WATER QUALITY OF THE ATHABASCA OIL SANDS AREA VOLUME IV AN INTERIM COMPILATION OF NON-AOSERP WATER QUALITY DATA

by

ANTHONY MARK AKENA

LYNNE L. CHRISTIAN

Alberta Environment

for

ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

WS 1.2.1

October 1981

ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

RESEARCH REPORTS

These research reports describe the results of investigations funded under the Alberta Oil Sands Environmental Research Program. This program was designed to direct and coordinate research projects concerned with the environmental effects of development of the Athabasca Oil Sands in Alberta.

A list of research reports published to date is included at the end of this report.

Enquiries pertaining to the reports in the series should be directed to:

Research Management Division
15th Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta
T5K 2J6
(403) 427-3943

Project WS 1.2.1

AOSERP Report L74

This report may be cited as: Akena, A.M. and L.L. Christian. 1981. Water quality of the Athabasca oil sands area. Volume IV: an interim compilation of non-AOSERP water quality data. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment. AOSERP Report L74. 242 pp.

Alberta

ENVIRONMENT Research Management Division 403/427-3943

15th Floor, Oxbridge Place
9820 - 106 Street
Edmonton, Alberta, Canada
T5K 2J6

The Hon. J.W. (Jack) Cookson
Minister of the Environment
222 Legislative Building
Edmonton, Alberta

Sir:

Enclosed is the report "Water Quality of the Athabasca Oil Sands Area, Volume IV, An Interim Compilation of Non-AOSERP Water Quality Data".

This report was prepared for the Alberta Oil Sands Environmental Research Program, through its Water System, under the Canada-Alberta Agreement of February 1975 (amended September 1977).

Respectfully,

W. Solodzuk, P. Eng.
Chairman, Steering Committee, AOSERP
Deputy Minister, Alberta Environment

TABLE OF CONTENTS

LIST OF TABLES

continued....

LIST OF TABLES, CONTINUED

continued....

LIST OF TABLES, CONTINUED

continued....

LIST OF TABLES, CONTINUED

continued....

LIST OF TABLES, CONCLUDED

LIST OF FIGURES

ACKNOWLEDGEMENTS

We are grateful to the workers and organizations cited in the text for giving us permission to assemble their data in this publication.

This research project WS 1.2.1 was funded by the Alberta Oil Sands Environmental Research Program, established to fund, direct, and coordinate environmental research in the Athabasca Oil Sands area of northeastern Alberta.

1. INTRODUCTION

Studies of the water quality of the Athabasca Oil Sands area (Figures 1 and 2) streams, rivers, and lakes have been conducted by numerous organizations and government agencies since the 1950's. The earlier studies involved efforts by provincial and federal government departments interested in ascertaining the suitability of these surface waters for various uses and concerned with the protection of human health and aquatic environments. Groups involved in subsequent studies collected surface and groundwater samples with a greater interest in the development of the Athabasca oil sands. Unfortunately, most of the groups did not provide documentations of sampling sites or the wide variety of sample collection, storage, and analysis procedures they used.

Subsequent to the establishment of the Alberta Oil Sands Environmental Research Program (AOSERP), a program established by an agreement between the governments of Alberta and Canada in February 1975 (amended September 1977), a number of AOSERP projects involving water quality sample collection and analysis were instituted. These projects followed AOSERP's general objectives (Smith et al. 1979) which were, specifically, the definition of baseline states and detection of changes that might be caused by the development of the Athabasca oil sands.

Under the regional surface water quality monitoring program (AOSERP Project WS 1.2.1, formerly HY 2.8.1) the standardization of sampling sites, procedures, and analysis received significant attention. A documentation of the locations of the water quality sampling sites, sampling, analytical, and quality control methods used; the volume and availability of assembled data; and a comprehensive appraisal of the quality of the data base

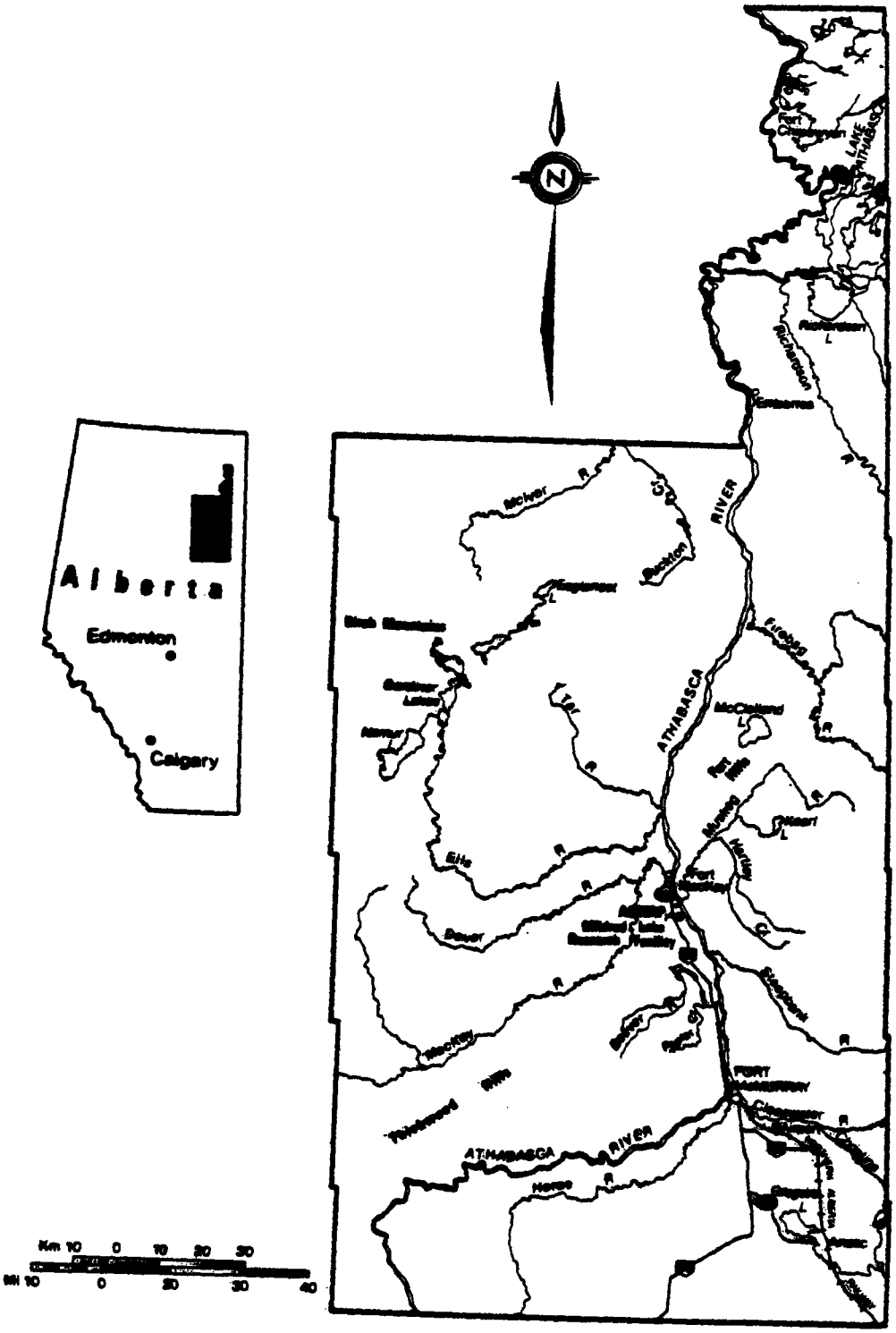


Figure 1. Athabasca oil sands area.

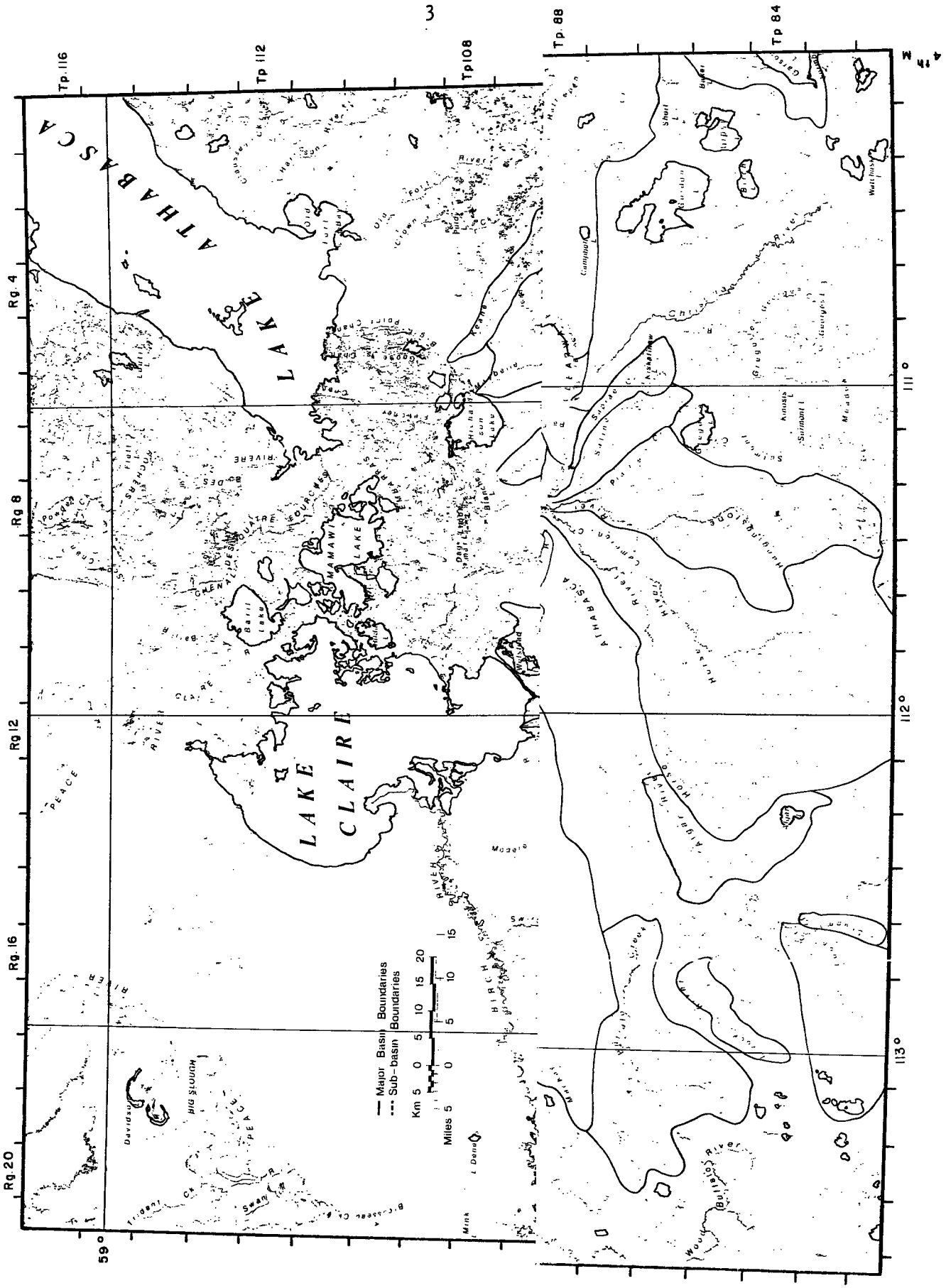


Figure 2. Surface water drai

can be found in a recent AOSERP report (Akena 1980). Another surface water quality report (Seidner 1980) in the series provides a discussion of the 1976 and 1977 data. The regional water quality monitoring program, initiated in 1976, has been maintained and now forms a significant part of the ongoing monitoring program managed by the Pollution Control Division. The 1981/1982 water quality monitoring activities will lead to a completion of the general baseline studies and a shift in emphasis to monitoring sections of the major water bodies which are believed to have the potential to be impacted by oil sands development.

1.1 REPORT OBJECTIVES

This report provides an assemblage of non-AOSERP surface water quality data dating back to the 1950's. Most of the data were abstracted from reports of federal and Alberta government departments, Alberta Research Council, universities, oil sands industry, and private consulting firms. Unfortunately, the studies culminating in these reports used a wide variety of sample collection, storage, and analysis procedures; and, in a large number of cases, the data bases did not contain:

1. descriptions of the exact locations of sampling sites;
2. a consistency of sites and parameters monitored;
3. documentations of the sampling procedures, sample preservatives, analytical methods, detection limits, and precision;
4. indications of the quantity, quality, or accuracy of the data base.

This report, therefore, has not attempted to validate or evaluate the data bases in terms of AOSERP's general objectives. It is hoped, however, that this compilation of surface water quality data could be used to supplement

the AOSERP surface water quality data base, especially in areas where, or on occasions when, AOSERP data were not collected.

1.2 AVAILABILITY OF AOSERP WATER QUALITY DATA

All the data generated by the AOSERP regional water quality monitoring program and the Muskeg River watershed study (Akena 1979) are stored in Alberta Environment's NAQUADAT files. Unfortunately, water quality data collected by other AOSERP studies, for instance, biological and groundwater studies, are not contained in this data bank. Most of these other data are, however, published in AOSERP reports. A list of AOSERP publications is included at the back of this report.

The water quality data stored in Alberta Environment's NAQUADAT files are updated regularly. In order to obtain a retrieval from the data files, it is only necessary to inform the

Water Quality Control Branch
Alberta Envrionment
9820 - 106 Street
Edmonton, Alberta
T5K 2J6
Telephone (403) 427-5828

of the information required from the NAQUADAT files and agree to pay the minimal computer costs associated with the request.

2. SURFACE WATER QUALITY DATA FROM ATHABASCA OIL SANDS AREA RIVERS, STREAMS, AND LAKES

Surface water quality data are presented in Tables 1 through 177.

Table 1. Monthly analysis of Athabasca River water sampled at and near Fort McMurray, Alberta (K.A. Clark, Alberta Research Council).

Athabasca River water samples were collected on a once-a-month basis for an entire year, September 1957 to September 1958, in response to requests from parties interested in the development of the tar sands (1 of 5 sites).

Location: Athabasca River, Fort McMurray[a]

Date(m-yr)	09-57	10-57	11-57	12-57	02-58	03-58
Total Solids	172	187	206	238	259	269
Turbidity	15	19	12	2	Clear	Clear
Organic Carbon	43	46	40	44	32	26
Calcium Carbonate	87	75	96	80	98	115
Magnesium Carbonate	9	38	34	41	52	38
Magnesium Sulfate	15	17	17	29	10	4
Magnesium Chloride	18	2	-	-	-	-
Sodium Chloride	Trace	7	8	15	8	25
Iron	Trace	6	4	3	.3	1.2
Sodium Sulfate	-	-	-	25	48	55
Silica	-	-	-	-	10	4.4
Color	-	-	200	120	-	-
pH	8.1	8.1	8.1	8.1	8.0	8.4

[a]Units were not given in this report.

Table 2. Water quality monitoring: Athabasca River 1968, 1969, 1970 (Syncrude Canada Limited Research Department).

These are excerpts from Syncrude's Annual Documentation (internal report). They discuss the types of studies done that particular year, the results of the studies, and the changes with respect to water quality. Samples were obtained from the McMurray Bridge upstream of the G.C.O.S. plant and at Syncrude.

Location: Athabasca River, McMurray Bridge[a]

Date (d-m-yr)	30-05-68	28-06-68	29-07-68	30-08-68	30-09-68	30-10-68	30-11-68	31-12-68	30-01-69	27-02-69
Sodium + Potassium	1	8	1	1	5	7	15	19	27	17
Calcium	32	29	28	31	33	44	55	57	48	51
Magnesium	8	8	9	8	9	11	15	16	13	21
Sulfate	15	21	14	7	20	29	42	48	44	53
Chloride	2	5	3	3	3	5	8	10	25	10
Bicarbonate	118	115	111	120	128	163	215	225	185	220
Hardness	113	105	107	110	119	155	119	208	173	214
Total Solids: Evap.	166	162	146	148	158	224	272	316	269	309
Ign.	88	94	86	94	96	134	166	178	169	193
Calc.	176	186	166	172	198	259	350	375	342	372
pH	7.8	7.9	8.0	8.4	7.9	7.9	8.3	8.1	7.8	7.6
Resistance	44.77	49.98	49.6	47.5	43.1	28.4	25.85	27.72	20.48	26.5
Phenol	L .001	L .001	L .001	L.001	L .001	0.003	L .001	L .001	L .001	L .001
Chemical Oxygen Demand	46.1	15.7	7.0	10.8	42.8	43.8	-	-	-	-
Biochemical Oxygen Demand	1	L 1.	3	6	1	2	-	-	-	-
Oil	5.6	9.2	0.9	0.5	0.4	0.9	2.0	2.0	4.1	2.1
Total Odor Number	150	50	10	30	5	5	-	-	-	-
Suspended Solids:										
Dried	210.0	54.6	39.8	29.8	21.6	5.8	2.6	2.6	7.2	1.6
Ign.	181.0	47.0	32.8	26.0	19.6	5.0	1.8	2.2	3.0	1.2

[a]All analyses except pH and resistance (ohm/m) expressed in mg/L.

continued . . .

Table 2. Continued

Date (d-m-yr)		29-03-69	30-04-69	30-05-69	30-06-69	30-07-69	30-08-69	30-09-69	29-11-69	07-01-70	09-03-70
Sodium + Potassium		27	6	9	5	11	8	8	1.6	13	15
Calcium		57	16	32	29	34	36	34	44	58	37
Magnesium		15	4	9	8	9	9	8	10	9	15
Sulfate		58	14	29	22	27	26	24	25	39	43
Chloride		22	3	4	2.2	7	2	2.6	4	3.9	8
Bicarbonate		209	61	124	110	131	140	132	150	199	221
Hardness		204	56	117	105	122	128	119	151	181	204
Total Solids:	Evap.	292	133	170	130	163	168	131	216	258	276
	Ign.	189	70	94	76	100	104	46	130	144	174
	Calc.	388	104	207	176	219	221	209	235	322	359
pH		7.7	7.5	7.8	8.1	7.7	8.1	7.6	7.7	7.9	7.7
Resistance		26.6	102	49	54.72	67.92	45.6	47.9	39.2	32.7	27.3
Phenol		L .001	0.003	L .002	L .001	L .001	L .001	L .001	0.001	L .001	0.005
Chemical Oxygen Demand		-	-	-	-	-	-	-	-	-	-
Biochemical Oxygen Demand		-	-	-	-	-	-	-	-	-	-
Oil		2.1	1.0	3.5	1.8	2.3	3.8	2.1	6.9	6.5	4.2
Total Odor Number		-	-	-	-	-	-	-	-	-	-
Suspended Solids:	Dried	3.4	415.6	117.2	45.8	16.6	95.4	72.6	4.4	3.8	3.6
	Ign.	3.0	375.6	113.2	39.4	13.4	82.8	63.0	2.8	1.8	1.2

continued . . .

Table 2. Concluded.

Date (d-m-yr)		12-04-70	11-05-70	30-05-70	30-06-70	07-07-70	31-08-70	28-09-70
Sodium + Potassium		14	2	11	9	3	6	1
Calcium		54	31	32	30	29	42	40
Magnesium		14	7	7	7	11	5	10
Sulfate		32	16	23	30	21	25	34
Chloride		6.4	8	7	5	3.5	4	3
Bicarbonate		215	100	120	105	118	130	129
Hardness		194	106	109	104	118	126	141
Total Solids:	Evap.	294	168	170	160	188	168	208
	Ign.	198	96	90	94	90	108	208
	Calc.	339	164	200	106	186	212	217
pH		8.5	7.8	8.2	8.1	7.6	7.6	8.2
Resistance		30	52.9	44.6	52.4	55.9	44.7	40.7
Phenol		0.012	L .001	L .001	L .001	L .005	L.005	0.009
Chemical Oxygen Demand		-	-	-	-	-	-	-
Biochemical Oxygen Demand		-	-	-	-	-	-	-
Oil		1.6	2.9	1.2	3.7	0.9	1.7	0.3
Total Odor Number		-	-	-	-	-	-	-
Suspended Solids:	Dried	5.4	204.6	80.8	579.0	89.8	25.0	29.0
	Ign.	4.4	182.2	70.0	514.0	82.4	19.0	22.4

Table 3. Water quality data, Alberta 1961-1973 (Publ. 1975, Inland Waters Directorate, Water Quality Branch, Ottawa)

The report presents a summary of water samples collected and analyzed between 1961 and 1973. The water quality data (chemical, physical, and biological) were collected by Water Quality Branch labs as part of the National Water Quality Monitoring Program. The Athabasca River, Fort McMurray and the Clearwater River, Fort McMurray were monitored between October 1967 and December 1973.

Location: Athabasca River, Fort McMurray[a] Station 00AL07DA0001 For Period 11/10/67 to 05/12/73 (Lat. 56° 46' 53", Long. 111° 24' 9")

	10301S pH	10301L pH	10101L Total Alkalinity	10151L Alkalinity Phenol-Phthalein	02011L Apparent Colour	02073L Turbidity	00210L Saturation Index (CALCD.)	00211L Stability Index (CALCD.)
			$CaCO_3$	$CaCO_3$	Rel. Units	JTU		
SAMPLES	3	61	60	55	60	62	59	59
LOW	7.2	7.6	64	0	5	1.0	-0.4	6.1
HIGH	8.8	8.6	200	0	100	650.	1.2	8.7
AVERAGE	7.9	8.1	119	0	39	42.	0.3	7.5
STD.DEV	0.8	0.2	34	0	21	86.	0.3	0.5
BACKUP CODES	--	--	--	--	21L	71L	--	--

	02041S Specific Conduct.	02041L Specific Conduct.	10603L Total Hardness	10401L Nonfiltered Residue	10501L Fixed Nonfiltered Residue	10451L Filtrable Residue	10551L Fixed Filtrable Residue	06001L Total Organic Carbon
	µS/cm	µS/cm	$CaCO_3$					
SAMPLES	3	62	61	21	22	1	1	10
LOW	220	193	73.4	3	L1	212	177	2.0
HIGH	267	476	221.	865	810	212	177	30.0
AVERAGE	249	296	136.	223	199	--	--	13.9
STD.DEV	25	82	38.	307	280	--	--	7.7

	06051LS Total Inorganic Carbon	06201L Bicarbont. (CALCD.)	06301L Carbonate (CALCD.)	06401L Free CO_2 (CALCD.)	06531P Phenolic Material	06711L Chlorophyll A	08401L Oxygen Consumed
SAMPLES	10	55	55	60	2	2	5
LOW	16.0	78	0	0.8	L.002	L.001	3.4
HIGH	35.0	228	0	7.0	0.017	0.012	12.1
AVERAGE	22.1	141	0	2.2	0.009	0.006	6.0
STD.DEV	6.5	39	0	1.4	0.011	0.008	3.6

[a]All results except pH expressed in mg/L unless otherwise indicated.

continued...

Table 3. Continued.

	07602L Total Nitrogen	07001L Total Kjeldahl Nitrogen	07105L Dissolved Nitrogen NO_3 & NO_2	07551L Dissolved Ammonia Nitrogen	05105L Dissolved Boron	09105L Dissolved Fluoride	11103L Dissolved Sodium	11201L Sodium Absorption Ratio
								Rel. Units
SAMPLES	1	1	55.	12	2	25	61	61
LOW	0.63	0.6	L.005	L.1	0.03	0.06	3.6	0.15
HIGH	0.63	0.6	0.371	0.4	0.08	0.23	20.8	0.98
AVERAGE	--	--	0.073	0.2	0.06	0.11	9.8	0.36
STD.DEV	--	--	0.069	0.1	0.04	0.04	4.8	0.16
BACKUP CODES	--	--	06L	--	--	04L	--	--

	12102L Dissolved Magnesium	13302P Extrble. Aluminum	14101L Reactive Silica	15255L Phosphorous Dissolved Ortho PO_4	15313L Phosphorous Total Inorg. PO_4	15363L Phosphorous Dissolved Inorg. PO_4	15413L Phosphorous Total Phosphate	16303L Dissolved Sulphate
SAMPLES	13	2	62	16	7	10	6	51
LOW	4.3	0.20	0.3	L.002	L.002	0.002	0.010	8.8
HIGH	15.0	0.46	8.0	0.050	0.023	0.035	0.033	55.6
AVERAGE	9.3	0.33	4.9	0.013	0.011	0.012	0.021	30.2
STD.DEV	2.9	0.18	1.4	0.015	0.008	0.010	0.008	11.5
BACKUP CODES	01L	--	02L	57L 59L	14L	64L	--	--

	17203L Dissolved Chloride	19103L Dissolved Potassium	20101L Dissolved Calcium	24052L Dissolved Chromium	24302P Extrble. Chromium	25101L Dissolved Manganese	25304L Extrble. Manganese	25304P Extrble. Manganese
SAMPLES	61	60	60	1	2	16	3	2
LOW	0.6	0.6	21.2	L.004	L.010	L.010	L.01	0.04
HIGH	40.5	4.0	67.2	L.004	L.010	0.01	L.01	0.05
AVERAGE	4.6	1.4	40.5	--	--	0.01	--	0.05
STD.DEV	6.2	0.6	11.2	--	--	0.0	--	0.01
BACKUP CODES	--	--	--	--	--	04L	--	--

	26102L Dissolved Iron	26302P Extrble. Iron	27302P Extrble. Cobalt	28101L Dissolved Nickel	28302P Extrble. Nickel	29105L Dissolved Copper	29305L Extrble. Copper	29305P Extrble. Copper
SAMPLES	19	2	2	1	2	13	6	2
LOW	L.001	0.82	0.003	L.00	L.001	L.001	L.01	0.002
HIGH	0.340	1.40	0.005	L.00	0.007	L.01	0.01	0.003
AVERAGE	0.094	1.11	0.004	--	0.004	0.01	0.01	0.003
STD.DEV	0.094	0.41	0.001	--	0.004	0.00	0.00	0.001
BACKUP CODES	04L	04L	--	--	--	06L	06L	--

continued...

Table 3. Concluded.

	30105L Dissolved Zinc	30305L Extrble. Zinc	30305P Extrble. Zinc	38101L Dissolved Strontium	38301P Extrble. Strontium	42301P Extrble. Molybdenum	47302P Extrble. Silver	48102L Dissolved Cadmium
SAMPLES	13	6	2	1	2	2	2	1
LOW	L.001	L.01	0.003	0.20	0.19	L.05	L.01	L.001
HIGH	0.011	L.01	0.013	0.20	0.19	L.05	L.01	L.001
AVERAGE	0.007	--	0.008	--	0.19	--	--	--
STD.DEV	0.004	--	0.007	--	0.00	--	--	--
BACKUP CODES	04L	04L	--	--	01L	--	01P	01L

	48302P Extrble. Cadmium	56301P Extrble. Barium	80311P Extrble. Mercury	81101L Dissolved Thallium	82103L Dissolved Lead	82301L Extrble. Lead	82302P Extrble. Lead	92101L Dissolved Uranium
SAMPLES	2	2	2	1	13	6	2	1
LOW	L.001	L.1	L.05	L.0	L.001	L.01	L.001	0.0004
HIGH	L.001	L.1	L.05	L.0	L.05	L.01	0.005	0.0004
AVERAGE	--	--	--	--	0.02	--	0.003	--
STD.DEV	--	--	--	--	0.02	--	0.003	--
BACKUP CODES	--	--	--	--	01L	--	--	--

	18160L Aroclor 1254 (PCB'S)	18161L Aroclor 1248 (PCB'S)	18162L Aroclor 1260 (PCB'S)	18163L Aroclor 1016 (PCB'S)
	µg/L	µg/L	µg/L	µg/L
SAMPLES	2	2	2	1
LOW	L.024	L.032	L.055	L.003
HIGH	L.024	L.032	L.055	L.003
AVERAGE	--	--	--	--
STD.DEV	--	--	--	--

Table 4. Detailed surface water quality data, Alberta 1974-1976 (Publ. 1980, Inland Waters Directorate, Western and Northern Region, Water Quality Branch, Calgary)

The report contains detailed chemical, physical, and biological data from short-term special studies, surveys, or long-term monitoring of selected surface waters in Alberta during the period of 1974 to 1976. Among the stations monitored were the Athabasca River at Fort McMurray and at Fort MacKay, and the Clearwater River above Fort McMurray and at Upper Wingdam.

Location: Athabasca River, Fort McMurray, Station 00AL07DA0001[ab] (Lat. 56D 46M 54S, Long. 111D 24M 9S, UTM 12 475400E 6292900N)

SAMPLE DATE D	M	Y	MST HR	SUBM ID	02061S Water Temp. °C	02041S Specific Conduct. USIE/cm	02041L Specific Conduct. USIE/cm	10301S pH	10301L pH	02073L Turbidity JTU	02011L Apparent Colour REL. UNITS	10401L Nonfiltered Residue
18	02	74	1200	0001	.0	--	405.	--	7.6	15.0	45.	17.
18	03	74	1200	0001	.0	--	374.	--	7.7	89.0	60.	294.
15	04	74	1200	0001	--	--	370.	--	7.8	13.0	50.	16.
04	06	74	1520	0003	17.0	247.	237.	8.2	7.9	42.0	--	--
08	08	74	0705	0003	19.0	180.	197.	--	8.1	29.0	30.	--
17	10	74	0715	0003	5.0	--	277.	8.4	8.1	23.	35.	--
22	01	75	1500	0003	.0	--	363.	7.8	7.6	3.7	L5.	--
19	06	75	0630	0003	15.	--	237.	7.9	7.9	22.	50.	--
21	08	75	0805	0003	17.	--	224.	8.2	8.2	16.	20.	--
09	02	76	1525	0003	0.	--	393.	7.2	7.5	6.2	10.	--
27	08	76	1800	0003	15.0	--	206.	--	8.0	91.	80.	13.
21	11	76	1000	0003	1.	340.	329.	8.2	8.1	6.0	30.	4.

SAMPLE DATE D	M	Y	MST HR	SUBM ID	10501L Fixed Nonfiltered Residue	06201L Bicarbont. (CALCD.)	10151L Alkalinity Phenol Phthalein $CaCO_3$	10101L Total Alkalinity $CaCO_3$	20103L Dissolved Calcium	12102L Dissolved Magnesium	12101L Dissolved Magnesium (CALCD.)	10603L Total Hardness
18	02	74	1200	0001	13.	188.	0.	154.	48.0 011	--	12.7	172.
18	03	74	1200	0001	219.	173.	0.	142.	44.0 011	--	13.6	166.
15	04	74	1200	0001	7.	168.	0.	138.	45.0 011	--	10.6	156.
04	06	74	1520	0003	--	135.	.0	111.	32.0 011	--	7.8	112.
08	08	74	0705	0003	--	110.	0.	90.0	30.0 011	--	6.6	102.
17	10	74	0715	0003	--	138.	.0	113.	39. 011	--	7.4	128.
22	01	75	1500	0003	--	195.	.0	160.	54. 011	--	13.4	190.
19	06	75	0630	0003	--	122.	.0	99.9	31.6	8.6	--	--
21	08	75	0805	0003	--	117.	.0	96.0	31.3	8.4	8.5	113. 06L
09	02	76	1525	0003	--	180.	.0	148.	50.0	14.2	--	--
27	08	76	1800	0003	4.	--	--	89.0	28.2	9.0	--	--
21	11	76	1000	0003	3.	166.	.0	136.	43.1	12.2	--	--

[a] For a description of procedures used refer to: Analytical Methods Manual, Inland Waters Directorate, Water Quality Branch, Ottawa, Canada 1974.
[b] All results except pH expressed in mg/L unless otherwise indicated.

continued...

Table 4. Continued.

SAMPLE DATE MST				SUBM	10602L Total Hardness (CALCD.)	11103L Dissolved Sodium	19103L Dissolved Potassium	17206L Dissolved Chloride	09105L Dissolved Fluoride	16306L Dissolved Sulphate	14102L Reactive Silica	00201L Total Dissolved Solids (CALCD.)
D	M	Y	HR	ID	$CaCO_3$							
18	02	74	1200	0001	--	18.0	1.8	6.3 03L	--	35.0 04L	6.6	221.
18	03	74	1200	0001	--	13.0	1.8	4.8	--	36.0 04L	--	--
15	04	74	1200	0001	--	15.0	1.9	5.4	--	39.0 04L	--	--
04	06	74	1520	0003	--	6.7	1.6	1.6	.1	16.0 04L	4.8	137.
08	08	74	0705	0003	--	5.2	.9	2.6	.1	18.	3.5	121.
17	10	74	0715	0003	--	8.4	1.3	2.5	.1	28.	3.6	158.
22	01	75	1500	0003	--	14.	2.5	6.4	.2	36.	5.9	228.
19	06	75	0630	0003	114.3	7.7	1.2	2.2	.1	23.	3.0	137.
21	08	75	0805	0003	112.7	6.1	1.1	1.9	.1	22.	3.7	132.
09	02	76	1525	0003	183.3	14.5	2.0	8.0	L.1	44.	5.6	227.
27	08	76	1800	0003	107.5	6.4	.8	1.0	.1	18.	9.0	126.
21	11	76	1000	0003	157.8	11.5	1.7	4.0	.1	29.	4.8	188.

SAMPLE DATE MST				SUBM	06051L Total Inorganic Carbon	06001L Total Organic Carbon	15406L Total Phosphorous	07002L Total Kjeldahl Nitrogen	07106L Dissolved Nitrogen NO_3 & NO_2	07602L Total Nitrogen (CALCD.)	06604P Dissolved Cyanide	06532P Phenolic Material
D	M	Y	HR	ID								
04	06	74	1520	0003	20.0	15.0	.083 13L	.8	.020	.82	--	.004
08	08	74	0705	0003	19.0	10.0	.047	.3	L.01	Q.31	--	.002
17	10	74	0715	0003	23.	12.	.036	.5	.01	.51	--	L.002
22	01	75	1500	0003	34.	9.	.016	1.3	.14	1.44	.006	.005
19	06	75	0630	0003	18.	15.	.074	.4	L.01	Q.41	L.005	.009
21	08	75	0805	0003	18.	10.	.063	.4	L.01	Q.41	.006	L.005
09	02	76	1525	0003	28.	10.	.02	.3	.19	.49	.005	.010
27	08	76	1800	0003	19.	23.	1.3	--	.035	--	L.005	L.001 35P
21	11	76	1000	0003	33.	12.	.012	--	.02 10L	--	L.005	.002 35P

MST				SUBM	04301P Extrble. Beryllium	05105L Dissolved Boron	13305P Extrble. Aluminum	23302P Extrble. Vanadium	24302P Extrble. Chromium	25304P Extrble. Manganese	26304P Extrble. Iron	27312P Extrble. Cobalt
D	M	Y	HR	ID								
04	06	74	1520	0003	--	.08	.65 02P	--	L.010	.06	1.70	.005
08	08	74	0705	0003	--	.07	.25 02P	--	L.010	.06	.77	L.001
17	10	74	0715	0003	--	.06	.098	--	L.015	.03	.37	.002
22	01	75	1500	0003	--	.08	.041	--	L.015	.02	.34	L.002
19	06	75	0630	0003	--	.08	.22	.002	L.015	.07	.71	L.002
21	08	75	0805	0003	--	.08	.17	L.001	L.015	.05	.68	L.002
09	02	76	1525	0003	--	.10	.066	L.001	L.015	.02	.27	L.002
27	08	76	1800	0003	L.01	.12	1.5 02P	.003	L.015	.10	4.7	.004
21	11	76	1000	0003	L.01	.07	.031	L.001	--	.01	.31	L.002

continued...

Table 4. Concluded.

SAMPLE DATE D	M	Y	MST HR	SUBM ID	28302P Extrble. Nickel	29305P Extrble. Copper	30305P Extrble. Zinc	33104L Dissolved Arsenic	34102L Dissolved Selenium	38301P Extrble. Strontium	42301P Extrble. Molybdenum	47321P Extrble. Silver
04	06	74	1520	0003	.005	.001	.006	L.0005	--	.19	L.05	L.0
08	08	74	0705	0003	L.001	.002	.005	.0056	.0028	.44	L.05	--
17	10	74	0715	0003	.004	L.001	.002	.0006	L.0005	.20	L.10	--
22	01	75	1500	0003	.007	.006	.024	.0008	L.0005	.33	L.10 02P	--
19	06	75	0630	0003	.002	.004	.001	L.0005	L.0005	.20	L.10	--
21	08	75	0805	0003	L.002	.004	.001	L.0005	L.0005	.20	L.10	--
09	02	76	1525	0003	L.002	.007	.020	.0005	L.0005	.37	L.10	--
27	08	76	1800	0003	.009	.007	.018	.0009	L.0005	.20	--	--
21	11	76	1000	0003	.002	L.001	.002	L.0005	L.0005	.29	--	--

SAMPLE DATE D	M	Y	MST HR		48302P Extrble. Cadmium	56301P Extrble. Barium	80311P Extrble. Mercury	82302P Extrble. Lead	08101P Dissolved Oxygen	06711L Chlorophyll A
04	06	74	1520	0003	L.001	L.1	L.05	L.001	7.8	0.009
08	08	74	0705	0003	L.001	L.1	L.05	L.001	10.8	L.001
17	10	74	0715	0003	L.001	.05	L.05	L.004	11.3	.024
22	01	75	1500	0003	L.001	.09	L.05	.004	12.9	.023
19	06	75	0630	0003	L.001	L.05	L.05	L.004	9.9	.005
21	08	75	0805	0003	L.001	L.05	L.05	L.004	10.0	.009
09	02	76	1525	0003	L.001	.06	L.05	L.004	12.3	L.005
27	08	76	1800	0003	L.001	.10	L.05	.006	9.6	--
21	11	76	1000	0003	L.001	.06	--	L.004	10.8	--

Table 5. Water sample analysis: water treatment plant, Fort McMurray, January to October 1979 (Pollution Control Laboratory, Pollution Control Division, Alberta Environment).

These are monthly laboratory results neither published nor put in report form. One of the samples was obtained from the Athabasca River, Fort McMurray and another from the Syne River Basin, Fort McMurray.

Location: Athabasca River, Fort McMurray[a]

Date	17-09-79	
Parameter	Code[b]	
pH	10301L	7.3
Iron	26304L	1.23
Calcium	20105L	21
Hardness as $CaCO_3$	10604L	77
Potassium	19103L	0.8
Nitrate + Nitrite	07105L	L 0.05
Fluoride	09107L	0.13
Sulfate	16306L	17
Alkalinity as $CaCO_3$	10101L	85
Conductivity	02041L	189
Total Dissolved Solids	00205L	109
Magnesium	12303L	6
Sodium	11103L	11
Silica	14102L	6.2
Nitrite	07205L	L 0.05
Chloride	17203I	2
Bicarbonate	06201L	104

[a]All results except pH and conductivity (µmho/cm) expressed in mg/L.

[b]For description of procedures used refer to: Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 6. Monthly analysis of Athabasca River water sampled at and near Fort McMurray, Alberta (K.A. Clark, Alberta Research Council).

Athabasca River water samples were collected on a once-a-month basis for an entire year, September 1957 to September 1958, in response to requests from parties interested in the development of the tar sands (1 of 4 sites).

Location: Athabasca River, 2 mi downstream of Fort McMurray[a]

Date(m-yr)	05-58	07-58	07-58[b]	08-58	09-58
Total Solids	250	2260	282	181	191
Suspended Solids	77	2048	117	24	36
Organic Carbon	24	74	16	16	14
Calcium Carbonate	82	64	81	72	74
Magnesium Carbonate	11	17	16	11	9
Magnesium Sulfate	29	21	27	26	18
Sodium Chloride	7	5	3	Trace	16
Iron	0.7	2.6	0.2	1.0	-
Sodium Sulfate	7	Trace	Trace	9	12
Silica	10	29	23	15	-
Color	50	120	20	18	100
pH	8.1	7.8	7.8	7.8	8.5

[a]Units were not given in this report.

[b]Sample taken after a 4 ft rise in river level.

Table 7. Monthly analysis of Athabasca River water sampled at and near Fort McMurray, Alberta (K.A. Clark, Alberta Research Council).

Athabasca River water samples were collected on a once-a-month basis for an entire year, September 1957 to September 1958, in response to requests from parties interested in the development of the tar sands (1 of 5 sites).

Location: Athabasca River, 4 mi downstream of Fort McMurray[a]

Date (m-yr)	05-58
Total Solids	459
Suspended Solids	322
Turbidity	37
Organic Carbon	65
Calcium Carbonate	25
Magnesium Carbonate	22
Magnesium Sulfate	-
Magnesium Chloride	-
Sodium Chloride	13
Iron	0.4
Sodium Sulfate	-
Silica	11.4
Color	300
pH	7.8

[a]Units were not given in this report.

Table 8. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd.; Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates and periphyton. Water quality data were collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.)

Location: Athabasca River, Station 1[a]

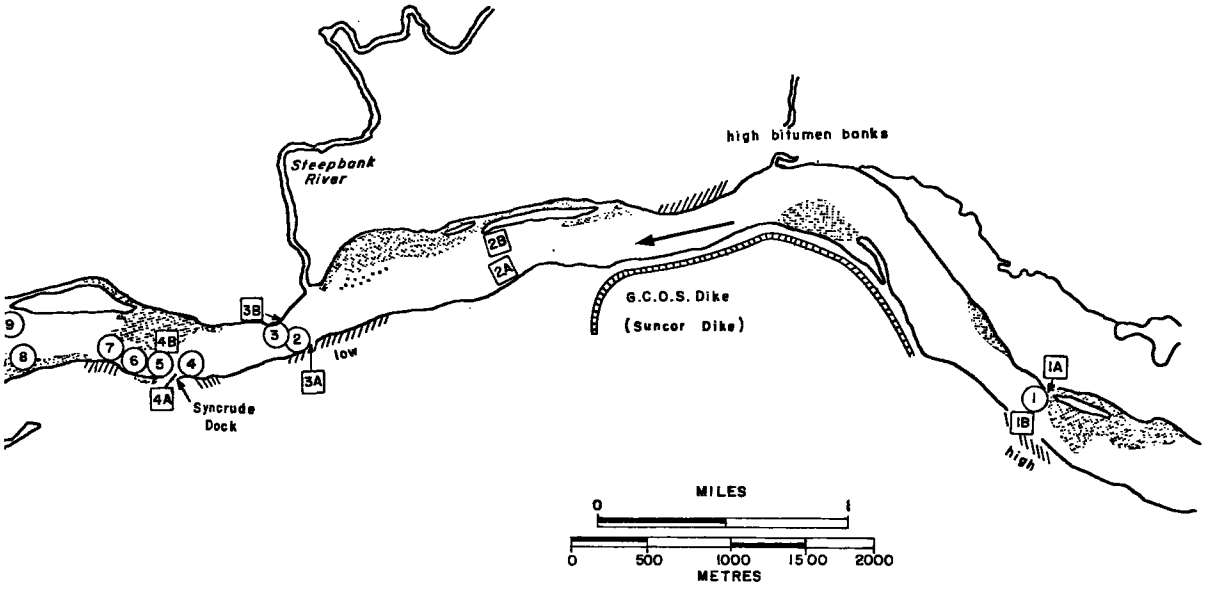
Date	03-09-74	25-10-74	14-12-74	17-01-75	22-02-75	20-03-75
Temperature °C	15.0	4.0	0.0	0.0	0.0	0.0
Conductivity µmho /cm	180	145	235	318	330	340
pH	8.3	-	8.0	-	7.7	7.9
Turbidity JTU						
shaken	15.0	7.4	4.6	5.5	3.9	3.5
settled	1.5	1.6	-	-	2.0	2.1
Suspended Solids	26.4	18.4	3.0	4.5	29.6	4.8
Dissolved Oxygen	14.0	12.0	-	12.7	11.8	11.9
Calcium	-	-	22.0	-	30.0	-
Magnesium	-	-	6.6	-	8.4	-
Sodium	-	-	24.5	-	29.2	-
Potassium	-	-	1.6	-	1.6	-
Chloride	1.5	-	36.0	45.0	45.0	44.0
Sulfate	-	-	12.9	7.2	15.1	-
Bicarbonate	99.0	-	77.0	-	88.0	86.0
Total Dissolved Nitrogen	0.303	-	-	-	-	-
Total Dissolved Phosphorus	0.003	-	0.020	0.011	0.015	0.025
Reactive Silica	1.450	-	5.125	4.300	1.650	5.530

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued ...

Table 8. Concluded.

Date	09-04-75	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	0.0	17.2	17.5	18.0	15.0	14.0	0.5
Conductivity µmho /cm	320	215	200	160	170	200	210
pH	7.3	8.0	7.6	7.8	7.6	7.9	8.0
Turbidity JTU							
shaken	6.1	27.0	31.0	37.0	21.0	7.0	9.2
settled	2.6	8.0	6.1	8.6	4.2	2.8	2.8
Suspended Solids	6.4	122.0	163.0	82.0	45.2	9.5	15.5
Dissolved Oxygen	12.6	9.1	8.5	7.5	9.2	10.0	13.6
Calcium	-	-	-	20.4	-	-	28.5
Magnesium	-	-	-	5.2	-	-	8.3
Sodium	-	-	-	9.8	-	-	10.5
Potassium	-	-	-	0.8	-	-	1.3
Chloride	44.0	10.3	12.0	22.8	9.8	12.8	4.5
Sulfate	-	-	-	3.8	-	-	25.0
Bicarbonate	89.0	59.0	71.0	62.0	65.0	72.0	98.0
Total Dissolved Nitrogen	-	-	-	0.450	0.395	0.420	0.390
Total Dissolved Phosphorus	0.025	0.040	0.055	0.066	0.071	0.030	0.031
Reactive Silica	4.990	2.060	2.346	3.144	3.906	3.645	3.180


N
LEGEND
SAND AND MUD
GRAVEL
ROCK
6 PERMANENT WATER CHEMISTRY, PERIPYTHON, AND BENTHIC MACROINVERTEBRATE SAMPLING SITES.
1A WATER QUALITY SITES SAMPLED 22 FEB. 1975
Steepbank River
high bitumen banks
G.C.O.S. Dike
(Suncor Dike)
Syncrude Dock
low
high
MILES
0
1
0 500 1000 1500 2000
METRES

iver
sites.

Table 25. Concluded.

Date		30-09-69	29-11-69	07-01-70	09-03-70	12-04-70	11-05-70	30-05-70	30-06-70	07-07-70	31-08-70	28-09-70
Sodium + Potassium		10	20	24	19	16	12	13	9	Trace	17	9
Calcium		34	40	30	48	47	33	31	34	40	33	32
Magnesium		8	12	13	14	13	7	7	8	8	4	10
Sulfate		25	24	34	37	40	21	23	45	20	20	35
Chloride		3.4	21	14	20	11.7	7	8	4	3	6	3.6
Bicarbonate		133	170	204	184	100	130	120	105	133	130	122
Hardness		118	149	179	177	171	111	106	118	134	99	121
Total Solids:	Evap.	178	242	266	266	204	180	172	180	192	158	184
	Ign.	107	124	140	162	164	90	104	112	96	100	106
	Calc.	213	287	346	322	308	210	202	205	204	210	212
pH		7.6	7.7	8.5	7.8	8.2	7.9	8.1	8.0	7.4	7.7	8.2
Resistance		47.9	33.8	30.3	28.0	31.6	48.8	45.0	47.5	48.6	46.6	47.0
Phenol		L .001	L .001	L .001	0.001	0.001	0.065	L .001	0.002	L .005	L .005	0.002
Chemical Oxygen Demand		-	-	-	-	-	-	-	-	-	-	-
Biochemical Oxygen Demand		-	-	-	-	-	-	-	-	-	-	-
Oil		1.3	7.2	4.1	4.4	3.2	3.9	4.5	1.0	0.3	1.9	0.2
Total Odor Number		-	-	-	-	-	-	-	-	-	-	-
Suspended Solids:												
Dried		54.8	5.3	5.2	4.6	9.6	200.6	96.4	2110.0	135.2	76.2	52.0
Ign.		48.2	3.5	2.0	3.2	10.8	177.8	86.2	1884.0	126.6	70.2	43.6

Table 26. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.)

Location: Station 4[a]

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	17.0	17.0	20.0	15.0	13.0	0.5
Conductivity µmho /cm	210	220	200	220	220	210
pH	8.0	7.8	7.9	7.8	8.0	8.2
Turbidity JTU						
shaken	43.0	47.0	57.0	24.0	16.0	11.0
settled	13.0	11.0	17.0	3.4	3.6	2.3
Suspended Solids	205.0	205.5	117.6	62.4	29.8	18.0
Dissolved Oxygen	9.0	8.5	7.5	9.0	9.9	13.6
Calcium	-	-	26.0	-	-	29.4
Magnesium	-	-	6.1	-	-	8.3
Sodium	-	-	6.1	-	-	11.5
Potassium	-	-	1.2	-	-	1.4
Chloride	-	-	-	1.3	1.0	5.5
Sulfate	-	-	10.3	-	-	23.5
Bicarbonate	87.0	93.5	86.5	92.0	92.5	103.0
Total Dissolved Nitrogen	-	-	0.385	0.350	0.435	0.460
Total Dissolved Phosphorus	0.037	0.070	0.063	0.047	L 0.030	0.031
Reactive Silica	1.545	1.660	2.460	3.380	1.980	2.870

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 27. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.).

Location: Station 5[a]

Date	03-09-74	14-12-74	17-01-75	22-02-75	20-03-75	09-04-75
Temperature °C	15.0	0.0	0.0	0.0	0.0	1.0
Conductivity µmho /cm	185	305	380	380	350	330
pH	8.0	8.1	-	8.0	8.2	7.8
Turbidity JTU						
shaken	15.0	7.7	4.7	7.2	3.1	4.5
settled	1.6	-	-	2.7	1.9	2.0
Suspended Solids	27.2	1.8	3.3	7.6	4.3	4.2
Dissolved Oxygen	13.0	13.3	12.6	12.0	11.9	12.7
Calcium	-	40.5	-	42.0	-	-
Magnesium	-	12.1	-	12.5	-	-
Sodium	-	16.4	-	17.8	-	-
Potassium	-	2.6	-	2.12	-	-
Chloride	8.0	9.5	13.5	21.5	17.0	16.5
Sulfate	-	21.5	17.9	37.2	-	-
Bicarbonate	86.0	144.0	-	142.0	134.0	134.0
Total Dissolved Nitrogen	0.303	-	-	-	-	-
Total Dissolved Phosphorus	0.008	0.020	0.025	0.026	0.017	0.015
Reactive Silica	2.130	3.710	2.875	0.830	3.250	2.500

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued...

Table 27. Concluded.

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	16.5	17.0	20.0	15.0	13.0	0.5
Conductivity µmho /cm	210	220	200	220	220	210
pH	8.0	7.8	7.9	7.8	8.0	7.9
Turbidity JTU						
shaken	45.0	51.0	58.0	26.0	16.0	8.2
settled	13.0	8.6	16.0	3.5	3.3	2.7
Suspended Solids	151.0	217.0	124.8	61.2	34.0	14.6
Dissolved Oxygen	9.0	8.6	7.7	9.0	10.0	13.3
Calcium	-	-	31.2	-	-	26.8
Magnesium	-	-	5.0	-	-	7.8
Sodium	-	-	6.5	-	-	11.5
Potassium	-	-	1.1	-	-	1.4
Chloride	-	0.3	-	2.0	L 1.0	6.3
Sulfate	-	-	12.8	-	-	20.6
Bicarbonate	87.0	92.5	83.0	91.0	91.5	96.0
Total Dissolved Nitrogen	-	-	0.375	0.350	0.425	0.420
Total Dissolved Phosphorus	0.044	0.066	0.078	0.045	L 0.030	0.030
Reactive Silica	1.550	1.624	2.460	3.180	2.280	2.280

Table 28. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.).

Location: Station 6[a]

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	16.5	17.0	20.0	15.0	13.0	0.5
Conductivity µmho /cm	160	220	200	220	220	210
pH	8.0	7.9	7.8	8.0	8.0	7.7
Turbidity JTU						
shaken	38.0	48.0	52.0	30.0	13.0	9.0
settled	13.0	8.2	16.0	2.6	3.0	1.6
Suspended Solids	193.0	203.5	110.0	75.2	33.8	13.6
Dissolved Oxygen	9.1	8.5	7.7	9.1	10.0	13.5
Calcium	-	-	23.4	-	-	28.1
Magnesium	-	-	7.7	-	-	8.3
Sodium	-	-	4.5	-	-	11.0
Potassium	-	-	1.1	-	-	1.4
Chloride	-	0.3	-	1.5	L 1.0	5.5
Sulfate	-	-	10.3	-	-	25.4
Bicarbonate	87.5	93.0	83.0	91.0	90.5	97.0
Total Dissolved Nitrogen	-	-	0.380	0.370	0.425	0.425
Total Dissolved Phosphorus	0.043	0.068	0.066	0.049	L 0.030	L 0.030
Reactive Silica	1.548	1.860	2.520	3.320	1.530	2.810

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 29. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water qulaity data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23).

Location: Station 7[a]

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	16.5	17.0	20.0	15.0	13.0	0.5
Conductivity µmho /cm	165	220	200	220	220	210
pH	8.0	8.0	7.9	7.5	7.6	7.7
Turbidity JTU						
shaken	44.0	50.0	54.0	28.0	15.0	9.9
settled	12.0	9.2	16.0	4.0	3.2	3.0
Suspended Solids	152.0	129.0	115.2	70.4	32.3	16.9
Dissolved Oxygen	9.0	8.4	8.0	8.9	9.8	13.6
Calcium	-	-	26.2	-	-	27.8
Magnesium	-	-	7.6	-	-	8.3
Sodium	-	-	6.1	-	-	11.5
Potassium	-	-	1.1	-	-	1.4
Chloride	-	-	-	2.0	1.3	5.0
Sulfate	-	-	20.8	-	-	25.9
Bicarbonate	87.0	92.0	81.0	88.0	89.5	97.0
Total Dissolved Nitrogen	-	-	0.390	0.335	0.415	0.480
Total Dissolved Phosphorus	0.043	0.068	0.060	0.044	0.035	L 0.030
Reactive Silica	1.560	1.624	2.475	2.840	2.155	2.930

[a]All results except pH expressed as mg/L, unless otherwise indicated.

Table 30. Baseline studies of aquatic environmnets in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.).

Location: Station 8[a]

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	16.0	17.5	20.0	15.0	12.0	0.5
Conductivity µmho /cm	210	220	200	220	220	210
pH	7.8	7.7	7.8	7.9	8.0	7.7
Turbidity JTU						
shaken	47.0	44.0	54.0	24.0	16.0	8.8
settled	12.0	7.8	15.0	3.6	2.9	2.8
Suspended Solids	133.0	149.0	103.2	64.0	35.6	16.0
Dissolved Oxygen	9.0	8.5	7.9	9.2	9.9	13.2
Calcium	-	-	26.0	-	-	25.8
Magnesium	-	-	6.7	-	-	8.0
Sodium	-	-	6.1	-	-	11.5
Potassium	-	-	1.1	-	-	1.3
Chloride	-	0.8	-	2.0	1.5	9.0
Sulfate	-	-	23.2	-	-	18.2
Bicarbonate	85.0	94.0	84.0	90.0	89.5	93.0
Total Dissolved Nitrogen	-	-	0.375	0.400	0.465	0.380
Total Dissolved Phosphorus	0.045	0.078	0.073	0.054	0.050	0.031
Reactive Silica	1.580	1.608	2.472	3.180	2.493	3.050

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 31. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23).

Location: Station 9[a]

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	16.5	16.0	19.0	14.0	12.0	0.5
Conductivity µmho /cm	165	170	175	190	230	200
pH	8.0	7.4	7.6	7.9	7.8	7.7
Turbidity JTU						
shaken	20.0	33.0	3.9	42.0	14.0	8.9
settled	9.0	5.9	12.0	4.4	7.4	2.5
Suspended Solids	99.0	174.5	26.0	184.4	17.2	21.2
Dissolved Oxygen	9.3	8.6	7.7	8.8	9.9	13.6
Calcium	-	-	21.6	-	-	21.8
Magnesium	-	-	5.4	-	-	7.0
Sodium	-	-	7.9	-	-	12.0
Potassium	-	-	0.8	-	-	1.1
Chloride	6.8	4.0	4.3	6.3	7.0	9.8
Sulfate	-	-	11.2	-	-	16.3
Bicarbonate	63.0	70.0	67.0	70.0	96.0	80.0
Total Dissolved Nitrogen	-	-	0.421	0.455	0.485	0.415
Total Dissolved Phosphorus	0.038	0.081	0.089	0.090	0.030	L 0.030
Reactive Silica	1.780	2.080	2.955	3.330	3.720	2.700

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 32. Athabasca River water survey, 8 August 1968 (Alberta Department of Health, Environmental Health Services Division).

Samples of Athabasca River water were obtained at intervals between Tar Island and Fort MacKay on 8 August 1968. (1 of 5 sites).

Location: Athabasca River, 3 mi downstream of G.C.O.S.[a]

Date Time	08-08-68 1400
Depth in feet	10
Nonfilterable Residue	104
Ignition Loss	32
Phenolics	1
Oils and Greases	1.2

[a]All data except phenolics (µg/L) expressed in mg/L.

Table 33. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conduct ed surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.).

Location: Station 10[a]

Date	03-09-74	14-12-74	17-01-75	22-02-75	20-03-75	09-04-75
Temperature °C	16.0	0.0	0.0	0.0	0.0	1.0
Conductivity µmho /cm	200	360	375	380	420	340
pH	8.3	8.0	-	7.9	8.2	7.6
Turbidity JTU						
shaken	11.0	6.5	4.1	5.3	4.8	3.5
settled	1.5	0.0	0.0	2.1	2.0	2.1
Suspended Solids	16.8	3.2	2.4	7.4	6.6	3.9
Dissolved Oxygen	13.0	13.1	12.5	11.2	12.0	12.5
Calcium	-	42.0	-	42.5	-	-
Magnesium	-	12.1	-	11.9	-	-
Sodium	-	16.4	-	16.0	-	-
Potassium	-	2.4	-	2.3	-	-
Chloride	6.5	7.5	12.0	21.0	16.0	16.5
Sulfate	-	37.6	23.4	35.6	-	-
Bicarbonate	91.0	141.0	148.0	134.5	136.0	134.0
Total Dissolved Nitrogen	0.620	-	-	-	-	-
Total Dissolved Phosphorus	0.010	0.024	0.021	0.020	0.025	0.013
Reactive Silica	2.265	5.215	2.925	0.690	3.200	2.465

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued ...

Table 33. Concluded.

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	17.0	17.0	20.0	15.0	12.0	0.5
Conductivity µmho /cm	210	220	200	230	210	200
pH	8.0	7.7	7.8	7.8	7.9	7.5
Turbidity JTU						
shaken	53.0	46.0	57.0	22.0	15.0	7.7
settled	13.0	7.8	15.0	3.8	3.8	3.1
Suspended Solids	146.0	299.0	121.2	54.8	32.4	14.0
Dissolved Oxygen	9.1	8.2	8.0	9.0	10.0	13.9
Calcium	-	-	30.4	-	-	25.0
Magnesium	-	-	7.6	-	-	7.8
Sodium	-	-	5.7	-	-	11.0
Potassium	-	-	1.3	-	-	1.3
Chloride	-	-	-	2.0	1.0	7.0
Sulfate	-	-	18.4	-	-	21.1
Bicarbonate	88.0	93.0	84.0	92.0	90.0	88.5
Total Dissolved Nitrogen	-	-	0.430	0.345	0.470	0.435
Total Dissolved Phosphorus	0.045	0.077	0.085	0.052	0.030	L 0.030
Reactive Silica	1.552	1.608	2.430	2.800	1.896	2.120

Table 34. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23).

Location: Station 11[a]

Date	03-09-74	25-10-74	14-12-74	17-01-75	22-02-75	20-03-75
Temperature °C	14.0	5.0	0.0	0.0	0.0	0.0
Conductivity µmho /cm	185	160	360	345	360	270
pH	8.1	-	7.8	-	7.9	8.2
Turbidity JTU						
shaken	16.0	8.7	7.0	4.5	4.4	3.6
settled	1.5	1.5	-	-	1.9	1.7
Suspended Solids	33.6	23.6	3.6	3.1	5.9	2.8
Dissolved Oxygen	14.0	12.0	12.7	12.4	11.3	11.8
Calcium	-	-	42.0	-	-	-
Magnesium	-	-	12.1	-	-	-
Sodium	-	-	11.6	-	-	-
Potassium	-	-	2.6	-	-	-
Chloride	5.0	-	8.0	12.5	21.0	17.0
Sulfate	-	-	40.0	35.6	34.4	-
Bicarbonate	90.0	-	140.0	145.0	130.0	135.0
Total Dissolved Nitrogen	0.330	-	-	-	-	-
Total Dissolved Phosphorus	0.011	-	0.04	0.046	0.033	0.025
Reactive Silica	2.109	-	3.240	3.000	0.553	3.105

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued ...

Table 34. Concluded.

Date	09-04-75	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	0.5	16.2	17.5	20.0	15.0	12.0	0.5
Cunductivity µmho /cm	360	210	220	200	230	210	210
pH	7.1	8.0	8.0	8.0	7.4	7.7	7.6
Turbidity JTU							
shaken	4.8	48.0	46.0	52.0	24.0	15.0	7.8
settled	2.4	12.0	7.6	14.0	3.3	3.8	2.7
Suspended Solids	10.5	86.0	284.0	112.0	80.4	32.8	20.5
Dissolved Oxygen	12.3	9.0	8.3	7.8	8.9	9.8	14.0
Calcium	-	-	-	31.0	-	-	25.8
Magnesium	-	-	-	6.5	-	-	7.8
Sodium	-	-	-	5.2	-	-	11.0
Potassium	-	-	-	1.1	-	-	1.3
Chloride	15.0	-	-	-	1.5	1.5	6.8
Sulfate	-	-	-	17.6	-	-	20.2
Bicarbonate	133.0	84.0	92.0	83.0	90.0	87.5	92.0
Total Dissolved Nitrogen	-	-	-	0.360	0.350	0.435	0.405
Total Dissolved Phosphorus	0.010	0.052	0.077	0.066	0.042	0.040	L 0.030
Reactive Silica	2.375	1.587	1.608	2.472	2.980	1.800	2.420

Table 35. Athabasca River water survey, 8 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Samples of river water were obtained at intermediate locations from upstream of the G.C.O.S. plant at Tar Island to Fort MacKay, as part of a compatability study of G.C.O.S. wastewater effluent and the Athabasca River (1 of 5 sites).

Location: Athabasca River, 5 mi downstream of G.C.O.S.[a]

Date Time	08-07-68 1215	08-07-68 1215	08-07-68 1215
Depth in feet	Surface	10	20
Threshold Odor Number Type	4[b] M	8[c] CH	4 CH
Nonfilterable Residue Ignition Loss	188 46	92 38	540 115
Phenolics	-	-	-
Oils and Greases	11.9	7.1	2.9

[a]All data except phenolics (µg/L) expressed in mg/L.

[b]Musty

[c]Chemical, not objectionable

Table 36. Athabasca River water survey, 29 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Water samples of the Athabasca River were obtained at 5 mi intervals between Tar Island and Fort MacKay, to derive an explanation for the excessive oil concentrations observed at Fort MacKay on 8 July 1968 (1 of 5 sites).

Location: Athabasca River, 5 mi downstream of G.C.O.S.[a]

Date Time	29-07-68 1400	29-07-68 1400	29-07-68 1400
Depth in feet	Surface	10	30
Nonfilterable Residue	-	92	-
Ignition Loss	-	17	-
Phenolics	3	13	5
Oils and Greases	0.1	0.6	0.1

[a]All data except phenolics (µg/L) expressed in mg/L.

Table 37. Water quality study: Athabasca River, 1966 (Bryant F. Bidgood, Fish and Wildlife Division).

Samples of Athabasca River water were obtained at five locations above and below the G.C.O.S. plant site at Tar Island, Alberta (1 of 5 sites).

Location: Athabasca River, 6 mi downstream of G.C.O.S. effluent outflow

Date - not given	
Total Solids	176
Ignition Loss	114
Hardness	105
Sulfates	6
Alkalinity	90
Iron	-
pH	7.6
Water Temp. °C	13.0
Dissolved Oxygen	10.0

[a]All data except pH and water temperature (°C) expressed in mg/L.

Table 38. Athabasca River water survey, 8 August 1968 (Alberta Department of Health, Environmental Health Services Division).

Samples of Athabasca River water were obtained at intervals between Tar Island and Fort MacKay on 8 August 1968 (1 of 5 sites).

Location: Athabasca River, 6 mi downstream of G.C.O.S.[a]

Date Time	08-08-68 1430
Depth in feet	10
Nonfilterable Residue	98
Ignition Loss	30
Phenolics	1
Oils and Greases	2.3

[a]All data except phenolics (µg/L) expressed in mg/L.

Table 39. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23).

Location: Station 12[a]

Date	14-12-74	17-01-75	22-02-75	20-03-75	09-04-75	02-06-75
Temperature °C	0.0	0.0	0.0	0.0	0.0	16.0
Conductivity µmho /cm	350	380	380	400	395	215
pH	8.0	-	7.7	8.2	7.3	8.0
Turbidity JTU						
shaken	8.2	4.6	4.0	3.5	3.9	44.0
settled	0.0	0.0	1.9	1.8	2.2	13.0
Suspended Solids	5.6	2.5	5.3	2.8	3.1	71.0
Dissolved Oxygen	13.0	12.3	11.4	11.9	12.0	9.0
Calcium	30.0	-	45.0	-	-	-
Magnesium	9.0	-	11.8	-	-	-
Sodium	36.5	-	16.7	-	-	-
Potassium	2.4	-	2.5	-	-	-
Chloride	8.0	18.0	21.0	16.5	25.5	-
Sulfate	34.4	22.4	31.6	-	-	-
Bicarbonate	135.0	149.0	133.0	131.0	141.0	85.5
Total Dissolved Nitrogen	-	-	-	-	0.286	-
Total Dissolved Phosphorus	0.015	0.014	-	0.025	0.013	0.049
Reactive Silica	3.510	3.230	0.597	2.985	2.350	1.594

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued ...

Table 39. Concluded.

Date	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	17.5	20.0	15.0	12.0	0.5
Conductivity µmho /cm	220	200	210	220	210
pH	8.0	7.8	8.0	7.8	7.9
Turbidity JTU					
shaken	55.0	56.0	27.0	15.0	7.8
settled	7.9	14.0	3.5	3.2	2.8
Suspended Solids	256.5	106.8	61.6	31.2	25.3
Dissolved Oxygen	8.3	7.6	8.9	9.9	13.9
Calcium	-	29.6	-	-	29.4
Magnesium	-	6.0	-	-	8.8
Sodium	-	5.7	-	-	11.5
Potassium	-	1.1	-	-	1.4
Chloride	0.5	-	1.8	2.3	7.5
Sulfate	-	18.4	-	-	26.9
Bicarbonate	92.0	83.0	90.5	88.0	98.5
Total Dissolved Nitrogen	-	0.400	0.340	0.465	0.405
Total Dissolved Phosphorus	0.078	0.078	0.037	0.113	0.058
Reactive Silica	1.650	2.460	3.180	2.748	2.440

Table 40. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure, 3, page 23.)

Location: Station 13[a]

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	16.0	16.5	20.0	13.0	11.0	0.5
Conductivity µmho /cm	220	240	260	430	340	260
pH	8.0	7.7	7.7	7.8	8.1	7.9
Turbidity JTU						
shaken	39.0	48.0	34.0	16.0	13.0	9.1
settled	11.0	14.0	14.0	4.6	5.0	2.6
Suspended Solids	75.2	200.0	78.4	102.8	20.8	36.8
Dissolved Oxygen	9.1	7.9	7.8	9.0	9.9	13.7
Calcium	-	-	29.4	-	-	28.8
Magnesium	-	-	11.1	-	-	8.8
Sodium	-	-	15.7	-	-	18.5
Potassium	-	-	1.4	-	-	1.4
Chloride	0.3	-	9.8	33.5	26.3	14.8
Sulfate	-	-	19.2	-	-	27.4
Bicarbonate	91.0	114.0	109.0	152.0	128.0	101.0
Total Dissolved Nitrogen	-	-	0.597	0.580	0.660	0.465
Total Dissolved Phosphorus	0.049	0.104	0.079	0.048	0.057	0.039
Reactive Silica	1.540	3.356	2.865	3.480	2.736	2.420

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 41. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.)

Location: Station 14[a]

Date	14-12-74	17-01-75	22-02-75	20-03-75	02-06-75	28-06-75
Temperature °C	0.0	0.0	0.0	0.0	16.0	17.5
Conductivity µmho /cm	335	340	365	390	210	220
pH	-	-	7.4	8.2	7.8	7.7
Turbidity JTU						
shaken	6.8	4.6	4.5	4.2	45.0	49.0
settled	0.0	0.0	2.1	2.1	12.0	9.5
Suspended Solids	2.8	3.7	8.8	3.2	88.0	216.5
Dissolved Oxygen	13.1	12.5	11.5	11.7	8.9	8.2
Calcium	-	-	44.0	-	-	-
Magnesium	-	-	12.2	-	-	-
Sodium	-	-	19.5	-	-	-
Potassium	-	-	2.6	-	-	-
Chloride	11.0	12.5	22.5	21.5	1.0	3.0
Sulfate	31.6	9.6	34.4	-	-	-
Bicarbonate	134.0	144.0	135.0	137.0	87.0	99.0
Total Dissolved Nitrogen	-	-	-	-	-	-
Total Dissolved Phosphorus	-	0.013	-	0.026	0.051	0.088
Reactive Silica	3.500	2.946	0.546	3.845	1.570	1.700

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued...

Table 41. Concluded.

Date	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	20.0	15.0	12.0	0.5
Conductivity µmho /cm	290	240	220	210
pH	7.8	7.9	7.8	7.8
Turbidity JTU				
shaken	56.0	39.0	20.0	11.0
settled	13.0	4.2	2.4	3.3
Suspended Solids	124.8	34.4	63.6	26.8
Dissolved Oxygen	7.8	8.9	9.5	13.8
Calcium	29.4	-	-	25.6
Magnesium	8.7	-	-	8.0
Sodium	5.3	-	-	12.5
Potassium	1.1	-	-	1.4
Chloride	-	3.8	5.0	8.0
Sulfate	20.7	-	-	25.9
Bicarbonate	83.0	93.0	87.0	88.0
Total Dissolved Nitrogen	0.422	0.385	0.515	0.495
Total Dissolved Phosphorus	0.104	0.071	0.061	L 0.030
Reactive Silica	2.415	3.300	2.310	2.200

Table 42. Athabasca River water survey, 8 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Samples of river water were obtained at intermediate locations from upstream of the G.C.O.S. plant at Tar Island to Fort MacKay, as part of a compatability study of G.C.O.S. wastewater effluent and the Athabasca River (1 of 5 sites).

Location : Athabasca River, 10 mi downstream of G.C.O.S.[a]

Date	08-07-68
Time	1230
Depth in feet	10
Threshold Odor Number	4
Type	M[b]
Nonfilterable Residue	186
Ignition Loss	42
Phenolics	-
Oils and Greases	0.2

[a]All data except phenolics (µg/L) expressed in mg/L.

[b]Musty

Table 43. Athabasca River water survey, 29 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Water samples of the Athabasca River were obtained at 5 mi intervals between Tar Island and Fort MacKay, to derive an explanation for the excessive oil concentrations observed at Fort MacKay on 8 July 1968 (1 of 5 sites).

Location: Athabasca River, 10 mi downstream of G.C.O.S.[a]

Date Time	29-07-68 1415
Depth in feet	10
Nonfilterable Residue	-
Ignition Loss	-
Phenolics	7
Oils and Greases	-

[a]All data except phenolics (µg/L) expressed in mg/L.

Table 44. Baseline studies of aquatic environments in the Athabasca River near Lease 17 (Syncrude Canada Ltd., Environmental Research Monograph 1977-2; P. McCart, P. Tsui, W. Grant, R. Green, Aquatic Environments Ltd.).

In an effort to provide baseline data for a program of continuous monitoring of the Athabasca River, Syncrude Canada Ltd. conducted surveys of water quality, fish species, benthic invertebrates, and periphyton. Water quality data was collected from 15 stations in the Athabasca River in the vicinity of Lease 17, from September 1974 to October 1975. (For location of sampling site see Figure 3, page 23.)

Location: Station 15[a]

Date	25-10-74	14-12-74	17-01-75	22-02-75	20-03-75	09-04-75
Temperature °C	5.0	0.0	0.0	0.0	0.0	0.0
Conductivity µmho /cm	162	310	360	380	360	345
pH	-	-	-	7.9	8.2	-
Turbidity JTU						
shaken	0.0	0.0	12.4	3.5	3.5	4.0
settled	0.0	0.0	0.0	2.1	2.6	2.5
Suspended Solids	0.0	0.0	3.3	5.2	3.3	2.9
Dissolved Oxygen	12.7	0.0	12.8	11.3	12.1	12.1
Calcium	-	-	-	-	-	-
Magnesium	-	-	-	-	-	-
Sodium	-	-	-	-	-	-
Potassium	-	-	-	-	-	-
Chloride	-	-	14.0	22.3	20.0	17.3
Sulfate	-	-	18.9	34.4	-	-
Bicarbonate	-	-	143.0	138.0	128.0	135.0
Total Dissolved Nitrogen	-	-	-	-	-	-
Total Dissolved Phosphorus	-	-	0.082	-	0.023	0.014
Reactive Silica	-	-	2.926	0.713	4.300	2.580

[a] All results except pH expressed in mg/L, unless otherwise indicated.

continued...

Table 44. Concluded.

Date	02-06-75	28-06-75	27-07-75	27-08-75	23-09-75	29-10-75
Temperature °C	16.0	17.0	20.0	14.0	11.0	0.5
Conductivity µmho /cm	210	195	290	210	210	210
pH	7.8	7.7	7.7	7.8	7.8	7.9
Turbidity JTU						
shaken	45.0	97.0	48.0	31.0	16.0	4.7
settled	12.0	11.0	14.0	3.4	3.6	2.7
Suspended Solids	92.0	579.5	113.6	77.6	46.4	6.5
Dissolved Oxygen	8.6	7.9	8.0	8.7	9.7	13.4
Calcium	-	-	27.2	-	-	26.0
Magnesium	-	-	7.9	-	-	8.3
Sodium	-	-	7.7	-	-	12.0
Potassium	-	-	1.1	-	-	1.2
Chloride	1.0	-	0.5	1.8	3.0	7.3
Sulfate	-	-	17.6	-	-	20.6
Bicarbonate	70.5	80.5	81.5	89.0	83.0	95.0
Total Dissolved Nitrogen	-	-	0.455	0.480	0.530	0.455
Total Dissolved Phosphorus	0.058	0.164	0.091	0.055	0.064	L 0.030
Reactive Silica	1.510	1.750	2.565	2.750	2.910	2.680

Table 45. Water quality study: Athabasca River, 1966 (Bryant F. Bidgood, Fish and Wildlife Division).

Samples of Athabasca River water were obtained at five locations above and below the G.C.O.S. plant site at Tar Island, Alberta (1 of 5 sites).

Location: Athabasca River, 13.8 mi downstream of the G.C.O.S. effluent outflow[a]

Date - not given	
Total Solids	298
Ignition Loss	160
Hardness	115
Sulfates	46
Alkalinity	100
Iron	Trace
pH	7.6
Water Temperature	13.0
Dissolved oxygen	10.0

[a]All data except pH and water temperature (°C) expressed in mg/L.

Table 46. Athabasca River water survey, 8 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Samples of river water were obtained at intermediate locations from upstream of the G.C.O.S. plant at Tar Island to Fort MacKay, as part of a compatability study of G.C.O.S. wastewater effluent and the Athabasca River (1 of 5 sites).

Location: Athabasca River, 15 mi downstream of G.C.O.S.[a]

Date	08-07-68
Time	1300
Depth in feet	10
Threshold Odor Number	4
Type	M[b]
Nonfilterable residue	154
Ignition Loss	48
Phenolics	-
Oils and Greases	1.9

[a]All data except phenolics (µg/L) expressed in mg/L.

[b]Musty

Table 47. Athabasca River water survey, 29 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Water samples of the Athabasca River were obtained at 5 mi intervals between Tar Island and Fort MacKay, to derive an explanation for the excessive oil concentrations observed at Fort MacKay on 8 July 1968 (1 of 5 sites).

Location: Athabasca River, 15 mi downstream of G.C.O.S.[a]

Date Time	29-07-68 1430
Depth in feet	10
Nonfilterable Residue	-
Ignition Loss	-
Phenolics	-
Oils and Greases	0.1

[a]All data except phenolics (µg/L) expressed in mg/L.

Table 48. Investigation of oil spill in Athabasca River, 4 April 1968 (Alberta Department of Health, Environmental Health Services Division).

Counteractive measures to restrict oil pollution of the Athabasca River from the contaminated slough area on the G.C.O.S. property were discussed in a meeting on 26 March 1968 in Edmonton. Subsequently, a trip was made on 4 April 1968 to observe the wastewater treatment facilities, the site of the oil spill, and the condition of the river. Samples were collected from six sites on the Athabasca, from Tar Island to Embarras Point (1 of 6 sites).

Location: Athabasca River, Fort MacKay[a]

Date Time	20-03-68 1400	04-04-68 1430
Temperature °C	1	-
Barometric Pressure	-	29.20
Dissolved Oxygen	12.5	14.1
Biochemical Oxygen Demand	0.9	2.7
pH	7.6	8.0
Alkalinity	140	123
Threshold Odor No. Type	100 CH[b]	16 CH[b]
Total Residue Ignition Loss	268 100	228 68
Turbidity as SiO_2	7	17
Total Hardness	170	126
Chlorides	21	9
Ammonia Nitrogen	0.4	0.3
Nitrate Nitrogen	0.3	0.1
Sulfates	60	50
Total Phosphates	0.1	0.2
Color 425 mμ 450 mμ 500 mμ	50 50 25	120 90 110
Phenols μg/l	0	14
Oils and Greases	5.6	0.1
Fluorides	0.14	0.12
Tannins + Lignins	0.8	1.2

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b]Chemical - Hydrocarbons

Table 49. Water sample analysis of the Athabasca River (Department of Energy and Natural Resources, Fish and Wildlife Division).

Water samples collected from sites on or near the Athabasca River were analyzed by the Alberta Department of Agriculture, Veterinary Service Division. These results were not published or put in any report.

Location: Athabasca River, Fort MacKay (one of four sites, three on the Athabasca River, one on the Firebag River)[a]

Date	22-03-68
Time	-
Total Solids	290
Ignition Loss	118
Hardness	174
Sulfates	29
Chlorides	22
Alkalinity	150
Nature of Alkalinity	Bicarbonate of Lime + Magnesium
Nitrite Nitrogen	nil
Nitrate Nitrogen	nil
Iron	0.29
Oil	47

[a]All results expressed in mg/L.

Table 50. Athabasca River water survey, 8 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Samples of river water were obtained at intermediate locations from upstream of the G.C.O.S. plant at Tar Island to Fort MacKay, as part of a compatability study of G.C.O.S. wastewater effluent and the Athabasca River (1 of 5 sites).

Location: Athabasca River, Fort MacKay, 20 mi downstream of G.C.O.S.[a]

Date	08-07-68	
Time	1330	
Depth in feet	10	20
Threshold Odor Number	4	2
Type	M[b]	CH[c]
Nonfilterable Residue	188	174
Ignition Loss	48	42
Phenolics	1	-
Oils and Greases	11.9	10.5
Biochemical Oxygen Demand	1.3	-
pH	8.1	-
Alkalinity as $CaCO_3$	89	-
Total Residue	324	-
Ignition Loss	74	-
Turbidity as SiO_2	156	-
Chlorides	8	-
Ammonia Nitrogen	0.7	-
Nitrate Nitrogen	0.2	-
Sulfates	16	-
Phosphates	0.6	-
Colour 425mμ	160	-
450mμ	120	-
500mμ	195	-
Fluorides	0.11	-

[a]All data except phenolics (μg/L), pH, and colour (mμ) expressed in mg/L.

[b]Musty

[c]Chemical, not objectionable

Table 51. Athabasca River water survey, 29 July 1968 (Alberta Department of Health, Environmental Health Services Division).

Water samples of the Athabasca River were obtained at 5 mi intervals between Tar Island and Fort MacKay, to derive an explanation for the excessive oil concentrations observed at Fort MacKay on 8 July 1968 (1 of 5 sites).

Location: Athabasca River, Fort McKay, 20 mi downstream of G.C.O.S.[a]

Date Time	29-07-68 1500
Depth in feet	10
Nonfilterable Residue Ignition Loss	64 14
Phenolics	3
Oils and Greases	0.1, 0.3

[a]All data except phenolics (µg/L) expressed in mg/L.

Table 52. Athabasca River water survey, 8 August 1968 (Alberta Department of Health, Environmental Health Services Division).

Samples of Athabasca River water were obtained at intervals between Tar Island and Fort MacKay on 8 August 1968 (1 of 5 sites).

Location: Athabasca River, Fort MacKay, 20 mi downstream of G.C.O.S.[a]

Date Time	08-08-68 1600
Depth in feet	10
Nonfilterable Residue Ignition Loss	108 38
Phenolics	2
Oils and Greases	1.0

[a]All data except phenolics (µg/L) expressed in mg/L.

Table 53. Fort MacKay settlement water supply report, 7 May 1969 (H.A. Kerr: Soils, Geology, and Groundwater Branch, Department of Agriculture; D.A. Shillabeer: Environmental Health Services Division, Department of Health).

An investigation of all potential water supplies for the settlement was conducted on 7 May 1969. The Athabasca River, MacKay River, and the Beaver River were included in those sources sampled.

Location: Athabasca River, Fort MacKay[a]

Date	07-05-69
pH	8.0
Alkalinity	57
Threshold Odor No.	4
Type	Musty
Oils + Greases	1.9
Chlorides	2
Total Phosphates	0.68
Iron	2.0
Ammonia Nitrogen	1.28
Nitrate Nitrogen	0.17
Sulfates	20
Total Hardness	720
Calcium Hardness	540
Fluorides	0.15
Total Residue	346
Ignition Loss	118
Total Suspended Solids	228
Ignition Loss	18
Turbidity	55
Color Hazen Units	88
Total Coliforms MPN/100mL	11.0
MPN E. coli/100mL	4.0
Standard Plate Count/mL	5100

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 54. Detailed surface water quality data, Alberta 1974-1976 (Publ. 1980, Inland Waters Directorate, Western and Northern Region, Water Quality Branch, Calgary)

The report contains detailed chemical, physical, and biological data from short-term special studies, surveys or long-term monitoring of selected surface waters in Alberta during the period of 1974 to 1976. Among the stations monitored were the Athabasca River at Fort McMurray and at Fort MacKay, and the Clearwater River above Fort McMurray and at Upper Wingdam.

Location: Athabasca River, Fort MacKay, Station 00AL07DA0003[ab] (Lat. 57D 11M 12S, Long. 111D 37M 30S, UTM 12 462200E 6338200N)

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S Water Temp. °C	02041S Specific Conduct. USIE/cm	02041L Specific Conduct. USIE/cm	10301S pH	10301L pH	02073L Turbidity JTU	02011L Apparent Colour Rel. Units	06711L Chlorophyll A
07	08	74	1420	0003	22.	--	206.	--	8.3	30.	70.	L.005
16	10	74	1400	0003	8.0	291.	271.	7.9	8.1	7.8	60.	.015
23	01	75	1000	0003	.0	--	325.	6.1	7.5	3.5	L5.	L.005
18	06	75	1320	0003	17.	--	196.	7.9	7.8	14.	80.	.006
20	08	75	1350	0003	17.	--	214.	7.9	7.9	15.	80.	.008
10	02	76	1125	0003	.5	322.	334.	6.7	7.4	3.6	5.	L.005
26	08	76	1600	0003	13.5	--	197.	--	8.0	78.	50.	--
17	11	76	1400	0003	.3	315.	332.	8.3	8.1	9.1	50.	--

SAMPLE DATE MST D	M	Y	HR	SUBM ID	08101P Dissolved Oxygen	06201L Bicarbont. (CALCD.)	10151L Alkalinity Phenol Phthalein $CaCO_3$	10101L Total Alkalinity $CaCO_3$	20103L Dissolved Calcium	12102L Dissolved Magnesium	12101L Dissolved Magnesium (CALCD.)	10603L Total Hardness
07	08	74	1420	0003	9.4	115.	.0	94.	30. 01L	--	7.1	104.
16	10	74	1400	0003	11.9	135.	.0	111.	36. 01L	--	7.1	119.
23	01	75	1000	0003	12.8	99.	.0	81.	41. 01L	--	8.9	139.
18	06	75	1320	0003	9.6	100.	.0	82.1	24.6	7.5	--	--
20	08	75	1350	0003	9.4	111.	.0	91.1	28.3	8.2	8.1	104. 06L
10	02	76	1125	0003	12.1	130.	.0	107.	34.0	9.7	--	--
26	08	76	1600	0003	9.3	108.	.0	89.0	27.0	8.6	--	--
17	11	76	1400	0003	10.6	156.	.0	128.	38.0	11.6	--	--

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10602L Total Hardness (CALCD.)	11103L Dissolved Sodium	19103L Dissolved Potassium	17206L Dissolved Chloride	09105L Dissolved Fluoride	16306L Dissolved Sulphate	14102L Reactive Silica	00201L Total Dissolved Solids
07	03	74	1420	0003	--	7.7	.8	3.3	.1	18.	4.6	128.
16	10	74	1400	0003	--	13.	1.2	6.2	.1	25.	4.9	160.
23	01	75	1000	0003	--	23.	1.5	25.	.1	22.	8.8	179.
18	06	75	1320	0003	92.3	9.8	1.0	3.0	.1	12.1	3.1	110.
20	08	75	1350	0003	104.4	9.5	.9	3.9	.1	20.	4.6	130.
10	02	76	1125	0003	124.8	22.4	1.3	22.5	.1	23.	9.0	186.
26	08	76	1600	0003	102.8	5.7	.8	2.7	.1	11.	9.2	118.
17	11	76	1400	0003	142.6	18.2	1.4	1.4	.1	23.	6.0	176.

[a]For a description of procedures used refer to: Analytical Methods Manual, Inland Waters Directorate, Water Quality Branch, Ottawa, Canada 1974.
[b]All results except pH expressed in mg/L unless otherwise indicated.

continued...

Table 54. Continued.

SAMPLE DATE MST D	M	Y	HR	SUBM ID	06051L Total Inorganic Carbon	06001L Total Organic Carbon	15406L Total Phosphorous	07002L Total Kjeldahl Nitrogen	07106L Dissolved Nitrogen NO_3 & NO_2	07602L Total Nitrogen (CALCD.)	06604P Dissolved Cyanide	05532P Phenolic Material	
07	08	74	1420	0003	18.	19.	.064	.6	L.01	Q.61	.034	.004	
16	10	74	1400	0003	23.	21.	.033	.5	.01	.51	.009	L.002	
23	01	75	1000	0003	21.	10.	.020	.3	.13	.41	L.005	.015	
18	06	75	1320	0003	6.	22.	.052	.7	L.01	Q.71	.008	.015	
20	08	75	1350	0003	15.	22.	.081	.8	L.01	Q.81	.005	.008	
10	02	76	1125	0003	22.	8.	.02	.6	.24	.84	.010	.012	
26	08	76	1600	0003	19.	15.	.129	--	.046	--	L.005	L.001	35
17	11	76	1400	0003	30.	13.	.031	--	--	--	L.005	.004	35

SAMPLE DATE MST D	M	Y	HR	SUBM ID	04301P Extrble. Beryllium	05105L Dissolved Boron	13305P Extrble. Aluminum	23302P Extrble Vanadium	24302P Extrble. Chromium	25304P Extrble. Manganese	26304P Extrble. Iron	27302P Extrble. Cobalt
07	08	74	1420	0003	--	.13	.24 02P	--	L.015	.06	1.10	L.002
16	10	74	1400	0003	--	.09	.082	--	L.015	.03	.63	L.002
23	01	75	1000	0003	--	.09	.020	--	L.015	.04	.46	L.002
18	06	75	1320	0003	--	.15	.12	.001	L.015	.04	.70	L.002
20	08	75	1350	0003	--	.15	.12	L.001	L.015	.05	.94	L.002
10	02	76	1125	0003	--	.13	.029	L.001	L.015	.02	.50	.002
26	08	76	1600	0003	L.01	.10	1.3 02P	.002	L.015	.13	2.5	.002
17	11	76	1400	0003	L.01	.09	.039	L.001	L.015	.03	.59	.003

SAMPLE DATE MST D	M	Y	HR	SUBM ID	28302P Extrble. Nickel	29305P Extrble. Copper	30305P Extrble. Zinc	33104L Dissolved Arsenic	34102L Dissolved Selenium	38301P Extrble. Strontium	42301P Extrble. Molybdenum	82302P Extrble. Lead
07	08	74	1420	0003	L.002	.001	.004	.0051	L.0005	.13	L.10	L.004
16	10	74	1400	0003	.003	.007	.001	.0006	L.0005	.18	L.10	L.004
23	01	75	1000	0003	.004	.001	L.001	L.0005	L.0005	.22	L.10 02P	L.004
18	06	75	1320	0003	L.002	.002	L.001	L.0005	L.0005	.15	L.10	L.004
20	08	75	1350	0003	L.002	.002	.002	L.0005	L.0005	.17	L.10	L.004
10	02	76	1125	0003	L.002	.007	.008	L.0005	L.0005	.25	L.10	L.004
26	08	76	1600	0003	.004	.005	.008	.0007	L.0005	.24	--	L.004
17	11	76	1400	0003	.011	L.001	.002	L.0005	L.0005	.24	--	L.004

continued...

Table 54. Concluded.

SAMPLE DATE					48302P Extrble. Cadmium	56301P Extrble. Barium	80311P Extrble. Mercury µg/L	10401L Nonfiltered Residue	10501L Fixed Nonfiltered Residue	18520L MCPA µg/L	18500L 2,4-D µg/L	18550L 2,4-D8 µg/L
MST				SUBM								
D	M	Y	HR	ID								
07	08	74	1420	0003	L.001	.05	L.05	--	--	L.2	L.004	L.009
16	10	74	1400	0003	L.001	L.05	L.05	--	--	L.2	L.004	L.009
23	01	75	1000	0003	L.001	L.05	L.05	--	--	L.2	L.004	L.009
18	06	75	1320	0003	L.001	L.05	L.05	--	--	L.2	L.004	L.009
20	08	75	1350	0003	L.001	L.05	L.05	--	--	L.2	L.004	L.009
10	02	76	1125	0003	L.001	L.05	L.05	134.	119.	L.2	L.004	L.009
26	08	76	1600	0003	L.001	.06	L.05	7.	5.	--	--	--
17	11	76	1400	0003	L.001	L.05	L.05	--	--	--	--	--

SAMPLE DATE					18555L Dichlorprop.	18510L 2,4,5-T	18161L Aroclor 1248 (PCB'S)	18160L Aroclor 1254 (PCB'S)	18162L Aroclor 1260 (PCB'S)	18075: Alpha-BHC	18070L Gamma-BHC (LINDANE)
MST				SUBM	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
D	M	Y	HR	ID							
07	08	74	1420	0003	L.004	L.002	L.02	L.03	L.06	--	--
16	10	74	1400	0003	L.004	L.002	L.02	L.03	L.06	--	--
23	01	75	1000	0003	L.004	L.002	L.02	L.03	L.06	--	.001
18	06	75	1320	0003	L.004	L.002	L.02	L.03	L.06	--	L.001
20	08	75	1350	0003	L.004	L.002	L.02	L.03	L.06	.004	L.001
10	02	76	1125	0003	L.004	L.002	L.02	L.03	L.06	.002	L.001

Table 55. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Athabasca River, Fort MacKay, southeast of Haight Island[a]

Date m-yr	02-74	02-75
Temperature °F	32	33
Color (Cl-Pt)	35	10
Conductivity (µmho/cm @ 77°F)	-	355
Suspended Solids	3	4
Total Solids (Calc.)	294	291
Turbidity (JTU)	L 25	5
pH	7.8	8.1
Total Hardness	136	130
Calcium	36	37
Magnesium	11	9
Sodium + Potassium	29	30
Bicarbonate	161	156
Carbonate	0	0
Chloride	27	25
Hydroxide	0	0
Sulfate	27	30
Total Dissolved Solids	291	287
Alkalinity as $CaCO_3$	132	128
Silica	5	4
Oil + Grease	L 1	L 1
Organic Carbon	11	8
Dissolved Oxygen	6.1	4.8
Phenols µg/L	L 2	L 2
Sulfides	L 0.01	L 0.01
Total Phosphate	0.2	L 0.1
Ammonia Nitrogen	1.3	0.3
Nitrate Nitrogen	0.6	0.8
Organic Nitrogen	-	L 0.1
Chemical Oxygen Demand	38	17
Biochemical Oxygen Demand	2	2

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 56. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Athabasca River, just upstream of Ings Island (Sec. 7 Twp. 95 Rge. 10)[a]

Date (m-yr)	05-74	07-74	10-74
Temperature °F	38	64	44
Color (Pt-Cl)	100	40	60
Conductivity (µmho/cm @ 77°F)	207	227	251
Suspended Solids	440	177	17
Total Solids (Calc.)	589	381	216
Turbidity (JTU)	57	57	8
pH	7.5	7.7	8.0
Total Hardness	84	106	104
Calcium	22	39	30
Magnesium	7	2	7
Sodium & Potassium	7	14	13
Bicarbonate	93	113	119
Carbonate	0	0	0
Chloride	7	20	11
Hydroxide	0	0	0
Sulfate	13	16	19
Total Dissolved Solids	149	204	199
Alkalinity as $CaCO_3$	76	92	98
Silica	8	18	2
Oil & Grease	3	L 1	L 1
Organic Carbon	17	9	13
Dissolved Oxygen	6.2	7.8	-
Phenols µg/L	L 2	L 2	L 2
Sulfides	0.01	L 0.01	L 0.01
Total Phosphate	0.3	0.2	L 0.1
Ammonia Nitrogen	0.9	0.09	L 0.01
Nitrate Nitrogen	1.4	0.4	0.7
Organic Nitrogen	1	L 1	L 1
Chemical Oxygen Demand	36	30	25
Biochemical Oxygen Demand	2	1	1

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 57. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Athabasca Flood Plain, Shell Lease 13 (Sec. 8 Twp. 95 Rge. 10)[a]

Date (m-yr)	03-75
pH	8.0
Total Hardness	-
Alkalinity as $CaCO_3$	-
Total Phosphate	-
Calcium	13
Magnesium	11
Sodium + potassium	1111
Bicarbonate	2654
Carbonate	0
Chloride	223
Sulfate	4
Total Dissolved Solids	4016

[a]All results except pH expressed in mg/L.

Table 58. Water quality study: Athabasca River, 1966 (Bryant F. Bidgood, Fish and Wildlife Division).

Samples of Athabasca River water were obtained at five locations above and below the G.C.O.S. plant site at Tar Island, Alberta (1 of 5 sites).

Location: Athabasca River, 29.2 mi downstream of G.C.O.S. effluent outflow[a]

Date - not given	
Total Solids	208
Ignition Loss	122
Hardness	110
Sulfates	20
Alkalinity	90
Iron	Trace
pH	7.6
Water Temperature	13.0
Dissolved Oxygen	9.6

[a]All data except pH and water temperature (°C) expressed in mg/L.

Table 59. Water analysis report from unknown published source. (Analyzed by Alberta Research Council for Petrofina.)

Location: Athabasca River, Ells Crossing (Twp. 96 Sec. 2 Rge. 11)[a]

Date	21-03-74
Total Dissolved Solids	212
Total Hardness as $CaCO_3$	115
Total Alkalinity	90
Lab pH	6.6
Calcium	32.9
Magnesium	7.9
Sodium	18.8
Potassium	5
Carbonate	0
Bicarbonate	110
Sulfate	24.5
Chloride	8
Nitrate	1.1
Fluoride	0.3

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 60. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 714).

Location: Unnamed spring entering Athabasca River 4 mi downstream from mouth of Pierre River (Twp. 98 Rge. 10 Sec. 5 Lsd. 16)[a]

Date	19-07-73
Field Temperature °C	7.0
Total Dissolved Solids	254.0
Hardness as $CaCO_3$	251.9
Alkalinity as $CaCO_3$	254.0
Specific Conductance	-
Lab pH	7.8
Calcium	75.6
Magnesium	15.4
Sodium	11.3
Potassium	3.8
Carbonate	0.0
Bicarbonate	310.0
Sulfate	8.3
Chloride	4.0
Nitrate	0.1
Fluoride	0.2
Total Anions (epm)	5.367
Total Cations (epm)	5.627

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 61. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 75 122, Index No. DH 91).

Location: Athabasca River, 2 mi upstream from mouth of unnamed creek (Twp. 99 Rge. 9 Sec. 30 Lsd. -1)[a]

Date	16-03-75
Field Specific Conductance (µmhos/cm)	500
Field pH	7.3
Field Temperature °C	0.0
Field Carbonate	0.0
Field Bicarbonate	346.0
Total Dissolved Solids	330.0
Hardness as $CaCO_3$	234.0
Alkalinity as $CaCO_3$	211.2
Specific Conductance (µmhos/cm @ 25°C)	480.0
Laboratory pH	8.4
Calcium	62.0
Magnesium	19.3
Sodium	16.3
Potassium	3.8
Carbonate	2.4
Bicarbonate	259.0
Sulfate	49.5
Chloride	8.0
Nitrate	11.2
Silica	16.0
Fluoride	0.2

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 62. Investigation of oil spill in Athabasca River, 4 April 1968 (Alberta Department of Health, Environmental Health Services Division).

Counteractive measures to restrict oil pollution of the Athabasca River from the contaminated slough area on the G.C.O.S. property were discussed in a meeting on 26 March 1968 in Edmonton. Subsequently, a trip was made on 4 April 1968 to observe the wastewater treatment facilities, the site of the oil spill, and the condition of the river. Samples were collected from six sites on the Athabasca, from Tar Island to Embarras Point (1 of 6 sites).

Location: Athabasca River, upstream of Firebag River[a]

Date	20-03-68
Time	1300
Temperature °C	1
Dissolved Oxygen	12.5
Biochemical Oxygen Demand	1.0
pH	7.7
Alkalinity	115
Threshold Odor No.	16
Type	Musty
Total Residue	310
Ignition Loss	118
Turbidity as SiO_2	6
Total Hardness	148
Chlorides	31
Ammonia Nitrogen	0.3
Nitrate Nitrogen	0.2
Sulfates	48
Total Phosphates	0.3
Color 425 mμ	50
450 mμ	40
500 mμ	30
Phenols μg/L	0
Oils + Greases	0.8
Fluorides	0.13
Tannins + Lignins	0.7

[a]All results expressed in mg/L, unless otherwise indicated.

Table 63. Investigation of oil spill in Athabasca River, 4 April 1968 (Alberta Department of Health, Environmental Health Services Division).

Counteractive measures to restrict oil pollution of the Athabasca River from the contaminated slough area on the G.C.O.S. property were discussed in a meeting on 26 March 1968 in Edmonton. Subsequently, a trip was made on 4 April 1968 to observe the wastewater treatment facilities, the site of the oil spill, and the condition of the river. Samples were collected from six sites on the Athabasca, from Tar Island to Embarras Point (1 of 6 sites).

Location: Athabasca River, Point Brule[a]

Date Time	20-03-68 1215
Temperature °C	1
Dissolved Oxygen	10.9
Biochemical Oxygen Demand	1.4
pH	7.6
Alkalinity	135
Thresbold Odor No. Type	32 Musty
Total Residue Ignition Loss	308 120
Turbidity as SiO_2	7
Total Hardness	156
Chlorides	37
Ammonia Nitrogen	0.2
Nitrate Nitrogen	0.2
Sulfates	50
Total Phosphates	0.3
Color 425 mμ 450 mμ 500 mμ	70 50 60
Phenols μg/L	0
Oils + Greases	1.6
Fluorides	0.14
Tannins + Lignins	0.8

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 64. Water sample analysis of the Athabasca River (Department of Energy and Natural Resources, Fish and Wildlife Division).

Water samples collected from sites on or near the Athabasca River were analyzed by the Alberta Department of Agriculture, Veterinary Service Division. These results were not published or put in any report.

Location: Athabasca River, Point Brule (one of four sites, three on the Athabasca River, one on the Firebag River)[b]

Date	22-03-68
Time	-
Total Solids	334
Ignition Loss	136
Hardness	163
Sulfates	31
Chlorides	38
Alkalinity	142
Nature of Alkalinity	Bicarbonate of Lime + Magnesium
Nitrite Nitrogen	nil
Nitrate Nitrogen	nil
Iron	0.42
Oil	trace

[a]All results expressed in mg/L.

Table 65. Investigation of oil spill in Athabasca River, 4 April 1968 (Alberta Department of Health, Environmental Health Services Division).

Counteractive measures to restrict oil pollution of the Athabasca River from the contaminated slough area on the G.C.O.S. property were discussed in a meeting on 26 March 1968 in Edmonton. Subsequently, a trip was made on 4 April 1968 to observe the wastewater treatment facilities, the site of the oil spill, and the condition of the river. Samples were collected from six sites on the Athabasca, from Tar Island to Embarras Point (1 of 6 sites).

Location: Athabasca River, Embarras Point[a]

Date Time	
Temperature °C	1
Dissolved Oxygen	12.0
Biochemical Oxygen Demand	3.6
pH	7.4
Alkalinity	115
Threshold Odor No. Type	8 Musty
Total Residue Ignition Loss	296 118
Turbidity as SiO_2	8
Total Hardness	164
Chlorides	36
Ammonia Nitrogen	0.3
Nitrate Nitrogen	0.2
Sulfates	54
Total Phosphates	0.2
Color 425 mμ 450 mμ 500 mμ	70 50 60
Phenols μg/L	0
Oils + Greases	0.4
Fluorides	0.14
Tannins + Lignins	0.8

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 66. Water sample analysis of the Athabasca River (Department of Energy and Natural Resources, Fish and Wildlife Division).

Water samples collected from sites on or near the Athabasca River were analyzed by the Alberta Department of Agriculture, Veterinary Service Division. These results were not published or put in any report.

Location: Athabasca River, sawmill near Embarras Point (one of four sites, one on the Firebag River, three on the Athabasca River)[a]

Date	22-03-68
Time	-
Total Solids	292
Ignition Loss	126
Hardness	174
Sulfates	32
Chlorides	16
Alkalinity	149
Nature of Alkalinity	Bicarbonate of Lime + Magnesium
Nitrite Nitrogen	nil
Nitrate Nitrogen	nil
Iron	0.42
Oil	61867

[a]All results expressed in mg/L.

Table 67. Water quality and aquatic resources of the Beaver Creek Diversion System, 1977 (Syncrude Canada, Environmental Research Monograph 1978-3; L.R. Noton, N.R. Chymko, Chemical and Geological Laboratories Ltd.).

The Beaver Creek Diversion System was investigated from March to November 1977, to describe post-diversion conditions in Beaver Creek, Ruth Lake, and Poplar Creek and to characterize the two newly created waterbodies in the system. Physical and chemical parameters were obtained regularly from ten sites. Other aspects studied included phytoplankton, zooplankton, benthic macroinvertebrates, fish, aquatic macrophytes, stream drift, and stream habitat. (For location of sampling site see Figure 4, page 97.)

Location: Upper Beaver Creek[a]

Date	31-03-77	04-05-77	01-06-77	27-06-77	28-07-77
pH	7.3	7.7	7.7	7.8	7.7
Alkalinity as $CaCO_3$	359	108	84	134	161
Turbidity NTU	8.5	14	18	3.8	3.2
Suspended Solids	22.6	10	38	9	1.5
Total Organic Carbon	6	20	26	41	34
Nitrate + Nitrite-N	1.4	0.27	0.035	0.046	L 0.03
Kjeldahl Nitrogen	2.6	6	0.2	0.2	0.2
Ortho Phosphate-P	0.180	0.051	0.045	0.044	0.042
Total Phosphorus	0.199	0.062	0.062	0.122	0.096
Reactive Silica	7.8	7.2	4.8	5.3	5.5
Filterable Residue	520	214	196	202	204
Ignition Loss	145	72	60	62	46
True Color APHA Units		110			75
Oil and Grease		22.6			15.8
Phenols		L 0.001			0.006
Chemical Oxygen Demand		113			68
Hardness as $CaCO_3$		70			107
Sodium		2.2			33.8
Magnesium		6.3			9.0
Calcium		17.5			28.0
Potassium		2.6			0.6
Chloride		14.0			1
Sulfate		7			8
Iron		1.16			1.61
Copper		0.005			0.012
Chromium		0.02			L 0.01
Lead		L 0.02			L 0.02
Zinc		0.015			0.008
Nickel		L 0.02			L 0.02
Cobalt		L 0.01			L 0.01
Aluminum		0.2			0.2
Cadmium		L 0.01			L 0.01
Boron		0.212			0.210

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued ....

Table 67. Concluded.

Date	25-08-77	23-09-77	16-10-77	20-11-77
pH	7.9	7.9	7.7	-
Alkalinity as $CaCO_3$	213	219	184	-
Turbidity NTU	12	8.7	5.4	22
Suspended Solids	9	1.6	1.6	6.8
Total Organic Carbon	38	36	19	27
Nitrate + Nitrite-N	L 0.03	L 0.016	L 0.016	0.111
Kjeldahl Nitrogen	0.1	-	0.7	0.3
Ortho Phosphate-P	0.071	0.042	0.036	0.079
Total Phosphorus	0.096	0.064	0.071	0.081
Reactive Silica	6.3	6.9	10.1	2.6
Filterable Residue	248	312	194	388
True Colour APHA Units			90	
Oil and Grease			13.4	
Phenols			L 0.001	
Chemical Oxygen Demand			83	
Hardness as $CaCO_3$			106	
Sodium			39.4	
Magnesium			9.8	
Calcium			26.4	
Potassium			1.4	
Chloride			1	
Sulfate			7	
Iron			2.04	
Copper			0.020	
Chromium			0.09	
Lead			0.05	
Zinc			0.028	
Nickel			0.02	
Cobalt			L 0.01	
Aluminum			0.02	
Cadmium			L 0.01	
Boron			0.200	

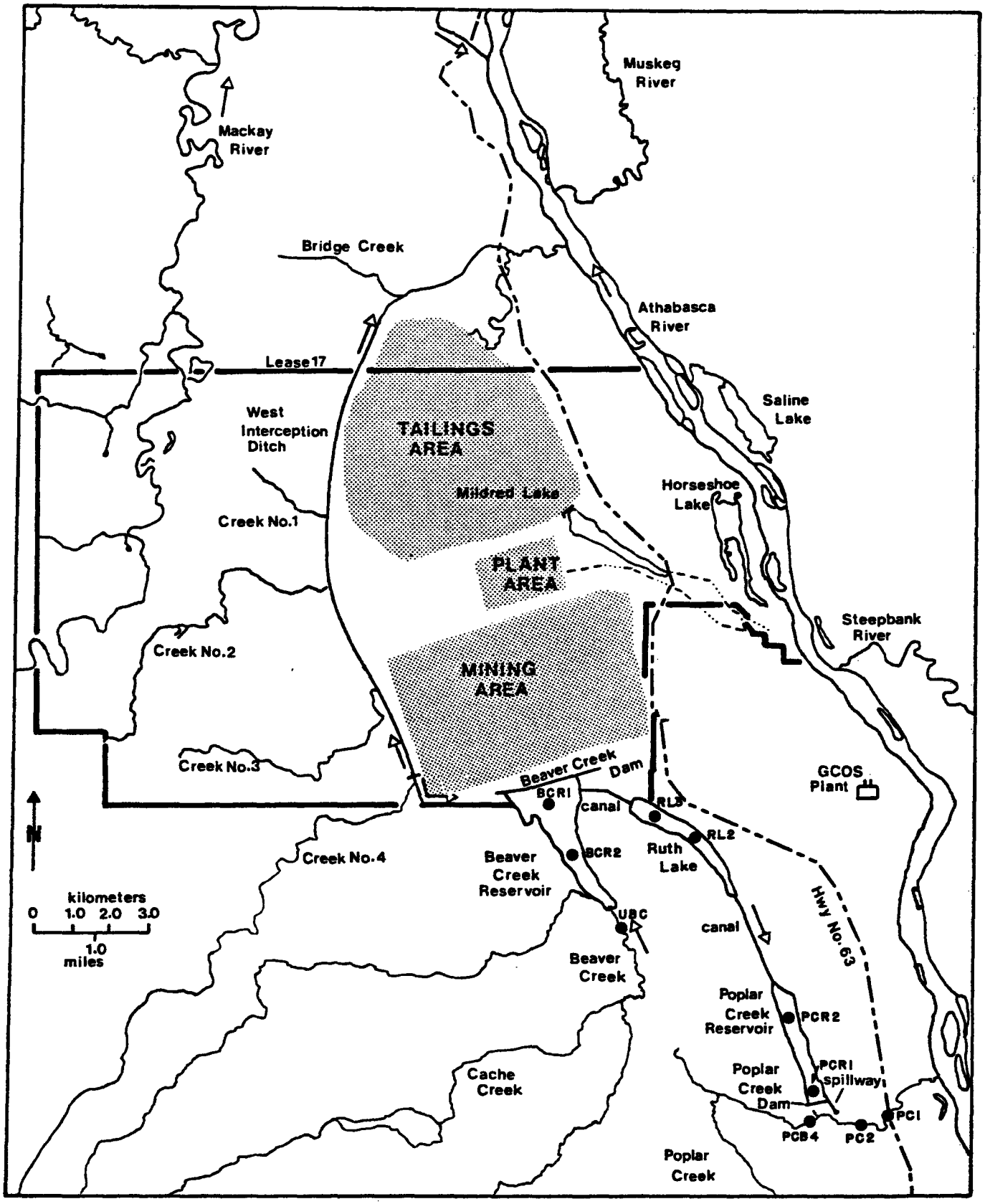


Figure 4. Surface drainage in the Syncrude lease area as modified for plant construction and operation, 1977.

Table 68. Water quality and aquatic resources of the Beaver Creek Diversion System, 1977 (Syncrude Canada, Environmental Research Monograph 1978-3, L.R. Noton, N.R. Chymko, Chemical and Geological Laboratories Ltd.)

The Beaver Creek Diversion System was investigated from March to November 1977, to describe the post-diversion conditions in Beaver Creek, Ruth Lake, and Poplar Creek and to characterize the two newly created waterbodies in the system. Physical and chemical parameters were obtained regularly from ten sites. Other aspects studied included phytoplankton, benthic macroinvertebrates, zooplankton, fish, aquatic macrophytes, stream drift, and stream habitat. (For location of sampling site see Figure 4, page .)

Location: Beaver Creek Reservoir[a]

Date in 1977	March 31	May 4	June 1	June 27	July 28	Aug. 25	Sept. 23	Oct. 15	Nov. 20
				BCR-1 - Top					
pH	7.0	7.5	7.9	7.7	8.3	7.8	7.8	7.7	7.9
pp alkalinity	0	0	0	0	0	0	0	0	0
Total alkalinity	186	153	127	137	150	170	178	181	196
Turbidity (NTU)	7.0	8.5	1.6	2.7	3.5	8.7	3.9	2.5	2.4
Suspended solids	16.6	14.0	5.0	--	0.5	8.0	3.6	3.2	LO.5
Total organic carbon	23	40	24	34	35	45	40	20	28
$NO_3 + No_2$ - N	0.53	0.12	0.035	0.248	LO.03	LO.03	0.023	0.085	0.144
Total Kjeldahl - N	10.3	13.4	0.3	0.2	0.4	0.5	0.8	0.3	LO.1
Ortho PO_4 - P	0.460	0.060	0.036	0.077	0.031	0.034	LO.016	LO.016	LO.016
Total P	0.603	0.102	0.064	0.116	0.100	0.061	0.082	0.052	0.052
Reactive SiO_2	13.6	7.5	3.5	4.1	3.4	3.3	2.4	5.4	4.7
Filtrable residue	520	254	218	306	296	372	396	210	385
Ignition loss	325	76	62	98	118	82	200	88	135
				BCR-1 - Bottom					
pH	7.3	7.5	7.6	7.4	7.6	--	--	--	--
pp alkalinity	0	0	0	0	0	--	--	--	--
Total alkalinity	347	160	131	131	156	--	--	--	--
Turbidity (NTU)	8.0	10	5.8	3.9	2.7	--	--	--	9.9
Suspended solids	19.6	10.4	2.7	2.0	1.5	--	--	--	4.4
Total organic carbon	15	19	24	33	32	--	--	--	36
$NO_3 + NO_2$ - N	0.61	0.14	LO.03	0.340	0.035	--	--	--	0.133
Total Kjeldahl - N	10.9	9.5	0.2	0.2	0.4	--	--	--	LO.1
Ortho PO_4 - P	0.490	0.056	0.030	0.149	0.026	--	--	--	LO.016
Total P	0.510	0.076	0.104	0.202	0.08	--	--	--	0.052
Reactive SiO_2	15.6	12.4	3.4	3.9	3.6	--	--	--	2.7
Filtrable residue	550	342	238	334	334	--	--	--	442
Ignition loss	240	160	72	106	130	--	--	--	226
				BCR-2					
pH	7.0	7.4	7.7	7.8	8.5	7.6	7.8	6.8	7.9
pp alkalinity	0	0	0	0	2	0	0	0	0
Total alklanity	260	146	119	127	150	173	179	180	202
Turbidity (NTU)	12.0	8.0	5.8	4.0	3.6	4.5	3.4	2.9	3.1
Suspended solids	7.8	7.6	5.5	0.5	1.5	1.0	4.4	1.2	2.0
Total organic carbon	31	20	24	36	32	46	37	26	34
$NO_3 + NO_2$ - N	1.42	0.15	LO.03	0.084	0.070	LO.03	LO.016	0.129	0.110
Total Kjeldahl - N	12.5	12.6	0.1	0.2	0.3	0.4	0.3	0.4	LO.1
Ortho PO_4 - P	0.350	0.066	0.050	0.091	0.025	0.034	LO.016	LO.016	LO.016
Total P	0.647	0.122	0.064	0.142	0.092	0.064	0.061	0.066	0.054
Reactive SiO_2	13.4	10.4	3.6	3.8	3.3	3.2	2.9	1.6	3.6
Filtrable residue	550	246	208	236	266	350	362	346	362
Ignition loss	240	76	74	50	136	82	176	134	98

[a]All results except pH and turbidity expressed in mg/L. Alkalinities as $CaCO_3$.

continued...

Table 68. Concluded.

Date in 1977	BCR-1 - Top			BCR-1-Bottom		BCR-2		
	May 4	July 28	Oct. 15	May 4	July 28	May 4	July 28	Oct. 15
True colour (APHA)	170	110	70	130	85	140	95	70
Oil and grease	16.6	12	40.2	19.6	11.4	7.8	5.6	65.0
Phenols	0.013	L0.001	0.012	L0.001	L0.001	0.005	L0.001	L0.001
Chemical oxygen demand	67	123	25	68	165	66	200	12
Hardness	127	116	89	109	118	97	115	97
Sodium	3.63	64.6	58.5	3.37	71.6	2.90	40.9	60.9
Magnesium	11.5	9.9	7.8	9.5	10.1	8.5	9.2	7.6
Calcium	32.1	30.2	22.7	28.2	30.7	25.3	30.9	26.1
Potassium	2.6	1.5	1.5	2.2	1.6	2.1	1.9	1.7
Chloride	24	59	44	35	51	9	41	59
Sulphate	13	6	6	14	8	10	7	10
Iron	1.04	0.63	0.53	0.65	0.51	0.95	0.37	0.58
Copper	0.022	0.014	0.013	0.009	0.018	0.011	0.017	0.022
Chromium	0.02	L0.01	0.03	0.02	L0.01	0.02	L0.01	0.03
Lead	0.02	L0.02	0.05	0.02	L0.02	0.04	L0.02	0.05
Zinc	0.019	0.008	0.105	0.021	0.011	0.015	0.012	0.076
Nickel	L0.02	L0.02	L0.02	L0.02	L0.02	L0.02	L0.02	0.03
Cobalt	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01
Aluminum	0.1	0.1	L0.1	0.1	0.1	0.2	0.2	0.2
Cadmium	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01
Boron	0.261	0.176	0.206	0.202	0.156	0.291	0.196	0.227

Table 69. Fort MacKay settlement water supply report, 7 May 1969 (H.A. Kerr: Soils, Geology, and Groundwater Branch, Department of Agriculture; D.A. Shillabeer: Environmental Health Services Division, Department of Health).

An investigation of all potential water supplies for the settlement was conducted on 7 May 1969. The Athabasca River, MacKay River, and the Beaver River were included in those sources sampled.

Location: Beaver River, Fort MacKay[a]

Date	07-05-69
pH	8.0
Alkalinity	66
Threshold Odor No.	2
Type	Musty
Oils + Greases	1.3
Chlorides	2
Total Phosphates	0.23
Iron	1.1
Ammonia Nitrogen	1.9
Nitrate Nitrogen	0.26
Sulfates	4
Total Hardness	700
Calcium Hardness	500
Fluorides	0.35
Total Residue	178
Ignition Loss	126
Total Suspended Solids	8
Ignition Loss	6
Turbidity	10
Color Hazen Units	80
Total Coliform MPN/100mL	7.8
MPN E. coli/100mL	7.8
Standard Plate Count/mL	5000

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 70. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 75 121, Index No. DH 90).

Location: Beaver River, old WSC site (Twp. 93 Rge. 11 Sec. 26 Lsd. -1)[a]

Date	16-03-75
Field Specific Conductance (µmho/cm)	700
Field pH	7.0
Field Temperature °C	0.0
Field Bicarbonate	447.0
Total Dissolved Solids	436.0
Hardness as $CaCO_3$	240.7
Alkalinity as $CaCO_3$	326.3
Specific Conductance (µmho/cm @ 25°C)	720.0
Laboratory pH	8.5
Calcium	64.0
Magnesium	19.7
Sodium	83.0
Potassium	2.1
Carbonate	0.0
Bicarbonate	378.0
Sulfate	50.0
Chloride	28.0
Nitrate	5.8
Silica	11.3
Fluoride	0.2
Total Anions (epm)	8.600
Total Cations (epm)	8.478

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 71. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 75 116, Index No. DH 85).

Location: Calumet River, WSC Site (Twp. 97 Rge. 11 Sec. 11 Lsd. -1)[a]

Date	16-03-75
Field Specific Conductance (µmho/cm)	1100
Field pH	7.2
Field Temperature °C	0.0
Field Carbonate	0.0
Field Bicarbonate	795.0
Total Dissolved Solids	846.0
Hardness as $CaCO_3$	353.1
Alkalinity as $CaCO_3$	476.8
Specific Conductance (µmho/cm @ 25°C)	1200.0
Laboratory pH	8.4
Calcium	71.0
Magnesium	42.8
Sodium	156.0
Potassium	6.3
Carbonate	4.8
Bicarbonate	586.0
Sulfate	64.0
Chloride	96.0
Nitrate	6.0
Silica	19.3
Fluoride	0.3
Total Anions (epm)	13.902
Total Cations (epm)	14.009

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 72. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 75 2, Index No. DH 79)

Location: Unnamed creek, tributary to Calumet River, middle of headwaters Twp. 97 Rge. 12 Sec. 11 Lsd. 1)[a]

Date	18-01-75
Field Specific Conductance (µmho/cm)	950
Field pH	-
Field Temperature °C	0.0
Total Dissolved Solids	676.0
Hardness as $CaCO_3$	375.5
Alkalinity as $CaCO_3$	350.4
Specific Conductance (µmho/cm @ 25°C)	920.0
Laboratory pH	7.2
Calcium	61.5
Magnesium	54.0
Sodium	118.7
Potassium	5.8
Carbonate	0.0
Bicarbonate	438.0
Sulfate	19.5
Chloride	36.0
Nitrate	7.7
Silica	12.4
Fluoride	0.3
Total Anions (epm)	8.725
Total Cations (epm)	12.821

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 73. Water quality data, Alberta 1961-1973 (Publ. 1975, Inland Waters Directorate, Water Quality Branch, Ottawa)

The report presents a summary of water samples collected and analyzed between 1961 and 1973. The water quality data (chemical, physical, and biological) were collected by Water Quality Branch labs as part of the National Water Quality Monitoring Program. The Athabasca River, Fort McMurray and the Clearwater River, Fort McMurray were monitored between October 1967 and December 1973.

Location: Clearwater River, Fort McMurray Station 00AL07CD0001[ab] For Period 03/10/67 to 05/12/73 (Lat. 56° 40' 50", Long. 111° 15' 0")

	10301S pH	10301L pH	10101L Total Alkalinity $CaCO_3$	10151L Alkalinity Phenol-Phthalein $CaCO_3$	02011L Apparent Colour Rel. Units	02073L Turbidity JTU	00210L Saturation Index (CALCD.)	00211L Stability Index (CALCD.)
SAMPLES	2	62	62	62	61	62	60	60
LOW	7.6	7.2	34	0	5	0.6	-1.3	7.7
HIGH	8.6	8.2	95	0	200	125.	0.2	9.9
AVERAGE	8.1	7.7	65	0	49	17.	-0.6	8.9
STD.DEV	0.7	0.3	9	0	32	24.	0.3	0.4
BACKUP CODES	--	--	--	--	--	71L	--	--

	02041S Specific Conduct. µS/cm	02041L Specific Conduct. µS/cm	10603L Total Hardness $CaCO_3$	10401L Nonfiltered Residue	10501L Fixed Nonfiltered Residue	10451L Filtrable Residue	10551 Fixed Filtrable Residue	06001L Total Organic Carbon
SAMPLES	2	62	62	17	18	1	1	7
LOW	180	136	51.6	L1	L1	218	190	4.0
HIGH	235	420	108.	149	970	218	190	18.0
AVERAGE	208	276	69.	31	77	--	--	10.9
STD.DEV	39	75	9.	43	226	--	--	5.6

	06051L Total Inorganic Carbon	06021L Bicarbont. (CALCD.)	06301L Carbonate (CALCD.)	06401L Free CO_2 (CALCD.)	06531P Phenolic Material	06711L Chlorophyll A	08401L Consumed Oxygen
SAMPLES	7	62	62	62	2	2	5
LOW	11.0	42	0	0.7	L.002	0.003	4.1
HIGH	17.0	116	0	7.2	0.007	0.009	7.4
AVERAGE	14.6	80	0	2.8	0.004	0.006	5.3
STD.DEV	2.4	11	0	1.7	0.004	0.004	1.3

[a]For a description of procedures used refer to: Analytical Methods Manual, Inland Waters Directorate, Water Quality Branch, Ottawa, Canada 1974.
[b]All results except pH expressed in mg/L unless otherwise indicated.

continued...

Table 73. Continued.

	07602L Total Nitrogen (CALCD.)	07001L Total Kjeldahl Nitrogen	07106L Dissolved Nitrogen NO_3 & NO_2	07551L Dissolved Ammonia Nitrogen	05105L Dissolved Boron	09105L Dissolved Fluoride	11103L Dissolved Sodium	11201L Sodium Absorption Ratio
								Rel. Units
SAMPLES	2	2	54	9	2	20	62	62
LOW	0.61	0.6	L.001	L.1	0.12	0.06	6.0	0.29
HIGH	0.70	0.7	0.452	0.2	0.17	0.30	54.3	2.82
AVERAGE	0.66	0.7	0.110	0.1	0.15	0.14	28.9	1.50
STD.DEV	0.06	0.1	0.112	0.0	0.04	0.07	12.9	0.64
BACKUP CODES	--	--	06L	--	--	04L	--	--

	12102L Dissolved Magnesium	13302P Extrble. Aluminum	14101L Reactive Silica	15255L Phosphorous Dissolved Ortho PO_4	15313L Total Inorg. PO_4 Phosphorous	15363L Dissolved Inorg. PO_4 Phosphorous	15413L Phosphorous Total Phosphate	16303L Dissolved Sulphate
SAMPLES	14	2	62	12	4	9	6	53
LOW	4.1	0.17	2.7	0.003	L.002	0.012	0.010	5.9
HIGH	7.4	0.25	13.2	0.065	0.068	0.036	0.033	25.2
AVERAGE	5.3	0.21	8.6	0.016	0.025	0.021	0.020	10.8
STD.DEV	0.9	0.06	2.7	0.016	0.029	0.007	0.010	3.6
BACKUP CODES	01L	--	02L	57L 59L	14L	--	--	--

	17203L Dissolved Chloride	19103L Dissolved Potassium	20101L Dissolved Calcium	24052L Dissolved Chromium	24302P Extrble. Chromium	25101L Dissolved Manganese	25304L Extrble. Manganese	25304P Extrble. Manganese
SAMPLES	62	62	62	1	2	14	1	2
LOW	1.7	0.6	13.5	L.004	L.010	L.01	L.01	0.06
HIGH	81.0	4.1	33.4	L.004	L.010	0.03	L.01	0.06
AVERAGE	37.0	1.1	19.6	--	--	0.01	--	0.06
STD.DEV	18.8	0.6	3.3	--	--	0.01	--	0.00
BACKUP CODES	--	--	--	--	--	04L	--	--

	26102L Dissolved Iron	26302P Extrble. Iron	27302P Extrble. Cobalt	28101L Dissolved Nickel	28302L Extrble. Nickel	29105L Dissolved Copper	29305L Extrble. Copper	29305P Extrble. Copper
SAMPLES	15	2	1	1	2	10	3	2
LOW	L.001	1.50	0.006	L.00	L.001	L.001	L.01	0.001
HIGH	0.310	1.50	0.006	L.00	0.004	L.01	L.01	0.003
AVERAGE	0.125	1.50	--	--	0.002	0.00	--	0.002
STD.DEV	0.107	0.00	--	--	0.002	0.00	--	0.001
BACKUP CODES	04L	04P	--	--	--	06L	06L	--

continued...

Table 73. Concluded.

	30305L Extrble. Zinc	30305P Extrble. Zinc	30105L Dissolved Zinc	38101L Dissolved Strontium	38301P Extrble. Strontium
SAMPLES	3	2	10	1	1
LOW	L.01	0.002	L.001	0.12	0.09
HIGH	L.01	0.004	L.01	0.12	0.09
AVERAGE	--	0.003	0.01	--	--
STD.DEV	--	0.001	0.00	--	--
BACKUP CODES	04L	--	04L	--	01L

	48302P Extrble. Cadmium	56301P Extrble. Barium	80311P Extrble. Mercury µg/L	81101L Dissolved Thallium	82103L Dissolved Lead
SAMPLES	2	2	2	1	9
LOW	L.001	L.1	L.05	L.0	L.001
HIGH	L.001	L.1	L.05	L.0	L.05
AVERAGE	--	--	--	--	--
STD.DEV	--	--	--	--	--
BACKUP CODES	--	--	--	--	01L

	18160L Aroclor 1254 (PCB'S) µg/L	18161L Aroclor 1248 (PCB'S) µg/L	18162L Aroclor 1260 (PCB'S) µg/L	18163L Aroclor 1016 (PCB'S) µg/L	42301P Extrble. Molybdenum
SAMPLES	2	2	2	1	2
LOW	L.024	L.032	L.035	L.033	L.05
HIGH	L.024	L.032	L.055	L.033	L.05
AVERAGE	--	--	--	--	--
STD.DEV	--	--	--	--	--

	82301L Extrble. Lead	83202P Extrble. Lead	92101L Dissolved Uranium	47302P Extrble. Silver	48102L Dissolved Cadmium
SAMPLES	3	2	1	2	1
LOW	L.01	L.001	0.0003	L.01	L.001
HIGH	L.01	L.001	0.0003	L.01	L.001
AVERAGE	--	--	--	--	--
STD.DEV	--	--	--	--	--
BACKUP CODES	--	--	--	01P	01L

Table 74. Detailed surface water quality data, Alberta 1974-76 (Publ. 1980, Inland Waters Directorate, Western and Northern Region, Water Quality Branch, Calgary)

The report contains detailed chemical, physical, and biological data from short-term special studies, surveys or long-term monitoring of selected surface waters in Alberta during the period of 1974 to 1976. Among the stations monitored were the Athabasca River at Fort McMurray and at Fort MacKay, and the Clearwater River above Fort McMurray and at Upper Wingdam.

Location: Clearwater River above Fort McMurray, Station 00aL07CD0001[ab] (Lat. 56D 40M 51S, Long. 111D 15M 0S, UTM 12 484700E 6281600N)

SAMPLE DATE MST D	M	Y	HR	SUBM ID	02061S Water Temp. °C	02041S Specific Conduct. USIE/cm	02041L Specific Conduct. USIE/cm	10301S pH	10301L pH	02073L Turbidity JTU	02011L Apparent Colour Rel. Units	10401L Nonfiltered Residue
12	02	74	1630	0003	1.0	--	333.	8.4	7.4	2.2	40.	--
22	03	74	1200	0001	.0	--	294.	--	7.2	150.	50.	861.
15	04	74	1200	0001	.0	--	310.	--	7.6	31.0	60.	37.
04	06	74	1440	0003	14.0	--	133.	8.3	7.2	30.0	--	--
08	08	74	0745	0003	20.0	143.	154.	--	7.8	11.0	80.	--
17	10	74	0800	0003	4.0	226.	207.	8.3	7.9	7.0	40.	--
22	01	75	1530	0003	.0	--	294.	8.0	7.2	4.0	L5	--
19	06	75	0700	0003	16.	--	168.	7.8	7.6	18.	55.	--
21	08	75	1715	0003	16.	--	178.	7.7	7.7	15.	60.	--
09	02	76	1215	0003	.0	--	302.	6.6	7.1	6.0	25.	--
28	08	76	1420	0003	--	--	266.	--	7.8	450.	18.	1751.
21	11	76	1000	0003	.8	235.	229.	7.9	7.6	8.5	40.	3.

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10501L Fixed Nonfiltered Residue	06201L Bicarbont. (CALCD.)	10151L Alkalinity Phenol Phthalein $CaCO_3$	10101L Total Alkalinity $CaCO_3$	20103L Dissolved Calcium	12102L Dissolved Magnesium	12101L Dissolved Magnesium (CALCD.)	10603L Total Hardness $CaCO_3$
12	02	74	1630	0003	--	101.	0.	83.0	24.0 01L	--	5.8	84.0
22	03	74	1200	0001	770.	80.	0.	66.0	19.0 01L	--	5.7	71.0
15	04	74	1200	0001	23.	95.	0.	78.0	21.0 01L	--	5.7	76.0
04	06	74	1440	0003	--	56.	.0	46.0	15.0 01L	--	2.8	49.0
08	08	74	0745	0003	--	67.	0.	55.0	17.0 01L	--	3.5	57.0
17	10	74	0800	0003	--	71.	.0	58.	16. 01L	--	5.1	61.
22	01	75	1530	0003	--	88.	.0	72.	24. 01L	--	3.7	75.
19	06	75	0700	0003	--	66.	.0	54.3	15.2	5.0	--	--
21	08	75	1715	0003	--	68.	.0	55.6	16.2	5.3	5.3	62.3 06L
09	02	76	1215	0003	--	83.	.0	68.0	18.7	6.3	--	--
28	08	76	1420	0003	1608.	--	--	81.0	24.0	9.4	--	--
21	11	76	1000	0003	1.	73.	.0	60.0	17.2	6.0	--	--

[a]For a description of procedures used refer to: Analytical Methods Manual, Inland Waters Directorate, Water Quality Branch, Ottawa, Canada 1974.
[b]All results except pH expressed in mg/L unless otherwise indicated.

continued...

Table 74. Continued.

SAMPLE DATE MST D	M	Y	HR	SUBM ID	10602L Total Inorganic Carbon (CALCD.)	11103L Dissolved Sodium	19103L Dissolved Potassium	17206L Dissolved Chloride	09105L Dissolved Fluoride	16306L Dissolved Sulphate	14102L Reactive Silica	00201L Total Dissolved Solids
12	02	74	1630	0003	--	33.0	1.1	42.0 03L	.1	10.0 04L	11.0	177.
22	03	74	1200	0001	--	33.0	.9	41.0	--	7.9 04L	--	--
15	04	74	1200	0001	--	31.0	1.2	38.0	--	13.0 04L	--	--
04	06	74	1440	0003	--	9.6	.8	9.1	.1	5.5 04L	7.0	77.
08	08	74	0745	0003	--	14.0	.5	15.0	.1	7.3	8.5	99.
17	10	74	0800	0003	--	21.	.8	24.	.1	6.7	8.9	117.
22	01	75	1530	0003	--	34.	1.5	49.	.1	9.5	13.	178.
19	06	75	0700	0003	58.5	13.4	.7	14.0	.1	5.0	5.8	92.
21	08	75	0715	0003	62.3	15.0	.6	18.3	.1	5.1	7.2	101.
09	02	76	1215	0003	72.6	32.6	1.3	43.0	.1	9.0	12.7	164.
28	08	76	1420	0003	98.6	24.3	1.4	24.	.1	19.	12.0	163.
21	11	76	1000	0003	67.7	22.5	.8	28.	.1	7.1	10.2	128.

SAMPLE DATE MST D	M	Y	HR	SUBM ID	06051L Total Inorganic Carbon	06001L Total Organic Carbon	15406L Total Phosphorous	07002L Total Kjeldahl Nitrogen	07106L Dissolved Nitrogen NO_3 & NO_2	07602L Total Nitrogen (CALCD.)	06604P Dissolved Cyanide	06532P Phenolic Material
12	02	74	1630	0003	14.0	13.0	.050 13L	.4 01L	.190	.59	--	L.002
04	06	74	1440	0003	10.0	20.0	.078 13L	.8	.030	.83	--	.013
08	08	74	0745	0003	12.0	15.0	.060	.6	L.01	Q.61	--	.017
17	10	74	0800	0003	12.	14.	.033	.2	L.01	Q.21	--	L.002
22	01	75	1530	0003	14.	8.	.045	L.1	.17	Q.27	.014	.013
19	06	75	0700	0003	10.	13.	.057	.5	L.01	Q.51	.007	.014
21	08	75	0715	0003	12.	15.	.072	.6	.01	.61	.005	.010
09	02	76	1215	0003	12.	21.	.07	.9	.30	1.20	.012	.008
28	08	76	1420	0003	16.	28.	.022	--	.035	--	L.005	.001 35P
21	11	76	1000	0003	15.	13.	.028	--	.05	--	.005	.002 35P

SAMPLE DATE MST D	M	Y	HR	SUBM ID	04301P Extrble. Beryllium	05105L Dissolved Boron	13305P Extrble. Aluminum	23302P Extrble. Vanadium	24312P Extrble. Chromium	25304P Extrble. Manganese	26304P Extrble. Iron	27302P Extrble. Cobalt
12	02	74	1630	0003	--	.13	L.10 02P	--	L.010	.03	.66	L.001
04	06	74	1440	0003	--	.14	.48 02P	--	L.010	.07	1.80	.006
08	08	74	0745	0003	--	.14	.16 02P	--	L.010	.07	1.31	L.001
17	10	74	0800	0003	--	.10	.042	--	L.015	.04	.97	L.002
22	01	75	1530	0003	--	.10	.080	--	L.015	.07	1.2	L.002
19	06	75	0700	0003	--	.13	.20	--	L.015	.07	.98	L.002
21	08	75	0715	0003	--	.14	.14	L.001	L.015	.07	1.5	L.002
09	02	76	1215	0003	--	.12	.14	.001	L.015	.07	1.2	L.002
28	08	76	1420	0003	L.01	.21	8.0 02P	.030	L.015	.69	24.	.019
21	11	76	1000	0003	L.01	.11	.030	L.001	L.015	.04	.72	.002

continued...

Table 74. Concluded.

SAMPLE DATE MST D	M	Y	HR	SUBM ID	28302P Extrble. Nickle	29305P Extrble. Copper	30305P Extrble. Zinc	33104L Dissolved Arsenic	34102L Dissolved Selenium	38301P Extrble. Strontium	42301P Extrble. Molybdenum	47301P Extrble. Silver
12	02	74	1630	0003	L.001	L.001	.018	--	--	.05	L.05	L.01
04	06	74	1440	0003	.006	.003	.007	L.0005	--	.07	L.05	L.01
08	08	74	0745	0003	L.001	L.001	.004	.0005	L.0005	.04	L.05	--
17	10	74	0800	0003	L.002	L.001	.002	L.0005	L.0005	.05	L.10	--
22	01	75	1530	0003	.004	.003	.001	L.0005	L.0005	.10	L.10 02P	--
19	06	75	0700	0003	.002	.003	L.001	L.0005	L.0005	.08	L.10	--
21	08	75	0715	0003	L.002	.001	.003	L.0005	L.0005	.10	L.10	--
09	02	76	1215	0003	L.002	.007	.005	L.0005	L.0005	.15	L.10	--
28	08	76	1420	0003	.042	.032	.087	.0021	L.0005	.23	--	--
21	11	76	1000	0003	.002	L.001	L.001	L.0005	L.0005	.10	--	--

SAMPLE DATE MST D	M	Y	HR	SUBM ID	48302P Extrble Cadmium	56301P Extrble. Barium	80311P Extrble. Mercury µg/L	82302P Extrble. Lead	08101P Dissolved Oxygen	06711L Chlorophyll A
12	02	74	1630	0003	L.001	L.1	L.05	L.001	--	.005
04	06	74	1440	0003	.001	L.1	L.05	L.001	9.0	.009
08	08	74	0745	0003	L.001	L.1	L.05	L.001	13.2	.018
17	10	74	0800	0003	L.001	L.05	L.05	L.004	12.1	.008
22	01	75	1530	0003	L.001	L.05	L.05	L.004	13.8	.022
19	06	75	0700	0003	L.001	L.05	L.05	L.004	9.6	L.005
21	08	75	0715	0003	.001	L.05	L.05	L.004	9.3	.008
09	02	76	1215	0003	L.001	L.05	.06	L.004	11.4	L.005
28	08	76	1420	0003	L.001	.15	L.05	.021	--	--
21	11	76	1000	0003	.001	L.05	L.05	L.004	--	--

Table 75. Detailed surface water quality data, Alberta 1974-1976 (Publ. 1980, Inland Waters Directorate, Western and Northern Region, Water Quality Branch, Calgary)

The report contains detailed chemical, physical, and biological data from short-term special studies, surveys or long-term monitoring of selected surface waters in Alberta during the period of 1974 to 1976. Among the stations monitored were the Athabasca River at Fort McMurray and at Fort MacKay, and the Clearwater above Fort McMurray and at Upper Wingdam.

Location: Clearwater River, Upper Wingdam, Station 00AL07CD0002[ab] (Lat. 56D 42M 0S, Long. 111D 20M 0S, UTM 12 479600E 6283800N)

Sample Date				
		MST		SUBM
D	M	Y	HR	ID
07	02	74	1200	0001

02061S	Water Temp. ^{o}C	.0	
02061L	Water Temp. ^{o}C	16.5	
02041L	Specific Conduct. (USIE/cm)	318.	
10301L	pH	7.3	
02073L	Turbidity JTU	3.9	
02011L	Apparent Colour (Rel. Units.)	50.	
10603L	Total Hardness ($CaCO_3$)	82.0	
00201L	Total Dissolved Solids (CALCD.)	172.	
06301L	Carbonate (CALCD.)	0.	
06201L	Bicarbont. (CALCD.)	95.	
10151L	Alkalinity Phenolphthalein ($CaCO_3$)	0.	
10101L	Total Alkalinity ($CaCO_3$)	78.0	
20103L	Dissolved Calcium	21.0	01L
11103L	Dissolved Sodium	33.0	
19103L	Dissolved Potassium	1.0	
17206L	Dissolved Chloride	43.0	01L
12101L	Dissolved Magnesium (CALCD.)	7.2	
16306L	Dissolved Sulphate	9.5	04L
14102L	Reactive Silica	11.0	

[a]For a description of procedures used refer to:

Analytical Methods Manual, Inland Waters Directorate, Water Quality Branch Ottawa, Canada 1974.

[b]All results except pH expressed in mg/L unless otherwise indicated.

Table 76. Aquatic studies on the various rivers in the Fort McMurray region: Horse River, Hangingstone River, and Clearwater River, September 1972 (Department of Natural Resources, Fish and Wildlife Division).

The report covers geographical and geological characteristics of each river plus biological and chemical characteristics of various sample sites in each river system.

Location: Clearwater River (Sec. 6 Twp. 89 Rge. 5)[a] This sampling site is located outside the AOSERP study area.

Date	24-08-72
Temperature °C	-
Dissolved Oxygen	-
pH Field	-
Laboratory	8.3
Specific Conductance	335
Total Hardness $CaCO_3$	68
Total Alkalinity $CaCO_3$	69
Sulfate	22
Chloride	50
Nitrate + Nitrite	0.1
Iron	0.2
Calcium	20
Magnesium	4
Sodium	39
Potassium	1.3
Phosphate	0.4
Ammonia Nitrogen	0.2
Turbidity	5

[a]All results except pH, specific conductance (µmho/cm), and turbidity (JTU) expressed in mg/L.

Table 77. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 76 7, Index No. DH 313).

Location: Unnamed spring, tributary to Clearwater River near a sawmill (Twp. 88 Rge. 9 Sec. 36 Lsd. -L)[a]

Date	08-01-76
Field pH	7.5
Field Bicarbonate	429
Field Carbonate	0
Total Dissolved Solids	422.0
Hardness as $CaCO_3$	327.2
Alkalinity as $CaCO_3$	328.0
Specific Conductance (µmho/cm @ 25°C)	780
Laboratory pH	7.5
Calcium	80.0
Magnesium	31.0
Sodium	22.5
Potassium	8.8
Carbonate	0.0
Bicarbonate	410.0
Sulfate	33.2
Chloride	4.0
Nitrate	0.9
Silica	12.9
Calcium (acid)	87.0
Magnesium (acid)	36.0
Calculate TDS	394.9
Aluminum	1.28
Copper	0.02
Iodine	0.05
Iron	3.5
Lead	0.01
Manganese	0.1
Mercury	0.00008
Fluoride	0.30
Total Anions (epm)	7.539
Total Cations (epm)	7.747

[a]All results except pH expressed as mg/L, unless otherwise indicated.

Table 78. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 76 8, Index No. DH 314).

Location: Conn Creek at Highway 63 crossing (Twp. 89 Rge. 9 Sec. 29 Lsd. 13)[a]

Date	10-01-76
Field Specific Conductance (µmho/cm)	-
Field pH	8.0
Field Temperature °C	0.0
Field Bicarbonate	603
Field Carbonate	0
Total Dissolved Solids	670.0
Hardness as $CaCO_3$	476.1
Alkalinity as $CaCO_3$	444.8
Specific Conductance (µmho/cm @ 25°C)	1130
Laboratory pH	8.2
Calcium	110.0
Magnesium	49.0
Sodium	47.5
Potassium	4.2
Carbonate	0.0
Bicarbonate	556.0
Sulfate	128.0
Chloride	4.0
Nitrate	1.0
Silica	14.5
Calcium (acid)	124.0
Magnesium (acid)	54.0
Calc. TDS	631.6
Aluminum	0.1
Copper	0.01
Iodine	0.03
Iron	0.8
Lead	0
Manganese	0.4
Mercury (µg/L)	56
Fluoride	0.4
Total Anions (epm)	11.907
Total Cations (epm)	11.696

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 79. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 76 3, Index No. DH 309).

Location: Conn Creek at Thickwood Tower Road (Twp. 89 Rge. 10 Sec. 23 LSD.-1)[a]

Date	08-01-76
Field Specific Conductance (µmho/cm)	-
Field pH	7.4
Field Temperature °C	0.0
Field Carbonate	0
Field Bicarbonate	512
Total Dissolved Solids	436.0
Hardness as $CaCO_3$	171.5
Alkalinity as $CaCO_3$	380.8
Specific Conductance (µmho/cm @ 25°C)	830
Laboratory pH	7.3
Calcium	43.0
Magnesium	15.6
Potassium	1.3
Carbonate	0.0
Bicarbonate	476.0
Sulfate	7.4
Chloride	4.0
Nitrate	3.0
Silica	12.8
Calcium (acid)	46.0
Magnesium (acid)	17.2
Calculated TDS	436.1
Total Anions (epm)	8.117
Total Cations (epm)	8.465
Aluminum	0.06
Copper	0.01
Iodine	0.11
Iron	3.2
Lead	0
Manganese	0.1
Mercury (µg/L)	0.08
Fluoride	0.30

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 80. Water analysis report (Alberta Research Council, Unpublished Data Lab No. 76 1, Index No. DH 307).

Location: Conn Creek, mainstream before fork (Twp. 89 Rge. 10 Sec. 31 Lsd. -1)[a]

Date	08-01-76
Field pH	7.1
Field Temperature °C	0.0
Field Carbonate	0
Field Bicarbonate	405
Total Dissolved Solids	346.0
Hardness as $CaCO_3$	147.1
Alkalinity as $CaCO_3$	304.8
Specific Conductance (µmho/cm @ 25°C)	660
Laboratory pH	7.2
Calcium	39.0
Magnesium	12.1
Sodium	85.0
Potassium	1.7
Carbonate	0.0
Bicarbonate	381.0
Sulfate	6.3
Chloride	4.0
Nitrate	1.6
Silica	13.9
Calcium (acid)	45.0
Magnesium (acid)	13.4
Calculated TDS	350.9
Total Anions (epm)	6.515
Total Cations (epm)	6.683
Aluminum	0.06
Copper	0.01
Iodine	0.03
Iron	4.0
Lead	0.0
Manganese	1.8
Mercury (µg/L)	0.04
Fluoride	0.03

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 81. Water Analysis Report (Alberta Research Council, Unpublished Data Lab No. 76 2, Index No. DH 308).

Location: Conn Creek, south fork of upper reaches (Twp. 89 Rge. 11 Sec. 35 Lsd. -1)[a]

Date	08-01-76
Field pH	6.9
Field Temperature °C	0.0
Field Carbonate	0
Field Bicarbonate	254
Total Dissolved Solids	208.0
Hardness as $CaCO_3$	145.0
Alkalinity as $CaCO_3$	189.6
Specific Conductance (µmho/cm @ 25°C)	420
Laboratory pH	7.2
Calcium	38.0
Magnesium	12.2
Sodium	28.7
Potassium	1.7
Carbonate	0.0
Bicarbonate	237.0
Sulfate	4.9
Chloride	4.0
Nitrate	1.9
Silica	14.0
Calcium (acid)	41.0
Magnesium (acid)	13.3
Calculated TDS	221.9
Total Anion	4.130
Total Cations	4.192
Aluminum	0.06
Copper	0.03
Iodine	0.01
Iron	4.8
Lead	0.32
Manganese	0.7
Mercury (µg/L)	0.06
Fluoride	0.20

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 82. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Dover River, confluence with MacKay River 00AT07DB2179[a]

Parameter	Code[b]	Date 31-07-72
pH	10301L	8.6
Specific Conductance (µmho/cm)	02041L	462
Calcium Dissolved	20101L	50.5
Magnesium Dissolved	12103L	13
Sodium Dissolved	11102L	43.1
Potassium Dissolved	19103L	1.8
Turbidity (JTU)	02073L	2.8
Color	02011L	120
Chloride Dissolved	17203L	8.3
Fluoride Dissolved	09105L	0.18
Total Kjeldahl Nitrogen	07001L	1.66
Nitrate + Nitrite	07106L	0.10
Ortho phosphorus	15255L	0.008
Inorganic phosphorus	15363L	0.034
Alkalinity pp	10151L	2.2
Total Alkalinity as $CaCO_3$	10101L	224
Total Hardness as $CaCO_3$	10603L	50.5
Sulfate Dissolved	16303L	25.4
Silica Reactive	14102L	1.8
Phenols	06531P	L 0.004
Tannins and Lignins	06551L	1.02
Cadmium extractable	48302P	L 0.001
Chromium extractable	24302P	L 0.006
Cobalt extractable	27302P	0.007
Copper extractable	29305P	0.001
Iron extractable	26307P	0.80
Lead extractable	82302P	L 0.004
Manganese extractable	25304P	0.040
Mercury extractable	80301P	0.00014
Nickel extractable	28302P	0.004
Zinc extractable	30305P	L 0.001
Oil and Grease	06521L	159
Arsenic extractable	33303L	L 0.004
Total Dissolved Solids calc.		268

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 83. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Departmnet of Environment; Sample No. 7888; Unpublished Data).

Location: Dover River, confluence with MacKay River 00AT07DB2179[a]

Date Time		17-08-72 1215
Parameter	Code[b]	
pH	10301L	8.3
Specific Conductance (µmho/cm)	02041L	420
Calcium	20105L	40
Magnesium	12102L	13
Sodium	11102L	33
Potassium	19102L	1.5
Iron	26302L	1.4
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07206L	L 0.1
Chloride	17203L	9
Sulfate	16302L	43
Fluoride	09105L	0.19
Bicarbonate	06201L	222
Chemical Oxygen Demand	08301L	60
Oil and Grease	06521L	L 1.0
Threshold Odor Number	02001L	2
Turbidity (JTU)	02073L	4
Ammonia Nitrogen	07551L	1.5
Phenols	06532L	L 0.001
Total Phosphate	15407L	L 0.1
Tannins and Lignins	06551L	2.8
Colour - Filter 1	02026L	91
Filter 2	02026L	85
Filter 3	02026L	59
Cadmium	48005L	L 0.001
Chromium	24005L	0.018
Cobalt	27005L	L 0.001
Copper	29009L	0.008
Manganese	25007L	0.006
Mercury	80003L	0.0003
Lead	82006L	L 0.001
Zinc	30006L	L 0.01
Total Alkalinity as $CaCO_3$	10101L	182
Total Hardness as $CaCO_3$	10604L	155
Total Dissolved Solids	00203L	253

[a] All results except pH expressed in mg/L unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 84. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Dover River, confluence with MacKay River 00AT07DB2179[a]

Date		25-09-72	05-10-72
Parameter	Code[b]	Sample No. 7508	Sample No. 7406
pH	10301L	8.3	8.2
Specific Conductance (µmho/cm)	02041L	550	550
Total Hardness as $CaCO_3$	10605L	184	194
Total Alkalinity as $CaCO_3$	10101L	240	262
Sulfate	16302L	80	40
Chloride	17203L	17	17
Nitrate + Nitrite	07107L	L 0.1	0.1
Iron	26002L	0.1	0.3
Calcium	20101L	68	54
Magnesium	12103L	3	13
Sodium	11101L	55	56
Potassium	19101L	2.6	1.8
Fluoride	09105L	-	L 0.05
Phosphate	15406L	2.3	0.3
Ammonia Nitrogen	07551L	0.7	0.8
Oil and Grease	06521L	-	1.3
Phenols	06531L	-	0.01
Tannins and Lignins	06551L	-	1.4
Colour - Filter 1	02026L	-	92.5
Filter 2	02026L	-	89.5
Filter 3	02026L	-	76.0
Threshold Odor Number	02001L	-	2
Turbidity (JTU)	02073L	4	3
Total Solids	10471L	-	398
Surfactants	10701L	-	2.6
Cobalt	27004L	-	0.004
Copper	29008L	-	0.004
Manganese	25006L	-	0.020
Nickel	28004L	-	0.006
Arsenic	33003L	-	0.001
Cadmium	48004L	-	0.004
Chromium	24004L	-	0.006
Lead	82005L	-	0.016
Mercury	80002L	-	0.0038
Zinc	30006L	-	0.008

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b]For a description of methods used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 85. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Dover River, confluence with Mackay River 00AT07DB2179[a]

Date		17-06-73
Time		1840
Parameter	Code[b]	Results
pH	10301L	7.9
Specific Conductance (µmho/cm)	02041L	189
Calcium	20101L	24
Magnesium	12103L	4
Sodium	11101L	26
Potassium	19101L	0.9
Iron	26002L	5.7
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07107L	L 0.1
Chloride	17203L	1
Sulfate	16302L	52
Bicarbonate	06201L	97
Total Alkalinity as $CaCO_3$	10101L	81
Total Hardness as $CaCO_3$	10602L	76
Oil and Grease	06521L	L 1
Colour - Filter 1	02026L	80
Filter 2	02026L	72
Filter 3	02026L	40
Threshold Odor Number	02001L	2
Turbidity (JTU)	02073L	-
Total Residue	10471L	378
Total Residue Fixed	10521L	158
Nonfilterable Residue	10401L	188
Ammonia Nitrogen	07551L	3.5
Phosphate	15406L	0.6
Phenols	06531L	0.01
Tannins and Lignins	06551L	3.4
Chemical Oxygen Demand	08301L	86
Cobalt	27004L	0.02
Copper	29008L	0.022
Manganese	25006L	0.104
Mercury	80002L	L 0.0002
Cadmium	48004L	L 0.001
Nickel	28004L	0.016
Chromium	24004L	0.020
Lead	82005L	0.001
Zinc	30006L	L 0.01

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 86. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Dover River, confluence with MacKay River 00AT07DB2179[a]

Date		14-08-73
Time		1705
Parameter	code[b]	Results
pH	10301L	8.3
Specific Conductance (µmho/cm)	02041L	325
Calcium	02103L	25
Magnesium	12103L	13
Sodium	11102L	27
Potassium	19102L	1.7
Iron	26002L	1.5
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07206L	L 0.1
Chloride	17203L	10
Sulfate	16302L	23
Fluoride	09105L	0.07
Bicarbonate	06201L	213
Chemical Oxygen Demand	08301L	89.4
Oil and Grease	06521L	1.2
Threshold Odor Number	02001L	2
Total Residue	10471L	272
Total Residue Fixed	10521L	138
Turbidity (JTU)	02073L	3
Ammonia Nitrogen	07551L	L 0.2
Phenols	06531L	0.021
Total Phosphate	15406L	1.2
Tannins and Lignins	06551L	3.5
Colour - Filter 1	02026L	88
Filter 2	02026L	81
Filter 3	02026L	51
Total Hardness as $CaCO_3$	10602L	115
Total Alkalinity as $CaCO_3$	10101L	175
Cobalt	27004L	L 0.001
Copper	29008L	0.005
Manganese	25006L	0.030
Mercury	80002L	0.0003
Nickel	28004L	0.003
Cadmium	48004L	L 0.001
Chromium	24004L	L 0.001
Lead	82005L	0.005
Zinc	30006L	0.01

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of methods used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 87. . Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Ells River, confluence with Athabasca River 00AT07DA2181[a]

Sample No.		5819
Date		31-07-72
Parameter	Code[b]	
pH	10301L	8.3
Specific Conductance (µmho/cm)	02041L	214
Total Alkalinity as $CaCO_3$	10101L	88.1
Total Hardness as $CaCO_3$	10603L	90.5
Calcium Dissolved	20101L	25.4
Magnesium Dissolved	12103L	7.0
Sulfate Dissolved	16303L	16.8
Sodium Dissolved	11103L	11.0
Silica Reactive	14102L	0.5
Chloride Dissolved	17203L	2.1
Fluoride Dissolved	09105L	0.10
Potassium Dissolved	19103L	0.8
Total Kjeldahl Nitrogen	07001L	0.85
Nitrate + Nitrite	07106L	0.04
Dissolved Inorg. Phosphate	15363L	0.007
Turbidity (JTU)	02073L	2.3
Colour	02011L	40
Phenols	06531P	L 0.004
Tannins and Lignins	06551L	0.32
Oils and Grease	06521L	66.1
Cadmium Extractable	48302P	L 0.001
Chromium Extractable	24302P	L 0.006
Cobalt Extractable	27302P	0.008
Copper Extractable	29305P	0.023
Iron Extractable	26307P	0.020
Lead Extractable	82302P	L 0.004
Manganese Extractable	25304P	0.020
Mercury Extractable	80301P	0.0001
Nickel Extractable	28302P	0.005
Zinc Extractable	30305P	L 0.001

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:

Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 88. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Ells River, confluence with Athabasca River 00AT07DA2181[a]

Sample No.		6498	7525
Date		22-08-72	25-09-72
Parameter	Code[b]		
pH	10301L	8.3	8.0
Specific Conductance (µmho/cm)	02041L	245	275
Total Alkalinity as $CaCO_3$	10101L	101	107
Total Hardness as $CaCO_3$	10605L	98	98
Sulfate	16302L	32	34
Chloride	17203L	6	4
Nitrate + Nitrite	07107L	L 0.1	0.1
Iron	26002L	0.3	0.1
Calcium	20101L	27	29
Magnesium	12103L	7	5
Sodium	11101L	16	20
Potassium	19101L	1.7	1.4
Phosphate	15406L	0.1	0.2
Ammonia Nitrogen	07551L	0.4	0.4
Turbidity (JTU)	02073L	2	4

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:

Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 89. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Ells River, confluence with Athabasca River 00AT07DA2181[a]

Sample No.		7514	7409
Date		28-09-72	05-10-72
Parameter	Codes[b]		
pH	10301L	7.6	8.1
Specific Conductance (µmho/cm)	02041L	150	335
Total Hardness as $CaCO_3$	10605L	72	128
Total Alkalinity as $CaCO_3$	10101L	67	138
Sulfate	16302L	15	52
Chloride	17203L	L 1	6
Nitrate + Nitrite	07107L	L 0.1	L 0.1
Iron	26002L	0.1	0.4
Calcium	20101L	24	40
Magnesium	12103L	2	6
Sodium	11101L	3	28
Potassium	19101L	1.2	2.3
Fluoride	09105L	-	L 0.05
Phosphate	15406L	0.2	0.1
Ammonia Nitrogen	07551L	0.5	0.6
Turbidity (JTU)	02073L	2	3
Oil and Grease	96521L	-	2.0
Phenols	06531L	-	0.003
Tannins and Lignins	06551L	-	0.9
Colour - Filter 1	02026L	-	94.0
Filter 2	02026L	-	91.5
Filter 3	02026L	-	82.0
Threshold Odor Number	02001L	-	4
Total Dissolved Solids	10471L	-	260
Surfactants	10701L	-	2.6
Cobalt	27004L	-	0.004
Copper	29008L	-	0.006
Manganese	25006L	-	0.020
Nickel	28004L	-	0.018
Arsenic	33003L	-	0.001
Cadmium	48004L	-	0.004
Chromium	24004L	-	0.003
Lead	82005L	-	0.022
Mercury	80002L	-	0.0035
Zinc	30006L	-	0.012

[a] [b] All results except pH expressed in mg/L, unless otherwise indicated.
For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, water Analysis Section.

Table 90. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Ells River, confluence with Athabasca River 00AT07DA2181[a]

Sample No.		5161	7305	
Date		17-06-73	14-08-73	
Time		1820	1615	
Parameter	Code[b]			Backup Code
pH	10301L	8.0	8.2	
Specific Conductance (µmho/cm)	02041L	197	150	
Calcium	20101L	28	16	02103L
Magnesium	12103L	12	6	
Sodium	11101L	12	11	
Potassium	19101L	1.1	1.1	02L
Iron	26002L	12.4	L 0.1	
Nitrate Nitrogen	07107L	L 0.1	L 0.1	
Nitrite Nitrogen	07107L	L 0.1	L 0.1	07206L
Chloride	17203L	4	8	
Sulfate	16302L	80	15	
Fluoride	09105L	-	0.06	
Bicarbonate	06201L	78	78	
Total Alkalinity as $CaCO_3$	10101L	-	64	
Total Hardness as $CaCO_3$	10602L	-	66	
Oil and Grease	06521L	1.8	1.7	
Chemical Oxygen Demand	08301L	52	53.6	
Threshold Odor Number	02001L	8	4	
Total Residue	10471L	890	172	
Total Residue Volatile	10521L	124	70	
Nonfilterable Residue	10401L	700	68	
Colour - Filter 1	02026L	76	90	
- Filter 2	02026L	72	86	
- Filter 3	02026L	49	69	
Turbidity (JTU)	02073L	G 15	30	
Ammonia Nitrogen	07551L	2.1	L 0.2	
Phosphate	15406L	0.9	0.7	
Phenols	06531L	0.005	0.011	
Tannins and Lignins	06551L	2.9	1.8	
Cadmium	48004L	L 0.001	L 0.001	05L
Chromium	24004L	0.038	L 0.001	05L
Cobalt	27004L	L 0.001	L 0.001	05L
Copper	29008L	0.026	0.014	09L
Lead	82005L	0.017	0.008	06L
Manganese	25006L	0.750	0.023	07L
Mercury	80002L	0.0009	L 0.0002	
Nickel	28004L	0.044	L 0.001	05L
Zinc	30006L	0.065	0.01	

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 91. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment; Unpublished Data).

Location: Ells River, confluence with Athabasca River 00AT07DA2181[a]

Sample No.		7884
Date		19-08-74
Time		1315
Parameter	Code[b]	
pH	10301L	7.9
Specific Conductance (µmho/cm)	02041L	180
Calcium	20105L	28
Magnesium	12102L	6
Sodium	11102L	6
Potassium	19102L	0.8
Iron	26302L	0.6
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07206L	L 0.1
Chloride	17203L	2
Sulfate	16302L	37
Fluoride	09105L	0.16
Bicarbonate	06201L	90
Chemical Oxygen Demand	08301L	39
Oil and Grease	06521L	2.3
Threshold Odor No.	02001L	1
Turbidity (JTU)	02073L	3
Ammonia Nitrogen	07551L	0.3
Phenols	06532L	L 0.001
Total Phosphate	15407L	L 0.1
Tannins and Lignins	06551L	1.0
Colour - Filter 1	02026L	94
Filter 2	02026L	94
Filter 3	02026L	82
Mercury	80003L	L 0.0001
Cobalt	27005L	L 0.001
Copper	29009L	0.007
Manganese	25007L	0.047
Nickel	28005L	0.004
Cadmium	48005L	L 0.001
Chromium	24005L	0.017
Lead	82006L	L 0.001
Zinc	30006L	L 0.01
Total Alkalinity as $CaCO_3$	10101L	73
Total Hardness as $CaCO_3$	10604L	94
Total Dissolved Solids[3]	00203L	126

[a] [b] All results except pH expressed in mg/L, unless otherwise indicated.
For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for the chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 92. Water analysis report (Alberta Research Council, Unpublished Data).

Location: Ells River, confluence with Athabasca River (Twp. 96 Rge. 11 Sec. 2 Lsd. -1)[a]

Sample No.	75 123	76 74
Index No.	DH 92	DH 345
Date	29-03-75	29-02-76
Field Specific Conductance (µmho/cm)	220	-
Field pH	6.3	7.6
Field Carbonate	0.0	-
Field Bicarbonate	122.0	122.0
Total Dissolved Solids	148.0	132.0
Hardness as $CaCO_3$	97.0	100.7
Alkalinity as $CaCO_3$	93.6	89.6
Specific Conductance (µmho/cm @ 25°C)	235.0	285.0
Laboratory pH	8.4	6.7
Calcium	28.0	28.0
Magnesium	6.6	7.5
Sodium	12.5	20.0
Potassium	1.7	4.6
Carbonate	2.4	0.0
Bicarbonate	112.0	112.0
Sulfate	22.3	19.2
Chloride	12.0	10.0
Nitrate	2.5	1.0
Silica	3.0	2.8
Calcium (acid)	-	28.0
Magnesium (acid)	-	7.3
Calculated TDS	-	148.2
Aluminum	-	0.08
Copper	-	0.01
Iodine	-	0.09
Iron	-	0.2
Lead	-	0.0
Manganese	-	0.1
Mercury	-	0.00011
Fluoride	0.1	0.2
Total Anions (epm)	2.759	2.534
Total Cations (epm)	2.527	3.002

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 93. Water analysis report (Alberta Research Council, Unpublished Data, Lab. No. 76 78, Index No. DH 349).

Location: Ells River, 6 mi northwest of Fort MacKay (Twp. 95 Rge. 11 Sec. 8 Lsd. -1)[a]

Date	29-03-75
Field pH	6.3
Field Temperature °C	0.0
Field Bicarbonate	107
Total Dissolved Solids	120.0
Hardness as $CaCO_3$	75.1
Alkalinity as $CaCO_3$	78.4
Specific Conductance (µmho/cm @ 25°C)	225
Laboratory pH	7.0
Calcium	23.0
Magnesium	4.3
Sodium	11.2
Potassium	1.7
Carbonate	0.0
Bicarbonate	98.0
Sulfate	16.0
Chloride	14.0
Nitrate	1.2
Silica	2.3
Calcium (acid)	27.0
Magnesium (acid)	6.4
Calculated TDS	121.9
Aluminum	0.06
Copper	0.0
Iodine	0.05
Iron	0.2
Fluoride	0.20
Total Anions (epm)	2.354
Total Cations (epm)	2.032
Lead	0.0
Manganese	0.1
Mercury	0.0002

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 94. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 119, Index No. DH 88).

Location: Eymundson Creek, confluence with Athabasca River (Twp. 98 Rge. 10 Sec. 9 Lsd. -1)[a]

Date	16-03-75
Field Specific Conductance (µmho/cm)	1100
Field pH	7.1
Field Temperature °C	0.0
Field Bicarbonate	673.0
Total Dissolved Solids	656.0
Hardness as $CaCO_3$	399.0
Alkalinity as $CaCO_3$	273.6
Specific Conductance (µmho/cm @ 25°C)	890.0
	8.2
Calcium	80.0
Magnesium	48.5
Sodium	65.0
Potassium	8.3
Carbonate	0.0
Bicarbonate	342.0
Sulfate	244.0
Chloride	12.0
Nitrate	3.1
Silica	25.2
Fluoride	1.60
Total Anions (epm)	11.074
Total Cations (epm)	11.020

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 95. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Eymundson Creek 00AT07DA2199[a]

Sample No.		6496
Date		19-09-72
Parameter	Code[b]	
pH	10301L	8.1
Specific Conductance (µmho/cm)	02041L	610
Total Hardness as $CaCO_3$	10605L	274
Total Alkalinity as $CaCO_3$	10101L	138
Sulfate	16302L	380
Chloride	17203L	9
Nitrate + Nitrite	07107L	0.8
Iron	26002L	6.4
Calcium	20101L	52
Magnesium	12103L	34
Sodium	11101L	31
Potassium	19101L	3.2
Ammonia Nitrogen	07551L	0.5
Phosphate	15406L	1.0
Turbidity (JTU)	02073L	73

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 96. Water sample analysis of the Athabasca River (Department of Energy and Natural Resources, Fish and Wildlife Division).

Water samples collected from sites on or near the Athabasca River were analyzed by the Alberta Department of Agriculture, Veterinary Service Division. The results were not published or put in any report.

Location: Firebag River[a]

Date Time: not given	22-03-68
Total Solids	294
Ignition Loss	116
Hardness	167
Sulfates	23
Chlorides	36
Alkalinity	140
Nature of Alkalinity	Bicarbonate of Lime + Magnesium
Nitrite Nitrogen	nil
Nitrate Nitrogen	nil
Iron	0.45
Oil	9

[a]All results expressed in mg/L.

Table 97. Water analysis report (Alberta Research Council, Unpbulished Data, Lab No. 75 107, Index No. DH 73).

Location: Firebag drainage basin, unnamed lake northeast of Muskeg Mountain (Twp. 94 Rge. 6 Sec. 11 Lsd. -1)[a]

Date	26-03-75
Field Specific Conductance (µmho/cm)	195
Field pH	5.5
Field Temperature °C	0.5
Field Bicarbonate	10.0
Total Dissolved Solids	126.0
Hardness as $CaCO_3$	22.0
Alkalinity as $CaCO_3$	11.7
Specific Conductance (µmho/cm @ 25°C)	-
Laboratory pH	6.3
Calcium	6.5
Magnesium	1.4
Sodium	2.5
Potassium	0.4
Carbonate	0.0
Bicarbonate	14.6
Sulfate	0.0
Chloride	1.0
Nitrate	4.7
Silica	6.5
Calcium (acid)	-
Magnesium (acid)	-
Fluoride	0.0
Total Anions (epm)	0.343
Total Cations (epm)	0.558

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 98. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Gardiner Lakes, channel between north and south lakes 01AT07DA2005[a]

Sample No.		5822
Date		31-07-72
Parameter	Code[b]	
pH	10301L	8.7
Specific Conductance (µmho/cm)	02041L	109
Alkalinity	10151L	2.19
Total Alkalinity as $CaCO_3$	10101L	51.2
Total Hardness as $CaCO_3$	10603L	57.4
Sulfate Dissolved	16303L	7.0
Chloride Dissolved	17203L	0.5
Nitrate + Nitrite	07106L	0.43
Total Kjeldahl Nitrogen	07001L	1.59
Ortho Phosphate	15255L	L 0.003
Dissolved Inorg. Phosphate	15363L	0.007
Calcium Dissolved	20101L	17.4
Magnesium Dissolved	12103L	3.3
Sodium Dissolved	11103L	2.7
Potassium Dissolved	19103L	0.8
Silica Reactive	14102L	0.5
Oil and Grease	06521L	127
Phenols	06531P	L 0.004
Tannins and Lignins	06551L	0.36
Fluorides	09105L	0.08
Colour	02011L	40
Turbidity (JTU)	02073L	5.5
Cadmium Extractable	48302P	L 0.001
Chromium Extractable	24302P	L 0.006
Cobalt Extractable	27302P	0.009
Copper Extractable	29305P	0.001
Iron Extractable	26307P	L 0.10
Lead Extractable	82302P	L 0.004
Manganese Extractable	25304P	0.045
Mercury Extractable	80301P	0.00039
Nickel Extractable	28302P	0.003
Zinc Extractable	30305P	L 0.001
Total Dissolved Solids Calc.		62

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 99. Water sample analysis (Pollution Control Lab oratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Gardiner Lakes, channel between north and south lakes 01AT07DA2005[a]

Sample No.		7408
Date		05-10-72
Parameter	Code[b]	
pH	10301L	7.7
Specific Conductance (µmho/cm)	02041L	118
Total Alkalinity as $CaCO_3$	10101L	50
Total Hardness as $CaCO_3$	10605L	53
Sulfate	16302L	15
Chloride	17203L	1
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	0.1
Calcium	20101L	15.2
Magnesium	12103L	3.6
Sodium	11101L	2
Potassium	19101L	1.0
Fluoride	09105L	L 0.05
Phosphate	15406L	0.2
Ammonia Nitrogen	07551L	0.3
Oil and Grease	06521L	1.9
Phenols	06531L	0.002
Tannins and Lignins	06551L	0.5
Colour - Filter 1	02026L	95
- Filter 2	02026L	94
- Filter 3	02026L	86
Threshold Odor Number	02001L	4
Turbidity (JTU)	02073L	2
Total Dissolved Solids	10471L	104
Surfactants	10701L	2.7
Cadmium	48004L	0.004
Chromium	24004L	0.003
Cobalt	27004L	0.004
Copper	29008L	0.004
Lead	82005L	0.006
Manganese	25006L	0.025
Mercury	80002L	L 0.0005
Nickel	28004L	0.055
Zinc	30006L	0.008
Arsenic	33003L	L 0.001

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 100. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Gardiner Lakes, channel between north and south lake 01AT07DA2005[a]

Sample No.		5166
Date		17-06-73
Time		1710
Parameter	Code[b]	
pH	10301L	7.9
Specific Conductance (µmho/cm)	02041L	119
Calcium	20101L	17
Magnesium	12103L	6
Sodium	11101L	3
Potassium	19101L	0.8
Iron	26002L	0.3
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07107L	L 0.1
Ammonia Nitrogen	07551L	1.3
Chloride	17203L	L 1
Sulfate	16302L	11
Bicarbonate	06201L	87
Total Alkalinity as $CaCO_3$	10101L	71
Total Hardness as $CaCO_3$	10602L	67
Threshold Odor Number	02001L	2
Colour - Filter 1	02026L	97.0
Filter 2	02026L	94.5
Filter 3	02026L	83.0
Turbidity (JTU)	02073L	9
Oil and Grease	06521L	L 1
Phenols	06531L	0.004
Tannins and Lignins	06551L	1.0
Phosphate	15406L	.2
Chlorophyll	06711L	0.007
Total Residue	10471L	112
Total Residue Fixed	10521L	30
Chemical Oxygen Demand	08301L	34
Cadmium	48004L	L 0.001
Chromium	24004L	0.001
Cobalt	27004L	L 0.001
Copper	29008L	0.005
Lead	82005L	L 0.001
Manganese	25006L	0.075
Mercury	80002L	0.0009
Zinc	30006L	L 0.01

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 101. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Gardiner Lakes, channel between north and south lakes 01AT07DA2005[a]

Sample No.		7310	7885	
Date		14-08-73	14-08-74	
Parameter	Code[b]			Backup Code
pH	10301L	7.9	7.5	
Specific Conductance (µS/cm)	02041L	110	115	
Calcium	02103L	7	24	05L
Magnesium	12102L	5	4	
Sodium	11102L	11	2	
Potassium	19102L	1.0	0.6	
Iron	26002L	0.2	0.3	
Nitrate	07107L	L 0.1	L 0.1	
Nitrate	07206L	L 0.1	L 0.1	
Chloride	17203L	5	1	
Sulfate	16302L	L 10	25	
Fluoride	09105L	L 0.05	0.15	
Bicarbonate	06201L	63	60	
Chemical Oxygen Demand	08301L	17	53	
Oil and Grease	06521L	1.1	2.0	
Phenols	06531L	0.002	0.005	32L
Tannins and Lignins	06551L	1.6	1.0	
Threshold Odor Number	02001L	2	2	
Turbidity (JTU)	02073L	3	2	
Total Residue	10471L	78	-	
Total Residue Fixed	10521L	60	-	
Ammonia Nitrogen	07551L	L 0.2	0.5	
Total Phosphate	15406L	0.7	L 0.1	
Chlorophylla	06711L	0.010	0.006	
Colour - Filter 1	02026L	94	94	
- Filter 2	02026L	94	90	
- Filter 3	02026L	83	86	
Cadmium	48005L	L 0.001	L 0.001	
Chromium	24005L	L 0.001	0.016	
Cobalt	27005L	L 0.001	L 0.001	
Copper	29009L	L 0.001	0.013	
Lead	82006L	0.002	L 0.001	
Manganese	25007L	0.023	0.036	
Mercury	80002L	L 0.0002	L 0.0001	
Nickel	28005L	L 0.001	0.003	
Zinc	30006L	0.013	0.02	
Total Alkalinity as $CaCO_3$	10101L	52	49	
Total Hardness as $CaCO_3$	10602L	41	77	04L
Total Dissolved Solids	00202L	70	73	03L

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to: Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 102. Gregoire Lake study, May 1969 (Department of Natural Resources, Fish and Wildlife Division).

The report covers morphology, physical and chemical data, inflow and outflow, plankton, bottom fauna, and fish fauna.

Location: Gregoire Lake, one-half mile south-southwest of island (Twp. 86 Rge. 7 W. 4)[a]

Date	22-05-69	
Depth in feet	Surface	23
Temperature °C	12	8.4
Dissolved Oxygen	9	9
Phenolphthalein Alkalinity	nil	nil
Total Alkalinity	50	55
Calcium Hardness	40	40
Total Hardness	50	50
pH	7.6	7.8
Total Dissolved Solids	96	95

[a]All results except pH expressed in mg/L.

Table 103. Water Sample Analyses (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Gregoire Lake 01AT07CE2002[a]

Parameter	Code						Backup Code
Date		31-07-72	05-10-72	18-06-73	14-08-73	19-08-74	03-07-75	
Time		1200	1200	0800	1130	1200	1200	
Temperature °C	02061F	-	-	-	-	-	20	
pH	10301L	8.1	8.0	7.8	8.2	8.3	7.9	
Specific Conductance (µmho/cm)	02041L	108	100	114	110	150	171	
Total Alkalinity as $CaCO_3$	10101L	46	46	70	45	30	105	
Total Hardness as $CaCO_3$	10604L	-	51	-	-	66	69	
Total Hardness as $CaCO_3$	10602L	54	48	66	39	-	-	
Carbonate	06301L	-	4	0	0	0	0	
Bicarbonate	06201L	-	49	85	55	37	128	
Oil and Grease	06521L	147	1	L 1	L 1	1	2	
Phenols	06532L	0.018	0.004	0.007	0.004	0.002	0.062	
Surfactants	10701L	-	2.6	-	-	-	-	
Threshold Odor Number	02001L	-	2	4	2	1	1	
Chemical Oxygen Demand	08301L	-	-	38	35	28	L 5.0	
Nitrite Nitrogen	07206L	-	-	-	L 0.1	L 0.1	L 0.1	
Nitrate + Nitrite	07107L	0.0	L 0.1	L 0.1	L 0.1	L 0.1	L 0.1	
Ammonia Nitrogen	07551L	-	0.2	1.4	L 0.2	L 0.2	L 0.2	
Phosphate	15407L	-	0.1	0.2	0.6	L 0.1	0.1	
Chloride Dissolved	17203L	1	4	1	6	3	L 1	
Sulfate Dissolved	16302L	10	6	12	14	36	15	
Fluoride Dissolved	09105L	0.08	0.09	-	0.10	0.12	0.20	
Calcium Calculated	20105L	15	17	-	-	22	21	
Calcium Dissolved	20101L	15	16	15	9	-	-	
Magnesium Dissolved	12102L	4	2	7	4	3	4	
Sodium Dissolved	11102L	2	L 1	3	11	2	1	
Potassium Dissolved	19102L	0.9	0.4	0.9	1.5	0.9	0.8	
Turbidity (JTU)	02073L	4	3	14	5	4	-	
Total Dissolved Solids	00203L	67	-	-	76	86	105	05L
Total Residue	10471L	-	130	156	70	-	-	

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued...

Table 103. Concluded.

Parameter	Code[a]											
Date Time		31-07-72 1200		05-10-72 1200		18-06-73 0800		14-08-73 1130		19-08-74 1200		03-07-75 1200
Total Residue Volatile	10521L	-		-		56.0		40.0		-		-
Chlorophyll	06711L	-		-		0.007		0.13		0.021		-
Kjeldahl Nitrogen	07001L	0.8		-		-		-		-		-
Silica Reactive	14102L	7.1		-		-		-		-		-
Tannins and Lignins	06551L	0.26		0.4		1.5		0.9		0.9		0.7
Cadmium	48005L	-		0.004	L	0.001	L	0.001	L	0.001		-
Cadmium Extractable	48304L	L 0.001		-		-		-		-	L	0.001
Chromium	24005L	-		-		-	L	0.001	L	0.001		-
Chromium Extractable	24304L	L 0.006		-		-		-		-	L	0.001
Cobalt	27005L	-		0.004		0.019	L	0.001	L	0.001		-
Cobalt Extractable	27303L	0.008		-		-		-		-	L	0.001
Copper	29009L	-		0.004		0.008		0.004		0.010		-
Copper Extractable	29302L	0.001		-		-		-		-	L	0.001
Iron	26002L	-	L	0.1		0.5		2.0		-		-
Iron Extractable	26302L	L 0.1		-		-		-		0.5	L	0.1
Manganese	25007L	-		0.065		0.128		0.012		0.027		-
Manganese Extractable	25301L	0.075		-		-		-		-		0.013
Mercury	80003L	-	L	0.0005	L	0.0002	L	0.0002		-	L	0.0001
Mercury Extractable	80301L	0.00008		-		-		-		-		-
Nickel	28005L	-		0.004		0.030	L	0.001		0.004		-
Nickel Extractable	28303L	0.004		-		-		-		-		0.002
Lead	82006L	-		0.025	L	0.001	L	0.001	L	0.001		-
Lead Extractable	82304L	L 0.004		-		-		-		-	L	0.001
Zinc	30006L	-		0.015	L	0.01		0.013		0.05		-
Zinc Extractable	30305L	L 0.001		-		-		-		-		-

[a]For a description of the procedures used refer to: Alberta Environment, 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 104. Gregoire Lake study, May 1969 (Department of Natural Resources, Fish and Wildlife Division).

The report covers morphology, physical and chemical data, inflow and outflow, plankton, bottom fauna, and fish fauna.

Location: Gregoire River[a]

Date	22-05-69
Depth in feet	2
Temperature °C	9
Dissolved Oxygen	10
Phenolphthalein Alkalinity	nil
Total Alkalinity	50
Calcium Hardness	35
Total Hardness	50
pH	7.8
Total Dissolved Solids	83

[a]All results except pH expressed in mg/L.

Table 105. Aquatic studies on the various rivers in the Fort McMurray region: Horse River, Hangingstone River, and Clearwater River, September 1972 (Department of Natural Resources, Fish and Wildlife Division).

The report covers geographical and geological characteristics of each river plus biological and chemical characteristics of various sample sites in each river system.

Location: Hangingstone River (Sec. 9 Twp. 89 Rge. 9)[a]

Date	20-09-72
Temperature °C	6
Dissolved Oxygen	9.6
pH Field	8.8
Laboratory	8.3
Specific Conductance	475
Total Hardness $CaCO_3$	190
Total Alkalinity $CaCO_3$	120
Sulfate	39
Chloride	17
Nitrate + Nitrite	L 0.1
Iron	0.1
Calcium	64
Magnesium	7
Sodium	35
Potassium	2.6
Phosphate	0.1
Ammonia Nitrogen	0.6
Turbidity	L 1

[a]All results except pH, specific conductance (µmho/cm), and turbidity (JTU) expressed in mg/L.

Table 106. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 38, Index No. DH 318).

Location: Hangingstone River, confluence to Clearwater River (Twp. 89 Rge. 9 Sec. 10 Lsd. 13)[a]

Date	10-01-76
Field pH	7.5
Field Temperature °C	0.0
Field Bicarbonate	356
Total Dissolved Solids	380.0
Hardness as $CaCO_3$	237.1
Alkalinity as $CaCO_3$	279.2
Specific Conductance (µmho/cm @ 25°C)	710
Laboratory pH	7.7
Calcium	66.0
Magnesium	17.6
Sodium	47.0
Potassium	1.7
Carbonate	0.0
Bicarbonate	349.0
Sulfate	47.5
Chloride	34.0
Nitrate	1.2
Silica	1.4
Calcium (acid)	75.0
Magnesium (acid)	20.0
Calculated TDS	388.0
Aluminum	0.0
Copper	0.0
Iodine	0.04
Iron	0.7
Lead	0.0
Manganese	0.1
Mercury	0.00022
Fluoride	0.40
Total Anions (epm)	7.688
Total Cations (epm)	6.830

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 107. Aquatic studies on the various rivers in the Fort McMurray region: Horse River, Hangingstone River, and Clearwater River, September 1972 (Department of Natural Resources, Fish and Wildlife Division).

The report covers geographical and geological characteristics of each river plus biological and chemical characteristics of various sample sites in each river system.

Location: Hangingstone River (Sec. 33 Twp. 85 Rge. 9)[a]

Date	16-09-72
Temperature °C	6
Dissolved Oxygen	9.2
pH Field	8.4
Laboratory	8.2
Specific Conductance	362
Total Hardness $CaCO_3$	172
Total Alkalinity $CaCO_3$	192
Sulfate	L 5.
Chloride	L 1.
Nitrate + Nitrite	L 0.1
Iron	0.3
Calcium	67
Magnesium	L 1.
Sodium	6
Potassium	2.0
Phosphate	0.3
Ammonia Nitrogen	0.4
Turbidity	13

[a]All results except pH, specific conductance (µmoh/cm), and turbidity (JTU) expressed in mg/L.

Table 108. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 9, Index No. DH 315).

Location: Hangingstone River, crossing Highway 63 by Stoney Mountain (Twp. 85 Rge. 9 Sec. 32 Lsd. -1)[a]

Date	10-01-76
Field pH	7.2
Field Temperature °C	0.0
Field Bicarbonate	332
Total Dissolved Solids	300.0
Hardness as $CaCO_3$	229.7
Alkalinity as $CaCO_3$	287.2
Specific Conductance (µmho/cm @ 25°C)	600
Laboratory pH	7.7
Calcium	66.0
Magnesium	15.8
Sodium	32.5
Potassium	4.2
Carbonate	0.0
Bicarbonate	359.0
Sulfate	29.5
Chloride	4.0
Nitrate	3.7
Silica	16.2
Calcium (acid)	72.0
Magnesium (acid)	17.1
Calculated TDS	348.4
Aluminum	0.08
Copper	0.00
Iodine	0.01
Iron	1.4
Lead	0.00
Manganese	0.3
Mercury	0.0001
Fluoride	0.40
Total Anions (epm)	6.671
Total Cations (epm)	6.115

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 109. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 11, Index No. DH 319).

Location: Unnamed creek, crossing Highway 63, 1 mi north of rifle range, tributary to Hangingstone River (Twp. 87 Rge. 9 Sec. 26 Lsd. -1)[a]

Date	10-01-76
Field pH	6.9
Field Temperature °C	0.0
Field Bicarbonate	293
Total Dissolved Solids	444.0
Hardness as $CaCO_3$	232.9
Alkalinity as $CaCO_3$	288.8
Specific Conductance (µmho/cm @ 25°C)	780
Laboratory pH	7.5
Calcium	62.0
Magnesium	19.0
Sodium	66.0
Postassium	2.1
Carbonate	0.0
Bicarbonate	361.0
Sulfate	13.3
Chloride	54.0
Nitrate	3.1
Silica	13.7
Calcium (acid)	62.0
Magnesium (acid)	20.7
Calculated TDS	410.7
Aluminum	0.24
Copper	0.04
Iodine	0.05
Iron	4.4
Lead	0.02
Manganese	0.4
Mercury	0.00012
Fluoride	0.20
Total Anions (epm)	7.767
Total Cations (epm)	7.582

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 110. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 10, Index No. DH 317).

Location: Unnamed creek, crossing Highway 63, 3 mi south of rifle range, tributary to Hangingstone River (Twp. 87 Rge. 9 Sec. 2 Lsd. -1)[a]

Date	10-01-76
Field pH	7.2
Field Temperature °C	0.0
Field Bicarbonate	683
Total Dissolved Solids	864.0
Hardness as $CaCO_3$	385.3
Alkalinity as $CaCO_3$	523.2
Specific Conductance (µmho/cm @ 25°C)	1770
Laboratory pH	7.1
Calcium	100.0
Magnesium	33.0
Sodium	179.0
Potassium	2.9
Carbonate	0.0
Bicarbonate	654.0
Sulfate	30.1
Chloride	4.0
Nitrate	2.5
Silica	19.9
Calcium (acid)	108.0
Magnesium (acid)	36.0
Calculated TDS	693.0
Aluminum	0.26
Copper	0.02
Iodine	0.1
Iron	6.8
Lead	0.01
Manganese	2.6
Mercury	0.00028
Fluoride	0.40
Total Anions (epm)	11.499
Total Cations (epm)	15.566

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table III. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Hartley Creek (Sec. 19 Twp. 95 Rge. 9)[a]

Date (m-yr)	05-74	07-74	10-74	02-75
Temperature °F	37	60	40	34
Color (Cl-Pt)	100	125	95	40
Conductivity (µmho/cm @ 77°F)	116	184	238	588
Suspended Solids	9	5	4	8
Total Solids	113	180	281	544
Turbidity (JTU)	L 25	3	3	11
pH	7.3	7.5	8.0	8.2
Total Hardness	60	98	104	275
Calcium	19	31	27	79
Magnesium	3	5	9	19
Sodium + Potassium	4	8	16	32
Bicarbonate	67	116	149	381
Carbonate	0	0	0	0
Chloride	5	11	8	8
Hydroxide	0	0	0	0
Sulfate	6	4	5	7
Total Dissolved Solids	104	175	214	536
Alkalinity as $CaCO_3$	55	95	122	312
Silica	2	3	3	5
Oil and Grease	L 1	2	L 1	1
Organic Carbon	L 1	30	32	27
Dissolved Oxygen	5.7	9.2	-	4.4
Phenols (µg/l)	L 2	L 2	L 2	L 2
Sulfides	L 0.01	L 0.01	L 0.01	L 0.01
Total Phosphate	0.1	L 0.1	L 0.1	0.3
Ammonia Nitrogen	0.5	0.9	0.9	0.9
Nitrate Nitrogen	0.6	0.3	0.2	0.7
Organic Nitrogen	3	17	L 1	L 1
Chemical Oxygen Demand	44	55	63	39
Biochemical Oxygen Demand	1	1	1	2

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 112. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Hartley Creek (Sec. 20 Twp. 95 Rge. 9)[a]

Date (m-yr)	10-73
Temperature °F	32
Colour (Cl-Pt)	130
Specific Conductance (µmho/cm @ 77°F)	160
Suspended Solids	2
Total Solids	-
Turbidity (JTU)	3
pH	8.0
Total Hardness	90
Calcium	-
Magnesium	-
Sodium + Potassium	13.6
Bicarbonate	-
Carbonate	-
Chloride	1
Hydroxide	-
Sulfate	-
Total Dissolved Solids	210
Alkalinity as $CaCO_3$	105
Silica	-
Oil and Grease	3
Organic Carbon	29
Dissolved Oxygen	13.5
Phenols (µg/L)	L 2
Sulfides	L 0.05
Total Phosphate	L 0.05
Ammonia Nitrogen	-
Nitrate Nitrogen	-
Organic Nitrogen	0.84
Chemical Oxygen Demand	52
Biochemical Oxygen Demand	L 1

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 113. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Hartley Creek (Sec. 9 Twp. 95 Rge. 9)[a]

Date	04-73	02-74
Temperature °F	-	32
Colour (Cl-Pt)	-	60
Specific Conductance (µmho/cm @ 77°F)	-	-
Suspended Solids	4	9
Total Solids	134	560
Turbidity (JTU)	-	L 25
pH	7.6	8.1
Total Hardness	-	299
Calcium	-	82
Magnesium	-	3
Sodium + Potassium	-	25
Bicarbonate	-	404
Carbonate	-	0
Chloride	-	12
Hydroxide	-	0
Sulfate	-	5
Total Dissolved Solids	130	551
Alkalinity as $CaCO_3$	-	331
Silica	-	8
Oil and Grease	1	L 1
Organic Carbon	-	26
Dissolved Oxygen	-	6.8
Phenols (µg/L)	L 2	L 2
Sulfides	L 0.01	L 0.01
Total Phosphate	0.02	0.4
Ammonia Nitrogen	0.94	1.6
Nitrate Nitrogen	-	0.8
Organic Nitrogen	1	-
Chemical Oxygen Demand	59	65
Biochemical Oxygen Demand	2	4

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 114. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 109, Index No. DH 75).

Location: Hartley Creek, southwest fork, 1.25 mi from junction with southeast fork (Twp. 94 Rge. 9 Sec. 20 Lsd. -L) 1 mi south of AOSERP Station 00AT07DA0087[a]

Date	01-03-75
Field Conductivity (µmho/cm)	925
Field pH	7.2
Field Temperature °C	0.0
Field Bicarbonate	360.0
Total Dissolved Solids	348.0
Hardness as $CaCO_3$	253.6
Alkalinity as $CaCO_3$	280.8
Specific Conductance (µmho/cm @ 25°C)	510.0
Laboratory pH	8.2
Calcium	71.0
Magnesium	18.6
Sodium	28.8
Potassium	0.8
Carbonate	0.0
Bicarbonate	351.0
Sulfate	1.6
Chloride	1.0
Nitrate	6.1
Silica	15.6
Total Anions (epm)	5.913
Total Cations (epm)	6.346

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 115. Aquatic studies on the various rivers in the Fort McMurray region: Horse River, Hangingstone River, and Clearwater River, September 1972 (Department of Natural Resources, Fish and Wildlife Division).

The report covers geographical and geological characteristics of each river plus biological and chemical characteristics of various sample sites in each river system.

Location: Horse River (Sec. 17 Twp. 89 Rge. 9)[a]

Date		29-08-72
Temperature °C		16
Dissolved Oxygen		9.4
pH	Field	8.8
	Laboratory	8.1
Specific Conductance	Field	-
	Laboratory	325
Total Hardness $CaCO_3$		120
Total Alkalinity $CaCO_3$		141
Sulfate		36
Chloride		10
Nitrate + Nitrite		L 0.1
Iron		0.6
Calcium		35
Magnesium		7
Potassium		1.6
Phosphate		0.3
Ammonia Nitrogen		1.0
Turbidity		5
Sodium		24

[a]All results except pH, specific conductance (µmho/cm), and turbidity (JTU) expressed in mg/L.

Table 116. Aquatic studies on the various rivers in the Fort McMurray region: Horse River, Hangingstone River, and Clearwater River, September 1972 (Department of Natural Resources, Fish and Wildlife Division).

The report covers geographical and geological characteristics of each river plus biological and chemical characteristics of various sample sites in each river system.

Location: Unnamed tributary of Horse River (Sec. 25 Twp. 84 Rge. 11)[a]

Date		16-09-72
Temperature °C		6
Dissolved Oxygen		5.0
pH	Field	8.4
	Laboratory	8.2
Specific Conductance	Field	320
	Laboratory	395
Total Hardness $CaCO_3$		182
Total Alkalinity $CaCO_3$		198
Sulfate		31
Chloride		1
Nitrate + Nitrite		0.1
Iron		0.2
Calcium		60
Magnesium		7
Sodium		17
Potassium		2.6
Phosphate		0.5
Ammonia Nitrogen		0.3
Turbidity		2

[a]All results except pH, specific conductance (µmho/cm), and turbidity (JTU) expressed in mg/L.

Table 117. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 79, Index No. DH 350).

Location: Joslyn Creek, one-half mile upstream of WSC gauge (Twp. 95 Reg. 11 Sec. 29 Lsd. -1)[a]

Date	24-02-76
Field pH	7.0
Field Bicarbonate	429
Field Temperature °C	0.0
Total Dissolved Solids	476.0
Hardness as $CaCO_3$	223.0
Alkalinity as $CaCO_3$	257.6
Specific Conductance (µmho/cm @ 25°C)	810
Laboratory pH	7.2
Calcium	62.0
Magnesium	16.6
Sodium	64.0
Potassium	3.3
Carbonate	0.0
Bicarbonate	322.0
Sulfate	111.0
Chlcride	10.0
Nitrate	3.9
Silica	13.0
Calcium (acid)	90.0
Magnesium (acid)	22.0
Calculated TDS	442.1
Aluminum	0.06
Copper	0.01
Iodine	0.04
Iron	0.1
Lead	0.06
Manganese	0.01
Mercury	0.0007
Fluoride	0.40
Total Anions (epm)	7.934
Total Cations (epm)	7.328

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 118. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 111, Index No. DH 77).

Location: Kearl Lake near outlet (Twp. 95 Rge. 8 Sec. 29 Lsd. -L)[a]

Date	24-02-75
Field Conductivity (µmho/cm)	550
Field pH	7.0
Field Temperature °C	2.0
Field Bicarbonate	157.0
Total Dissolved Solids	216.0
Hardness as $CaCO_3$	106.7
Alkalinity as $CaCO_3$	123.2
Specific Conductance (µmho/cm @ 25°C)	270
Laboratory pH	8.2
Calcium	27.6
Magnesium	9.2
Sodium	17.5
Potassium	2.9
Carbonate	0.0
Bicarbonate	154.0
Sulfate	0.0
Chloride	4.0
Nitrate	3.6
Silica	8.5
Fluoride	1.20
Total Anions (epm)	2.695
Total Cations (epm)	2.969

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 119. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 85, Index No. DH 356).

Location: MacKay River, confluence with Athabasca River (Twp. 94 Rge. 11 Sec. 24 Lsd. -1)[a]

Date	25-02-76
Field pH	7.6
Field Bicarbonate	356
Total Dissolved Solids	424.0
Hardnesss as $CaCO_3$	240.1
Alkalinity as $CaCO_3$	269.6
Specific Conductance (µmho/cm @ 25°C)	790
Laboratory pH	7.3
Calcium	69.0
Magnesium	16.5
Sodium	67.0
Potassium	3.3
Carbonate	0.0
Bicarbonate	337.0
Sulfate	51.0
Chloride	42.0
Nitrate	4.5
Silica	11.7
Calcium (acid)	76.0
Magnesium (acid)	21.0
Calculated TDS	430.7
Aluminum	0.04
Copper	0.01
Iodine	0.11
Iron	0.8
Lead	0.0
Manganese	0.1
Mercury	0.0001
Fluoride	0.20
Total Anions (epm)	7.843
Total Cations (epm)	7.800

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 120. Fort MacKay settlement water supply report, 7 May 1969 (H.A. Kerr: Soils, Geology, and Groundwater Branch, Department of Agriculture; D.A. Shillabeer: Environmental Health Services Division, Department of Health).

An investigation of all potential water supplies for the settlement was conducted on 7 May 1969. The Athabasca River, MacKay River, and the Beaver River were included in those sources sampled.

Location: MacKay River, Fort MacKay[a]

Date	07-05-69
pH	7.7
Alkalinity	48
Threshold Odor No.	8
Type	Musty
Oils + Greases	1.9
Chlorides	2
Total Phosphates	0.43
Iron	1.3
Ammonia Nitrogen	1.6
Nitrate Nitrogen	0.19
Sulfates	12
Total Hardness	580
Calcium Hardness	420
Fluorides	0.15
Total Residue	282
Ignition Loss	148
Total Suspended Solids	131
Ignition Loss	10
Turbidity (JTU)	35
Colour Hazen Units	84
Total Coliform MPN/100ml	4.5
MPN E. coli/100ml	4.5
Standard	1500

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 121. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 120, Index No. DH 89).

Location: MacKay River, Fort MacKay at bridge (Twp. 94 Rge. 11 Sec. 23 Lsd.-1).[a]

Date	16-03-75
Field Specific Conductance (µmho/cm)	750
Field pH	7.7
Field Temperature °C	0.0
Field Carbonate	0.0
Field Bicarbonate	461.0
Total Dissolved Solids	542.0
Hardness as $CaCO_3$	269.8
Alkalinity as $CaCO_3$	324.7
Specific Conductance (µmho/cm @ 25°C)	830.0
Laboratory pH	8.5
Calcium	62.0
Magnesium	28.0
Sodium	96.0
Potassium	5.4
Carbonate	9.6
Bicarbonate	386.0
Sulfate	103.0
Chloride	40.0
Nitrate	5.0
Silica	12.9
Fluoride	0.20
Total Anions (epm)	10.000
Total Cations (epm)	9.710

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 122. Baseline study of the water quality and aquatic resources of the MacKay River, Alberta (Syncrude Canada, Environmental Research Monograph 1978-4; P. MacCart, P. Tsui, W. Grant, R. Green, D. Tripp, Aquatic Environments Ltd).

Three locations along the MacKay River were sampled on eight occasions from March 1977 to January 1978. One of the objectives of the study was to describe seasonal variations of various physical and chemical characteristics of the MacKay River as it flows into Syncrude's Lease 17 and on into the Athabasca River. The periphyton, macroinvertebrate, and fishery communities of the river were also studied.

Location: MacKay River, 1.75 km before confluence with Athabasca River[a]

Date (m-yr)	03-77	05-77	06-77	07-77	08-77
Total Dissolved Solids	735	280	225	175	215
Total Volatile Solids	375	130	105	100	110
True Colour APHA Units	47	110	160	165	125
Total Solids	755	290	285	190	270
Chemical Oxygen Demand	160	29	79	150	77
Suspended Solids	5.8	12.0	32.6	9.1	2.6
Conductivity µmho/cm	-	-	199	194	276
pH	7.1	7.5	7.4	7.8	7.6
Hardness	324	80	84	88	108
Dissolved Oxygen	6.2	8.6	8.0	8.4	9.2
Temperature °C	0	15	18	18	16
Percent Saturation-DO	43	84	84	88	92
Bicarbonate as $CaCO_3$	330	108	97	98	115
Alkalinity as $CaCO_3$	366	108	97	98	115
Carbonate as $CaCO_3$	36	0	0	0	0
Turbidity JTU-Shaken	9.7	6.4	8.6	6.8	4.3
Settled	7.4	3.3	3.2	3.9	2.8
Sodium	71.9	16	15.6	10.9	19.0
Potassium	4.9	2.0	1.4	0.5	1.0
Calcium	86	23	19.2	20.4	32.0
Magnesium	39	9.6	8.0	8.5	10.7
Iron	1.0	0.7	0.6	0.7	1.0
Sulfate	90	23	14	14	27
Chloride	27.5	0.5	1.0	0.5	3.0
Nitrate Nitrogen	0.288	0.004	0.004	0.003	0.009
Total Nitrogen	0.720	0.780	0.595	0.685	0.516
Ortho Phosphate-P	0.022	0.011	0.022	0.033	0.021
Total Phosphorus	0.054	0.079	0.082	0.087	0.033
Total Organic Carbon	20.9	18.6	28.8	10.5	22.65
Mercury	0.002	0.0016	-	0.001	0.0009
Silica	8.1	0.86	1.32	1.66	0.54
Boron	0.8	L 0.05	0.7	1.0	0.6
Lead	-	L 0.002	L 0.002	0.02	L 0.002
Nickel	L 0.01	0.15	0.01	L 0.01	0.02
Vanadium	L 0.001	L 0.001	L 0.001	L 0.001	L 0.001

[a]All results except pH expressed in mg/L unless otherwise indicated.

continued...

Table 122. Continued.

Date (m-yr)	03-77	05-77	06-77	07-77	08-77
Aluminum	L 0.04	0.22	-	-	-
Chromium	L 0.01	L 0.01	-	-	-
Cobalt	L 0.008	L 0.005	-	-	-
Copper	L 0.001	0.02	-	-	-
Zinc	0.04	L 0.02	-	-	-
Cadmium	0.44	0.01	-	-	-
Oil & Grease	6.8	7.4	-	-	-
Phenols	0.03	0.02	-	-	-

continued ...

Table 122. Concluded.

Date (m-yr)	09-77	12-77	01-78
Total Dissolved Solids	224	430	420
Total Volatile Solids	136	128	72
True Colour APHA Units	120	140	110
Total Solids	256	465	544
Chemical Oxygen Demand	58	103	68
Suspended Solids	0.9	2.8	5.8
Conductivity µmho/cm	314	571	742
pH	7.2	7.7	7.6
Hardness	88	188	264
Dissolved Oxygen	9.8	12.2	8.7
Temperature °C	13	0	0
Percent Saturation - DO	92	84	60
Bicarbonate as $CaCO_3$	142	284	338
Alkalinity as $CaCO_3$	142	284	338
Carbonate as $CaCO_3$	0	0	0
Turbidity JTU-Shaken	3.5	9.2	9.3
Settled	3.2	6.1	7.5
Sodium	34.3	45	63
Potassium	1.3	2.7	3.1
Calcium	33.5	51	57
Magnesium	13.1	37	31
Iron	0.3	1.3	1.0
Sulfate	26	40	51
Chloride	4	14	17.5
Nitrate Nitrogen	0.023	0.186	0.378
Total Nitrogen	0.715	1.160	1.140
Total Phosphorus	0.028	0.084	0.098
Ortho Phosphate-P	0.013	0.045	0.041
Total Organic Carbon	18.3	26.9	36.3
Mercury	0.0015	0.001	L 0.001
Silica	0.66	4.1	6.05
Boron	L 0.2	L 0.2	0.6
Lead	L 0.002	0.01	L 0.002
Nickel	0.04	L 0.01	L 0.01
Vanadium	L 0.001	L 0.001	L 0.001

Table 123. Water sample analysis (Pollution Control Laboraotry, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: MacKay River, before confluence with Dover River 00AT07DB2176[a]

Sample No.		5818
Date		31-07-72
Parameter	Code[b]	
pH	10301L	8.26
Specific Conductance (µmho/cm)	02041L	293
Calcium Dissolved	20101L	34.5
Magnesium Dissolved	12103L	10
Sulfate Dissolved	16303L	21.0
Sodium Dissolved	11103L	21.7
Chloride Dissolved	17203L	5.4
Fluoride Dissolved	09105L	0.11
Potassium Dissolved	19103L	0.7
Silica Reactive	14102L	0.4
Total Kjeldahl Nitrogen	07001L	1.44
Nitrate + Nitrite	07106L	0.43
Dissolved Ortho Phosphate	15255L	0.010
Dissolved Inorg. Phosphate	15363L	0.022
Total Alkalinity as $CaCO_3$	10101L	128
Total Hardness as $CaCO_3$	10603L	127
Turbidity (JTU)	02073L	1.5
Colour	02011L	150
Oil and Grease	06521L	300
Phenols	06531P	0.008
Tannins and Lignins	06551L	1.12
Cadmium Extractable	48302P	0.001
Chromium Extractable	24302P	L 0.006
Cobalt Extractable	27302P	0.009
Copper Extractable	29305P	0.006
Iron Extractable	26307P	0.70
Lead Extractable	82302P	L 0.004
Manganese Extractable	25304P	0.025
Mercury Extractable	80301P	0.00009
Nickel Extractable	28302P	0.005
Zinc Extractable	30305P	L 0.001
Total Dissolved Solids		172

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 124. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: MacKay River, before confluence with Dover River 00AT07DB2176[a]

Sample No.		6499	7522
Date		23-08-72	24-09-72
Parameter	Code[b]		
pH	10301L	8.3	7.9
Specific Conductance (µmho/cm)	02041L	465	350
Total Alkalinity as $CaCO_3$	10101L	193	158
Total Hardness as $CaCO_3$	10605L	180	144
Sulfate	16302L	58	70
Chloride	17203L	16	2
Nitrate + Nitrite	07107L	L 0.1	L 0.1
Iron	26002L	0.2	1.0
Calcium	20101L	49	51
Magnesium	12103L	13	3
Sodium	11101L	49	24
Potassium	19101L	2.0	1.4
Phosphate	15406L	0.2	0.5
Ammonia Nitrogen	07551L	0.3	0.7
Turbidity (JTU)	02073L	3	14

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 125. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: MacKay River, before confluence with Dover River 00AT07DB1176[a]

Sample No.		7410
Date		05-10-72
Parameter	Code	
pH	10301L	8.2
Specific Conductance (µmho/cm)	02041L	400
Total Alkalinity as $CaCO_3$	10101L	191
Total Hardness as $CaCO_3$	10605L	163
Sulfate	16302L	49
Chloride	17203L	8
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	0.5
Calcium	20101L	44
Magnesium	12103L	12
Sodium	11101L	39
Potassium	19101L	1.6
Fluoride	09105L	L 0.05
Phosphate	15406L	0.2
Ammonia Nitrogen	07551L	L 0.1
Oil and Grease	06521L	5.4
Phenols	06531L	L 0.001
Tannins and Lignins	06551L	1.5
Colour Filter 1	02026L	85.0
Filter 2	02026L	81.0
Filter 3	02026L	62.5
Threshold Odor Number	02001L	2
Turbidity (JTU)	02073L	4
Total Solids	10471L	338
Surfactants	10701L	2.7
Cadmium	48004L	0.004
Chromium	24004L	0.006
Cobalt	27004L	0.004
Copper	29008L	0.004
Lead	82005L	0.016
Manganese	25006L	0.030
Mercury	80002L	L 0.0005
Zinc	30006L	0.008
Arsenic	33003L	L 0.001

[a]All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 126. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: MacKay River, before confluence with Dover River 00AT07DB2176[a]

Sample No.		5160
Date		17-06-73
Time		1845
Parameter	**Code**	
pH	10301L	8.1
Specific Conductance (µmho/cm)	02041L	162
Total Alkalinity as $CaCO_3$	10101L	-
Total Hardness as $CaCO_3$	10602L	-
Calcium	20101L	32
Magnesium	12103L	12
Sodium	11101L	13
Potassium	19101L	1.1
Iron	26002L	45.5
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07107L	L 0.1
Chloride	17203L	4
Sulfate	16302L	170
Bicarbonate	06201L	84
Turbidity (JTU)	02073L	G 15
Threshold Odor Number	02001L	2
Colour - Filter 1	02026L	59.5
Filter 2	02026L	55.5
Filter 3	02026L	29.0
Oil and Grease	06521L	3.6
Phenols	06531L	0.005
Tannins and Lignins	06551L	4.25
Ammonia Nitrogen	07551L	2.4
Phosphate	15406L	4.0
Total Residue	10471L	2374
Total Residue Volatile	10521L	308
Nonfilterable Residue		2200
Cadmium	48004L	0.001
Chromium	24004L	0.075
Cobalt	27004L	0.064
Copper	29008L	0.050
Lead	82005L	0.030
Manganese	25006L	1.400
Mercury	80002L	L 0.0002
Nickel	28004L	0.070
Zinc	30006L	L 0.01
Chemical Oxygen Demand	08301L	78

[a]All results except pH expressed in mg/L, unless otherwise indicated.
b For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 127. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: MacKay River, before confluence with Dover River 00AT07DB2176[a]

Sample No.		7302	7889	
Date		14-08-73	19-08-74	
Time		1710	1720	
Parameter	Code[b]			Backup Codes
pH	10301L	8.3	8.3	
Specific Conductance (µS/cm)	02041L	200	280	
Total Alkalinity as $CaCO_3$	10101L	101	118	
Total Hardness as $CaCO_3$	10602L	92	120	04L
Calcium	02103L	22	32	20105L
Magnesium	12103L	8	10	02L
Sodium	11102L	13	14	
Potassium	19102L	0.9	0.8	
Iron	26002L	1.8	L 0.1	302L
Nitrate	07107L	L 0.1	L 0.1	
Nitrite	07206L	L 0.1	L 0.1	
Chloride	17203L	6	5	
Sulfate	16302L	19	50	
Fluoride	09105L	L 0.05	0.17	
Bicarbonate	06201L	123	144	
Chemical Oxygen Demand	08301L	30	50	
Turbidity (JTU)	02073L	8	5	
Threshold Odor Number	02001L	2	4	
Colour - Filter 1	02026L	86	90	
Filter 2	02026L	79	84	
Filter 3	02026L	49	55	
Oil and Grease	06521L	-	1.4	
Phenols	06531L	0.022	0.002	
Tannins and Lignins	06551L	4.5	3.3	
Ammonia Nitrogen	07551L	L 0.2	2.1	
Phosphate	15406L	1.0	L 0.2	07L
Cadmium	48005L	0.005	L 0.001	
Chromium	24005L	L 0.001	0.016	
Cobalt	27005L	L 0.001	L 0.001	
Copper	29009L	L 0.001	0.008	
Lead	82006L	0.004	L 0.001	
Manganese	25007L	0.020	0.009	
Mercury	80002L	L 0.0002	0.0003	03L
Nickel	28005L	0.002	0.008	
Zinc	30006L	0.013	L 0.01	
Total Residue	10471L	180	-	
Total Residue Volatile	10521L	100	-	
Total Dissolved Solids	00202L	126	185	03L

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 128. Baseline study of the water quality and aquatic resources of the MacKay River, Alberta (Syncrude Canada, Environmental Research Monograph 1978-4; P. McCart, P. Tsui, W. Grant, R. Green, D. Tripp, Aquatic Environments Ltd.).

Three locations along the MacKay River were sampled on eight occasions from March 1977 to January 1978. One of the objectives of the study was to describe seasonal variations of various physical and chemical characteristics of the MacKay River as it flows into Syncrude's Lease 17 and on into the Athabasca River. The periphyton, macroinvertebrate, and fishery communities of the river were also studied.

Location: MacKay River (Twp. 94 Rge. 11 Sec. 18)[a]

Date (m-yr)	03-77	05-77	06-77	07-77	08-77
Total Dissolved Solids	565	250	210	170	240
Total Volatile Solids	245	90	115	100	115
True Color APHA Units	42	120	115	150	125
Total Solids	575	280	295	180	290
Chemical Oxygen Demand	207	74	93	60	68
Suspended Solids	8.0	10.0	44.0	14.6	2.0
Conductivity µmho/cm	-	-	186	165	243
pH	7.0	7.5	7.5	7.7	7.6
Hardness	300	76	80	84	96
Dissolved Oxygen	8.4	9.2	9.0	8.8	9.3
Temperature °C	0	14	16	15	16
Percent Saturation-DO	58	89	90	86	93
Bicarbonate as $CaCO_3$	308	102	87	84	106
Alkalinity as $CaCO_3$	360	102	87	84	106
Carbonate as $CaCO_3$	52	0	0	0	0
Turbidity JTU-Shaken	11	6.2	12	7.8	2.5
Settled	9.5	3.0	3.6	3.9	1.9
Sodium	61	1.4	12.8	11.8	14.9
Potassium	5.3	1.9	1.3	0.6	0.9
Calcium	91	23	18	21.9	30.4
Magnesium	39	9.1	7.7	8.9	10.3
Iron	1.4	0.7	0.6	0.7	0.8
Sulfate	133	29	18.4	17.0	23
Chloride	10.0	0.5	1.0	0.5	2.5
Nitrate Nitrogen	0.374	0.008	0.007	0.003	0.002
Total Nitrogen	1.130	0.710	0.610	0.655	0.730
Ortho Phosphate-P	0.056	0.014	0.029	0.032	0.024
Total Phosphorus	0.145	0.076	0.122	0.093	0.050
Total Organic Carbon	25.5	22.5	28.7	25.0	-
Mercury	0.0019	0.006	-	0.001	0.006
Silica	7.440	0.840	1.310	1.380	0.700
Boron	0.8	L 0.05	0.9	1.0	0.6
Lead	-	L 0.002	L 0.002	0.02	L 0.002
Nickel	L 0.01	0.15	0.02	L 0.01	0.01
Vanadium	L 0.001	L 0.001	L 0.001	L 0.001	L 0.001

[a]All results except pH expressed in mg/L, unless otherwise indicated.

continued ...

Table 128. Continued.

Date (m-yr)	03-77	05-77	06-77	07-77	08-77
Aluminum	L 0.04	L 0.04	-	-	-
Chromium	L 0.01	L 0.01	-	-	-
Cobalt	L 0.008	L 0.005	-	-	-
Copper	L 0.001	0.01	-	-	-
Zinc	0.05	L 0.02	-	-	-
Cadmium	L 0.007	0.01	-	-	-
Oil and Grease	4.1	7.1	-	-	-
Phenols	0.02	0.002	-	-	-

continued ...

Table 128. Concluded.

Date (m-yr)	09-77	12-77	01-78
Total Dissolved Solids	216	310	456
Total Volatile Solids	140	165	76
True Colour APHA Units	110	165	120
Total Solids	264	390	500
Chemical Oxygen Demand	61	100	69
Suspended Solids	1.7	2.6	-
Conductivity µmho/cm	278	571	-
pH	7.1	7.5	-
Hardness	104	212	244
Dissolved Oxygen	12.4	7.8	8.5
Temperature °C	12	0	0
Percent Saturation-DO	115	53	58
Bicarbonate as $CaCO_3$	127	244	304
Alkalinity as $CaCO_3$	127	244	304
Carbonate as $CaCO_3$	0	0	0
Turbidity JTU-Shaken	4.1	7.2	-
Settled	3.7	5.8	-
Sodium	18.1	44	56
Potassium	1.1	2.5	2.7
Calcium	25.6	53	53
Magnesium	10.8	32	28
Iron	0.3	1.5	1.3
Sulfate	19	64	60
Chloride	2.0	22.0	20.5
Nitrate Nitrogen	0.007	0.230	0.460
Total Nitrogen	0.770	1.540	1.420
Ortho Phosphate-P	0.013	0.054	0.057
Total Phosphorus	0.033	0.091	0.122
Mercury	0.0015	L 0.001	L 0.001
Silica	0.680	5.950	5.700
Boron	L 0.2	L 0.2	0.4
Lead	L 0.002	0.01	L 0.002
Nickel	0.04	L 0.01	L 0.01
Vanadium	L 0.001	L 0.001	L 0.001
Total Organic Carbon	22.4	29.1	42.0

Table 129. Baseline study of the water quality and aquatic resources of the MacKay River, Alberta (Syncrude Canada, Environmental Research Monograph 1978-4; P. McCart, P. Tsui, W. Grant, R. Green, D. Tripp, Aquatic Environments Ltd.).

Three locations along the MacKay River were sampled on eight occasions from March 1977 to January 1978. One of the objectives of the study was to describe seasonal variations of various physical and chemical characteristics of the MacKay River as it flows into Syncrude's Lease 17 and on into the Athabasca River. The periphyton, macroinvertebrate, and fishery communities of the river were also studied.

Location: MacKay River (Twp. 92 Rge. 12 Sec. 34)[a]

Date (m-yr)	03-77	05-77	06-77	07-77	08-77
Total Dissolved Solids	540	310	215	160	215
Total Volatile Solids	245	220	110	85	90
True Colour APHA Units	70	140	145	165	100
Total Solids	550	320	305	180	240
Chemical Oxygen Demand	210	58	87	63	73
Suspended Solids	4.5	7.5	22.3	8.6	2.9
Conductivity µmho/cm	-	-	179	165	172
pH	7.0	7.5	7.4	7.6	7.6
Hardness	292	80	80	76	80
Dissolved Oxygen	9.2	8.8	9.0	8.6	9.9
Temperature °C	0	15	16	15	19
Percent Saturation-DO	63	86	90	84	105
Alkalinity as $CaCO_3$	328	94	84	94	99
Bicarbonate as $CaCO_3$	284	94	84	94	99
Carbonate as $CaCO_3$	44	0	0	0	0
Turbidity JTU-Shaken	9.9	5.5	11.0	5.3	2.6
-Settled	9.4	2.9	4.0	3.0	1.0
Sodium	54.6	12	12	10.4	12.5
Potassium	4.8	1.8	1.3	0.4	1.2
Calcium	85	20	17.4	19.6	24.6
Magnesium	37	8	7.4	7.9	12.1
Iron	1.6	0.7	0.6	0.7	0.9
Sulfate	111	15	10.5	9.8	13
Chloride	11	0.5	0.5	1.0	1.0
Nitrate Nitrogen	0.342	0.009	0.006	0.008	0.002
Total Nitrogen	1.06	0.68	0.54	0.68	0.73
Ortho Phosphate-P	0.066	0.013	0.025	0.039	0.033
Total Phosphorus	0.101	0.086	0.135	0.086	0.048
Total Organic Carbon	15.8	20.9	33.8	15.2	-
Mercury	0.002	0.009	-	0.002	0.0012
Silica	7.02	0.8	1.396	1.38	1.28
Boron	0.8	0.6	1.0	0.9	0.6
Lead	-	L 0.002	L 0.002	0.002	L 0.002
Nickel	L 0.01	0.15	0.02	L 0.01	0.01
Vanadium	L 0.001	L 0.001	L 0.001	L 0.001	L 0.001

[a]All results except pH expressed as mg/L, unless otherwise indicated.

continued ...

Table 129. Continued.

Date (m-yr)	03-77	05-77	06-77	07-77	08-77
Aluminum	L 0.04	0.24	-	-	-
Chromium	L 0.01	L 0.01	-	-	-
Cobalt	L 0.008	L 0.005	-	-	-
Copper	L 0.001	0.01	-	-	-
Zinc	0.04	L 0.02	-	-	-
Cadmium	L 0.007	0.01	-	-	-
Oil and Grease	6.8	9.2	-	-	-
Phenols	0.03	0.02	-	-	-

continued ...

Table 129. Concluded.

Date (m-yr)	09-77	12-77	01-78
Total Dissolved Solids	208	430	368
Total Volatile Solids	140	120	60
True Colour APHA Units	130	140	120
Total Solids	264	435	500
Chemical Oxygen Demand	49	89	69
Suspended Solids	1.1	7.1	4.8
Conductivity µmho/cm	245	520	621
pH	7.2	7.3	7.8
Hardness	96	220	216
Dissolved Oxygen	11.8	9.1	8.4
Temperature °C	9	0	0
Percent Saturation-DO	102	62	57
Bicarbonate as $CaCO_3$	117	264	276
Alkalinity as $CaCO_3$	117	264	276
Carbonate as $CaCO_3$	0	0	0
Turbidity JTU - Shaken	3.8	9.9	11.0
Settled	3.4	8.3	8.6
Sodium	15.9	40	44
Potassium	1.2	2.6	2.7
Calcium	31.8	53	49
Magnesium	12.2	33	25
Iron	0.4	1.7	1.5
Sulfate	21	48	54
Chloride	1.0	4.5	4.5
Nitrate Nitrogen	0.006	0.230	0.438
Total Nitrogen	0.745	1.420	1.340
Ortho Phosphate-P	0.020	0.070	0.068
Total Phosphorus	0.039	0.124	0.132
Total Organic Carbon	23.8	25.9	40.8
Mercury	0.001	0.001	L 0.001
Silica	1.180	6.750	5.500
Boron	L 0.2	L 0.2	0.5
Lead	L 0.002	0.01	L 0.002
Nickel	0.05	L 0.01	L 0.01
Vanadium	L 0.001	L 0.001	L 0.001

Table 130. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 36, Index No. DH 331).

Location: MacKay River (Twp. 92 Rge. 12 Sec. 16 Lsd. -1)[a]

Date	07-02-76
Field pH	7.3
Field Temperature °C	0.0
Field Bicarbonate	300
Total Dissolved Solids	368.0
Hardness as $CaCO_3$	209.7
Alkalinity as $CaCO_3$	224.8
Specific Conductance (µmho/cm @ 25°C)	600
Laboratory pH	7.0
Calcium	55.0
Magnesium	17.6
Sodium	35.0
Potassium	0.8
Carbonate	0.0
Bicarbonate	281.0
Sulfate	66.0
Chloride	10.0
Nitrate	6.4
Silica	1.2
Calcium (acid)	63.0
Magnesium (acid)	19.7
Calculated TDS	330.2
Aluminum	0.0
Copper	0.01
Iodine	0.04
Iron	1.0
Lead	0.0
Manganese	0.1
Mercury	0.0001
Fluoride	0.2
Total Anions (epm)	6.365
Total Cations (epm)	5.736

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 131. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 30, Index No. DH 323).

Location: MacKay River, one-and-one-half miles downstream from mouth of Dunkirk River (Twp. 90 Rge. 16 Sec. 4 Lsd. 1)[a]

Date	18-01-76
Field pH	6.9
Field Temperature °C	0.0
Field Bicarbonate	237
Total Dissolved Solids	664.0
Hardness as $CaCO_3$	197.3
Alkalinity as $CaCO_3$	181.6
Specific Conductance (µmho/cm @ 25°C)	480
Laboratory pH	7.5
Calcium	54.0
Magnesium	15.2
Sodium	20.0
Potassium	0.4
Carbonate	0.0
Bicarbonate	227.0
Sulfate	50.0
Chloride	8.0
Nitrate	5.0
Silica	1.3
Calcium (acid)	58.0
Magnesium (acid)	16.2
Calculated TDS	265.5
Aluminum	0.3
Copper	0.01
Iodine	0.04
Iron	3.8
Lead	0.02
Manganese	0.2
Mercury	0.00081
Fluoride	0.20
Total Anions (epm)	5.068
Total Cations (epm)	4.826

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 132. Water Analysis Report (Alberta Research Council, Unpublished Data, Lab No. 76 34, DH 329).

Location: Unnamed creek, right fork of tributary entering Mackay River north of Thickwood Tower (Twp. 91 Rge. 12 Sec. 28 Lsd. -1)[a]

Date	03-02-76
Field pH	7.3
Field Temperature °C	0.0
Field Bicarbonate	212
Total Dissolved Solids	226.0
Hardness as $CaCO_3$	170.3
Alkalinity as $CaCO_3$	169.0
Specific Conductance (µmho/cm @ 25°C)	360
Laboratory pH	7.2
Calcium	46.0
Magnesium	13.5
Sodium	5.0
Potassium	1.7
Carbonate	0.0
Bicarbonate	210.0
Sulfate	7.0
Chloride	4.0
Nitrate	4.4
Silica	1.5
Calcium (acid)	50.0
Magnesium (acid)	15.2
Calculated TDS	186.4
Aluminum	0.12
Copper	0.04
Iodine	0.01
Iron	2.8
Lead	0.0
Manganese	0.2
Mercury	0.00048
Fluoride	0.20
Total Anions (epm)	3.772
Total Cations (epm)	3.667

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 133. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpbulished Data).

Location: Marguerite River 00AT07DC2198[a]

Sample No.		7521
Date		02-10-72
Parameter	Code[b]	
pH	10301L	8.0
Specific Conductance (µmho/cm)	02041L	230
Total Hardness as $CaCO_3$	10605L	120
Total Alkalinity as $CaCO_3$	10101L	117
Sulfate	16302L	11
Chloride	17203L	3
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	0.3
Calcium	20101L	37
Magnesium	12103L	6
Sodium	11101L	3
Potassium	19101L	0.7
Ammonia Nitrogen	07551L	0.4
Phosphate	15406L	0.2
Turbidity (JTU)	02073L	2

[a] [b] All results except pH expressed in mg/L, unless otherwise indicated.
For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 134. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: McClelland Lake, west side 01AT07DA2004[a]

Sample No.		7413
Date		05-10-72
Parameter	Code	
pH	10301L	7.4
Specific Conductance (µmho/cm)	02041L	230
Total Alkalinity as $CaCO_3$	10101L	117
Total Hardness as $CaCO_3$	10605L	106
Sulfate	16302L	10
Chloride	17203L	L 1
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	0.1
Calcium	20101L	24
Magnesium	12103L	11
Sodium	11101L	4
Potassium	19101L	3.0
Fluoride	09105L	0.22
Phosphate	15406L	0.2
Ammonia Nitrogen	07551L	0.3
Oil and Grease	06521L	0.9
Phenols	06531L	L 0.001
Tannins and Lignins	06551L	0.6
Colour- Filter 1	02026L	96.0
Filter 2	02026L	95.5
Filter 3	02026L	90.5
Threshold Odor Number	02001L	8
Turbidity (JTU)	02073L	2
Total Solids	10471L	174
Nonfilterable Residue	10401L	8
Surfactants	10701L	2.6
Arsenic	33003L	L 0.001
Cadmium	48004L	0.004
Chromium	24004L	0.003
Cobalt	27004L	0.004
Copper	29008L	0.006
Lead	82005L	0.014
Manganese	25006L	0.042
Mercury	80002L	L 0.0005
Nickel	28004L	0.004
Zinc	30006L	0.008

[a]All results except pH expressed in mg/L, unless otherwise indicated.
[b]For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 135. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: McClelland Lake, west side 01AT07DA2004[a]

Sample No.		5164
Date		17-06-73
Time		1750
Parameter	Code[b]	
pH	10301L	8.0
Specific Conductance (µmho/cm)	02041L	240
Total Alkalinity as $CaCO_3$	10101L	126
Total Hardness as $CaCO_3$	10602L	124
Calcium	20101L	25
Magnesium	12103L	15
Sodium	11101L	5
Potassium	19101L	2.5
Nitrate + Nitrite	07107L	L 0.1
Sulfate	16302L	7
Chloride	17203L	L 1
Bicarbonate	06201L	153
Ammonia Nitrogen	07551L	1.2
Phosphate	15406L	L 0.1
Chlorophyll	06711L	0.007
Chemical Oxygen Demand	08301L	28
Oil and Grease	06521L	L 1
Phenols	06531L	0.004
Tannins and Lignins	06551L	0.60
Colour- Filter 1	02026L	98.0
Filter 2	02026L	97.5
Filter 3	02026L	95.0
Threshold Odor Number	02001L	4
Turbidity (JTU)	02073L	9
Total Residue	10471L	232
Total Residue Volatile	10521L	98
Cadmium	48004L	0.006
Chromium	24004L	L 0.001
Cobalt	27004L	L 0.001
Copper	29008L	0.070
Lead	82005L	0.006
Manganese	25006L	0.004
Mercury	80002L	0.0004
Nickel	28004L	0.003
Zinc	30006L	L 0.01

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 136. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: McClelland Lake, west side 01AT07DA2004[a]

Sample No.		7309
Date		14-08-73
Time		1540
Parameter	Code[b]	
pH	10301L	8.9
Specific Conductance (µmho/cm)	02041L	195
Total Alkalinity as $CaCO_3$	10101L	85
Total Hardness as $CaCO_3$	10602L	75
Calcium	02103L	6
Magnesium	12102L	15
Iron	26002L	0.2
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07206L	L 0.1
Chloride	17203L	6
Sulfate	16302L	L 10
Fluoride	09105L	0.10
Carbonate	06301L	21
Bicarbonate	06201L	61
Ammonia Nitrogen	07551L	L 0.2
Phosphate	15406L	0.45
Chlorophyll	06711L	0.007
Chemical Oxygen Demand	08301L	53
Oil and Grease	06521L	1.1
Phenols	06531L	0.01
Tannins and Lignins	06551L	0.3
Colour Filter 1	02026L	98
Filter 2	02026L	96
Filter 3	02026L	94
Threshold Odor Number	02001L	4
Turbidity (JTU)	02073L	2
Total Residue	10471L	114
Total Residue Volatile	10521L	70
Total Dissolved Solids	00202L	89
Mercury	80002L	0.0009

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 137. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: McClelland Lake, west side 01AT07DA2004[a]

Sample No.		7887
Date		19-08-74
Time		1435
Parameter	**Code***	
pH	10301L	7.8
Specific Conductance (µmho/cm)	02041L	220
Total Alkalinity as $CaCO_3$	10101L	54
Total Hardness as $CaCO_3$	10604L	105
Calcium	20105L	19
Magnesium	12102L	14
Sodium	11102L	3
Potassium	19102L	2.4
Iron	26302L	1.4
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07206L	L 0.1
Chloride	17203L	1
Sulfate	16302L	37
Fluoride	09105L	0.21
Bicarbonate	06201L	66
Ammonia Nitrogen	07551L	L 0.2
Phosphate	15407L	L 0.1
Chlorophyll	06711L	0.002
Oil and Grease	06521L	L 1.0
Phenols	06532L	L 0.001
Tannins and Lignins	06551L	0.6
Chemical Oxygen Demand	08301L	22
Colour Filter 1	02026L	97
Filter 2	02026L	96
Filter 3	02026L	94
Threshold Odor Number	02001L	4
Turbidity (JTU)	02073L	2
Cadmium	48005L	L 0.001
Chromium	24005L	0.015
Cobalt	27005L	L 0.001
Copper	29009L	0.062
Lead	82006L	L 0.001
Manganese	25007L	0.003
Mercury	80003L	0.0002
Nickel	28005L	0.003
Zinc	30006L	L 0.01
Total Dissolved Solids	00203L	113

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 138. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Mildred Lake, east side at north end 01AT07DA2003[a]

Sample No.		5815
Date		31-07-72
Parameter	Code[b]	
pH	10301L	8.4
Specific Conductance (µmho/cm)	02041L	224
Total Alkalinity as $CaCO_3$	10101L	122
Phenolphthalein Alkalinity	10151L	0.30
Total Hardness as $CaCO_3$	10603L	120
Calcium Dissolved	20101L	34.1
Magnesium Dissolved	12103L	8
Sulfate Dissolved	16303L	2.2
Sodium Dissolved	11103L	5.2
Chloride Dissolved	17203L	0.4
Fluoride Dissolved	09105L	0.13
Potassium Dissolved	19103L	0.1
Silica Reactive	14102L	2.6
Total Kjeldahl Nitrogen	07001L	1.08
Nitrate + Nitrite	07106L	0.03
Dissolved Ortho Phosphate	15255L	0.12
Dissolved Inorg. Phosphate	15363L	0.13
Turbidity (JTU)	02073L	3
Colour	02011L	30
Oil and Grease	06521L	84.4
Phenols	06531P	0.005
Tannins and Lignins	06551L	0.340
Surfactants	10701L	3.3
Cadmium Extractable	48302P	L 0.001
Chromium Extractable	24302P	L 0.006
Cobalt Extractable	27302P	0.009
Copper Extractable	29305P	0.073
Iron Extractable	26307P	0.30
Lead Extractable	82302P	L 0.004
Manganese Extractable	25304P	0.030
Mercury Extractable	80301P	L 0.00008
Nickel Extractable	28302P	0.004
Zinc Extractable	30305P	L 0.001
Total Dissolved Solids		127

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 139. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Mildred Lake, east side at north end 01AT07DA2003[a]

Sample No.		7404
Date		05-10-72
Parameter	Code[b]	
pH	10301L	7.8
Specific Conductance (µmho/cm)	02041L	235
Total Alkalinity as $CaCO_3$	10101L	133
Total Hardness as $CaCO_3$	10605L	136
Sulfate	16302L	10
Chloride	17203L	2
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	0.3
Calcium	20101L	36
Magnesium	12103L	11
Sodium	11101L	5
Potassium	19101L	0.7
Fluoride	09105L	L 0.05
Phosphate	15406L	0.9
Ammonia Nitrogen	07551L	0.4
Oil and Grease	06521L	3.0
Phenols	06531L	0.005
Tannins and Lignins	06551L	0.6
Colour Filter 1	02026L	90.0
Filter 2	02026L	88.5
Filter 3	02026L	80.5
Threshold Odor Number	02001L	4
Turbidity (JTU)	02073L	4
Surfactants	10701L	2.6
Total Solids	10471L	190
Arsenic	33003L	L 0.001
Cadmium	48004L	0.004
Chromium	24004L	0.004
Cobalt	27004L	0.004
Copper	29003L	0.004
Lead	82005L	0.018
Manganese	25006L	0.093
Mercury	80002L	L 0.0005
Zinc	30006L	0.008

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 140. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment. Unpublished Data).

Location: Mildred Lake, east side at north end 01AT07DA2003[a]

Sample No.		5163	7301	
Date		17-06-73	14-08-73	
Time		1935	1735	
Parameter	Code[b]			Backup Codes
pH	10301L	8.5	8.6	
Specific Conductance (µmho/cm)	02041L	280	-	
Calcium	20101L	30	20	02103L
Magnesium	12103L	16	14	02L
Sodium	11101L	6	4	02L
Potassium	19101L	0.6	0.5	02L
Iron	26002L	0.2	1.7	
Nitrate Nitrogen	07107L	L 0.1	L 0.1	
Nitrite Nitrogen	07107L	L 0.1	L 0.1	206L
Chloride	17203L	L 1	5	
Sulfate	16302L	15	L 10	
Fluoride	09105L	-	L 0.5	
Bicarbonate	06201L	150	152	
Carbonate	06301L	6	10	
Total Alkalinity as $CaCO_3$	10101L	133	142	
Total Hardness as $CaCO_3$	10602L	140	108	
Ammonia Nitrogen	07551L	0.7	L 0.2	
Phosphate	15406L	0.2	0.4	
Chlorophyll	06711L	0.020	0.008	
Total Residue	10471L	210	164	
Total Residue Volatile	10521L	64	92	
Chemical Oxygen Demand	08301L	33	36	
Oil and Grease	06521L	L 1.0	L 1.0	
Phenols	06531L	0.003	0.015	
Tannins and Lignins	06551L	0.9	1.3	
Colour - Filter 1	02026L	96	97	
Filter 2	02026L	95	96	
Filter 3	02026L	91	89	
Threshold Odor Number	02001L	2	2	
Turbidity (JTU)	02073L	3	2	
Cadmium	48004L	L 0.001	L 0.001	
Chromium	24004L	0.015	L 0.001	
Cobalt	27004L	L 0.001	L 0.001	
Copper	29008L	0.005	L 0.001	
Lead	82005L	0.002	0.002	
Manganese	25006L	0.044	0.020	
Mercury	80002L	L 0.0002	0.0009	
Zinc	30006L	L 0.01	0.01	
Nickel	28004L	0.005	L 0.001	

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes.

Table 141. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Mildred Lake, east side at north end 01AT07DA2003[a]

Sample No.		7886
Date		19-08-74
Time		1130
Parameter	**Code[b]**	
pH	10301L	7.4
Specific Conductance (µmho/cm)	02041L	280
Total Alkalinity as $CaCO_3$	10101L	140
Total Hardness as $CaCO_3$	10604L	164
Calcium	20105L	44
Magnesium	12102L	13
Sodium	11102L	4
Potassium	19102L	0.6
Iron	26302L	0.3
Nitrate	07107L	L 0.1
Nitrite	07206L	L 0.1
Chloride	17203L	1
Sulfate	16302L	31
Fluoride	09105L	0.17
Bicarbonate	06201L	171
Ammonia Nitrogen	07551L	0.3
Phosphate	15407L	L 0.1
Oil and Grease	06521L	1.0
Phenols	06532L	0.110
Tannins and Lignins	06551L	0.7
Chemical Oxygen Demand	08301L	27
Threshold Odor Number	02001L	2
Turbidity (JTU)	02073L	4
Colour Filter 1	02026L	96
Filter 2	02026L	94
Filter 3	02026L	90
Total Dissolved Solids	00203L	176
Chlorophyll	06711L	0.004
Cadmium	48005L	L 0.001
Chromium	24005L	0.017
Cobalt	27005L	L 0.001
Copper	29009L	0.016
Lead	82006L	L 0.001
Mangenese	25007L	0.037
Mercury	80003L	L 0.0001
Nickel	28005L	0.003
Zinc	30006L	0.02

[a] All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and Wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 142. Water sample analysis (Water Quality Branch Western Region, Unpublished Data, Lab No. 4617).

Location: Mildred River, 200 ft east of west bank, due east from Syncrude Plant stack[a]

Date	12-02-76		
Time	1710		
Field Temperature °C	0.0	Calcium Dissolved	57.3
Field pH	7.2	Sulfate Dissolved	3.4
Specific Conductance (umho/cm)	387	Sodium Dissolved	7.2
Temperature °C - Laboratory	20.7	Potassium Dissolved	2.3
Laboratory pH	7.7	Chloride Dissolved	8.0
Turbidity (JTU)	1.9	Silica Reactive	11.6
Nonfilterable Residue	L 1.	Fluoride Dissolved	0.06
Nonfilterable Residue Fixed	L 1.	Nitrate + Nitrite Dissolved	0.05
Colour	15	Magnesium Dissolved	19.9
Total Dissolved Nitrogen	0.95	Hydroxide	0
Total Phosphorous	0.007	Carbonate	0
Dissolved Inorganic Carbon	54.	Bicarbonate	273.1
Dissolved Organic Carbon	21.	Calculated TDS	244.49
Total Inorganic Carbon	54.	Sum Cations (meq/L)	4.868
Total Organic Carbon	21.	Sum Anions (meq/L)	4.7786
Phenols	0.009		
Oil and Grease	L 1.0		
Aluminum	0.015		
Antimony	L 0.010		
Arsenic	L 0.0005		
Barium	0.11		
Beryllium	L 0.005		
Cadmium	L 0.001		
Chromium	L 0.015		
Cobalt	L 0.002		
Copper	0.006		
Iron	0.14		
Lead	0.005		
Manganese	0.019		
Mercury	L 0.0005		
Molybdenum	L 0.10		
Nickel	L 0.002		
Selenium	L 0.0005		
Silver	L 0.004		
Strontium	0.14		
Vanadium	L 0.001		
Zinc	L 0.001		
Specific Conductance (µmho/cm	420.		
Alkalinity pp	0.0		
Total Alkalinity as $CaCO_3$	224		
Total Hardness as $CaCO_3$	225		

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 143. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location : Muskeg River, above confluence with Athabasca River 00AT07DA2178[a]

Sample No.		5817
Date		31-07-72
Parameter	Code[b]	
pH	10301L	8.5
Specific Conduct. µmho/cm	02041L	282
Total Alkalinity as $CaCO_3$	10101L	149
Phenolphthalein Alkalinity	10151L	2.6
Total Hardness	10603L	145
Calcium Dissolved	20101L	43.4
Magnesium Dissolved	12303L	9
Sulfate Dissolved	16303L	2.1
Sodium Dissolved	11103L	11.6
Chloride Dissolved	17203L	3.0
Fluoride Dissolved	09105L	0.11
Potassium Dissolved	19103L	0.4
Silica Reactive	14102L	7.6
Total Kjeldahl Nitrogen	07001L	1.13
Nitrate + Nitrite	07106L	0.02
Ortho Phosphate Dissolved	15255L	0.029
Dissolved Inorg. Phosphate	15363L	0.041
Oil and Grease	06521L	250
Phenols	06531P	L 0.004
Tannins and Lignins	06551L	0.94
Turbidity (JTU)	02073L	3
Colour	02011L	150
Cadmium Extractable	48302P	L 0.001
Chromium Extractable	24302P	0.009
Cobalt Extractable	27302P	0.008
Copper Extractable	29305P	0.052
Iron Extractable	26307P	0.90
Lead Extractable	82302P	L 0.004
Manganese Extractable	25304P	0.030
MercuryExtractable	80301P	0.00009
Nickel Extractable	28302P	0.005
Zinc Extractable	30305P	L 0.001

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for the chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 144. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Muskeg River, above confluence with Athabasca River 00AT07DA2178[a]

Sample No.		6493
Date		24-08-72
Parameter	Code[b]	
pH	10301L	8.3
Specific Conductance (µmho/cm)	02041L	375
Total Alkalinity as $CaCO_3$	10101L	196
Total Hardness as $CaCO_3$	10605L	180
Calcium	20101L	57
Magnesium	12103L	8
Sulfate	16302L	20
Chloride	17203L	2
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	0.7
Sodium	11101L	14
Potassium	19101L	1.0
Ammonia Nitrogen	07551L	0.7
Phosphate	15406L	0.2
Turbidity (JTU)	02073L	3

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 145. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Muskeg River, above confluence with Athabasca River 00AT07DA2178[a]

Sample No.		7405
Date		05-10-72
Parameter	Code[b]	
Specific Conductance (µmho/cm)	02041L	340
pH	10301L	8.3
Total Alkalinity as $CaCO_3$	10101L	199
Total Hardness as $CaCO_3$	10605L	182
Sulfate	16302L	10
Chloride	17203L	6
Nitrate + Nitrite	07107L	0.1
Iron	26002L	0.8
Calcium	20101L	60
Magnesium	12103L	7
Sodium	11101L	13
Potassium	19101L	0.9
Fluoride	09105L	L 0.05
Ammonia Nitrogen	07551L	0.9
Phosphate	15406L	0.6
Oil and Grease	06521L	1.5
Phenols	06531L	0.002
Tannins and Lignins	06551L	1.4
Colour - Filter 1	02026L	88.5
Filter 2	02026L	85.0
Filter 3	02026L	68.0
Threshold Odor Number	02001L	4
Turbidity (JTU)	02073L	4
Total Solids	10471L	282
Surfactants	10701L	2.6
Arsenic	33003L	0.001
Cadmium	48004L	0.004
Chromium	24004L	0.006
Cobalt	27004L	0.004
Copper	29008L	0.004
Lead	82005L	0.016
Manganese	25006L	0.050
Mercury	80002L	L 0.0005
Zinc	30006L	0.025

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 146. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Muskeg River, above confluence with Athabasca River 00AT07DA2178[a]

Sample No.		5165	7300	
Date		17-06-73	14-08-73	
Time		1925	1720	
Parameter	Code			Backup Codes
pH	10301L	8.1	7.8	
Specific Conductance (µmho/cm)	02041L	250	235	
Total Alkalinity as $CaCO_3$	10101L	66	102	
Total Hardness as $CaCO_3$	10602L	72	104	
Calcium	20101L	24	26	02103L
Magnesium	12103L	3	9	02L
Sodium	11101L	10	6	02L
Potassium	19101L	0.4	1.1	02L
Iron	26002L	1.1	1.3	
Nitrate	07107L	L 0.1	L 0.1	
Nitrite	07101L	L 0.1	L 0.1	206L
Chloride	17203L	L 1	4	
Sulfate	16302L	18	12	
Fluoride	09105L	-	L 0.05	
Bicarbonate	06201L	80	124	
Ammonia Nitrogen	07551L	2.4	L 0.2	
Phosphate	15406L	L 0.1	0.6	
Oil and Grease	06521L	1.7	L 1.0	
Tannins and Lignins	06551L	1.7	3.5	
Phenols	06531L	0.002	0.011	
Colour Filter 1	02026L	78	88	
Filter 2	02026L	76	83	
Filter 3	02026L	72	55	
Threshold Odor Number	02001L	2	2	
Turbidity (JTU)	02073L	-	3	
Chemical Oxygen Demand	08301L	61	98	
Total Residue	10471L	270	304	
Total Residue Volitile	10521L	130	168	
Nonfilterable Residue		50	-	
Cadmium	48004L	L 0.001	L 0.001	05L
Chromium	24004L	L 0.001	0.007	05L
Cobalt	27004L	0.007	L 0.001	05L
Copper	29008L	0.022	0.004	09L
Lead	82005L	0.013	L 0.001	06L
Manganese	25006L	0.142	0.019	07L
Mercury	80002L	0.0007	L 0.0002	
Nickel	28004L	0.005	L 0.001	05L
Zinc	30006L	0.115	0.01	

[a]All results except pH expressed in mg/L, unless otherwise indicated.
[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 147. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Muskeg River, above confluence with Athabasca River 00AT07DA2178[a]

Sample No.		7892
Date		19-08-74
Time		1200
Parameter	Code[b]	
pH	10301L	8.0
Specific Conductance (µmho/cm)	02041L	320
Calcium	20105L	50
Magnesium	12102L	10
Sodium	11102L	12
Potassium	19102L	0.6
Iron	26302L	0.9
Nitrate Nitrogen	07107L	L 0.1
Nitrite Nitrogen	07206L	L 0.1
Chloride	17203L	9
Sulfate	16302L	31
Fluoride	09105L	0.16
Bicarbonate	06201L	180
Total Alkalinity as $CaCO_3$	10101L	147
Total Hardness as $CaCO_3$	10604L	166
Ammonia Nitrogen	07551L	1.6
Phosphate	15407L	L 0.1
Oil and Grease	06521L	1.5
Phenols	06532L	L 0.001
Tannins and Lignins	06551L	2.0
Colour Filter 1	02026L	94
Filter 2	02026L	90
Filter 3	02026L	71
Threshold Odor Number	02001L	1
Turbidity (JTU)	02073L	3
Chemical Oxygen Demand	08301L	62
Total Dissolved Solids	00203L	201
Cadmium	48005L	L 0.001
Chromium	24005L	0.017
Cobalt	27005L	L 0.001
Copper	29009L	L 0.001
Lead	82006L	L 0.001
Manganese	25007L	0.014
Mercury	80003L	L 0.0001
Nickel	28005L	0.006
Zinc	30006L	0.02

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 148. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discusses water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin. Also included were some previous water quality study data:
Alberta Department of Lands and Forests, Fish and Wildlife Division, Lab Sample No. 6493, Lower Muskeg River, 24 August 1972.

Location: Lower Muskeg River[a]

Date	24-08-72
Temperature °F	59
Conductivity (µmho/cm @ 77°F)	375
Turbidity (JTU)	3
pH	8.3
Total Hardness	180
Calcium	57
Magnesium	8
Sodium + Potassium	15
Chloride	2
Sulfate	20
Alkalinity as $CaCO_3$	196
Dissolved Oxygen	8.0
Total Phosphate	0.2
Ammonia Nitrogen	0.7
Nitrate Nitrogen	L 0.1

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 149. Water Analysis Report (Alberta Research Council, Unpublished Data, Lab No. 75 106, Index No. DH 72).

Location: Muskeg River, WSC gauge (Twp. 94 Rge. 10 Sec. 29 Lsd. -1)[a]

Date	01-03-75
Field Specific Conductance (µmho/cm)	1225
Field pH	7.2
Field Temperature °C	0.5
Field Bicarbonate	395.0
Total Dissolved Solids	398.0
Hardness as $CaCO_3$	244.1
Alkalinity as $CaCO_3$	291.1
Specific Conductance (µmho/cm @ 25°C)	640.0
Laboratory pH	8.5
Calcium	68.0
Magnesium	18.1
Sodium	56.0
Potassium	2.5
Carbonate	12.0
Bicarbonate	339.0
Sulfate	4.5
Chloride	41.0
Nitrate	3.3
Silica	10.8
Fluoride	0.2
Total Anions (epm)	7.260
Total Cations (epm)	7.381

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 150. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 77, Index No. DH 348).

Location: Muskeg River, WSC gauge (Twp. 94 Rge. 10 Sec. 29 Lsd. -1)[a]

Date	24-02-76
Field pH	6.4
Field Temperature °C	0.0
Field Bicarbonate	342
Total Dissolved Solids	316.0
Hardness as $CaCO_3$	248.5
Alkalinity as $CaCO_3$	253.6
Specific Conductance (µmho/cm @ 25°C)	550
Laboratory pH	7.3
Calcium	77.0
Magnesium	13.7
Sodium	17.5
Potassium	2.1
Carbonate	0.0
Bicarbonate	317.0
Sulfate	3.3
Chloride	6.0
Nitrate	3.5
Silica	12.1
Calcium (acid)	85.0
Magnesium (acid)	17.0
Calculated TDS	291.1
Alumiunum	0.04
Copper	0.01
Iodine	0.08
Iron	0.6
Lead	0.01
Manganese	0.2
Mercury	0.0001
Fluoride	0.20
Total Anions (epm)	5.490
Total Cations (epm)	5.785

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 151. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Muskeg River (Sec. 33 Twp. 94 Rge. 10)[a]

Date	02-74
Temperature °F	32
Color (Cl-Pt)	65
Specific Conductance	-
Suspended Solids	6
Total Solids	482
Turbidity (JTU)	L 25
pH	7.5
Total Hardness	271
Calcium	74
Magnesium	21
Sodium & Potassium	16
Bicarbonate	350
Carbonate	0
Chloride	8
Hydroxide	0
Sulfate	7
Total Dissolved Solids	476
Alkalinity as $CaCO_3$	287
Silica	7
Oil and Grease	L 1
Organic Carbon	26
Dissolved Oxygen	6.0
Phenols (µg/L)	L 2
Sulfides	L 0.01
Total Phosphates	0.2
Ammonia Nitrogen	1.6
Nitrate Nitrogen	0.3
Organic Nitrogen	-
Chemical Oxygen Demand	67
Biochemical Oxygen Demand	4

[a]All results except pH expressed in mg/L unless otherwise indicated.

Table 152. Water analysis report (Alberta Research Council, Unpublished Data, Lab no. 75 105, Index No. DH 71).

Location: Muskeg River, 1 mi downstream of confluence with Hartley Creek (Twp. 95 Rge. 10 Sec. 24 Lsd. -1)[a]

Date	01-03-75
Field Conductivity (µmho/cm)	1400
Field pH	7.2
Field Temperature °C	0.0
Field Bicarbonate	420.0
Total Dissolved Solids	474.0
Hardness as $CaCO_3$	272.7
Alkalinity as $CaCO_3$	328.0
Specific Conductance (µmho/cm @ 25°C)	755.0
Laboratory pH	8.5
Calcium	78.0
Magnesium	19.0
Sodium	75.0
Potassium	2.5
Carbonate	7.2
Bicarbonate	395.0
Sulfate	6.8
Chloride	61.0
Nitrate	3.0
Silica	12.1
Total Anions (epm)	8.625
Total Cations (epm)	8.781

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 153. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 81, Index No. 352)

Location: Muskeg River, 1 mi downstream of confluence with Hartley Creek (Twp. 95 Rge. 10 Sec. 24 Lsd. -1)[a]

Date	24-02-76
Field pH	6.8
Field Bircarbonate	332
Total Dissolved Solids	330.0
Hardness as $CaCO_3$	236.0
Alkalinity as $CaCO_3$	245.6
Specific Conductance (µmho/cm @ 25°C)	530
Laboratory pH	6.6
Calcium	73.0
Magnesium	13.1
Sodium	16.2
Potassium	1.7
Carbonate	0.0
Bicarbonate	307.0
Sulfate	3.3
Chloride	6.0
Nitrate	3.8
Silica	13.0
Calcium (acid)	76.0
Magnesium (acid)	16.5
Calculated TDS	281.1
Aluminum	0.08
Copper	0.01
Iodine	0.03
Iron	0.6
Lead	0.0
Manganese	0.4
Mercury	0.00015
Fluoride	0.20
Total Anions (epm)	5.331
Total Cations (epm)	5.469

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 154. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Muskeg River (Sec. 25 Twp. 95 Rge. 10)[a]

Date (m-yr)	04-73	10-73
Temperature °F	-	33
Color (Cl-Pt)	-	130
Specific Conductance (µmho/cm @ 77°F)	-	220
Suspended Solids	7	3
Total Solids	162	-
Turbidity (JTU)	-	3
pH	7.6	7.9
Total Hardness	-	145
Calcium	-	-
Magnesium	-	-
Sodium & Potassium	-	14
Bicarbonate	-	-
Carbonate	-	-
Chloride	-	1
Hydroxide	-	-
Sulfate	-	-
Total Dissolved Solids	155	243
Alkalinity as $CaCO_3$	-	150
Silica	-	-
Oil and Grease	2	3
Organic Carbon	-	33
Dissolved Oxygen	-	11.9
Phenols (µg/L)	L 2	L 2
Sulfides	L 0.01	L 0.05
Total Phosphate	0.4	L 0.05
Ammonia Nitrogen	1.3	-
Nitrate Nitrogen	-	-
Organic Nitrogen	1	0.9
Chemical Oxygen Demand	57	44
Biochemical Oxygen Demand	2	L 1

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 155. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Muskeg River (Sec. 30 Twp. 95 Rge. 9)[a]

Date (m-yr)	05-74	07-74	10-74	02-75
Temperature °F	38	61	40	34
Color (Cl-Pt)	90	115	100	40
Specific Conductance (µmho/cm @ 77°F)	162	237	369	530
Suspended Solids	3	3	4	10
Total Solids	144	230	270	362
Turbidity (JTU)	L 25	2	5	23
pH	7.6	7.5	7.9	8.2
Total Hardness	84	126	179	268
Calcium	24	42	52	78
Magnesium	6	5	12	18
Sodium &Potassium	6	19	13	20
Bicarbonate	104	159	235	354
Carbonate	0	0	0	0
Chloride	6	22	7	10
Hydroxide	0	0	0	0
Sulfate	5	5	4	7
Total Dissolved Solids	151	252	323	487
Alkalinity as $CaCO_3$	85	130	192	290
Silica	3	4	5	5
Oil and Grease	2	2	L 1	2
Organic Carbon	17	30	30	-
Dissolved Oxygen	5.1	8.8	9.2	3.5
Phenols (µg/L)	L 2	L 2	L 2	L 2
Sulfides	L 0.01	L 0.01	L 0.01	L 0.01
Total Phosphate	0.2	L 0.1	L 0.1	0.2
Ammonia Nitrogen	0.5	0.7	0.5	1.5
Nitrate Nitrogen	0.7	0.1	0.4	0.4
Organic Nitrogen	2	9	L 1	L 1
Chemical Oxygen Demand	61	53	46	50
Biochemical Oxygen Demand	2	-	1	1

[a]All results except pH expressed in mg/L unless otherwise indicated.

Table 156. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Muskeg drainage basin, Lakes 6, 7, 8 (Sec. 2 Twp. 95 Rge. 10)[a]

Date (m-yr)	04-73		
	6	7	8
pH	8.0	7.6	7.4
Total Hardness	149	177	250
Alkalinity as $CaCO_3$	160	196	252
Total Phosphate	nil	nil	nil

[a]All results except pH expressed in mg/L.

Table 157. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited).

One chapter in the report discussed water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Muskeg Drainage Basin Stream E (Sec. 22 Twp. 95 Rge. 9)[a]

Date (m-yr)	04-73
pH	7.0
Total Hardness	40
Alkalinity as $CaCO_3$	60
Total Phosphate	nil

[a]All results except pH expressed in mg/L.

Table 158. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 108, Index No. DH 74).

Location: Unnamed creek, tributary feeding Muskeg River near AOSERP Station 00AT07DA0091 (Twp. 95 Rge. 9 Sec. 25 Lsd. -1)[a]

Date	29-02-75
Field Specific Conductance (µmho/cm)	950
Field pH	6.8
Field Temperature °C	1.0
Field Bicarbonate	344.0
Total Dissolved Solids	320.0
Hardness as $CaCO_3$	225.4
Alkalinity as $CaCO_3$	248.0
Specific Conductance (µmho/cm @ 25°C)	470.0
Laboratory pH	7.2
Calcium	61.0
Magnesium	17.8
Sodium	28.8
Potassium	2.1
Carbonate	0.0
Bicarbonate	310.0
Sulfate	0.0
Chloride	1.0
Nitrate	6.7
Silica	21.2
Fluoride	0.10
Total Anions (epm)	5.217
Total Cations (epm)	5.814

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 159. Environmental impact assessment, Lease 13 Mining Project, Alberta Oil Sands, June 1975 (Shell Canada Limited)

One chapter in the report discusses water quality studies conducted within the Shell Lease 13 area. The studies date back to spring 1973 and involve the lower Muskeg drainage basin.

Location: Muskeg drainage basin, Stream D (Sec. 24 Twp. 95 Rge. 9)[a]

Date (m-yr)	04-73
pH	7.5
Total Hardness	50
Alkalinity as $CaCO_3$	60
Total Phosphate	0.03

[a]All results except pH expressed in mg/L.

Table 160. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 110, Index No. DH 76).

Location: Unnamed lake in Muskeg River watershed (Twp. 94 Rge. 7 Sec. 22 Lsd. -1)[a]

Date	01-03-75
Field Specific Conductance (µmho/cm)	780
Field pH	6.8
Field Bicarbonate	109.0
Total Dissolved Solids	172.0
Hardness as $CaCO_3$	98.7
Alkalinity as $CaCO_3$	88.0
Specific Conductance (µmho/cm @ 25°C)	172.0
Laboratory pH	7.9
Calcium	26.2
Magnesium	8.1
Sodium	5.0
Potassium	1.3
Carbonate	0.0
Bicarbonate	110.0
Sulfate	0.0
Chloride	1.0
Nitrate	1.2
Silica	7.5
Fluoride	0.10
Total Anions (epm)	1.851
Total Cations (epm)	2.224

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 161. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Namur Lake, south end 01AT07DA2006[a]

Sample No.		5823
Date		31-07-72
Parameter	Code[b]	
pH	10301L	7.5
Specific Conductance (µmho/cm)	02041L	55
Total Alkalinity as $CaCO_3$	10101L	20.0
Phenolphthalein Alkalinity	10151L	-
Total Hardness as $CaCO_3$	10603L	23.2
Calcium Dissolved	20101L	6.2
Magnesium Dissolved	12103L	2
Sulfate Dissolved	16303L	7.2
Sodium Dissolved	11103L	2.2
Chloride Dissolved	17203L	0.6
Fluoride Dissolved	09105L	0.06
Potassium Dissolved	19103L	0.9
Silica Reactive	14102L	0.6
Total Kjeldahl Nitrogen	07001L	0.93
Nitrate + Nitrite Nitrogen	07106L	0.08
Dissolved Ortho Phosphate	15255L	0.016
Dissolved Inorg. Phosphate	15363L	0.034
Oil and Grease	06521L	23.6
Phenols	06531P	0.15
Tannins and Lignins	06551L	0.24
Turbidity (JTU)	02073L	3
Colour	02011L	20
Cadmium Extractable	48302P	L 0.001
Chromium Extractable	24302P	L 0.006
Cobalt Extractable	27302P	0.009
Copper Extractable	29305P	0.025
Iron Extractable	26307P	L 0.10
Lead Extractable	82302P	L 0.004
Manganese Extractable	25304P	0.010
Mercury Extractable	80301P	0.0001
Nickel Extractable	28302P	0.004
Zinc Extractable	30305P	0.01
Total Dissolved Solis		32

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and Wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 162. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Namur Lake, south end 00AT07DA2006[a]

Sample No.		7407
Date		05-10-72
Parameter	Code[b]	
pH	10301L	7.8
Specific Conductance (µmho/cm)	02041L	48
Total Alkalinity as $CaCO_3$	10101L	20
Total Hardness as $CaCO_3$	10605L	22
Sulfate	16302L	L 5
Chloride	17203L	1
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	L 0.1
Calcium	20101L	6
Magnesium	12103L	1
Sodium	11101L	L 1
Potassium	19101L	0.4
Fluoride	09105L	0.08
Ammonia Nitrogen	07551L	0.2
Phosphate	15406L	0.2
Oil and Grease	06521L	1.3
Phenols	06531L	L 0.001
Tannins and Lignins	06551L	0.2
Colour Filter 1	02026L	98
Filter 2	02026L	97
Filter 3	02026L	94
Threshold Odor Number	02001L	2
Turbidity (JTU)	02073L	L 1
Total Solids	10471L	52
Surfactants	10701L	2.6
Arsenic	33003L	0.002
Cadmium	48004L	0.004
Chromium	24004L	0.003
Cobalt	27004L	0.004
Copper	29008L	0.004
Lead	82005L	0.025
Manganese	25006L	0.015
Mercury	80002L	0.0005
Nickel	28004L	0.004
Zinc	30006L	0.020

[a]All results except pH expressed in mg/L, unless otherwise indicated.

[b]For a description of procedures used refer to: Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 163. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Namur Lake at south end 01AT07DA2006[a]

Sample No.		5162
Date		17-06-73
Time		1645
Parameter	Code[b]	
pH	10301L	7.9
Specific Conductance (µmho/cm)	02041L	56
Total Alkalinity as $CaCO_3$	10101L	22
Total Hardness as $CaCO_3$	10602L	29
Calcium	20101L	10
Magnesium	12103L	1
Sodium	11101L	2
Potassium	19101L	0.9
Iron	26002L	L 0.1
Nitrate + Nitrite	07107L	L 0.1
Chloride	17203L	L 1
Sulfate	16302L	9
Bicarbonate	06201L	27
Ammonia Nitrogen	07551L	0.4
Phosphate	15406L	L 0.1
Oil andGrease	06521L	1.6
Phenols	06531L	0.001
Tannins and Lignins	06551L	0.6
Colour Filter 1	02026L	99
Filter 2	02026L	98
Filter 3	02026L	95
Threshold Odor Number	02001L	2
Turbidity (JTU)	02073L	1
Total Residue	10471L	60
Total Residue Volatile	10521L	44
Chemical Oxygen Demand	08301L	20
Chlorophyll	06711L	0.007
Cadmium	48004L	L 0.001
Chromium	24004L	0.015
Cobalt	27004L	0.009
Copper	29008L	0.005
Lead	82005L	0.002
Manganese	25006L	0.132
Mercury	80002L	L 0.0002
Nickel	28004L	0.008
Zinc	30006L	L 0.01

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 164. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Namur Lake at south end 01AT07DA2006[a]

Sample No.		7297	7890	
Date		14-08-73	19-08-74	
Time		1435	1330	
Parameter	Code[b]			Backup Codes
pH	10301L	8.2	7.9	
Specific Conductance (µmho/cm)	02041L	50	55	
Total Alkalinity as $CaCO_3$	10101L	24	18	
Total Hardness as $CaCO_3$	10602L	21	31	04L
Calcium	02103L	5	10	20105L
Magnesium	12102L	2	1	
Sodium	11102L	7	1	
Potassium	19102L	1.3	0.6	
Iron	26002L	0.4	0.6	6302L
Nitrate Nitrogen	07107L	L 0.1	L 0.1	
Nitrite Nitrogen	07206L	L 0.1	L 0.1	
Chloride	17203L	5	2	
Sulfate	16302L	L 10	15	
Fluoride	09105L	L 0.05	0.14	
Bicarbonate	06201L	30	22	
Ammonia Nitrogen	07551L	L 0.2	0.3	
Phosphate	15406L	0.7	0.3	07L
Chlorophyll	06711L	27.284	0.010	
Oil and Grease	06521L	L 1.0	L 1.0	
Phenols	06531L	0.008	0.002	02L
Tannins and Lignins	06551L	0.5	0.5	
Colour Filter 1	02026L	98	98	
Filter 2	02026L	97	98	
Filter 3	02026L	93	94	
Threshold Odor Number	02001L	2	2	
Turbidity (JTU)	02073L	1	1	
Total Residue	10471L	34	-	
Total Residue Volatile	10521L	30	-	
Chemical Oxygen Demand	08301L	8.9	24	
Total Dissolved Solids	00202L	40	43	03L
Cadmium	48005L	L 0.001	L 0.001	
Chromium	24005L	L 0.001	0.018	
Cobalt	27005L	L 0.001	L 0.001	
Copper	29009L	0.009	0.005	
Lead	82006L	0.006	L 0.001	
Manganese	25007L	0.002	0.010	
Mercury	80002L	L 0.0002	L 0.0001	03L
Nickel	28005L	L 0.001	0.005	
Zinc	30006L	0.02	0.07	

[a] All results except pH expressed in mg/L, unless otherwise indicated.

[b] For a description of procedures used refer to:
Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory Water Analysis Section.

Table 165. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 114, Index No. DH 83).

Location: Pierre River, confluence with Athabasca River (Twp. 97 Rge. 10 Sec. 30 Lsd. -1)[a]

Date	16-03-75
Field Specific Conductance (µmho/cm)	650
Field pH	6.8
Field Temperature °C	0.0
Field Bicarbonate	471.0
Total Dissolved Solids	352.0
Hardness as $CaCO_3$	261.5
Alkalinity as $CaCO_3$	244.0
Specific Conductance (µmho/cm @ 25°C)	560.0
Laboratory pH	8.3
Calcium	59.0
Magnesium	27.8
Sodium	27.5
Potassium	4.6
Carbonate	0.0
Bicarbonate	305.0
Sulfate	30.2
Chloride	12.0
Nitrate	3.6
Silica	19.1
Fluoride	0.9
Total Anions (epm)	6.024
Total Cations (epm)	6.544

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 166. Water quality and aquatic resources of the Beaver Creek Diversion System, 1977 (Syncrude Canada, Environmental Research Monograph 1978-3, L.R. Noton, N.E. Chymko, Chemical and Geological Laboratories Ltd.)

The Beaver Creek Diversion System was investigated from March to November 1977, to describe the post-diversion conditions in Beaver Creek, Ruth Lake, and Poplar Creek and to characterize the two newly created waterbodies in the system. Physical and chemical parameters were obtained regularly from ten sites. Other aspects studied included phytoplankton, zooplankton, benthic macroinvertebrates, fish, aquatic macrophytes, stream drift, and stream habitat. (For location of sampling site see Figure 4, page 97.)

Location: Poplar Creek[a]

Date in 1977	March 30	May 3	May 31	June 29	July 27	Aug. 27	Sept. 22	Oct. 14	Nov. 18
				PC-1					
pH	7.5	7.9	8.1	8.1	8.3	8.1	8.0	8.1	8.3
pp alkalinity	0	0	0	0	0	0	0	0	0
Total alkalinity	170	139	134	154	154	166	190	169	185
Turbidity (NTU)	4.5	16.0	11	4.4	4.7	1.3	3.1	4.1	11
Suspended solids	8.2	2.8	23.5	1.5	1.0	1.5	L0.5	14.4	12.0
Total organic carbon	27	21	25	36	32	42	42	22	28
$NO_3 + NO_2$ - N	0.32	0.08	0.035	0.115	0.50	0.078	0.027	0.081	0.217
Total Kjeldahl - N	12.1	10.6	0.2	0.2	0.2	0.3	0.6	0.8	0.6
Ortho PO_4 - P	0.180	0.061	L0.016	0.025	L0.016	L0.028	L0.016	L0.030	0.023
Total P	0.406	0.076	0.044	0.064	0.098	0.049	0.051	0.055	0.052
Reactive SiO_2	5.9	6.4	4.0	5.0	6.2	4.7	5.5	6.9	9.4
Filtrable residue	525	232	222	270	240	310	360	104	294
Ignition loss	230	80	68	78	104	100	96	48	124
				PC-2					
pH	7.5	7.7	8.1	8.1	8.3	8.2	7.8	8.0	8.0
pp alkalinity	0	0	0	0	0	0	0	0	0
Total alkalinity	172	140	133	151	155	167	186	170	187
				PC-B4					
pH	7.6	7.9	8.0	8.1	8.2	8.2	8.0	8.2	8.0
pp alkalinity	0	0	0	0	0	0	0	0	0
Total alkalinity	368	94	98	136	145	171	190	142	175
Turbidity (NTU)	6.0	18.0	24	8.7	5.4	6.2	2.2	3.5	4.8
Suspended solids	17.8	22.4	41.0	--	L0.5	5.0	L0.5	1.2	L0.5
Total organic carbon	21	26	28	36	37	42	42	31	30
$NO_3 + NO_2$ - N	0.87	0.09	L0.03	L0.03	0.038	L0.03	L0.016	L0.016	0.023
Total Kjeldahl - N	4.3	7.0	0.1	0.2	0.1	0.1	0.2	0.6	--
Ortho PO_4 - P	0.140	0.030	L0.016	0.022	0.023	0.029	L0.016	L0.016	L0.016
Total P	0.423	0.052	0.060	0.068	0.092	0.047	0.051	0.048	0.047
Reactive SiO_2	14.3	3.2	3.6	4.0	4.7	6.5	5.6	4.2	5.5
Filtrable residue	545	202	190	278	290	340	390	272	376
Ignition loss	190	74	44	70	146	78	165	120	236

[a]All results except pH and turbidity expressed in mg/L. Alkalinities as $CaCO_3$

continued...

Table 166. Continued.

Date in 1977	PC-1			PC-B4		
	May 3	July 27	Oct. 14	May 3	July 27	Oct. 14
True colour (APHA)	220	90	75	100	150	130
Oil and grease	8.20	14.4	18	17.8	56.8	6.2
Phenols	L0.001	L0.001	0.003	0.001	L0.001	L0.001
Chemical oxygen demand	103	45	99	52	55	--
Hardness	66	115	77	138	117	80
Sodium	2.99	42.4	19.2	4.07	46.4	24.5
Magnesium	4.8	9.4	5.0	12.0	10.8	7.5
Calcium	18.5	30.5	22.8	35.7	28.9	19.7
Potassium	0.7	1.7	1.2	2.6	0.4	1.0
Chloride	12	21	17	20	37	18
Sulphate	6	4	5	10	6	6
Iron	0.89	0.40	0.61	1.28	0.94	0.70
Copper	0.006	0.009	0.019	0.007	0.01	0.015
Chromium	0.02	L0.01	0.03	0.04	L0.01	0.03
Lead	0.03	L0.02	0.05	0.03	L0.02	0.05
Zinc	0.005	0.009	0.052	0.023	0.011	0.064
Nickel	L0.02	L0.02	0.03	L0.02	L0.02	0.02
Cobalt	L0.01	L0.01	L0.01	0.01	L0.01	L0.01
Aluminum	L0.1	0.2	0.2	0.3	0.3	0.2
Cadmium	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01
Boron	0.107	0.193	0.167	0.247	0.146	0.157

continued...

Table 166. Concluded.[a]

Date in 1977	March 30	April 14	April 20	April 26	April 27	May 2	May 3	May 6	May 11-12	May 18	May 31	June 29	July 25	July 27	Aug. 27	Sept. 22	Oct. 14	Nov. 18
Station PC-1																		
Temp. (°C)	1.0	4.0	2.5	6	3.5	--	8.0	--	14.8	--	14.0	18.5	22.0	22.0	11.0	11.0	6.5	0
Oxygen (% Sat.)	94	98	94	99	--	--	95	--	--	--	89	94	--	94	89	85	98	101
Oxygen (mg/L)	12.30	11.9	12.0	11.4	--	10.4	--	--	--	--	8.5	8.1	--	7.6	9.2	8.7	11.2	13.7
Station PC-2																		
Temp. (°C)	1.0	--	--	--	--	9.5	9.0	10.0	15.0	8.5	17.0	18.5	--	23.0	13	11	6.5	0
Oxygen (% Sat.)	90	--	--	--	--	--	94	--	--	--	97	89	--	88	93	78	98	107
Oxygen (mg/L)	11.95	--	--	--	--	10.1	--	--	--	--	8.3	7.8	--	7.1	9.0	8.0	11.1	14.6
Station PC-B4																		
Temp. (°C)	0.5	--	--	--	--	--	9.0	--	--	--	16.0	15.5	--	20.0	11.0	10.5	3.0	0
Oxygen (% Sat.)	93	--	--	--	--	--	94	--	--	--	89	94	--	93	93	93	97	89
Oxygen (mg/L)	12.35	--	--	--	--	10.1	--	--	--	--	8.2	8.6	--	7.8	9.5	9.6	12.1	12.2

[a]Measurements with thermometer and azide - Winkler method.

[a]Measurements with thermometer and azide - Winkler method.

Table 167. Water quality and aquatic resources of the Beaver Creek Diversion System, 1977 (Syncrude Canada, Environmental Research Monogragh 1978-3, L.R. Noton, N.E. Chymko, Chemical and Geological Laboratories Ltd.)

The Beaver Creek Diversion System was investigated from March to November 1977, to describe the post-diversion conditions in Beaver Creek, Ruth Lake, and Poplar Creek and to characterize the two newly created waterbodies in the system. Physical and chemical parameters were obtained regularly from ten sites. Other aspects studied included phytoplankton, zooplankton, benthic macroinvertebrates, fish, aquatic macrophytes, stream drift, and stream habitat. (For location of sampling site see Figure 4, page 97.)

Location: Poplar Creek Reservoir[a]

Date in 1977	March 30	May 5	May 31	June 28	July 29	Aug. 26	Sept. 22	Oct. 15	Nov. 19
				PCR-1 - Top					
pH	6.9	7.4	7.9	7.9	8.0	7.7	7.6	7.6	7.7
pp alkalinity	0	0	0	0	0	0	0	0	0
Total alkalinity	180	146	151	156	156	166	168	175	180
Turbidity (NTU)	4.0	4.0	1.6	1.7	1.9	3.2	2.3	3.4	2.6
Suspended solids	10.6	8.4	2.0	LO.5	LO.5	0.5	0.8	0.8	LO.5
Total organic carbon	20	22	21.0	30	37	42	36	30	30
NO_3 + NO_2 - N	0.16	0.09	0.04	0.038	0.038	LO.03	0.023	0.109	0.195
Total Kjeldahl - N	14.2	10.2	0.3	0.2	0.3	0.3	0.346	.0.8	0.5
Ortho PO_4 - P	0.210	0.051	LO.016	0.032	LO.016	LO.016	0.016	LO.016	LO.016
Total P	0.291	0.056	0.04	0.072	0.092	0.047	0.051	0.055	0.048
Reactive SiO_2	6.6	7.0	3.3	5.2	6.1	4.7	6.1	1.0	2.6
Filtrable residue	285	208	256	268	244	302	278	318	278
Ignition loss	130	98	74	64	144	74	102	112	90
				PCR-1 - Bottom					
pH	--	7.1	7.3	7.1	7.1	7.1	7.2	7.5	7.7
pp alkalinity	--	0	0	0	0	0	0	0	0
Total alkalinity	--	181	173	169	174	189	180	174	179
Turbidity (NTU)	--	20	12	8.3	7.0	13.0	11.0	2.1	3.3
Suspended solids	--	10	7.5	8.0	12.5	31.0	23.6	LO.5	1.2
Total organic carbon	--	26	26	43	33	51	44	26	29
NO_3 + No_2 - N	--	0.13	0.045	LO.03	0.04	0.074	0.022	0.115	0.224
Total Kjeldahl - N	--	10.4	0.5	0.2	0.4	0.3	0.886	1.0	0.4
Ortho PO_4 - P	--	0.056	0.053	0.095	0.043	0.028	0.120	LO.016	LO.016
Total P	--	0.158	0.118	0.138	0.106	0.187	0.168	0.056	0.052
Reactive SiO_2	--	8.6	8.3	6.3	7.3	7.6	8.6	4.9	5.2
Filtrable Residue	--	250	254	238	244	258	270	242	302
Ignition loss	--	106	60	76	116	72	132	72	54
				PCR-2					
pH	6.8	7.4	7.8	7.7	7.7	7.7	7.6	7.7	7.5
pp alkalinity	0	0	0	0	0	0	0	0	0
Total alkalinity	195	135	154	155	155	167	175	175	187
Turbidity (NTU)	4.5	4.0	22	2.2	3.4	3.4	1.8	3.5	2.9
Suspended solids	4.8	14.8	6.5	LO.5	1.0	3.0	0.5	LO.5	2.0
Total organic carbon	34	36	20.0	38	35	38	36	30	29
NO_3 + No_2 - N	0.235	0.08	0.035	0.038	0.035	LO.03	0.023	0.139	0.219
Total Kjeldahl - H	13.3	7.9	0.2	0.2	0.3	0.4	0.250	0.8	LO.1
Ortho PO_4 - P	0.320	0.04	0.024	0.021	0.024	0.031	0.016	LO.016	LO.016
Total P	0.529	0.05	0.092	0.092	0.092	0.051	0.058	0.054	0.047
Reactive SiO_2	11.2	7.0	4.1	6.3	7.3	4.6	5.6	4.7	5.3
Filtrable residue	330	202	260	270	200	272	320	344	274
Ignition loss	200	92	76	68	116	110	125	172	72

[a]All results except pH and turbidity expressed in mg/L. Alkalinities as $CaCO_3$.

continued...

Table 167. Concluded.

Date in 1977	PCR-1 - Top			PCR-1 - Bottom			PCR-2		
	May 5	July 29	Oct. 15	May 5	July 29	Oct. 15	May 5	July 29	Oct. 15
True colour (APHA)	140	65	55	500	55	70	120	120	95
Oil and grease	4.8	141	51.2	10.6	44.8	26.4	4.8	43	24.2
Phenols	0.003	L0.001	L0.001	0.005	L0.001	L0.001	L0.001	L0.001	L0.001
Chemical oxygen demand	82	61	71	123	91	77	91	82	49
Hardness	127	110	87	115	132	116	97	114	193
Sodium	3.45	52.1	31.6	3.59	33.2	43.9	2.68	41.9	46.5
Magnesium	10.8	9.3	7.1	8.9	10.5	9.9	8.4	9.2	10.2
Calcium	33.2	28.7	23.0	31.3	35.6	30.2	25.2	30.7	60.4
Potassium	2.1	1.3	1.7	1.4	2.3	2.7	2.3	1.8	2.5
Chloride	6	20	27	9	13	25	7	20	31
Sulphate	5	4	5	5	4	4	6	3	4
Iron	2.43	0.79	0.98	1.39	6.36	0.96	0.88	0.71	0.69
Copper	0.014	0.014	0.014	0.009	0.016	0.016	0.007	0.13	0.029
Chromium	0.02	L0.01	0.03	0.03	L0.01	0.03	0.02	L0.01	0.02
Lead	0.03	L0.02	0.04	0.03	0.024	0.06	0.02	L0.02	0.05
Zinc	0.012	L0.005	0.068	0.009	0.033	0.065	0.064	0.006	0.774
Nickel	L0.02	L0.02	0.02	L0.02	L0.02	0.03	L0.02	L0.02	0.03
Cobalt	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01
Aluminum	L0.1	0.1	L0.1	L0.1	0.2	0.5	0.1	0.2	0.2
Cadmium	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01
Boron	0.123	0.173	0.117	0.086	0.200	0.156	0.137	0.176	0.374

Table 168. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 6, Index No. DH 312).

Location: Prairie Creek crossing Highway 63 south of Fort McMurray (Twp. 88 Rge. 9 Sec. 23 Lsd. 16)[a]

Date	08-01-76
Field pH	7.2
Field Temperature °C	0.0
Field Bicarbonate	293
Total Dissolved Solids	434.0
Hardness as $CaCO_3$	233.3
Alkalinity as $CaCO_3$	214.4
Specific Conductance (µmho/cm @ 25°C)	770
Laboratory pH	7.4
Calcium	61.0
Magnesium	19.7
Sodium	56.0
Potassium	1.3
Carbonate	0.0
Bicarbonate	268.0
Sulfate	15.2
Chloride	76.0
Nitrate	2.8
Silica	13.9
Calcium (acid)	64.0
Magnesium (acid)	20.9
Calculated TDS	377.7
Aluminum	0.14
Copper	0.01
Iodine	0.08
Iron	3.8
Lead	0.0
Manganese	2.5
Mercury	0.00008
Fluoride	0.20
Total Anions (epm)	6.898
Total Cations (epm)	7.134

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 169. Water quality and aquatic resources of the Beaver Creek Diversion System, 1977 (Syncrude Canada, Environmental Research Monograph 1978-3, L.R. Noton, N.E. Chymko, Chemical and Geological Laboratories Ltd.)

The Beaver Creek Diversion System was investigated from March to November 1977, to describe the post-diversion conditions in Beaver Creek, Ruth Lake, and Poplar Creek and to characterize the two newly created waterbodies in the system. Physical and chemical parameters were obtained regularly from ten sites. Other aspects studied included phytoplankton, zooplankton, benthic macroinvertebrates, fish, aquatic macrophytes, stream drift, and stream habitat. (For location of sampling site see Figure 4, page 97.)

Location: Ruth Lake[a]

Parameter	Depth (m)	March 31[b] 1977	May 4 1977	June 1 1977	June 26[b] 1977	July 29 1977	Aug. 6 1977	Aug. 24 1977	Sept. 23 1977	Oct. 15 1977	Nov. 19-20 1977
						RL-2					
Dissolved Oxygen (mg/L)	0	--	9.4	7.8	--	11.2	10.8	6.6	6.0	9.7	8.0
	0.5	--	9.4	7.8	--	11.4	8.8	6.5	6.0	9.7	7.0
	1.0	0.7	9.2	7.8	8.5	11.6	6.8	6.5	5.9	9.7	6.6
	1.5	--	9.1	7.8	--	9.0	5.5	6.4	5.8	9.7	5.3
	2.0	0.1	8.0	7.7	--	6.8	--	--	--	--	--
						RL-3					
Dissolved Oxygen (mg/L)	0	--	9.5	6.3	--	11.6	--	8.3	8.0	10.6	11.8
	0.5	0.5	9.2	6.3	9.6	11.8	--	8.2	8.0	10.6	11.1
	1.0	--	9.2	6.3	--	11.3	--	8.2	8.0	10.6	9.0
	1.5	0.4	7.7	6.2	--	9.8	--	--	--	--	--

[a]Measurements with dissolved oxygen - temperature meter unless noted otherwise.
[b]Measurements with azide - Winkler method.

continued...

Table 169. Continued.[a]

Dated in 1977	March 31	May 4	June 1	June 26	July 29	Aug. 24	Sept. 23	Oct. 15	Nov. 19-20
Parameter									
				RL-2					
pH	7.0	7.8	8.1	8.2	9.3	7.9	8.0	7.9	7.8
pp alkalinity	0	0	0	0	25	0	0	0	0
Total alkalinity	201	131	148	145	149	173	186	190	212
Turbidity (NTU)	9.0	4.6	2.4	1.5	4.1	2.3	1.5	2.2	1.5
Suspended solids	12.2	10.4	32.0	L0.5	2.0	3.0	L0.5	L0.5	L0.5
Total organic carbon	32	34	24	46	43	40	41	27	35
$NO_3 + NO_2 - N$	0.37	0.09	L0.03	0.084	0.047	L0.03	0.044	0.376	0.130
Total Kjeldahl - N	20.4	8.2	0.6	0.3	0.3	0.2	0.4	0.9	0.4
Ortho $PO_4 - P$	0.330	0.054	0.048	L0.016	0.022	0.031	L0.016	L0.016	L0.016
Total P	0.384	0.760	0.062	0.112	0.100	0.051	0.051	0.046	0.049
Reactive SiO_2	12.9	6.7	2.8	4.7	4.6	3.0	9.3	6.6	8.8
Filtrable residue	310	--	258	248	254	332	356	304	338
Ignition loss	185	--	72	68	108	76	100	82	44
				RL-3					
pH	6.9	7.8	7.9	8.4	9.2	8.2	8.0	7.8	8.0
pp alkalinity	0	0	0	3.5	20	0	0	0	0
Total alkalinity	183	150	142	156	151	176	184	184	213
Turbidity (NTU)	6.0	5.6	6.5	2.6	4.4	3.4	1.9	1.3	1.5
Suspended solids	5.2	6.0	10.0	0.5	3.5	1.0	L0.5	4.4	L0.5
Total organic carbon	30	38	23	37	32	51	38	16	35
$NO_3 + NO_2 - N$	0.28	0.09	0.04	0.095	0.038	L0.03	L0.016	0.100	0.132
Total Kjeldahl - N	15.0	10.8	0.4	0.3	1.0	0.4	0.3	0.8	0.3
Ortho $PO_4 - P$	0.340	0.064	0.046	0.024	0.023	L0.016	L0.016	L0.016	L0.016
Total P	0.357	0.064	0.062	0.094	0.108	0.05	0.051	0.052	0.048
Reactive SiO_2	9.6	7.1	3.7	3.6	4.4	2.7	2.8	3.0	3.1
Filtrable residue	290	--	260	264	300	372	366	154	394
Ignition loss	165	--	80	68	142	88	228	54	210

[a]All results except pH and turbidity expressed in mg/L. Alkalinities as $CaCO_3$.

continued...

Table 169. Concluded.

Date in 1977	RL-2			RL-3		
	May 4	July 29	Oct. 15	May 4	July 29	Oct. 15
True colour (APHA)	130	65	55	110	95	55
Oil and grease	12.2	156.2	86.0	5.2	42.4	25.4
Phenols	0.005	L0.001	L0.001	0.001	L0.001	0.002
Chemical oxygen demand	52	28	66	--	163	70
Hardness	84	111	61	86	113	77
Sodium	2.56	56.6	39.6	2.68	60.6	42.7
Magnesium	7.1	9.4	4.8	7.1	9.5	6.0
Calcium	22.2	29.0	16.6	22.9	29.6	20.8
Potassium	1.8	1.7	1.5	1.5	1.6	1.4
Chloride	4	50	60	22	44	39
Sulphate	16	6	11	10	6	6
Iron	0.38	0.40	0.25	0.39	0.76	0.36
Copper	0.010	0.013	0.015	0.015	0.093	0.020
Chromium	0.02	L0.01	0.02	0.02	L0.01	0.02
Lead	0.08	L0.02	0.05	L0.02	0.10	0.07
Zinc	0.011	L0.010	0.024	0.008	0.019	0.106
Nickel	L0.02	L0.02	L0.02	L0.02	L0.02	L0.02
Cobalt	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01
Aluminum	0.1	0.1	0.2	L0.1	0.2	0.1
Cadmium	L0.01	L0.01	L0.01	L0.01	L0.01	L0.01
Boron	0.105	0.168	0.114	0.136	0.225	0.107

Table 170. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 5, Index No. DH 311).

Location: Saline Creek, confluence with Clearwater River (Twp. 89 Rge. 9 Sec 10 Lsd. -1)[a]

Date	08-01-76
Field pH	7.7
Field Temperature °C	0.0
Field Bicarbonate	405
Total Dissolved Solids	407.0
Hardness as $CaCO_3$	321.4
Alkalinity as $CaCO_3$	321.0
Specific Conductance (µmho/cm @ 25°C)	820
Laboratory pH	7.6
Calcium	81.0
Magnesium	29.0
Sodium	41.2
Potassium	1.7
Carbonate	0.0
Bicarbonate	390.0
Sulfate	60.8
Chloride	8.0
Nitrate	2.2
Silica	12.3
Calcium (acid)	84.0
Magnesium (acid)	30.5
Calculated TDS	428.0
Aluminum	0.78
Copper	0.01
Iodine	0.0
Iron	2.7
Lead	0.0
Manganese	0.2
Mercury	0.0001
Fluoride	0.20
Total Anions (epm)	7.919
Total Cations (epm)	8.264

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 171. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 4, Index No. DH 310)

Location: Saprae Creek, confluence with Clearwater River (Twp. 88 Rge. 8 Sec 32 Lsd. -1)[a]

Date	08-01-76
Field pH	7.5
Field Temperature °C	0.0
Field Bicarbonate	300
Total Dissolved Solids	332.0
Hardness as $CaCO_3$	233.3
Alkalinity as $CaCO_3$	228.0
Specific Conductance (µmho/cm @ 25°C)	570
Laboratory pH	7.6
Calcium	63.0
Magnesium	18.5
Sodium	20.0
Potassium	2.1
Carbonate	0.0
Bicarbonate	285.0
Sulfate	27.4
Chloride	4.0
Nitrate	2.3
Silica	10.0
Calcium (acid)	64.0
Magnesium (acid)	20.3
Calculated TDS	287.4
Aluminum	0.18
Copper	0.01
Iodine	0.01
Iron	0.9
Lead	0.34
Manganese	0.1
Mercury	0.00004
Fluoride	0.20
Total Anions (epm)	5.392
Total Cations (epm)	5.590

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 172. Gregoire Lake study, May 1969 (Department of Natural Resources, Fish and Wildlife Division).

The report covers morphology, physical and chemical data, inflow and outflow, bottom fauna, and fish fauna.

Location: Surmont Creek[a]

Date	20-05-69
Depth in feet	1
Temperature °C	8
Dissolved Oxygen	10
Phenolphthalein Alkalinity	nil
Total Alkalinity	40
Calcium Hardness	30
Total Hardness	40
pH	7.2
Total Dissolved Solids	29

[a]All results except pH expressed in mg/L.

Table 173. Water sample analysis: Water Treatment Plant, Fort McMurray. January to October 1979 (Pollution Control Laboratory, Pollution Control Division, Alberta Environment).

These are monthly laboratory results neither published nor put in report form. One of the samples was obtained from the Athabasca River, Fort McMurray and another from the Syne River Basin, Fort McMurray.

Location: Syne River, Fort McMurray[a]

Date	17-05-79	
Parameter	Code[b]	Results
pH	10301L	6.6
Iron	26304L	1.14
Calcium	20105L	12
Hardness as $CaCO_3$	10604L	50
Potassium	19103L	0.8
Nitrate + Nitrite	07105L	L 0.05
Fluoride	09107L	0.14
Sulfate	16306L	9
Alkalinity as $CaCO_3$	10101L	50
Specific Conductance	02041L	140
Total Dissolved Solids	00205L	74
Magnesium	12303L	5
Sodium	11103L	9
Silica	14102L	5.9
Nitrite	07205L	L 0.05
Chloride	17203L	7
Bicarbonate	06201L	61

[a]All results except pH and conductance (µmho/cm) expressed in mg/L.

[b]For description of procedures used refer to: Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboroatory, Water Analysis Section.

Table 174. Water sample analysis (Pollution Control Laboratory, Pollution Control Division, Alberta Department of Environment, Unpublished Data).

Location: Tar River[a]

Sample No.		7511
Date		27-09-72
Parameter	Code[b]	
pH	10301L	7.9
Specific Conductance (µmho/cm)	02041L	445
Total Alkalinity as $CaCO_3$	10101L	173
Total Hardness as $CaCO_3$	10605L	176
Sulfate	16302L	69
Chloride	17203L	4
Nitrate + Nitrite	07107L	L 0.1
Iron	26002L	0.2
Calcium	20101L	56
Magnesium	12103L	8
Sodium	11101L	27
Potassium	19101L	2.6
Ammonia Nitrogen	07551L	0.5
Phosphate	15406L	0.3
Turbidity (JTU)	02073L	11

[a]All results except pH expressed in mg/L, unless othewise indicated.

[b]For a description of procedures used refer to: Alberta Environment. 1977. Methods manual for chemical analysis of water and wastes. Alberta Environment, Pollution Control Laboratory, Water Analysis Section.

Table 175. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 76 80, Index No. DH 351).

Location: Tar River at WSC site (Twp. 96 Rge. 11 Sec. 29 Lsd. -1)[a]

Date	24-02-76
Field pH	6.8
Field Temperature °C	0.0
Field Bicarbonate	200
Total Dissolved Solids	352.0
Hardness as $CaCO_3$	226.4
Alkalinity as $CaCO_3$	218.4
Specific Conductance (µmhos/cm @ 25°C)	620
Laboratory pH	7.1
Calcium	66.0
Magnesium	15.0
Sodium	35.0
Potassium	2.5
Carbonate	0.0
Bicarbonate	273.0
Sulfate	65.0
Chloride	12.0
Nitrate	2.1
Silica	12.0
Calcium (acid)	33.5
Magnesium (acid)	17.3
Calculated TDS	343.8
Aluminum	0.02
Copper	0.01
Iodine	0.04
Iron	0.1
Lead	0.0
Manganese	0.1
Mercury	0.00006
Fluoride	0.40
Total Anions (epm)	6.200
Total Cations (epm)	6.114

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 176. Water analysis report (Alberta Research Council, Unpublished Data, Lab No. 75 1, Index No. DH 79).

Location: Unnamed creek, one-half mile tributary entering Tar River above mouth (twp. 96 Rge. 11 Sec. 15 Lsd. 8)[a]

Date	18-01-75
Field Specific Conductance (µmho/cm)	580
Field Temperature °C	0.0
Total Dissolved Solids	418.0
Hardness as $CaCO_3$	260.2
Alkalinity as $CaCO_3$	211.2
Specific Conductance (µmho/cm @ 25°C)	620
Laboratory pH	6.8
Calcium	73.8
Magnesium	18.5
Sodium	23.8
Potassium	0.8
Carbonate	0.0
Bicarbonate	264.0
Sulfate	8.0
Chloride	4.0
Nitrate	4.3
Silica	14.7
Fluoride	0.40
Total Anions (epm)	4.676
Total Cations	6.260

[a]All results except pH expressed in mg/L, unless otherwise indicated.

Table 177. Water analysis report. (Alberta Research Council, Unpublished Data, Lab No. 75 3, Index No. DH 81).

Location: Unnamed lake in upper one-third of Tar River system (Twp. 99 Rge. 13 Sec. 26 Lsd. -L)[a]

Date	18-01-75
Field Specific Conductance (µmho/cm)	350
Field Temperature °C	0.0
Total Dissolved Solids	226.0
Hardness as $CaCO_3$	126.9
Alkalinity as $CaCO_3$	54.4
Specific Conductance (µmho/cm @ 25°C)	305.0
Laboratory pH	6.9
Calcium	35.2
Magnesium	9.5
Sodium	10.0
Potassium	1.7
Carbonate	0.0
Bicarbonate	68.0
Sulfate	75.0
Chloride	4.0
Nitrate	4.9
Silica	4.8
Fluoride	0.2
Total Anions (epm)	2.868
Total Cations (epm)	3.016

[a]All results except pH expressed in mg/L, unless otherwise indicated.

3. REFERENCES CITED

Akena, A.M. 1979. An intensive surface water quality study of the Muskeg River watershed. Volume I: water chemistry. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment. AOSERP Report 85. 187 pp.

Akena, A.M. 1980. Water quality of the Athabasca oil sands area. Volume I: data collection and quality. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment, Pollution Control Division. AOSERP Project WS 1.2.1. 100 pp.

Seidner, R.T. 1980. Regional water quality of the Alberta Oil Sands Environmental Research Program study area. Volume II: discussion of 1976 and 1977 data. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment, Pollution Control Division. AOSERP Project HY 2.8.1. 246 pp.

Smith, S.B. ed. 1979. Alberta Oil Sands Environmental Research Program interim report covering the period of April 1975 to November 1978. Prep. by A.S. Mann, R.A. Hursey, R.T. Seidner, and B. Kasinska-Banas. AOSERP Report 22. 101 pp.

4. LIST OF AOSERP WIDE DISTRIBUTION RESEARCH REPORTS

Report	Project	Reference
1	PM	Alberta Oil Sands Environmental Research Program. 1976. First annual report, 1975. Alberta Oil Sands Environmental Research Program. AOSERP Report 1. 58 pp.
2	AF 4.1.1	Kristensen, J., B.S. Ott, and A.D. Sekerak. 1976. Walleye and goldeye fisheries investigations in the Peace-Athabasca Delta--1975. Prep. for the Alberta Oil Sands Environmental Research Program by LGL Ltd., Environmental Research Associates. AOSERP Report 2. 103 pp.
3	HE 1.1.1	McVey, W.W. 1976. Structure of a traditional baseline data system. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Population Research Laboratory. AOSERP Report 3. 26 + 266 pp.
4	VE 2.2	Stringer, P.W. 1976. A preliminary vegetation survey of the Alberta Oil Sands Environmental Research Program study area. Prep. for the Alberta Oil Sands Environmental Research Program by Intraverda Plant Systems Ltd. AOSERP Report 4. 108 pp.
5	HY 3.1	Strosher, M.T. and E. Peake. 1976. The evaluation of wastewaters from an oil sand extraction plant. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Calgary, Environmental Sciences Centre (Kananaskis). AOSERP Report 5. 103 pp.
6	PM	Patterson, R. and A.M. Lansdown. 1976. Housing for the north--the stackwall system; construction report--Mildred Lake tank and pump house. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Manitoba, Faculty of Engineering, Northern Housing Committee. AOSERP Report 6. 36 pp.
7	AF 3.1.1	Jantzie, T.D. 1977. A synopsis of the physical and biological limnology and fishery programs within the Alberta oil sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Renewable Resources Consulting Services Ltd. AOSERP Report 7. 73 pp.

8 AF 1.2.1 Machniak, K. 1977. The impact of saline waters upon freshwater biota (a literature review and bibliography). Prep. for the Alberta Oil Sands Environmental Research Program by Aquatic Environments Ltd. AOSERP Report 8. 258 pp.

9 ME 3.3 Croft, B.R., A. Lamb, and R.N. Dawson. 1977. A preliminary investigation into the magnitude of fog occurrence and associated problems in the oil sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Stanley Associates Engineering Ltd. AOSERP Report 9. 87 pp.

10 HE 2.1 Millar, J.F.V. 1977. Development of a research design related to archaeological studies in the Athabasca Oil Sands area. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Saskatchewan. AOSERP Report 10. 69 pp.

11 AF 2.2.1 Flannagan, J.F. 1977. Life cycles of some common aquatic insects of the Athabasca River, Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 11. 20 pp.

12 ME 1.7 Mercer, J.M. and R.B. Charlton. 1977. Very high resolution meteorological satellite study of oil sands weather: "a feasibility study". Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Department of Geography. AOSERP Report 12. 44 pp.

13 ME 2.3.1 Davison, D.S., C.J. Fortems, and K.L. Grandia. 1977. Plume dispersion measurements from an oil sands extraction plant, March 1976. Prep. for the Alberta Oil Sands Environmental Research Program by Intera Environmental Consultants Ltd. AOSERP Report 13. 195 pp.

14 none

15 ME 3.4 Denison, P.J. 1977. A climatology of low-level air trajectories in the Alberta oil sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Acres Consulting Services. AOSERP Report 15. 118 pp.

16 ME 1.6 Barge, B.L., R.G. Humphries, and S.L. Olson. 1977. The feasibility of a weather radar near Fort McMurray, Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Research Council, Atmospheric Sciences Division. AOSERP Report 16. 72 pp.

17 AF 2.1.1 Lutz, A. and M. Hendzel. 1977. A survey of baseline levels of contaminants in aquatic biota of the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 17. 51 pp.

18 HY 1.1 Loeppky, K.D. and M.O. Spitzer. 1977. Interim compilation of stream gauging data to December 1976 for the Alberta Oil Sands Environmental Research Program. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Water Survey Branch. AOSERP Report 18. 257 pp.

19 ME 4.1 Walmsley, J.L. and D.L. Bagg. 1977. Calculations of annual averaged sulphur dioxide concentrations at ground level in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by Atmospheric Environment Service. AOSERP Report 19. 40 pp.

20 HY 3.1.1 Strosher, M.T. and E. Peake. 1978. Characterization of organic constituents in waters and wastewaters of the Athabasca Oil Sands mining area. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Calgary, Environmental Sciences Centre (Kananaskis). AOSERP Report 20. 71 pp.

21 PM Alberta Oil Sands Environmental Research Program. 1977. Second Annual Report, 1976-77. Alberta Oil Sands Environmental Research Program. AOSERP Report 21. 62 pp.

22 PM Smith, S.B., ed. 1979. Alberta Oil Sands Environmental Research Program Interim Report covering the period April 1975 to November 1978. Prep. by A.S. Mann, R.A. Hursey, R.T. Seidner, and B. Kasinska-Banas. AOSERP Report 22.

23 AF 1.1.2 Lake, W. and W. Rogers. 1979. Acute lethality of mine depressurization water to trout-perch and rainbow trout: Volume I. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment, Water Control Branch. AOSERP Report 23. 44 pp.

24 ME 1.5.2 ME 3.5.1 Fanaki, F., R. Mickle, M. Lusis, J. Kovalick, J. Markes, F. Froude, J. Arnold, A. Gallant, S. Melnichuk, D. Brymer, A. Gaudenzi, A. Moser, and D. Bagg. 1979. Air system winter field study in the AOSERP study area, February 1977. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Atmospheric Environment Service. AOSERP Report 24. 182 pp.

25 ME 3.5.1 Bottenheim, J.W. and O.P. Strausz. 1977. Review of pollutant transformation processes relevant to the Alberta oil sands area. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Hydrocarbon Research Centre. AOSERP Report 25. 166 pp.

26 AF 4.5.1 Bond, W.A. and K. Machniak. 1977. Interim report on an intensive study of the fish fauna of the Muskeg River watershed of northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Department of Fisheries. AOSERP Report 26. 137 pp.

27 ME 1.5.1 Fanaki, F., compiler. 1978. Meteorology and air quality winter field study in the AOSERP study area, March 1976. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Atmospheric Environment Service. AOSERP Report 27. 249 pp.

28 VE 2.1 Turchenek, L.W. and J.D. Lindsay. 1978. Interim report on a soils inventory in the Athabasca Oil Sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Research Council, Soils Division. AOSERP Report 28. 100 pp.

29 ME 2.2 Shelfentook, W. 1978. An inventory system for atmospheric emissions in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by SNC Tottrup Services Ltd. AOSERP Report 29. 58 pp.

30 ME 2.1 Strosher, M.M. 1978. Ambient air quality in the AOSERP study area, 1977. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment, Pollution Control Division. AOSERP Report 30. 74 pp.

31 VE 2.3 Thompson, M.D., M.C. Wride, and M.E. Kirby. 1978. Ecological habitat mapping of the AOSERP study area: Phase I. Prep. for the Alberta Oil Sands Environmental Research Program by Intera Environmental Consultants Ltd. AOSERP Report 31. 176 pp.

32 PM Alberta Oil Sands Environmental Research Program. 1979. Third Annual Report, 1977-78. Alberta Oil Sands Environmental Research Program. AOSERP Report 32. 114 pp.

33 TF 1.2 Nowlin, R.A. 1978. Relationships between habitats, forages, and carrying capacity of moose range in northern Alberta. Part I: moose preferences for habitat strata and forages. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Recreation, Parks and Wildlife, Fish and Wildlife Division. AOSERP Report 33. 63 pp.

34 HY 2.4 Allan, R. and T. Jackson. 1978. Heavy metals in bottom sediments of the mainstem Athabasca River system in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 34. 72 pp.

35 AF 4.9.1 Griffiths, W.H. and B.D. Walton. 1978. The effects of sedimentation on the aquatic biota. Prep. for the Alberta Oil Sands Environmental Research Program by Renewable Resources Consulting Services Ltd. AOSERP Report 35. 86 pp.

36 AF 4.8.1 Jones, M.L., G.J. Mann, and P.J. McCart. 1978. Fall fisheries investigations in the Athabasca and Clearwater rivers upstream of Fort McMurray: Volume 1. Prep. for the Alberta Oil Sands Environmental Research Program by Aquatic Environments Ltd. AOSERP Report 36. 71 pp.

37 HE 2.2.2 Van Dyke, E.W. and C. Loberg. 1978. Community studies: Fort McMurray, Anzac, Fort MacKay. Prep. for the Alberta Oil Sands Environmental Research Program by Applied Research Associates Ltd. AOSERP Report 37. 195 pp.

38 VE 7.1.1 Green, J.E. 1979. Techniques for the control of small mammal damage to plants: a review. Prep. for the Alberta Oil Sands Environmental Research Program by LGL Ltd., Environmental Research Associates. AOSERP Report 38. 111 pp.

39 ME 1.0 Longley, R.W. and B. Janz. 1979. The climatology of the Alberta Oil Sands Environmental Research Program study area. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Atmospheric Environment Service. AOSERP Report 39. 102 pp.

40 WS 3.3 Beltaos, S. 1979. Mixing characteristics of the Athabasca River below Fort McMurray--winter conditions. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Research Council, Transportation and Surface Water Engineering Division. AOSERP Report 40. 110 pp.

41 AF 3.5.1 Sprague, J.B., D.A. Holdway, and D. Stendahl. 1978. Acute and chronic toxicity of vanadium to fish. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Guelph. AOSERP Report 41. 92 pp.

42 TF 1.1.4 Todd, A. 1978. Analysis of fur production records for registered traplines in the AOSERP study area, 1970-75. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Recreation, Parks, and Wildlife. AOSERP Report 42. 17 pp.

43 TF 6.1 Phillips, W., D. DePape, and L. Ewanyk. 1979. A socioeconomic evaluation of the recreational use of fish and wildlife resources in Alberta, with particular reference to the AOSERP study area. Volume 1: summary and conclusions. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Department of Rural Economy. AOSERP Report 43. 116 pp.

44 VE 3.1 Malhotra, S.S. and P.A. Addison. 1979. Interim report on symptomology and threshold levels of air pollutant injury to vegetation, 1975 to 1978. Prep. for the Alberta Oil Sands Environmental Research Program by Canadian Forestry Service, Northern Forest Research Centre. AOSERP Report 44. 13 pp.

45 VE 3.3 Malhotra, S.S. 1979. Interim report on physiology and mechanisms of air-borne pollutant injury to vegetation, 1975 to 1978. Prep. for the Alberta Oil Sands Environmental Research Program by Canadian Forestry Service, Northern Forest Research Centre. AOSERP Report 45. 38 pp.

46 VE 3.4 Addison, P.A. and J. Baker. 1979. Interim report on ecological benchmarking and biomonitoring for detection of air-borne pollutant effects on vegetation and soils, 1975 to 1978. Prep. for the Alberta Oil Sands Environmental Research Program by Canadian Forestry Service, Northern Forest Research Centre. AOSERP Report 46. 40 pp.

47 TF 1.1.1 Cook, R.D. and J.O. Jacobson. 1979. A visibility bias model for aerial surveys of moose on the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by Interdisciplinary Systems Ltd. AOSERP Report 47. 28 pp.

48 HG 1.1 Schwartz, F.W. 1979. Interim report on a hydrogeological investigation of the Muskeg River basin, Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Department of Geology. AOSERP Report 48. 104 pp.

49 WS 1.3.3 Hartland-Rowe, R.C.B., R.W. Davies, M. McElhone, and R. Crowther. 1979. The ecology of macrobenthic invertebrate communities in Hartley Creek, northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Calgary, Department of Biology. AOSERP Report 49. 144 pp.

50 ME 3.6 Denison, P.J., T.A. McMahon, and J.R. Kramer. 1979. Literature review on pollution deposition processes. Prep. for the Alberta Oil Sands Environmental Research Program and Syncrude Canada Ltd. by Acres Consulting Services Limited and Earth Science Consultants Inc. AOSERP Report 50. 264 pp.

51 HY 1.3 Warner, L.A. and M.O. Spitzer. 1979. Interim compilation of 1976 suspended sediment data for the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by Environment Canada, Water Survey of Canada. AOSERP Report 51. 59 pp.

52 ME 2.3.2 Davison, D.S. and K.L. Grandia. 1979. Plume dispersion measurements from an oil sands extraction plant, June 1977. Prep. for the Alberta Oil Sands Environmental Research Program by Intera Environmental Consultants Ltd. AOSERP Report 52. 209 pp.

53 HY 3.1.2 Strosher, M.T. and E. Peake. 1979. Baseline states of organic constituents in the Athabasca River System upstream of Fort McMurray. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Calgary, Environmental Sciences Centre (Kananaskis). AOSERP Report 53. 71 pp.

54 WS 2.3 Nix, P.G., J.W. Costerton, R. Ventullo, and R.T. Coutts. 1979. A preliminary study of chemical and microbial characteristics of the Athabasca River in the Athabasca Oil Sands area of northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Chemical and Geological Laboratories Ltd., Microbios Ltd., and Xenotox Services Ltd. AOSERP Report 54. 135 pp.

55 HY 2.6 Costerton, J. and G.G. Geesey. 1979. Microbial populations in the Athabasca River. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Calgary, Department of Biology. AOSERP Report 55. 65 pp.

56 AF 3.2.1 Giles, M.A., J.F. Klaverkamp, and S.G. Lawrence. 1979. The acute toxicity of saline groundwater and of vanadium to fish and aquatic invertebrates. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 56. 216 pp.

57 LS 2.3.1 Thompson, M.D. 1979. Ecological habitat mapping of the AOSERP study area (supplement): Phase I. Prep. for the Alberta Oil Sands Environmental Research Program by Intera Environmental Consultants Ltd. AOSERP Report 57. 45 pp.

58 AF 2.0.2 Lock, M.A. and R.R. Wallace. 1979. Interim report on ecological studies on the lower trophic levels of Muskeg rivers within the Alberta Oil Sands Environmental Research Program study area. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada. AOSERP Report 58. 105 pp.

59 TF 3.1 Gilbert, F.F., S.A. Brown, and M.E. Stoll. 1979. Semi-aquatic mammals: annotated bibliography. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Guelph, Department of Zoology. AOSERP Report 59. 167 pp.

60 WS 1.1.1 Neill, C.R. and B.J. Evans. 1979. Synthesis of surface water hydrology. Prep. for the Alberta Oil Sands Environmental Research Program by Northwest Hydraulic Consultants Ltd. AOSERP Report 60. 84 pp.

61 AF 4.5.2 Machniak, K. and W.A. Bond. 1979. An intensive study of the fish fauna of the Steepbank River watershed of northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 61. 196 pp.

62 TF 5.1 Roberts, W., V. Lewin, and L. Brusnyk. 1979. Amphibians and reptiles in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Museum of Zoology. AOSERP Report 62. 51 pp.

63 ME 3.8.3 Davison, D.S. and E.D. Leavitt. 1979. Analysis of AOSERP plume sigma data. Prep. for the Alberta Oil Sands Environmental Research Program by Intera Environmental Consultants Ltd. AOSERP Report 63. 251 pp.

64 LS 21.6.1 Thomson, D.C., D.M. Ealey, and K.H. McCourt. 1979. A review and assessment of the baseline data relevant to the impacts of oil sands developments on large mammals in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by McCourt Management Ltd. AOSERP Report 64. 155 pp.

65 LS 21.6.2 Penner, D.F., K.H. McCourt, and K.E. Smythe. 1979. A review and assessment of the baseline data relevant to the impacts of oil sands development on black bear in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by McCourt Management Ltd. AOSERP Report 65. 53 pp.

66 AS 4.3.2 Reid, J.D., J.L. Walmsley, I.B. Findleton, and A.D. Christie. 1979. An assessment of the models LIRAQ and ADPIC for application to the Alberta Oil Sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Atmospheric Environment Service. AOSERP Report 66. 95 pp.

67 WS 1.3.2 Lock, M.A. and R.R. Wallace. 1979. Aquatic biological investigations of the Muskeg River watershed. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 67. 29 pp.

68 AS 1.5.3 Fanaki, F., R. Hoff, L. Barrie, R. Mickle, M. Lusis, K. Anlauf, A. Gallant, J. Kovalick, F. Froude, J. Markes, J. Arnold, S. Melnichuk, A. Moser, D. Bagg. 1979. Air system summer field study in the AOSERP study area, June 1977. Prep. for the Alberta Oil Sands Environmental Research Program by Atmospheric Environment Serivce. AOSERP Report 68, 248 pp.

69 HS 40.1 Deines, A., C. Littlejohn, and T. Hunt. 1979. Native employment patterns in Alberta's Athabasca Oil Sands region. Prep. for the Alberta Oil Sands Environmental Research Program by Canadian Institute for Research in the Behavioral and Social Sciences. AOSERP Report 69. 216 pp.

70 LS 28.1.2 Ealey, D.M., S. Hannon, and G.J. Hilchie. 1979. An interim report on the insectivorous animals in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by McCourt Management Ltd. AOSERP Report 70. 294 pp.

71 HY 2.2 Hesslein, R.H. 1979. Lake acidification potential in the Alberta Oil Sands Environmental Research Program study area. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 71. 36 pp.

72 LS 7.1.2 Green, J.E. 1979. The ecology of five major species of small mammals in the AOSERP study area: a review. Prep. for the Alberta Oil Sands Environment Research Program by LGL Limited, Environmental Research Associates. AOSERP Report 72. 104 pp.

73 LS 23.2 Searing, G.F. 1979. Distribution, abundance, and habitat associations of beavers, muskrats, mink, and river otters in the AOSERP study area, northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by LGL Limited, Environmental Research Associates. AOSERP Report 73. 119 pp.

74 AS 4.5 Angle, R.P. 1979. Air quality modelling and user needs. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment, Air Quality Control Branch. AOSERP Report 74. 34 pp.

75 WS 1.3.4 Hickman, M., S.E.D. Charlton, and C.G. Jenkerson. 1979. Interim report on a comparative study of benthic algal primary productivity in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Department of Botany. AOSERP Report 75. 107 pp.

76 AF 4.5.1 Bond, W.A. and K. Machniak. 1979. An intensive study of the fish fauna of the Muskeg River watershed of northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 76. 180 pp.

77 HS 20.1 Peter C. Nichols and Associates Ltd. 1979. Overview of local economic development in the Athabasca Oil Sands region since 1961. Prep. for the Alberta Oil Sands Environmental Research Program by Peter C. Nichols & Associates Ltd. AOSERP Report 77. 221 pp.

78 LS 22.1.1 Francis, J. and K. Lumbis. 1979. Habitat relationships and management of terrestrial birds in northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Canadian Wildlife Service. AOSERP Report 78. 365 pp.

79 AF 3.6.1 Anderson, P.D., P. Spear, S. D'Apollonia, S. Perry, J. Deluca, and J. Dick. 1979. The multiple toxicity of vanadium, nickel, and phenol to fish. Prep. for the Alberta Oil Sands Environmental Research Program by Concordia University, Department of Biology. AOSERP Report 79. 109 pp.

80	HS 10.2 & HS 10.1	Parker, J.M. and K.W. Tingley. 1980. History of the Athabasca Oil Sands region, 1890 to 1960's. Volume I: socio-economic developments. Volume II: oral history. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Alberta, Boreal Institute for Northern Studies. AOSERP Report 80. 155 and 70 pp.
81	LS 22.1.2	Hennan, E. and B. Munson. 1979. Species distribution and habitat relationships of waterfowl in northeastern Alberta. Prep. for Alberta Oil Sands Environmental Research Program by Canadian Wildlife Service. AOSERP Report 81. 115 pp.
82	LS 22.2	Beaver, R. and M. Ballantyne. 1979. Breeding distribution and behaviour of the White Pelican in the Athabasca Oil Sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Canadian Wildlife Service. AOSERP Report 82. 93 pp.
83	LS 22.2	Ealey, D. 1979. The distribution, foraging behaviour, and allied activities of the White Pelican in the Athabasca Oil Sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Canadian Wildlife Service. AOSERP Report 83. 70 pp.
84	WS 1.6.1	Tripp, D.B. and P.J. McCart. 1979. Investigations of the spring spawning fish populations in the Athabasca and Clearwater rivers upstream from Fort McMurray: Volume I. Prep. for the Alberta Oil Sands Environmental Research Program by Aquatic Environments Limited. AOSERP Report 84. 128 pp.
85	HY 2.5	Akena, A.M. 1979. An intensive surface water quality study of the Muskeg River watershed. Volume I: water chemistry. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment. AOSERP Report 85. 187 pp.
86	AS 3.7	Murray, W.A. and T.B. Low. 1979. An observational study of fog in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by Promet Environmental Group Ltd. AOSERP Report 86. 54 pp.

87 WS 2.2 Schwartz, F.W. 1980. Hydrogeological investigation of Muskeg River basin, Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by University of Alberta, Department of Geology. AOSERP Report 87. 97 pp.

88 AF 2.0.1 Barton, D.R. and R.R. Wallace. 1980. Ecological studies of the aquatic invertebrates of the Alberta Oil Sands Environmental Research Program study area of northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Fisheries and Environment Canada, Freshwater Institute. AOSERP Report 88. 216 pp.

89 AF 4.3.2 Bond, W.A. 1980. Fishery resources of the Athabasca River downstream of Fort McMurray, Alberta: Volume I. Prep. for the Alberta Oil Sands Environmental Research Program by Department of Fisheries and Oceans, Freshwater Institute. AOSERP Report 89. 81 pp.

90 AS 3.2 Barrie, L.A. and J. Kovalick. 1980. A wintertime investigation of the deposition of pollutants around an isolated power plant in northern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Atmospheric Environment Service. AOSERP Report 90. 115 pp.

91 LS 5.2 Kong, K., J.D. Lindsay, and W.B. McGill. 1980. Characterization of stored peat in the Alberta Oil Sands area. Prep. for the Alberta Oil Sands Environmental Research Program by Research Council of Alberta, Soils Division, and the University of Alberta, Department of Soil Science. AOSERP Report 91. 116 pp.

92 WS 1.6.2 Tripp, D.B. and P.T.P. Tsui. 1980. Fisheries and habitat investigations of tributary streams in the southern portion of the AOSERP study area. Volume I: summary and conclusions. Prep. for the Alberta Oil Sands Environmental Research Program by Aquatic Environments Limited. AOSERP Report 92. 224 pp.

93 WS 1.3.1 Machniak, K., W.A. Bond, M.R. Orr, D. Rudy, and D. Miller. 1980. Fisheries and aquatic habitat investigations in the MacKay River watershed of northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program and Syncrude Canada Ltd. by Department of Fisheries and Oceans. AOSERP Report 93. 273 pp.

94	WS 1.4.1	Ash, G.R. and L.R. Noton. 1980. A fisheries and water quality survey of ten lakes in the Richardson Tower area, northeastern Alberta. Volume 1: methodology, summary, and discussion. Prep. for the Alberta Oil Sands Environmental Research Program by R.L.&L. Environmental Services Ltd. AOSERP Report 94. 187 pp.
95	AS 4.2.6	Venkatram, A. 1980. Evaluation of the effects of convection on plume behaviour in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program. AOSERP Report 95. 75 pp.
96	HS 20.3	Peter C. Nichols & Associates Ltd. 1980. Service delivery in the Athabasca Oil Sands region since 1961. Prep. for the Alberta Oil Sands Environmental Research Program by Peter C. Nichols & Associates Ltd. AOSERP Report 96. 92 pp.
97	LS 3.4.1	Baker, J. 1980. Differences in the composition of soils under open and canopy conditions at two sites close-in to the Great Canadian Oil Sands operation, Fort McMurray, Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by Northern Forest Research Centre, Canadian Forestry Service. AOSERP Report 97. 24 pp.
98	LS 3.4.2	Addison, P.A. 1980. Baseline condition of jack pine biomonitoring plots in the Athabasca Oil Sands area; 1976 - 1977. Prep. for the Alberta Oil Sands Environmental Research Program by Northern Forest Research Centre, Canadian Forestry Service. AOSERP Report 98. 43 pp.
99	LS 10.1	Eulert, G.K. and H. Hernandez. 1980. Synecology and autecology of boreal forest vegetation in the Alberta Oil Sands Environmental Research Program study area. Prep. for the Alberta Oil Sands Environmental Research Program by Interdisciplinary Systems Ltd. AOSERP Report 99. 184 pp.
100	LS 10.2	Thompson, M.S. and J. Crosby-Diewold. 1980. Baseline inventory of aquatic macrophyte species distributions in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by Intera Environmental Consultants Ltd. and Beak Consultants Ltd. AOSERP Report 100. 73 pp.

101 LS 21.1.3 Fuller, T.K. and L.B. Keith. 1980. Woodland caribou population dynamics in northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by the University of Wisconsin, Department of Wildlife Ecology. AOSERP Report 101. 63 pp.

102 LS 21.1.4 Fuller, T.K. and L.B. Keith. 1980. Wolf population dynamics and prey relationships in northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research program by the University of Wisconsin, Department of Wildlife Ecology. AOSERP Report 102. 58 pp.

103 HS 50.4 MTB Consultants Ltd. 1980. Analysis of the leisure delivery system 1972-1979, with projections for future servicing requirements. Prep. for the Alberta Oil Sands Environmental Research Program by MTB Consultants Ltd. AOSERP Report 103. 204 pp.

104 AS 4.2.4 Davison, D.S. and R.B. Lantz. 1980. Review of requirements for air quality simulation models. Prep. for the Alberta Oil Sands Environmental Research Program by Intera Environmental Consultants Ltd. AOSERP Report 104. 86 pp.

105 LS 11.3 Hilchie, G.J. and J.K. Ryan. 1980. Approaches to the design of a biomonitoring program using arthropods as bioindicators for the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by McCourt Management Ltd. AOSERP Report 105. 47 pp.

106 AS 2.1 Strosher, M.M. and R.R. Peters. 1980. Meteorological factors affecting ambient SO_2 concentrations near an oil sands extraction plant. Prep. for the Alberta Oil Sands Environmental Research Program by Alberta Environment, Pollution Control Division and AOSERP. AOSERP Report 106. 87 pp.

107 LS 7.1.2 Green, J.E. 1980. Small mammal populations of northeastern Alberta. Volume I: populations in natural habitats. Prep. for the Alberta Oil Sands Environmental Research Program by LGL Limited, Environmental Research Associates. AOSERP Report 107. 294 pp.

108 LS 7.1.3 Green, J.E. 1980.. Small mammal populations of northeastern Alberta. Volume II: populations in reclamation areas. Prep. for the Alberta Oil Sands Environmental Research Program by LGL Limited, Environmental Research Asspcoates/ AOSERP Report 108. 136 pp.

109	LS 3.1	Malhotra, S.S., P.A. Addison, and A.A. Khan. 1980. Symptomology and threshold levels of air pollutant injury to vegetation, 1979-80. Prep. for the Alberta Oil Sands Environmental Research Program by Northern Forest Research Centre, Canadian Forestry Service. AOSERP Report 109. 17 pp.
110	LS 3.3	Malhotra, S.S. and A.A. Khan. 1980. Physiology and mechanisms of airborne pollutant injury to vegetation, 1979-80. Prep. for the Alberta Oil Sands Environmental Reserach Program by Northern Forest Research Centre, Canadian Forestry Service. AOSERP Report 110. 49 pp.
111	LS 3.4	Addison, P.A. 1980. Ecological bench-marking and biomonitoring for detection of airborne pollutant effects on vegetation and soils. Prep. for the Alberta Oil Sands Environmental Research Program by Northern Forest Research Centre, Canadian Forestry Service. AOSERP Report 111. 48 pp.
112	HS 30.5	Gartrell, J.W., H. Krahn, and F.D. Sunahara. 1980. A study of human adjustment in Fort McMurray. Volume I: field study and results. Prep. for the Alberta Oil Sands Environmental Research Program by Thames Group Research Inc. through the University of Alberta, Population Research Laboratory. AOSERP Report 112. 404 pp.
113	WS 2.6.1	Tsui, P.T.P., B.R. McMahon, P.J. McCart, and J.V. McCart. 1980. A laboratory study of long-term effects of mine depressurization groundwater on fish and invertebrates. Prep. for the Alberta Oil Sands Environmental Research Program by Aquatic Environments Ltd. AOSERP Report 113. 211 pp.
114	WS 3.4	Sekerak, A.D. and G.L. Walder. 1980. Aquatic biophysical inventory of major tributaries in the AOSERP study area. Volume I: summary report. Prep. for the Alberta Oil Sands Environmental Research Program by LGL Limited, Environmental Research Associates. AOSERP Report 114. 100 pp.
115	LS 28.1.1	Ryan, J.K. and G.J. Hilchie. 1980. Report on an ecological survey of terrestrial insect communities in the AOSERP study area. Prep. for the Alberta Oil Sands Environmental Research Program by McCourt Management Ltd. AOSERP Report 115. 202 pp.

116 WS 1.3.5 Crowther, R.A. and B.J. Lade. 1980. An assessment of benthic secondary production in the Muskeg River of northeastern Alberta. Prep. for the Alberta Oil Sands Environmental Research Program by IEC International Environmental Consultants Ltd. AOSERP Report 116. 106 pp.