24'44"	112°56'01"	JE2500	JE2501
Unnamed	57°25'29"	112°14'47"	DA4000	DA4001
Region: Canadian Shield Flight Trip #5				
Unnamed	57°03'52"	111°07'51"	NA0500	NA0501
Barrow	59°15'42"	111°12'04"	NA1000	NA1001
Fletcher	59°07'14"	110°49'11"	NA1500	NA1501
Florence	59°17'16"	110°23'39"	MD2500	MD2501
Wylie	59°19'59"	110°22'29"	MD2600	MD2601
Unnamed	59°25'57"	110°18'22"	MD2700	MD2701
Unnamed	59°29°08"	110°28'55"	MD2800	MD2801
Colin	59°35'51"	110°07'19"	MD2900	MD2901
Weekes	59°43'06"	110°00'50"	MD3200	MD3201
Region: Canadian Shield Flight Trip #6				
Arch	59°52'06"	110°37'05"	QA0600	QA0601
N. Leland	59°57'17"	111°00'31"	NB0500	NB0501
Tulip	59°54'19"	111°09'10"	NB0600	NB0601
Myers	59°41'14"	111°16'03"	NB0700	NB0701
Bocquene	59°29'03"	111°07'05"	NA2000	NA2001
Unnamed	59°27'37"	110°49'26"	NA2500	NA2501
Unnamed	59°45'40"	110°46'38"	NB0800	NB0801
Whaleback	59°42'28"	110°21'18"	MD3300	MD3301
Andrew	59°55'41"	110°05'56"	QA0500	QA0501

Table 2 Continued

Lake	Latitude	Longitude	Euphotic Code	Profile Code
Region: Caribou Mountains Flight Trip #7				
Fleming	58°46'15"	115°26'03"	JF0500	JF001
Caribou	59°03'10"	116°04'43"	JF0600	JF0601
Unnamed	59°15'40"	114°21'07"	KB0500	KB0501
Unnamed	59°14'19"	114°31'27"	KB0600	KB0601
Unnamed	59°24'29"	114°45'33"	PC0500	PC0501
Unnamed	59°28'49"	115°09'43"	PC0600	PC0601
Cladonia	59°19'52"	115°02'16"	PC0700	PC0701
Rocky Is.	59°08'06"	115°08'01"	JF0700	JF0701
Margaret	58°56'45"	115°20'45"	JF0800	JF0801
Wentzel	59°01'05"	114°28'02"	KA0500	KA0501
Semo	58°50'40"	115°00'00"	KA0600	KA0601
Region: Caribou Mountains Flight Trip #8				
Hotte	58°57'26"	116°07'29"	OB1500	OB1501
Unnamed	59°03'16"	116°14'51"	OB1600	OB1601
Unnamed	59°14'58"	116°01'42"	PA0500	PA0501
Unnamed	59°29'08"	115°31'37"	PA0600	PA0601
Unnamed	59°18'39"	115°21'03"	PA0700	PA0701
Whitesand	59°11'53"	115°27'21"	PA0800	PA0801
Pitchimi	59°00'58"	114°28'05"	KA0700	KA0701
Region: Swan Hills Flight Trip #9				
God's Lake	56°49'03"	114°17'13"	JB1200	JB1201
Unnamed	56°14'19"	114°23'20"	JA1200	JA1201
Cranberry	56°14'11"	115°03'49"	JA0500	JA0501
Nipisi	55°47'25"	114°57'10"	JA0600	JA0601
McMullen	55°50'26"	114°05'15"	JA1100	JA1101
Lylich	55°43'52"	114°34'50"	JA0800	JA0801
Mitsue	55°14'56:	114°36'24"	BK2700	BK2701

Table 2 Continued

Lake	Latitude	Longitude	Euphotic Code	Profile Code
Region: Swan Hills Flight Trip #10				
Mink	56°01'02"	115°35'58"	JA0900	JA0901
Unnamed	55°58'30"	116°29'04"	BF0500	BF0501
Unnamed	56°11'40"	116°56'32"	HA0500	HA0501
Cadotte	56°26'34"	116°23'22"	HB0500	HB0501
Unnamed	56°46'05"	116°37'57"	HB0600	HB0601
Haig	56°53'40"	116°06'29"	HB0700	HB0701
Talbot	57°27'44"	115°44'04"	JD0500	JD0501
Region: Grande Prairie Flight Trip #11				
Boundary	56°20'11"	119°59'27"	FD0500	FD0501
Unnamed	56°39'27"	119°17'33"	HC0500	HC0501
Ray	56°39'45"	119°07'27"	HC0600	HC0601
Sulphur	56°42'25"	118°18'42"	HC2020	HC2021
Deadwood	56°42'53"	117°35'28"	HC0700	HC0701
Leddy	56°23'58"	117°27'37"	FD0600	FD0601
Gerry	56°18'02"	118°16'11"	FD6810	FD6811
Region: Grande Prairie Flight Trip #12				
Kakut	55°37'47"	118°31'44"	GH0500	GH0501
Boone	55°34'28"	119°25'20"	GJ0600	GJ0601
Sinclair	55°23'48"	119°44'49"	GJ0500	GJ0501
Wapiti	54°49'54"	119°54'36"	GC0500	GC0501
Saskatoon	55°13'02"	119°05"16"	GE1100	GE1101
Wilson	54°55'38"	119°02'49"	GE0500	GE0501
Musreau	54°32'50"	118°37'05"	GB0500	GB0501
Unnamed	54°54'43"	118°08'04"	GF0500	GF0501
Region: Swan Hills Flight Trip #13				
Manawan	54°54'22"	113°41'39"	EA0500	EA0501
Goodridge	54°25'53"	114°14'53"	BC0500	BC0501
Foley	54°37;35"	114°47'28"	BD0500	BD0501
Roche	54°45'58"	114°54'21"	BK4100	BK4101
Agnes	54°55'00"	114°58'10"	BK3700	BK3701
Chisholm	54°54'52"	114°16'48"	BD0700	BD0701
Fawcett	55°18'31"	114°01'26"	BK4000	BK4001
L. Gray	54°50'30"	113°57'33"	BD0600	BD0601
Wakoma	54°10'09"	113°33'15"	EC0500	EC0501

Table 3. Chemical data: pH, alkalinity, TDS, conductivity and calcium in 107 lakes sampled in the Autumn of 1983. The data represent laboratory results.

LAKE	pH UNITS	ALKALINITY TOTAL mg/L $CaCO_3$ AEC	ALKALINITY TOTAL mg/L $CaCO_3$ FIELD	TDS mg/L	CONDUCTIVITY µS/cm	CALCIUM mg/L
Region: Fort McMurray, Flight Trip #1						
Unnamed (near Christina R.)	7.6	71		76	138	19
Unnamed	7.3	42		46	84	10
Base	7.6	65		69	132	16
Goodwin	7.5	50		52	97	10
Christina	8.2	115		117	220	26
Grist	8.4	118		119	224	29
Unnamed (near Cowper Lake	8.9	84		87	163	17
Birch	8.9	126		130	242	16
Region: Fort McMurray, Flight Trip #2						
Unnamed	6.3	24		32	57	4
Johnson	7.9	139		144	288	23
Audet	7.7	153		162	321	30
Unnamed	6.6	52		54	106	8
Kearl	8.4	100		104	201	17
Unnamed	6.1	9		14	31	<1
Unnamed	6.3	20		25	55	<1
Unnamed	7.8	88		83	170	<1
Unnamed	8.7	78		76	148	14
Region: Fort McMurray, Flight Trip #3						
Wood Buffalo	6.7	44		51	97	11
Kamaskikawik	7.4	92		107	208	24
Teepee	7.6	109		120	235	27
Corn	7.1	112		118	236	27
Unnamed	7.7	120		143	278	20
Carrot	7.3	93		100	200	20
Rabbit	8.5	140		164	307	15
Unnamed	6.5	44		46	93	7

Table 3 Continued

LAKE	pH UNITS	ALKALINITY TOTAL mg/L $CaCO_3$ AEC	FIELD	TDS mg/L	CONDUCTIVITY µS/cm	CALCIUM mg/L
Region: Fort McMurray, Flight Trip #4						
Bayard	6.4	19		36	70	6
Unnamed	6.8	21		34	67	6
Unnamed	5.7	5		13	23	<1
Unnamed	6.4	11		20	36	4
Jean	7.5	51		60	116	15
Osi	7.2	34		40	71	10
Legend	6.6	11		17	28	2
Unnamed	8.5	124		145	274	32
Region: Canadian Shield, Flight Trip #5						
Unnamed	7.4	68	67	80	164	10
Barrow	6.9	29	27	39	83	4
Fletcher	6.4	23	20	28	64	2
Florence	6.7	25	22	25	55	<1
Wylie	7.1	42	41	43	94	5
Unnamed	7.1	34	32	34	73	2
Unnamed	7.4	65	63	114	147	11
Colin	7.2	42	41	45	94	6
Weekes	6.7	24	25	28	63	2
Region: Canadian Shield, Flight Trip #6						
Arch	7.2	40	37	47	102	5
N. Leland	6.9	34	31	42	91	5
Tulip	7.3	47	45	49	104	5
Myers	6.6	38	37	44	96	5
Bocquene	7.8	63	62	69	148	10
Unnamed	7.0	45	43	47	102	6
Unnamed	7.0	39	37	45	93	5
Whaleback	6.8	26	24	32	67	4
Andrew	6.8	32	30	37	81	5

Table 3 Continued

LAKE	pH UNITS	ALKALINITY TOTAL mg/L $CaCO_3$ AEC	FIELD	TDS mg/L	CONDUCTIVITY µS/cm	CALCIUM mg/L
Region: Caribou Mountains, Flight Trip #7						
Fleming	6.3	13	10	18	35	<1
Caribou	6.5	25	23	29	69	4
Unnamed	7.3	68	66	84	173	18
Unnamed	6.1	7	4	13	23	<1
Unnamed	6.4	16	13	19	40	<1
Unnamed	6.8	51	50	53	112	11
Cladonia	6.5	19	15	23	49	3
Rocky Is.	6.3	15	13	19	36	<1
Margaret	6.6	17	15	22	47	2
Wentzel	6.8	32	31	42	90	7
Semo	6.8	26	22	29	57	5
Region: Caribou Mountains, Flight Trip #8						
Hotte	6.6	13	6	17	31	<1
Unnamed	7.1	19	17	21	44	<1
Unnamed	7.5	30	28	30	63	4
Unnamed	7.8	36	33	35	75	5
Unnamed	6.9	12	8	16	31	<1
Whitesand	7.0	14	11	18	36	<1
Pitchimi	7.7	38	35	42	90	6
Region: Swan Hills, Flight Trip #9						
God's Lake	8.0	169	170	220	403	33
Unnamed	6.8	72	66	74	146	18
Cranberry	8.1	148	144	167	320	37
Nipisi	8.5	121	118	144	270	35
McMullen	6.7	54	51	61	128	14
Lylich	6.4	24	23	35	66	8
Mitsue	6.6	86	86	100	203	18

Table 3 Continued

LAKE	pH UNITS	ALKALINITY TOTAL mg/L $CaCO_3$ AEC	FIELD	TDS mg/L	CONDUCTIVITY µS/cm	CALCIUM mg/L
Region: Swan Hills, Flight Trip #10						
Mink	7.3	132	128	148	293	38
Unnamed	6.8	30	25	58	108	12
Unnamed	7.2	109	97	232	414	50
Cadotte	7.8	126	125	216	400	47
Unnamed	7.2	83	78	140	267	32
Haig	7.7	98	96	99	207	25
Talbot	7.5	69	68	78	159	17
Region: Grande Prairie, Flight Trip #11						
Boundary	7.4	114	88	215	394	40
Unnamed	5.9	<5	4	12	13	<1
Ray	6.4	15	13	20	38	2
Sulphur	7.5	101	99	196	356	38
Deadwood	7.6	179	176	429	717	47
Leddy	8.1	95	94	337	574	31
Gerry	8.1	128	126	190	348	39
Region: Grande Prairie, Flight Trip #12						
Kakut	7.8	160	155	184	347	24
Boone	7.2	44	41	50	99	10
Sinclair	7.6	83	80	91	189	17
Wapiti	7.9	105	103	108	207	24
Saskatoon	8.7	439	444	480	848	26
Wilson	7.2	67	59	80	143	13
Musreau	7.4	69	67	75	142	18
Unnamed	7.5	124	122	128	257	29
Region: Swan Hills, Flight Trip #13						
Manawan	8.9	107	112	379	612	44
Goodridge	8.2	132	132	137	258	24
Foley	8.0	84	83	88	164	16
Roche	7.5	30	28	36	62	6
Agnes	7.3	18	16	23	44	2
Chisholm	8.4	139	140	140	267	23
Fawcett	7.8	63	61	67	132	14
L. Gray	8.2	107	105	108	211	20
Wakoma	7.9	168	164	249	449	36

5.0 REFERENCES

Erickson, P.E. 1987. An assessment of the potential sensitivity of Alberta lakes to acidic deposition. Water Quality Control Branch, Alberta Environment, Edmonton. 102 p.